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U.S.A.

Maintenance Manual

TPL-100A PROCESSOR MILACAS-FR Part No. 940-0530-001

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TPL-100A Processor / Part No. 940-0530-001

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RECORD OF TEMPORARY REVISIONS

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

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

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SERVICE BULLETIN LIST

Service Bulletin	Identified Mod	Date Included in this Manual	Description
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Service Bulletin	Identified Mod	Date Included in this Manual	Description
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INTRODUCTION

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C. Special Precautions

- (1) Warnings, cautions, and notes in this manual give the data that follows:
 - A WARNING is an operation or maintenance procedure or condition that, if not obeyed, can cause injury or death.
 - A CAUTION is an operation or maintenance procedure or condition that, if not obeyed, can cause damage to the equipment.
 - A NOTE gives data to make the work easier or gives directions to go to a procedure.
- (2) All personnel who operate equipment and do maintenance specified in this manual must know and obey the safety precautions. The warning and cautions that follow apply to all parts of this manual.

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

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

CAUTION: THE MILACAS-FR PROCESSOR CONTAINS ITEMS THAT ARE ELECTROSTATIC DISCHARGE SENSITIVE (ESDS). IN THE IPL OF THIS MANUAL, THESE ITEMS ARE IDENTIFIED AS 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 INSERT PARTS OR ASSEMBLIES.

2. Content Data

A. How to Use This Manual

- (1) The instructions in this manual give the data necessary to do all recommended maintenance functions to put the MILACAS-FR Processor in serviceable condition. Standard maintenance procedures that technicians are thought to know are not given in this manual.
- (2) Refer to the table of contents to see which subheadings are included in this manual. The table of contents identifies those subheadings that are not applicable or require no special instructions.
- (3) We recommend that the tests in FAULT ISOLATION be done before the unit is disassembled. These tests can tell the condition of the MILACAS-FR Processor or most probable cause of any malfunction. Should any malfunction occur, repair as necessary.
- (4) To decrease the length of sentences and titles, complete part numbers are not always shown in this manual. A piece of the part number can show applicability to a specific assembly or component on illustrations as well as in text and tables.
- (5) Related publications that are referred to in this manual are identified in Table Intro-1.

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Table Intro-1. Related Publications

Publication	Publication No.	ATA No.
Test Software Component Maintenance Manual	I.B. 1181A	34-45-01A
TPT-81A TCAS Interface Test Panel Component Maintenance Manual	I.B. 1181AT	34-34-02
ANT-81A Directional Antenna Array Component Maintenance Manual	I.B. 1181C	34-45-15
IVA-81A Traffic Advisory/Vertical Speed Indicator (TA/VS) Component Maintenance Manual	I.B. 1181D I.B. 1181D-1	34-45-20 34-45-21
IVA-81B Resolution Advisory/Vertical Speed Indicator (RA/VS) Component Maintenance Manual	I.B. 1181E	34-45-25
ITA-81A Traffic Display Component Maintenance Manual	I.B. 1181G	34-45-30
TPL-100A Processor Component Maintenance Manual	012-0794-001	34-45-55
TPL-100A Test Assembly Ground Equipment Manual	012-0816-001	
Standard Repair Procedures for Honeywell Avionics Equipment Instruction Manual	A09-1100-004	
The United States Government Printing Office (GPO) Style Manual 2000		
Abbreviations for Use on Drawings and in Text*	ASME Y14.38-1999 (Formerly ASME Y1.1-1989)	
Graphic Symbols for Electrical and Electronics Diagrams*	ANSI Y32.2 (1975)	
Standard Letter Symbols for Units of Measurement*	ANSI/IEEE Standard (Std) 260 (1978)	
Graphic Symbols for Logic Functions*	ANSI/IEEE STD 91 (1984)	
NOTES: 1. You can order a Honeywell publication from Honeywell as follows: Telephone No.: 425-885-8367 Fax No.: 425-885-8722 E-mail: sandra.slick@honeywell.com 2. *Available from the American National Standards Institute, New York, NY		

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B. Verification

- (1) Verification of these technical instructions is done by performance or by simulation of the necessary procedures. Checks of the manual by the engineering staff make sure the instructions and description data agree with the applicable engineering specifications and drawings and are accurate and sufficient.

Subheading	Level of Verification
Fault Isolation	By performance, 1 Sep 2005
Disassembly	By simulation, 1 Sep 2005
Assembly	By simulation, 1 Sep 2005

- (2) Honeywell will revise this manual as necessary to give current data. The sources for data supplied in this manual include engineering drawings and change orders released as of 1 Sep 2005.

C. Symbols

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

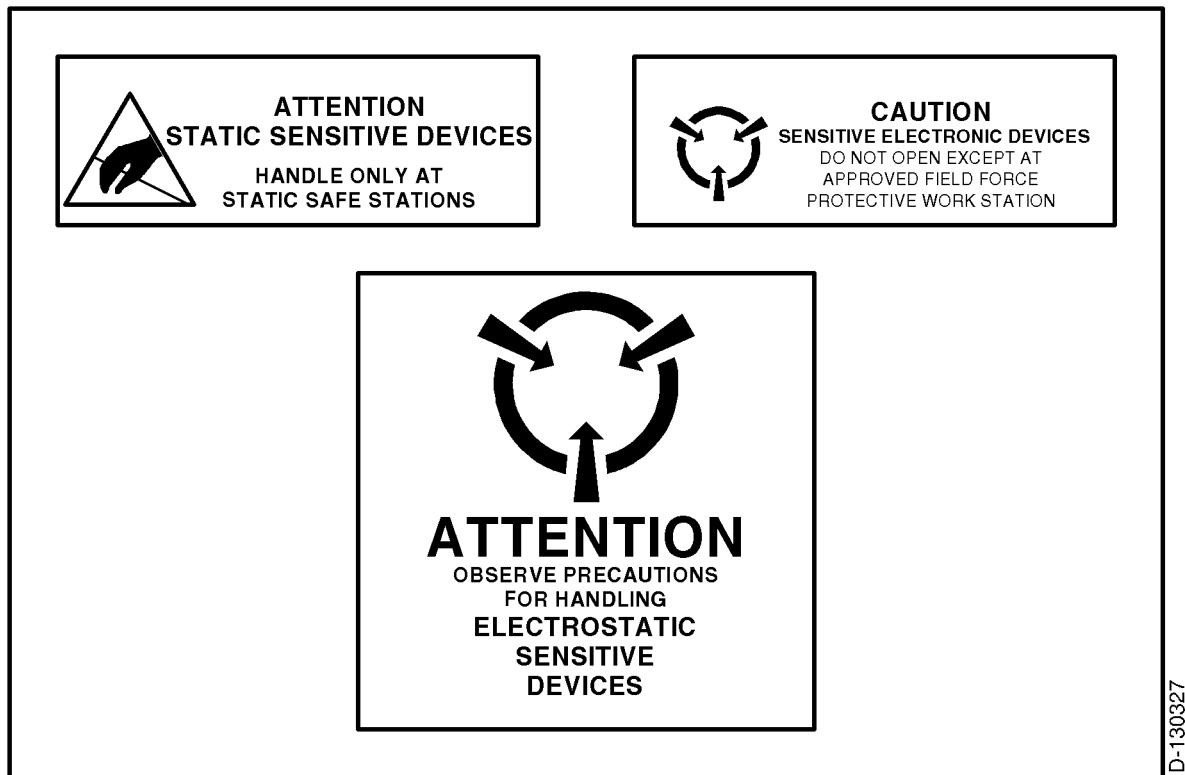


Figure Intro-1. ESDS Symbols

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D. Weights and Measurements

- (1) All weights and measurements are in U.S. and S.I. (metric) values.
- (2) The letter symbols for units of measurement are the same as shown in the GPO Style Manual and in ANSI/IEEE Std 260.

E. Acronyms and Abbreviations

- (1) The acronyms and abbreviations that follow help the reader identify terms and definitions used by Honeywell.
- (2) The letter symbols for units of measurement are the same as shown in the GPO Style Manual and in ANSI/IEEE Std 260.

Term	Definition
ADS-B	Automatic Dependent Surveillance Broadcast
AGL	above ground level
ANSI	American National Standards Institute
ARINC	Aeronautical Radio Incorporated
ASME	American Society of Mechanical Engineers
ATC	air traffic control
ATE	automated test equipment
BIT	built-in-test
BP	bottom plug
CFDS	centralized fault display system
ERP	effective radiated power
ETCAS	enhanced traffic alert and collision avoidance system
FAA	Federal Aviation Administration
FMS	flight management system
FPM	feet per minute
GND	ground
GPS	global positioning system
I/O	input/output
ICAO	International Civil Aviation Organization
IFF	identification friend-or-foe
ILA	interference limit algorithm
IPL	Illustrated Parts List

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Term	Definition
LBP	left bottom plug
LED	light emitting diode
LMP	left middle plug
LRU	line replaceable unit
LTP	left top plug
MAX	maximum
MCD	maintenance control display
MILACAS-FR	military airborne collision avoidance system - formation rendezvous
MIN	minimum
MOPS	minimum operational performance standards
MP	middle plug
MSL	mean sea level
MTL	minimum triggering level
NAR	non-altitude reporting
NM	nautical miles
No.	number
NTA	number of TCAS aircraft in area
PPI	planned position indicator
PRF	pulse repetition frequency
RA	resolution advisories
RA/VS	resolution advisory/vertical speed indicator
RBP	right bottom plug
RF	radio frequency
RMP	right middle plug
RTCA	Radio Technical Commission for Aeronautics
RTP	right top plug
SARP	Standards and Recommended Practices
S.I.	System of International Units
Std	standard
TA	traffic alerts
TA/VS	traffic advisory/vertical speed indicator

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Term	Definition
TAU	time to closest approach
TCAS	traffic alert and collision avoidance system
TOT	time over target
TP	top plug

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DESCRIPTION AND OPERATION

1. Physical Description

A. General

This manual contains descriptive information about the TPL-100A Processor (MILACAS-FR Processor). The components associated with the MILACAS-FR system are shown in Figure 1.

The MILACAS-FR Processor uses Mode S extended squitter to support passive surveillance. Extended squitter permits a decreased traffic alert and collision avoidance system (TCAS) interrogation rate. The TCAS aircraft receives the global positioning system (GPS) location information of the intruder target. This concept is called Automatic Dependent Surveillance Broadcast (ADS-B). The use of this extended squitter lowers interrogation rates in the TCAS signal environment.

The MILACAS-FR Processor also performs formation flight functions. The MILACAS-FR uses a standard TCAS antenna system. It combines the functions of TCAS and formation flight subsystems into one unit.

The TCAS and formation flight systems share the same hardware. The software is partitioned into two systems. The two systems are capable of separate control and function. The MILACAS-FR system supports formation position keeping.

MILACAS-FR gives the TCAS function and situational awareness for 53 aircraft within 60 nautical miles. The maximum formation is dependent on the installation and operational concept.

2. System Description

A. TCAS

TCAS performs the collision avoidance function when it actively interrogates nearby aircraft with Mode S and ATCRBS Mode C altitude interrogations. The intruder aircraft replies to TCAS interrogations and sends the parameters that follow:

- Range
- Change in range
- Approximate bearing
- Approximate change in bearing
- Altitude
- Approximate change in altitude.

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The TCAS unit then finds which transponder-equipped aircraft are a threat, and the TCAS unit issues:

- A warning
- Up/down maneuver instructions
- Coordinates advisories
- Traffic alerts (TA) for TCAS II
- Resolution advisories (RA) for TCAS II.

The above warnings and advisories depend on the class of TCAS equipment used.

The MILACAS-FR Processor consists of a new generation of TCAS. This new generation makes use of the Mode S extended squitter. Each Mode S aircraft transmits:

- Aircraft position from GPS input
- Velocity
- Identification.

MILACAS-FR was developed to use the ADS-B extended squitter that gives GPS location information. Using extended squitter, aircraft are tracked passively. Once the intruder is being tracked, and only if the intruder becomes a close threat, the MILACAS-FR switches to active interrogations for surveillance.

(1) TCAS Surveillance

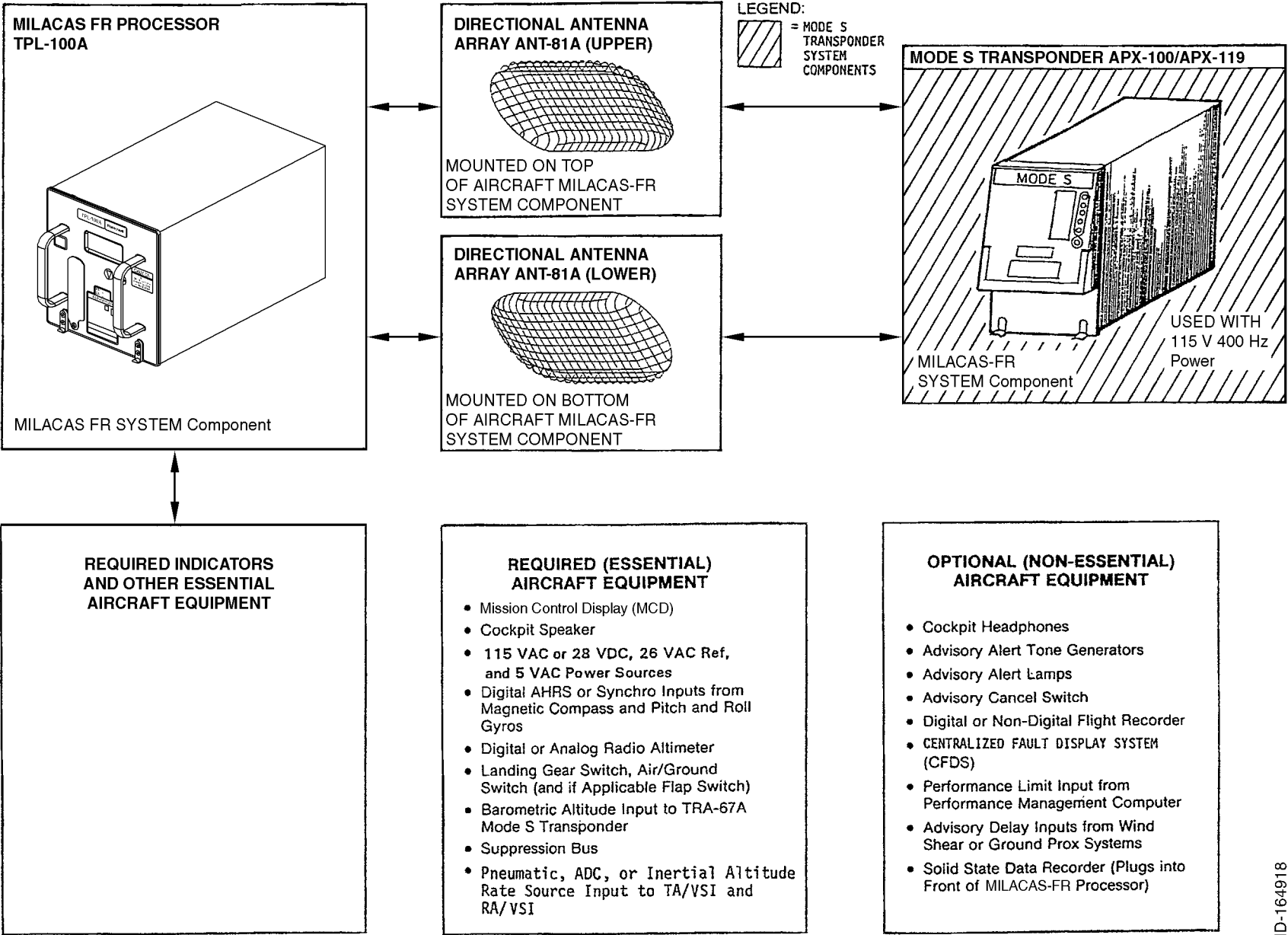
The MILACAS-FR Processor operates as described in the RTCA DO-185A minimum operational performance standards (MOPS) and the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs).

In ATCRBS transponder-equipped aircraft, surveillance is done by the TCAS Mode C-only interrogations. For the top antenna, high-density interrogation, moderate-density and low-density interrogation patterns defined in RTCA DO-185A are available for use.

The moderate-density interrogation pattern consists of:

- Six steps for the front quadrant
- Five steps for the side quadrants
- Four steps for the aft quadrant.

The low-density interrogation pattern uses a single step for each quadrant. If no intruders are detected in a quadrant, the single interrogation is used to monitor that quadrant. If a Mode C aircraft is detected, the moderate-density pattern is used.



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Figure 1. MILACAS-FR System Required Components and Other Optional Equipment

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The high-density pattern is only used to separate transponder replies (i.e., for de-garbling). The maximum power output (regardless of pattern density) is:

- 53 dBm effective radiated power (ERP) for the front quadrant
- 49 dBm ERP for the side quadrants
- 44 dBm ERP for the aft quadrant.

The bottom antenna uses a 10-step interrogation pattern in four directions. It has a maximum power of 39 dBm ERP. If no Mode C aircraft are present, a single Mode C-only interrogation at 39 dBm ERP is transmitted to the monitor.

Mode S surveillance listens first for the Mode S acquisition squitter (DF11) that is transmitted by every Mode S transponder. The second step of MODE S surveillance is to interrogate with Mode S UF0. This interrogation is transmitted with a maximum power of 53 dBm. Once a Mode S intruder is tracked, power programs are used to efficiently manage the power transmitted to targets.

Mode S intruders that are a lower threat are interrogated only once every five seconds. Mode S intruders with a relative altitude greater than 10,000 feet from the own TCAS aircraft are interrogated only once every 10 seconds. TCAS to TCAS coordination messages are communicated using UF16 transmitted at full power.

Mode S intruders with a relative altitude difference of less than 10,000 feet are interrogated at a rate of 0.2 Hz (once every five seconds) if the conditions that follow are true:

- TAU (time to closest approach) is more than 60 seconds.
- Mode S intruder range is more than 3 nautical miles.
- Both intruder and own TCAS altitude are less than 18,000 ft.
- Either or both intruder altitude and own TCAS altitude is equal or greater than 18,000 feet.
- Intruder range is greater than seven nautical miles.

For all other conditions where tracking of Mode S intruders is necessary, the aircraft are interrogated at a rate of 1.0 Hz (one interrogation every second).

MILACAS-FR uses top and bottom directional antennas. The antennas give a beam approximately 95 degrees wide. The beam is steered in the forward, side, or aft direction. The nominal gain of the antenna is 3.6 decibels at an elevation angle of 85 degrees from vertical, or 5 degrees above the horizon. The antenna cables have a nominal 2.5 decibel loss.

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(a) Interference Limiting

The interference limiting algorithms are used to minimize the effects of TCAS surveillance on aircraft transponders and secondary surveillance radars. These algorithms match TCAS MOPS specification.

The power output permitted is a function of both the number of TCAS in the vicinity (NTA) and the distribution parameter. This distribution parameter (alpha) examines the counts of TCAS II aircraft within 3, 6, and 30 nautical miles.

Interference limiting is managed by MILACAS-FR the same as civil TCAS II DO-185A. While in interference limiting conditions, the TCAS minimum triggering level (MTL) for Mode S reception goes up and the transmit power of the Mode S interrogation goes down until the TCAS power limitations of interference limiting are satisfied.

The MILACAS-FR Processor has the ability to inhibit its UF16 TCAS broadcast interrogations, which eliminates the MILACAS-FR from the NTA counts of other TCAS in the area. This minimizes the possibility of unduly lowering the surveillance range of other TCAS II DO-185A systems near own aircraft flying in formation.

The suppression of the TCAS broadcast interrogation when flying in formation does not compromise the air-to-air communication capability of MILACAS-FR. The transponder still replies to UF0 surveillance interrogations. Because those aircraft are not included in the NTA count, higher interference levels can exist due to transmissions from TCAS aircraft.

When the MILACAS-FR Processor operational modes are activated, the U19 transmit power is included in the power summation and MILACAS-FR suppression time is included in the suppression time summation.

(b) Collision Avoidance Logic

The MILACAS-FR Processor implements the collision avoidance logic, as stated in the TCAS MOPS, without deviation. While in TA-only mode, the MILACAS-FR only sends traffic alerts and inhibits resolution advisories. In TA/RA mode, the MILACAS-FR Processor sends traffic alerts and resolution advisories. The possible resolution advisories are listed in the MOPS. If the intruder is TCAS II equipped, MILACAS-FR coordinates resolution advisories with the other aircraft as stated in the MOPS.

(2) Hybrid Surveillance

Reductions to the signal environment are achieved with modifications in the surveillance protocol. Additional reductions are achieved with the introduction of the 1090-MHz extended squitter transmission into new Mode S transponders.

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Hybrid surveillance modifications permit the MILACAS-FR system to do its surveillance mission without causing an increase in the signal environment. MILACAS-FR uses hybrid surveillance with the 1090-MHz extended squitter to minimize the impact on the TCAS signal environment. Currently hybrid surveillance is not supplied in the MILACAS-FR system for TCAS 1030-MHz surveillance.

(3) Interoperability with ATC Ground Radar and Other TCAS II Systems

In coordination with the Federal Aviation Administration (FAA), the air traffic control (ATC) ON/OFF function was developed to stop ground controllers from receiving proximity alarms between formation members within US airspace. When ATC OFF is selected, MILACAS-FR aircraft do not respond to ground based Mode 3/A, Mode C, or Mode S (UF4 and UF11) interrogations. The system continues to respond to airborne-based Mode S interrogations. This gives full TCAS traffic avoidance functionality.

When ATC ON is selected, Mode 3/A and Mode C are de-selected independently of the ATC ON/OFF function. All of these features and functions can be selected by the aircrew. The functions used are selected at the discretion of the ground controller.

Normally, in formation, all aircraft (except lead), fly with ATC OFF selected. In large formations (four or more), the trail aircraft can fly with ATC ON selected. This allows ATC to find the location of the lead and trailing formation aircraft to make sure other aircraft do not fly through the formation.

A MILACAS-FR Processor-equipped aircraft's answer to ATC ground radar and other TCAS II systems is a function of the operational mode of the Identification Friend or Foe (IFF) transponder.

The IFF transponder can stop its replies to ground interrogators while it maintains its data-link with airborne equipment (ATC OFF mode). Modes 1, 2, 3/A, C, and 4 are individually disabled. Table 1 shows a summary of the answers by the IFF transponder to each interrogation format.

Table 1. MILACAS-FR ATC Interoperability

Interrogation	Reply	
IFF Transponder Mode		
Mode / UF	ATC On	ATC Off
1	Replies with Mode 1 identity	Replies with Mode 1 identity
2	Replies with Mode 2 identity	Replies with Mode 2 identity
3/A	Replies with Mode 3/A identity	No Reply
C	Replies with Mode C altitude	No Reply
4	Replies with Mode 4 IFF	Replies with Mode 4 IFF
UF0	Replies with DF0/DF16	Replies with DF0/DF16

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Table 1. MILACAS-FR ATC Interoperability (cont)

Interrogation	Reply	
IFF Transponder Mode		
Mode / UF	ATC On	ATC Off
UF4	Replies with DF4/DF20	No Reply
UF5	Replies with DF5/DF21	Replies with DF5/DF21
UF11	Replies with DF11	No Reply
UF16	Replies with DF0/DF16	Replies with DF0/DF16
UF19	No Reply	No Reply
UF20	Replies with DF4/DF20	Replies with DF4/DF20
UF21	Replies with DF5/DF21	Replies with DF5/DF21
Intermode: Mode 3/A All-Call	No Reply	No Reply
Intermode: Mode C All-Call	No Reply	No Reply
Intermode: Mode 3/A/S All-Call	Replies with DF11	No Reply
Intermode: Mode C/S All-Call	Replies with DF11	No Reply

NOTE: The ATC OFF function applies to the transponder. This function, as well as Modes 1, 2, 3/A, C, and S are independent of the MILACAS-FR and are individually selected on or off to support alternative foreign national mode/code signaling needs.

B. MILACAS-FR

The MILACAS-FR system controls extended squitter output power to manage emissions while it gives formation flight capability. UF19 formats are used to validate DF19 extended squitter messages and transmit formation flight coordination messages.

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(1) UF19 Messages

Military Mode S formats are needed to help:

- Normal daily operations in civil airspace
- Military training operations outside of high-density airspace
- Stop all unprotected transmissions.

There are situations in which military operations benefit from a military Mode S format. The benefit is to not disclose aircraft data to unauthorized users. In these cases, a data protected military Mode S up-link/down-link format helps military operations.

The MILACAS-FR Mode S data link addresses the need for private communication. It supports transmission and reception of data between formation aircraft. The MILACAS-FR system transmits and receives position, velocity, flight commands and other information using the DF19 extended squitter.

Range and bearing measurements are derived by actively interrogating aircraft. For hybrid/passive surveillance use, it is necessary to make sure extended squitter content is correct. If DF19s are used for military applications, it is necessary to make sure the DF19 content is correct.

The use of UF0 can cause an ambiguity (since transponders reply to a UF0 with a DF0). Use UF19 instead of UF0 to eliminate ambiguity. For military applications, UF19 transmissions trigger a DF19 response for validation. Each UF19 transmission has the Mode S address as the aircraft identifier which selectively interrogates the aircraft of interest.

For a variety of military operations, data security techniques are used to protect the data contained in the up-link/down-link (UF19/DF19) formats. It is not appropriate to use these techniques on standard formats dedicated for civil use.

In the MILACAS-FR implementation, UF19 interrogation rates change and depend on the distance between aircraft. For close-in aircraft, interrogation rates are not above 2 Hz. For aircraft at longer distances (approximately 5 nautical miles), average interrogation rates do not exceed 1 per second.

The UF19 transmissions have power levels set with an algorithm consistent with TCAS II DO-185A MOPS. Due to the distance between aircraft in formation, the minimum power used is lower than the minimum requirement defined in the MOPS. Power levels must be in the 10-50 Watt range to lower unwanted interference outside of the formation. UF19 interrogations are used in the interference limiting calculations.

Long interrogations are better than short interrogations. The use of long military Mode S formats gives an essential improvement over existing military modes. Because of the data-link capability of Mode S, a long Mode S reply format consists of 112 bits:

- Eight bits identify the format within a Mode S message.
- 104 bits are available for the data content.

Data content is protected using data protection techniques.

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(2) DF19 Messages

DF19 extended squitter data is data-linked between formation members to support between 2 and 53 (or more) aircraft. The formations consist of one or multiple elements. The formation leader gives flight commands to the formation. Data is transmitted from the formation leader to element leaders. Then the element leaders transfer data to the wingmen in their formation. Guidance data is calculated and data-linked through the DF19 squitter to formation aircraft.

Unlike standard DF17 squitters transmitted by civil or IFF/Mode S transponders, DF19 1090-MHz extended squitters have power levels set by the MILACAS-FR to lower emissions. DF19 squitter rates vary depending on the distance between aircraft. Due to the closeness of aircraft in formation, the minimum power used is less than the minimum requirement defined in the TCAS II DO-185A MOPS.

Power levels must be in the 10-50 Watt range to lower unwanted interference outside of the formation and to allow transmission of additional squitters beyond current requirements. The total power transmitted per second by the MILACAS-FR over the 1090-MHz link is lower than a standard transponder squittering at the maximum rate.

(3) MILACAS-FR Operational Modes

(a) Maximum Mode

Maximum mode is used when the formation is flying in peacetime operations or in a refueling rendezvous. Positioning is done with modified hybrid surveillance. Modified hybrid surveillance has passive (listening) tracking with minimal interrogations.

Each aircraft is passively surveyed to 100 nautical miles. Active interrogation is performed to initially validate the range and bearing of other formation aircraft. Active validation interrogations are done at low frequency and depend on the distance between aircraft. The formation has total identification, maneuver capability, and a protected data link.

(b) Normal Mode

This mode is used in a combat environment when low probability of detection and interception are essential. The MILACAS-FR has very low power output, with automatic adjustments in receiver sensitivity to maintain the formation. The intra-formation link is data protected and formation distance alerts are adjustable to meet the formation needs.

(c) Silent Mode or EMCON (Emission Control)

The silent mode permits formation or non-formation members to track the formation without any power output.

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(4) Intra-Formation Message/Transmission Characteristics

Intra-formation transmissions comply with the specifications identified in Table 2 (on average per aircraft):

Table 2. MILACAS-FR UF19/DF19 Extended Squitter Messages

MESSAGE	SOURCE	RATE	POWER LEVEL	INFORMATION CONTENT
UF19	MILACAS-FR (1030-MHz link)	2 Hz from wing aircraft 1 Hz from lead aircraft	Changes with different power programming (30-52 dBm)	Mil A/C ID, position data request for squitter validation
DF19	MILACAS-FR (1090-MHz link)	2-4 Hz from lead aircraft	Changes with different power programming (30-57 dBm)	Mil A/C ID, A/C position data, formation data, formation command and guidance data

(5) MODE S Data Protection

MILACAS-FR data protection techniques use the existing Mode S error detection and correction (EDAC) logic combined with data protection keys. The data protection keys come from strong commercial-grade algorithms.

In pre-flight, each formation aircraft pilot enters a mission-specific pass-phrase into the mission computer. The mission computer communicates the pass-phrase to the MILACAS-FR Processor. The processor uses this value and a pre-stored random seed to generate two mission-specific data protection keys:

- 112-bit data protection key
- 80-bit masking key.

When the flight crew selects the data protection function, each 112-bit data-link message is protected with the 112-bit key before the computation of the parity field. The parity computed over the protected message is inserted in the PI field of the data stream in place of the standard parity. Standard parity is computed over the unprotected message.

Before transmission, the ME and PI fields of the data stream are protected with the 80-bit masking key. The masking key protects the fields against monitoring by and disclosure to an unauthorized entity. The DF, AF, and AA fields are not protected so that the protected data-link message is received and interpreted as a valid DF19 Mode S extended squitter.

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A MILACAS-FR equipped formation aircraft with data protection selected does complementary operations to verify the parity field and recover the ME field. The data protection operations do not change the linear characteristics of the EDAC logic, or the ability of the EDAC logic to detect, locate, and correct bit and burst errors introduced during transmission.

(6) Datalink Protocol

The datalink protocol supports the three data categories that follow.

(a) Guidance data includes:

- ID
- time tag
- flight command indicator (FCI) command/numeric
- roll
- true airspeed
- aircraft configuration
- current engine pressure ratio (EPR)
- EPR target
- other data
- Data from lead/element lead to its wings.

(b) Air drop data includes:

- ID
- delta time
- time over target (TOT)
- heading
- current/drop wind (direction and magnitude)
- current/drop Baro setting
- Data from lead/element lead to its wings or inter-formation lead to lead.

(c) Text message includes:

- ID
- 19-alphanumeric character text message
- Data from lead/element lead to its wings or ID to ID.

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C. Equipment Part Numbers

Table 3 lists the equipment types, the Honeywell part numbers, and a brief description of the components that make up the MILACAS-FR system. Other required equipment is not listed. Table 5 lists the accessories used with the MILACAS-FR system. The equipment is categorized as follows:

MILACAS-FR system components

- MILACAS-FR Processor
- ANT-81A directional antennas (2 each)
- Mode S transponder, APX110/APX-119.

The equipment that follows is required but is not part of the MILACAS-FR system. The combinations of this equipment are selectable upon installation.

- Resolution advisory indicators (TA/VSI or RA/VSI)
- Traffic advisory indicators (TA/VSI, PPI, dedicated, etc.)
- Other required aircraft equipment as listed in Table 6.

NOTE: Optional (non-essential) aircraft equipment applicable to the MILACAS-FR system is listed in Table 7.

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Table 3. MILACAS-FR System Components

Equipment Type	Part Number	Description
TPL-100A Processor	940-0530-001	Tray-mounted Aeronautical Radio Incorporated (ARINC) 735A assembly. Contains a microprocessor-based central TCAS system control unit and L-band RF transmitter/receiver. The MILACAS-FR Processor is the heart of the system. It controls all surveillance, data acquisition, tracking, advisory, and air-to-air maneuvering coordination functions in the system. The MILACAS-FR Processor selects directional antenna beams, generates and transfers pulsed 1030-MHz RF surveillance interrogation data to the TCAS top and bottom antennas, and receives 1090-MHz RF reply data from the TCAS antennas. The MILACAS-FR Processor examines the reply data and determines the threat potential of the intruder aircraft. The MILACAS-FR Processor sends ARINC 429 traffic and resolution advisory display data to the TA/VSI, RA/VSI and other optional display units. The MILACAS-FR Processor also sends ARINC 429 coordination and housekeeping data to the Mode S transponder subsystem. The MILACAS-FR Processor receives ARINC 429 data, which includes coordination, pressure altitude, TCAS control, own-aircraft I.D., and own-aircraft maximum airspeed from the Mode S transponder. The MILACAS-FR Processor receives its own aircraft information on the following inputs from on-board aircraft equipment: • magnetic heading, and pitch and roll attitude on an AHRS 429 bus or X, Y, Z synchro inputs • radio altitude from 429 digital or analog radio altimeters • discrete inputs from aircraft switches and straps • discrete advisory inhibit inputs from ground proximity and wind shear warning systems, if applicable • discrete input from an advisory cancel switch.

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Table 3. MILACAS-FR System Components (cont)

Equipment Type	Part Number	Description
TPL-100A Processor (cont)		The MILACAS-FR Processor sends a suppression pulse to on-board L-band RF equipment and receives suppression pulses from the same L-band equipment. Voice audio advisory outputs go to a cockpit speaker and headphones. Discrete advisory alert outputs go to optional tone generators and lamps. Straps are available to select volume for both the speaker and headphones. The MILACAS-FR Processor I/O is equipped to communicate with a centralized fault display system (CFDS) or maintenance computer through a bidirectional ARINC 429 data link. The processor also provides twenty automated test equipment (ATE) test points. ARINC 429 data can be sent to a digital flight recorder. An ARINC 573 output port is available for non-digital flight recording. In addition, the MILACAS-FR Processor monitors numerous failure status inputs from external equipment and continuously performs built-in-test diagnostics. When a functional test is initiated from the Mode S transponder/TCAS control unit, the MILACAS-FR Processor does extensive system functional test diagnostics. Two alphanumeric displays on the front of the unit supply failure status indications. The MILACAS-FR Processor sends outputs to a solid-state data recorder that can be mounted on the processor front panel. The MILACAS-FR Processor receives 115 V, 400 Hz or 28 V dc primary power and 26 V ac synchro reference power from aircraft power sources.

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Table 3. MILACAS-FR System Components (cont)

Equipment Type	Part Number	Description
DIRECTIONAL ANTENNA		
ANT-81A NOTE: One or two directional antennas may be used in a MILACAS-FR Subsystem. A top-mounted ANT-81A is always required. For intruder bearing to be determined on the bottom antenna, an ANT-81A must be used on the bottom of the aircraft.	071-50001-XXX	The ARINC 735A assembly is screw-mounted directly to the fuselage of the aircraft. The antenna contains an array of four passive, steerable, radiating elements mounted at 0°, 90°, 180°, and 270° in relationship to the forward axis of the antenna. During Mode S and ATCRBS Mode C interrogation message transmissions, the directional antenna receives 1030-MHz pulses on the four cabled inputs from the MILACAS-FR Processor. During TCAS receptions, each of the four directional antenna elements accepts any 1090-MHz RF signal that is present. The phasing of these received signals is determined by the direction from which the RF energy is received. These signals are directed onto the same four cables that connect transmit signals between the MILACAS-FR Processor and the directional antenna. The ANT-81A is a passive device and does not require input power.
APX-100/APX-119 Mode S Transponder	4070740-0506 4079100-0507	The tray mounted ARINC 718 assembly contains: • microprocessor-based Mode S/ATCRBS transponder control and processing unit • L-band RF transmitter/receiver • various synchro discrete and digital interface networks. A Mode S transponder transmits 1090-MHz Mode S or ATCRBS reply messages when it receives appropriate 1030-MHz Mode S or ATCRBS interrogations from other TCAS-equipped aircraft or air traffic control ground stations. Mode S interrogations contain a unique aircraft address and only the Mode S transponder assigned that address replies. ATCRBS interrogations do not contain a transponder address. If the transponder is connected to equipment that measures pressure altitude, the Mode S or ATCRBS Mode C reply contains the pressure altitude.

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Table 3. MILACAS-FR System Components (cont)

Equipment Type	Part Number	Description
APX-100/APX-119 Mode S Transponder (cont)		At a rate of once per second, Mode S transponders automatically transmit a squitter message containing the aircraft address. These squitter messages notify other TCAS-equipped aircraft and ground stations that the Mode S-equipped aircraft is present. In TCAS-equipped aircraft, the Mode S transponder is connected to the MILACAS-FR Processor by means of a bi-directional ARINC 429 data link. Extensive data link communications between the MILACAS-FR processor and Mode S transponder occur continuously. The transponder control unit gives on-board manual selection of Mode S transponder and TCAS operational modes. Mode control data from the control unit goes to the Mode S transponder and then goes to the MILACAS-FR Processor on ARINC 429 data links. When Mode S ground stations become available in the future, ground station messages to Mode S transponders will include a request to change to TCAS operational modes. The Mode S transponder sends the mode control request to the MILACAS-FR Processor on the ARINC 429 data link. The MILACAS-FR Processor routinely sends operational mode status information to the Mode S transponder. Upon request from a ground station, the operational mode status data is inserted into a message sent from the Mode S transponder. Through the directional TCAS antenna, all TCAS equipped aircraft periodically send a broadcast message that notifies other TCAS-equipped aircraft that they are present and TCAS equipped. The Mode S transponders receive the broadcast messages and notify the MILACAS-FR Processor through the ARINC 429 data link that a broadcast message was received. The ARINC 429 data link also sends the data that follows from the transponder to the MILACAS-FR Processor: • maximum airspeed • pressure altitude • aircraft address • TCAS coordination message data.

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Table 3. MILACAS-FR System Components (cont)

Equipment Type	Part Number	Description
APX-100/APX-119 Mode S Transponder (cont)		The ARINC 429 datalink processor sends housekeeping and coordination update data from the MILACAS-FR Processor to the transponder. Built-in-test equipment software continuously monitors for the possible events that follow: • transponder internal failures • transponder control unit failures • transponder antenna failures • pressure altitude input failures • ARINC 429 data failures. Detailed transponder subsystem failure status is reported to the MILACAS-FR Processor through the 429 data link. A transponder or transponder control unit failure lights the FAIL light on the transponder control unit. The Mode S transponder receives 115 V 400 Hz from an aircraft power source. If a synchro altitude source input is used, the transponder receives 26 V ac synchro reference power from an aircraft power source. The transponder is connected to the aircraft suppression bus.

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D. Environmental Certification

MILACAS-FR system equipment meets the environmental specifications of the Radio Technical Commission for Aeronautics (RTCA) document number DO-160A or DO-160B. Environmental certification categories for MILACAS-FR system equipment are defined in Table 4. Refer to the manuals shown in Table 4 for Environmental Certification Categories for other related equipment.

Table 4. DO-160D Environmental Certification Table Insert

Test	DO-160D Section	Category
Temperature/altitude	4	A2/F2: Y=300 minimum without forced air cooling
Temperature variation	5	B
Humidity	6	B
Shock	7	B
Vibration	8	H2
Explosion	9	E
Waterproofness	10	X
Fluids susceptibility	11	X
Sand and dust	12	X
Fungus resistance	13	F
Salt spray	14	X
Magnetic effect	15	Z
Power input	16	AB
Voltage spike	17	A
Audio frequency, conducted susceptibility - power inputs	18	Z
Induced signal susceptibility	19	C
Radio frequency susceptibility	20	WW
Emission of RF energy	21	M
Lightning induced transient susceptibility	22	A3C3
Lightning direct effects	23	X
Icing	24	A
Electrostatic discharge (EDS)	25	A
Note: X = N/A (not applicable)		

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E. System Maintainability

The MILACAS-FR Processor and the other components of the MILACAS-FR system have built-in tests (BIT) to fully monitor and report the operations and status of the system.

