Publication 1793-01-2-2041

AD A077388

AVIONICS INTERFACE DATA SUMMARIES: A-10A, EF-111A, F-4E, F-4G, F-15A, F-16A, F-111A, F-111E, F-111F, RF-4C

October 1979

Prepared for
DEPUTY FOR AVIONICS CONTROL
AERONAUTICAL SYSTEMS DIVISION (ASD/AX)
WRIGHT-PATTERSON AFB, OHIO
under Contract F33657-79-C-0567

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

ARINC RESEARCH CORPORATION
2551 Riva Road · Annapolis, Maryland 21401

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: 14 1750-01-2-2041
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:
4. TITLE (and Subtitle): 6 Avionics interface data summaries: A-10A, EF-111A, F-4E, F-4G, F-15A, F-16A, F-111A, F-111E, F-111F, RF-4C
5. TYPE OF REPORT & PERIOD COVERED:
6. PERFORMING ORG. REPORT NUMBER: 1750-01-2-2041
7. AUTHOR(s):
8. CONTRACT OR GRANT NUMBER(s): 15 F33657-79-C-0567
9. PERFORMING ORGANIZATION NAME AND ADDRESS:
   ARINC Research Corp.
   2551 Riva Road
   Annapolis, Md. 21401
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS:
12. REPORT DATE: 11 Oct[redacted]79
13. NUMBER OF PAGES: 724
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): 12 724
15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:
16. DISTRIBUTION STATEMENT (of this Report):
   Unlimited

   DISTRIBUTION STATEMENT A
   Approved for public release
   Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):
18. SUPPLEMENTARY NOTES:
19. KEY WORDS (Continue on reverse side if necessary and identify by block number):
   Avionics
   Aircraft
   Data sheets
20. ABSTRACT (Continue on reverse side if necessary and identify by block number):

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

400 347

Best Available Copy

AVIONICS INTERFACE DATA SUMMARY
FOR
A-10A

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

Record of Changes			
Change	Subject	Date Entered	Initials

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF FIGURES OF TABLES (continued)

LIST OF FIGURES AND TABLES (continued)

1. INTRODUCTION

This document contains summary configuration data relevant to the integration of additional avionics into the A-10A aircraft.

The applicable Technical Orders are included in the references listed in Section 10.

This document will be revised periodically as additional modification are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

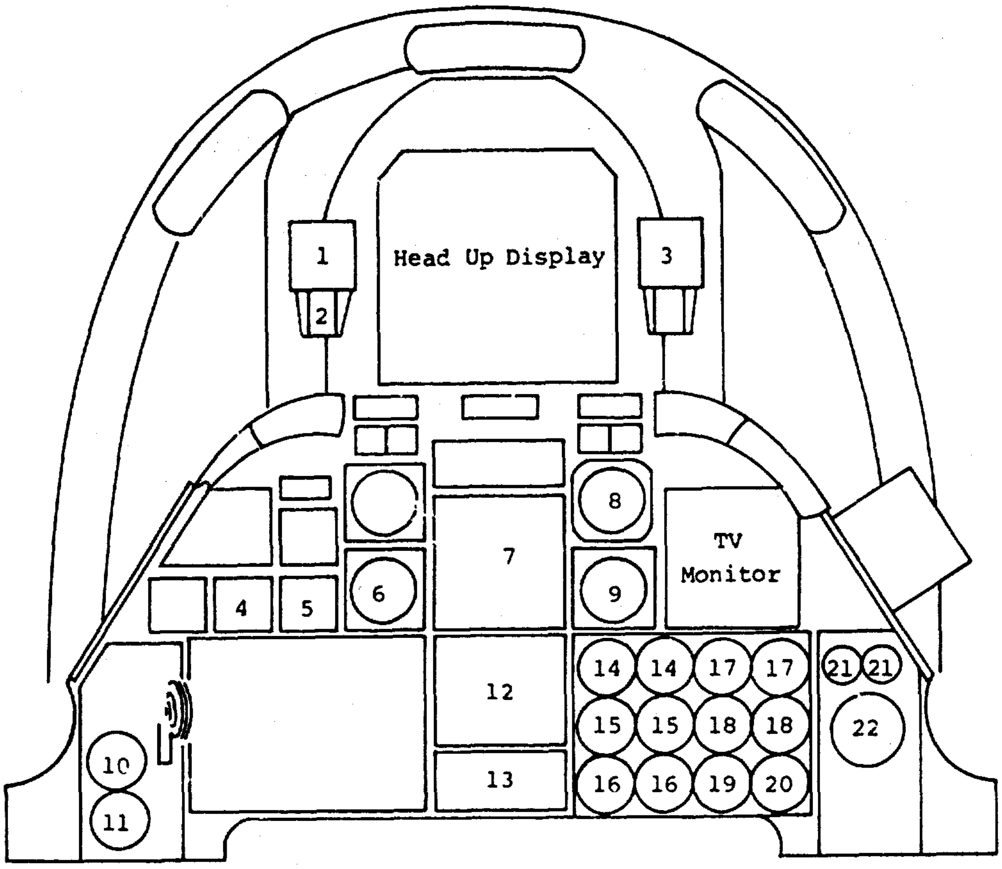
The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

This document was compiled from Air Force Source Materials by ARINC Research Corporation under Contract F33657-79-C-0567.

2. COCKPIT SPACE

2.1 Cockpit Layout

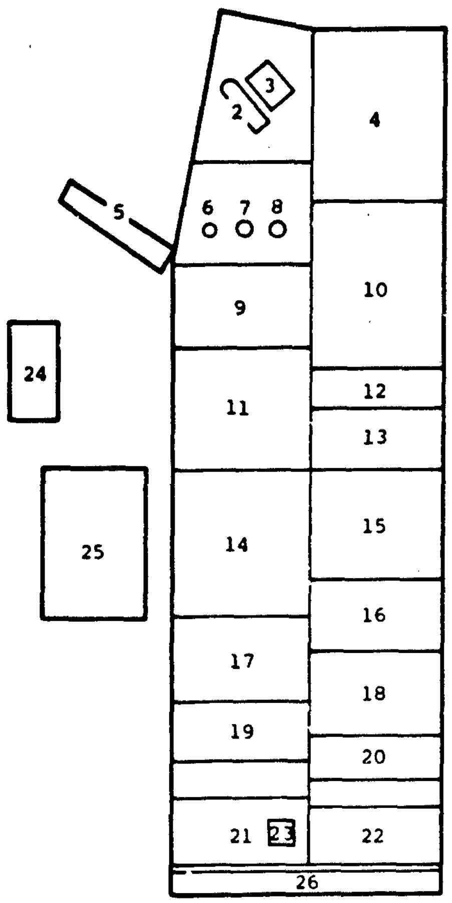
Figures 2-1 through 2-3 show the current cockpit arrangement for the production version of the A-10A. We expecr at least one more iteration of the arrangement shown, including incorporation of the ALE-40 Chaff Dispenser Control Unit. Although a few blank panels are noted, the space available is extremely limited at the present time.



1. Accelerometer
2. Angle of Attack Indexer
3. Standby Compass
4. Clock
5. Angle of Attack Indicator
6. Airspeed Indicator
7. Attitude Director Indicator (ADI)
8. Vertical Velocity Indicator
9. Altimeter
10. Flap Position Indicator
11. Blank
12. Horizontal Situation Indicator (HSI)
13. Navigation Mode Select Panel
14. Interstage Turbine Temperature Indicator (L & R)
15. Gas Generator Speed Indicator (L & R)
16. Engine Oil Pressure Indicator (L & R)
17. Fan Speed Indicator (L & R)
18. Fuel Flow Indicator
19. APU Tachometer
20. APU Temperature Indicator
21. Hydraulic Pressure Indicator (Sys L & R)
22. Fuel Quantity Indicator
23. Standby Attitude Indicator

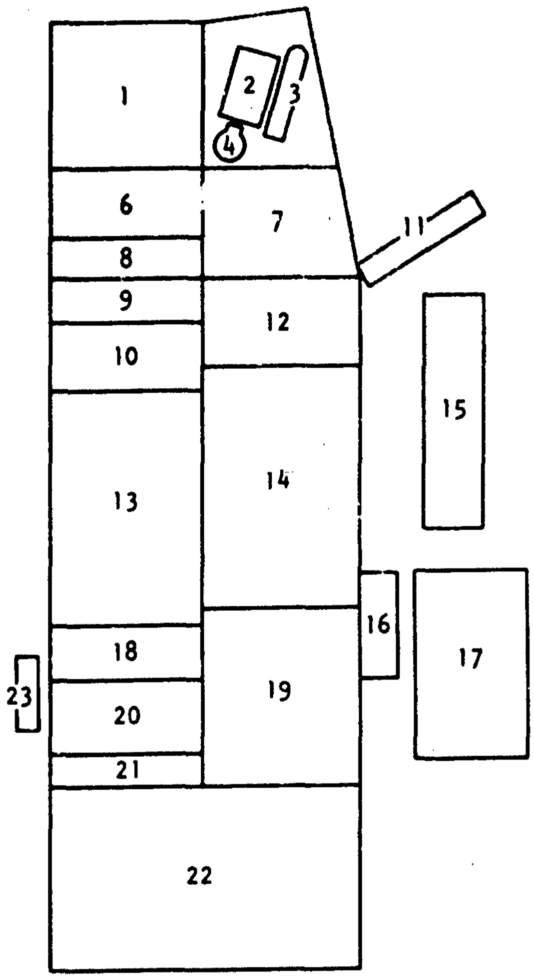
Figure 2-1. INSTRUMENT PANEL (TYPICAL)

3



1. Deleted
2. Emergency Brake Handle
3. Seat Height Adjustment Switch
4. Fuel System Control Panel
5. Manual Canopy Opening Assist Handle
6. Indexer and A/R Status Lights Dimming Control
7. Signal Lights Lamp Test Button
8. Fire Detector and Fleed Air Leak Test Button
9. Stability Augmentation System Panel (SAS)
10. Throttle Quadrant
11. IFF Control Panel
12. TV Monitor Control Panel
13. VHF/AM Radio Control Panel
14. Emergency Flight Control Panel
15. UFH Radio Control Panel
16. VHF/FM Radio Control Panel
17. Intercom Control Panel
18. HF/VHF Radio Control Panel
19. CIPHONY Panel (Prior to serno 75-00280) Antenna Select Parel (Serno 75-00280 and subsequent)
20. Antenna Select Panel (Prior to serno 75-00280) CIPHONY Panel (Serno 75-00280 and subsequent)
21. Utility Light
22. Anti-G Suit Valve Test Button
23. Armament Override Switch
24. Modification Placard
25. Piddle Pak Stowage
26. Piddle Pak Disposal

Figure 2-2. LEFT CONSOLE (TYPICAL)



1. Caution Annunicator Panel
2. Canopy Control Switch
3. Canopy Jettison Handle
4. Boarding Ladder Extension Button
5. Deleted
6. ECM Panel
7. Electrical Power Panel
8. Infra-red Panel
9. ILS Panel
10. TACAN Control Panel
11. Manual Canopy Opening Assist Handle
12. Oxygen Control Panel
13. LORAN Control Panel
14. Environment Control Panel
15. Canopy Breaker Tool
16. Canopy Actuator Disengage Lever
17. Safety Pin Stowage
18. HARS Control Panel
19. Lighting Control Panel
20. Blank Panel
21. Blank Panel
22. Flight Data Stowage
23. Emergency Oxygen Handle (Serno 76-0512 and subsequent and aircraft modified by T.O. 1A-10534)

Figure 2-3. RIGHT CONSOLE (TYPICAL)

5

3. AVIONICS SPACE

Some of the alternatives for providing space in the A-10A are compiled in the Form, Fit, and Environmental (F^2E) Summary (Table 3-1). Figure 3-1 shows the approximate location of these spaces and is keyed to this table.

The following basic points should be made relative to the data presented in the tables:

- A moderate amount of space is available in an equipment compartment if the HF radio is not installed. However, the Compass Tie Program is competing strongly for that space.
- The A-10 SPO indicates the existence of space in the tail area. However, overall aircraft weight-distribution considerations are critical.
- Moderate space is available if the recording and data conversion LRUs of the Velocity Gravity Height (VGH) system are removed.
- Plans for 1985 usage of the VGH measurement system need to be identified. Moderate space is available if the system is removed. Current plans call for only 20 percent of the aircraft to have the system installed, though all have the space allocated and 50 percent have Group A wiring.
- A small space becomes available if the IFF system is installed within the cockpit.
- In the A-10A, normal equipment cooling is not environmentally controlled outside the cockpit. There are plans to expand the cooling capacity to accommodate the INS, but the limit for heat dissipation (after INS requirements are satisfied) is about 1,200 watts as currently envisioned.

6

Table 3-1. F^2E SUMMARY - A-10A

F^2E Criteria	Available Space				
Location Reference and Description	A Access Door 106 Adjacent to Compass Tie	B Aft Fuselage – Tail Section Exact Location TBD	C Fuselage Right Fwd of Wing Access Door F10 Remove Recorder and Signal Data Converter of VGH System	D Fuselage Right Fwd of Wing Access Door F40 Remove Transducer of VGH System	E Fuselage Right Fwd of Wing Access Door F44 Remove Gyro, Strain Gage Ampl, and Accelerometers of VGH System
Rectangular Size * (H, W, D) Volume	12" 12" 20" 1.7 Ft^3 Below Eqpt. Shelf 12" 12" 20" Max 1.4 Ft^3 Above Eqpt. Shelf	TBD But Should Exceed 1 Ft^3	10.0" 28.8" 8.0" 1.3 Ft^3	TBD	TBD
Type Cooling Available	Cool Ram Air Blown through Compartment	Currently Convection Only	Cool Ram Air Blown through Compartment	Cool Ram Air Blown through Compartment	Cool Ram Air Blown through Compartment
Temperature-Altitude Vibration (Normal Mount Values)	MIL-E-5400 Class 2 -54°C to +71°C CTS 30 Min @ +95° C 70,000 Ft. Limit Design – .01g^2/Hz Endurance – .06g^2/Hz	MIL-E-5400 Class 2 -54°C to +71° C CTS 30 Min @ +95°C 70,000 Ft Limit Design – .12g^2/Hz Endurance – .5g^2/Hz	MIL-E-5400 Class 2 -54°C to +71°C CTS 30 Min @ +95°C 70,000 Ft Limit Design – 0.03g^2/Hz Endurance – 0.20g^2/Hz	MIL-E-5400 Class 2 -54°C to +71°C CTS 30 Min @ +95°C 70,000 Ft Limit Design – 0.01g^2/Hz Endurance – 0.01g^2/Hz	MIL-E-5400 Class 2 -54°C to +71°C CTS 30 Min @ +95°C 70,000 Ft Limit Design – 0.01g^2/Hz Endurance – 0.01g^2/Hz
Possible Candidates for the Space		None Known	None Known	None Known	None Known
Remarks	Existing as HF Radio Probably Will Not Be Installed.	SPO Indicated that Air Conditioning Installation Would Be Relatively Easy and Efficient but Due to C.G. Consideration Ballast Could Be Problem.	VGH System Not Scheduled for Removal/Replacement. 50% A-10 Aircraft Have Group A. 20% Have Group B Components.	Velocity Gravity Height (VGH) Measurement System Not Scheduled for Removal. 50% A-10 Aircraft Wired (Group A), But only 20% Will Have Components (Group B).	

* When LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.

7

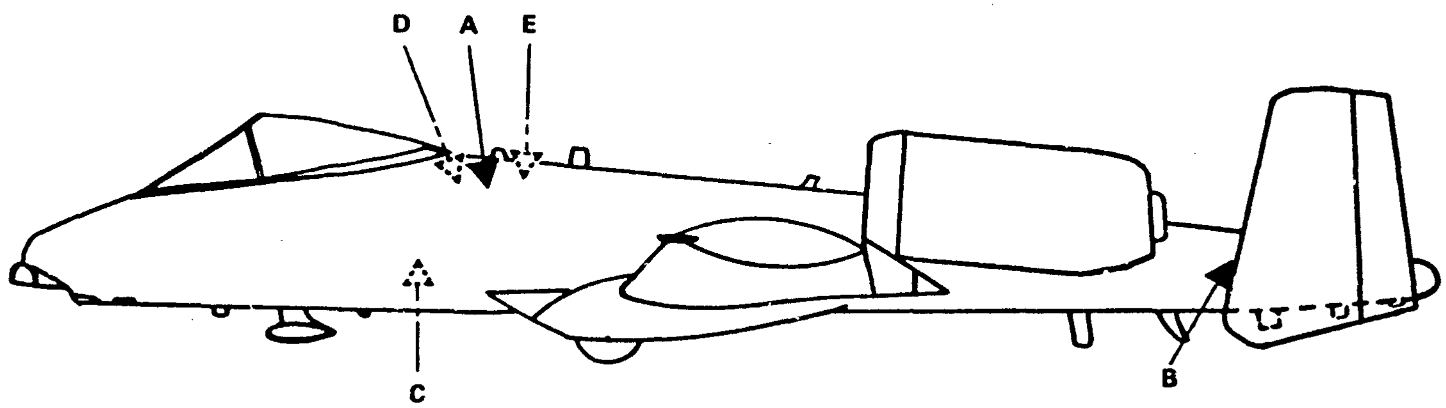


Figure 3-1. A-10A SPACE LOCATIONS

4. ELECTRICAL POWER SYSTEM

The electrical power system provides 115/200 V, 400 Hz, three-phase ac and 28 Vdc power to operate the various A-10A aircraft systems. The overall system is composed of two independent systems (left and right). Table 4-1 lists the particulars of the ac and dc components of each independent system and the emergency power capabilities.

Each independent ac system drives a converter to provide the dc power for each system. Under normal operation the ac generators each drive their main ac buses while only one system (usually the left) drives the ac essential bus.

In the event of complete in-flight loss of normal ac power, or on the ground with no external power applied to the aircraft, emergency power is supplied by a system consisting of a battery and inverter. This system supplies power to the ac and dc essential buses and the battery bus.

Table 4-1. A-10A ELECTRICAL POWER SYSTEM

AC Power	DC Power	Emergency Power
40 kVA each independent system	Maximum of 100-ampere 28 Vdc from each independent ac system	24 V, 34 ampere-hour battery with inverter unit capable of 750 VA 115/200 Vac, 400 Hz, phase output

9

5. ENVIRONMENT CONTROL SYSTEM

The Environment Control System includes the cockpit air conditioning system, avionics compartment environment control, cockpit pressurization system, and a number of other aircraft environment-related systems.

The cockpit air conditioning system operates on bleed air extracted from the main engines or auxiliary power unit (APU). A maximum airflow of 21.3 lb./min. is provided on a hot day (125°F) at sea level and V maximum. This airflow rate is adequate to cool the cockpit to 92°F. The A-10 APU provides sufficient capacity to cool the cockpit to 79°F on a 125°F day during ground operations. Ram-air ventilation is also available to the cockpit.

The avionics and equipment compartments use electrically operated exhaust blowers located in each compartment for cooling during ground operations; these compartments use ram-air cooling for flight operations. The ram-air cooling is accomplished without cockpit controls. At present, both the ground- and air-cooling modes have sufficient capacity to maintain equipment ambient temperatures within safe limits.

In addition to the ram-air cooling of the avionics compartments, above 10,000 feet cockpit air is ventilated into the forward right-hand equipment compartment by the cabin pressure regulator. This vented cockpit air assists in cooling the electrical and electronic equipments.

Table 5-1 illustrates the maximum ground power dissipation capability of the avionics compartments. The primary cooling design criterion for the A-10A was to limit the maximum compartment ambient temperature to 160°F during all flight conditions and during continuous ground operations. A total of eight inlets and six identical cooling fans are required for cooling a maximum of 5.8 kW during ground static conditions (hot day, 125°F, sea level).

Future cooling requirements are not completely defined. Flight testing of a technique to cool the Inertial Navigation System (INS), located in fuselage compartment 44, should be completed in late 1979. Current plans call for cockpit discharge air as the primary cooling medium. However, if this air was to become too warm, air orifice would open to extract cooling air directly from the cockpit air conditioning supply ducts to supply the INS compartment. The orifice would direct cooling air from the cockpit supply air supply at a 1 lb./min. flow rate.

10

Table 5-1. **MAXIMUM GROUND POWER DISSIPATION FOR AVIONICS COMPARTMENTS**

Avionics Area	Compartments Included	Fuselage Station 268/286 (Watts)	Fuselage Station 296/314 (Watts)	Fuselage Station 314/344 (Watts)	Fuselage Station 344/365 (Watts)	Solar Load (Watts)	Total Dissipation (Watts)	Number of Inlets	Number of Cooling Fans	Minimum* Cooling Airflow (Lb./Min.)
Upper Right	F-40, 42, 44	65	403	665	143	75	1,351	2	1	9.1
Lower Right	F-10, 12, 14	0	330	630	375	0	1,335	2	1	9.0
Upper Left	F-101, 103, 105	70	1,028	769	245	75	2,187	2	2	14.8
Lower Left	-	-	-	-	-	-	100	**	-	-
Inverter	F-61	-	-	-	-	-	805†	1	1	5.45
Battery	F-65	-	-	-	-	-	30	1	1	-
							5,808	8	6	-

*Ambient 125°F @ Sea Level pressure.
**Induced draft cooled.
†Power dissipation is 40 watts with inverter off.

6. CURRENT AVIONICS

Tables 6-1 through 6-19 and 9-1 through 9-4 contain LRU data relating to the A-10A avionics systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Antenna locations are depicted in Section 7, Figure 7-1. Data pertaining to future avionics modifications are presented in Section 9.

12

Table 6-1. A-10A AVIONICS CONFIGURATION DATA: VHF/AM RADIO SYSTEM, WILCOX 807A (AN/ARC-134) NSN: 5821-00-937-1086*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receive-Transmit Unit	VHF/AM-807A	F40	7.75	5.0	14.6	566	15.9	--	28V, 300W (Xmt Mode)		Convection	Shock
Control Unit	97733-100	Cockpit Left Console	3.0	5.75	6.0	104	2.0				Convection	Console
Antenna	DM-C50-1	Bottom Rear Fuselage Center									Convection	
Shock Mount	88246	F40						--	--		Convection	Hard

*NSNs for ARC-134A are 5821-00-879-1377 and -181-0430.

13

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receive-Transmit Unit	VHF/FM-622A	F103	7.9	6.0	15.8	749	25.2	--	28V, 112W (Xmt Mode)		Convection w/ Internal Blower	Shock
Mount	709116-401	F103						--	--		Convection	Hard
Control Unit	C-921/FM-622A	Cockpit Left Console	3.0	5.75	6.4	11.[illegible]	2.[illegible]	--	28V		Convection	Console
Antennas (2) Comm	4375-1/1C	Bottom of Fuselage Rear										
Homing	AS-1922/ARC	Bottom of Fuselage Forward Wings									Convection	Hard

Table 6-2. A-10A AVIONICS CONFIGURATION DATA: VHF/FM RADIO SET, AN/ARC-131, NSN: 5821-00-937-4686

Table 6-3. A-10A AVIONICS CONFIGURATION DATA: UHF RADIO SET, AN/ARC-164(V) MSN:*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Main Receive-Transmit Unit	RT-1168**	Cockpit Left Console	4.9	5.75	8.6	242	9.25	400Hz 5V Panel Light	27.5V	110W TX Mode 35W RX Mode	Convection	Console
Guard Receive-Transmit Unit	RT-1145**	Cockpit Left Console	4.7	5.0	8.25	194	8.10	--	27.5V		Convection	Console
Control Unit	C-9533**	Cockpit Left Console	4.9	5.75	5.3	149	4.32				Convection	Console
Indicator Unit	ID-1961A	Cockpit Main Instrument Panel	2.25	2.4	5.9	32	0.90				Convection	Panel
Antenna Selector	C-4808/ARC	Cockpit Left Console Access-F 103									Convection	Console
UHF Blade Antennas (2)		Co-located with TACAN Antennas									Convection	Hard

*ARC-164/V13; 5821-01-008-4600; V14: -4601; V15: -4599; V24: -4603; V3: -4604, V4: -4598.
**All contained in one unit.

15

Table 6-4. A-10A AVIONICS CONFIGURATION DATA: UHF-DF NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Relay-Amplifier Assembly	OA-8697/ARD	Left Console										
Direction Finder	PN DF-301E	F3	Approximately 5.0	Approximately 5.0	Approximately 6.0	150	Approximately 5.0					

Table 6-5. A-10A AVIONICS CONFIGURATION DATA: HF RADIO SET, AN/ARC-154 (NOT INSTALLATED - SPACE ONLY)* NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
HF Radio Set	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

*Probably will not be installed.

17

Table 6-6. A-10A AVIONICS CONFIGURATION DATA: INTERCOMMUNICATIONS SET, AN/AIC-18 NSN: 5831-00-116-6503*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Intercom Station	C-2105( )	Access F103	3.6	5.1	4.4	81	2.4	--	27.5V 5.3W		Convection	
Control Panel	C-3942(P)	Left Console	3.75	5.75	6.75	146	4.0	6Vac 2.4W Lights 400Hz	27.5V 5.3W		Convection	Console

*Also 5831-00-668-8778.

18

Table 6-7. A-10A AVIONICS CONFIGURATION DATA: CRYPTOGRAPHIC EQUIPMENT NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Secure Speech Device Remote	TSEC/KY-28		7.8	5.0	9.1	355	15	--	28Vdc 40 Watts	100BTU/Hours 29 Watts	Convection	
Control Unit	C-8057/ARC	Cockpit Left Console	2.6	5.75	2.3	35		--	28Vdc		Convection	Console

19

Table 6-8. A-10A AVIONICS CONFIGURATION DATA: PITOT-STATIC SYSTEM - FLIGHT AND NAV INSTRUMENTS NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Attitude Direction Indicator		Cockpit Main Instrument Panel									Convection	Console
Horizontal Situation Indicator	AQU-6A	Cockpit Main Instrument Panel									Convection	Console
Magnetic Compass	AQU-3/A	Cockpit Right Side of Windshield									Convection	Console
Angle of Attack Indicator		Cockpit Main Instrument Panel									Convection	Console
Clock	ABU-11/A	Cockpit Instrument Panel									Convection	Console
Accelerometer	ABU-4A/A	Left Side of Windshield									Convection	Consc.
NAV Mode Select Panel		Main Instrument Panel										
Standby Attitude Indicator		Main Instrument Panel										
Airspeed Indicator		Instrument Panel										
Altimeter	AAU-19/A	Instrument Panel										
Altitude Computer	CPU-46A	F40										

20

Table 6-9. A-10A AVIONICS CONFIGURATION DATA: ANGLE OF ATTACK SYSTEM, COUNTING ACCELEROMETER SYSTEM, AND VELOCITY GRAVITY HEIGHT SYSTEM NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Vert Velocity Indicator		Instrument Panel										
AOA Transmitter		Left Side Fuselage										
AOA Indicator		Instrument Panel										
AOA Approach Indexer		Left Side of Windshield										
Counting Accelerometer System												
Accelerometer Transmitter		F44										
Accelerometer Indicator		F10										
Velocity Gravity Height System												
Vert Accelerometer	TRU-106/A1	F44										
Transceiver Accelerometer	TRU-107/A	F44										
Strain Gauge Amplifier	ASU-38/A	F44										
Signal Data Recorder	MXU-553	F10										
Signal Data CONV-MUX	ECU-68/A	F10										
Transducer	TRU-164/A	F40										
Rate Gryo	SBU-13/A	F44										

21

Table 6-10. A-10A AIONICS CONFIGURATION DATA: TACAN, AN/ARN-118(V) (INSTALLED ON A-10A AFTER T.O. 1A-10-538, REPLACING AN/ARN-84) NSN: 5826-01-015-0834

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Transceiver Unit	RT-1159/A	F103	6.8	7.5	14.6	745	26.5	115V 400Hz 1ϕ 250VA Maximum	28V		Convection with Internal Blower	Shock
Digital-to-Analog Adapter	SX-9577/A	F103	6.8	1.7	13.1	151	5.0	26V 400Hz	--		Convection	Shock
Mount Base	MT-4680/A or MT-4682/A	F103	6.6 (Maximum Dimension)**	11.7	20.5	504*			28V, 28V Maximum		Convection	Console
Control Unit**	C-100XX/A	Cockpit Right Console	3.0 or 2.25	5.75	5.4	94 or 70	2.0				Convection	Console

*Only 2.1" added height when packaged with above two units.
**Replaces 3" Control Unit Space - two Options on height dimension.

22

Table 6-11. A-10A AVIONICS CONFIGURATION DATA: TACAN, AN/ARN-84(V)* NSN 5826-00-357-2886
(INSTALLED ON A-10A BEFORE T.O. 1A-10-538; REPLACED BY AN/ARN-118)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Transceiver Unit	RT-1127	F103										Shock
Data Converter Assembly	CV-3135	F103										Shock
Mount	MT-4616	F103										Hard
Control Unit	C-9475	Cockpit Right Console									Convection	Console

*To be replaced with AN/ARN-118(V).

23

Table 6-12. A-10A AVIONICS CONFIGURATION DATA: ILS AN/ARN-108 MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver	R-1871	F103	5.1	3.9	11.5	229	7.0	--	28V, 45W Maximum		Convection	
Control Unit		Cockpit Right Console	2.25	5.75	6.0	78	2.0				Convection	Console
Flight Director Computer	CPU-80A	F103										
Glide/Slope Antenna												
Localizer Antenna												
Marker Beacon Antenna												

24

Table 6-13. A-10A AVIONICS CONFIGURATION DATA: HEADING ATTITUDE REFERENCE SYSTEM MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Displacement Gyro	CN-1466	F42										
Amplifier-Electronic Control	AM-6851	F42										
Controller-Compass System	C-1005	Right Console										
Magnetic Azimuth		Inside Left Vertical Fin										

25

Table 6-14. A-10A AVIONICS CONFIGURATION DATA: IFF SYSTEM, AN/APX-101 NSN: 5895-01-016-6739

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Transponder	RT-1063B	F103	5.8	6.0	10.8	377	17.3	--	28V 63.5W			
Control Panel	C-6280A/APX	Left Console	5.25	5.75	3.1	94	3.0	400Hz, 6Vac, 1A	28V 0.2A			Console
Transponder Computer	KIT-1A/TSEC	F99	6.5	5.0	8.2	267	11.0	115V, 1Ø 400Hz, 30W	--	30W	Convection	Shock
Antenna Selector Switch		Left Console										
Upper Antenna		Top Fuselage Behind Cockpit										
Lower Antenna		Bottom Fuselage Rear										

26

Table 6-15. A-10A AVIONICS CONFIGURATION DATA: RADAR BEACON SYSTEM, AN/UPM-25 NSN: 5895-00-137-0439

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receive-Transmit Unit	RT-855	Behind Panel E6 on Right Vertical Fin	2.9	3.4	4.0	39	3.3	--	28V		Convection	Hard
Code Selector Box											Convection	Hard
Antenna		Right Vertical Fin									Convection	Hard

27

Table 6-16. A-10A AVIONICS CONFIGURATION DATA: FIRE CONTROL SYSTEMS TARGET ID SYSTEM, LASER PAVE PENNY SYSTEM AN/AAS-35(V), MAVERICK MONITOR, AND GUN SYSTEM ELECTRONICS NSN:*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Target ID System												
Control Panel	PN6273153(0)	Pedestal Cockpit										
POD Assembly	PN160D891701-3	Lower Fuselage Right Side										
Detector, Laser	PN627221200-019	Lower Fuselage Right Side										
Adapter, Control Detector	PN627215100-019	F10				Data for these equipments are Classified.						
Maverick/Mk-84 TV System												
Display	PN102704	Main Instrument Panel										
Control	PN102707	Left Console										
Inter Standard Control	PN924131CU01	F14										
Gun Electronics												
Electronic Gun Control Unit	PN132D10()	F14										

*For AAS-35(V)1, 1230-01-008-7266.

