Honeywell International Inc.
15001 N.E. 36 Street
Redmond, Washington 98052-5317
U.S.A.
CAGE: 97896
Telephone: (800) 601-3099 (Toll Free U.S.A./Canada)
Telephone: (602) 365-3099 (International Direct)
Telephone: 00-800-601-30999 (EMEA Toll Free)
Telephone: 420-234-625-500 (EMEA Direct)
Web site: www.myaerospace.com

Maintenance Manual

RTA-50D VHF Data Radio System

Part Number	CAGE
965-1696-021	97896
965-1696-051	97896

Legal Notice

Export Control

This document contains technical data and is subject to U.S. export regulations. These commodities, technology, or software were exported from the United States in accordance with the export administration regulations. Diversion contrary to U.S. law is prohibited.
ECCN: 7E994, NLR Eligible.

Publication Number D201010000047, Revision 0

Proprietary Information

Honeywell - Confidential

Honeywell Materials License Agreement

The documents and information contained herein ("the Materials") are the proprietary data of Honeywell International Inc. and Honeywell Intellectual Properties Inc. (collectively "Honeywell"). These Materials are provided for the exclusive use of Honeywell Service Centers; Honeywell-authorized repair facilities; operators of Honeywell aerospace products subject to an applicable product support agreement, their wholly owned-subsidiaries or a formally designated third party service provider; and direct recipients of Materials from Honeywell's Aerospace Technical Publication Distribution. The terms and conditions of this License Agreement govern your use of these Materials, except to the extent that any terms and conditions of another applicable agreement with Honeywell regarding the operation, maintenance, or repair of Honeywell aerospace products conflict with the terms and conditions of this License Agreement, in which case the terms and conditions of the other agreement will govern. However, this License Agreement will govern in the event of a conflict between its terms and conditions and those of a purchase order or acknowledgement.

1. License Grant - If you are a party to an applicable product support agreement, a Honeywell Service Center agreement, or an authorized repair facility agreement, Honeywell hereby grants you a limited, non-exclusive license to use these Materials to operate, maintain, or repair Honeywell aerospace products only in accordance with that agreement.

If you are a direct recipient of these Materials from Honeywell's Aerospace Technical Publication Distribution and are not a party to an agreement related to the operation, maintenance or repair of Honeywell aerospace products, Honeywell hereby grants you a limited, non-exclusive license to use these Materials to maintain or repair the subject Honeywell aerospace products only at the facility to which these Materials have been shipped ("the Licensed Facility"). Transfer of the Materials to another facility owned by you is permitted only if the original Licensed Facility retains no copies of the Materials and you provide prior written notice to Honeywell.

2. Rights In Materials - Honeywell retains all rights in these Materials and in any copies thereof that are not expressly granted to you, including all rights in patents, copyrights, trademarks, and trade secrets. No license to use any Honeywell trademarks or patents is granted under this License Agreement.

3. Confidentiality - You acknowledge that these Materials contain information that is confidential and proprietary to Honeywell. You agree to take all reasonable efforts to maintain the confidentiality of these Materials.

4. Assignment And Transfer - This License Agreement may be assigned to a formally designated service designee or transferred to a subsequent owner or operator of an aircraft containing the subject Honeywell aerospace products. However, the recipient of any such assignment or transfer must assume all of your obligations under this License Agreement. No assignment or transfer shall relieve any party of any obligation that such party then has hereunder.

5. Copies of Materials - Unless you have the express written permission of Honeywell, you may not make or permit making of copies of the Materials. Notwithstanding the foregoing, you may make copies of only portions of the Material for your internal use. You agree to return the Materials and any copies thereof to Honeywell upon the request of Honeywell.

6. Term - This License Agreement is effective until terminated as set forth herein. This License Agreement will terminate immediately, without notice from Honeywell, if you fail to comply with any provision of this License Agreement or will terminate simultaneously with the termination or expiration of your applicable product support agreement, authorized repair facility agreement, or your formal designation as a third party service provider. Upon termination of this License Agreement, you will return these Materials to Honeywell without retaining any copies and will have one of your authorized officers certify that all Materials have been returned with no copies retained.

7. Remedies - Honeywell reserves the right to pursue all available remedies and damages resulting from a breach of this License Agreement.

8. Limitation of Liability - Honeywell does not make any representation regarding the use or sufficiency of the Materials. THERE ARE NO OTHER WARRANTIES, WHETHER WRITTEN OR ORAL, EXPRESS, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, (i) WARRANTIES ARISING FROM COURSE OF PERFORMANCE, DEALING, USAGE, OR TRADE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED, OR (ii) WARRANTIES AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF THIRD PARTIES, EVEN IF HONEYWELL HAS BEEN ADVISED OF ANY SUCH INFRINGEMENT. IN NO EVENT WILL HONEYWELL BE LIABLE FOR ANY INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES, SPECIAL DAMAGES, INDIRECT DAMAGES, LOSS OF PROFITS, LOSS OF REVENUES, OR LOSS OF USE, EVEN IF INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. TO THE EXTENT PERMITTED BY APPLICABLE LAW, THESE LIMITATIONS AND EXCLUSIONS WILL APPLY REGARDLESS OF WHETHER LIABILITY ARISES FROM BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING BUT NOT LIMITED TO NEGLIGENCE), BY OPERATION OF LAW, OR OTHERWISE.

9. Controlling Law - This License shall be governed and construed in accordance with the laws of the State of New York without regard to the conflicts of laws provisions thereof. This license sets forth the entire agreement between you and Honeywell and may only be modified by a writing duly executed by the duly authorized representatives of the parties.

Safety Advisory

WARNING: BEFORE THE MATERIALS CALLED OUT IN THIS PUBLICATION ARE USED, KNOW THE HANDLING, STORAGE AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO OBEY THE MANUFACTURERS’ OR SUPPLIERS’ RECOMMENDATIONS CAN RESULT IN PERSONAL INJURY OR DISEASE.

This publication describes physical and chemical processes which can make it necessary to use chemicals, solvents, paints, and other commercially available materials. The user of this publication must get the Material Safety Data Sheets (OSHA Form 174 or equivalent) from the manufacturers or suppliers of the materials to be used. The user must know the manufacturer/supplier data and obey the procedures, recommendations, warnings and cautions set forth for the safe use, handling, storage, and disposal of the materials.

Warranty/Liability Advisory

WARNING: HONEYWELL ASSUMES NO RESPONSIBILITY FOR ANY HONEYWELL EQUIPMENT WHICH IS NOT MAINTAINED AND/OR REPAIRED IN ACCORDANCE WITH HONEYWELL’S PUBLISHED INSTRUCTIONS AND/OR HONEYWELL’S FAA/SFAR 36 REPAIR AUTHORIZATION. NEITHER DOES HONEYWELL ASSUME RESPONSIBILITY FOR SPECIAL TOOLS AND TEST EQUIPMENT FABRICATED BY COMPANIES OTHER THAN HONEYWELL.

WARNING: INCORRECTLY REPAIRED COMPONENTS CAN AFFECT AIRWORTHINESS OR DECREASE THE LIFE OF THE COMPONENTS. INCORRECTLY FABRICATED SPECIAL TOOLING OR TEST EQUIPMENT CAN RESULT IN DAMAGE TO THE PRODUCT COMPONENTS OR GIVE UNSATISFACTORY RESULTS.

Copyright - Notice

TRANSMITTAL INFORMATION

THIS IS AN INITIAL RELEASE OF RTA-50D VHF DATA RADIO SYSTEM MM ATA NO. 23-20-59 AND IS ISSUED FOR USE IN SUPPORT OF THE FOLLOWING:

Table TI-1. Applicable Components

Component PN	Nomenclature
965-1696-021	RTA-50D VHF Data Radio System
965-1696-051	RTA-50D VHF Data Radio System

Revision History

Table TI-2 shows the revision history of this MM.

Table TI-2. Revision History

Revision Number	Revision Date
0	1 Mar 2011

Blank Page

RECORD OF REVISIONS

For each revision, write the revision number, revision date, date put in the manual, and your initials in the applicable column.

NOTE: Refer to the Revision History in the TRANSMITTAL INFORMATION section for revision data.

Revision Number	**Revision Date**	**Date Put in Manual**	**By**		**Revision Number**	**Revision Date**	**Date Put in Manual**	**By**

Blank Page

RECORD OF TEMPORARY REVISIONS

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

Definition of Status column: TR can be active, cancelled, or incorporated. If TR is incorporated, list the revision number. For example, enter: INC Rev 7. If TR is replaced by another TR, then put “Cancelled”. For example: Cancelled by TR NN-NN. “Active” is entered by the holder of manual.

Temporary Revision Number	Status	Page Number	Issue Date	Date Put in Manual	By	Date Removed from Manual	By

Blank Page

SERVICE BULLETIN LIST

Service Bulletin / Revision Number	Title	Modification	Date Put in Manual

Blank Page

LIST OF EFFECTIVE PAGES

Subheading and Page	Date
Title	
T-1	1 Mar 2011
T-2	1 Mar 2011
T-3	1 Mar 2011
T-4	1 Mar 2011
Transmittal Information	
TI-1	1 Mar 2011
TI-2	1 Mar 2011
Record of Revisions	
RR-1	1 Mar 2011
RR-2	1 Mar 2011
Record of Temporary Revisions	
RTR-1	1 Mar 2011
RTR-2	1 Mar 2011
Service Bulletin List	
SBL-1	1 Mar 2011
SBL-2	1 Mar 2011
List of Effective Pages	
LEP-1	1 Mar 2011
LEP-2	1 Mar 2011
Table of Contents	
TC-1	1 Mar 2011
TC-2	1 Mar 2011
TC-3	1 Mar 2011
TC-4	1 Mar 2011
TC-5	1 Mar 2011
TC-6	1 Mar 2011
Introduction	
INTRO-1	1 Mar 2011
INTRO-2	1 Mar 2011
INTRO-3	1 Mar 2011
INTRO-4	1 Mar 2011
INTRO-5	1 Mar 2011
INTRO-6	1 Mar 2011
INTRO-7	1 Mar 2011
INTRO-8	1 Mar 2011
INTRO-9	1 Mar 2011
INTRO-10	1 Mar 2011
INTRO-11	1 Mar 2011
INTRO-12	1 Mar 2011
INTRO-13	1 Mar 2011
INTRO-14	1 Mar 2011
INTRO-15	1 Mar 2011
INTRO-16	1 Mar 2011
INTRO-17	1 Mar 2011
INTRO-18	1 Mar 2011
INTRO-19	1 Mar 2011
INTRO-20	1 Mar 2011
Description and Operation	
1	1 Mar 2011
2	1 Mar 2011
3	1 Mar 2011
4	1 Mar 2011
5	1 Mar 2011
6	1 Mar 2011
7	1 Mar 2011
8	1 Mar 2011
9	1 Mar 2011
10	1 Mar 2011
11	1 Mar 2011
12	1 Mar 2011
13	1 Mar 2011
14	1 Mar 2011
15	1 Mar 2011
16	1 Mar 2011
17	1 Mar 2011
18	1 Mar 2011
19	1 Mar 2011
20	1 Mar 2011
F 21/22	1 Mar 2011
F 23/24	1 Mar 2011
25	1 Mar 2011
26	1 Mar 2011
F 27/28	1 Mar 2011

*	indicates pages changed or added data
F	indicates a right foldout
LF	indicates a left foldout

LIST OF EFFECTIVE PAGES (Cont)

	Subheading and Page	Date
	29	1 Mar 2011
	30	1 Mar 2011
F	31/32	1 Mar 2011
	33	1 Mar 2011
	34	1 Mar 2011
	35	1 Mar 2011
	36	1 Mar 2011
	37	1 Mar 2011
	38	1 Mar 2011
F	39/40	1 Mar 2011
	41	1 Mar 2011
	42	1 Mar 2011
	43	1 Mar 2011
	44	1 Mar 2011
	45	1 Mar 2011
	46	1 Mar 2011
	Fault Isolation	
	1001	1 Mar 2011
	1002	1 Mar 2011
	1003	1 Mar 2011
	1004	1 Mar 2011
	1005	1 Mar 2011
	1006	1 Mar 2011
	Maintenance Practices	
	2001	1 Mar 2011
	2002	1 Mar 2011
	2003	1 Mar 2011
	2004	1 Mar 2011
	2005	1 Mar 2011
	2006	1 Mar 2011
	2007	1 Mar 2011
	2008	1 Mar 2011
	2009	1 Mar 2011
	2010	1 Mar 2011
	2011	1 Mar 2011
	2012	1 Mar 2011
F	2013/2014	1 Mar 2011
F	2015/2016	1 Mar 2011
F	2017/2018	1 Mar 2011
F	2019/2020	1 Mar 2011

---

* indicates pages changed or added data
F indicates a right foldout
LF indicates a left foldout

TABLE OF CONTENTS

LIST OF SECTIONS

TABLE OF CONTENTS (Cont)

LIST OF SECTIONS (Cont)

TABLE OF CONTENTS (Cont)

LIST OF SECTIONS (Cont)

Blank Page

TABLE OF CONTENTS (Cont)

LIST OF FIGURES

TABLE OF CONTENTS (Cont)

LIST OF TABLES

INTRODUCTION

1. How to Use This Manual (TASK 23-20-59-99F-801-A01)

A. General (Subtask 23-20-59-99F-001-A01)

(1) This publication gives maintenance instructions for the equipment shown on the Title page.

(2) Standard maintenance procedures that technicians must know are not given in this manual.

(3) This publication is written in agreement with the ATA Specification.

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

- A WARNING gives a condition or tells personnel what part of an operation or maintenance procedure, which if not obeyed, can cause injury or death
- A CAUTION gives a condition or tells personnel what part of an operation or maintenance procedure, which if not obeyed, can cause damage to the equipment
- A NOTE gives data, not commands. The NOTE helps personnel when they do the related instruction.

(5) Warnings and cautions go before the applicable paragraph or step. Notes follow the applicable paragraph or step.

B. Observance of Manual Instructions (Subtask 23-20-59-99F-002-A01)

(1) The procedures used must be consistent with standard shop practices and be carefully examined to make sure that all safety, efficiency, and operation procedures of the unit are obeyed.

(2) All personnel who operate equipment and do maintenance specified in this manual must know and obey the safety precautions.

C. Symbols (Subtask 23-20-59-99F-003-A01)

(1) The symbols and special characters are in agreement with IEEE Publication 260 and IEC Publication 27. Special characters in text are spelled out.

(2) The signal mnemonics, unit control designators, and test designators are shown in capital letters.

(3) The signal names followed by an “*” show an active low signal.

(4) Some figures in this manual incorporate standard geometric characteristic symbols. Refer to Figure INTRO-1 for the geometric characteristic symbols.

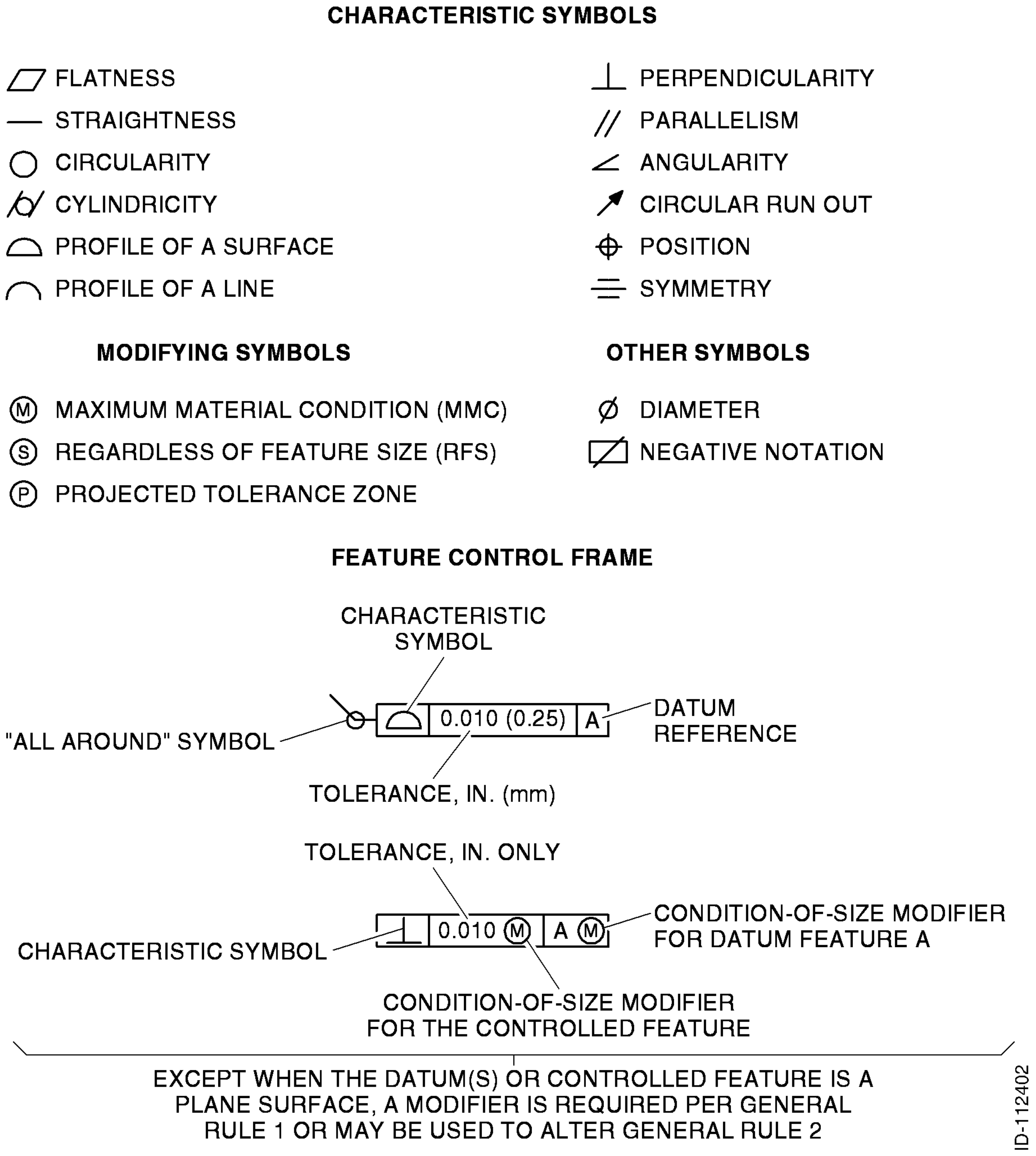
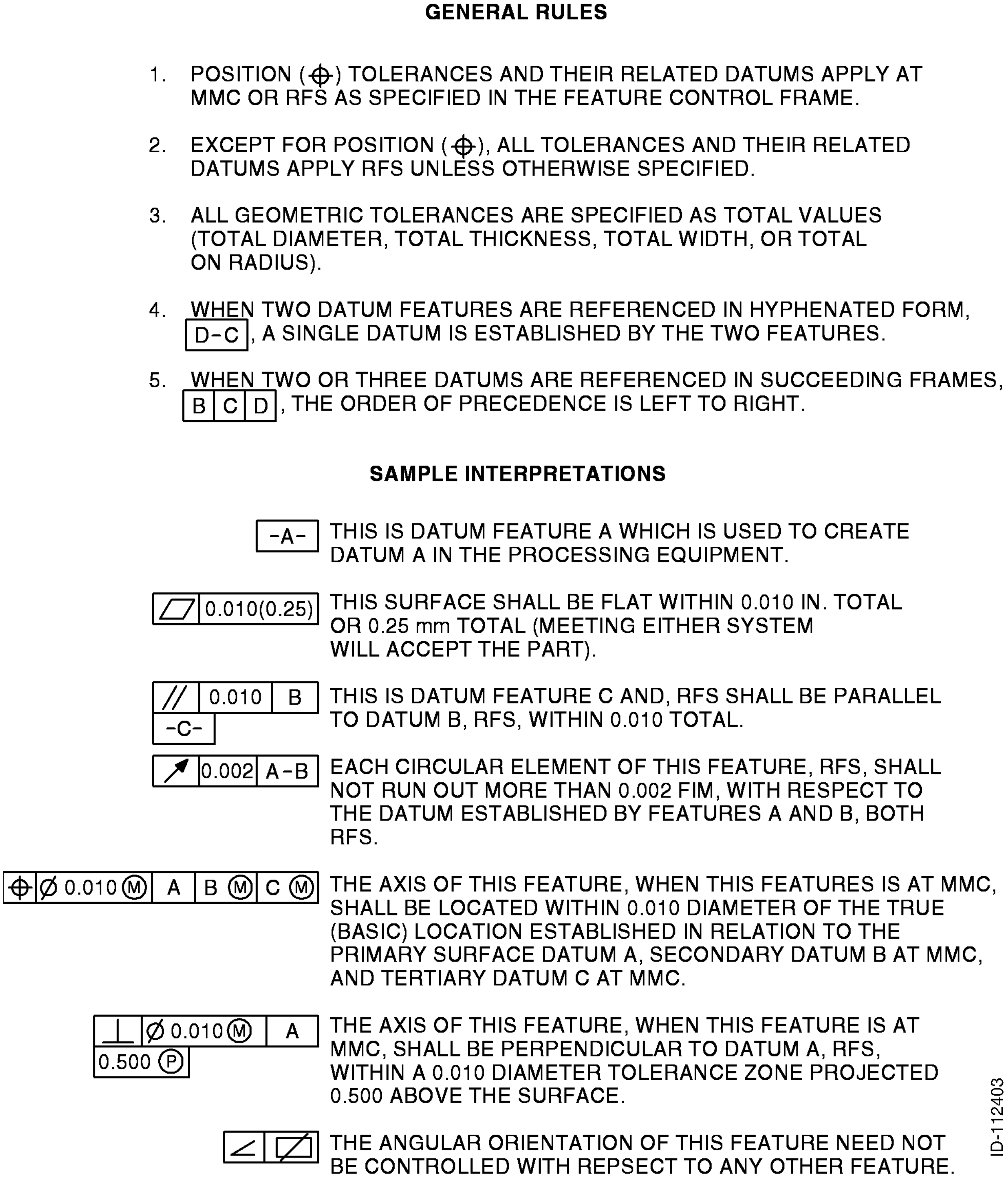


Figure INTRO-1. (Sheet 1 of 2) Geometric Tolerance Symbols (GRAPHIC 23-20-59-99B-801-A01)



GENERAL RULES

1. POSITION (⌖) TOLERANCES AND THEIR RELATED DATUMS APPLY AT MMC OR RFS AS SPECIFIED IN THE FEATURE CONTROL FRAME.
2. EXCEPT FOR POSITION (⌖), ALL TOLERANCES AND THEIR RELATED DATUMS APPLY RFS UNLESS OTHERWISE SPECIFIED.
3. ALL GEOMETRIC TOLERANCES ARE SPECIFIED AS TOTAL VALUES (TOTAL DIAMETER, TOTAL THICKNESS, TOTAL WIDTH, OR TOTAL ON RADIUS).
4. WHEN TWO DATUM FEATURES ARE REFERENCED IN HYPHENATED FORM, D-C, A SINGLE DATUM IS ESTABLISHED BY THE TWO FEATURES.
5. WHEN TWO OR THREE DATUMS ARE REFERENCED IN SUCCEEDING FRAMES, B | C | D, THE ORDER OF PRECEDENCE IS LEFT TO RIGHT.