There are two different methods to start and observe functional self-test of the MILACAS-FR system. The first starts at the MCD Maintenance page and annunciates detected failures on the traffic displays. The second method starts when the TEST button located on the front panel of the MILACAS-FR Processor is pushed. Fault codes are annunciated on a front-panel LED indicator.

The second method is available in the event of a display malfunction that does not annunciate the MILACAS-FR Processor failure.

F. Fault Isolation

The system incorporates extensive built-in-test equipment (BITE) monitors. BITE monitors the system components constantly. Failures are annunciated on the screen of the PPI or dedicated traffic display and on various FAIL lamps and flags throughout the system. The BITE monitors are totally transparent to the pilot and do not affect TCAS operation unless a failure is detected. When a primary system failure is detected, specific LRU failures are annunciated on the PPI or dedicated traffic display. If a PPI weather/traffic display is used in a weather mode, "TCAS FAIL" is annunciated. When the display is switched to TCAS mode, the specific LRU failure(s) is annunciated.

Fault isolation is done on individual components prior to installation on the aircraft. Table 8 shows publications that contain the tests for the different units. Post-installation tests performed on the aircraft start from the transponder control panel or the MILACAS-FR Processor TEST button. Fault codes indicate a system component failure or wiring malfunctions on the aircraft.

G. Equipment Required But Not Supplied

Table 5 shows the accessories for the MILACAS-FR Processor in the MILACAS-FR system and associated equipment. Accessories for the APX-100/APX-119 Mode S transponder are described in the Mode S transponder maintenance manual. Other related accessories are described in the appropriate manuals.

Table 6 shows the equipment required but not supplied with the MILACAS-FR system. Table 7 shows the aircraft optional equipment.

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Table 5. MILACAS-FR System Accessories

Equipment Type	Honeywell Part Number		Description
MILACAS-FR Processor installation kit-connector	050-50000-0501		Supplies parts for assembling the MILACAS-FR Processor mounting tray connector.
MILACAS-FR Processor coax termination kit (requires 4 for each directional antenna)	<u>Cable Type</u> RG-214 RG-393 AA-5886 AA-5887, FC-28 AA-5888 ECS-311201	Honeywell <u>P/N 050-50005-</u> 0501 0502 0503 0504 0505 0506	Supplies parts to connect the directional antenna cable to the MILACAS-FR Processor mounting tray.
ANT-81A directional antenna connector kit; TNC straight	<u>Cable Type</u> RG-214 RG-393 AA-5888	Honeywell <u>P/N 050-50003-</u> 0502 0503 0505	Supplies parts to connect the directional antenna to the cable using a straight TNC connector.
ANT-81A directional antenna connector kit; TNC 90-degree	<u>Cable Type</u> RG-214 RG-393 AA-5887 AA-5888	Honeywell <u>P/N 050-50003-</u> 0512 0513 0514 0515	Supplies parts to connect the directional antenna to the cable using a 90-degree TNC connector.
ANT-81A antenna adapter kit (replaced by P/N 047-50357-XXX See adapters below.)	Adapter Plate <u>Description</u> 82 in. radius for 8-hole antenna 82 in. radius for 4-hole antenna 110 in. radius for 8-hole antenna 110 in. radius for 4-hole antenna NOTE: One O-RING, Honeywell P/N 36030-0023, is supplied with the antenna and one 36030-0023 is part of the antenna adapter kit.	Honeywell <u>P/N 050-50006</u> -0501 -0503 -0502 -0504	Supplies an adapter plate and O-ring to mount a flat base antenna on a curved surface.
ANT-81A antenna adapter	Adapter Plate <u>Description</u> 35 in. radius for 8-hole antenna 45 in. radius for 8-hole antenna 65 in. radius for 8-hole antenna 95 in. radius for 8-hole antenna	Honeywell <u>P/N 047-50357</u> -0001 -0003 -0002 -0004	Supplies an adapter plate to mount a flat base antenna on a curved surface. (See Figure 2001 for installation drawing.)

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Table 6. Equipment Required but Not Supplied

Aircraft Equipment	Description
115 V 400 Hz	Primary power source for MILACAS-FR Processor, TA/VSI, RA/VSI, dedicated TCAS traffic display, and Mode S transponder system
5 V ac or dc, or 28 V dc lighting bus	Panel lighting power source for TA/VSI, RA/VSI, and dedicated TCAS traffic display
5 V ac or 28 V dc power source (separate)	Fault lamp power for Mode S transponder/TCAS control unit
ARINC 429 Attitude/heading reference system (digital)	Supplies own pitch, roll, and heading of the aircraft on an ARINC 429 digital input to the MILACAS-FR Processor.
Radio altimeter - digital type (one or two)	Supplies the altitude of own aircraft on an ARINC 429 digital input to the MILACAS-FR Processor.
Aircraft switches • Landing gear switch • Air/ground switch	Supplies the status of aircraft landing gear extended or retracted discrete input to MILACAS-FR Processor. Supplies the status of aircraft on-the-ground/ in-flight discrete status input to MILACAS-FR Processor.
Suppression bus	Supplies mutual suppression of L-band equipment on aircraft including MILACAS-FR Processor bidirectional bus.
Altitude rate source (electrical)	Supplies the altitude rate of the aircraft on an electrical ARINC 429, ARINC 565, or ARINC 575 input to the TA/VSI and RA/VSI.
Pressure altimeter source	Supplies the pressure altitude input to the Mode S transponder. Refer to the applicable Mode S transponder system maintenance manual for the types of pressure altimeters that can be used with the Mode S transponder.
Cockpit speaker	Audio speaker, 8 ohms, 4 Watts nominal. Annunciates voice advisory messages from the voice synthesizer in the MILACAS-FR Processor.
Miscellaneous installation hardware	Mounting bracketry, wire, cables, nuts, bolts, screws, and other items.

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Table 7. Aircraft Optional Equipment

Optional Aircraft Equipment	Description
Cockpit headphones	Augment the cockpit speaker with headset annunciations of advisory alert messages from the voice synthesizer in MILACAS-FR Processor.
External tone generator and/or warning indicator lamps	Supply additional visual and audible tone annunciations for advisory alerts from the MILACAS-FR Processor.
Advisory cancel switch	Permits the flight crew to cancel verbal advisory alerts on the cockpit speaker, cockpit headphones, tone generators, and alert lamps.
PPI modified to provide TCAS traffic displays <u>NOTE:</u> PPI display is used to show independent or combined radar and TCAS traffic on the same display.	Supplies separate or combined displays of weather/map data and TCAS traffic data. Display modes are selectable from the modified PPI control panel.
ARINC 429 (digital) or ARINC 573 (non-digital) flight recorder	Records TCAS data. Digital data is received on a low-speed ARINC 429 data bus from the MILACAS-FR Processor. Non-digital data is received as ARINC 573 parallel data from the MILACAS-FR Processor.
Performance management computer	Supplies climb rate performance limit discrete input to the MILACAS-FR Processor.
Wind shear system and/or ground proximity system	Supply TCAS advisory inhibit discrete inputs to the MILACAS-FR Processor during wind shear or ground proximity alarm conditions.
ARINC 615 data loader (airborne or portable)	Reprograms the MILACAS-FR Processor program memory without requiring physical access to the unit itself. Programming is done through the ARINC 429 input and output ports on the MILACAS-FR Processor rear connector or a dedicated data loader connector on the front panel. Data loading may be done at either the low-speed or high-speed ARINC 429 data transfer rate. The data loader has an adapter cable (Honeywell P/N 300-80179-0501) to connect a portable data loader to the MILACAS-FR Processor front panel connector.

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3. Configurations Available

A. System

The MILACAS-FR system configuration is dependent on the equipment available in the aircraft.

The following text describes the available configurations and features for the MILACAS-FR Processor and directional antenna.

NOTE: Available configurations and features for the Mode S transponder and control units are described in separate manuals (shown in Table INTRO-1, Related Publications).

B. MILACAS-FR Processor

Only the MILACAS-FR Processor 940-0530-001 is used in this version. Table 8 contains a brief description of the features that are not self-explanatory.

Table 8. MILACAS-FR Processor Features

Feature	Description
Basic unit	Supplies master processing and control for TCAS II and formation keeping.
Input power	115 V, 400-Hz or 28 V dc power input.
S/W data load	Software data loading. Program memory can be reprogrammed with the data loader interface without physical access to the unit itself.
Omni ant	Omnidirectional antenna. Designed for installation on the bottom of the aircraft.
Ch 7 (software change 7)	Incorporated new CAS logic and voice commands as required by RTCA DO-185A.
RA event	Stores information on the last several RA events in non-volatile memory.

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C. ANT-81A Directional Antenna

Table 9 shows the available configurations of the directional antenna and the associated features. Table 10 contains a brief description of the features that are not self-explanatory.

Table 9. ANT-81A Directional Antenna, Configurations Available

Part Number	Dash Number	Features			
		Basic Unit	Paint Color	Basic Shape	Number Of Mounting Screws
071-50001	-8102	X	White	Flat	4
	-8103	X	White	Flat	8
	-8104	X	White	Curved	8
	-8105	X	Gray	Flat	4
	-8106	X	Blue	Flat	4

Table 10. ANT-81A Directional Antenna Features

Feature	Description
Basic unit	Four-element passive array. The antenna is screw-mounted to the aircraft fuselage. The antenna radiates 1030-MHz, pulse-modulated inputs from the MILACAS-FR Processor. The antenna detects radiated 1090-MHz, pulse-modulated signals. Table 3 and Table 14 show additional information.

4. System Leading Particulars

A. TCAS Surveillance Volumes

Surveillance volume is the volume of airspace within which other aircraft with Mode S or ATCRBS transponders are tracked by the own aircraft MILACAS-FR Processor System.

(1) Range Tracking Volumes

The shape and size of the range tracking volume is dependent on:

- Whether Mode S or ATCRBS transponders are being interrogated
- Whether tracking is occurring on a directional or omni antenna
- The attenuation levels applied to the transmitted pulses from the MILACAS-FR Processor.

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

(2) Altitude Tracking Volumes

The MILCAS-FR Processor tracks other transponder-equipped aircraft that are within a relative altitude range of ± 9000 feet (10,000 feet for units with Change 7 software). Note that the display altitude volumes differ from internal tracking volumes. Typical display volumes are ± 8700 feet (± 9000 feet for Change 7 units).

B. TCAS Sensitivity Level - Operating Modes

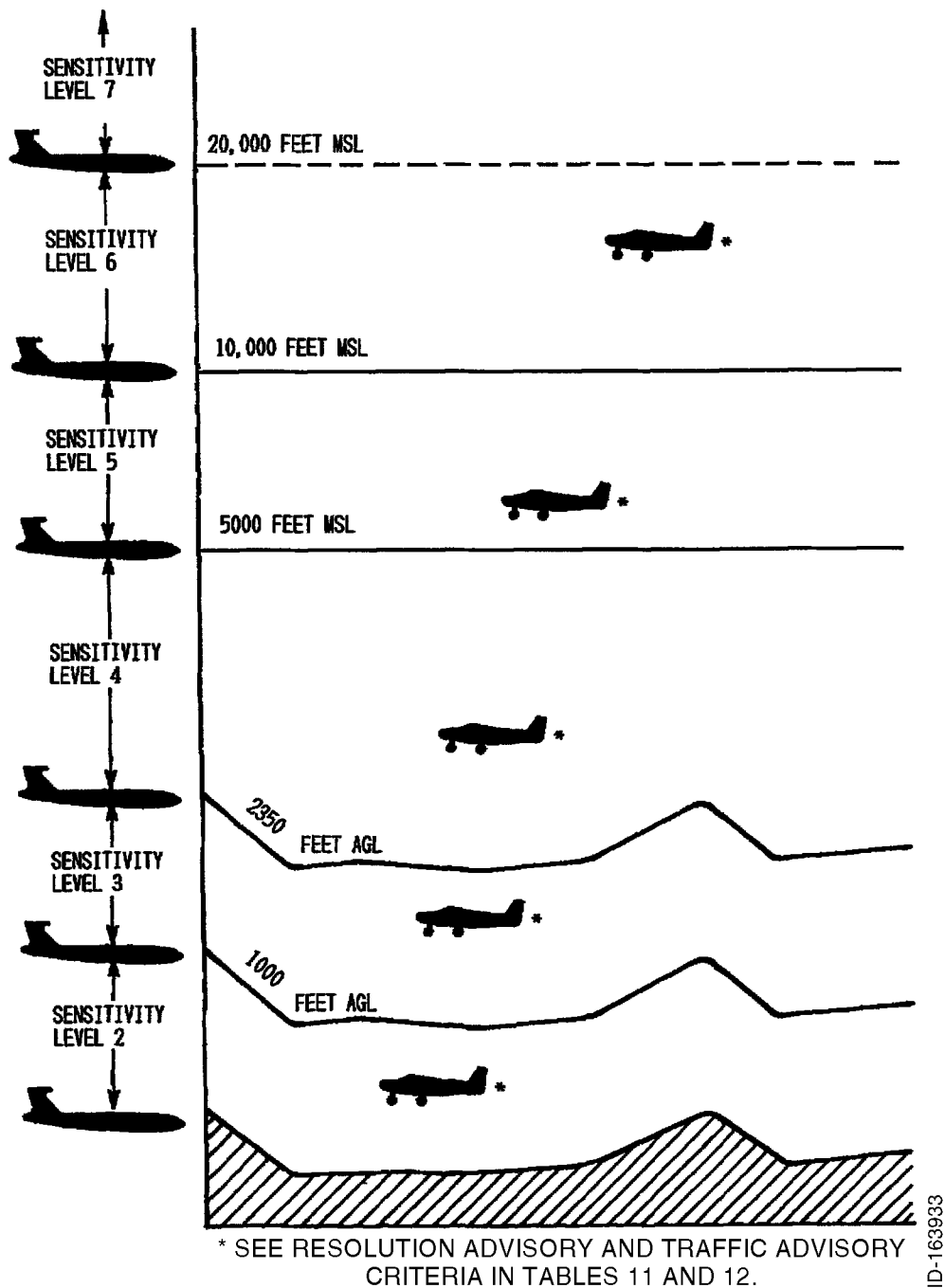
TCAS logic separates the surrounding airspace into altitude layers as shown in Figure 2. Each altitude layer has a different sensitivity threshold to issue RAs (resolution advisories) and TAs (traffic advisories). Lower altitudes have less sensitive RA and TA thresholds to prevent unnecessary advisories in the higher traffic densities anticipated at lower flight levels, such as terminal areas.

The information that follows about TCAS sensitivity levels, resolution advisories, and traffic advisory criteria is available as an aid to explain basic TCAS operation. The information in this manual may be superseded by the data in the MOPS document and the latest Honeywell software documentation.

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

Figure 2. Sensitivity Level Altitude Layers

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Table 11 shows information related to sensitivity level determinations. Table 12 shows information related to the conditions for resolution and traffic advisory threshold sensitivity levels. The information in Table 11 and Table 12 is used throughout this manual.

Table 11. TCAS Sensitivity Level Determinations

Modes	Description
Sensitivity Level 0	In automatic mode, sensitivity level is selected by altitude or by ground command. Sensitivity level 0 is selected manually when the control unit function switch is in the TA/RA mode position (in-flight). This selection enables all TCAS surveillance, tracking, and resolution advisory functions.
Sensitivity Level 1	In sensitivity level 1, TCAS stops all surveillance, tracking, and resolution advisory functions. The traffic advisory display is blank except for a STANDBY mode annunciation. Sensitivity level 1 requires one of the parameters that follows: (1) On the control unit or MCD, the function switch is set to ATC 1 TEST, ATC 1 STBY, ATC 1 ON, an ATC 2 position, or the ALT SOURCE switch is in the OFF position. (2) TCAS is in STANDBY mode or TEST mode. (3) TCAS has failed.
Sensitivity Level 2	In sensitivity level 2, TCAS performs surveillance and tracking functions and provides traffic advisories only. Sensitivity level 2 requires one of the parameters that follows: (1) Own aircraft is in-flight and TA or TA/RA is below 1000 feet AGL. (2) Own aircraft is in-flight and transponder/TCAS control unit is set to TA. (3) Own aircraft is on the ground and transponder/TCAS control unit is set to TA or TA/RA.
Sensitivity Level 3, 4, 5, 6, and 7	In sensitivity levels 3 thru 7, TCAS performs surveillance and tracking functions and supplies both resolution advisories and traffic advisories. Note that the transponder TCAS control panel must be in the TA/RA mode for these sensitivity levels. The parameters for sensitivity levels 3 thru 7 are based on own aircraft altitude as follows: (1) Sensitivity level 3 - Own aircraft altitude is between 1,000 and 2,350 feet AGL (radio altitude). (2) Sensitivity level 4 - Own aircraft altitude is between 2,350 feet AGL and 5,000 feet MSL (pressure altitude). (3) Sensitivity level 5 - Own aircraft altitude is not higher than 10,000 feet MSL. (4) Sensitivity level 6 - Own aircraft altitude is 10,000 to 20,000 feet MSL. (5) Sensitivity level 7 - Own aircraft altitude is above 20,000 feet MSL.

Table 12 is a matrix that shows typical protection times and volumes for 7.0 units. (These include units with dash numbers that end in 07 or greater.) When radio (AGL) and pressure altitude (MSL) select different sensitivity levels, the TCAS uses the lower level.

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Table 12. Typical Resolution Advisory and Traffic Advisory Volumes for Sensitivity Levels

	Own Altitude (feet) (Note 2)		Up to 1000 AGL	1000 to 2350 AGL	2350 to 5000 AGL	5000 to 10,000 MSL	10,000 to 20,000 MSL	20,000 to 42,000 MSL (Note 1)	Above 42,000 MSL (Note 1)
	Sensitivity Level	1	2	3	4	5	6	7	7
Traffic Advisory (TA) parameters	TA alarm time (seconds)	TCAS is OFF	20	25	30	40	45	48	48
	TA protection volume (nmi)		0.30	0.330	0.48	0.75	1.0	1.3	1.3
	TA relative altitude threshold (feet)		850	850	850	850	850	850	1200
Resolution Advisory (RA) parameters	RA alarm time (seconds)		Resolution Advisory not generated at sensitivity level 2	15	20	25	30	35	35
	RA protection volume (nmi)			0.20	0.35	0.55	0.80	1.10	1.10
	Corrective RA relative altitude threshold (feet)			300	300	350	400	600	700
	RA relative altitude threshold (feet)			600	600	600	600	700	800

Notes: 1. For pre-Change 7 units, 30,000 feet is used in place of 42,000 feet.
2. When AGL and MSL select different sensitivity levels, the TCAS uses the lower level.

The two conditions that follow cause TAs to be issued:

1. TCAS computes that at the current closure rate, and the distance the time separating own aircraft and intruder aircraft is less than "TA Alarm Time"
AND
the altitude difference between own and intruder aircraft is less than the "TA Relative Altitude Threshold."
2. Separation in slant range between own and intruder aircraft is less than minimum "TA Protection Volume".

The two conditions that follow cause RAs to be issued:

1. TCAS computes that at the current closure rate, and the distance the time separating own aircraft and intruder aircraft is less than "RA Alarm Time"
AND
the altitude difference between own and intruder aircraft is less than the "RA Relative Altitude Threshold".
2. Separation in slant range between own and intruder aircraft is less than minimum "RA Protection Volume".

Use the rule that follows to determine if the Resolution Advisory is corrective or preventive.

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

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C. MILACAS-FR System Leading Particulars

Table 13 and Table 14 show the leading particulars for the MILACAS-FR Processor and the ANT-81A Directional Antenna.

Leading particulars for the Mode S transponder system components and optional display units are described in separate manuals (shown in Table INTRO-1, Related Publications).

(1) MILACAS-FR Processor Leading Particulars

Table 13 shows the leading particulars of the MILACAS-FR Processor.

Table 13. MILACAS-FR Processor Leading Particulars

Characteristic	Description
Form factor	6 MCU, ARINC Specification 600.
Maximum weight	20 lb (9,07 kg)
Power requirements All except P/N 066-50000-03XX P/N 066-50000-03XX	115 V 400 Hz, 150 Watts (maximum) and 26 V ac synchro reference power as required by ARINC 413A. 28 V dc 150 Watts (maximum) and 26 V ac synchro reference power as required by ARINC 413A.
Temperature Range • Operating • Storage	-67 °F to +158 °F (-55 °C to +70 °C) -67 °F to +185 °F (-55 °C to +85 °C)
Cooling	ARINC 404/600 required or tray must be equipped with integral fan.
General requirements	
Surveillance range and altitude volumes	See paragraph 3.A.
Threat evaluation criteria	See paragraph 3.B.
Surveillance capacity	45 aircraft. However, TCAS will display up to 30 of the closest-range intruders.
Processor Mode S address capacity	150 addresses of detected Mode S-equipped aircraft.
System delay	Resolution advisory within 1.5 seconds after threat intruder is detected.
Voice synthesizer output power (nominal)	4 Watts into 8 ohms - speaker. 40 milliwatts into 600 ohms - headphones.

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Table 13. MILACAS-FR Processor Leading Particulars (cont)

Characteristic	Description
Receiver	
Frequency	
For DF19	1090 ± 0.01 MHz
For UF19	1030 ± 0.01 MHz
Decoding Ratio	
Input at -78 dBm or less at antenna	10% maximum
Input at MTL +3 dB to -21 dBm	99% minimum
Out-of-band rejection (reply signal level required to provide 90% decoding ratio)	
At 1084.5 and 1095.5 MHz	3 dB above MTL minimum
At 1075 and 1105 MHz	40 dB above MTL minimum
At 1065 and 1115 MHz	60 dB above MTL minimum
Dynamic minimum trigger level (DMTL) threshold	
ATCRBS	MTL + 13 dB
Mode S	MTL + 10 dB
Minimum Pulse Width	300 nsec
Maximum Pulse Rise Time	0.5 µsec
Delay Difference (between top and bottom antenna channels, including transmission lines)	0.050 µsec
Transmitter	
Frequency	
For UF19	1030.00 ±0.01 MHz
For DF19	1090.00 ±0.01 MHz
Omni antenna	
Minimum	+52.0 dBm (160 Watts)
Maximum	+56.0 dBm (400 Watts)
Directional antenna (total radiated power)	
Minimum	+47 dBm ±2 dBm (50 Watts)
Maximum	+51 dBm ±2 dBm (125 Watts)
Nominal	+49 dBm ±2 dBm (80 Watts)
Unwanted output power (inactive state)	-70 dBm maximum

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Table 13. MILACAS-FR Processor Leading Particulars (cont)

Characteristic	Description
Interrogation repetition interval	1 second
Broadcast interrogation interval	10 seconds in each direction (nominal)
Interrogation interval jitter ATCRBS Mode C and Mode S TCAS broadcast	+0.05 to -0.05 seconds about the nominal 1-second interval. -0.2 to +0.2 seconds about the nominal 10-second interval.
Transmitter delay difference (between top and bottom antenna channels, including transmission lines)	0.050 μ sec maximum
Transmitter pulse characteristics Mode C Only All-Call (P1, P2, P3, P4) Pulse duration Rise time Decay time Pulse spacing P1 to P2 P1 to P3 P3 to P4	 0.80 $\pm$ 0.05 μ sec 0.05 to 0.10 μ sec 0.05 to 0.20 μ sec 2.00 $\pm$ 0.10 μ sec 21.00 $\pm$ 0.10 μ sec 2.00 $\pm$ 0.04 μ sec
Mode S Pulse duration P1, P2 P6 (short) P6 (long) Rise time Decay time Pulse spacing P1 to P2 P2 to P6 sync phase reversal P6 leading edge to P6 sync phase reversal	 0.80 $\pm$ 0.05 μ sec 16.250 $\pm$ 0.125 μ sec 30.250 $\pm$ 0.125 μ sec 0.05 to 0.10 μ sec 0.05 to 0.20 μ sec 2.00 $\pm$ 0.04 μ sec 2.75 $\pm$ 0.04 μ sec 1.25 $\pm$ 0.04 μ sec
Twenty-four whisper-shout Mode C power levels S1 Pulse	 2 dB below the highest power pulses in previous set of pulses
Environmental certification	Refer to Table 4.

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(2) Directional Antenna Leading Particulars

Table 14 shows the leading particulars of the ANT-81A directional antenna.

Table 14. ANT-81A Directional Antenna Leading Particulars

Characteristic	Description
Form factor	ARINC 735A (teardrop shape)
Antenna base types	Curved base (071-50001-8104) Flat base (071-50001-8102, -8103)
Temperature • Operating • Storage	-67 °F to +158 °F (-55 °C to +70 °C) -67 °F to +185 °F (-55 °C to +85 °C)
Maximum weight	2.0 lb (0.91 kg)
Overall dimensions	See Figure 2001.
Antenna mounting footprint	See Figure 2001.
Antenna mounting	Mounts directly to aircraft using mounting screws, defined in Figure 2001. An antenna adapter (Figure 2001) is available for mounting flat-base antenna on a curved surface.
Exterior material	High-strength composite
Number of antenna array elements	Four
Polarization	Vertical
Power requirements	None
Transmission frequency	1030 ±1 MHz
Receiving frequency	1090 ±3 MHz
Connectors • Quantity • Type	Four See Figure 2001.
Pressurization	Withstands a pressure differential of 25 P.S.I.
Lightning protection	Meets swept zone 2A lightning strike requirements.
Main beam characteristics • Operational beam positions • Half power azimuth beam width (measured over -15 to +20 elevation) • Steering quantization	4 ≥90° 90°

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Table 14. ANT-81A Directional Antenna Leading Particulars (cont)

Characteristic	Description
Omni beam characteristics	
Operational beam positions	360°
Beam null compared to main beam (at each elevation from -15 to +20)	≥9 dB
Input port VSWR	1.5:1 maximum
Antenna cable loss requirement	2.5 ±0.5 dB at 1030 MHz for each coaxial cable including connectors.
Antenna cable differential phase delay	One-half wavelength maximum (approximately 5 inches)
Maximum peak input power	1000 W pulsed
Maximum average input power	10 W continuous
ARINC characteristic	ARINC 735A
TSO	C119a (C119b for change 7 units)
Environmental certification	In addition to the environmental requirements defined in Figure 4, an altitude immersion environmental specification requires that the antenna not outgas at an altitude of 55,000 feet when submersed in water for 30 minutes.

5. System Block Diagrams

A. General

The Honeywell MILACAS-FR System equipment shown in Figure 1 includes the following equipment:

- (1) MILACAS-FR Processor
- (2) ANT-81A Directional Antenna
- (3) Mode S transponder (APX-100/APX-119) which includes a Mode S transponder and a transponder/TCAS control unit.

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NOTE: The MILCAS-FR Processor and directional antenna are discussed in detail in this manual. Additional equipment is discussed to a level necessary to understand the overall system operation. The Mode S transponder and associated control units, including installation information, are discussed in detail in separate manuals shown in Table INTRO-1. Table INTRO-1 also shows other related manuals. See Figure 3 for a system simplified block diagram.

B. System Functional Overview

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

NOTE: Mode A/C transponders are Mode A transponders that respond to Mode C interrogations.

System operation is separated into the major functions that follow:

(1) Surveillance Function

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

(2) Tracking Function

- Tracks up to 45 combined Mode S and Mode A/C transponder-equipped intruder aircraft. Tracks range of intruder aircraft. Tracks the intruder's relative bearing if tracking occurs on a directional antenna. Tracks the intruder's relative altitude if intruder reports altitude.
- Computes the projected relative position of the intruder.
- Computes closing range rate.
- Computes altitude change rate if intruder reports altitude.
- Estimates projected miss distance.

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

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(3) Threat Potential Evaluation Function

- Determines threat potential of intruder aircraft based on computations from tracking data.
- Identifies intruders as resolution advisory threats (RAs), traffic advisories (TAs), proximities, or non-threats.

(4) Collision Avoidance Computation and Resolution Advisory Display Function

- If an RA threat aircraft is present, TCAS determines the appropriate vertical maneuvering for own aircraft that will attain or maintain a safe distance between own aircraft and intruder aircraft while creating the least deviation from own aircraft's vertical rate. Communicates advised maneuver to the pilot by means of a resolution advisory display on the TA/VSI or RA/VSI units.

(5) Traffic Advisory Display Function

- Provides a display of RA, TA, proximity, or non-threat category traffic that are present in the surrounding airspace. The traffic display depicts the position and threat potential of intruder aircraft which alerts the flight crew to potentially dangerous situations. Depending on the aircraft equipment, the traffic display may appear on a TA/VSI unit or an optional PPI or dedicated TCAS display unit.

(6) Aural Alert Function

- Provides voice message advisory alerts on the cockpit audio system.

(7) Air-to-Air Coordination Function

- If the intruder aircraft is TCAS equipped and becomes a threat, a maneuvering coordination data link is established with the intruder. This data link makes sure that the resolution advisories in both TCAS equipped aircraft are coordinated and compatible. The coordination links are established between the two TCAS systems by the Mode S transponders.

(8) Data Recorder Function

- If the optional solid state data recorder is attached to the front of the MILACAS-FR Processor, TCAS history data is periodically transferred from the MILACAS-FR Processor to the recorder.

(9) Data Loader Function

- If an ARINC 615 data loader is connected to a MILACAS-FR Processor that has data loader capability, the unit software may be updated without opening up the unit.

C. System Component Description and Functions

(1) MILACAS-FR Processor

(a) General

The microprocessor based MILACAS-FR Processor is the master control unit in the system. It consists of a combined computerized control system and L-band receiver/transmitter. Operation of the TCAS system is controlled by TCAS software resident in the computer control memory.

(b) MILACAS-FR Processor Description and Basic Functions

The MILACAS-FR Processor routinely reads and stores the own aircraft information that follows:

- 1 Own aircraft heading, pitch, roll, and radio altimeter inputs. This information, in conjunction with own pressure altitude data, allows TCAS to determine own aircraft position and flight path for use during tracking, RA and TA advisories, and traffic display computations.
- 2 Own aircraft pressure altitude data received on the ARINC 429 data bus from the Mode S transponder. Pressure altitude is input to the transponder from own aircraft pressure altitude source. Pressure altitude is used to calculate own aircraft altitude relative to the intruder altitude and own aircraft flight level altitudes.
- 3 Mode control requests and traffic display control inputs from the Mode S transponder on the ARINC 429 data bus. The Mode S transponder receives data from the transponder control panel (and may in the future also receive control inputs from ground stations). This information is a factor in TCAS sensitivity level calculations and traffic display formats.
- 4 Own aircraft identification code (transponder I.D.) received on the ARINC 429 data bus from own Mode S transponder. Own aircraft identification is input to the transponder by 24 discrete bit strapped inputs. Own aircraft I.D. is used by the MILACAS-FR Processor during air-to-air coordination routines.
- 5 Own aircraft maximum airspeed data received on the ARINC 429 data bus from own Mode S transponder. Own aircraft maximum airspeed is input to the transponder by three discrete bit strapped inputs. This information is used in maximum closing rate projections and RA computations.
- 6 Antenna delay strap inputs. These 3 discrete inputs are used during TCAS range computations to compensate for cable delay differences between the top and bottom antennas.

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Performance limit inputs. These inputs are used as factors in RA computations. Performance limit inputs include:

- Performance limit discrete input or ARINC 429 input from performance management computer
- Five discrete altitude limit program strap inputs (2000, 4000, 8000, 16,000, and 32,000)
- Four discrete 1500 fpm climb inhibit inputs which are configured by the user to limit RAs to performance capabilities of aircraft (Example: wing flap retracted/extended switch can be connected to these inputs or the increased climb inhibit inputs depending on the characteristics of the aircraft.)
- Four discrete 2500 fpm increased climb inhibit inputs configured by the user to limit RAs to performance capabilities of aircraft.

NOTE: Although not specifically a part of performance limits, the discrete input from the landing gear retracted/extended switch can be used for performance limit input in conjunction with inputs described in paragraphs 4 and 5 above. However, this input is intended for other functions, such as making a bottom directional antenna behave as an omni antenna in gear-down situations.

- Discrete input from weight-on-gear (air-ground) strut switch. Notifies TCAS as to whether own aircraft is in-flight or on-the-ground.
- Advisory delay discrete inputs from ground proximity and wind shear system (if applicable)
- Discrete input from optional advisory cancel switch
- Five discrete inputs from RA/TA intruder display limit straps. These straps determine the maximum number of aircraft that can be displayed on the traffic display (from 1 to 30).
- Discrete input from ground display mode strap. This input determines if traffic is displayed when own aircraft is on-the-ground.
- Discrete input from RA/TA display all traffic mode strap. This input determines if all targets are displayed at all times or only when an RA or TA is present.

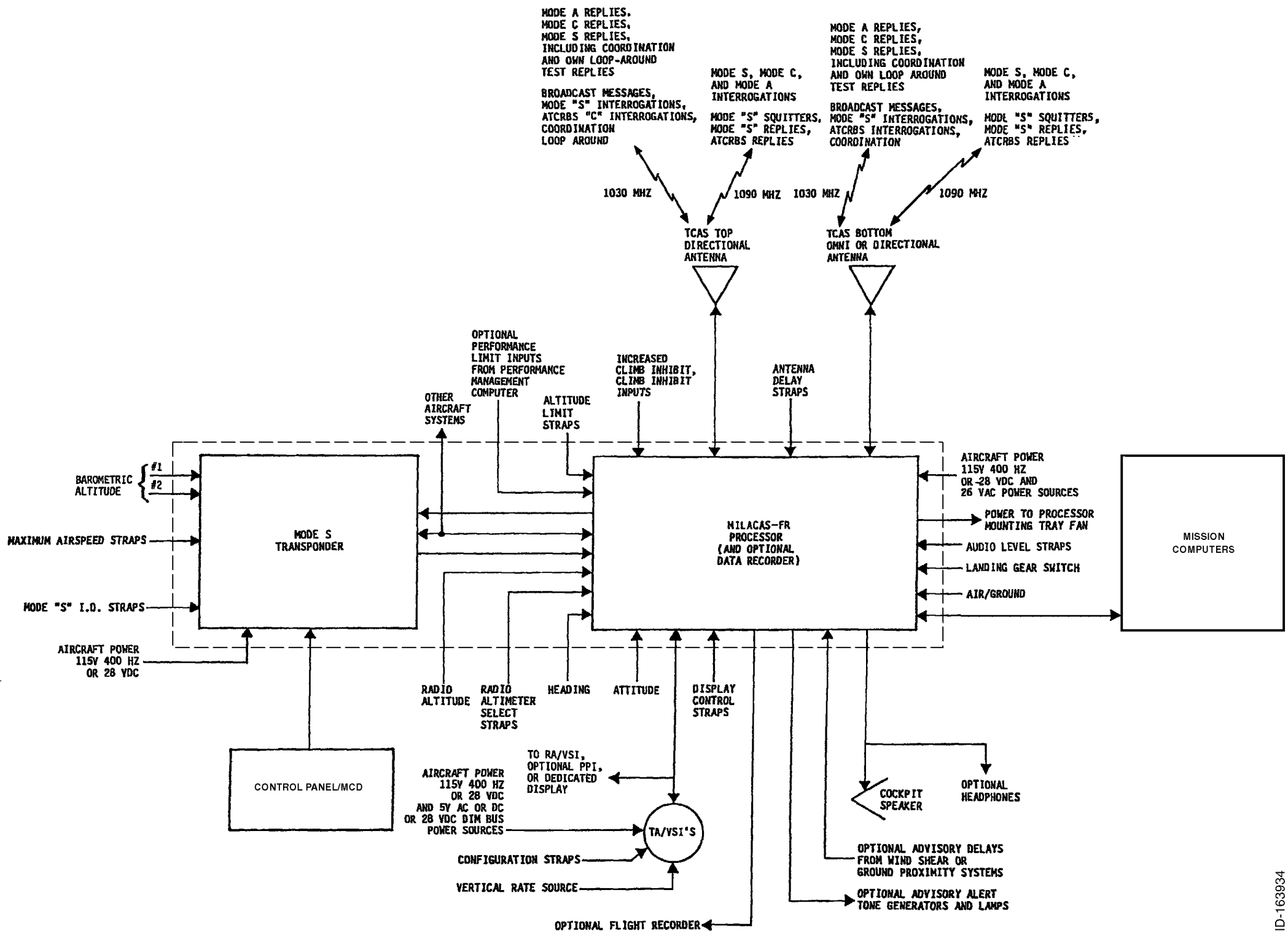


Figure 3. System Simplified Block Diagram

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- (c) Continuity/resistance checks on top and bottom TCAS antenna ports. This information permits the MILACAS-FR Processor to determine if an omni or directional antenna is used as the bottom TCAS antenna and if the antenna cables are properly connected to the top and bottom antennas. The four ports for each directional antenna must reflect specific and different resistance values due to port identification resistors mounted inside the directional antenna.
- (d) System validity inputs. TCAS generates failure annunciation data to the resolution advisory and traffic displays when a failure is detected on one of the inputs that follows:

- Discrete failure status inputs from the TA/VSI units, RA/VSI units, or other optional display units

NOTE: In the event of a display unit failure, the display sets its "display valid" output discrete to invalid and attempts to display the status of the fault it has detected, if it is not prevented from doing so by the nature of the fault (i.e., certain faults result in a blank display and not allow the display of any data).

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

NOTE: If both radio altimeters, both RA/VSI units, or both TA/VSI units fail, the MILACAS-FR Processor automatically goes into the standby mode.

- Loss of continuity through the TCAS antennas
 - Failure status data or loss of data on the ARINC 429 data link from the Mode S transponder
 - Internal MILACAS-FR Processor failures including failure of internal power supplies
 - Invalid data from the radio altimeter if only one is connected, or both radio altimeters if two are connected.
- (e) If a particular failure degrades TCAS operation, the MILACAS-FR Processor stops all TCAS processes and displays an appropriate annunciation on the display units.
- (f) Five discrete inputs from synthesized voice output loudness control straps. Three of these straps determine the audio output levels to the speaker and headphones when the aircraft is airborne. The other two straps determine the audio output levels when the aircraft is on the ground. The discretely are as follows:
- Discrete input from the functional test inhibit strap. This input determines whether or not TCAS functional test is inhibited when the aircraft is airborne.

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- Discrete input from the transponder interface select strap. This input shows whether one or two transponders are installed on the aircraft.
- Discrete input from the radio altimeter interface select strap. This input shows whether one or two radio altimeters are installed.
- Discrete input from the RA status inhibit strap. This input shows RA display status as active or inhibited.
- Discrete input from the on-ground intruder disable strap. This input determines whether or not intruders determined to be "on ground" is displayed when own aircraft is below 1750 feet (radio altitude).

(3) The MILACAS-FR Processor controls the following real-time functions of TCAS:

- (a) The MILACAS-FR Processor formats and transmits broadcast messages and listens for broadcasts. Broadcast messages are transmitted at 1030 MHz by each system to notify other TCAS-equipped aircraft that own TCAS-equipped aircraft is present. Broadcast messages are transmitted on the TCAS directional and omni antennas. Each TCAS, including own TCAS, keeps track of the number of broadcast messages being received by its Mode S transponder. This provides each TCAS with the number of TCAS-equipped aircraft within broadcast range. This number is used in TCAS interference limiting formulas and is used to control the power output levels and rates of TCAS Mode S interrogations.
- (b) The MILACAS-FR Processor reduces the number of TCAS Mode S interrogations and also reduces the power output levels as the number of TCAS-equipped aircraft (number of broadcast receptions) increases. This reduces the detectable interrogation load on Mode S transponders in situations where numerous TCAS-equipped aircraft are present in the same airspace volume. The effect of reducing the number of air-to-air interrogations and associated transmit power levels is a reduction of unsolicited replies (fruit overload) received by ground stations.
- (c) The MILACAS-FR Processor listens for Mode S transponder squitter messages from the other aircraft. Mode S transponders indicate their presence by transmitting a 1090-MHz squitter message once every second. The MILACAS-FR Processor listens for squitters on the TCAS directional antennas.