25

Table 6-17. A-10A AVIONICS CONFIGURATION DATA: RADAR HOMING AND WARNING SYSTEM, AN/ALR-46(V) NSN: 5865-00-091-8623

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Amplifier-225 Degree Detector	AM-6639	Aft Radome	6.7	1.7	7.6	87	3.5	--	±12V		Convection	Hard
Amplifier-315 Degree Detector	AM-6639	Aft Radome	6.7	1.7	7.6	87	3.5	--	±12V		Convection	Hard
Indicator-Control	ID-190[illegible]	Main Instrument Panel									Convection	
Indicator-Azimuth	IP-957/APR-36	Main Instrument Panel									Convection	Panel
Digital Signal Analyzer	CM-442	F103						115V 400Hz 2.5A	--		Convection	
Receiver-Countermeasure	R-1854	F103	4.0	[illegible]	10.8	259	8.0	115V 400Hz 0.25A	--		Convection	
Amplifier-45 Degree Detector	AM-6639	Forward Radome	6.7	1.7	7.6	87	3.5	--	±12V		Convection	Hard
Amplifier-135 Degree Detector	AM-6639	Forward Radome	6.7	1.7	7.6	87	3.5	--	±12V		Convection	Hard
Antennas (4)												Hard

29

Table 6-18. A-10A AVIONICS CONFIGURATION DATA: ECM SYSTEM

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Panel - ECM		Right Console									Convection	
ECM PODS	AN/ALQ-119(V)-10, -12										Convection	On Pylon Stations 1 and 11
	AN/ALQ-131 (Terminal Threat Version)											

Data for this equipment are Classified.

30

Table 6-1?. A-10A AVIONICS CONFIGURATION DATA: STABILITY AUGMENTATION SYSTEM NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Computer-Stability Augment	PN292E790G4	F42										
Control Panel-Stability Augment	PN123D6220G1	Left Console										

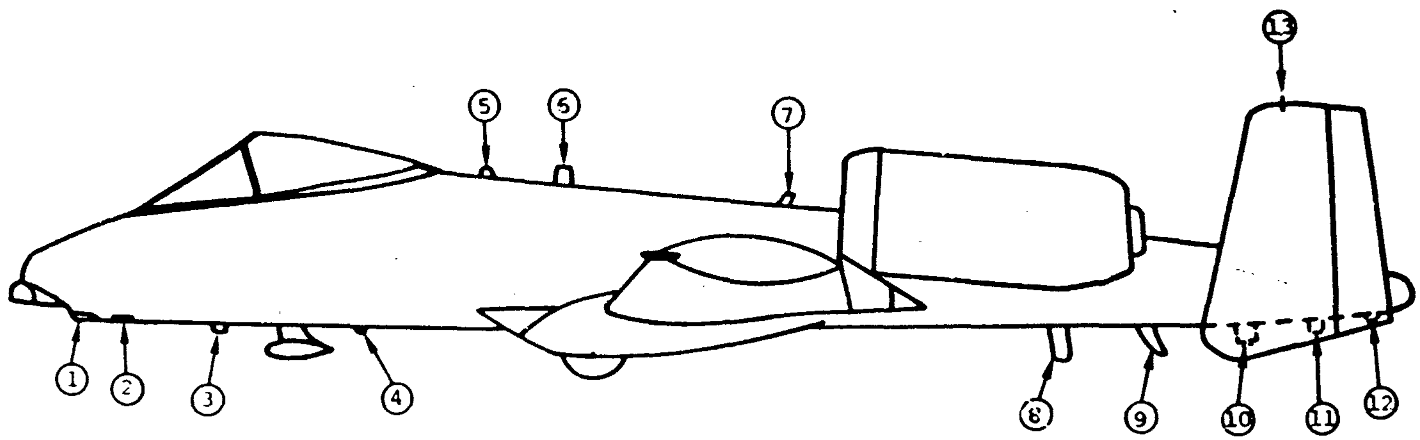
31

7. ANTENNAS

Figure 7-1 shows the approximate location of the antennas of the A-10A.

The A-10A antenna nomenclature is as follows:

Figure 7-1 Legend	Antenna	Nomenclature
1	RHAW	58-871502-7
2	UHF/ADF	OA-8697/ARD(DMN 15-5)
3	UHF/TACAN	DMCN 18-4
4	VHF/FM Homing	AS-1922/ARC
5	IFF	AT741BA
6	UHF/TACAN	DMCN 18-4
7	LORAN/GPS Antenna	Unknown
8	VHF/FM	4375-1/1C(777-1950-001)
9	VHF/AM	DM-C50-1
10	L-Band RHAW	11D28500
11	IFF	AT741BA
12	RHAW	53-871502-7
13	X-Band Beacon	AS2038/UPN



1. RHAW Antenna	8. VHF/FM Antenna
2. UHF ADF Antenna	9. VHF/AM Antenna
3. UHF/TACAN Antenna	10. L-Band RHAW Antenna
4. VHF/FM Homing Antenna	11. IFF Antenna
5. IFF Antenna	12. RHAW Antenna
6. UHF/TACAN Antenna	13. X-Band Radar Antenna (RH Fin)
7. LORAN or GPS Antenna	ILS system antenna locations are TBD.

Figure 7-1. ANTENNA LOCATIONS

33

8. INTERFACE DATA

This section contains examples of interface signal characteristics. These data were extracted from applicable sections of the Interface Control Drawings (ICDs) for integration of GPS user equipment in the A-10 aircraft. Each sheet discussed a particular signal. The top line contains the signal name, type of signal (digital, analog, discrete or synchronous), signal source and load, and whether the signal is an input or output of the GPS user equipment. A functional description follows, together with a description of the signal's characteristics.

34

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Bearing	Synchro	O	UE	Pilot's HSI

Functional Description

Provides angular information to the bearing pointer to display relative bearing of the aircraft's present position to selected waypoint.

Signal Characteristics

RANGE: 0^{o} to 360^{o}
ACCURACY: $\pm 0.5^{o}$
INDEX REFERENCE: Aircraft Heading
POSITIVE DIRECTION SENSE: Increasing Bearing
SCALE FACTOR: $1^{o} = 1^{o}$
RESOLUTION $\pm 0.5^{o}$

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), 3-Wire Synchro (see page 10-3)

SOURCE: (TBD-1)

Interconnection Data

(TBD-1)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034

A		ICD-GPS-002
	REV	SHEET 10-2

35

ELECTRICAL CHARACTERISTICS

LOAD 1	
HSI (AQU-6/A), 3-Wire Synchro, EP AY500-5 or equal	

Rotor

Input Voltage	26	Volts
Frequency	400	Cycles
Resistance (DC)	530	Ohms
Brush Contact Resistance	0.5	Ohms

Stator

Input Voltage	11.8	Volts
Input Current	20	ma
Input Power	0.090	Watts
Resistance (DC)	188	Ohms
Rotor Output Voltage	19	Volts
Phase Shift (S to R)	15	Degrees
Accuracy (Max)	15	Minutes
Null Voltage (Max)	50	mv

Impedance

Zso	222 + j470	Ohms
Zro	940 + j2260	Ohms
Zrss	1050 + j450	Ohms

A ICD-GPS-002 SHEET 10-3

36

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Bearing Flag	Discrete	0	UE	Pilot's HSI

Functional Description

Provides a discrete signal to operate the bearing warning flag. The flag is normally out of view when the bearing pointer is operating and the bearing data is valid. The flag appears when the bearing information is not valid or the device supplying the bearing data is not operating.

Signal Characteristics

RANGE: 28 Vdc ground applied = out-of-view
28 Vdc ground not applied = in-view

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), Shutter Mechanism
Meter movement (28 Vdc)

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034

A ICD-GPS-002
SHEET 10-4

37

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Units	Synchro	0	UE	Pilot's HSI

Functional Description

Provides angular information to rotate the units digit in the range window. Displays aircraft present position distance to selected waypoint in 1nm increments (0.5nm indexed). Driven independently of other digits, but read in conjunction with them in order to provide the least significant digit.

Signal Characteristics

RANGE: 0 to 9 (0^o to 360^o)
ACCURACY: $\pm$ 0.1 ($\pm$ 3.6^o)
INDEX REFERENCE: $\bar{0}$
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^o = 1 numeral
RESOLUTION: $\pm$ 3.6^o

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), 3-Wire Synchro, Clifton CRC-8-A-1 or equal (See page 10-8).

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034

A		ICD-GPS-002
SCALE	REV	SHEET 10-5

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, tens	Synchro	0	UE	Pilot's HSI

Functional Description

Provides angular information to rotate the tens digit in the range window. Displays aircraft present position distance to selected waypoint in 10nm increments. Driven independently of other distance digits but read in conjunction with them.

Signal Characteristics

RANGE: 0 to 9 (0° to 360°)
ACCURACY: $\pm$ 0.1 ($\pm 3.6^\circ$)
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36° = 1 numeral
RESOLUTION: $\pm$ 3.6°

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), 3-Wire Synchro, Clifton CRC-8-A-1 or equal (see page 10-8)

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A), MIL-I-83034

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-6

39

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, hundreds	Synchro	O	UE	Pilot's HSI

Functional Description

Provides angular information to rotate the hundreds digit in the range window. Displays aircraft present position distance to the selected waypoint in 100nm increments. Driven independently of the other distance digits, but read in conjunction with them in order to provide the most significant digit for the distance value.

Signal Characteristics

RANGE: 0 to 9 (0° to 360°)
ACCURACY: $\pm$ 0.1 ($\pm$ 3.6°)
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36° = 1 numeral
RESOLUTION: $\pm$ 3.6°

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), 3-Wire Synchro, Clifton CRC-8-A-1 or equal (see page 10-8)

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034

A ICD-GPS-002
REV SHEET 10-7

ELECTRICAL CHARACTERISTICS

LOAD 1	
HSI, AQU-6/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal	
Primary Winding: Rotor Primary Voltage (400 Hz): 26 Volts Secondary Voltage: 11.8 Volts Input Current: 100 ma Input Power: .54 Watts Accuracy: 30 Minutes Impedance, Zro: 54 + j260 Ohms Impedance, Zso: 12 + j45 Ohms Rotor DC Resistance: 37 Ohms Stator DC Resistance: 12 Ohms Phase Shift: 8.5 Degrees	

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-8

41

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Course Set	Synchro	I	Pilot's HSI	UE

Functional Description

Provides an electrical reference signal of the course manually selected by the Course Set control on the HSI. This signal will be used by the UE as a reference for positioning the course deviation and To-From indicators on the HSI.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: Aircraft Heading
POSITIVE DIRECTION SENSE: Increased Heading
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: $\pm 2.5^{\circ}$

Electrical Characteristics (Continued on next page)

SOURCE: Pilot's HSI Course Resolver,
Eclipse Pioneer Type AY221-5-B

LOAD: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-9

42

ELECTRICAL CHARACTERISTICS

SOURCE 1	
HSI, AQU-6/A, Course Resolver, Eclipse Pioneer Type AY221-5-B	
Input Voltage 26 Vac, 400 Hz Input Current 12 ma Input Power 100 mw Output Voltage 17.2 Vac Phase Shift (Lead) 10 degrees DC Resistance, Rotor 400 Ohms DC Resistance, Stator 175 Ohms Zro 700 + j2100 Ohms Zso 345 + j1220 Ohms Accuracy 20 minutes	

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-10

43

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation	Analog	0	UE	Pilot's HSI & ADI

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft to the left or right of a selected course. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 10° for a TACAN approach: 2.5° for ILS) or distance. For an area navigation systems, the Area Navigation Subcommittee of the Air Transport Association's Air Traffice Control Committee has recommended the following ranges for the flight modes indicated: a) Enroute: 2-6 miles full scale, b) Terminal: 1-2 miles full scale and c) Approach: 600-3000 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-3).

Signal Characteristics

RANGE: 0 to ± 150 µa
RESOLUTION: 5 µa
ACCURACY: ± 10 µa
INDEX REFERENCE: Selected course
POSITIVE DIRECTION SENSE: Fly right (+)
SCALE FACTOR: 75 µa/dot on the indicator
Distance/angular displacement scale factor (TBD-3)

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A); course bar mechanism, 1000 ohms ± 3%
2) Pilot's ADI (ARU-2B/A), 1000 ohms ± 3%

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034
ARU-2B/A, MIL-I-27193

A ICD-GPS-002
SHEET 10-11

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
To-From	Analog	O	UE	Pilot's HSI

Functional Description

Provides a d.c. analog signal to drive the To-From indicator. If the aircraft is flying toward the waypoint and has not intercepted a reference line perpendicular to the aircraft ground track and through the waypoint, the indication will be TO. Once past the waypoint reference line, the indication will be FROM as long as this waypoint is still selected.

Signal Characteristics

RANGE: TO = + 225 ua maximum
BLANK = no signal
FROM = -225 ua maximum

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), Meter movement, 200 ohms ± 15%

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034

A | | ICD-GPS-002
SCALE | REV | SHEET 10-12

45

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Flag	Discrete	O	UE	Pilot's HSI

Functional Description

Provides a discrete signal to operate the distance warning flag. The flag is normally out of view when the range indicator is operating and the range data is valid. The flag covers the range indicator when the distance information is not valid or the device supplying the distance data is not operating.

Signal Characteristics

RANGE: 28 Vdc ground applied = out-of-view
28 Vdc ground not applied = in-view

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), Distance Shutter Mechanism, Meter movement (28 Vdc)

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034

A ICD-GPS-002
SHEET 10-13

46

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation Flag	Discrete	0	UE	Pilot's HSI & ADI

Functional Description

Provides a discrete signal to operate the deviation warning flag or circuit when the deviation data is unreliable or a malfunction has occurred in the course deviation circuitry.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv.

Electrical Characteristics

LOAD: 1) Pilot's HSI (AQU-6/A), Suppressed zero meter movement, 1000 ohms, 3%

2) Pilot's ADI (ARU-2B/A), 1000 ohms, 3%

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: AQU-6/A, MIL-I-83034
ARU-2B/A, MIL-I-27193

A		ICD-GPS-002
		10-14

47

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
INS Update	Digital	O	UE	INS

Functional Description

GPS output data will be provided to the INS (when installed) for use in alignment and other uses as required.

Output Data:
a) Latitude
b) Longitude
c) N-S Velocity
d) E-W Velocity
e) Altitude
f) Time

Signal Characteristics

MIL-STD-1553 or ARINC Specification 419.

Electrical Characteristics

(TBD-1)

Interconnection Data

(TBD-1)

A/C: A-10A
REF:

A		ICD-GPS-002
SCALE	REV	SHEET 10-15

48

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation	Analog	O	UE	ADI

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft above or below a desired flight path. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 0.5° for ILS) or distance. For an area navigation systems, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: a) Enroute: 200-2000 feet full scale, b) Terminal: 60-200 feet full scale and c) Approach: 40-100 feet full scale. Choice of presentation (distance/degrees) and scales are TBD-3.

Signal Characteristics

RANGE: 0 to + 150 ua
RESOLUTION: 3 μa
ACCURACY: + 10 μa
INDEX REFERENCE: Desired flight path
POSITIVE DIRECTION SENSE: Fly Down (+)
SCALE FACTOR: 75 ua/dot on the indicator
Distance/angular displacement scale factor TBD-3

Electrical Characteristics

LOAD: 1) Pilot's ADI (ARU-2B/A), 1000 ohms ± 3%

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: ARU-2B/A, MIL-I-27193

A | | ICD-GPS-002
10-16

49

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation Flag	Discrete	0	UE	Pilot's ADI

Functional Description

Provides a discrete signal to operate the deviation warning flag or circuit when the deviation data is unreliable or a malfunction has occurred in the course deviation circuitry.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv.

Electrical Characteristics

LOAD: 1) Pilot's ADI (ARU-2B/A), Suppressed Zero Meter Movement, 1000 Ohms ± 3%

SOURCE: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: ARU-2B/A, MIL-I-27193

A ICD-GPS-002
SHEET 10-17

51

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Magnetic Heading	Analog, Synchro	I	Heading Attitude Reference System	UE

Functional Description

Provide angular reference signal of aircraft heading relative to magnetic north.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm$ 0.5%
INDEX REFERENCE: Magnetic North
POSITIVE DIRECTION SENSE: Nose Right
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: (TBD-2)

Electrical Characteristics

SOURCE: 1) Heading Attitude Reference System, 3-Wire Synchro

LOAD: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF:

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-18

51

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
True Air Speed	Synchro	I	Airspeed Indicator	UE

Functional Description

Provides an input of true airspeed in synchro format.

Signal Characteristics

SCALE RATE: 334.285° for 500 knots V_c (0.66857°/knot)
Display to electrical angle output

ACCURACY: ± 1.5 knots

Electrical Characteristics

SOURCE:
- Electrical Zero: 50 knots
- Rotor Excitation: 26 Vrms, 400 Hz
- Stator Output: 3.9 Vrms max, 400 Hz line-to-line open circuit @ 57° phase
- Rotor Res.(DC): 54 ohm I/0%
- Rotor Imp.(Z): 216 + j302
- Stator Res.(DC): 249 ohms ±15%
- Input Cur., rotor: 0.060 amps
- Input Pwr., rotor: 0.800 W
- Stator Load: 10KΩ/leg matched (min.)

LOAD: (TBD-1)

Interconnection Data

(TBD-3)

A/C: A-10A
REF: MIL-I-83152B

SIZE	CAGE CODE NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-19

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulse	Pulse	I	IFF, AN/APX-101(V)	UE

Functional Description

Provides a blanking pulse to protect UE from damage while other L band systems are transmitting.

Signal Characteristics

SIGNAL TYPE: Positive Pulse
AMPLITUDE: 0 to +40 volts
FREQUENCY RANGE: 20,000 PPS (max.)
DUTY CYCLE: 15% (max.)
LOGIC ONE LEVEL (SUPPRESSION): +20 to +40 volts
LOGIC ZERO (NON-SUPPRESSION): 0 ± 0.5 volts
START TIME: See next page
STOP TIME: See next page

Electrical Characteristics

SOURCE: IFF (AN/APX-101), Receiver-Transmitter RT-1063B/APX-101(V), R = 100 Ohms ± 10%

LOAD: 300 to 2,200 Ohms shunted by 1850 Pf

Interconnection Data

WIRE TYPE: RG-58C/U Coaxial Cable

A/C: A-10A
REF:

A		ICD-GPS-002
	REV	SHEET 10-20

53

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulse (continued)	Pulse	I	IFF, AN/APX-101(V)	UE

Signal Characteristics (continued)

START TIME: The suppression pulse shall rise to 7.5 volts minimum at least 0.5 usec but not more than 3.0 usec before the RF output pulse has reached 10% of its amplitude. For auxiliary trigger and Mode 4 replies, the pulse shall rise to 7.5 volts minimum less than 0.5 usec before the RF output pulse has reached 10% of its amplitude. Maximum rise time (10-90%) shall be 0.5 usec.

STOP TIME: The suppression pulse shall be less than 1.0 volt, 3.0 usec after the 10% amplitude point of the trailing edge of the last RF framing pulse of the reply pulse train or after the 10% amplitude point of the trailing edge of each RF output pulse resulting from the auxiliary trigger input.

A/C: A-10A
REF:

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-21

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Barometric Altitude	Analog, Synchro	I	Altitude Computer	UE

Functional Description

Provides an input of pressure altitude in synchro format for use by the system when operating with less than full navigation capability.

Signal Characteristics

RANGE: -1000 to +70,000 feet
ACCURACY: ± 100 feet at 50,000 feet
INDEX REFERENCE: 29.92 inches Hg.
SCALE FACTOR: Output 1: 36^{o} per 1,000 feet
Output 2: 36^{o} per 1,000 feet
Output 3: 36^{o} per 100 feet
Output 4: 1.869^{o} per 1,000 feet

Electrical Characteristics (Continued next page)

SOURCE: Altitude Encoder, Altitude Transducer Computer, Type CPU-46/A10, P/N A43700-00-050 (Vollsman), 3-wire Synchro, P/N 100GZ-88-A1 (Eclipse-Pioneer) or equal
LOAD: (TBD-1)

Interconnection Data

(TBD-2)

A/C: A-10A
REF: T.O. 5F5-4-13-13
MIL-C-27889

A ICD-GPS-002
SHEET 10-22

55

ELECTRICAL CHARACTERISTICS

LOAD 1	
Synchro Transmitter, Eclipse-Pioneer P/N 100GZ-88-A1 or Equal	
(TBD-2)	

SIZE	CODE IDENT NO	DRAWING NO	
A		ICD-GPS-002	
SCALE	REV	SHEET	10-23

56

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
INS Data	Digital	I	INS	UE

Functional Description

GPS will require the following data from the INS in order to lock-on to satellites rapidly and to maintain stabilization for the high AJ antenna:

a) True Air Speed
b) Pressure Altitude
c) Latitude
d) Longitude
e) X Velocity
f) Y Velocity
g) Z Velocity
h) Pitch
i) Roll
j) Magnetic Heading
k) True Heading

Signal Characteristics

MIL-STD-1553 or ARINC Specification 419

Electrical Characteristics

(TBD-1)

Interconnection Data

(TBD-1)

A/C: A-10A
REF:

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-24

57

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Pitch	Synchro	I	HARS	UE

Functional Description

Provides an input of aircraft pitch attitude in synchro format to the UE.

Signal Characteristics

RANGE: $\pm 90^\circ$
ACCURACY: $\pm 0.5^\circ$
INDEX REFERENCE: 0° Pitch
POSITIVE DIRECTION SENSE: Nose Up
SCALE FACTOR: $1^\circ = 1^\circ$

Electrical Characteristics

SOURCE: (TBD-2)
LOAD: (TBD-1)

Interconnection Data

(TBD-1)

A/C: A-10A
REF:

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-002
SCALE	REV	SHEET 10-25

58

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Roll	Synchro	I	HARS	UE

Functional Description

Provides an input of aircraft roll attitude in synchro format to the UE.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: 0° Roll
POSITIVE DIRECTION SENSE: Right Wing Down
SCALE FACTOR: $1^{\circ} = 1^{\circ}$

Electrical Characteristics

SOURCE: (TBD-2)

LOAD: (TBD-1)

Interconnection Data

(TBD-1)

A/C: A-10A
REF:

A ICD-GPS-002
SHEET 10-26

59

9. FUTURE MODIFICATIONS

Table 9-1 presents planned or tentative Class V modifications. Only those systems not previously addressed in Section 6 are included. Tables 9-2 through 9-4 present limited LRU data on the ARC-186 VHF radio, the Inertial Measurement Unit, and the Compass Tie System.

Table 9-1. A-10A CLASS V AVIONICS MODIFICATIONS

Terminology/Nomenclature	Remarks
Inertial Navigation System	Selection of the F^3/INS compatible system is to be made in the near future. See Table 9-2.
Chaff Dispenser/ALE-40	Will be incorporated in the near term.
VHF AM/FM Radio/ARC-186	Two will be installed. One will replace the VHF AM radio before production begins. The other will replace the VHF FM radio under a retrofit activity later. See Table 9-3.
Global Positioning System	Space located-three dimensional, continuous, worldwide precision positioning system.
Compass Tie/ALR-69	Updated RHAW system with jammer power management capability. (Uncertain modification for A-10A at this time.)

Table 9-2. A-10A AVIONICS CONFIGURATION DATA: VHF AM/FM RADIO SET AN/ARC-186*

Name	Nomenclature	Location	Dimensions (Inches) H	Dimensions (Inches) W	Dimensions (Inches) D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	Aircraft Power DC	Heat Dissipation	Cooling Method	Housing
Receiver-** Transmitter (Quantity 2)		+	4.75	5.0	9.5	226	6.5 Each	5Vac Panel Lighting	28V 0.71 RX 50W 4.0A TX 150W (Each)		Convection	On Adapters
Control Unit (Quantity 2)		Cockpit Left Console	2.25	5.75	6.6	85	3 Each				Convection	Console
AM Adapter (Used in ARC-134 VHF/AM Replacement)	998G-3	+	1.5	4.35	12.6	82	5				--	Shock
FM Adapter (Used in ARC-131 VHF/AM Replacement)	998G-1	+	1.25	5.0	13.6	85	5				--	Shock
FM Homing Module (Applicable to VHF/FM Replacement Only)		+	3.0 (Included within FM Adapter Dimensions)	3.0	4.5	41	2				Convection	Shock

*This list includes the total ARC-186 installation (2 systems). One R/T, one control, and the AM adapter replace the original VHF AM Radio. The remaining items will replace the VHF FM radio during retrofit.
**Each R/T will have both AM and FM capability.
+The frist ARC-186 system R/T unit will be located behind access F40. The second system will be located behind access F103.

Best Available Copy

Table 9-3. A-10A AVIONICS CONFIGURATION DATA: INTERTIAL MEASUREMENT UNIT DATA (SUPPLIED BY A-10 SPO)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Inertial Measurement Unit			9.1	7.9	15.6	1121	35 Maximum	115V 3ϕ 400Hz ϕA 340VA Start 280VA Steady ϕB, C 710VA Start 70VA Steady 26Vac 40VA Start 35VA Steady	28V 240W IF AC Power Lost Only		Forced Air Conditioning	

Table 9-4. A-10A AVIONICS CONFIGURATION DATA: COMPASS TIE

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Compass Tie												
Signal Processor	ALR-69	F-103	5.0	7.59	14.808	562.9	25	115v 3.5A		175	Forced Air	Shock
FSRS:												
Controller	C-10373	F-105	7.0	5.0	12.39	433.7	22.3	115v3Ø 1.1A/Ø	28v, 1A	357	Forced Air	Shock
Receiver	R-2094	F-105	6.0	4.0	10.77	258.5	15	FM Controller			Forced Air	Hard
Transmission Line Coupler	CU-2220	F-105	2.0	6.0	8.98	107.8	4.1	115v .35A		25	Forced Air	Hard
E/J Receivers (See ALR-46, Table 6-17)	AM-6639											HA
C/D Receiver	AM-6971	F-103	4.0	6.0	10.6	254.4	7.5	FM CM-479		20	HA	Hard
Antenna Switch	MT-3989	F-105	1.13	3.5	2.5	9.89	1.0	FM Controller		-	Convection	Hard

63

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Information contained in the JTIDS Aircraft Configuration Data Summary - A-10A. (Source ASD/XRE)
- A-10 System Program Office
- ICD-TPS-002, GPS Phase II User Equipment Interface Requirements for the A-10A Aircraft
- Letter from ASD/YXEA to ASD/EN, 1 February 1978, Subject "A-10A Avionics"
- Avionics Planning Baseline Document, October 1978
- Rockwell International/Collins ARC-186 VHF Radio Description Data
- ARINC Research Informal Report - Technical Report, Preliminary JTIDS Configuration Data Analyses, May 1978
- ASD YXEA Letters, 19 September 1978, ALR-69 Installation Drawings

List of Technical Orders

Technical Order Number	Title	Change	Date
1A-10A-01	List of Publications		4/1/77
1A-10A-1	Flight Manual		3/30/79
1A-10A-1-1	Flight Manual	2	9/15/77
1A-10A-2-1-1	General Manual	Basic	1/25/77
1A-10A-2-110-1	Wiring Diagrams	3	10/15/77
1A-10A-2-34TS-1	Navigation/Instrument System	2	7/15/77
1A-10A-2-28MS-1	Fuel System	Basic	3/1/77
1A-10A-2-27MS-1	Flight Control	2	3/1/77
1A-10A-2-94MS-1	Fire Control	Basic	9/1/77
1A-10A-2-94MS-2	Armament	Basic	1/3/77
1A-10A-2-21MS-1	Environmental Control System	2	3/15/77
1A-10A-2-34MS-1	Instrument System	1	5/20/77
1A-10A-4-27	Flight Controls	Basic	2/1/77
1A-10A-4-1	Parts Index	Basic	12/15/77
1A-10A-4-23	Parts-Communications	1	11/1/77
1A-10A-4-34	Parts-Instrument System	1	11/15/77
1A-10A-4-93	Parts-Electronic Warfare	1	11/1/77
1A-10A-21	Inventory	1	3/15/77
12R2-ARC164-2	Radio Set	Basic	6/20/76
12R5-ARN118-1	TACAN Navigational Set	Basic	10/15/76
12P4-2APX101-2	Radio	Basic	9/1/75

64

AVIONICS INTERFACE DATA SUMMARY
FOR
EF-111A

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

65

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

66

Record of Changes			
Change	Subject	Date Entered	Initials

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

68

LIST OF FIGURES AND TABLES (continued)

69

LIST OF FIGURES AND TABLES (continued)

1. INTRODUCTION

This document contains configuration data relating to the integration of additional avionics into the EF-111A aircraft.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable Technical Orders are included in the references listed in Section 10.

2. COCKPIT SPACE

2.1 Introduction

The cockpit in the EF-111A is divided into six main areas: the left and right instrument panel; the left, center, and right consoles (Figures 2-1, 2-2, 2-3); and the back wall. Changes from the current prototype configuration to the production configuration are as follows:

- Left Console
  - HF radio control panel moved from left rear wall to center console
- Center Console
  - KY-28 control panel demoded
  - CVDS control panel demoded
  - HF communication control added
  - IFF control added
  - TV monitor demoded, flight test only
- Right Console
  - IFF control removed from right rear wall and put on center console
  - Instrumentation control panel demoded
- Left Instrument Panel
  - No changes
- Right Instrument Panel
  - Instrumentation test panel demoded

2.2 Possible Control and Display Space

The changes that may be made for the production configuration produce several space options. If the IFF control panel is moved back to its original position on the right back wall, a large space would be available on the center console. Another possibility would be the relocation of the HF Communications Control from the center console to the left rear wall.