SAMPLE INTERPRETATIONS

-A-	THIS IS DATUM FEATURE A WHICH IS USED TO CREATE DATUM A IN THE PROCESSING EQUIPMENT.
▱ | 0.010(0.25)	THIS SURFACE SHALL BE FLAT WITHIN 0.010 IN. TOTAL OR 0.25 mm TOTAL (MEETING EITHER SYSTEM WILL ACCEPT THE PART).
// | 0.010 | B -C-	THIS IS DATUM FEATURE C AND, RFS SHALL BE PARALLEL TO DATUM B, RFS, WITHIN 0.010 TOTAL.
↗ | 0.002 | A-B	EACH CIRCULAR ELEMENT OF THIS FEATURE, RFS, SHALL NOT RUN OUT MORE THAN 0.002 FIM, WITH RESPECT TO THE DATUM ESTABLISHED BY FEATURES A AND B, BOTH RFS.
⌖ | ⌀ 0.010 Ⓜ | A | B Ⓜ | C Ⓜ	THE AXIS OF THIS FEATURE, WHEN THIS FEATURES IS AT MMC, SHALL BE LOCATED WITHIN 0.010 DIAMETER OF THE TRUE (BASIC) LOCATION ESTABLISHED IN RELATION TO THE PRIMARY SURFACE DATUM A, SECONDARY DATUM B AT MMC, AND TERTIARY DATUM C AT MMC.
⊥ | ⌀ 0.010 Ⓜ | A 0.500 Ⓟ	THE AXIS OF THIS FEATURE, WHEN THIS FEATURE IS AT MMC, SHALL BE PERPENDICULAR TO DATUM A, RFS, WITHIN A 0.010 DIAMETER TOLERANCE ZONE PROJECTED 0.500 ABOVE THE SURFACE.
∠ | ▱	THE ANGULAR ORIENTATION OF THIS FEATURE NEED NOT BE CONTROLLED WITH REPSECT TO ANY OTHER FEATURE.

Figure INTRO-1. (Sheet 2 of 2) Geometric Tolerance Symbols (GRAPHIC 23-20-59-99B-801-A01)

(5) The symbols in Figure INTRO-2 show ESDS and moisture sensitive devices.

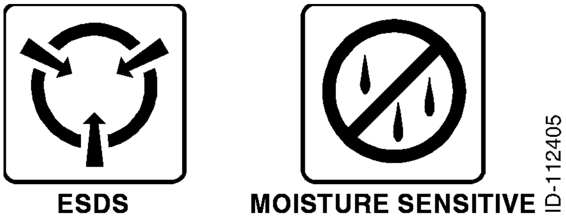


Figure INTRO-2. (Sheet 1 of 1) Symbols (GRAPHIC 23-20-59-99B-802-A01)

D. Units of Measure (Subtask 23-20-59-99F-004-A01)

(1) Measurements, weights, temperatures, dimensions, and other values are expressed in the USMS followed by the appropriate SI metric units in parentheses. Some standard tools or parts such as drills, taps, bolts, nuts, etc., do not have an equivalent.

E. Page Number Block Explanation (Subtask 23-20-59-99F-005-A01)

(1) The data in this manual is divided into sections. A standard page number block system is used. Page number blocks are shown in Table INTRO-1.

Table INTRO-1. Page Number Blocks

Section	Page Number Block
Description and Operation	1 thru 999
Fault Isolation	1001 thru 1999
Maintenance Practices	2001 thru 2999

F. Application of Maintenance Task Oriented Support System (MTOSS) (Subtask 23-20-59-99F-006-A01)

(1) In accordance with the ATA Specification 2200, this publication uses a Maintenance Task Numbering System which make the maintenance procedures in this manual compatible with an automated shop environment.

(2) The system uses standard and unique number combinations to identify maintenance tasks and subtasks.

(3) The MTOSS structure is the logical approach to organizing maintenance tasks and subtasks. The MTOSS numbering system includes the ATA Chapter-Section-Subject number as well as a function code and unique identifiers. The purpose of incorporating the MTOSS numbering system is to give a means for the automated sorting, retrieval, and management of digitized data.

(4) Section and Subsection Numbering System

(a) All procedures in this publication have TASK and SUBTASK numbers at key data retrieval points. The numbers give the following:

- Identification of the hardware (parts or parts) primary to the TASK
- Identification of the maintenance function applied to the part or parts
- A unique identifier for a set of instructions (known as TASK or SUBTASK)

- Identification of alternate methods and configuration differences that change the procedure applied to the TASK
- Identification of airline changes to a TASK or SUBTASK.

(5) Components of Task and Subtask Number

(a) The numbering system is an expansion of the ATA three-element numbering system. The number has seven elements. The first five elements are necessary for each TASK or SUBTASK. The sixth and seventh elements are applied only when necessary. Refer to Figure INTRO-3.

(b) Elements 1, 2, and 3 identify the ATA Chapter-Section-Subject number of the page block.

(c) Element 4 defines the maintenance function being performed. This element is a three position element. The third position is zero filled when further definition is not required. If required, the manufacturer will use the numbers 1 thru 9 or letters A thru Z, excluding the letters I and O. Refer to Table INTRO-2.

(d) Element 5 provides a unique identification for each TASK or SUBTASK number which is similarly numbered through the first four elements as follows:

- TASKS are numbered from 801 thru 999
- SUBTASKS are numbered from 001 thru 800.

(e) Element 6 is a three position alphanumeric element used for identification of differences in configurations, methods or techniques, variations of standard practice applications, etc.

(f) Element 7 provides coding of those tasks or subtasks that have been changed by the customer (e.g., those tasks or subtasks accomplished by an outside repair source).

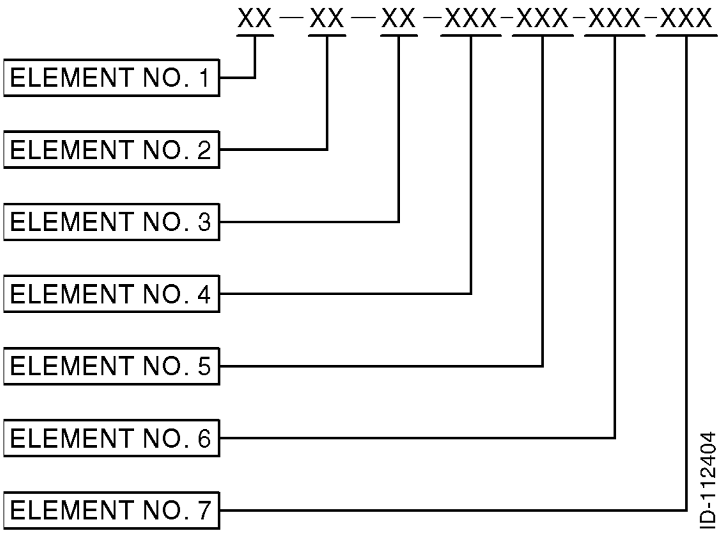


Figure INTRO-3. (Sheet 1 of 1) MTOSS Code Positions (GRAPHIC 23-20-59-99B-803-A01)

Table INTRO-2. MTOSS Function Code Definitions

Code	Function	Definition
000	REMOVAL AND DISASSEMBLY	

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
010	Removal	Removal of the engine/component from a workstand, transport dolly, test stand, etc., or aircraft.
020	Remove Modular Sections	This is the first echelon of disassembly which has sectionalization of the unit/engine into primary modular sections. Modular sections are identified by the third element of the ATA number when removed from the unit/engine.
030	Disassemble Modular Sections	This is the second echelon of disassembly which has disassembly of the modular sections into subassemblies after removal from the unit/engine. Modular section designations appear in the second element of the ATA number for this echelon of disassembly.
040	Disassemble Subassemblies	This is the third echelon of engine disassembly which has disassembly of subassemblies to the piece part level. The subassemblies are identified by the third element of the ATA number.
050	Remove Accessory/Power Plant Components	This has removing individual accessory/power plant components from either installed or uninstalled engines.
060	Disassemble Accessory	This involves disassembly of accessories /components into subassemblies.
070	Disassemble Accessory Subassembly	This involves disassembly of accessories /components subassemblies into piece parts.
080	Remove Test Equipment	This has removing equipment and instrumentation after accessory/component test.
090	Disassemble Support Equipment	This has disassembly of support equipment required to maintain said support equipment.
100	CLEANING	
110	Chemical	Removal of surface deposits from a part by use of a chemical cleaning agent. After being dissolved, the deposit is washed or rinsed away after a soaking period. Also includes chemical power flushing.
120	Abrasive	Removal of surface deposits from a part by wet or dry particle impingement.

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
130	Ultrasonic	Removal of surface deposits and entrapped material by use of high frequency sound waves to produce cavitation at the surface of the part. Cleaning is performed in a liquid bath that transmits the sound energy and keeps the removed material in suspension.
140	Mechanical	Removal of surface deposits from a part by use of a brush, felt bob, sandpaper, or other hand or mechanical action.
150	Unassigned	
160	Miscellaneous	Removal of deposits from parts with compressed air, miscellaneous hand cleaning, and various combinations of cleaning procedures.
170	Foam/Water Wash	Removal of post emulsified fluorescent penetrant through an agitated water wash, automatic spray rinse, or an aqueous remover aerated to produce a foam.
180	Testing of Solutions	Test used to assist in identifying certain materials by electro-mechanically determining the presence or absence of known constituents.
190	Unassigned	
200	INSPECTION	
210	Check	A thorough visual examination of components, accessories, subsystems, and piece parts to detect structural failure, deterioration or damage and to determine the need for corrective action. For example: exterior surfaces, electronic circuit cards, gears, control systems, linkages, accessories, components, tubing, wiring and connections, safety wiring, fasteners, clamps, etc., are inspected to verify correct condition and acceptability for continued service.

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
220	Visual/Dimensional	A comparison of the dimensions and material conditions of parts, subassemblies, and assemblies with the specifications contained in technical manuals and/or blueprints, to detect deviations from established standard and limits and determine the acceptability for continued service, repair, or need to discard the item. A visual/dimensional function code is also required to verify that correct corrective maintenance has been accomplished. Although some of these tasks do not require measurements, a complete spectrum of tasks/sub tasks requires a variety of measuring equipment to determine runout, concentricity, flatness, parallelism, hardness, thickness, clarity, dimensions, etc.
230	Penetrant	Fluorescent penetrant inspection to detect surface cracks.
240	Magnetic	Magnetic particle inspection to detect surface cracks in magnetic materials.
250	Eddy Current	Inspection for subsurface cracks, porosity, inclusions, or other nonhomogeneous material structure by use of high frequency electromagnetic wave equipment. Parts are scanned and compared to similar parts or test specimens having known material defects.
260	X-Ray	Inspection for subsurface cracks, porosity, inclusions, or other nonhomogeneous material structure by use of x-ray techniques.
270	Ultrasonic	Inspection for subsurface cracks, porosity, inclusions, or other nonhomogeneous material structure by use of contact pulse echo ultrasonic techniques.
280	Special	Any special inspection to determine the integrity of a part for continued operation In-Service or qualitative analysis.
290	Unassigned	
300	REPAIR	

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
310	Welding and Brazing	The joining of pieces by welding (fusion, resistance, spot, electron beam, plasma arc), brazing (furnace, torch, induction), or soldering. This category includes hard facing.
320	Machining	The process of obtaining a desired shape or finish by grinding, turning, boring, reaming, broaching, milling, drilling, lapping, honing, sizing, polishing, buffing, cutting, forming, stamping, blanking, etc.
330	Stripping and Plating	Removing or applying a metallic coating on a surface by mechanical, chemical, or electrical means. Plating of chromium, cadmium, tin, etc., to build up the size of a part or supply surface protection. Includes masking or waxing before the process.
340	Plasma and Flame Spraying	The application of a protective coating to a part by feeding a powder into an ionized gas stream. Flame spraying uses a fuel oxygen flame to melt and propel metal onto parts to build up the size or supply surface protection.
350	Miscellaneous Repairs	Repairing parts by hand (cutting, drilling, polishing, grinding, lapping, riveting, blending, routing, fitting, burring, planishing, sanding, sawing, recambering, drilling, tapping, heating, chilling) and including miscellaneous disassembly and assembly required.
360	Bonding and Molding/Sealing	Joining and curing of parts with an adhesive or fusible material (including silicone, fiberglass, glues).
370	Heat Treating	Controlled heating and cooling of a material to obtain the desired physical property (includes annealing, tempering, quenching, stress relieving, solution heat treat, etc.).
380	Surface Treating	Treating the surface of a part by painting, varnishing, aluminizing, Teflon coating, zinc chromate priming, tumble finishing, shot peening, etc. Baking and masking processes are included.
390	Machine Riveting and Flaring	Joining of parts by riveting and flaring the rivet.
400	INSTALLATION AND ASSEMBLY	

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
410	Install	Installation of the unit/engine onto a workstand, transport dolly, test stand, or aircraft.
420	Install Modular Sections	The third echelon of assembly consisting of assembly of the modular assemblies into a complete unit/engine assembly. The modular sections are identified by the third element of the ATA number.
430	Assemble Modular Sections	The second echelon of assembly consisting of assembling subassemblies into modular sections. The modular section is identified by the second element of the ATA number.
440	Assemble Subassemblies	The first echelon of assembly consisting of assembling piece parts into subassemblies. The subassemblies are identified by the third element of the ATA number.
450	Install/Close Items Removed/Opened for Access	Installation or closing of access plates, closing of ports, installation of components, tubing or any item which was removed or opened in order to supply access to do the task.
460	Assemble Accessory	Assemble accessory components.
470	Assemble Accessory Subassembly	Assembly of accessory subassembly components.
480	Install Test Equipment	Install equipment and instrumentation required for accessory component test.
490	Assemble Support Equipment	Any assembly required to maintain support equipment.
500	MATERIAL HANDLING	
510	Shipping	The movement of any part, subassembly, assembly, or component from the time it is packaged until it reaches its destination.
520	Receiving	The receipt activity for any incoming part, subassembly, assembly, or component.
530	Packing	Installing parts, subassemblies, assemblies, or components into shipping containers.
540	Unpacking	Removing parts, subassemblies, assemblies, or components from shipping containers.
550	Storage	Safekeeping of parts, subassemblies, assemblies, or components until required for use.

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
560	Marshaling/Positioning	Marshaling is collection of parts, subassemblies, and accessories before release for assembly. Positioning is movement from one fixed state to another.
570	Engine Ferry/Pod Maintenance	Necessary preparations before and after transporting an engine by aircraft ferry method.
580	Unassigned	
590	Unassigned	
600	SERVICING/PRESERVING/LUBRICATING	
610	Servicing	Action required to sustain a unit or system in correct operating status including priming with applicable fluids before use.
620	Preserving	Preparation of a unit, part, assembly, etc., for safekeeping from decomposition or deterioration. Includes preparation for storage (applying a preservative layer, desiccants, etc.).
630	Depreserving	Removing preservatives, desiccants, etc., from a unit, part, assembly, etc., before installation or operation.
640	Lubricating	Applying oil, grease, dry film, or silicon lubricants on moving parts to decrease friction or cool the item.
650	Unassigned	
660	Unassigned	
670	Unassigned	
680	Unassigned	
690	Unassigned	
700	TESTING/CHECKING	
710	Oil Flow	Measuring the flow of oil through components or compartments under specific conditions.
720	Air Flow	Measuring the flow of air through components or compartments under specific conditions.
730	Fuel Flow	Function checks and flow measurements through the part or system being tested.

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
740	Water Flow	Function checks and flow measurements through the part or system being tested.
750	Electrical/Return to Service	Functional tests (manual or ATE) of the system or component as well as measurement of electrical or electronic parameters designed to determine whether the item can be returned to service. May include fault isolation procedures for components that require close correlation between test results and fault indications.
760	Engine	Operation of an engine to establish systems function or operation under specific conditions to measure performance.
770	Accessory/Bite	Testing of an accessory to make sure of correct operation or function.
780	Pressure Check	Testing to establish the ability of a normally pressurized component or system to operate correctly.
790	Leak Check	Determine the ability of a component or system to operate without leaking.
800	MISCELLANEOUS	
810	Fault Isolation	Operation of an engine at constant thrust level or identical engine pressure ratio engine pressure ratio to locate the prime suspect deficient system operating an incorrectly functioning system or component to locate the cause; or performing a series of checks to isolate a failed part or component.
820	Adjusting/Aligning/Calibrating	Making a physical correction to make sure of correct placement or operation of a system or component.
830	Rigging	Hooking-up, arranging, or adjusting a component or accessory linkage for correct operation.
840	Service Bulletin Incorporation	Performing the work specified in the service bulletin. Provides for identification of modification tasks at the task level with subtasks recognizing any functional changes (chemical, visual/dimensional, cleaning, machining, etc.) necessary to incorporate the service bulletin.

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
850	Part Number Change/Re-identification	Change of part number, application of part number by transfer, engrave repair number, etc.
860	Unassigned	
870	Description and Operation	Electrical and mechanical description of the unit or component. Includes leading particulars, descriptions, limitations, specifications, and theory of operation.
880	Approved Vendor Processes	Includes processes that can be proprietary and controlled by a particular manufacturer, or by nonproprietary and approved for application by conforming vendors.
890	Airline Maintenance Program (Customer Use)	
900	Unassigned	
910	Special Equipment Maintenance	Identification of tasks to maintain special support equipment.
920	Standard Equipment Maintenance	Identification of tasks to maintain standard support equipment.
930	Tool Fabrication	Includes fabricating any tool for which procedures to use are included in the manual.
940	Special Tools, Equip, and Consumables Listing	Listing of all special tools, standard equipment, special equipment, and consumables required to do maintenance on the unit or component.
94A	Consumables	
94B	Special Tools/Non Std Tools	
94C	Fixtures/Test Equipment	
94D	Standard Tools	
950	Illustrated Parts List (Detailed Parts List)	Section of IPL/IPC that contains parts description and identification in top-down break down sequence.
960	Illustrated Parts List (Equipment Designation Index)	Section of IPL/IPC that contains equipment designators cross-referenced to detailed parts list.
970	Illustrated Parts List (Numerical Index)	Section of IPL/IPC that contains an alphanumeric listing of all parts in the unit cross-referenced to the detailed parts list.
980	Illustrated Parts List (Alternate Vendor Index)	Optional section of IPL/IPC that contains an alphanumeric listing of all parts in the unit that have more than one vendor source.

Table INTRO-2. MTOSS Function Code Definitions (Cont)

Code	Function	Definition
990	Illustrations, Tables, Front Matter, Etc.	
99A	Tables	
99B	Illustrations	
99C	Front Matter Pageblock (TASK Level MTOSS) Front Matter Task (Collection of Subtask MTOSS)	
99D	Access	
99E	References	
99F	General/Introduction	

G. **Standard Practices Manual** (Subtask 23-20-59-99F-007-A01)

(1) Standard cleaning, check, repair, and assembly procedures applicable to multiple models can be found in a standard practices manual. Refer to Paragraph 3 (TASK 23-20-59-99F-803-A01).

H. **Electrostatic Discharge** (Subtask 23-20-59-99F-008-A01)

(1) Touch the items susceptible to electrostatic discharge in accordance with MIL-HDBK-263. Refer to MIL-STD-1686 for definition of the standards and conditions.

2. Customer Support (TASK 23-20-59-99F-802-A01)

A. **Honeywell Aerospace Online Technical Publications Web Site** (Subtask 23-20-59-99F-009-A01)

(1) Go to the Honeywell Online Technical Publications Web site at (www.myaerospace.com).

- To download or see publications online
- To order a publication
- To tell Honeywell of a possible data error in a publication.

B. **Global Customer Care Center** (Subtask 23-20-59-99F-010-A01)

(1) If you do not have access to the Honeywell Technical Publications Web site, or if you need to speak to personnel about non-Technical Publication matters, the Honeywell Aerospace Global Customer Care Center gives 24/7 customer service to Air Transport & Regional, Business & General Aviation, and Defense & Space customers around the globe.

- Telephone: 800-601-3099 (Toll Free U.S.A./Canada)
- Telephone: 602-365-3099 (International)
- Telephone: 00-800-601-30999 (EMEA Toll Free)
- Telephone: 420-234-625-500 (EMEA Direct).

3. References (TASK 23-20-59-99F-803-A01)

A. **Honeywell/Vendor Publications** (Subtask 23-20-59-99F-011-A01)

(1) Related Honeywell publications in this manual are shown in the list that follows:

- ATA No. 23-20-56 (Pub. No. 012-0797-001), CMM, RTA-50D VHF Data Radio
- Pub. No. A09-1100-004, Standard Repair Procedures for Honeywell Avionics Equipment Instruction Manual.

B. **Other Publications** (Subtask 23-20-59-99F-012-A01)

(1) These publications are standard references. Check for latest version of publication.

- The United States GPO Style Manual 2000 (available at http://www.gpoaccess.gov /stylemanual/browse.html)
- IEEE Std 260, Standard Letter Symbols for Units of Measurement (available from the American National Standards Institute, New York, NY)
- ASME Y14.38, Abbreviations for Use on Drawings and in Text (available from the American National Standards Institute, New York, NY)
- ANSI/IEEE Std 91, Graphic Symbols for Logic Functions (available from the American National Standards Institute, New York, NY)
- H4/H8 CAGE Codes (available at http://www.dlis.dla.mil/cage_welcome.asp)
- IEEE 315/ANSI Y32.2, Graphic Symbols for Electrical and Electronics Diagrams (available from the American National Standards Institute, New York, NY)
- MIL-HDBK-263, Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric) (available from any military standards database)
- MIL-STD-1686, Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric) (available from any military standards database).

4. Acronyms and Abbreviations (TASK 23-20-59-99F-804-A01)

A. **General** (Subtask 23-20-59-99F-013-A01)

(1) The abbreviations are used in agreement with ASME Y14.38.

(2) Acronyms and non-standard abbreviations used in this publication are as follows.

List of Acronyms and Abbreviations

Term	Full Term
A/D	analog-to-digital
ACARS	airborne communications addressing and reporting system
ACR	aircraft communications router
ADC	analog-to-digital converter
ADS-B	automatic dependent surveillance broadcast
AGC	automatic gain control
ALC	automatic level control
AM	amplitude modulation
AMM	aircraft maintenance manual
AMP	ampere
ANSI	American National Standards Institute

List of Acronyms and Abbreviations (Cont)

Term	Full Term
AOA	airborne communications addressing and reporting system over aviation very-high frequency link control
AOC	airline operational communications
ARINC	Aeronautical Radio, Incorporated
ASCII	American Standard Code for Information Interchange
ASME	American Society of Mechanical Engineers
ATA	Air Transport Association
ATC	air traffic control
ATE	automated test equipment
ATN	aeronautical telecommunication network
ATR	Air Transport Radio
ATSU	air traffic services unit
BIT	built-in test
BITE	built-in test equipment
BOP	bit oriented protocol
CCA	circuit card assembly
CFDS	central fault display system
CMC	central maintenance computer
CMM	component maintenance manual
CMU	communications management unit
CODEC	coder-decoder
CPDLC	controller pilot data link communication
CSMA	carrier sense multiple access
D/A	digital-to-analog
DC	direct current
DDC	digital down converter
DSB-AM	double side band-amplitude modulation
DSP	digital signal processor
DUC	digital up converter
ECC	error correction control
ECCN	export control classification number
EEPROM	electronically erasable programmable read only memory
EMEA	Europe, the Middle East, and Africa
ESDS	electrostatic discharge sensitive

List of Acronyms and Abbreviations (Cont)

Term	Full Term
EUROCAE	Equipment and European Organization for Civil Aviation Equipment
FANS	future air navigation system
FM	frequency module
FPGA	field-programmable gate array
GPO	Government Printing Office
GPS	global positioning system
HIRF	high-intensity radiated field
HPI	host port interface
Hz	hertz
I/O	input/output
ICAO	International Civil Aviation Organization
ID	identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IF	intermediate frequency
IPC	illustrated parts catalog
IPL	illustrated parts list
Kbit	kilobit
Kbps	kilobyte per second
LED	light-emitting diode
LNA	low noise amplifier
LO	local oscillator
LRU	line-replaceable unit
MAX	maximum
MCBSP	multichannel buffered serial port
MCU	micro-controller unit
MHz	megahertz
MIC	microphone
MIN	minimum
MM	maintenance manual
MOPS	minimum operational performance standard
MSK	minimum shift keying
MTOSS	maintenance task oriented support system
MU	management unit

List of Acronyms and Abbreviations (Cont)

Term	Full Term
MUX	multiplexor
Mbit	megabit
NA	not applicable
NLR	no license required
No.	number
OEM	original equipment manufacturer
OMS	on-board maintenance system
PA	power amplifier
PC	personal computer
PCI	peripheral component interconnect
PLL	phase-locked loop
PN	part number
POA	plain old airborne communications addressing and reporting system
PPM	parts per million
PS	power supply
PTT	push-to-talk
Pub.	publication
RAM	random access memory
RF	radio frequency
RTCA	Radio Technical Commission for Aeronautics
RTP	radio tuning panel
Rx	receive
SAW	surface acoustical wave
SDI	source/destination identifier
SDRAM	synchronous dynamic random access memory
SELCAL	selective calling
SEU	single event upset
SI	International System of Units
SINAD	signal noise and distortion
SNR	signal-to-noise ratio
SPI	serial peripheral interface
STDMA	self-organizing time division multiple access
TCXO	temperature-controlled crystal oscillator
TDMA	time division multiple access

List of Acronyms and Abbreviations (Cont)

Term	Full Term
TR	temporary revision
Tx	transmit
USMS	United States Measurement System
UTC	universal time coordinated
VCO	voltage-controlled oscillator
VDC	volt, direct current
VDL	very-high frequency data link
VDR	very-high frequency data radio
VHF	very-high frequency
VSWR	voltage standing wave ratio
Vrms	volt, root mean square
bps	bytes per second
dB	decibel
dBm	decibel (referenced to one milliwatt)
kHz	kilohertz
kbps	kilobyte per second
kg	kilogram
mW	milliwatt
mm	millimeter
ms	millisecond

5. Process Verification (TASK 23-20-59-99F-805-A01)

A. **Verification Data** (Subtask 23-20-59-99F-014-A01)

(1) Honeywell does a verification of these technical instructions by performance or by simulation of the necessary procedures. Performance shows that the procedures were checked by the use of the manual. Simulation shows that the applicable personnel looked at the procedure in the manual and that the procedure is technically correct. The dates of verification for this manual are given in Table INTRO-3.