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- (d) If a valid Mode S squitter message is detected, the MILACAS-FR Processor interrogates the intruder. If an interrogated Mode S equipped aircraft is within TCAS Mode S tracking range and altitude, the Mode S equipped intruder is placed into track. The MILACAS-FR Processor formats and transmits a 1030-MHz Mode S interrogation messages on the directional antenna and/or the omni antenna and receives a 1090-MHz Mode S reply messages on the directional antenna to update intruder aircraft in the Mode S track. The MILACAS-FR Processor selects one of four directional antenna beams to be used for directional message transmission and reception.
- (e) The MILACAS-FR Processor does ATCRBS search, track initialization, and track updates. If an ATCRBS equipped aircraft is within TCAS ATCRBS tracking range and altitude, the ATCRBS equipped intruder is placed into track. The MILACAS-FR Processor formats and transmits 1030-MHz ATCRBS interrogations and receives 1090-MHz ATCRBS replies on the directional antenna to update intruder aircraft in the ATCRBS track. The MILACAS-FR Processor selects one of four directional antenna beams to be used for ATCRBS directional message transmission and reception.

NOTE: Mode S and ATCRBS interrogation and reply message formats are shown in Figures 4 and 5.

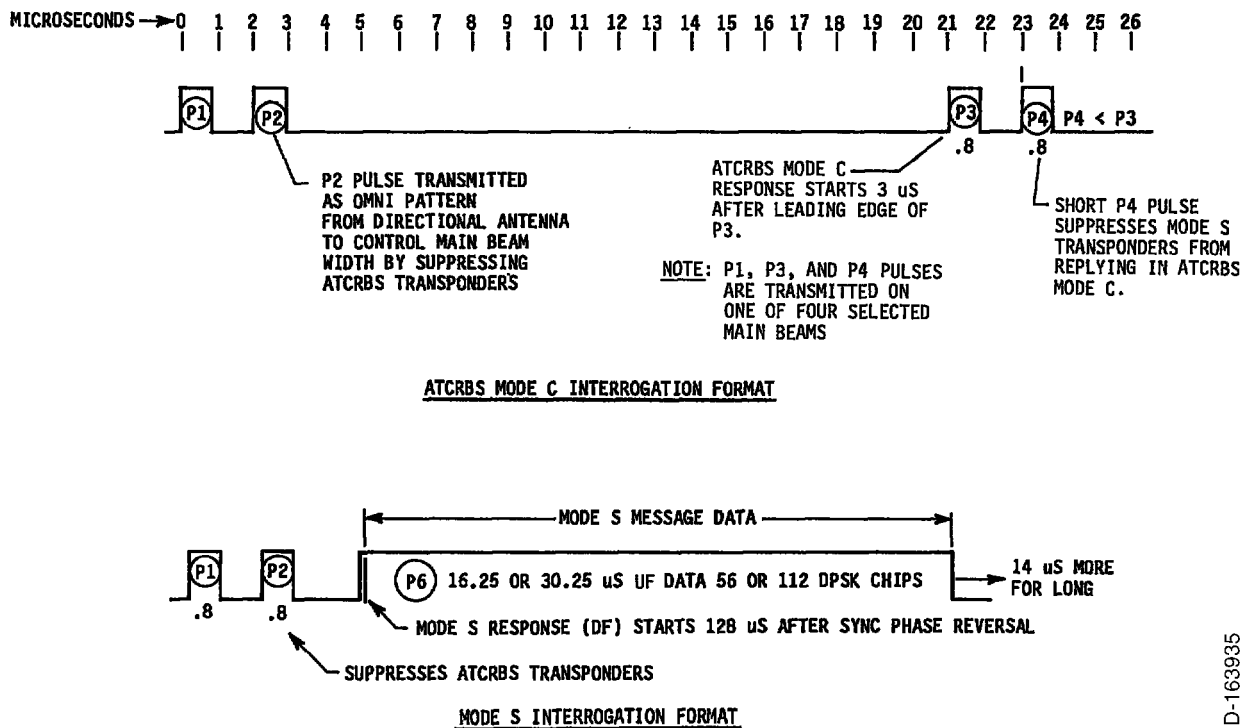


Figure 4. ATCRBS Mode C and Mode S Interrogation Formats

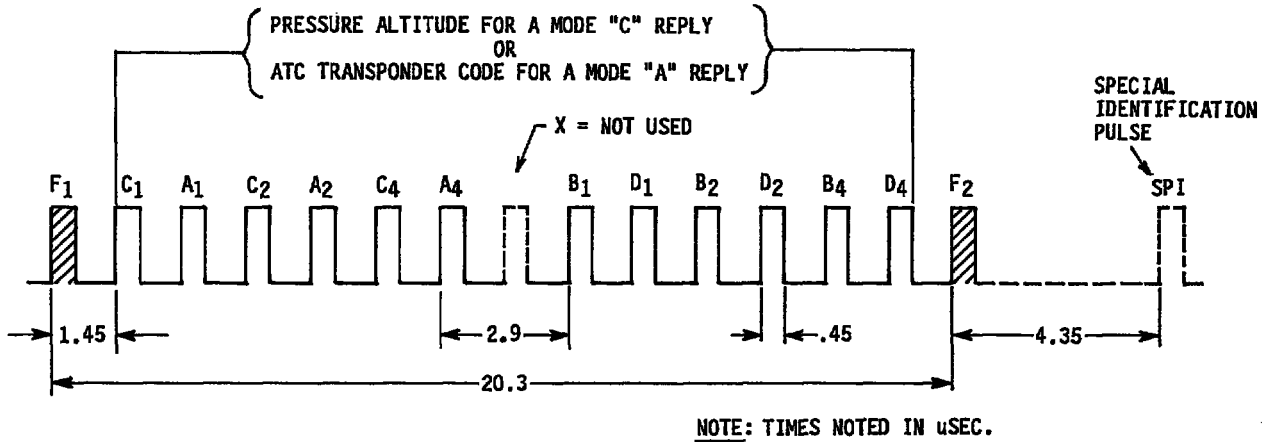
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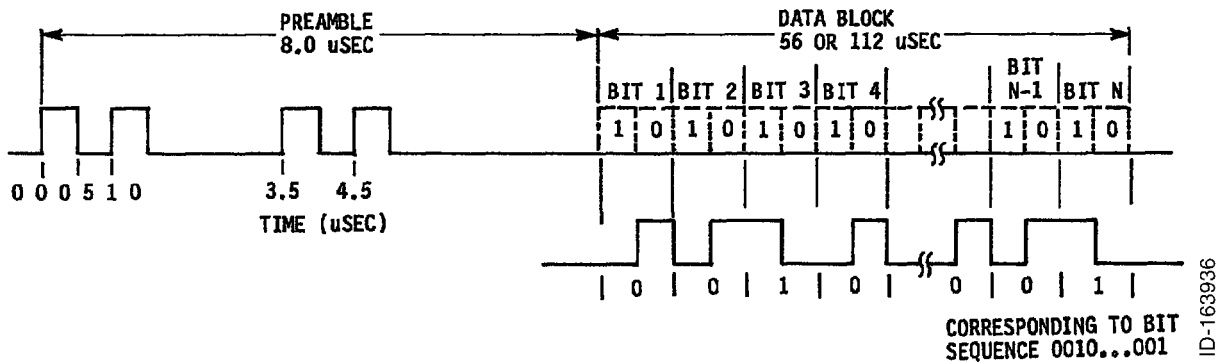
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MODE C AND MODE A REPLY MESSAGE FORMATS



Mode S Reply Message Formats

NOTE: FOR ADDITIONAL DETAILS, REFER TO APPLICABLE MODE S TRANSPONDER MANUAL, LISTED IN TABLE INTRO-1.

Figure 5. ATCRBS/Mode S Transponder Reply Message Formats

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- (f) The MILACAS-FR Processor calculates range, bearing, and altitude of the intruder aircraft based on information computed from or contained in the reply messages. Bearing is only determined for intruder replies received on the directional antenna. Altitude is only determined if the intruder is reporting altitude in its transponder reply message.
- (g) Based on the reply, the MILACAS-FR Processor evaluates the threat potential of the intruder by calculating the intruder closing rate and position relative to own aircraft. Based on this evaluation, the MILACAS-FR Processor categorizes the intruder as a non-threat, proximity, traffic advisory, or resolution advisory.
- (h) For threat category aircraft, the MILACAS-FR Processor computes the proper resolution advisory to maintain or establish safe separation between own and intruder aircraft. The MILACAS-FR Processor then:
 - Outputs resolution advisory data on the ARINC 429 buses to the TA/VSI or RA/VSI units
 - Outputs RA traffic symbol position and alert data on the ARINC 429 data bus to the TA/VSI or PPI display unit
 - Outputs resolution advisory alert voice messages to the cockpit audio system and alert outputs for optional tone generators and/or lamps.
- (i) For proximity and non-threat category aircraft, the MILACAS-FR Processor outputs proximity or non-threat traffic symbol position data on the ARINC 429 data bus to the traffic advisory display. (Voice alerts are not generated for proximity or non-threat category aircraft.)
- (j) For traffic advisory category aircraft, the MILACAS-FR Processor outputs TA traffic symbol position and alert data on the ARINC 429 data bus to the TA/VSI or PPI display, outputs traffic advisory alert voice messages to the cockpit audio system, and alert outputs for optional tone generators and/or lamps.
- (k) The MILACAS-FR Processor establishes a coordination data link with threat aircraft that are also TCAS equipped. The own MILACAS-FR Processor transmits coordination messages to threat aircraft's transponder through own TCAS antennas and receives coordination messages from threat aircraft's transponder. The TCAS equipped threat aircraft uses the same process with its Mode S transponder and establishes a full two-way coordination data link. TCAS-equipped aircraft use the coordination data to avoid conflicting maneuvers between mutual threat aircraft.
- (l) During each TCAS 1030 MHz transmission on the directional or omni antenna, the MILACAS-FR Processor generates a suppression pulse to other L-band equipment on own aircraft.

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(m) The MILACAS-FR Processor reduces fruit and synchronous garble interference by the following interference limiting methods:

- An ATCRBS P2 sidelobe suppression pulse is transmitted as an omnidirectional pattern on the directional antenna to control the effective beam width.
- A sequence of ATCRBS interrogations are transmitted at different power levels (whisper-shout levels). These whisper-shout levels divide the surrounding airspace into range segments. The maximum number of whisper-shout levels (24) are used when interrogating in the forward direction on the directional antenna.
- Interrogate more than once to check reply validity.
- Transmit a P2 ATCRBS suppression pulse in Mode S interrogation transmissions.
- Transmit a P4 Mode S suppression pulse during ATCRBS interrogation transmissions.

(n) The MILACAS-FR Processor also controls:

- Scheduling for interrogations performed on the directional and omni antennas
- TCAS sensitivity level operating modes
- Generation of coasting data during periods when tracking data is temporarily lost.

(o) The MILACAS-FR Processor transmitter and receiver are both calibrated automatically during power up, during functional test, and every two seconds (at a minimum) thereafter to compensate for phase shifts contributed by cables, relative phase error in the receiver circuitry, and temperature effects.

(p) MILACAS-FR Processors that incorporate 02 software or later also contain a transmitter cable calibration BITE test that operates whenever power is applied to the MILACAS-FR Processor. The transmitter cable calibration calculates the phase differences between the cables to each antenna. This information is used to compensate for the cable length differences, during TCAS transmissions, by adjusting internal phase shifters. If the results of the cable calibration are inconsistent, then a BITE fault is reported against the top or bottom antenna.

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(q) The MILACAS-FR Processors that have unit MOD 15 incorporated do not report this fault against the lower antenna if the landing gear is extended. If the fault is detected while at cruise, the fault is "latched" and continues to be reported until power-off regardless of the position of the landing gear.

(4) Power Requirements

The MILACAS-FR Processor receives 115 V ac, 400 Hz or 28 V dc primary power and 26 V ac synchro reference input power from aircraft power sources.

(5) Rear Connector

A six section rear connector provides the system interconnects to the MILACAS-FR Processor. The six sections of the connector are designated left bottom plug (LBP), right bottom plug (RBP), left middle plug (LMP), right middle plug (RMP), left top plug (LTP), and right top plug (RTP). The system interconnect diagram, Table 15, shows the specific pin connections into the MILACAS-FR Processor.

Table 15. MILACAS-FR Processor Rear Interconnects/Interwiring

Pin	Signal Name	Description
RBP4A	Alternate voice enable discrete input	A ground on this pin enables all voice annunciations from MILACAS-FR to be made using a different voice from all the standard TCAS voices. When this pin is set to open, all voice annunciations from MILACAS-FR is made using the standard TCAS voice.
RBP4C	TCAS aural annunciation enable (applies to -2930 units only)	A ground on this pin enables an aural annunciation (ARINC 429 Label 057) on the following high speed ARINC 429 data buses: • TA/RA display No. 1, pins RMP7C and RMP7D • TA/RA display No. 2, pins RMP7G and RMP7H It also makes this information available to the data recorder. An open on this pin inhibits the aural annunciation (ARINC 429 Label 057) to the display buses and to the data recorder.
RBP4D	TCAS select program pin	This pin defines the TPL-100A as a MILACAS-FR unit. This pin is strapped to the program common pin RBP7K.

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Table 15. MILACAS-FR Processor Rear Interconnects/Interwiring (cont)

Pin	Signal Name	Description
RMP7E RMP7J	Display status discretes	Not used. No longer monitors traffic display discretes.
RMP14D RMP14E	Display input bus	This high speed ARINC 429 input bus is used by the TCAS or MILACAS-FR to input control data word, label 017.

(6) Fault Monitoring

Selecting START TEST on the MILACAS-FR Processor front panel causes the front panel liquid crystal display to show a two character fault code if a system fault exists. Fault code CD indicates a TCAS control data input fault. The CD fault code can appear if a TCAS non-compatible control panel is used and a self-test is indicated.

(7) Processor Strapping

Table 16 shows the strap information (pins RMP12A, RMP12B, and RMP12C) for additional radio altimeters that can interface with the MILACAS-FR Processor.

Table 16. Radio Altimeter Straps

Radio Altimeter Type	Electrical Characteristics	Pin 12C	Pin 12B	Pin 12A
0	CP-140 LPIA 0 to 5000 ft: 0 ft = +1.000 V 0 - 500 = +1.000 V + 16 mV/ft 500 ft = +9.000 V 500 - 5000 = +9.000 V +2.67 mV/ft 5000 ft = +21.015 V	0	0	0
1	LPIA / APN - 194 0 to 5100 ft 0 ft = +1.000 V 0 - 400 ft = +1.000 V +20 mV/ft 400 ft = +9.000 V 400 - 5100 ft = +9.000 V +2.61 mV/ft 5100 ft = +21.267 V	0	0	1
2	CARA (signal RTFAA) 0 to 5400 ft -8.0 mV/ft, 0 ft = 0 V	0	1	0
3	-20 to 2650 ft -10 mV/ft, 0 ft = 0 V	0	1	1

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Table 16. Radio Altimeter Straps (cont)

Radio Altimeter Type	Electrical Characteristics	Pin 12C	Pin 12B	Pin 12A
4	CARA (signal RTFAAA) 0 to 5400 ft 5.0 mV/ft, 0 ft = 0 V	1	0	0
5	0 to 2650 ft -4 mV/ft, 0 ft = 0 V	1	0	1
6	-20 to 2867 ft -20 to 500 ft: 20 mV/ft 500 to 2867 ft: 10.4 V + 3 mV/ft 0 ft = 0.4 V	1	1	0
7	ARINC 552A/429 0 to 480 ft: $0.02(h+20)$ 480 ft to 2857 ft: $10 \cdot 1n((e(h+20))/500)$ Where h = height = $500 \cdot (e^{((V-10)/10)} - 20)$, e = 2.7183	1	1	1
NOTES: 1. The KING KRA-405 outputs 3 and 6 above. 2. The Honeywell RT-300 outputs 5 and 7 above. 3. 1 = pin open, 0 = pin connected to common (RMP6K)				

D. Directional Antenna

(1) General

The ANT-81A directional antenna calculates the bearing of intruder aircraft. The MILACAS-FR Processor transmits interrogations and receives replies on one of four antenna beams. When it selects a beam, the MILACAS-FR Processor electronically points the antenna in a surveillance direction during TCAS transmit and receive operations.

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(2) TCAS Directional Antenna Description and Basic Functions

The directional antenna is a phased array and consists of four top-loaded monopole elements. The directional antenna is steered electronically.

Unlike mechanically steered antennas, the antenna pattern can be pointed in one of four directions without physically moving the antenna. This is achieved by independently varying the drive level and phase to each of the four antenna elements contained in the directional antenna.

The four beam-forming elements are located on the perimeter of the antenna. The whole assembly is in an aerodynamic fiberglass enclosure just over one inch in height. The top directional antenna should be mounted at or near the longitudinal centerline of the aircraft +5° and as far forward as is practical. The bottom directional antenna or omni antenna (if used) should be collocated as near as possible to the vertical plane of the top directional antenna.

During TCAS transmission, the directional antenna (top or bottom) radiates 1030 MHz. The directional antenna main beam patterns and directional antenna omni beam patterns are under control of the four antenna element drive signals from the MILACAS-FR Processor (see beam patterns in Figure 6).

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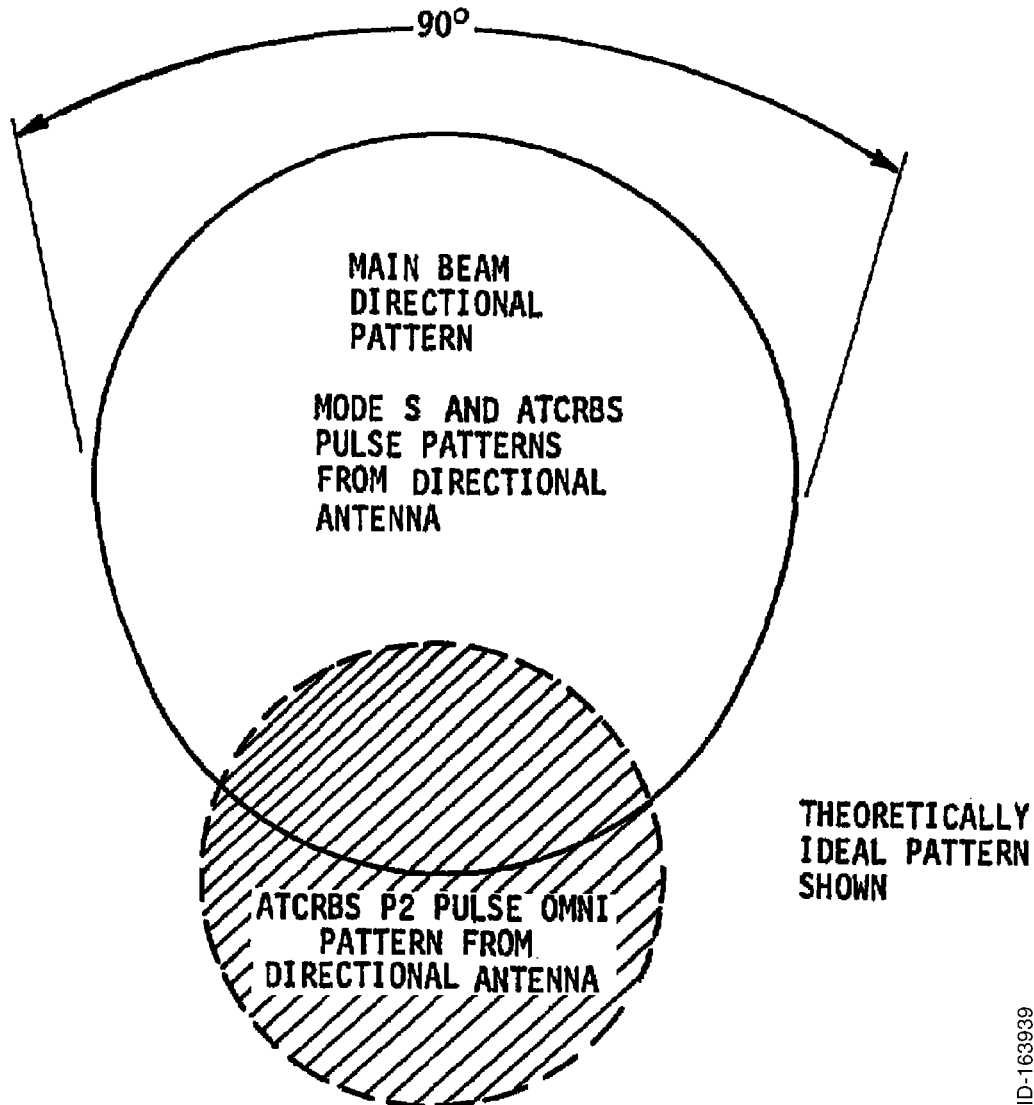


Figure 6. TCAS Transmit and Receive Beam Patterns for Directional Antenna

All pulses in a TCAS (Mode S) message transmission from the directional antenna are radiated as a directional main beam pattern. To obtain the main beam pattern, the four signals representing each transmit pulse are individually phase shifted by the MILACAS-FR Processor. The phase shifting imposed on the four elements represents the direction of the main beam to be transmitted (one of four beams). The resultant 1030-MHz signals radiated from the four elements of the antenna combine and cancel in a manner that creates a main beam directional pattern for each and all pulses transmitted.

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In the case of a TCAS/ATCRBS interrogation transmission, the TCAS message is transmitted from the directional main beam with the exception of the ATCRBS suppression pulse (P2) which is transmitted in an omni pattern as shown in Figure 6. To create the omni pattern for the ATCRBS suppression pulse, the four signals representing the suppression pulse from the MILACAS-FR Processor to the four elements of the antenna are of equal phase and amplitude. This results in the omni pattern being radiated for the ATCRBS suppression pulse.

NOTE: The P2 pulse for Change 7 units is transmitted with a directional pattern, but in a direction opposite the main beam.

ATCRBS Mode A and Mode C transponders in the surrounding airspace (which detect an omni suppression beam signal larger in amplitude than the main beam signal) are suppressed from replying to the interrogation. The result of the ATCRBS P2 suppression is to control the effective TCAS interrogation beam width and thus limit interference from unwanted ATCRBS receptions. The effective beam width is narrowed by increasing the amplitude of the suppression omni pattern output or decreasing the amplitude of the main beam pattern output.

During TCAS receptions, each of the four directional antenna elements receives any 1090-MHz signal that passes by the element. The phasing of these received signals is determined by the direction from which the RF energy is received. These signals are directed onto the same four cables that connect transmit signals between the MILACAS-FR processor and the directional antenna.

Multiple receivers are used in the MILACAS-FR Processor to perform noise suppression and pulse shaping on the received signals. Phase detectors in the MILACAS-FR Processor then examine the relative phasing of the four signals from the antenna and produce an analog voltage that represents the bearing of the intruder aircraft that sent the replies.

The main beam pointing angle is redirected in a matter of microseconds, to any of four 90° pointing positions.

Four coaxial cables with type TNC plugs on the antenna end connect the directional antenna to the MILACAS-FR Processor.

Each of the four ports of the directional antenna contains a resistor located across the antenna element to ground. Each of the four resistors is a different value. The MILACAS-FR Processor periodically performs a continuity check on the antenna ports and to see the correct resistance value (through an A/D converter) if the port is not shorted or not open.

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

Refer to ANT-81A Directional Antenna Component Maintenance Manual for additional information.

E. Mode S Transponder

The Mode S transponder is discussed in this manual to an extent required to understand overall TCAS operation. For additional information refer to the applicable Mode S transponder system maintenance manual.

The microprocessor-based Mode S transponder has the functions that follow:

- (1) Automatically transmits 1090-MHz Mode S squitter messages every second. These squitter messages notify other TCAS equipped aircraft and ground stations that own Mode S equipped aircraft is present.
- (2) Receives broadcast messages from other TCAS equipped aircraft and notifies own MILACAS-FR Processor that a broadcast message was received.
- (3) Replies to 1030-MHz Mode S interrogations from other TCAS equipped aircraft.
- (4) Replies to 1030-MHz Mode A, Mode C, and Mode S interrogations from ATC ground stations with a 1090-MHz message in the traditional manner.
- (5) Transmits 1090-MHz resolution advisory air-to-air coordination message data (received from the MILACAS-FR Processor) during threat conditions between own and other TCAS equipped aircraft.
- (6) Provides the data that follows to the MILACAS-FR Processor through an ARINC 429 data link:
 - Own aircraft identification code, pressure altitude, and maximum airspeed data
 - TCAS broadcast information and air-to-air resolution advisory coordination information received from other TCAS equipped aircraft
 - TCAS sensitivity level and other mode control data received by own Mode S transponder from own transponder/TCAS control unit
 - TCAS sensitivity level control data from Mode S ground control stations at 1030-MHz (future application)
 - Mode S ARINC 604 maintenance status.
- (7) Receives TCAS capability, TCAS validity, sensitivity level, and TCAS coordination update data from the MILACAS-FR Processor over the ARINC 429 data link. The Mode S transponder inserts this data into 1090-MHz coordination messages (and replies to interrogations from Mode S ground stations - future application).

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The Mode S transponder contains BITE software. The BITE continuously monitors for transponder internal failures, transponder control unit failures, and ARINC 429 data failures. The ARINC 429 data link reports failure status to the MILACAS-FR Processor. The transponder reports failure status to the FAIL lamp on the transponder control unit through a discrete output signal.

The Mode S transponder receives 115 V ac or 28 V dc primary input power, and 26 V ac synchro altitude reference power from aircraft power sources. The transponder receives a suppression pulse from the MILACAS-FR Processor during TCAS transmissions.

F. Operation

(1) General

The information in this section gives a description of overall system operation including:

- 1 Detailed block diagram and description of input and output signals
- 2 TCAS failure monitoring.

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

(2) Detailed Block Diagrams and Description of Input/Output Signals

Figure 7 is a block diagram of the overall system unit interconnects of the MILACAS-FR Processor. Table 17 describes the MILACAS-FR Processor input/output signals. The interconnect diagram, Figure 2002 in the Maintenance Practices section, provides specific interconnect pin numbers on the MILACAS-FR Processor. Figure 2002 also shows the pins on the Mode S transponders and indicators that connect to the MILACAS-FR Processor.

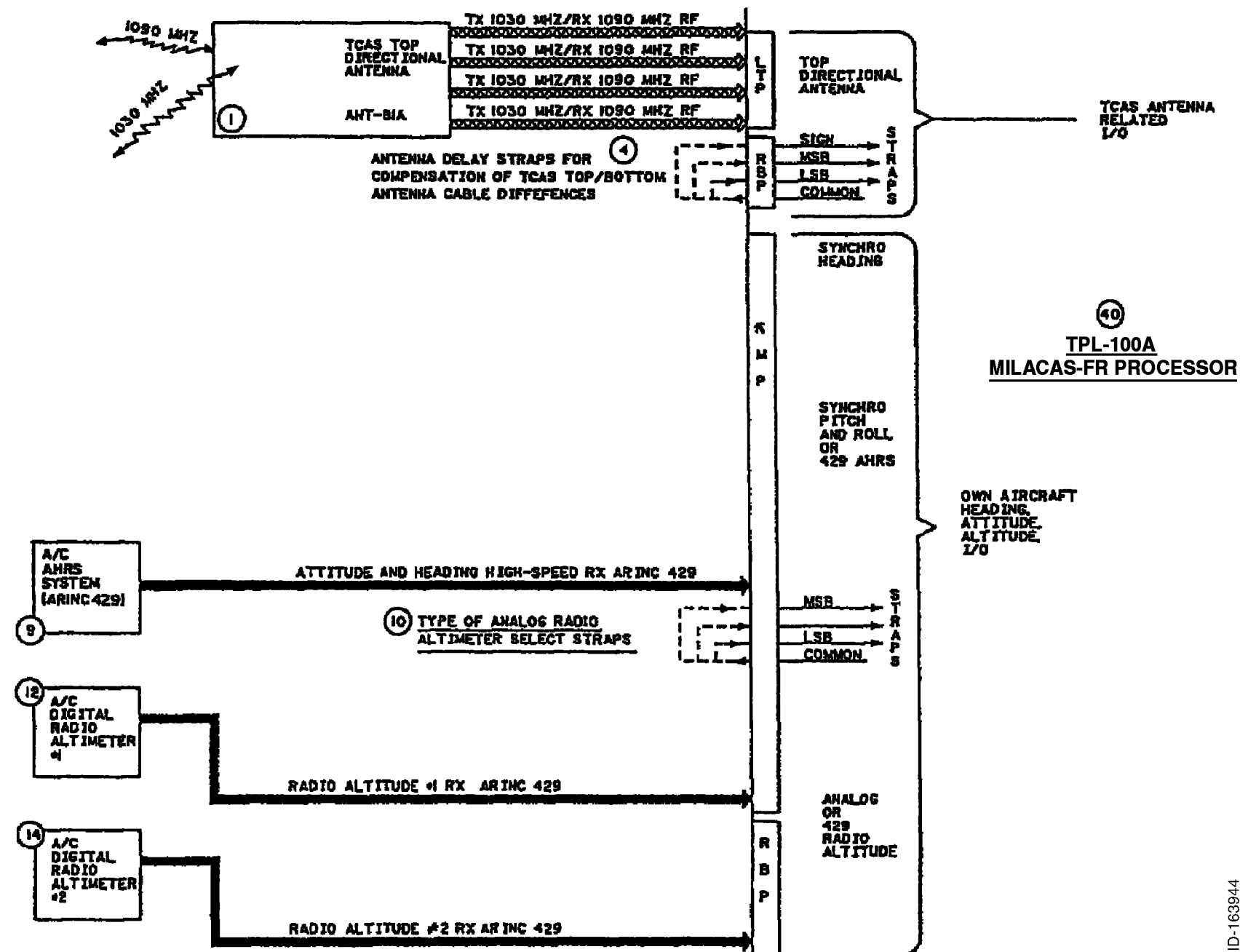
Total system interconnects for the Mode S transponder and control units are described in the applicable maintenance manual.

System interconnects into the optional PPI are described in the associated maintenance manual listed in Table Intro-1.

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Figure 7 (Sheet 1). MILACAS-FR Processor System Interconnect Block Diagram

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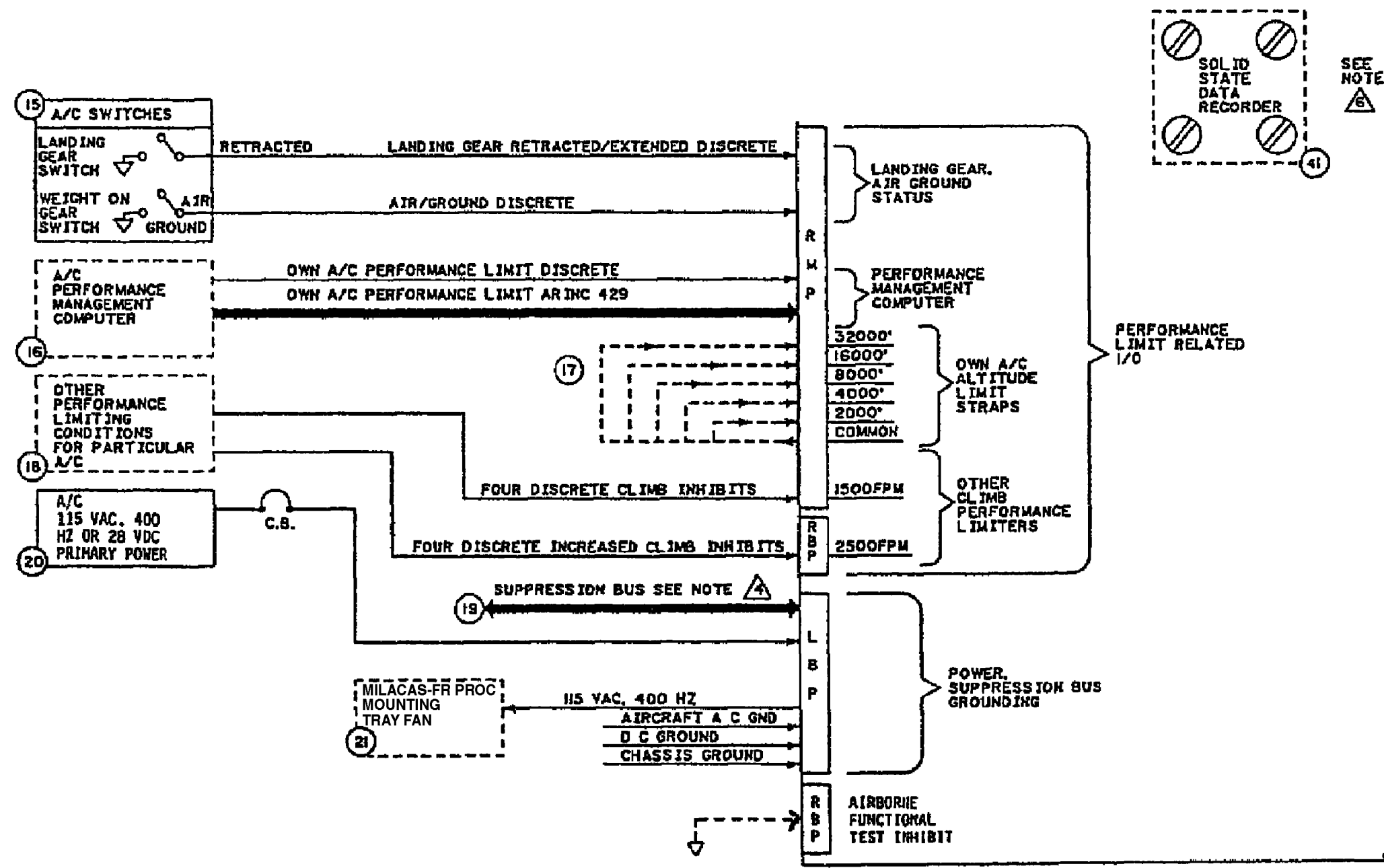


Figure 7 (Sheet 2). MILACAS-FR Processor System Interconnect Block Diagram

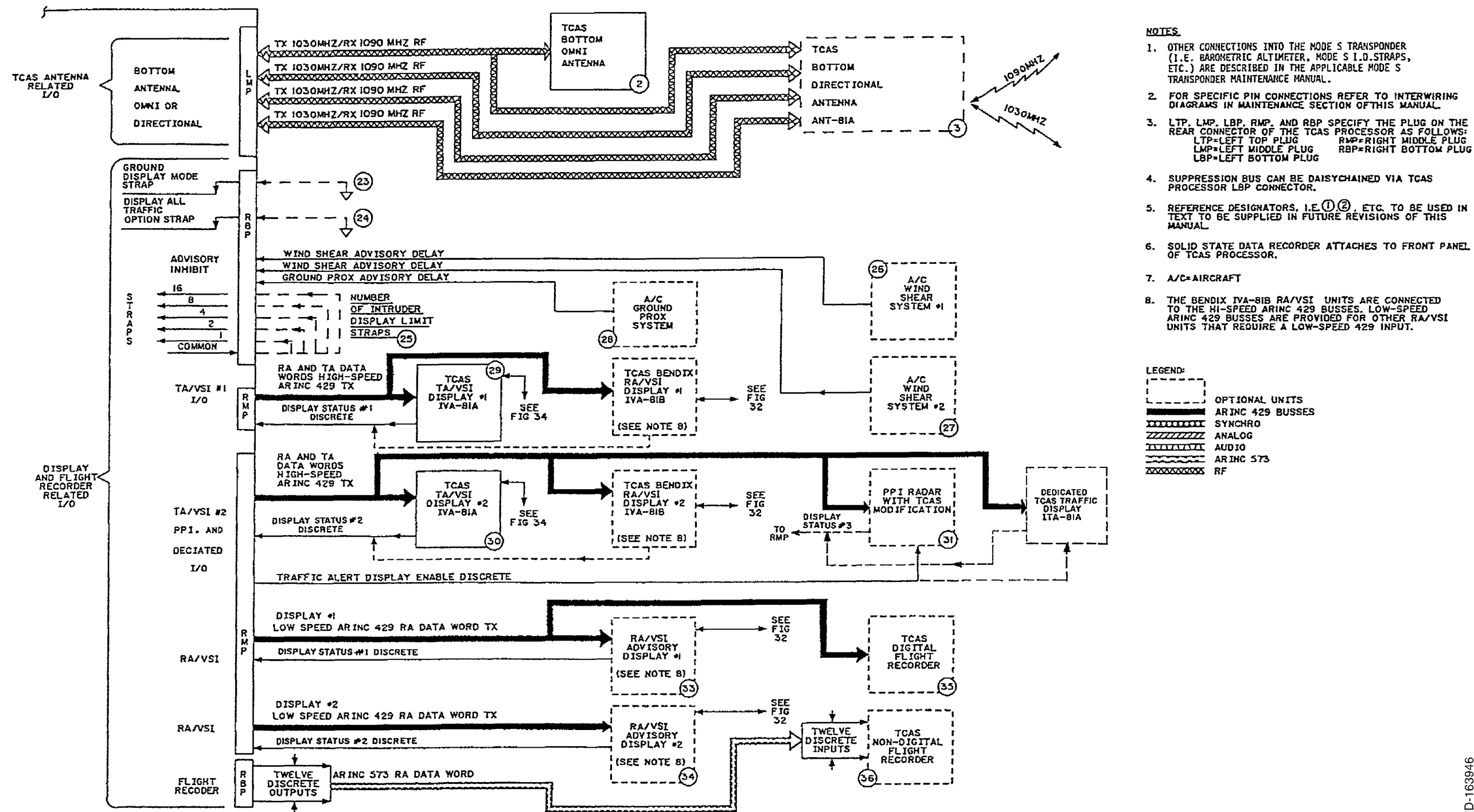


Figure 7 (Sheet 3). MILACAS-FR Processor System Interconnect Block Diagram

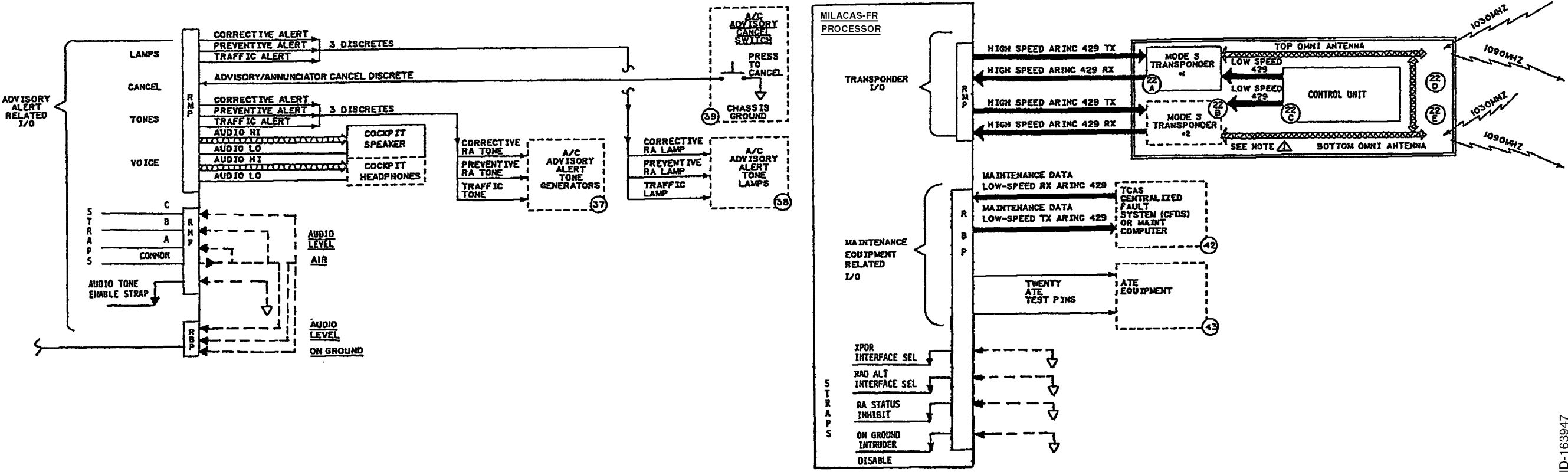


Figure 7 (Sheet 4). MILACAS-FR Processor System Interconnect Block Diagram

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Table 17. MILACAS-FR Processor Inputs and Outputs

Source or Destination	Processor I/O Signal Name and Type	General Description
TCAS ANTENNA RELATED I/O		
Directional antenna	Top and bottom directional antenna. Four RF, bidirectional, transmit/receive channels.	1030-MHz DPSK modulated TCAS transmit messages from the MILACAS-FR Processor to the directional antenna and 1090-MHz PPM-modulated receive messages from the directional antenna to the MILACAS-FR Processor.
Bottom TCAS omni antenna	Bottom omni antenna. One RF, bidirectional, transmit/receive channel. (Same channel as the element No. 1 port used for the directional antenna.)	1030-MHz DPSK modulated transmit messages from MILACAS-FR Processor to omni antenna and 1090-MHz PPM-modulated received messages from the omni antenna to MILACAS-FR Processor.
Three strapped pins on MILACAS-FR Processor rear connector	Antenna delay straps. Three discretes.	Provide calibration data base inputs to MILACAS-FR Processor to compensate for difference in cable lengths between top and bottom antenna.
MODE S TRANSPONDER RELATED I/O		
Mode S transponder No. 1 and No. 2	Coordination data. ARINC 429 high-speed transmit bus and ARINC 429 high-speed receive bus.	ARINC real-time and periodic data from MILACAS-FR Processor to the transponder. Data from the processor to the transponder includes TCAS equipage and coordination update information. Real-time and periodic data from transponder to the MILACAS-FR Processor. Data from the transponder to the processor includes TCAS control, own barometric altitude, own ID., own maximum airspeed, broadcast and coordination information.
Strap pin on MILACAS-FR Processor rear connector	Discrete input from transponder interface select strap.	Tells the MILACAS-FR Processor whether one or two transponders are installed.