The only blank panel space available without relocation is 1-7/8 inch high in the left console, behind the pilot's shoulder line and 1-1/2 inch high in the right console, behind the EWO's shoulder line.

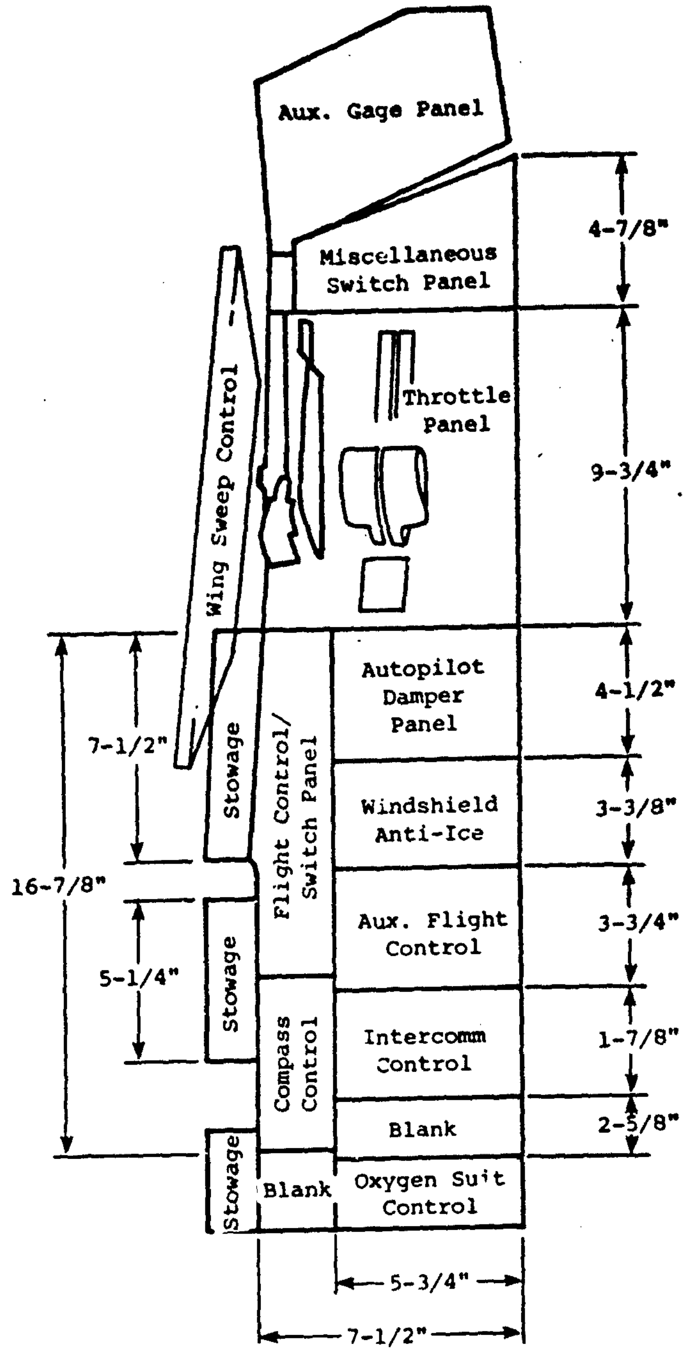


Figure 2-1. PROPOSED PRODUCTION EF-111A LEFT CONSOLE

73

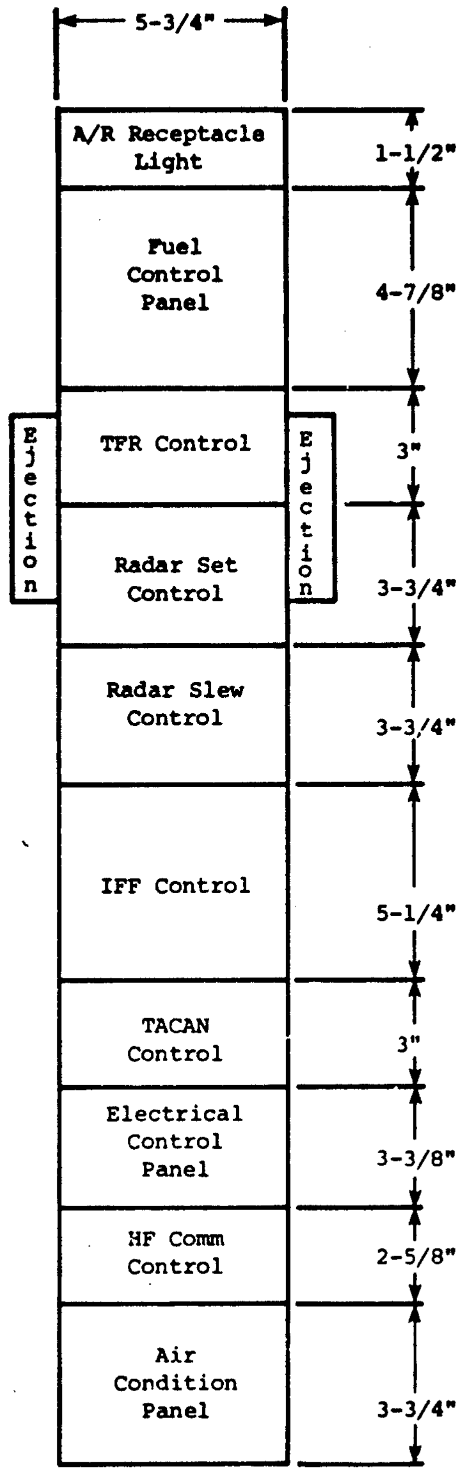


Figure 2-2. PROPOSED PRODUCTION EF-111A CENTER CONSOLE

74

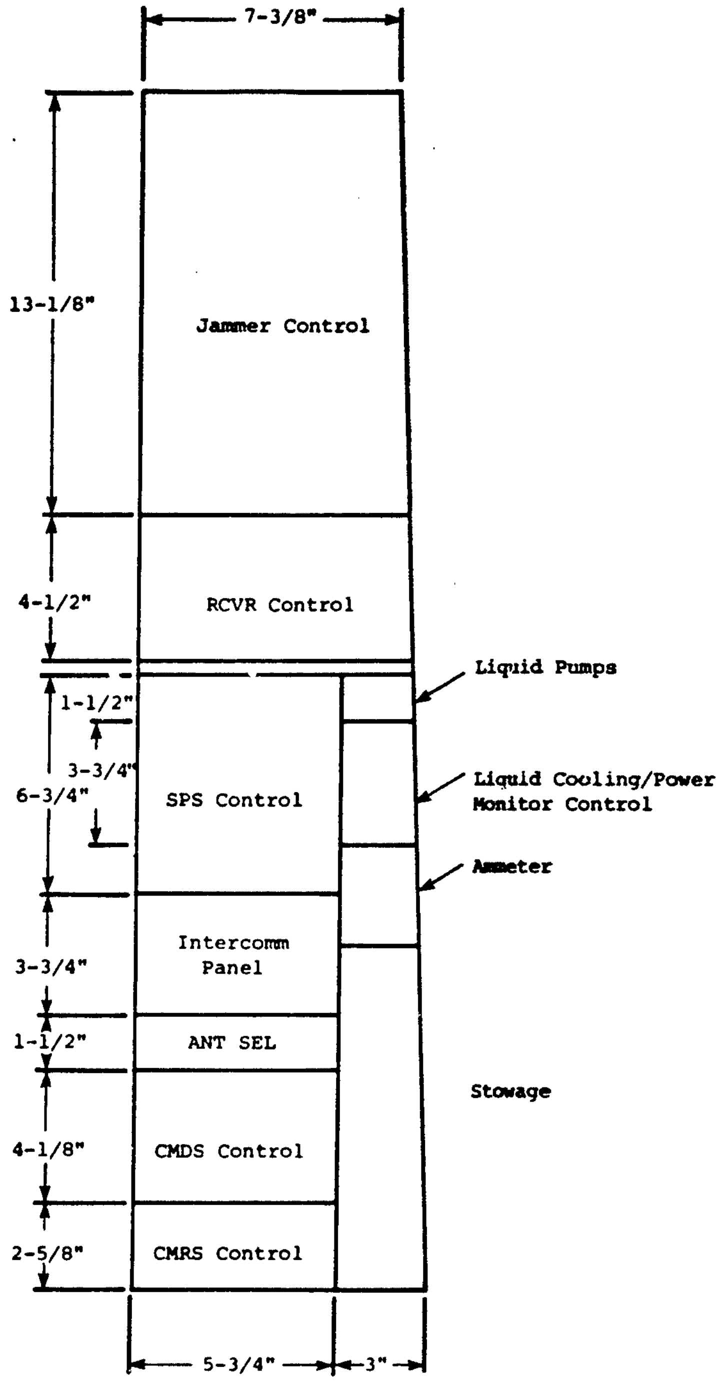


Figure 2-3. PROPOSED PRODUCTION EF-111A RIGHT CONSOLE

3. AVIONICS SPACE

3.1 Right Forward Equipment Bay

All potentially available avionics space is in the forward, right hand equipment bay under access doors 1201 and 1202 (as illustrated in Figure 3-1). Some of the alternatives for providing space in the EF-111A into which LRUs might be placed are compiled in the Form, Fit, and Environmental (F^2E) Summary, Table 3-1.

3.2 Other Locations

No other available locations have been identified from examination of the available drawings and discussions with the EF-111A SPO personnel.

Table 3-1. F^2E SUMMARY - F-111A

F^2E Criteria	Potential Available Space							
Location Reference and Description	A ARC-109 Door 1202 1202	B Demod Strike Camera Door 1201	C&I APX-64 IFF Door 1201	D ARC-112HF Amp-Pwr Supply Door 1201	E ARC-112HF Rcvr-Xmtr. Door 1201	F Flt Loads Recorder Door 1201	G APN-167 Dual Altimeter Door 1201	H Demod Ballistics Computer Door 1201
Rectangular Size * (H, W, D – Inches) Volume (Ft^3)	7.2 X 9.5 X 17.5 0.7 Ft^3	10 X 10 X 17 1.0 Ft^3	8.6 X 6.7 X 20.2 4 X 4 X 6 0.7 Ft^3	9.5 X 9.9 X 20.2 1.1 Ft^3	11 X 12.8 X 18.4 1.5 Ft^3	9 X 14 X 17 1.2 Ft^3	6 X 11.5 X 14 0.6 Ft^3	9.5 X 12 X 16.5 1.1 Ft^3
Type of Cooling Available	Forced Air Available			Forced Air Available**				
Temperature-Altitude Vibration	Class 2, Mil-E-5400 Normal Eqpt. Area			Class 2, MIL-E-5400 Normal Eqpt. Area				
Possible Candidates for this Space	None Known	ECM	None Known	None Known	None Known	None Known	None Known	ECM
Remarks	RT-1168/ARC-164 in Cockpit Volume of ARC-109	Weapons Removed	Replace with APX-101 IFF Transponder	Replace HF Comm with Single LRU in Loc. D	Replace HF Comm with Single LRU in Loc. D	Every Other Aircraft is Equipped with Recorder	Replace with 2 APN-194 Altimeters, Stacked	Weapons Removed

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.

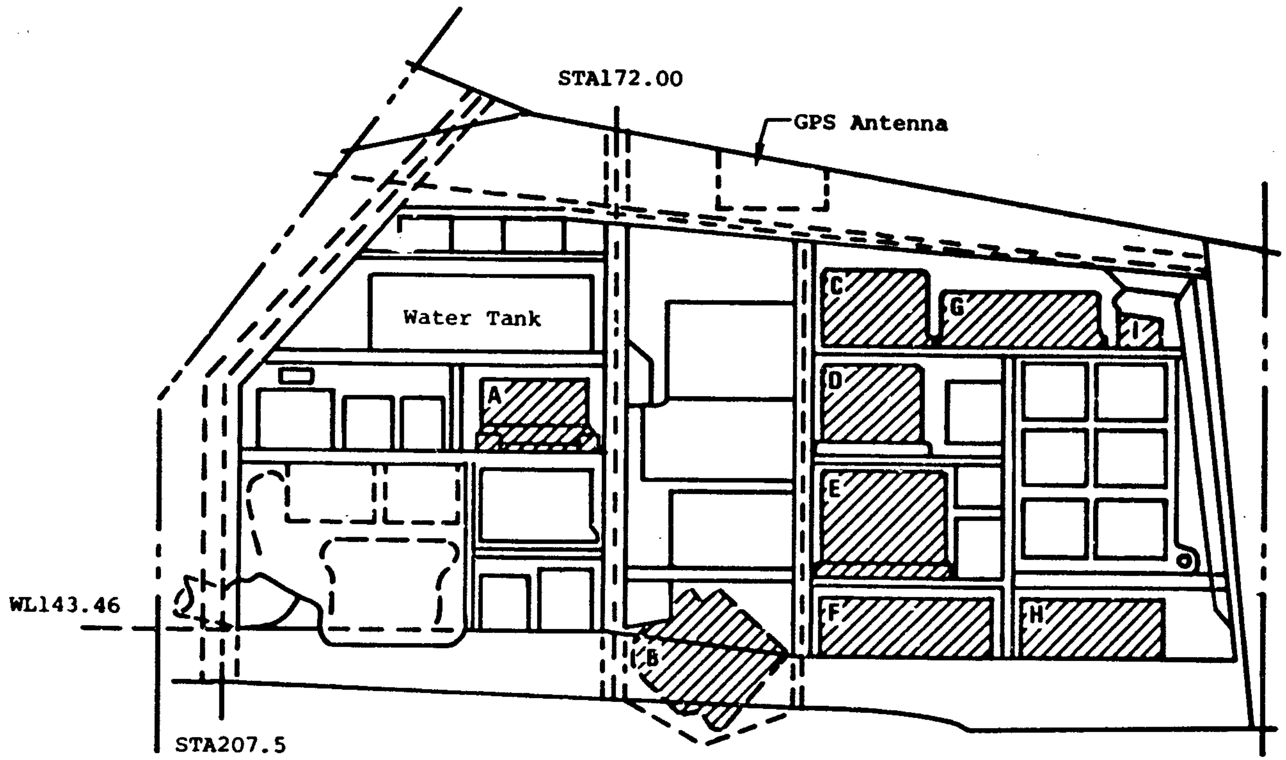


Figure 3-1. RIGHT FORWARD EQUIPMENT BAY, EF-111A

4. ELECTRICAL POWER SYSTEM

4.1 Introduction

115 volt, three phase, 400 cycle ac power and 28 volt dc power is provided for the electrical power system in the EF-111A. This power is generated by two 90 kVA ac generator drive assemblies, one mounted on each engine. These generators are supplemented by two transformer rectifier units that convert the power to 28 volts dc. The electrical power and lighting system consists of the following systems:

- Main ac power system
- External ac power and monitor system
- Emergency ac power system
- Dc power system
- Exterior lighting system
- Interior lighting system
- Warning and caution system

4.2 Power Requirements

In the EF-111A, as well as the F-111A, there is a basic avionics electrical power requirement of 40 kVA, assuming that the removal of attack equipment offsets the added ECM equipment. Ten ALQ-99 jammers require 125 kVA of electrical power. This requires a total load of 165 kVA, leaving a 15 kVA growth capability.

4.3 Power Generation and Distribution

The main sources of electrical power are 90 kVA indirect drive generators. These generators replace the two 60 kVA generators in the F-111A. Both are 90 kVA constant speed drive generators. The control units for these generators are in the forward equipment bay. The electrical power distribution system is functionally identical to that of the F-111A. The only differences are the Jammer Subsystem (JSS) monitoring and control unit and an increase in feeder cable size.

4.4 Emergency ac Power System

The 10 kVA emergency ac power system provides electrical power for operation of safety-of-flight equipment in the event the main ac power system fails or hydraulic power is applied to the aircraft without electrical power, or both. The emergency ac power generator is operated by the utility hydraulic system.

4.5 DC Power System

The dc power system supplies the aircraft with the necessary 28-volt direct current power. The main dc power system uses two ac-to-dc power converters to supply the main and essential dc buses. The aircraft battery ensures that standby power is available to power engine starts, aircraft position lights, and pylon refuel/defuel valves without external power units.

80

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The Environmental Control System (ECS) in the EF-11A contains an air cycle cooling section (AACS) and a liquid thermal transport section (TTS). The AACS, which utilizes the open bootstrap air cycle configuration for heat exchange, provides conditioned air to the cockpit and to the various avionics and equipment bays for both force-cooled equipment and compartment cooling. The TTS, which has two closed, self-contained recirculating liquid coolant loops, is utilized to remove the heat from the jamming subsystem transmitters and the ALQ-137 Self-Protection System.

5.2 Cabin Air Conditioning

The cabin cooling and heating requirements are satisfied by an air flow from the AACS; the actual airflow rate is determined by the flow schedule at the flow control system. From the cockpit, the cooling air is dumped into the forward equipment bay at an exhaust temperature of 80°F.

5.3 Avionics Air Conditioning

The AACS provides conditioned air to the avionics to meet the minimum requirements for compartment cooling and force-cooled equipment. The forward equipment bay (FEB) heat load has grown by 2,974 watts (from 13,494 watts), because of increased wiring losses and the addition of ambient-cooled equipment. Because the FEB ambient temperature is raised by less than 10°F, this heat increase is not considered significant in view of the 32.8 lbs/min. of conditioned air being supplied to the FEB and nose radome. Table 5-1 illustrates the power dissipation required in the various areas of the aircraft served by the AACS and TTS.

Table 5-1. EF-111A COOLING POWER ALLOCATIONS

Compartment	Cooling Power (Watts)		Equipment Forced-Air Cooling lbs/min		Compartment Air†† @40°F - lbs/min		Allowable Temperature (°F)##
	Liquid Cooled	Air Cooled**	Required at 40°F	Supplied† at 40°F	SL @ MIL PWR	40,000 Ft Vmax	
Weapons Bay Upper	0	5,816	23.4	24.7	2.3	2.3	160/185
Weapons Bay Lower	106,300	3,000	7.5	7.9	14.5	14.5	160/185
Fin Fairing	0	1,290	8.1	9.3	1.2	1.2	160/185
Cabin	0	2,197	3.2	4.0	32.1*	45.6#	80
Nose Radome*	0	278	1.1	1.8	0	0	270/270
Forward Equipment Bay*	0	13,494	22.8	31.0	0	0	160/160
Aft Cheek Area							
Left	0	140	0	0	1.0	1.0	160/160
Right	0	48	0	0	1.0	1.0	160/160
Speed Bumps	2,625	205	0	0	0	0	400/500 (estimated)
Totals	108,925	26,468	66.1	78.7	52.1	66.6	-

*Equipment airflows include compartment cooling air.
**Does not include wiring losses (2,974 watts) or radiating horn dissipations (2,100 watts).
†Air supplied at both sea level at military power and 40,000 ft. at Vmax.
††Supplied flows above ram air temperature of 130°F only. Flows are for standard hot day operation.
#Cabin flow is a function of flight condition.
##Temperatures indicate maximum continuous rating/intermittent rating.

82

6. CURRENT AVIONICS

Tables 6-1 through 6-21 contain LRU data relating to the EF-111A systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

Table 6-1. EF-111A AVIONICS CONFIGURATION DATA: UHF COMMUNICATION SET, AN/ARC-109 NSN: 5821-00-496-9236

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF Communication	AN/ARC-109						38.8	150		150 W		
Rcvr-Trans	RT-749/ARL-109	Door 1202	6.87	8.87	14.87	9[illegible]6.1	28.7	115 VAC, 400 Hz		370 W (Transmitting)		MT-3322/ARL-109
Control	C-6364/ARL-109	Cockpit	4.87	5.75	5.0	140	4.4					
Antenna Selector	C-4808	Door 1202	3.0	3.25	4.5	41.[illegible]	1.5					MT-1932/A
Antenna	AS-1918						1.0					Hard

84

Table 6-2. EF-111A AVIONICS CONFIGURATION DATA: HF COMMUNICATION SET, AN/ARC-112 NSN: 5821-00-496-9235

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
HF Communication	AN/ARC-112							1.100				
Control Panel	C-6454/ARC-112	Cockpit	2.62	5.75	5.0	75.3	1.8					
Amplifier Power Supply	AM-4239/ARC-112	Door 1201	8.5	9.25	17.87	1.05	40					Mount Included
Rcvr-Trans	RT-759/ARC-112	Door 1201	10.0	11.62	16.0	1859	42.5			955 W		Mount Included
Antenna Coupler Set	AN/ARC-112 (OA-7149A)		6.0	5.0	12.62	378.6						
Antenna Loop Control	C-6455/ARC-112	Door 1202	15.25	6.5	1.75	173.5	7.4					
Coupler	LU-1402/ARC-112		10.25	10.0	12.75	1307	14.8					MT-3357
Antenna	AN/ARC-112											Hard

Table 6-3. EF-111A AVIONICS CONFIGURATION DATA: INTERCOM. SET, AN/AIC-25

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Intercom. Set	AN/AIC-25 TBD								0.02			
Control	C6567/AIC-25 NSN: 5831-00-880-2834	Cockpit	3.75	5.75	5.62	121.2	4.2			20 W		
Intercom. Station	C-6624/AIC-25 NSN: 5831-00-880-2835		4.38	3.62	5.12	81.2	2.7					

86

Table 6-4. EF-111A AVIONICS CONFIGURATION DATA: UHF-ADF, AN/ARA-50 NSN: 5826-00-883-5777

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF-ADF	AN/ARA-50							0.04	0.01	50 W		
Amplifier Relay Assembly	AM-3624/ARA-50	Door 1202	6.6	7.1	8.0	375	5.4				Forced Air	MT-19551 ARA-50
UHF/ADF Loop Antenna	AS-909/ARA-48		3.5	10.25	10.25	368	10					Hard

Table 6-5. EF-111A AVIONICS CONFIGURATION DATA: FLIGHT INSTRUMENTS

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Attitude Director Indicator	ARU-11/A NSN: 6610-00-424-874	Cockpit	5.25	5.0	10.68	280.4	8.1			35/10 W		
Attitude Indicator	ARU-42/A-2 NSN: 6610-00-200-8744	Cockpit	2.40	2.40	7.61	43.8	2.5	0.002	0.034/ 0.008	36/10 W		
Horizontal Situation Indicator	AQU4/A TBD	Cockpit	4.25	5.00	8.37	178	8.0			54 W		
Total/Selected Fuel Quantity		Cockpit	(2.0 diameter)			3.14	1.5					
Recorder Flight Load Type	HXK-316/A24U6 TBD	Door 1104										

88

Best Available Copy

Table 6-6. EF-111A - FLIGHT DIRECTOR COMPUTER NSN: 610-00-116-4581; 610-00-920-8874

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Flight Director Computer	CPU-76/A	Door 1101	7.35	5.5	9.48	393	10.0	0.016	0.085	26W		

Table 6-7. EF-111A AVIONICS CONFIGURATION DATA: RADAR ALTIMETER AN/APN-167 NSN: 5841-00-772-1819

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Radar Altimeter	AN/APN-167											
Rcvr/Trans	RT-771/APN-167	Door 1201	[illegible]	7.5	14.5	707	11.0	0.086	0.01	192 W		Shock
Antenna	AS-1758/APN-167		4.5	4.5	9.25	187	1.1					Hard
Radar Altimeter Indicators	K5186000100	Cockpit					1.6/1.8*				Convection	
Radar Altimeter Low Warning Lamp		Cockpit									Convection	

*Two indicators.

90

Table 6-8. EF-111A AVIONICS CONFIGURATION DATA: CENTRAL AIR DATA COMPUTER, CC00004-1 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
CADC	CC00004-1	Door 1101					47.0	0-.081		68 W		Shock

91

Table 6-7. EF-111A AVIONICS CONFIGURATION DATA: INERTIAL NAVIGATION SYSTEM, AN/AJQ-20A NSN: 6605-00-170-6701

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Stabilized Platform	MX-6767/AJQ-20	Door 1102					75.0			275 W		
Flux Valve Transmitter	TRU-79/A		(4.0 diameter)		2.0	25.1	1.8					
Navigation Computer	CP-812/AJQ-20	Cockpit					77.8			281 W		

92

Table 6-10. EF-111A AVIONICS CONFIGURATION DATA: ILS AN/ARN-58 NSN: 5826-00-883-5795*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
ILS	AN/ARN-58								.02			
Rcvr Localizer	R-843/ARN-58	Door 2204	7.75	6.87	5.01	267	7.9		220 mA	48 W		
Rcvr	R-844/ARN-58	Door 2204	9.75	6.87	5.01	336	9.6			48 W		
Control	C-6376/ARN-58A		3.0	5.75	5.0	86.3	1.1				Convection	
MKR. BCN. Antennas		Door 1101					1.0					Hard
Glide Slope Antennas		Door 1101					0.8					Hard
Localizer Antennas												Hard

93

Table 6-11. EF-111A AVIONICS CONFIGURATION DATA: TACAN, AN/ARN-118 NSN: 5826-01-015-0839

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
TACAN	AN/ARN-118		8.9	11.7	20.5			0.250	0.0616	100W		
Rcvr-Xmtr	RT-1159(A)/ARN-118		6.8	7.5	14.6	745	26.5					MT-4682A 118
D/A	MX9577		6.9	1.7	13.1		5.0					
Control	C-10058/ARN-118		3.0	5.75	5.4							
Antenna RF Switch	SA521/A	Cockpit	2.7	3.2	3.2	27.7				28W		MT-1995A A
Antenna TACAN Blade	AS-1918	Door 1101					1					Hard

94

Table 6-12. EF-111A: INTERFERENCE BLANKER NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Interference Blanker	MX-9879/A	Door 1102	4.25	10.0	4.5	191	6.0		0.048	48W		

95

Table 6-13. EF-111A AVIONICS CONFIGURATION DATA: IFF TRANSPONDER, AN/APX-64 NSN: 589[illegible]-00-115-7812

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
IFF Transponder	AN/APX-64							0.3	0.03			
Rcvr-Xmtr	RT-728/APX-64	Door 1201		11.13	19.21		30.0	0.08		110 W		MT-3497/APX-64
Control	C-6717/APX-64	Cockpit	5.25	5.75	5.00	151	2.5			7.5 W		
Test Set Airborne	TS-1843/APX	Door 1201	3.15	3.25	7.81	[illegible]	3.0		[illegible]	[illegible]		MT-3513
Antenna Blade	AS-1919						2.0					
Transponder Computer	KIT-1A/[illegible]	Door 1201	8.62	6.6	14.25	810.7	12.0	0.025	0.012	30 W		MT-4579/U

96

Table 6-14. EF-111A AVIONICS CONFIGURATION DATA: TERRAIN FOLLOWING RADAR SYSTEM, AN/APQ-110 NSN: 5841-00-772-1811

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
TF Computer	CP-799/APQ-110						13.8					Rack
Antenna Rcvr.	AS-2136/APQ-128	Nose Radome					27.9			90 W		Rack
TF Indicator	IP-773/APQ-110	Cockpit					23.7			126 W		Rack
TF Radar Set Control	C-6456/APQ-110	Cockpit	3.0	5.75	7.31	126.1	2.6			11 W	Convection	Rack
Amplifier Power Supply	AM-4240/APQ-110	Door 1201	6.0	6.75	17.61	713	17.6					Rack
Sync. Xmtr.	SN-379/APQ-110	Door 1201					26.8					Rack

Table 6-15. EF-111A AVIONICS CONFIGURATION DATA: ATTACK RADAR NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches) H	Dimensions (Inches) W	Dimensions (Inches) D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	Aircraft Power DC	Heat Dissipation	Cooling Method	Mounting
Attack Radar	AN/APQ-160							1.637	.1			
Antenna Assembly	AS-1749/APQ-113	Nose Radome	25.4	34.8	32.3	28,550	54.5					
Antenna Control	C-6498/APQ-113	Nose Radome	7.9	[illegible]	26.5	2,353	38.0			98 W		Rack
Modulator Rcvr-Transmitter	MD-608/APQ-113	Door 1101	20.27	12.75	19.3	4,988	160			[illegible]		Rack
Synchronizer Electronic	SN-380/APQ-113	Door 1101	13.25	13.09	19.3	3,347	60			392 W		Rack
Radar Set Control	C-6499/APQ-113	Cockpit	3.75	5.75	5.21	112.3	3.1					Rack
Indicator Azimuth Elevation Range	IP-1260/A	Cockpit	10.94	6.5	25.0	1778	37.0	135 W	0.007	179 W		Rack
Control Indicator	C-10255/APQ-160	Cockpit	3.75	5.75	2.5	53.9	2.3					Rack

98

Table 6-16. EF-111A AVIONICS CONFIGURATION DATA: RADAR WARNING RECEIVER SET (IR), AN/ALR-23 NSN: 5865-00-104-9842

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Rcvr. (IR)	AN/ALR-23						68.29	1.35	0.12	729 W		
Video Signal Processor	CM-319(XA-2)/ALR-23	Door 1101	7.76	7.00	16.25	683	21.37			33 W		CH-542/XA-1/ALR-23
Scanner Search/Track	CV-1853/ALR-23(V)	Fin	(7.63 diameter)		5.45	185	27.02			60 W		
Cryogenic Converter	MX-6708(XJ-2)/ALR-23	Fin	(6.80 diameter)		22.0	235	16.0	0.460		500 W		
CM Control	C-6474/ALR-23	Cockpit	2.5	5.75	2.62	37 7	1.13			136 W		Panel

Table 6-17. EF-111A AVIONICS CONFIGURATION DATA: RADAR WARNING RECEIVER SET, AN/ALR-62(V) NSN: 5865-01-048-9989

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Rcvr. Set							115.6	0.66	0.1	912 W		
Multi Channel Rcvr.	R-2058/ALR-62(V)		8.06	9.8	12.13	960	52.0			480 W		
Dual Channel Rcvr.	R-2059/ALR 62(V)	Door 1102	5.28	6.08	20.03	643	19.2			25 W		MT-4910/AIR-62
Digital Processor	CM-474/ALR-62	Door 1102	8.06	4.78	21.03	810	29.8			325 W		
Indicator Unit Control	IP-1293/ALR-62(V)	Cockpit	5.50	3.75	15.37	317	11			72 W		

100

Table 6-18. EF-111A AVIONICS CONFIGURATION DATA: COUNTERMEASURES SET, AN/ALQ-137 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Amplifier RF (Low)	AM-6938/ALQ-137	Door 1101	8.3	10.9	22.6	2045	63.8	[illegible]		2000 W		Rack
Rcvr (Low)	R-2060/ALQ-137	Door 1101	7.8	12.8	25.8	2576	71.2		0.125			Rack
Amplifier RF (Mid)	AM-6939/ALQ-137	Door 1101	8.3	10.9	22.7	2054	70.0	3.02		2840 W		Rack
Rcvr (Mid)	R-2061/ALQ-137	Door 1101	7.8	12.8	25.8	2576	81.7		0.125			Rack
Amplifier RF (Hi)	AM-6862/ALQ-137	Door 1201	8.3	10.9	21.8	1972	69.5	1.5		1425 W		Rack
Rcvr (Hi)	R-2062/ALQ-137	Door 1201	7.8	12.8	21.9	2186	67.2	0.075				Rack
Amplifier RF (Hi)	AM-6863/ALQ-137		(9.9 diameter)		30.0	467	78.2	1.5		1425 W		Rack
Rcvr (Hi)	R-2063		(9.9 diameter)		30.0	467	81.1		0.075			Rack

Table 6-19. EF-111A AVIONICS CONFIGURATION DATA: JAMMING SYSTEM, AN/ALQ-99(V) NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Indicator Digital Display	IP-1299/ALQ-99(V)	Cockpit	13.37	[illegible]	18.0	2406	47.0	0.703	0.025	264 W		
Converter Signal Data	CP-1298/ALQ-99E(V)	Weapons Bay	9.81	7.56	21.5	1595	61.0			464 W		
Control	C-9877A/A	Cockpit	7.88	5.75	[illegible]	[illegible]	6.0			35 W		
Jammer Control Panel		Cockpit	13.62	7.65	6.	[illegible]	11.3	0.03		[illegible]		
Rcvr Control Panel		Cockpit	4.5	7.85	[illegible]	141	2.8	0.004		7 W		
Comparator Converter Signal	CM-476/ALQ-99	Weapons Bay	8.13	13.59	21.1	2331						
Converter Synch. Signal Data	CV-3451/ALQ-99E(V)	Weapons Bay	[illegible]	21.0	[illegible]	5290				180 W		
Coupler Computer Data	CV-1768/AYA-6	Weapons Bay	8.52	10.2	19.8	1721	60.8	0.308		309 W		
Computer Digital Data	CP-926/AYA-6	Weapons Bay	8.52	10.4	19.8	1721	49.0	0.215		215 W		

102

Best Available Copy

Table 6-20. EF-111A AVIONICS CONFIGURATION DATA: CM DISPENSER SET, AN/ALE-28 NSN: 5865-00-105-8987*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Dispenser Set								0.15	0.075	111 W		
Control	C-6471/ALE-28	Cockpit	4.12	5.75	6.25	148	4.6			20 W		
Control, Sea-Eject	C-6472/ALE-28		2.25	7.00	5.31	83.6	2.7					
Eject Force Dispenser	D-22/ALE-28		11.6	9.8	32.4	3683	51			2 05 W		
Disposables Control Panel		Cockpit	1.12	5.75	4.0	25.76	.4	0.005	0.007	12 W		

103

Table 6-21. EF-111A AVIONICS CONFIGURATION DATA: FC-11 AUTOMATIC FLIGHT CONTROL SYSTEM MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Computer - Yaw		Door 1101	7.0	4.5	10.0	315	21.0			40 W		
Computer - Pitch		Door 1101	7.0	4.5	10.0	315	21.0			40 W		
Computer - Roll		Door 1101	7.0	4.5	10.0	315	21.0			40 W		
Stick Force Sensor			(2.75 diameter)		1.5	5.3	5.0					
Rate Sensor Assembly		Cockpit	4.5	2.5	5.0	56.25	1.3					
Lateral Accelerometer Assembly			1.0	1.0	4.0	0.4	[illegible]					
Fuel and Trim							24.0			52 W		

104

7. ANTENNA LOCATIONS

7.1 Existing Antennas

Figure 7-1 show the locations of existing EF-111A antennas.

