installation manual

TSS-4100 Integrated TCAS, Transponder, and ADS-B Traffic Surveillance System

Notice

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TSS-4100 Integrated TCAS, Transponder, and ADS-B Traffic Surveillance System

installation manual

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INSTALLATION MANUAL

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INTRODUCTION

1. GENERAL.

This Installation Manual (IM) provides installation information regarding the TSS-4100 Traffic Surveillance System and its related equipment.

2. HOW TO USE THE MANUAL.

This IM is written to Air Transport Association (ATA) Specification 100 standards and contains the chapters outlined below:

2.1. Chapter 1.

General Information chapter describes the purpose and technical properties of the Traffic Surveillance System LRUs.

2.2. Chapter 2.

System Components chapter describes each LRU separately and in detail. First the LRU is described as it relates to the rest of the Traffic Surveillance System. Then the LRU is described as a stand alone piece of avionics equipment.

2.3. Chapter 3.

Operation chapter provides a description of the operating controls and displays that are available in the Traffic Surveillance System.

2.4. Chapter 4.

Maintenance chapter provides flight line maintenance instructions for the Traffic Surveillance System. This includes theory of operation.

2.5. APPENDICES .

Appendices describe very detailed information about the avionics system.

1. APPENDIX A Faults and Warnings
2. APPENDIX B Maintenance Words
3. APPENDIX C Buses and Other Interfaces
4. APPENDIX D Equipment Characteristics
5. APPENDIX E Interconnect Diagram

3. ACRONYMS, ABBREVIATIONS, AND MNEMONICS.

The list that follows shows the abbreviations, acronyms, and mnemonics that are used in this publication to describe the avionics system.

TERM	MEANING
ABS	Absolute
ACAS	Airborne Collision Avoidance System
ADC	Air Data Computer
ADLP	Aircraft Data Link Processor (MODE-S)
ADS	Air Data System
ADS-B	Automatic Dependent Surveillance-Broadcast
AFD	Adaptive Flight Display
AHC	Attitude Heading Computer
ALT	Altitude
ANT	Antenna
ARINC	Digital Database Protocols
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System

AUTO	Automatic
BITE	Built-In Test Equipment
BNR	Binary
CDU	Control Display Unit
CPN	Collins Part Number
CRC	Cyclic Redundancy Check
DCP	Display Control Panel
DCU	Data Concentrator Unit
DPSK	Differential Phase Shift Keying
ECU	External Compensation Unit
EFIS	Electronic Flight Instrument System
ESDS	Electrostatic Discharge Sensitive
FMS	Flight Management System
GPS	Global Positioning System
HAE	Height Above Ellipsoid
HDG	Heading
Hg	Millimeters of Mercury
HIRF	High Intensity Radiated Field
HSI	Horizontal Situation Indicator
HV	High-Voltage
IAPS	Integrated Avionics Processor System
IRS	Inertial Reference System
LRU	Line Replaceable Unit
MCU	Modular Concept Unit
MFD	Multifunction Display
ms	Millisecond
MSL	Mean Sea Level
NA	Not Applicable
NVRAM	Non-Volatile RAM
PAM	Pulse Amplitude Modulation
PFD	Primary Flight Display
PPOS	Present Position
RA	TCAS Resolution Advisory
RAM	Random Access Memory
REL	Relative
RIU	Radio Interface Unit
ROM	Read Only Memory
RTU	Radio Tuning Unit
SDI	Source Destination Identifier
SLS	Side-Lobe-Suppression
STBY	Standby
STC	Supplemental Type Certificate
TA	Traffic Advisory
TBD	To Be Determined
TC	Type Certificate
TCAS	Traffic Alert Collision Avoidance System
TDR	Transponder
TFC	Traffic
TRE	TCAS II Directional Antenna
TSO	Technical Standard Order
TSA	Traffic Surveillance Antenna
TSS	Traffic Surveillance System
TSSA	Traffic Surveillance System Application
TSM	Traffic Surveillance Mount
TTC	TCAS Transponder Control
TX	Transmit

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SAFETY SUMMARY

1. GENERAL SAFETY INSTRUCTIONS.

This manual describes physical and chemical processes which may cause injury or death to personnel or damage to equipment if not properly followed. This safety summary includes general safety precautions and instruction that must be understood and applied during operation and maintenance to make sure personnel safety and protection of equipment. Prior to performing any task, the WARNING, CAUTIONS, and NOTES included in that task shall be reviewed and understood.

2. WARNING, CAUTIONS AND NOTES.

WARNINGS and CAUTIONS are used in this manual to highlight operating or maintenance procedures, practices, conditions or statements which are considered essential to protection of personnel (WARNING) or equipment (CAUTION). WARNINGS and CAUTIONS immediately precede the step or procedure to which they apply. WARNINGS and CAUTIONS consist of four parts: heading (WARNINGS, CAUTIONS or Icon [HAZARDOUS MATERIALS WARNING]), a statement of the hazard, minimum precautions, and possible result if disregarded. NOTES are used in this manual to highlight operating or maintenance procedures, practices, conditions or statements which are not essential to protection of personnel or equipment. NOTES may precede or follow the step or procedure, depending upon the information to be highlighted. The headings used and definitions are as follows.

WARNING

Highlights an essential operating or maintenance procedure, practice, condition, or statement, etc. which if not strictly observed, could result in injury to, or death of, personnel or long term health hazards.

CAUTION

Highlights an essential operating or maintenance procedure, practice, condition, or statement, etc. which if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

NOTE

Highlights an essential operating or maintenance procedure, condition, or statement.

CHAPTER 1
General Information

1.1. INTRODUCTION.

This publication provides all the specifications, principles of operation, and information necessary to install, test, and troubleshoot the TSS-4100 Traffic Surveillance System (TSS). The three major functions of the TSS-4100 follow:

- The TSS-4100 is a Mode S transponder that replies to directed and all-call interrogations.
- The TSS-4100 is a Traffic Alert Collision Avoidance System (TCAS) II, change 7 unit. It monitors the area around the aircraft for potential airspace conflicts.
- When enabled, the TSS-4100 is also an Automatic Dependent Surveillance-Broadcast (ADS-B) transmitter/receiver unit. It transmits the aircraft position, velocity, and identification. It also processes the transmissions of other ADS-B equipped aircraft.

1.2. EQUIPMENT.

The Equipment Covered table shows the system avionics, mount, and avionics software. Associated equipment shows closely related avionics. Refer to Figure 1-1 for the hardware of a typical single Traffic Surveillance System.

1.2.1. Equipment Covered.

Refer to Table 1-1 for a complete list of the Rockwell Collins avionics equipment covered in this manual.

Table 1-1. Equipment Covered.

UNIT	DESCRIPTION	COLLINS PART NUMBER	STANDARD QUANTITY	OPTIONAL QUANTITY
TSS-4100	Traffic Surveillance System	822-2132-001	1	
TSSA-4100	Traffic Surveillance System Application	810-0052-001	1	
TSM-4100	Traffic Surveillance Mount	866-0128-020	1	
ECU-3000	External Compensation Unit	822-1200-80X	1	
	-802: TCAS II, EHS Mode S Transponder			
	-803: TCAS II, EHS Mode S Transponder, ADS-B Out			
TSA-4100	Traffic Surveillance Antenna	866-0016-X01	1	+1
	-101: Baseline antenna; short connectors			
	-001: Optional replacement; long connectors			
TRE-930	Omnidirectional Antenna	866-5019-010	1	-1

Table 1-2. Associated Equipment.

UNIT	DESCRIPTION	COLLINS PART NUMBER	STANDARD QUANTITY	OPTIONAL QUANTITY
NOTE Information for the TDR-94D and ANT-42 is for reference only. Refer to the Pro Line II Comm/Nav/Pulse System Installation Manual, Collins Part Number (CPN) 523-0772719.				
TDR-94D	Air Traffic Control Radar Beacon System (ATCRBS) Mode S Transponder: -008, -108, -308, -309, -408, or -409.	622-9210-X0X	1	
ANT-42	Mode S omnidirectional antenna. Used with TDR-94D.	622-6591-001	2	

1.2.1.1. In addition to the Avionics, the TSS-4100 Mode S Address Programming Tool, CPN 811-3937-002, is covered in chapter 4 of this installation manual. This is used to program the Mode S Address for use by the TSS-4100.

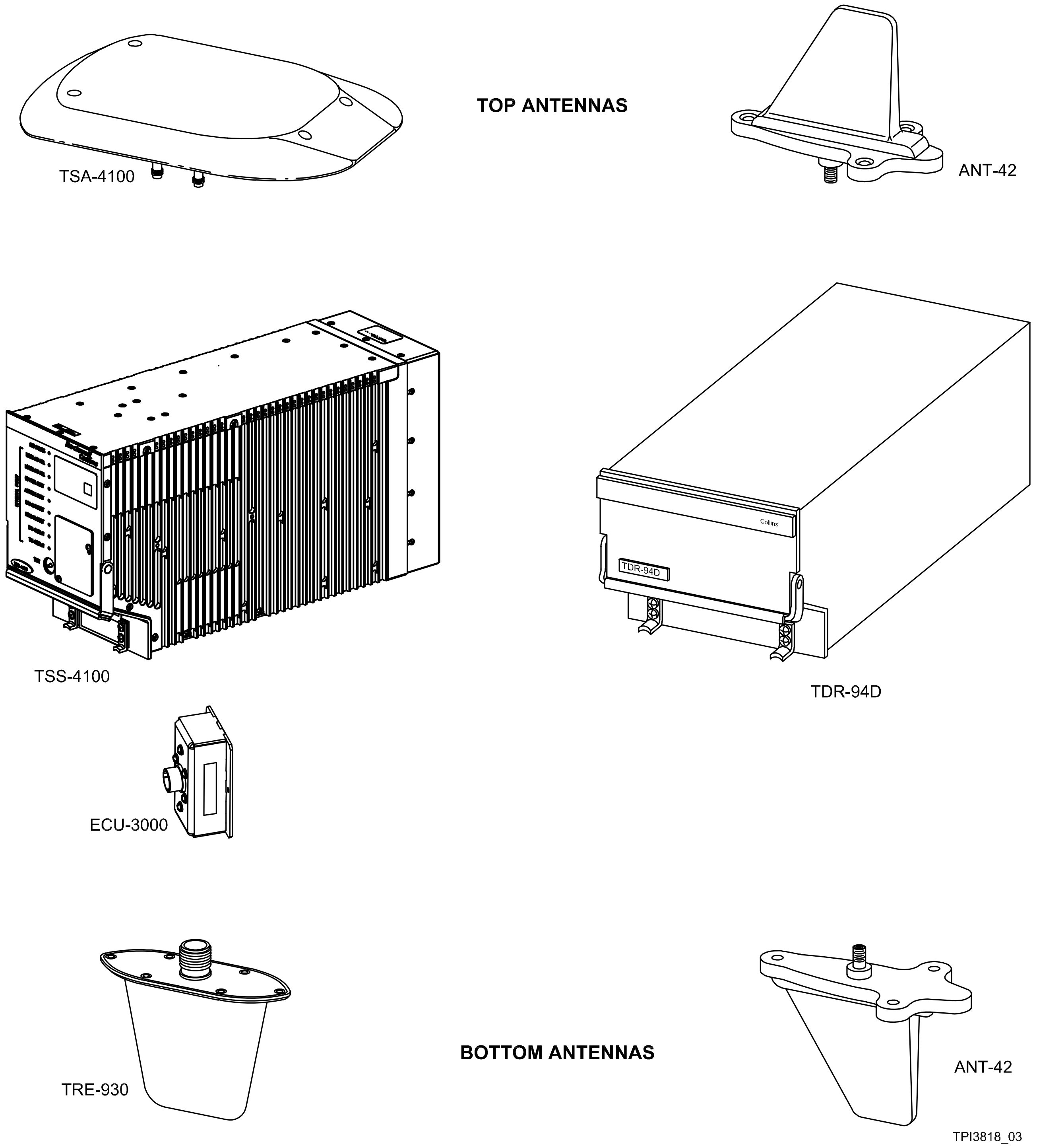


Figure 1-1. Typical Single Traffic Surveillance System

1.3. SYSTEM OVERVIEW.

This section gives an overview of the Traffic Surveillance System.

1.3.1. System Block Diagram.

NOTE

Most units report maintenance information in a diagnostic word to the built-in diagnostic system. This section does not refer to these diagnostic words. Refer to the maintenance section of this manual for diagnostic information.

The system schematics are not intended to replace bench level repair coverage. Component level coverage is provided in the applicable repair manual.

Refer to Figure 1-2 for a block diagram of a typical Traffic Surveillance System with Radio Interface Unit (RIU). Refer to Figure 1-3 for a block diagram of a typical Traffic Surveillance System without RIUs. Heavy solid-black borders identify all system units. The slashed border outlines identify the interfacing units.

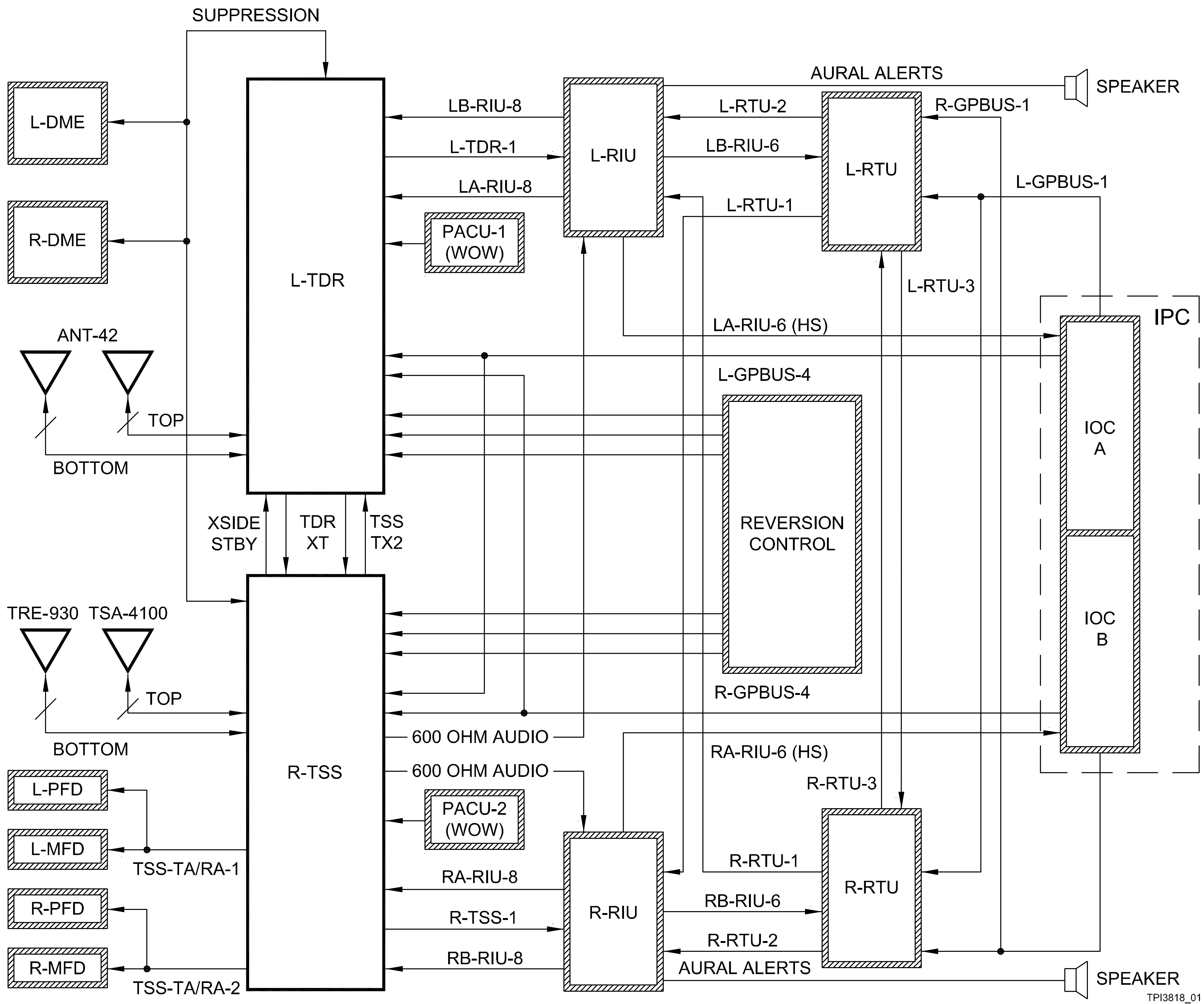


Figure 1-2. Typical Traffic Surveillance System with RIUs, Block Diagram

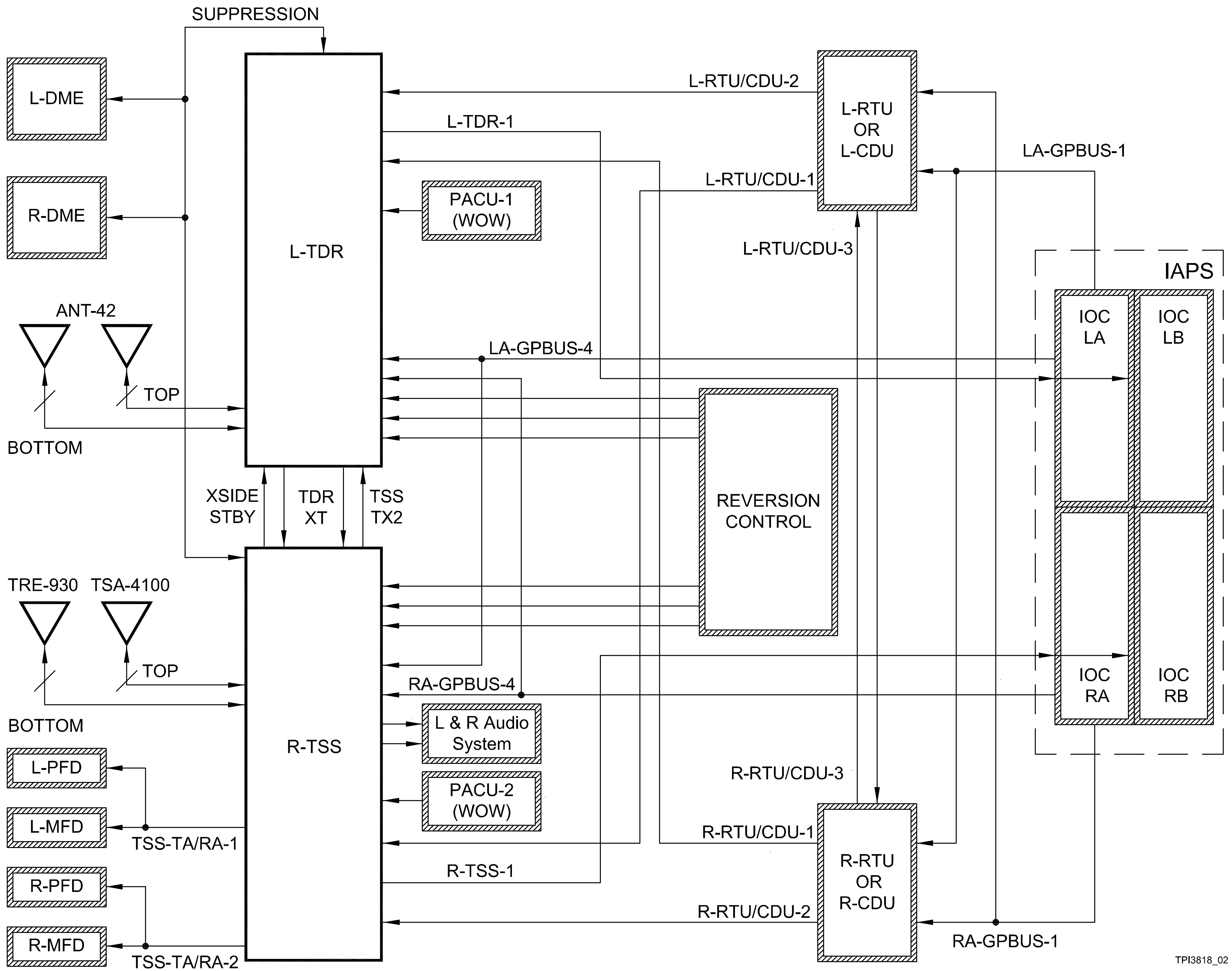


Figure 1-3. Typical Traffic Surveillance System without RIUs, Block Diagram

1.4. COMPONENT DESCRIPTIONS.

The Traffic Surveillance System fully integrates with an airplane transponder and TCAS control system. The Traffic Surveillance System includes the Line Replaceable Units (LRU) that follow:

- One TSS-4100 Traffic Surveillance System LRU
- TSSA-4100 Traffic Surveillance System Application (TSSA) software
- One ECU-3000 External Compensation Unit (ECU)
- One upper TSA-4100 Traffic Surveillance Antenna (TSA)
- One lower TRE-930 L-Band Omnidirectional TCAS Antenna (TRE)
- One TSM-4100 Traffic Surveillance Mount (TSM) with monitored cooling fan
- One Air Traffic Control (ATC) Mode-S Transponder (TDR)
- Two ANT-42 L-Band Transponder Omnidirectional Antennas (ANT)
- A transponder/TCAS control unit
- A traffic display
- An aural alert system.

The LRU overviews below describe each unit in the Traffic Surveillance System.

1.4.1. TSS-4100 Traffic Surveillance System.

The TSS-4100 is the main component of the Traffic Surveillance System. The TSS-4100 operates on 28-V dc. It contains all circuits necessary for computing, transmitting, and receiving functions of the Traffic Surveillance System and interfacing with a stand-alone transponder, other aircraft sensors (for example, Air Data Computer (ADC), Inertial Reference System (IRS), Global Positioning System (GPS), etc.), antennas, controls, and displays.

1.4.1.1. The TSSA-4100 Traffic Surveillance System Application is necessary software for the TSS-4100. The TSSA-4100 files are field loadable.

1.4.2. ECU-3000 External Compensation Unit.

The ECU is used to hold all of the aircraft and unit configuration data necessary for the TSS-4100 to operate properly. This simplifies the wiring for the Traffic Surveillance System. For example, instead of program pins for the Mode S address, maximum aircraft altitude, and bus speeds that must be wired and tested for every aircraft, a simple file is dataloaded through the TSS and stored in the ECU.

1.4.3. TDR-94D ATC/Mode S Transponder.

The TDR-94D Duplex ATC/Mode S Transponder operates on 28-V dc. The TDR-94D has the capability of operating with Mode S interrogators. The Mode S capability permits sending and receiving messages via the interrogation/reply data link.

1.4.4. TSA-4100 Directional Antenna.

The TSA-4100 directional antenna is the top antenna for the TSS. It is also optionally used as the lower antenna for the TSS. It has four passive antenna elements for directionality and is mounted on the outside of the aircraft fuselage.

1.4.5. TRE-930 Omnidirectional Antenna.

The TRE-930 omnidirectional antenna is an optional lower antenna for the TSS.

1.4.6. ANT-42 Omnidirectional Antenna.

Two ANT-42 omnidirectional antennas, one upper and one lower antenna, connect to the TDR-94D mode S transponder.

1.4.7. TSM-4100 Traffic Surveillance Mount.

The TSM-4100, or Traffic Surveillance Mount, is a standard 4 Modular Concept Unit (MCU) mount with a fan that can be controlled and monitored.

CHAPTER 2
System Components

2.1. INTRODUCTION.

NOTE

The names of some Line Replaceable Unit (LRU) types do not match the initials of the functional name of the equipment. For example, the name TRE-930 does not match the initials of its functional name, the Mode S Omnidirectional Antenna.

The information and instructions provided in this section are recommendations and do not necessarily correspond with any actual aircraft installation and wiring. This section cannot be used in place of a Supplemental Type Certificate (STC) or Type Certificate (TC).

2.1.1. LRU System Section.

The first section under a tab shows the LRU-type name (for example, TDR-94D), and the external theory of operation for each LRU of that LRU-type. This includes all the sources of all the input signals to the LRU, and all the output signals from the LRU. Then a simplified diagram shows what pins are used for each signal to and from the LRU.

2.1.2. LRU Data Section.

The next section contains blocks of data that describe, where applicable, general details about the same LRU. These data include, for example:

- LRU purpose
- LRU graphic
- LRU connector graphic
- LRU connector data
- LRU installation control drawing
- LRU install and removal instructions
- LRU internal theory
- LRU internal block diagram.

2.2. COMPONENT DESCRIPTIONS.

This section describes the necessary and some optional LRU components of the Traffic Surveillance System (TSS).

2.2.1. ANT-42 Mode S L-Band Antenna.

The TDR-94D Mode S Transponder requires two Antenna (ANT), one L-Band antenna (upper) and one L-Band antenna (lower). The ANT-42 is an ac (capacitive) coupled antenna and does not meet the requirements for being an antenna for the TSS-4100.

2.2.2. TDR-94D ATC/Mode S Transponder.

The TDR-94D Air Traffic Control (ATC)/Mode S Transponder operates on 28 V dc. The TDR-94D has the capability of operating with Mode S interrogators as well as the standard 4096 interrogators. The Mode S capability permits sending and receiving messages via the interrogation/reply data link.

2.2.3. TRE-930 Mode S Omnidirectional Antenna.

The TRE-930 Traffic Alert Collision Avoidance System (TCAS) Antenna is the recommended lower omnidirectional antenna for the Traffic Surveillance System. It is a DC-grounded omnidirectional antenna, and is mounted on the outside of the aircraft fuselage.

2.2.4. TSA-4100 Mode S Directional Antenna.

The TSS-4100 requires the upper antenna to be the TSA-4100 directional antenna. The lower antenna can be another TSA-4100 directional antenna or it can be an omnidirectional antenna like the TRE-930.

2.2.5. TSS-4100 Traffic Surveillance System.

The TSS-4100 (hardware) and TSSA-4100 (software) work together to provide TCAS, Mode S transponder, and Automatic Dependent Surveillance-Broadcast (ADS-B) capability in one LRU.

2.3. ANT-42 34-54-00.

The sections that follow describe the external theory of operation, and general data of the ANT-42 L-Band antenna.

2.3.1. ANT-42, External Theory of Operation.

Refer to Figure 2-7. This sheet shows the external wire signals to and from the ANT-42 and the TDR-94D. The ANT-42 antenna mounts on the top or bottom of an airplane. The antenna connects to the TDR-94D mode S transponder. There are no operator controls or adjustments on this antenna.

2.4. L-BAND ANTENNA, ANT-42, DATA.

The ANT-42 is an L-Band antenna. The ANT-42 antenna mounts on the top or bottom of an aircraft. There are no operator controls or adjustments on this antenna.

2.4.1. ANT-42 Illustration.

Refer to Figure 2-1 for an illustration of the ANT-42.

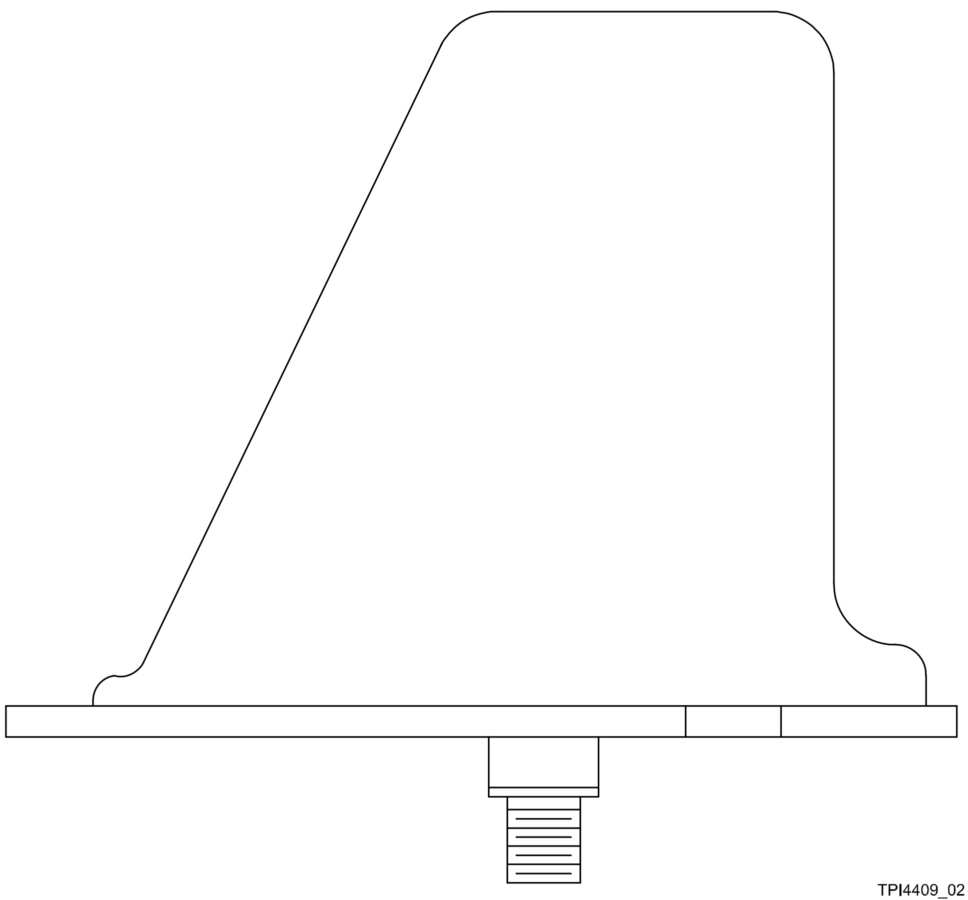


Figure 2-1. ANT-42

2.4.2. ANT-42 Mating Connector Data.

Table 2-1 shows the mating connector hardware and tooling for the ANT-42. Also refer to Figure 2-7 for the interconnect wiring diagram.

NOTE

The ANT-42 only requires one of the connectors in the table that follows.

Table 2-1. ANT-42 Mating Connector Hardware and Tooling.

ANT-42 HARDWARE/TOOLING
RF connector 90° TNC for ECS cable 311201: Collins Part Number (CPN) 857-1502-020 (CTS122), Vendor Ref VC-8,
RF connector straight, TNC for ECS cable 311201: CPN 857-1502-010 (CTR122), Vendor Ref VC-8
RF connector, straight, TNC for RG-142: CPN 357-9666-000
RF connector, 90°, TNC for RG-142: CPN 357-9664-000
RF grounding gasket: CPN 018-1394-110

2.4.3. ANT-42 Outline and Mounting Dimensions.

Refer to Figure 2-2 for an illustration of the ANT-42 Outline and Mounting Dimensions.

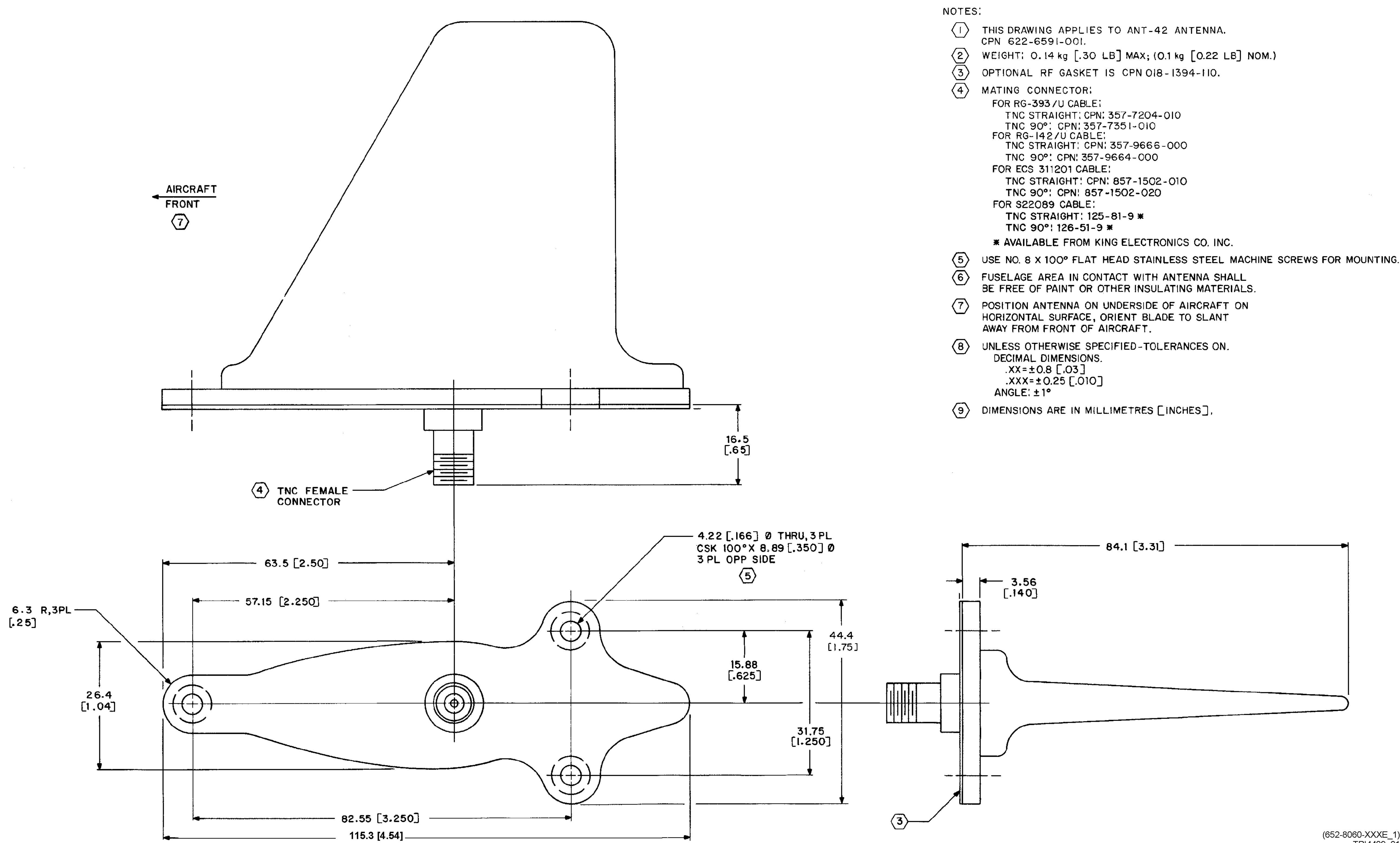


Figure 2-2. ANT-42 L-Band Antenna, Outline and Mounting Dimensions

2.4.4. Installation and Removal.

WARNING

Make sure that the aircraft battery master switch is turned off before installing any equipment, mounts, or interconnect cables. Failure to do so could irradiate the installer.

The TDR-94D ATC/Mode S transponder requires two ANT-42 antennas. One ANT-42 L-Band Antenna is mounted on top of the fuselage and the second ANT-42 antenna is mounted on the bottom of the fuselage. All antennas should be mounted in a location that keeps the interconnecting coaxial cables as short as practicable.

2.4.4.1. Installation. The procedure to install the ANT-42 follows (Refer to Paragraph 2.12.5.1.3 for instructions on antenna placement relative to other antennas):

a. Verify interconnect cabling before proceeding.

b. Connect the connector to the ANT-42 antenna and position the Antenna on the fuselage.

c. Secure with three mounting screws. No. 8 Stainless steel flat head screws are recommended. Zinc, cadmium plated, or aluminum alloy screws are not recommended.

d. Apply any weather/aerodynamic fillet of sealant to the periphery of the antenna and shape as necessary. The height of the bead should not exceed 2.5 mm (0.1 in).

2.4.4.2. Removal. The procedure to remove the ANT-42 follows:

a. Remove sealant around periphery of the ANT-42 antenna.

CAUTION

Do not allow the antenna to hang from cable. Allowing the antenna to hang from the cable could damage the connector.

b. Remove three screws from antenna.

c. Disconnect connector from antenna.

2.5. ECU-3000 34-54-00.

The sections that follow describe the external theory of operation, internal theory of operation, and general data of the External Compensation Unit (ECU) in a Traffic Surveillance System.

2.5.1. External Control Unit, External Theory of Operation.

The ECU is connected to the TSS through nine wires. Refer to Figure 2-3. This sheet shows a typical TSS External Compensation Unit connection, and the external wire signals to and from the TSS.

NOTE

There should be three twisted-shielded pairs and one twisted-shielded triple when wiring the ECU to the TSS. The wires that are bracketed together should be within the same shield.

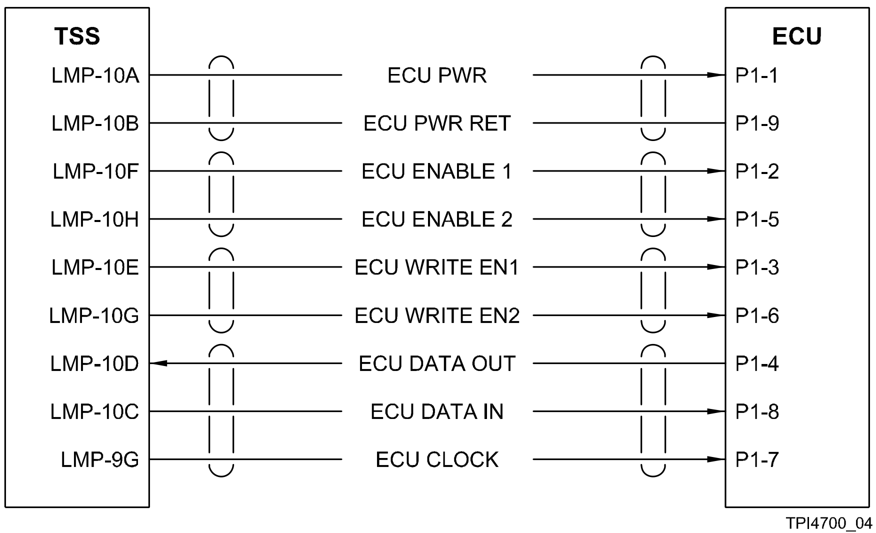


Figure 2-3. External Compensation Unit, ECU-3000, External Simplified Schematic

2.6. EXTERNAL CONTROL UNIT , ECU-3000, DATA.

The ECU-3000 holds Rockwell Collins programmed data, aircraft-specific configuration data, and Mode S address. The ECU has two halves.

2.6.1. ECU Top Half.

Pre-programmed data for the TSS LRU is in the top half.

2.6.2. ECU Bottom Half, First Partition.

Refer to Table 2-2 for a list of the parameters that need to be set and their possible values. The first partition of the bottom half has the characteristics that follow:.

- Programmed by the installer
- Contains installation strapping, including number of GPSs, ARINC 429 bus speeds, airplane height and length, etc.
- Must be data loaded.

2.6.3. ECU Bottom Half, Second Partition.

The second partition of the bottom half is used to store the Mode S address, and has the characteristics that follow:

- Programmed by the installer
- Contains the Mode S address
- Either data loaded, or programmed using the TSS-4100 ECU Mode S Address Programming Tool.

Table 2-2. ECU Installation Strapping Data.

Description	Values	Recommend (Function Using Setting)
Installation Part Number		Up to 16 alpha-numeric characters
Aircraft Installation	0000 0000 = Default 0000 0001 = BRS	Recommend: 0000 0001 (BRS)
Antenna Monitoring	1 = Enable Antenna Monitoring 0 = Disable Antenna Monitoring	Recommend: 1 (Enable)
Antenna Coaxial Cable Loss Upper	00 = Not used 01 = 0 to 1 db 10 = 1 to 2 db 11 = 2 to 3 db	
Antenna Coaxial Cable Loss Lower	00 = Not used 01 = 0 to 1 db 10 = 1 to 2 db 11 = 2 to 3 db	
Antenna Coaxial Cable Delay	00 = 0 to 50 nsec 01 = 51 to 150 nsec 10 =151 to 250 nsec 11 = 251 to 300 nsec	
Cable Delay Sign Bit	1 = Add Cable Delay to Bottom Antenna 0 = Add Cable Delay to Top Antenna	
Share Antennas	1 = Enable (share antennas) 0 = Disable (independent antennas)	Recommend: 0 (Disable)
Bearing Lookup Configuration	0 = Standard 1 = Enhanced	Recommend: 1 (Enhanced)
Fan Speed	0 = 0 (Fan monitor not connected) 1..255 = 500..127500 (X times 500) (In Pulses Per Minute)	Recommend: 42 (21000 pulses per minute) if have TSM; 0 otherwise
RA Valid Discrete Disable	1 = Disable RA Display Status Discrete Monitor 0 = Enable RA Display Status Discrete Monitor	Recommend: 0 (Enable) (TCAS)
Display All Traffic/Threat Traffic	1 = Display all intruders 0 = Display only TA and RA intruders	Recommend: 1 (Display all) (TCAS)
Ground Display Mode	1 = TCAS in Standby mode on ground 0 = TCAS in to TA Only mode on ground	Recommend: 0 (TA Only mode) (TCAS)
TA Display Intruder Limit	Range 0 - 31 decimal	Recommend: 31 (TCAS)
Default Altitude Limit A	Range 0 - 127 decimal	Recommend: 27 (2,700 ft) (TCAS)

Table 2-2. ECU Installation Strapping Data. - Continued

Description	Values	Recommend (Function Using Setting)
Default Altitude Limit B	Range 0 - 127 decimal	Recommend: 99 (9,900 ft) (TCAS)
Aural Files Used	1 = Aural Files Used 0 = Aural Files Not Used	(TCAS)
Aural Advisory Discrete Delay	1 = Add delay to Aural Advisory discrete output 0 = No delay	(TCAS)
In Air Volume	000 = 16 dBm 40 mW 001 = 13 dBm 20 mW 010 = 10 dBm 10 mW 011 = 7 dBm 5 mW 100 = 4 dBm 2.5 mW 101 = 1 dBm 1.25 mW 110 = -2 dBm 0.625 mW 111 = 19 dBm 80 mW	**NOTE** This value is only applicable if using the TSS's 600 ohm output. Audio power output tolerance is +35%/-25% of power outputs show in Watts (TCAS)
On Ground Volume	000 = Match "In Air Volume" 001 = 13 dBm 20 mW 010 = 10 dBm 10 mW 011 = 7 dBm 5 mW 100 = 4 dBm 2.5 mW 101 = 1 dBm 1.25 mW 110 = -2 dBm 0.625 mW 111 = 19 dBm 80 mW	**NOTE** This value is only applicable if using the TSS's 600 ohm output. Audio power output tolerance is +35%/-25% of power outputs show in Watts (TCAS)
Maximum Climb Altitude	Range 0 - 31 decimal	(TCAS)
Aircraft Category (maximum takeoff weight)	0000 = Not available 0001 = < 15,500 lbs 0010 = 15,500 to 75,000 0011 = 75,000 to 300,000 0100 = High Vortex Large 0101 = > 300,000 0110 = High Performance 0111 = Rotorcraft 1000 through 1111 = Reserved for Set "B"	(ADS-B)
Maximum Cruising Airspeed	000 = Not available 001 = 0 to 75 knots 010 = 75 to 150 knots 011 = 150 to 300 knots 100 = 300 to 600 knots 101 = 600 to 1200 knots 110 = more than 1200 knots 111 = not used	(ADS-B)

Table 2-2. ECU Installation Strapping Data. - Continued

Description	Values	Recommend (Function Using Setting)
Aircraft Length/Width	0000 = L ≤ 15m, W ≤ 11.5m 0001 = L ≤ 15m, W ≤ 23m 0010 = L ≤ 25m, W ≤ 28.5m 0011 = L ≤ 25m, W ≤ 34m 0100 = L ≤ 35m, W ≤ 33m 0101 = L ≤ 35m, W ≤ 38m 0110 = L ≤ 45m, W ≤ 39.5m 0111 = L ≤ 45m, W ≤ 45m 1000 = L ≤ 55m, W ≤ 45m 1001 = L ≤ 55m, W ≤ 52m 1010 = L ≤ 65m, W ≤ 59.5m 1011 = L ≤ 65m, W ≤ 67m 1100 = L ≤ 75m, W ≤ 72.5m 1101 = L ≤ 75m, W ≤ 80m 1110 = L ≤ 85m, W ≤ 80m 1111 = L > 85m, W > 80m	(ADS-B)
FMS Surveillance Integrity Limit	00 = Unknown 01 = e-3 10 = e-5 11 = e-7	Recommend: 00 (Unknown) (ADS-B)
GPS Surveillance Integrity Limit	00 = Unknown 01 = e-3 10 = e-5 11 = e-7	Recommend: 10 (e-5) (ADS-B)
GPS Time Mark Source	00 = No GPS Time Mark 01 = Single GPS Time Mark Only 10 = Dual GPS Time Mark 11 = Not Used	(ADS-B)
Position Offset Applied	1 = Position Offset applied 0 = No offset applied	Recommend: 0 (No offset) (ADS-B)
Allow/Disallow Use of GPS from Concentrator	1 = Disallow use of GPS data from IAPS bus 0 = Allow use of GPS data from IAPS busses	
Cross-side XPDR Installed	1 = Installed 0 = Not Installed	(TCAS)
Dual or Triple AHRS	1 = Triple 0 = Dual	
ADLP Installed	1 = ADLP Installed 0 = ADLP Not Installed	Recommend: 0 (Not Installed) (XPDR)
Bus Speed LMP-1DC (Control A Input)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-7DC (Control B Input)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-1DC (Control C Input)	1 = High Speed 0 = Low Speed	

Table 2-2. ECU Installation Strapping Data. - Continued

Description	Values	Recommend (Function Using Setting)
Bus Speed LMP-8HG (IAPS #1 Input)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-8HG (IAPS #2 Input)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-8AB (XT2 (XPDR to TSS) or ADLP Input)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-8DC (TX2 (TSS to XPDR) or ADLP Output)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-1EF (TA/RA-1 Output)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-1EF (TA/RA-2 Output)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-7AB (TSS-1 Output)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-1AB (TSS-2 Output)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-1AB (TSS-3; Data Load Output)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-7JK (Data Load Input)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-6HG (GPS #1 Input)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-2HG (GPS #2 Input)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-7EF (ADS-B #1 Input − Provision)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-7HG (ADS-B #2 Input − Provision)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-9EF (ADS-B #1 Output − Provision)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-8JK (CMU #1 Input − Provision)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-8JK (CMU #2 Input − Provision)	1 = High Speed 0 = Low Speed	
Bus Speed RMP-9EF (CMU Output − Provision)	1 = High Speed 0 = Low Speed	

Table 2-2. ECU Installation Strapping Data. - Continued

Description	Values	Recommend (Function Using Setting)
Bus Speed RMP-7DC (A768 Future Input − Provision)	1 = High Speed 0 = Low Speed	
Bus Speed LMP-9DC (General Purpose #1 − Provision Output)	1 = High Speed 0 = Low Speed	

2.6.4. ECU-3000 Illustration.

Refer to Figure 2-4 for an illustration of the ECU-3000.

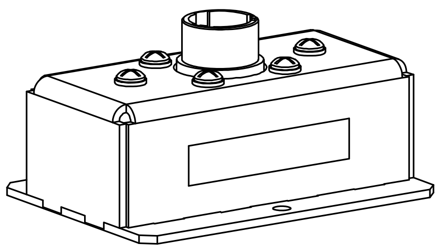


Figure 2-4. ECU-3000

2.6.5. ECU-3000 Mating Connector Data.

NOTE

The wiring to the ECU should be done with three twisted shield pairs and one twisted shield triple.

Figure 2-5 shows a mating connector pictorial for the ECU-3000. Each connector shows pin locations to aid the troubleshooting effort. Also refer to the interconnect wiring diagram in the appendix.

2.6.5.1. Table 2-3 shows the mating connector hardware and tooling for the ECU-3000.

Table 2-3. ECU-3000 Mating Connector Hardware and Tooling.

ECU-3000 HARDWARE/TOOLING
Mating connector: MIL MS27484T10F35S, Collins 359-0645-020
Contacts: MIL M39029/57-354, Collins 359-0608-110
Strain relief: MIL M85049/49-2-10N, Collins 859-6604-110
Insertion/extraction tool: MIL M81969/14-01, Collins 359-8032-010
Crimp tool: MIL M22520/2-01, Collins 359-8102-010
Crimp tool positioner: MIL M22520/2-06, Collins 359-8102-060

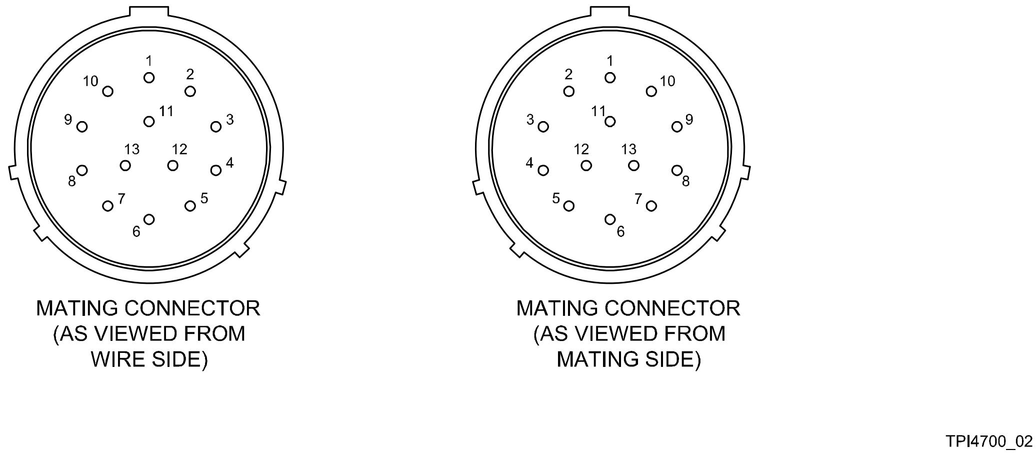


Figure 2-5. ECU-3000 Mating Connectors

2.6.6. ECU-3000 Outline and Mounting Dimensions.

Refer to Figure 2-6 for an illustration of the ECU outline and mounting dimensions.