Table INTRO-3. Verification Data

Section	Method	Date
Fault Isolation [1]	Performance	11 Feb 2011

NOTE:

1 Only the TESTING portion of the FAULT ISOLATION section was done by performance.

DESCRIPTION AND OPERATION

1. Description (TASK 23-20-59-870-801-A01)

A. General (Subtask 23-20-59-870-001-A01)

(1) This section contains a description of the RTA-50D VDR and lists other components required for system operation.

(2) Refer to Table 1 for the leading particulars.

Table 1. Leading Particulars

Characteristic	Specification
Weight	9.0 pounds (4.1 kg)
Length	12.72 to 12.80 inches (323.1 to 325.1 mm)
Width	3.58 inches (90.9 mm)
Height	7.88 inches (200 mm)
Power:	
• Receive	20 to 32 VDC 1.5 AMP MAX
• Transmit	8.0 AMP MAX
Frequency range	118.000 to 136.975 MHz
Frequency control	Dual ARINC 429 (serial digital) low-speed (13 kbps) inputs
Channel spacing:	
• All modes	25 kHz
• DSB-AM voice only	8.33 kHz
Cooling	Forced air in accordance with ARINC Specification 600
Transmitter (DSB-AM voice and data)	
Output power	25 watts (nominal)
Output impedance	50 ohm
Frequency stability	±0.0005%
Voice modulation level	90% MIN modulation for an input level of 0.25 Vrms at 1,000 Hz
Voice audio distortion	6% MAX for 30% modulation and 10% MAX for 90% modulation with a 0.5-volt input and a modulating frequency from 300 to 2,500 Hz
Voice audio frequency response	Flat within 6 dB from 300 to 2,500 Hz
Spurious radiation	118 dB MIN below desired carrier level
Harmonic radiation	60 dB MIN below desired carrier level

Table 1. Leading Particulars (Cont)

Characteristic	**Specification**
Mode 0 data modulation level	70% modulation MIN for a frequency of 1,000 Hz at −10 dBm level
Mode 0 data input frequency response	Flat within 5.5 dB from 600 to 6,600 Hz
Mode 0 data input distortion	9.5% MAX for up to 90% modulation from 600 to 6,600 Hz
Receiver (DSB-AM voice and data)	
Sensitivity	Greater than 6 dB SINAD for −107 dBm signal modulated 30% at 1,000 Hz
Input Impedance	50 ohm
Frequency stability	±0.0005%
Selectivity:	
• 8.33-kHz channel spacing at 6-dB bandwidth	±2.78 kHz
• 8.33-kHz channel spacing at 60-dB bandwidth	±7.365 kHz
• 25-kHz channel spacing at 6-dB bandwidth	±8 kHz
• 25-kHz channel spacing at 60-dB bandwidth	±17 kHz
Cross modulation	Meets requirements of ARINC Characteristic 716, Section 3.6.4
Intermodulation	Meets ICAO Annex 10, RTCA DO-186B, ED-23B
AGC	Audio output will vary not more than 3 dB with inputs of 5 to 100,000 microvolts and not more than 6 dB to 500 millivolts
Audio output	40 mW MIN into a 600 ohm ±20% resistive load
Audio distortion	Total harmonic distortion will not exceed 5% with a 1,000-microvolt input signal modulated 30% at 1,000 Hz
Audio frequency response	Within 6 dB from 300 to 2,500 Hz
Audio output regulation:	From a 10-mW reference level into 600 ohms
• Resistive load variations between 450 to 2,400 ohms	Less than 2-dB voltage change
• Resistive load variations between 200 to 20,000 ohms	No more than 6 dB voltage change
Undesired responses	80 dB MIN
SELCAL/data output	0.6 Vrms MIN with a 2-microvolt signal modulated 30% at 1,000 Hz into a 600-ohm load

Table 1. Leading Particulars (Cont)

Characteristic	Specification
SELCAL/data response	±2.5 dB from 312 to 1,200 Hz (post-detection response with respect to 1,000 Hz is ±4.5 dB from 300 to 6,600 Hz)
SELCAL/data distortion	4.5% MAX for a 1,000-microvolt input modulated 30% at 1,000 Hz producing 0.5 Vrms into 600 ohms
Phase shift	Audio output does not depart from that of the positive-going modulation envelope at the receiver input by more than −30 to +120 degrees with a 1,000-microvolt input signal modulated 30% at 1,000 Hz
Transmitter (Mode 2 data)	
Output power	17.5 watts (nominal)
Frequency stability	±0.0005%
Modulation	D8PSK at 31.5 kilobits/second
Error vector magnitude (distortion)	6% MAX
Adjacent channel emissions	Less than −18 dBm in 16 kHz centered ±25 kHz away from the transmit frequency Less than −28 dBm in 25 kHz centered ±50 kHz away from the transmit frequency Less than −38 dBm in 25 kHz centered ±100 kHz away from the transmit frequency Less than −48 dBm in 25 kHz centered ±400 kHz away from the transmit frequency Less than −53 dBm in 25 kHz centered ±800 kHz or greater away from the transmit frequency
Spurious emissions	Meets requirements of RTCA DO-281A and EUROCAE ED-92A
Harmonic spurious emissions	Meets requirements of RTCA DO-281A and EUROCAE ED-92A
Mode 2 data input physical interface	ARINC 429 high-speed bus
Mode 2 data input protocol	In accordance with ARINC 750-3, Attachment 10
Receiver (Mode 2 data)	
Sensitivity	Less than 0.001 uncorrected bit error rate for −98 dBm received signal
Frequency stability	±0.005%
Selectivity (25-kHz channel)	Less than 44-dB adjacent channel rejection
Interference rejection	Meets requirements of RTCA DO-281A and EUROCAE ED-92A

Table 1. Leading Particulars (Cont)

Characteristic	Specification
Intermodulation performance	Meets requirements of RTCA DO-281A and EUROCAE ED-92A
Mode 2 data output physical interface	ARINC 429 high-speed bus
Mode 2 data output protocol	In accordance with ARINC 750-3, Attachment 10
Tuning time	100 ms MAX

(3) Refer to Figure 1 for a typical RTA-50D VDR.

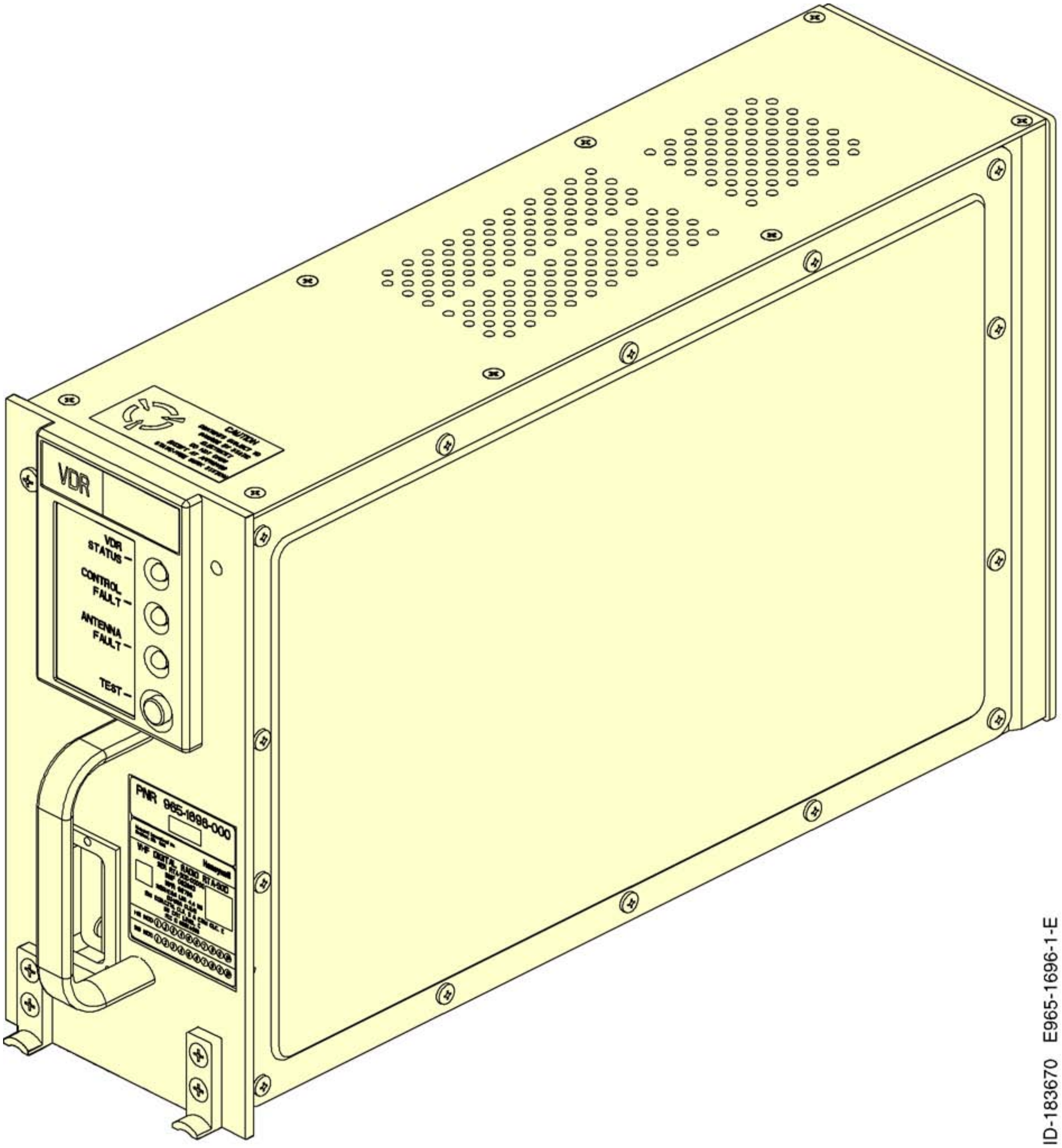


Figure 1. (Sheet 1 of 1) Typical RTA-50D VDR (GRAPHIC 23-20-59-99B-804-A01)

B. **Job Setup Data** (Subtask 23-20-59-99C-001-A01)

(1) The list that follows identifies Honeywell publications that are related to this section:

- Not applicable.

C. Purpose of Equipment (Subtask 23-20-59-870-002-A01)

(1) The RTA-50D VDR system is an airborne VHF communications transceiver that provides voice and data communication between on-board aircraft systems, other aircraft systems, and ground-based systems. It can operate in analog DSB-AM analog voice mode, VHF ACARS data modes (Mode A and Mode 0), and VDL Mode 2 data mode. It also provides future support for VDL Mode 3 digital voice and data modes.

(2) The RTA-50D VDR agrees with the standards and specifications for VHF radios that operate in the 118 to 137-MHz band as follows:

- ARINC 716-11 airborne VHF communications transceiver
- ARINC 750-4 airborne VHF data radio
- EUROCAE ED-23B minimum performance specification for airborne VHF communications equipment operating in the frequency range 117,975 to 137,000 MHz
- EUROCAE ED-92A MOPS for airborne VDL Mode 2 transceiver operating in the frequency range 118-136.975 MHz
- RTCA DO-186B MOPS for airborne radio communications equipment operating within the radio frequency range 117.975 to 137.000 MHz
- RTCA DO-207 MOPS for devices that prevent blocked channels used in two-way radio communications due to unintentional transmissions
- RTCA DO-281A MOPS for aircraft VDL Mode 2 transceiver physical, link and network layer.

(3) The RTA-50D VDR operates as a voice transceiver that agrees with the voice mode defined in ARINC Characteristic 716 when operated as a 716 voice radio. Microphone audio and PTT audio are inputs and side-tone audio is output. The RF signal is double sideband AM. Frequency and channel bandwidth selection is made through a low-speed ARINC 429 bus input interface to an RTP.

(4) The RTA-50D VDR operates as a transceiver when used as a 716 data radio. In this mode, it agrees with the external data modem interface defined in ARINC Characteristic 716. The data modem audio input, data key-line input, and data modem audio output interface to an ACARS MU. The ACARS data modem audio input and output are 2,400-bps MSK modulated signals. The RF signal is a double sideband AM-MSK signal. Channel frequency selection is made through a second low-speed ARINC 429 bus input interface to the ACARS MU.

(5) The data modem audio output can be wired to a SELCAL decoder when the radio is not wired to support 716 data mode operation. In ARINC 750 Data Mode A, the RTA-50D VDR provides 2,400-bps MSK modem functionality within the radio with ARINC 429 digital data input/output interfaces to a CMU as defined in ARINC Characteristic 750. The command and data transfer protocol between the VDR and CMU uses the ARINC 429 Williamsburg BOP Version 1 or Version 3. The RF signal is a double sideband AM-MSK signal. Channel frequency selection is made through the ARINC 429 interface to the CMU.

(6) When operated in Mode 2, the VDR supplies Mode 2 functionality defined in ARINC Characteristic 750 and a 31,500-bps D8PSK modem functional internal to the radio. The Mode 2 radio uses ARINC 429 digital data input/output interfaces to a CMU as specified in ARINC Characteristic 750. The command and data transfer protocol between the VDR and CMU uses the ARINC 429 Williamsburg BOP Version 3. The RF signal is a D8PSK-modulated RF carrier. Channel frequency selection is made through the ARINC 429 interface to the CMU.

(7) The RTA-50D VDR system requires an antenna for its RF inputs and outputs, a control head or radio management panel, an audio input source and output sink for its analog voice functions, and an ACARS MU or a CMU for its digital control and data functions. The VDR system can also be connected to a CMC to transfer maintenance data. To give future support for VDL Mode 3 data and enhanced voice features, the RTA-50D VDR requires interface to two sources of aircraft ICAO address such as Mode S transponder Number 1 and Number 2.

(8) When operated in voice mode, the RTA-50D VDR supplies both 25-kHz and 8.33-kHz channel spacing to meet European airspace requirements. The unit is fully interchangeable with older ARINC 716 communications equipment for backward compatibility. Older equipment includes the former Allied Signal or Bendix RTA-44A, RTA-44D, and RTA-83B VHF radios, and Collins VHF 700 and VHF 700A radios.

D. **Equipment Required but Not Supplied** (Subtask 23-20-59-870-003-A01)

(1) Table 2 lists the equipment required for the RTA-50D VDR system that is not supplied by Honeywell.

Table 2. Equipment Required but Not Supplied

Equipment	**Description**
Power source: • Receive • Transmit	DC power supply of 27.5 volts 1.5 AMP 8 AMP
Audio distribution system	Audio system with an input impedance of 200 to 10,000 ohms
Control panel	Provides remote control of frequency selection for 25-kHz or 8.33-kHz channel spacing system operation (serial digital ARINC 429-7 and ARINC 716 Supplement 8), power on/off, volume, and squelch control in accordance with ARINC 716
MU/CMU/ATSU	Provides control and data source/sink when operating in the 750 data mode
Mount	Provides a means of mounting RTA-50D VDR in the aircraft
VHF antenna	Capable of receiving and transmitting VHF signals over a frequency range of 118.000 to 136.975 MHz.
Microphone	150-ohm impedance microphone (either carbon or transistor) operating from approximately 16-volt power supply
Cables and connectors	Necessary connectors and cables

2. <u>Configurations Available</u> (TASK 23-20-59-870-802-A01)

A. **General** (Subtask 23-20-59-870-004-A01)

(1) Table 3 lists the available configurations of the RTA-50D VDR and the features contained in each configuration. Table 4 contains a brief description of each feature.

Table 3. RTA-50D VDR Configurations Available

PN	8.33-kHz Channel Spacing	ACARS	Mode A	Mode 2	Airbus CFDS /CMC	Boeing CMC
965-1696-021	X	X	X	X		X
965-1696-051	X	X	X	X	X	

Table 4. RTA-50D VDR Features

Description
118.000 to 136.975 MHz operation
8.33-kHz and 25-kHz channel spacing
ICAO Annex 10 FM immunity
ACARS MSK (Mode A) data link function
VDL Mode 2 (D8PSK) data link function
Growth function to VDL Mode 3 digital voice and data transmission
Growth function to single-channel VDL Mode 4 data for data link communications applications only
Dual ARINC 429 tuning interfaces
CMC/CFDS maintenance system interface
200-ms power interrupt transparency
DO-160E environmental test compliant
HIRF protection
Lightning protection (Level 3)
35-second stuck mike protection and protection disable circuitry
RS-232 PC maintenance port

B. **Environmental Certification** (Subtask 23-20-59-870-005-A01)

(1) The RTA-50D VDR communications transceiver meets the environmental conditions of the RTCA DO-160E, Environmental Conditions and Test Procedures for Airline Electronic/Electronical Equipment and Instruments. The environmental certification categories of the RTA-50D VDR, PN 965-1696-021 and -051, are [(A2)(D2)Z]BAE[RB1]XXXXXXZAAZ[CC][RR]M[ZZZZZ]XXA. Refer to Table 5.

Table 5. RTA-50D VDR Environmental Certification Categories

Test	PN 965-1696-021	PN 965-1696-051
Temperature and altitude	A2D2	A2D2
In-flight loss of cooling	Z (18 hours)	Z (18 hours)
Temperature variation	B	B
Humidity	A	A

Table 5. RTA-50D VDR Environmental Certification Categories (Cont)

Test	PN 965-1696-021	PN 965-1696-051
Operational shocks and crash safety	E	E
Vibration	RB1	RB1
Explosion proofness	X	X
Waterproofness	X	X
Fluids and susceptibility	X	X
Sand and dust	X	X
Fungus resistance	X	X
Salt spray	X	X
Magnetic effect	Z	Z
Power input	A	A
Voltage spike	A	A
Audio frequency conducted susceptibility - Power inputs	Z	Z
Induced signal susceptibility	CC	CC
Radio frequency susceptibility (radiated and conducted)	RR	RR
Emission of radio frequency energy	M	M
Lightning induced transient susceptibility	ZZZZZ	ZZZZZ
Lightning direct effects	X	X
Icing	X	X
Electrostatic discharge	A	A

3. System Description (TASK 23-20-59-870-803-A01)

A. RTA-50D VDR Data Radio System (Subtask 23-20-59-870-006-A01)

(1) The items that follow are necessary for the RTA-50D VDR:

- An antenna for RF input and output
- A control head or radio management panel for voice/data mode and voice channel selection
- An audio input source and output destination for voice functions, and/or a data link input source and output destination for data link functions.

(2) The RTA-50D VDR can also transfer maintenance data to an on-board maintenance system.

(3) Three VHF radios are necessary for typical commercial air transport aircraft installations. Two radios are for voice communications. The third radio is for data communications and for voice communications when the other radios do not work. Refer to Figure 2.

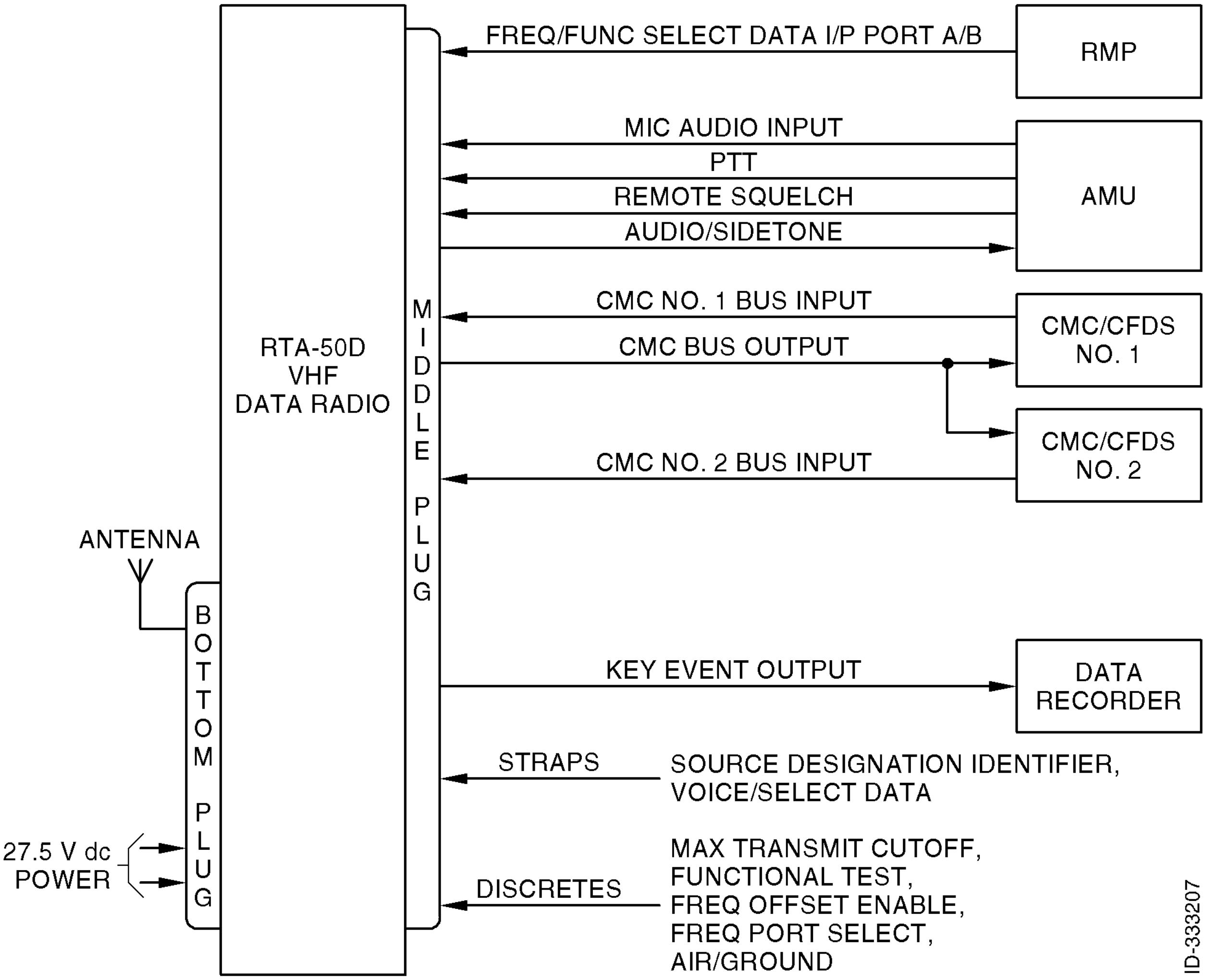


Figure 2. (Sheet 1 of 1) VHF Communications for Voice Operation (GRAPHIC 23-20-59-99B-805-A01)

B. Description of Equipment (Subtask 23-20-59-870-007-A01)

(1) Refer to Table 6 for a list of all modules and assemblies in the unit. Refer to Figure 3 for the location of the modules and assemblies.