7.2 Planned Antennas

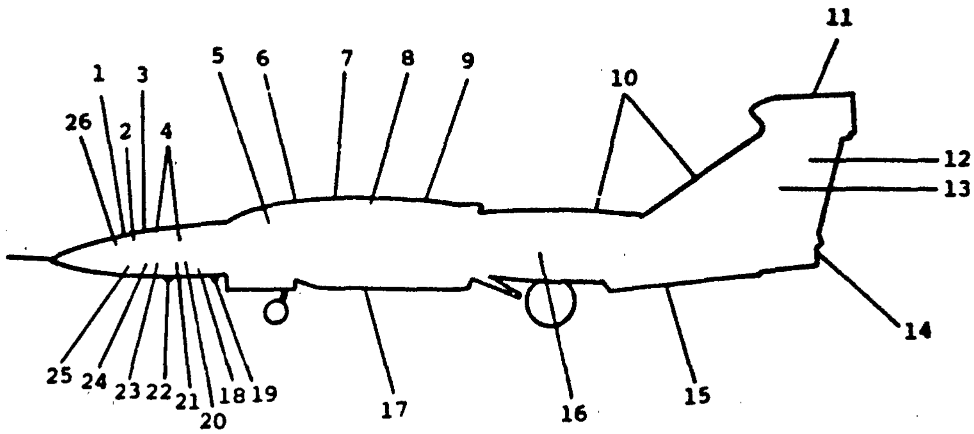
The proposed location for the GPS antenna is at the top of the forward equipment bays, approximately at fuselage station 160.

The EF-111A antenna nomenclature is as follows:

Location	Antenna	Nomenclature or Part Number
1	Glide Slope	
2	High Frequency Radar Homing	TBD
3	ADF	AS-909/ARA-48
4	Low and Medium Frequency Radar	TBD
5	ALQ-137 Hi Band	AS-3203/ALQ-137
6	IFF and UHF Data Link	AS-1919
7	Radio Beacon Set	TBD
8	TTW and SPS	TBD
9	UHF/TACAN Upper	AS-1918/AR
10	HF	TBD
11	ALQ-99 Band 8, Band 9	AS-2911/ALQ-99, AS-3203/ ALQ-99
12	ALQ-99 Band 1 (2)	AS-3206/ALQ-99
13	ALQ-99 Band 2 (2)	AS-3207/ALQ-99
14	ALQ-137 Hi Band	AS-3203/ALQ-137
15	IFF Lower	AS-1919
16	ALQ-99 Blade (2)	TBD
17	ALQ-99 Band 4, 5/6, 7, 8, 9	AS-3208/ALQ-99
18	Localizer (2)	TBD
19	UHF/TACAN Lower	AT-741B/A
20	ALQ-137 Low Band	TBD
21	ALQ-137 Mid Band	TBD
22	Marker Beacon	TBD
23	Forward Radar Warning (2)	TBD

Location	Antenna	Nomenclature or Part Number
24	High Frequency Radar Homing (4)	TBD
25	TFR (2)	TBD
26	NAV Radar	TBD

106



1. Glide Slope
2. High Frequency Radar Homing
3. ADF
4. Low and Medium Frequency Radar
5. ALQ-137 Hi Band
6. IFF (Upper) and UHF Data Link
7. Radio Beacon Set
8. TTW & SPS
9. UHF #1 and TACAN Upper
10. HF
11. ALQ-99 Band 8, Band 9 Multiband, ALR-62, ALQ-137
12. ALQ-99 Band 1 (2)
13. ALQ-99 Band 2 (2)
14. ALQ-137 Hi Band
15. IFF Lower
16. ALQ-99 Blade Antenna (RH Band 1 - LH Band 2)(2)
17. ALQ-99 Band 4, Band 5/6, Band 7, Band 8, Band 9
18. Localizer (2)
19. UHF #2 and TACAN Lower
20. ALQ-137 Low Band
21. ALQ-137 Mid Band
22. Marker Beacon
23. Forward Radar Warning (2)
24. High Frequency Radar Homing (4)
25. TFR (2)
26. NAV Radar

Figure 7-1. ANTENNA LOCATIONS

107

8. INTERFACE DATA

Data were not available for this section.

108

9. FUTURE MODIFICATIONS

This section is not applicable to the EF-111A at this time, since the production configuration has yet to be approved.

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Aircraft and avionics configuration data assembled by ARINC Research, principally in the form of copies of applicable sections, tables, and figures, form the aircraft and equipment Technical Orders listed at the end of this section.
- JTIDS Configuration Data Summary, 5/31/78
- Requirements Analysis for a Multifunction, Multiband Airborne Radio System (MFBARS), AFAL TR-7899, July 1978
- Training Notes

Inventory of Technical Orders

T.O. #	Title	Change Number	Date
IEF-111A-2-1	General Information	Basic	Manuscript
IEF-111A-1	Flight Manual	Basic	3/1/78
IF-111A-1	Flight Manual	Basic	1/28/78
12R2-2ARC164-2	Radio Set	Basic	6/20/76
12R5-2ARN118-1	TACAN Navigational Set	Basic	10/15/76
12R5-2URT27-2	Radio Beacon Set	Basic	6/1/77
12R5-2ARN58-2	Radio Receiving	Basic	5/13/77

AVIONICS INTERFACE DATA SUMMARY
FOR
F-4E

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

112

Record of Changes			
Change	Subject	Date Entered	Initials

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

114

LIST OF FIGURES AND TABLES (continued)

115

LIST OF FIGURES AND TABLES (continued)

116

1. INTRODUCTION

This document contains configuration data relating to the integration of additional avionics into the F-4E aircraft. The data presented describe the F-4E aircraft avionics configuration in Block 48 and in subsequent blocks where the Digital Navigation (ARN-101) and the PAVE TACK systems have been installed.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

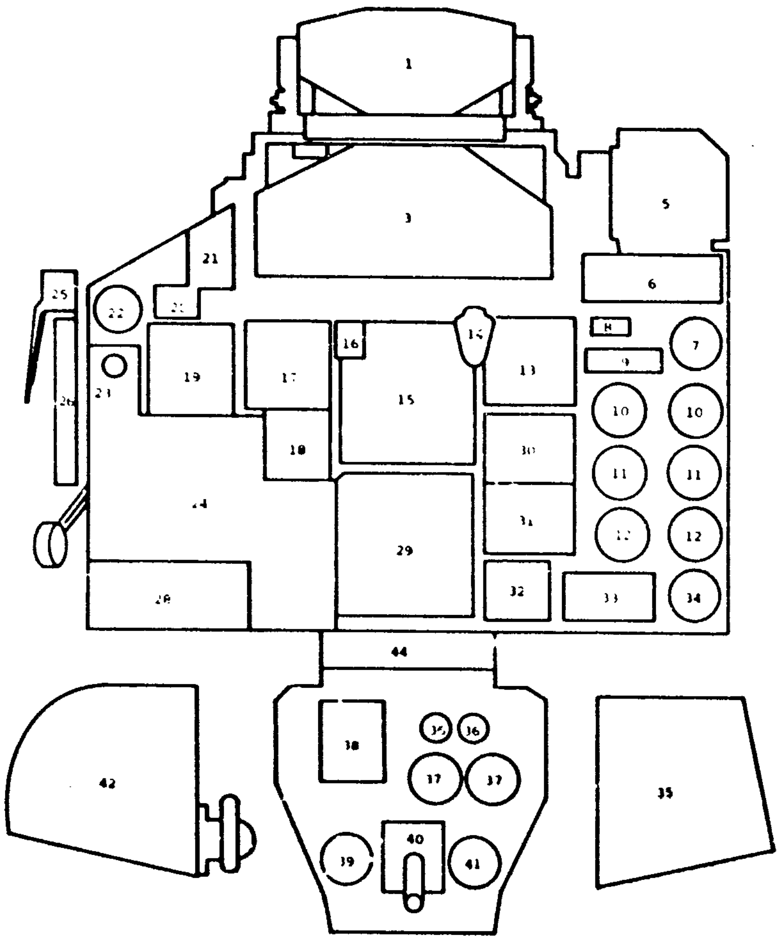
This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable Technical Orders are included in the references listed in Section 10.

2. COCKPIT SPACE

Figures 2-1 through 2-8 show the current forward and aft cockpit layout.

The console and panel space available in the F-4E is very limited. There are two adjacent blank panels on the forward cockpit left console (Figure 2-3) that are about 6 inches high collectively. (The standard width is 5.75 inches.) There are two blank panels in the aft cockpit left console (Figure 2-7), only one of which is practically usable (1.5 inches high). Finally, there are two blank panels on the aft cockpit right console (Figure 2-8). One of these is 1 inch high; the other is not standard width and is about 3 inches square.



1. Optical Sight Unit
2. Angle of Attack Indexer Lights
3. Radar Scope
4. Landing Gear Warning Light
5. Strobe Display Scope
6. Threat Display Panel
7. Internal Fuel Quantity Indicator
8. Master Caution Lamp
9. Fire-Overheat Warning Lights
10. Fuel Flow Indicators
11. Tachometers
12. Exhaust Gas Temperature Indicators
13. Altimeter
14. Marker Beacon Switch
15. Attitude Director Indicator
16. Reference System Selector Switch
17. Airspeed Mock Indicator
18. Angle of Attack Indicator
19. Radar Altimeter
20. UHF Remote Channel Indicator
21. Head-up Weapons Ready Indicator
22. True Airspeed Indicator
23. Flight Instruments Light Control
24. Multiple Weapons Selector Panel
25. Canopy Emergency Jettison Panel
26. Scope Display Selector Buttons
27. Landing Gear Control Handle
28. Automatic Weapons Release Unit
29. Horizontal Situation Indicator
30. Vertical Velocity Indicator
31. Standby Attitude Indicator
32. Digital Auxiliary Display
33. Nav Function Select Panel
34. Exhaust Nozzle Position Indicator (Dual)
35. Right Sub Panel
36. Oil Pressure Indicators
37. Hydraulic Pressure Indicators
38. Accelerometer
39. Rounds Remaining Indicator
40. Rudder Pedal Adjustment Crank
41. Pneumatic Pressure Indicator
42. Left Subpanel
43. Emergency Brake Control Handle
44. Course Select Control Panel

Figure 2-1. **FORWARD COCKPIT, MAIN INSTRUMENT PANEL, F-4E**

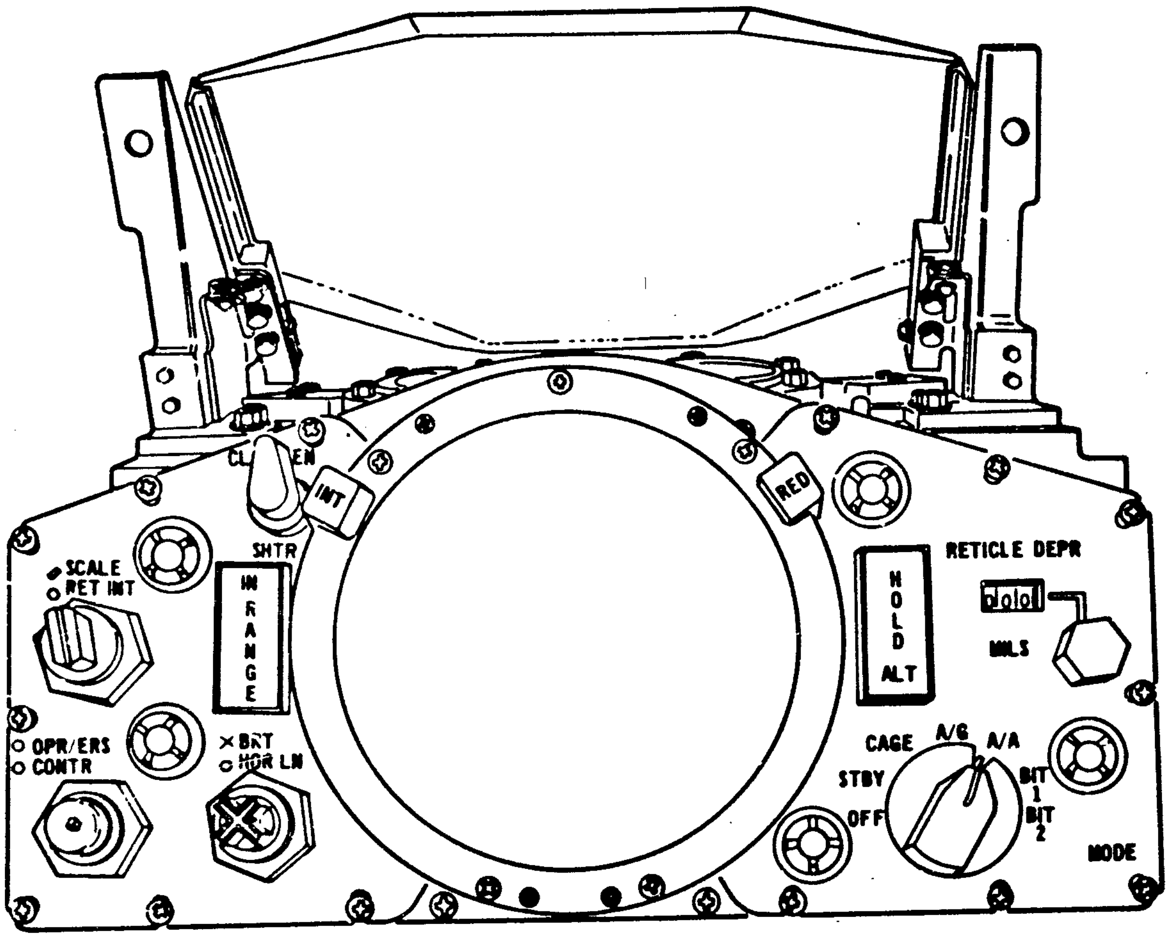
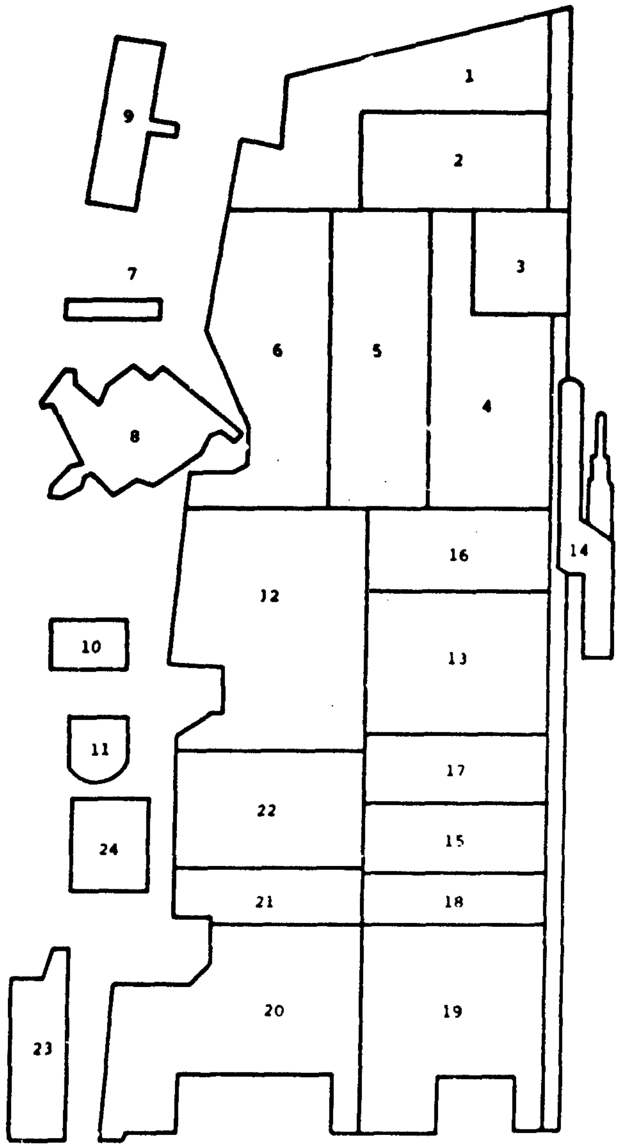


Figure 2-2. MULTIPLE SENSOR DISPLAY GROUP (MSDG) DISPLAY UNIT, FORWARD COCKPIT, F-4E

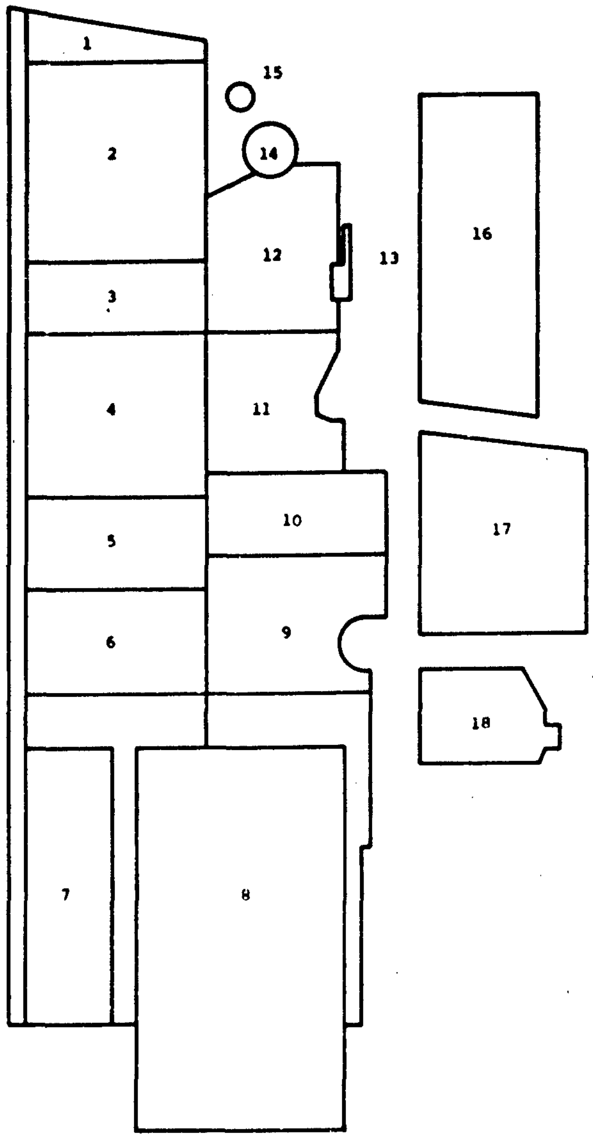
120



1. Utility Panel Left
2. Oxygen Control Panel
3. AGM Control Handle
4. Engine Control Handle (Inboard)
5. Throttles
6. Engine Control Handle (Outboard)
7. Eject Light/Switch
8. Flap/Slats Control Panel
9. Canopy Selector
10. Extra Picture Switch
11. Gun Camera Switch
12. Fuel Control Panel
13. AFCS Control Panel
14. Drag Chute Control Handle
15. Intercom System Control Panel
16. VOR Control Panel
17. Boarding Steps Position Indicator
18. Blank Panel
19. Blank Panel
20. Anti-G Suite Control Panel
21. Auxiliary Armament Control Panel
22. ALE-40 Control Panel
23. Armament Safety Override Switch
24. Slats Override Switch

Figure 2-3. FORWARD COCKPIT, LEFT CONSOLE, F-4E

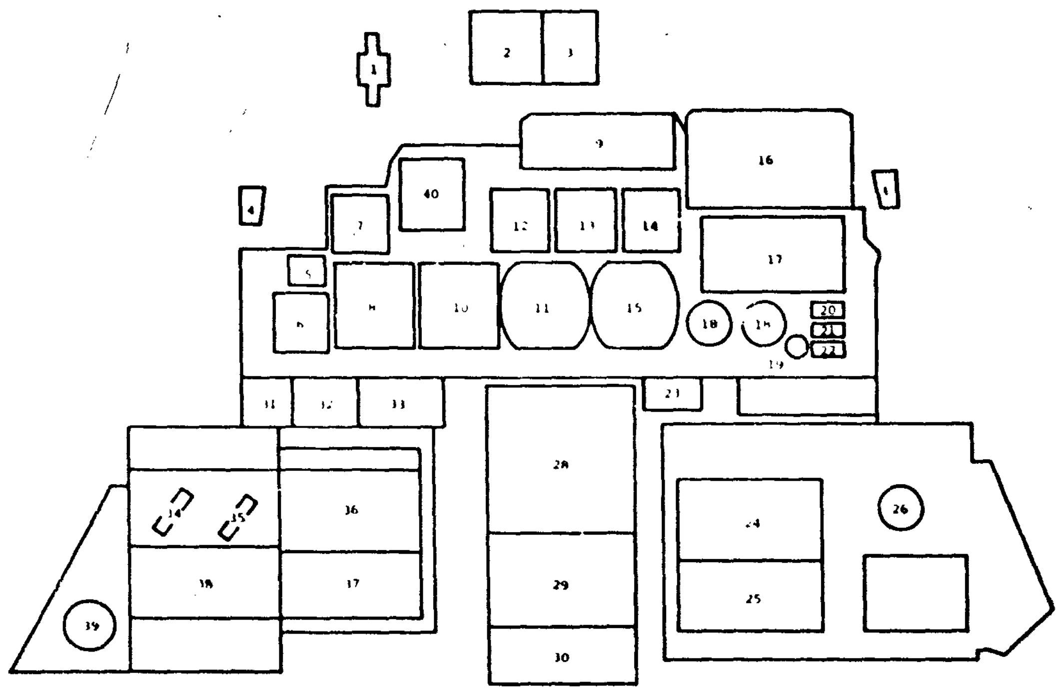
121



1. Master Caution Reset
2. Communications Control Panel
3. Navigation Control Panel
4. IFF Control Panel
5. DCU-94A Bomb Control-Monitor Panel
6. DCU-94A Bomb Control-Monitor Panel
7. Compass Control Panel
8. Airborne Video Tape Recorder
9. Cockpit Lights Control Panel
10. Temperature Control Panel
11. Generator Control Panel
12. Utility Panel (Right)
13. Defog/Foot Heat Control Handle
14. Emergency Vent Handle
15. CNI Equipment Cooling Reset Button
16. Intensity Control Panel
17. Circuit Breaker Panel
18. Standby Attitude Circuit Breaker and Intensity Control Panel

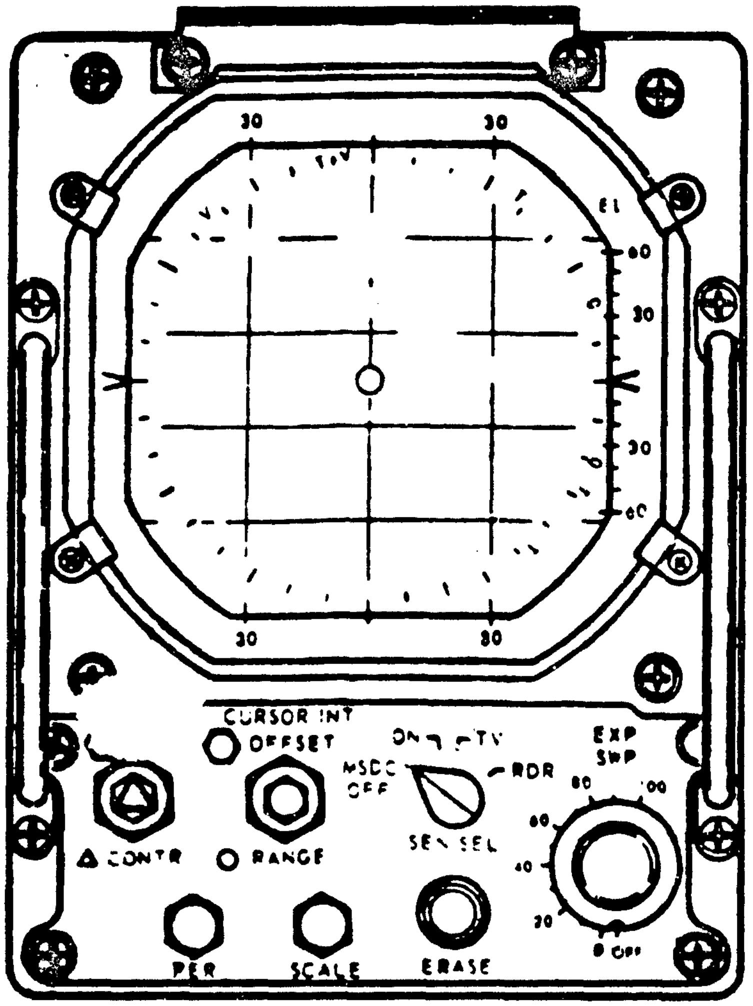
Figure 2-4. FORWARD COCKPIT, RIGHT CONSOLE, F-4E

123



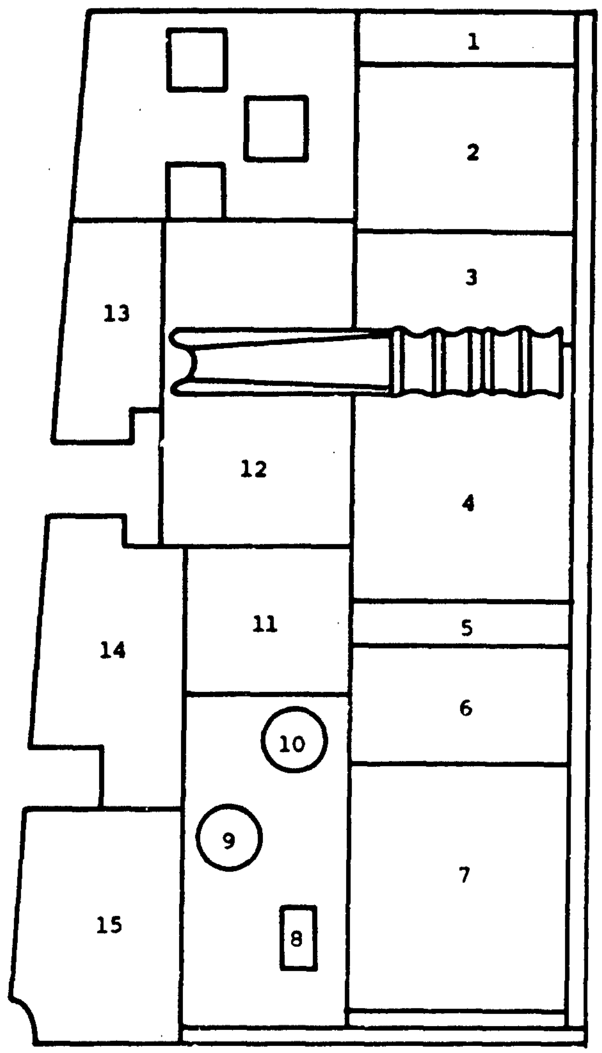
1. Command Selector Valve
2. Standby Magnetic Compass
3. KY-28 Mode Light Panel
4. Angle of Attack Indexer and Activity Lights
5. UHF Channel Remote Indicator
6. Vertical Velocity Indicator
7. Angle of Attack Indicator
8. Altimeter
9. Threat Display Panel
10. Attitude Indicator
11. Airspeed Mock Indicator
12. Eight Day Clock
13. Accelerometer
14. Turn and Slip Indicator
15. Bearing-Distance-Heading Indicator
16. ALR-46 Strobe Display Scope
17. Digital Display
18. Tachometers
19. Radar CNI Cooling Reset Button
20. Canopy Unlocked Warning Light
21. IMU Out Warning Light
22. Radar-CNI Cool-off Warning Light
23. Eject Light
24. ECM Panel
25. Labs Release Angle Control Panel
26. Air Vent Nozzle
27. Bombing Timer Control
28. Multiple Sensor Display Group
29. Target Designator Panel
30. Rudder Pedal Adjustment Crank
31. Gun Camera and Contrast Switches
32. Air-to-Air Button
33. Video Select Button
34. Emergency Landing Gear Control Handle
35. Emergency Brake Control Handle
36. APX-80A Control Panel
37. Landing Gear Slats/Flap Indicator Panel
38. Oxygen Control Panel
39. Air Vent Nozzle
40. Range Indicator

Figure 2-5. AFT COCKPIT, MAIN INSTRUMENT PANEL, F-4E



IP-1093/APQ-120E

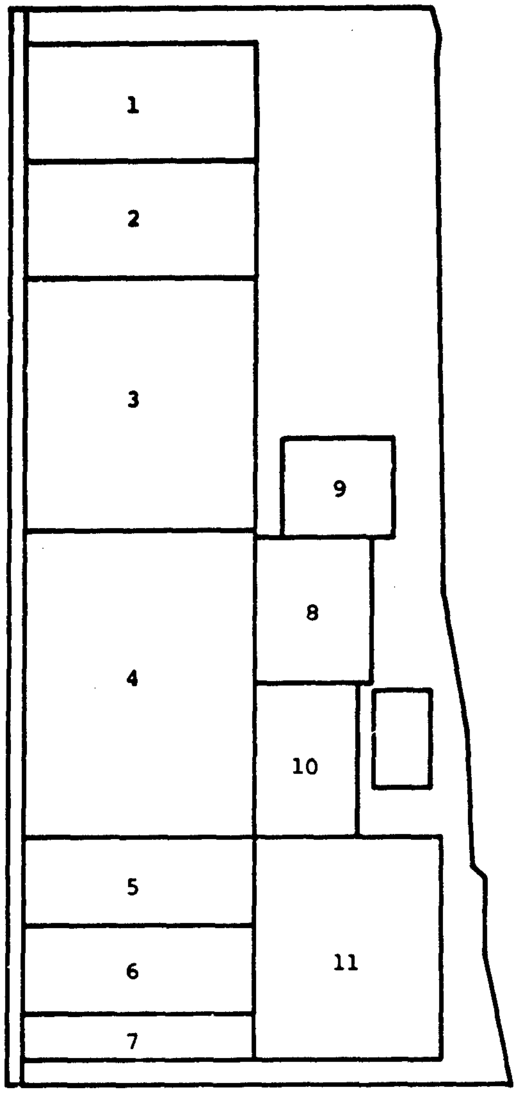
Figure 2-6. MULTIPLE SENSOR DISPLAY GROUP (MSDG) DISPLAY UNIT, AFT COCKPIT



1. Blank Panel
2. Sensor Select Panel
3. AIC Control Panel
4. Radar Set Control Panel
5. Target Insert Panel
6. Nav Computer Set Control
7. UHF Radio Control
8. MKR BCN VOR/IUS Audio Control
9. Oxygen Quantity Gage
10. Cabin ALTIM Indicator
11. Remote Switching Panel
12. Throttles
13. Blank Panel
14. Pull up Tone Switch
15. Anti-G Suit Valve Control

Figure 2-7. AFT COCKPIT, LEFT CONSOLE, F-4E

125



1. Laser Code Control Panel
2. Pave Tack Control
3. Integrated Hand Control
4. KEYER Control Panel
5. TACAN Control Panel
6. Intercom Control Panel
7. Blank Panel
8. Blank Panel
9. Stall Warning Tone Control Panel
10. Nuclear Store Consent Switch
11. Cockpit Lights Control Panel

Figure 2-8. AFT COCKPIT, RIGHT CONSOLE, F-4E

3. AVIONICS SPACE

Some of the alternatives for space provisions in the F-4E are compiled in the Form, Fit, and Environmental (F^2E) Summary Table 3-1. Figure 3-1 shows the approximate locations of these spaces and is keyed to Table 3-1. The temperature-altitude-vibration environmental data relative to the identified locations are presented in Table 3-2.