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Table 17. MILACAS-FR Processor Inputs and Outputs (cont)

Source or Destination	Processor I/O Signal Name and Type	General Description
OWN ATTITUDE AND HEADING RELATED I/O		
Synchro magnetic compass system	Heading synchro X, Y, Z heading Discrete heading valid 26 VAC reference input	Own heading information to MILACAS-FR Processor from aircraft synchro heading system. Synchro heading system failure status to MILACAS-FR Processor. Heading synchro reference voltage to MILACAS-FR Processor.
Pitch and roll gyros	Pitch synchro X, Y, Z Discrete pitch/roll valid Roll synchro X, Y, Z 26 VAC reference input	Own synchro pitch attitude information to MILACAS-FR Processor from pitch gyro. Own pitch gyro and roll gyro failure status to MILACAS-FR Processor. Own synchro roll attitude information to MILACAS-FR Processor from roll gyro. Reference voltage for pitch and roll synchro inputs to MILACAS-FR Processor.
Attitude/Heading Reference System (AHRS or IRS)	AHRS ARINC 429 high-speed pitch/roll/magnetic heading input	Own digital ARINC 429 digital pitch/roll/ magnetic heading to MILACAS-FR Processor from AHRS system.
OWN ALTITUDE RELATED I/O		
Analog radio altimeter No. 1	± Analog radio altitude No. 1 input Discrete radio altitude No. 1 valid	AGL altitude information to MILACAS-FR Processor from analog radio altimeter No. 1. Radio altimeter No. 1 failure status input to MILACAS-FR Processor.
Analog radio altimeter No. 2	± Analog radio altitude No. 2 Discrete radio altitude No. 2 valid	AGL altitude information to MILACAS-FR Processor from analog radio altimeter No. 2. Radio altitude No. 2 failure status input to MILACAS-FR Processor.
ARINC 429 digital radio altimeter No. 1	ARINC 429 digital radio altitude No. 1	ARINC 429 data from digital radio altimeter No. 1 to MILACAS-FR Processor.

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Table 17. MILACAS-FR Processor Inputs and Outputs (cont)

Source or Destination	Processor I/O Signal Name and Type	General Description
ARINC 429 digital radio altimeter No. 2	ARINC 429 digital radio altitude No. 2	ARINC 429 data from digital radio altimeter No. 2 to MILACAS-FR Processor.
Three strapped pins on processor rear connector	Three discretes from analog radio altimeter select straps	Specify the type of analog radio altimeter that is connected to the analog radio altitude No. 1 and No. 2 inputs (i.e., King, Sperry, Collins, ARINC 552A, etc.).
Strap pin on processor rear connector	Discrete input from radio altimeter interface select strap	Notifies MILACAS-FR Processor whether one or two radio altimeters are installed.
OWN AIRCRAFT PERFORMANCE LIMIT AND FLIGHT STATUS RELATED I/O		
Optional performance management computer	Climb performance limit discrete Climb performance limit ARINC 429	Notifies MILACAS-FR Processor that after considering own altitude, attitude, cargo weight factors, etc., a performance management computer has determined whether it is possible or not possible for own aircraft to climb at a rate of 1500 feet per minute. Digital equivalent of climb performance discrete from a performance management computer.
Five strapped pins on processor rear connector	Five discretes from altitude limit straps	Specify the maximum altitude at which own aircraft can attain a climb rate of 1500 feet per minute.
Air/ground strut switch	Air/ground strut discrete	Notifies MILACAS-FR Processor whether own aircraft is on-the-ground or in-flight.
Strap pin on processor rear connector	Discrete input from functional test inhibit strap	Inhibits functional test when aircraft is airborne.
Landing gear retracted/extended switch	Landing gear up/down discrete	Notifies MILACAS-FR Processor whether own aircraft landing gear is retracted or extended.
Optional aircraft equipment that monitor aircraft factors relating to 1500 feet per minute climb rate performance	Climb inhibit 1, 2, 3 and 4. Four discrete inputs.	Notify the MILACAS-FR Processor that conditions exist to inhibit or not inhibit an own aircraft climb rate of 1500 feet per minute.

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Table 17. MILACAS-FR Processor Inputs and Outputs (cont)

Source or Destination	Processor I/O Signal Name and Type	General Description
Optional aircraft equipment that monitor aircraft factors relating to 2500 feet per minute climb rate performance	Increase climb inhibit 1, 2, 3 and 4. Four discrete inputs.	Notify the MILACAS-FR Processor that conditions exist to inhibit or not inhibit an own aircraft climb rate of 2500 feet per minute.
TCAS valid monitor	TCAS system valid output discrete	Available to accommodate retrofit installations where instrumentation may need to monitor TCAS system status.
RA AND TA DISPLAY RELATED I/O		
TA/VSI No. 1 or RA/VSI No. 1, PPI, or dedicated display.	Display No. 1, high-speed ARINC 429, RA and TA data words Display Status No. 1 discrete Display Status No. 3 discrete (Optional for maintenance reporting.)	Resolution advisory, traffic display, operating mode, and failure data from MILACAS-FR processor to TA/VSI No. 1, the RA/VSI No. 1, a PPI, or a dedicated display. TA/VSI No. 1 or RA/VSI No. 1 failure status output to MILACAS-FR Processor. Failure status output of PPI or dedicated display connected to TA/RA Display No. 1 high-speed ARINC 429 bus.
TA/VSI No. 2 or RA/VSI No. 2, PPI or dedicated display	Display No. 2, high-speed ARINC 429, RA and TA data words Display Status No. 2 discrete Display Status No. 4 discrete (Optional for maintenance reporting.)	Resolution advisory, traffic display, operating mode, and failure status data from MILACAS-FR Processor to TA/VSI No. 2, or RA/VSI No. 2, a PPI, or a dedicated display. TA/VSI No. 2 or RA/VSI No. 2 failure status output to MILACAS-FR Processor. Failure status output of PPI or dedicated display connected to TA/RA Display No. 2 high-speed ARINC 429 bus.
RA/VSI No. 1 (RA/VSI that accepts low-data speed 429 input data)	Display No. 1, low-speed ARINC 429 RA data words Display Status No. 1 discrete	Resolution advisory, operating mode, and failure status from MILACAS-FR processor to low-speed 429 RA/VSI No. 1 or optional flight recorder. RA/VSI No. 1 failure status output to MILACAS-FR Processor.

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Table 17. MILACAS-FR Processor Inputs and Outputs (cont)

Source or Destination	Processor I/O Signal Name and Type	General Description
RA/VSI No. 2 (RA/VSI that accepts low-speed 429 input data)	Display No. 2 low-speed ARINC 429 RA data words Display Status No. 2 discrete	Resolution advisory operating mode, and failure status data from MILACAS-FR Processor to low-speed 429 RA/VSI No. 2. RA/VSI No. 2 failure status output to MILACAS-FR Processor.
Five strapped pins on processor rear connector	Intruder display limit straps. Five discrete inputs	Specify the maximum number of intruder aircraft (0-30) to be displayed on the traffic displays.
One strapped pin on processor rear connector	Ground display mode strap discrete	Controls whether traffic is displayed when own aircraft is on-the-ground. If strapped to not display traffic on-the-ground, TCAS goes to STANDBY on-the-ground.
One strapped pin on processor rear connector	RA/TA display mode strap discrete	Displays either all traffic or TA/RA and proximity traffic only (i.e., non-threat traffic not displayed).
Optional ground proximity system	Ground proximity (GPWS) advisory delay discrete	Puts TCAS into the TA only mode (sensitivity level 2) and inhibits all audio and aural advisories.
Optional wind shear system No. 1 and No. 2	Wind shear advisory delay No. 1 and No. 2 discretess	Puts TCAS into the standby mode (sensitivity level 1) until wind shear condition is over.
Optional advisory alert cancel switch	Advisory alert cancel discrete	When pressed and released, this switch cancels active advisory alert conditions.
Cockpit speaker and optional cockpit headphones	Audio HI and LO outputs. Speaker output - 8 ohms, 8 Watts maximum. Headphone output - 600 ohms, 80 milliwatts maximum. (Adjustable using audio level program straps, below. See Figure 2002 in Maintenance Practices section for adjustment ranges.)	Supplies voice advisory message alerts to cockpit speaker and optional headset.
RA AND TA ALERT RELATED I/O		
Three strapped pins on processor rear connector	Audio level program straps (airborne). Three discrete inputs.	For adjusting synthesized voice output of the MILACAS-FR Processor when the aircraft is airborne.

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Table 17. MILACAS-FR Processor Inputs and Outputs (cont)

Source or Destination	Processor I/O Signal Name and Type	General Description
Three strapped pins on processor rear connector	Audio level program straps (on ground). Three discrete inputs.	For adjusting synthesizer voice output of the MILACAS-FR Processor when aircraft is on the ground.
Audio tone generators	Aural advisory alerts. Three discrete outputs for corrective RA tone, preventive RA tone, and TA tone alerts. (1 second ground, 20 milliamp maximum.)	Provide TA and RA alert outputs that activate optional tone generators located externally in the aircraft.
Strapped pin on processor rear connector.	Audio tone enable program strap. Discrete input.	When strapped, provides delay of voice output 1 second with respect to aural advisory output. When open, drives aural advisory discrete outputs.
Annunciator lamps	Visual annunciator outputs. Three discrete outputs for corrective RA lamp, preventive RA lamp, and TA lamp alerts. (Active = ground, 200 milliamp maximum.)	Provide TA and RA alert outputs that activate operational lamp indicators located externally in the aircraft.
Strapped pin on processor rear connector. NOTE: Not used with Change 7 units. On-ground intruders never displayed.	On ground intruder disable strap. discrete Input.	Determines whether or not, when own aircraft is below 1750 feet (radio altitude), intruders determined to be on-the-ground is displayed.
Strapped pin on processor rear connector	RA status inhibit strap. Discrete input.	Determines whether RA display status is active or inhibited.
MAINTENANCE RELATED I/O		
Maintenance computer or centralized failure display system (CFDS)	Maintenance data. ARINC 429 high-speed transmit bus and ARINC 429 high-speed receive bus.	Maintenance digital 429 data from maintenance computer or CFDS to MILACAS-FR Processor and maintenance digital 429 data from MILACAS-FR processor to maintenance computer or CFDS.
Automatic test equipment (ATE)	ATE test pins. Twenty discrete outputs.	MILACAS-FR Processor status outputs to ATE monitors. Not required for aircraft installation use.

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Table 17. MILACAS-FR Processor Inputs and Outputs (cont)

Source or Destination	Processor I/O Signal Name and Type	General Description
Data loader	Data loader high or low-speed ARINC 429 transmit bus and receive bus. Data loader discrete Input No. 1, No. 2, No. 3, and No. 4. Four discrete inputs (one spare).	Data for software updates. Supports data loading process, indicate to the MILACAS-FR Processor which memory section to re-program, and instruct the MILACAS-FR processor to output the software part number.
NON-DIGITAL FLIGHT RECORDER RELATED I/O		
Optional flight recorder (non-digital type)	ARINC 573 resolution advisory (RA) word	Resolution advisory data word output from MILACAS-FR Processor to aircraft non-digital flight recorder. <u>NOTE:</u> An ARINC 429 output is also provided for an optional digital type flight recorder. See output to RA/VSI No. 1.
SUPPRESSION BUS RELATED I/O		
Own aircraft L-band equipment	Suppression pulse input/output	Bidirectional bus. An input pulse suppresses the TCAS receiver. An output suppression pulse suppresses other L-band equipment in the aircraft.
POWER RELATED I/O		
Own aircraft power supplies	115 V 40 Hz or 28 V dc and 26 V ac reference power inputs.	Supplies power to MILACAS-FR Processor from own aircraft power sources.
Fan on MILACAS-FR Processor mounting tray	115 V 400 Hz output (or from 28 V dc source).	Supplies power from MILACAS-FR Processor to cooling fan on processor mounting tray.

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G. Controls and Indicators

(1) General

The primary manual controls that operate the system are on the MCD transponder. TCAS functions are also available on the transponder/TCAS control unit.

TCAS advisory and/or operational status indicators show on the TA/VSI, RA/VSI, PPI, dedicated traffic display, transponder/TCAS control unit, front panel of the MILACAS-FR Processor, and front panel of the Mode S transponder unit. Aural advisories and indicators are heard on the cockpit audio system

The transponder/TCAS control unit supplies remote control of the traffic advisory display range selection. A front panel range selector switch, or switches, supplies local control of traffic advisory displays. The type of display unit used and display unit configuration strapping determine the front panel switch options.

(2) TCAS Input Power Control

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

(3) TA/VSI Indicators

The TA/VSI shows resolution advisory maneuvering information to the pilot during threat conditions. The TA/VSI also supplies a display of airspace traffic conditions within the traffic display range and altitude volume limits.

Resolution advisories are corrective or preventive, and positive or negative.

A corrective advisory requires a vertical maneuver and is always displayed with red and green arcs. The red arc represents the vertical speed rates that are not acceptable in the presence of the RA and the green arc represents the vertical speeds that should be flown during a corrective advisory. A preventive advisory requires no maneuver and is represented with only a red arc. (Refer to the TCAS Pilot's Guide.)

The MILACAS-FR Processor sends the limits of the red arc to the TA/VSI through the ARINC 429 bus. The limits of the green arc are do not come from TCAS. The green arc is immediately adjacent to the red arc. The green arc has a width approximately equal to the space between 1500 ft/min and 2000 ft/min.

It is possible to show two red arcs simultaneously. Simultaneous RAs might indicate not to climb greater than 1000 feet and not to descend greater than 2000 feet. Since only one action is correct, the green arc is immediately adjacent to the red arc which represents the corrective advisory. If both actions are preventive, then only the red arcs are present.

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(4) Traffic Display

The traffic display supplies the information that follows:

- Standard symbology consisting of own aircraft symbol and a two mile range ring marker
- Resolution advisory, traffic advisory, proximity, and non-threat category aircraft symbols that depict range, bearing (if tracking is occurring on a directional antenna), and altitude (if intruder aircraft is reporting altitude)
- Numerous text message annunciations relating to the presence of TAs and RAs that cannot be displayed by a symbol because bearing is not available, TAs and RAs that are outside the range scaling of the traffic display, display operating modes, and fail conditions.

NOTE: A pilot's guide supplied by Honeywell describes the TA/VSI operation in detail.

(5) Optional Aural/Lamp Advisory Outputs

Optional aural and lamp traffic advisory and resolution advisory outputs are available and may be activated by connecting external tone generators and/or indicator lamps to the appropriate rear connector pins on the MILACAS-FR Processor.

The aural advisory outputs make tones that accompany corrective, preventive, and traffic advisories generated by the MILACAS-FR Processor. The activated aural advisory discrete output is generated for a 1.0 ± 0.2 second period. When the aural advisory discrete outputs are used in an installation, the Audio Tone Enable Program pin should be strapped to provide a 1.0 ± 0.2 second delay of the synthesized voice output in order to be properly phased with the aural advisories.

The lamp advisory outputs operate annunciator lights that identify the advisory as a corrective, preventive, or traffic advisory. The activated output remains on for the duration of the advisory unless cancelled.

(6) MILACAS-FR Processor and Mode S Transponder Front Panel Indicators and TEST Switch

These front panel indicators and TEST switches provide a fault isolation maintenance aid in failure situations where the traffic advisory display subsystem has failed and is incapable of displaying TCAS failure annunciations. Refer to the Fault Isolation and Maintenance Practices sections of this manual for details.

(7) Optional Advisory Cancel Switch

This momentary switch cancels active advisory alert conditions.

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(8) Range Selection and Range Rings

The MILACAS-FR Processor can be configured to control the traffic advisory display range selection either externally or internally. Data input to the display through the ARINC 429 bus supplies external control. A front panel selector switch (PPI weather/traffic display) or optional front panel pushbutton switches (TA/VSI or dedicated traffic display) supply internal control. Range rings that show on the display are a function of range selected, regardless of whether range selection is made remotely or locally. Table 18 summarizes range ring distances for each possible range selected on the various types of traffic displays available.

NOTE: Range selections beyond 40 nautical miles are possible only on PPI weather/traffic displays. For these displays, the range ring information in Table 18 is applicable only when the display is in the TCAS mode, displaying only TCAS data.

Table 18. Range Rings Displayed vs Selected Range

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

FAULT ISOLATION

1. Fault Isolation

A. General

- (1) Fault isolation is a process used to find the source of a TCAS failure at the assembly level (black box level) or aircraft wiring level.
- (2) MILACAS-FR system failures are shown by failure annunciations on:
 - PPI Radar/TCAS displays
 - Dedicated traffic display unit cathode ray tube (CRT)
 - Electromechanical fail flag on the RA/VSI units
 - Failure indicator lamps on the front panels of the TCAS components.
- (3) TCAS failures are detected, then the appropriate failure indicator is activated. This is a result of full-time TCAS built-in-test equipment monitors and manually started TCAS functional self-test monitors.
- (4) Fault isolation is typically done on the ground. Failures are shown during post-installation or pre-flight tests. Malfunctions are sometimes observed in flight.

B. Pre-Installation Tests

All components of the MILACAS-FR system are tested before they are installed on the aircraft. Most components of the system have automated tests. These tests are run on the bench to certify the equipment airworthiness and reliability. These tests are contained in the component maintenance manuals (CMM) of the equipment which is selected to be installed in the system.

C. Post-Installation Tests

Once the equipment is installed on the aircraft, tests are run to make sure the system functions properly. Table 1001 and Table 1002 show the indications which are seen on the maintenance computer display (MCD) when on-board system maintenance tests are run.

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Table 1001. MILACAS-FR System Maintenance Test (IBIT)

Action	Initial Indications	IBIT Status	Pass	Fail	Corrective Action
With power on start test from MCD Maintenance Page.	"SKE: IN PROGRESS" is displayed on MCD followed by: "IN TEST" displayed in test pattern on MFD	MCD displays the reported SKE IBIT status: "PASS" "RT" "UA" "LA" "GU" "GE" "SYN" "SYS"	CAWS Voice message: "TCAS System Test OK" MCD displays "PASS"	1. CAWS Voice Message: "TCAS System Test Fail" 2. MFD "IN TEST" annunciation replaced by "TCAS FAIL"	Perform MILACAS-FR Processor self-test using Front Panel to verify failure and source of fault (MILACAS-FR or External Fault) Refer to paragraph 1.F

Table 1002. MCD LRU Fault List Display

MCD LRU Avionics Fault List	Failure Cause	Corrective Action
SKE-RT	Faulty processor	Perform MILACAS-FR Processor self-test using front panel to verify failure and source of fault. Refer to paragraph 1.F. Remove and replace faulty MILACAS-FR Processor.
SKE-U_ANT SKE-L_ANT	Faulty antenna	Perform MILACAS-FR Processor self-test using front panel to verify failure and source of fault. Refer to paragraph 1.F. Remove and replace antenna, remove and replace circuit breaker or remove and replace/repair aircraft wiring. Refer to TPL-100A CMM 012-0794-001.
SKE-GUID_DATA	Faulty external LRU or wiring	Perform MILACAS-FR Processor self-test using front panel to verify failure and source of fault. Refer to paragraph 1.F. Remove and replace faulty LRU, remove and replace circuit breaker or remove and replace/repair aircraft wiring. Refer to TPL-100A CMM 012-0794-001.

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Table 1002. MCD LRU Fault List Display (cont)

MCD LRU Avionics Fault List	Failure Cause	Corrective Action
SKE-GEN_DATA SKE-SYNC_DATA SKE-SYS	Faulty external LRU or wiring	Perform MILACAS-FR Processor self-test using front panel to verify failure and source of fault. Refer to paragraph 1.F. Remove and replace faulty LRU, remove and replace circuit breaker or remove and replace/repair aircraft wiring. Refer to TPL-100A CMM 012-0794-001.

The MILACAS-FR Processor finds malfunctions of TCAS components that degrade or prevent possible collision avoidance protection. The APX-100/APX-119 Mode S transponder finds malfunctions in the Mode S transponder system that degrade normal TCAS functions. In the event of a transponder system failure, the transponder causes the transponder FAIL or ATC FAIL indicator on the transponder control unit to light. It also communicates the failure status to the MILACAS-FR Processor. A failure of the Mode S transponder or system results in the following actions by the MILACAS-FR Processor:

- Supplies an indication to the flight crew that an abnormal condition exists
- Causes Mode S transmissions that report own aircraft status to indicate that own aircraft has no on-board resolution capability
- Prevents interrogations by own aircraft TCAS
- Deactivates the normal TCAS display functions.

NOTE: Refer to the pilot's guide for specific failure indications that appear on the various aircraft displays and indicators.

There are two different methods to start and observe the functional self test of the MILACAS-FR system. The first method is started at the transponder control unit. Failures are annunciated on the aircraft traffic displays.

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The second method is used if other traffic displays are unable to show the failure because of a display malfunction or some other reason. To start the second method, push the TEST button located on the front panel of the MILACAS-FR Processor and read the fault codes shown on the front panel LED indicator.

Before doing a Mode S/TCAS system self test, make sure the following aircraft systems are powered and operate with no failure flags on the cockpit instruments:

- Air data systems
- Radio altimeter systems
- Altitude (vertical gyro) systems
- Heading (compass) systems.

NOTE: If the attitude and heading data supplied to the system is from an attitude heading reference system (AHRS), inertial reference system (IRS) or inertial navigation system (INS). Make sure they are aligned and in an operational mode.

D. Using Transponder Control Unit

NOTE: If a PPI radar/TCAS display is used as the traffic display and has a TCAS mode on the selector switch, it must be turned to the TCAS position for the test. If not, the selector switch should be turned to the OFF position to allow the traffic display enable discrete (from the MILACAS-FR processor) to turn the display on. It needs about 5 seconds after the test is started for the display to warm up.

- (1) In dual Mode S-equipped aircraft, set the transponder selector on the transponder control unit to position 1 to test the No. 1 transponder.
 - (a) Rotate the function selector counterclockwise to the TEST position and hold the switch in this position for at least one second.
 - (b) Thereafter, the self-test continues automatically for approximately 12 seconds.
- (2) If there are no malfunctions, the test sequence is as follows:
 - (a) A test pattern appears on the display to verify each type of intruder symbol. See Figure 1001.
 - (b) For aircraft equipped with RA/VSI:
 - 1 During the first few seconds of the test, the RA/VSI red and green circumference lamps (climb/descend indicators) illuminate sequentially. The TCAS flag is in view throughout the test period.

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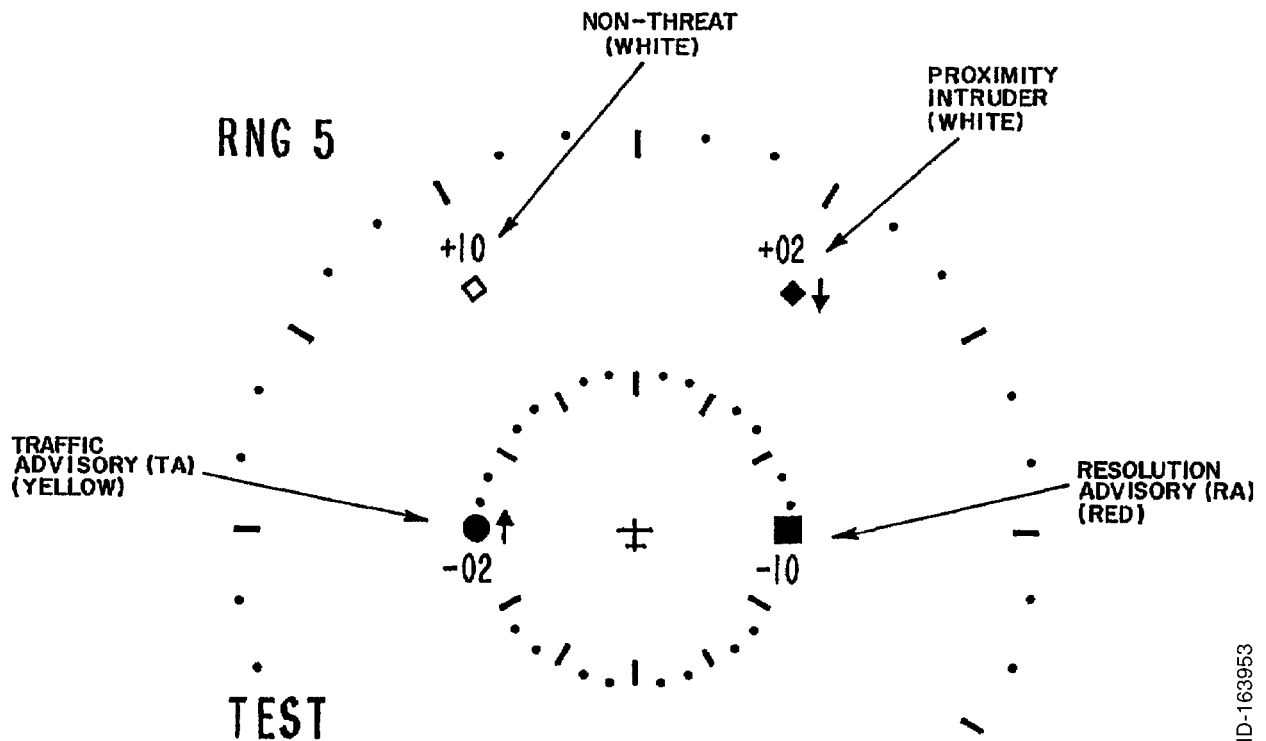


Figure 1001. Test Pattern

- 2 After the RA/VSI sequential lamp test, the red and green climb/descend lamps display a fixed test command which represents a typical resolution advisory throughout the remainder of the test sequence.

NOTE: Loss of valid vertical speed input causes the VSI flag to appear on the RA/VSI. If a TA/VSI is used, the legend "VSI" appears on the display. A MILACAS-FR Processor failure causes the TCAS flag to appear on the RA/VSI, and TCAS to be shown on the TA/VSI.

- (c) For aircraft equipped with TA/VSI

The TA/VSI shows a fixed resolution advisory and the traffic symbol test pattern. A "TEST" message is indicated.

- (d) For aircraft equipped with PPI radar/TCAS or dedicated display:

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

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- (e) At the successful conclusion of a self-test, the MILACAS-FR Processor outputs onto the audio bus the synthesized voice message, "TCAS System Test OK".
- (3) In the event that a failure is found during the self-test, the voice message output from the MILACAS-FR Processor is "TCAS System Test Fail". The PPI radar/TCAS display or dedicated display annunciates the failed system component(s).

Possible traffic display fault annunciations are as follows:

- MILACAS-FR PROCESSOR
- UPPER ANTENNA
- LOWER ANTENNA
- RADIO ALT No. 1
- RADIO ALT No. 2
- RADIO ALT No. 1 and No. 2
- No. 1 XPNDR DATA BUS
- No. 2 XPNDR DATA BUS
- TRAFFIC DISPLAY
- RA DISPLAY No. 1
- RA DISPLAY No. 2
- RA DISPLAY No. 1 and No. 2
- SELECTED XPNDR
- XPNDR TOP ANT
- XPNDR LOWER ANT
- XPNDR TCAS DATA
- XPNDR CONTROL DATA
- XPNDR ALT No. 1 and No. 2
- No. 1 XPNDR ALT DATA
- No. 2 XPNDR ALT DATA
- ATTITUDE
- HEADING

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- NO TCAS (NO DATA on some versions)
- TD FAIL
- TCAS FAIL.

(4) If self test results are not met, do the following:

- (a) If PPI or dedicated display is used, check and record fault annunciation(s). For Mode S transponder system and TCAS line maintenance troubleshooting procedures, refer to Tables 1003 and 1004, respectively.
- (b) In non-PPI or dedicated display aircraft, perform Mode S and MILACAS-FR Processor self tests on the front of each unit for further clarification of the problem.

(5) In a dual Mode S-equipped aircraft, set the transponder selector on the transponder control unit to 2 to test No. 2 transponder. Turn the function selector to TA for 10 seconds (minimum), then repeat.

CAUTION: REMOVE POWER PRIOR TO REPLACING A MODE S OR TCAS SYSTEM COMPONENT. DAMAGE TO THE EQUIPMENT MAY RESULT IF POWER IS NOT REMOVED.

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**Table 1003. Mode S Line Maintenance Troubleshooting Procedure
(Fault Indication on PPI or Dedicated Display)**

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

**Table 1004. TCAS Line Maintenance Troubleshooting Procedure
(Fault Indication on PPI or Dedicated Display)**

Fault Annunciation	Remedy
MILACAS-FR PROCESSOR UPPER ANTENNA LOWER ANTENNA ATTITUDE HEADING	Perform MILACAS-FR Processor self test Refer to paragraph 1.F.
TCAS FAIL/NO TCAS TRAFFIC DISPLAY	PPI or dedicated display failure.
RA DISPLAY No. 1	A single RA DISPLAY or RADIO ALT FAULT are not annunciated in a dual system unless other faults are present.
RA DISPLAY No. 2 RA DISPLAY No. 1 and No. 2	Check ADCs, VSIs, wiring, power.
RADIO ALT No. 1 and No. 2 TD FAIL	Check both radio altimeters. PPI failed.

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E. MILACAS-FR Processor Front-Panel Buttons and LCD Display

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

(1) General

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

If none of the two pushbuttons is operated for one minute, the Main Menu is shown. See Figure 1003 for a typical Main Menu. The first line of each display contains a title. The page number shows the number of pages that the display contains.

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

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

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

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

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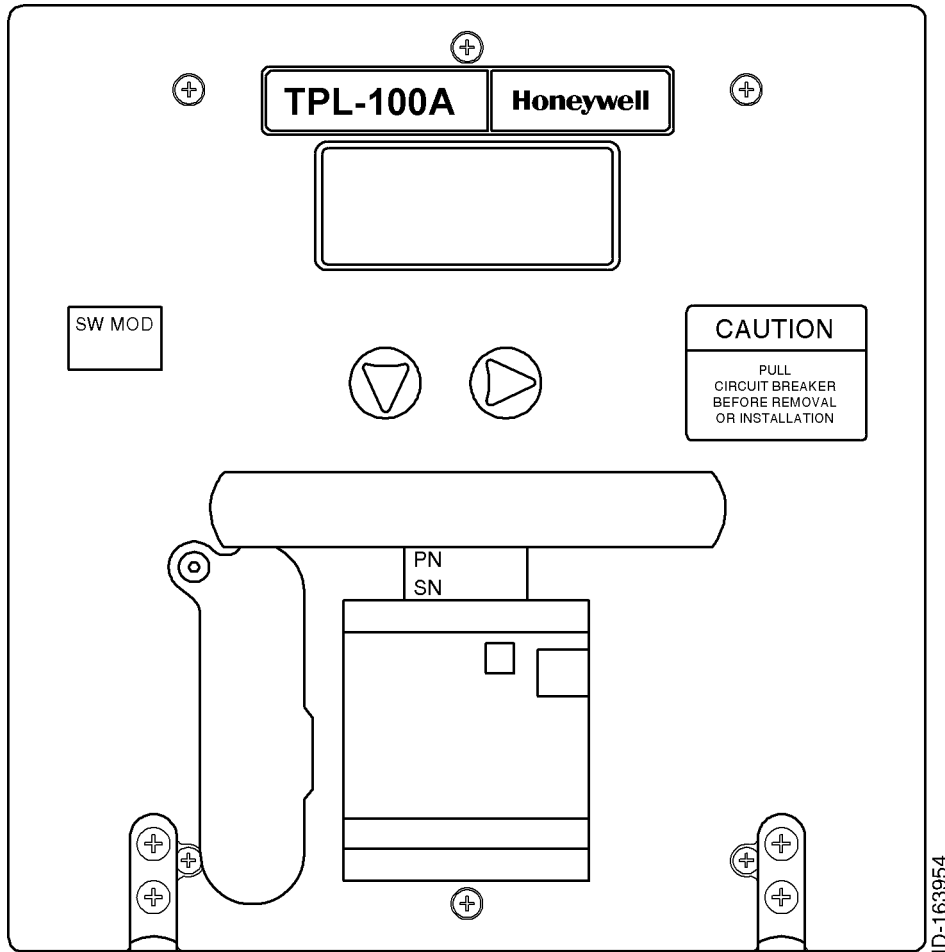


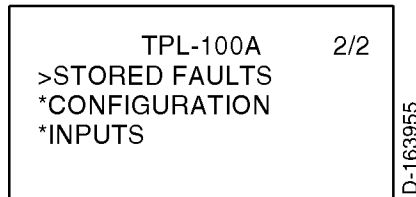
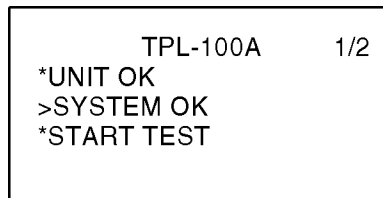
Figure 1002. MILACAS-FR Processor Front Panel LCD and Pushbuttons

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

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(Typical Pages 1 and 2 of Menu Screen)

Figure 1003. Typical Main Menu Screen

NOTE: The caret is located at SYSTEM OK.

(2) Unit Failed/System Failed

If UNIT FAILED is the active selectable item on the Main Menu, the MILACAS-FR Processor has an internal fault. Rerun BIT to verify the failure. Refer to paragraph 1.F. Replace the processor if the fault persists.

(3) Unit OK/System Failed

If UNIT OK is displayed and SYSTEM FAILED is the active selectable item on the Main Menu, the system faults are active and the input faults can be active at the same time. When the Select button is pushed, the text for all active system and input faults are shown. The display title will be INPUT FLTS. See Table 1005 for a list of the system and the input faults.

(4) Unit OK/Inputs Faulted

See Table 1006 for a list of the program pin faults. The program pins being shorted to ground cause these faults except for BINT and BLIM. The BINT fault is caused by strapping fewer than 3 intruders to be shown. The BLIM fault is caused by the altitude limit program pins (RMP 6E through RMP 6J) being open.

When SYSTEM OK is the active selectable item, only input faults are in operation. Push the Select button to show the input fault text. The display title is INPT FLTS.

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Table 1005. System and Input Faults

Front Panel Text	Fault Description
Top Ant Fail	1. TX Cal Delta 24 or 31 Top (Antenna Failure)
Top Ant E1	1.1 Top Antenna Element 1 failed
Top Ant E2	1.2 Top Antenna Element 2 failed
Top Ant E3	1.3 Top Antenna Element 3 failed
Top Ant E4	1.4 Top Antenna Element 4 failed
Bott Ant Fail	2. TX Cal Delta 24 or 31 Bot (Antenna Failure)
Bott Ant E1	2.1 Bottom Antenna Element 1 failed
Bott Ant E2	2.2 Bottom Antenna Element 2 failed
Bott Ant E3	2.3 Bottom Antenna Element 3 failed
Bott Ant E4	2.4 Bottom Antenna Element 4 failed
Radio Alt 1	3. Radio Altitude 1 (for A330, A340, and Boeing)
Radio Alt 2	4. Radio Altitude 2 (for A330, A340, and Boeing)
Radio Alt 1	3a. Radio Altitude 1 (for A320)
Radio Alt 2	4a. Radio Altitude 2 (for A320)
Transponder 1	5. Mode-S Transponder 1
Transponder 2	6. Mode-S Transponder 2
Roll Att Data	7. Roll Angle
Pitch Att Data	8. Pitch Angle
Heading Data	9. Magnetic Heading
TA/VS1 1	10. TA/VS1 1
TA/VS1 2	11. TA/VS1 2
RA Display 1	12. RA/VS1 1
RA Display 2	13. RA/VS1 2
CMC Bus	14. CFDIU (for A320)
CMC Bus	14. CMC (for A330, A340, and Boeing)
ATC Ctl Panel	15. Mode-S Control Panel (for A330 and A340)
ATC Ctl Panel	15.1 Mode-S Control Panel (for A320 and Boeing)
FMC	16. FMC (for aircraft type not A330 and not A340)
FMC	16.1 FMC (for A340 and A330)
Suppression Line	17. Suppression Line
TCAS Unit Failed	18. TCAS Unit Fault
Power Interrupt	19. Power Supply Interrupted
Program Pin	20. Program Pin

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Table 1006. Program Pin Faults

Front Panel Text	Fault Description
PP RMP 12A	Analog Radio Altimeter Prgm, RMP 12A
PP RMP 12B	Analog Radio Altimeter Prgm, RMP 12B
PP RMP 12C	Analog Radio Altimeter Prgm, RMP 12C
PP RBP 7D	Audio Tone Enable Program, RBP 7D
PP RBP 7E	Ground Display Mode, RBP 7E
PP RBP 7F	Display All Traffic Program, RBP 7F
PP RBP 7G	Cable Delay Program Sign, RBP 7G
PP RBP 7H	Cable Delay Program MSB, RBP 7H
PP RBP 7J	Cable Delay Program LSB, RBP 7J
PP RBP 8F	TA/RA Display Symbols Max Prgm, RBP 8F
PP RBP 8G	TA/RA Display Symbols Max Prgm, RBP 8G
PP RBP 8H	TA/RA Display Symbols Max Prgm, RBP 8H
PP RBP 8J	TA/RA Display Symbols Max Prgm, RBP 8J
PP RBP 8K	TA/RA Display Symbols Max Prgm, RBP 8K
PP RBP 8E	Functional Test Inhibit Prgm, RBP 8E
PP RBP 7A	Audio Level Prgm, RBP 7A
PP RBP 7B	Audio Level Prgm, RBP 7B
PP RBP 7C	Audio Level Prgm, RBP 7C
PP RMP 6E	Altitude Limit Prgm, RMP 6E
PP RMP 6F	Altitude Limit Prgm, RMP 6F
PP RMP 6G	Altitude Limit Prgm, RMP 6G
PP RMP 6H	Altitude Limit Prgm, RMP 6H
PP RMP 6J	Altitude Limit Prgm, RMP 6J
PP TARA <3 Intrd	TA/RA Display Limit Program Pins set less than 3 Intruders
PP Alt Limit Opn	Altitude Limit Program Pins All Open
PP RBP 7K	Program Pin Common, RBP 7K
PP RMP 6K	Aircraft Alt. Limit Prgm Common, RMP 6K
PP RBP 8A	Audio Level On Ground, RBP 8A
PP RBP 8B	Audio Level On Ground, RBP 8B
PP RBP 8C	Audio Level On Ground, RBP 8C
PP RBP 4G	RA Valid Discrete Disable Program Pin, RBP 4G
PP RBP 6J	Transponder Interface Select, RBP 6J
PP RBP 6K	Rad Alt Interface Select, RBP 6K
PP RMP 5E	ADS-B (Intruder File Enable) Program Pin

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

Table 1007 shows the relation in unit, system, input active faults, and the status on the display. The asterisk (*) shows that the text is selectable.