NOTES:

1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETERS [INCHES], AND TOLERANCES ARE: ⌓ 0.51 [.020] A B C.
2. MATING SURFACE FLATNESS AND CLEANLINESS TO BE CONTROLED SUCH THAT 2.5 MILLIOHM MAX CONTACT RESISTANCE IS ATTAINED BETWEEN THE ECU-3000 AND THE MMT-3010 OR VERTICAL MATING SURFACE.
3. UNIT WEIGHT: 0.08 kg [0.17] LB.
4. POWER SUPPLIED BY THE HOST LRU. ⟨F⟩
5. CHANGE INDICATED BY LAST REVISION LETTER DENOTED INSIDE ARROW BLOCK.
6. THIS DRAWING APPLIES TO ECU-3000 CPN: 822-1200-XXX.
7. SEE TABLE 1 FOR WIRING INFORMATION.
8. MATING CONNECTOR (CPN: 359-0645-020) MS27484T10F35S. BACKSHELL (CPN: 859-6604-110) M85049/49-2-10N.
9. ⊕ DENOTES CENTER OF GRAVITY.
10. UNIT SHOULD BE MOUNTED ON A VERTICAL SURFACE WITHIN 5 FEET OF THE HOST UNIT. OTHER MOUNTING ORIENTATIONS MAY BE ACCEPTABLE UPON CONFIRMATION BY ENGINEERING. MOUNTING ON A HORIZONTAL SURFACE WITH THE CONNECTOR FACING UP IS NOT ACCEPTABLE.

UNIT CONNECTOR P1

FUNCTION	PIN NO.
ECU POWER INPUT (8VDC NOM)	1 ⟨F⟩
ECU ENABLE #1 INPUT	2
ECU WRITE ENABLE #1 INPUT	3
ECU SERIAL DATA OUTPUT	4
ECU ENABLE #2 INPUT	5
ECU WRITE ENABLE #2 INPUT	6
ECU CLOCK	7
ECU SERIAL DATA INPUT	8
ECU POWER RETURN/COMMON	9

TABLE 1

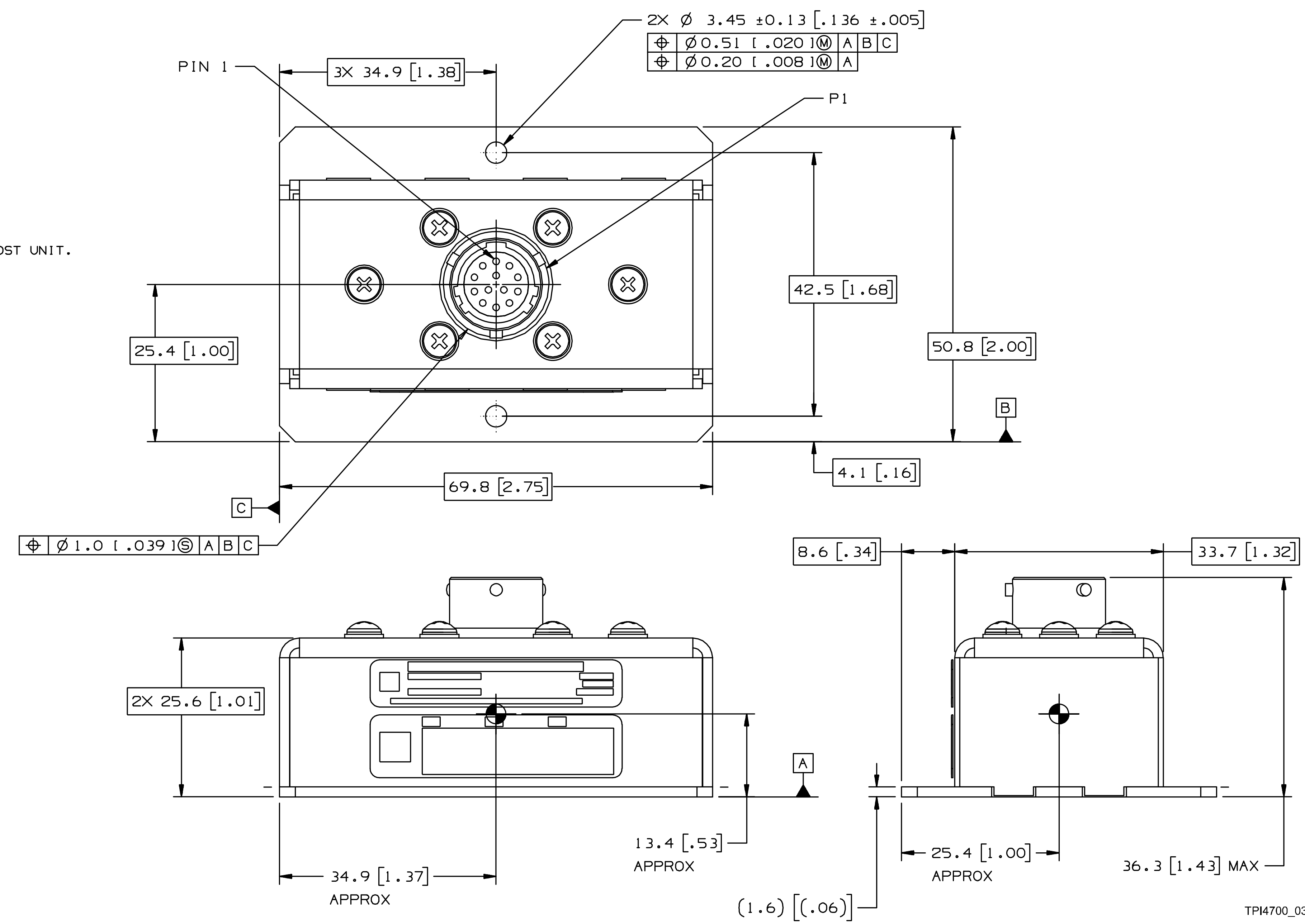


Figure 2-6. ECU-3000 Outline and Mounting Dimensions

2.6.7. Installation and Removal.

CAUTION

Make sure that the aircraft battery master switch is turned off before installing any equipment, mounts, or interconnect cables. Failure to do so can damage the equipment.

The unit should be mounted on a vertical surface. Other mounting orientations may be acceptable upon confirmation by engineering. Mounting on a horizontal surface with the connector facing up is not acceptable, and can cause operational failure or damage to the ECU due to water that does not drain out.

For installations with a TSS, the maximum length of each wire between the TSS and the ECU should be one meter to avoid potentially damaging currents.

NOTE

Refer to the ECU-3000 outline and mounting diagram Figure 2-6 for further instructions. Refer to Table 2-3 for specific mating connector and contact information.

The installation and removal instructions for the ECU-3000 follow.

2.6.7.1. Installation. The ECU-3000 is designed to stay with the aircraft during a TSS-4100 removal. The ECU-3000 is designed to be secured to a vertical surface of the aircraft frame. Instructions for installing the unit are as follows:

a. Remove aircraft power.

b. Secure the ECU to the mounting surface with two mounting screws.

c. Connect the mating connector cable assembly to the unit connector.

2.6.7.2. Removal. The procedure to remove the ECU-3000 follows:

a. Remove aircraft power.

b. Disconnect the mating connector cable assembly from the unit connector.

c. Remove the two mounting screws that secure the ECU to the mounting surface.

2.6.8. Internal Theory of Operation.

The ECU-3000 is used to store aircraft specific configuration data. The ECU has two halves in which it stores data. The top half is programmed by Rockwell Collins to enable basic functionality of the TSS. The bottom half is programmed by the aircraft manufacturer. There are two partitions of this bottom half. The first partition contains all of the aircraft specific transponder, TCAS, and ADS-B strapping information. The second partition contains the aircraft Mode S address.

2.7. TDR-94D 34-54-00.

The sections that follow describe the external theory of operation, internal theory of operation, and general data of the Mode S transponder in a traffic surveillance system.

2.7.1. Mode S Transponder, External Theory of Operation.

NOTE

The term CONTROLLER refers to any transponder control unit, such as an Radio Tuning Unit (RTU), a Transponder Control (CTL), or a Control Display Unit (CDU). Buses and discretes are followed in parentheses by the specific bus name shown in the example illustration, Figure 2-7.

Refer to Figure 2-7. This sheet shows a typical transponder system, and the external signals to and from the Transponder (TDR). Operating power is derived from the +28 V dc avionics triple-fed bus supply.

2.7.1.1. The TDR is controlled by an ARINC standard transponder controller such as an RTU or a CDU. A controller provides the transponder state (STANDBY, ALTITUDE REPORTING OFF, ALTITUDE REPORTING ON), the flight ID, the squawk code, the selected altitude, and TCAS control data.

2.7.1.2. Either two or three ARINC 429 low-speed control busses may be routed to the TDR containing control and altitude data. The on-side data comes to Control Port B. The cross side data comes to Control Port A. An optional back up third controller comes to Control Port C. The microprocessor reads the discrete (RTU PORT A/B SELECT, P2-57) and selects the active port. Normally, port B is selected and the TDR is tuned by the on-side controller (RTU). When the reversion switch (RTU1 INHB) is set to inhibit, a ground is applied to pin P2-57, which selects port A of the right side controller (RTU) tune data. When the reversion switch (RTU2 INHB) is also set to inhibit, a ground (BURST TUNE ENABLE) is applied to pin P2-59, which selects port C (IAPS) burst tune data.

2.7.1.3. The TCAS/transponder cross talk busses (TSS-TX and TDR-XT busses) are used for coordination between the TCAS function of the TSS and the TDR.

2.7.1.4. The Mode S address is set by rear connector strapping (P1-33 through P1-56) and is unique for each aircraft.

2.7.1.5. The main transponder output bus (TDR-1) outputs maintenance data and echoes selected control data.

2.7.1.6. The TDR-94D operates with two antennas to provide traffic air-to-air capability. The 1030 Hz interrogation input is received on either or both L-band antennas, low-pass filtered, and applied through diversity and transmit/receive switches to the front-end receiver. The diversity switch is not used in receive mode. The transmit/receive switch connects the antennas to the receiver (not the transmitter) in receive mode.

2.7.1.7. The TDR responds to Air Traffic Control Radar Beacon System (ATCRBS) and Mode S All-Call interrogations.

2.7.1.8. The TDR also responds to selective Mode S interrogations. These interrogations use the transponder Mode S address. This mode allows the air traffic controller to identify each aircraft by tail number. It is also used by the traffic surveillance system for air-to-air communication with a cooperating aircraft.

2.7.1.9. A suppression pulse (P1-29) is generated while the TDR is transmitting a response to an interrogation. This pulse is intended to inhibit the receivers in other L-band radios, such as the TSS and the DME. These other radios also generate a suppression pulse while they are transmitting. While this is active the TDR will inhibit its replies.

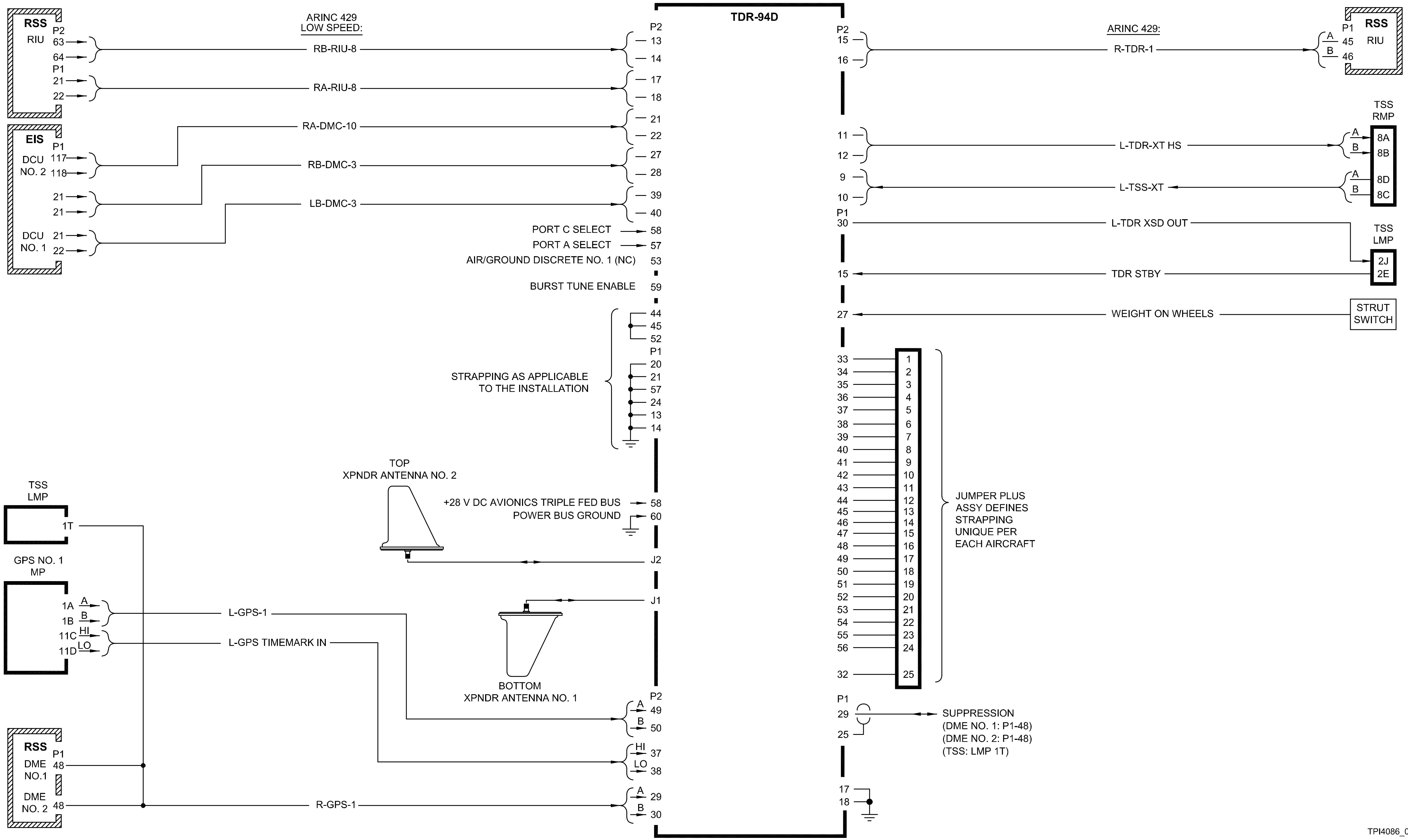


Figure 2-7. Mode S Transponder, TDR-94D, External Theory of Operation

2.8. MODE S TRANSPONDER, TDR-94D, DATA.

The TDR-94D is a Mode-A, Mode-C, and Mode-S diversity (two antenna) transponder.

2.8.1. TDR-94D ATC/Mode S Transponder Mounting Considerations.

The TDR-94D transponder is mounted on the MMT-150 Modular Mounting Tray, CPN 622-9672-XXX. Piggyback mounting brackets are available to mount an MMT-150 Modular Mounting Tray over another MMT-150 Modular Mounting Tray. Refer to the Pro Line II Installation Manual (CPN 523-0772719) for additional information.

2.8.2. TDR-94D Illustration.

Refer to Figure 2-8 for an illustration of the TDR-94D.

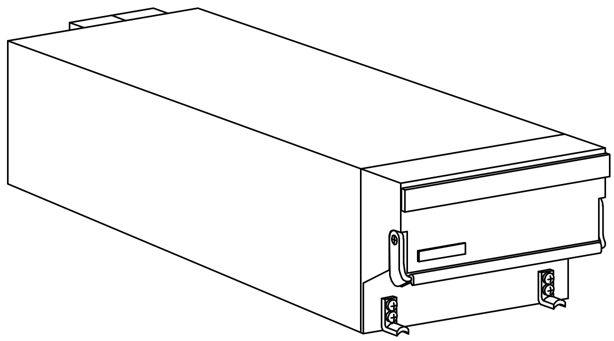


Figure 2-8. TDR-94D

2.8.3. TDR-94D Mating Connector Data.

Figure 2-9 shows a mating connector pictorial for the TDR-94D. Each connector shows pin locations to aid the troubleshooting effort. Refer to Figure 2-11 for internal signals for the TDR-94D. Also refer to the interconnect wiring diagram in the appendix. Table 2-4 shows the mating connector hardware and tooling for the TDR-94D.

Table 2-4. TDR-94D Mating Connector Hardware and Tooling.

TDR-94D HARDWARE/TOOLING
Mating connector kit: CPN 628-8661-001 (qty 2)
Connector: 60-pin Thinline II, CPN 634-1112-001
Contacts: CPN 372-2514-110 (insulation up to 1.27 mm (0.050 in) diameter)
Contacts: CPN 372-2514-180 (insulation from 1.27 mm (0.050 in) to 2.03 mm (0.080 in) diameter)
TNC connector: Automatic 301-T2100N, CPN 357-7351-010 (qty 2)
Tooling *
*Thinline II Connector Tooling:
Insertion tool: Daniels DAK-188, CPN 359-0697-050
Extraction tool: Daniels DRK-188, CPN 359-0697-060
Crimp tool: Daniels GMT-221, CPN 359-0697-010
Coax extraction tool: Cannon CET-C6B, CPN 370-8040-030
Coax crimp tool: MIL M22520/5-01, CPN 359-8103-010
Crimp tool positioner: Daniels Y142, CPN 359-8103-050

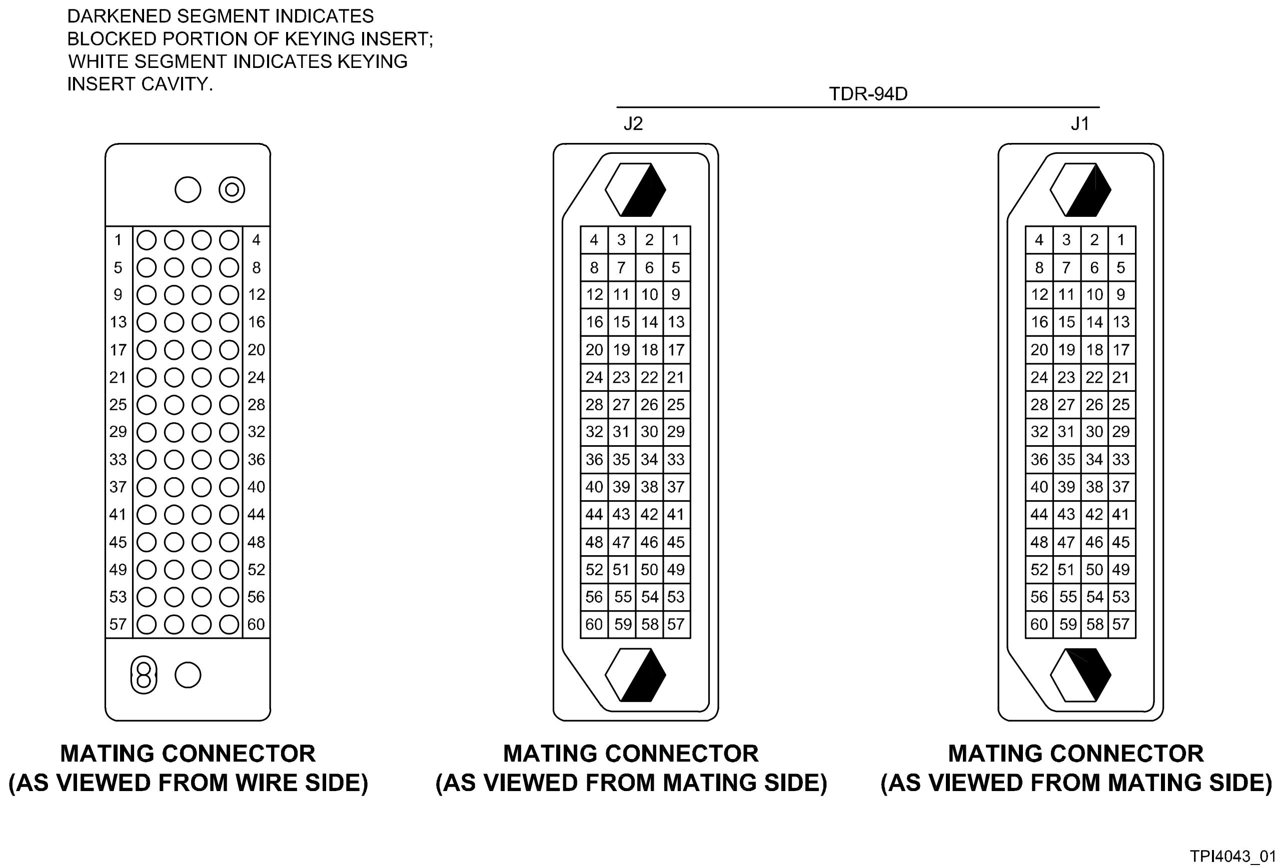
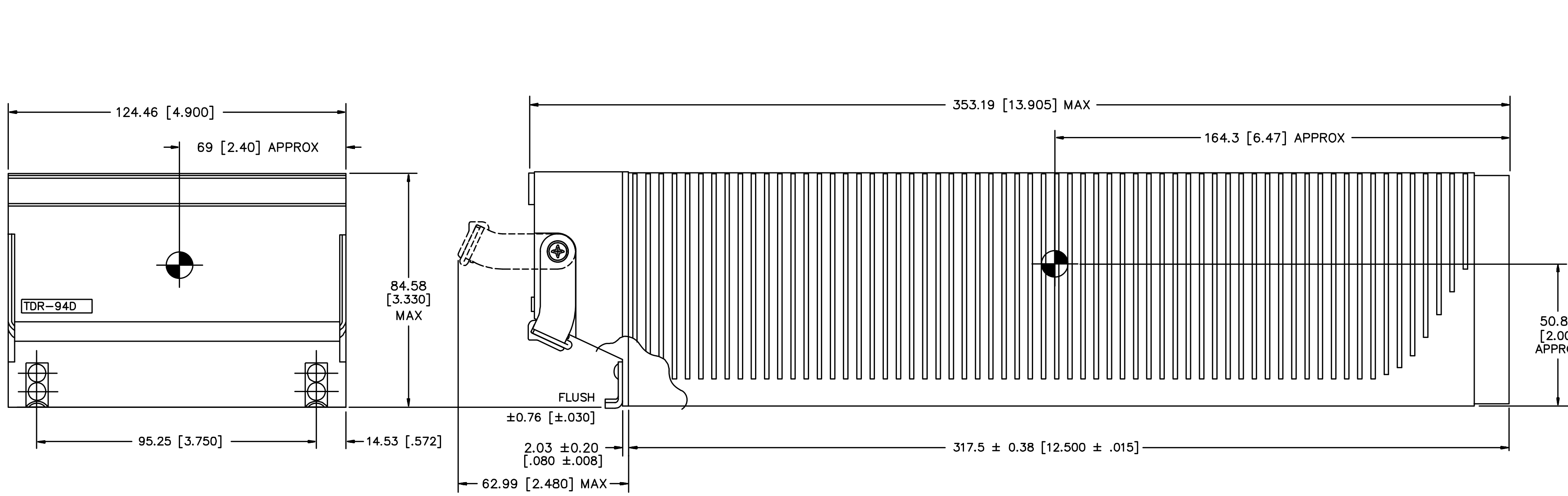
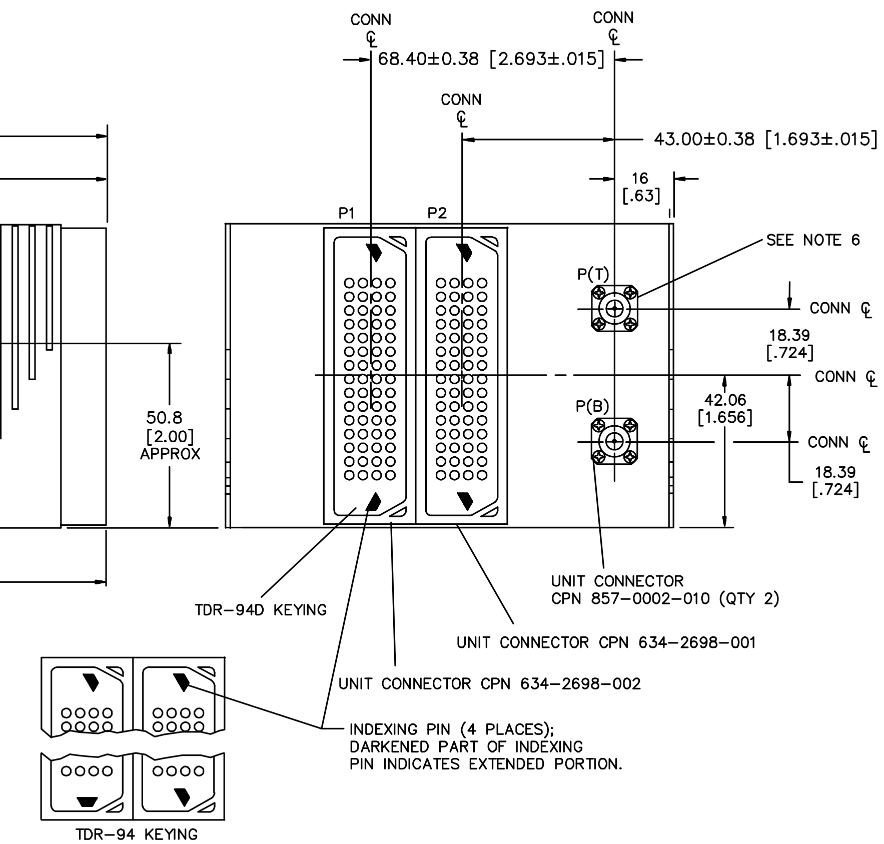


Figure 2-9. TDR-94D Mating Connectors

2.8.4. TDR-94D Outline and Mounting Dimensions.

Refer to Figure 2-10 for an illustration of the TDR outline and mounting dimensions.





NOTES:

1. DIMENSIONS ARE IN MILLIMETRES [INCHES].
2. (center of gravity symbol) DENOTES CENTER OF GRAVITY.
3. UNIT WEIGHT IS 3.8 kg [8.5 LB] NOMINAL.
4. THIS UNIT USES A MMT-150 MOUNTING TRAY (CPN 622-9672-003)
5. FOR MATING CONNECTOR INFORMATION REFER TO INSTALLATION INSTRUCTIONS.
6. NOT USED ON TDR-94.
7. INSTALLATION HARDWARE (NOT INCLUDED WITH UNIT)

TDR-94 ⟨F⟩

DESCRIPTION	COLLINS PART NO.	NOTE	OPTIONS/QTY	
			A	B
MOUNT MMT-150	622-9672-003	7.4	1	1
CONNECTOR KITS: INCLUDING CONTACTS EXCLUDING CONTACTS	 628-8660-002 628-8661-002		 1 	 1
CONNECTOR CONTACTS CONNECTOR CONTACTS 90° TNC CONNECTOR		7.1 7.2 		25 75 1

TDR-94D

DESCRIPTION	COLLINS PART NO.	NOTE	OPTIONS/QTY				
			A	B	C	D	E
MOUNT MMT-150 MOUNT MMT-150 MOUNT MMT-150	622-9672-001 622-9672-004 622-9672-003	7.3 7.5 7.4	1 	1 	 1	 1	 1
CONNECTOR KITS: INCLUDING CONTACTS INCLUDING CONTACTS EXCLUDING CONTACTS EXCLUDING CONTACTS	 628-8660-001 628-8660-003 628-8661-001 634-1021-002		 1 	 1	 1 	 1 	 1
CONNECTOR CONTACTS CONNECTOR CONTACTS 90° TNC CONNECTOR	372-2514-110 372-2514-180 357-7351-010	7.1 7.2 		25 75 2		25 75 2	

7.1 CONTACTS (COLLINS PART NO. 372-2514-110) ARE FOR USE WITH WIRE HAVING AN INSULATION OD OF 1.27 [.050] MAX.

7.2 CONTACTS (COLLINS PART NO. 372-2514-180) ARE AVAILABLE FOR USE WITH WIRE HAVING AN INSULATION OD OF 1.27 [.050] TO 2.03 [.080].

7.3 PREFERRED MOUNT WITH CONNECTOR PLATE.

7.4 PREFERRED MOUNT WITHOUT CONNECTOR PLATE.

7.5 MOUNT FOR RUGGED VIBRATION (HELICOPTER).

8. THIS DRAWING IS APPLICABLE TO THE FOLLOWING EQUIPMENT:

EQUIPMENT	COLLINS PART NO
TDR-94	622-9352-XXX
TDR-94D	622-9210-XXX

9. CHANGE INDICATED BY LAST REVISION LETTER DENOTED INSIDE ARROW BODY.

(653-0705-001F_1)
TPI4055_01

Figure 2-10. TDR-94D Outline and Mounting Dimensions

2.8.5. Installation and Removal.

WARNING

Make sure that the aircraft battery master switch is turned off before installing any equipment, mounts, or interconnect cables.

The installation and removal instructions for the TDR-94D follow.

2.8.5.1. Installation. The procedure to install the TDR-94D follows:

a. Remove electrical power from the aircraft.

b. Install the MMT-150 Modular Mounting Tray and connector kit according to the procedures printed in the Pro Line II Installation Manual (CPN 523-0772719).

c. Install and orient the mating connector keyway pins, (part of the mating connector kits). If installing systems on multiple aircraft, similar orientation of the keyways is advisable for quick maintenance removal and replacement.

d. Verify all interconnect wiring before proceeding. Verify input power is applied to appropriate pins only.

e. Remove aircraft power and slide TDR-94D ATC/Mode S Transponder into mount until mating connector is fully engaged.

f. Position knurled knobs on front of mount to engage unit-mounting projections and tighten knurled knobs.

g. Push on the front panel to make sure that the unit is fully seated in the mount. Retighten the knurled knobs until the unit is secure in mount.

h. Make sure a good electrical bond exists between the unit and mount.

i. Install safety wire.

2.8.5.2. Removal. The procedure to remove the TDR-94D follows:

a. Remove electrical power from the aircraft.

b. Remove the safety wire.

c. Loosen the knurled knobs that secure the unit to the mount.

d. Pull TDR-94D ATC/Mode S Transponder from mount.

2.8.6. Internal Theory of Operation.

Refer to Figure 2-11. When active, the TDR responds to valid ATCRBS radar interrogations with a coded identification in Mode-A or reporting altitude in Mode-C reply. The response code is selected on the controller.

2.8.6.1. The TDR consists of a main microprocessor, serial and discrete I/O interfaces, a 1030 MHz receiver, an interrogation processor, and a 1090 MHz transmitter. Operating power is derived from the +28 V dc avionics triple-fed bus supply. This input is filtered and applied through an internal breaker to the low-voltage power supply. This supply generates internally required low-level voltages, and feeds the high-voltage power supply. A voltage monitor reports power supply integrity to the microprocessor.

2.8.6.2. Refer to Figure 2-11. The main microprocessor uses a 16-bit bidirectional data bus to control unit operation. An address latch and a data transceiver provide the interface between the processor and internal circuits. This processor controls all I/O data transfer, monitors key internal power levels, programs the frequency synthesizer, generates high-voltage supply disable logic, and shares data with the dedicated video processor through a dual-port Random Access Memory (RAM). The processor also directly monitors the temperature of the transmit modulator. If temperature becomes excessive, data is latched that toggles a discrete to inhibit the high-voltage power supply.

2.8.6.3. The I/O interface circuits consist of three input UARTs, two discrete input buffers, and two output UARTs. The main microprocessor accesses each circuit using the bidirectional data bus (DB0-DB15).

2.8.6.4. ARINC 429 low-speed data buses are received and applied to the RTU multiplexer. The microprocessor reads the PORT A/B select discrete and selects the active port. The RTU multiplexer supplies control data from the selected port, A or B, through an input UART to the microprocessor.

2.8.6.5. The second input UART is reserved for two Air Data Computer (ADC) air data input buses.

2.8.6.6. The data bus input through an ARINC 429 high-speed receiver to the third input UART is read from the UART by the microprocessor.

2.8.6.7. The processor reads the discrete inputs through two buffer circuits. The first buffer provides the input port A/B select logic, strut switch logic, source identification logic, maximum airspeed logic, altitude input logic, and TCAS installed logic.

2.8.6.8. Parallel data is output from the microprocessor to the output UARTs. Both UARTs are enabled by the processor to decode and transmit serial data.

2.8.6.9. The TDR is interrogated by the 3-pulse Side-Lobe-Suppression (SLS) method. The TDR-94D operates with one antenna to provide TCAS air-to-air capability. The 1030-MHz interrogation input is received on the L-band antenna, low-pass filtered, and applied through the transmit/receive switch to the front end receiver. The transmit/receive switch connects the antennas to the receiver, but not the transmitter, in receive mode.

2.8.6.10. The front end receiver is a dual 1030-MHz bandpass filter that rejects images and spurious responses. The two filtered rf inputs are then independently mixed with a 1090-MHz injection frequency from the synthesizer. This local oscillator frequency is programmed by the microprocessor using latched data, clock, and enable logic. The two resultant 60-MHz if signals are amplified and applied to the Differential Phase Shift Keying (DPSK) detector and the video processor.

2.8.6.11. The DPSK detector is a part of the receiver circuit that senses phase reversals present in mode-S interrogations. The DPSK detector outputs are applied to the Pulse Amplitude Modulation (PAM) decoder. The video processor monitors the received signal strengths and generates video signals to the PAM decoder.

2.8.6.12. The PAM decoder and a dedicated video microprocessor function together as an interrogation processor. This circuit processes the video inputs to determine if the received interrogation is a valid ATCRBS or Mode-S interrogation. If a response is required, the processor determines if the top or the bottom antenna should be used for the reply. The processor then enables the transmit mode and generates the proper response. The TCAS generated collision avoidance transmit data is input to the interrogation processor through the dual port RAM.

2.8.6.13. When transmit mode is enabled by the interrogation processor, INT SUPRN logic activates the suppression amplifier and XMT ENBL logic activates the transmit enable driver. During transmit mode, the suppression amplifier momentarily inhibits other L-band units, described in a later paragraph. During transmit mode, the enable driver closes the transmit/receive switch. This isolates the receiver and connects the transmitter to the selected antenna. The interrogation processor generates the ATCRBS or Mode-S reply output and top/bottom antenna select logic. This response is applied through a multiplexer to the rf transmit modulator.

2.8.6.14. The 1090-MHz transmitter circuit consists of an rf modulator and a power amplifier. The rf modulator receives operating power from the high-voltage power supply. This power supply provides the voltage levels required for L-band transmission. A current monitor disables both the rf modulator and the High-Voltage (HV) supply if the current draw or power output becomes excessive. An HV power monitor provides a high-power monitor output through a buffer to the main microprocessor.

2.8.6.15. The reply output from the interrogation processor controls the modulator bias applied to the power amplifier. The power amplifier is driven by a 1090-MHz CW signal generated by the synthesizer. The ON/OFF BIAS from the modulator causes the power amplifier to generate a corresponding pulse train output, at the 1090-MHz drive frequency. This rf reply output is a series of pulses, the number and spacing of which is determined by the ATC code plus a trailing IDENT pulse, if selected, and the operating mode. The pulse transmission is applied through the closed transmit/receive switch and radiated out the antenna. The transmit signal is sampled by a forward power monitor, which provides a low-power monitor output through a buffer to the processor.

2.8.6.16. A suppression amplifier generates a blanking pulse output when the interrogation processor selects transmit mode.

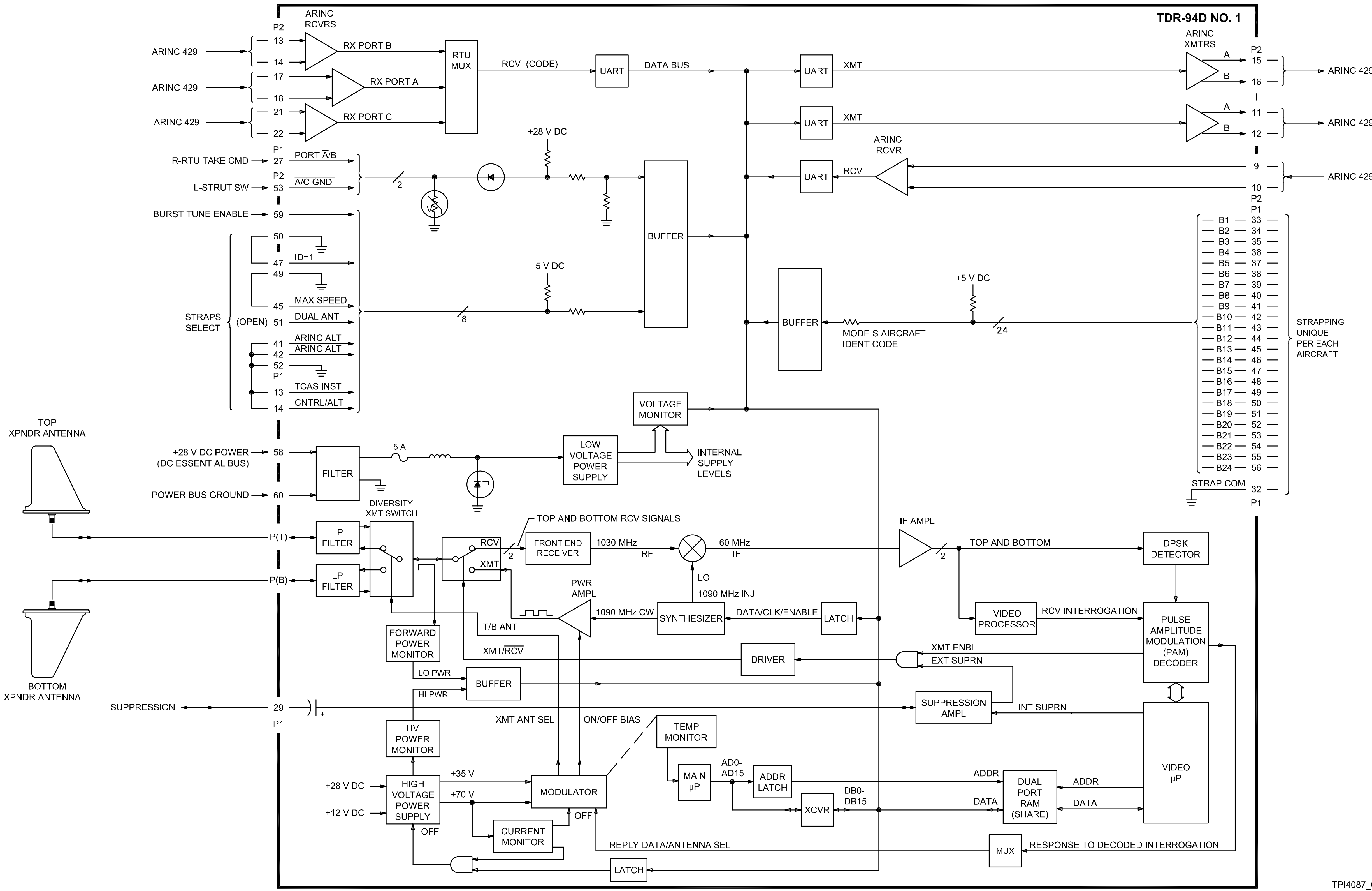


Figure 2-11. Mode S Transponder, TDR-94D, Internal Theory of Operation

2.9. TRE-930 34-54-00.

The sections that follow describe the external theory of operation, internal theory of operation, and general data of the TRE L-Band Omnidirectional Antenna in the traffic surveillance system.

2.9.1. TRE-930 L-Band Directional Antenna, External Theory of Operation.

Refer to the TSS External Simplified Schematic Figure 2-19. This sheet shows the external wire signals to and from the TRE-930 and the TSS-4100. The TRE-930 antenna is a single, non-repairable unit. When used with the TSS-4100, the TRE-930 antenna mounts only on the bottom of the aircraft. There are no operator controls or adjustments on this antenna.

2.10. ANTENNA, TRE-930, DATA.

NOTE

If the TRE-930 or any other omni-directional antenna is used, the option for antenna monitoring in the aircraft configuration portion of the ECU must be enabled. The TSS uses antenna monitoring to determine that there is only a single connection on the bottom of the aircraft. If antenna monitoring is off, the TSS will assume that there is a directional antenna on the bottom of the aircraft. If antenna monitoring is off, any TSS antenna port not connected to an antenna may cause a failure of the TSS transmitter or receiver.

The TRE is an L-band omnidirectional antenna. The TRE radiates and receives L-band signals in an omnidirectional pattern.

2.10.1. TRE-930 Illustration.

Refer to Figure 2-12 for an illustration of the TRE-930.

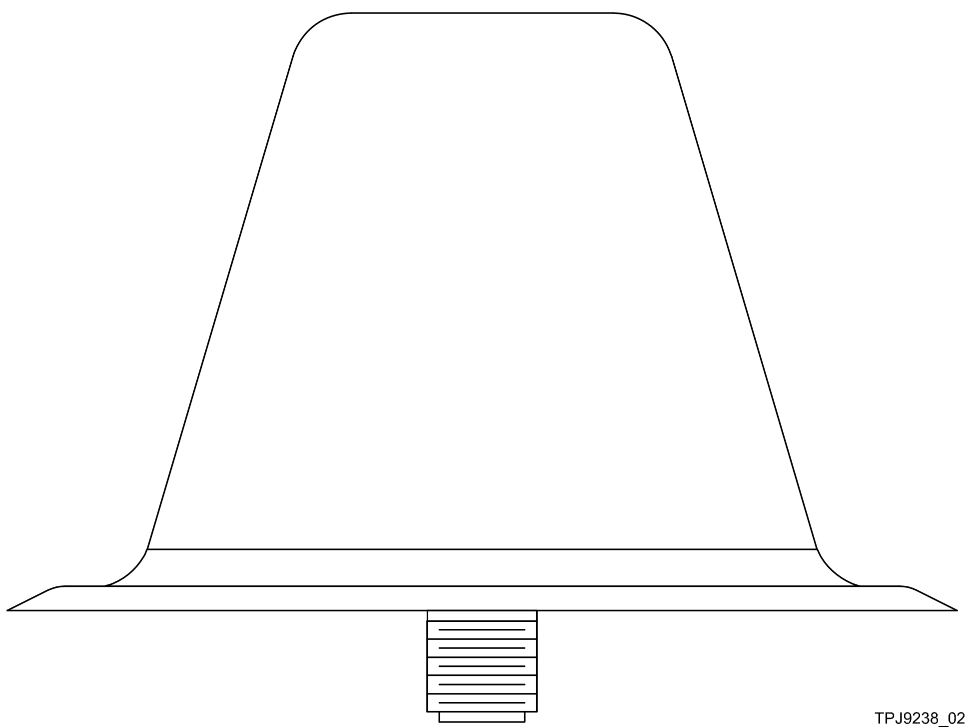


Figure 2-12. TRE-930

2.10.2. TRE-930 Mating Connector Data.

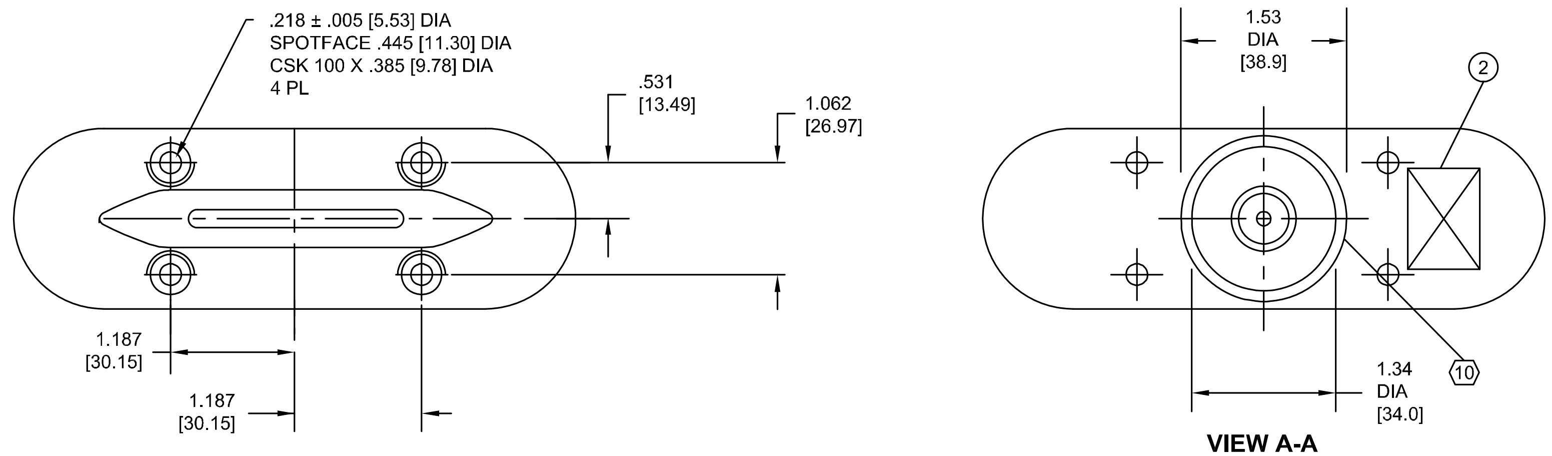
Table 2-5 shows the mating connector hardware and tooling for the TRE-930. Also refer to the interconnect wiring diagram in the appendix.

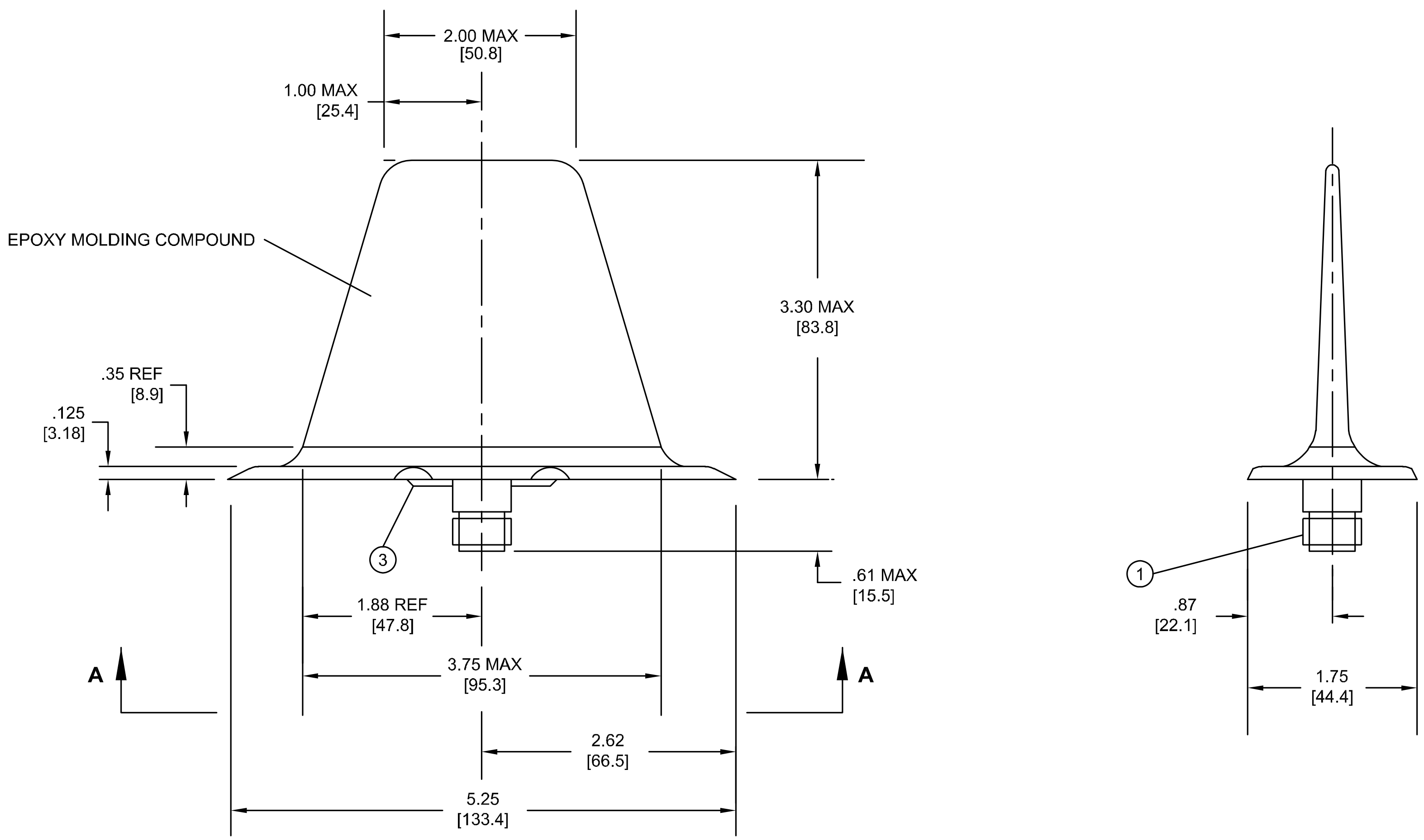
Table 2-5. TRE-930 Mating Connector Hardware and Tooling.

TRE-930 HARDWARE/TOOLING
RF connector 90° TNC for ECS cable 311201: CPN 857-1502-020 (CTS122), Vendor Ref VC-8,
RF connector straight, TNC for ECS cable 311201: CPN 857-1502-010 (CTR122), Vendor Ref VC-8
RF connector, straight, TNC for RG-142: CPN 357-9666-000
RF connector, 90°, TNC for RG-142: CPN 357-9664-000
RF grounding gasket: CPN 018-1394-110

2.10.3. TRE-930 Outline and Mounting Dimensions.

Refer to Figure 2-13 for an illustration of the TRE-930 Outline and Mounting Dimensions.





NOTES:

1. ANTENNA CERTIFIED PER TSO C66, C74 & DO160C.
2. IMPEDENCE: 50 OHMS NOMINAL.
3. FREQUENCY: 1000-1100 MHZ, VSWR 1.5:1.
4. POWER: 3K WATTS PEAK , 100 WATTS AVERAGE.
5. RADIATION PATTERN: WITHIN 0.75 dB OF A MATCHED λ/4 STUB OVER 90% COVERAGE VOLUME FROM -15° TO +20° IN ELEVATION
6. LIGHTNING PROTECTION: DC GROUNDED.
7. WEIGHT: 6 OZ MAX.
8. FINISH: MOUNTING SURFACE - BLACK ANODIZE REMAINING SURFACES GLOSS WHITE POLYURETHANE PAINT COLOR NO. 17925 PER FED-STD-595 4 MTG HOLES CSK'S TO BE TREATED WITH CHEM FILM PER MIL-C-5541 & BE FREE OF PAINT & ANODIZE.
9. SPEED RATED TO 600 KNOTS.