Table 6. Module and Assembly Designations

PN	Module/Assembly
700-1768-002	Rear interconnect assembly
700-1782-001	Main processor assembly
700-1854-001	Front panel assembly
710-0361-001	Power supply assembly
722-4444-006	RF transceiver module
722-4445-006	Main processor module

Table 6. Module and Assembly Designations (Cont)

PN	Module/Assembly
722-4446-002	Front panel module
722-4576-003	DC to DC converter
722-4577-005	Power supply output module
722-4600-004	Rear interconnect module
722-4767-001	Power supply input module
727-0008-001	RF transceiver assembly
965-1696-051	Final assembly

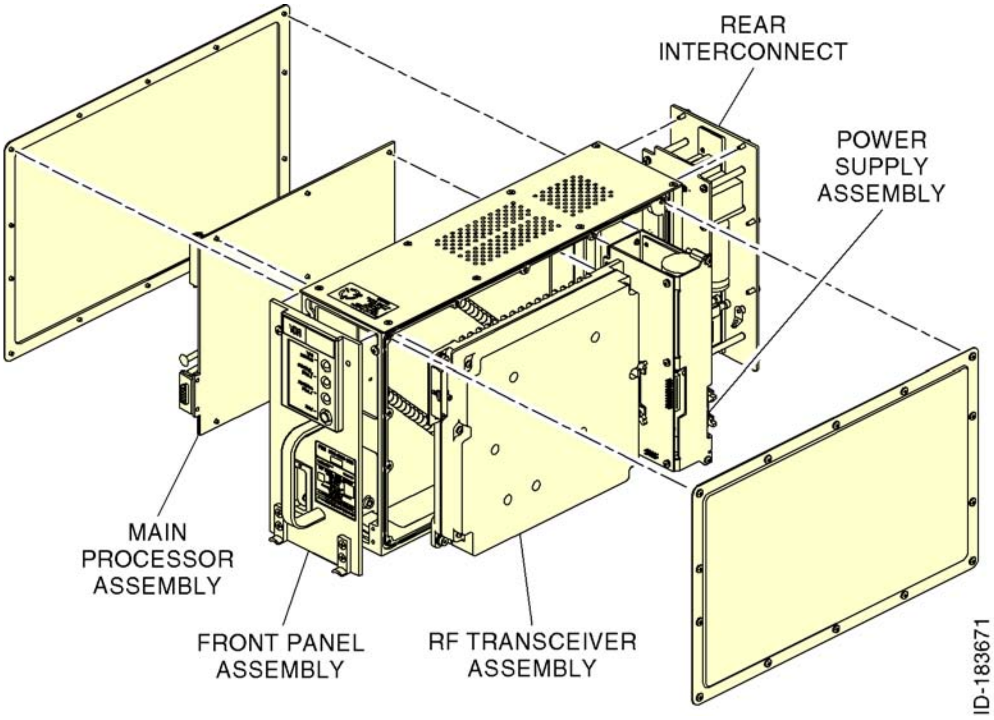


Figure 3. (Sheet 1 of 1) Module and Assembly Locations (GRAPHIC 23-20-59-99B-806-A01)

(2) Electrical Description

(a) The RTA-50D VDR provides high-speed data link communications as well as voice and data modes. The RTA-50D VDR can provide for future Mode 3 operation which requires digital voice and data transmission at the same time, or Mode 4 data link only.

(b) When in voice mode, the RTA-50D VDR provides both 25-kHz and 8.33-kHz channel spacing to meet European airspace requirements. The unit can be interchanged with older ARINC 716 communications equipment such as the former AlliedSignal or Bendix RTA-44A, RTA-44D, and RTA-83B VHF radios, and Collins VHF 700 and VHF 700A radios.

(c) To provide high-speed data link communications, the RTA-50D VDR also operates in VDL Modes A and 2, and can provide future VDL Mode 3 digital voice and data, and single-channel VDL Mode 4 data services.

(d) Refer to Table 7 for the modes of operation supported by the RTA-50D VDR.

Table 7. Modes of Operation

Mode	Modulation Scheme	Channel Spacing	Access Scheme	Data Rate (bits/sec)	User Traffic Type	Interface
Voice	DSB-AM	25/8.33 kHz	PTT	NA	Voice audio	Analog audio
Mode 0 data	DSB-AM MSK	25 kHz	CSMA	2,400	ACARS (POA)	Analog audio
Mode A data	DSB-AM MSK	25 kHz	CSMA	2,400	ACARS (POA)	A429
Mode 2 data	D8PSK	25 kHz	CSMA	31,500	Simultaneous ACARS and ATN data	A429
Mode 3 voice and data [1]	D8PSK	25 kHz	TDMA	31,500	Simultaneous ACARS and ATN data	Analog audio and A429
Mode 4 data [1] [2]	GFSK	25 kHz	TDMA	19,200	ATN data	A429

NOTES:

1 Requires software upgrade.

2 May also require hardware modifications.

C. **ARINC 716 Data Mode** (Subtask 23-20-59-870-008-A01)

(1) In ACARS, the VDR system is a simple transceiver with an analog interface to the ACARS MU. Refer to Figure 4.

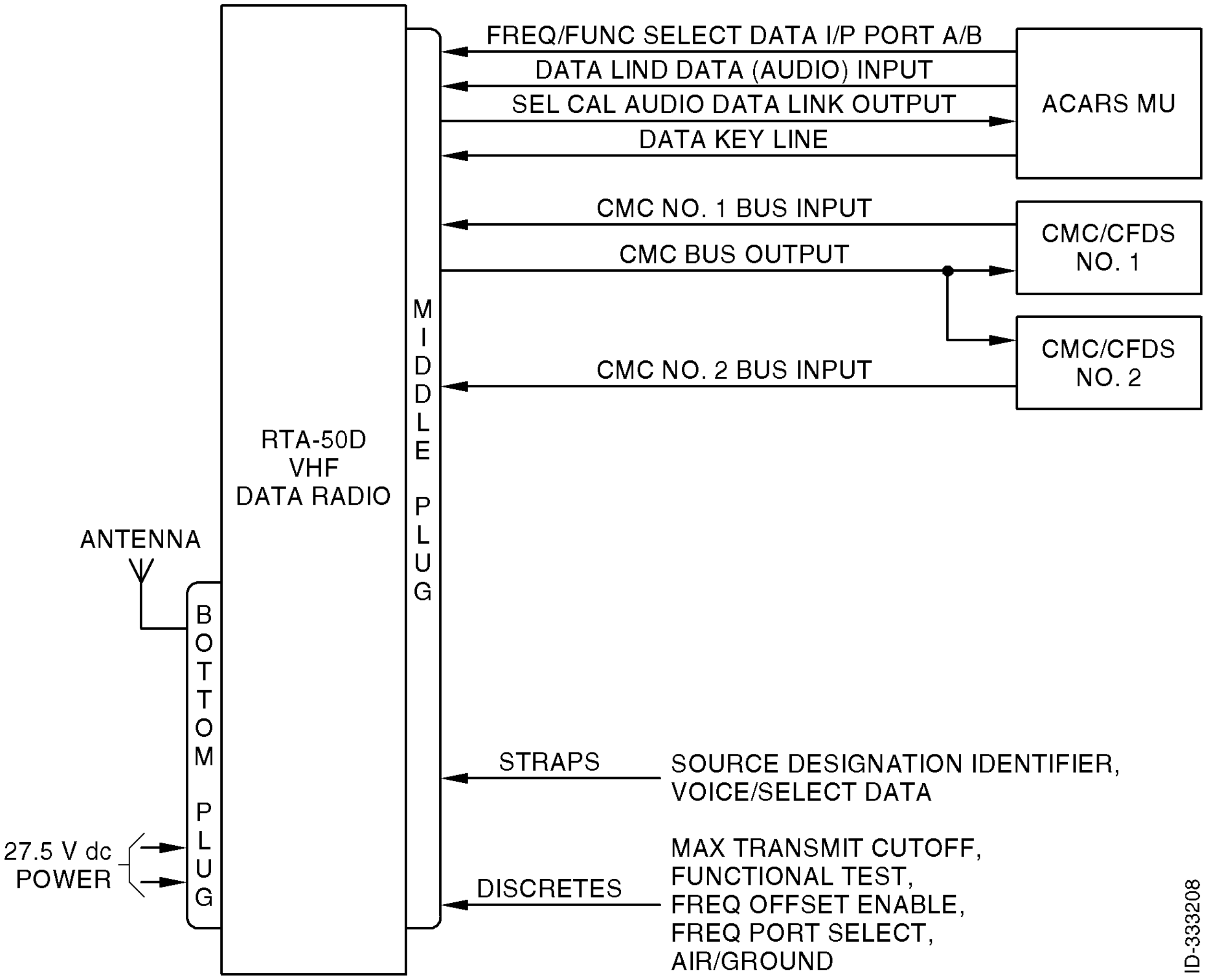


Figure 4. (Sheet 1 of 1) ACARS Audio Interface (GRAPHIC 23-20-59-99B-807-A01)

D. **ARINC 750 Mode A and Mode 2** (Subtask 23-20-59-870-009-A01)

(1) Figure 5 illustrates the same interfaces when the radio is operating in ARINC 750 Mode with a compatible CMU, ACARS MU, or ATSU. This wiring configuration would be used for Mode A and Mode 2 operation. The Mode A and Mode 2 VDR can be installed in an ARINC 716 configuration if Mode A and Mode 2 operation is not required.

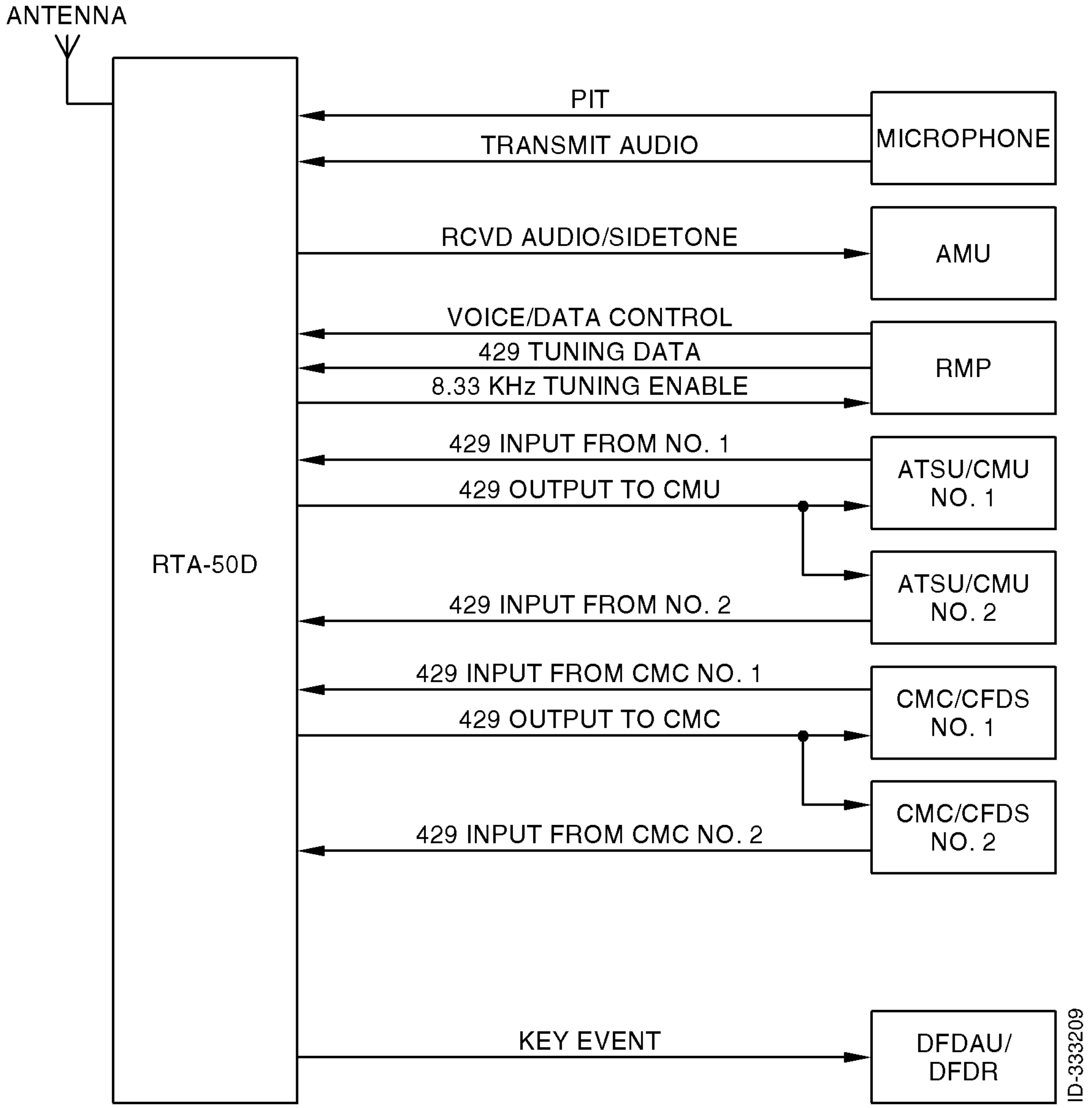


Figure 5. (Sheet 1 of 1) RTA-50D VDR External Interfaces (ARINC 750 Mode) (GRAPHIC 23-20-59-99B-808-A01)

4. System Component Description (TASK 23-20-59-870-804-A01)

A. RTA-50D VDR (Subtask 23-20-59-870-010-A01)

(1) The VDR is a VHF transmitter-receiver that provides modulation for double-sideband amplitude modulation for analog voice/data operation in the 25-kHz or 8.33-kHz spaced channels of the 118.000 to 136.975 MHz. Frequency is provided through a serial-digital format in accordance with ARINC Specification 429.

(2) The VDR is completely solid-state and is housed in a 3MCU case in accordance with ARINC Characteristic 600. A handle is located on the front panel of the VDR to facilitate installation, removal, and transport of the VDR.

(3) The VDR uses a low insertion force, Size 1 shell ARINC 600 rear panel connector with two inserts. The middle insert is used for aircraft interconnections and the bottom insert is used for input power and coaxial antenna connectors. The keying pins are set to index pin code 04.

(4) Forced air cooling, in accordance with ARINC Specification 600, is required for cooling the VDR.

(5) Three front panel LEDs provides visual indication of real-time BITE status as follows:

- Internal fault status monitoring
- External controller status
- External antenna status.

(6) One front panel push-button switch allows activation of manual self-test.

(7) The VDR is partitioned into five subassemblies as follows:

- Front panel module
- Main processor module
- Power supply module
- Rear interconnect module
- RF module.

B. **Other Components in the System** (Subtask 23-20-59-870-011-A01)

(1) Other VDR system components are not supplied by Honeywell. Information on these units must be obtained from their respective manufacturers.

5. Operation (TASK 23-20-59-870-805-A01)

A. **Voice Mode** (Subtask 23-20-59-870-012-A01)

(1) In voice mode, the RTA-50D VDR supports simplex PTT communications in any of the 760 channels with 25-kHz spacing or 2,280 channels with 8.33-kHz spacing in the 118 to 136.975-MHz range.

(2) DSB-AM is used for voice communications where the voice audio from the microphone modulates the VHF carrier frequency. The spectrum required for this type of modulation is less than 7 kHz. When operating in a 25-kHz channel, the excess bandwidth of the channel is used as a guard band to reduce emissions into adjacent channels.

(3) Voice channel selection is controlled from the flight deck by a radio tuning panel. In installations where a radio can be used in either voice or data mode, voice and data can be set from the flight deck by the radio tuning panel.

B. **Mode 0 Data** (Subtask 23-20-59-870-013-A01)

(1) Mode 0 and Mode A support data link communications that use protocols now called POA. POA uses ASCII character-oriented message formats and protocols to ensure end-to-end error-free delivery of messages. The difference between these two modes is the interface to the source and destination of the POA messages.

(2) Mode 0 connects to a legacy ARINC 724 or 724B ACARS MU or CMU through an analog audio interface. Data is transmitted between the MU/CMU and VDR units at a rate of 2,400 bits each second by MSK modulated audio signals. The MSK audio modem is in the MU or CMU. The MSK audio signal produced by the modem is a 1,200 or 2,400-Hz tone that indicates if the polarity of the transmitted data bit is the same as the previous bit or is different.

(3) The 1,200 or 2,400-Hz tones sent by the MU or CMU modulate the amplitude of the VHF carrier generated by the VDR. This modulated signal is a DSB-AM signal whose amplitude is modulated at 2,400 bps. The MU/CMU controls the access to the channel and initiates the transmission of a message by a data key line discrete input to the VDR. The MU/CMU also controls the data link channel selection through one of the low-speed (13 Kbps) ARINC 429 tuning inputs. Mode 0 operation is backward compatible with legacy ARINC 716 radios.

C. Mode A Data (Subtask 23-20-59-870-014-A01)

(1) Mode A allows the RTA-50D VDR to exchange downlink and uplink POA data messages with an Airbus ATSU or an ARINC 758 CMU through a transmit/receive pair of 100 Kbps ARINC 429 digital interfaces instead of the analog audio interfaces used by Mode 0.

(2) The downlink message data bits transferred to the VDR modulate the RF carrier at a rate of 2,400 bps using the same DSB-AM MSK modulation scheme used in Mode 0. The difference is that the MSK modem functionality resides in the RTA-50D VDR.

(3) The VDR also controls when to access the channel to transmit data. The channel access protocol is the same CSMA employed by the MU/CMU in Mode 0 operation. The data link channel selection is still controlled by the ATSU/CMU, but channel selection messages are exchanged through the same high-speed ARINC 429 interface used to exchange POA messages which simplifies wiring.

D. VDL Mode 2 (Subtask 23-20-59-870-015-A01)

(1) The newest VHF data link communication mode is VDL Mode 2. VDL Mode 2 is the term used to describe a suite of air/ground protocols that increases the data rate of the air/ground link to 31,500 bps.

(2) VDL Mode 2 allows the transition from character-oriented ACARS protocols for end-to-end delivery of messages to one that uses bit-oriented ATN protocols using the same VHF ground and aircraft radios. The RTA-50D VDR Mode 2 capability supports the transmission and reception of standard ACARS messages such as those generated by FANS A and FANS 1 applications using a protocol referred to as AOA.

(3) The RTA-50D VDR Mode 2 capability also supports the transmission and reception of bit-oriented ATN application messages such as CPDLC. The delivery of FANS A over AOA and CPDLC over ATN/VDL Mode 2 is supported concurrently. The set of VDL Mode 2 protocols consist of the physical layer protocol, channel access protocol, data link service and management protocol, and Mode 2 network access protocol. The physical layer protocol includes the modulation, data rate, and forward error correction techniques used to transmit data over the air/ground link.

(4) The channel access protocol is the method that allows multiple aircraft to communicate with the ground stations on the same frequency. The data link service and management protocol includes procedures to establish, maintain and hand-off an air/ground link, and ensure error-free delivery of messages. The network access protocol is the interface between users and the Mode 2 air/ground link service providers. As in Mode A, only the physical layer and channel access protocols are performed by the RTA-50D VDR while the data link service and management, and the network access protocols are performed by the CMU.

(5) The VDL Mode 2 physical layer protocol employs a bit transmission rate of 31,500 bps over the air/ground link on a single 25-kHz channel. The increased utilization of the 25-kHz channel is achieved by use of a bandwidth modulation scheme known as D8PSK. A D8PSK transmitter transmits a carrier whose phase is modulated by the data. The phase can be 0, 45, 90, 135, 180, 225, 270, or 315 degrees. The rate at which the carrier phase is changed is the modulation rate.

(6) The phase difference or D8PSK symbol between successive phase changes can be equal to 0, 45, 90, 135, 180, 225, 270, or 315 degrees. Since there are eight possible phase differences, each phase change (D8PSK symbol) represents three bits of information: 000, 001, 011, 010, 110, 111, 101, or 100.

(7) For example, if the phase changes at a 10.5-kHz rate, the bit transmission rate is equal to 31.5 Kbps. The VDL Mode 2 D8PSK modulator uses the bits in the message, three at a time, to select the carrier phase change at a rate of 10,500 D8PSK symbols each second. A 10.5-kHz D8PSK phase modulation rate corresponds to a D8PSK bit transmission rate of 31.5 Kbps.

(8) The VDL Mode 2 channel access protocol is CSMA modified to let all terminals to have equal chances to access the channel when multiple terminals have data to transmit. The ability to optimize the CSMA protocol is included in the VDL Mode 2 channel access protocol specification.

(9) As in Mode A, the Mode 2 data link channel selection is controlled by the ATSU/CMU through the same high-speed ARINC 429 interface used to exchange downlink and uplink AOA or ATN messages. The ATSU/CMU also dynamically controls the switching between Mode A and Mode 2 operation subject to available coverage. Since the VDL Mode 2 data rate and modulation scheme differ from those used in Mode A, separate VHF frequencies and ground-based VHF equipment must be used to give POA and AOA/ATN service coverage. As a result, the availability of high-speed AOA service depends on the availability of ground stations.

E. **VDL Mode 3** (Subtask 23-20-59-870-016-A01)

(1) VDL Mode 2 is a data link protocol that has been optimized for efficient delivery of as much data traffic as possible within a 25-kHz channel assignment and with radio transmitters limited to 15 watts output power. It requires dedicated 25-kHz channel assignments. However, there is also a need to increase the number of VHF channels available in the 118 to 137-MHz band. To provide for additional voice and data channels, the FAA is developing a VHF digital transmission mode known as VDL Mode 3.

(2) The RTA-50D VDR has been designed to support VDL Mode 3 voice and data operation through a software upgrade. Although VDL Mode 3 functionality is not available in the current FAA ground stations, a prototype software upgrade to the RTA-50D VDR has proven the functionality with FAA VDL Mode 3 test ground stations.

(3) VDL Mode 3 takes a 25-kHz frequency assignment and breaks it up into 120-ms frames with four time slots of 30-ms duration each. Each time slot is a different channel. Each channel (frequency and time slot) can be assigned for use by a different ATC sector. The selection of which VDL Mode 3 frequency and time slot to use is initially performed by the Pilot using a radio control panel in the same way 25-kHz or 8.33-kHz channel selection is now performed. Frequency division into time slots (channels) and the assigned use of the channels (slots) to different sectors is called TDMA. The slots can be used to transmit packets of digitized voice or data sized to fit in the appropriate time slot.

(4) VDL Mode 3 uses TDMA to allow access to multiple voice and data users on the same 25-kHz frequency assignment. VDL Mode 3 ground stations can be configured to support different combinations of voice and data services.

(5) VDL Mode 3 ground stations can be configured so that each of the four time slots is assigned to voice traffic only (4V configuration). Slot use can be assigned to a different sector. When an aircraft enters a sector that has been assigned a particular frequency and time slot (channel), the Pilot can select the appropriate channel on the radio control panel.