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

Push the Select button when the caret is adjacent to the Start Test selectable item to show the Test In Progress screen and to start the test.

The three possible results of the test are:

- (a) No faults (unit and system ok)
- (b) System or input faults (unit ok, system failed)
- (c) Internal faults (unit failed/system failed).

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

Table 1007. Active Unit, System and Input Faults, and Display Status Indication

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

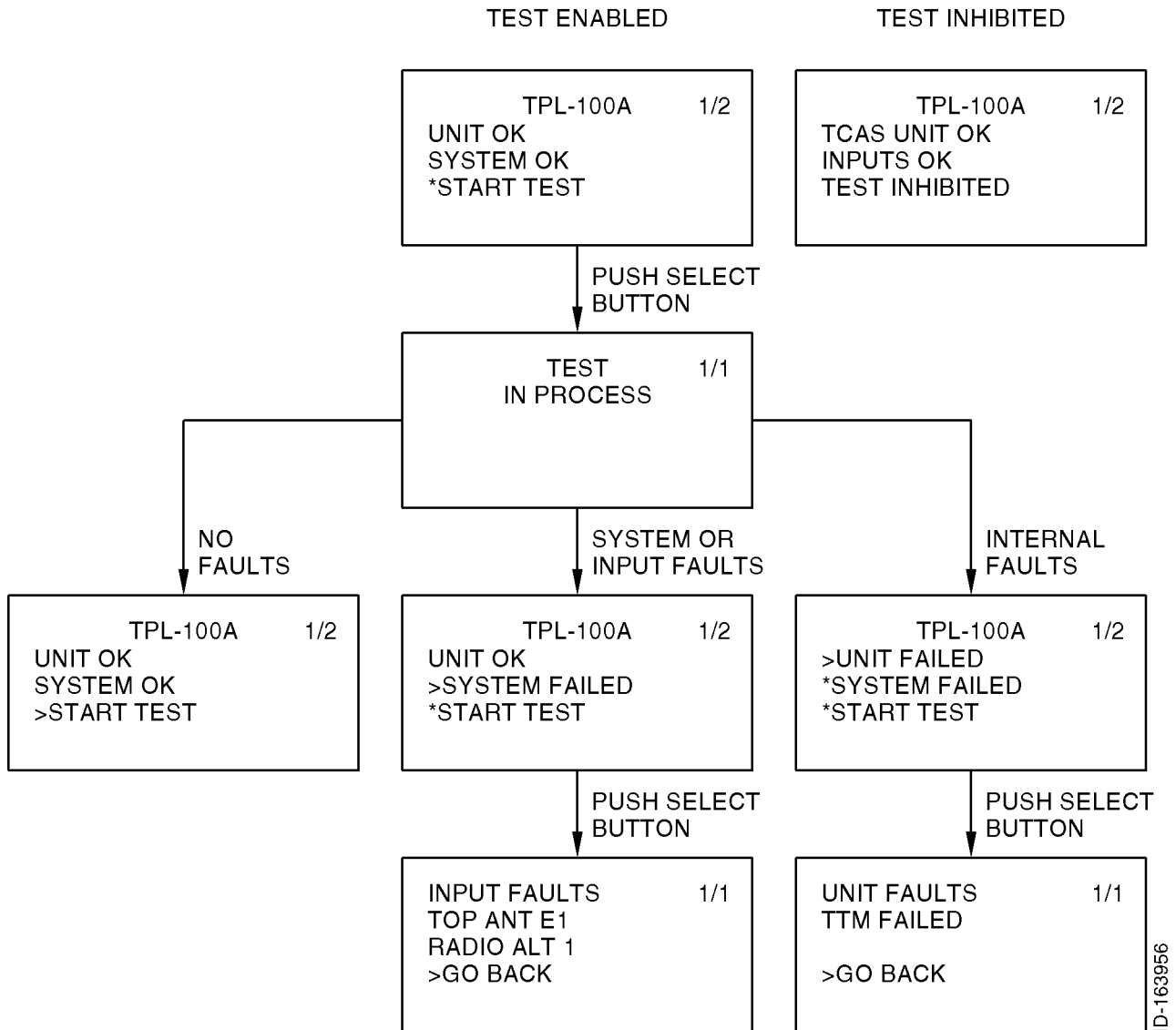


Figure 1004. Start Test/Test Inhibited Sample Flow Diagram

F. MILACAS-FR Processor Bit Tests

- (1) To start or rerun BIT from the MILACAS-FR Processor front panel, use the scroll pushbutton to select START TEST and push the select pushbutton. Refer to paragraph 1.E for a description of the LCD display and controls.
- (2) When BIT completes, the front panel shows the results of the tests.

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G. Directional Antenna and Coaxial Cable Testing

Table 1008 provides information to test the TCAS directional antenna which includes coaxial cables and connectors. The test equipment required is Site Master S331 that is part of the ECS RF Troubleshooting Kit, Part Number 11044-101.

Table 1008. Directional Antenna Test Procedure

1. PURPOSE

A. General

- (1) This procedure has been written under the assumption the operator is familiar with the basic operation of the Site Master S331. Chapter 2 of the user's guide, Operation is an excellent reference tool.
- (2) To provide a standard test procedure for directional TCAS II antenna systems (including the coax cables, connectors and the directional antenna). This procedure explains how to:
 - Use the ECS RF Troubleshooter kit to quickly evaluate the health of your antenna system.
 - Take Standing Wave Ratio (SWR) readings from the rack to the antenna.
 - Take SWR readings of a directional antenna, while the antenna is installed.
 - Take SWR readings of single and combination cable runs.
 - Distant to fault (DTF) measurements.
 - Define the typical SWR value for a given interface (i.e., BNC, TNC, "N") over the test frequency band.

2. Equipment

A. General

- (1) ECS RF Troubleshooter Kit, part number 11044-101.

3. TCAS II SWR Test Set-Up

A. General

- (1) Remove the Site Master S331 from the hard case. Open the cover of the soft case and press the ON/OFF key. As the display turns on, verify the self test indicator displays "Passed". Check the battery indicator and confirm the unit is sufficiently charged. The battery charge symbol, is continuously displayed in the top-right corner of the display. A totally black bar indicates a fully charged battery. If the charge is low, the AC to DC power adapter can be connected and used during this test.
- (2) Check Site Master's Optional settings by pressing the OPT soft key from the main menu. Verify the options are set according to table 1. The user has the option of selecting either English or Metric measuring system, by pressing B5 soft key.

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Table 1008. Directional Antenna Test Procedure (cont)

Table 1. Site Master Setting

Soft key	Setting	Soft key	Setting
B1:	Mode= SWR	B5:	UNIT=ENGLISH
B2:	LIMIT BEEP OFF	B6:	FIXED CW OFF
B3:	KEYBD LOCK OFF	B7:	PRINTER=NOTE
B4:	SINGLE SWP OFF		

- (3) Return to the main menu by pressing the MAIN soft key. Set start frequency F1 and stop frequency F2 as follows:
 - (a) The Site Master is capable of storing ten setup's. The above setup is complete and can be saved for future use. Refer to the User's Guide for information on saving and recalling setup a specific setup.
 - (b) Press FREQ soft key.
 - (c) Press F1 soft key and use the keyboard to enter the numerical value 995, then press ENTER when data entry is complete.
 - (a) Press F2 soft key and use the keyboard to enter the numerical value 1124 then press ENTER when data entry is complete.
 - (b) Check that the FREQ (MHz) scale in the display area indicates the above start and stop values.
- (4) Set the marker frequencies as follows:
 - (c) Press MKRS soft key and M1 twice. Use the keyboard to enter the numerical value 1030 and press ENTER
 - (d) Press MKRS soft key and then press M2 twice. Use the keyboard to enter the numerical value 1090 and press ENTER.
 - (e) Check that the marker frequencies in MHz, indicates M1=1030 and M2=1090.

4. Performance Calibration

A. General

- (1) The calibration should be performed in the same environment as the actual test. Like most electronic test equipment, the Site Master S331 is temperature sensitive. If the temperature changes a few degrees, a warning indicator will appear on the left-hand edge of the LCD screen. If the temperature indicator appears, the Site Master S331 should be calibrated again to improve the accuracy of the readings.

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Table 1008. Directional Antenna Test Procedure (cont)

B. Procedure

- (1) Remove the adapter cable (part number 965RFTS-201) from the hard case and connect it to the Site Master S331 test port.

NOTE: All connections should be finger tight. DO NOT OVER TIGHTEN OR USE PLIERS.

- (2) Select the SMA jack to "N" Jack adapter (part number NS010, see Figure 1) from the hard case and connect the SMA plug end of the adapter cable.

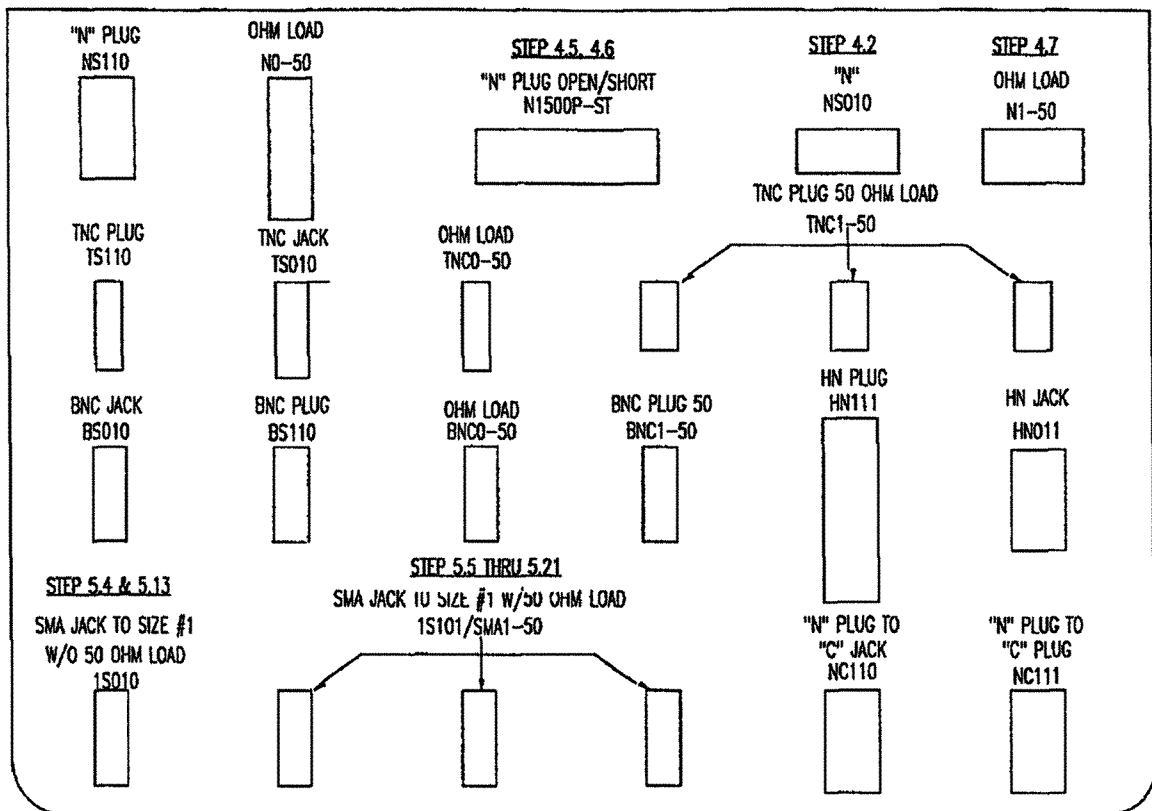


Figure 1. RF Trouble Shoot Adapter Kit Layout

- (3) Perform a measurement calibration by pressing the START CAL on to keyboard.
- (4) Select the desired location to store the calibration, CAL A or CAL B, by using the **Up/Down** Arrow key. Place the > symbol adjacent to the desired location and press the ENTER key.

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Table 1008. Directional Antenna Test Procedure (cont)

NOTE: Once the Calibration is performed the existing calibration frequencies will be overwritten by the frequencies in step 3.C. Step (1) thru (4).

- (5) Follow the open instructions presented in the message area of the screen, "Connect **OPEN**, press **ENTER**." The Open "N" connector is the half marked open on the "N" Plug-Open/Short adapter (part number N1500P-ST see Figure 1).

NOTE: The "N" Open connector is used to improve the accuracy of all readings. The "N" Open adapter provides 50 ohms to the end of adapter NS010.

- (6) Follow the instructions presented in the message area of the screen "Connect **SHORT**, press **ENTER**." The Short "N" connector is the half marked short on the "N" Plug Open/Short adapter (part number N1500P-ST).

- (7) Follow the instructions presented in the message area of the screen, "Connect **LOAD**, press **ENTER**." The "N" plug 50 ohm load adapter is (part number N1-50 see figure 1).

- (8) The calibration is complete. The SWR Value should read M1 = 1.00 at 1030 MHz and M2 = 1.00 at 1090 MHz. If either value is greater than 1.00 then repeat all of step 4.

NOTE: If the adapter cable or any of the adapters become loose during the calibration, start the calibration from the beginning. If the power is interrupted for reasons such as low battery, accidental shut down or applying AC/DC adapter power, repeat the calibration.

5. TEST AND RECORD TCAS II DIRECTIONAL ANTENNA SYSTEM

A. General

- (1) The Site Master SWR readings represent the same values that the TCAS computer is seeing. Most TCAS computers have safety circuitry that will shut down the computer if the SWR reaches a predetermined value. A typical shut down value is 1.8:1 @ 1090 MHz. Contact your TCAS manufacturers for acceptable values.

B. Procedure

- (1) Remove the TCAS computer per the equipment manufacturer's removal procedure.
- (2) The ARINC connector block at the back of the rack will be exposed. The ARINC connector block will be either a 600 or 404 configuration (see Figure 2).
- (3) If the ARINC connector block is a 600 configuration, then continue with step 5.B.4. If the ARINC connector block is a 404 configuration then go to step 5.B.13.

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Table 1008. Directional Antenna Test Procedure (cont)

NOTE: A hard copy of the trace can be produced in two different ways. One method is through the use of the Site Master Software Tools. The trace can be stored in the Site Master S331 and down loaded to a PC. A copy of the trace can then be generated through the Site Master Software Tools. To save the trace, press **SAVE DISPLAY** on the keyboard then enter the desired memory location (1 thru 40) and press **ENTER**. The Site Master S331 is capable of storing up to 40 traces. A log or table should be used that records where a given trace is stored. The Site Master has a printer port and is capable of printing a trace direct. See the Site Master User's Guide for information on compatible printer.

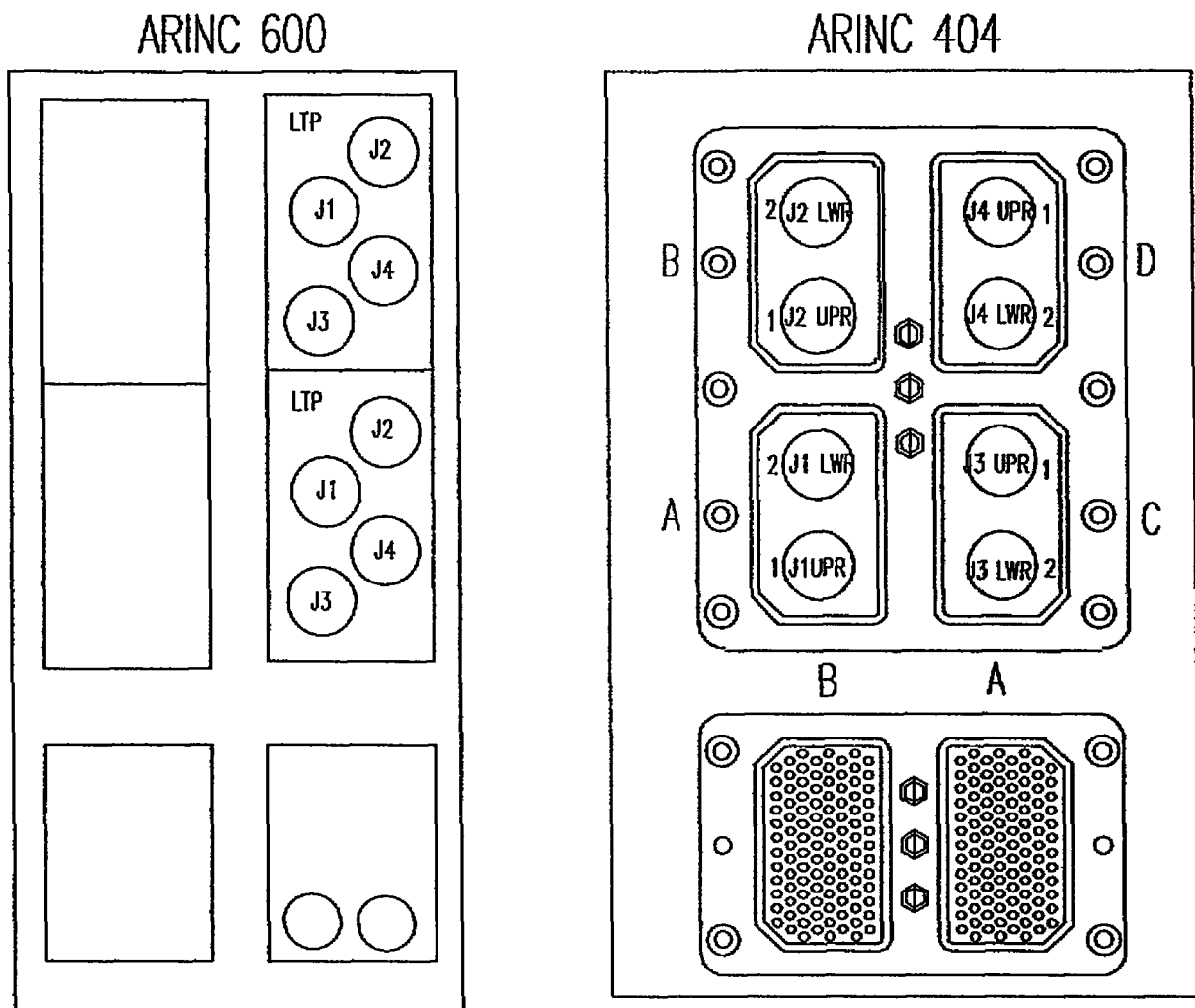


Figure 2. ARINC TCAS Connector Configurations

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Table 1008. Directional Antenna Test Procedure (cont)

- (4) Remove the SMA jack to "N" jack adapter (P/N NS010) from the end of adapter cable (P/N 965RFTS-201) and connect the SMA jack to Size #1 adapter (P/N 1S010, see Figure 1).
- (5) Insert the Size #1 adapter into LTP J1. To improve the accuracy of the SWR readings, insert the Size #1 50 ohm load (P/N 1S101/SMA1-50, see Figure 1) into LTP J2, J3, and J4. Press **AUTO SCALE** on the keyboard and record the SWR values at marker frequencies 1030 MHz and 1090 Mhz (see Figure 3).

NOTE: The display will look similar to the VSWR plot in Figure 3. A good antenna cable run will display the lowest VSWR reading at the system's operating frequency. The VSWR plot was generated in the software tools.

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Table 1008. Directional Antenna Test Procedure (cont)

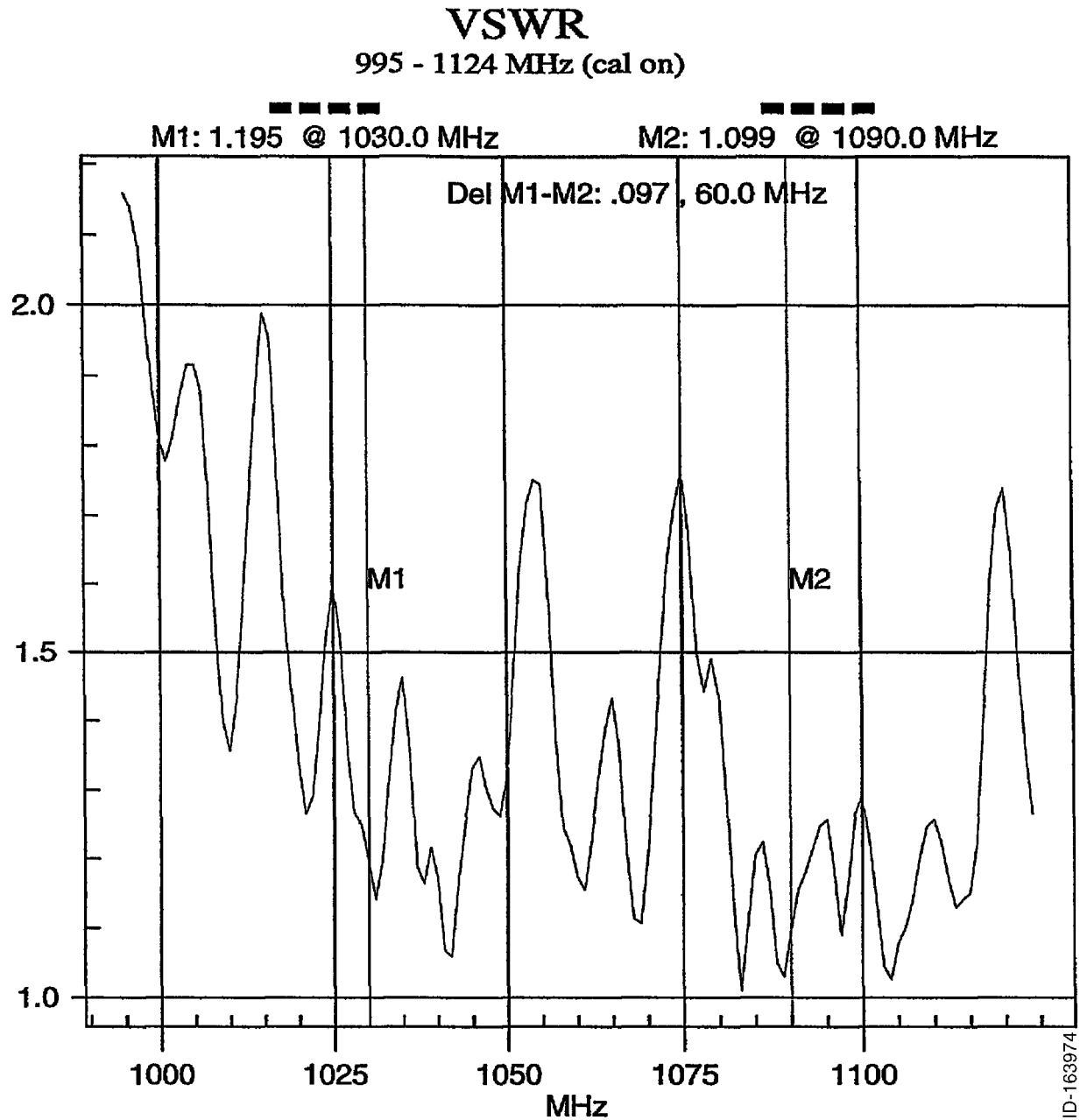


Figure 3. Typical Antenna Cable Run VSWR Display

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Table 1008. Directional Antenna Test Procedure (cont)

- (6) Insert the Size #1 adapter into LTP J2. Insert the Size #1 50 ohm loads into LTP J1, J3, and J4. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (7) Insert the Size #1 adapter into LTP J3. Insert the Size #1 50 ohm loads into LTP J1, J2, and J4. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (8) Insert the Size #1 adapter into LTP J4. Insert the Size #1 50 ohm loads into LTP J1, J2, and J3. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (9) Insert the Size #1 adapter into LMP J1. Insert the Size #1 50 ohm loads into LMP J2, J3, and J4. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (10) Insert the Size #1 adapter into LMP J2. Insert the Size #1 50 ohm loads into LMP J1, J3, and J4. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (11) Insert the Size #1 adapter into LMP J3. Insert the Size #1 50 ohm loads into LMP J1, J2, and J4. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (12) Insert the Size #1 adapter into LMP J4. Insert the Size #1 50 ohm loads into LMP J1, J2, and J3. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (13) Remove the SMA jack to "N" jack adapter (P/N NS010) from the end of adapter cable (P/N 965RFTS-201) and connect the SMA jack to Size #1 adapter (P/N 1S010, see Figure 1).
- (14) Insert the Size #1 adapter into A1 J1 UPR. To improve the accuracy of the SWR readings, insert the Size #1 50 ohm load (P/N 1S10I/SMA 1-50, see Figure 1) into B1 J2 UPR, C1 J3 UPR, and D1 J4 UPR. Press **AUTO SCALE** on the keyboard, and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (15) Insert the Size #1 adapter into B1 J2 UPR. Insert the Size #1 50 ohm loads into A1 J1 UPR, C1 J3 UPR and D1 J4 UPR. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (16) Insert the Size #1 adapter into C1 J3 UPR. Insert the Size #1 50 ohm loads into A1 J1 UPR, B1 J2 UPR and D1 J4 UPR. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.

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Table 1008. Directional Antenna Test Procedure (cont)

- (17) Insert the Size #1 adapter into D1J4 UPR. Insert the Size #1 50 ohm loads into A1 J1 UPR, B1 J2 UPR and C1 J3 UPR. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (18) Insert the Size #1 adapter into A2 J1 LWR. Insert the Size #1 50 ohm loads into B2 J2 LWR, C2 J3 LWR and D2 J4 LWR. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (19) Insert the Size #1 adapter into B2 J2 LWR. Insert the Size #1 50 ohm loads into A2 J1 LWR, C2 J3 LWR and D2 J4 LWR. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (20) Insert the Size #1 adapter into C2 J3 LWR. Insert the Size #1 50 ohm loads into A2 J1 LWR, B2 J2 LWR, and D2 J4 LWR. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.
- (21) Insert the Size #1 adapter into D2 J4 LWR. Insert the Size #1 50 ohm loads into A2 J1 LWR, B2 J2 LWR and C2 J3 LWR. Press **AUTO SCALE** and record the SWR values at marker frequencies 1030 MHz and 1090 MHz.

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2. MILACAS-FR Display Navigation

A. Fault Code Storage

Push the Select button when STORED FAULTS (Figure 1005) is the active selectable item to show the Stored Faults screen (Figure 1006). The fault data is shown five legs back from the most recent fault to the oldest fault. The title of the Stored Fault Display shows in which leg the stored fault is found. The title shows the current leg minus the number of legs to where the fault is kept. For example, LEG-2 shows the fault is found two legs back from the present leg. If the current leg equals the leg with the fault, then the title is INBOUND.

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

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

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

LEG-2	1/2
FAULT_TEXT	
MO/DD/YY HH:MM	
PHASE: SS OCCUR: 0	

STORED	2/2
FAULTS	
>MENU	

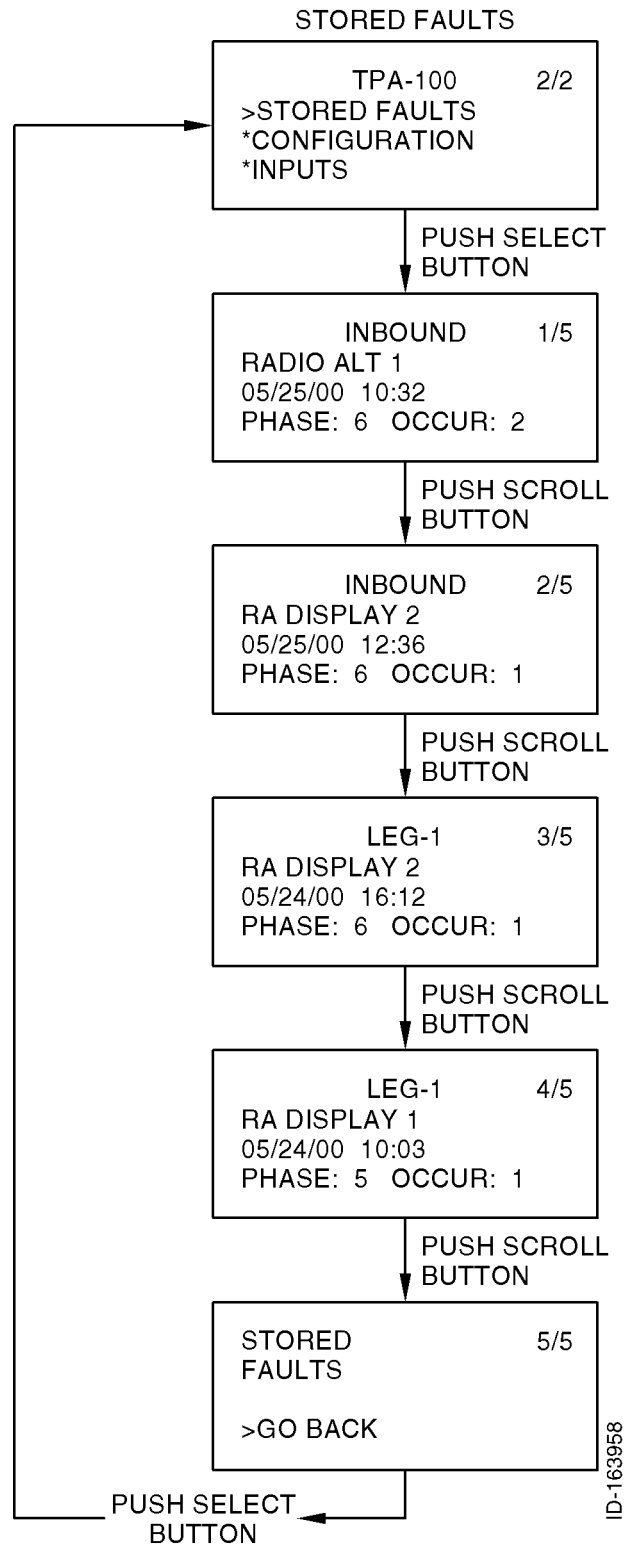
ID-163957

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

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Figure 1006. Stored Faults LCD Screen Example

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B. Configuration Display Screen

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

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

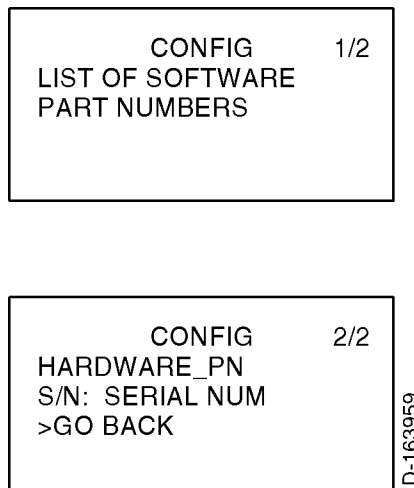


Figure 1007. Typical Configuration Display Screen

C. Inputs Display Screen

Pushing the Select button when Input is the Active Selectable Item on the Menu Screen, causes the Input select screen page 1/3 to come into the view. See Figure 1008. Refer to Table 1009 for Program Pin displayed text and fault descriptions.

Program Pins Display Screen

Refer to Figure 1008 for typical input display screens.

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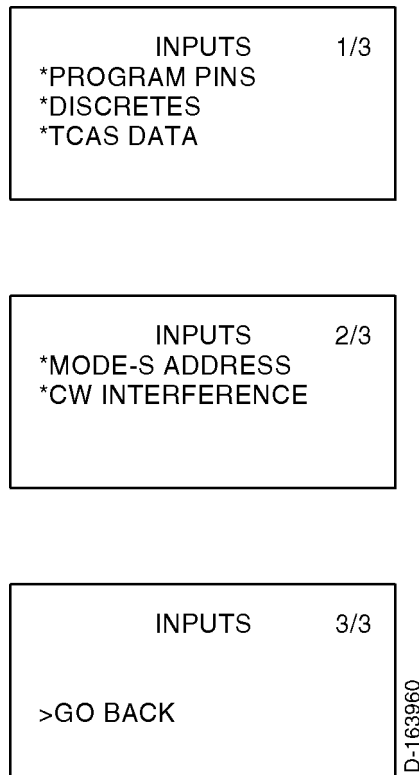


Figure 1008. Typical Input Display Screens (Pages 1-3)

Table 1009. Program Pins

Program Pin	Display Text	Fault Description
PP RBP 6J	Single Xpdr	One Transponder Program Pin shows how many transponders are installed: *O = Both Transponders Installed *1 = One Transponder Installed
PP RBP 6K	Single RA	One Radio Altitude Program Pin shows how many Radio Altimeters are installed: *O = Both Altimeters Installed *1 = One Altimeter Installed
PP RBP 7A	Airborne Audio Level # 1	Airborne Audio Level Program Pins set the speaker and phones audio level output when the aircraft is airborne by strapping one or more Airborne Audio Level Program Pins to Program Pin Common RBP7K
PP RBP 7B	Airborne Audio Level # 2	
PP RBP 7C	Airborne Audio Level # 3	

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Table 1009. Program Pins (cont)

Program Pin	Display Text	Fault Description
PP RBP 7D	Audio Advisory Discrete	Audio Advisory Discrete Program Pins show if there is an interval in the Synthesizer Voice output when an advisory is given: *O = No Delay *1 = 1 ± 0.2 second delay (an audio tone is output prior to the issuance of a voice command)
PP RBP 7E	Ground Display Mode	Ground Display Mode Program Pin shows the correct mode for TCAS when the aircraft is on the ground: *O = TA Only mode (Sensitivity Level = 2, RAs prevented) *1 = Standby Mode (Sensitivity Level = 1)
PP RBP 7F	Display All Traffic	Display All Traffic/Threat Program Pin calculates the traffic that is shown: *O = Display All Traffic *1 = Display TA/RA Traffic Only
PP RBP 7G	Cable Delay Sign	The Cable Delay Program Pins show the differential interval between the top and the bottom antenna.
PP RBP 7H	Cable Delay MSB	
PP RBP 7J	Cable Delay LSB	
PP RBP 8A	On Ground Audio Level No. 1	Ground Audio Level Program Pins find the speaker and phones audio level output when the aircraft is on the ground by strapping one or more Ground Audio Level Program Pins to Program Pin Common RBP7K.
PP RBP 8B	On Ground Audio Level No. 2	
PP RBP 8C	On Ground Audio Level No. 3	
PP RBP 8E	Self Test Inhibit	Test Inhibit Program Pin shows when to prevent functional test when airborne: *O = Functional Test In Air Permitted *1 = Functional Test In Air Prevented
PP RBP 8F	Disp Intruder Limit 16	TA/RA Display Intruder Limit Program Pins limit the number of intruders that can be shown (all pins = maximum traffic can be displayed = 31). There are five straps to limit the number of intruders that are shown (0-31). The pins connected to RBP7K are not shown.
PP RBP 8G	Disp Intruder Limit 8	
PP RBP 8H	Disp Intruder Limit 4	
PP RBP 8J	Disp Intruder Limit 2	
PP RBP 8K	Disp Intruder Limit 1	

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Table 1009. Program Pins (cont)

Program Pin	Display Text	Fault Description
PP RMP 6E	Altitude Limit 2000 ft	Altitude Limit Program Pins show the altitude Performance Limits of an aircraft. If no straps are installed the altitude Performance Limit is zero feet. If all straps are installed the Performance Limit is 62,000 feet.
PP RMP 6F	Altitude Limit 4000	
PP RMP 6G	Altitude Limit 8000	
PP RMP 6H	Altitude Limit 16000	
PP RMP 6J	Altitude Limit 32000	
PP RMP 12A	RA Type Straps A	Radio Altimeter Type Straps Program Pins show the type of radio altimeter that supplies altitude data to the TCAS system.
PP RMP 12B	RA Type Straps B	
PP RMP 12C	RA Type Straps C	
* 0 = Open, 1 = Ground (Connected to Program Pin Common (RBP7K))		

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

Discretes Display Screen

Figure 1009 is an example of a Discrete screen. Line 1 contains the screen title, and line 2 shows the pin number followed by Open or Ground. Lines 3 and 4 are reserved for the name of the discrete. On the last Discrete page, the Active Selectable Item GO BACK is shown. Table 1010 lists the discrete pins, the text shown, and a short description of the discrete.

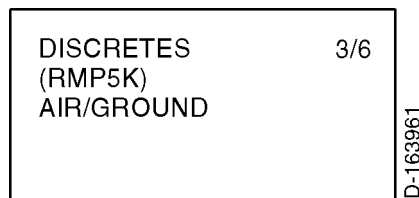


Figure 1009. Example of Discrete Screen

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Table 1010. Discrete Pin Numbers

Discrete Pin Number	Display Text	Discrete Description
RBP5A	Advisory Inhibit 1	The four inputs to the TCAS prevent annunciations when more important events occur. The source of the four inputs are Input 1, Aircraft System; Input 2, Windshear System 1; Input 3, Windshear 2; Input 3, EGPWC. See Table 1011.
RBP5B	Advisory Inhibit 2	
RBP5C	Advisory Inhibit 3	
RBP5D	Advisory Inhibit 4	
RBP5E	Increase Climb Inhibit 1	The following logic applies to the four Increase Climb Inhibit Inputs to the TCAS from the system. (Increase Climb Inhibit 1 AND Increase Climb Inhibit 2) OR (Increase Climb Inhibit 3 AND Increase Climb Inhibit 4) = Cannot climb at 2500 feet for each minute. The low is the in operation condition.
RBP5F	Increase Climb Inhibit 2	
RBP5G	Increase Climb Inhibit 3	
RBP5H	Increase Climb Inhibit 4	
RMP1J	Climb Inhibit 1	TCAS is Climb Inhibited when the logic is as follows: Climb Inhibit 1 AND Climb Inhibit 2 OR Climb Inhibit 3 AND Climb Inhibit 4. The low is the in operation condition. The Climb Inhibit discretes are influenced by the landing gear position, flap position, and other aircraft configurations that give climb performance.
RMP13G	Climb Inhibit 2	
RBP5J	Climb Inhibit 3	
RBP5K	Climb Inhibit 4	
RBP6A	Data Loader Enable	Data loader enable discrete input to TCAS from the data loader.
RMP3D	Advisory/Annunc Cancel	This discrete input gives the procedure for cancelling current aural advisory, synthesized voice, and visual annunciator alerts. This is an option of the flight crew. When cancelled, it stays cancelled until the currently active advisory becomes inactive and then active again or the current active advisory is replaced by a different advisory. Where 0 = Open = No Advisory Cancel 1 = Ground = Advisory Cancel

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Table 1010. Discrete Pin Numbers (cont)

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

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Table 1011. Advisory Inhibit and TCAS Mode Data

Advisory Inhibit				TCAS Mode
No.1	No.2	No.3	No.4	
1	X	X	X	Standby (SL=1)
0	1	X	X	TA Only (SL=2)
0	X	1	X	TA Only (SL=2)
0	X	X	1	TA Only (SL=2)
0	0	0	0	Normal
0 = open, 1 = ground, X = do not care Advisory inhibit 1 has precedence over the other advisory inhibit inputs.				

(a) TCAS Data Display Screen

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

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

- Digital Radio Altitude
- Analog Radio Altitude

The priority of Radio Altitude sources is:

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

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

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1 Digital Radio Altitude

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

DIGITAL RA	1/8
#1 2440	+
#2 2440	

ID-163962

Figure 1010. Digital Radio Altitude Display Screen Example

2 Analog Radio Altitude

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

ANALOG RA	2/8
#1 INVALID	
#2 2440	+

ID-163963

Figure 1011. Analog Radio Altitude Display Screen Example

3 Pressure Altitude

The pressure altitude data is supplied to TCAS from the transponder through XT Coordination No. 1 and No. 2 ARINC 429 data bus (Data Word Label 203). Figure 1012 shows a sample Pressure Altitude screen. Line 2 contains the altitude data from XT Coordination No. 1 pressure altitude data source. In this example the data source is correct (altitude = 2400 ft.) and the plus sign shows that the XPDR No. 1 is the active source. If the data is correct, then line 2 shows INVALID. The line 3 indications are almost the same except that they are for XPDR No. 2.