(10) O-RING GROOVE MAY BE TREATED WITH CHEM FILM PER MIL-C-5541 OR MAY BE TREATED WITH BLACK ANODIZE PER MIL-A-8625.

(983-8003-046-_2)
TPJ9238_01

Figure 2-13. TRE-930 L-Band Antenna, Outline and Mounting Dimensions

2.10.4. Omni-Directional Requirements.

If a different antenna is used instead of a TRE-930, there are requirements to be compatible with the TSS-4100. There are also requirements to facilitate certification with a TCAS/transponder system.

2.10.4.1. The requirements of an antenna to replace the TRE-930 for use with the TSS-4100 follow:

- It must have a DC impedance of 50 Ω.
- It must have continuous power at a minimum of 50 W.
- It must have peak power at a minimum of 4 kW.
- It must be certified to work at a minimum of the maximum altitude of the aircraft.

2.10.4.2. The recommended requirements to facilitate the certification of the TCAS, transponder, and related antenna system on an aircraft are below:

- It is recommended that the system be certified as operational, at a minimum, between -55 and 80 ºC.
- It is recommended that the system have a Voltage-Standing Wave Ratio (VSWR) of 1.5 to 1 or less, for 1000 to 1100 MHz.
- It is recommended that the system be compliant with TSO-C119. Specifically, it is recommended that the antenna comply with the requirement in Section 2.2.4.7.2.1 of DO-185A. This requires that the gain of an omnidirectional wave pattern not be less than the gain of a matched quarter-wave stub, minus one dB, over 90% of a coverage volume from 0 to 360 degrees in azimuth, and -15 to +20 degrees in elevation.

2.10.5. Installation and Removal.

WARNING

Make sure that the aircraft battery master switch is turned off before installing any equipment, mounts, or interconnect cables.

The installation and removal instructions for the TRE-930 follow.

2.10.5.1. Installation. The procedure to install the TRE-930 follows:

a. Make sure that the cabling to the TSS-4100 is correct before proceeding.

b. Connect the connector to the TRE-930 antenna and position the antenna on the fuselage.

c. Secure with four mounting screws.

d. Apply any weather or aerodynamic strip of sealant to the periphery of the antenna and shape as necessary.

2.10.5.2. Removal. The procedure to remove the TRE-930 follows:

a. Remove sealant around periphery of the TRE-930 antenna.

b. Remove the four screws from the antenna and do not allow the antenna to hang from the cable.

c. Disconnect the connector from the antenna.

2.11. TSA-4100 34-54-00.

The sections that follow describe the external theory and general data of the directional Traffic Surveillance Antenna (TSA) in the Traffic Surveillance System.

2.11.1. Traffic Surveillance Antenna, External Theory of Operation.

Refer to Figure 2-18 for a simplified block diagram that includes this antenna. The TSA-4100 Antenna acts both as an omni and a directional antenna at 1030 MHz & 1090 MHz at +/- 3 MHz for the Traffic Surveillance System. It has four passive antenna elements for directionality and is mounted on the outside of the aircraft fuselage. The upper antenna must be the TSA-4100 directional antenna. The lower antenna can be another TSA-4100 directional antenna or it can be an omnidirectional antenna. The return loss for each connector is less than or equal to -12.5 dB. Meeting the MOPS requirements for TSO-C112 and TSO-C119b, the antenna is vertically polarized. The TSA-4100 meets all lightning protection requirements for Zone 1A on an aluminum ground plane.

2.12. ANTENNA, TSA-4100, DATA.

The TSA is Mode S directional antenna. The number 1 TSA is mounted on the top of the aircraft. The optional number 2 TSA is mounted on the bottom of the aircraft. For the TCAS function of the TSS, the TSA is directional, which allows the system to compute bearing to a target aircraft. For the transponder function of the TSS, the TSA acts as an omnidirectional antenna.

2.12.1. TSA-4100 Illustration.

Refer to Figure 2-14 for an illustration of the TSA-4100.

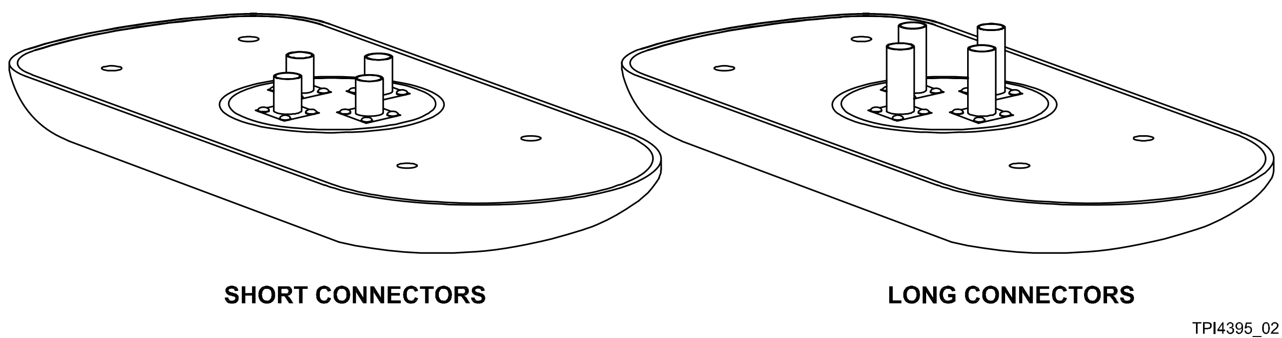


Figure 2-14. TSA-4100, Short and Long Connectors

2.12.2. TSA-4100 Outline and Mounting Diagram.

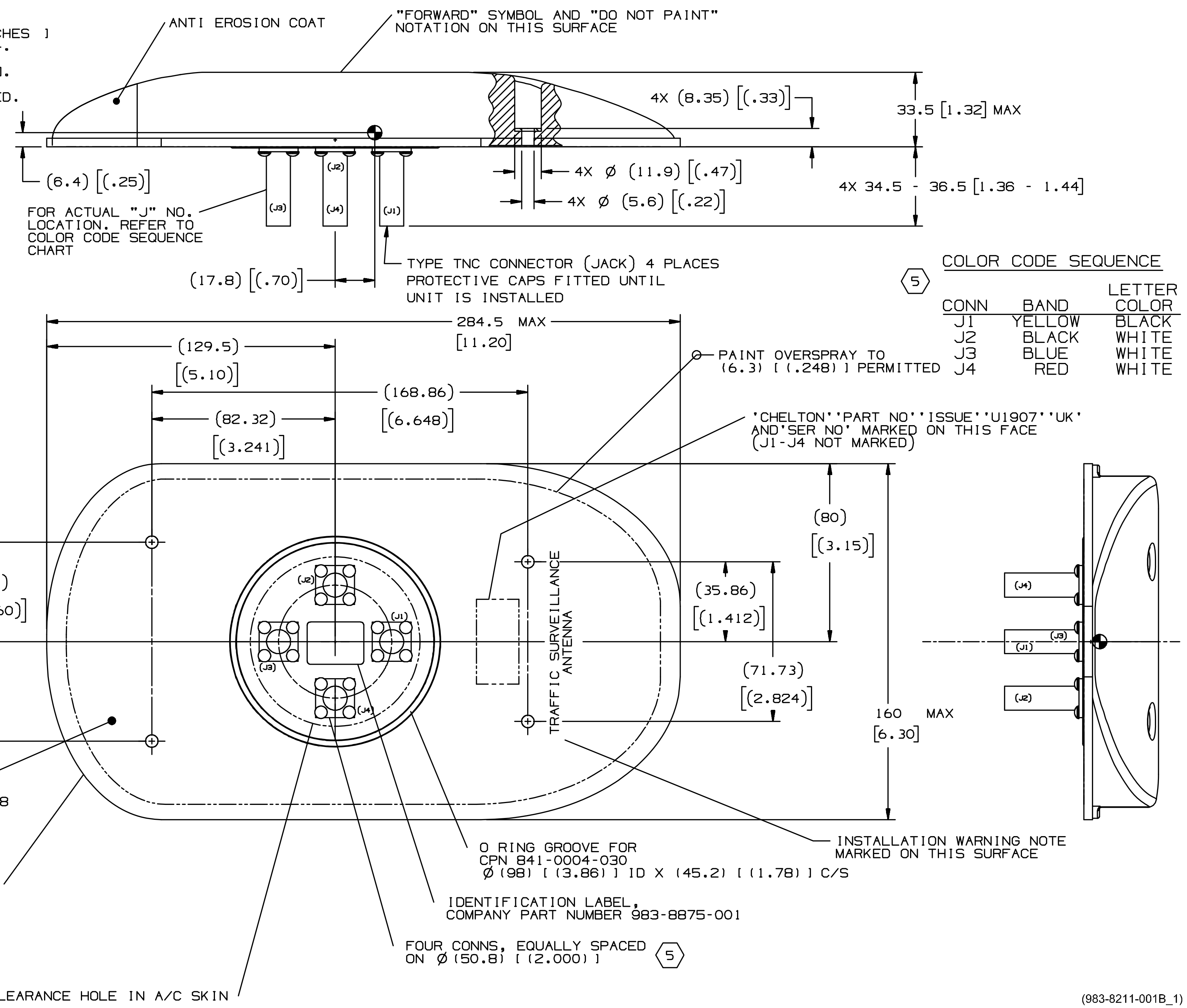
NOTE

There are two versions of connectors on the TSA. One version of TSA has longer connectors, the other version has shorter connectors. Refer to Figure 2-15 for connector lengths.

Refer to Figure 2-15 for outline and mounting diagrams of the TSA-4100 with long connectors. Refer to Figure 2-16 for outline and mounting diagrams of the TSA-4100 with short connectors.

NOTES:

1. THIS DRAWING DEFINES THE INSTALLATION REQUIREMENTS FOR EQUIPMENT TYPE TSA-4100 (TOP LEVEL ASSEMBLY 866-0016-001).
2. DIMENSIONS AND TOLERANCES ARE EXPRESSED IN MILLIMETERS [INCHES] AND SHALL BE INTERPRETED IN ACCORDANCE WITH ASME Y14.5M-1994. UNLESS OTHERWISE SPECIFIED, DIMENSIONS AND TOLERANCES ARE .X = ± 0.8 [.XX = ± .032] AND .XX = ± 0.25 [.XXX = ± .010].
3. HOLE LOCATION TO PROVIDE FORWARD KEYING. NO KEY PIN REQUIRED.
4. UNIT WEIGHT: 1.0 KG [2.2 LBS.] MAXIMUM.
5. FOR UNIT CONNECTOR INFORMATION, REFER TO BOTTOM VIEW AND RELATED CHART ON SHEET 1.
6. AFTER MOUNTING ANTENNA TO AIRCRAFT BY PROPERLY TIGHTENING MOUNTING HARDWARE, INSTALL SILICON RUBBER PLUGS (COMPANY PART NUMBER 676-3291-002) BELOW FLUSH WITH ANTENNA SURFACE. USE A RUBBER SEALANT, DOW CORNING RTV-3145 OR AN ELECTRICAL EQUIVALENT WITH LESS THAN 2.8 DIELECTRIC CONSTANT AT 100 Hz, TO COMPLETELY FILL AND BLEND SMOOTH THE MOUNTING HOLES. IF ALTERNATE CONSTANT OF SLIGHTLY GREATER THAN 2.8, SUCH AS BMS-5-95, CARE MUST BE TAKEN TO ENSURE THAT SEALANT THICKNESS IS NOT ALLOWED TO BE GREATER THAN 0.125 INCH.
7. PAINT FINISH: GLOSS WHITE POLYURETHANE TO MIL-C-85285. FED, STD 595-17925.
8. ANTI-EROSION COATING: ANTI-EROSION POLYURETHANE TO MIL-C-83445 (CAAPCOAT C-W4 WHITE)
9. PEAK RF PULSE INPUT POWER IS +57dBm.
10. DC RESISTANCE OF EACH PORT AS FOLLOWS: J1=1.2 MOhms, J2=680 kOhms, J3=390 kOhms, J4=220 kOhms.
11. SYMBOL AND ASSOCIATED DIMENSIONS IDENTIFY THE UNIT CENTER OF GRAVITY.



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TPI4395_01

Figure 2-15. TSA-4100 Outline and Mounting Diagram, Long Connector Version (Sheet 1 of 2)

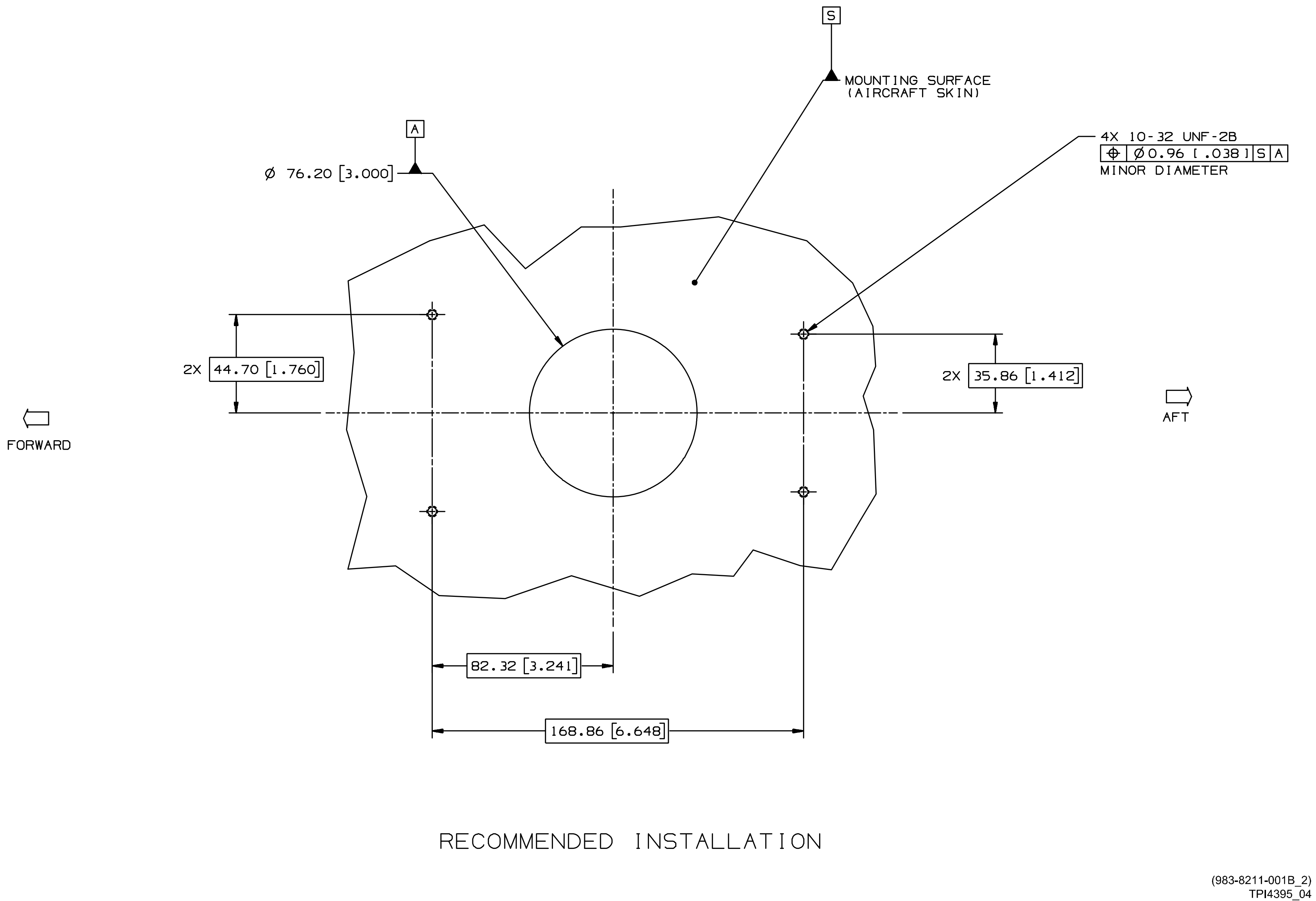
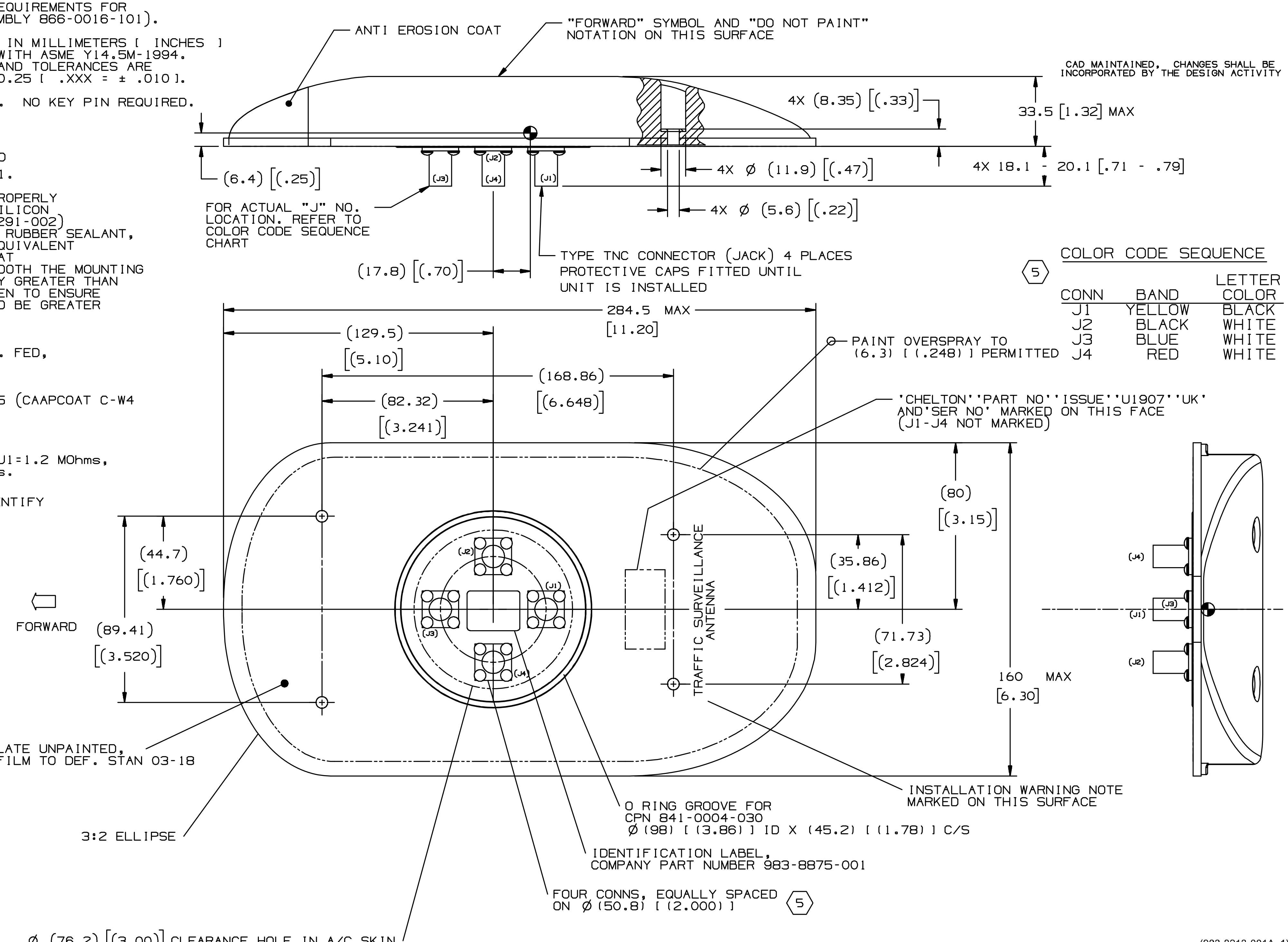


Figure 2-15. TSA-4100 Outline and Mounting Diagram, Long Connector Version (Sheet 2 of 2)

NOTES:

1. THIS DRAWING DEFINES THE INSTALLATION REQUIREMENTS FOR EQUIPMENT TYPE TSA-4100 (TOP LEVEL ASSEMBLY 866-0016-101).
2. DIMENSIONS AND TOLERANCES ARE EXPRESSED IN MILLIMETERS [INCHES] AND SHALL BE INTERPRETED IN ACCORDANCE WITH ASME Y14.5M-1994. UNLESS OTHERWISE SPECIFIED, DIMENSIONS AND TOLERANCES ARE .X = ± 0.8 [.XX = ± .032] AND .XX = ± 0.25 [.XXX = ± .010].
3. HOLE LOCATION TO PROVIDE FORWARD KEYING. NO KEY PIN REQUIRED.
4. UNIT WEIGHT: 1.0 KG [2.2 LBS.] MAXIMUM.
5. FOR UNIT CONNECTOR INFORMATION, REFER TO BOTTOM VIEW AND RELATED CHART ON SHEET 1.
6. AFTER MOUNTING ANTENNA TO AIRCRAFT BY PROPERLY TIGHTENING MOUNTING HARDWARE, INSTALL SILICON RUBBER PLUGS (COMPANY PART NUMBER 676-3291-002) BELOW FLUSH WITH ANTENNA SURFACE. USE A RUBBER SEALANT, DOW CORNING RTV-3145 OR AN ELECTRICAL EQUIVALENT WITH LESS THAN 2.8 DIELECTRIC CONSTANT AT 100 Hz, TO COMPLETELY FILL AND BLEND SMOOTH THE MOUNTING HOLES. IF ALTERNATE CONSTANT OF SLIGHTLY GREATER THAN 2.8, SUCH AS BMS-5-95, CARE MUST BE TAKEN TO ENSURE THAT SEALANT THICKNESS IS NOT ALLOWED TO BE GREATER THAN 0.125 INCH.
7. PAINT FINISH: GLOSS WHITE POLYURETHANE TO MIL-C-85285. FED, STD 595-17925.
8. ANTI-EROSION COATING: ANTI-EROSION POLYURETHANE TO MIL-C-83445 (CAAPCOAT C-W4 WHITE)
9. PEAK RF PULSE INPUT POWER IS +57dBm.
10. DC RESISTANCE OF EACH PORT AS FOLLOWS: J1=1.2 MOhms, J2=680 kOhms, J3=390 kOhms, J4=220 kOhms.
11. (center of gravity symbol) SYMBOL AND ASSOCIATED DIMENSIONS IDENTIFY THE UNIT CENTER OF GRAVITY.



COLOR CODE SEQUENCE (5)

CONN	BAND	LETTER COLOR
J1	YELLOW	BLACK
J2	BLACK	WHITE
J3	BLUE	WHITE
J4	RED	WHITE

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TPI4395_05

Figure 2-16. TSA-4100 Outline and Mounting Diagram, Short Connector Version (Sheet 1 of 2)

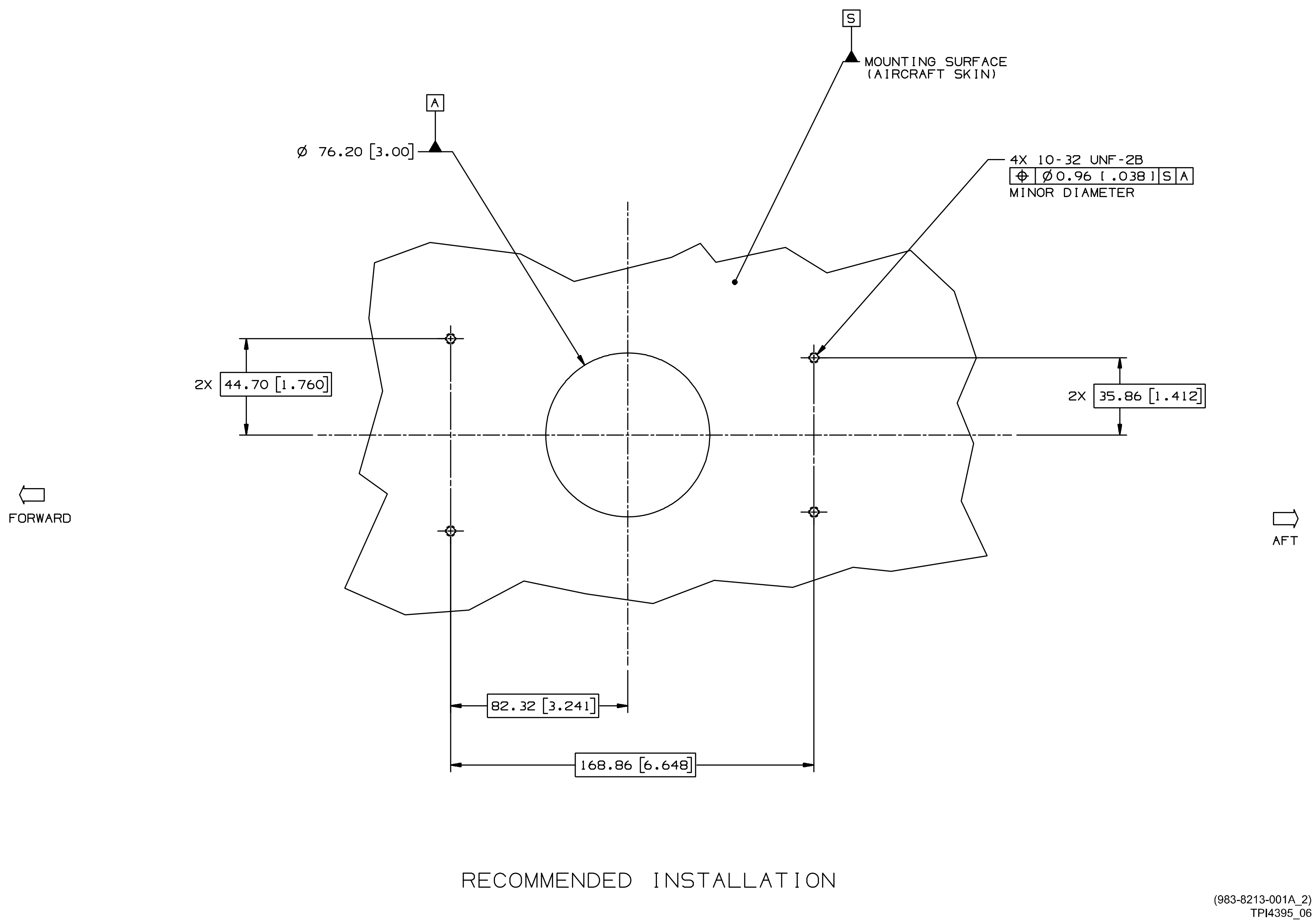

Figure 2-16. TSA-4100 Outline and Mounting Diagram, Short Connector Version (Sheet 2 of 2)

2.12.3. TSA-4100 Mating Connector Data.

Table 2-6 shows the mating connector hardware and tooling for the TSA-4100. Also refer to the interconnect wiring diagram in Figure E-1.

Table 2-6. TSA-4100 Mating Connector Hardware and Tooling.

TSA-4100 HARDWARE/TOOLING
RF connector, TNC for RG-142, qty 4 required: CPN 357-9664-000, Mil M39012/30/0101
RF connector, straight, low loss for ECS cable: CPN 857-1502-010
RF connector 90 degrees low-loss for ECS cable: CPN 857-1502-020
Silicon rubber plug (qty 4): CPN 676-3291-002
O-ring: CPN 841-0004-030

2.12.4. Cabling Considerations.

The recommended cable for use between the TSS-4100 and the TSA-4100 is ECS 311201. Information for RG-142/U has also been provided in the following table, but no testing has been done with the TSS using this cable. The maximum allowable loss between the TSS and its antennas is 3.0 dB. Refer to the values below. The maximum length of the cables is calculated by dividing 3.0 dB by the Loss Factor.

Cable Type	Collins P/N	Delay	Loss Factor	Max Length
ECS 311201	858-5804-010	1.26 ns/ft	0.0589 dB/ft	15.5 m (51 ft)
RG-142/U	Not Available	4.6 ns/ft	0.13 dB/ft	7.0 m (23 ft)

2.12.4.1. The ECU contains settings based on the type and length of cable used (refer to Table 2-2). The antenna coaxial-cable loss is calculated by multiplying the loss factor of the cable used by the length of the cable. The coaxial cable delay is calculated by subtracting the amount of delay from the antenna that is closer to the TSS from the amount of delay from the antenna that is further away from the TSS. The cable delay sign bit is simply a way to determine which antenna is further away from the TSS. Adding the delay to the bottom antenna means that the bottom antenna is closer to the TSS.

2.12.4.2. The TSA-4100 directional antenna requires four antenna cables. Unlike other TCAS antennas, the TSA-4100/TSS-4100 combination does not require the four cables to be in phase. The requirements for the four cables are:

- They are of the same type.
- They are within .3 m (12 in) of length of each other (so cable delay difference between the cables is minimized).
- They are within 0.5 dB of loss of each other (including loss due to the connectors. This is so the Coaxial Cable Loss is the same for all of the cables to the same antenna).

2.12.5. Installation and Removal.

WARNING

Make sure that the aircraft battery master switch is turned off before installing any equipment, mounts, or interconnect cables.

One TSA-4100 Traffic Surveillance Antenna is mounted on top of the fuselage and the second antenna, either another TSA-4100 or an omnidirectional antenna, is mounted on the bottom of the fuselage. All antennas should be mounted in a location that keeps the interconnecting coaxial cables as short as practicable.

2.12.5.1. Antenna Placement. One TSA-4100 is mounted on top of the aircraft fuselage. Another TSA-4100 or an omnidirectional antenna is mounted on the bottom.

2.12.5.1.1. Place the antennas, especially the top antenna, as forward as possible on the aircraft fuselage. Make sure there are as few obstructions as possible between the antenna and the front of the aircraft.

2.12.5.1.2. Make sure that the lateral deviation between the top and bottom antenna is less than 25 feet. This is to make sure that both antennas receive and reply to an interrogation at about the same time.

2.12.5.1.3. Separate the antennas as much as possible from other antennas. The minimum distances from a TSS or TDR antenna, to another type of antenna, are specified below:

- To an ADF antenna, 2 feet
- To a VHF antenna, 5 feet
- To an L-band antenna, 30 inches (approximately 20 dB isolation).

NOTE

Other L-band antennas include the DME, TDR, and TSS antennas.

2.12.5.1.4. Make sure that the tilt angle both in the longitudinal and in the latitudinal directions are as close to parallel to the horizon as possible. Refer to Figure 2-17 for limitations on mounting the antenna.

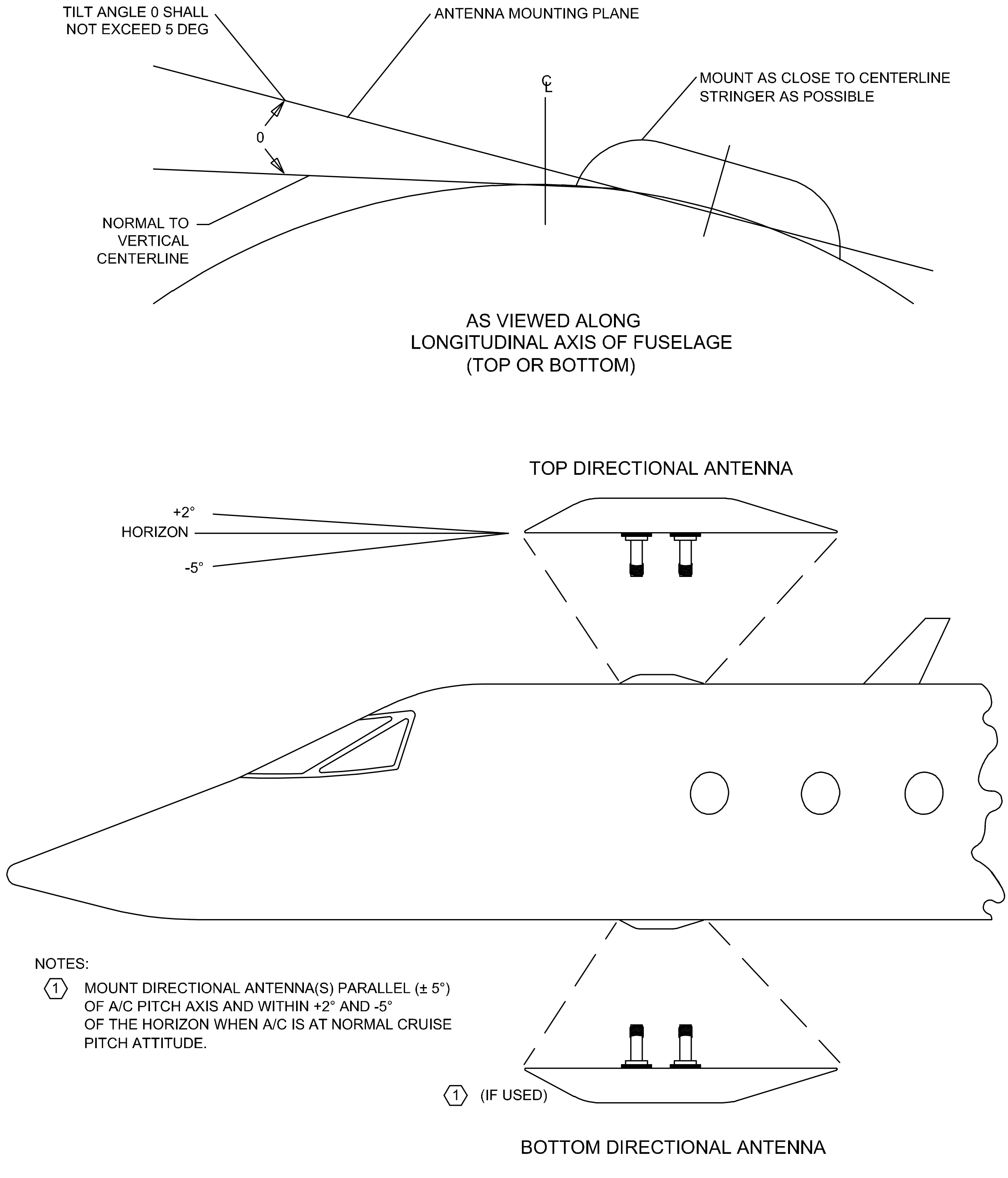

Figure 2-17. TCAS Directional Antenna, Mounting Diagram

2.12.5.2. Installation. To install a directional antenna, follow the steps below:

a. Make sure all interconnect cabling is correct before continuing.

b. Inspect the aircraft skin surface at the mounting location for dirt and corrosion. Clean as necessary.

c. Install an O-ring, CPN 841-0004-030, in the groove on the bottom of the antenna.

d. Connect the appropriate cable to the color-coded J1, J2, J3, and J4 of the antenna, then position the TSA-4100 Antenna.

- J1 – Yellow
- J2 – Black
- J3 – Blue
- J4 – Red.

e. Use four mounting screws to secure the antenna. Stainless-steel socket head-cap screws are recommended. Zinc, cadmium-plated, or aluminum-alloy screws are not recommended.

f. Tighten the screws to almost contact with the bearing surface, and then torque to 25 ±5 lb in.

g. Apply any weather/aerodynamic fillet of sealant to the periphery of the antenna, and shape it as necessary. The height of the bead should not exceed 2.5 mm (0.1 in).

h. Install the four foam-rubber plugs, CPN 676-3291-002, in the antenna mounting holes. Push them down below the antenna surface. Cover the plugs with a layer of Dow Corning gray RTV-3145 (CPN 005-1531-010, or three 3 oz collapsible tubes, or CPN 005-2531-030 for one 11 oz cartridge), or equivalent sealant. Feather sealant over mounting holes and remove any excess sealant.

2.12.5.3. Removal. To remove a directional antenna, follow the steps below:

a. Remove the sealant from mounting holes and around periphery of the TSA-4100 Antenna.

b. Remove the foam plugs from the antenna mounting holes.

c. Remove the four mounting screws from the antenna. Do not allow the antenna to hang from cables.

d. Disconnect connectors P1, P2, P3, or P4 from the antenna.

2.13. TSS-4100 34-43-00.

The sections that follow describe the external theory of operation, internal theory of operation, and general data of the Traffic Surveillance System LRU in a traffic surveillance system.

2.13.1. Traffic Surveillance System, External Theory of Operation.

Refer to Figure 2-18 and Figure 2-19. A transponder provides air traffic control and other aircraft with appropriate information about its own aircraft. When interrogated, the transponder may provide an aircraft's current altitude, squawk code (4096 code), or other information that is requested. The TSS receives this information through ARINC 429 messages that are routed through the aircrafts wiring. Other A429 signals that are received by the TSS are used to control the transponder and TCAS functions.

2.13.1.1. A pilot may put his own aircraft's transponder into one of three modes: standby, on with altitude reporting off, or on with altitude reporting on. TCAS may also be put into one of three modes: standby, TA Only, or TA/RA. TCAS interrogates the transponders of other aircraft to gather the altitude, range, relative speed, and bearing of those aircraft. The altitude, range, and bearing information is then passed along to a display so that it can be shown to the pilots.

2.13.1.2. If TCAS determines that one of those other aircraft is going to be a potential threat, then it issues a TA (Traffic Advisory). This is noted by a TRAFFIC, TRAFFIC aural and a visual annunciation on the display. The icon representing the offending aircraft is changed as well.

2.13.1.3. If TCAS believes that a collision is possible, it will issue an RA (Resolution Advisory). This resolution advisory will advise the pilot to climb, descend, or maintain the current vertical rate. This information will be related aurally and via a visual annunciation on the display. Again, the icon representing the offending aircraft is changed. If an RA is issued and both aircraft are TCAS equipped, then the TCAS and transponder of both aircraft coordinate which aircraft goes up and which goes down. The TSS may use either its internal transponder or an external TDR-94D in order to perform this coordination.

2.13.1.4. Automatic Dependant Surveillance - Broadcast (ADS-B) allows for traffic information to be made available without interrogations. If enabled, the transponder function of the TSS takes own aircraft position, velocity, track, and flight ID information and makes it available at a periodic basis for anyone to receive. Either a ground station or another aircraft may read this information and use it for one of many defined applications. If enabled, a TSS will merge the ADS-B messages it receives with TCAS targets and send them to a display as one data block.

2.13.1.5. The TSM-4100 is a standard 4 Modular Concept Unit (MCU) mount with a fan that can be controlled and monitored. The Traffic Surveillance Mount (TSM) has a discrete line in that turns on and off the fan. The TSM also has a line out which contains a signal wave form that indicates the speed of the fan. The TSS uses this output to determine if the fan has failed by checking the speed against a predetermined threshold.

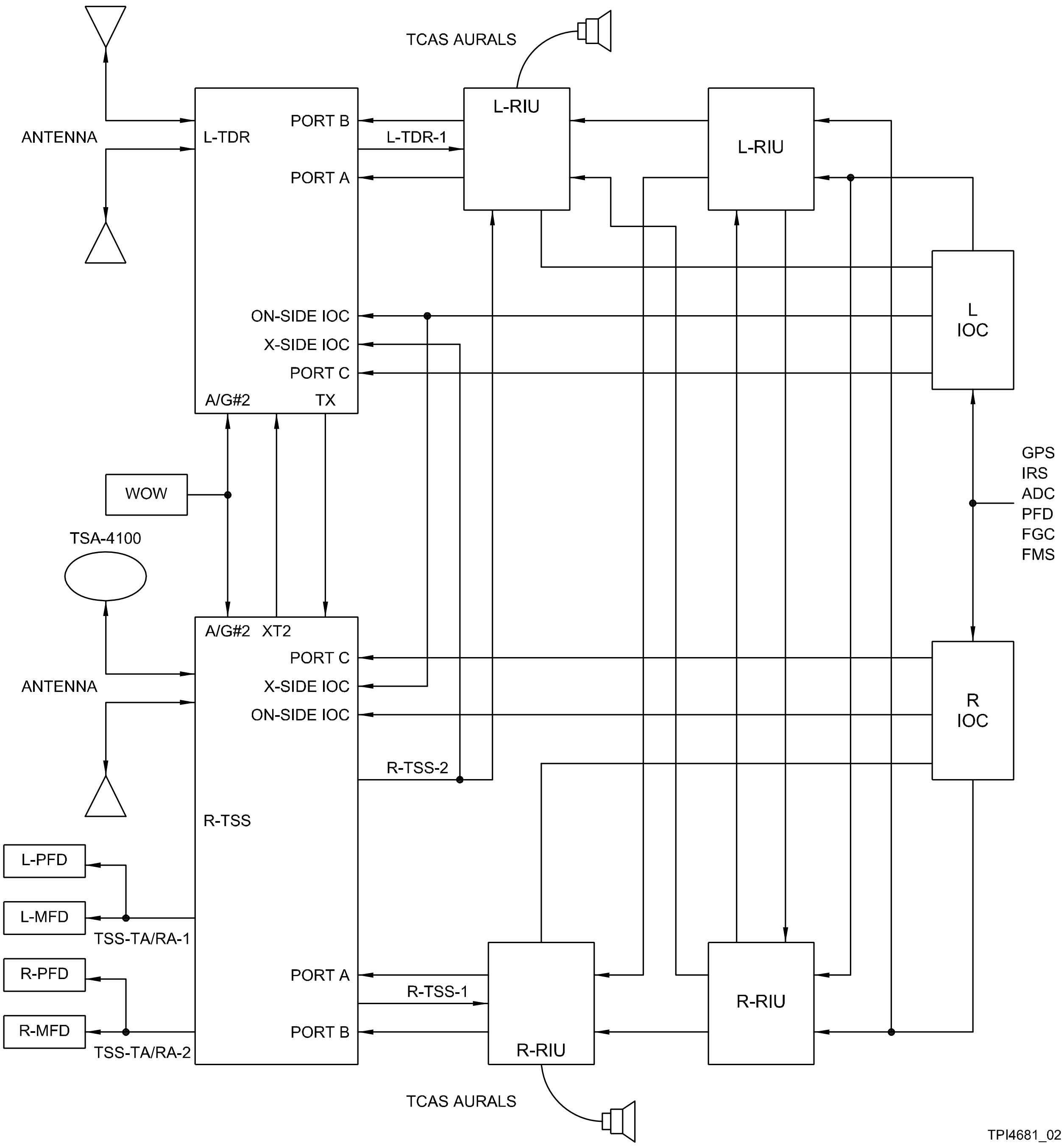

Figure 2-18. Traffic Surveillance System, External Block Diagram

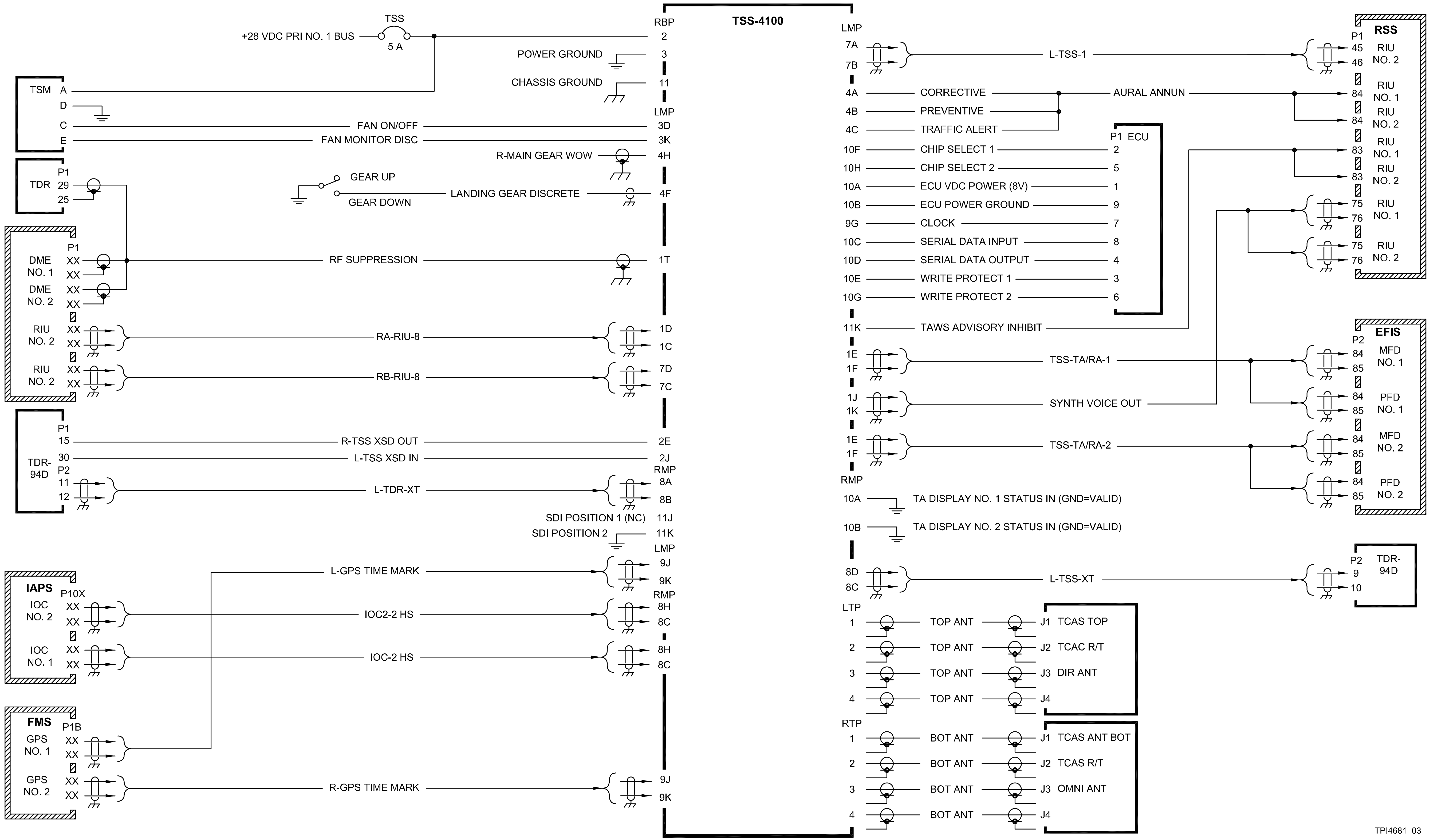

Figure 2-19. Traffic Surveillance System, TSS-4100 No. 1, External Simplified Schematic

2.14. TRAFFIC SURVEILLANCE SYSTEM, TSS-4100, DATA.

The TSS-4100 Traffic Surveillance System is a major component of an aircraft traffic system. The TSS-4100 operates on 28 V dc. It contains all circuits necessary for computing, transmitting, and receiving functions of the TSS and interfacing with a transponder, antennas, and displays. The TSS LRU and Traffic Surveillance System Application (TSSA) work together to provide TCAS, Mode S transponder, and ADS-B capability in one LRU. The TSS, TSSA, and Traffic Surveillance Mount (TSM) are described in this section.

2.14.1. TSS-4100 Antenna Requirements.

The TSS-4100 requires two antennas. One antenna is mounted on the fuselage on top of the aircraft. The other antenna is mounted on the fuselage on the bottom of the aircraft. The top antenna is a TSA-4100 directional antenna. The bottom antenna can either be a second TSA-4100 antenna, or it can be an omnidirectional antenna such as the TRE-930.

2.14.2. TSS-4100 and TSM-4100 Illustration.

Refer to Figure 2-20 for an illustration of the TSS-4100. Refer to Figure 2-21 for an illustration of the TSM-4100.

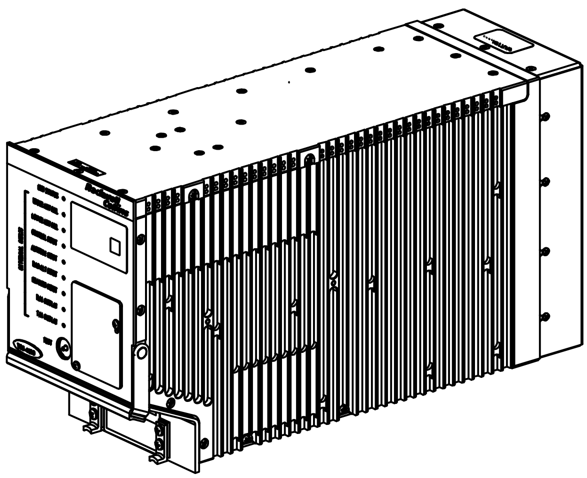

Figure 2-20. TSS-4100

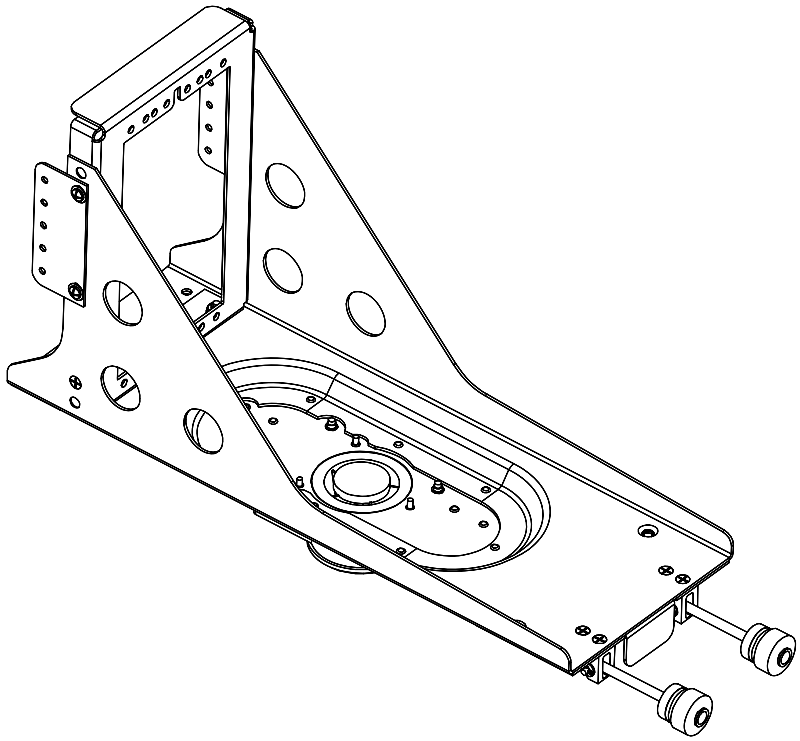

Figure 2-21. TSM-4100

2.14.3. TSS-4100 Mating Connector Data.

Figure 2-22 shows a mating connector pictorial for the TSS-4100. Each connector shows pin locations to aid the troubleshooting effort. Refer to the interconnect wiring diagram in the appendix. Table 2-7 shows the mating connector hardware and tooling for the TSS-4100.