The following basic points should be made with respect to the data contained in the tables:

- There is a large space apparently available in the tail area. However, there is a severe temperature environment to contend with, and cooling and power must be provided to the area. The attractiveness of this space depends on the amount of power and cooling required for candidate avionics.
- Small space may become available through equipment size reduction or relocation of other units. The latter might involve significant aircraft rewiring.
- The temperature data represent *uncontrolled* environmental conditions. Equipment installed in any area must be cooled to the extent necessary to meet Class 2 requirements.
- With the exception of the "Rat Bay" (Table 3-1, Space C) the condition I avionics areas have direct forced air conditioning. The condition II area in the tail is not cooled and has a severe temperature environment.
- The vibration data represent compartment conditions existing for any equipment mounted therein. The necessity for shock mounting can be determined from these data. The CNI bay has the most vibration in the 10 Hz to 15 Hz band, while the upper equipment bay has the largest vibration in the 20 Hz to 23 Hz band of the three regions examined.

127

Table 3-1. F^2E SUMMARY - F-4E

F^2E Criteria	Potential Available Space					
Location Reference and Description	A CNI Behind KY-28	A CNI Bay Behind KIR-1A	A CNI Bay Replacement of Amp-Power Supply-Aux Rcvr AM-2349/ASQ	B Upper Avionics Bay Door 19 Behind Lead Computing Gyro	C "Rat" Bay Door 186L	D Tail Area Behind Door 61L and Aft of #7 Fuel Cell
Rectangular Size* (H, W, D) Volume	7.8" 5.0" 11.0" 0.25 ft³	6.0" 6.7" 10.0" 0.2 ft³	8.5" 6.4" 23.2" 0.7 ft³ (Current Size) Unit need only provide power for Intercom IFF IFF transponder and Aux Rcvr Power; Reduction in volume by prehaps 50 percent.	8.5" 7.0" 6.0" 0.2 ft³	17.0" 25.0"† 0.6 – 1.2 ft³ ††	16" 18" 22" 16" 8" 22" Total – 5.3 ft³
Type Cooling Available	Forced Air Conditioning	Forced Air Conditioning	Forced Air Conditioning (Cooling Air Flow TBD) Total CNI Elec. Central System Requires 3.2 Lb/Min.	Forced Air Conditioning	Cooling Air Bled into Bay from Upper Avionics Bay	Currently Convection Only
McDonnell Report 8738** Temperature-Altitude Vibration	Condition I Region IX	Condition I Region IX	Condition I Region IX	Condition I Region X	Condition I Region I	Condition II Region I
Possible Candidates for the Space	VHF AM/FM (ARC-186) Compass Tie	VHF AM/FM (ARC-186) Compass Tie	Smaller Amp-Pwr Supply-Rcvr Unit	VHF AM/FM (ARC-186) Compass Tie	2 AN/ALR-46(V) LRUs to be Installed Here	None Known
Remarks	Adjacent		Requirement Reduced with ARN-118 and ARC-164 Installed. Only needed for – Intercom – IFF Xponder – Aux UHF Rcvr Perhaps Gain Half of Vol.	Existing	Very Shallow	

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.
**See Table 3-2.
†Depth Varies 2.5" – 5.1".
††Less Approximate 0.35 ft³ for ALR-46 LRUs.
=No power currently available; no forced-air cooling currently available; severe ambient temperature environment.

128

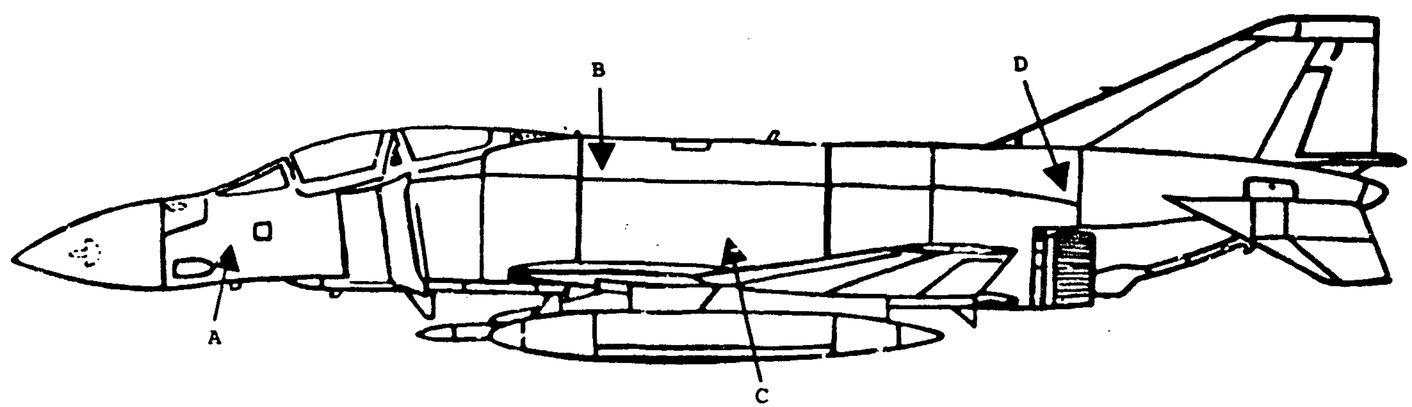


Figure 3-1. F-4E/RF-4C SPACE LOCATIONS

Table 3-2. F-4E RAW ENVIRONMENTAL DATA SYNPOSIS

Temperature Data		
Temperature-Altitude Condition	Condition	
	I	II
Continuous	-54°C to +71°C, Sea level -54°C to +24°C, 60,000′	-54°C to +71°C, Sea level -54°C to +24°C, 60,000′
30 Minutes	to +95°C, Sea level to +83°C, 60,000′	to +95°C, Sea level to +100°C, 60,000′
10 Minutes	to +101°C, Sea level to +143°C, 50,000′	to +109°C, Sea level to +170°C, 50,000′

Vibration Data			
Equipment Performance	Region		
	I	IX	X
5-10 Hz	0.060 inches	0.060 inches	0.060 inches
10-15 Hz	0.063 inches	0.078 inches	0.064 inches
15-20 Hz	0.036 inches	0.036 inches	0.036 inches
20-23 Hz	0.036 inches	0.060 inches	0.060 inches
23-50 Hz	0.036 inches	0.036 inches	0.036 inches
>50 Hz	±5g	±5g	±5g

130

4. ELECTRICAL POWER SYSTEM

4.1 Main Power System

The main electrical power system in the F-4E is composed of two 30 kVA, 115 volt, 400 Hz 3-phase power generators with a constant-speed drive (CSD) unit regulating the generator at 8,000 rpm. The load is evenly divided between the generators when they are operating in parallel. If a fault in either generator occurs, it is removed from the line. Two underfrequency protectors prevent underfrequency operation of the generators.

4.2 Power Conversion and Distribution System

The power conversion and distribution system has three main functions: (1) distributes internal emergency and external ac power to the aircraft, (2) distributes dc power to the aircraft, and (3) converts 115 Vac to 28/14 Vac and 28 Vdc. Power from the left generator is supplied to the left main 115 Vac bus and instrument 200/115 Vac bus. The right generator delivers power to the 115 Vac right main bus and the essential 115 Vac bus. In normal operation the emergency generator delivers ac power to the essential and instrument buses.

Two 100 ampere transformer-rectifiers convert the received ac power from their generators to the 28 Vdc power.

4.3 Battery Power

The battery power supply system contains a 24 volt nickel cadmium battery rated at 11 ampere-hours at a 2-hour discharge rate. The aircraft battery is used for normal ground and emergency air starts as well as to provide power to the four floodlights. If total ac-to-dc power conversion fails, the battery will supply power to the essential dc bus.

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The aircraft environmental control system air conditioning is divided into two major systems, one for cabin areas and one for electronic equipment cooling. Both systems utilize high-temperature, high-pressure, seventeenth stage engine compressor bleed air from either or both engines.

5.2 Cabin Air Conditioning

The cabin air conditioning system on the right side of the fuselage contains two air-to-air heat exchangers and other associated equipment that allow a selection of cabin air conditioning temperatures, vent air temperatures, defogging, rain removal, and ram air operations. This same cabin air is also used to purge the gun gases from the breech of the M61A1 nose gun.

5.3 Equipment Air Conditioning

The equipment air conditioning system on the left side of the fuselage supplies cooling air for the main radar package in the nose, the CNI package aft of the nosewheel well, and the electronic equipment shelf behind the rear cockpit bulkhead. Control of the air conditioning system is completely automatic. The temperature is controlled at approximately 84°F from seal level to 25,000 feet and 40°F from 25,000 feet up.

5.4 Equipment Auxiliary Air System

The equipment air conditioning system also supplies partially cooled air to the equipment auxiliary air system (EAAS). The EAAC automatically distributes partially cooled, low-pressure bleed air from the engine bleed air system to the following systems:

- Anti-G system
- Canopy seal system
- Air data computer
- Fuel pressurization system
- Pneumatic system air compressor
- Radio Receiver-transmitters
- Forward looking radar system

5.5 Cooling Power

The actual cooling power required (bused on flight test results) is shown in Table 5-1 for two extreme flight conditions.

Table 5-1. F-4E COOLING POWER REQUIRED FOR EXTREME FLIGHT CONDITIONS

Compartment	Sea Level, Vmax (Hot Day)				48,000 Feet, Mach 0.81			
	Heat Dissipated (Watts)	Air Flow Lb/Min	Air Temperature		Heat Dissipated (Watts)	Air Flow Lb/Min	Air Temperature	
			°F in	°F out			°F in	°F out
Radar	8,741	29.9	100	169	3,052	14.7	40	89
CNI	1,208	5.0	100	157	418	2.1	40	87
Upper Equipment Bay	617	2.8	100	152	234	1.2	40	86
Cabin	10,910	28.3	41	132	2,101	17.1	41	70
Totals	21,476				5,805			

6. CURRENT AVIONICS

Tables 6-1 through 6-20 contain LRU data relating to the F-4E avionics systems that make up the current or near-term configuration Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

134

Table 6-1. F-4E AVIONICS CONFIGURATION DATA: INTEGRATED ELECTRONIC CENTRAL SYSTEM [AN/ASQ-19( )] NSN: 5895-00-411-1666

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method*	Mounting
			H	W	D			AC	DC			
UHF Subsystem												
Antennas (2)	AS-1611A	Upper in Fin Cap on Vert Fin (Door 68);** Lower on Nose Wheel Door				166	2.0					
Control Unit	C-6684/ASQ	Fwd Cockpit Right Console	6.4	5.75	5.0	184	5.5					
Control Unit (TACAN)	C-6685/ASQ	Aft Cockpit Left Console	2.25	5.75	3.3	43	1.1					
Freq Channel Indicator	ID-1311/ASQ	Fwd Cockpit Main Instr. Panel	1.3	1.6	5.9	12	1.0	5V Light	25-29V,1A			
Receiver Transmitter	RT-793/ASQ	Below Aft Cockpit Left Console	7.5	11.85	16.3	1449	35.9	115V 400 Hz 3φ 230VA (XMT) 91VA (RX)	27.5 [illegible] (RX)			
Amplifier-Power Supply-Receiver (AUX)	AM-2349A/ASQ-19	CNI Bay (Nose Wheelwell)	8.5	6.4	23.2	1262	36.0	6.3V 4.5A	130V† .27A		Forced Air	
IFF Subsystem												
Antenna††	2285-1	Above Door 19				86	0.[illegible]					
Transponder Computer	KIT-1A/TSEC	CNI Bay				244	14.0	#	#		Forced Air	
Transponder Control	C-6280(P)/APX	Fwd cockpit Right Console	5.75	5.75	3.0	99					Convection	
Coder-Receiver Transmitter	KY-532( )/ASQ-19	CNI Bay	8.6	6.4	22.5	1238	26.0	115V 400 Hz 70VA	28V, .2A		Forced Air	

*The overall CNI requires cooling air at 3.2 lb/min.
**Upper UHF Antenna will be relocated to top of fuselage forward of Vertical Fin with ARN-101 installation.
†Auxiliary Receiver power only. Power supply is the central source for entire Integrated Electronic Central System and its power requirement is TBD.
††Not applicable with AN/APX-80A installation.
#Powered from KY-532( ).

(continued)

135

Best Available Copy

Table 6-1. (continued)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
TACAN Subsystem												
Radio Receiver Transmitter	RT-547-ASQ-19	CNI Bay	8.5	7.5	22.6	1441	40.0	400 Hz* 115V	27.5V 27.4W		Convection w/internal Blower	
Pulse Decoder	KY-312/ASQ-19	Door 19	7.5	6.4	22.5	1080	29.5	400 Hz 115V .5A 67.5VA	27.5V 27.4W		Convection	
Antennas (2)	DM-NI-29	Upper-Above Door 135				36	0.5					
	TRANSCO 2282-1	Lower-on Fwd Nose Gear Door				36	0.5					
Intercomm Subsystem												
Intercomm Stations (2)	LS-460B/AIC	Fwd and Aft Cockpit Left Consoles	2.25	5.75	6.4	83	3.0		Each 28V 15W		Convection	Console
ADF Subsystem												
Antenna	AS-909/ARA-48	On Door 167	12.4	11.4	3.5	495	9.5	115V 26V 400 Hz	** 27.5V .7W			

*Powered by Amplifier-Power Supply Unit.
**To operate Antenna Drive Motor, Rate Generator, and Position Synchro.

 136

Table 6-2. F-4E AVIONICS CONFIGURATION DATA: SECURE COMMUNICATIONS SET KY-28

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Unit	C-8057/ARC NSN: 5821-00-087-1504	Fwd Cockpit Right Console	2.6	5.75	2.3	34			28		Convention	Console
Remote Unit	TSEC/KY-28 NSN: TBD	Lower Shelf CNI Bay Aft of Nose Wheelwell	7.8	5.0	9.1	355	15.0		28V			
Indicator Lights (2)		Fwd Cockpit Main Instr. Panel Lower Right Aft Cockpit on Canopy Arch Panel Assy.										

137

Table 6-3. F-4E AVIONICS CONFIGURATION DATA: RADIO TRANSPONDER SST-181X, AN/UPN-25 NSN: 5895-00-137-0439

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Radio Transponder or Radio Receiver Transmitter*	RT-846/UPN RT-855/UPN-25	Door 19	3.4	2.9	4.0	39	3.3		24-30V 16-27W		Convection	Hard
Antenna	AS-2038/UPN	Door 19	1.0 (diam.)		5.0	3.9	0.4				Convection	Hard

*Either may be installed depending on requirements. Characteristics cited apply to both.

 138

Table 6-4. F-4E AVIONICS CONFIGURATION DATA: FLIGHT DIRECTOR GROUP NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Flight Director Computer		Aft Cockpit Right										
Mode Selector Control		Fwd Cockpit Main Instr. Panel										
Horizontal Situation Indicator	AF/A24G-1	Fwd Cockpit Main Instr. Panel										
HSI Amplifier		Fwd Cockpit Above Left Console										
Bearing Distance Heading Indicator		Aft Cockpit Main Instr. Panel										
BDHI Mode Select Switch		Aft Cockpit Main Instr. Panel										

139

Table 6-5. F-4E AVIONICS CONFIGURATION DATA: FLIGHT CONTROL GROUP AN/ASA-32

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Amplifier	C-6563/ASA-32B NSN: TBD	Aft Cockpit Left Console										
Auto-Pilot Engaging Controller	C-6564/ASA-32H NSN: 6615-00-907-0197	Fwd Cockpit Left Console										
Rate GYRCS												
Pitch Roll Yaw	CN-506/ASA-32 CN-558/ASA-32 CN-559/ASA-32 NSN: TBD	Door 89L Behind Aft Cockpit seat Door 89R										
Accelerometers G-Limiting	MX-3423/ASA-320 NSN: 6615-00-600-1007	Door 168										
Lateral	MX-3421/ASA-32D NSN: 6615-00-600-0969	Door 168										
Motional Pick-Up Transducer	TR-175/ASA-32D NSN: 6615-00-590-5172	Fwd Stick Grip										

 140

141

Table 6-6. F-4E AVIONICS CONFIGURATION DATA: RADAR ALTIMETER SYSTEM, AN/APN-155 NSN: 5841-00-411-1661

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver-Transmitter	RT-689	Door 19**	6.8	3.75	15.75	402	11.7	115V 400 Hz 1 φ 34W	27.5V 15W*		Forced Air 0.4 lb/min.	
Receive Antenna	AS-1386	Door 27L	3.0	9.6	14.2	409	3.3					
Transmitter Antenna	AS-1442	Door 27R	3.0	9.6	14.2	409	3.3					

*42W during warm-up.
**Located in CNI Bay on 8 aircraft.

Table 6-7. F-4E AVIONICS CONFIGURATION DATA: AIR DATA COMPUTER SYSTEM

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Air Data Computer	CPK-92/A24G-34 NSN: TBD	Aft Cockpit Left										Rack
Angle of Attack XMTR	TRK-58/A24G-16 NSN: 6610-00-987-5611	Door 3										Hard
Electrical Resistance Temperature Transmitter	TRK-64/A24G-19 NSN: TBD	Door 2	5.0	3.6	2.5	45						Hard
Angle of Attack Indicators	ARK-10A/A24G-8	Fwd and Aft Cockpit Main Instr. Panels										Panel
Altitude Encoder Unit	CVK-99/A24G-34 NSN: TBD	Door 19	3.3	6.4	5.5	116	4.0					
True Airspeed Indicators	AVK-14/A24G-8 NSN: TBD	Fwd and Aft Cockpit Main Instr. Panels	2.0 (diam.)		6.9	22	1.0					Panel
Dual Servoed Altimeters	ARU-19A NSN: TBD	Fwd and Aft Cockpit Main Instr. Panels	3.3 (diam.)		8.8	75	4.5					Panel
Stall Warning Aural Tone Generator	O-1647/APN NSN: TBD	Fwd Cockpit Center										Hard

142

Table 6-8. F-4E AVIONICS CONFIGURATION DATA: NAVIGATIONAL COMPUTER SYSTEM, AN/ASN-46A*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Computer-Control	CP-723B NSN: 6605-00-867-6159	Aft Cockpit Right Console	7	7	11	539						Console-mounted
Amplifier-Computer	AM-3724 NSN: 6605-00-957-3810	Aft Cockpit Left	9	9	11	891						
Ground Speed Indicator	ID-1126 NSN: TBD	Aft Cockpit Main Instr. Panel Right	3	3	7	63					Convection	Panel-mounted
							34.0**	** 26V 400 Hz 1 φ 25VA - - - - 115V 400 Hz 1 φ 135VA - - - - [illegible]-28V Lighting Separate Source	** 24-28V 45W			

143

Best Available Copy

Table 6-9. F-4E AVIONICS CONFIGURATION DATA: ILS/VOR SYSTEM, AN/ARN-127 MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Panel	C-10124	Fwd Cockpit Left Console	5.75	2.6	4.5	68	2.2		27.[illegible]		Convection	
Course Indicator	ID-351B/ARN	Aft Cockpit Canopy										
GS/VOR/ILS Antenna	DMN9-5	Nose Radome Left Door 1										
Marker Beacon Antenna		Door 25L										
Receiver Mounting Base	R-2032	Aft Cockpit Right	5.1	7.2	12.6	463	10.0	26V 400 Hz 1A	27.5V 2A Max		Convection	

Best Available Copy

144

Table 6-10. F-4E AVIONICS CONFIGURATION DATA: INERTIAL NAVIGATION SYSTEM, AN/ASN-63 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power**		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Navigation Set Control	C-4779/ASN	Aft Cockpit Right Console	2.2	5.4	5.1	61	1.5	400 Hz 115V	28V		Convection	Console-mounted
Navigation Computer	CP-733/ASN	Aft Cockpit Right Console	8.0	7.3	26.1	1524	45.0	3 ϕ 750VA Per ϕ and 28V 1 ϕ 70VA			Forced Air	Console-mounted
GYRO Stabilized Platform	MX-4839/ASN MX-7299/ASN-74*	Aft Cockpit Right	10.0	11.25	14.9	1676	30.6				Internal Blower to circulate heated air with forced air intake to cool and stabilize temperature.	Hard
Output Signal Distribution Unit	MX-6728/ASN-63	Aft Cockpit Right	6.1	7.1	14.7	637	10.0					Hard

*Either unit may be included in F-4E INS.
**System power value only.

145

Table 6-11. F-4E AVIONICS CONFIGURATION DATA: IFF SYSTEM, AN/APX-80A NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches) H	Dimensions (Inches) W	Dimensions (Inches) D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	Aircraft Power DC	Heat Dissipation	Cooling Method	Mounting
Receiver-Transmitter	RT-868A/APX-76	Door 19	7.6	5.0	19.4	737	19.0	115V, 2A 400 Hz	28V, 1A		Forced Air 0.27-0.50 lb/min.	
Receiver Transmitter	RT-961A/APX-81A	Door 19	7.5	7.5	21.5	1209	29.0	15V 125W 400 Hz	28V, 0.6A		Convection	
Interrogator Set Control	C-8518A/APX-80A	Aft Cockpit Left Vert Panel	3.0	5.75	3.7	64	2.0	0-, 28V 400 Hz	28V 0.075A		Convection	
Electrical Synchronizer	SN-416( )/APX-76	Door 19	6.9	5.1	7.5	230	7.3	115V 0.24A 400 Hz	28V, 1A		Convection	
Switch Amplifier	SA-1568A/APX-76	Door 19	6.0	5.1	11.4	349	10.0	115V 0.1A 400 Hz	28V, 0.2A		Convection	
Interrogator Computer	KIR-1A/TSEC	CNI Bay	6.0	6.7	10.0	402	15.0				Convection	
Bandpass Filters	F-1346/APX	Door 19	7.0	8.0	1.0	56	4.0				Convection	
Coupler	CU-2099/APX	Nose Radome	2.5	4.0	1.4	14	0.4				Convection	
Coupler	CU-2100/APX	Nose Radome	2.5	4.0	1.4	14	0.4				Convection	
Coaxial Switch	TRANSCO 13730	Door 19	2.5	5.0	7.1	89	2.0				Convection	
Hybrid Coupler Dipole Antennas (4)	HAZELTINE 117893	Nose Radome	0.9	4.0	0.9	3	0.25				Convection	
Dipole Antennas (4)		Nose Radome										

146

Table 6-12. F-4E AVIONICS CONFIGURATION DATA: FIRE CONTROL SYSTEM RADAR SET, AN/APQ-120 D/E/F/V NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power*		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna	AS-2072( ) or AS-2781 or AS-2961	Radome					81.5	115V 400 Hz	28V 525W		Forced Air	Rack
Antenna Control	C-7346( )	Aft Cockpit Right Console					3.3	3 ϕ 6600VA			Convection	Console
Radar Set Control	C-8908( )	Aft Cockpit Left Console					5.1	28V 1 ϕ 50VA			Convection	Console
Control-Monitor	C-7345	Aft Cockpit Center					2.7				Convection	Panel
Control-Indicator	C-8909** or C-9798† or C-8671( )	Aft Cockpit Left Console					47.0 42.0 29.8				Internal Blower	Console
Intratarget Indicators												
Fwd	IP-1094** or 1204†	Cockpit Center					37.8/38.1				Internal Blower	
Aft	IP-1093** or 1205†						42.8/35.0					
TGT												
Intercept Computer	CP-891B or CP-891C	Radome					43.7				Forced Air	Rack
Power Supply	PP-4848 or PP-6992	Radome					43.1				Forced Air	Rack
Transmitter	T-1050A or T-1269( )	Radome					78.9				Forced Air	Rack
Electrical Synchronizer	SN-464 or SN-472 or SN-483	Radome					12.5				Forced Air	Rack
Antenna Control (Servo)	C-9047 or C-9736 or C-9737	Radome					27.9				Forced Air	Rack
Gyro Stable Platform	MX-8276	Radome					6.0				Forced Air	Rack

*Total system power.
**Comprise multisensor display group in APQ-120E/F versions.
†Comprise digital scan converter group in APQ-120V version.

147

Table 6-12. (continued)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Blanking Pulse Amplifier/ Divider	AM-6044	Below Aft Left Console					1.1				Convection	Console
Elect Equipment Pack	MT-3868 or MT-4612 or MT-4613 or MT-4439 or MT-4720	Radome					111.5				Forced Air	Hard
Cable Assembly	CX-10548	Radome					25.0				Forced Air	Hard
Control	C-7349 or C-9465	Radome					5.9				Forced Air	Rack
Waveguide Assembly	CG-3365 or CG-3775	Radome					40.2				Forced Air	Rack
Power Supply (Pump Tube)	PP-4847 or PP-6993	Radome					9.3				Forced Air	Rack
RF Oscillator	O-1430( )	Radome					9.4				Forced Air	Rack
Range Indicator	ID-1494	Aft Cockpit Instr. Panel					1.5				Conve:tion	Panel
Modulator-Oscillator	MD-735	Radome					11.8				Forced Air	Rack
RF Amplifier	AM-4827	Radome					40.8				Forced Air	Rack
AUX Armament Control Panel		Fwd Cockpit Left										
Control Relay Panel		Aft Cockpit Left										
AIM-4D SEQ Relay		Left Fwd Missile Cavity										

Table 6-13. F-4E AVIONICS CONFIGURATION DATA: TARGET IDENTIFICATION SYSTEM ELECTROOPTICAL (TISEO), AN/ASX-1 NSN: 1270-00-216-3435

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Converter Stabiliser Generator Group	OA-8585	Left wing Inboard Door 141L						115V 26-28V 400 Hz 3 ∅	±20V ±12V ±31V +5V		Forced 2.1-3.1 lbs/min	
Power Supply	PP-6425	Door 188 or 36L						115V 400 Hz 3 ∅	*			
Control	C-8591	Aft Cockpit Left Console						14V 28V 5V	±12V +20V +28V		Convection	
Video Processor	SN-451	Left wing Inboard Edge Door 141L							±12V ±33V		Forced .35-.50 lbs/min	
Radar Logic Unit	MX-9338/A	CNI Bay (M... wheelwell)						115V 400 Hz 3 A	+28V		Convection	
Forward Scope Display Panel		Fwd Cockpit Left Main Instr. Panel										

*Supplies power to remaining TISEO elements.