(6) The aircraft radio would then tune to the frequency associated with the channel and would look for an uplink from the sectors ground station to synchronize its receive time slot clocks with those of the ground station. VDL Mode 3 ground stations transmit management burst uplinks in their allocated time slots to allow aircraft to synchronize their clocks. If the aircraft does not receive any uplink transmissions from the ground station, it cannot synchronize its clock and communication with the ground is not possible.

(7) When the aircraft is synchronized with the ground station, voice communications between the aircraft and the ground station on the selected time slot can proceed. When operating in VDL Mode 3, voice communications is initiated with a “listen before PTT” procedure. When the VDL 3 radio uses a selected time slot, all digital voice traffic received on the selected time slot is sent to the radio speaker. Voice traffic received on any other time slot is discarded.

(8) VDL Mode 3 ground stations can be also be configured so that two time slots are used for voice traffic and two used for data traffic (2V/2D configuration). Each sector is assigned a voice and a data channel pair. When the airborne radio is tuned to a sector’s voice channel, it also automatically tunes to the sectors data channel. If the ground station supports data services in addition to basic voice services as indicated in its management bursts, the radio sends a net entry request message to the ground station on the selected time slot to gain access to the data services. When the VDL Mode 3 ground station receives a net entry request, a net response message is sent to the aircraft to configure access.

(9) The net entry request message includes the 24-bit ICAO identifier assigned to the aircraft. To support the enhanced features, VDL Mode 3 radios require access to a source of ICAO ID such as the Mode S transponder.

(10) Downlink data transmission on the data channel is sent on slots reserved by the ground station for exclusive use by the aircraft. Reservation request messages can be sent by the aircraft using either slotted aloha random access protocol or in response to polling from the ground station. The maximum number of contiguous slots requested is 15.

(11) The 2V/2D configurations require the airborne VDR to process voice audio and data link traffic simultaneously. For example, while the VDR outputs received voice audio or digitizes and compresses transmit voice audio, it must also process and deliver received uplink data messages or accept and transmit downlink data messages. As a result, the processing load is significantly higher than that required for operation in a voice-only or data-only mode.

(12) Like VDL Mode 2, VDL Mode 3 uses D8PSK modulation at a bit transmission rate of 31,500 bps to deliver digitized and compressed speech as well as data messages. Note that VDL Mode 3 requires that the modulation rate have an accuracy of ±5 PPM, where VDL Mode 2 requires a modulation rate accuracy of ±50 PPM. As a result, VDL Mode 3 requires transmitter clocks that are 10 times more accurate than VDL Mode 2. The greater accuracy is needed to provide aircraft at the edges of the coverage area to maintain time slot synchronization with the VDL Mode 3 ground station. This synchronization ensures that transmissions from aircraft at the edge of the coverage area do not interfere with transmissions in adjacent time slots.

(13) VDL Mode 3 operation requires radio management panels to have the capability to select the VDL 3 channel as well as to support unique enhanced voice services.

F. **VDL Mode 4** (Subtask 23-20-59-870-017-A01)

(1) VDL Mode 2 provides data link throughput and VDL Mode 3 provides communications capacity enhancements and simultaneous voice and data communications. VDL Mode 4 provides both broadcast surveillance applications and air/ground data link communications. The surveillance application supported by VDL Mode 4 allows aircraft to periodically broadcast their position and monitor and display the position of other similarly equipped aircraft.

(2) VDL Mode 4 subdivides each 25-kHz channel into periodic slots of 13.33-ms duration to allow short periodic transmissions from many aircraft. VDL Mode 3 requires each aircraft to synchronize its TDMA slot timing to that of a ground station. VDL Mode 4 stations synchronize their TDMA slot timing to UTC derived from a source such as GPS.

(3) VDL Mode 4 uses a slot reservation protocol that allows VDL Mode 4 stations to access the network and assure that ADS-B transmission will not be interfered with, without the need for coordination through a ground station. The access protocol used by VDL Mode 4 is STDMA.

(4) VDL Mode 2 and VDL Mode 3 operate in simplex mode; that is, they operate in either transmit or receive mode on the same frequency. ADS-B operation over VDL Mode 4, requires concurrent transmission and reception on two different frequencies. Use of VDL Mode 4 for both ADS-B surveillance and applications and for data link applications requires concurrent transmission and reception on three different frequencies. If VDL Mode 4 is used only for data link communications, transmission and reception on only one frequency at a time is required. As a result the required applications determine the type of radio required to support VDL Mode 4.

6. Theory of Operation (TASK 23-20-59-870-806-A01)

A. VDR Overview (Subtask 23-20-59-870-018-A01)

(1) The RTA-50D VDR is an airborne VHF radio whose function is to provide aircraft with line-of-sight air/ground ATC voice and AOC data communications capability in the 118 to 136.975-MHz VHF frequency band. The RTA-50D VDR is capable of operating in DSB-AM analog voice mode, VHF ACARS data modes (Mode A and Mode 0), and VDL Mode 2 data mode.

(2) A typical aircraft installation consists of two VDRs dedicated for ATC voice communications and one VDR for data link communications and back up voice communications. Each VDR interfaces to its own dedicated VHF blade antenna so that simultaneous operation of all three VDRs is possible.

(3) Figure 6 shows the interfaces between the RTA-50D VDR and other avionics equipment.

NOTE: Figure 6 also shows the inputs and outputs that are processed in each of the modes of operation. Interfaces that apply to typical new aircraft installations are shown as solid lines. Interfaces that apply to legacy retrofit DSB-AM voice-only installations that do not require VDL Mode A or VDL Mode 2 functionality are shown as dashed lines.

Blank Page

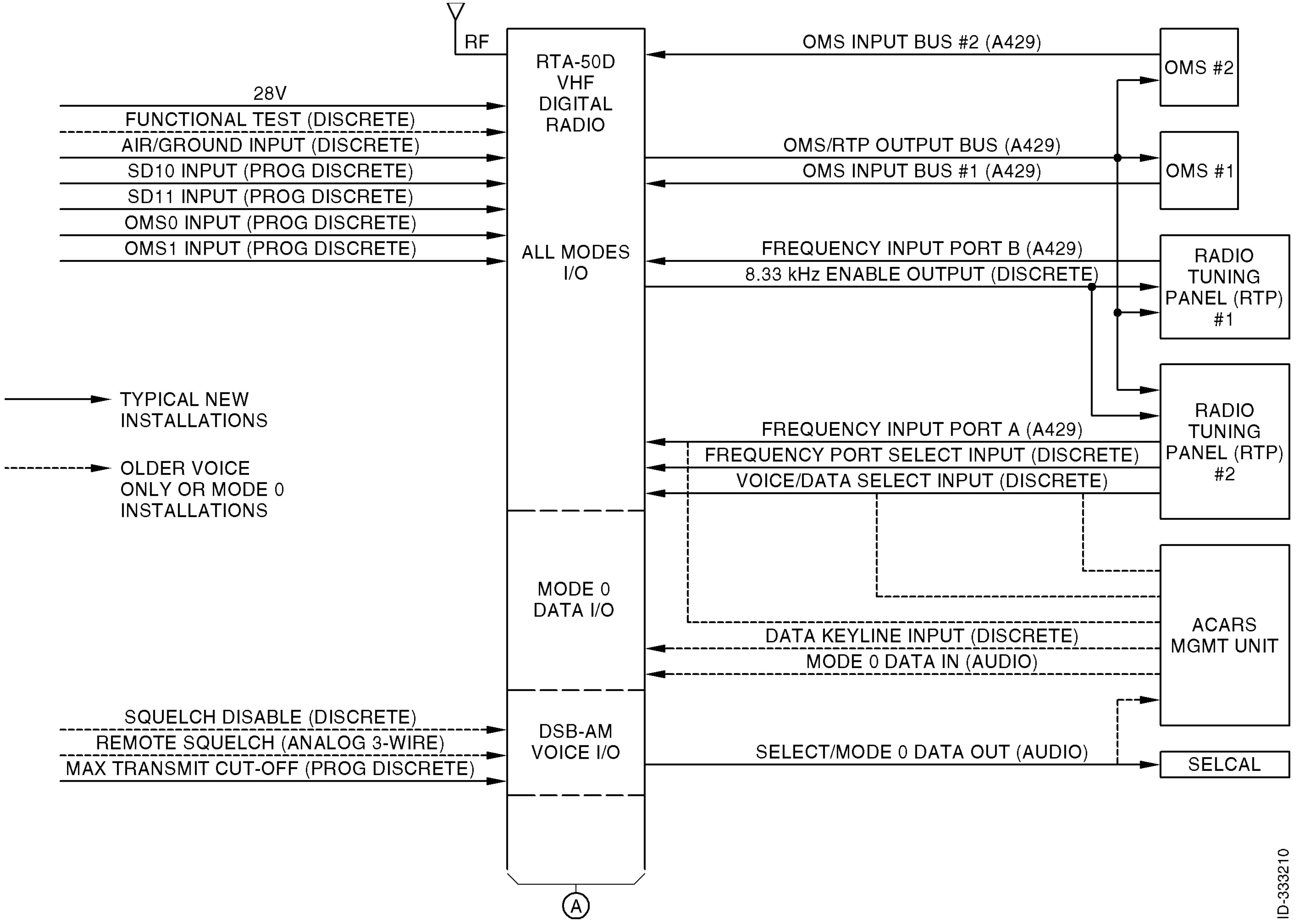


Figure 6. (Sheet 1 of 2) RTA-50D VDR Interface Context Diagram (GRAPHIC 23-20-59-99B-809-A01)

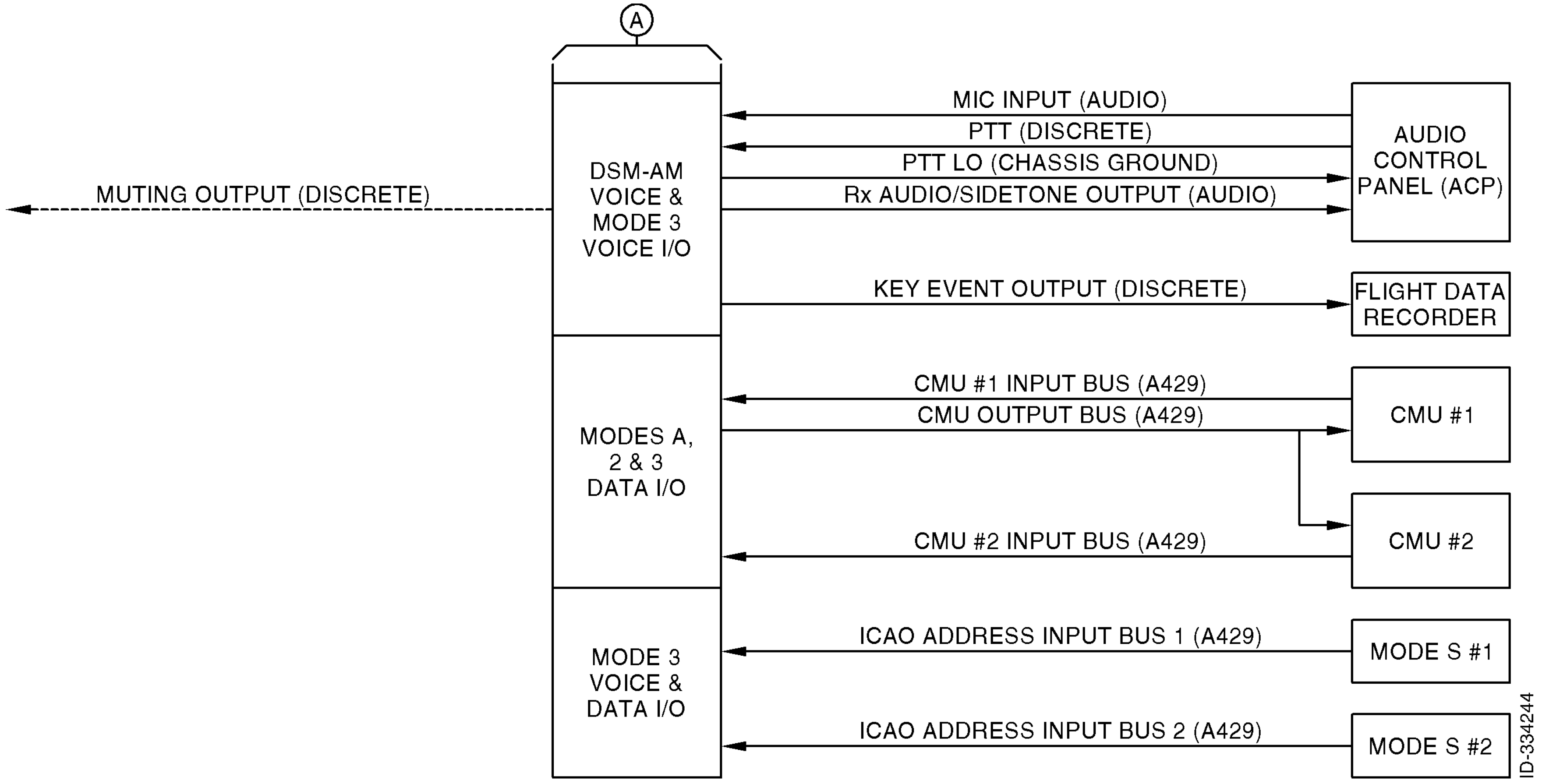


Figure 6. (Sheet 2 of 2) RTA-50D VDR Interface Context Diagram (GRAPHIC 23-20-59-99B-809-A01)

(4) Voice Communications Installations

(a) Each VHF radio is controlled through one or two RTPs. The RTA-50D VDR provides ARINC 429 interfaces to two RTPs. A discrete input labeled "frequency port select input" is used to determine which of the two RTP inputs controls the operation of the VDR. The contents of the ARINC 429 words received from the RTP are used by the VDR to determine the voice channel (frequency) selected, as well as the type of voice channel:

- DSB-AM voice with 8.33-kHz channel spacing
- DSB-AM voice with 25-kHz channel spacing.

(b) An analog audio input and output pair provide the interfaces to the microphone and speakers. A discrete input labeled PTT provides the means to switch between transmit and receive operation. When the VDR is operating in transmit mode (PTT is grounded), the transmitted audio is output to the Rx audio/side-tone output port. The Rx audio/side-tone output is muted during transmit operation if an internal VDR failure prevents the radio from transmitting RF.

(c) The RTA-50D VDR provides ARINC 429 interfaces to the OMS. Two different OMS interface protocols are supported as follows:

- Airbus CMC/CFDS protocol
- Boeing CMC protocol.

(d) However, only one of the OMS interface protocols is supported at a time, depending on the software version loaded (VDR part number).

(5) Data Link Communications Installations

(a) Data link capable installations can support data communications only or they can be wired to support both data and voice communications. When supporting voice and data communications, one or two RTPs provide the means to select the mode of operation (voice or data) and the means to select the voice channel. The mode of operation is determined from the contents of the ARINC 429 words received from the RTP or from a discrete input labeled "voice/data select input" depending on the aircraft installation.

(b) The RTA-50D VDR provides ARINC 429 data link interfaces to a CMU, ATSU, or ACR which is the source of the transmitted data messages and the destination of the received data messages. A second CMU, ATSU, or ACR may be operated in standby mode if the aircraft installation supports ATC data link communications.

(c) When the selected mode of operation is a data only mode (Mode 0, Mode A, or Mode 2), the particular data-only mode is determined from the presence or absence of ARINC 429 data on the ARINC 429 data link interfaces to the two CMUs/ATSUs/ACRs.

B. **RTA-50D VDR System Architecture** (Subtask 23-20-59-870-019-A01)

(1) A high-level block diagram of the internal architecture of the RTA-50D VDR is shown in Figure 7. The RTA-50D VDR consists of five subassemblies as follows:

- Digital processor CCA
- Front panel CCA
- Power supply module
- Rear interconnect module
- RF CCA.

(2) The RTA-50D VDR is packaged in a 3MCU standard form factor. A low insertion force, Size 1 shell ARINC 600 connector with three inserts provides the means to interface to other onboard avionics as well as the antenna and aircraft power. The top plug and middle plug inserts are used for system interconnects. The bottom plug insert is used for input power and coaxial antenna connections.

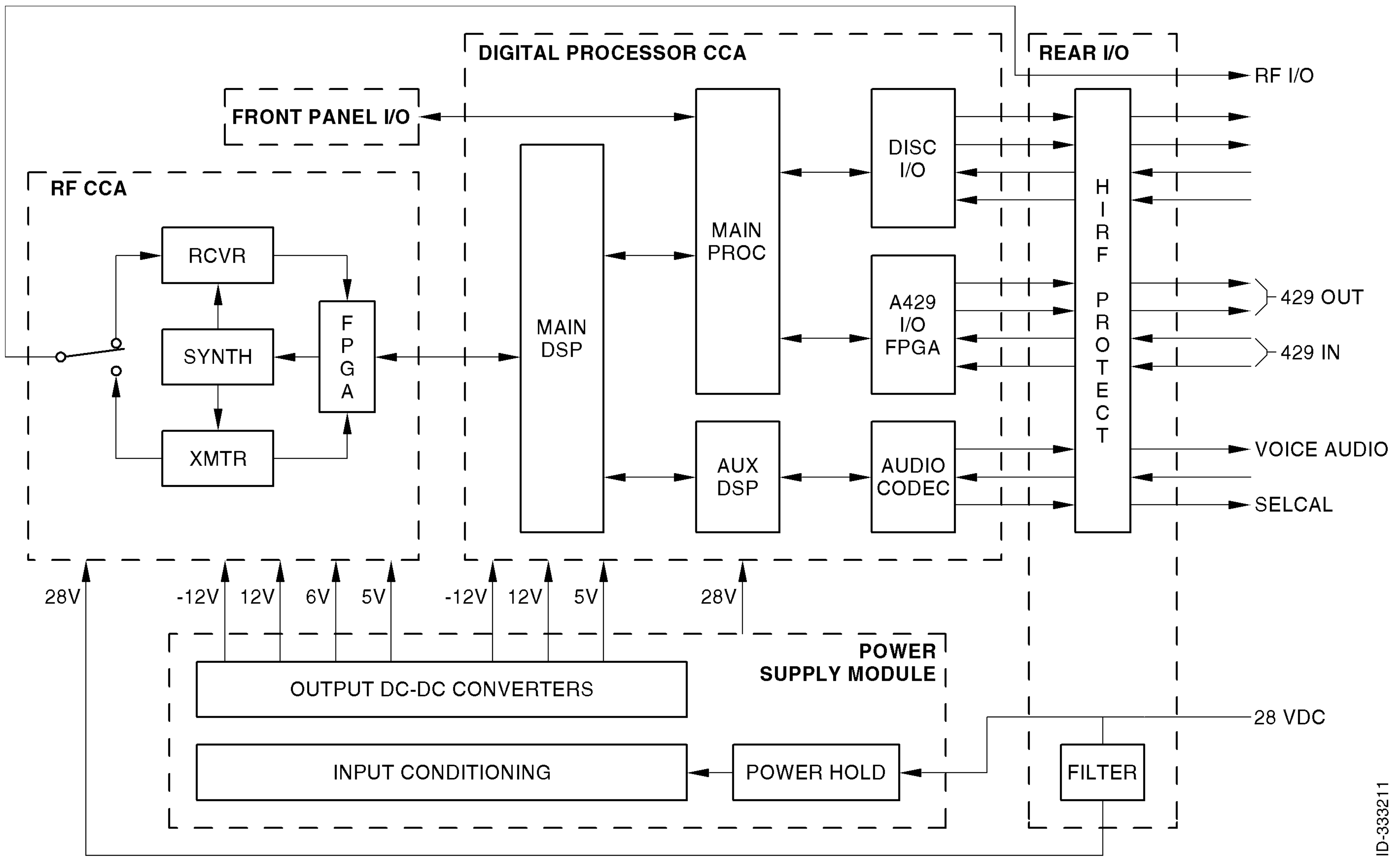


Figure 7. (Sheet 1 of 1) RTA-50D VDR Internal Architecture (GRAPHIC 23-20-59-99B-810-A01)

C. RF CCA (Subtask 23-20-59-870-020-A01)

(1) General

(a) The RF CCA performs the basic VHF receive and transmit functions of the VDR in all voice and data modes of operation. The RF CCA circuitry is comprised of five processing sections:

- Receiver section
- Transmitter section
- LO frequency synthesizer section
- RF control
- BIT monitoring circuits.

(b) A block diagram of the RF CCA is shown in Figure 8.

Blank Page

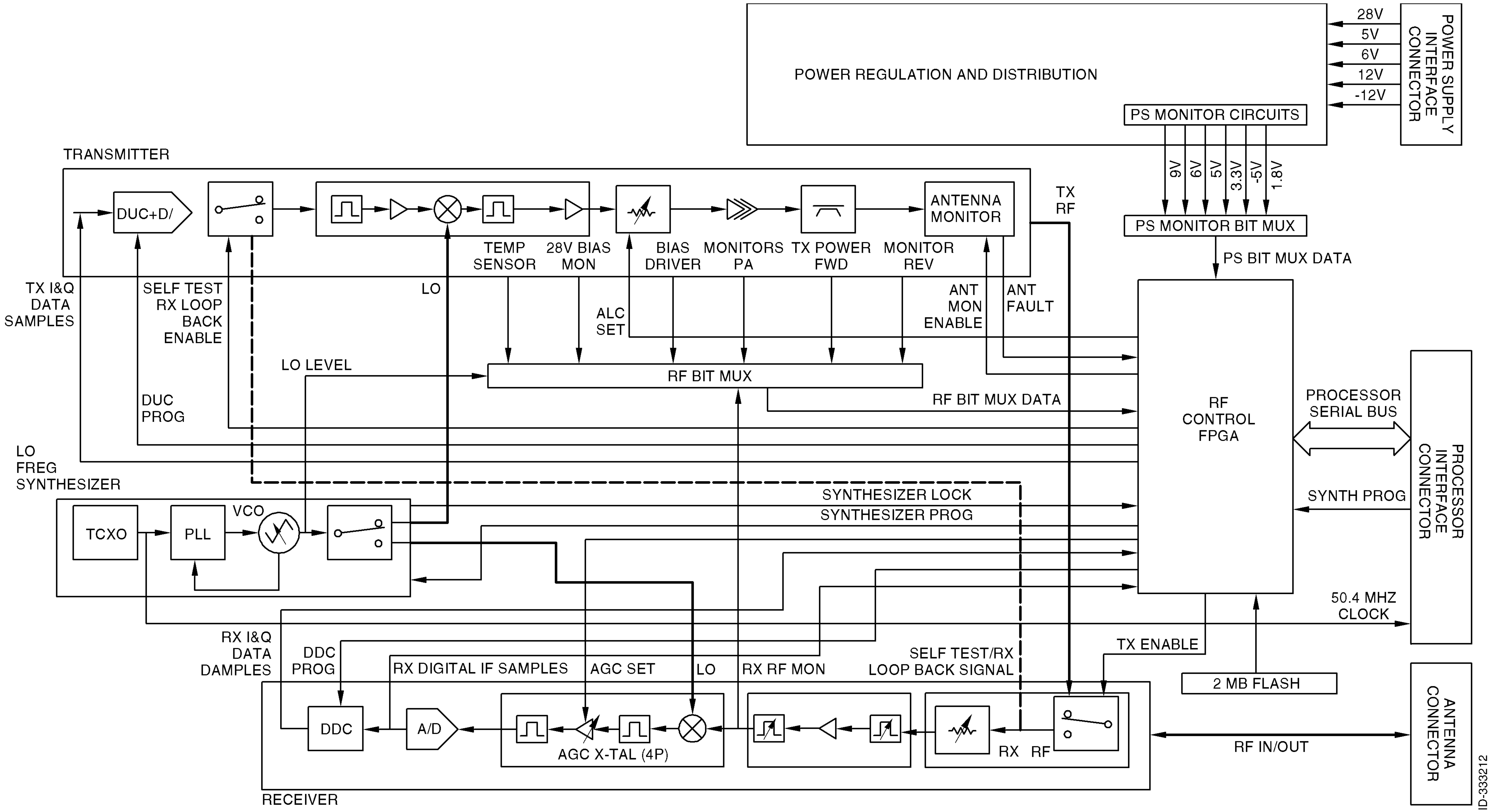


Figure 8. (Sheet 1 of 1) RF CCA (GRAPHIC 23-20-59-99B-811-A01)

(2) Receiver

(a) The receiver section of the RF CCA employs a heterodyne architecture to convert a received RF signal in the 118 to 136.975-MHz range to baseband quadrature digital samples.