Table 2-7. TSS-4100 Mating Connector Hardware and Tooling.

TSS-4100 HARDWARE/TOOLING
Mating connector kit: CPN 628-8661-001 (qty 2) Connector: 60-pin Thinline II, CPN 859-3477-510 Contacts: Standard Size 22 pins (RADIALL 620200) Contacts: CPN 372-2514-180 (insulation from 1.27 mm (0.050 in) to 2.03 mm (0.080 in) diameter) TNC connector: Automatic 301-T2100N, CPN 357-7351-010 (qty 2)
Mating connector: ARINC 600, Cannon BKAD3-67404-55, CPN 370-0501-050 Contacts (size 12): Cannon 031-1308-000, CPN 370-0066-090 Insertion/extraction tool: Cannon CET 12-4, CPN not assigned Crimp tool: MIL M22520/1-01, CPN 359-8101-010 Crimp tool positioner: MIL M22520/1-11, CPN 359-8101-120 Contacts (size 16): Cannon 031-1303-000, CPN 370-0066-080 Insertion/extraction tool: Cannon CET 16-9, CPN 371-8445-080

Table 2-7. TSS-4100 Mating Connector Hardware and Tooling. - Continued

TSS-4100 HARDWARE/TOOLING
Crimp tool: MIL M22520/1-01, CPN 359-8101-010
Crimp tool positioner: MIL M22520/1-02, CPN 359-8101-020
Contacts (size 20): Cannon 031-1302-000, CPN 370-0066-070
Insertion/extraction tool: Cannon CIET 20HDL, CPN 371-8445-040
Crimp tool: MIL M22520/2-01, CPN 359-8102-010
Crimp tool positioner: MIL M22520/2-08, CPN 359-8101-080
Contacts (size 22): Cannon 030-2259-000, CPN 370-0066-060
Insertion/extraction tool: Cannon CIET 22, CPN 371-8445-020
Crimp tool: MIL M22520/2-01, CPN 359-8102-010
Crimp tool positioner: MIL M22520/2-23, CPN 359-8102-130
TNC connector (qty 8): Cannon 349-1046-000, CPN 370-0066-220
Contact, coaxial RG-178 (qty 2): Cannon 249-2080-000, CPN 370-0055-100

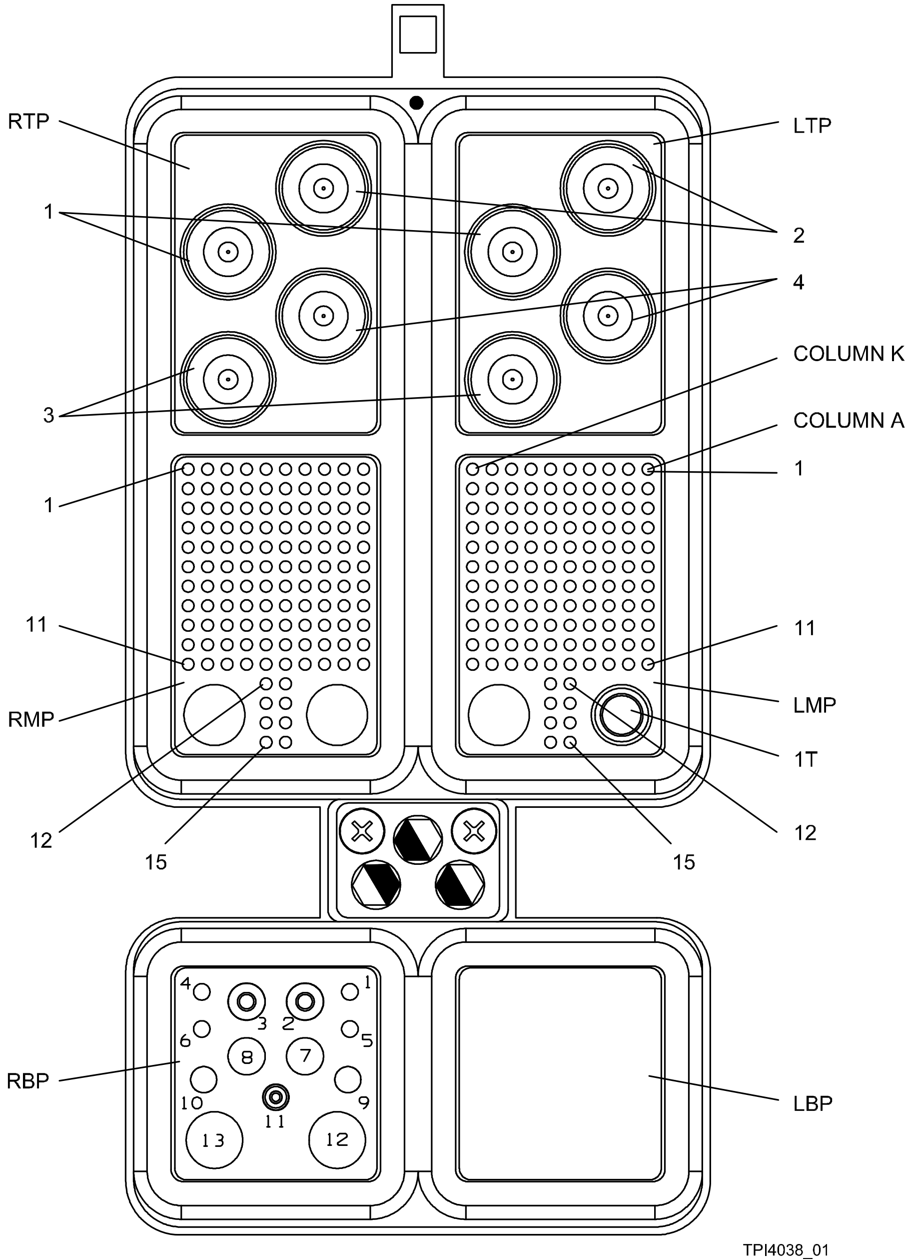

Figure 2-22.   TSS-4100 Mating Connectors

2.14.3.1.   TSS-4100 Mating Connector Pins and Functions follow:

Table 2-8.   TSS-4100 Mating Connector Pins and Functions, Power, Ground, Suppression.

Pin Name	Connector	Pin
+ 28 VDC Power In	RBP	2
Power Return	RBP	3

Table 2-8. TSS-4100 Mating Connector Pins and Functions, Power, Ground, Suppression. - Continued

Pin Name	Connector	Pin
Chassis Ground	RBP	11
Suppression Coax - coaxial insert in the bottom corner of LMP	LMP	1T

Table 2-9. TSS-4100 Mating Connector Pins and Functions, ARINC 429 Input.

Pin Name	Connector	Pin A	Pin B
Control A	LMP	1D	1C
Control B	LMP	7D	7C
Control C	RMP	1D	1C
IAPS #1 (on-side)	LMP	8H	8G
IAPS #2 (cross-side)	RMP	8H	8G
GPS #1	LMP	6H	6G
GPS #2	RMP	2H	2G
XT2 (TDR to TSS) (or ADLP)	RMP	8A	8B
Data Load	LMP	7J	7K
CMU #1 (Provision)	LMP	8J	8K
CMU #2 (Provision)	RMP	8J	8K
ADS-B #1 (Provision)	LMP	7E	7F
ADS-B #2 (Provision)	LMP	7H	7G
A768 Future (Provision)	RMP	7D	7C

Table 2-10. TSS-4100 Mating Connector Pins and Functions, ARINC 429 Output.

Pin Name	Connector	Pin A	Pin B
TSS-1	LMP	7A	7B
TSS-2	LMP	1A	1B
TSS-3 (Data Load)	RMP	1A	1B
TA/RA-1	LMP	1E	1F
TA/RA-2	RMP	1E	1F
TX2 (TSS to TDR) (or ADLP)	RMP	8D	8C
ADS-B #1 (Provision)	LMP	9E	9F

Table 2-10. TSS-4100 Mating Connector Pins and Functions, ARINC 429 Output. - Continued

Pin Name	Connector	Pin A	Pin B
CMU (Provision)	RMP	9E	9F
General Purpose #1 (Provision)	LMP	9D	9C

Table 2-11. TSS-4100 Mating Connector Pins and Functions, GPS Time Mark Input.

Pin Name	Connector	Pin +	Pin -
GPS Time Mark #1 (On-side)	LMP	9J	9K
GPS Time Mark #2 (Cross-side)	RMP	9J	9K

Table 2-12. TSS-4100 Mating Connector Pins and Functions, Discrete Input (Gnd = Active).

Pin Name	Conn	Pin
Spare	LMP	2H
XTDR Active (from XTDR)	LMP	2J
Extended Squitter Disable	LMP	2K
Perf Limit	LMP	3E
Simulator Enable	LMP	3F
Air/Gnd(F) #1	LMP	3G
Spare	LMP	3H
Spare	LMP	3J
Fan Monitor	LMP	3K
Spare	LMP	4F
Air/Gnd(F) #2	LMP	4H
Spare	LMP	4J

Pin Name	Conn	Pin
Advisory Inhibit #3	LMP	11J
Advisory Inhibit #4	LMP	11K
Advisory Inhibit #1	LMP	10J
Advisory Inhibit #2	LMP	10K
Shop Mode Enable	RMP	6A
ATE Discrete In (Spare)	RMP	6B
TA Display Valid #1	RMP	10A
TA Display Valid #2	RMP	10B
RA Display Valid #1	RMP	10C
RA Display Valid #2	RMP	10D
Burst Tune Select	RMP	10E
Control Port Select 0	RMP	10F

Table 2-12. TSS-4100 Mating Connector Pins and Functions, Discrete Input (Gnd = Active). - Continued

Pin Name	Conn	Pin		Pin Name	Conn	Pin
Climb Inhibit #1	LMP	11A		Control Port Select 1	RMP	10G
Climb Inhibit #2	LMP	11B		Advisory Annun Cancel	RMP	10H
Climb Inhibit #3	LMP	11C		Spare	RMP	10J
Climb Inhibit #4	LMP	11D		Data Load Enable	RMP	10K
Increase Climb Inh #1	LMP	11E		Program Pin Common	RMP	11H
Increase Climb Inh #2	LMP	11F		Source Destination Identifier (SDI) Position 1	RMP	11J
Increase Climb Inh #3	LMP	11G		SDI Position 2	RMP	11K
Increase Climb Inh #4	LMP	11H				

Ctrl Port:	Ctrl Port Sel 0	Ctrl Port Sel 1		SDI code:	SDI Pos 1	SDI Pos 2	
	Gnd	Open	Ctrl Bus A		Gnd	Open	Side 1 - Left
	Open	Open	Ctrl Bus B		Open	Gnd	Side 2 - Right
	X	Gnd	Ctrl Bus C		Open	Open	Not Used
					Gnd	Gnd	Not Used

Table 2-13. TSS-4100 Mating Connector Pins and Functions, Discrete Output (Gnd = Active).

Pin Name	Conn	Pin		Pin Name	Conn	Pin
TSS Active (to XTDR)	LMP	2E		Test Data 1	RMP	6D
Spare +28/Open	LMP	2F		Test Data 2	RMP	6E
Spare	LMP	2G		Test Data 3	RMP	6F
Visual Annun C	LMP	3A		Test Data 4	RMP	6G
Visual Annun P	LMP	3B		Test Data 5	RMP	6H
Visual Annun TA	LMP	3C		Test Data 6	RMP	6J
Fan Off (100ma)	LMP	3D		Test Data 7	RMP	6K

Table 2-13. TSS-4100 Mating Connector Pins and Functions, Discrete Output (Gnd = Active). - Continued

Pin Name	Conn	Pin		Pin Name	Conn	Pin
Aural Advisory C	LMP	4A		Test Data Address 0	RMP	7G
Aural Advisory P	LMP	4B		Test Data Address 1	RMP	7H
Aural Advisory TA	LMP	4C		Test Read	RMP	7J
Test Data 0	RMP	6C		Test Write	RMP	7K

Table 2-14. TSS-4100 Mating Connector Pins and Functions, Audio Output.

Pin Name	Connector	Pin Hi	Pin Lo
Audio #1	LMP	1J	1K
Audio #2	RMP	1J	1K

Table 2-15. TSS-4100 Mating Connector Pins and Functions, ECU Interface.

Pin Name	Connector	Pin
Clock Out to ECU	LMP	9G
Power Out to ECU	LMP	10A
Power Return from ECU	LMP	10B
Serial Data In from ECU	LMP	10C
Serial Data Out to ECU	LMP	10D
Write Enable #1 Out to ECU	LMP	10E
Enable #1 Out to ECU	LMP	10F
Write Enable #2 Out to ECU	LMP	10G
Enable #2 Out to ECU	LMP	10H

2.14.4. TSS-4100 Outline and Mounting Dimensions.

Refer to Figure 2-23 for an illustration of the TSS-4100 Outline and Mounting Dimensions. Refer to Figure 2-24 for an illustration of the TSM-4100 Outline.

NOTES:

1. THIS DRAWING DEFINES THE INSTALLATION REQUIREMENTS FOR EQUIPMENT TYPE TSS-4100 (TOP LEVEL ASSEMBLY 822-2132-XXX).
2. (2) SYMBOL AND ASSOCIATED DIMENSIONS IDENTIFY THE UNIT CENTER OF GRAVITY.
3. (3) FOR UNIT CONNECTOR INFORMATION, REFER TO DETAIL E AND RELATED CHART ON SHEET 1.
4. (4) DARKENED HALF OF HEXAGON DESIGNATES THE EXTENDED PORTION OF THE KEYING PIN.
5. (5) UNIT IS DESIGNED FOR FORCED AIR UPWARD-FLOWING AIR COOLANT USING MOUNT WITH INTEGRAL FAN, COMPANY PART NUMBER (866-0128-020).
6. DIMENSIONS AND TOLERANCES ARE EXPRESSED IN MILLIMETERS [INCHES] AND SHALL BE INTERPRETED IN ACCORDANCE WITH ASME Y14.5M-1994. UNLESS OTHERWISE SPECIFIED, DIMENSIONAL TOLERANCES ARE .X = ± 0.5 [.XX = ± .02] AND .XX = ± 0.20 [.XXX = ± .008].
7. INPUT POWER 28 VDC.
8. POWER DISSIPATION: 120 WATTS MAXIMUM.
9. THIS UNIT HAS BEEN DESIGNED AND TESTED FOR INSTALLATION ON A HORIZONTAL SURFACE. OTHER ORIENTATIONS SHALL REQUIRE RETESTING AND APPROVAL BY ROCKWELL COLLINS, INC.
10. UNIT WEIGHT: 7.98 kg [17.6 LB] MAXIMUM, (7.53 kg) [(16.6 LB)] NOMINAL.
11. (11) THIS UNIT COMPLIES WITH ALL 4 MCU DIMENSION AND TOLERANCE REQUIREMENTS FOR INSTALLATION INTO A STANDARD ARINC 600 EQUIPMENT RACK. EXCEPT FOR AIR OUTLET HOLE PATTERN (INDICATED). COOLING HOLES MUST BE KEPT CLEAR FOR PROPER OPERATION OF UNIT.
12. (12) DC RESISTANCE SHALL BE 2.5 MILLI-OHMS MAXIMUM BETWEEN THE REAR CONNECTOR SHELL AND THE MOUNTING SURFACE(S) WHERE INDICATED REFER TO COMPANY PART NUMBER (523-0775254) INSTALLATION PRACTICES AND COMPANY PART NUMBER (523-0776007) BONDING AND GROUNDING PRACTICES.
13. THE TSS-4100 SHALL BE INSTALLED WITH ROCKWELL COLLINS CPN 866-0128-020 MOUNTING TRAY OR EQUIVALENT.

CONNECTOR INFORMATION (3)

REF. DES.	CONNECTOR PART NUMBER(S):	CONTACT PART NUMBER(S):	MATING CONNECTOR PART NUMBER(S):	MATING CONTACT PART NUMBER(S):
A1A1P1	859-2777-450	NO. 1 PIN COAX CONTACT 859-2004-030 349-1042-000(ITT)	859-3477-510 (RADIALL PN NSXN3M627X01) OR EQUIVALENT	NO. 1 COAX CONTACT CPN 370-0066-220 (ITT PN 349-1046-000) OR EQUIVALENT
		NO. 12 PIN CONTACT 370-0067-570 030-3287-013(ITT)		NO. 12 SOCKET CONTACT CPN 370-0066-090 (ITT PN 031-1308-000) OR EQUIVALENT
		NO. 16 PIN CONTACT 370-0067-580 030-3287-012(ITT)		NO. 16 SOCKET CONTACT CPN 370-0066-080 (ITT PN 031-1303-000) OR EQUIVALENT
		NO. 22 SOCKET CONTACT 370-0067-230 031-1352-017(ITT)		NO. 22 PIN CONTACT CPN 370-0066-060 (ITT PN 030-2259-000) OR EQUIVALENT
		NO. 8 COAX CONTACT CPN 370-0067-550 349-1084-003(ITT)		NO. 8 COAX CONTACT CPN 370-0066-330 (ITT PN 349-1083-001) OR EQUIVALENT

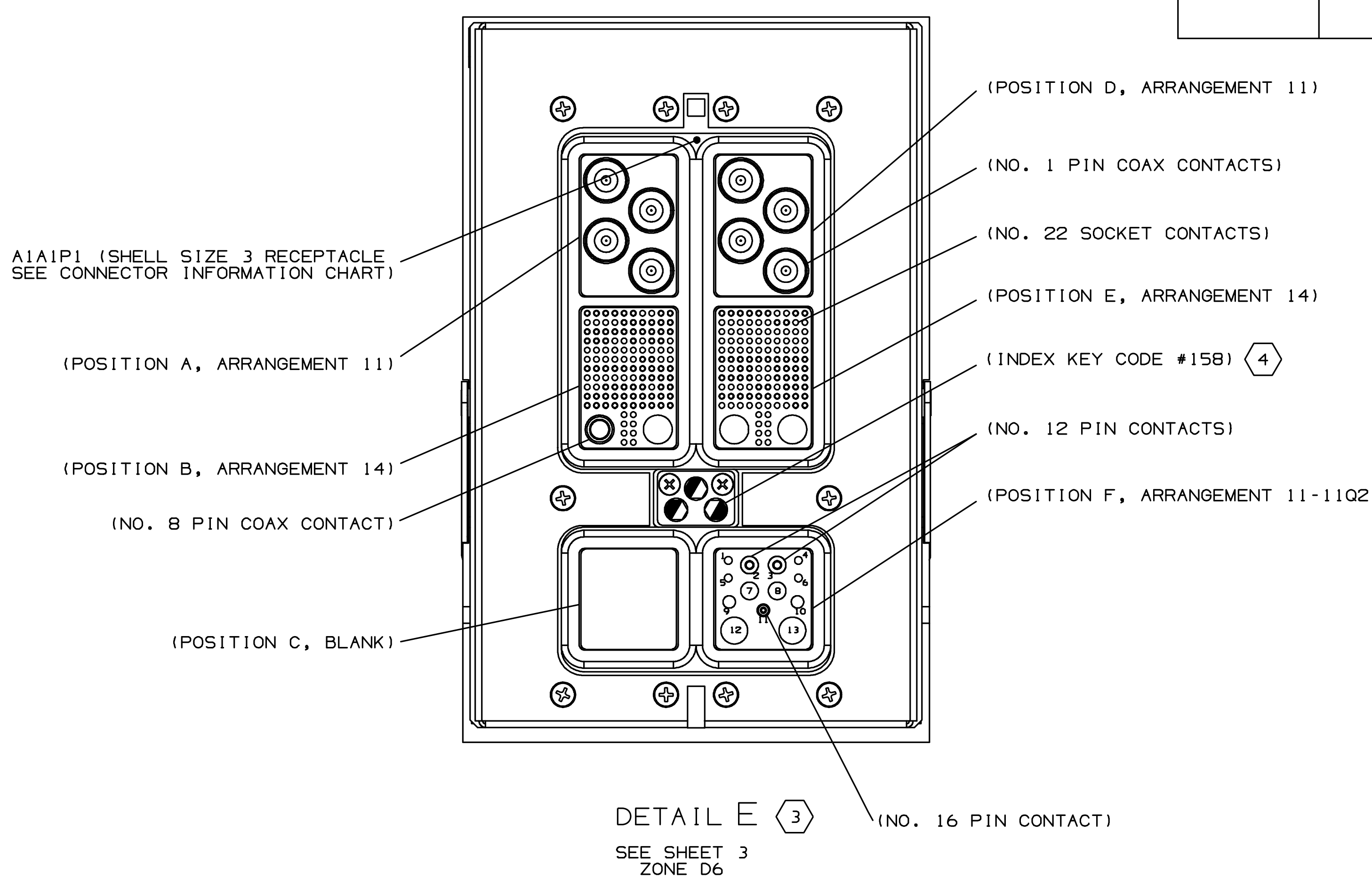

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Figure 2-23. TSS-4100 Traffic Surveillance System, Outline and Mounting Dimensions (Sheet 1 of 3)

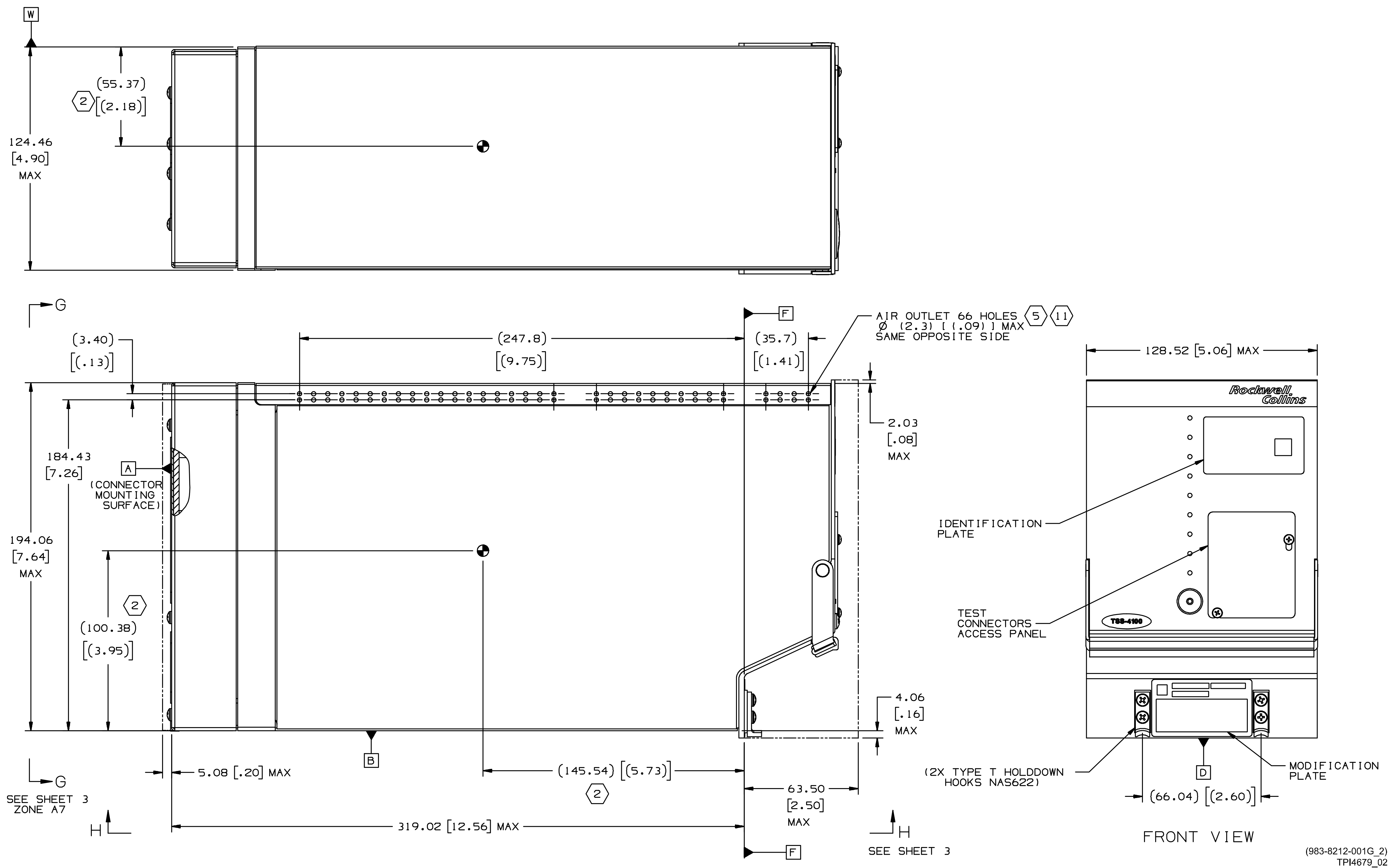

Figure 2-23. TSS-4100 Traffic Surveillance System, Outline and Mounting Dimensions (Sheet 2 of 3)

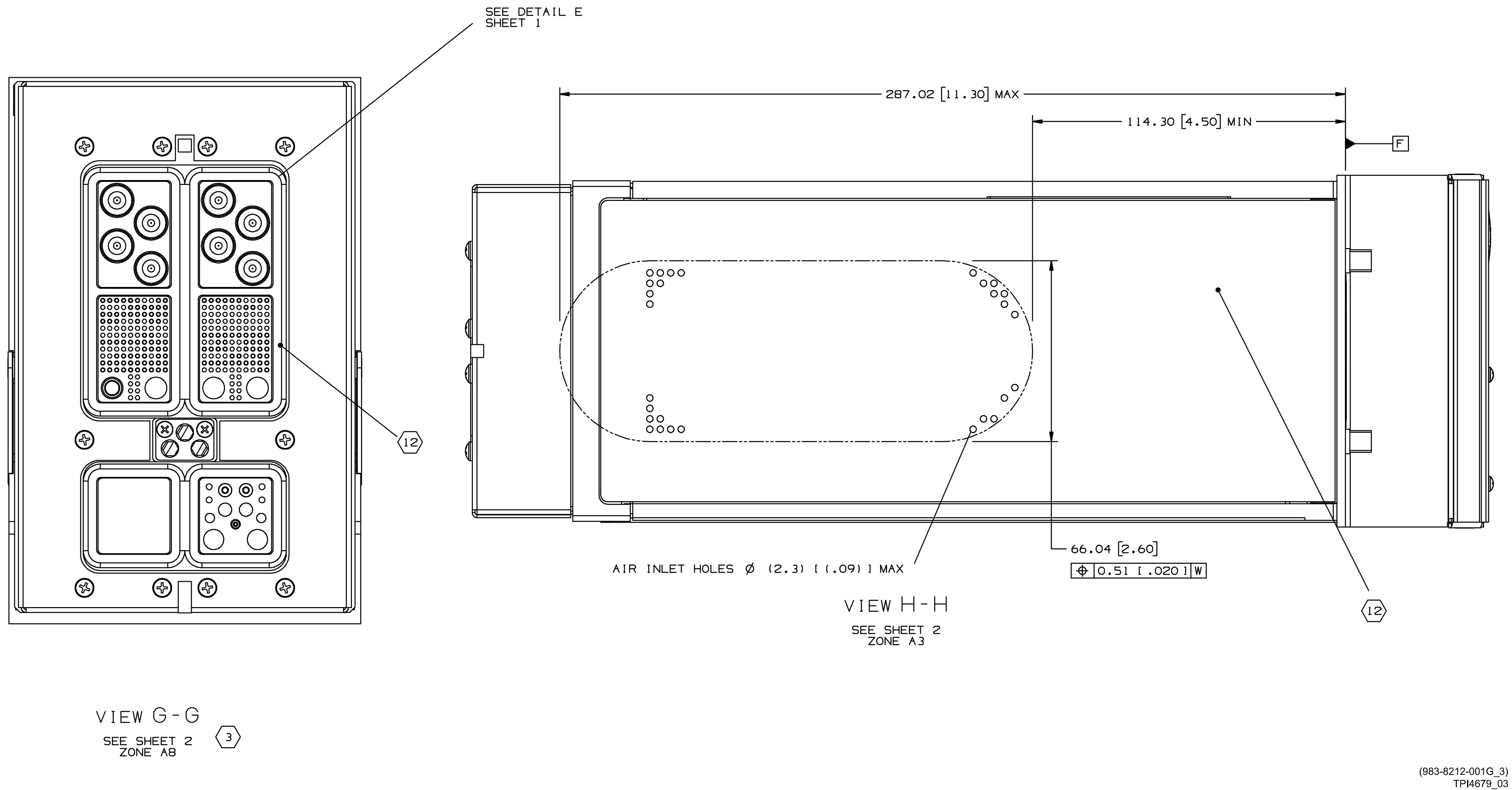

Figure 2-23. TSS-4100 Traffic Surveillance System, Outline and Mounting Dimensions (Sheet 3 of 3)

NOTES:

1. THIS DRAWING DEFINES THE INSTALLATION REQUIREMENTS FOR EQUIPMENT TYPE TSM-4100 (TOP LEVEL ASSEMBLY 866-0128-020).

2. DIMENSIONS AND TOLERANCES ARE EXPRESSED IN MILLIMETERS [INCHES] AND SHALL BE INTERPRETED IN ACCORDANCE WITH ASME Y14.5M-1994.

3. ◕ SYMBOL AND ASSOCIATED DIMENSIONS IDENTIFY THE UNIT CENTER OF GRAVITY.

⟨4⟩ IDENTIFIED WITH ECS PART NUMBER LOT NUMBER AND ECS CAGE CODE LOCATED APPROXIMATELY WHERE SHOWN.

5. UNIT DESIGNED TO MEET THE APPLICABLE REQUIREMENTS OF THE FOLLOWING:
   - A. ARINC 600: 4 MCU
     EXCEPTIONS AND LIMITATIONS TO ARINC:
     1. MAX LRU WEIGHT OF 21 LBS.
   - B. RTCA/DO-160E ENVIRONMENTAL TEST CONDITIONS.
     1. TEMPERATURE: CAT F2
     2. ALTITUDE: CAT F2
     3. TEMPERATURE VARIATION: CAT A
     4. HUMIDITY: CAT B
     5. OPERATIONAL SHOCK: CAT B
     6. CRASH SAFETY: FIXED WING TRANSPORT A/C. RANDOM ORIENTATION
     7. VIBRATION: CAT S. CURVE C, L, M
        CAT R. CURVE B, B1
        CAT H, CURVE R
     8. EXPLOSION: CAT E
     9. WATERPROOF: CAT Y
     10. MAGNETIC EFFECT: CAT Z
     11. POWER IN: CAT BZ
     12. VOLTAGE SPIKE: CAT A
     13. AUDIO FREQUENCY CONDUCTED SUSCEPTIBILITY: CAT Z
     14. INDUCED SIGNAL SUSCEPTIBILITY: CAT CC
     15. RADIO FREQUENCY SUSCEPTIBILITY: CAT: RR
     16. EMISSIONS OF RF ENERGY: CAT M
     17. LIGHTNING INDUCED TRANSIENT SUSCEPTIBILITY: CAT B3K33
     18. ICING: CAT A
     19. ESD: CAT A

6. UNIT DESIGNED FOR PRESSURIZED OR UNPRESSURIZED APPLICATIONS UP TO 55,000 FT.

7. ELECTRICAL SPECIFICATIONS:
   FAN: 26 VDC. .025A, (NOMINAL)
   RELAY: 28 VDC, 87Ma

8. FINISH: TRAY AND CONNECTOR PLATE
   CLEAR CHEM FILM IN ACCORDANCE WITH MIL-DTL-5541, TYPE II, CLASS 3.
   RADIUS BAR FINISH: PASSIVATE IN ACCORDANCE WITH QQ-P-35, TYPE II.

9. THE RECOMMENDED CLEARANCE BELOW THE FAN IS 2.00 ± .03 INCHES. THE MINIMUM CLEARANCE BELOW THE FAN IS 1.00 INCH.

⟨10⟩ CONNECTOR INFORMATION:
10A. J1 CONNECTOR PART NUMBER: D38999/20FB5PN
10B. CONTACTS: SIZE 20
10C. MATING CONNECTOR PART NUMBER: D38999/26FB5SN

⟨11⟩ LOCTITE 222 APPLIED TO NUMBER 4 SYNCLAMPS THAT ATTACH FAN TO TRAY.

⟨12⟩ RECOMMENDED HARDWARE FOR INSTALLING A TSM-4100 INTO AN AIRCRAFT INCLUDE (2) 100 DEGREE NUMBER 10-32 SCREWS AND (2) NUMBER 10-32 SCREWS. HARDWARE LOCKING MECHANISM IS REQUIRED.

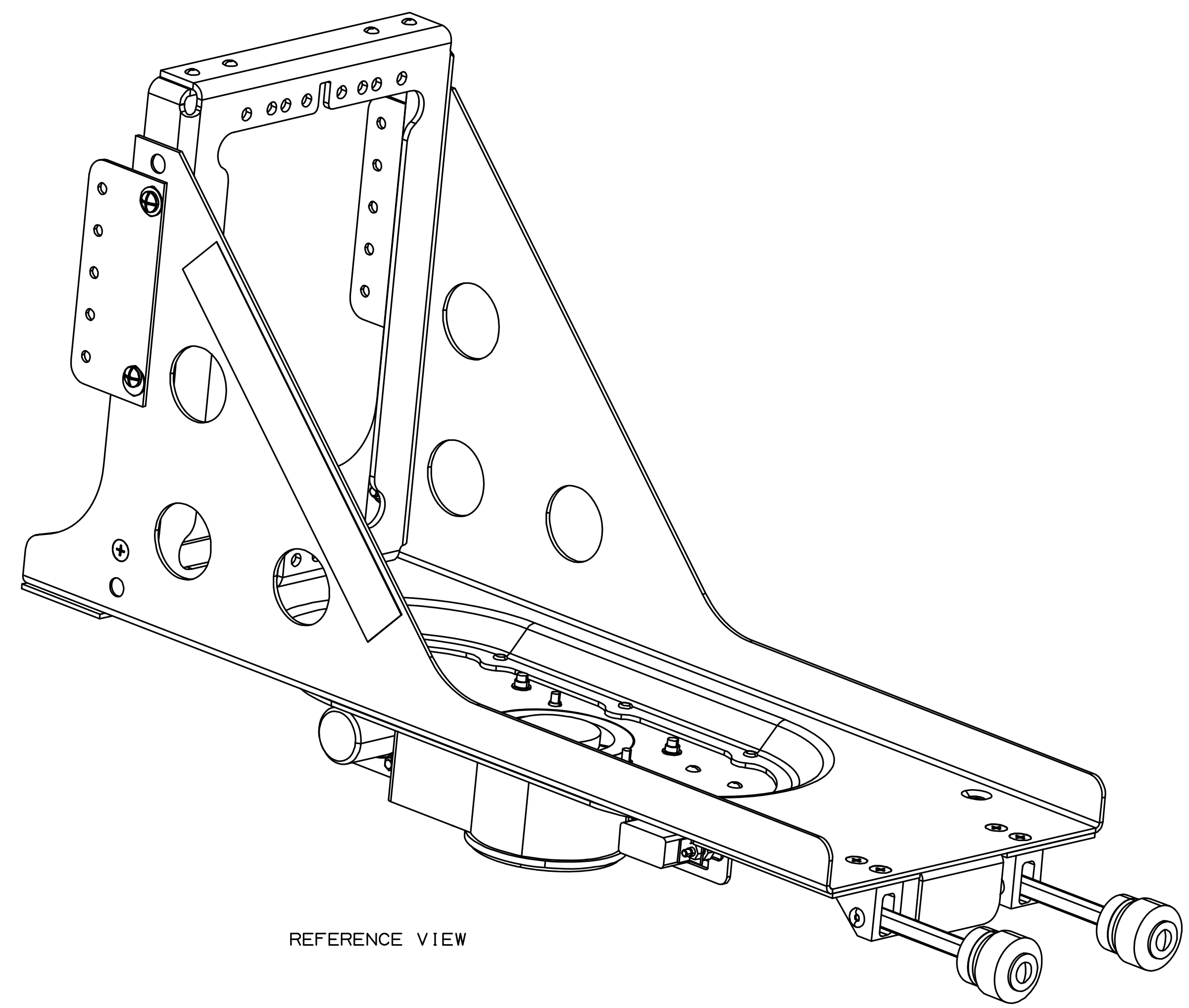

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Figure 2-24. TSM-4100 Traffic Surveillance Mount, Outline (Sheet 1 of 3)

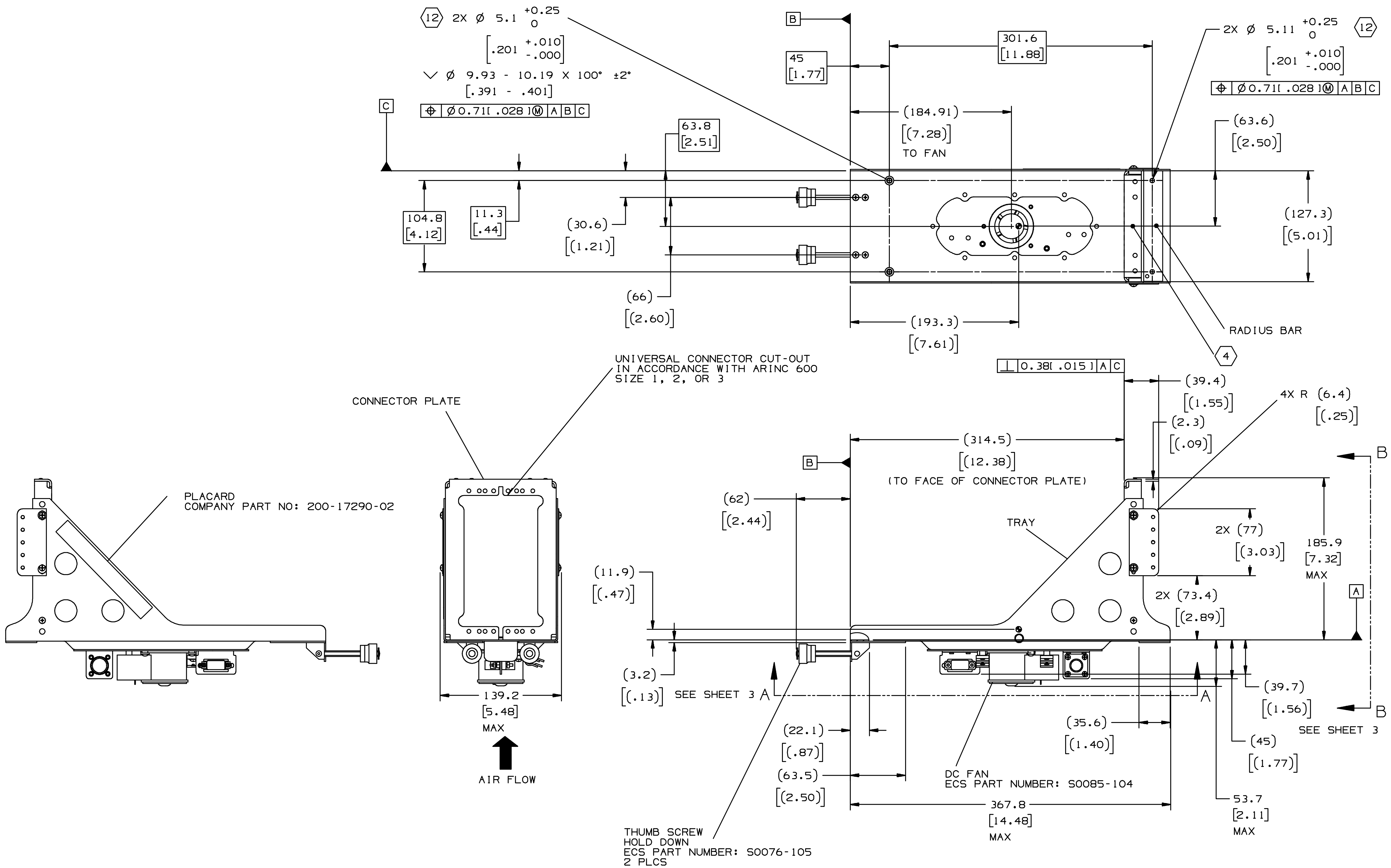

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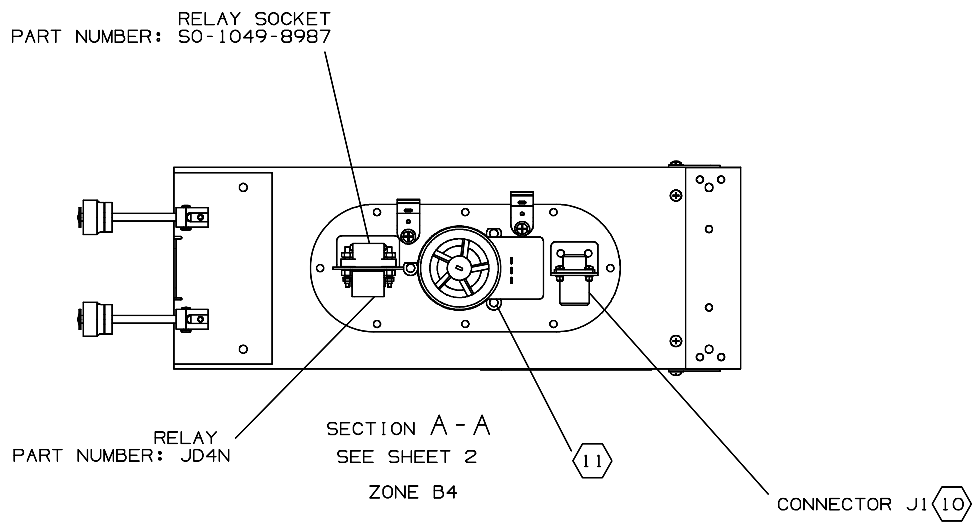
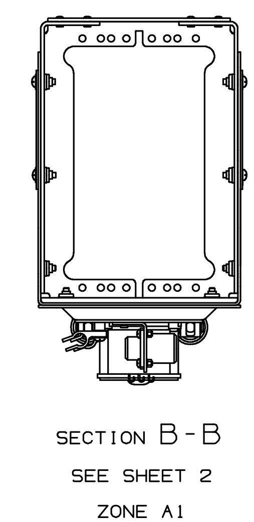
Figure 2-24. TSM-4100 Traffic Surveillance Mount, Outline (Sheet 2 of 3)





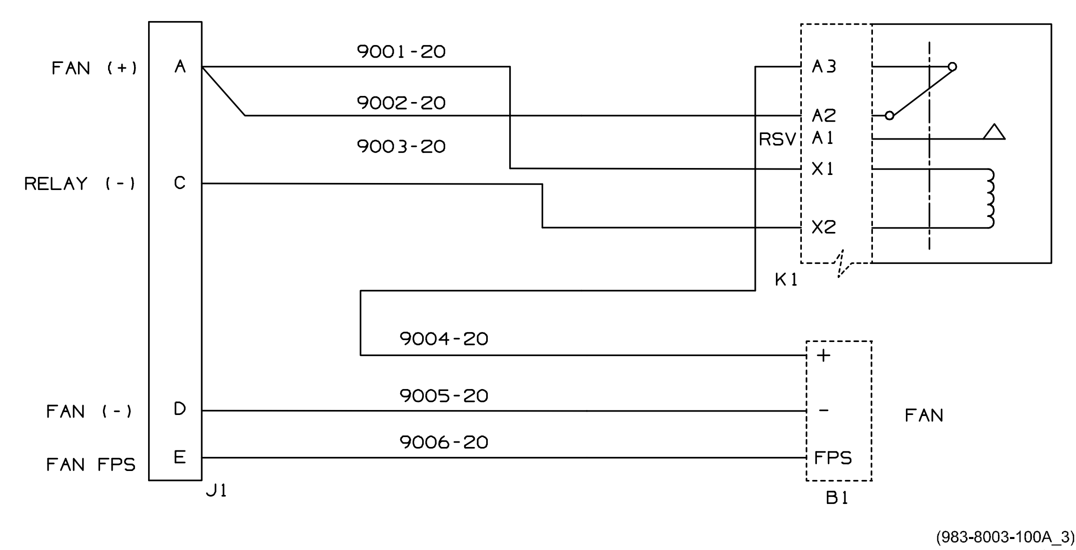


Figure 2-24. TSM-4100 Traffic Surveillance Mount, Outline (Sheet 3 of 3)

2.14.5. Cabling Considerations.

For the TSS-4100:

- Shield wires shall be no greater than 4 inches in length.
- The wires from the TSS to the ECU shall be no greater than one meter in length.
- The SDI strap shall be no greater than 6 inches in length.
- The length of the wires from the TSS to the TSM shall be no greater than 18 inches in length.
- The circuit breaker for the TSS should be rated for 7.5 Amps.

2.14.6. Installation and Removal.

WARNING

Make sure that the aircraft battery master switch is turned off before installing any equipment, mounts, or interconnect cables.

NOTE

The resistance between the TSS-4100 and the rear contact shell and mounting surfaces must not be greater than 2.5 milliohms.

The TSS-4100 is rack mounted in the TSM-4100.

2.14.6.1. Installation. The procedure to install the TSS-4100 follows:

a. Remove electrical power from the aircraft.

b. Slide the unit into the mount until the mating connectors are fully engaged.

c. Position the knurled knobs (on the front of mount) to engage the unit holddown hooks. Tighten the knurled knobs to secure the unit to the mount. Safety-wire the knurled knobs.

2.14.6.2. Removal. The procedure to remove the TSS-4100 follows:

a. Remove electrical power from the aircraft.

b. Remove the safety wire and loosen the knurled knobs that secure the unit to the mount.

c. Slide the unit straight out to disconnect it from the mount connectors.

2.14.7. Internal Theory of Operation.

The TSS-4100 Processing unit provides the main processing, system I/O, and traffic RF functions for the system in an ARINC 600 4 MCU Line Replaceable Unit (LRU). The paragraphs that follow outline the functions of the main assemblies. Refer to Figure 2-25 for an internal block diagram of the TSS-4100.

2.14.7.1. Power Supply Assembly. Power supply assembly develops the primary 12 V dc bus voltage from the 28 V dc aircraft power. The power supply assembly consists of a power supply circuit card and a storage capacitor assembly which enables the TSS-4100 to continue operating through momentary power interruptions. The power supply assembly supplies +31.6 V dc to the transmitter module and +12 V dc to the other circuit cards and sub-assemblies of the TSS-4100.

2.14.7.2. System Processor Input / Output Assembly. The System I/O Circuit Card (SysIO) controls almost all of the input and output between the TCAS/transponder function and other aircraft systems. SysIO outputs display data, aural messages, fault information, aircraft system discretes, and data logging outputs. SysIO receives data used by the TCAS/transponder card and performs most of the source selection logic. SysIO manages the data loading of the unit and of the attached ECU. SysIO is responsible for communications with the ECU and for monitoring of an external fan.

2.14.7.3. Traffic Receiver Assembly. The traffic receiver assembly consists of three circuit card assemblies, the RF switch, receiver circuits and digital signal processing circuits for the ACAS/transponder function. The RF switch circuit controls the selection function for the top and bottom antennas, antenna element selection and the transmit/receive switch function. There are eight parallel antenna ports, four each for the top and bottom antennas on the aircraft. Each port represents a beam heading: fore, aft, port, starboard. The transmit port from the power amplifier is switched to one of these eight antenna ports. The receiver paths on the RF switch include fixed-gain, low-noise amplifiers and band-pass filtering. Each of the eight antenna ports feeds a separate receiver path. The receiver circuits down-convert the band-pass filtered L-band frequencies provided through the switch card to intermediate frequencies, provide additional filtering and provide receiver gain. There are 16 parallel transponder receiver paths; eight each high and low gain. There are four parallel TCAS receiver channels, with switchable high/low gain. These 16 Transponder and four TCAS signals become 20 parallel high speed Analog to Digital Converter channels to the signal processor circuit card. The TSS design also supports a 5 antenna port installation where top ports one thru four are connected to a directional antenna and bottom port 1 is connected to an omni-directional antenna. Bottom ports two thru four would not be used in this configuration. The signal processing circuits correlate and track the replies of Mode S and Mode C transponders for the TSS-4100 TCAS function. The signal processing circuits use these replies to calculate intruder aircraft range, altitude and bearing. From this calculation, the signal processing circuits also develop resolution and traffic advisory data. Resolution Advisories (RA) and Traffic Advisories (TA) are sent to the aural and visual displays. The signal processing circuits also receive and prepare responses to ATCRBS and Mode S interrogations for the TSS-4100 transponder function.

2.14.7.4. Traffic Transmitter Assembly. The traffic transmitter module consists of a modulator circuit card and a power amplifier circuit card. The Traffic Transmitter Module receives serial frequency tuning data and a set of digital commands from the digital signal processor that specify the desired pulses to be sent. The modulator circuit card then generates the appropriate ACAS Differential Phase Shift Keying (DPSK) modulation, Mode-C whisper shout, or transponder interrogation output that will be sent to the ATC/ACAS antenna. The modulator card implements a power control loop so that the drive to the power amplifier is varied to achieve the desired output power. Modulation is produced in a quadrature modulator, allowing amplitude only (pulse), PPM, and the PSK waveform to be produced. The modulator drive level changes on a 16.667 nsec (60.000 MHz) clock, allowing tight control of the rise and fall times of the pulse. The power amplifier circuit amplifies the transmit signals before the signals are sent through the RF switch to the antenna.

2.14.7.5. TSS-4100 Cooling Considerations. Because the TSS-4100 was tested without the TSM-4100 for the loss of cooling test, the TSS-4100 must be installed with cooling. If the TSM-4100 is not used, equivalent cooling must be supplied or a thermal analysis of the installation must be done to show that the TSS-4100 will remain within its operating temperature range (-55 to +80 degrees C).

2.14.7.5.1. If the traffic module of the TSS detects that the transmitter is getting too hot, the TSS-4100 will put itself into standby and declare itself failed.