149

Table 6-14. F-4E AVIONICS CONFIGURATION DATA: RHAW SET AN/ALR-46(V) NSN: 5865-00-091-8623

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Signal Processor	CM-442( )	Door 185						115V 400 Hz 2.5A				
Counter-Measures Receiver	R-1854( )	Door 185	4.0	6.0	10.8	259	8.0	1 ϕ 115V 400 Hz .25A				
Amplifier Detectors (4)	AM-6639	Door 65 (2) Door 196R Door 19[illegible]L	6.7	1.7	7.6	87	3.5		±12V		Convection	
Indicator Controls (2)	ID-1902	Fwd and Aft Main Instr. Panels										
Azimuth Indicators (2)	ID-957/APR-39(V)	Fwd and Aft Main Instr. Panels										
Antennas (4)		Door 107 Door 107 Right Wing Tip Left Wing Tip	5.5	2.6 (each)	4.0	57 (each)						

Best Available Copy

Table 6-15. F-4E AVIONICS CONFIGURATION DATA: ECM JAMMING SYSTEMS (PODS) NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)		Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power*		Heat Dissipation	Cooling Method	Mounting
			Diameter	D			AC	DC			
ECM Pod	ALQ-71(V)-2	Wing Pods	10			242					Pods use Mounting Lugs
ECM Pod	ALQ-71(V)-3	Wing Pods	10	114.6	9001	350					
ECM Pod	ALQ-72	Wing Pods	10	99.0	7775	237					
ECM Pod	ALQ-87, A, (F)	Wing Pods	10			300					
ECM Pod	ALQ-101A	Wing Pods	10	100	7854	232					
ECM Pod	ALQ-101(V)-8	Wing Pods	10	157	12331	579					
ECM Pod	ALQ-119(V)-7, 8, 9	Wing Pods	10 10	154 104	12095 8168	565 307					
ERCM Pod	AAQ-8	Wing Pods				264					
ECM Pod**	ALQ-131( )	Wing Pods	12 max.	172	19453	831					
Control Panel	C-9501/AAQ-8	Part of 6631 panel when used									
Control Panel†	C-6631/ALQ	Aft Cockpit Lower Right Instr. Panel									
Control Panel†	C-9492/ALQ										

*Pods use aircraft power.
**Expected to supersede ALQ-119 and become standard USAF tactical aircraft pod.
†Only one control panel installed in aircraft.

151

Table 6-16. F-4E AVIONICS CONFIGURATION DATA: CHAFF DISPENSING SYSTEM, AN/ALE-40 NSN: 5865-01-060-7327

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Unit		Aft Cockpit Left Console										
Programmer		Fwd Cockpit Left Console										
Chaff Payload Module		Inboard Armament Pylon	4.8	9.5	8.2	374	6.1					
Flare Payload Module		Inboard Armament Pylon	5.7	7.5	8.2	351	7.2					

 152

Table 6-17. F-4E AVIONICS CONFIGURATION DATA: ATTITUDE REFERENCE BOMING COMPUTER SYSTEM, AN/AJB-7 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Accelerometer*	MX-2911/AJB-3A MX-6663/AJB-7	Door 89L	3.5	4.1	3.5	50	3.0	407VA @ 115Vac (Total**)	20W @ 28Vdc			
Amplifier-PWR Suppy	ASK-12/A24-1A	Aft Cockpit Left	3.0	5.0	11.7	176	9.25					
Attitude Indicator*	ID-1144/AJB-7 ARU-11/A	Fwd Cockpit Main Instr. Panel	5.25	5.0	8.0	210	5.00					
Bomb Release Angle Computer	CP-735/AJB-7	Aft Cockpit Right Vertical Panel	2.6	5.8	6.4	96	3.0					
Compass Adapter Compensator	ADK-182/A24G-1A	Aft Cockpit Right Behind Seat	4.1	5.1	9.6	201	8.5					
Compass Controller	G-4781/AJB-7	Fwd Cockpit Right Console	2.6	5.6	3.0	45	3.0					
Compass Transmitter	ML-[illegible]	Left Wing Door 197 or 646	3.8	3.1	2.1	25	1.2					
Displacement GYRO Assembly	SBK-8/A24G-1A	Aft Cockpit Left	7.7	7.1	15.2	831	2[illegible]					
Dual Timer	---	Aft Cockpit Right Vertical Panel	2.4	2.4	8.25	48	2.7					
Flight Director Bombing Computer	CP-734/AJB-7	Aft Cockpit Left	5.4	4.7	10.4	264	7.[illegible]					
Rate GYRO Transmitter*	T-751/AJB-3A T-970/AJB-7	Aft Cockpit Left Console	2.8	2.7	4.9	37	3.[illegible]					
Remote Attitude Indicator	ARU-13A	Aft Cockpit Main Instr. Panel	3.25	8.6	3.25	[illegible]1	3.8					
Switching Rate GYRO	HC-1	Aft Cockpit BHD Seat Left	2.65	2.4	4.8	31	0.6					

*Either type may be used in the system.
**Total system power data.

Table 6-18. F-4E AVIONICS CONFIGURATION DATA: WEAPON RELEASE COMPUTER SYSTEM, AN/ASQ-91 NSN: 1270-00-410-9123

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power*		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Ballistics Computer	CP-805( )	Door 19	8.4	7.2	19.6	1185	36.6					
Computer Control	C-6480A	Aft Cockpit Right Console	6.0	5.75	5.0	173	3.6					
Cursor Control	C-6481A	Aft Right Console	3.0	3.75	3.75	42	1.4					
Weapons Delivery Panel	MFG Part No. 53-81211-1	Aft Cockpit Right Console										
								400 Hz 115V 3 φ 120VA -------- 14/28V 25VA 400 Hz	28V 30W			

*Total system power data.

Best Available Copy

154

Table 6-19. F-4E AVIONICS CONFIGURATION DATA: LEAD COMPUTING OPTICAL SIGHT SYSTEM (LCOSS), AN/ASG-26( ) NSN: 1270-00-105-9006

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power*		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Optical Display Unit	SU-40	Fwd Cockpit Front Center	10.6	12.0	12.5	1590	25.0				Convection	Attached to Fwd Radar Indicator Unit
Computing Amplifier	AM-6492	Door 19	8.5	5.9	18.3	918	16.4				Convection	Hard
Computing Gyroscope	CN-1388	Door 19	8.9	7.9	8.3	935	11.2				Convection	Shock
Gyro Mount	MT-3909	Door 19	2.25	10.5	10.4	246	1.3	400 Hz 115 3 φ 390VA	24-29V 40W		Convection	Hard

*Total system power data.

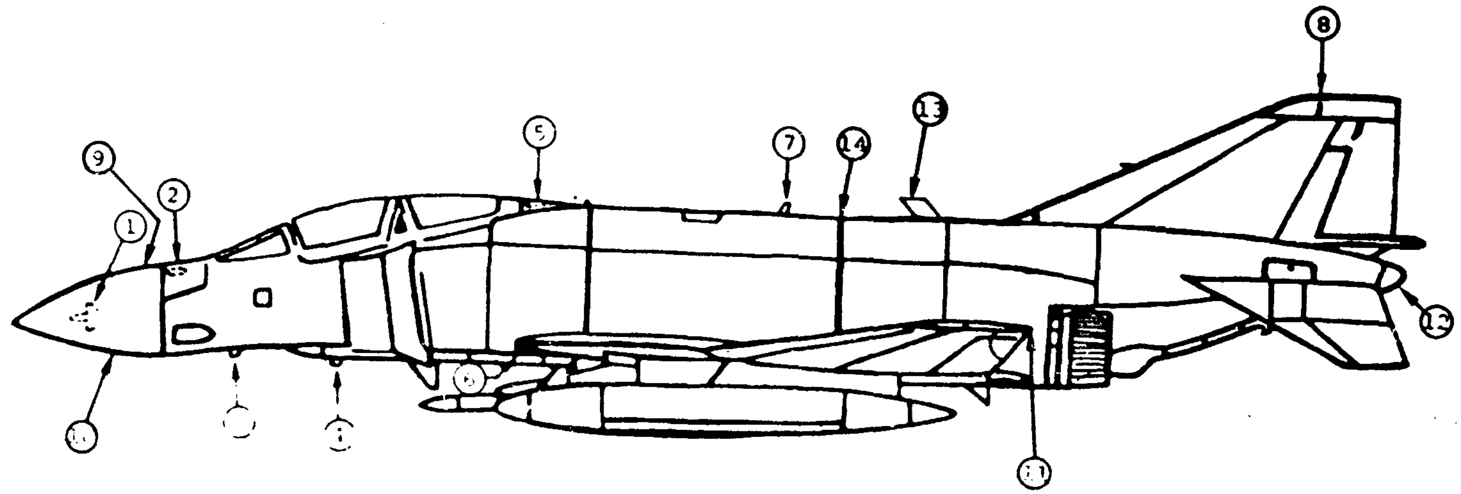
155

7. ANTENNA LOCATIONS

Figure 7-1 shows the approximate location of the antennas on the F-4E. The F-4E antenna nomenclature is as follows from the most recently dated technical orders:

	Antenna	Nomenclature or Part Number
1.	Radar	AS-3083/APQ-120(V)
2.	ADF	AS-909A/ARA-48
3.	Lower	11C21400
4.	Lower UHF	AS-1611/A
5.	IFF	2285-/A
6.	Radar Altimeter	AS-1386/AS-1142
7.	Upper TACAN	DMNI-29
8.	LORAN X-Axis	TBD
9.	VOR/ILS Glide Slope	DMN9-5
10.	AN/APX-80A IFF Dipole	TBD
11.	Left Wing Tip ALR-46 RHAW (Same on right wing)	TBD
12.	ALR-46 RHAW (2)	93346
13.	Upper UHF	AS-1611/A
14.	LORAN X-Y Axis Cross Loop	AS-4010/A

156



1. Radar Antenna
2. ADF Antenna
3. Lower TACAN Antenna
4. Lower UHF Antenna
5. IFF Antenna
6. Radar Altimeter Antenna
7. Upper TACAN Antenna
8. LORAN X-Axis Antenna
9. VOR/ILS Glide Slope Antenna
10. AN/APX-80A IFF Dipole
11. Left Wing Tip ALR-46 RHAW Antenna (Same Right Wing)
12. ALR-46 RHAW Antennas (2)
13. Upper UHF Comm Antenna
14. LORAN X-Y Axis Cross Loop Antenna

Figure 7-1. **F-4E ANTENNA LOCATIONS**

8. INTERFACE DATA

Data were not available for this section.

158

9. FUTURE MODIFICATIONS

Table 9-1 lists the known ongoing or near-term F-4E modifications (Block 48 and up) not previously discussed in Section 6. Table 9-2 presents some of the planned or tentative Class V modifications. Because the details of some modifications are classified, this section is limited in its content. Tables 9-3 through 9-5 list LRU data for the ARC-164, ARN-118, and ARN-101, respectively.

159

Table 9-1. F-4E ONGOING MODIFICATIONS	
Terminology/Nomenclature	**Remarks**
AIM-7E Interface	Replaces analog fire control computer with digital air combat computer.
PAVE TACK/AVQ-26	Provides ARN-101-equipped aircraft with the capability to acquire targets and employ terminally guided direct attack weapons.
Maverick/AGM-65A	Maverick missile carriage and launch capability.
UHF Radio/ARC-164	Replaces appropriate UHF portion of ASQ-19( ). (Near Completion)
TACAN/ARN-118	Replaces appropriate TACAN portion of ASQ-19( ).
Digital Avionics System/ ARN-101	Replaces ASN-63, ASN-46A, and ASQ-91 systems.
GBU-15 Data Link/AXQ-14	Provides ARN-101 aircraft with TV display signals and provides data link for GBU-15 weapon guidance.
Digital Scan Converter Group	Provides integrated and improved radar, optical, and TV display capability to the forward cockpit and radar/TV display to the rear cockpit.
Video Tape Recorder	Provides capability to tape information presented on the Digital Scan Converter displays.

Table 9-2. F-4E PLANNED/TENTATIVE MODIFICATIONS	
Terminology/Nomenclature	Remarks
Compass Tie/ALR-69	Improved RHAW system and added ECM power management capability.
AIM-9L	TBD
Global Positioning System	Space-based radio navigation system that provides worldwide precise three-dimensional location information.
AN/ALQ-131( ) Jammer	Replacement for ALQ-119 Pod Jammer. The system will be modularized to provide mission-tailored ECM jamming capability.
VHF AM-FM Radio/ARC-186	Addition of VHF communication capability.
Vinson/KY-58	Secure-voice replacement for KY-28.
GBU-15	Planar wing weapon.

Table 9-3. F-4E AVIONICS CONFIGURATION DATA: UHF RADIO SET LRUS, AN/ARC-164 (TWO COMPLETE SYSTEMS MAY BE INSTALLED)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver-Transmitter (Remote)	RT-1145	*	4.7	5.0	8.25	194	8.1	400 Hz 5Vac (Panel Lights)	27.5V 105W TX Mode 30W RX Mode		Forced Air	
Main Receiver**	R-1977											
Guard Receiver**	R-1976											
Transmitter**	T-1307											
Signal Data Converter**	CV-3297											
Radio Control Panel	C-6684	TBD	4.9	5.75	5.3	149	4.3		27.5V 10W		Convection	Console
Freq/Channel Indicator	ID-1961† or ID-1994A	TBD	2.25	2.4	5.9	32					Convection	Console of Panel
ADF Amplifier Relay Assembly	AM-3624/ARA-50											

*Anticipate likely installation in spaces vacated by Integrated Electronic Central UHF Communications equipment.
**Included in RT-1145 data.
†Configuration not yet decided.

161

Table 9-4. F-4E AVIONICS CONFIGURATION DATA: TACAN LRUS, AN/ARN-118

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Tranceiver	RT-1159/A	*	6.8	7.5	14.6	745	26.5	115V 400 Hz 1 ϕ 250VA max.			Internal Mount	On Trans-ceiver Mount
Digital-to-Analog Adapter	MX-9577/A	*	6.8	1.77	13.1	151	6.0	26V** 400 Hz			Convection	On Adapter Mount
Transceiver Mount	MT-4926/A	*	2.1	11.7	20.5	504		28 Vdc 28VA			Convection	Shock
Control Unit	C-10062/A	TBD	2.25	5.75	5.4	70	2.0				Convection	Console
Adapter Mount	MT-4927/A	*										

*Installation into space vacated by Integrated Electronic Central TACAN equipment is likely.
**For analog indicators.

162

Best Available Copy

Table 9-5. F-4E AVIONICS CONFIGURATION DATA: AN/ASN-101 COMPONENTS

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power (Total Watts)	Heat Dissipation	Cooling Method	Mounting
			H	W	D						
Signal Data Converter, Unit 301	CV-3467/A	Aft Cockpit RH Console	9.34	7.61	9.25	635	16.9	138			
Computer, Navigation, Unit 302	CP-1314/A	Aft Cockpit RH Console Area	11.88	11.02	7.60	966	38.7	320			
Inertial Measurement Unit Buffer, Unit 304	MX-9697/A	Aft Cockpit RH Console	6.58	9.31	6.08	372	12.0	83			
Power Supply, Unit 305	PP-7428/A	Aft Cockpit LH Console Area	7.53	7.52	6.76	383	17.2	110			
Keyer Control, Unit 306	C-9474/A	Aft Cockpit RH Console	6.50	5.75	7.87	256	7.9	77			
Control, Nav. Computer, Unit 307	C-9472/A	Aft Cockpit LH Console	4.50	5.75	3.00	68	2.2	16			
Indicator, Digital Display, Unit 308	ID-1942/A	Aft Cockpit Instrument Panel	5.75	5.75	3.00	86	2.8	45			
Indicator, Aux. Digital Display, Unit 309	ID-1943/A	Fwd Cockpit Instrument Panel	6.00	2.38	2.38	34	1.1	9			
Receiver, Loran, Unit 310	R-2086A	Upper Equipment Bay Shelf	12.86	3.76	7.63	369	13.2	105			
Antenna Coupler, Unit 311	CU-2150/A	Upper Equipment Bay	7.52	2.91	2.53	55	1.8	3			
Course Select Panel, Unit 312		Fwd Cockpit Instrument Panel	1.87	6.52	1.85	22.6	2.0	4			
Relay Assembly, Unit 313**	RE-1118/A	Upper Equipment Bay Door 19	8.25	4.72	4.37	155	6	75			

*Replaces the ASQ-91, ASN-46A, and ASN-63 systems in the F-4E.
**Also herein referred to as Relay Box Unit (RBU).

Table 9-5. (continued)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power (Total Watts)	Heat Dissipation	Cooling Method	Mounting
			H	W	D						
Antenna, Loran, X-Y Axis, Unit 314	AS-4010/A	Center Fuselage Door 48	3.93	9.02	1.90	220	10.0	N/A			
Antenna, Loran, Z Axis, Unit 315	AS-4011/A	Aft Fuselage Vertical Tail Fin	6.19	1.75	9.19	71	4.0	N/A			
Target Insert Panel, Unit 316		Aft Cockpit LH Console	2.90	5.75	1.12	18.7	1.5	8			

164

Best Available Co...

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Aircraft and avionics configuration data assembled by ARINC Research, principally in the form of copies of applicable sections, tables, and figures from the aircraft and equipment Technical Orders listed at the end of this section
- Avionics Planning Baseline Document - October 1978
- McDonnell Report 8738, Environmental Design Requirements and Test Procedures - Aircraft Electronic Equipment - 5 April 1962, Rev. 1 July 1964.
- Information supplied by Ogden ALC
- Technical Order T.O. 12P2-2APQ-120-2-1 for the MSDG and DSCG display information
- ARINC Research Informal Report: Technical Report, Preliminary JTIDS Configuration Data Analyses, May 1978

Inventory of Technical Orders

T.O. Number	Subject	Change Number	Date
1F-4E-1	Flight Manual	9	9/15/78
1F-4E-2-1	Aircraft, General	18	4/15/78
1F-4E-2-4	Flight Control Systems	5	12/15/77
1F-4E-2-9	Air Induction System	13	6/1/77
1F-4E-2-10	Fuel Sys ms	12	11/15/77
1F-4E-2-11	Instrument System	19	12/15/77
1F-4E-2-12	Air Data Computer Set	8	12/15/77
1F-4E-2-13	Electrical System	2	12/15/77
1F-4E-2-14	Integrated Electronic Central Radar Altimeter Radar Beacon System	Original	6/15/77
1F-4E-2-15	Navigation System	17	4/15/77
1F-4E-2-17	Avionics Navigation Instrument System	8	12/1/77
1F-4E-2-18 (Volume 1)	Armament Systems (Sections 1&2)	15	6/1/77
1F-4E-2-18 (Volume 2)	Armament Systems (Sections 3,4,5,6,7)	15	6/1/77
1F-4E-2-19-1 (Volume 1)	Weapons Control System (P. 1-1; 6-430)	16	4/15/77

(continued)

Inventory of Technical Orders (continued)

T.O. Number	Subject	Change Number	Date
1F-4E-2-19-1 (Volume 2)	Weapons Control System (6-430, end)	16	4/15/77
1F-4E-2-22	Systems Integration	16	7/15/77
1F-4E-2-23 (Volume 1)	Wiring Diagrams (Sections 1,2,3)	Basic	4/1/77
1F-4E-2-23 (Volume 2)	Wiring Diagrams (Sections 4,5)	Basic	4/1/77
1F-4E-2-30	Electronic Intelligence System	3	4/1/77
1F-4E-2-33	Weapons Release Computer	9	4/1/77
1F-4E-2-38	Electronic Optical Target Designator	Basic	4/1/77
1F-4E-4-4	Instrument, Electric, Systems	24	4/15/77
1F-4E-4-7	Index	2	8/15/77
1F-4E-21	Equipment Inventory	3	11/4/76
1F-4E-34-1-1	Weapons Delivery	1	7/15/77
12R2-2ARC164-2	Radio Set	Basic	6/20/76
12R5-?ARN118-1	TACAN Navigational Set	Basic	10/15/76
12P5-2APN-32	Receiver-Transmitter and Antennas	13	12/1/76
12R5-2ARN127-2	Radio Receiving	Basic	1/15/77
12P3-2ALR46-42	Signal Processor	4	12/31/77

166

AVIONICS INTERFACE DATA SUMMARY
FOR
F-4G

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

167

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

168

Record of Changes			
Change	Subject	Date Entered	Initials

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

/7(

LIST OF FIGURES AND TABLES (continued)

/71

1. INTRODUCTION

This document contains configuration data relating to the integration of additional avionics into the F-4G aircraft.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

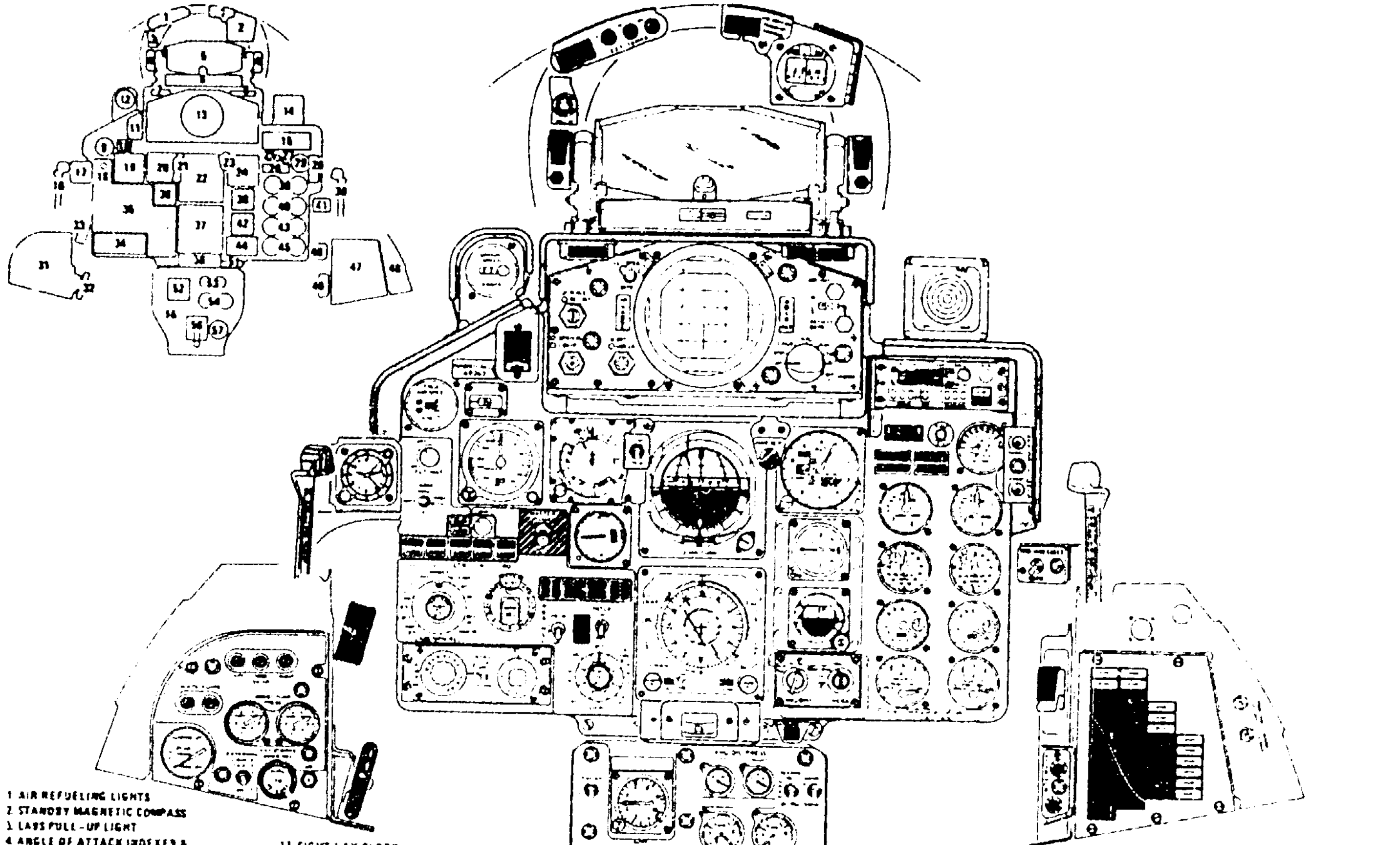
This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable Technical Orders are included in the references listed in Section 10.

2. COCKPIT SPACE

Figures 2-1 through 2-6 present the current forward and rear cockpit layout, respectively, for the F-4G aircraft. Space availability within each cockpit is extremely limited. The rear cockpit underwent an extensive change as a result of APR-38 ECM system installation.

It is expected that further significant cockpit modifications will occur in the near future with the addition of an airborne video tape recorder in the forward cockpit right console and a new navigation system (such as the ARN-101 or AJQ-25). It is noteworthy also that the layout shown does not reflect the ARC-164 UHF Radio or the ARN-118 TACAN installations that are nearing completion.



1 AIR REFUELING LIGHTS
2 STANDBY MAGNETIC COMPASS
3 LABS PULL-UP LIGHT
4 ANGLE OF ATTACK INDEXER & ACTIVITY LIGHTS
5 OPTICAL SIGHT UNIT
6 OPTICAL SIGHT CAMERA
7 LANDING GEAR WARNING LIGHT
8 RANGE LIGHTS PANEL
9 TRUE AIRSPEED INDICATOR
10 UHF REMOTE CHANNEL INDICATOR
11 HEAD-UP DISPLAY (HUD)
12 GROUND SPEED INDICATOR
13 RADAR SCOPE
14 PLAN POSITION INDICATOR
15 WARNING PANEL
16 CANOPY EMERGENCY JETTISON HANDLE
17 EIGHT DAY CLOCK
18 FLIGHT INSTRUMENT LIGHTS CONTROL
19 RADAR ALTIMETER
20 AIRSPEED MACH INDICATOR
21 REFERENCE SELECTOR SWITCH
22 ATTITUDE DIRECTOR INDICATOR
23 MARKER BEACON LIGHT
24 ALTIMETER
25 MASTER CAUTION LIGHT
26 FIRE-OVERHEAT WARNING LIGHTS
27 FIRE DETECTOR CHECK BUTTON
28 INTERNAL FUEL QUANTITY INDICATOR
29 APR 36 LIGHTS CONTROL PANEL
30 CANOPY MANUAL UNLOCK HANDLE
31 LEFT SUB PANEL
32 EMERGENCY BRAKE CONTROL HANDLE
33 LANDING GEAR CONTROL HANDLE
34 AUTOMATIC WEAPONS RELEASE UNIT
35 MULTIPLE WEAPONS SELECTOR PANEL
36 ANGLE OF ATTACK INDICATOR
37 HORIZONTAL SITUATION INDICATOR
38 VERTICAL VELOCITY INDICATOR
39 FUEL FLOW INDICATORS
40 TACHOMETERS
41 FEED TANK CHECK SWITCH
42 EMERGENCY ATTITUDE INDICATOR
43 EXHAUST GAS TEMPERATURE INDICATORS
44 NAVIGATION FUNCTION SELECTOR PANEL
45 EXHAUST NOZZLE POSITION INDICATORS
46 ARRESTING HOOK CONTROL HANDLE
47 RIGHT SUB PANEL
48 PRIMARY INSTRUMENT & MODE LIGHTS CONTROL CIRCUIT BREAKERS
49 KY-28 MODE LIGHTS
50 SLIP INDICATOR
51 VOR MODE LIGHT
52 ACCELEROMETER
53 OIL PRESSURE INDICATORS
54 HYDRAULIC PRESSURE INDICATORS
55 PEDESTAL PANEL
56 RUDDER PEDAL ADJUSTMENT CRANK
57 PNEUMATIC PRESSURE INDICATOR