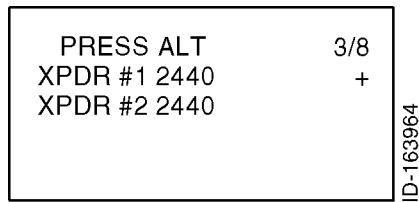


Figure 1012. Pressure Altitude Display Screen Example

4 Roll

An example of a Roll display is shown in Figure 1013. Line 2 shows the data from ARINC 429 Mag Heading/Attitude data bus (label 325). The (+) indicates that data source is the active source. If the roll data from the 429 data source is not correct, then line 2 can show INVALID. Line 3 shows the data from a roll attitude synchro. In this case the data is incorrect.

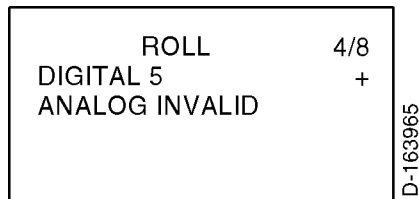


Figure 1013. Roll Display Screen Example

5 Pitch

An example of a Pitch display screen is shown in Figure 1014. Line 2 shows the data from ARINC 429 Mag Heading/Allotted data bus (label 324). The (+) shows that source is the active source. If the Pitch data from the 429 data source is not correct, then line 2 shows INVALID. Line 3 shows the data from a Pitch attitude synchro. In this case the data is correct.

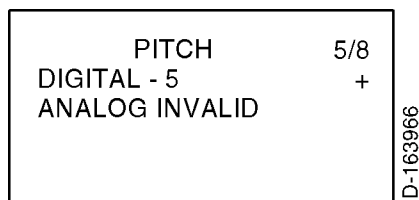


Figure 1014. Pitch Display Screen Example

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6 Heading

There are two types of heading data, one is ARINC 429 and the other is synchro. There are two types of ARINC 429 heading data, true and magnetic. An example of a Heading display is shown in Figure 1015. The second line shows the true heading data from ARINC 429 label 314. The (+) indicates that the data source is the active source. If the data from one of the data sources is not correct, then it shows INVALID (as shown on the line 3). Line 3 shows Magnetic heading data from ARINC 429 data source (label 320). Line 4 shows the data from the Magnetic Synchro data source. In this case the data is incorrect.

HEADING	6/8
TRUE -86	
MAG -106	
ANALOG INVALID	

ID-163967

Figure 1015. Heading Display Screen Example

7 Climb Inhibit

An example of a Climb Inhibit display screen is shown in Figure 1016. The second line shows if climb is inhibited or not (yes or no). Line 3 shows if increased climb is inhibited (yes or no).

CLIMB INHS	7/8
C1 INH	YES
INC C1 INH	NO

ID-163968

Figure 1016. Climb Inhibit Display Screen Example

8 Air/Ground and Landing Gear

An example of an Air/Ground and Landing Gear display screen is shown in Figure 1017. The second line shows if Air/Ground Input Discretes show Ground, Air, or invalid. Line 3 shows if Landing Gear Discrete Input shows the gear is RETRAC or EXTEND. The Active Selectable Item is GO BACK.

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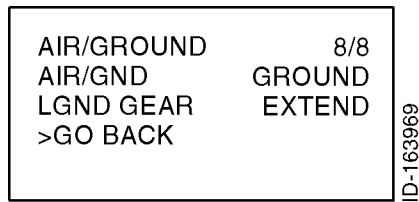


Figure 1017. Air/Ground Display Screen Example

(b) Mode-S Address

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

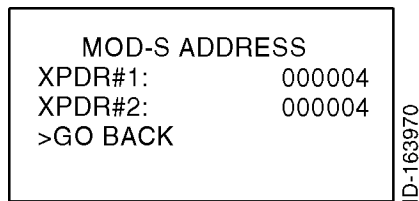


Figure 1018. Typical Mode S Transponder Display Screen

(c) Continuous Wave Interference

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

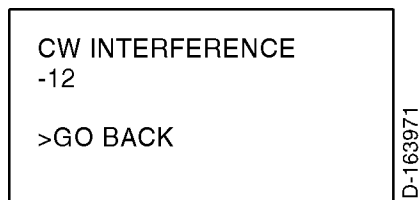


Figure 1019. Continuous Wave Interference Display Screen

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MAINTENANCE PRACTICES

1. Overview

A. General

The purpose of this section is to supply service personnel with installation and maintenance information pertaining to the MILACAS-FR system. This information pertains to the components that follow:

- MILACAS-FR Processor
- ANT-81A Directional Antenna
- Mode S Transponder (APX-100/APX-119).

Installation and maintenance information for the Mode S transponder, control units, and transponder associated omni antennas are described in the applicable Mode S transponder system maintenance manual.

Installation instructions are supported by mechanical outline drawings and electrical interconnection drawings. These drawings, located at the back of this section, should be reviewed by the installing agency and special requirements that refer to the particular airframe must be identified before installation starts.

2. Inspection and Unpacking

Use care when unpacking the MILACAS-FR system components. Open shipping cartons and carefully remove all items. Check the contents to make sure that all items identified on the packing list are included. Visually inspect each component for damage incurred during shipment. Look for dents, deep abrasions, chipped paint, and other damage. If a component is damaged, notify the transportation carrier immediately.

The components of the MILACAS-FR Processor have been adjusted and tested prior to shipment. Therefore, preinstallation testing is not required. If preinstallation bench testing of the units is desired, refer to the Testing and Troubleshooting section of the component maintenance manual for the applicable unit.

Honeywell uses a standardized marking system to identify equipment that has changes incorporated. Refer to the front of the applicable component maintenance manual for a list of service bulletins that change the various units in the system.

3. Installation Planning

A. General

The paragraphs that follow contain information about the initial installation of the MILACAS-FR Processor and supply instructions about the location and installation of the various components of the system.

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Install the MILACAS-FR in the aircraft in a manner consistent with acceptable workmanship and engineering practices. Follow the instructions in this publication. To make sure that the system has been properly and safely installed in the aircraft, the installer must make a thorough visual inspection. The installer must perform the post-installation/operational check of the system on the ground prior to flight.

CAUTION: AFTER INSTALLATION OF THE CABLING AND BEFORE INSTALLATION OF THE EQUIPMENT, APPLY AIRCRAFT PRIMARY POWER TO THE UNIT CONNECTORS AND MAKE SURE THAT POWER GOES ONLY TO THE PINS SPECIFIED IN THE INTERCONNECT DIAGRAMS, FIGURE 2002.

B. Location of Equipment

(1) TCAS Antenna Location

The system uses a top-mounted directional antenna and either a bottom-mounted directional or omnidirectional antenna.

Refer to directional antenna outline drawings in Figure 2001, and if applicable, manufacturer's documentation for the omnidirectional antenna.

The top directional ANT-81A TCAS antenna is mounted within 5 degrees of the centerline of the aircraft and as far forward on the constant radius portion of the fuselage as possible.

Obstructions, including other antennas, must not be present in the forward direction of either the top or bottom ANT-81A TCAS antenna.

The bottom ANT-81A TCAS antenna (directional or omni) is located within 5 degrees of the centerline of the aircraft and as close as possible to the vertical frame station location of the top directional antenna (but can vary up to a maximum of 25 feet longitudinally from the top antenna).

The ANT-81A TCAS top and bottom antenna must not be mounted closer than 30 inches from any other antenna on the aircraft. This provides 20 dB of isolation or 2.5 wavelengths at 1090 MHz.

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NOTE: Except for the above mentioned antenna location considerations, location of the system equipment is not critical, as long as the environment is compatible with the equipment design. The location of system components vary with different aircraft types.

Use care to avoid mounting the components near equipment that has high pulse current or high power outputs such as radar and satellite communications equipment. In general, the equipment must be installed in a location convenient for operation, inspection, and maintenance. The equipment must be in an area free from excessive vibration, heat, and noise generating sources.

(2) MILACAS-FR Processor Location

The MILACAS-FR Processor is installed in a convenient remote location that is free of excessive heat and vibration and which supplies reasonable access for inspection and maintenance. To achieve maximum performance, the MILACAS-FR Processor is installed adjacent to other receiver/transmitters or boxes with similar functions. Length of cables from the MILACAS-FR Processor mounting tray connector to other system units, except for the TCAS antennas, is not critical because TCAS unit interfaces are designed with high impedance inputs, low impedance outputs, and low noise susceptibility characteristics. If ARINC cooling is not supplied, a processor mounting tray with a blower assembly supplies the unit with forced-air cooling. There must be air space between and around the unit.

NOTE: Refer to interconnect diagram Figure 2002 for processor wiring particulars and interconnects.

C. Interwiring and Cable Fabrication

(1) General

Figure 2002 is a detailed MILACAS-FR system interconnect diagram for the processor. Figure 2002 shows a detailed view of the MILACAS-FR rear connectors. Table 2002 shows the MILACAS-FR Processor connector pins.

Cables must be fabricated in accordance with the interwiring diagrams in Figure 2002 and Table 2002. The length of the wires to parallel pins must be approximately the same length to supply the best distribution of current. Honeywell recommends that all wires shown on the interwiring diagram, including spares, be included in the fabricated harness. However, if full wiring is not desired, the installer must make sure that the minimum wiring requirements for the features and functions are incorporated.

Wires for optional functions are shown on the interconnect diagram. The actual use of these wires depends upon the installation, customer requirements, and capability of the units installed.

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When the cables are installed in the aircraft, they must be supported firmly enough to prevent movement and carefully protected from abrasion. Additional protection must be supplied in all locations where the cables may be subject to abuse. In wire bundles, the cables must not be tied tightly together because this increases the possibility of noise pickup and similar interference. When routing cables through the airframe, the cables must cross high-level lines at a right angle.

The installer must be knowledgeable of system variations that are unique to the installation, such as system strapping requirements. The installer must use ARINC Characteristic 718 and 735 as a guide and reference throughout the fabrication and installation of the cables in the aircraft.

Antenna cabling with unique requirements is described in paragraph 3.C.(5).

(2) Interface Capability and Requirements

The Description and Operation section of this manual lists the types of external avionics equipment that can be connected to the MILACAS-FR Processor, TA/VSI, and RA/VSI and describes the types of signals. Determine the types of aircraft equipment to be connected to the MILACAS-FR system.

(3) Primary Power and Circuit Breaker Requirements

The MILACAS-FR system operates primarily from 115 V 400 Hz or 28 V dc power supplied by the aircraft. The displays use 5 V 400 Hz, 5 V dc or 28 V dc lighting power. A 26 V 400 Hz input is provided for reference for the synchro-to-digital converters. Power dissipation varies with the system configuration. Power connections are shown in the interwiring diagrams, Figure 2002.

(4) Suppression Pulse Requirements and Wiring

Connections for the suppression pulse from the MILACAS-FR Processor (see Figure 2002) are dependent on aircraft equipment and wiring. Typically, the suppression pin is connected from the MILACAS-FR Processor to the suppression inputs on the L-band equipment (i.e., transponder and DME equipment).

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(5) Antenna Cable Type Selection and Antenna Delay Program Strapping

NOTE: Always check the following information in conjunction with information on the aircraft interconnect diagram in Figure 2002.

The following MILACAS-FR Processor-to-antenna cable installation requirements must be adhered to:

- The total dB losses in any of the coaxial cable runs and associated interconnects between the MILACAS-FR Processor and each antenna port connector must not be less than 2 dB and must not be greater than 3 dB at 1030 MHz.
- The round-trip (receive/transmit) delay imposed by any individual cable run and associated interconnects between the MILACAS-FR Processor and top antenna (as opposed to the round-trip (receive/transmit) delay imposed by any cable run and interconnects between the MILACAS-FR Processor and the bottom antenna) must be seen by the TCAS as an effective delay difference of less than 50 nanoseconds. If the installation configuration does not impose a delay differential greater than 350 nanoseconds, four antenna delay program pins on the MILACAS-FR Processor allow strapped compensation to meet the 50 nanoseconds effective delay difference requirement.

The procedure for selecting the type of MILACAS-FR Processor-to-antenna coaxial cable and connectors and the antenna delay program pin strapping required to satisfy the aforementioned installation requirements is as follows:

- (a) Determine the routing for the four cable runs from the MILACAS-FR Processor rear connector to the four RF connectors on the top directional antenna (and if applicable, the bottom directional antenna). The four cable runs to a directional antenna must follow the same routing paths and have the same number of disconnects in each path. To make sure the cables are of equal distance, the four cables must approach the bottom center of the directional antenna in a vertical direction and then flare out to the four RF connectors on the antenna.

If the bottom antenna is an omnidirectional antenna, determine the routing for the cable run from the MILACAS-FR Processor rear connector to the single RF connector on the omni antenna.

NOTE: Calculations in the following procedures compare the top antenna cabling to the bottom antenna cabling. Make sure the routing and number of disconnects is identical in the four cable runs to a directional antenna (see step (a) above). If they are identical, then only one of the four cable runs to a directional antenna needs to be used as a reference in the following procedures (unless otherwise specified).

- (b) Determine the interconnects that will exist in the cable run between the MILACAS-FR Processor and each antenna. The antenna connection between the MILACAS-FR Processor rear connector and the MILACAS-FR Processor mounting tray connector is one interconnect. The TNC coaxial connection at the antenna port is a second interconnect.

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- (c) Determine the manufacturer's type of connectors that will exist at each cable run interconnect between the MILACAS-FR Processor and each antenna. Check the manufacturer's specifications for each connector and determine the associated dB loss that will exist per interconnect. Make a record of these figures for future reference.
- (d) Add together the dB losses for interconnects in an individual cable run between the MILACAS-FR Processor and the top antenna. Add together the dB losses for interconnects in an individual cable run between the MILACAS-FR Processor and the bottom antenna. Make a record of these figures for future reference.
- (e) If the total dB interconnect loss in a cable run between the MILACAS-FR Processor and top or bottom antenna exceeds 3 dB, the loss caused by interconnections must be reduced. To lower the dB loss, select different types of connectors or reduce the number of interconnects.
- (f) If total connector dB losses in a cable run between the MILACAS-FR Processor and the top or bottom antenna is greater than 2 dB and less than 3 dB, subtract that total loss from 3 dB. This difference is the maximum allowable dB loss that can be imposed by the coaxial cable run from the MILACAS-FR Processor to that antenna. In this case, minimum cable loss is not applicable. Make a record of this maximum allowable loss for future reference.
- (g) If the total connector dB losses in a cable run between the MILACAS-FR Processor and the top or bottom antenna is less than 2 dB, subtract that total loss from 2 dB. The remainder is the minimum amount of dB loss that must be imposed by the coaxial cable run from the MILACAS-FR Processor to that antenna. Then, subtract the total dB loss between the MILACAS-FR Processor and the antenna from 3 dB. The remainder after this subtraction is the maximum allowable dB loss that can be imposed by the coaxial cable run from the MILACAS-FR Processor to that antenna. Make a record of both the required minimum loss and the maximum allowable loss for future reference.

NOTE: At this point the installer has determined the physical length of the cables to the top and bottom antennas and has calculated the dB loss limitations of the cable runs. Top and bottom antenna cables must be selected that meet the 2.5 dB +0.5 dB requirement and do not exceed the 350 nanosecond maximum delay difference requirement between the top and bottom antenna cable runs.

- (h) Consult the manufacturer's coaxial cable data sheet specifications. Use the length of the top and bottom antenna cables measured in step (a) and the manufacturer specified dB loss in each foot of each cable type and select a particular type or types of cable that meet the top and bottom cable loss limitations calculated in steps (f) and (g). In anticipation of aging factors, the installer must select a cable type that has an insertion loss that when combined with interconnect losses will equal a dB loss as close as practical to 2.5 dB.

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NOTE: The type of cable selected to meet the dB loss requirements of the top antenna cable can be different from the type of cable selected to meet the dB loss requirements of the bottom antenna. For example: if the cable run to one antenna is long and the cable run to the other antenna is short, the long run may require a low loss antenna cable to meet the less than 3 dB antenna cable/interconnect requirement. The short run may require a relatively high loss cable to exceed the 2 dB antenna cable/interconnect loss requirement.

- (i) Consult the manufacturer's data sheets to determine the nanosecond delay in each foot (at 1030 MHz) for the type or types of cable selected in step (h).
- (j) Calculate the round-trip (receive/transmit) cable delay in the top antenna cable run and then the bottom antenna cable run as follows:

Length of cable [see step (a)] X nanosecond delay per foot [see step (i)] X 2 (round-trip) = cable run delay.

Example: Top cable length = 65 feet
Top cable delay = 1.25 nanoseconds per foot
Round-trip top cable delay = $65 \times 1.25 \times 2 = 162.5$ nanoseconds

Bottom cable length = 20 feet
Bottom cable delay = 1.25 nanoseconds per foot
Round-trip bottom cable delay = $20 \times 1.25 \times 2 = 50$ nanoseconds

- (k) Subtract the smallest round-trip cable delay from the largest round-trip cable delay to determine cable delay difference between top and bottom antennas.

Example: Top round-trip cable delay = 162.5 nanoseconds
Bottom round-trip cable delay = 50.0 nanoseconds
Top/Bottom Cable Delay Differential = 112.5 nanoseconds
(see note below)

NOTE: Antenna delay program pins are supplied on the MILACAS-FR Processor rear connector that allow straps to be installed to compensate for up to a 350 nanosecond delay difference between the top and bottom antenna cable runs. If the top/bottom antenna cable delay differential does not exceed 350 nanoseconds, selection of the appropriate antenna delay program pin strapping compensates the delay differences to within 50 nanoseconds.

If the top/bottom cable delay difference calculated in step (k) exceeds 350 nanoseconds, steps (h) through (k) must be repeated using different cable type(s).

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- (l) Refer to the interconnect diagram in Figure 2002. If the length of the cable run to the top antenna, measured in step (a), is longer than the cable run length to the bottom antenna, also measured in step (a), strap the antenna delay program pin on the MILACAS-FR Processor connector RBP pin 7G to common on RBP pin 7K. This permits the MILACAS-FR Processor software to add the antenna delay factor to bottom antenna signal processing.

If the length of the cable run to the top antenna is shorter than the cable run length to the bottom antenna, leave antenna delay program RBP pin 7G open. This allows MILACAS-FR Processor software to add the antenna delay factor to top antenna signal processing.

Example: Top cable run length = 75 feet

Bottom cable length = 25 feet

Strap RBP pin 7G to RBP pin 7K.

- (m) Refer to the antenna delay program strap table in Figure 2002. Based on the top/bottom antenna delay differential calculated in step (k), select the applicable strapping configuration for MILACAS-FR Processor connector RBP pins 7H and 7J that supply the correct amount of delay compensation and strap as applicable.

Example: Top/Bottom Cable Delay Differential = 112 nanoseconds

Strap RBP pin 7J to common on RBP pin 7K.

Leave RBP pin 7H open.

- (n) Cut antenna cables to lengths calculated in step (a) of this procedure. Make sure to cut the four cables to a directional antenna to equal lengths. Five inches is the maximum length difference that can be tolerated between the four cables to a directional antenna.

- (o) Fabricate the cables.

(6) Connectors

Mating connectors for the MILACAS-FR Processor units are identified on Figure 2002. Associated connector kits are specified in the Description and Operation section of this manual.

(a) MILACAS-FR Processor Connectors

The connector for the MILACAS-FR Processor is mounted on the center grid of the MILACAS-FR Processor rear panel in accordance with ARINC Characteristic 735. This connector is a low-insertion-force, size-3 shell, ARINC 600 connector with polarization projections that prevent incorrect connector insertion.

The rear connector (Figure 2002) has six sections:

- left bottom plug (LBP)
- right bottom plug (RBP)
- left middle plug (LMP)

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- right middle plug (RMP)
- left top plug (LTP)
- right top plug (RTP).

Table 2002 lists the MILACAS-FR Processor connector pin assignments.

(b) Directional Antenna Connectors

Four coaxial cables with TNC connectors connect the ANT-81A directional antenna connectors J1 through J4 to the MILACAS-FR Processor, shown in Figure 2001 and 2002.

D. Wire Strapping Options

MILACAS-FR system wire strapping options are implemented by externally connecting pins on the MILACAS-FR system connectors. The configurations of the straps are identified by the software in the particular unit. In most cases, the selected strap is connected to a common ground pin on the associated connector but in some instances may be connected to aircraft ground.

(1) MILACAS-FR Processor Straps

(a) Cable Delay Program Straps

Three straps, on RBP pins 7G, 7H, and 7J, are selectively connected to a common ground on RBP pin 7K, to compensate for the differences in coaxial cable lengths between the top and bottom TCAS antennas (up to a maximum of 300 nanoseconds). See the interconnect diagram, Figure 2002, for strapping details.

(b) Aircraft Altitude Limit Program Straps

Some aircraft may not be able to achieve a 0.25 G vertical acceleration to a 1500 FPM climb rate for an altitude gain of 750 feet above a certain altitude under all circumstances. The logic is made aware of these conditions by the altitude limit straps so that a resolution advisory such as "Don't Climb" is issued. These program pins select the "can't climb" altitude in 2000 foot increments up to 62,000 feet. Jumper wires from pins RMP-6E through RMP-6J to RMP-6K are necessary to program the required altitude. The limits set by the pins represent the worst case. The limits set by the pins must be used as a default when the flight management computer indicates that the climb must be limited. If no jumpers are installed, the altitude will be zero feet.

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The five strap pins on RMP-6E, 6F, 6G, 6H, 6J are selectively connected to a common ground on RMP pin 6K to program the selected altitude limit as follows:

<u>PIN</u>	<u>ALTITUDE LIMIT</u>
RMP-6E	2000 ft
RMP-6F	4000 ft
RMP-6G	8000 ft
RMP-6H	16,000 ft
RMP-6J	32,000 ft

(c) Type of Analog Radio Altimeter Select Straps

The MILACAS-FR Processor accepts radio altitude inputs from digital radio altimeters and some analog radio altimeters.

The three straps on RMP pins 12A, 12B, and 12C, are selectively connected to a common on RMP-6K, to identify the type of analog radio altimeter to the MILACAS-FR Processor software. Refer to the interconnect diagram, Figure 2002, for strapping details.

(d) TA/RA Display Symbol Maximum Program

The five straps on RBP pins 8F, 8G, 8H, 8J, and 8K, are selectively connected to a common on RBP pin 7K, to set the maximum number of intruder aircraft that can appear on those display units that cannot display the system maximum of 30 intruders (e.g., the TA/VSI display unit).

The MILACAS-FR Processor reads these straps and sends associated control data to the displays. The display unit's software uses this strap-controlled data to control the maximum number of intruder symbols that appear on the traffic display.

Refer to the interwiring diagram, Figure 2002, for strapping details.

(e) Ground Display Mode

This strap on RBP pin 7E controls whether or not traffic is displayed on the TCAS traffic display while own aircraft is on-the-ground. Leaving this strap input open permits traffic displays on-the-ground. Grounding this strap input inhibits traffic displays on the ground (puts TCAS in STANDBY mode). The interconnect diagram, Figure 2002, has additional details.

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(f) Display All/Threat Traffic Program

This strap on RBP pin 7F controls whether all traffic is displayed all the time on the TCAS traffic display or only if a TA or RA is present. Leaving this strap open permits all proximity, non-threat, TA, and RA category traffic to be displayed at all times. Grounding this strap input inhibits the display of aircraft symbols unless a TA or RA is present. The interconnect diagram, Figure 2002, has additional details.

(g) Functional Test Inhibit

The strap on RBP pin 8E controls whether or not the functional test can be performed while the aircraft is airborne. Leaving this strap open permits the functional test during flight. Grounding this pin will inhibit the functional test while the aircraft is off the ground. Refer to the interconnect diagram, Figure 2002, for additional details.

(h) Audio Tone Enable Program

The strap on RBP pin 7D is for applications that make tones to accompany synthesized voice advisories. When this pin is grounded, the synthesized voice output is delayed by 1 second in order to be properly phased with the aural advisories. When this pin is open, there is no delay of the voice output. The interconnect diagram, Figure 2002, has additional details.

(i) Audio Level Program

Two sets of strap pins permit audio level adjustment. Three strap pins, on RBP pins 7A, 7B and 7C, are selectively connected to a common on RBP pin 7K to adjust the audio output to the speaker and headphones to the desired level when the aircraft is airborne. The second set of three straps pins, on RBP pins 8A, 8B, and 8C, permit adjustment of the audio level when the aircraft is on the ground. The interconnect diagram, Figure 2002, has strapping details.

(j) Transponder Interface Select

This strap on RBP pin 6J tells the MILACAS-FR Processor whether one or two transponders are installed in the system. When this pin is strapped (connected to RBP pin 7K), only the No. 1 transponder is installed. When open, it indicates that both the No. 1 and No. 2 transponders are installed.

(k) Radio Altimeter Interface Select

This strap on RBP pin 6K tells the MILACAS-FR Processor whether one or two radio altimeters are installed. When this pin is strapped (connected to RBP pin 7K) it indicates that only the No. 1 radio altimeter is installed. When open, both the No. 1 and No. 2 radio altimeters are installed.

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(l) RA Status Inhibit

This strap on RBP pin 4G controls whether RA display status is active or inhibited. When this pin is strapped (connected to RBP pin 7K), RA display status is inhibited.

(m) On Ground Intruder Disable

This strap on RBP pin 4F controls whether or not intruders determined to be on-the-ground will be displayed when own aircraft is below 1,750 feet (radio altitude). When strapped (connected to RBP pin 7K), intruders on the ground will not be displayed when own aircraft is below 1,750 feet.

4. Equipment Installation

A. MILACAS-FR Processor Installation

Mount the MILACAS-FR Processor with its mounting tray component. The mounting tray is available with a fan assembly. This fan operates from 115 V, 400 Hz or 28 V dc. Operating power for the 115 V 400 Hz fan comes from the MILACAS-FR Processor when power is applied to the MILACAS-FR Processor unit.

The mounting tray connector must be wired in accordance with the interconnect diagram (Figure 2002) and the manufacturer's instructions.

NOTE: To allow for inspection or repair of the connector assembly wiring, sufficient lead length must be left so that when the mounting hardware for the rear connector assembly is removed the rear connector assembly may be pulled forward several inches. The installer must make a bend in the harness (at the rear connectors) to permit water droplets, that might form on the harness due to condensation, to drip off at the bend and not collect in the connector.

When locating the mount in the aircraft, allow at least two inches free space on the top and sides of the unit to give sufficient clearance for sway and ease of removal of the MILACAS-FR Processor. Clean all mounting surfaces prior to installation.

Once the mounting tray is installed, the MILACAS-FR Processor unit may be easily installed in the mounting tray. Put the MILACAS-FR Processor on the mounting base and slide it forward until the electrical connector is fully engaged. Then tighten the two knurled screw clamps (located on front of the mount) until they are firmly seated over the hold-down hooks on the front of the MILACAS-FR Processor.

B. TCAS Directional Antenna Installation

- (1) Directional antenna positioning and wiring requirements. Refer to paragraph 3.B.(1), 3.C.(5) and, 3.C.(6)(b).
- (2) Directional antenna footprint drilling and mounting

Before mounting the antenna, make sure that aircraft mounting surface is clean.

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The directional antenna is mounted on the aircraft by 4 or 8 mounting screws depending on user mounting requirements. A center hole must be provided on the aircraft to attach the four coaxial cables to the antenna connectors. An O-ring gasket is installed around the outside circumference of the center hole. An approved lock-tight sealant must be applied to each mounting screw. After the antenna is installed, an approved silicant must be applied around the outer circumference of the antenna to seal the antenna to the aircraft fuselage. For mounting hole dimensions, mounting screw type, antenna footprint patterns, and other mounting details, refer to antenna outline drawings, Figure 2001.

When the antenna has been mounted, connect the four coaxial cables from the MILACAS-FR Processor to the bottom of the antenna.

(3) Electrical Bonding

Electrical bonding resistance of the installed antenna to aircraft skin should not exceed 0.01 ohms.

C. Mode S Transponder System Component Installation

Refer to the applicable Mode S transponder system maintenance manual.

5. Inspection and System Checkout

A. Inspection

(1) Individual Unit Inspection

Table 2001 is a visual inspection/check procedure that must be performed after system installation as part of a system checkout. In addition, the procedure must be used as a periodic maintenance inspection check.

NOTE: For system units not covered in this manual, refer to the installation section of the applicable maintenance manual for proper inspection procedures.

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Table 2001. Inspection/Check Procedure

Equipment	Inspection/Check Procedure
MILACAS-FR Processor	(1) Inspect for any sign of damage. (2) Check that unit is properly installed and that retaining mechanism and connectors are securely tightened.
Directional Antenna	(1) Inspect for any sign of damage. (2) Check that antenna has been properly installed and all mounting screws are firmly tightened. (3) Make sure that the four coaxial connectors are all properly mated to antenna.

B. System Checkout

(1) General

Installation of the MILACAS-FR system requires three stages of testing to ensure the proper operation of the system components. First, do a check of the system interwiring prior to installation of the MILACAS-FR processor and display units. This check makes sure that the aircraft and all system intraconnections are correct before power is applied. After the units are installed, make a visual inspection of the equipment and connections. The post-installation test is used to apply power and do a functional check of the system. Successful completion of the post-installation test makes sure that the system works correctly.

(2) System Interwiring Check

Check the aircraft and transponder system interconnections, with the steps that follow:

- (a) Check that all cables and interwiring are installed in accordance with the interwiring and cable fabrication instructions.
- (b) Check that the functions that follow are properly strapped to reflect the aircraft system configuration:
 - 1 Cable Delay Program
 - 2 Aircraft Altitude Limit Program
 - 3 Type of Analog Radio Altimeter Select
 - 4 TA/RA Display Symbol Maximum Program
 - 5 Ground Display Mode

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6 Display All/Threat Traffic Program

7 Functional Test Inhibit

8 Audio Tone Enable Program

9 Audio Level Program

10 Transponder Interface Select

11 Radio Altimeter Interface Select

12 RA Status Inhibit

13 On Ground Intruder Disable

14 Configuration Straps

15 Rate Source Select Strap.

- (c) Use the interconnect diagram, Figure 2002, to check wiring for correct destinations, opens, and shorts.
- (d) Inspect all RF cables for signs of incorrect crimps and connectors not fully tightened. Also, the RF connectors on the ARINC 600 trays are spring loaded and must return smoothly when pushed and released, to make sure there is a positive connection with the MILACAS-FR processor.
- (e) Check RF cables for insertion loss and VSWR.

(3) Visual Inspection

In conjunction with system installation, do the visual inspection/check procedure, Table 2001.

(4) Post-Installation Test

This test makes sure that the MILACAS-FR system works correctly. Use the self-test function and an optional ramp test after the system units have been initially installed and thereafter as an operational check. This procedure consists of a pretest setup, self-test, manual test, and ramp test. The following tests are performed on the ground. The Mode S transponder system post-installation test is contained in the associated Mode S transponder maintenance manual.

(a) Pretest Setup

The following steps apply/check the system input power, configure the operational controls, and make sure that the system is ready for testing.

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- 1 Perform the Mode S transponder system post-installation test.
- 2 Confirm that the aircraft 115 V 400 Hz or 28 V dc, and 26 V ac power sources work correctly. Make sure the power bus meter works correctly.
- 3 Check that the aircraft 5 V ac or dc, or 28 V dc panel background lighting power source and dimmer control work correctly by adjusting the cockpit dimmer switch for proper cockpit panel background illumination.
- 4 Select transponder No. 1 and put transponder No. 1 and No. 2 in STANDBY mode.
- 5 Operate the applicable aircraft circuit breakers to apply power to the MILACAS-FR Processor, traffic and resolution advisory displays, Mode S transponder system, and all other aircraft equipment connected to the MILACAS-FR Processor and Mode S transponder subsystem. Make sure that circuit breakers remain closed.
- 6 Allow sufficient time for equipment to warm up. Equipment in the system requires one minute to warm up. External sensors may require more than one minute warmup time.

(b) Manual Test

- 1 On the traffic display screen, TCAS STBY mode annunciation must be visible.
- 2 Check that brightness of traffic display can be controlled. Brightness of traffic display on the TA/VSI is controlled by the aircraft dimmer switch. Brightness of the traffic display on the PPI or dedicated display is controlled by the BRT control on the display control panel.
- 3 On the transponder/TCAS control unit, the ATC FAIL lamp must be extinguished.
- 4 On the transponder/TCAS control unit, rotate the function selector switch to TA position. The following conditions must be met:
 - a Traffic display indicates TA ONLY.
 - b RA OFF flag is present on RA/VSI.
 - c Transponder/TCAS control panel ATC FAIL lamp is extinguished.
 - d TA/VSI and RA/VSI red and green eyebrows are extinguished.
 - e No fault or fail annunciations are present on traffic display.
 - f TA/VSI and RA/VSI vertical speed needle indicates "0" vertical speed.

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- g Traffic may be displayed on the traffic display depending upon MILACAS-FR Processor strapping configuration and whether traffic exists in the area:

- Non-threat traffic shows as an open white diamond.
- Proximity intruder traffic shows as a filled white diamond.
- Traffic advisory (TA) traffic shows as a filled yellow circle.

NOTE: Except for TEST mode, resolution advisory (RA) traffic is never displayed while the aircraft is on the ground. The RA symbol is a solid red square.

- 5 If CTA-81A control unit is used, select Mode S transponder No. 2 by setting ATC 1/2 switch to ATC 2 position. If KFS-578A control unit is used, push the 1/2 pushbutton so that transponder No. 2 shows in the LCD display. Make sure that the conditions are identical to the ones outlined in paragraph 4 above.

- 6 At the transponder control unit, set the ABOVE-NORM-BELOW switch as follows:

- a Set ABOVE-NORM-BELOW switch on the transponder/TCAS control unit to ABOVE. On the traffic display screen, ABOVE must be annunciated.
- b Set switch to BELOW. The traffic display screen must annunciate BELOW in place of the ABOVE annunciation.
- c Set switch to NORM. The traffic display screen area that annunciated ABOVE and BELOW must be blank.

- 7 On the transponder control unit, rotate the function selector switch to the TA/RA position.

(c) Self-Test

On the MCD, from the TCAS setup page, start the self-test of the MILACAS-FR system. The system successfully passes all tests when the TCAS system TEST OK is announced over the CAWS voice message and PASS shows on the MCD.

If MILACAS-FR INOP or TCAS INOP shows on the MCD, do the MILACAS-FR self-test from the front panel of the MILACAS-FR Processor. Refer to paragraph 1.F in FAULT ISOLATION.

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(d) Ramp Test (Optional)

This test requires the use of a TCAS ramp tester. Specific instructions for operating the ramp tester are contained in the applicable operator's manual. In systems with dual transponders, configure the system to check each function. Use the ATC 1/2 switch to select transponders. Use the TCAS ramp tester to test the TCAS with the various intruder aircraft scenarios. Monitor the displays and aural messages to make sure that the system response is correct.

(e) Antenna Test

Some of the antenna BITE tests are only performed when the aircraft is airborne. To initiate these tests, operate the air/ground strut switch or the landing gear retracted/extended switch in a way to make the TCAS think that own aircraft is airborne. Allow the equipment to operate for approximately 20 minutes. This allows the BITE circuits to record results of antenna tests in the flight fault memory.

6. Removal and Replacement

A. MILACAS-FR Processor

(1) Removal

- (a) Loosen the retaining screw clamps, located on the front of the MILACAS-FR Processor mount, that hold the MILACAS-FR Processor to the mount.
- (b) Gently pull the MILACAS-FR Processor forward until the unit disconnects from the rear connector on the mounting tray. The unit slips out of guide pins on the mount as it disconnects. Remove the unit from the mount.

(2) Reinstallation

- (a) Slide the MILACAS-FR Processor onto the mount and then gently push the unit toward the rear until guide pins are aligned and the connector is fully engaged.
- (b) Engage and tighten the retaining screw clamps to hold the unit firmly in place.

B. Directional Antenna

(1) Removal

- (a) Detach the four coaxial cables from connectors J1-J4.
- (b) Remove the four or eight screws that hold the antenna to the airframe. Remove the antenna and the antenna O-ring.

(2) Reinstallation

- (a) Clean the aircraft antenna mounting surface.
- (b) Install a new antenna O-ring.

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- (c) Secure the antenna to the aircraft using four or eight screws. Apply approved lock-tight sealant to the mounting screws.
- (d) Connect the four coaxial cables to the corresponding connectors J1-J4 on the antenna.
- (e) Apply approved sealant around the outer edge of the antenna to seal the antenna to the aircraft fuselage.

C. System Functional Testing (Self-Test)

After removal and replacement of any component of the system, do an inspection and system checkout as described in paragraph 5.A and 5.B.

7. Maintenance Procedures

A. In-Aircraft Adjustments

All alignment and adjustment procedures are accomplished during bench maintenance. When unit performance indicates an adjustment or an alignment is required, the technician must remove the unit from the aircraft. See the applicable component maintenance manual for the unit.

B. System Protection

There are no fuses integral to the system equipment. The system is protected by circuit breakers located at the circuit breaker panel in the aircraft.

C. Lubrication

There are no moving parts in the system. No lubrication is required.

D. Cleaning

When necessary, depending upon the environment to which the equipment is exposed and the intensity of use, periodic cleaning must be done. The exterior of the units must be wiped with a lint-free cloth dampened with an approved cleaning agent.

NOTE: Any cleaning of equipment interiors must be limited to that required when performing overhaul (bench-type) work.