(b) A preselector filter followed by an LNA and another preselector filter first limit the RF bandwidth to about less than 2 MHz centered about the selected operating frequency. The preselectors center frequency is voltage controlled. The voltage level is selected by the RF control FPGA from a table of settings prestored in an EEPROM whenever a new operating frequency is selected. A pin-diode variable attenuator preceding the first preselector provides the means to attenuate the received RF signal when the output of the second preselector exceeds the level at which the RF-to-IF conversion mixer becomes nonlinear.

(c) The RF-to-IF conversion is accomplished by mixing the received RF signal with a LO signal in the 139.825 to 158.800-MHz range to produce an IF signal at 21.825 MHz. A four-pole crystal filter with nominal 25-kHz bandwidth which follows the mixer provides enough rejection of undesired signals occupying channels adjacent to the selected frequency to prevent aliasing and/or desensitization in the A/D conversion process.

(d) The IF signal is then digitized at 50.4 mega-samples each second by an ADC and digitally down converted to baseband in-phase and quadrature digital sample streams using a programmable DDC integrated circuit. The DDC also performs the 25 or 8.33-kHz channel selectivity filtering to reject adjacent channel signals. The DDC channel selectivity is preprogrammed and the desired channel bandwidth is selected by the RF control FPGA whenever a new channel is selected. The filtered in-phase and quadrature digital sample streams are decimated by the DDC and sent to the digital processor CCA at an 84-kHz rate through a serial bus interface provided by the RF control FPGA.

(e) The input signal level at the ADC is held constant by means of an AGC amplifier circuit. The AGC control signal is generated by a DSP in the digital processor CCA and passed on to the RF CCA through the serial bus connection to the RF control FPGA.

(3) Transmitter

(a) The transmitter section of the RF CCA also utilizes a heterodyne architecture for conversion of in-phase and quadrature digital samples to a RF signal in the 118 to 136.975-MHz band.

(b) Baseband in-phase and quadrature digital sample streams generated by the digital processor CCA are sent to the RF CCA at a 252-kHz rate in serial format through the serial bus connection to the RF control FPGA. A preprogrammed DUC up samples and interpolates the in-phase and quadrature digital sample streams to a 50.4-MHz sample rate and up converts them to an analog IF signal at 21.825 MHz.

(c) A four-pole crystal filter with nominal 25-kHz bandwidth is used to reject the harmonics and spurious of the D/A conversion process. This IF signal is amplified and up converted to the selected VHF channel by mixing it with the same 139.825 to 158.800-MHz LO used by the receiver. A SAW filter with 20-MHz bandwidth (centered on the 118 to 137-MHz band), followed by a post selector filter with about a 4-MHz bandwidth (centered about the selected operating frequency) are then used to reject LO leakage and harmonic products of the mixer. The post selectors center frequency is voltage controlled. The voltage level is selected by the RF control FPGA from a table of settings prestored in an EEPROM whenever a new operating frequency is selected.

(d) The filtered RF signal is then amplified to produce a 25-watt average RF output signal when operating in DSB-AM voice or ACARS Mode A data mode, or a 17.5-watt average RF output signal when operating in VDL Mode 2 data mode. An ALC signal generated by the RF control FPGA is used to set the transmitter output power at the desired level for the operating mode during the ramp-up transition from receive to transmit. When operating in DSB-AM voice or data mode, the ALC signal is also used to maintain the output signal level at the desired level throughout the transmission.

(e) A 20-dB coupler at the output of the transmitter is used to obtain low-power forward and reverse voltage replicas of the transmitted RF signal. The forward and reverse voltages are envelope detected and digitized for downstream processing by the RF control FPGA and DSPs on the digital processor CCA. The forward voltage signal is used by the FPGA to derive the ALC control signal and by the DSPs to derive transmit audio side tone when operating in DSB-AM voice mode. The forward and reverse voltages are used by the DSP to monitor the antenna VSWR during transmit operation in all modes.

(f) An antenna DC ground monitoring circuit is also used at the antenna port to detect antenna faults on aircraft installations that use DC grounded antennas (pin programming selectable).

(4) LO Frequency Synthesizer

(a) The LO frequency synthesizer section of the RF CCA generates the 139.825 to 158.800-MHz LO signal that is used by the transmitter and receiver chains. The LO frequency synthesizer is comprised of a reference oscillator, a PLL frequency synthesizer integrated circuit, and VCO.

(b) The reference oscillator is a TCXO that generates a 50.4-MHz reference clock signal that is used to generate the LO frequency as well as the clocks for the ADC, DDC, DUC, and for the digital processor circuitry.

(c) The PLL and VCO generate the selected LO frequency from the reference frequency provided by the TCXO. The LO frequency selection (tuning) is controlled by the digital processor CCA and the synthesizer programming data is passed to the LO frequency synthesizer through the RF control FPGA. The LO frequency synthesizer provides an indication (synthesizer lock) to the RF control FPGA when it has tuned to the selected frequency.

(5) RF Control

(a) The RF control functions are implemented in a Xilinx Spartan IIe FPGA with 300,000 gates. The RF control FPGA is responsible for managing the flow of transmit and receive digital data samples, and command and control data by interfaces to the devices that follow:

- TMS320C6711 DSP bi-directional serial communications port (MCBSP) interface
- MPC8250 processor SPI
- Transmitter DUC interface
- Receiver DDC interface
- Receiver high-speed A/D converter (ADC) interface
- Frequency synthesizer interface
- RF BIT MUX A/D converter interface
- Voltage monitoring BIT MUX A/D converter interface

- Digital potentiometer interface
- Serial EEPROM interface
- Transmitter ALC
- External discrete I/O interface.

(b) The RF control FPGA receives 24-bit command data consisting of alternating 14-bit I and Q transmit data samples, 6-bit control words, and 4-bit command code sent from the TMS6711 DSP on the downstream MCBSP serial bus at a 504-kHz rate. The RF control FPGA writes the 14-bit I or Q data to the DUC if transmit mode is enabled (appropriate bit in control word is set), and decodes the 6-bit control words to control various transceiver components on the RF CCA. The transceiver functions controlled are as follows:

- Enabling of Tx function
- Antenna Tx/Rx switching
- LO Tx/Rx switching
- Driver/PA Tx bias enabling
- Forced termination of Tx data flow.

(c) The TMS6711 DSP also uses the downstream 24-bit command data to command the RF control FPGA to program and configure the DUC and DDC during power up and after mode changes.

(d) The RF control FPGA sends 192-bit data frames to the TMS6711 DSP on a second (upstream) MCBSP serial bus at an 84-kHz rate. The 192-bit frame contains:

- The 32-bit I and Q receive data from DDC channel 0 for data demodulation
- The 32-bit I and Q receive data from DDC channel I for adjacent channel interference detection
- The 32-bit ADC output values for AGC
- The 32-bit frame ID/BIT data values for frame synchronization and fault/event detection.

(e) The BIT data content of the last 32 bits of each frame rotates on an 8-frame cycle. The 17-bit data consists of an 8-bit field that alternates between data samples of:

- Driver bias monitor
- PA bias monitor
- Temperature sense
- An Rx RF monitor
- A 28-volt monitor
- Rx LO level monitor
- Requested data ID or requested data
- An 8-bit field that alternates between samples of forward power and reverse power
- A 1-bit field that alternates between antenna DC monitor, synthesizer lock, FPGA SEU flag, FPGA watchdog, and DUC overflow flag status.

(f) The transmission of each frame is periodic and synchronized to the receiver DDC frame synchronization signal. An automatic upstream mode also exists to send data when the DDC is not operating.

(g) In transmit mode, the RF control FPGA uses the RF BIT MUX forward power samples to derive an automatic level control signal to adjust the PA gain using the digital potentiometer interface.

(h) Other functions performed by the RF control FPGA include:

- MPC8250 processor and TMS6711 DSP write access to the LO frequency synthesizer device to select the LO frequency
- TMS6711 DSP read/write access to the serial EEPROM through commands
- TMS6711 DSP write access to the serial pot interface to update 1 of 16 available digital potentiometers
- TMS6711 DSP write access to various FPGA mode and discrete output registers
- TMS6711 DSP read access to RF control FPGA revision and discrete input bits.

(6) BIT Monitoring

(a) The RF CCA incorporates BIT circuitry to detect failures both during normal operation as well as during power on self-test and operator-initiated self-test.

(b) The Tx/Rx BIT signals continuously monitored (RF BIT MUX) during normal transmit and receive operation include:

- Transmit forward power measured at the antenna port during transmit operation
- Reflected power measured at the antenna port during transmit operation
- Primary 28-volt input to the RTA-50D VDR
- DC bias voltages of the driver and final PA devices
- Temperature of the RF CCA
- Received signal level at down converter mixer
- LO output level.

(c) The distributed voltage regulators continuously monitored (PS monitor BIT MUX) include:

- 9-volt regulator output
- 6-volt regulator output
- 5-volt regulator output
- 3.3-volt regulator output
- -5-volt regulator output
- 1.8-volt regulator output.

(d) Other signals continuously monitored are the synthesizer lock detector output.

(e) During power on self-test, the RF CCA performs an antenna continuity test to detect the presence or absence of an antenna connection and a receiver functionality test under the control of the digital processor CCA. The receiver functionality test consists of looping back a test RF signal generated by the DUC that is injected into the receiver chain and measuring the SNR of the received signal. Refer to Figure 8.

(f) When self-test is initiated by the operator, the RF CCA performs the antenna continuity test and receiver functionality test as well as a transmitter/antenna test. The transmitter/antenna test consists of the transmission of a test signal at 118 MHz and the measurement of the forward transmitted and reflected powers at the antenna port.

Reporting of the measurements to the digital processor CCA for computation of the VSWR then takes place.

D. **Digital Processor CCA** (Subtask 23-20-59-870-021-A01)

(1) General

(a) The digital processor CCA comprises nine processing sections:

- MPC8250 main processor
- TMS320C6711 digital signal processor (main DSP)
- TMS320VC5410A digital signal processor (auxiliary DSP)
- Audio I/O circuitry
- ARINC 429 I/O circuitry
- Discrete I/O circuitry
- Clock generation circuitry
- Monitoring circuitry
- Manufacturing and engineering support I/O circuitry.

(b) A block diagram of the digital processor CCA is shown in Figure 9.

Blank Page

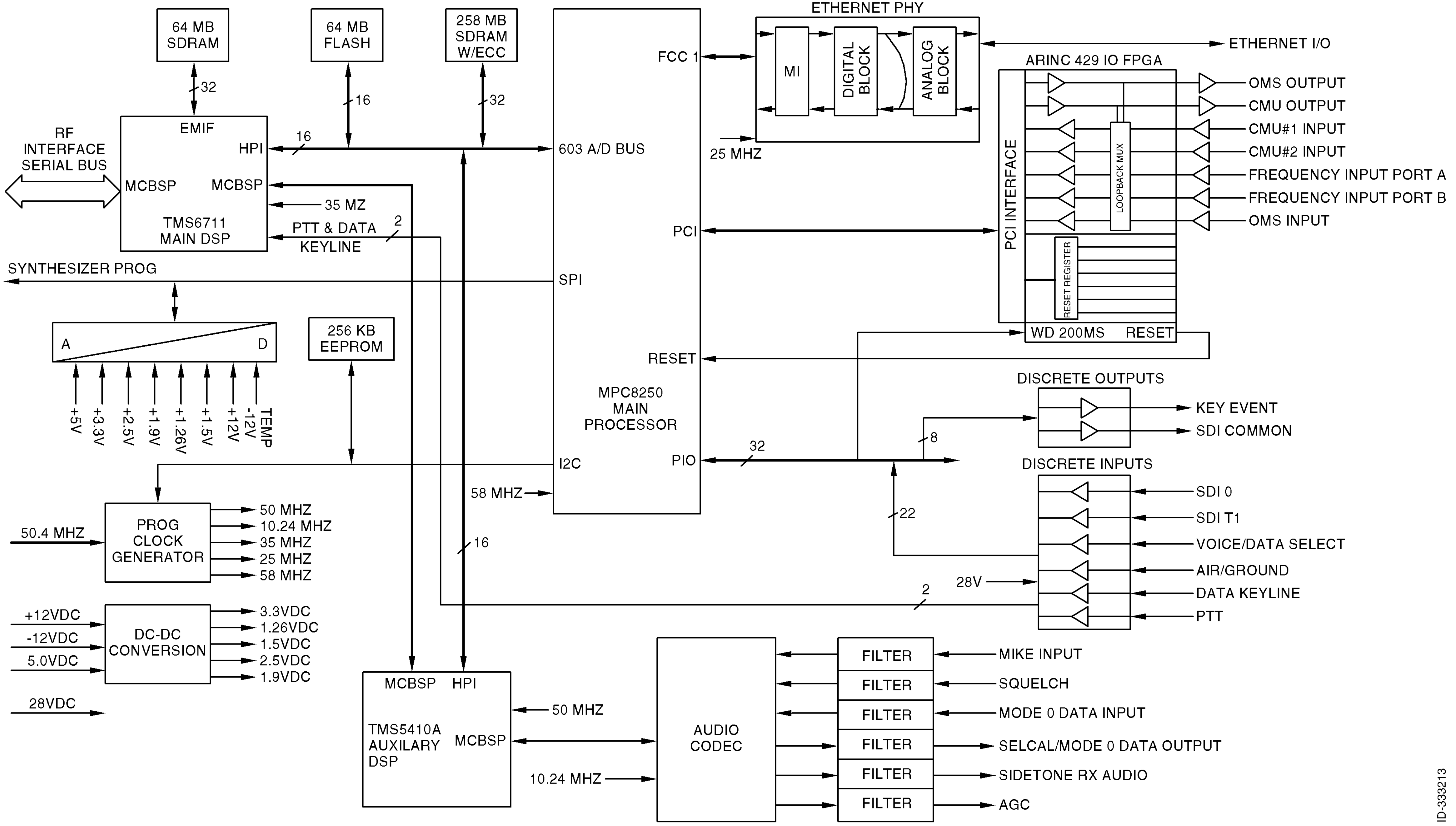


Figure 9. (Sheet 1 of 1) Digital Processor CCA Block Diagram (GRAPHIC 23-20-59-99B-812-A01)

(2) Main Processor

(a) The main processor is a Motorola MPC8250 Power PC with 64 Mbit of external flash for boot/program memory, 256 Mbit of external SDRAM for program and data memory, 64 Mbit of external SDRAM for program and data memory ECC, and 256 Kbit external EEPROM for fault and configuration memory.

(b) The MPC8250 processor interfaces to the ARINC 429 I/O FPGA through a PCI bus and to discrete inputs and outputs to determine the mode of operation and frequency/channel selection. The MPC8250 processor performs the tuning of the VHF transceiver LO synthesizer according to the selected mode and channel through the RF control FPGA on the RF CCA by means of a SPI.

(c) The MPC8250 processor interfaces to the TMS6711 DSP and TMS5410 DSP through shared memory messages accessed by HPI built into each DSP. The HPI is a parallel port through which the MPC8250 can directly access the DSP shared memory. When operating in the Mode A or Mode 2 data modes, the MPC8250 manages the delivery of uplink data messages received from the TMS6711 DSP to the ARINC 429 transmitter within the ARINC 429 I/O FPGA that interfaces to the external user (ATSU or CMU). It also controls the flow of downlink data messages received from the ARINC 429 receiver that interfaces to ATSU or CMU to the TMS6711 DSP.

(d) The MPC8250 processor also interfaces on an external OMS through an ARINC 429 transmitter/receiver pair synthesized within the ARINC 429 I/O FPGA to report fault data collected by BIT function.

(e) The MPC8250 processor BIT function controls three different modes of self-test that are used to monitor the health of the RTA-50D VDR and detect faults:

- Power on self-test
- Operator initiated functional self-test
- Background (continuous monitoring) self-test.

(f) Power on self-test is initiated each time the power is cycled on the unit. Some tests are intrusive meaning that some VDR to aircraft interfaces can not be read or driven according to normal aircraft operation. The list that follows describes the functional blocks that are tested but not in what order:

- MPC8250 register test
- MPC8250 SDRAM
- MPC8250 FLASH
- MPC8250 EEPROM
- DSP HPI interface
- TMS6711 DSP register test
- TMS6711 DSP SDRAM
- TMS5410 DSP register test
- Audio CODEC register test
- ARINC 429 I/O FPGA PCI register test
- SDI discrete test
- Antenna monitor discrete test
- ARINC 429 I/O loopback

- Ethernet loopback
- RF control FPGA interface test
- Voltage monitor.

(g) Operator-initiated functional self-test can be initiated by pressing the front panel switch, grounding the functional test discrete or OMS command. The set of tests executed are the same as in the power on self-test plus additional transmitter and receiver loop back tests that check the functionality of the transmitter, antenna, interface, and receiver. This mode is useful in diagnosing problems only seen after the RTA-50D VDR has been running for some time.

(h) Background self-tests are run continuously in the RTA-50D VDR as long as power is applied. These tests only exercise circuitry in a way that is nonintrusive to system operation. The background self-tests listed as follows are a subset of the functional self-tests but, where possible, use the same test software routines:

- MPC8250 SDRAM
- MPC8250 FLASH
- MPC8250 EEPROM
- DSP HPI interface
- TMS6711 DSP SDRAM
- Ethernet loopback
- RF control FPGA interface test
- Voltage monitor.

(3) Main DSP

(a) The main DSP is a Texas Instruments TMS320C6711 DSP with 64 Mbit of external SDRAM for program and data memory.

(b) The TMS6711 DSP interfaces to the RF control FPGA through a MCBSP serial bus and to the TMS5410 DSP through a second MCBSP serial bus. The TMS6711 DSP interfaces to the MPC8250 through shared memory accessed by its HPI interface. The shared memory is configured as 64 message buffers of 4,096 bytes for each transfer direction as well as a 592-byte control/status buffer. The TMS6711 DSP program is loaded into its internal RAM and external SDRAM by the MPC8250 on power up.

(c) The TMS6711 DSP processes digital data provided by the RF control FPGA to generate the receiver AGC loop control voltage in all voice and data receive modes of operation.

(d) When operating in voice mode, the TMS6711 DSP monitors the PTT input to determine when to switch between receive and transmit operation, and controls the switching of the TMS5410 DSP between transmit and receive operation.

(e) When operating in voice transmit mode, the TMS6711 DSP performs the real-time DSB-AM of digitized voice samples received from the TMS5410 DSP and delivers 252-kilo sample each second streams of I and Q digital modulation samples to the RF CCA for RF carrier modulation and downlink transmission. Simultaneously while transmitting the modulation samples, the TMS6711 DSP delivers the forward power samples received from the RF CCA to the TMS5410 for side-tone output.

(f) When operating in voice receive mode, the TMS6711 DSP performs envelope detection of the 84-kilo sample each second I and Q digital data streams received from the RF CCA and delivers the demodulated samples to the TMS5410 DSP.

(g) When operating in Mode A or Mode 2 data mode, the TMS6711 DSP monitors the receiver AGC control loop voltage to determine when the channel is idle and available for transmit operation. When the channel is idle and a data message is queued for transmission, the TMS6711 DSP switches to data transmit operation; otherwise it operates in data receive mode. When operating in data transmit mode, the TMS6711 DSP performs the encoding of data messages received from the MPC8250 and generates a 252-kilo sample each second. Streams of I and Q digital samples of the modulation waveform correspond to the data mode selected by the user. When operating in data receive mode, the TMS6711 DSP performs message detection, decoding, error detection, and address screening, and delivers the error-free decoded messages with matching address to the MPC8250 for up-stream delivery.

(4) Auxiliary DSP

(a) The auxiliary DSP is a Texas Instruments TMS320VC5410 DSP with no external memory.

(b) The TMS5410 DSP interfaces to the TMS6711 DSP through McBSP serial bus and to the audio input/output CODEC through a second McBSP serial bus. The TMS5410 DSP interfaces to the MPC8250 through shared memory accessed by its HPI interface. The shared memory is configured as 8 message buffers of 176 bytes for data transfer to the MPS8250, 12 message buffers of 176 bytes for data transfer from the MPC8250, and a 16-byte control/status buffer. The TMS5410 DSP program is loaded into its internal RAM by the MPC8250 on power up.

(c) When operating in transmit mode, the TMS5410 DSP performs digital filtering of the digitized audio input samples provided by the audio CODEC at 42-kilo samples each second and sends the filtered transmit audio samples to the TMS6711 DSP for DSB-AM modulation and up-sampling. The demodulated transmit audio which is simultaneously received from the TMS6711 DSP is sent to the side-tone output of the audio CODEC.

(d) When operating in receive mode the TMS5410 DSP performs the audio bandpass filtering and squelch control processing functions and sends the 42-kilo sample each second stream of digital audio samples to the receive/side-tone output of the audio CODEC.

(5) Audio I/O Circuitry

(a) The audio I/O circuitry is comprised of an Analog Devices ADI836AS audio CODEC integrated circuit that supports A/D and D/A conversion of up to four channels, and audio input/output conditioning (low-pass filters) for each audio signal.

(b) Three CODEC A/D channels are used to support the following audio inputs:

- Microphone audio input for use on installations that support DSB-AM voice
- Modem audio input for use on installations that support Mode 0 data
- Remote squelch control input for use on installations that support remote squelch control of DSB-AM voice audio.

(c) Three CODEC D/A channels are used to support the following audio outputs:

- Received audio/side-tone output to the speaker for use on installations that support DSB-AM voice
- SELCAL audio output for use on installations that support DSB-AM voice or Mode 0 data link modem audio output for use on Mode 0 data installations
- Analog AGC control voltage to support DSB-AM MOPS compliance testing.

(6) ARINC 429 I/O Circuitry

(a) The ARINC 429 I/O transmitter encoding and receiver decoding logic is implemented in an Actel ProASIC Plus flash FPGA with 600,000 gates. Digital logic-to-CMOS level translation circuits are provided externally for each transmitter and receiver.

(b) The ARINC429 I/O FPGA interfaces to the MPC8250 through a PCI bus interface. The ARINC 429 I/O FPGA supports 4 ARINC 429 transmitters and 11 ARINC 429 receivers with automatic speed detection.

(c) The ARINC 429 transmitters are used to do the following functions:

- Data link output high-speed transmitter
- OMS output low-speed transmitter
- Two spare transmitters.

(d) The ARINC 429 receivers are used to do the following functions:

- Two frequency select tuning input receivers
- Two data link input receivers
- Two OMS input receivers
- Five spare receivers.

(7) Clock Generator

(a) The clocks for the various processors are generated by a Cypress Semiconductor programmable clock generator integrated circuit. The clock generator derives the following clocks from a 50.4-MHz clock input from RF CCA:

- 58-MHz clock provided to the MPC8250
- 50-MHz clock provided to the TMS5410 DSP
- 35-MHz clock provided to the TMS6711 DSP
- 25-MHz clock provided to the Ethernet transceiver
- 10.24-MHz clock provided to the audio CODEC.

(8) Monitoring Circuitry

(a) The monitoring circuitry consists of voltage level monitoring circuits and a processor watchdog circuit. The digital processor regulator voltage levels monitored are as follows:

- +12 volts
- −12 volts
- +5 volts
- +3.3 volts
- +2.5 volts
- +1.9 volts
- +1.5 volts
- +1.26 volts.