Figure 2-1. FRONT MAIN PANEL AREA

174

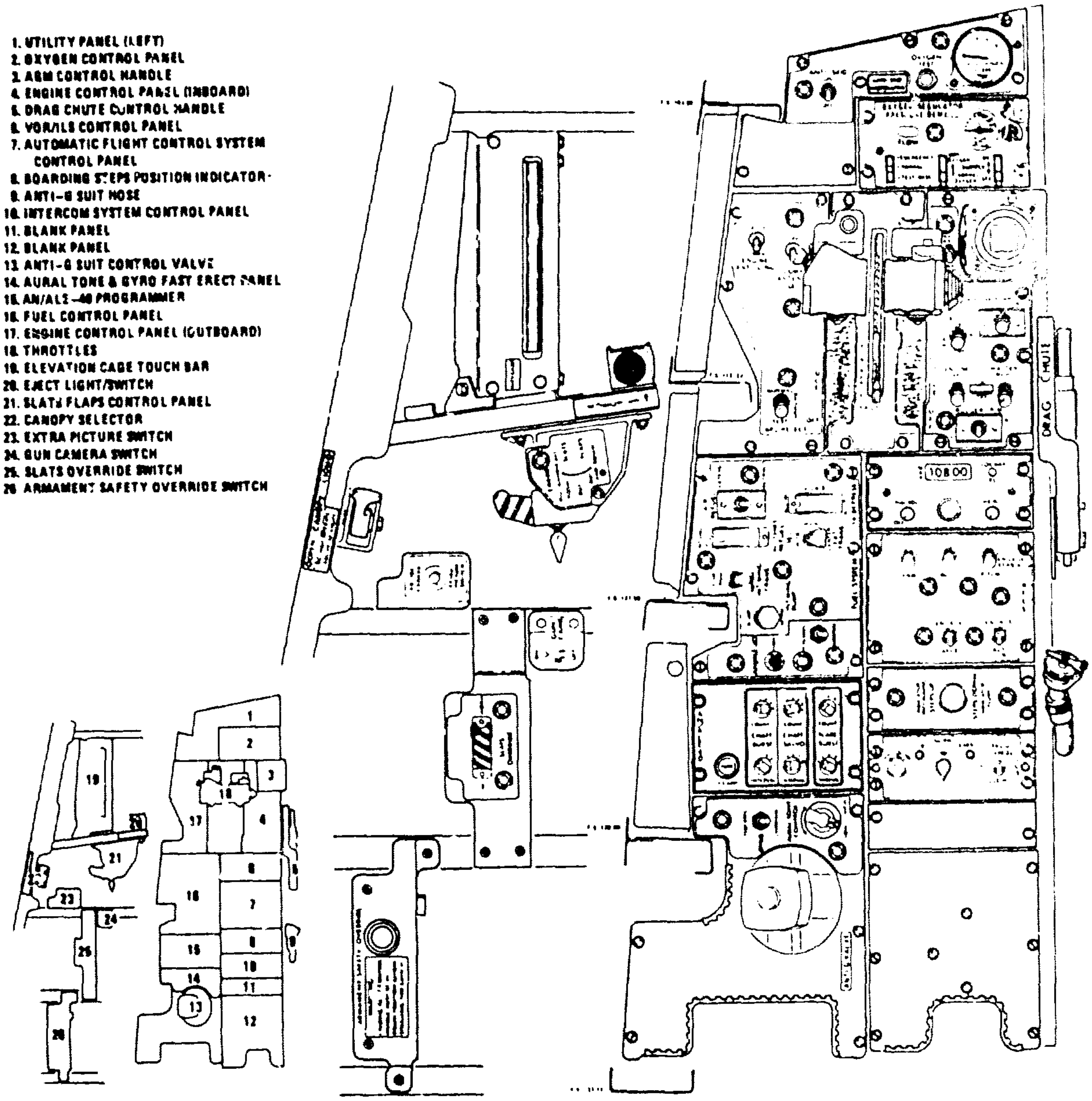


Figure 2-2. FRONT LEFT CONSOLE AREA

175

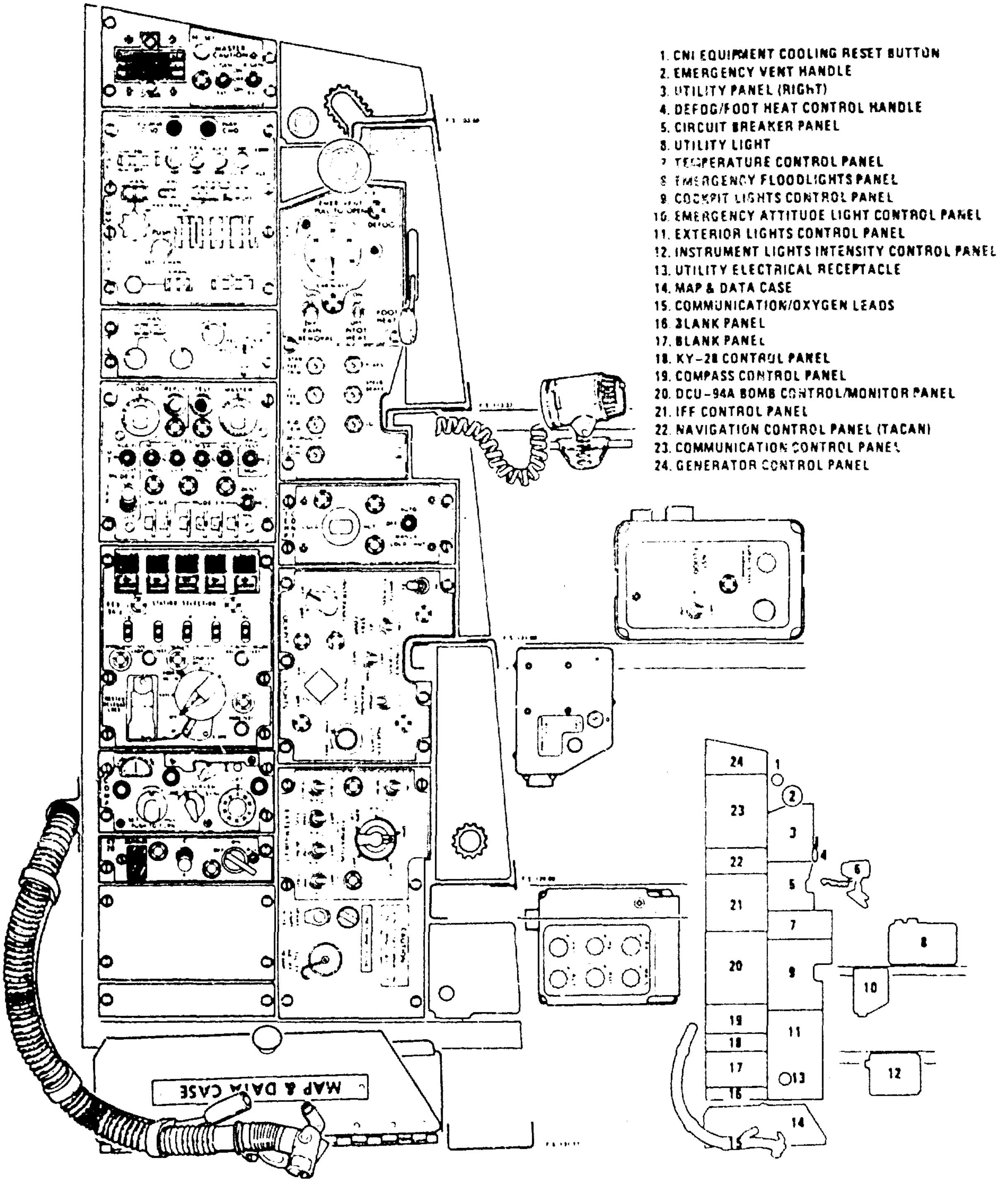


Figure 2-3. FRONT RIGHT CONSOLE AREA

176

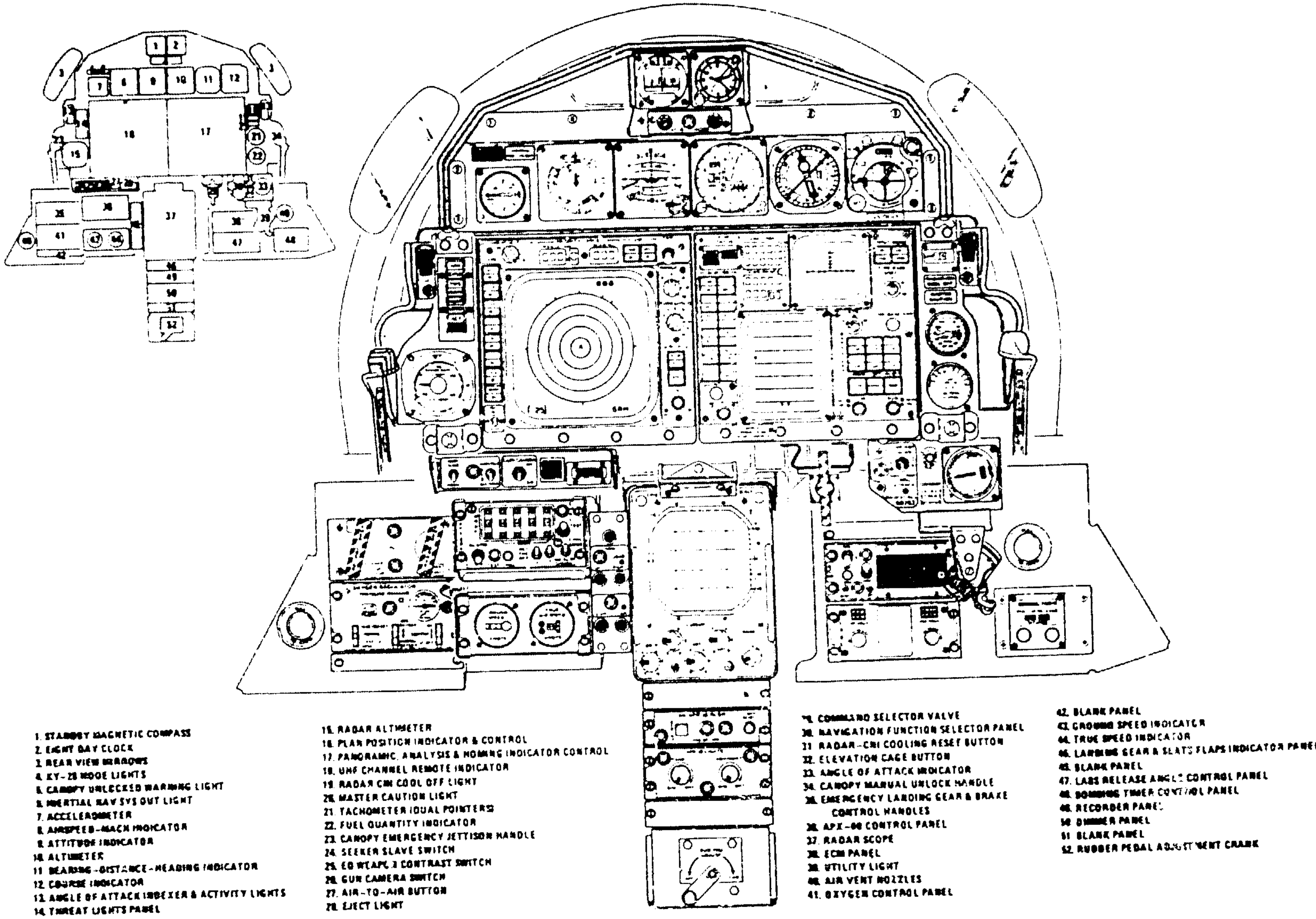
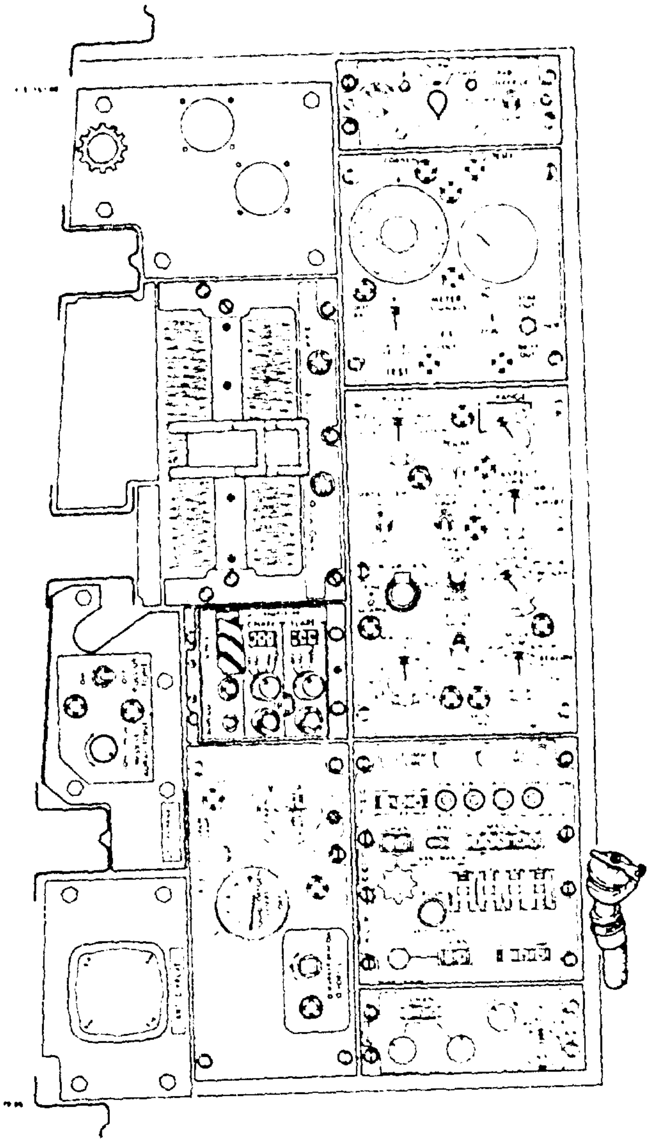


Figure 2-4. REAR MAIN PANEL AREA

1. INTERCOM CONTROL PANEL
2. CONTROL-MONITOR PANEL
3. RADAR CONTROL PANEL
4. COMMUNICATION CONTROL PANEL
5. ANTI-G SUIT HOSE
6. NAVIGATION CONTROL PANEL
7. MARKER BEACON VOR/ILS AUDIO CONTROL
8. ANTI-G SUIT CONTROL VALVE
9. OXYGEN QUANTITY GAGE
10. CABIN ALTIMETER
11. UTILITY PANEL
12. AN/ALE-40 PROGRAMMER
13. THROTTLES
14. BLANK PANEL
15. EMERGENCY SLATS FLAPS
16. CANOPY CONTROL HANDLE



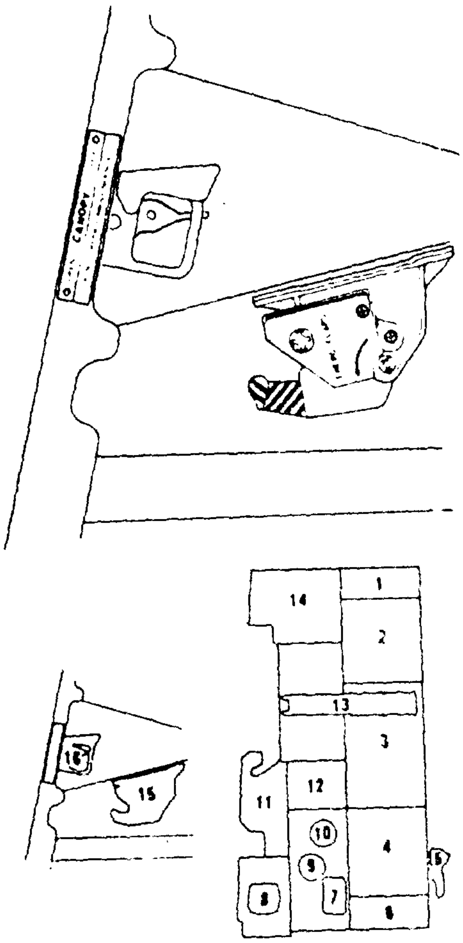
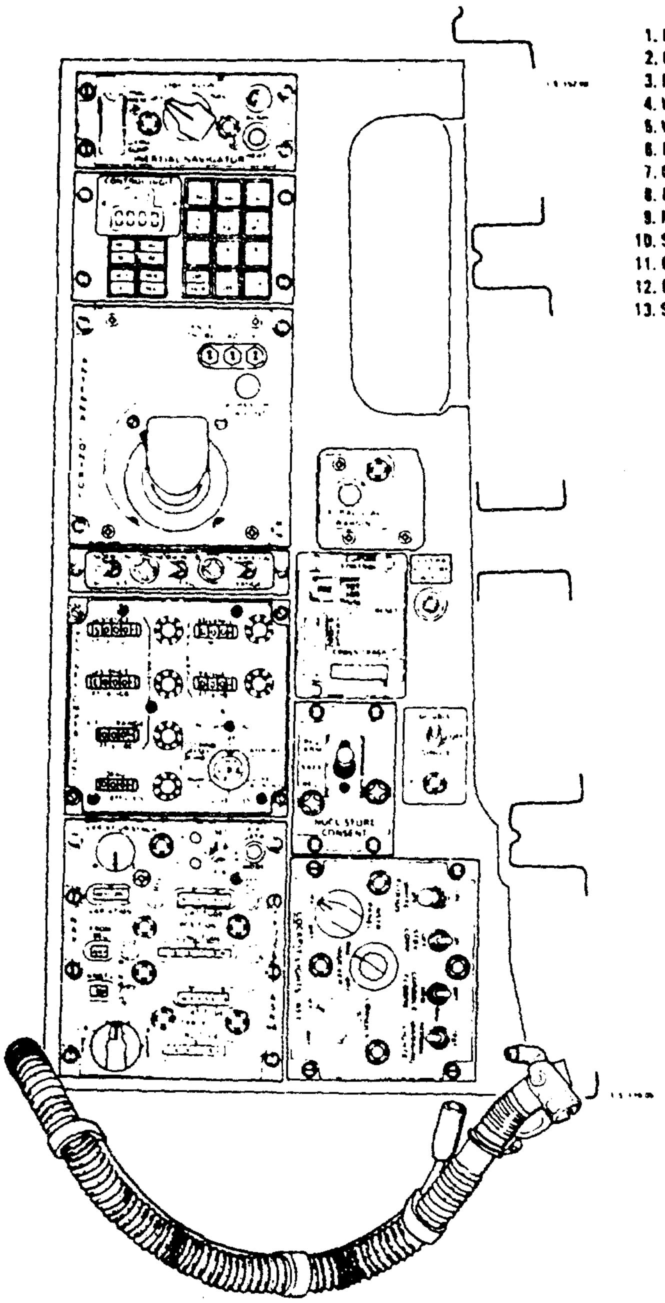


Figure 2-5. REAR LEFT CONSOLE AREA

Best Available Copy



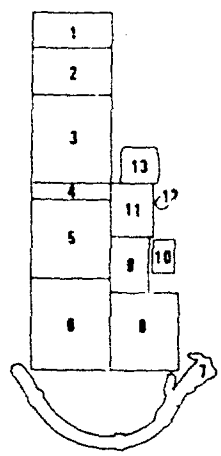


Figure 2-6. REAR RIGHT CONSOLE AREA

Best Available Copy

179

3. AVIONICS SPACE AVAILABLE

On the basis of the examination of a production F-4G aircraft (Serial Number 69-7201) at Ogden ALC with the APR-38 system installed, available avionics space, as shown in Table 3-1, were identified. The location of these areas are listed in the table and are also keyed to Figure 3-1.

There exists a large space in the tail area, moderate space in the upper avionics bay and in the "Rat Bay", and smaller spaces in various other locations throughout the aircraft.

Table 3-2 details several possibilities for providing space in the 1984 time frame. These alternatives will require replacement or modification of certain systems. Locations are keyed to Figure 3-1.

The environmental data for the areas cited has been extracted from McDonnell Report 8738 and presented in Table 3-3. Although the addition of the "chin" pod and other structural changes made during the F-4E to F-4G conversion might produce some aerodynamic effects (e.g., added drag at low speeds and altitudes), the applicability of the environmental data contained in the report is considered valid currently and no known new/special temperature - altitude - vibration testing is now planned.

Table 3-1. F^2E SUMMARY - F-4G

F^2E Criteria	Potential Available Space				
	A	A	A	A	B
Location Reference and Description	CNI Bay. Replacement of Amp-Power Supply-Aux Rcvr AM-2349/ASQ	CNI Bay Nose Wheel-well behind KIT-1A	CNI Bay Nose Wheel-well Behind KIR-1A	CNI Bay Nose Wheel-well Behind KIR-1A	Upper Avionics Bay - Door 19 Previous Lead Computing Gyro Location
Rectangular Size (H, W, D) Volume	8.5", 6.4", 23.2" 0.7 ft^3	8.0", 6.0", 10.0" 0.3 ft^3	7.8", 5.0", 11.0" 0.25 ft^3	6.7", 6.0", 10.0" 0.2 ft^3	14", 14", 16" 1.8 ft^3
Type Cooling Available	Forced Air Conditioning	Forced Air Conditioning	Forced Air Conditioning	Forced Air Conditioning	Forced Air Conditioning
Temperature - Altitude Condition*	Condition I	Condition I	Condition I	Condition I	Condition I
Vibration Region**	Region IX	Region IX	Region IX	Region IX	Region X
Possible Candidates for the Space	None Known	None Known	VHF AM/FM ARC - 186	VHF AM/FM ARC - 186	VHF AM/FM ARC - 186
Remarks	The unit provides aux UHF receiver & intercom power functions. It is conceivable that at least half of the volume shown could be gained through replacement or repackaging methods without a loss of capability.				

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.
**See Table 3-2.

Best Available Copy

181

Table 3-1. (CONTINUED)

F² E Criteria	Potential Available Space				
	C	D	E	F	G
Location Reference and Description	"Rat" Bay Door 185L	Tail Area of Fuselage Aft of =7 Fuel Cell Door 61L	APR-38 Chin Pod Under Radome Door 71L Next to Analysis Rcvr.	Nose Radome Area	Door 183 Over Left Wing TISEO Power Supply Location on F-4E
Rectangular Size (H, W, D) Volume	17.0", 25.0", 5.1", (max) 1.3 ft³	27.0", 17.0", 15.0" 4.0 ft³	7.0", 6.0", 19.0" 0.5 ft³	4", 6", 10" 0.14 ft³	6.1", 6.2", 12.4" 0.3 ft³
Type Cooling Available	Cooling Air Bled Into Bay From Upper Avionics Bay	Convection Only	Forced Air Conditioning	Forced Air Conditioning	TBD. Forced Air Conditioning Available to TISEO on F-4E
Temperature - Altitude Condition*	Condition I	Condition II	Condition IV	Condition IV	Condition I
Vibration Region**	Region I	Region I	Region VII	Region VII	Region I
Possible Candidates for the Space	None Known	None Known	APR-38 Enhancement Program (Not Yet Approved)	None Known	None Known
Remarks	This is a very shallow compartment.	No power or forced air cooling currently available. Severe ambient temperature environment.		4 spaces approximately this size currently exist on the radar shock mount. Spaces are not adjacent.	F-4G does not have TISEO (ASX-1) System installed. This space as well as space on left wing inboard used for TISEO on F-4E should be available. This space size has not been confirmed.

**Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.
**See Table 3-2.

152

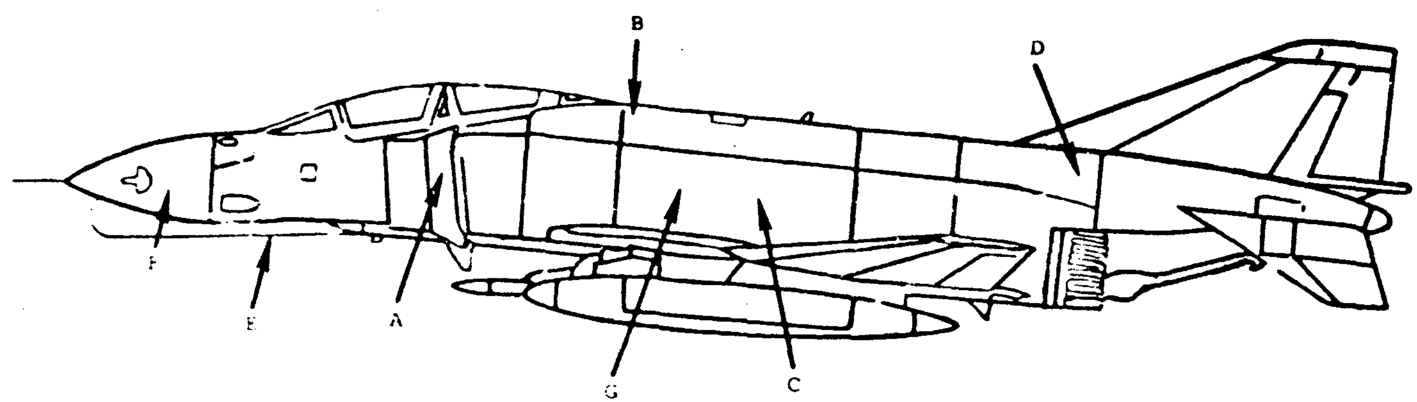


Figure 3-1. F-4G SPACE LOCATIONS

Table 3-2. F-4G RAW ENVIRONMENTAL DATA SYNOPSIS

Temperature Data

Temperature-Altitude Condition	Condition I	Condition II	Condition IV
Continuous	-54°C to +71°C, Sea level -54°C to +24°C, 60,000′	-54°C to +71°C, Sea level -54°C to +24°C, 60,000′	Per MAC Detailed Performance Specification
30 Minutes	to +95°C, Sea level to +83°C, 60,000′	to +95°C, Sea level to +100°C, 60,000′	
10 Minutes	to +101°C, Sea level to +143°C, 50,000′	to +109°C, Sea level to +170°C, 50,000′	

Vibration Data

Equipment Performance (double amplitude)	Region I	Region VII	Region IX	Region X
5-10 Hz	0.060 inches	0.060 inches	0.060 inches	0.060 inches
10-15 Hz	0.063 inches	0.100 inches	0.078 inches	0.064 inches
15-20 Hz	0.036 inches	0.036 inches	0.036 inches	0.036 inches
20-23 Hz	0.036 inches	0.080 inches	0.050 inches	0.060 inches
23-50 Hz	0.036 inches	0.036 inches	0.036 inches	0.036 inches
<50 Hz	+5g	+5g	+5g	+5g

4. ELECTRICAL POWER SYSTEM

4.1 Main Power System

The main electrical power system in the F-4G is composed of two 30 kVA, 115 volt, 400 Hz 3-phase power generators with a constant-speed drive (CSD) unit regulating the generator at 8,000 rpm. The load is evenly divided between the generators when they are operating in parallel. If a fault in either generator occurs, it is removed from the line. Two underfrequency protectors prevent underfrequency operation of the generators.

4.2 Power Conversion and Distribution System

The power conversion and distribution system has three main functions: (1) distributes internal emergency and external ac power to the aircraft, (2) distributes dc power to the aircraft, and (3) converts 115 Vac to 28/14 Vac and 28 Vdc. Power from the left generator is supplied to the left main 115 Vac bus and instrument 200/115 Vac bus. The right generator delivers power to the 115 Vac right main bus and the essential 115 Vac bus. In normal operation the emergency generator delivers ac power to the essential and instrument buses.

Two 100 ampere transformer-rectifiers convert the received ac power from their generators to the 28 Vdc power.

4.3 Battery Power

The battery power supply system contains a 24 volt nickel cadmium battery rated at 11 ampere-hours at a 2-hour discharge rate. The aircraft battery is used for normal ground and emergency air starts as well as to provide power to the four floodlights. If total ac-to-dc power conversion fails, the battery will supply power to the essential dc bus.

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The aircraft environmental control system air conditioning is divided into two major systems, one for cabin areas and one for electronic equipment cooling. Both systems use high temperature, high pressure, and seventeenth-stage engine compressor bleed air from either or both engines.

5.2 Cabin Air Conditioning

The cabin air conditioning system (CACS) on the right side of the fuselage consists of two air-to-air heat exchangers and other associated equipment. The CACS allows a selection of cabin conditioning temperatures, defogging, rain removal, and ram air operations.

5.3 Equipment Air Conditioning

The equipment air conditioning system, located on the left side of the forward fuselage, supplies cooling air for the radar compartment in the nose, the electronic equipment compartment aft of the nosewheel well, and the electronic equipment shelf behind the rear cockpit bulkhead. System control is entirely automatic with the temperature being controlled at approximately 84°F from sea level to 25,000 feet and 40°F from 25,000 feet up.

5.4 Equipment Auxiliary Air System

The equipment auxiliary air system (EAAS) uses partially cooled air from the equipment air conditioning system. The EAAS distributes the cooled air as follows:

- Anti-G System
- Canopy Seal System
- Air Data Computer
- Radar Wave Guide
- Rear Cockpit Radar Scope
- Radio Receiver(s) - Transmitter
- Fuel Pressurization System
- Pneumatic System Air Compressor

6. CURRENT AVIONICS

6.1 Summary of Current Avionics

Table 6-1 lists the current avionics systems in the F-4G. Those that are different from the F-4E configuration or unique to the F-4G are annotated.

Systems unique to the F-4G are described in this section. The reader is referred to the F-4E Configuration Data Summary for details of the common avionics systems. The unique systems are the AN-APR-38 ECM System and the AN/ASG-30 Computing Optical Sight.

Tables 6-2 and 6-3 list the available LRU data for the ECM System and the Computing Optical Sight System, respectively. A detailed description of the APR-38 system was not available for this report; however a mock diagram of the APR-38 ECM system is presented in Figure 6-1.

Refer to Section 9 of this document for avionics systems which can be expected to exist on the F-4G in the 1984 time frame (some pending approval) and replace many of those listed in Table 6-1.

Table 6-1. PRINCIPAL AVIONICS SYSTEMS CURRENTLY INSTALLED ON THE F-4G AIRCRAFT

Flight Control	ASA-32( )
Flight Director Computer	TBD (Same as non-ARN-101 equipped F-4E aircraft)
Air Data Computer	CPK-92/A24G-34
Attitude Reference Bombing Computer	AJB-7
Fire Control	APQ-120(V) with Digital Scan Converter Group Display
Flight Data Recording	TBD (Same as F-4E)
Inertial Navigation	ASN-63
Integrated Electronic Central	ASQ-19A w/KIT-1A, KIR-1A IFF CRYPTO
Intercommunications	
UHF Communications	
Automatic Direction Finding	
TACAN	
IFF	
Computing Optical Sight	ASG-30*
Navigation Computer	ASN-46A
Radar Altimeter	APN-155
Radar Beacon	SST-181X or UPN-25
IFF Interrogator	APX-80A
Speech Security	KY-28
Weapons Release Computer	ASQ-91
Radar Receiving Set (RHAW)	APR-38**
ILS/VOR	ARN-127
Countermeasure Dispenser	ALE-40
Data Recording Cameras	KB-18A or KB-25A
Electronic Countermeasures Pods	ALQ-119(V)-12, -14
Armament	
Missile Launching System	For AIM-7, -9 and AGM-45, -65A
Multiple Weapons System	For conventional stores
Special Weapons Monitor	Nuclear Stores Consent Switch and DCU-94/A.
Centerline Weapons Release	AERO-27A, or BRU-5/A

*Differs from F-4E.
**Unique to F-4G.

Table 6-2. AN/APR-38 ECM SYSTEM (WILD WEASEL) NSN: TBD

Name	Nomenclature	Location	Dimension* (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Frequency Select Control/ Converter	CV-3358 (Quantity of 2)	Chin Pod Radome, Aft Side					25 each					
Forward Radio Receiver Array	R-2019	Gun Compartment Radome Access Door 8					20					
Side Radio Receiver/Array	R-20.8	Radome Access Doors 52L/R					38					
Antenna Selector Low Band/ Special Warning Switch	SA-2091	Access Door 171										
Lighting Unit	PP-7290	Bulkhead Aft Cockpit Right Side										
Mid-Band Antenna	AS-3120	Bottom of Chin Pod				Data for this equipment are Classified.						
High Band Antenna	AS-3121	Bottom of Chin Pod										
Omni Antenna (Blade)	AS-3122	Bottom of Chin Pod										
Antenna	AS-3119 (Quality of 9)	Left Side (3) and Right Side (3) of Radome & 2 on vertical stabilizer										
Digital Computer	CP-1255	Access Door 171					53					
Signal Data Converter (SPU)	CV-3355	Access Door 77					24					
Mounting Base	MT-4826											
Signal Data Converter/ Storer (NAV Coupler)	CV-3356	Access Door 171					19					

*To be supplied when available.

(continued)

Table 6-2. AN/APR-38 ECM System (Wild Weasel) NSN: TBD (continued)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Electronic Frequency Synthesizer	C-1722	Access Door 168					33					
Electronic Equipment Mounting Base	MT-4828											
Analysis Receiver	R-2020	Access Door 71R					14					
Low Band Radio Receiver	R-2021	Access Door 77					29					
Central Power Supply	PP-7298	Access Door 171					49					
Mounting Base	MT-4827 (Quantity of 2)					Data for this equipment are Classified.						
Signal Data Converter (IF Processor)	CV-3357	Access Door 173					19					
Antenna Selector/Low Band Special Warning Switch	SA-2091	Access Door 171										
Signal Data Converter (DEU)	CV-3352	Access Door 170					30					
Plan Position Indicator	IP-1250	Forward Cockpit Instrument Panel					5					
Cdr Warning Control/Indicator	ID-2066	Forward Cockpit Instrument Panel										
Panoramic Analysis and Homing Indicator	IP-1249	Aft Cockpit Instrument Panel					22					
Plan Position Indicator and Control Unit	IP-1248	Aft Cockpit Instrument Panel										

*To be supplied when available.

(continued)

190

Table 6-2. AN/APR-38 ECM SYSTEM (WILD WEASEL) NSN: TBD (continued)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Programming Indicator Control	C-10023	Aft Cockpit Right Console										
Aft Receiver Array	R-2019	Tail Pod Top of Vert Stabilizer Doors 97 and 177					20					
Frequency Select Control	CV-3358	Tail Pod Top of Vert Stabilizer Door 85					13					

Data for this equipment are Classified.