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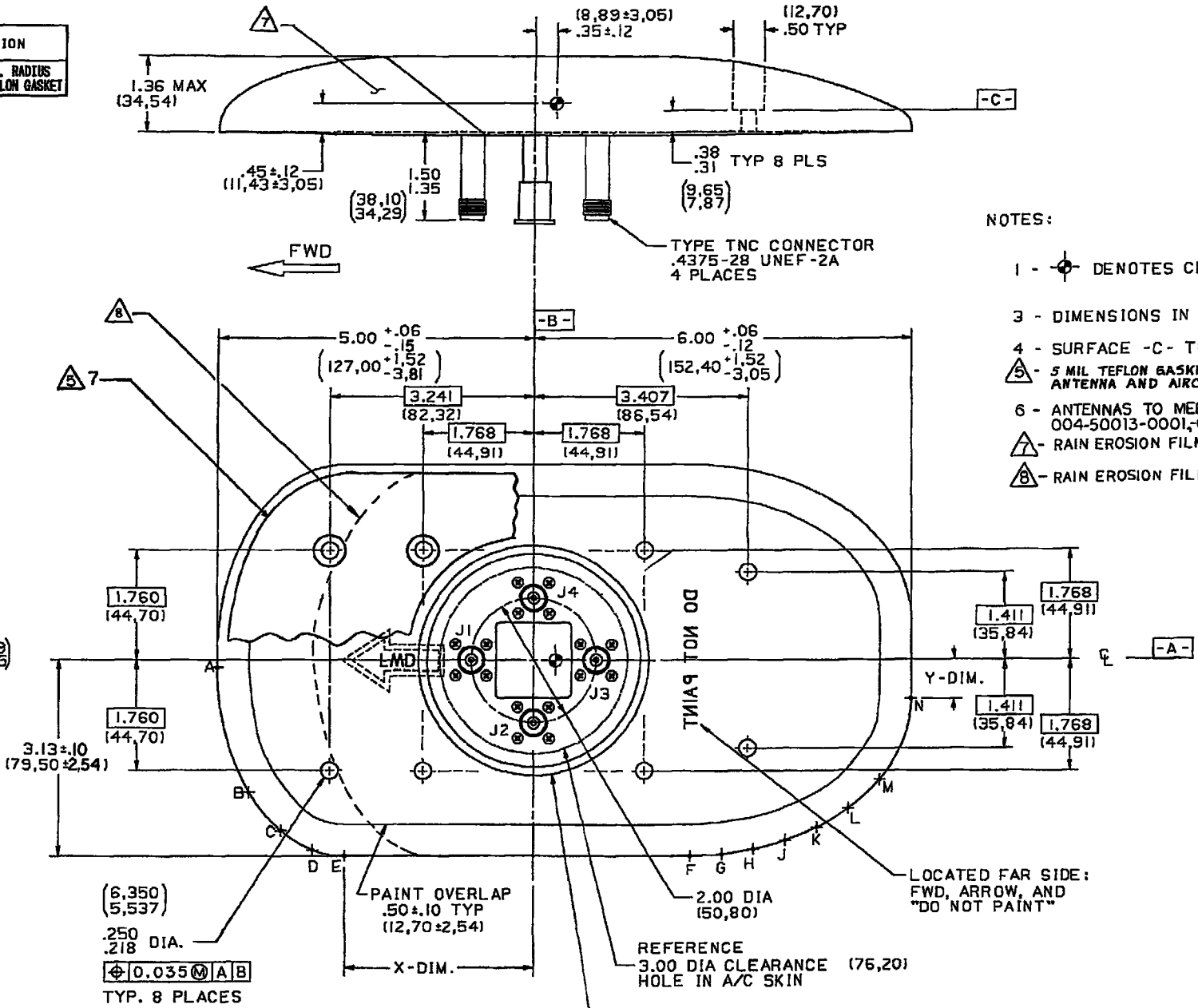
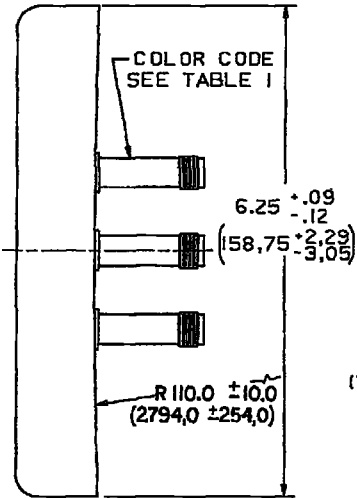
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BENDIX/KING ATAD PART OR IDENTIFYING NUMBER	MAX WEIGHT		DESCRIPTION
	LBS	KGS	
071-50001-8104	2.0	0.9	8 HOLE .110 IN. RADIUS WHITE WITH TEFLON GASKET

TABLE I

CONNECTOR	COLOR CODE
J1	YELLOW
J2	BLACK
J3	BLUE
J4	RED



CONTOUR	A	B	C	D	E	F	G	H	J	K	L	M	N
X ±.15	5.00	4.50	4.00	3.50	3.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00
Y ±.15	0.13	2.11	2.72	3.03	3.12	3.12	3.10	3.02	2.88	2.68	2.38	1.81	0.63

O-RING NAS 1611-153
O-RING GROOVE DIMENSIONS
3.740 O.D. X .140 WIDE
3.670
X .080 DEEP
.070

071-50001 REV V

FOUR-ELEMENT ARRAY, CURVED BASE

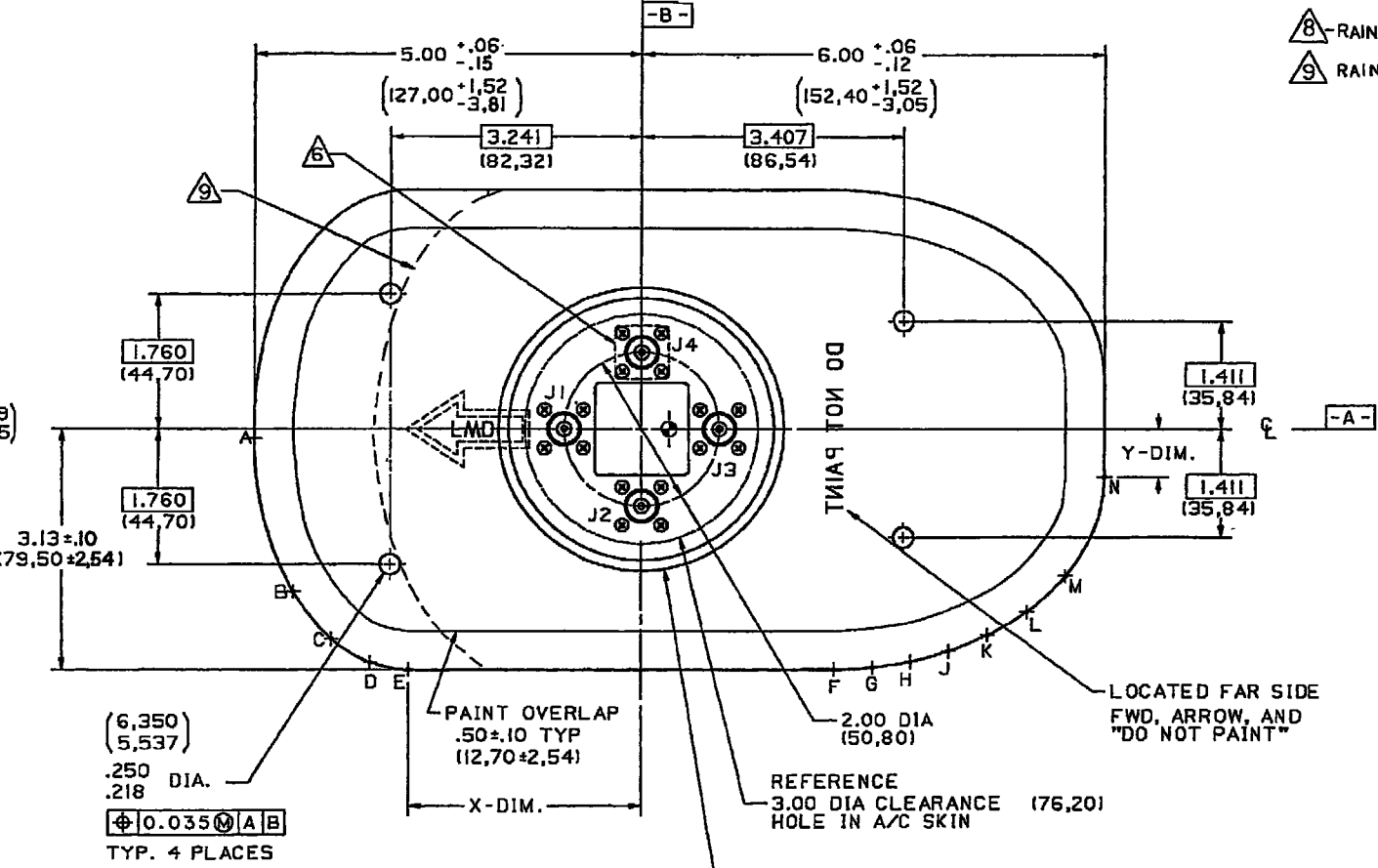
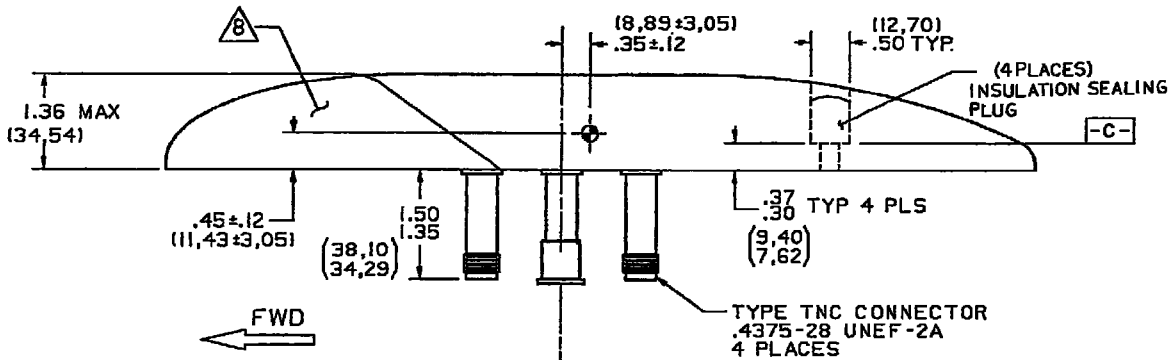
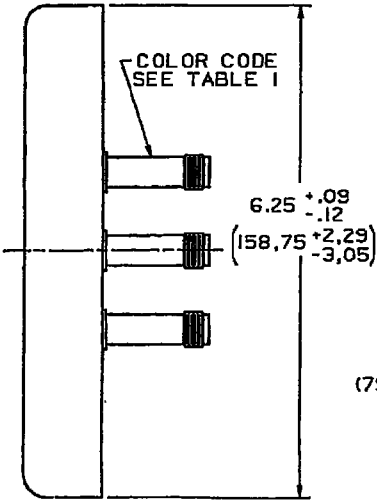
Figure 2001 (Sheet 1). ANT-81A Directional Antenna Outline Drawing

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BENDIX/KING ATAD PART OR IDENTIFYING NUMBER	MAX WEIGHT		DESCRIPTION
	LBS	KGS	
071-50001-8102	2.0	0.9	4 HOLE, FLAT, WHITE
071-50001-8105	2.0	0.9	4 HOLE, FLAT, GREY PAINT
071-50001-8106	2.0	0.9	4 HOLE, FLAT, BLUE PAINT

TABLE 1

CONNECTOR	COLOR CODE
J1	YELLOW
J2	BLACK
J3	BLUE
J4	RED



CONTOUR	A	B	C	D	E	F	G	H	J	K	L	M	N
X ±.15	5.00	4.50	4.00	3.50	3.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00
Y ±.15	0.13	2.11	2.72	3.03	3.12	3.12	3.10	3.02	2.88	2.68	2.38	1.81	0.63

O-RING NAS 1611-153
O-RING GROOVE DIMENSIONS
3.740 O.D. X .140 WIDE
3.670
X .080 DEEP
.075

071-50001 REV V

FOUR-ELEMENT ARRAY, FLAT BASE, FOUR MOUNTING SCREWS

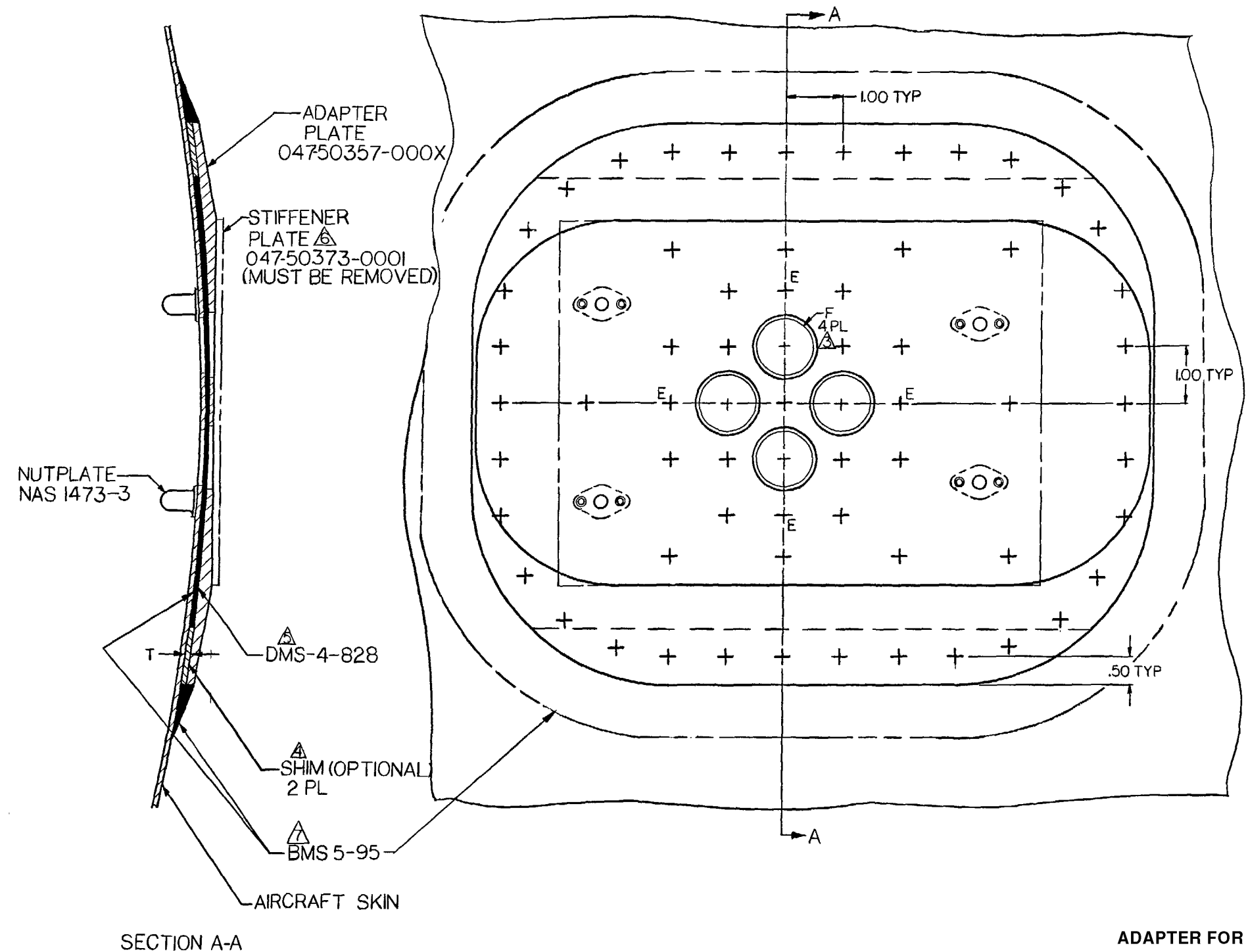
- NOTES:
- 1 - DENOTES CENTER OF GRAVITY.
 - 2 -
 - 3 - ANTENNAS TO MEET REQUIREMENTS OF SPECIFICATIONS 004-50013-0001, 0002, 0003.
 - 4 - DIMENSIONS IN PARENTHESES ARE MILLIMETERS.
 - 5 - SURFACE -C- TO BE FREE OF PAINT 4 PLACES.
 - 6 - TYPE TNC CONNECTOR FLANGES EXTERNALLY MOUNTED ON ANTENNAS SUPPLIED BY SENSOR SYSTEMS.
 - 7 WHEN INSTALLING ANTENNA ON A RADIUS SURFACE REFER TO RECOMMENDED INSTALLATION PROCEDURE 004-50119-0001.
 - 8 - RAIN EROSION FILM
 - 9 - RAIN EROSION FILM, FAR SIDE

Figure 2001 (Sheet 2). ANT-81A Directional Antenna Outline Drawing

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- NOTES:
- 1. THIS DRAWING IS NOT COMPLETE WITHOUT LATEST REVISION OF ANT-81A ADAPTER INSTALLATION PROCEDURE (P/N 004-50119-0001).
 - 2. RIVET PATTERN, DENOTED BY "+" ON DRAWING, IS SHOWN FOR REFERENCE ONLY. THE RIVET PATTERN SPECIFIED HAS BEEN CONFIGURED TO EVENLY DISTRIBUTE STRESSES CAUSED BY ADAPTER PLATE INSTALLATION.
 - △ DETERMINE AT INSTALLATION, THE SMALLEST ACCEPTABLE CONNECTOR CLEARANCE ("F" HOLES), IN AIRCRAFT SKIN.
 - △ ONE INCH WIDE EDGE GAP SHIMS. DETERMINE THICKNESS "T" AT INSTALLATION (PROCEDURE "B" ONLY).
 - △ MOLDABLE SHIM MATERIAL APPROXIMATE FILL.
 - △ STIFFENER PLATE USE WITH PROCEDURE "B" ONLY.
 - △ APPLY BMS 5-95 BETWEEN ADAPTER PLATE AND AIRCRAFT SKIN. BLEND EDGE OF ADAPTER PLATE APPROX. AS SHOWN IN SECTION A-A AROUND PERIMETER OF ADAPTER PLATE.

Figure 2001 (Sheet 4). ANT-81A Directional Antenna Outline Drawing

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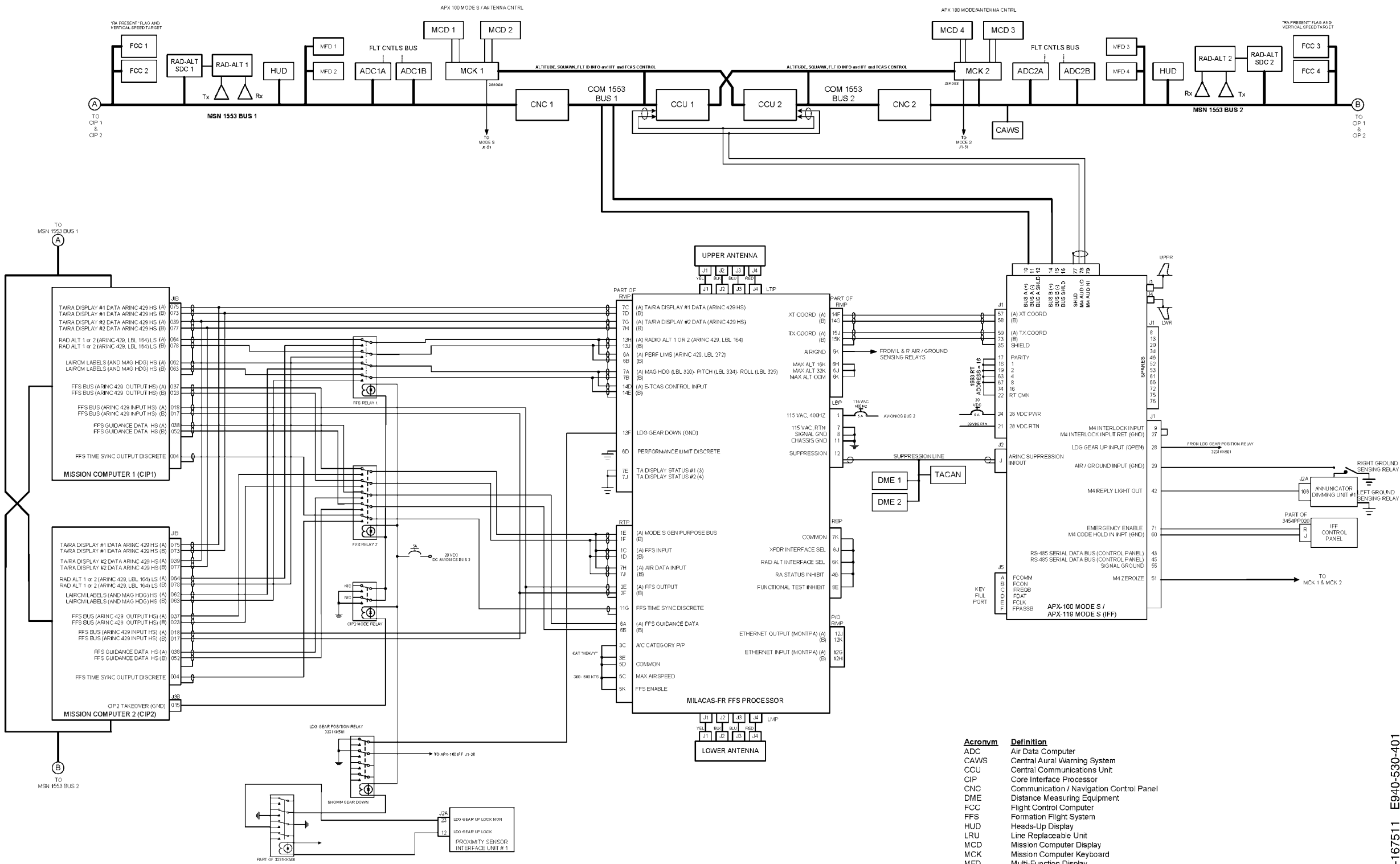
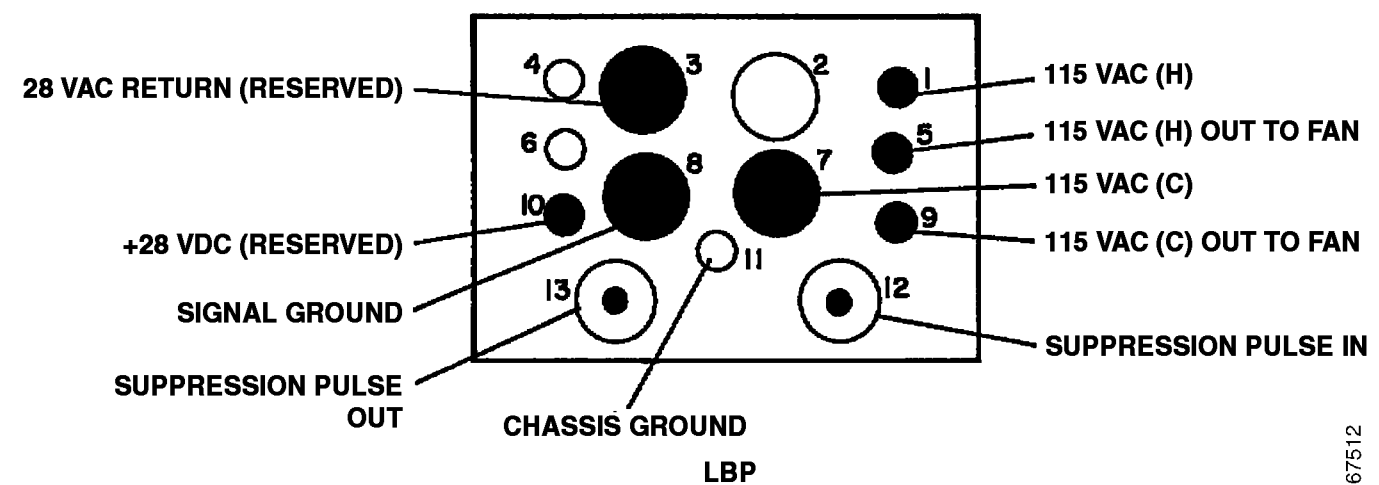


Figure 2002 (Sheet 1). MILACAS-FR System Interconnect

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	A		B	C		D	E		F	G		H	J		K
1	Reserved General Purpose A #2 LSHS A429 Input			FFS Data In HS A429 Input			Reserved FFS Gen Purpose Mode S HS A429 Input			Reserved General Purpose C #1 LSHS A429 Input			Reserved GPS Time Mark #2 (Differential)		
2	Reserved FMC/GNSS #1 LSHS A429 Input			Reserved IRS/FMS Data Con. #1 LSHS A429 Input			FFS Data Out HS A429 Output			Reserved General Purpose A #1 LSHS A429 Input			Reserved General Purpose B #2 LSHS A429 Input		
3	Reserved Hijack Mode	Reserved XPDR Fail #2		Aircraft Category Prog Pin			Reserved Acquisition Squitter Initial Prog Pin		Reserved SDI Input Prog Pin			Reserved FMC/GNSS 1/2 Select		Spare	
4	Reserved Gen. Input A #1/2 Select	Reserved Gen. Input B #1/2 Select		Reserved Gen. Input C #1/2 Select	Spare		Spare	Reserved General Purpose I/O Configuration Prog Pins							
5	Reserved Maximum Airspeed Program Pin			RTP Program Pin Common			Spare HS A429 Input		Spare HS A429 Output			Reserved Air/Gnd #2		FFS Enable	
6	Guidance Data HS A429 Input			Reserved	Reserved GPS Time Mark #1 (Differential)			Reserved	Reserved	Reserved GPS/GNSS In #1 LSHS A429 Input			Reserved Single Ant Enable		
7	Reserved Control Data "A" or FCC #1/MCP #1 / VHF LSHS A429 Input			Reserved Hijack Mode	Reserved Control Port Select	Reserved Control Data In LSHS A429 Input		Reserved Standby On	Reserved Digital Air Data #1 LSHS A429 Input			Reserved FCC/MCP #2			
8	Reserved ICAO 24 Prog Pin														
9	Bit Address														
10	ICAO Program Pin		Reserved FCC #1/MCP #1 / VHF #3 LSHS A429 Input		Reserved Functional Test		Reserved	Reserved XPDR Fail #1							
11	Reserved IRS/FMS Data Con. #2 LSHS A429 Input		Reserved FMC/GNSS #2 LSHS A429 Input		Reserved GPS/GNSS In #2 LSHS A429 Input		Time Sync								
12	Reserved Digital Air Data #2 LSHS A429 Input		XPDR Maint Data LSHS A429 Output		Reserved MSP/ATSU/CMU Out #1 LSHS A429 Output		Reserved Ext Squitter Disable	Reserved Rst, Mode S DUOLP							
13	8 SPARES														
14															
15															

	A	B	C	D	E	F	G	H	J	K
1	Reserved 1 o Disc Out	Reserved o Disc Out	Reserved 3 o Disc Out	Reserved 4 o Disc Out	TA Display Enable o Disc Out	Aural Advisory (Corrective) o Disc Out	Reserved 5 o Disc Out	Reserved 6 o Disc Out	Climb Inhibit #1 o Disc In	Aural Advisory (Preventative) o Disc Out
2	Aural Advisory (Traffic Alert) o Disc Out	Spare		Advisory/ Announce Common o Ground	Spare	TCAS Audio Output (8 ohms) Ohms o H o L		Reserved Radio Altimeter #1 (ARINC 552/552A) o + o -		Reserved Radio Alt #1 AS52/AS52A Valid o Disc In
3	Visual Annunciator (Corrective) o Disc Out	Visual Annunciator (Preventative) o Disc Out	Visual Annunciator (Traffic Alert) o Disc Out	Advisory/ Annunciator Cancel o Disc In	o o H	TCAS Audio Output (600 ohms) o H o L		Spare		Reserved 1 o Disc In
4	Spare									o o Disc In
5	o o Disc In		Reserved o Disc In		ADS - B (Intruder File Enable) o Prog Pin	Reserved GPBus Enable o Prog Pin	Reserved ADS - B o Prog Pin	o o Disc In		
6	Performance Limit LSHS A429 Input o A o B		Spare o Disc In	Performance Limit o Disc In	Altitude Limit Program Pin o 2000 ft o 4000 ft o 8000 ft o 16000 ft o 32000 ft o Common					
7	MAG Heading/Altitude LSHS A429 Input o A o B		TA/RA Display #1 HS A429 Output o A o B		Reserved o Disc In	Spare o	TA/RA Display #2 HS A429 Output o A o B		Reserved o Disc In	Spare o
8	Data Loader HS A429 Input o A o B		Reserved TA/RA Display Control #1 LS A429 Input o A o B		Reserved General Purpose F #1 LSHS A429 Input o A o B		Reserved TA/RA Display Control #2 LS A429 Input o A o B		Reserved General Purpose F #2 LSHS A429 Input o A o B	
9	Data Loader HS A429 Output o A o B		Spare Data Bus Output 1 LSHS A429 Output o A o B		Spare Data Bus Output 2 LSHS A429 Output o A o B		Reserved General Purpose D #1 LSHS A429 Output o A o B		Reserved General Purpose D #2 LSHS A429 Output o A o B	
10	Enable Factory Functions o Disc In	Reserved o Disc In	Reserved o Disc In	Spare o Disc In o Disc In o Disc In o Disc In o Disc In o Disc In						
11	Spare o Disc In	Reserved RMP o Common	Spare User Defined o o o o o o o o							
12	Reserved Radio Altimeter Type Straps Prog Pins o A o B			Reserved IRS/ADIRS #1/#2 Select o Disc In	Spare User Defined o o		A615 A Data Load Input Ethernet o A o B		A615 A Data Load Output Ethernet o A o B	
13	RA Display #1 LS A429 Output o A o B		RA Display #2 LS A429 Output o A o B		RA Display #2 Status o Disc In	Landing Gear o Disc In	Climb Inhibit #2 o Disc In	Radio Altitude #1 LS A429 Input o A o B		TCAS System Status o Disc Out
14	TX Coordination #2 HS A429 Output o A o B		RA Display #1 Status o Disc In	E - TCAS Control/Selected Altitude LS A429 Input o A o B		XT Coordination #1 HS A429 Input o A o B		XT Coordination #2 HS A429 Input o A o B		Reserved o Disc In
15	Reserved EGPWC to TCAS HS A429 Input o A o B		Reserved WXR to TCAS HS A429 Input o A o B		Reserved TCAS to EGPWC HS A429 Output o A o B		Reserved TCAS to WXR HS A429 Output o A o B		TX Coordination #1 HS A429 Output o A o B	

Figure 2002 (Sheet 3). MILACAS-FR System Interconnect

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	A	B	C	D	E	F	G	H	J	K
1	Spare							Reserved 8	Reserved 9	Reserved 10
	o	o	o	o	o	o	o	o Disc Out	o Disc Out	o Disc Out
2	Spare							Reserved 11	Reserved 12	Reserved 13
	o Prog Pin	o Prog Pin	o Prog Pin	o Prog Pin	o Prog Pin	o Prog Pin	o Prog Pin	o Disc Out	o Disc Out	o Disc Out
3	Reserved Radio Altitude #2 ARINC 552/552A		Reserved Radio Alt #2 A552/A552A Valid	Radio Altitude #2 LS A429 Input		Spare	Reserved A/C Reset	Spare		
	o +	o -	o Disc In	o A	o B	o	o Disc In	o Disc Out	o Disc Out	o Disc Out
4	Alternate Voice Audio Enable	Spare	Aural Label 057 Enable	E-TCAS Select	Reserved Discrete Input	Reserved Discrete Input	RA Valid Discrete Disable	Spare		
	o Disc In	o	o Disc In	o Prog Pin	o Disc In	o Disc In	o Prog Pin	o Disc Out	o Disc Out	o Disc Out
5	Advisory Inhibit Discrete Input				Increase Climb Inhibit Discrete Input				Climb Inhibit Discrete Input	
	o 1	o 2	o 3	o 4	o 1	o 2	o 3	o 4	o #3	o #4
6	Data Loader Enable	Spare		Reserved	TCAS Maintenance Data LS A429 Output		Maintenance Data LS A429 Input		Single Transponder	Single Radio Altimeter
	o Disc In	o Disc In	o Disc In	o Disc In	o A	o B	o A	o B	o Prog Pin	o Prog Pin
7	Airborne Audio Level Program Pin			Aural Advisory Discrete	Ground Display Mode	Display All Traffic/Threat Traffic	Cable Delay Program Pin			RBP Program Pin Common
	o #1	o #2	o #3	o Prog Pin	o Prog Pin	o Prog Pin	o Sign	o MSB	o LSB	o Common
8	On Ground Audio Level Program Pin			Spare	Self Test Inhibit	TA/RA Display Intruder Limit Program Pin				
	o #1	o #2	o #3	o	o Prog Pin	o 16	o 8	o 4	o 2	o 1
9	ATE Discrete Output									
	o D0	o D1	o D2	o D3	o D4	o D5	o D6	o D7	o CK	o Log Video
10	ATE Discrete Output									
	o A0	o A1	o A2	o R1	o R2	o R3	o R4	o R5	o R6	o Common

Figure 2002 (Sheet 4). MILACAS-FR System Interconnect

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Table 2002. MILACAS-FR Processor Pin-outs

Pin	Port	Data Type	Function	Source	Destination
LBP1	Power	Power/Gnd	115 VAC Primary Power Hot	Shelf	TCAS
LBP2	Spare	Power/Gnd	Spare	n/a	n/a
LBP3	Power	Power/Gnd	+28 VDC Return	Shelf	FFS
LBP4	Spare	Power/Gnd	Spare	n/a	n/a
LBP5	Power	Power/Gnd	115 VAC (H) Output to Fan	Shelf	TCAS
LBP6	Spare	Power/Gnd	Spare	n/a	n/a
LBP7	Power	Power/Gnd	115 VAC Primary Cold	Shelf	TCAS
LBP8	Signal Ground	Ground	Signal Ground	Shelf	FFS
LBP9	Power	Power/Gnd	115 VAC (C) Output to Fan	Shelf	TCAS
LBP10	Power	Power/Gnd	+28 VDC Primary Power	Shelf	FFS
LBP11	Power	Power/Gnd	Chassis Ground	Shelf	FFS
LBP12	Suppression Pulse I/O	Suppression	Suppression Pulse I/O	TCAS, XPDR - Internal, FFS	L-Band units
LBP13	Suppression Pulse I/O	Suppression	Suppression Pulse I/O	TCAS, XPDR - Internal, FFS	L-Band units
LMP1	Bottom Antenna	RF	Bottom Antenna, J1	Antenna	FFS
LMP2	Bottom Antenna	RF	Bottom Antenna, J2	Antenna	FFS
LMP3	Bottom Antenna	RF	Bottom Antenna, J3	Antenna	FFS
LMP4	Bottom Antenna	RF	Bottom Antenna, J4	Antenna	FFS
LTP1	Top Antenna	RF	Top Antenna, J1	Antenna	FFS
LTP2	Top Antenna	RF	Top Antenna, J2	Antenna	FFS
LTP3	Top Antenna	RF	Top Antenna, J3	Antenna	FFS
LTP4	Top Antenna	RF	Top Antenna, J4	Antenna	FFS
RBP1A	Spare	Spare	Spare	n/a	n/a
RBP1B	Spare	Spare	Spare	n/a	n/a
RBP1C	Spare	Spare	Spare	n/a	n/a
RBP1D	Spare	Spare	Spare	n/a	n/a
RBP1E	Spare	Spare	Spare	n/a	n/a
RBP1F	Spare	Spare	Spare	n/a	n/a

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RBP1G	Spare	Spare	Spare	n/a	n/a
RBP1H	Reserved Discrete Output 8	Reserve	Reserved Discrete Output 8	n/a	n/a
RBP1J	Reserved Discrete Output 9	Reserve	Reserved Discrete Output 9	n/a	n/a
RBP1K	Reserved Discrete Output 10	Reserve	Reserved Discrete Output 10	n/a	n/a
RBP2A	Spare	Prog Pin	Spare	n/a	n/a
RBP2B	Spare	Prog Pin	Spare	n/a	n/a
RBP2C	Spare	Prog Pin	Spare	n/a	n/a
RBP2D	Spare	Prog Pin	Spare	n/a	n/a
RBP2E	Spare	Prog Pin	Spare	n/a	n/a
RBP2F	Spare	Prog Pin	Spare	n/a	n/a
RBP2G	Spare	Prog Pin	Spare	n/a	n/a
RBP2H	Reserved Discrete Output 11	Reserve	Reserved Discrete Output 11	n/a	n/a
RBP2J	Reserved Discrete Output 12	Reserve	Reserved Discrete Output 12	n/a	n/a
RBP2K	Reserved Discrete Output 13	Reserve	Reserved Discrete Output 13	n/a	n/a
RBP3A	Radio Altimeter No. 2 ARINC 552/552A	Reserve	Reserved - Radio Altimeter No. 2 ARINC 552/552A +	Radio Alt No. 2	TCAS
RBP3B	Radio Altimeter No. 2 ARINC 552/552A	Reserve	Reserved - Radio Altimeter No. 2 ARINC 552/552A -	Radio Alt No. 2	TCAS
RBP3C	Radio Altitude No. 2 A552/A552A Valid Discrete Input	Reserve	Reserved - Radio Altitude No. 2 A552/A552A Valid Discrete Input	Radio Alt No. 2	TCAS
RBP3D	Radio Altitude No. 2 - A429 Input	LS 429 In	Radio Altitude No. 2 - A429 Input A	Radio Alt No. 2	TCAS
RBP3E	Radio Altitude No. 2 - A429 Input	LS 429 In	Radio Altitude No. 2 - A429 Input B	Radio Alt No. 2	TCAS
RBP3F	Spare	Spare	Spare	n/a	n/a
RBP3G	Reserved A/C Reset Discrete In	Reserve	Reserved A/C Reset Discrete In	n/a	n/a
RBP3H	Spare	Disc Out	Spare	n/a	n/a
RBP3J	Spare	Disc Out	Spare	n/a	n/a

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RBP3K	Spare	Disc Out	Spare	n/a	n/a
RBP4A	Alternate Voice Audio Enable Discrete Input	Disc In	Alternate Voice Audio Enable Discrete Input	Aircraft	TCAS
RBP4B	Spare	Spare	Spare	n/a	n/a
RBP4C	Aural Annunciations Label 057 Enable Discrete Input	Disc In	Aural Annunciations Label 057 Enable Discrete Input	Aircraft	TCAS
RBP4D	TCAS Select Program Pin	Prog Pin	TCAS Select Program Pin	Aircraft	TCAS
RBP4E	Reserved Discrete Input	Reserve	Reserved Discrete Input	n/a	n/a
RBP4F	Reserved Discrete Input	Reserve	Reserved Discrete Input	n/a	n/a
RBP4G	RA Valid Discrete Disable Program Pin	Prog Pin	RA Valid Discrete Disable Program Pin	RBP7K	TCAS
RBP4H	Spare	Disc Out	Spare	TCAS	n/a
RBP4J	Spare	Disc Out	Spare	TCAS	n/a
RBP4K	Spare	Disc Out	Spare	TCAS	n/a
RBP5A	Advisory Inhibit Discrete Input	Disc In	Advisory Inhibit Discrete Input 1	Aircraft system	TCAS
RBP5B	Advisory Inhibit Discrete Input	Disc In	Advisory Inhibit Discrete Input 2	Aircraft system	TCAS
RBP5C	Advisory Inhibit Discrete Input	Disc In	Advisory Inhibit Discrete Input 3	Aircraft system	TCAS
RBP5D	Advisory Inhibit Discrete Input	Disc In	Advisory Inhibit Discrete Input 4	Aircraft system	TCAS
RBP5E	Increase Climb Inhibit Discrete Input	Disc In	Increase Climb Inhibit Discrete Input 1	Aircraft system	TCAS
RBP5F	Increase Climb Inhibit Discrete Input	Disc In	Increase Climb Inhibit Discrete Input 2	Aircraft system	TCAS
RBP5G	Increase Climb Inhibit Discrete Input	Disc In	Increase Climb Inhibit Discrete Input 3	Aircraft system	TCAS
RBP5H	Increase Climb Inhibit Discrete Input	Disc In	Increase Climb Inhibit Discrete Input 4	Aircraft system	TCAS
RBP5J	Climb Inhibit Discrete Input	Disc In	Climb Inhibit No. 3 Discrete Input	Aircraft system	TCAS
RBP5K	Climb Inhibit Discrete Input	Disc In	Climb Inhibit No. 4 Discrete Input	Aircraft system	TCAS
RBP6A	Data Loader Enable Discrete Input	Disc In	Data Loader Enable Discrete Input	Data Loader	TCAS

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RBP6B	Spare	Disc In	Spare	n/a	n/a
RBP6C	Spare	Disc In	Spare	n/a	n/a
RBP6D	Reserved Discrete Input	Reserve	Reserved Discrete Input	n/a	n/a
RBP6E	TCAS Maintenance Data - A429 Output	LS 429 Out	TCAS Maintenance Data - A429 Output A	TCAS	CFDS
RBP6F	TCAS Maintenance Data - A429 Output	LS 429 Out	TCAS Maintenance Data - A429 Output B	TCAS	CFDS
RBP6G	Maintenance Data - A429 Input	LS 429 In	Maintenance Data - A429 Input A	CFDS	TCAS, XPDR - Internal
RBP6H	Maintenance Data - A429 Input	LS 429 In	Maintenance Data - A429 Input B	CFDS	TCAS, XPDR - Internal
RBP6J	Single Transponder Program Pin	Prog Pin	Single Transponder Program Pin	RBP7K	TCAS
RBP6K	Single Radio Altimeter Program Pin	Prog Pin	Single Radio Altimeter Program Pin	RBP7K	TCAS
RBP7A	Airborne Audio Level Program Pin	Prog Pin	Airborne Audio Level Program Pin No. 1	RBP7K	TCAS
RBP7B	Airborne Audio Level Program Pin	Prog Pin	Airborne Audio Level Program Pin No. 2	RBP7K	TCAS
RBP7C	Airborne Audio Level Program Pin	Prog Pin	Airborne Audio Level Program Pin No. 3	RBP7K	TCAS
RBP7D	Aural Advisory Discrete Program Pin	Prog Pin	Aural Advisory Discrete Program Pin	RBP7K	TCAS
RBP7E	Ground Display Mode Program Pin	Prog Pin	Ground Display Mode Program Pin	RBP7K	TCAS
RBP7F	Display All Traffic/Threat Traffic Program Pin	Prog Pin	Display All Traffic/Threat Traffic Program Pin	RBP7K	TCAS
RBP7G	Cable Delay Program Pin	Prog Pin	Cable Delay Program Pin - Sign	RBP7K	TCAS, XPDR - Internal
RBP7H	Cable Delay Program Pin	Prog Pin	Cable Delay Program Pin - MSB	RBP7K	TCAS, XPDR - Internal
RBP7J	Cable Delay Program Pin	Prog Pin	Cable Delay Program Pin - LSB	RBP7K	TCAS, XPDR - Internal
RBP7K	RBP Program Pin Common	Prog Pin	RBP Program Pin Common	TCAS	Prog Pins
RBP8A	On Ground Audio Level Program Pin	Prog Pin	On Ground Audio Level Program Pin No. 1	RBP7K	TCAS