(b) The ARINC 429 I/O FPGA provides a supervisory watchdog function used to monitor the MPC8250 main processor. If the MPC8250 fails to monitor the watchdog register at 10-ms intervals, the MPC8250 is reset by the ARINC 429 I/O FPGA.

(9) Manufacturing and Engineering Support I/O Circuitry

(a) The manufacturing and engineering support I/O circuitry consists of:

- Ethernet interface used for data loading and troubleshooting
- RS232 port used for test equipment support.

E. Front Panel I/O Board (Subtask 23-20-59-870-022-A01)

(1) The front panel I/O board performs the conditioning of the signals that drive three LED lights and monitors a push-button switch on the front panel of the RTA-50D VDR to initiate LRU self-test. No self-test is available for this subassembly.

F. Power Supply (Subtask 23-20-59-870-023-A01)

(1) The power supply subassembly is a self-contained high-efficiency power supply that converts the 28-VDC power into the DC operating voltages required by each subassembly. The power supply circuitry is grouped into three sections:

- Power hold circuitry
- Input voltage conditioning circuitry
- DC-to-DC voltage conversion and output voltage conditioning.

(2) The power supply is capable of holding power up during power input interrupts lasting up to 200 ms. Each of the power supply output voltages are monitored on either the RF subassembly or the processor subassembly.

G. Rear Interconnect (Subtask 23-20-59-870-024-A01)

(1) The rear interconnect subassembly consists of the ARINC 600 connector that provides the means to interface the power supply module, the processor CCA, and the RF CCA to the aircraft wiring, and HIRF and lightning protection circuitry for each input/output. The RF and power supply inputs are in the bottom plug. Discrete, ARINC 429, and analog audio inputs/outputs are in the middle plug and the top plug.

(2) There is no active circuitry on this assembly and thus it has a low failure rate. No self-test is available for the rear interconnect.

Blank Page

FAULT ISOLATION

1. Planning Data (TASK 23-20-59-99C-801-A01)

A. Reason for the Job (Subtask 23-20-59-99C-002-A01)

(1) Use the procedures in this section to isolate faults.

(2) Fault isolation is the process of isolating the source of a system failure to an LRU or to the aircraft wiring.

(3) It is recommended that a system test of the RTA-50D VDR be done in accordance with the instructions provided in the aircraft manufacturer’s AMM to confirm the reported fault condition.

(4) Access to the equipment bay is necessary to view the RTA-50D VDR front panel maintenance status information and/or to initiate a self-test of the RTA-50D VDR equipment.

(5) Fault isolation in the RTA-50D VDR includes a continuity check of the interwiring and the assurance that correct installation techniques and procedures have been followed.

B. Job Setup Data (Subtask 23-20-59-99C-003-A01)

(1) The list that follows identifies Honeywell publications that are related to this section:

- Not applicable.

2. Procedure (TASK 23-20-59-810-801-A01)

A. Job Setup (Subtask 23-20-59-810-001-A01)

CAUTION: USE INDUSTRY APPROVED ELECTROSTATIC DISCHARGE SENSITIVE PRECAUTIONS. THE RTA-50D VERY-HIGH FREQUENCY DATA RADIO CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE ITEMS.

CAUTION: DO NOT DROP OR HIT THE RTA-50D VERY-HIGH FREQUENCY DATA RADIO DURING THESE PROCEDURES. THE RTA-50D VERY-HIGH FREQUENCY DATA RADIO CONTAINS AN ASSEMBLY THAT CAN BE DAMAGED FROM INCORRECT USE.

(1) Obey the precautions.

B. Functional Self-Test (Subtask 23-20-59-810-002-A01)

(1) A functional self-test of the RTA-50D VDR can be initiated by pressing the test key push-button on the front panel.

(2) Results of the functional self-test are displayed on the LEDs located on the front panel. Refer to Figure 1001.

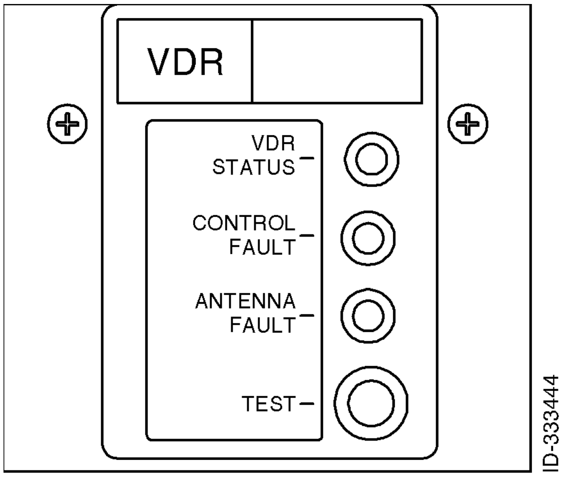


Figure 1001. (Sheet 1 of 1) RTA-50D VDR Front Panel Functional Self-Test Interface
(GRAPHIC 23-20-59-99B-813-A01)

C. **RTA-50D VDR Test Results** (Subtask 23-20-59-810-003-A01)

(1) Apply power to the RTA-50D VDR in accordance with the aircraft manufacturer’s AMM and confirm that the circuit breaker associated with the RTA-50D VDR equipment is closed.

(2) Locate the RTA-50D VDR in the equipment bay and observe the status of the LEDs according to the information provided in Table 1001.

(3) In the event that a failure condition is indicated, do a self-test on the RTA-50D VDR as follows.

(a) While power is applied to the RTA-50D VDR, momentarily depress the TEST push button on the front panel.

(b) Observe the LEDs according to the information provided in Table 1001.

(c) In the event that a failure condition is indicated, note the indication and do the corrective action associated with the indicated fault condition.

Table 1001. Front Panel Functional Self-Test Results

Mode	RTA-50D Power	VDR Status	Control Fault	Antenna Fault	Reported Condition	Possible Corrective Action	Comment
Power off	Off	Off	Off	Off	LRU powered off	None	LRU power not applied
Normal operation	On	Green	Off	Off	Normal operation	None	LRU operational, no errors detected

Table 1001. Front Panel Functional Self-Test Results (Cont)

Mode	RTA-50D Power	VDR Status	Control Fault	Antenna Fault	Reported Condition	Possible Corrective Action	Comment
General fault	On	Off	Off	Off	1. Breaker malfunction 2. LRU malfunction	1. Check aircraft breaker to LRU 2. Reapply power to LRU, remove if condition repeats	1. Power not reaching LRU due to breaker problem or 2. LRU has internal malfunction
External fault (control)	On	Green	Amber	Off	1. RTP and/or CMC controller not present 2. Internal malfunction of RTP/CMC interface	1. Check aircraft RTP and CMC controllers and/or connections 2. Press functional self-test button, remove if condition repeats	1. RTP and/or CMC controller is not present or 2. LRU has internal malfunction of RTP/CMC interface [1]
External fault (antenna)	On	Green	Off	Amber	1. Antenna is not present. 2. Internal malfunction of antenna interface.	1. Check aircraft antenna, and antenna connection 2. Press functional self-test button, remove if condition repeats	1. Antenna or antenna connection is not present or 2. LRU has internal malfunction of antenna interface [2]
External fault (control /antenna)	On	Green	Amber	Amber	Refer to external (control) fault and external (antenna) fault	Refer to External (control) fault and external (antenna) fault	Refer to external (control) fault and external (antenna) fault

Table 1001. Front Panel Functional Self-Test Results (Cont)

Mode	RTA-50D Power	VDR Status	Control Fault	Antenna Fault	Reported Condition	Possible Corrective Action	Comment
Internal fault (boot)	On	Amber	Amber	Amber	LRU did not complete boot sequence	Reapply power to LRU, remove if condition repeats	Boot sequence did not complete due to internal malfunction
Internal fault	On	Red	Off or Amber	Off or Amber	LRU reports internal malfunction	1. Press functional self-lest button 2. If condition repeats, reapply power to LRU 3. If condition repeats, remove LRU	LRU has detected internal malfunction

Table 1001. Front Panel Functional Self-Test Results (Cont)

Mode	RTA-50D Power	VDR Status	Control Fault	Antenna Fault	Reported Condition	Possible Corrective Action	Comment
Internal fault	On	Amber	Off or Amber	Off or Amber	LRU reports internal malfunction	1. Press functional self-test button 2. If condition repeats, reapply power to LRU 3. If condition repeats, remove LRU	LRU has detected internal malfunction
Internal fault	On	Off	Off or Amber	Off or Amber	LRU reports internal malfunction	1. Press functional self-test button 2. If condition repeats, reapply power to LRU 3. If condition repeats, remove LRU	LRU has detected internal malfunction

NOTES:

1 Only remove LRU if both RTP ports and both CMC ports are known to be connected and operating at time of fault inspection.

2 Only remove LRU if antenna is known to be good and antenna connection is verified to be good at time of fault inspection.

D. **Job Close-up** (Subtask 23-20-59-810-004-A01)

(1) Not applicable.

Blank Page

MAINTENANCE PRACTICES

1. Planning Data (TASK 23-20-59-99C-802-A01)

A. Reason for the Job (Subtask 23-20-59-99C-004-A01)

(1) This section gives service personnel installation and maintenance information for the RTA-50D VDR. Installation instructions are supported by mechanical outline drawings and an electrical interconnection diagram. These drawings must be reviewed by the installer and requirements unique to the airframe must be established before starting the installation.

(2) Use these diagrams as an aid to fault isolate the RTA-50D VDR.

B. Job Setup Data (Subtask 23-20-59-99C-005-A01)

(1) The list that follows identifies Honeywell publications that are related to this section:

- Not applicable.

2. Inspection After Unpacking (TASK 23-20-59-000-801-A01)

A. General (Subtask 23-20-59-000-001-A01)

CAUTION: THIS EQUIPMENT CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) DEVICES. EQUIPMENT, MODULES, AND ESDS DEVICES MUST BE HANDLED WITH APPROPRIATE PRECAUTIONS.

(1) Visually inspect the RTA-50D VDR and all associated equipment for possible damage which can have occurred during shipment. Inspect for dents, deep abrasions, chipped paint, etc. If any equipment is damaged, notify the transportation carrier immediately.

(2) The Honeywell test, inspection record, and quality report tag is included with each shipped unit. This informs the customer that the necessary production tests and inspection operations have been performed on that particular unit.

(3) One copy of the report tag is affixed to each unit by the first assembly inspector. As the unit proceeds through production and stock to the shipping area, the appropriate blocks on the test and inspection record of the tag are stamped. This tag accompanies the unit when it is shipped to the customer. Customers are requested to complete the Honeywell Airlines and Avionics Products quality report portion of the tag and return it to the Honeywell Airlines and Avionics Products Quality Assurance Department. This portion of the tag provides Honeywell with the necessary information required to evaluate shipping methods as well as test and inspection effectiveness.

(4) Completed cards are accumulated to give information for a periodic analysis.

3. Preinstallation Testing (TASK 23-20-59-000-802-A01)

A. Overview (Subtask 23-20-59-000-002-A01)

(1) The components in the RTA-50D VDR have been adjusted and tested before shipment. Preinstallation testing is not required. However if preinstallation testing of the RTA-50D VDR is desired, refer to the customer acceptance criteria given in the CMM for the appropriate unit in the system. Refer to Paragraph 3.A. (Subtask 23-20-59-99F-011-A01) in the INTRODUCTION (PGBLK 23-20-59-0) section for a list of related CMMs.

4. Equipment Changes and Marking (TASK 23-20-59-000-803-A01)

A. Overview (Subtask 23-20-59-000-003-A01)

(1) Honeywell uses a standardized marking system to identify equipment and their subassemblies which have had changes incorporated. Refer to the front of the appropriate CMM for a list of service bulletins affecting the unit.

5. Interchangeability (TASK 23-20-59-000-804-A01)

A. Overview (Subtask 23-20-59-000-004-A01)

(1) The RTA-50D VDR will operate in any installation that complies with ARINC Characteristic 566A. Refer to Figure 2001.

NOTE: Contact the OEM for certification status.

6. Installation (TASK 23-20-59-000-805-A01)

A. General (Subtask 23-20-59-000-005-A01)

CAUTION: AFTER INSTALLATION OF THE CABLING AND BEFORE INSTALLATION OF THE EQUIPMENT, A CHECK MUST BE MADE WITH AIRCRAFT PRIMARY POWER SUPPLIED TO THE MOUNT CONNECTORS TO MAKE SURE THAT POWER IS APPLIED ONLY TO THE PINS SPECIFIED IN INTERWIRING DIAGRAM. REFER TO FIGURE 2001.

(1) The RTA-50D VDR must be installed in the aircraft in a manner consistent with acceptable workmanship and engineering practices, and in accordance with the instructions in this manual. To make sure that the system has been properly and safely installed in the aircraft, the installer must make a thorough visual inspection and conduct an overall operational and functional check of the system on the ground before flight.

B. Location of Equipment (Subtask 23-20-59-000-006-A01)

(1) Location of the RTA-50D VDR in the aircraft is not critical as long as the environment is compatible with the equipment sign. Refer to Table 1 in the DESCRIPTION AND OPERATION (PGBLK 23-20-59-1) section. Forced air cooling is required for cooling the RTA-50D VDR communications transceiver in accordance with ARINC Characteristic 404A. The associated cooling equipment must be mounted in accordance with the manufacturer’s instructions.

(2) The RTA-50D VDR can use the existing MTA-43A mount or any other equivalent mounting tray that is compatible for securing a unit meeting the 1/2 ATR short form factor according to ARINC Characteristic 404.

(3) Antenna mounting must be in accordance with the manufacturer’s instructions for the antenna being used. The coaxial cable connecting the antenna to the mount must be as short and direct as possible and any required bends must be gradual. When two or more RTA-50D VDR systems are installed in an aircraft, it is necessary to give adequate space isolation between the antennas of each system to make sure that the use of one unit does not interfere with reception from another system. A minimum of 35 dB of space isolation must be provided and any steps which can be taken to give further isolation must be considered.

(4) Control unit location and mounting can be determined by mutual agreement between the user and airframe manufacturer.

C. **Interwiring and Cable Fabrication** (Subtask 23-20-59-000-007-A01)

(1) General

(a) Figure 2001 is the complete aircraft interwiring diagram for a single RTA-50D VDR system and associated components. This diagram requires complete study before the installer begins installation of the aircraft wiring.

(b) When two or more systems are being installed in the aircraft, the interconnecting wiring as well as all other installation instructions must be duplicated.

(c) Cabling must be fabricated by the installer. Wires connected to parallel pins must be approximately the same length so that the best distribution of current can be effected. Honeywell recommends that all wires including the spares must be included in the fabricated harness. However, if full ARINC wiring is not desired, the installer must make sure that the minimum wiring requirements for the features and functions are incorporated. Refer to Figure 2001.

NOTE: To allow for inspection or repair of the connector or the wiring to the connector, sufficient lead length must be provided. This will let the rear connector assembly to be pulled forward several inches when the mounting hardware for the rear connector assembly is removed. A bend must be made in the harness near the connector to let water condensation drip off at the bend and not collect at the connector.

(d) When the cables are installed in the aircraft, they must be supported firmly enough to prevent movement and must be carefully protected against chafing. Additional protection must also be provided in all locations where the cables can be subject to abuse. In wire bundles, the cabling must not be tied tightly together as this tends to increase the possibility of noise pick-up and similar interference. When routing cables through the airframe, try to avoid running cables or wire close to power sources (400-Hz generator, etc.). If unavoidable, the cables must cross high-level lines at a right angle or high-quality shielded conductors must be used.

(e) If a cable must pass through a bulkhead between pressurized and unpressurized zones, this passage must conform to the aircraft manufacturer's specifications.

(f) The assembler must be knowledgeable of any system variations unique to the installation and must completely understand the complexities associated with handling related problems of line lengths, capacitance, and of susceptibility to interference.

(g) The following determinants are the responsibility of the installation agency for fabrication of the wiring harness. Refer to Table 2001.

Table 2001. RTA-50D VDR Communications Transceiver Connector Determinants

Pin No.	Type	Signal Name	Function
MPA1	Input	MIC audio input (high)	Microphone audio input. Part of the standard four wire microphone interwiring as described in Attachment 6 of ARINC 716-10. Required for ARINC 716 VHF communication only.
MPB1	Input	MIC audio input (low)	Microphone audio input. Part of the standard four wire microphone interwiring as described in Attachment 6 of ARINC 716-10. Required for ARINC 716 VHF communication only.

Table 2001. RTA-50D VDR Communications Transceiver Connector Determinants (Cont)

Pin No.	Type	Signal Name	Function
MPC1	Input	MIC PTT	Microphone PTT discrete input. Ground/low = transmitter keyed. Open/high = transmitter not keyed. Part of the standard four-wire MIC interwiring as described in Attachment 6 of ARINC 716·10. Required for ARINC 716 VHF communication only.
MPD1	Output	Key event	Discrete input to flight recorder. Follows the state of MIC PTT input. Ground/low = transmitter keyed Open/high = transmitter not keyed Required for ARINC 716 VHF communication only.
MPA2	Input	MAX transmit time cutoff function	Discrete input that enables the MAX transmit cutoff function. Ground/Low = cutoff disabled Open/High = cutoff enabled
MPB2	NA	MIC input ground	Required for ARINC 716 VHF communication only.
MPC2	Input	Data loader input Bus A	A high-speed ARINC 429 input port to allow on-board data loading for software.
MPD2	Input	Data loader input Bus B	A high-speed ARINC 429 input port to allow on-board data loading for software.
MPA3	Input	Optional remote squelch (high)	To accommodate an optional remote squelch adjustment if so required or provided. Required for ARINC 716 VHF communication only.
MPB3	Input	Optional remote squelch (arm)	To accommodate an optional remote squelch adjustment if so required or provided. Required for ARINC 716 VHF communication only.
MPC3	Input	Optional remote squelch (low)	To accommodate an optional remote squelch adjustment if so required or provided. Required for ARINC 716 VHF communication only.
MPD3	NA	DC ground	Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
MPA4	Input	Functional test	Discrete input that activates LRU functional test function. ground/low = activate functional test. Required for ARINC 716 VHF communication.
MPB4	NA	Audio ground	Required for ARINC 716 VHF communication only.
MPC4	Output	Data loader output Bus A	A high-speed ARINC 429 output port to allow on-board data loading for software.
MPD4	Output	Data loader output Bus B	A high-speed ARINC 429 output port to allow on-board data loading for software.

Table 2001. RTA-50D VDR Communications Transceiver Connector Determinants (Cont)

Pin No.	Type	Signal Name	Function
MPA5	Input	Data link data input (high)	Analog 2,400-bps ACARS data input. Required for ARINC 716 VHF communication only.
MPB5	Input	Data link data input (low)	Analog 2,400-bps ACARS data input. Required for ARINC 716 VHF communication only.
MPC5	NA	Reserved No. 1	Leave open.
MPD5	Output	8.33 kHz programming	Discrete output that indicates to control panel the VDR is capable of 8.33 or 25-kHz operation. This output is internally grounded.
MPA6	Input	Data from OMS/CFDS No. 1 Input Port (A)	One of two low-speed ARINC 429 data input ports provided for dual OMS/CFDSs. Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
MPB6	Input	Data from OMS/CFDS No. 1 Input Port (B)	One of two low-speed ARINC 429 data input ports provided for dual OMS/CFDSs. Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
MPC6	Input	Data from OMS/CFDS No. 2 Input Port (A)	One of two low-speed ARINC 429 data input ports provided for dual OMS/CFDSs. Required for ARINC 750 VDR only.
MPD6	Input	Data from OMS/CFDS No. 2 Input Port (B)	One of two low-speed ARINC 429 data input ports provided for dual OMS/CFDSs. Required for ARINC 750 VDR only.
MPA7	Input	Frequency/function select data I/P Port B (A)	One of two low-speed ARINC 429 input ports to provide frequency tuning data. Required for ARINC 716 VHF communication only.
MPB7	Input	Frequency/function select data I/P Port B (B)	One of two low-speed ARINC 429 input ports to provide frequency tuning data. Required for ARINC 716 VHF communication only.
MPC7	Input	Voice/data select	Discrete input that enables either the PTT key line (MPC1) or the Data key line (MPD7). Ground/low = data Key line enabled Open/High = PTT enabled. Required for ARINC 716 VHF communication only.
MPD7	Input	Data key line	Discrete input that keys the transmitter. Ground/low = transmitter keyed. Open/high = transmitter not keyed. Required for ARINC 716 VHF communication only.
MPA8	Input	Antenna monitor enable input	Discrete input that allows antenna monitor function at power-up. Ground/low = monitor enabled. Open/high = monitor disabled.

Table 2001. RTA-50D VDR Communications Transceiver Connector Determinants (Cont)

Pin No.	Type	Signal Name	Function
MPB8	Input	Data loader enable input	Discrete input to allow on-board data loading of software. Required for ARINC 750 VDR only.
MPC8	Input	Frequency offset enable	Not implemented.
MPD8	NA	Data key line return	Required for ARINC 716 VHF communication only.
MPA9	Input	SDI Bit 0 program	A discrete input pair pre-wired at the rear connector to identify the specific VHF radio location in the aircraft. Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
MPB9	Input	SDI Bit 1 program	A discrete input pair pre-wired at the rear connector to identify the specific VHF radio location in the aircraft. Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
MPC9	NA	SPI program pin common	Ground for the SDI code inputs. Required for ARINC 716 VHF communication only.
MPD9	Output	AGC out	AGC output signal for test purposes.
MPA10	NA	Spare	NA
MPB10	NA	Spare	NA
MPC10	Output	Data to CMU No. 1, CMU No. 2 output Port (A)	A high-speed ARINC 429 output port to CMU/MU/ATSU No. 1 and No. 2. Required for ARINC 750 VDR only.
MPD10	Output	Data to CMU No. 1, CMU No. 2 output Port (B)	A high-speed ARINC 429 output port to CMU/MU/ATSU No. 1 and No. 2. Required for ARINC 750 VDR only.
MPA11	Input	Frequency/function select data I/P Port A (A)	One of two low-speed ARINC 429 input ports to provide frequency tuning data. Required for ARINC 716 VHF communication only.
MPB11	Input	Frequency/function select data I/P Port A (B)	One of two low-speed ARINC 429 input ports to provide frequency tuning data. Required for ARINC 716 VHF communication only.
MPC11	Input	Maintenance system ID 1	Identifies CFDS type along with MPA14.
MPD11	Input	Frequency port select	Discrete input used to select either frequency/function select data I/P Port A or B. Ground/low = Select Port A. Open/high = Select Port B. Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
MPA12	Input	CMU No. 1 input Bus A	A high-speed ARINC 429 input port from CMU/MU/ATSU No. 1. Used to receive commands/status/data in Williamsburg files, and periodic and aperiodic ARINC 429 words. Required for ARINC 750 VDR only.