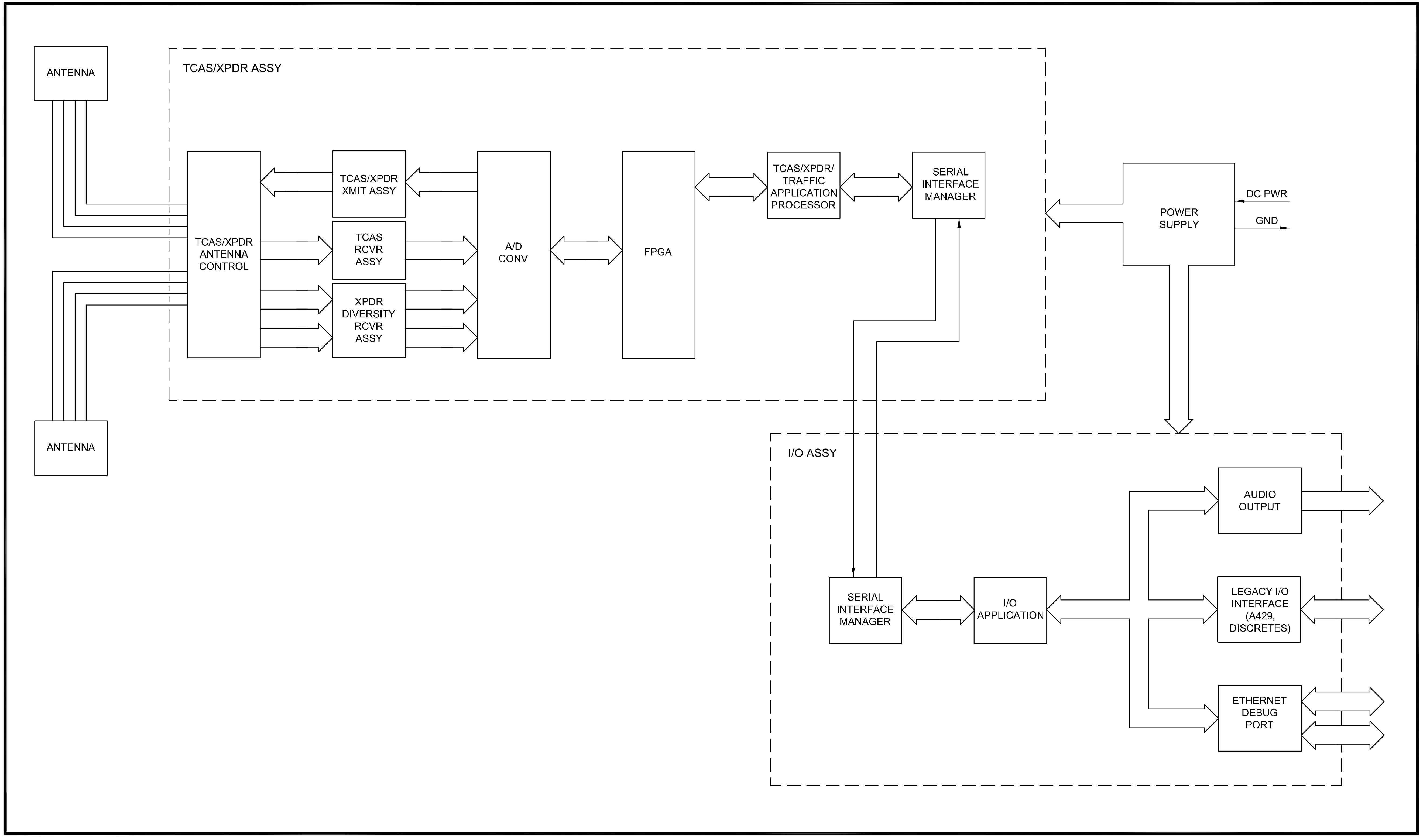


Figure 2-25. Traffic Surveillance System, TSS-4100, Internal Block Diagram

CHAPTER 3
Operation

3.1. INTRODUCTION.

NOTE

This section is not intended to be a pilot's guide, but is written to provide a basic knowledge and understanding of operating procedures for this system. For detailed data about the controls and displays of a specific airplane, refer to the Operator's Guide for that airplane.

Line Replaceable Units (LRU) with specific controls and displays are described in this section. However, the Traffic Surveillance System (TSS) can be controlled by any Transponder (TDR) / Traffic Alert Collision Avoidance System (TCAS) control unit, and TCAS traffic. Also, Traffic Advisory (TA) / Resolution Advisory (RA) information can be shown by any ARINC 735A standard display.

Only basic controls and indicators, plus those related to TRAFFIC operation, are discussed in this manual.

This section shows the typical operating controls and displays of a Traffic Surveillance System. Tables describe each control or display in sufficient detail so that the flight-line technician can operate the equipment and troubleshoot the complete system.

3.2. GENERAL.

This chapter of the Traffic Surveillance System installation manual contains examples and a description of the controls and indicators listed below:

- Traffic Display on an Adaptive Flight Display (AFD)
- RA Displays on an AFD
- Top Level Radio Page on a Radio Tuning Unit (RTU) or a Control Display Unit (CDU)
- TCAS Control Page on an RTU or CDU
- Transponder Control Page on a CDU or an RTU.

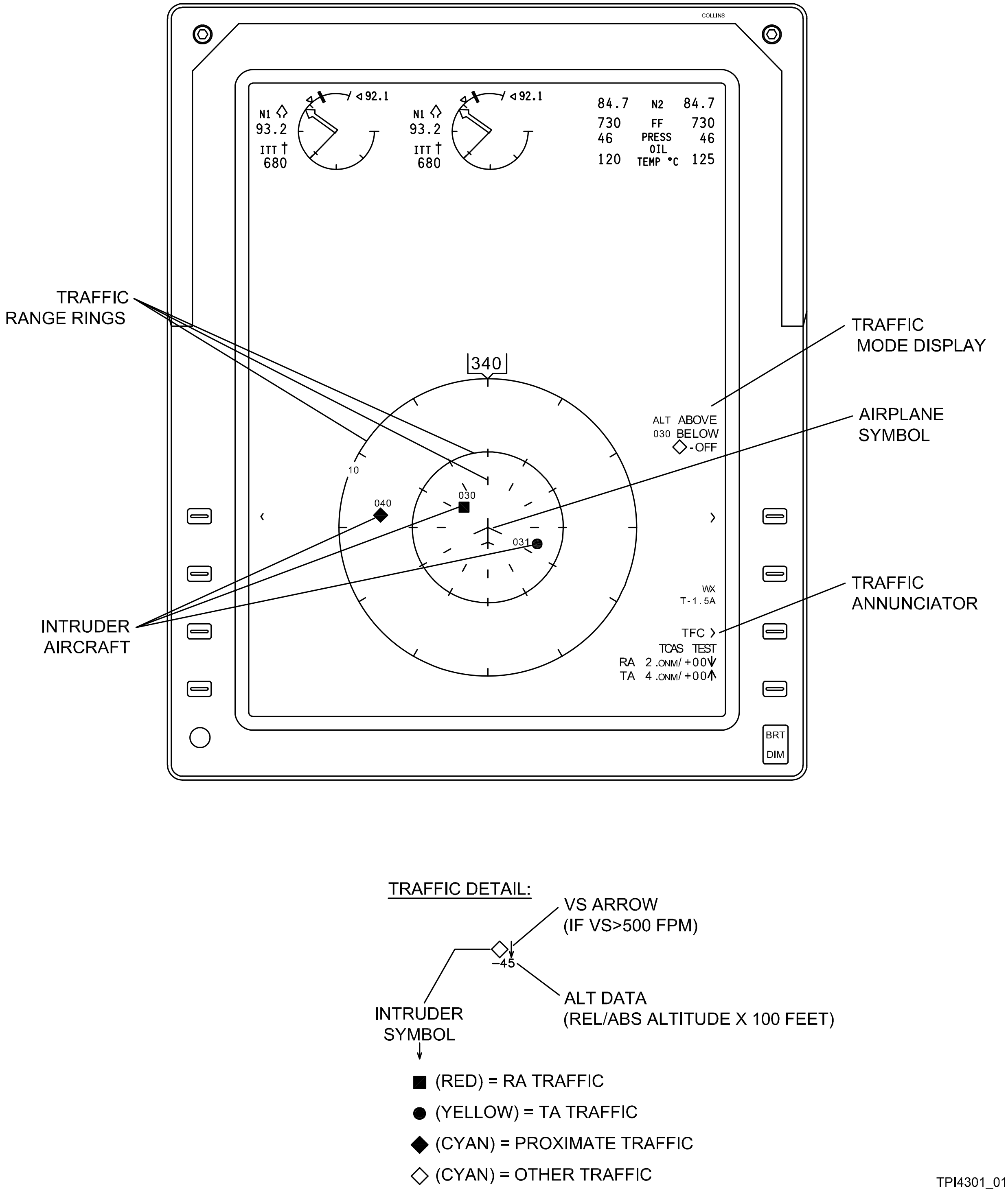


Figure 3-1. Traffic Display (AFD-3010/3010E), TRAFFIC Page

Table 3-1. Traffic Display (AFD-3010/3010E), TRAFFIC Page.

CONTROL OR DISPLAY	FUNCTION/DESCRIPTION
	Refer to Figure 3-1.
TRAFFIC map	The TSS traffic symbology is available for display on the display. Push the Traffic (TFC) line select key to show the TSS traffic overlay on the Horizontal Situation Indicator (HSI), arc, or Present Position (PPOS) Map formats. This map is a dynamic, heading-up pictorial that shows nearby transponder-equipped aircraft. This screen shows traffic symbols that alert the crew to potential and predicted collision threats. A traffic only format, along with the standard traffic overlay option, is available from the PPOS Map using either a LOWER FORMAT or the TFC line select key. The traffic only format erases all non-traffic symbols.
TRAFFIC RANGE RINGS	Three range rings provide a distance measuring scale. These rings show distance from the aircraft. Turn the RANGE knob on the Display Control Panel (DCP) to select the desired full-scale display range. The outer ring is a full-intensity circle with a tic mark every 30 degrees. This ring represents the selected full-scale range. A numeric distance label shows by the outer range ring. The middle ring is a half-intensity circle with a tic mark every 30 degrees. This ring marks the half-scale range (not shown when full-scale range is 5 miles). The inner ring consists of (only) tic marks every 30 degrees. This ring normally marks a range of 3 miles, but blanks when the full-scale range is more than 25 miles.
INTRUDER AIRCRAFT	INTRUDER AIRCRAFT are shown with an INTRUDER SYMBOL, Altitude (ALT) DATA, and a VS ARROW.
INTRUDER SYMBOL	Four kinds of intruder aircraft symbols may show. **NOTE** If a Traffic Advisory (TA) or TCAS Resolution Advisory (RA) intruder is detected that is beyond the selected display range, (only) half of the TA or RA traffic symbol shows. This half-symbol appears on the outer ring at the appropriate bearing. • The cyan open-diamond symbol shows an aircraft that is in the protected air space volume, but is not considered to be a collision threat. • The cyan solid-diamond symbol is a proximate traffic symbol. This symbol shows an aircraft that is nearby (<1200 feet relative altitude), but not close enough to be considered advisory traffic. • The yellow solid-circle is a TA traffic symbol. This is a traffic advisory that means the intruder aircraft is a potential threat. • The red solid-square is an RA traffic symbol. This is a resolution advisory that means the intruder aircraft is an immediate threat. Take corrective or preventive action to maintain minimum air space separation. RA traffic symbols are shown only with traffic.
VS ARROW	If the vertical trend rate of the intruder is greater than 500 feet per minute, the VS arrow shows. The arrow points up if the intruder is climbing, and down if descending.

Table 3-1. Traffic Display (AFD-3010/3010E), TRAFFIC Page. - Continued

CONTROL OR DISPLAY	FUNCTION/DESCRIPTION
TRAFFIC MODE DISPLAY	The traffic mode display shows the traffic altitude above/below limits selected, the aircraft altitude, and other traffic selected off. This window defines a zone of vertical air space relative to the aircraft. Intruders into this zone are tracked and considered potential threats. Four selections are possible, and the selected option on the CDU is enlarged. • NORM: The protection window is 2700 feet above and 2700 feet below the aircraft. • ABOVE: The protection window is 9900 feet above and 2700 feet below the aircraft. • BELOW: The protection window is 2700 feet above and 9900 feet below the aircraft. • ABOVE/BELOW: The protection window is 9900 feet above and 9900 feet below the aircraft. When Absolute (ABS) altitude is selected, the airplane absolute altitude shows in hundreds of feet. This field is blank when Relative (REL) altitude is selected.
AIRPLANE SYMBOL	This symbol is a reference that represents the airplane. This symbol is used to visualize the relative positions of intruder aircraft. The airplane symbol is stationary and always shows in the center of the screen. Intruder traffic symbols show and move about the screen as long as valid bearing information is received, and the aircraft is within the selected range and relative altitude window.
TRAFFIC ANNUNCIATOR	Push the TFC line select key to add or remove the traffic overlay from the arc or present position map formats. The selected traffic operating mode annunciates below the TFC annunciator. Select the traffic mode from the TRAFFIC CONTROL page on the CDU or Radio Tuning Unit (RTU). When TA/RA mode is selected, the TFC annunciator field is blank. TA and RA symbols may show. TA/RA mode is inhibited when the aircraft is on the ground. When Standby (STBY) mode is selected, TRAFFIC OFF (or TCAS OFF) annunciates in white. When TA mode is selected, TA ONLY annunciates in white (no intruders) or flashes yellow (TA intruder detected). RA symbols are not shown in this mode. TRAFFIC FAIL (or TCAS FAIL) annunciates if the display is not receiving the TRAFFIC bus. TRAFFIC TEST (or TCAS TEST) annunciates when the TSS is in test mode.
No bearing table	This two line table, shown below the TRAFFIC operating mode, automatically shows when the TSS detects an RA or TA intruder, but does not receive valid bearing information. This table shows data for the first two TA/RA intruders for which bearing information is not available. Each line lists the RA/TA advisory type, distance/altitude, and a VS trend arrow (if trend is more than 500 feet/minute). The lines are red (RA) or yellow (TA).

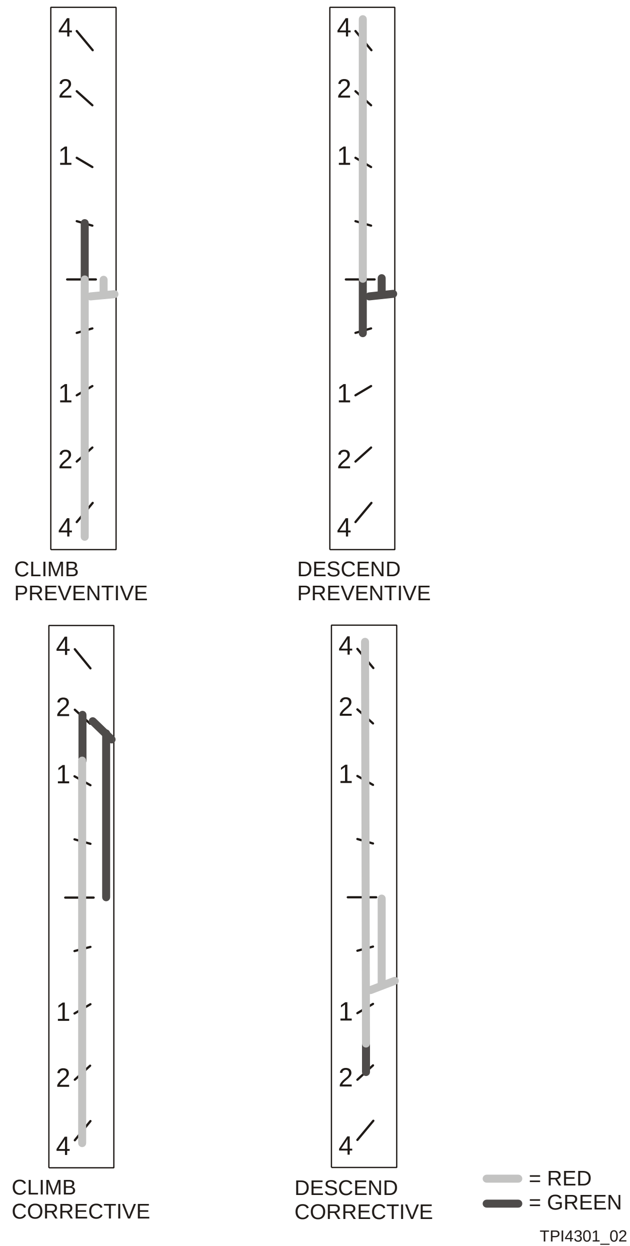


Figure 3-2. Resolution Advisory Display (AFD), TCAS II Fly-To Commands

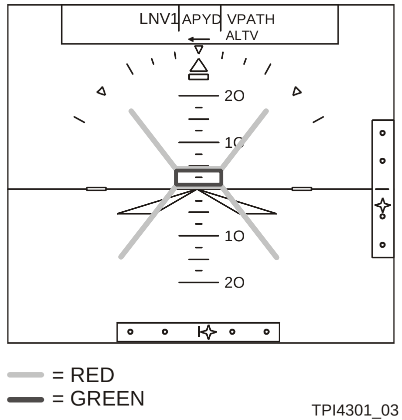


Figure 3-3. Resolution Advisory Display (AFD), Pitch Cues

Table 3-2. Resolution Advisory Display (AFD), TCAS II Fly-To Commands and Pitch Cues.

CONTROL OR DISPLAY	FUNCTION/DESCRIPTION
RA Fly-To Commands	Refer to Figure 3-2 for an illustration of Fly-To Commands on an RA Vertical Speed indicator. **NOTE** The message TRAFFIC shows in red below the vertical speed scale on the PFD when the system detects RA traffic. The message shows in yellow below the vertical speed scale when the system detects TA traffic. RA vertical speed fly-to commands show on the PFD vertical speed scale when in TA/RA mode and a traffic conflict exists. The fly-to commands show as red and green bands. To comply with an RA, avoid flying vertical speeds within the red-banded areas and do fly the vertical speeds within the green-banded areas. There are two types of RAs that show on the PFD, preventive and corrective. These are described below: • Preventive RAs are issued for threat traffic for which the TSS has determined current vertical speed will resolve the threat situation. The vertical speed range to avoid shows in red on the PFD vertical speed scale. • Corrective RAs are issued for threat traffic for which the TSS has determined that corrective action needs to be taken to avoid the traffic. The vertical speed range to seek (green) and avoid (red) shows on the PFD vertical speed scale. Aural commands are issued over the cockpit audio system. Refer to Figure 3-3 for an illustration of RA pitch cues on an attitude indicator.

Table 3-2. Resolution Advisory Display (AFD), TCAS II Fly-To Commands and Pitch Cues. - Continued

CONTROL OR DISPLAY	FUNCTION/DESCRIPTION
RA Pitch Cues, Attitude Indicator	The TCAS Resolution Advisory (RA) pitch cues are shown on the PFD attitude indicator. The pitch cues advise the pilot of the pitch attitude that is necessary to satisfy a vertical RA. RA cues are issued by the TSS when aircraft corrective maneuvering is required in order to avoid a potential collision. The pitch cues are shown as red avoidance zones and green fly to zones. A yellow NO ATT RA message is shown in the TCAS data field when RA pitch cues cannot be computed or if pitch data is not in view on the PFD. The pitch cues are disabled when an excessive attitude condition exists. When any data required to compute pitch cues is invalid, the pitch cues are removed. The two types of RA cues that can be issued by the TSS are preventative and corrective. These are described above.

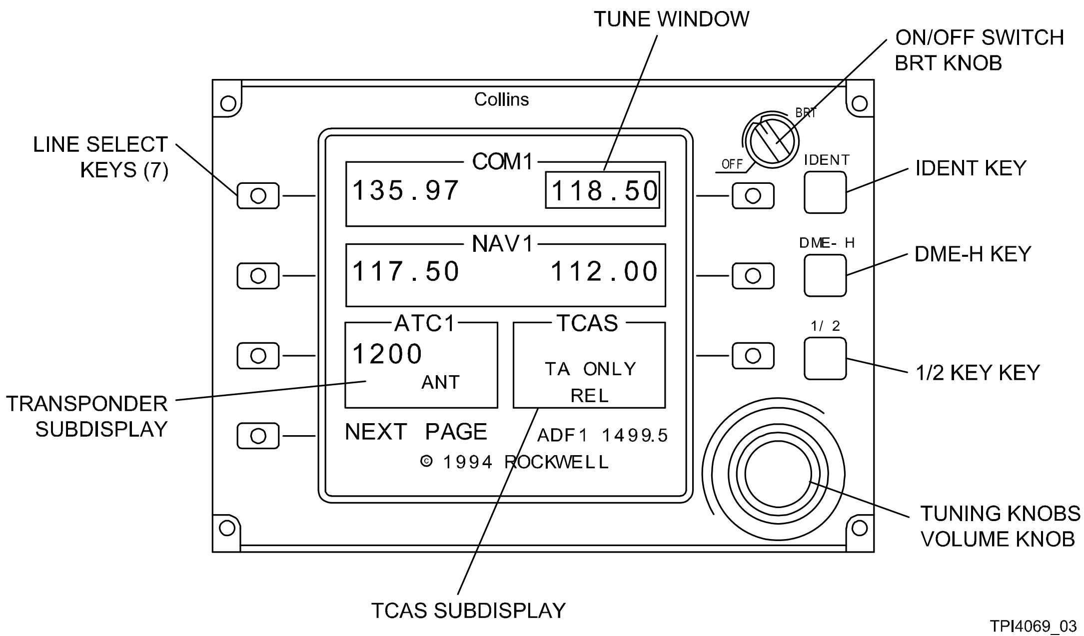


Figure 3-4. Top Level Radio Tuning Page, RTU-42XX Radio Tuning Unit

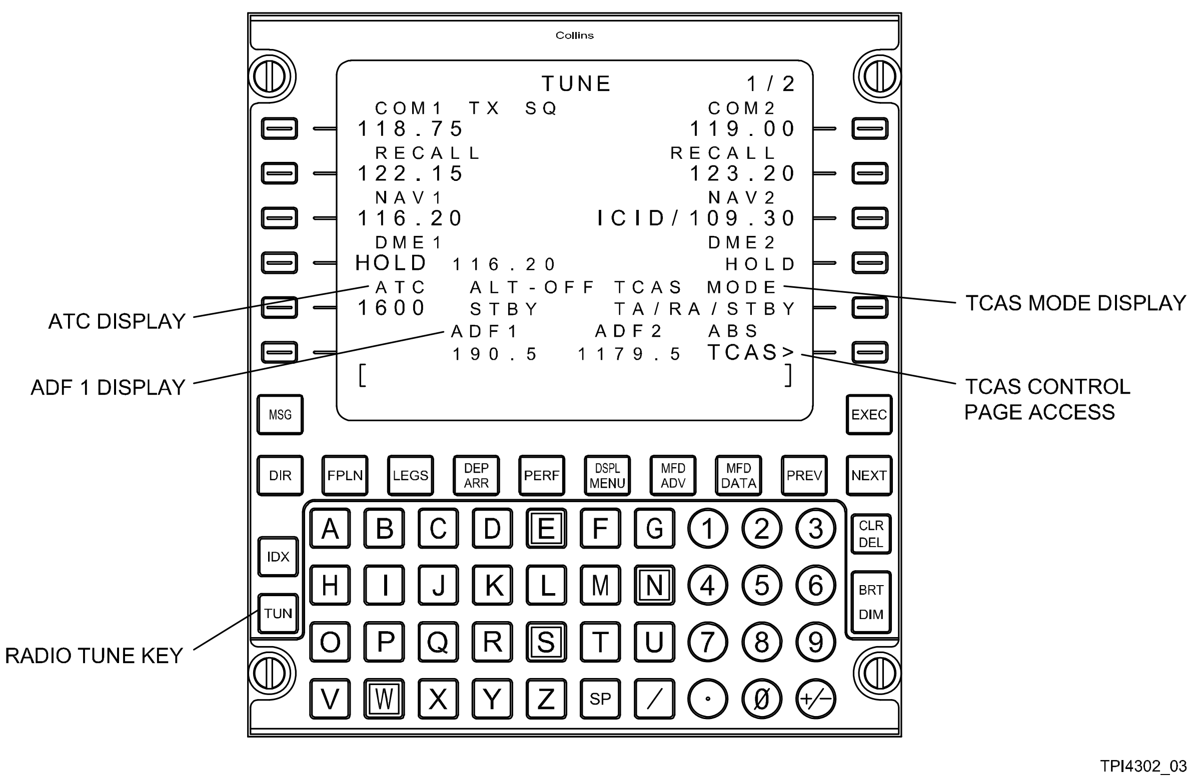


Figure 3-5. Top Level Radio Tune Page, CDU-62XX Control Display Unit

Table 3-3. Top Level Radio Tune Page, RTU Radio Tuning Unit or CDU Control Display Unit.

CONTROL OR DISPLAY	FUNCTION / DESCRIPTION
	Refer to Figure 3-4 for the top level radio tune page on an RTU. Refer to Figure 3-5 for the top level radio tune page on a CDU. **NOTE** Some of the controls listed are optional and may or may not be included depending on the installation.
LINE SELECT KEYS	The RTU and CDU have several panel mounted line select keys. These are used to select control of individual radio frequencies, presets, codes, and modes.
TCAS SUBDISPLAY (RTU) or TCAS MODE DISPLAY (CDU)	Displays various TCAS operating modes and selections.
TCAS CONTROL PAGE ACCESS (CDU only)	Push the TCAS line key to view the ATC/TCAS CONTROL page. Refer to Figure 3-7. The selected TCAS altitude display format ABS (Absolute) or REL (Relative) also shows above the TCAS legend.
ATC DISPLAY (CDU only)	Set the active ATC beacon code by keying the desired beacon code onto the scratch pad line. Then push the ATC line key to transfer this code to the selected field. If the beacon code is valid, it shows in the data field, and the active transponder immediately responds to the new beacon code. ALT OFF is shown to the right of the ATC legend when reply Mode A is selected. STBY shows when standby is selected. REPLY shows when the active TDR replies to an interrogation. IDENT shows when the IDENT line key on the ATC/TCAS CONTROL page is pushed and the active TDR transmits. The digit to the right of the ATC legend shows which transponder is active.
TUNE WINDOW (RTU only)	The tune window surrounds the item selected for control.
TUNING KNOBS (RTU only)	The tuning knobs are used to set the value shown in the tune window. When a frequency, code, or mode is shown in the tune window, the large tuning knob controls the most significant digits, and the small tuning knob controls the least significant digits.
VOLUME KNOB (RTU only)	If present, the volume knob is the third (smallest diameter) knob on the knob cluster. As the volume knob is rotated, a volume scale is displayed adjacent to the selected radio.
IDENT KEY (RTU only)	Push the IDENT function key to transmit an Air Traffic Control (ATC) identification pulse. When the ident feature is active, ID is shown in cyan on the ATC sub-display and on the ATC main display page.

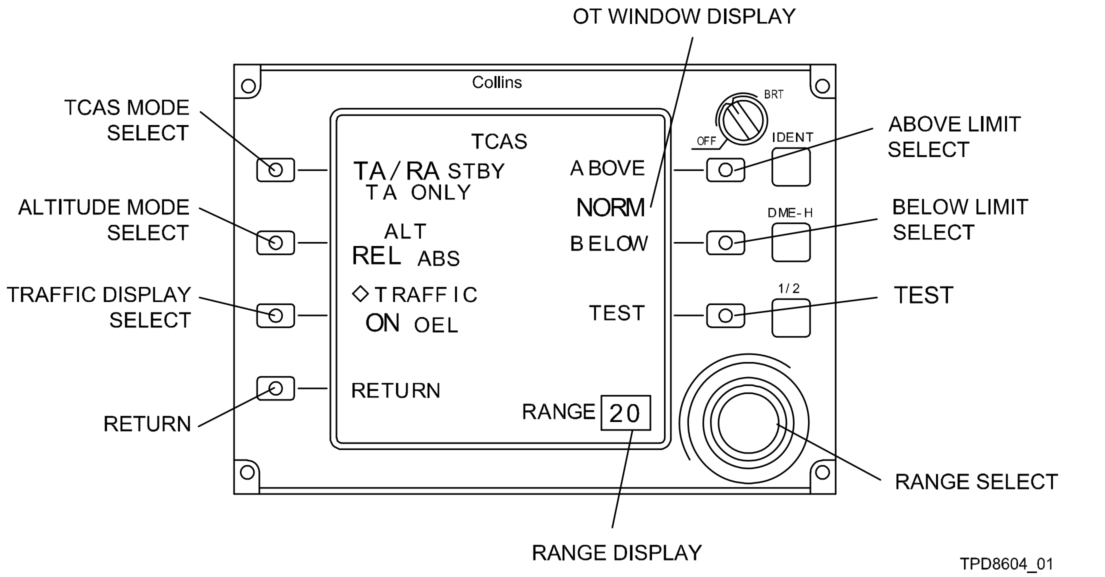


Figure 3-6. TCAS Page, Radio Tuning Unit (RTU-42XX)

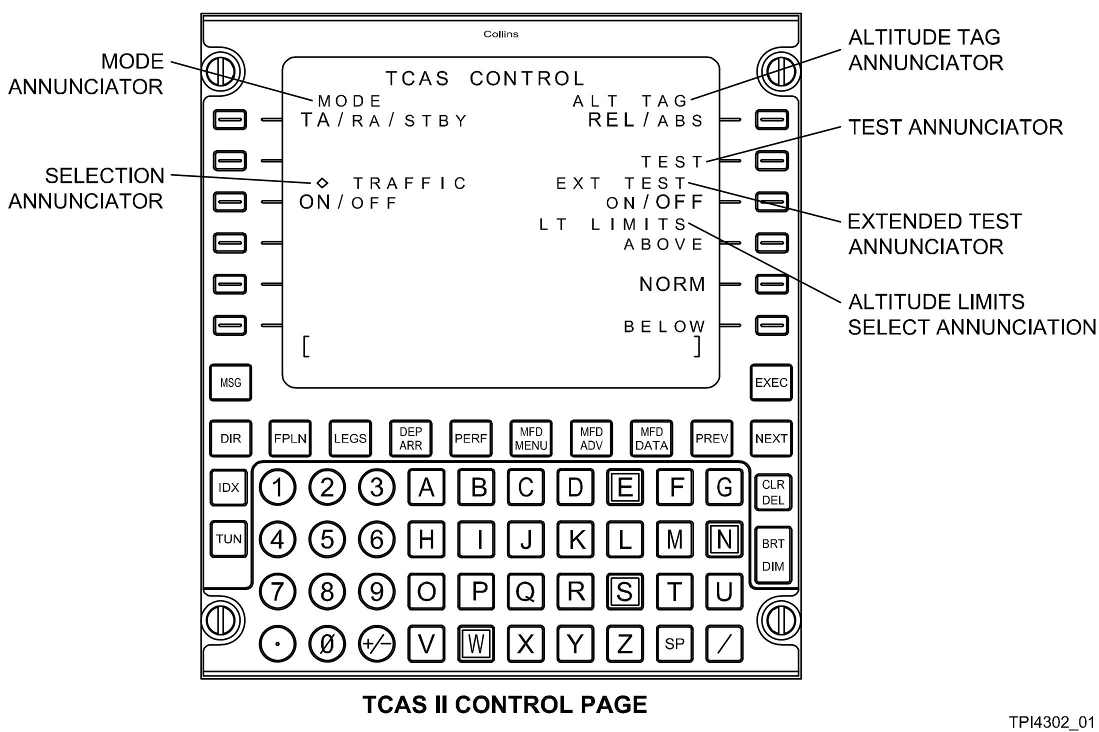


Figure 3-7. TCAS Page, Control Display Unit (CDU-62XX)

Table 3-4. TCAS Page, Radio Tuning Unit or Control Display Unit.

CONTROL OR DISPLAY	FUNCTION/DESCRIPTION
	NOTE Some of the controls listed are optional and may or may not be included depending on the installation. Refer to Figure 3-6 for a typical TCAS Page on an RTU. Refer to Figure 3-7 for a typical TCAS Page on a CDU.
TCAS CONTROL page	Push the TCAS line key on the top level CDU (or RTU) page to select the TCAS CONTROL page.
MODE ANNUNCIATOR or MODE SELECT line key	Push the MODE line key to to toggle through the TCAS modes: • TA/RA (Traffic and Resolution Advisories) • STBY (Standby) • TA ONLY (Traffic Advisories Only). The active mode is shown in cyan and in large letters. Open-diamond traffic is other traffic. RA traffic, TA traffic, and proximate traffic may still show.
ALTITUDE TAG ANNUNCIATOR or ALTITUDE MODE SELECT line key	Push this line select key to toggle between the altitude modes. The available modes are Relative (REL) and Absolute (ABS).
TEST ANNUNCIATOR and line key	Push the TEST line key to initiate the TSS self-test routines. When self test is active, TEST is annunciated in cyan and in large letters for approximately 10 seconds. When TSS self test is initiated, the ATC self test is also initiated. **NOTE** If an extended test is an option, push and hold the TEST line select key to initiate the extended self test.
ALTITUDE LIMITS SELECT line keys and OT WINDOW DISPLAY	Push the ABOVE, NORM, or BELOW line key to select the altitude range of the traffic protection window. The active altitude volume limit of Other Traffic (OT) is shown in cyan and in large letters. **NOTE** If there is no NORM line key between the ABOVE and BELOW line keys (for example, on the RTU shown), then NORM is selected when neither ABOVE nor BELOW are selected. The altitude limit defines a volume of vertical air space relative to the aircraft. Intruders into this volume are tracked and considered potential threats. When NORM is selected, the protection volume is 2700 feet above and 2700 feet below the aircraft. When ABOVE is selected, the protection volume is 9900 feet above and 2700 feet below the aircraft. When BELOW is selected, the protection volume is 2700 feet above and 9900 feet below the aircraft. When ABOVE and BELOW are both selected, the protection volume is 9900 feet above and 9900 feet below the aircraft.

Table 3-4. TCAS Page, Radio Tuning Unit or Control Display Unit. - Continued

CONTROL OR DISPLAY	FUNCTION/DESCRIPTION
SELECTION ANNUNCIATOR or TRAFFIC DISPLAY SELECT	Push the adjacent line select key to set other traffic (non-threat traffic) monitoring ON (all traffic) or OFF (threat traffic only). The active state is shown in cyan and in large letters.
RANGE SELECT (RTU only)	Turn either tuning knob to set the display range. Clockwise rotation selects increasing ranges and counterclockwise rotation selects decreasing ranges. Available range depends on the installation and may be either 6/12, 6/12/20/40, 3/5/10/20/40, or 5/10/20/40 (nmi).

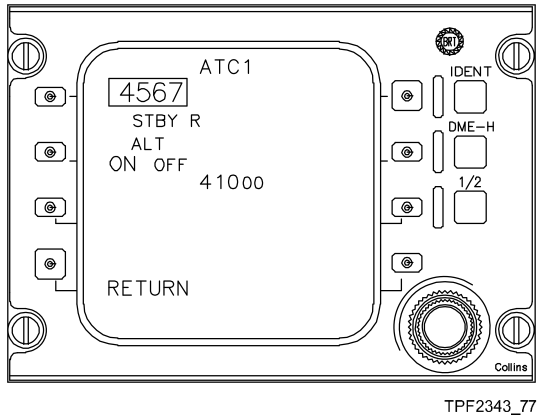


Figure 3-8. Transponder Page, RTU-42XX Radio Tuning Unit

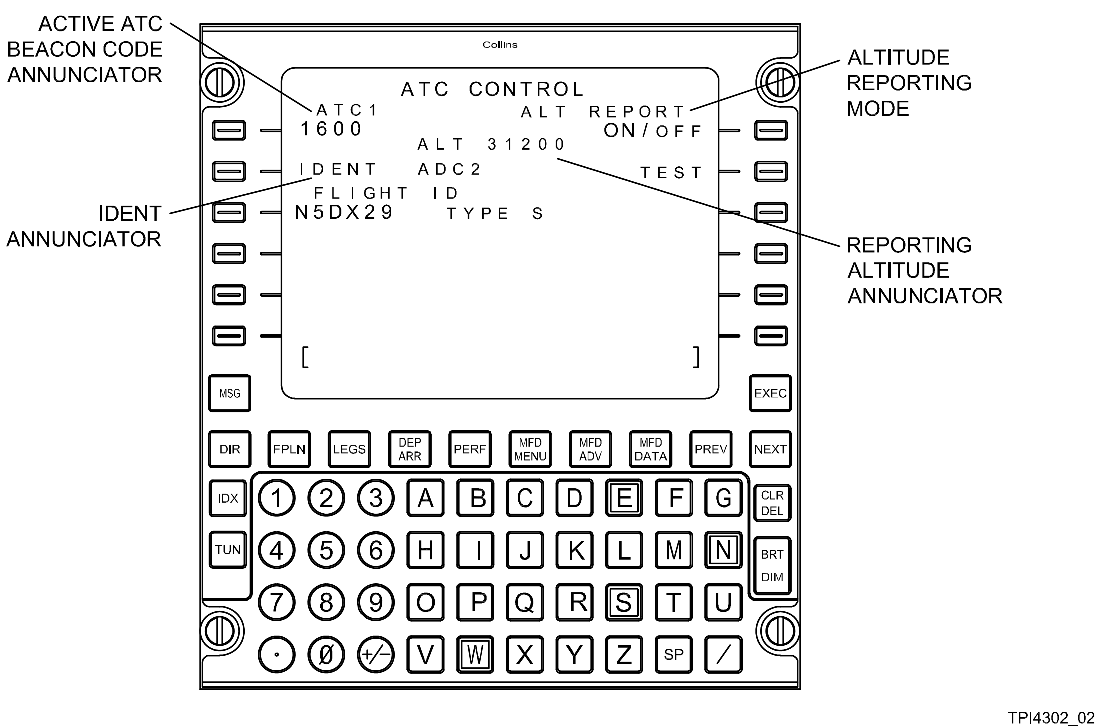


Figure 3-9. Transponder Page, CDU-62XX Control Display Unit

Table 3-5. Transponder Page, RTU Radio Tuning Unit or Control Display Unit.

CONTROL OR DISPLAY	FUNCTION / DESCRIPTION
	Figure 3-8 shows the ATC main display page on an RTU. Figure 3-9 shows the ATC controls on a CDU.

Table 3-5. Transponder Page, RTU Radio Tuning Unit or Control Display Unit. - Continued

CONTROL OR DISPLAY	FUNCTION / DESCRIPTION
ATC Page (RTU or CDU)	**NOTE** Identical control selections are presented on both RTUs (or on both CDUs) for the ATC transponder so that either pilot can make transponder control selections. To access the ATC Transponder main display page from the RTU or CDU top level page, push the ATC line select key two times. The first push positions the tune window around the ATC code, and the second push shows the ATC main display page.
ACTIVE ATC BEACON CODE ANNUNCIATOR	To enter the ATC Ident code from the TUNE page or ATC CONTROL page, enter the desired code in the scratchpad. The conditions that follow define a valid beacon code entry: • One to four digits have been entered (i.e., 1 = 0001). • Each digit entered is between 0 and 7 (i.e., 2753, 7367, 377, etc.).
IDENT ANNUNCIATOR	Push the IDENT ANNUNCIATOR ident line key to transfer the contents of the scratchpad to the ATC field on a CDU.
ALTITUDE REPORTING MODE	The ALTITUDE REPORTING MODE is set from the ATC main display page. The line select key adjacent to the ALT legend is used to select altitude reporting mode (push-on/push-off). **NOTE** TCAS operation requires altitude data, so if the ATC transponder is not set to ALT reporting mode, the TCAS system automatically selects STBY mode.
REPORTING ALTITUDE ANNUNCIATOR	

CHAPTER 4
Maintenance

4.1. INTRODUCTION.

NOTE

Use the flight line maintenance procedures as customer acceptance test procedures by interconnecting the equipment on the bench using the equivalent of an aircraft interconnect harness and appropriate sensor data sources.

Throughout these procedures the term Traffic Control is intended to apply to any traffic control Line Replaceable Unit (LRU).

The term Traffic Surveillance System applies to the entire traffic system. The abbreviation TSS-4100 applies to the LRU.

Throughout these procedures, the term Traffic Display refers to whatever traffic display device is present in the installation. This can be a single or dual VSI/Resolution Advisory (RA)/TA display like the TVI-920D, an Electronic Flight Instrument System (EFIS) display like an MFD-3010E, or a combination of these or other traffic displays.

This section contains the procedures necessary to assure proper post-installation system operation.

4.1.1. Flight Line Maintenance.

The flight line maintenance procedures assist the flight line technician in isolating a reported failure to a given LRU. Therefore, the instructions in this series favor a higher probability of traffic surveillance system equipment failure. Faulty units then can be tested and repaired with the bench procedures given in the associated unit repair manual.

4.1.2. Automatic Testing.

The traffic surveillance system incorporates automatic testing routines (Built-In Test Equipment (BITE)) in the TSS-4100 Transmitter/Receiver to check the operational integrity of the system. Monitoring of system functions is continuous during operation. Testing may be initiated manually via the traffic control LRU, or by pushing the TEST switch on the front panel of the TSS-4100. If a system failure is detected during operation or after initiating test, an indicator illuminates on the TSS-4100 front panel and a red Traffic Alert Collision Avoidance System (TCAS) System flag displays on the TCAS display. Refer to the Operation chapter of this manual for a description of front panel control and indicators.

4.2. MAINTENANCE SCHEDULE.

The TCAS function of the TSS-4100 does not require any periodic maintenance. However, the transponder function must have an Air Traffic Control (ATC) transponder test and inspection according to FAR part 91 at a minimum of once every two years.

4.2.1. Cleaning and Painting.

NOTE

Observe all warnings and cautions listed in the advisories paragraph of this manual and the Collins Avionics Standard Shop Practices Manual.

This section presents the special instructions necessary for cleaning the traffic surveillance system equipment. For standard cleaning instructions, the technician should follow the instructions outlined in the Collins Avionics Standard Shop Practices Manual, Collins Part Number (CPN) 523-0768039.

4.2.2. Cleaning Indicators.

There are no indicators coming from any part of the Traffic Surveillance System to indicate necessary cleaning.

4.2.3. Cleaning Antennas.

CAUTION

Do not paint the antenna surface. Do not attempt to touch up the silk screening with paint.

Do not use cleaning solvents on the antennas.

NOTE

Refer to TRE-920 Service Information Letter 1-95, Radome Paint Peeling, for cleaning the TSA-4100 or TRE-930.

Methods of cleaning antennas follow.

a. Clean the exposed antenna surface using a soft cloth moistened with soap and water.

b. Rinse the surface with clean water and allow to air dry.

4.2.4. Approved Repairs.

No repairs should be attempted on any component of the traffic surveillance system while the equipment is installed in the aircraft.

4.3. CONVERSION FROM TTR/TDR TO TSS SYSTEM.

The Traffic Surveillance System (TSS) is designed to take the place of one TDR-94D and a TTR-920, TTR-921, or TCAS-4000, in an integrated system.

4.3.1. Preparation for Conversion.

A list of requirements follows:

- The TSS-4100 requires a 7.5 Amp breaker and 28 V input power.
- The TSS-4100 requires concentrated input busses. If the existing system has a TDR-94D strapped to Configuration 2, this is already available. If the TDR-94D is strapped to any other configuration more changes will be necessary to the architecture of the aircraft to accommodate the TSS-4100.
- The TSS-4100 requires radio altitude on the concentrated input bus for the TCAS function. This may require a change to the input/output concentrator routing in order to route this data to the TSS-4100. This is already true for most Configuration 2 TDR-94D installations.
- The TSS-4100 requires the following interfaces from the TDR it is replacing: Concentrated bus inputs, Control bus inputs, Control bus control discretes, All GPS inputs, X-side transponder standby input and output discretes, TDR No. 1 output bus (used for TSS No. 1 output bus), and Air/Gnd input.
- The TSS-4100 requires the following interfaces from the TTR it is replacing: TA/RA output busses, RA Display and TA Display input discretes, XT and TX busses to stand alone transponder, 600 Ω output, (Climb Inhibit, Increase Climb Inhibit, Perf Limit, and Advisory Inhibit) discrete inputs), and Visual Annunciation and Aural Annunciation output discretes.
- The TSS-4100 requires ARINC 615-3/4 data load capability. This is required to load aircraft configuration data.
- The TSS-4100 requires a couple of changes to the maintenance system. The maintenance labels being sent through the TSS No. 1 output bus are different. In addition there must be an option to show the TSS-4100 electronic nameplate.
- A change to the input/output concentrator tables to route the maintenance and electronic nameplate labels to the maintenance system is necessary.
- The TSA-4100 replaces the TRE-920 directional antenna. The connectors for the TSA-4100 are rotated 45 degrees from the placement of the connectors for the TRE-920. This is not an issue if there is only one hole in the skin of the aircraft for all of the connectors to go through.

4.3.2. Differences between TTR/TDR and TSS.

Differences between the TTR/TDR and TSS systems follows:

- It is recommended that the TDR is on the left and the TSS-4100 is on the right. This is because a transponder is required to be on the emergency battery bus. Typically, the left transponder is on this bus. A stand alone TDR uses less power than the TSS-4100.
- The TSS-4100 only supports A429 input busses. CSDB inputs, Gillham altitude, and analog inputs (for example, an analog radio altitude input) are not supported.
- The TSS-4100 does not support an 8 Ω audio output.
- The TSS-4100 supports a Time Mark input from both GPS sources. The TDR only supports an input from one GPS.
- Aircraft configuration data is maintained electronically in a file loaded through the TSS-4100 into an attached ECU. In a TDR/TTR, this aircraft configuration data is maintained through hard straps on the back of the unit.
- The Mode S address for the TSS-4100 is maintained electronically within the attached ECU. TDR has 24 discrete inputs to set the Mode S Address.
- The TSS-4100 requires cooling. It is highly recommended that the TSM is used as the fan. This mount can be monitored by the TSS-4100.

NOTE

The TSS-4100 (hardware only) and TSSA-4100 (software only) are separate top level part numbers. Both must be maintained as part numbers on the aircraft.

The TDR and TTR top level part numbers are different. Each includes both software, and hardware, components.

4.4. DATA LOADING.

Explanations of data loading the ECU and the TSS-4100 follow.

4.4.1. ECU Data.

The External Compensation Unit (ECU) attached to the TSS-4100 holds two sets of data. The first set of data, the TSS ECU Media Set Builder, contains the aircraft-configuration strapping for the TSS. These straps are detailed in Table 2-2. These data must be data loaded through the TSS-4100. Refer to Table 4-1 for the data load busses and pins. The TSS-4100 will recognize the format of the data set and store the data appropriately. The second set of data contains the aircraft Mode S Address. The TSS Mode S Address Programming Tool loads just the Mode S address onto the ECU, refer to Paragraph 4.5 for details. Verification of a proper load of these sets of data will be accomplished by reviewing the TSS-4100 Electronic Nameplate on the aircraft maintenance system. See Paragraph 4.4.3 for more information on the TSS electronic nameplate.

Table 4-1. Data Load Buses And Pins

Bus Name	Pin Numbers (Hi & Low)	Bus Speed
Control B Input Bus	LMP-7D & 7C	Low
Dataload Input Bus	LMP-7J & 7K	High
TSS-1 Output Bus	LMP-7A & 7B	Low
TSS-2 Output Bus	LMP-1A & 1B	High
TSS-3 Output Bus	RMP-1A & 1B	High

4.4.1.1. If the bus speeds are configured differently in the ECU than what is listed in Table 4-1, follow the following steps in order to load data.

a. Disconnect the cable from the ECU.

b. Power cycle the TSS-4100. This forces the TSS to use the default speeds listed in Table 4-1.

c. Reconnect the cable to the ECU.

d. Start the data load process as normal. The data load software always uses the default bus speeds. The bus speeds in the ECU are ignored once the data load process has begun.

4.4.2. TSS Data Loading.

The TSSA-4100 and the ECU files are field loadable. Rockwell Collins has tested the TSS data load procedure using the ARINC 615-3 data loaders shown in Table 4-2. It is recommended that one of these data loaders, or an upgraded version of one of these data loaders, is used to load the Traffic Surveillance System Application (TSSA) or the ECU.

4.4.2.1. The TSS may be data loaded using one of two input buses and one of three output buses. Loading must be done using the default speed of the bus. Refer to Table 4-1 for bus names, pin numbers, and bus speeds. Refer to Table 4-2 for a list of the data loaders that the TSS-4100 has been tested with. Most standard ARINC 615-3/4 compatible data loaders should be able to interface to the TSS-4100. No special adaptor is called out for the TSS-4100. See the specifications of the applicable data loader for information on the mating connector to be used.

4.4.2.2. The TSS-4100 needs one of the following sets of requirements in order to enter data load mode:

• Set the SDI code of the unit to right or left. • Make sure the airspeed and ground speed are each less than 40 kts. • Make sure the Data Load Enable discrete (RMP-10K) is grounded. • Make sure one of the air ground discretes is grounded. • Make sure the TSS-4100 receives an ARINC label with a data load request. The TSS uses ARINC label 027 as the data load input label and sends label 226 as the data load output label.	OR	• Set the SDI code of the unit is set to indeterminate (neither of the SDI pins are grounded). • Make sure the Data Load Enable discrete (RMP-10K) is grounded. • Make sure the Shop Mode Enable discrete (RMP-6A) is grounded. • Make sure the TSS-4100 receives an ARINC label with a data load request.

4.4.2.3. Refer to Figure 4-1. To make sure that the TSSA has been loaded correctly, look at the electronic nameplate being sent to the maintenance system. Refer to Paragraph 4.4.3 for data about the TSS electronic nameplate, and for what needs to be verified after a TSSA or ECU media set data load.

Table 4-2. ARINC 615 Data Loaders.