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RBP8B	On Ground Audio Level Program Pin	Prog Pin	On Ground Audio Level Program Pin No. 2	RBP7K	TCAS
RBP8C	On Ground Audio Level Program Pin	Prog Pin	On Ground Audio Level Program Pin No. 3	RBP7K	TCAS
RBP8D	Spare	Spare	Spare	n/a	n/a
RBP8E	Self Test Inhibit Program Pin	Prog Pin	Self Test Inhibit Program Pin	RBP7K	TCAS
RBP8F	TA/RA Display Intruder Limit Program Pin	Prog Pin	TA/RA Display Intruder Limit 16 Program Pin	RBP7K	TCAS
RBP8G	TA/RA Display Intruder Limit Program Pin	Prog Pin	TA/RA Display Intruder Limit 8 Program Pin	RBP7K	TCAS
RBP8H	TA/RA Display Intruder Limit Program Pin	Prog Pin	TA/RA Display Intruder Limit 4 Program Pin	RBP7K	TCAS
RBP8J	TA/RA Display Intruder Limit Program Pin	Prog Pin	TA/RA Display Intruder Limit 2 Program Pin	RBP7K	TCAS
RBP8K	TA/RA Display Intruder Limit Program Pin	Prog Pin	TA/RA Display Intruder Limit 1 Program Pin	RBP7K	TCAS
RBP9A	ATE Output	Disc Out	ATE D0 Discrete Output	TCAS	ATE
RBP9B	ATE Output	Disc Out	ATE D1 Discrete Output	TCAS	ATE
RBP9C	ATE Output	Disc Out	ATE D2 Discrete Output	TCAS	ATE
RBP9D	ATE Output	Disc Out	ATE D3 Discrete Output	TCAS	ATE
RBP9E	ATE Output	Disc Out	ATE D4 Discrete Output	TCAS	ATE
RBP9F	ATE Output	Disc Out	ATE D5 Discrete Output	TCAS	ATE
RBP9G	ATE Output	Disc Out	ATE D6 Discrete Output	TCAS	ATE
RBP9H	ATE Output	Disc Out	ATE D7 Discrete Output	TCAS	ATE
RBP9J	ATE Output	Disc Out	ATE CK Discrete Output	TCAS	ATE
RBP9K	ATE Output	Disc Out	ATE Log Video Discrete Output	TCAS	ATE
RBP10A	ATE Output	Disc Out	ATE A0 Discrete Output	TCAS	ATE
RBP10B	ATE Output	Disc Out	ATE A1 Discrete Output	TCAS	ATE
RBP10C	ATE Output	Disc Out	ATE A2 Discrete Output	TCAS	ATE
RBP10D	ATE Output	Disc Out	ATE R1 Discrete Output	TCAS	ATE
RBP10E	ATE Output	Disc Out	ATE R2 Discrete Output	TCAS	ATE
RBP10F	ATE Output	Disc Out	ATE R3 Discrete Output	TCAS	ATE
RBP10G	ATE Output	Disc Out	ATE R4 Discrete Output	TCAS	ATE

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RBP10H	ATE Output	Disc Out	ATE R5 Discrete Output	TCAS	ATE
RBP10J	ATE Output	Disc Out	ATE R6 Discrete Output	TCAS	ATE
RBP10K	ATE Output	Disc Out	ATE Common	TCAS	ATE
RMP1A	Reserved Discrete Output	Reserve	Reserved Discrete Output 1	n/a	n/a
RMP1B	Reserved Discrete Output	Reserve	Reserved Discrete Output 2	n/a	n/a
RMP1C	Reserved Discrete Output	Reserve	Reserved Discrete Output 3	n/a	n/a
RMP1D	Reserved Discrete Output	Reserve	Reserved Discrete Output 4	n/a	n/a
RMP1E	TA Display Enable Discrete Output	Disc Out	TA Display Enable Discrete Output	TCAS	PPI or TA display
RMP1F	Aural Advisory Discrete Output	Disc Out	Aural Advisory (Corrective) Discrete Output	TCAS	Aural Warning System
RMP1G	Reserved Discrete Output	Reserve	Reserved Discrete Output 5	n/a	n/a
RMP1H	Reserved Discrete Output	Reserve	Reserved Discrete Output 6	n/a	n/a
RMP1J	Climb Inhibit Discrete Input	Disc In	Climb Inhibit No. 1 Discrete Input	Aircraft system	TCAS
RMP1K	Aural Advisory Discrete Output	Disc Out	Aural Advisory (Preventative) Discrete Output	TCAS	Warning System
RMP2A	Aural Advisory Discrete Output	Disc Out	Aural Advisory (Traffic Alert) Discrete Output	TCAS	Warning System
RMP2B	Spare	Spare	Spare	n/a	n/a
RMP2C	Spare	Spare	Spare	n/a	n/a
RMP2D	Advisory/Announce Common	Prog Pin	Advisory/Announce Common	TCAS	Prog Pins
RMP2E	Spare	Spare	Spare	n/a	n/a
RMP2F	TCAS Audio Output (8 ohms)	Audio	TCAS Audio Output (8 ohms) (H)	TCAS	speaker
RMP2G	TCAS Audio Output (8 ohms)	Audio	TCAS Audio Output (8 ohms) (L)	TCAS	speaker
RMP2H	Radio Altimeter No. 1 ARINC 552/552A	Reserve	Reserved - Radio Altimeter No. 1 ARINC 552/552A +	Radio Alt No. 1	TCAS
RMP2J	Radio Altimeter No. 1 ARINC 552/552A	Reserve	Reserved - Radio Altimeter No. 1 ARINC 552/552A -	Radio Alt No. 1	TCAS
RMP2K	Radio Altitude No. 1 A552/552A Valid Discrete Input	Reserve	Reserved - Radio Altitude No. 1 A552/552A Valid Discrete Input	Radio Alt No. 1	TCAS

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RMP3A	Visual Annunciator Discrete Output	Disc Out	Visual Annunciator (Corrective) Discrete Output	n/a	n/a
RMP3B	Visual Annunciator Discrete Output	Disc Out	Visual Annunciator (Preventative) Discrete Output	n/a	n/a
RMP3C	Visual Annunciator Discrete Output	Disc Out	Visual Annunciator (Traffic Alert) Discrete Output	n/a	n/a
RMP3D	Advisory/Annunciator Cancel Discrete Input	Disc In	Advisory/Annunciator Cancel Discrete Input	Aircraft system	TCAS
RMP3E	Spare	Spare	Spare	n/a	n/a
RMP3F	TCAS Audio Output (600 ohms)	Audio	TCAS Audio Output (600 ohms) (H)	TCAS	phone
RMP3G	TCAS Audio Output (600 ohms)	Audio	TCAS Audio Output (600 ohms) (L)	TCAS	phone
RMP3H	Spare	Spare	Spare	n/a	n/a
RMP3J	Spare	Spare	Spare	n/a	n/a
RMP3K	Reserved Discrete Input	Reserve	Reserved Discrete Input	n/a	n/a
RMP4A	Spare	Synchro	Spare	n/a	n/a
RMP4B	Spare	Synchro	Spare	n/a	n/a
RMP4C	Spare	Synchro	Spare	n/a	n/a
RMP4D	Spare	Synchro	Spare	n/a	n/a
RMP4E	Spare	Synchro	Spare	n/a	n/a
RMP4F	Spare	Synchro	Spare	n/a	n/a
RMP4G	Spare	Synchro	Spare	n/a	n/a
RMP4H	Spare	Synchro	Spare	n/a	n/a
RMP4J	Spare	Synchro	Spare	n/a	n/a
RMP4K	Spare	Disc In	Spare	n/a	n/a
RMP5A	Spare	Synchro	Spare	n/a	n/a
RMP5B	Spare	Synchro	Spare	n/a	n/a
RMP5C	Spare	Synchro	Spare	n/a	n/a
RMP5D	Reserved Discrete Input	Disc In	Reserved Discrete Input	n/a	XPDR - Internal
RMP5E	ADS-B Program Pin	Prog Pin	ADS-B (Intruder File Enable) Program Pin	RMP11B	TCAS

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RMP5F	Reserved GP Bus Enable Program Pin	Reserve	Reserved GP Bus Enable Program Pin	RMP11B	TCAS
RMP5G	Reserved ADS-B Program Pin	Reserve	Reserved ADS-B Program Pin	RMP11B	TCAS
RMP5H	Spare	Synchro	Spare	n/a	n/a
RMP5J	Spare	Synchro	Spare	n/a	n/a
RMP5K	Air/Ground Discrete Input	Disc In	Air/Ground No. 1 Discrete Input	Air/ground relay	TCAS, XPDR - Internal
RMP6A	Performance Limit - A429 Input	LS 429 In	Performance Limit - A429 Input A	FMC	TCAS
RMP6B	Performance Limit - A429 Input	LS 429 In	Performance Limit - A429 Input B	FMC	TCAS
RMP6C	Spare	Disc In	Spare	n/a	n/a
RMP6D	Performance Limit Discrete Input	Disc In	Performance Limit Discrete Input	Performance source (FMC)	TCAS
RMP6E	Altitude Limit Program Pin	Prog Pin	Altitude Limit Program Pin 2000ft	RMP6K	TCAS
RMP6F	Altitude Limit Program Pin	Prog Pin	Altitude Limit Program Pin 4000ft	RMP6K	TCAS
RMP6G	Altitude Limit Program Pin	Prog Pin	Altitude Limit Program Pin 8000ft	RMP6K	TCAS
RMP6H	Altitude Limit Program Pin	Prog Pin	Altitude Limit Program Pin 16000ft	RMP6K	TCAS
RMP6J	Altitude Limit Program Pin	Prog Pin	Altitude Limit Program Pin 32000ft	RMP6K	TCAS
RMP6K	Altitude Limit Program Pin	Prog Pin	Altitude Limit Program Pin Common	TCAS	TCAS
RMP7A	Mag Heading/Attitude - A429 Input	LS/HS 429 In	Mag Heading/Attitude - A429 Input A	Mission Computer	TCAS
RMP7B	Mag Heading/Attitude - A429 Input	LS/HS 429 In	Mag Heading/Attitude - A429 Input B	Mission Computer	TCAS
RMP7C	TA/RA Display No. 1 - A429 Output	HS 429 Out	TA/RA Display No. 1 - A429 Output A	TCAS	TA/RA disp No. 1
RMP7D	TA/RA Display No. 1 - A429 Output	HS 429 Out	TA/RA Display No. 1 - A429 Output B	TCAS	TA/RA disp No. 1
RMP7E	TA Display Status Discrete Input	Disc In	TA Display No. 1 Status Discrete Input	TA disp No. 1	TCAS

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RMP7F	Spare	Spare	Spare	n/a	n/a
RMP7G	TA/RA Display No. 2 - A429 Output	HS 429 Out	TA/RA Display No. 2 - A429 Output A	TCAS	TA/RA disp No. 2
RMP7H	TA/RA Display No. 2 - A429 Output	HS 429 Out	TA/RA Display No. 2 - A429 Output B	TCAS	TA/RA disp No. 2
RMP7J	TA Display Status Discrete Input	Disc In	TA Display No. 2 Status Discrete Input	TA disp No. 2	TCAS
RMP7K	Spare	Spare	Spare	n/a	n/a
RMP8A	Data Loader - A429 Input	HS 429 In	Data Loader - A429 Input A	Data Loader	TCAS, XPDR - Internal
RMP8B	Data Loader - A429 Input	HS 429 In	Data Loader - A429 Input B	Data Loader	TCAS, XPDR - Internal
RMP8C	Reserved TA/RA Display Control No. 1 - A429 Input	Reserve	Reserved TA/RA Display Control No. 1 - A429 Input A	TA/RA disp No. 1	TCAS
RMP8D	Reserved TA/RA Display Control No. 1 - A429 Input	Reserve	Reserved TA/RA Display Control No. 1 - A429 Input B	TA/RA disp No. 1	TCAS
RMP8E	Reserved General Purpose F No. 1 - A429 Input	Reserve	Reserved General Purpose F No. 1 - A429 Input A	ADS-B LRU	TCAS
RMP8F	Reserved General Purpose F No. 1 - A429 Input	Reserve	Reserved General Purpose F No. 1 - A429 Input B	ADS-B LRU	TCAS
RMP8G	Reserved TA/RA Display Control No. 2 - A429 Input	Reserve	Reserved TA/RA Display Control No. 2 - A429 Input A	TA/RA disp No. 2	TCAS
RMP8H	Reserved TA/RA Display Control No. 2 - A429 Input	Reserve	Reserved TA/RA Display Control No. 2 - A429 Input B	TA/RA disp No. 2	TCAS
RMP8J	Reserved General Purpose F No. 2 - A429 Input	Reserve	Reserved General Purpose F No. 2 - A429 Input A	ADS-B LRU	TCAS
RMP8K	Reserved General Purpose F No. 2 - A429 Input	Reserve	Reserved General Purpose F No. 2 - A429 Input B	ADS-B LRU	TCAS
RMP9A	Data Loader - A429 Output	HS 429 Out	Data Loader - A429 Output A	TCAS, XPDR	Data Loader
RMP9B	Data Loader - A429 Output	HS 429 Out	Data Loader - A429 Output B	TCAS, XPDR	Data Loader
RMP9C	Spare Data Bus Output 1 - A429 Output	HS 429 Out	Spare Data Bus Output 1 - A429 Output A	TCAS	n/a
RMP9D	Spare Data Bus Output 1 - A429 Output	HS 429 Out	Spare Data Bus Output 1 - A429 Output B	TCAS	n/a
RMP9E	Spare Data Bus Output 2 - A429 Output	HS 429 Out	Spare Data Bus Output 2 - A429 Output A	TCAS	n/a

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RMP9F	Spare Data Bus Output 2 - A429 Output	HS 429 Out	Spare Data Bus Output 2 - A429 Output B	TCAS	n/a
RMP9G	Reserved General Purpose D No. 1 - A429 Output	Reserve	Reserved General Purpose D No. 1 - A429 Output A	TCAS	n/a
RMP9H	Reserved General Purpose D No. 1 - A429 Output	Reserve	Reserved General Purpose D No. 1 - A429 Output B	TCAS	n/a
RMP9J	Reserved General Purpose D No. 2 - A429 Output	Reserve	Reserved General Purpose D No. 2 - A429 Output A	TCAS	n/a
RMP9K	Reserved General Purpose D No. 2 - A429 Output	Reserve	Reserved General Purpose D No. 2 - A429 Output B	TCAS	n/a
RMP10A	Reserved Discrete Input	Reserve	Reserved Discrete Input	n/a	TCAS
RMP10B	Reserved Discrete Input	Reserve	Reserved Discrete Input	n/a	n/a
RMP10C	Reserved Discrete Input	Reserve	Reserved Discrete Input	n/a	n/a
RMP10D	Spare	Disc In	Spare	n/a	n/a
RMP10E	Spare	Disc In	Spare	n/a	n/a
RMP10F	Spare	Disc In	Spare	n/a	n/a
RMP10G	Spare	Disc In	Spare	n/a	n/a
RMP10H	Spare	Disc In	Spare	n/a	n/a
RMP10J	Spare	Disc In	Spare	n/a	n/a
RMP10K	Spare	Disc In	Spare	n/a	n/a
RMP11A	Spare	Spare	Spare	n/a	n/a
RMP11B	RMP Prog Pin Common	Prog Pin	RMP Prog Pin Common	TCAS	n/a
RMP11C	Spare	Spare	Spare	n/a	n/a
RMP11D	Spare	Spare	Spare	n/a	n/a
RMP11E	Spare	Spare	Spare	n/a	n/a
RMP11F	Spare	Spare	Spare	n/a	n/a
RMP11G	Spare	Spare	Spare	n/a	n/a
RMP11H	Spare	Spare	Spare	n/a	n/a
RMP11J	Spare	Spare	Spare	n/a	n/a
RMP11K	Spare	Spare	Spare	n/a	n/a

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RMP12A	Radio Altimeter Type Strap Program Pin	Reserve	Reserved - Radio Altimeter Type Strap Program Pin A	RMP11B	TCAS
RMP12B	Radio Altimeter Type Strap Program Pin	Reserve	Reserved - Radio Altimeter Type Strap Program Pin B	RMP11B	TCAS
RMP12C	Radio Altimeter Type Strap Program Pin	Reserve	Reserved - Radio Altimeter Type Strap Program Pin C	RMP11B	TCAS
RMP12D	Reserved IRS/ADIRS No. 1/No. 2 Select Discrete Input	Reserve	Reserved IRS/ADIRS No. 1/No. 2 Select Discrete Input	n/a	n/a
RMP12E	Spare	Spare	Spare	n/a	n/a
RMP12F	Spare	Spare	Spare	n/a	n/a
RMP12G	A615-A Data Load Input	Ethernet	A615-A Data Load Input A	615-A Data Loader	TCAS
RMP12H	A615-A Data Load Input	Ethernet	A615-A Data Load Input B	615-A Data Loader	TCAS
RMP12J	A615-A Data Load Output	Ethernet	A615-A Data Load Output A	TCAS	Data Loader
RMP12K	A615-A Data Load Output	Ethernet	A615-A Data Load Output B	TCAS	Data Loader
RMP13A	RA Display No. 1 - A429 Output	LS 429 Out	RA Display No. 1 - A429 Output A	TCAS	RA Display No. 1, FDR
RMP13B	RA Display No. 1 - A429 Output	LS 429 Out	RA Display No. 1 - A429 Output B	TCAS	RA Display No. 1, FDR
RMP13C	RA Display No. 2 - A429 Output	LS 429 Out	RA Display No. 2 - A429 Output A	TCAS	RA Display No. 2, FDR
RMP13D	RA Display No. 2 - A429 Output	LS 429 Out	RA Display No. 2 - A429 Output B	TCAS	RA Display No. 2, FDR
RMP13E	RA Display No. 2 Status Discrete Input	Disc In	RA Display No. 2 Status Discrete Input	RA disp No. 2	TCAS
RMP13F	Landing Gear Discrete Input	Disc In	Landing Gear Discrete Input	Landing gear relay	TCAS
RMP13G	Climb Inhibit No. 2 Discrete Input	Disc In	Climb Inhibit No. 2 Discrete Input	Aircraft system	TCAS
RMP13H	Radio Altitude No. 1 - A429 Input	LS 429 In	Radio Altitude No. 1 - A429 Input A	Radio Alt No. 1	TCAS
RMP13J	Radio Altitude No. 1 - A429 Input	LS 429 In	Radio Altitude No. 1 - A429 Input B	Radio Alt No. 1	TCAS
RMP13K	TCAS System Status Discrete Output	Disc Out	TCAS System Status Discrete Output	TCAS	system monitoring TCAS

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RMP14A	TX Coordination No. 2 - A429 Output	HS 429 Out	TX Coordination No. 2 - Output A	TCAS	XPDR
RMP14B	TX Coordination No. 2 - A429 Output	HS 429 Out	TX Coordination No. 2 - Output B	TCAS	XPDR
RMP14C	RA Display No. 1 Status Discrete Input	Disc In	RA Display No. 1 Status Discrete Input	RA disp No. 1	TCAS
RMP14D	ETCAS Control/Selected Altitude - A429 Input	HS 429 In	ETCAS Control/Selected Altitude - A429 Input A	ETCAS controller	TCAS
RMP14E	ETCAS Control/Selected Altitude - A429 Input	HS 429 In	ETCAS Control/Selected Altitude - A429 Input B	ETCAS controller	TCAS
RMP14F	XT Coordination No. 1 - A429 Input	HS 429 In	XT Coordination No. 1 - A429 Input A	XPDR	TCAS
RMP14G	XT Coordination No. 1 - A429 Input	HS 429 In	XT Coordination No. 1 - A429 Input B	XPDR	TCAS
RMP14H	XT Coordination No. 2 - A429 Input	HS 429 In	XT Coordination No. 2 - A429 Input A	XPDR	TCAS
RMP14J	XT Coordination No. 2 - A429 Input	HS 429 In	XT Coordination No. 2 - A429 Input B	XPDR	TCAS
RMP14K	Reserved Discrete In	Reserve	Reserved Discrete In	n/a	n/a
RMP15A	Reserved EGPWC to TCAS - A429 Input	Reserve	Reserved EGPWC to TCAS - A429 Input A	EGPWC	TCAS
RMP15B	Reserved EGPWC to TCAS - A429 Input	Reserve	Reserved EGPWC to TCAS - A429 Input B	EGPWC	TCAS
RMP15C	Reserved WXR to TCAS - A429 Input	Reserve	Reserved WXR to TCAS - A429 Input A	WXR	TCAS
RMP15D	Reserved WXR to TCAS - A429 Input	Reserve	Reserved WXR to TCAS - A429 Input B	WXR	TCAS
RMP15E	Reserved TCAS to EGPWC - A429 Output	Reserve	Reserved TCAS to EGPWC - A429 Output A	TCAS	EGPWC
RMP15F	Reserved TCAS to EGPWC - A429 Output	Reserve	Reserved TCAS to EGPWC - A429 Output B	TCAS	EGPWC
RMP15G	Reserved TCAS to WXR - A429 Output	Reserve	Reserved TCAS to WXR - A429 Output A	TCAS	WXR
RMP15H	Reserved TCAS to WXR - A429 Output	Reserve	Reserved TCAS to WXR - A429 Output B	TCAS	WXR
RMP15J	TX Coordination No. 1 - A429 Output	HS 429 Out	TX Coordination No. 1 - A429 Output A	TCAS	XPDR

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RMP15K	TX Coordination No. 1 - A429 Output	HS 429 Out	TX Coordination No. 1 - A429 Output B	TCAS	XPDR
RTP1A	Reserved General Purpose A No. 2 - A429 Input	Reserve	Reserved General Purpose A No. 2 - A429 Input A	n/a	XPDR - Internal
RTP1B	Reserved General Purpose A No. 2 - A429 Input	Reserve	Reserved General Purpose A No. 2 - A429 Input B	n/a	XPDR - Internal
RTP1C	FFS Data Input - A429 Input	HS 429 In	FFS Data Input - A429 Input A	C-17 Mission Computer	FFS
RTP1D	FFS Data Input - A429 Input	HS 429 In	FFS Data Input - A429 Input B	C-17 Mission Computer	FFS
RTP1E	Reserved FFS General Purpose Mode S - A429 Input	Reserve	Reserved FFS General Purpose Mode S - A429 Input A	C-17 Mission Computer	FFS
RTP1F	Reserved FFS General Purpose Mode S - A429 Input	Reserve	Reserved FFS General Purpose Mode S - A429 Input B	C-17 Mission Computer	FFS
RTP1G	Reserved General Purpose C No. 1 - A429 Input	Reserve	Reserved General Purpose C No. 1 - A429 Input A	n/a	XPDR - Internal
RTP1H	Reserved General Purpose C No. 1 - A429 Input	Reserve	Reserved General Purpose C No. 1 - A429 Input B	n/a	XPDR - Internal
RTP1J	Reserved GPS Time Mark No. 2 - A743 Diff Input	Reserve	Reserved GPS Time Mark No. 2 - A743 Diff Input A	GPS	XPDR - Internal
RTP1K	Reserved GPS Time Mark No. 2 - A743 Diff Input	Reserve	Reserved GPS Time Mark No. 2 - A743 Diff Input B	GPS	XPDR - Internal
RTP2A	Reserved FMC/GNSS No. 1 - A429 Input	Reserve	Reserved FMC/GNSS No. 1 - A429 Input A	FMC/GNSS No. 1	XPDR - Internal
RTP2B	Reserved FMC/GNSS No. 1 - A429 Input	Reserve	Reserved FMC/GNSS No. 1 - A429 Input B	FMC/GNSS No. 1	XPDR - Internal
RTP2C	Reserved IRS/FMS/Data Concentrator In No. 1 - A429 Input	Reserve	Reserved IRS/FMS/Data Concentrator In No. 1 - A429 Input A	IRS/FMS/Data Concentrator	XPDR - Internal
RTP2D	Reserved IRS/FMS/Data Concentrator In No. 1 - A429 Input	Reserve	Reserved IRS/FMS/Data Concentrator In No. 1 - A429 Input B	IRS/FMS/Data Concentrator	XPDR - Internal
RTP2E	FFS Data Out - A429 Output	HS 429 Out	FFS Data Out - A429 Output A	FFS	C-17 Mission Computer
RTP2F	FFS Data Out - A429 Output	HS 429 Out	FFS Data Out - A429 Output B	FFS	C-17 Mission Computer
RTP2G	Reserved General Purpose A No. 1 - A429 Input	Reserve	Reserved General Purpose A No. 1 - A429 Input A	n/a	XPDR - Internal

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RTP2H	Reserved General Purpose A No. 1 - A429 Input	Reserve	Reserved General Purpose A No. 1 - A429 Input B	n/a	XPDR - Internal
RTP2J	Reserved General Purpose B No. 2 - A429 Input	Reserve	Reserved General Purpose B No. 2 - A429 Input A	n/a	XPDR - Internal
RTP2K	Reserved General Purpose B No. 2 - A429 Input	Reserve	Reserved General Purpose B No. 2 - A429 Input B	n/a	XPDR - Internal
RTP3A	Reserved Hijack Mode Discrete Ouput	Reserve	Reserved Hijack Mode Discrete Output	XPDR - Internal	Hijack Indicator
RTP3B	XPDR Fail No. 2 Discrete Output	Disc Out	XPDR Fail No. 2 Discrete Output	XPDR - Internal	Control / Display
RTP3C	Aircraft Category Prog Pin	Prog Pin	Aircraft Category Prog Pin No. 1	Shelf	FFS
RTP3D	Aircraft Category Prog Pin	Prog Pin	Aircraft Category Prog Pin No. 2	Shelf	FFS
RTP3E	Aircraft Category Prog Pin	Prog Pin	Aircraft Category Prog Pin No. 3	Shelf	FFS
RTP3F	Reserved Acquisition Squitter Disable Program Pin	Reserve	Reserved Acquisition Squitter Inhibit Program Pin	RTP5D	XPDR - Internal
RTP3G	Reserved SDI Input Program Pin	Reserve	Reserved SDI Program Pin	RTP5D	XPDR - Internal
RTP3H	Reserved SDI Input Program Pin	Reserve	Reserved SDI Program Pin	RTP5D	XPDR - Internal
RTP3J	Reserved FMC/GNSS 1/2 Select Discrete Input	Reserve	Reserved FMC/GNSS 1/2 Select Discrete Input	Aircraft	XPDR - Internal
RTP3K	Spare	Disc In	Spare	n/a	n/a
RTP4A	Reserved General Input A No. 1/2 Select Discrete Input	Reserve	Reserved General Input A No. 1/2 Select Discrete Input	n/a	XPDR - Internal
RTP4B	Reserved General Input B No. 1/2 Select Discrete Input	Reserve	Reserved General Input B No. 1/2 Select Discrete Input	n/a	XPDR - Internal
RTP4C	Reserved General Input C No. 1/2 Select Discrete Input	Reserve	Reserved General Input C No. 1/2 Select Discrete Input	n/a	XPDR - Internal
RTP4D	Spare	Spare	Spare	n/a	n/a
RTP4E	Spare	Spare	Spare	n/a	n/a
RTP4F	Reserved General Purpose I/O Configuration Program Pin	Reserve	Reserved General Purpose I/O Configuration Program Pin No. 1	n/a	XPDR - Internal

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RTP4G	Reserved General Purpose I/O Configuration Program Pin	Reserve	Reserved General Purpose I/O Configuration Program Pin No. 2	n/a	XPDR - Internal
RTP4H	Reserved General Purpose I/O Configuration Program Pin	Reserve	Reserved General Purpose I/O Configuration Program Pin No. 3	n/a	XPDR - Internal
RTP4J	Reserved General Purpose I/O Configuration Program Pin	Reserve	Reserved General Purpose I/O Configuration Program Pin No. 4	n/a	XPDR - Internal
RTP4K	Reserved General Purpose I/O Configuration Program Pin	Reserve	Reserved General Purpose I/O Configuration Program Pin No. 5	n/a	XPDR - Internal
RTP5A	Maximum Airspeed Program Pin	Prog Pin	Maximum Airspeed Program Pin - Bit 17	RTP5D	XPDR - Internal
RTP5B	Maximum Airspeed Program Pin	Prog Pin	Maximum Airspeed Program Pin - Bit 16	RTP5D	XPDR - Internal
RTP5C	Maximum Airspeed Program Pin	Prog Pin	Maximum Airspeed Program Pin - Bit 15	RTP5D	XPDR - Internal
RTP5D	RTP Program Pin Common	Prog Pin	RTP Program Pin Common	XPDR - Internal	Program Pins
RTP5E	Spare	HS 429 In	Spare	n/a	n/a
RTP5F	Spare	HS 429 In	Spare	n/a	n/a
RTP5G	Spare	HS 429 Out	Spare	n/a	n/a
RTP5H	Spare	HS 429 Out	Spare	n/a	n/a
RTP5J	Reserved Air/Gnd No. 2 Discrete Input	Reserve	Reserved Air/Gnd No. 2 Discrete Input	Air/ground relay	TCAS, XPDR - Internal
RTP5K	FFS Function enable Program Pin	Prog Pin	FFS Function enable Program Pin	RTP5D	FFS
RTP6A	Guidance Data - A429 Input	HS 429 In	Guidance Data - A429 Input A	C-17 Mission Computer	FFS
RTP6B	Guidance Data - A429 Input	HS 429 In	Guidance Data - A429 Input B	C-17 Mission Computer	FFS
RTP6C	Reserved Discrete Out	Reserve	Reserved Discrete Out	n/a	n/a
RTP6D	Reserved GPS Time Mark No. 1 - A743 Diff Input	Reserve	Reserved GPS Time Mark No. 1 - A743 Diff Input A	GPS	XPDR - Internal
RTP6E	Reserved GPS Time Mark No. 1 - A743 Diff Input	Reserve	Reserved GPS Time Mark No. 1 - A743 Diff Input B	GPS	XPDR - Internal

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RTP6F	Reserve XPDR Top Ant Tx Inhibit Discrete Input	Reserve	Reserved XPDR Top Ant Tx Inhibit Discrete Input	Test Bench	XPDR - Internal
RTP6G	Reserve XPDR Top Ant Tx Inhibit Status	Reserve	Reserved XPDR Top Ant Tx Inhibit Status	n/a	XPDR - Internal
RTP6H	Reserved GPS/GNSS In No. 1- A429 Input	Reserve	Reserved GPS/GNSS In No. 1- A429 Input A	GPS/GNSS No. 1	XPDR - Internal
RTP6J	Reserved GPS/GNSS In No. 1- A429 Input	Reserve	Reserved GPS/GNSS In No. 1- A429 Input B	GPS/GNSS No. 1	XPDR - Internal
RTP6K	Reserved Single Antenna Enable Prog Pin	Reserve	Reserved Single Antenna Enable Prog Pin	RTP5D	XPDR - Internal
RTP7A	Reserved Control Data In A - A429 Input	Reserve	Reserved Control Data In "A" or FCC No. 1/MCP No. 1 /VHF - A429 Input A	Control panel	XPDR - Internal
RTP7B	Reserved Control Data In A - A429 Input	Reserve	Reserved Control Data In "A" or FCC No. 1/MCP No. 1 /VHF - A429 Input B	Control panel	XPDR - Internal
RTP7C	Reserved Hijack Mode Discrete Input	Reserve	Reserved Hijack Mode Discrete Input	n/a	XPDR - Internal
RTP7D	Reserved Control Port Select Discrete Input	Reserve	Reserved Control Port Select Discrete Input	Control Panel	XPDR - Internal
RTP7E	Reserved Control Data In B - A429 Input	Reserve	Reserved Control Data In B - A429 Input A	Control Panel	XPDR - Internal
RTP7F	Reserved Control Data In B - A429 Input	Reserve	Reserved Control Data In B - A429 Input B	Control Panel	XPDR - Internal
RTP7G	Reserved Standby/On Discrete In	Reserve	Reserved Standby/On Discrete In	n/a	XPDR - Internal
RTP7H	Reserved Digital Air Data No. 1 - A429 Input	LS/HS 429 In	Reserved Digital Air Data No. 1 - A429 Input A	Digital Air Data No. 1	XPDR - Internal
RTP7J	Reserved Digital Air Data No. 1 - A429 Input	LS/HS 429 In	Reserved Digital Air Data No. 1 - A429 Input B	Digital Air Data No. 1	XPDR - Internal
RTP7K	Reserved FCC/MCP No. 1/2 Select Discrete Input	Reserve	Reserved FCC/MCP No. 1/2 Select Discrete Input	Aircraft system	XPDR - Internal
RTP8A	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A1 (MSB) Program Pin	RTP10E	XPDR - Internal
RTP8B	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A2 Program Pin	RTP10E	XPDR - Internal
RTP8C	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A3 Program Pin	RTP10E	XPDR - Internal

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RTP8D	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A4 Program Pin	RTP10E	XPDR - Internal
RTP8E	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A5 Program Pin	RTP10E	XPDR - Internal
RTP8F	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A6 Program Pin	RTP10E	XPDR - Internal
RTP8G	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A7 Program Pin	RTP10E	XPDR - Internal
RTP8H	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A8 Program Pin	RTP10E	XPDR - Internal
RTP8J	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A9 Program Pin	RTP10E	XPDR - Internal
RTP8K	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A10 Program Pin	RTP10E	XPDR - Internal
RTP9A	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A11 Program Pin	RTP10E	XPDR - Internal
RTP9B	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A12 Program Pin	RTP10E	XPDR - Internal
RTP9C	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A13 Program Pin	RTP10E	XPDR - Internal
RTP9D	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A14 Program Pin	RTP10E	XPDR - Internal
RTP9E	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A15 Program Pin	RTP10E	XPDR - Internal
RTP9F	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A16 Program Pin	RTP10E	XPDR - Internal
RTP9G	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A17 Program Pin	RTP10E	XPDR - Internal
RTP9H	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A18 Program Pin	RTP10E	XPDR - Internal
RTP9J	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A19 Program Pin	RTP10E	XPDR - Internal
RTP9K	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A20 Program Pin	RTP10E	XPDR - Internal
RTP10A	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A21 Program Pin	RTP10E	XPDR - Internal
RTP10B	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A22 Program Pin	RTP10E	XPDR - Internal

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RTP10C	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A23 Program Pin	RTP10E	XPDR - Internal
RTP10D	Reserved ICAO 24-Bit Address Program Pin	Reserve	Reserved ICAO 24-Bit Address Bit A24 (LSB) Program Pin	RTP10E	XPDR - Internal
RTP10E	Reserved ICAO 24-Bit Address Program Pin Common	Reserve	Reserved ICAO 24-Bit Address Bit Program Pin Common	XPDR - Internal	ICAO Address Pins
RTP10F	Reserved FCC No. 1/MCP No. 1/VHF No. 3 - A429 Input	Reserve	Reserved FCC No. 1/MCP No. 1/VHF No. 3 - A429 Input A	FCC No. 1/MCP No. 1/VHF No. 3	XPDR - Internal
RTP10G	Reserved FCC No. 1/MCP No. 1/VHF No. 3 - A429 Input	Reserve	Reserved FCC No. 1/MCP No. 1/VHF No. 3 - A429 Input B	FCC No. 1/MCP No. 1/VHF No. 3	XPDR - Internal
RTP10H	Reserved Functional Test Discrete Input	Reserve	Reserved Functional Test Discrete Input	Control panel	XPDR - Internal
RTP10J	Reserved Discrete Output	Reserve	Reserved Discrete Output	n/a	XPDR - Internal
RTP10K	Reserved XPDR FAIL No. 1 5V Lamp Power Output	Reserve	Reserved XPDR FAIL No. 1 5V Lamp Power Output	XPDR - Internal	lamp
RTP11A	Reserved IRS/FMS/Data Concentrator No. 2 - A429 Input	Reserve	Reserved IRS/FMS/Data Concentrator No. 2 - A429 Input A	IRS/FMS/Data Concentrator	XPDR - Internal
RTP11B	Reserved IRS/FMS/Data Concentrator No. 2 - A429 Input	Reserve	Reserved IRS/FMS/Data Concentrator No. 2 - A429 Input B	IRS/FMS/Data Concentrator	XPDR - Internal
RTP11C	Reserved FMC/GNSS No. 2 - A429 Input	Reserve	Reserved FMC/GNSS No. 2 - A429 Input A	FMC/GNSS No. 2	XPDR - Internal
RTP11D	Reserved FMC/GNSS No. 2 - A429 Input	Reserve	Reserved FMC/GNSS No. 2 - A429 Input B	FMC/GNSS No. 2	XPDR - Internal
RTP11E	Reserved GPS/GNSS In No. 2 - A429 Input	Reserve	Reserved GPS/GNSS In No. 2 - 429 Input A	GPS/GNSS No. 2	XPDR - Internal
RTP11F	Reserved GPS/GNSS In No. 2 - A429 Input	Reserve	Reserved GPS/GNSS In No. 2 - 429 Input B	GPS/GNSS No. 2	XPDR - Internal
RTP11G	Time Sync Discrete Input	Disc In	Time Sync Discrete Input	C-17 Mission Computer	XPDR - Internal
RTP11H	Spare	HS 429 In	Spare	n/a	n/a
RTP11J	Spare	HS 429 In	Spare	n/a	n/a
RTP11K	Spare	HS 429 In	Spare	n/a	n/a

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Table 2002. MILACAS-FR Processor Pin-outs (cont)

Pin	Port	Data Type	Function	Source	Destination
RTP12A	Reserved Digital Air Data In No. 2 - A429 Input	Reserve	Reserved Digital Air Data In No. 2 - A429 Input A	Digital Air Data No. 2	XPDR - Internal
RTP12B	Reserved Digital Air Data In No. 2 - A429 Input	Reserve	Reserved Digital Air Data In No. 2 - A429 Input B	Digital Air Data No. 2	XPDR - Internal
RTP12C	Reserved XPDR Maintenance Data Out - A429 Output	Reserve	Reserved XPDR Maintenance Data Out - A429 Output A	XPDR - Internal	CMU
RTP12D	Reserved XPDR Maintenance Data Out - A429 Output	Reserve	Reserved XPDR Maintenance Data Out - A429 Output B	XPDR - Internal	CMU
RTP12E	Reserved MSP/ATSU/CMU No. 1 Output - A429 Output	Reserve	Reserved MSP/ATSU/CMU No. 1 Output - A429 Output A	XPDR - Internal	MSP/ATSU/CMU Out No. 1
RTP12F	Reserved MSP/ATSU/CMU No. 1 Output - A429 Output	Reserve	Reserved MSP/ATSU/CMU No. 1 Output - A429 Output B	XPDR - Internal	MSP/ATSU/CMU Out No. 1
RTP12G	Reserved Ext Squitter Disable Discrete Input	Reserve	Reserved Ext Squitter Disable Discrete Input	N/A	XPDR - Internal
RTP12H	Reserved Mode S DL/DLP Program Pin	Reserve	Reserved Mode S DL/DLP Program Pin	RTP5D	FFS, TCAS
RTP12J	Spare	Spare	Spare	n/a	n/a
RTP12K	Spare	Spare	Spare	n/a	n/a
RTP13A-13K	Spare	Spare	Spare	n/a	n/a
RTP14A-14K	Spare	Spare	Spare	n/a	n/a
RTP15A-15K	Spare	Spare	Spare	n/a	n/a

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