Table 2001. RTA-50D VDR Communications Transceiver Connector Determinants (Cont)

Pin No.	Type	Signal Name	Function
MPB12	Input	CMU No. 1 input Bus B	A high-speed ARINC 429 input port from CMU/MU/ATSU No. 1. Used to receive commands/status/data in Williamsburg files, and periodic and aperiodic ARINC 429 words. Required for ARINC 750 VDR only.
MPC12	Input	CMU No. 2 input Bus A	A high-speed ARINC 429 input port from CMU/MU/ATSU No. 2. Used to receive commands/status data in Williamsburg files, and periodic and aperiodic ARINC 429 words. Required for ARINC 750 VDR only.
MPD12	Input	CMU No. 2 input Bus B	A high-speed ARINC 429 input port from CMU/MU/ATSU No. 2. Used to receive commands/status data in Williamsburg files, and periodic and aperiodic ARINC 429 words. Required for ARINC 750 VDR only.
MPA13	Output	SELCAL audio and data link output (high)	An analog output to provide 2400-bps MSK data to the ACARS MU. May also be used for SELCAL provisions. Required for ARINC 716 VHF communication only.
MPB13	Output	SELCAL audio and data link output (low)	An analog output to provide 2400-bps MSK data to the ACARS MU. May also be used for SELCAL provisions. Required for ARINC 716 VHF communication only.
MPC13	Input	Squelch disable	A discrete input to provide squelch override or disable capability. Required for ARINC 716 VHF communication only.
MPD13	NA	Squelch disable return	A discrete input to provide squelch override or disable capability. Required for ARINC 716 VHF communication only.
MPA14	Input	Maintenance system ID 0	Identifies CFDS type along with MPC11.
MPB14	Input	Air/ground discrete	A discrete input to indicate if the aircraft is in the air or on the ground. Ground/low = airborne. Open/high = on ground. Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
MPC14	Output	Data to OMS/CFDS output Port A	A low-speed ARINC 429 output port to one or two OMS/CFDSs. Required for both ARINC 716 VHF communication and ARINC 750 VDR. Functions are identical.
MPD14	Output	Data to OMS/CFDS output Port B	A low-speed ARINC 429 output port to one or two OMS/CFDSs. Required for both ARINC 716 VHF communication and ARINC 750 VDR. Functions are identical.

Table 2001. RTA-50D VDR Communications Transceiver Connector Determinants (Cont)

Pin No.	Type	Signal Name	Function
MPA15	Output	Audio/side-tone output (high)	An analog output for receiver audio during receive mode and side-tone audio during voice transmit modes. Required for ARINC 716 VHF communication only.
MPB15	Output	Audio/side-tone output (low)	An analog output for receiver audio during receive mode and side-tone audio during voice transmit modes. Required for ARINC 716 VHF communication only.
MPC15	Output	Muting	An optional two wire discrete output to provide a switch closure internal to the VHF communication for external system muting applications during transmit modes. Open = muting off. Ground = muting on. Required for ARINC 716 VHF communication only.
MPD15	NA	Muting return	An optional two wire discrete output to provide a switch closure internal to the VHF communication for external system muting applications during transmit modes. Open = muting off. Ground = muting on. Required for ARINC 716 VHF communication only.
BP1	Input /output	Antenna RF input	Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
BP2	Input	DC power input +27.5 VDC	Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
BP3	NA	Spare	NA
BP4	NA	DC power ground	Required for both ARINC 716 VHF communication and ARINC 750 VDR; functions are identical.
BP5	NA	Spare	NA

(2) Reserved and Spare Wires

(a) It is not necessary to connect all wires. Wires reserved for optional functions can be selected, which the system does not contain, and deleted. Also decide which future spare wires to include in the installation. The reserved and spare wires are identified in Table 2001 and in Figure 2001.

D. Installation of System (Subtask 23-20-59-000-008-A01)

(1) The RTA-50D VDR is secured in the airframe with 3 MCU unit mounts. The mounts are designed to be removed without rewiring the connectors. Follow the equipment manufacturer’s installation instructions to install the mount into the airframe.

(2) To wire the mounts into the system, perform the steps that follow.

(a) Remove the mount connector cover and connector plate assembly.

(b) Crimp or solder (as applicable) the interconnecting wiring to the appropriate connector pins.

(c) Return the connector plate assembly and cover to their original positions.

(3) To install the RTA-50D VDR in the mount, perform the steps that follow.

(a) Slide the RTA-50D VDR into the mount until the guide pins are aligned and the electrical connectors are firmly engaged.

(b) Attach the front of the RTA-50D VDR to the mount by tightening the two knurled screw clamps (located on the front of the mount) until they are firmly seated over the hold-down hooks located on the front of the unit.

(c) Safety-wire the two screw clamps.

7. Inspection and System Check Procedures (TASK 23-20-59-000-806-A01)

A. Inspection (Subtask 23-20-59-000-009-A01)

(1) Inspection and check procedures for the RTA-50D VDR include checkout of all interfacing units that can affect performance of the VDR.

(2) Table 2002 is a visual inspection check procedure and must be performed after system installation, before system checkout. In addition, the procedure must be used as a periodic inspection check.

Table 2002. Inspection/Check Procedures

Equipment	Inspection/check Procedure
3MCU unit mount	As defined by manufacturer’s instructions.
RTA-50D VDR	1. Check that unit is fully inserted in mount and that the knurled screw clamps, which attach the unit in the mount, are tight and safety wired. 2. Inspect the case for deformation, dents. corrosion, and damage to finish; make sure that ventilation holes in the unit are not clogged.
ARINC 716/750 control panel	As defined by manufacturer’s instructions.
ARINC 716/750 VHF antenna	As defined by manufacturer’s instructions.

B. System Checkout (Subtask 23-20-59-000-010-A01)

(1) General

(a) After installation of the RTA-50D VDR and inspection of the equipment, do a continuity and visual check of the system interwiring. A post-installation test must then be performed.

(2) System Interwiring Check

(a) Visually check the system interwiring for abnormalities, such as cables rubbing unprotected metal edges or tightly stretched cables. Check continuity of all interwiring. Specifically check the following:

- Check that the RTA-50D VDR is properly installed and the hold-down screw clamps are tight.
- Check the wiring harness connectors for security and connection to the RTA-50D VDR.
- Check that antenna transmission line connectors are securely fastened.
- Check that cables do not interfere with aircraft controls or other equipment.

(3) Post-Installation Check

(a) Required Test Equipment

1 Not applicable.

(b) System Test

1 A functional self-test of the LRU can be initiated by pressing the test key push-button on the front panel. Refer to Figure 1001.

2 The result of the functional self-test is displayed on the LEDs located on the front panel.

3 After completion of functional self-test, the RTA-50D VDR status LED must be green and all other LEDs must be off. For more information, refer to the FAULT ISOLATION (PGBLK 23-20-59-1000) section.

C. Flight Tests (Subtask 23-20-59-000-011-A01)

(1) Preflight Test

(a) The following test procedure gives instructions for a preflight test which ensures that the RTA-50D VDR is functioning in an acceptable manner before takeoff.

(b) Test Procedure

1 Establish the initial control settings. Refer to Table 2003.

Table 2003. Initial Control Settings

Control Panel	**Position**
Power	On.
Frequency selector	Tune to any local VHF frequency (local control tower or ground control frequency).
Volume control	Midrange.

2 Use the system headphones (or speaker) and microphone to check operation of the RTA-50D VDR.

3 Key the microphone and speak into it. Request a radio check and release the PTT button.

4 As soon as possible, a local flight check must be made to verify system operation for both local and distant stations.

(2) In-Flight Confidence Test

(a) After completion of the post-installation and preflight checks, a local flight can be made to verify system operation for both local and distant stations. Repeat the test procedure found in Paragraph 7.C. (Subtask 23-20-59-000-011-A01)(1)(b).

8. Removal and Replacement (TASK 23-20-59-000-807-A01)

A. Removal (Subtask 23-20-59-000-012-A01)

(1) Loosen the two knurled screw clamps (located on the front of the mount) that attach the RTA-50D VDR to the mount.

(2) Gently pull the RTA-50D VDR forward until it is disconnected from the rear connector and the guide pins.

B. **Replacement** (Subtask 23-20-59-000-013-A01)

(1) Slide the RTA-50D VDR onto the tray of the mount and then gently push the RTA-50D VDR until the guide pins are aligned and the connectors make a firm connection.

(2) Tighten the two knurled screw clamps located on the front of the mount until they are firmly seated over the hold-down hooks located on the front of the RTA-50D VDR.

(3) Safety wire the two knurled screw clamps.

9. Maintenance Procedures (TASK 23-20-59-000-808-A01)

A. **Adjustments and Alignments** (Subtask 23-20-59-000-014-A01)

(1) There are no adjustments or alignments required for the RTA-50D VDR. All alignment and adjustment procedures are accomplished during bench maintenance. The technician must remove the unit from the aircraft and reference must be made to the related maintenance manual when unit performance indicates an adjustment or an alignment is required.

B. **System Protection** (Subtask 23-20-59-000-015-A01)

(1) The system must be protected by a 10-AMP circuit breaker located at the circuit breaker panel in the aircraft.

C. **Lubrication Practices** (Subtask 23-20-59-000-016-A01)

(1) There are no requirements for lubrication of any RTA-50D VDR components.

D. **Cleaning** (Subtask 23-20-59-000-017-A01)

(1) When deemed necessary, depending on the environment to which the equipment is exposed and the intensity of use, periodic cleaning can be performed. Any dust on the RTA-50D VDR must be wiped off with a lint-free cloth.

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

10. Diagrams (TASK 23-20-59-000-809-A01)

A. **RTA-50D VDR Diagrams** (Subtask 23-20-59-000-018-A01)

(1) Diagrams for the RTA-50D VDR are listed in Figure 2001.

Blank Page

NOTES:

1. Primary dimensions are in inches, millimeters are shown for reference only.
2. Bottom surface of connector locator boss must be flush with or extend no more than 0.010 inch (0.25 mm) below datum -B- .
3. Deleted.
4. Deleted.
5. All screw or rivet heads must be within this dimension.
6. External surface finish is textured polyurethane paint.
7. CAUTION: USE INDUSTRY APPROVED ELECTROSTATIC DISCHARGE SENSITIVE PRECAUTIONS. THE RTA-50D VHF DATA RADIO SYSTEM CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE ITEMS.
8. Maximum unit weight is 9.00 pounds (4.1 Kg). ⊕ symbol denotes unit center of gravity.
9. The 3.54 to 3.58 inches (89.9 to 90.9 mm) dimension applies across the connector plate only. The chassis, covers, and attaching hardware must not exceed 3.58 inches (90.9 mm).
10. The conditions and tests required for TSO approval for this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within TSO standards. TSO articles must have seperate approvals for installation in an aircraft. The article may be installed only according to 14 CFR part 43 or the applicable airworthiness requirements.

ID-333445 E965-1696-201-1-D

Figure 2001. (Sheet 1 of 4) RTA-50D VDR Detail/Interwiring Diagram (GRAPHIC 23-20-59-99B-814-A01)

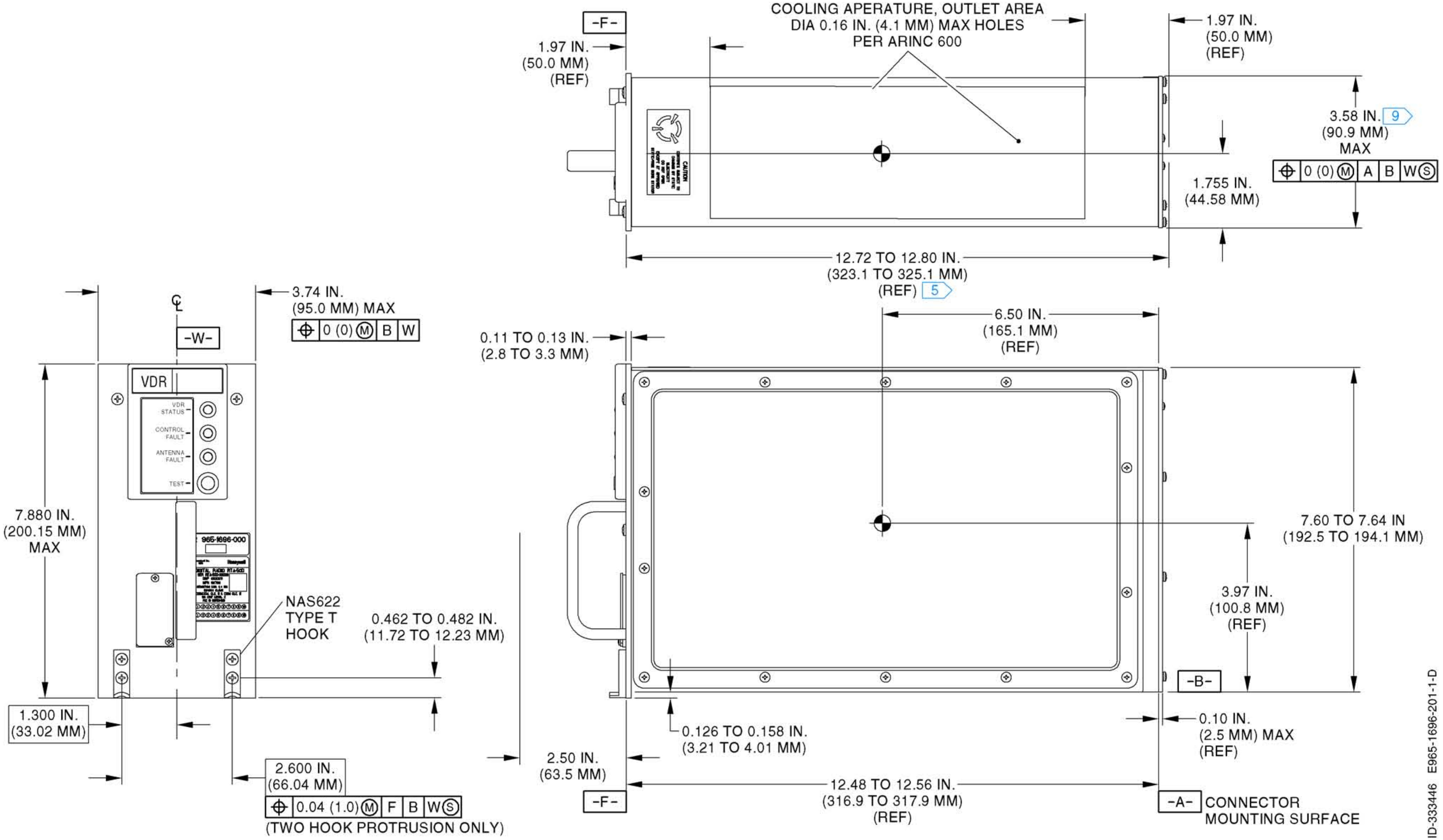
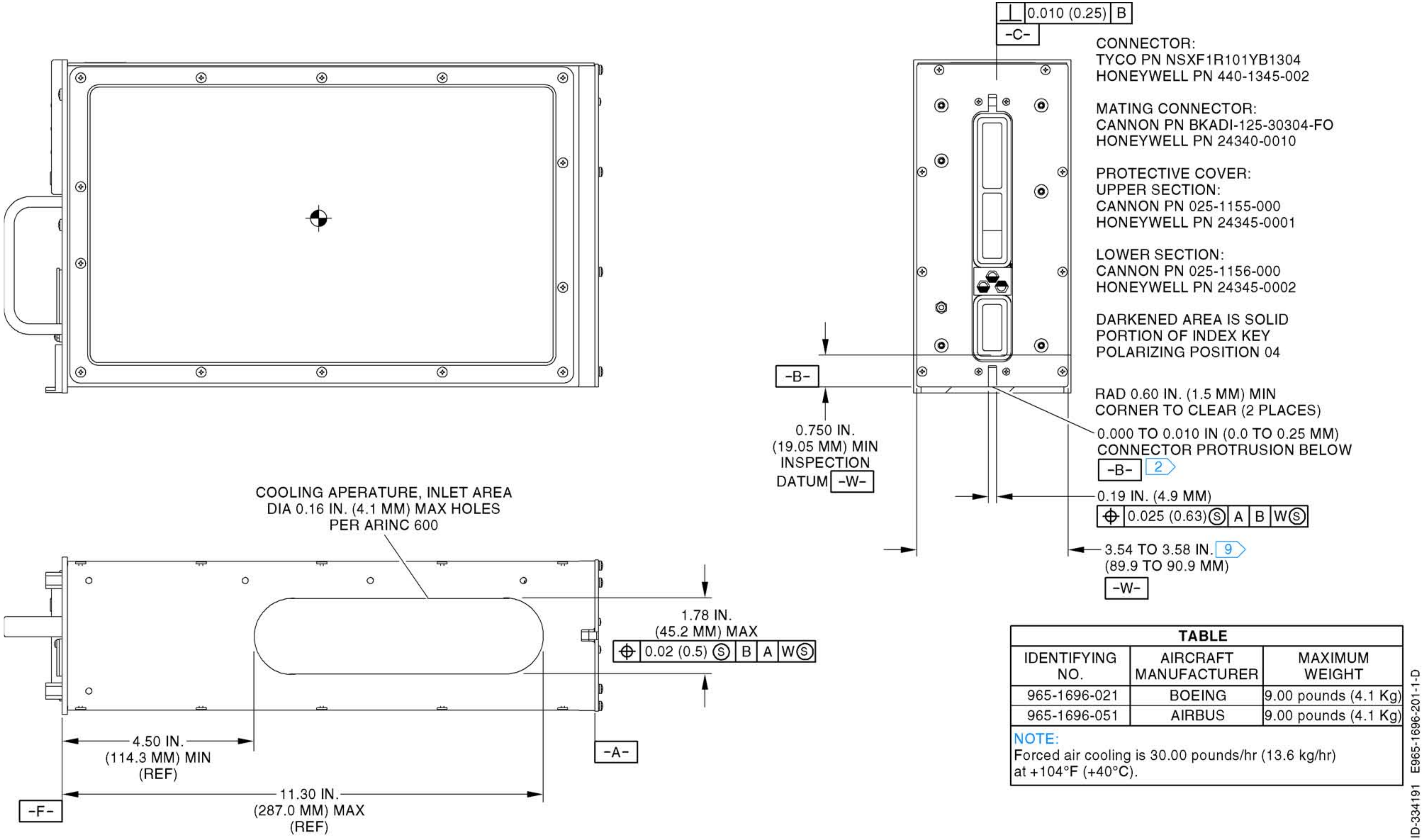


Figure 2001. (Sheet 2 of 4) RTA-50D VDR Detail/Interwiring Diagram (GRAPHIC 23-20-59-99B-814-A01)

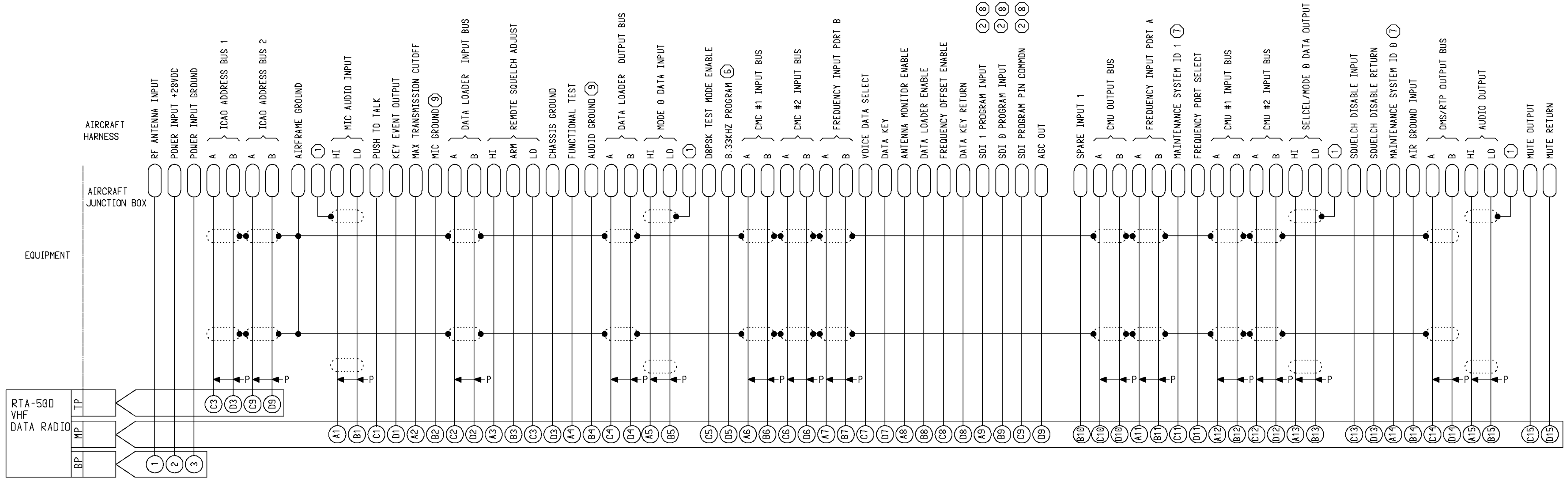


TABLE

IDENTIFYING NO.	AIRCRAFT MANUFACTURER	MAXIMUM WEIGHT
965-1696-021	BOEING	9.00 pounds (4.1 Kg)
965-1696-051	AIRBUS	9.00 pounds (4.1 Kg)

NOTE:
Forced air cooling is 30.00 pounds/hr (13.6 kg/hr) at +104°F (+40°C).

Figure 2001. (Sheet 3 of 4) RTA-50D VDR Detail/Interwiring Diagram (GRAPHIC 23-20-59-99B-814-A01)



NOTES:

① GROUND AT AUDIO SYSTEM END ONLY;
NOT GROUNDED AT RADIO END.

② TO ENCODE LOCATION OF VHF DATA RADIO IN AIRCRAFT, LEAVE PINS AS OPEN CIRCUIT OR CONNECTED TO MPC9 AS FOLLOWS:

COMM NO.	CONNECTOR PIN		ARINC ⑩ REQUIREMENT
	MPA9	MPB9	716
1/2/3	OPEN	OPEN	716,750
1 (LEFT)	OPEN	TO MPC9	716,750
2 (RIGHT)	TO MPC9	OPEN	716,750
3 (CENTER)	TO MPC9	TO MPC9	716,750

③ RACK MOUNT LOGIC CAN HELP IDENTIFY PROPER LRU ENGAGEMENT, TO ENABLE THIS FEATURE CONNECT PIN MPA14 TO GROUND AND ADD A JUMPER FROM MPB10 TO MPC11.

4. |◄—|◄-P INDICATES TWISTED PAIR.

5. CMC= CENTRAL MAINTENANCE COMPUTER.
CMU= COMMUNICATION MANAGEMENT UNIT.
OMS= ON-BOARD MAINTENANCE SYSTEM.
RTP= RADIO TUNING PANEL.

⑥ WHEN MPD5 IS INTERNALLY GROUNDED, THE VDR IS CAPABLE OF OPERATING IN EITHER OF 8.33 KHZ OR 25 KHZ MODES. CONTROL PANEL PROGRAMMING IS OPTIONAL.

⑦ MAINTENANCE SYSTEM IDENTIFICATION

MPC11	MPA14	AIRCRAFT / OMS TYPE	ARINC REQUIRED
GROUND	GROUND	AIRBUS	750-3 & UP
GROUND	OPEN	BOEING	750-3 & UP
OPEN	GROUND	McDONNELL-DOUGLAS	750-3 & UP
OPEN	OPEN	UNDEFINED	716

⑧ WHEN CONFIGURING THE RTA-50D AS AN ARINC 750 VDR TO BE INTERFACED TO A CMU FOR MODE A, 2, OR 3 OPERATION. THE SDI STRAPS MUST BE SELECTED TO THE APPROPRIATE RADIO POSITION.

⑨ MICROPHONE WIRING IS PER ARINC 716 ATTACHMENT 6, AND AS FOLLOWS:
PIN MPB2 IS CONNECTED INTERALLY TO PIN MPB1.
THE MICROPHONE CAN BE GROUNDED BY EITHER OF THE FOLLOWING THREE METHODS:
A. PIN MPB2 CAN BE JUMPERED TO PIN MPB4 TO OBTAIN INTERNAL GROUNDING, OR
B. PIN MPB2 CAN BE CONNECTED TO SPASE, OR
C. PIN MPB1 CAN BE CONNECTED TO SPASE.
ONLY ONE OF THE THREE GROUND ALTERNATIVES SHOULD BE IMPLEMENTED IN ANY GIVEN INSTALATION
(MPB2 TO SPASE, MPB1 TO SPASE, OR MPB2 TO MPB4).

ID-333447 E014-1071-000-1

Figure 2001. (Sheet 4 of 4) RTA-50D VDR Detail/Interwiring Diagram (GRAPHIC 23-20-59-99B-814-A01)