Company	Product	Part Number
Honeywell (Allied Signal)	PDL	964-0400-024
Avionica	USB429win − USB/ ARINC 429 Adapter	650-0200
	USB429win − 615 Data Loader SW for PC	700-0300; (version 040903)
Demo Systems	PMAT-2000	
Demo Systems	PDL-615/MSD	

4.4.3. TSS Electronic Nameplate.

Refer to Figure 4-1. Through the aircraft maintenance system it is necessary to access the TSS Electronic Nameplate. There are three sections of the electronic nameplate.

```
TYPE NO:TSSA-4100  CPN:810-0052-XXX
MFR:4V792         DO-178B LEVEL B,D
TSO:C119B,C112 CL 2A1 121 011,
    C166A CL A3-TRANSMITTING ONLY
ETSO:2C112A,C119B       DMF:01JAN09
CRC32-SYSIO:               YYYYYYYY
CRC32-TRAFFIC:             YYYYYYYY
ROCKWELL COLLINS, INC
CEDAR RAPIDS, IA  52498 USA
MANUFACTURED:MELBOURNE, FL

ECU-3000 DATA    HW PN:822-1200-80X
LOADED CONFIG PN:  WWWWWWWWWWWWWWWW
CRC32-AIRCRAFT CONFIG:     YYYYYYYY
MODE-S ADDRESS:            XXXXXXXX

TSS HW PN:822-2132-001  SN:XXXXXXXX
SERVICE BULLETINS:XX,XX,XX,XX,XX,XX
```

TPI4679_04

Figure 4-1. TSS-4100, Electronic Nameplate

4.4.3.1. The top section of the electronic nameplate (lines 1 - 10) contains information regarding the TSSA-4100 software. When the software is updated, make sure the items that follow:

- CPN – this is the top level software part number for the TSSA loaded
- CRC32-SysIO – this is a Cyclic Redundancy Check (CRC) on the first of two load sets that are part of the TSSA-4100
- CRC32-SysIO – this is a CRC on the second of two load sets that are part of the TSSA-4100.

4.4.3.2. The second section of the electronic nameplate (lines 12 - 15) contains data about the ECU connected to the TSS-4100.

4.4.3.2.1. When the ECU is properly connected to the TSS-4100, the hardware part number of the ECU is shown. If the ECU is incorrectly formatted for the TSS or is not properly connected, the hardware part number will be shown as INVALID.

4.4.3.2.2. The second and third lines of the ECU portion of the electronic nameplate show the aircraft configuration that is loaded into the ECU. If there is not an aircraft configuration loaded, or if the load is invalid, both the LOADED CONFIG PN and CRC32-AIRCRAFT CONFIG line of the aircraft configuration are INVALID. When a valid aircraft configuration file is loaded into the ECU, the part number and the CRC must be compared against the part number and CRC provided with the configuration file.

4.4.3.2.3. The last line of the ECU portion of the electronic nameplate shows the Mode S address stored within the ECU. The Mode S address is shown in octal. Do not use this display of the Mode S address to verify a changed Mode S address. Instead, use a transponder test set such as the IFR-6000 to verify a changed Mode S address.

4.4.3.3. The third section of the electronic nameplate (lines 17+) contains some information about the TSS-4100 hardware. This is reported as a convenience only and is not to be used for official record keeping. The official part number, serial number, and list of installed service bulletins are on the physical TSS-4100 nameplates.

4.5. TSS-4100 MODE S ADDRESS PROGRAMMING TOOL.

Rockwell Collins provides the TSS-4100 Mode S Address Programming Tool (Mode S tool). This tool changes the Mode S address, and does not require data loading. The Mode S tool is provided to allow an update to the Mode S address of the TSS-4100 without requiring a data load and without removing the TSS-4100 or the ECU from the aircraft.

4.5.1. Programming Tool Support.

Support for the TSS-4100 Mode S Programming Tool is provided by Rockwell Collins Product Support Representatives.

4.5.2. Programming Tool System Requirements.

The system requirements for using the TSS-4100 Mode S Address Programming Tool are as follows:

- A PC or laptop with Microsoft Windows™ XP or later

- Be logged in with administrator credentials
- At least one RJ-45 port on the PC/laptop
- A Cross-Over RJ-45 Ethernet Cable.

4.5.3. Programming Tool Installation.

NOTE

This program requires Microsoft™ .NET 3.5 on the PC. If there is difficulty in installing .NET, uninstall all currently installed versions of Microsoft™ .NET before attempting the new installation. Contact your network administrator or information technology department for further assistance.

Do the steps that follow to install the Mode S Programming Tool:

a. Obtain the TSS-4100 Mode S Address Programming Tool (CPN 811-2989-001).

NOTE

This is available through a CD-ROM. It may also be available through a digital download. Contact a Rockwell Collins Product Support Representative for more information regarding this option.

b. Open the directory with the TSS-4100 Mode S Address Programming Tool setup files.

c. If .NET is not already installed, run `Install .NET 3.5 Offline.exe`. If unsure whether or not .NET is installed, proceed to the next step. This setup program is provided by Microsoft™. This setup program will indicate that it is downloading files from the internet, and will say, "Download Complete. You can now disconnect from the Internet." These statements are normal. All necessary files are contained within the executable.

d. Run the `Mode S Tool Installation Package.msi` program. Follow the prompts to install the TSS-4100 Mode S Address Programming Tool.

NOTE

If .NET is not installed, a prompt to download the applicable files from the Internet will show. It is recommended to decline this download, and to perform Step 4.5.3.c. This is because the .NET framework is very large, and downloading the files will take a significant amount of time.

4.5.4. Programming Tool Setup.

Make sure the IP address of the PC or laptop is within the proper address space. If the Mode S Programming Tool is expected to be used often, then configure an IP port, on the PC or laptop, to not get an IP address from a DNS server at start-up.

NOTE

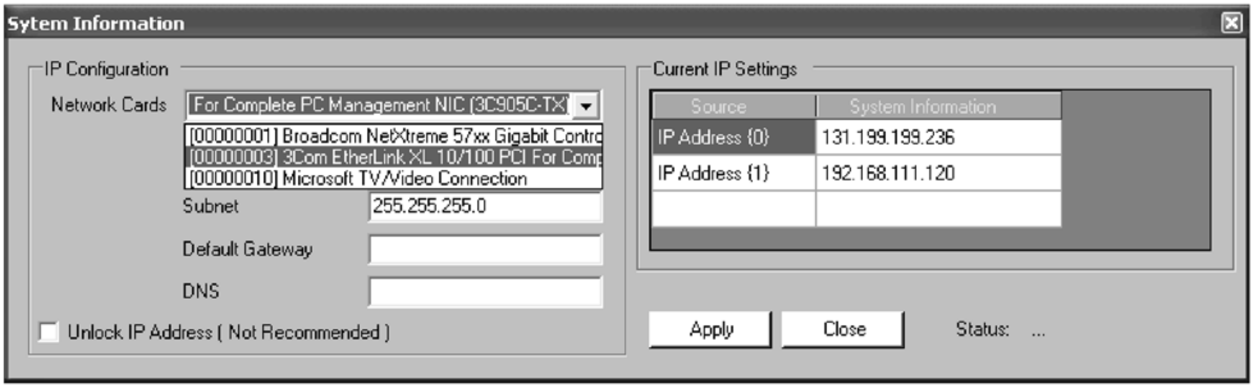
If there are problems setting up the IP address of the PC or laptop, contact your network administrator or information technology department for assistance.

a. On the TSS-4100 Mode S Address Programming Tool, select the `System > IP Addresses` option.

b. Select the appropriate Network Interface Card (NIC). Refer to Figure 4-2.

NOTE

In the example below, the second NIC card is being selected.



TPK0232_01

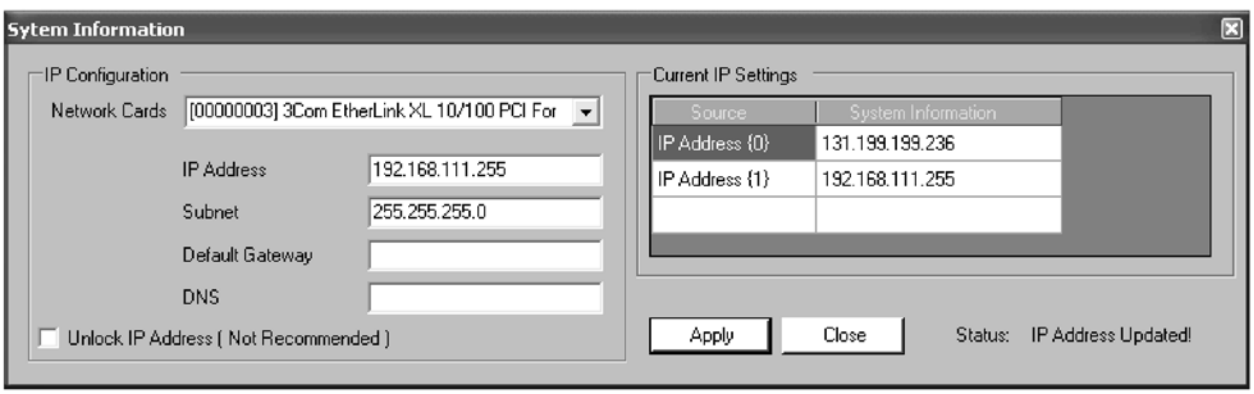
Figure 4-2. Programming Tool - Select Network Interface Card

c. Refer to Figure 4-3. If necessary, change the IP address to be 192.168.111.XXX, where XXX is anything except 110. Change the Subnet mask to 255.255.255.0. Make sure the Default Gateway and DNS server are blank.

NOTE

In the example below, the second IP address was changed from 192.168.111.120 to 192.168.111.255. This can be seen by looking at the `IP Address (1)` field in the `Current IP Settings` window.

Also, the status now indicates `IP Address Updated`.



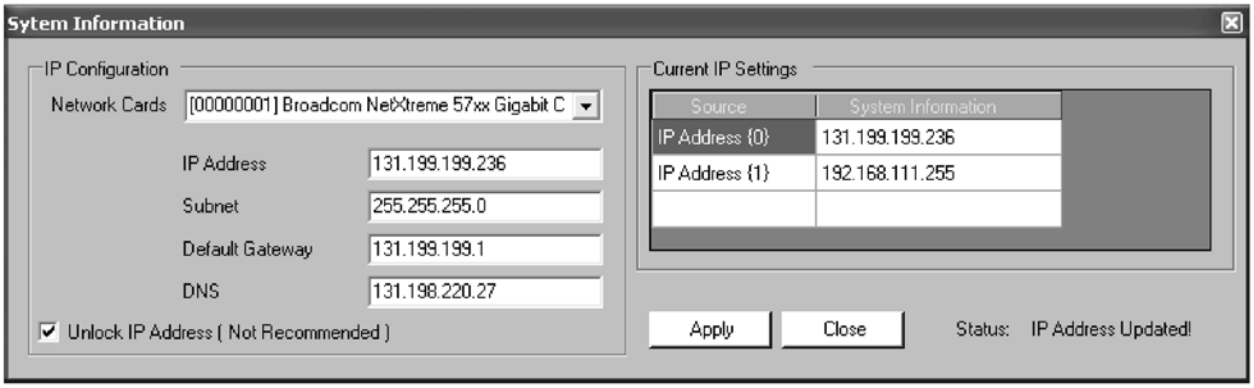
TPK0232_02

Figure 4-3. Programming Tool - Change the IP Address

d. Refer to Figure 4-4. If the IP address is locked by the program, it is possible to unlock the IP address and make changes. This is not recommended, and if this is done it is recommended that these settings are changed back after use of the tool.

NOTE

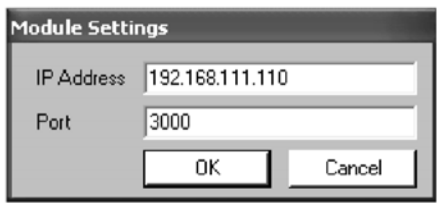
In the example below, the first NIC card is selected, and there is a Default Gateway and DNS server. In order for this NIC card to be used to communicate with the TSS-4100, these values would need to be cleared, and the IP address would need to be set to the proper address space.



TPK0232_03

Figure 4-4. Programming Tool - Unlock the IP Address

e. On the Programming Tool, select the `System > Settings` option. Make sure that the target IP address is 192.168.111.110 and that the port is 3000. Refer to Figure 4-5.



TPK0232_04

Figure 4-5. Programming Tool - Verify the IP Address

4.5.5. Programming Tool Instructions.

These instructions assume that the TSS-4100 is installed properly on the aircraft.

a. Make sure that the TSS-4100 is off and in the "On Ground" state.

CAUTION

Do not attempt to remove the front panel screws from the TSS-4100. This will likely result in either a sheared screw or the screw not being able to be screwed back in. If this happens, please return the TSS-4100 to a Rockwell Collins Service Center. These screws are designed to stay on the TSS-4100.

b. Loosen, but do not remove, the screws located on the front panel of the TSS-4100. Slide the access panel up and rotate it so that the TSS-4100 RJ-45 maintenance ports are accessible.

c. Connect the cross-over cable from the PC to the TSS-4100 SYSP port.

NOTE

If a cross-over cable is not used, there will be no connection between the PC and the TSS-4100.

d. Turn the TSS-4100 on. Allow the unit up to 30 seconds to complete its power up sequence.

e. Run the TSS-4100 Mode S Address Programming Tool. If a default installation is done, the program may be accessed through a shortcut on the desktop, or in the START menu under > Rockwell Collins > Mode S Programmer > TSS-4100 Mode S Tool.

f. Select the appropriate base for programming the Mode S address – either octal or hexadecimal.

g. Enter the Mode S Address. If entering in octal, the entered is eight digits between 0 and 7. If entering in hexadecimal, the entered value is 6 characters, each character being either a single digit (0 – 9), or a letter A thru F.

NOTE

If there are not enough characters for the selected base, zeroes (0s) will be added to the beginning of the value entered.

h. Push the PROGRAM button and wait for up to a minute. The system will attempt to send the new Mode S address to the TSS-4100. If the process completes incorrectly, an error message will appear in the Display Log. If the process completes correctly, the TSS-4100 will reset itself. Allow the TSS-4100 to complete its power up sequence.

i. Push the QUERY button. Make sure that the Mode S address displayed is the newly programmed address.

NOTE

This is not an approved way to officially verify the current Mode S address setting.

j. Select the TSS-4100 as the active transponder. Make sure that there is no annunciation of a transponder failure. Interrogate the TSS-4100 using a test set (such as the IFR-6000), and verify the Mode S Address.

k. Turn off the power to the TSS-4100.

l. Remove the cross-over cable from the TSS-4100.

m. Slide the cover back onto the front panel of the TSS-4100 and tighten the screws.

4.5.6. Programming Tool Overview.

Figure 4-6 shows a screen shot of the TSS-4100 Mode S Address Programming Tool. The description of the screen shot follows:

1. Octal / Hexadecimal: Radio buttons used to change between Octal and Hex just by clicking on the radio button with the appropriate base for ease of readability. This affects both the input and the output.
2. Mode S Address: Text box in which to enter a Mode S address. If octal is selected, only the characters 0 – 7 are accepted. If hexadecimal is selected, only the characters 0 – 9 and A – F are accepted.
3. Current Mode S: Text field that shows the Mode S address currently being used by the TSS-4100. This is only populated after the Query button is pushed. This output is either in octal or in hexadecimal based on the current setting.

NOTE

The Current Mode S field is for informational use only. This is not an approved way to officially verify the current Mode S Address setting. Checking the reported Mode S Address from the reply to an interrogation of the TSS-4100 (using a test set such as the IFR-6000) is the appropriate way to verify the Mode S address.

4. Program Button: This button makes the programming tool attempt to program a new Mode S address into the TSS-4100.
5. Query Button: Button that causes the Programming Tool to obtain and display the Mode S address currently being used by the TSS-4100. Pushing this button populates the Current Mode S text field. Pushing this button also causes a comparison between the value in the Mode S address text field and the value in the Current Mode S text field.
6. Display Log: Log of communications between the TSS-4100 and the programming tool.
7. File: Three options are available under File: an option that replicates the functionality of the Program Button, an option that replicates the functionality of the Query Button, and an option to exit the programming tool.
8. System: Two options are available under System: an option to view and change the target port and IP address, and an option to view and change the IP address of the PC or laptop in use. These options are described in the Setup section of these instructions.

9. Help: Two options are available under Help: an option to view programming tool version information and an option to view these instructions.
10. Match Indicator: After pushing the Query Button, there will be an indication here if the address in the Mode S address box matches the Current Mode S box. If they match it will be green; if they do not match it will be red.

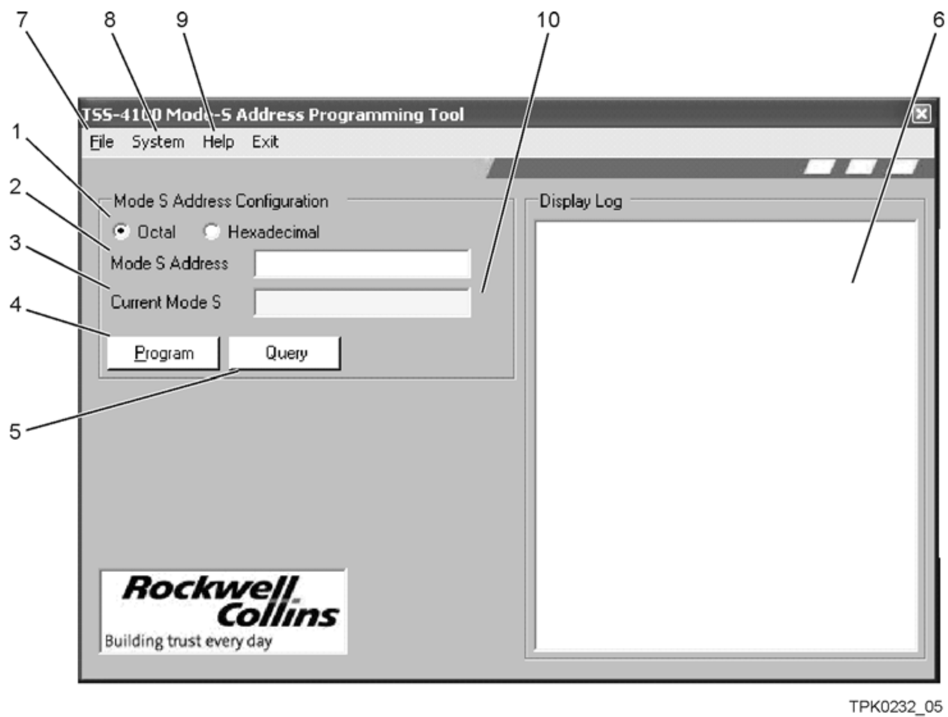


Figure 4-6. Programming Tool - Screen Shot

4.6. LED INDICATORS.

This section contains descriptions of the Traffic Surveillance System (TSS) Light Emitting Diodes (LED) that show on the front panel of the TSS-4100.

NOTE

Refer to the system pilot guide or the operation section of the system installation manual for displays indicators and data.

4.6.1. LED Descriptions.

There are nine LED indicators on the front panel of the TSS-4100 to show the internal status and some external faults. Refer to Figure 4-7. And, refer to Table 4-3 for a description of what each LED represents. The LED indicators show the results of the power-up self-test and the results when the front panel TEST push button is pushed. The LED indicators also show the results of any continuous monitoring errors detected during normal operation.

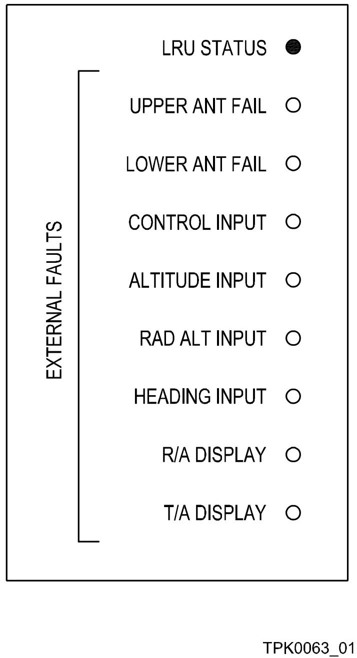


Figure 4-7. TSS-4100 Front Panel LEDs

Table 4-3. LED Descriptions

Indicator	Color	Description
LRU STATUS	RED/GREEN	LRU STATUS indicator will light green whenever the self-test is successful. The LRU STATUS indicator will light red whenever the self-test fails. If this is red, it is probable that the TSS will need to be replaced. See the maintenance words for more information on this.
UPPER ANT FAIL	RED	UPPER ANT FAIL indicator will light red whenever the impedance of the upper antenna does not meet specification. If this is lit the cabling from the TSS to the upper antenna needs to be checked.
LOWER ANT FAIL	RED	LOWER ANT FAIL indicator will light red whenever the impedance of the lower antenna does not meet specification. If this is lit the cabling from the TSS to the lower antenna needs to be checked.
CONTROL INPUT	RED	CONTROL INPUT indicator will light whenever a fault with the control panel is detected. If this is lit the connection between the TSS and the selected control panel needs to be checked. Alternately, check the control panel selection discretes and verify they are correctly being set.

Table 4-3. LED Descriptions - Continued

Indicator	Color	Description
ALTITUDE INPUT	RED	ALTITUDE FAULT indicator will light whenever the selected altitude source is failed or missing. If this is lit, check the transponder control panel to see if it is indicating that it is sending a valid altitude. If the transponder control panel is not sending the altitude, check to verify that the ADC on the PFD which is coupled to the autopilot is sending valid information.
RAD ALT INPUT	RED	The RAD ALT INPUT indicator will light whenever the selected radio altitude inputs are missing, or when there are two radio altitude inputs and they are not in agreement. If this is lit and there are two radio altimeters, try turning off one at a time to see if the failure goes away. If the failure persists or if there is only one radio altimeter, check the wiring from the radio altimeter.
HEADING INPUT	RED	The HEADING INPUT indicator will light whenever one of the following is missing: selected heading, pitch angle, roll angle, or true heading. These are optional parameters for the TCAS function. If these parameters are not available, the Traffic Surveillance System will work properly.
R/A DISPLAY	RED	The R/A DISPLAY indicator will light whenever either R/A display discrete input is not grounded. If this is lit, check that both the left and right displays are active and can display TCAS traffic. Push the TCAS test button, if the targets do not appear on one of the displays – check the TA/RA port to that display. If the targets are shown on all displays, check the RA discrete connection from the display to the TSS.
T/A DISPLAY	RED	The T/A DISPLAY indicator will light whenever either T/A display discrete input is not grounded. This is a legacy TCAS discrete input and is not generally used any more. If this is lit check to make sure that the straps setting the two T/A discrete inputs are correctly strapped to ground.

4.7. TEST EQUIPMENT AND POWER REQUIREMENTS.

Test equipment required to perform the post-installation test procedures is below. Other equipment may be entirely satisfactory if it meets the specifications and is calibrated as necessary.

- Combined TCAS/Transponder test set (such as the IFR-6000), or a TCAS test set and a transponder test set
- Pitot Static Ramp Tester
- Radio Altimeter Ramp Tester.

4.7.1. Power Requirements.

All power required to perform the system tests and trouble shooting is provided by the aircraft in which the system is installed.

4.8. TESTING AND TROUBLESHOOTING.

The procedures in this section help isolate LRU failures. The built-in tests present in the Traffic Surveillance System and in the cross-side Mode S transponder system, make diagnostics easy to use on the flight line. For more information on the maintenance reporting of the TSS-4100 and TDR-94D see Appendix B.

4.8.1. Pre-installation Testing.

To make sure that equipment works before installing the equipment in an aircraft, perform one of the tests that follow:

- The final performance test
- The customer acceptance test
- Connect the unit to a system mock-up.

4.8.2. TCAS Self Test.

NOTE

Run this test as a Return to Service Test, and as part of the pilot pre-flight check.

The TCAS System Test shows that the Traffic Surveillance System is working properly. Run this test first whenever there is an problem with the TCAS function. To initiate a TCAS self-test, perform the steps that follow:

a. Push the TEST button on the TCAS control, or push any other remote TCAS self-test button.

NOTE

The TSS will only go into test while on the ground.

b. Make sure that TEST is shown on the Traffic Display.

c. Make sure that the test intruder set of traffic symbols are as shown in Figure 4-8 and are as follows:

   - An RA symbol (solid red square) at 2 nmi, at 200 feet relative altitude, above (+02), with no VS arrow, at a relative bearing of +90 degrees.
   - A TA symbol (solid yellow circle) at 2 nmi, at 200 feet relative altitude, below (–02), with ascending arrow, and a relative bearing of –90 degrees.
   - An PT symbol (solid cyan or white diamond) at 3.625 nmi, at 1000 feet relative altitude, below (–10), with descending arrow, at a relative bearing of +33.75 degrees.
   - An OT symbol (open cyan or white diamond) at 3.625 nmi, at 1000 feet relative altitude, above (+10), with no arrow, at a relative bearing of –33.75 degrees.

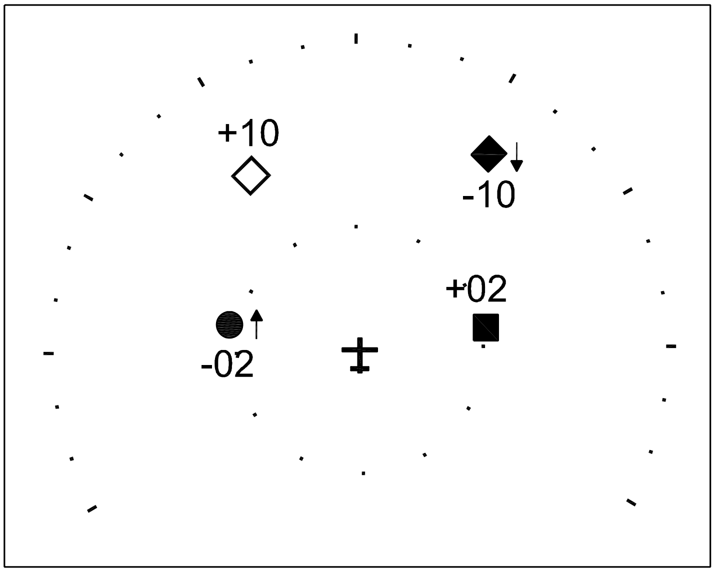


Figure 4-8. TCAS Self Test Standard Output

d. Verify that RA vertical guidance is shown on the system. This may be done in the form of pitch cues, path cues, or on a vertical speed tape.

e. After the test is completed, the audio system announces, "TCAS SYSTEM TEST OK." If the audio system announces, "TCAS FAIL," instead, repeat self-test by pushing the TEST button on the front of the TSS-4100. The LEDs on the front of the unit show the source of the failure. See section XXXX for a description of the meaning of the LEDs.

4.8.3. Equipment Setup.

Perform the steps that follow to setup the TCAS test equipment, only if a ramp-tester is used:

a. Position the TCAS test set according to the instructions supplied with the test set.

b. Make sure that the electrical power is applied to all of the aircraft systems that are required for Traffic Surveillance System operation.

c. Turn off any Traffic Surveillance System ground operation controls that may be present in the installation under test. This includes the WOW automatic-standby, and landing gear and flaps extended switching features.

d. Perform the test set self-test procedure to be sure the set is operating properly.

4.8.4. Radio Altitude System Failure Tests.

Perform this test when a pilot complaint suggests a problem related to the TCAS/Radio Altitude interface. A failure of all radio altitude sources will fail the TCAS function. Do the steps that follow to perform a radio altitude system failure test:

a. Set the aircraft simulated altitude to 2,000 feet, both radio and barometric altimeters, and simulate WOW in air.

b. Select Traffic Advisory (TA)/RA or Automatic (AUTO) and verify that Traffic Surveillance System operation is normal.

c. Select the TSS-4100 as the active transponder.

d. Make sure no transponder failure annunciates.

e. Make sure that the single and dual radio altitude source operation is normal.

(1) If this is a single radio altimeter installation, simulate a radio altimeter system failure by opening the circuit breaker for the radio altimeter. Make sure that TCAS FAIL is annunciated.

(2) Reset the circuit breaker opened in the previous step. Make sure that the Traffic Surveillance System returns to normal operation.

(3) If this is a dual radio altimeter installation, simulate a radio altimeter system failure by opening both of the radio altimeter circuit breakers. Verify that TCAS FAIL is annunciated.

(4) Reset the circuit breaker for the No. 1 radio altimeter. Make sure that the Traffic Surveillance System returns to normal operation.

(5) Open the circuit breaker for the No. 1 radio altimeter. Make sure that TCAS FAIL is annunciated.

(6) Reset the circuit breaker for the No. 2 radio altimeter. Make sure that the Traffic Surveillance System returns to normal operation.

(7) Reset the circuit breaker for the No. 1 radio altimeter.

4.8.5. Pressure Altitude System Failure Tests.

Perform this test when there is pilot complaint suggesting a problem related to both the pressure altitude, and either the TCAS or the transponder systems. A failure of the pressure altitude source makes the TCAS function fail. To perform a pressure altitude system failure test, do the steps that follow:

a. If this is a single ADC installation, make sure that the source operation is normal.

(1) Select the left transponder. Select No. 1 or single altitude source.

(2) Make sure that the Traffic Surveillance System operation is normal.

(3) Open the circuit breaker for the No. 1 altitude source. Make sure that the TCAS FAIL annunciates.

(4) Reset the circuit breaker for the No. 1 altitude source. Make sure that the Traffic Surveillance System returns to normal operation.

(5) Select the right transponder and repeat this procedure.

b. If this is a multiple ADC installation, make sure that the source operation is normal.

(1) Make sure that all of the ADCs are on and are working. Make sure that the TSS-4100 is the selected transponder.

(2) Select the pilot PFD as the side that is driving the auto pilot (couple the auto pilot to the pilot side PFD). Have the pilot side PFD use the No. 1 ADC. Make sure that the Traffic Surveillance System operation is normal.

(3) Open the circuit breaker for the ADC No. 1. Make sure that TCAS FAIL annunciates.

(4) If possible, select the ADC No. 2 on the pilot PFD. If this is not possible, then skip to Step 4.8.5.b.(6). Make sure that the system returns to normal operation.

(5) Reset the circuit breaker for the No. 1 ADC and open the circuit breaker for the No. 2 ADC. Make sure that TCAS FAIL annunciates.

(6) Reset the circuit breaker for the No. 2 ADC. If possible, select the No. 3 ADC on the pilot PFD. If this is not possible, then skip to Step 4.8.5.b.(8). Make sure that the system returns to normal operation.

(7) Open the circuit breaker for the No. 3 ADC. Make sure that TCAS FAIL annunciates. Reset the circuit breaker for the No. 3 ADC.

(8) Select the copilot PFD as the side driving the auto pilot (couple the auto pilot to the pilot PFD). Have the copilot PFD use the No. 2 ADC. Make sure that the Traffic Surveillance System operates normally.

(9) Open the circuit breaker for the No. 2 ADC. Make sure that a TCAS FAIL is annunciated.

(10) If possible, select the No. 1 ADC on the copilot PFD. If this is not possible, then skip to Step 4.8.5.b.(12). Make sure that the system returns to normal operation.

(11) Reset the circuit breaker for the No. 2 ADC and open the circuit breaker for the No. 1 ADC. Make sure that TCAS FAIL annunciates.

(12) Reset the circuit breaker for the No. 1 ADC. If possible, select the No. 3 ADC on the pilot PFD. If this is not possible, then skip to Step 4.8.5.b.(14). Make sure that the system returns to normal operation.

(13) Open the circuit breaker for the No. 3 ADC. Make sure that TCAS FAIL annunciates. Reset the circuit breaker for the No. 3 ADC.

(14) Reset the system so that each PFD is using its primary ADC source. Select the off side transponder as the active transponder. Make sure that the system operates normally.

4.8.6. Range and Bearing Test.

Perform this test when there is pilot complaint suggesting a problem that is related to bearing accuracy. Run this test with an IFR-6000 or other equivalent TCAS test set.

a. When testing the top antenna, monitor the TCAS display in the cockpit of the aircraft. Set the viewed range to 10 NM.

b. Set the Traffic Surveillance System aircraft simulated altitude below 400 ft agl. This automatically disables Mode C interrogations (Mode S is still enabled) from the bottom antenna.

c. Set the test set parameters as follows:

   (1) Altitude: Same as Traffic Surveillance System aircraft altitude

   (2) Range: 8 nmi. Make sure a stationary PT symbol shows on the display. Make sure the PT symbol is at a relative bearing that is equivalent to the bearing to the test set.

   (3) VS: 0

   (4) Rate: 0.

d. If a tarmac clock pattern (as shown in Figure 4-9) or a compass rose is available, use it as a reference to position the test set. If not, position the TCAS test set at 45° intervals around the airplane and make sure that the displayed PT-symbol bearing agrees with the bearing to the test set. Use two technicians if possible: one moves the test set around the aircraft, the other one watches the display. The symbol moves about the aircraft symbol with no dropouts and no deviations in bearing that are more than 15 degrees. The center of the rose should be the TCAS antenna, not the center of the airplane. It is not required to test behind the aircraft.

NOTE

Watch for large and constant bearing errors. An occasional bearing drift can be caused by signal reflections, and is not an equipment failure. But if the symbol shifts to an adjacent or opposite quadrant, and remains there when the test set moves into a test quadrant, then suspect a problem with the installation. Make sure this is a problem by rotating the aircraft 90 degrees, then repeating the test. If the problem quadrant remains in the same position relative to the aircraft, suspect an equipment failure (the TSS-4100, the TSA-4100, or the cabling). If the problem quadrant stays fixed in space, suspect signal reflections or other outside interference.

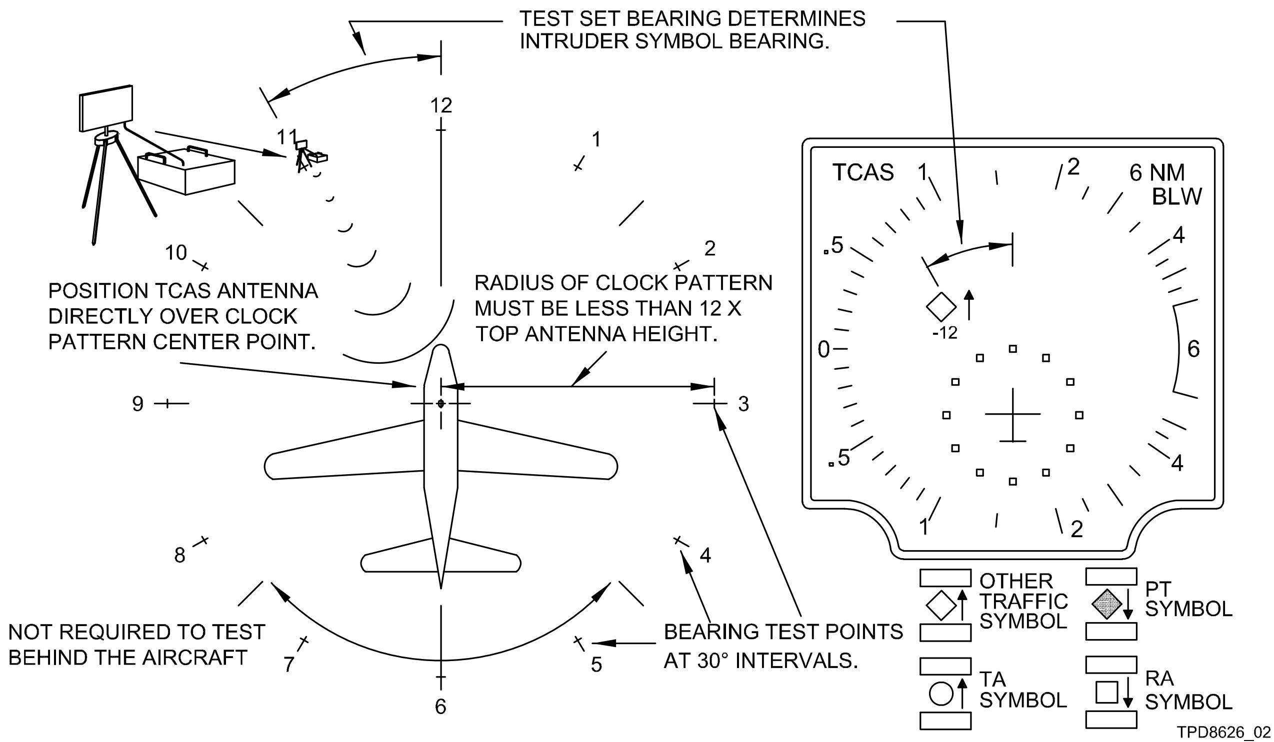


Figure 4-9. Bearing Test, Aircraft and TCAS Test Set Orientation

4.8.7. TCAS RA Test.

Perform a TCAS RA test when there is pilot complaint suggesting a problem related to TAs or to RAs. Find out which approximate bearing to check, if necessary. Run this test with an IFR-6000, or other equivalent TCAS test set.

a. Make sure that the pressure altitude and radio altitude is at or above 1500 ft.

b. Set the TCAS test set to make a collision course starting from 10 nmi away at 200 ft below the aircraft. Choose an appropriate bearing from which this target should approach.

c. Make sure that initially on the TCAS display, an open cyan diamond is shown, then a filled-in cyan diamond is shown, then a yellow circle is shown, then a red square is shown.

d. Make sure that when the yellow circle shows, a "Traffic, Traffic" aural is also heard.

e. Make sure that when the red square shows, that a "Climb, Climb" aural is also heard. Also make sure that a vertical advisory shows on the Primary Flight Display (PFD). This indicates that a climb is commanded.

4.8.8. Transponder Tests.

Verify that the TSS transponder is functioning properly. This test should be performed whenever there is pilot complaint suggesting a transponder issue. This may be run with an IFR-6000 or other equivalent transponder test set. It is recommended that all of the transponder tests on the test set are run, but provided is a minimum subset that should be run.

NOTE

For a transponder to reply to Mode A, Mode C, or Mode S interrogations, it will be necessary to simulate the aircraft being in the air. At a minimum this includes ensuring that the weight on wheels discrete is open and that the radio altimeter reads above 50 feet. If possible it would be best to also simulate an airspeed of greater than 100 knots.

a. Simulate a 2000 ft pressure altitude (uncorrected). Set the squawk code to 1234. Set the Flight ID to TEST1234. Set the selected altitude to 16000 ft.

NOTE

Other altitude values can be used to run this test.

b. Run a Mode A/C decode and Side Lobe Suppression (SLS) test. Make sure they pass. Make sure that the proper altitude (2000 ft) and squawk code (1234) are reported.
c. Run an XPDR A/C Spacing Width Test, which also tests the ATCRBS all-call functionality. Make sure it passes.
d. Run the power and frequency tests. This also tests receiver sensitivity. Make sure they pass.
e. Run a Mode S All Call test. Make sure it passes. Make sure the Mode S address is correct.
f. Run a Mode S Reply test that includes a test of diversity. Make sure it passes.
g. Run a Mode S UF0 test. Make sure it passes. Make sure that the maximum airspeed range is what should be programmed for that aircraft.

NOTE

The maximum airspeed range is programmed in the ECU as part of the aircraft configuration. If necessary, read the documentation that comes with the aircraft configuration media set to see what this value should be.

h. Run a Mode S UF4 test. Make sure it passes. Make sure that the reported altitude is 2000 ft.
i. Run a Mode S UF5 test. Make sure it passes. Make sure that the reported squawk code is 1234.
j. Run a Mode S UF11 test. Make sure it passes.
k. Run Elementary Surveillance tests. Retrieve, at a minimum, registers 1,0, 1,7 and 2,0. Make sure that the tests pass and that the retrieved value of register 2,0 is TEST1234.
l. Run Enhanced Surveillance tests. Retrieve, at a minimum, registers 4,0, 5,0, and 6,0. Make sure that the tests pass and that the selected altitude reported in Register 4,0 is 16000 ft.

4.8.9. ADS-B Transmit Ground Test.

Run this test only if the ADS-B Out option is available. Perform this test when there is pilot complaint that there is an issue with the ADS-B position transmissions from the aircraft.

NOTE

Flight testing, or GPS simulation of a flying aircraft, is required to do more testing than specified here.

a. Set the TSS-4100 as the selected transponder, and have it set to reporting altitude. Turn on the primary GPS and turn off any secondary GPS. Allow the GPS to obtain a good position fix.
b. Use the IFR-6000, or any other ADS-B capable test set. Use it to monitor for Register 0.6, the surface position squitter. Make sure that the decoded position is correct. Make sure that the position is synced to the time mark. On the IFR-6000, this is indicated by the annunciation UTC. The indication that the position is not synced to the time mark is N/UTC.
c. If there is a secondary GPS, then turn off the primary GPS and turn on the secondary GPS. Let the secondary GPS to obtain a good position fix.
d. Use the IFR-6000, or any other ADS-B capable test set, and use it to monitor for Register 0.6, the surface position squitter. Make sure that the decoded position is correct. Make sure that the position is synced to the time mark.

4.8.10. Transponder/TCAS Suppression Bus Issues.

If the pilot report describes a Tracking Own Aircraft TCAS error when the non-TSS transponder is selected, then the transponder suppression interface should be examined for open/short circuits. The suppression interface connects each TDR-94D connector, TSS-4100 connector, and DME radio. When there is a suppression interface problem, the traffic display shows an intruder aircraft at zero-range, and at the same altitude (±200 ft) as own aircraft. The intruder stays at own altitude regardless of evasive vertical maneuver. The problem can also make the display show a cluster of intruder targets at own altitude that move randomly. Check the continuity of the suppression interfaces to show any short-circuits.

a. Remove all units connected to the suppression interface, including the TSS-4100, the transponder, and DME units.

b. Make sure that the continuity is less than 1Ω to each contact in the interface. Make sure an open is greater than 100 kΩ between the center conductor and the shield/barrel of the coaxial connector.

c. Make sure that all coaxial pin contacts are positioned correctly.

d. When each unit is inserted back into the system but not powered, make sure that the connections to that unit are open.

4.9. INITIAL INSTALLATION CHECK OUT PROCEDURE.

Follow the procedures that follow to make sure the initial installation of the TSS-4100 performs well.

4.9.1. Initial Transponder Check Out.

Follow the procedures described in Paragraph 4.8.8.

4.9.2. Initial TCAS Check Out.

Follow the procedures that follow to make sure the initial installation of the TSS-4100 performs TCAS functions correctly.

4.9.2.1. Introduction.

NOTE

These tests simulate TCAS-equipped aircraft at different altitudes with altimeter test equipment, but simulate the aircraft as stationary in space.

The instructions in this section use the TCAS test set to simulate certain flight scenarios. The activity of intruder aircraft is simulated by the TCAS test set. That activity simulates the combined relative horizontal and vertical movements of both aircraft in an actual flight situation. For example, in an actual flight situation in which a TCAS equipped aircraft and an intruder are approaching at the same altitude both with a speed of 360 kts, the relative approach speed is 720 kts. This situation can be simulated by giving the intruder a speed of 720 kts. Refer to Figure 4-10 for the parameters involved in the flight scenarios (CPA = Closest Point of Approach).

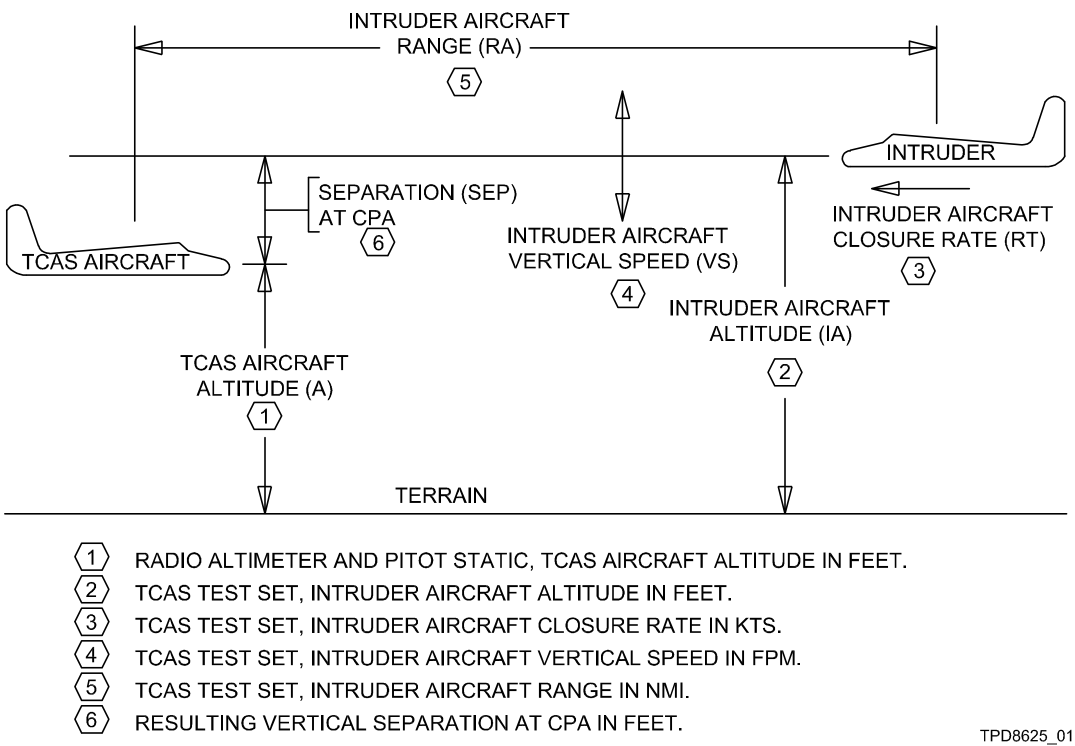


Figure 4-10. Simplified Flight Scenario and Parameters

4.9.2.2. The altitude of the TCAS aircraft is simulated by means of radio and barometric altimeter system test equipment. The TCAS test set allows entry of intruder-simulated altitude and vertical speed. A change in relative vertical speed can be simulated by changing the intruder vertical speed while the test runs.

4.9.2.3. You should be familiar with how to use the TCAS test set you are using. This procedure does not give detailed instructions on test set operation. These are general instructions for a normal TCAS test set. Change these instructions to apply to your test set if necessary.

4.9.2.4. Equipment Preparation.

NOTE

Equipment Preparation means running any necessary self-tests, making the necessary connections, and placing the equipment as required for executing the test scenarios.

Follow the instructions supplied with the test equipment.

a. Prepare the TCAS test set, pitot-static ramp tester, and radio altimeter ramp tester for the tests that follow.

b. Prepare aircraft to simulate an in-flight condition. If necessary:
   - Defeat the strut switch automatic standby feature.
   - Apply electrical power.

c. Set the TCAS control to the STBY (standby) position.

d. If the TCAS system has an altitude volume selector switch (ABOVE-NORM-BELOW), then select NORM.

e. If the TCAS system has an altitude reference selector switch (REL-ABS), then select REL (relative).

f. Make sure the TCAS display shows no RA (resolution advisory), TA (Traffic Advisory), or PT (proximity traffic) symbols.

g. Make sure the TCAS display shows that the TCAS system is in standby mode.

h. Select TA/RA mode on the TCAS control.

NOTE

The TCAS controls may have a position labeled AUTO. If so, use AUTO instead of TA/RA.

i. Make sure the TCAS display shows that TCAS is no longer in standby.

j. Make sure the TCAS display is set for full-time traffic display. If it is not, then select traffic mode. Set the TCAS Display Range to 15 nmi or greater.

NOTE

If airborne aircraft are near (i.e. within approximately 15 nmi), the display can show an other traffic (OT) or PT symbol.

4.9.2.5. Test Scenarios. Refer to Figure 4-10 for the Test Scenario setups. If using the IFR-6000 Test Set, pre-program the unit for the desired scenarios. This can save time on the flight line. In all test scenarios, the bearing to the intruder symbol on the TCAS display will always be in the direction of the test set with respect to the airplane. That is, if the test set is situated off the right wing, all intruder symbols will appear at or very near, the 3:00 o'clock position on the TCAS display. Here is a summary of the scenarios:

- Scenario 1a: Climb RA
- Scenario 1b: Descend RA
- Scenario 2a: Climb RA just below maximum climb altitude
- Scenario 2b: Descend RA just above the maximum climb altitude
- Scenario 3a: Increase Climb RA
- Scenario 3b: Increase Climb Inhibit (not applicable to all installations)
- Scenario 3c: Climb Inhibit (not applicable to all installations)
- Scenario 4a: Low Altitude Allow Increase Descent

- Scenario 4b: Low Altitude Don't Allow Increase Descent
- Scenario 4c: Low Altitude TA Only.

NOTE

(1) There may be an approximately one second delay between symbol display and the aural advisory.

(2) The maximum climb altitude is documented at airplane certification and may be different than the airplane service ceiling. Consult airplane data for applicable altitude. This altitude is programmed in the ECU.

4.9.2.5.1. Scenario 1a: Climb RA. In Scenario 1a, the intruder is placed below own airplane to induce a CLIMB RA command.

a. Set the airplane under test (UUT) simulated altitude to 12,000 ft and the radio altimeter to maximum setting.

b. Set the following values as necessary:
   - TCAS Type: TCAS II
   - Intruder Type: Mode S
   - Range at Start: 15.00 nmi
   - Range Rate: +720 kts
   - Altitude at Start: 11900 ft (if entering as an absolute altitude) or -100 ft (if entering relative altitude)
   - Altitude Rate: 0.

c. Start the scenario.

d. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
9 nmi	TA Symbol	TRAFFIC, TRAFFIC
6 nmi	RA Symbol	CLIMB, CLIMB

4.9.2.5.2. Scenario 1b: Descend RA. In Scenario 1b, the intruder is placed above own airplane to induce a DESCEND RA command.

a. Set the airplane under test (UUT) simulated altitude to 12,000 ft and the radio altimeter to the maximum setting.

b. Set the following values as necessary.
   - TCAS Type: TCAS II
   - Intruder Type: Mode S
   - Range at Start: 15.00 nmi
   - Range Rate: +720 kts
   - Altitude at Start: 12,100 ft (if entering as an absolute altitude) or +100 ft (if entering relative altitude)
   - Altitude Rate: 0.

c. Start the scenario.

d. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
9 nmi	TA Symbol	TRAFFIC, TRAFFIC
6 nmi	RA Symbol	CLIMB, CLIMB

4.9.2.5.3. Scenario 2a: Climb RA just below maximum climb altitude. Scenario 2a and 2b are tests intended to ensure that the maximum climb altitude is properly programmed and read by TCAS.

a. Set airplane under test (UUT) simulated altitude to 50 ft below (+/- 10 ft) the maximum climb altitude (NOTE 2). Set the radio altimeter to the maximum setting.

b. Set the following values as necessary:
- TCAS Type: TCAS II
- Intruder Type: Mode S
- Range at Start: 15.00 nmi
- Range Rate: +720 kts
- Altitude at Start: Set to 50 ft below the UUT altitude (or equal to 100 ft below the maximum climb altitude)
- Altitude Rate: 0.

c. Start the scenario.

d. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
If the maximum climb altitude is set between 10,000 and 20,000 ft:		
12 nmi	Other Traffic Symbol	None
9 nmi	TA Symbol	TRAFFIC, TRAFFIC
6 nmi	RA Symbol	CLIMB, CLIMB
If the maximum climb altitude is set to 20,000 ft or more:		
12 nmi	Other Traffic Symbol	None
9.6 nmi	TA Symbol	TRAFFIC, TRAFFIC
7 nmi	RA Symbol	CLIMB, CLIMB

4.9.2.5.4. Scenario 2b: Descend RA just above the maximum climb altitude. Scenario 2a and 2b are tests intended to ensure that the maximum climb altitude is properly programmed and read by TCAS.

a. Set airplane under test (UUT) simulated altitude to 50 ft above (+/- 10 ft) the maximum climb altitude (NOTE 2). Set the radio altimeter to the maximum setting.

b. Set the following values as necessary:
- TCAS Type: TCAS II
- Intruder Type: Mode S
- Range at Start: 15.00 nmi
- Range Rate: +720 kts
- Altitude at Start: Set to 50 ft below the UUT altitude (or equal to the maximum climb altitude)
- Altitude Rate: 0.

c. Start the scenario.

d. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
If the maximum climb altitude is set between 10,000 and 20,000 ft:		
12 nmi	Other Traffic Symbol	None
9 nmi	TA Symbol	TRAFFIC, TRAFFIC
6 nmi	RA Symbol	CLIMB, CLIMB
If the maximum climb altitude is set to 20,000 ft or more:		
12 nmi	Other Traffic Symbol	None
9.6 nmi	TA Symbol	TRAFFIC, TRAFFIC
7 nmi	RA Symbol	CLIMB, CLIMB

4.9.2.5.5. Scenario 3a: Increase Climb RA. Scenario 3a can always be run.

a. Set airplane under test (UUT) simulated altitude to 11990 ft and set the radio altimeter to the maximum setting.

b. Set the following values as necessary.
- TCAS Type: TCAS II
- Intruder Type: Mode S
- Range at Start: 15.00 nmi
- Range Rate: +720 kts
- Altitude at Start: 11,500 ft (if entering as an absolute altitude) or -490 ft (if entering relative altitude)
- Altitude Rate: 0.

c. Start the scenario.

d. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
8 nmi	TA Symbol	TRAFFIC, TRAFFIC
6 nmi	RA Symbol	CLIMB, CLIMB
1.3	RA Symbol	INCREASE CLIMB, INCREASE CLIMB

4.9.2.5.6. Scenario 3b: Increase Climb Inhibit. Scenario 3b can only be run if the "Increase Climb Inhibit" discretes are connected and can be stimulated. This test is intended to ensure TCAS properly recognizes the increase climb inhibit input (2500 ft/min climb inhibit). Follow the same steps as SCENARIO 3a except as follows:

a. Configure the airplane as needed to enable the 2500 ft/min climb inhibit condition. This may require a change to both the altitude of the own aircraft and the altitude of the target aircraft. If the altitude of this test is greater than 20,000 ft, then the ranges in the following step will be off. Also, the TA and the RA will occur sooner than indicated.

b. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
8 nmi	TA Symbol	TRAFFIC, TRAFFIC
6 nmi	RA Symbol	CLIMB, CLIMB
At a range < 6 nmi	Verify that no increase climb advisory is issued. An RA should be maintained, but which RA being issued can change. This test passes as long as it is not an increase climb advisory.	

4.9.2.5.7. Scenario 3c: Climb Inhibit. Scenario 3c can only be run if the "Climb Inhibit" discretes are connected and can be stimulated. This test is intended to ensure TCAS properly recognizes the climb inhibit input (1500 ft/min climb inhibit). Follow the same steps as SCENARIO 3a except as follows:

a. Configure the airplane as needed to enable the 1500 ft/min climb inhibit condition. This may require a change to both the altitude of the own aircraft, and the altitude of the target aircraft. If the altitude of this test is greater than 20000 ft, the ranges in the following step will be off. Also, the TA and the RA will occur sooner than indicated.

b. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
8 nmi	TA Symbol	TRAFFIC, TRAFFIC
At a range < 8 nmi	RA Symbol	See Below
Verify no climb or increase climb advisory issued. **NOTE** An RA should be issued at about 6 nmi, and that it is possible that there is a change in which RA is being issued inside of 6 nmi. This test passes as long as there is not a climb or an increase climb advisory.		

4.9.2.5.8. Scenario 4a: Low Altitude Allow Increase Descent. Scenario 4a shows that a descend and increase descent advisories will be given at low altitudes above a certain radio altimeter threshold.

a. Set airplane under test (UUT) simulated altitude to 1390 ft and set the radio altimeter to 1700 ft agl.

b. Set the following values as necessary.

- TCAS Type: TCAS II
- Intruder Type: Mode S
- Range at Start: 15.00 nmi
- Range Rate: +720 kts
- Altitude at Start: 1600 ft (if entering as an absolute altitude) or +210 ft (if entering relative altitude)
- Altitude Rate: 0.

c. Start the scenario.

d. At a range of 5 nmi set the altitude rate to -500 fpm. This altitude rate change must occur as close to 5 nmi as possible. The timing of the alert is tight. Changing the value too soon or too late may cause other alerts to be annunciated.

e. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
5 nmi	TA Symbol	TRAFFIC, TRAFFIC
3 nmi	RA Symbol	DESCEND, DESCEND
At a range < 3 nmi	RA Symbol	INCREASE DESCENT, INCREASE DESCENT

4.9.2.5.9. Scenario 4b: Low Altitude Don't Allow Increase Descent. Scenario 4b shows that within a certain radio altimeter range, a descend advisory will be given, but an increase descent advisories will not be issued.

a. Set airplane under test (UUT) simulated altitude to 1390 ft and set the radio altimeter to 1400 ft agl.

b. Set the following values as necessary.

- TCAS Type: TCAS II
- Intruder Type: Mode S
- Range at Start: 15.00 nmi
- Range Rate: +720 kts
- Altitude at Start: 1600 ft (if entering as an absolute altitude) or +210 ft (if entering relative altitude)
- Altitude Rate: 0.

c. Start the scenario.

d. At a range of 5 nmi set the altitude rate to -500 fpm. This altitude rate change must occur as close to 5 nmi as possible. The timing of the alert is tight. Changing the value too soon or too late may cause other alerts to be annunciated.

e. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
5 nmi	TA Symbol	TRAFFIC, TRAFFIC
3 nmi	RA Symbol	DESCEND, DESCEND
At a range < 3 nmi	RA Symbol	Make sure that there is no Increase Descent RA, but that the RA continues.

4.9.2.5.10. Scenario 4c: Low Altitude TA Only. Scenario 4c shows that below a certain radio altimeter threshold, TCAS will be in TA ONLY mode.

a. Set airplane under test (UUT) simulated altitude to 1390 ft and set the radio altimeter to 850 ft agl.

b. Set the following values as necessary.

- TCAS Type: TCAS II
- Intruder Type: Mode S
- Range at Start: 15.00 nmi
- Range Rate: +720 kts
- Altitude at Start: 1600 ft (if entering as an absolute altitude) or +210 ft (if entering relative altitude)
- Altitude Rate: 0.

c. Verify that the TCAS display shows that TCAS is in TA ONLY mode.

d. Start the scenario.

e. At a range of 5 nmi (or less) set the altitude rate to -500 fpm. This altitude rate change should occur as close to 5 nmi as possible.

f. Monitor the TCAS display and audio system for correct presentation as follows (NOTE 1):

Display Range (approx)	Display	Aural
12 nmi	Other Traffic Symbol	None
4 nmi	TA Symbol	TRAFFIC, TRAFFIC

4.10. RETURN TO SERVICE TEST PROCEDURE.

Use the procedures that follow to make sure that the Traffic Surveillance System equipment that has been removed for maintenance, repair, or bench testing and is now being reinstalled in an aircraft, operates normally. If the equipment fails these tests, use the fault isolation procedures to determine which LRUs should be removed for shop maintenance.

4.10.1. Return to Service Test.

Perform the test steps that follow to return TSS equipment to service:

a. Perform the procedures in the TCAS self-test, described in Paragraph 4.8.2.

b. Perform the procedures in Transponder Tests, described in Paragraph 4.8.8.

4.11. INSPECTION/CHECK.

This section presents the unique instructions necessary to verify that the conditions of the Traffic Surveillance System are normal in the airplane. Refer to the applicable component maintenance manual if any repair to the equipment is required.

4.11.1. Antennas.

CAUTION

Do not paint any antenna. Paint can affect the performance of the antenna.

Perform the items that follow:

- Make sure that the antenna is free of dents, cracks, punctures, and dirt.
- Make sure that the plugs are installed and sealed correctly.

4.11.2. TSS-4100 Traffic Surveillance System.

Perform the inspections that follow:

- Make sure that the transmitter/receiver and mount connectors are properly mated and that the transmitter/receiver is securely fastened to the rack mounting position.
- Make sure that the knurled hold-down knobs on the rack are secured to the transmitter/receiver and are properly safety-wired.
- Make sure that the front RJ-45 access panel is properly fastened with both screws.

4.11.3. TDR-94D ATC/Mode S Transponder.

Perform the inspections that follow:

- Make sure that the transponder and mount connectors are properly mated and that the transponder is securely fastened to the rack mounting position.
- Make sure that the knurled hold-down knobs on the rack are secured to the transponder and are properly safety-wired.

APPENDIX A
Faults and Warnings

A.1. GENERAL.

The faults and warnings generated by the TSS-4100 include Light Emitting Diodes (LED) and maintenance words. The LEDs show on the front panel of the TSS-4100, and are described in Paragraph A.1. The maintenance words are sent by the TSS-4100 to the Maintenance Diagnostic Computer, and are described in Appendix B.

APPENDIX B
Maintenance Words

B.1. MAINTENANCE DIAGNOSTIC WORDS.

Refer to Table B-1 for a list of the diagnostic words from the Traffic Surveillance System (TSS). Table B-2 shows how to interpret a diagnostic word. Use this table to decode the hexadecimal readouts. Refer to Table B-3 for the hexadecimal-to-binary conversion table. Refer to Table B-4 through Paragraph B.1.7 for a bit definition of each diagnostic word.

Table B-1. LRU Diagnostic Data, Reporting LRUs

Bus	Label Number	Label Name
TSS #1, #2, #3 Output Bus	350	TDR Maintenance Word
TSS #1, #2, #3 Output Bus	351	TSS-4100 Diagnostic Word 1
TSS #1, #2, #3 Output Bus	352	CDU Diagnostic Word 1
TSS #1, #2, #3 Output Bus	353	TSS-4100 Diagnostic Word 2
TSS #1, #2, #3 Output Bus	354	TSS-4100 Diagnostic Word 3
TSS #1, #2, #3 Output Bus	355	TSS-4100 Diagnostic Word 4
TA/RA #1, #2 Output Bus	350	ACAS Diagnostics

Table B-2. Diagnostic Word Interpretation.

These words show on the ADVANCED DIAGNOSTICS pages.								
SAMPLE 6-DIGIT HEXADECIMAL DISPLAY:			**2**	**0**	**5**	**7**	**A**	**E**
BINARY VALUE	**BIT NUMBER**	**HEX VALUE**						
1	9	E						0
2	10							1
4	11							1
8	12							1
1	13	A					0	
2	14						1	
4	15						0	
8	16						1	
1	17	7				1		
2	18					1		
4	19					1		
8	20					0		
1	21	5			1			
2	22				0			
4	23				1			
8	24				0			
1	25	0		0				
2	26			0				
4	27			0				
8	28			0				
1	29	2	0					
2	30		1		Bits 10–12, 14, 16–19, 21, 23, and 30 are set.			
4	31		0					
8	32		0					

Table B-3. Hexadecimal to Binary Conversion Table.

	HEXADECIMAL DIGIT															
BINARY VALUE	0	1	2	3	4	5	6	7	8	9	A (10)	B (11)	C (12)	D (13)	E (14)	F (15)
1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
2	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
4	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

1. Turn to the table that shows the Line Replaceable Unit (LRU) diagnostic word to be decoded.
2. Convert each of the 6 hexadecimal digits shown on Multifunction Display (MFD) to a binary value.
3. Mark a 1 or a 0 by each bit number in the left column of the table.
4. The description of each line marked with a 1 is true.

B.1.1. Label 350 TDR Maintenance Word.

This word is included as an output from the TSS as a way to be backward compatible with installations that previously had the TDR. Many of the controllers use this label as a way to know if the selected transponder is failed. The only field of this word that should be used is the SSM. If the SSM is 11, the TSS is not failed. If the SSM is 00, the TSS is failed. Refer to Paragraph B.2 for a complete definition of this word. There has been no attempt to replicate TDR fault ID's by the TSS. This field will always be 0.

B.1.2. Label 351 TSS-4100 Diagnostic Word 1.

Refer to Table B-4 for the definition of this word and a possible solution to the indicated issue.

Table B-4. Label 351 TSS-4100 Diagnostic Word 1

Bit	Label 351- TSS-4100 Diagnostics Word 1	Possible Solution
9	SDI*	
10	SDI*	
11	TSS-4100 Unit Failure (Normal = 0 Fail = 1)	Replace the unit
12	ACAS Function Summary (Normal = 0 Fail = 1)	Replace the unit
13	XPDR Function Summary (Normal = 0 Fail = 1)	Replace the unit
14	SysIO Function Summary (Normal = 0 Fail = 1)	Replace the unit
15	ACAS System Summary (Normal = 0 Fail = 1)	Check for other faults.
16	XPDR System Summary (Normal = 0 Fail = 1)	Check for other faults.
17	ECU Unit Failure (Normal = 0 Fail = 1)	Reprogram the ECU with the appropriate configuration data. If this does not work replace the ECU.
18	Fan Unit Failure (Normal = 0 Fail = 1)	Replace mount with integral fan
19	Upper Antenna Unit Failure (Normal = 0 Fail = 1)	If no TSS unit failure, check wiring to the top antenna; replace antenna if there is no wiring problem.
20	Lower Antenna Unit Failure (Normal = 0 Fail = 1)	If no TSS unit failure, check wiring to the bottom antenna; replace antenna if there is no wiring problem.
21 to 29	Pad	
30	SSM**	
31	SSM**	
32	Odd Parity	

*SDI Code:	Bit 10	Bit 9	LRU Number	**SSM Code:	Bit 31	Bit 30	LRU Status
	0	0	Not Used		0	0	Normal
	0	1	Left		0	1	Not Used
	1	0	Right		1	0	Test
	1	1	Not Used		1	1	Not Used

B.1.3. Label 352 CDU Diagnostic Word 1.

This label is forwarded if it is received through the selected control bus. The only change made to this label is changing the label number from 350 (from the selected control bus) to 352. See the appropriate documentation for the attached controller if a definition of this word is desired.

B.1.4. Label 353 TSS-4100 Diagnostic Word 2.

Refer to Table B-5 for the definition of this word.

Table B-5. Label 353 TSS-4100 Diagnostic Word 2

Bit	Label 353- TSS-4100 Diagnostics Word 2	Note
9	SDI*	
10	SDI*	
11	Pad	
12	ACAS Function Fault (Normal = 0 Failed = 1)	Indicated fault sets bit 12 in Label 351
13	XPDR Function Fault (Normal = 0 Failed = 1)	Indicated fault sets bit 13 in Label 351
14	SysIO/ECU/Fan Function Fault (Normal = 0 Failed = 1)	Indicated fault sets bit 14, 17, or 18 in Label 351
15	ACAS System Fault (Normal = 0 Failed = 1)	Indicated fault sets bit 15 in Label 351
16	XPDR System Fault (Normal = 0 Failed = 1)	Indicated fault sets bit 16 in Label 351
28 to 17	12-bit Monitor IDRange 0 − 4095	Refer to Table B-4 for Monitor IDs
29	Start of Reporting Cycle (True = 1 False = 0)	
30	SSM**	
31	SSM**	
32	Odd Parity	

*SDI Code:	Bit 10	Bit 9	LRU Number	**SSM Code:	Bit 31	Bit 30	LRU Status
	0	0	Not Used		0	0	Normal
	0	1	Left		0	1	Not Used
	1	0	Right		1	0	Test
	1	1	Not Used		1	1	Not Used

B.1.4.1. TSS-4100 Monitor IDs. Label 353 cycles through all active faults detected by the TSS-4100. If there is more than one active fault, every 500 ms a different Monitor ID will be transmitted. The "Start of Reporting Cycle" bit is implemented so that it is possible to know that all currently active faults are recorded. For example, if there are four active faults corresponding to Monitor ID 2150, 2151, 2152, and 2153, then label 353 will output Monitor ID 2150 with the Start of Reporting Cycle bit set to 1. The other Monitor IDs will be output one at a time with the "Start of Reporting Cycle" bit set to 0. Once all of the Monitor IDs have been output, the TSS will start with Monitor ID 2150 again. Refer to Table B-6 for a list of all the possible Monitor IDs and the associated faults.

Table B-6. LRU Diagnostic Data, Fault Names and Categories.

Monitor ID	Fault Name	TSS-4100 Fault Category	Monitor Name	Internal / External Fault
259	SysIO Failure	SysIO Function	SysIO PPC Program CRC Test	Internal
260	SysIO Failuree	SysIO Function	SysIO Program RAM Monitor	Internal
263	Module Synchronization Fault	SysIO Function	Traffic Synchronization Monitor	Internal
264	SysIO Failure	SysIO Function	DSP Init Monitor	Internal
265	SysIO Failure	SysIO Function	DSP Program CRC Test	Internal
267	Dataload Inhibited Request Fault Report	SysIO Function	Dataload – Dataload Enable Monitor	External
269	Dataload Inhibited Request Fault Report	SysIO Function	Dataload – Air Ground Monitor	External
273	SysIO To TFC IMC Transmit Fault	SysIO Function	Intermodule Communication SysIO to TFC Transmit Monitor	Internal
278	SysIO – TFC Comm Fault	SysIO Function	Traffic Receive Monitor	Internal
279	SysIO Health Fault	SysIO Function	Internal Power Supply Monitor	Internal
280	SysIO Health Fault	SysIO Function	Temperature Sensor Monitor	Internal
281	SysIO Health Fault	SysIO Function	Boot Config ROM Monitor	Internal
282	SysIO Health Fault	SysIO Function	NVRAM Monitor	Internal
299	SysIO Load List Check Fault	SysIO Function	SysIO Load List Check Test	Internal
303	TFC Load List Check Fault	SysIO Function	TFC OPS Load List Check Test	Internal
304	SysIO Part Number Comp Fault	SysIO Function	SysIO Part Number Compatibility Test	Internal
305	Traffic Part Number Comp Fault	SysIO Function	Traffic Part Number Compatibility Test	Internal
310	Test Inhibited Request Fault Report	SysIO Function	Initiated Test – Air Speed Monitor	External
311	Test Inhibited Request Fault Report	SysIO Function	Initiated Test – Air Ground Monitor	External
339	ECU Fault	ECU Function	ECU Data Fault Monitor	External
340	Fan Fault	Fan Function	Fan Fault	External
343	SysIO – TFC Comm Fault	SysIO Function	Traffic PTT Time-out Fault	Internal
346	SysIO – TFC Comm Fault	SysIO Function	Traffic UIT Time-out Fault	Internal
360	ACAS Aural File Fault	ACAS Function	ACAS Aural File Load List Check Test	Internal

Table B-6. LRU Diagnostic Data, Fault Names and Categories. - Continued

Moni-tor ID	Fault Name	TSS-4100 Fault Category	Monitor Name	Internal / External Fault
361	ECU Fault	ECU Function	ECU Write Protection Fault Monitor	External
362	ECU Fault	ECU Function	ECU Installation Part Number Fault Monitor	External
363	SysIO Part Number Comp Fault	SysIO Function	Top Level Load Set Mismatch Monitor	Internal
2048	Traffic Unit Failure	ACAS & XPDR Function	PPC Program Memory CRC Monitor	Internal
2049	Traffic Input Failure	XPDR System	Mode S Discrete Address Continuous Monitor	External
2050	Traffic Unit Failure	ACAS & XPDR Function	Mode S Discrete Address Continuous Monitor	Internal
2053	Traffic Unit Failure	ACAS & XPDR Function	Radio Altitude Right Activity	External
2069	Traffic Unit Failure	ACAS & XPDR Function	Receiver Monitor	Internal
2071	Traffic Unit Failure	ACAS & XPDR Function	Receiver Frequency Lock Monitor	Internal
2072	Traffic Unit Failure	ACAS & XPDR Function	Transmitter Frequency Lock Monitor	Internal
2073	Traffic Unit Failure	ACAS & XPDR Function	Transmitter Power Monitor	Internal
2074	Traffic Unit Failure	ACAS & XPDR Function	Transmitter Calibration Pulse Power Monitor	Internal
2075	Traffic Unit Failure	ACAS & XPDR Function	Transmitter DAC Monitor	Internal
2076	Traffic Unit Failure	ACAS & XPDR Function	Switch Card Monitor (Diode Monitor)	Internal
2077	Traffic Unit Failure	ACAS & XPDR Function	Resolution Message Queue Full DSP-XPDR Mon	Internal
2078	Traffic Unit Failure	ACAS & XPDR Function	Link DSP Initialization Monitor	Internal
2079	Traffic Unit Failure	ACAS & XPDR Function	NVRAM Monitor	Internal
2080	XPDR Input Failure	XPDR System	Mode S Discrete Address Monitor	External
2083	Traffic Unit Failure	ACAS & XPDR Function	Hardware Init Status Monitor	Internal
2084	Traffic Unit Failure	ACAS & XPDR Function	Watch Dog Timer Test Monitor	Internal
2085	Traffic Unit Failure	ACAS & XPDR Function	Power Supply Monitors	Internal

Table B-6. LRU Diagnostic Data, Fault Names and Categories. - Continued

Moni-tor ID	Fault Name	TSS-4100 Fault Category	Monitor Name	Internal / External Fault
2086	Traffic Unit Failure	ACAS & XPDR Function	IOSM - FPGA Initialization Monitor	Internal
2087	Traffic Unit Failure	ACAS & XPDR Function	FPGA Health Status Monitor	Internal
2088	Traffic Unit Failure	ACAS & XPDR Function	Transponder/ACAS Interface Monitor	Internal
2089	Traffic Unit Failure	ACAS & XPDR Function	Mode S DSP Initialization Monitor	Internal
2090	Traffic Unit Failure	ACAS & XPDR Function	Mode S DSP heart Beat Monitor	Internal
2091	XPDR Input Failure	XPDR System	On Side GPS Time Mark Fault	External
2092	Bottom Antenna Connector Failure	ACAS & XPDR Function	Bottom Antenna Connector Monitor	External
2094	Top Antenna Connector Failure	ACAS & XPDR Function	Top Antenna Connector Monitor	External
2096	Traffic Input Failure	ACAS System	Barometric Altitude Monitor	External
2097	Barometric Altitude Parametric Failure	ACAS System	Barometric Altitude CRED Monitor	External
2098	XPDR Input Failure	XPDR System	Cross Side GPS Time Mark Fault	External
2100		ACAS Function	Intruder Buffer Monitor	Internal
2102	Receiver Calibration Bottom Antenna Failure	ACAS Function	Receiver Calibration Bottom Antenna Monitor	Internal
2103	Receiver Calibration Top Antenna Failure	ACAS Function	Receiver Calibration Top Antenna Monitor	Internal
2104	ACAS Failure	ACAS Function	Resolution Message Queue Full XPDR-ACAS Monitor	Internal
2105	Traffic Input Failure	ACAS System	Resolution Advisory (RA) Display 1 BITE	External
2106	Traffic Input Failure	ACAS System	Resolution Advisory (RA) Display 2 BITE	External
2107	Traffic Input Failure	ACAS System	RA Display 1 Status Discrete	External
2108	Traffic Input Failure	ACAS System	RA Display 2 Status Discrete	External
2109	Traffic Advisory (TA) Display 1 Status Discrete Failure	ACAS System	Traffic Advisory (TA) Display 1 Status Discrete	Internal
2110	Traffic Advisory (TA) Display 2 Status Discrete Failure	ACAS System	Traffic Advisory (TA) Display 2 Status Discrete	Internal
2112	XPDR Failure	XPDR Function	Acquisition Squitter Monitor	Internal

Table B-6. LRU Diagnostic Data, Fault Names and Categories. - Continued

Monitor ID	Fault Name	TSS-4100 Fault Category	Monitor Name	Internal / External Fault
2113	ACAS / XPDR Control Panel Validity Failure	ACAS & XPDR System	Acquisition Squitter Monitor	External
2114	ACAS / XPDR Control Panel Validity Failure	ACAS & XPDR System	ACAS Control Panel Validity Monitor	External
2135	Traffic Unit Failure	ACAS & XPDR Function	ACAS 1Hz Producer IOSM Monitor	Internal
2136	Traffic Unit Failure	ACAS & XPDR Function	XPDR 100 Hz Producer Monitor	Internal
2138	Traffic Unit Failure	ACAS & XPDR Function	XPDR 10 Hz Producer IOSM Monitor	Internal
2139	Traffic Unit Failure	ACAS & XPDR Function	CDTI 10 Hz Producer IOSM Monitor	Internal
2140	Traffic Unit Failure	ACAS & XPDR Function	ADSB 10 Hz Producer Monitor	Internal
2145	Traffic Unit Failure	ACAS & XPDR Function	CDTI to IOSM Display Data Monitor	Internal
2146	Traffic Unit Failure	ACAS & XPDR Function	ACAS 1 Hz Producer CDTI Monitor	Internal
2149	Traffic Unit Failure	ACAS & XPDR Function	Link DSP CRC Monitor	Internal

Table B-6. LRU Diagnostic Data, Fault Names and Categories. - Continued

Moni-tor ID	Fault Name	TSS-4100 Fault Category	Monitor Name	Internal / External Fault
2150	Traffic Unit Failure	ACAS & XPDR Function	Link DSP CRC Monitor	Internal
2151	Traffic Unit Failure	ACAS & XPDR Function	Mode S DSP CRC Monitor	Internal
2152	Traffic Unit Failure	ACAS & XPDR Function	Configuration Monitor	Internal
2157	Traffic Input Failure	ACAS System	Pitch Angle Input Monitor	External
2158	Traffic Input Failure	ACAS System	Roll Angle Input Monitor	External
2160	Traffic Input Failure	ACAS System	Mag Heading Input Monitor	External
2168	Traffic Input Failure	ACAS System	Radio Altitude Left Activity	External
2177	Traffic Unit Failure	ACAS & XPDR Function	ACAS Null Pointer Monitor	Internal
2178	Radio Altitude Parametric Failure	ACAS System	Radio Altitude Parametric Failure	External
2180	XPDR Failure	XPDR Function	Extended Squitter Monitor	Internal
2190	Bottom Antenna Failure	ACAS & XPDR System	Bottom Forward Monitor	External
2191	Bottom Antenna Failure	ACAS & XPDR System	Bottom Right Monitor	External
2192	Bottom Antenna Failure	ACAS & XPDR System	Bottom Left Monitor	External
2193	Bottom Antenna Failure	ACAS & XPDR System	Bottom Aft Monitor	External
2194	Top Antenna Failure	ACAS & XPDR System	Top Forward Monitor	External
2195	Top Antenna Failure	ACAS & XPDR System	Top Right Monitor	External
2196	Top Antenna Failure	ACAS & XPDR System	Top Left Monitor	External
2197	Top Antenna Failure	ACAS & XPDR System	Top Aft Monitor	External

B.1.5. Label 354 TSS-4100 Diagnostic Word 3.

Refer to Table B-7 for the definition of this word and a possible solution to the indicated issue.

Table B-7. Label 354 TSS-4100 Diagnostic Word 3

Bit	Label 354- TSS-4100 Diagnostics Word 3	Possible Solution
9	SDI*	
10	SDI*	
11	LMP - 1C/D (Control A) (Active = 0 Inactive = 1)	Check wiring from appropriate controller to the TSS. Repair wiring or replace the appropriate unit.
12	LMP - 6G/H (GPS #1) (Active = 0 Inactive = 1)	(Optional connection) Check wiring from the onside GPS. Repair wiring or replace the GPS.
13	LMP - 7C/D (Control B) (Active = 0 Inactive = 1)	Check wiring from appropriate controller to the TSS. Repair wiring or replace the appropriate unit.
14	LMP - 7E/F (ADS-B #1) (Active = 0 Inactive = 1)	
15	LMP - 7G/H (ADS-B #2) (Active = 0 Inactive = 1)	
16	LMP - 7J/K (Data Load) (Active = 0 Inactive = 1)	
17	LMP - 8G/H (IAPS #1) (Active = 0 Inactive = 1)	Check wiring from the onside I/O Concentrator. Repair wiring or replace the concentrator.
18	LMP - 8J/K (CMU #1) (Active = 0 Inactive = 1)	
19	RMP - 1C/D (Control C) (Active = 0 Inactive = 1)	(Optional connection) Check wiring from appropriate controller to the TSS. Repair wiring or replace the appropriate unit.
20	RMP - 2G/H (GPS #2) (Active = 0 Inactive = 1)	(Optional connection) Check wiring from the cross-side GPS. Repair wiring or replace the GPS.
21	RMP - 7C/D (A768) (Active = 0 Inactive = 1)	
22	RMP - 8G/H (IAPS #2) (Active = 0 Inactive = 1)	Check wiring from the cross-side I/O Concentrator. Repair wiring or replace the concentrator.
23	RMP - 8J/K (CMU #2) (Active = 0 Inactive = 1)	
24	RMP - 8A/B (XT #2) (Active = 0 Inactive = 1)	Check both the XT and TX bus wiring; check to see if off side TDR is working properly.
25 to 29	Pad	
30	SSM**	
31	SSM**	
32	Odd Parity	

*SDI Code:	Bit 10	Bit 9	LRU Number	**SSM Code:	Bit 31	Bit 30	LRU Status
	0	0	Not Used		0	0	Normal
	0	1	Left		0	1	Not Used
	1	0	Right		1	0	Test
	1	1	Not Used		1	1	Not Used

B.1.6. Label 355 TSS-4100 Diagnostic Word 4.

Refer to Table B-8 for the definition of this word.

Table B-8. Label 355 TSS-4100 Diagnostic Word 4

Bit	Label 355 − TSS Diagnostic Word 4
9	SDI*
10	SDI*
14 to 11	Voltage Index (Range: 1 - 12) 1) Traffic reported 33VDC (LVDS message from Traffic) 2) Power Supply Side A 12 VDC (ADC Channel 12) 3) SysIO GAIN_REF (ADC Channel 10) 4) SysIO Top Temp (ADC Channel 15) 5) SysIO Bottom Temp (ADC Channel 14) 6) SysIO +8 VDC (ADC Channel 6) 7) SysIO - 8 VDC (ADC Channel 7) 8) SysIO Post Switch 12 VDC (ADC Channel 8) 9) SysIO 3.3 VDC (ADC Channel 4) 10) SysIO 1.5 VDC (ADC Channel 2) 11) SysIO DSP Core Voltage (ADC Channel 0) 12) SysIO RAM Voltage (ADC Channel 9)
15	Pad
16	Pad
28 to 17	12-bit Voltage Value (Range: 0 - 0xFFF) **NOTE** 0xBAD means no voltage present to report (1011 1010 1101)
29	Pad
30	SSM**
31	SSM**
32	Odd Parity

*SDI Code:	Bit 10	Bit 9	LRU Number	**SSM Code:	Bit 31	Bit 30	LRU Status
	0	0	Not Used		0	0	Normal
	0	1	Left		0	1	Not Used
	1	0	Right		1	0	Test
	1	1	Not Used		1	1	Not Used

B.1.6.1. TSS-4100 Label 355 Voltage Decode. Refer to Table B-7 to determine what the reading is and whether or not the reading is within the specified range for the TSS-4100. In the Decode column,

```
V = (2.5 / 4096) X
```

where X is the raw decimal value encoded in bits 28 to 17.

Table B-9. Label 355 Voltage Decode

Voltage Index	Decode	Nominal	Upper Limit	Lower Limit
1	(VDC) = V * 32.66	31.5	36.3	29.7
2	(VDC) = V * 11.01	12.0	12.60	11.40
3	(VDC) = V	1.5	1.575	1.425
4	(°C) = (V − 0.424) * 160	Ambient temp	N/A	
5	(°C) = (V − 0.424) * 160	Ambient temp	N/A	
6	(VDC) = V * 5.71	8.0	8.22	7.54
7	(VDC) = V * -4.21	-8.0	-7.24	-8.34
8	(VDC) = V * 10.53	12.0	12.60	11.40
9	(VDC) = V * 2.00	3.3	3.44	3.16
10	(VDC) = V	1.5	1.57	1.43
11	(VDC) = V	1.26	1.32	1.20
12	(VDC) = V	1.25	1.35	1.15

B.1.7. Label 350 ACAS Diagnostics.

Refer to Table B-10 for the definition of this word and a possible solution to the indicated issue. This label is created to replicate an equivalent word from Rockwell Collins TTR series of TCAS units. This is not sent through the TSS #X output busses. This label should only be used as a supplement to Label 351 and Label 354 on the TSS #X output busses.

NOTE

This label is sent to the displays on the TA/RA busses.

Table B-10. Label 350 ACAS Diagnostics Word

Bit	Label 350 − ACAS Diagnostics	Possible Solution
9	Pad	
10	Pad	
11	TSS ACAS Fail (Normal = 0 Failure = 1)	Check for other faults.
12	Upper Antenna (Normal = 0 Failure = 1)	Check wiring to the top antenna; replace antenna if there is no wiring problem or a TSS unit fault.
13	Lower Antenna (Normal = 0 Failure = 1)	Check wiring to the bottom antenna; replace antenna if there is no wiring problem or a TSS unit fault.
14	Radio Altimeter Input Bus #1 (Normal = 0 Inactive = 1)	Check the units and the wiring path from radio altimeter #1 to the I/O Concentrator to the TSS.
15	Radio Altimeter Input Bus #2 (Normal = 0 Inactive = 1)	Check the units and the wiring path from radio altimeter #2 to the I/O Concentrator to the TSS.
16	TSS Transponder (Active or Stby = 0 Fail = 1)	Check for other faults.
17	X-Side Transponder (Active or Stby = 0 Fail = 1)	Check wiring to the Cross side TDR; replace TDR if necessary.
18	Attitude Input Bus (Normal = 0 Inactive = 1)	Check the units and the wiring path from the selected AHRS/IRS to the I/O Concentrator to the TSS.
19	Magnetic Heading Input Bus (Normal = 0 Inactive = 1)	Check the units and the wiring path from the selected AHRS/IRS to the I/O Concentrator to the TSS.
20	TCAS System Status (Normal = 0 Failure = 1)	Check for other faults.
21	Pad	
22	Pad	
23	TA 1 Display System Status (Normal = 0 Failure = 1)	Check the ground strap to the TA #1 discrete.
24	TA 2 Display System Status (Normal = 0 Failure = 1)	Check the ground strap to the TA #2 discrete.
25	RA 1 Display System Status (Normal = 0 Failure = 1)	Check the discrete wire from the displays to the TSS; check the RA/TA bus to the appropriate displays. If the wiring is OK AND there is no TSS unit fault, then Replace Display.
26	RA 2 Display System Status (Normal = 0 Failure = 1)	Check the discrete wire from the displays to the TSS; check the RA/TA bus to the appropriate displays. If the wiring is OK AND there is no TSS unit fault, then Replace Display.

Table B-10. Label 350 ACAS Diagnostics Word - Continued

Bit	Label 350 − ACAS Diagnostics	Possible Solution
27	Not Used	
28	Not Used	
29	Not Used	
30	SSM*	
31	SSM*	
32	Odd Parity	

*SSM Code:	Bit 31	Bit 30	LRU Status
	0	0	Normal
	0	1	Not Used
	1	0	Test
	1	1	Not Used

B.2. TDR-94D DIAGNOSTIC CODES.

Refer to Table B-11. A traffic control unit such as the CTL-92(), or a maintenance diagnostic system, lists TDR-94D diagnostic codes.

Table B-11. TDR-94D Diagnostic Codes.

PRIMARY CODE	SECONDARY CODE	DESCRIPTION	DIAGNOSTIC DISPLAY	
			T1	F/W
None (refer to Note)		No Fault Found		
		NOTE With a No Fault Found condition, a pulsating AL will appear in the upper window and the baro altitude will appear in the lower window.		
10		Power Supply Diagnostics	(Note 1)	(Note 1)
	11	+5-V dc	Yes	Yes
	12	+ 70-V dc	No	No
	13	+35-V dc	No	No
	14	LVPS	No	No
20		Transmitter / Modulator diagnostics	(Note 2)	(Note 2)
	21	Final stage over current	Yes	Yes
	22	Top antenna low-power output	No	No
	23	Bottom antenna low-power output	No	No
	24	Transmitter over temperature	No	No
30		Synthesizer diagnostics	No	No
	31	Synthesizer lock detect	No	No
	32	Synthesizer low-power detect	No	No
40		Receiver / IF diagnostics	No	No
	41	Top receiver channel	No	No
	42	Bottom receiver channel	No	No
	43	Top Differential Phase Shift Keying (DPSK) demodulator	No	No
	44	Bottom DPSK demodulator	No	No
50		Program memory (ROM) diagnostics	Yes	Yes
	51	High-byte ROM	Yes	Yes
	52	Low-byte ROM	Yes	Yes
	53	Both ROM chips	Yes	Yes
60		Volatile memory (RAM) diagnostics	Yes	Yes
	61	High-byte RAM	Yes	Yes

Table B-11. TDR-94D Diagnostic Codes. - Continued

PRIMARY CODE	SECONDARY CODE	DESCRIPTION	DIAGNOSTIC DISPLAY	
			T1	F/W
	62	Low-byte RAM	Yes	Yes
	63	Both RAM chips	Yes	Yes
	64	Cache RAM	Yes	Yes
	65	Cache RAM and high-byte RAM	Yes	Yes
	66	Cache RAM and low-byte RAM	Yes	Yes
	67	Cache RAM and both RAM chips	Yes	Yes
	68	Dual Port RAM	Yes	Yes
70		Non-Volatile RAM (NVRAM) diagnostics	No	No
80		Serial input control bus diagnostics	(Note 4)	No
	81	ARINC 429 control UART	(Note 4)	No
	82	ARINC 429 control Port A inactive	(Note 4)	No
	83	ARINC 429 control Port B inactive	(Note 4)	No
	84	ARINC 429 control Port C inactive	(Note 4)	No
	85	CSDB control input Port A inactive	(Note 4)	No
	87 (-004 TDR-94D only)	AIS/Air Data System (ADS) UART failure	No	No
	88 (-004 TDR-94D only)	GPS UART failure	No	No
	89 (-004 TDR-94D only)	IRS UART failure	No	No
90		Serial altitude input diagnostics	No	No
	91	ARINC 429/575 altitude UART	No	No
	92	ARINC 429/575 input Port A inactive	No	No
	93	ARINC 429/575 input Port B inactive	No	No
	94	CSDB altitude input Port A inactive	No	No
	95	CSDB altitude input Port B inactive	No	No
	99	No data received	—	—
A0		ADLP communication diagnostics	No	No
	A1	ADLP com A/B UART	No	No
	A2	ADLP com A/B bus inactive	No	No
	A3	ADLP com C/D UART	No	No
	A4	ADLP com C/D bus inactive	No	No
B0		TCAS communication diagnostics	No	No
	B1	TCAS UART	No	No

Table B-11. TDR-94D Diagnostic Codes. - Continued

PRIMARY CODE	SECONDARY CODE	DESCRIPTION	DIAGNOSTIC DISPLAY	
			T1	F/W
	B2	TCAS unit	—	—
	B3	TCAS bus inactive	No	No
	B4	TCAS protocol error	No	No
C0		Squitter diagnostics	No	Yes
	C1 (TDR-94D only)	Top channel squitter	No	Yes
	C2 (TDR-94D only)	Bottom channel squitter	No	Yes
D0	(TDR-94D only)	Diversity diagnostic	No	Yes
E0		Message processor diagnostics	No	No
	E1 (TDR-94D only)	Top channel message processor, soft failure	No	No
	E2	Bottom channel message processor, soft failure	No	No
	E3	Top channel message processor, hard failure	Yes	Yes
	E4	Bottom channel message processor, hard failure	Yes	Yes
F0		Configuration diagnostics	No	No
	F1	Mode S discrete address changed	No	No
	F2	TCAS selection changed	No	No
	F3	Altitude units selection changed	No	No
	F4	Max airspeed program selects changed	No	No
	F5	Port selects changed	No	No
	F6	SDI selects changed	No	No
	F7	Single antenna selection changed	No	No
	F8	ADLP selection changed	No	No
	F9-FE	Not assigned	No	No

Table B-11. TDR-94D Diagnostic Codes. - Continued

PRIMARY CODE	SECONDARY CODE	DESCRIPTION	DIAGNOSTIC DISPLAY T1	DIAGNOSTIC DISPLAY F/W
	FF	Unacceptable Mode S address selected (all address lines identical)	Yes	Yes

NOTE

1. Transmitter is inhibited (TI) and failure warn (F/W1) output (P1-31) is set only if a diagnostic Code 11 is detected.
2. Transmitter is inhibited and F/W1 discrete is set only if a diagnostic Code 21 is detected.
3. Transmitter is inhibited and TDR-94/TDR-94D is set to standby only if all selected control inputs are nonfunctional.
4. Transmitter is inhibited and TDR-94/TDR-94D is set to standby only if the control bus failure is detected on the selected control bus.
5. Transmitter is inhibited and TDR-94/TDR-94D is set to standby only if serial control is selected and all serial inputs are nonfunctional.
6. Except for 00, 70, and D0, primary diagnostics are not displayed.
7. F/W SET refers to:

- TDR-94D fault monitor discrete output, P1-31, set to high level
- TDR-94D CSDB data word Label 1F, Byte-1, Bit-7, set to logic 0
- TDR-94D ARINC 429 SSM and other data bits related to diagnostics set to the appropriate fault level.

APPENDIX C
Buses and Other Interfaces

C.1. INTERFACE TYPES.

The various Line Replaceable Unit (LRU) in the Traffic Surveillance System (TSS) interface with each other and other systems using primarily ARINC 429 or discrete interfaces. Each bus has a unique name. The buses are primarily ARINC 429 or discrete format. Refer to Table C-1 for a list of the possible discrete and ARINC bus names. Refer to Table C-2 through Table C-16 for lists of the word labels on each digital bus. Interfaces to the ECU, audio systems, and test equipment are not described here.

Table C-1. Buses and Discretes

Name of Bus or Discrete	Type of Bus or Discrete
TSS Active (to XTDR)	Discrete Output
Visual Annun C	Discrete Output
Visual Annun P	Discrete Output
Visual Annun TA	Discrete Output
Fan Off (100ma)	Discrete Output
Aural Advisory C	Discrete Output
Aural Advisory P	Discrete Output
Aural Advisory TA	Discrete Output
XTDR Active (from XTDR)	Discrete Input
Extended Squitter Disable	Discrete Input
Perf Limit	Discrete Input
Simulator Enable	Discrete Input
Air/Gnd(F) #1	Discrete Input
Fan Monitor	Discrete Input
Air/Gnd(F) #2	Discrete Input
Climb Inhibit #1	Discrete Input
Climb Inhibit #2	Discrete Input
Climb Inhibit #3	Discrete Input
Climb Inhibit #4	Discrete Input
Increase Climb Inh #1	Discrete Input
Increase Climb Inh #2	Discrete Input
Increase Climb Inh #3	Discrete Input
Increase Climb Inh #4	Discrete Input
Advisory Inhibit #1	Discrete Input
Advisory Inhibit #2	Discrete Input

Table C-1. Buses and Discretes - Continued

Name of Bus or Discrete	Type of Bus or Discrete
Advisory Inhibit #3	Discrete Input
Advisory Inhibit #4	Discrete Input
TA Display Valid #1	Discrete Input
TA Display Valid #2	Discrete Input
RA Display Valid #1	Discrete Input
RA Display Valid #2	Discrete Input
Burst Tune Select	Discrete Input
Control Port Select 0	Discrete Input
Control Port Select 1	Discrete Input
Advisory Annun Cancel	Discrete Input
Data Load Enable	Discrete Input
SDI Position 1	Discrete Input
SDI Position 2	Discrete Input
TSS-1	Output Bus
TSS-2	Output Bus
TSS-3 (Data Load)	Output Bus
TA/RA-1	Output Bus
TA/RA-2	Output Bus
TX2 (TSS to TDR) (or ADLP)	Output Bus
ADS-B #1 (Provision)	Output Bus
CMU (Provision)	Output Bus
General Purpose #1 (Provision)	Output Bus
Control A	Input Bus
Control B	Input Bus
Control C	Input Bus
IAPS #1	Input Bus
IAPS #2	Input Bus
GPS #1	Input Bus
GPS #2	Input Bus
XT2 (TDR to TSS) (or ADLP)	Input Bus
Data Load	Input Bus
CMU #1 (Provision)	Input Bus
CMU #2 (Provision)	Input Bus
ADS-B #1 (Provision)	Input Bus

Table C-1. Buses and Discretes - Continued

Name of Bus or Discrete	Type of Bus or Discrete
ADS-B #2 (Provision)	Input Bus
A768 Future (Provision)	Input Bus

C.2. TSS DISCRETE OUTPUTS.

Refer to Table C-2 for a list of the discrete outputs for the TSS and their expected destinations.

Table C-2. TSS Discrete Outputs

Pin Name	Conn	Pin	Expected Connection/Notes
TSS Active (to XTDR)	LMP	2E	Cross side transponder, even if it is another TSS
Visual Annun C	LMP	3A	Not normally connected
Visual Annun P	LMP	3B	Not normally connected
Visual Annun TA	LMP	3C	Not normally connected
Fan Off (100ma)	LMP	3D	Connect to TSM to control the fan
Aural Advisory C	LMP	4A	May be connected as a push-to-talk for audio outputs
Aural Advisory P	LMP	4B	May be connected as a push-to-talk for audio outputs
Aural Advisory TA	LMP	4C	May be connected as a push-to-talk for audio outputs

C.3. TSS DISCRETE INPUTS.

Refer to Table C-3 for a list of the discrete inputs to the TSS and their expected connections.

Table C-3. TSS Discrete Inputs

Pin Name	Conn	Pin	Expected Connection/Notes
XTDR Active (from XTDR)	LMP	2J	Cross side transponder
Extended Squitter Disable	LMP	2K	This will only be connected if there is a switch to turn off extended squitters
Perf Limit	LMP	3E	This is an ARINC 735 (TCAS) pin that is not usually used
Simulator Enable	LMP	3F	Not normally connected
Air/Gnd(F) #1	LMP	3G	Not normally connected − use Air/Gnd #2
Fan Monitor	LMP	3K	Connect to TSM to monitor fan speed
Air/Gnd(F) #2	LMP	4H	Connect to Weight on Wheels indicator
Climb Inhibit #1	LMP	11A	This is an ARINC 735 (TCAS) pin that is not usually used
Climb Inhibit #2	LMP	11B	This is an ARINC 735 (TCAS) pin that is not usually used
Climb Inhibit #3	LMP	11C	This is an ARINC 735 (TCAS) pin that is not usually used
Climb Inhibit #4	LMP	11D	This is an ARINC 735 (TCAS) pin that is not usually used
Increase Climb Inh #1	LMP	11E	This is an ARINC 735 (TCAS) pin that is not usually used; in some installations connected to ADC to inhibit increase climbs at some altitude
Increase Climb Inh #2	LMP	11F	This is an ARINC 735 (TCAS) pin that is not usually used; in some installations connected to ADC to inhibit increase climbs at some altitude
Increase Climb Inh #3	LMP	11G	This is an ARINC 735 (TCAS) pin that is not usually used; in some installations connected to ADC to inhibit increase climbs at some altitude
Increase Climb Inh #4	LMP	11H	This is an ARINC 735 (TCAS) pin that is not usually used; in some installations connected to ADC to inhibit increase climbs at some altitude
Advisory Inhibit #1	LMP	10J	Not usually used; puts TCAS into standby
Advisory Inhibit #2	LMP	10K	Connect to TAWS or CAS system; puts TCAS into TA only mode and inhibits all aurals
Advisory Inhibit #3	LMP	11J	Connect to TAWS or CAS system; puts TCAS into TA only mode and inhibits all aurals
Advisory Inhibit #4	LMP	11K	Connect to TAWS or CAS system; puts TCAS into TA only mode and inhibits all aurals
TA Display Valid #1	RMP	10A	Usually strapped to ground; for use on TA only display
TA Display Valid #2	RMP	10B	Usually strapped to ground; for use on TA only display
RA Display Valid #1	RMP	10C	Connect to pilot side displays
RA Display Valid #2	RMP	10D	Connect to co-pilot side displays

Table C-3. TSS Discrete Inputs - Continued

Pin Name	Conn	Pin	Expected Connection/Notes
Burst Tune Select	RMP	10E	If control port C is a burst tuner, connect to same source as Control Port Select 1 pin (RMP 10G)
Control Port Select 0	RMP	10F	See control bus section in this appendix
Control Port Select 1	RMP	10G	See control bus section in this appendix
Advisory Annun Cancel	RMP	10H	Not usually connected; cancels aurals, but RA info still sent on TA/RA bus
Data Load Enable	RMP	10K	Connect to data load enable switch
SDI Position 1	RMP	11J	*Refer to Note
SDI Position 2	RMP	11K	*Refer to Note

NOTE

TSS SDI strap encoding is as follows:

SDI Coding	Side 1 - Left	Side 2 - Right	Not Used	Not Used
SDI Position 1 (RMP 11J)	Gnd	Open	Open	Gnd
SDI Position 2 (RMP 11K)	Open	Gnd	Open	Gnd

C.4. TSS A429 OUTPUT BUSES.

Refer to Table C-4 for a list of the ARINC 429 output buses and their expected destinations.

Table C-4. TSS A429 Output Buses

Pin Name	Con-nector	Pin A	Pin B	Destination
TSS-1	LMP	7A	7B	Onside controller or concentrator
TSS-2	LMP	1A	1B	Offside controller or concentrator
TSS-3 (Data Load)	RMP	1A	1B	Data loader or maintenance system
TA/RA-1	LMP	1E	1F	Pilot side displays
TA/RA-2	RMP	1E	1F	Copilot side displays
TX2 (TSS to TDR) (or ADLP)	RMP	8D	8C	Cross-side TDR
ADS-B #1 (Provision)	LMP	9E	9F	Not connected
CMU (Provision)	RMP	9E	9F	Not connected
General Purpose #1 (Provision)	LMP	9D	9C	Not connected

C.4.1. TSS-1 and TSS-2 Output Bus Labels.

Refer to Table C-5 for a list of the labels output on the TSS-1 and the TSS-2 output buses and their expected output rate.

Table C-5. TSS-1 and TSS-2 Output Bus Labels

Label	Parameter Name	Rate (ms)
011	TSS Configuration Data	100
013	TCAS Control Word	100
015	Altitude Select Limits	100
016	TCAS/Mode-S Transponder	100
031	ATC Transponder	200
203	Pressure Altitude	200
204	Baro-Corrected Altitude	200
226	Data Load Output	On Demand
233	Aircraft Ident Word 1	1000
234	Aircraft Ident Word 2	1000
235	Aircraft Ident Word 3	1000
236	Aircraft Ident Word 4	1000
237	Aircraft Ident Word 5	1000
243	Aural Annunciation	50
275	Mode S Address Part 1	1000
276	Mode S Address Part 2	1000

Table C-5. TSS-1 and TSS-2 Output Bus Labels - Continued

Label	Parameter Name	Rate (ms)
301	Aircraft Registry Word 1	1000
302	Aircraft Registry Word 2	1000
303	Aircraft Registry Word 3	1000
350	TDR Maintenance Word	500
351	TSS-4100 Diagnostic Word 1	500
352	CDU Diagnostic Word 1	500
353	TSS-4100 Diagnostic Word 2	500
354	TSS-4100 Diagnostic Word 3	500
355	TSS-4100 Diagnostic Word 4	500
356	ARINC 604 to CMS	On Demand
357	TSS-4100 Diagnostic Word 5 (Reserved)	500
377	TSS-4100 Equipment Identification	1000

C.4.2. TSS-3 Output Bus Labels.

Refer to Table C-6 for a list of the labels output on the TSS-3 output bus and their expected output rate.

Table C-6. TSS-3 Output Bus Labels

Label	Parameter Name	Rate (ms)
011	TSS Configuration Data	100
226	Data Load Output	On Demand
350	TDR Maintenance Word	500
351	TSS-4100 Diagnostic Word 1	500
352	CDU Diagnostic Word 1	500
353	TSS-4100 Diagnostic Word 2	500
354	TSS-4100 Diagnostic Word 3	500
355	TSS-4100 Diagnostic Word 4	500
356	ARINC 604 to CMS	On Demand
357	TSS-4100 Diagnostic Word 5 (Reserved)	500
361	NVRAM Download Header Words (Shop Mode)	On Demand
362	NVRAM Download Data Words (Shop Mode)	On Demand
377	TSS-4100 Equipment Identification	1000

C.4.3. TA/RA-1 and TA/RA-2 Output Bus Labels.

Refer to Table C-7 for a list of the labels output on the TA/RA-1 and TA/RA-2 output buses and their expected output rate.

Table C-7. TA/RA-1 and TA/RA-2 Output Bus Labels

Label	Parameter Name	Rate (ms)
013	TCAS Control Word	100
015	Altitude Select Limits	100
016	TCAS/Mode-S Transponder	100
130	Intruder Range	Block
131	Intruder Altitude	Block
132	Intruder Bearing	Block
203	Pressure Altitude	500
204	Baro-Corrected Altitude	500
270	Vertical Resolution Advisory	500
274	TX Word 2	500
320	Magnetic Heading	500
350	ACAS Diagnostics	500
357	Intruder File, Block Protocol	Block
377	ACAS Equipment ID	500

C.4.4. TX-2 Output Bus Labels.

Refer to Table C-8for a list of the labels output on the TX-2 output bus and their expected output rate.

NOTE

The TSS only supports the DO-185A XT/TX protocol. It does not support the older TSO C119A protocol.

Table C-8. TX-2 Output Bus Labels

Label	Parameter Name	Rate (ms)
270	TGD Protocol	On Demand
274	TX Word 2	200
275	TX Word 3	On Demand

C.5. A429 INPUT BUSES.

Refer to Table C-9 for a list of the A429 Input Buses and their expected source.

Table C-9. A429 Input Buses

Pin Name	Con-nector	Pin A	Pin B	Source
Control A	LMP	1D	1C	Offside controller, directly or via RIU
Control B	LMP	7D	7C	Onside controller, directly or via RIU
Control C	RMP	1D	1C	Third control source
IAPS #1	LMP	8H	8G	On side data concentrator
IAPS #2	RMP	8H	8G	Cross-side data concentrator
GPS #1	LMP	6H	6G	On side GPS
GPS #2	RMP	2H	2G	Cross-side GPS
XT2 (TDR to TSS) (or ADLP)	RMP	8A	8B	Cross-side TDR
Data Load	LMP	7J	7K	Data loader
CMU #1 (Provision)	LMP	8J	8K	Not connected
CMU #2 (Provision)	RMP	8J	8K	Not connected
ADS-B #1 (Provision)	LMP	7E	7F	Not connected
ADS-B #2 (Provision)	LMP	7H	7G	Not connected
A768 Future (Provision)	RMP	7D	7C	Not connected

C.5.1. Control Bus Selection.

The control port is selected using the control-port select discretes as encoded in Table C-10.

Table C-10. Control Bus Selection

Control Port Select Coding	Ctrl Bus A	Ctrl Bus B	Ctrl Bus C	Not Used
Control Port Select 0 (RMP 10F)	Gnd	Open	Open	Gnd
Control Port Select 1 (RMP 10G)	Open	Open	Gnd	Gnd

NOTE

If both the control-port select 0 and control-port select 1 pins are grounded, then the control bus selection is invalid. If the installation will cause this to happen, it is recommended that the source of the discrete for selecting control bus C is connected to the burst tuning discrete.

C.5.2. Control Bus Labels.

Refer to Table C-11 for a list of the labels expected to be received on the control buses and notes regarding their use.

Table C-11. Control Bus Labels

Label	Parameter Name	Notes
006	Mode-S Address Set Word 1	Not required; only received when controller is attempting to set the Mode S address
007	Mode-S Address Set Word 2	Not required; only received when controller is attempting to set the Mode S address
013	TCAS Control Word	Not used by TSS; passed through to display
015	TCAS Altitude Select Limits	Not used by TSS; passed through to display
016	TCAS/Mode-S Transponder	Required; TCAS control word
027	TSS Data Load Receive (Dataloader)	TSS Control B port only; may data load through this port
031	Mode-S ATC Control	Required; transponder control word
203	Pressure Altitude (ADC)	Required, but may be passed through concentrated buses instead of through controller
204	Baro-Corrected Altitude (ADC)	May be passed through concentrated buses instead of through controller
227	ARINC 604 from CMS	TSS Control B port only; maintenance system may request ECU data through this port
233	Aircraft Ident Word 1	Required, but may be passed through concentrated buses instead of through controller
234	Aircraft Ident Word 2	Required, but may be passed through concentrated buses instead of through controller
235	Aircraft Ident Word 3	Required, but may be passed through concentrated buses instead of through controller
236	Aircraft Ident Word 4	Required, but may be passed through concentrated buses instead of through controller
237	Aircraft Ident Word 5	May be passed through concentrated buses instead of through controller; this label is not present from all sources of flight ID − will usually only have labels 233 − 236 available
350	CDU Diagnostics Word 1 (CDU)	Not required; only needed if the controller does not have its own interface to the maintenance system
360	Download NVRAM Request (Shop Mode)	TSS Control B port only while in shop mode; response to a request to download NVRAM

C.5.3. Concentrated Bus Inputs.

It is expected that the left and right transponders, whether the transponder is a TSS or a TDR, will receive exactly the same information. This may be done either through separate or through shared concentrated buses. The only difference is that data will come in from a different side. Table C-12lists the TDR concentrated bus inputs and the TSS bus inputs and how they correspond.

Table C-12. Concentrated Bus Inputs

Bus Source	TDR Bus	TSS Bus
Onside data concentrator	FMS/IRS	IAPS #1
Cross-side data concentrator	AIS/ADS	IAPS #2

C.5.3.1. The following figure is of the expected concentrated bus architecture with a right TSS and a left TDR using a single output bus from both the left and the right concentrator.

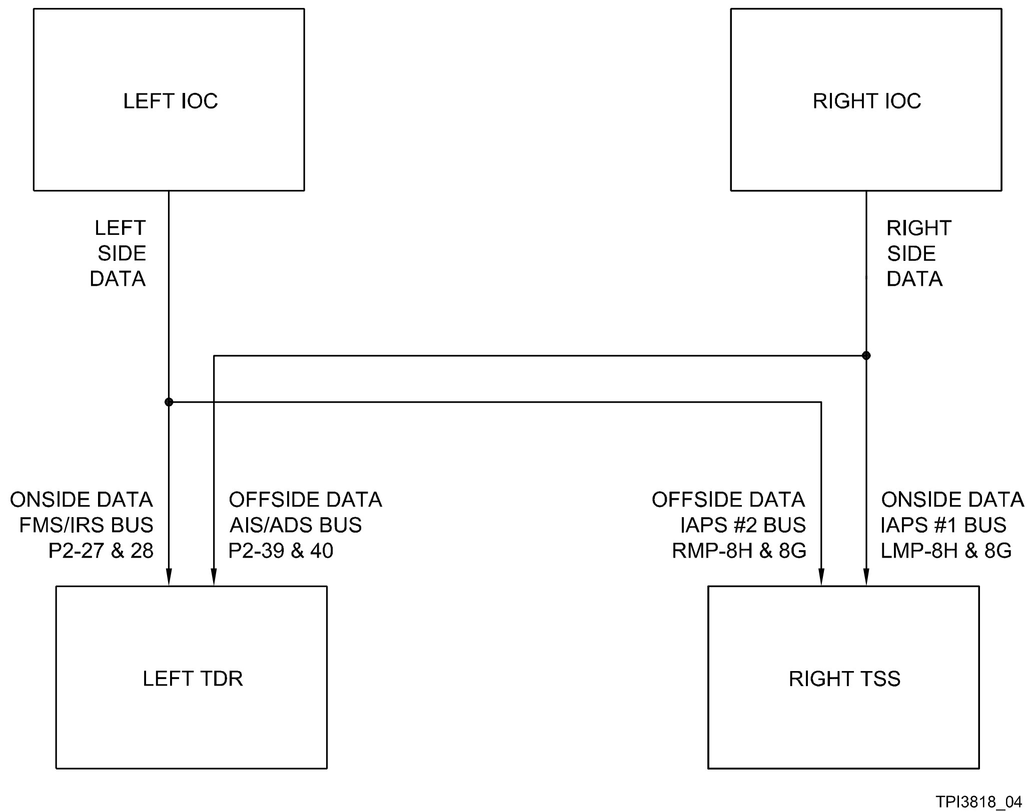


Figure C-1. Bus Architecture, TSS (R) and TDR (L)

C.5.3.2. A summary of the data sources that are sorted based on SDI is below. Data from all other sources are sorted by the bus that the data is received.

- Radio Altimeter
- PFD
- ADC
- AHC/IRS.

C.5.3.3. Here is a list of the labels that can be received on the concentrated buses, the ultimate expected source of the data, and notes regarding their use. Not Required does not mean that it is not desired or will not be used – it means that at this time it is not a required parameter.

Label	Parameter Name	Notes
076	GNSS Altitude (MSL) (GPS)	May be on GPS bus
101	Selected Heading/Track	Required for ADS-B
102	Selected Altitude	Either this or label 226 required for enhanced surveillance; 102 used for selected altitude that comes from a source other than the FMS
103	GPS Track Angle (GPS)	Required for ADS-B, but may be on GPS bus
110	GNSS Latitude - Coarse (GPS)	Required for ADS-B, but may be on GPS bus
111	GNSS Longitude - Coarse (GPS)	Required for ADS-B, but may be on GPS bus
112	GNSS Ground Speed (GPS)	Required for ADS-B, but may be on GPS bus
120	GNSS Latitude - Fine (GPS)	Required for ADS-B, but may be on GPS bus
121	GNSS Longitude - Fine (GPS)	Required for ADS-B, but may be on GPS bus
130	Horizontal Integrity Limit (GPS)	Required for ADS-B, but may be on GPS bus
133	Vertical Integrity Limit (GPS)	Required for ADS-B, but may be on GPS bus
136	Vertical Figure of Merit (GPS)	Required for ADS-B, but may be on GPS bus
151	GNSS UTC (Time) (GPS)	Required for ADS-B, but may be on GPS bus
164	Radio Height (RALT)	Required
165	Vertical Velocity (GPS)	Required for ADS-B, but may be on GPS bus
166	GNSS N/S Velocity (GPS)	Required for ADS-B, but may be on GPS bus
174	GNSS E/W Velocity (GPS)	Required for ADS-B, but may be on GPS bus
175	PFD Mode Select Word (PFD)	Required; use bits 11, 12, 13, 15, & 25-28
203	Pressure Altitude (ADC)	Required, but may be received on selected control bus
204	Baro-Corrected Altitude (ADC)	May be on selected control bus
205	Mach (ADC)	Required
206	Computed Airspeed (ADC)	Required
210	True Airspeed (BNR) (ADC)	Required
212	Altitude Rate (ADC)	Required
213	Static Air Temperature (BNR) (ADC)	Not required
217	Static Pressure (Hg) SSE Corrected (ADC)	Not required
226	Target Altitude (From FMS)	Either this or label 102 required for enhanced surveillance; 226 used for target altitude that comes from the FMS
240	Barometric Correction (ADC)	Required
247	Horizontal Figure of Merit (GPS)	Required for ADS-B, but may be on GPS bus
253	FGC Mode Word 2 (FGC)	Required; only use bit 19
261	GNSS Date (GPS)	May be on GPS bus
273	GNSS Sensor Status (GPS)	Required for ADS-B, but may be on GPS bus
301	Aircraft Registry Word 1 (Central Maint)	Not required

Label	Parameter Name	Notes
302	Aircraft Registry Word 2 (Central Maint)	Not required
303	Aircraft Registry Word 3 (Central Maint)	Not required
310	Present Position Latitude (FMS)	Not required, but desired as backup to GPS position
311	Present Position Longitude (FMS)	Not required, but desired as backup to GPS position
312	Ground Speed (FMS)	Required
313	Track Angle (True) (FMS)	Required
314	True Heading (FMS)	Not required
315	Wind Speed (FMS)	Not required
316	Wind Direction (FMS) (Reserved)	Not required
317	Track Angle, Magnetic (IRS)	Not required
320	Magnetic Heading (AHC)	Required − must be magnetic heading, not displayed heading
324	Pitch Angle (IRS)	Not required
325	Roll Angle (IRS)	Required
335	Track Angle Rate (IRS)	Required, but known that it is not available on an AHRS system; for new AHRS installations it is expected that the FMS will calculate this value and it will be received as label 336
336	Track Angle Rate (FMS)	Required − see above
365	Inertial Vertical Speed (IRS)	Required, may be from FMS instead of IRS
366	North/South Velocity (FMS)	Not required, but desired as backup to GPS velocity
367	East/West Velocity (FMS)	Not required, but desired as backup to GPS position
370	GNSS Altitude (HAE) (GPS)	Required for ADS-B, but may be on GPS bus
376	PFD Discrete Wd 2 (PFD)	Required; using bits 27-28

C.5.4. GPS Input Data.

GPS Input Data section includes information about:

- GPS Bus Labels
- GPS Data Latency
- GPS Data/Time Mark Input Correlation
- Single vs Dual GPS Installation.

C.5.4.1. GPS Bus Labels. Refer to Table C-13 for a listing of the data used from the ARINC 429 data block coming from a GPS.

Table C-13. GPS Bus Labels

Label	Parameter Name
076	GNSS Altitude (MSL)
103	GPS Track Angle True

Table C-13. GPS Bus Labels - Continued

Label	Parameter Name
110	GNSS Latitude − Coarse
111	GNSS Longitude − Coarse
112	GNSS Ground Speed
120	GNSS Latitude − Fine
121	GNSS Longitude − Fine
130	Horizontal Integrity Limit
133	Vertical Integrity Limit
136	Vertical Figure of Merit
150	GNSS UTC Time
165	GPS Vertical Velocity
166	GNSS N/S Velocity
174	GNSS E/W Velocity
247	Horizontal Figure of Merit
260	GNSS Date
273	GNSS Sensor Status
370	GNSS Altitude (HAE)

C.5.4.2. GPS Data Latency. It is important that the GPS time mark (which comes out once a second) and the ARINC 429 data block associated with it have less than a 200 ms lag between them. Typically, a high speed data block associated with the time mark comes out about 150 ms after the time mark. A low speed data block comes out just under 200 ms. If there is not a direct connection between the GPS and the TSS or TDR transponder, the latency through the rest of the system must be minimized. A GPS may transmit data at either a 1 Hz rate or at a 5 Hz rate. Either input rate is acceptable for the transponders. GPS data may not be down-sampled (for example, to one every 5 data blocks) as the block that corresponds to the time mark must be received by the transponder.

C.5.4.3. GPS Data/Time Mark Input Correlation. GPS data may either come in through the dedicated GPS bus or through the concentrated bus. It is not allowable to have the data come in through both. When received on the concentrated bus, GPS data is sorted by the bus it comes in, so the data from the left GPS must come from the left concentrator and the data from the right GPS must come from the right concentrator. In addition, the GPS Time Mark input being used must match the input of the ARINC 429 data. Refer to Table C-14 for which time mark matches which input port.

NOTE

For the TDR there is only one time mark input. Data received either from the cross-side GPS or the cross-side concentrator will not have an associated time mark.

Table C-14. GPS Data/Time Mark Input Correlation

Unit	Time Mark Input	GPS Input	Concentrated Bus Input
TSS	GPS Time Mark #1 (LMP 9J & 9K)	GPS #1	IAPS #1
TSS	GPS Time Mark #2 (RMP 9J & 9K)	GPS #2	IAPS #2

Table C-14. GPS Data/Time Mark Input Correlation - Continued

Unit	Time Mark Input	GPS Input	Concentrated Bus Input
TDR	GPS Time Tag (P2-37 & 38)	GPS #1	FMS/IRS
TDR	None	GPS #2	AIS/ADS

C.5.4.4. Single vs Dual GPS Installation. Refer to Figure C-2 for an example block diagram of a GPS installation. In this diagram the Left GPS is standard and the right GPS is optional.

NOTE

There is an ECU setting for the TSS as to whether there should be one or two GPS inputs expected.

In a single GPS installation, a right TSS expects that the single GPS input to come in from the cross side – to come in on the #2 input.

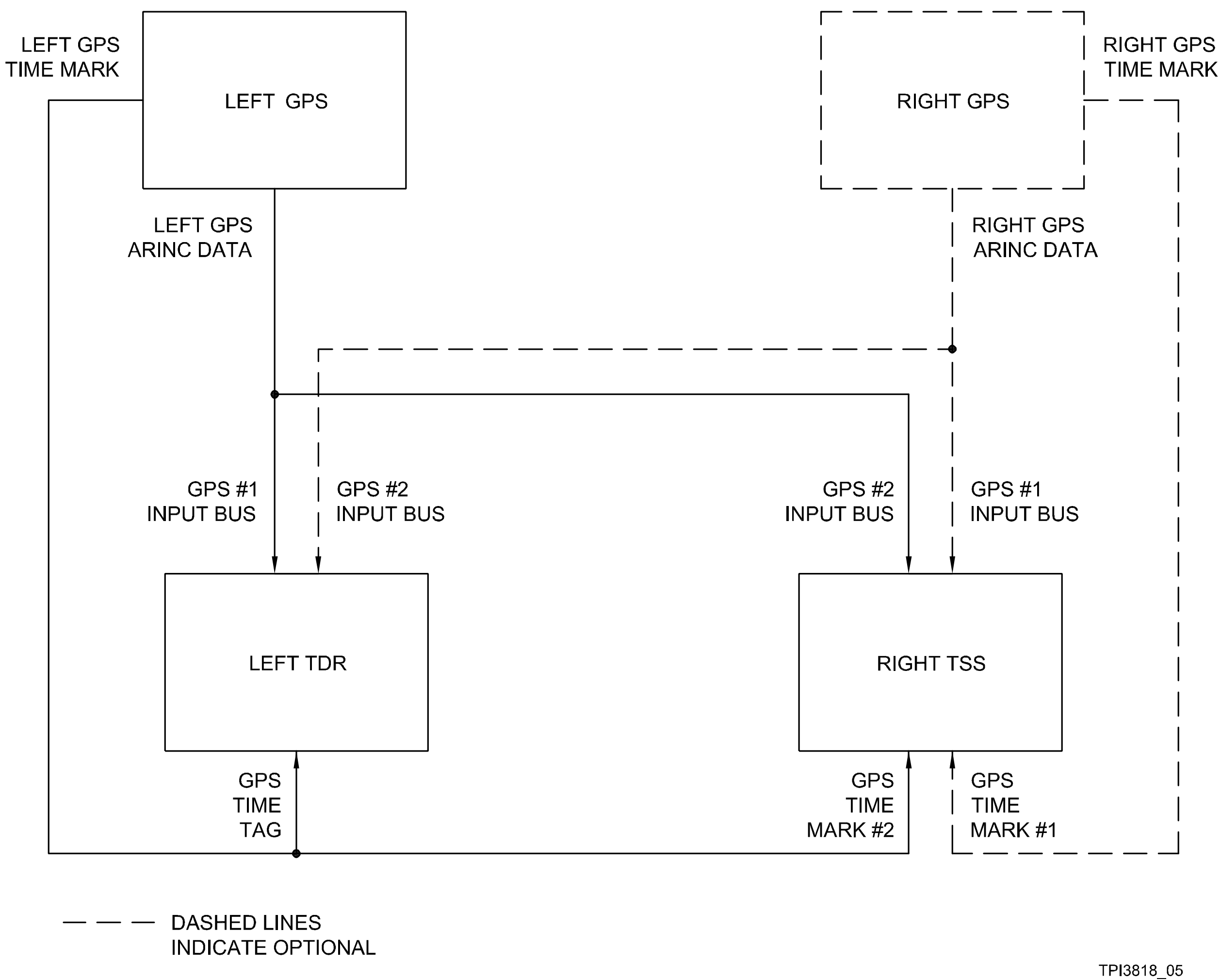


Figure C-2. Dual GPS Installation

C.5.5. XT-2 Input Bus (TDR to TSS).

Refer to Table C-15 for a list of the labels received on the XT-2 input bus.

NOTE

The TSS only supports the DO-185A XT/TX protocol; it does not support the older TSO C119A protocol.

Table C-15. XT-2 Input Bus (TDR to TSS)

Label	Parameter Name
013	TCAS Control Word
015	TCAS Altitude Select Limits
016	TCAS/Mode-S Transponder
203	Pressure Altitude (XT Word 4)
204	Baro-Corrected Altitude (XT Word 9)
270	XGD Protocol (XT Word 10) (Reserved)
271	XT Word 1
272	XT Word 2
273	XT Word 3
274	XT Word 8
275	XT Word 5
276	XT Word 6
277	XT Word 7

C.5.6. TSS Data Load Bus.

Refer to Table C-16 for a list of the labels received on the data load input bus.

Table C-16. TSS Data Load Bus

Label	Parameter Name
027	TSS Data Load Receive (Dataloader)
227	ARINC 604 from CMS

APPENDIX D
Equipment Characteristics

D.1. EQUIPMENT CHARACTERISTICS.

Refer to Table D-1 for the equipment specifications. Refer to Table D-2 for the certification categories. Refer to Table D-3 for the equipment weight, power requirements, and size. Refer to Table D-4 through Table D-8 for the environmental qualifications of each piece of equipment.

Table D-1. Equipment Specifications.

CHARACTERISTIC	SPECIFICATION
Certification	
FAA Technical Standard Order (TSO)	Refer to Table D-2.
Environmental	Refer to Table D-2 and to the environmental qualification forms provided in Table D-4 through Table D-8.
Size	Refer to Table D-3.
Weight	Refer to Table D-3.
Power requirements	Refer to Table D-3 (typical values).
Maintenance requirements	The TCAS function of the TSS-4100 does not require any periodic maintenance -- it is on condition. The exception follows: TSS-4100 and TDR-94D: The transponder function must have an Air Traffic Control (ATC) transponder test and inspection according to FAR part 91 at a minimum of once every two years.

Table D-2. Certification Categories.

Unit	FAA TSO	Environmental Categories
ANT-42	C66b,C74c	DO-160A E1/B/JLY/XRHXXXXXXXX
ECU-3000	TSO-C112 & TSO-C119b (-802 status)+ TSO-C166a Transmit only (-803 status)	DO-160E [(F2)(A2)V]ABB[(RBB1)(SCLM)(HR)] EYXXXXZ[AB]AZ[CC] [RR]M[X][X]AAX
TDR-94D	TSO-C112 Class 3A2 121 011 Level 3es	DO-160E [(A2)(E1)-]BBA[SCLM] EXXXFXZZAZZC [RR]M[(A3)(Z3)X]XXAX
TRE-930	C66, C74	DO-108 ABAXXXXCL1 **NOTE** This unit is not tested to DO-160 levels.
TSA-4100	TSO-C112, TSO-C119b & TSO-C166a Transmit only.	DO-160E [(D2)(F2)X]ABB[(RCC1)(HR)(SLM)] XSFDFSZ[X]XX[CW] [RR]H[(XX)(K4)4][1A]AAX
TSS-4100	TSO-C112 Class 2A1 121 011 Level 2es, TSO-C119b & TSO-C166a Transmit Only	DO-160E [(F2)(A2)V]ABB[(RBB1)(SCLM)(HR)] EYXXXXZ[AB]AZ[CC] [RR]M[(B3)(K3)3]XAAX

Table D-3. Unit Weight, Power Requirements, and Size.

UNIT	WEIGHT kg (lb)	POWER (Nominal)	POWER (Max)	SIZE (H × W × L) mm (in)
ANT-42	96 (0.2)	Not Applicable (NA)		84.1 x 44.5 x 115.3 (3.31 x 1.75 x 4.45)
TSA-4100	1.0 (2.2)	NA		33.0 x 160 x 284.5 (1.30 x 6.30 x 11.20) **NOTE** Height does not include length of connector. The -101 connector is 20 mm long. The -001 connector is 39 mm long.
ECU-3000	0.08 (0.17)	Powered by TSS-4100		36 x 51 x 70 (1.4 x 2.0 x 2.8)
TDR-94/94D	3.86 (8.5)	28.0 W		85.0 x 124 x 353 (3.31 x 4.87 x 14.0) (1/2 ATR, short-low)
TRE-930	0.17 (0.38)	NA		84 x 44 x 133 (3.3 x 1.7 x 5.24)
TSS-4100	7.55 (16.6)	85 W	120 W	194 x 129 x 382 (7.64 x 5.08 x 15.0)

Table D-4. ANT-42 Environmental Qualification Form.

CONDITIONS	DO-160A SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
Temperature and Altitude	4.0	Category E1
- Temperature		
- Low Operating Temperature		–55 °C (+5 °F)
- High Operating Temperature		+70 °C (+158 °F)
- Low Storage Temperature		–55 °C (-67 °F)
- High Storage Temperature		+85 °C (+185 °F)
- Altitude		E1
Temperature Variation	5.0	B
Humidity	6.0	J
Shock	7.0	L
- Operational		
- Crash Safety		
Vibration	8.0	Y
Explosion	9.0	X
Waterproofness	10.0	R
Fluids Susceptibility	11.0	H
Sand and Dust	12.0	X
Fungus	13.0	X
Salt Spray	14.0	X
Magnetic Effect	15.0	X
Power Input	16.0	X
Voltage Spike Conducted	17.0	X
Audio Frequency Conducted Susceptibility	18.0	X
Induced Signal Susceptibility	19.0	X
Radio Frequency Susceptibility	20.0	X

Table D-5. ECU-3000 Environmental Qualification Form.

CONDITIONS	DO-160E SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
Temperature and Altitude	4.0	(F2)(A2)V
- Temperature		
- Low Operating Temperature		F2 –55 °C (–67 °F)
- High Operating Temperature		F2 +70 °C (+158 °F)
- Low Storage Temperature		F2 –55 °C (–67 °F)
- High Storage Temperature		F2 +85 °C (+185 °F)
- High (Short Time) Operating Temperature		F2 +70 °C (+158 °F)
- Altitude		F2 16 800 m (55 000 ft)
- In-Flight Loss of Cooling		V
- Decompression		A2
- Over pressure		A2
Temperature Variation	5.0	A
Humidity	6.0	B
Shock	7.0	B
- Operational		Tested at 6 g peak
- Crash Safety		Tested at 20 g peak
Vibration	8.0	Equipment Tested to Cat R curves BB1, Cat S curves CLM and Cat H curve R
Explosion Proofness	9.0	E
Waterproofness	10.0	Y
Fluids Susceptibility	11.0	X
Sand and Dust	12.0	X
Fungus Resistance	13.0	X
Salt Spray	14.0	X
Magnetic Effect	15.0	Z
Power Input	16.0	AB
Voltage Spike	17.0	A
Audio Frequency Conducted Susceptibility	18.0	Z
Induced Signal Susceptibility	19.0	CC
Radio Frequency Susceptibility	20.0	RR
Emission of Radio Frequency Energy	21.0	M
Lightning Induced Transient Susceptibility	22.0	X
Lightning Direct Effects	23.0	X
Icing	24.0	A
Electrostatic Discharge	25.0	A

Table D-5. ECU-3000 Environmental Qualification Form. - Continued

CONDITIONS	DO-160E SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
Fire/Flammability	26.0	X

NOTE

The ECU-3000 Power Input is tested to the worst case of categories A, B, and Z with the exception of the 1 second power interruption test required for category Z.

Table D-6. TDR-94D Environmental Qualification Form.

CONDITIONS	DO-160E SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
Temperature and Altitude	4.0	A2 and E1
- Temperature		
- Low Operating Temperature		–55 °C (–67 °F)
- High Operating Temperature		+70 °C (+158 °F)
- Low Storage Temperature		–55 °C (–67 °F)
- High Storage Temperature		+85 °C (+185 °F)
- Altitude		21 300 m (70 000 ft)
- In-Flight Loss of Cooling		- (Not applicable)
Temperature Variation	5.0	B
Humidity	6.0	B
Shock	7.0	A
- Operational		Tested at 6 g peak
- Crash Safety		Tested at 15 g (11 ms duration)
Vibration	8.0	Equipment Tested to Cat S, curves CLM
Explosion	9.0	E
Waterproofness	10.0	X
Fluids Susceptibility	11.0	X
Sand and Dust	12.0	X
Fungus	13.0	F
Salt Spray	14.0	X
Magnetic Effect	15.0	Z
Power Input	16.0	Z
Voltage Spike Conducted	17.0	A
Audio Frequency Conducted Susceptibility	18.0	Z
Induced Signal Susceptibility	19.0	ZC
Radio Frequency Susceptibility	20.0	RR
Radio Frequency Emission	21.0	M
Lightning Induced Transient Susceptibility	22.0	A3Z3X
Lightning Direct Effects	23.0	X
Icing	24.0	X
Electrostatic Discharge	25.0	A
Flammability	26.0	X
Electrical	NA	
		Primary Power 28 V DC, 28 W nominal, 100 W max
Receive Frequency	NA	

Table D-6. TDR-94D Environmental Qualification Form. - Continued

CONDITIONS	DO-160E SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
		1030 ±0.2 MHz from ATCRBS interrogators 1030 ±0.01 MHz from Mode-S interrogators
Transmit Frequency	NA	1090 ± 1 MHz
Transmit Peak Power	NA	min 250 W, max 625 W

Table D-7. TSA-4100 Environmental Qualification Form.

CONDITIONS	DO-160E SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
Temperature and Altitude	4.0	(D2)(F2)X
- Temperature		
- Low Short Time Operating Temperature		D2
- Low Operating Temperature		D2
- High Short Time Operating Temperature		D2
- High Operating Temperature		D2
- Altitude		F2
Temperature Variation	5.0	A
Humidity	6.0	B
Shock	7.0	B
Vibration	8.0	Equipment Tested to Cat R curves CC1, Cat H curve R and Cat S curves LM (RCC1)(HR)(SLM)
Explosion	9.0	X
Waterproofness	10.0	S
Fluids Susceptibility	11.0	F
Sand and Dust	12.0	D
Fungus	13.0	F
Salt Spray	14.0	S
Magnetic Effect	15.0	Z
Power Input	16.0	X
Voltage Spike Conducted	17.0	X
Audio Frequency Conducted Susceptibility	18.0	X
Induced Signal Susceptibility	19.0	CW
Radio Frequency Susceptibility	20.0	RR
Radio Frequency Emission	21.0	H
Lightning Induced Transient Susceptibility	22.0	(XX)(K4)4
Lightning Direct Effects	23.0	1A
Icing	24.0	A
Electrostatic Discharge	25.0	A
Fire/Flammability	26.0	X
DC Input Resistance:	NA	
NOTE These values are used by the TSS-4100 during initialization to verify proper antenna connections		J1 to ground - 1.2 MΩ J2 to ground - 680 kΩ J3 to ground - 390 kΩ J4 to ground - 220 kΩ

Table D-8. TSS-4100 Environmental Qualification Form.

CONDITIONS	DO-160E SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
Temperature and Altitude	4.0	[(F2)(A2)V]
- Temperature		
- Low Temperature Storage		F2
- High Temperature Operation		F2
- High Temperature Storage		F2
- Low Temperature Operation		F2
- In-Flight Loss of Cooling		V
- Altitude		F2
- Decompression		A2
- Overpressure		A2
Temperature Variation	5.0	A
Humidity	6.0	B
Shock	7.0	B
- Operational		
- Crash Safety		
Vibration	8.0	Equipment Tested to Cat R curves BB1, Cat S curves CLM and Cat H curve R
Explosion	9.0	E
Waterproofness	10.0	Y
Fluids Susceptibility	11.0	X
Sand and Dust	12.0	X
Fungus	13.0	X
Salt Spray	14.0	X
Magnetic Effect	15.0	Z
Power Input	16.0	AB
Voltage Spike Conducted	17.0	A
Audio Frequency Conducted Susceptibility	18.0	Z
Induced Signal Susceptibility	19.0	CC
Radio Frequency Susceptibility	20.0	RR
Radio Frequency Emission	21.0	M
Lightning Induced Transient Susceptibility	22.0	(B3)(K3)3
Lightning Direct Effects	23.0	X
Icing	24.0	A
Electrostatic Discharge	25.0	A
Fire/Flammability	26.0	X
TCAS RF Characteristics	NA	

Table D-8. TSS-4100 Environmental Qualification Form. - Continued

CONDITIONS	DO-160E SECTION AND REV	EQUIPMENT QUALIFICATIONS CATEGORIES OF CONDUCTED TESTS
		Transmit Frequency 1030 ± 0.01 MHz Receive Frequency 1090 ± 3 MHz Sensitivity 75 ± 1 dBm
XPDR RF Characteristics	NA	Receive Frequency (XPDR) 1030 ± 0.2 MHz Transmit Frequency 1090 ± 1 MHz Transmit Peak Power min 125 W, max 500 W Sensitivity 74 ± 3 dBm
Electrical	NA	Primary Power 28 V DC, 85 W nominal, 120 W max Inrush current – 40 amps max 1.875 microhenry inductor

NOTE

The TSS-4100 has been tested to the highest level of power input testing of Category A, B, and Z – with the exception of a one second power interrupt test required for Category Z.

The TSS-4100 has undergone flammability testing/ analysis that meets Rockwell Collins standard CS-ENG-M-122: Flammability, Toxicity, and Smoke Density Analysis Method.

APPENDIX E
Interconnect Diagram

E.1. INTRODUCTION.

This appendix contains the interconnect wiring diagram. Refer to Figure E-1.

E.2. CABLING INSTRUCTIONS.

WARNING

Make sure the aircraft battery master switch is turned off before installing any interconnect cabling.

NOTE

Figure E-1 shows a possible interconnect between the TSS-4100 and various altitude and control sources. Because various part numbers of the TSS-4100 provide different strapping options this information is for reference only.

The Traffic Surveillance System (TSS) interconnect diagram is shown in Figure E-1. All installations follow this general configuration pattern. Various options offer the installer a wide choice of configurations for new and retrofit installations. Use the generic interconnect diagram to help locate specific interconnect data. Each functional area, shown in bold type, is complete only with respect to TSS interface data for that particular function. That is, for peripheral systems, for example the air data system or radio altimeter system, interconnect data to non-TSS related equipment is not provided here. In those cases, you must refer to other appropriate documentation. Most of the application groupings are also shown in bold type. Subordinate application groupings are shown in normal type.

During preparation of the interconnect cables, observe the precautions that follow:

a. Read all notes on drawings and interconnect diagrams prior to fabricating interconnect wiring cables.

b. Bond and shield all parts of the aircraft electrical system, such as generator and ignition systems.

c. Keep the interconnect cables away from circuits carrying heavy current, pulse transmitting equipment, and other sources of information.

d. Make all external connections of the equipment through the designated connectors listed on the outline and mounting diagrams.

e. For balanced connections, use twisted-pair shielded wiring for minimum pickup of electrostatic and magnetic fields. Avoid long runs of wire and keep input and output circuits separated as much as possible.

f. All interconnect wires and cables should be marked in accordance with the Aircraft Electronics Association Wire Marking Standard.

g. Avoid excessive cable lengths, but allow sufficient slack for movements due to vibration.

h. After installation of the cables in the aircraft, and before installation of the equipment, check to make sure that aircraft power is applied to the pins specified on the interconnect diagrams and that all other wires and shields are properly terminated.

E.3. GROUNDING AND HIRF GUIDELINES.

The notes on the system interconnect wiring diagram (refer to Figure E-1, sheet 1) describe the recommended methods and techniques for reducing the hazards of High Intensity Radiated Field (HIRF). These are general recommendations that apply to wiring modification/repair as well as to new installations. It shows the preferred method for grounding the shields of shielded wires.

E.4. SYSTEM INTERCONNECT DIAGRAM.

Figure E-1 is the TSS interconnect wiring diagram in a consolidated format. The interconnect information for the TSS-4100 is also provided in the individual simplified Line Replaceable Unit (LRU) schematic diagrams in Chapter 2.

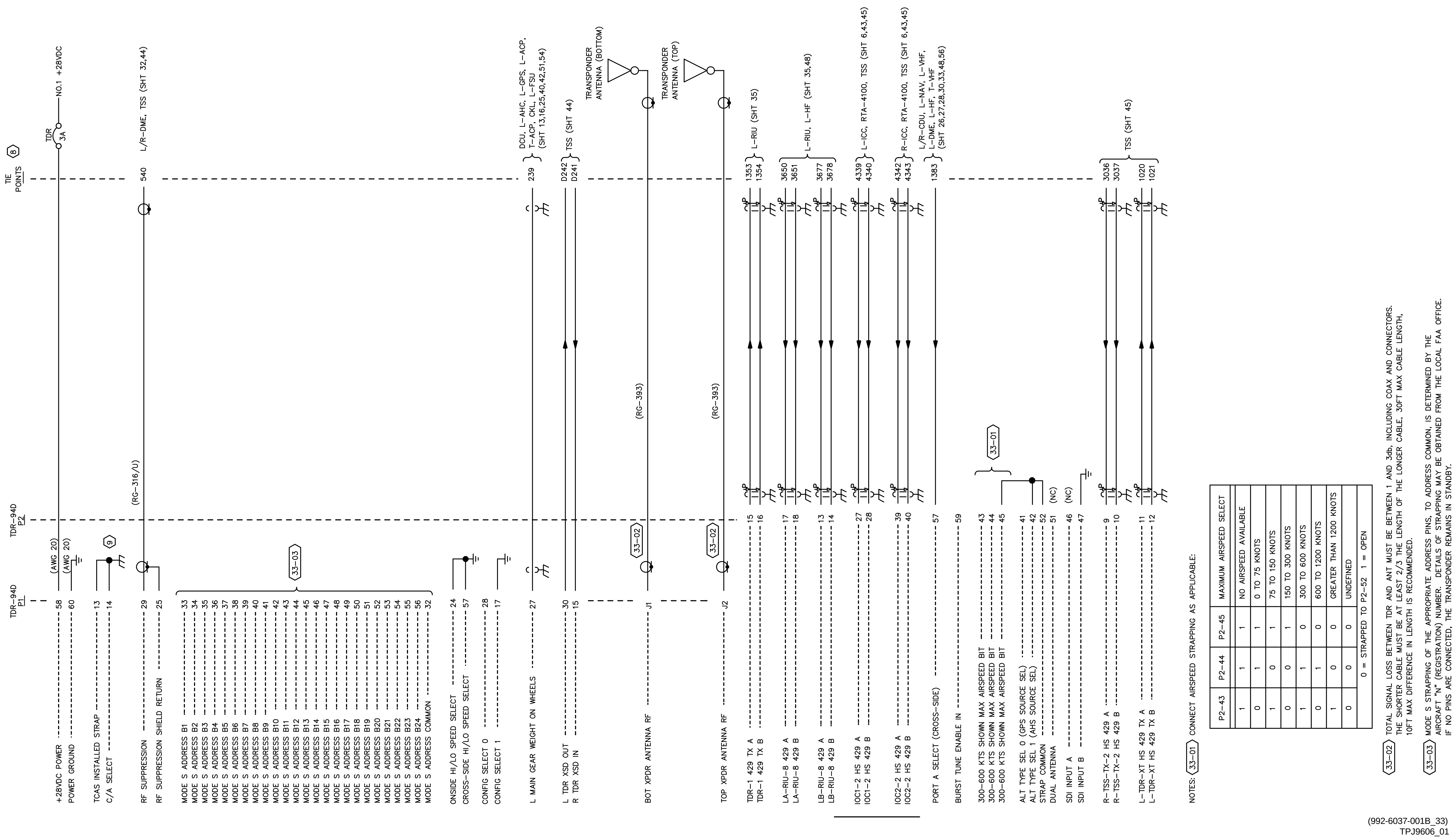


Figure E-1. Traffic Surveillance System, Interconnect Wiring Diagram (Sheet 1 of 3)

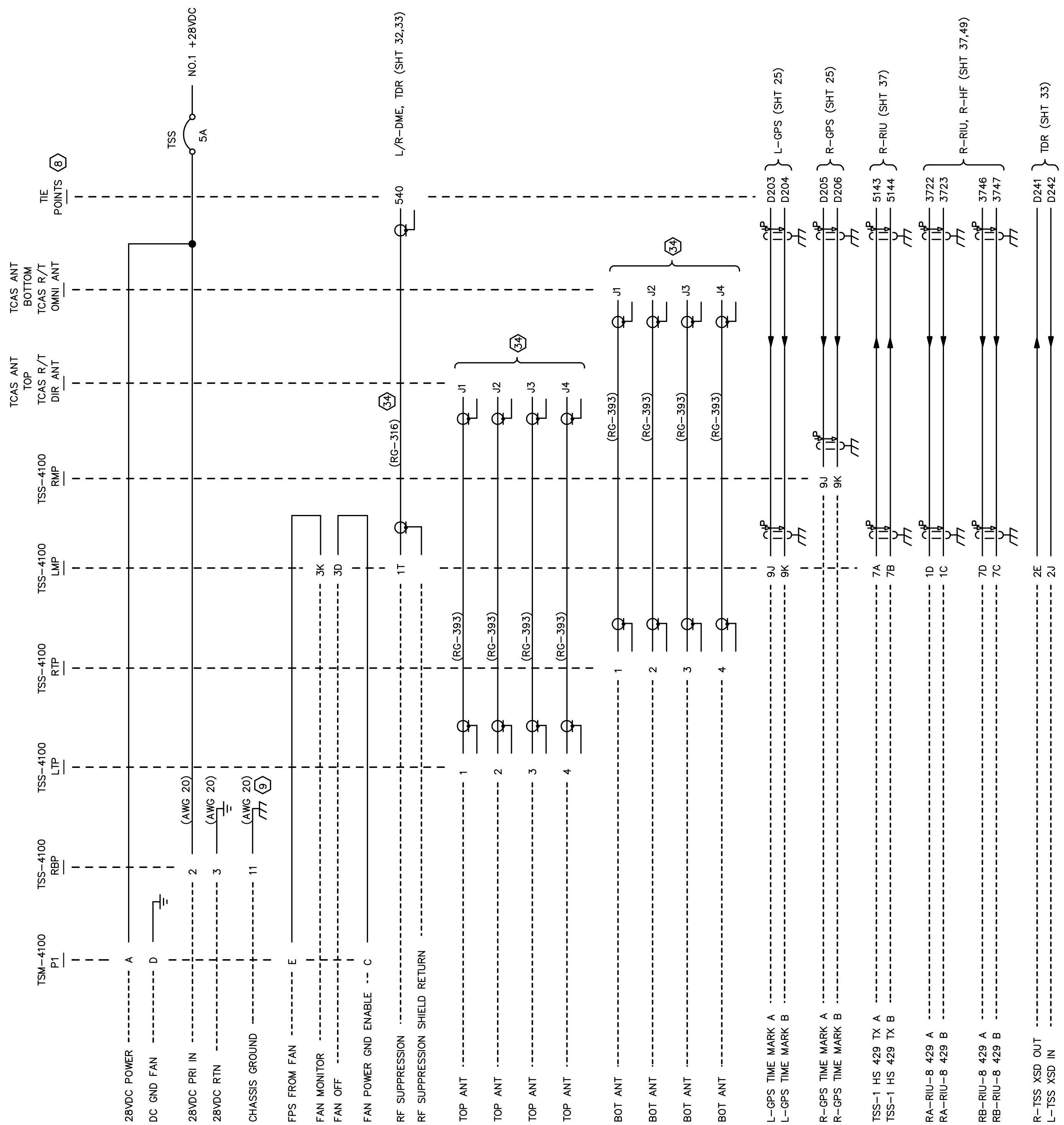


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Figure E-1. Traffic Surveillance System, Interconnect Wiring Diagram (Sheet 2 of 3)

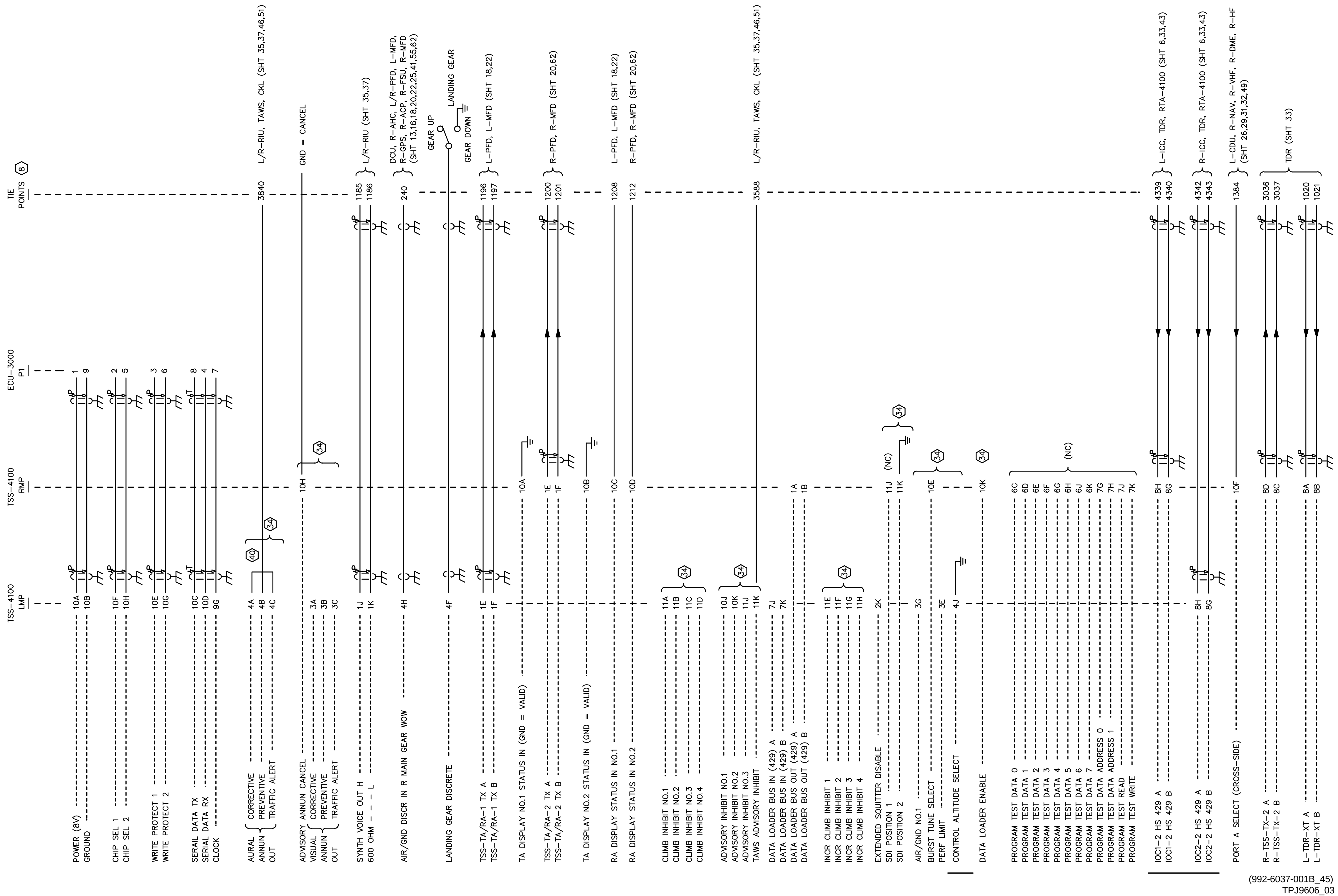

Figure E-1. Traffic Surveillance System, Interconnect Wiring Diagram (Sheet 3 of 3)

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