Table 6-3. COMPUTING OPTICAL SIGHT SYSTEM AN/ASG-30 WSM: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Lead Computing Amplifier	AM-6843	Door 19 Upper Bay	8.5	5.9	18.3	918	18				Convection	
Optical Display Unit	SU-83	Forward Cock-pit Front Center	10.6	12.0	12.5	1590	25				Convection	
								115V 400 Hz 3 ø 390 VA	24-29V 40W			
								Total System Power				

192

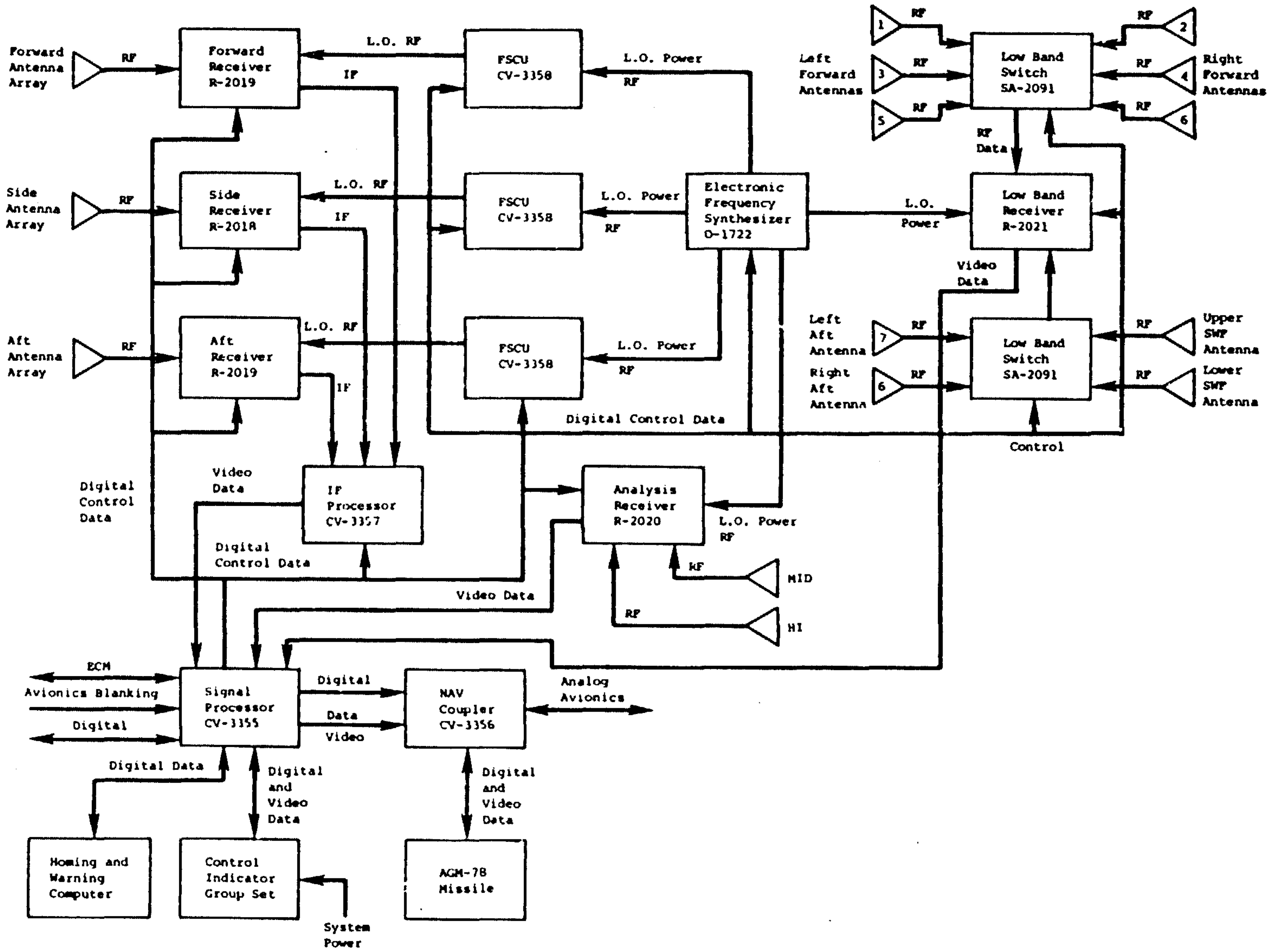


Figure 6-1. AN/APR-38 Simplified Block Diagram

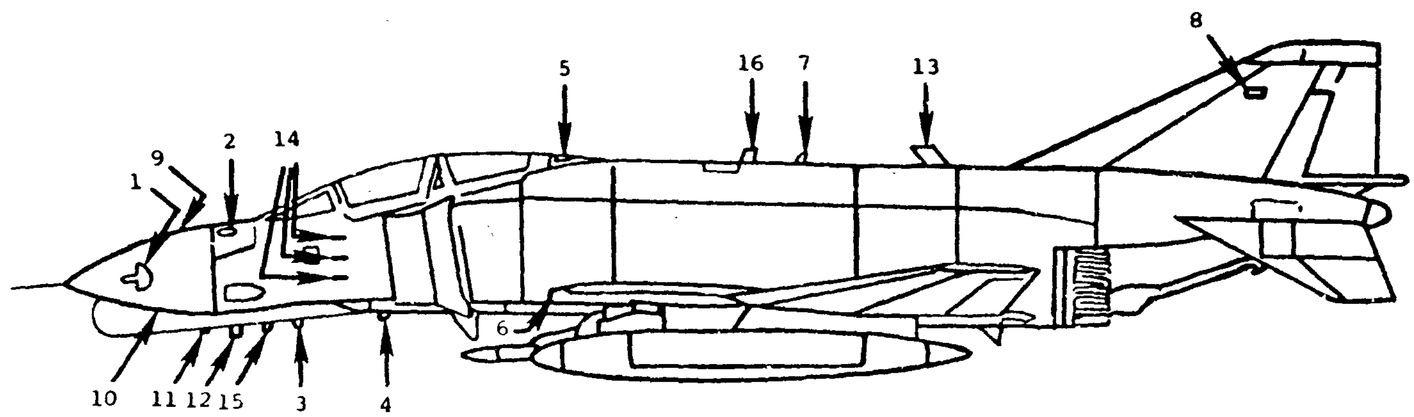
Best Available Copy

193

7. ANTENNA LOCATIONS

Figure 7-1 shows the approximate location of the antennas on the F-4G. Antenna nomenclature from current technical orders is as follows:

	Antenna	Nomenclature
1.	Radar	AS-3083/APQ-120(V)
2.	ADF	AS-909A/ARA-48
3.	Lower TACAN	11C21400
4.	Lower UHF Comm.	AS-1611/A
5.	IFF	2285-1
6.	Radar Altimeter	AS-1386/AS-1442
7.	Upper TACAN	11C21400
8.	APR-38 Low Band	AS-3119/APR-38
9.	VOR/ILS Glide Slope	DMN9-5
10.	AN/APX-SOA IFF	AS-2072/APQ-120
11.	APR-38 High Band	AS-3121/APR-38
12.	APR-38 Special Warning (Lower)	AS-3122/APR-38
13.	Upper UHF Comm.	AS-1611/A
14.	APR-38 Low Band	AS-3119/APR-38
15.	APR-38 Mid Band	AS-3120/APR-38
16.	APR-38 Special Warning (Upper)	AS-3122/APR-38



1. Radar Antenna
2. ADF Antenna
3. Lower TACAN Antenna
4. Lower UHF Antenna
5. IFF Antenna
6. Radar Altimeter Antenna
7. Upper TACAN Antenna
8. APR-38 Low Band Antenna
9. VOR/ILS Glide Slope Antenna
10. AN/APX-80A IFF Dipoles (4)
11. APR-38 High Band Antenna
12. APR-38 Special Warning Antenna (Lower)
13. Upper UHF Comm Antenna
14. APR-38 Low Band Antennas
15. APR-38 Mid Band Antenna
16. APR-38 Special Warning Antenna (Upper)

Figure 7-1. F-4G ANTENNA LOCATIONS

195

8. INTERFACE DATA

This section contains examples of interface signal characteristics. These data were extracted from applicable sections of the Interface Control Drawings (ICDs) for integration of GPS user equipment in the F-4G aircraft. Each sheet discusses a particular signal. The top line contains the signal name, type of signal (digital, analog, descrete, or synchronous), its signal source and load, and whether the signal is an input or output of the GPS user equipment. A functional description follows, as well as a description of the signal's characteristics.

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Bearing	Synchro	O	UE	Pilot's HSI & WSO's BDHI

Functional Description

Provides angular information to the bearing pointer* to display relative bearing of the aircraft's present position to selected waypoint.

*Note: No. 1 pointer on BDHI

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 1^{\circ}$
INDEX REFERENCE: Aircraft Heading
POSITIVE DIRECTION SENSE: Increasing Bearing
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: $\pm 2.5^{\circ}$ (HSI); $\pm 1.25^{\circ}$ (BDHI)

Electrical Characteristics (continued on next page)

LOAD: 1) Pilot's HSI (AF/A24J-1), 3-Wire Synchro, Bendix Type EP AY-500-5 or equal
2) WSO's BDHI (ID-663( )/U), 3-Wire Synchro, Type 26V-1[illegible]X4, or equal
SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair (X,Y)
Wire Size; No. 22 AWG
Note: "Z" tied to ground

A/C: F-4G
REF: MIL-I-22075
MIL-H-27269
1F-4E-2-14

A | ICD-GPS-020 | 10-2

197

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI (AF/A24J-1), Bearing Pointer, 3-Wire Synchro, Bendix Type AY-500-5 or equal	BDHI (ID-663( )/U), Synchro, Type 26V-11TX4 or equal

LOAD 1

ROTOR		
Input Voltage	26	Volts
Frequency	400	Cycles
Input Current	--	ma
Input Power	--	Watts
Resistance (DC)	530	Ohms

STATOR		
Input Voltage	11.8	Volts
Input Current	20	ma
Input Power	0.090	Watts
Resistance (DC)	188	Ohms
Rotor Output Voltage	19	Volts
Phase Shift (S to R)	15	Degrees
Accuracy (Max)	15	Minutes
Null Voltage (Max)	50	mv

IMPEDANCE		
Zso	222 + j470	Ohms
Zro	940 + j2260	Ohms
Zrss	1050 + j450	Ohms

LOAD 2

Input Voltage	26	Volts
Input Current	242	ma
Input Power	.87	Watts
Transformation Ratio	.454	
Sensitivity	206	mv/deg
Phase Shift	4°	lead
Impedance, Zro	14.9 + j106	Ohms
Impedance, Zso	760 + j4540	Ohms

A ICD-GPS-020 SHEET 10-3

198

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Units	Synchro	0	UE	Pilot's HSI & WSO's BDHI

Functional Description

Provides angular information to rotate the units digit in the range window. Displays aircraft present position distance to selected waypoint in 1nm increments (0.5nm indexed). Driven independently of other digits, but read in conjunction with them in order to provide the least significant digit.

Signal Characteristics

RANGE: 0 to 9 (0^{0} to 360^{0})
ACCURACY: $\pm 3.6^{0}$
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^{0} = 1 numeral
RESOLUTION: $\pm 9^{0}$

Electrical Characteristics (continued on next page)

LOAD: 1) Pilot's HSI (AF/A24J-1), 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) WSO's BDHI ID-663( )/U, 3-Wire Synchro, Type 26V-11TX4 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair (X,Y)

Wire Size: No. 22 AWG

Note; "Z" leg tied to ground

A/C: F-4G
REF: MIL-I-22075
MIL-H-27269
1F-4E-2-14

A ICD-GPS-020 SHEET 10-4

199

ELECTRICAL CHARACTERISTICS

LOAD 1			LOAD 2		
HSI (AF/A24J-1), Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal			BDHI (ID-663( )/U), Synchro, Type 26V-11TX4 or equal		
Primary Winding	Rotor		Input Voltage	26	Volts
Primary Voltage (400 Hz)	26	Volts	Input Current	242	ma
Secondary Voltage	11.8	Volts	Input Power	.87	Watts
Input Current	100	ma	Transformation Ratio	.454	
Input Power	.54	Watts	Sensitivity	206	mv/deg
Accuracy	30	feet	Phase Shift	4°	lead
Impedance, Zro	54 + j260	Ohms	Impedance, Zro	14.9 + j106	Ohms
Impedance, Zso	12 + j45	Ohms	Impedance, Zso	760 + j4540	Ohms
Rotor DC Resistance	37	Ohms			
Stator DC Resistance	12	Ohms			
Phase Shift	8.5	Degrees			

A ICD-GPS-020

SHEET 10-5

200

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, tens	Synchro	O	UE	Pilot's HSI & WSO's BDHI

Functional Description

Provides angular information to rotate the tens digit in the range window. Displays aircraft present position distance to selected waypoint in 10nm increments. Driven independently of other distance digits but read in conjunction with them.

Signal Characteristics

RANGE: 0 to 9 (0^{o} to 360^{o})
ACCURACY: $\pm$ 3.6^{o}
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^{o} = 1 numeral
RESOLUTION: $\pm 9^{o}$

Electrical Characteristics (continued on page 10-5)

LOAD: 1) Pilot's HSI (AF/A24J-1), 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) WSO's BDHI (ID-663( )/U), 3-Wire Synchro, Type 26V-11TX4 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair (X,Y)

Wire Size: No. 22 AWG

Note: "Z" leg tied to ground

A/C: F-4G
REF: MIL-I-22075
MIL-H-27269
1F-4E-2-14

A ICD-GPS-020
SHEET 10-6

201

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, hundreds	Synchro	0	UE	Pilot's HSI & WSO's BDHI

Functional Description

Provides angular information to rotate the hundreds digit in the range window. Displays aircraft present position distance to the selected waypoint in 100nm increments. Driven independently of the other distance digits, but read in conjunction with them in order to provide the most significant digit for the distance value.

Signal Characteristics

RANGE: 0 to 9 (0^o to 360^o)
ACCURACY: $\pm$ 3.6^o
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^o = 1 numeral
RESOLUTION: $\pm$ 9^o

Electrical Characteristics (continued on page 10-5)

LOAD: 1) Pilot's HSI (AF/A24J-1), 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) WSO's BDHI (ID-663( )/U), 3-Wire Synchro, Type 26V-11TX4 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair (X,Y)

Wire Size: No. 22 AWG

Note: "Z" leg tied to ground

A/C: F-4G
REF: MIL-I-22075
MIL-H-27269
1F-4E-2-14

A ICD-GPS-020
10-7

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Flag	Discrete	O	UE	Pilot's HSI WSO's BDHI

Functional Description

Provides a discrete signal to operate the distance warning flag. The flag is normally out of view when the range indicator is operating and the range data is valid. The flag covers the range indicator when the distance information is not valid or the device supplying the distance data is not operating.

Signal Characteristics

RANGE: 28 Vdc applied, Flag out-of-view
28 Vdc not applied, Flag-in-view

Electrical Characteristics

LOAD: 1) Pilot's HSI (AF/A24J-1), Distance shutter mechanism, 28 Vdc, 150ma Max.
2) WSO's BDHI (ID-663( )/U), Distance shutter mechanism, 28 Vdc, 150ma Max.

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors

Wire Size: No. 22 AWG

A/C: F-4G
REF: MIL-I-22075
MIL-H-27269
1F-4E-2-14

A ICD-GPS-020

10-8

203

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Thousand Digit	Discrete	O	UE	Pilot's HSI WSO's BDHI

Functional Description

Provides a discrete output signal to operate the thousand digit shutter of the HSI when the distance to a selected waypoint is greater than 999 nautical miles.

Signal Characteristics

RANGE: 28 Vdc applied, thousand digit in-view
28 Vdc not applied, thousand digit out-of-view

Electrical Characteristics

LOAD: 1) Pilot's HSI (AF/A24J-1), Distance 1000 digit shutter, 28 Vdc, 150 ma (Max)
2) WSO's BDHI (ID-663( )/U), Distance 1000 digit shutter, 28 Vdc, 150 ma (Max)

SOURCE: TBD-1

Interconnection Data

WIRE TYPE & NO.: Two Single Conductors
WIRE SIZE: No. 22 AWG

A/C: F-4G
REF: MIL-I-22075
MIL-H-27269
1F-4E-2-14

A		ICD-GPS-020
SCALE	REV	SHEET 10-9

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
To-From	Analog	O	UE	Pilot's HSI FDC

Functional Description

Provides a d.c. analog signal to drive the To-From indicator. If the aircraft is flying toward the waypoint and has not intercepted a reference line perpendicular to the aircraft ground track and through the waypoint, the indication will be TO. Once past the waypoint reference line, the indication will be FROM, as long as the same waypoint is selected.

Signal Characteristics

RANGE: TO = +225 μa Max
BLANK = no signal
FROM = -225 μa Max

Electrical Charecteristics

LOAD: 1) Pilot's HSI (AF/A24J-1), To-From Arrow Meter movement, 150 - 250 Ohms

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.:

Wire Size: No. 22 AWG

A/C: F-4G
REF: MIL-H-27269
1F-4E-2-14

A ICD-GPS-020 10-10

205

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation	Analog	O	UE	Pilot's HSI FDC

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft to the left or right of a selected course. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 10° for a TACAN approach: 2.5° for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee has recommended the following ranges for the flight modes indicated: a) Enroute: 2-6 miles full scale, b) Terminal: 1-2 miles full scale and c) Approach: 600-3000 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to ± 150 μa
RESOLUTION: 3 μa
ACCURACY: ± 12 μa
INDEX REFERENCE: Selected Course
POSITIVE DIRECTION SENSE: Fly right (+)
SCALE FACTOR: 75 μa/dot on the HSI
Distance/angular displacement scale factor (TBD-1)

Electrical Characteristics

LOAD: 1) Pilot's HSI (AF/A24J-1), course bar mechanism,
Input Impedance: 1000 Ohms ± 3%
Input Current (Max): 500 μa
2) Flight Director Computer (CPU-82/A)
Input Impedance: 1000 Ohms ±3%
Input Current (Max): 500 μa

SOURCE: (TBD-1)

Interconnection Data

WIRE TYPE & NO.: Two Single Conductors
WIRE SIZE: No. 22 AWG

A/C: F-4G
REF: MIL-H-27269
1F-4E-2-14
ARINC Characteristic 582-5

A ICD-GPS-020
10-11

206

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation Flag	Discrete	O	UE	FDC

Functional Description

Provides a discrete signal to operate the vertical director warning flag of the ADI when the deviation data is unreliable or a malfunction has occurred in the horizontal deviation circuitry.

Signal Characteristics

RANGE: Flag in view, input current <245 μa
Flag out-of-view, input current >245 μa

Electrical Characteristics

LOAD: Flight Director Computer (CPU-82/A)
Input Impedance: 1000 Ohms ±3%
Input Current (Max): 380 μa

SOURCE: (TBD-1)

Interconnection Data

WIRE TYPE & NO.: Two Single Conductors
WIRE SIZE: No. 22 AWG

A/C: F-4G
REF: MIL-I-27619
1F-4E-2-17

A ICD-GPS-020
SHEET 10-12

207

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation	Analog	O	UE	FDC

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft above or below a desired flight path. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 0.5° for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: a) Enroute: 200 to 2000 feet full scale, b) Terminal: 60-200 feet full scale and c) Approach: 40-100 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to ± 10 ma
RESOLUTION: ∓ 0.1 ma
ACCURACY: ± 7.5%
INDEX REFERENCE: Desired flight path
POSITIVE DIRECTION SENSE: Fly down (+)
SCALE FACTOR: 2.51 ma/inch deflection on the indicator
Distance/angular displacement scale factor (TBD-1)

Electrical Characteristics

LOAD: Flight Director Computer (CPU-82/A)
Input Impedance: 1000 Ohms ±3%
Input Current (Max): 13.5 ma

Interconnection Data

WIRE TYPE & NO.: Two Single Conductors
WIRE SIZE: No. 22 AWG

A/C: F-4G
REF: MIL-I-27619
1F-4E-2-17
ARINC Characteristics 582-5

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-020
SCALE	REV	SHEET 10-13

208

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation Flag	Discrete	O	UE	FDC

Functional Description

Provides a discrete signal to the FDC to advise when the UE vertical deviation signal is not reliable.

Signal Characteristics

RANGE: Flag in view, input current <245 μa
Flag out-of-view, input current >245 μa

Electrical Characteristics

LOAD: Flight Director Computer (CPU-82/A)
Input Impedance: 1000 Ohms ±3%
Input Current (Max): 380 μa

SOURCE:

Interconnection Data

Wire Type & No.: Two Single Conductors

Wire Size: No. 22 AWG

A/C: F-4G
REF: MIL-I-27619
1F-4E-2-17

A ICD-GPS-020
SHEET 10-14

209

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Output Data	Digital	O	UE	AN/ARN-101 (Future Mod)

Functional Description

Provides the following digital data to update the INS and to aid in navigation/bombing solutions:

1) Latitude
2) Longitude
3) Altitude
4) Velocities (Vx, Vy, Vz)
5) Covariances
6) Time
7) Display Data

Signal Characteristics

(TBD-3)

Electrical Characteristics

(TBD-3)

Interconnection Data

(TBD-3)

A/C: F-4G
REF:

A		ICD-GPS-020
SCALE	REV	SHEET 10-15

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Magnetic Heading	Synchro	I	ARBCS	UE

Functional Description

Provides angular reference signal of aircraft heading relative to magnetic north.

Signal Characteristics

RANGE: 0^{o} to 360^{o}
ACCURACY: $\pm$ 0.5^{o}
INDEX REFERENCE: Magnetic North
POSITIVE DIRECTION SENSE: Nose Right
SCALE FACTOR: 1^{o} = 1^{o}
RESOLUTION: (TBD-1)

Electrical Characteristics (continued on next page)

SOURCE: 1) ARBCS, Compass Adapter Compensator (ADK-182/A24G-1A); Synchro, Bendix Type EP AY-500-5 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Two Conductors (X,Y)

Wire Size: No. 22 AWG

Note: "Z" leg tied to ground

A/C: F-4G
REF: 1F-4E-2-17
MIL-C-26485

A		ICD-GPS-020
		10-16

211

ELECTRICAL CHARACTERISTICS

SOURCE	
Synchro, Bendix Type EP AY-500-5 or equal	

Rotor

Input Voltage	26	Volts
Frequency	400	Cycles
Input Current	--	ma
Input Power	--	Watts
Resistance (DC)	530	Ohms

Stator

Input Voltage	11.8	Volts
Input Current	20	ma
Input Power	0.090	Watts
Resistance (DC)	188	Ohms
Rotor Output Voltage	19	Volts
Phase Shift (S to R)	15	Degrees
Accuracy (Max)	15	Minutes
Null Voltage (Max)	50	mv

Impedance

Zso	222 + j470	Ohms
Zro	940 + j2260	Ohms
Zrss	1050 + j450	Ohms

A ICD-GPS-020 10-17

212

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Pitch	Synchro	I	ARBCS	UE

Functional Description

Provides a synchro signal representing aircraft pitch attitude to the UE.

Signal Characteristics

RANGE: 0 to 360°
ACCURACY: ± 0.5°
INDEX REFERENCE: 0° Pitch
POSITIVE DIRECTION SENSE: Nose up
SCALE FACTOR: 1° = 1°
RESOLUTION: (TBD-1)

Electrical Characteristics

SOURCE: ARBCS, Displacement Gyroscope Assembly (SBK-8/A24G-1A), Synchro Bendix Type AY-500-5 or equal (see page 10-17 for synchro characteristics)

LOAD: (TBD-1)

Interconnection Data

WIRE TYPE & NO.: Twisted Triad
WIRE SIZE: No. 22 AWG

A/C: F-4G
REF: MIL-C-26485
1F-4E-2-17

A		ICD-GPS-020
SCALE	REV	SHEET 10-18

213

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Roll	Synchro	I	ARBCS	UE

Functional Description

Provides a synchro signal representing aircraft roll attitude to the UE.

Signal Characteristics

RANGE: 0 to 360°
ACCURACY: ± 0.5°
INDEX REFERENCE: 0° Roll
POSITIVE DIRECTION SENSE: Right Wing Down
SCALE FACTOR: 1° = 1°
RESOLUTION: (TBD-1)

Electrical Characteristics

SOURCE: ARBCS, Displacement Gyroscope Assembly (SBK-8/A24G-1A), Synchro, Bendix Tyep AY-500-5, or equal (see page 10-17 for synchro characteristics)

LOAD: (TBD-1)

Interconnection Data

WIRE TYPE & NO.: Twisted Traid
WIRE SIZE: No. 22 AWG

A/C: F-4G
REF: MIL-C-26485
1F-4E-2-17

A | | ICD-GPS-020
SHEET 10-19

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
True Airspeed	Synchro	I	Air Data Computer	UE

Functional Description

Provides an input of true air speed in synchro format.

Signal Characteristics

RANGE: 150 - 1500 knots
ACCURACY: (TBD-2)
INDEX REFERENCE: (TBD-2)
POSITIVE DIRECTION SENSE: Increasing air speed
SCALE FACTOR: (TBD-2)

Electrical Characteristics

SOURCE: Air Data Computer (CPK-92/A24G-34), Synchro, Type (TBD-2)

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad

Wire Size: No. 22 AWG

A/C: F-4G
REF: T.O. IF-4E-2-12

A ICD-GPS-020 10-20

215

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Barometric Altitude	Synchro	I	Altitude Encoder Unit	UE

Functional Description

Provides an input of pressure altitude in synchro format for use by the system when operating with less than full navigation capability.

Signal Characteristics

RANGE: -1000 to 80,000 feet
ACCURACY: + 0.05 inch Hg and + 0.2% indication
INDEX REFERENCE: 0 Feet (29.92 inches of mercury)
SCALE FACTOR: 36°/1000 feet
POSITIVE DIRECTION SENSE: Up-perpendicular to horizontal earth plane
RESOLUTION: 0.01 inch Hg

Electrical Characteristics

SOURCE: Altitude Encoder Unit (CVK-99/A24G)

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad

Wire Size: No. 22 AWG

A/C: F-4G
REF: 1F-4E-2-12

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-020
SCALE	REV	SHEET 10-21

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Course Set	Synchro	I	Pilot's HSI	UE

Functional Description

Provides an electrical reference signal fo the course manually selected by the course set control on the HSI. This signal will be used by the UE as a reference for positioning the course deviation and To-From indicators on the HSI.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY + 0.5°
RESOLUTION: + 1.0°
INDEX REFERENCE: Magnetic North
POSITIVE DIRECTION SENSE: Right Hand Increments
SCALE FACTOR: $1^{\circ} = 1^{\circ}$

Electrical Characteristics (continued on next page)

SOURCE: HSI (AF/A24J-1), Course Resolver, Bendix Type EP AY221-5-B, or equal

LOAD: (TBD-1)

Interconnection Data

WIRE TYPE & NO.: Seven conductors; one twisted, shielded pair and five single conductors
WIRE SIZE: No. 22 AWG

A/C: F-4G
REF: MIL-H-27269
1F-4E-2-14

A ICD-GPS-020 10-22

217

ELECTRICAL CHARACTERISTICS

SOURCE	
HSI (AF/A24J-1), Course Resolver, Bendix Type EP AY-221-5-B, or equal	
Input Winding Rotor Input Voltage 26 Vac, 400 Hz Input Current 12 ma Input Power 100 mw Impedance, Zso 700 + j2100 Ohms Rotor Resistance (DC) 400 Ohms Output Voltage 17.2 Volts Accuracy 20 Minutes (max.) Phase Shift 10 Degrees	

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-020
SCALE	REV	SHEET 10-23

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Input Data	Digital	I	AN/ARN-101 (Future Mod)	UE

Functional Description

Provides the UE with the following digital data to aid in acquiring satellites and improving AJ capabilities:

1) Latitude
2) Longitude
3) Velocities (Vx, Vy, Vz)
4) Covariances
5) Others (TBD-3)

Signal Characteristics

(TBD-3)

Electrical Characteristics

(TBD-3)

Interconnection Data

(TBD-3)

A/C: F-4G
REF:

A | | ICD-GPS-020
SHEET 10-24

219

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulses	Pulse	I	IFF	UE

Functional Description

Provides blanking pulses (suppression) to blank the GPS UE receiver when the IFF is transmitting.

Signal Characteristics

(TBD-2)

Electrical Characteristics

SOURCE: IFF, Coder-Receiver Transmitter (KY-532A/ASQ)

LOAD: (TBD-1)

Interconnection Data

WIRE TYPE & NO.: Coaxial Cable, Type (TBD-2)

A/C: F-4G
REF: 1F-4E-2-14

A ICD-GPS-020
SHEET 10-25

9. FUTURE MODIFICATIONS

9.1 On-Going and Near-Term Modifications

Table 9-1 lists some of the known on-going or near-term F-4G modifications not previously addressed herein. Some of the modifications (e.g., the installation of the ARC-164 UHF Radio and the ARN-118 TACAN Set) may be incorporated shortly into the actual F-4E to F-4G conversion/production modification process. If so, then only a limited number of F-4G production aircraft completed previously would need a retrofit for these systems, that could be accomplished at the operational squadron or wing location.

9.2 Future Planned Modifications

Table 9-2 lists some of the planned or tentative Class IV and V modifications that could impact an available spares if approved.

Table 9-1. ON-GOING/NEAR-TERM MODIFICATIONS

Terminology/Nomenclature	Remarks
UHF Radio/ARC-164	Replaces appropriate UHF radio portion of the ASQ-19 Integrated Electronic Central. The RT-1145 transceiver unit with associated mounting adapter (Magnavox #706521-801) replaces the RT-793A unit. See the RF-4C and F-4E configuration summaries, Section 11 for ARC-164 details.
TACAN Set/ARN-118	Replaces appropriate TACAN portion of the ASQ-19 system including the RT-547 transceiver and the KY-312 pulse decoder. See the F-4E and RF-4C data summaries for details.
ECM Mission Recorder	Mounting provisions are provided as part of the APR-38 installation. The unit is not yet in production.
Navigation System	An improved navigation system will most likely be installed in the F-4G. However, the candidate has yet to be selected from among several contenders, including the ARN-101 and the AJQ-25 systems. Details of the ARN-101 are contained in the F-4E Data Summary, Section 11.5.

(continued)

Table 9-1. (continued)	
Terminology/Nomenclature	**Remarks**
Airborne Video Tape Recorder	**This forward cockpit console mounted unit will provide capability to video tape information presented on radar and E/O displays.**
AGM-65A Maverick Capability	Already part of the F-4G production modification cycle, this mod provides AGM-65A missile carriage and launch capability and the Digial Scan Converter to the F-4G. An improved TV display for the APQ-120 Fire Control Radar System is included

Table 9-2. PLANNED MODIFICATIONS	
Terminology/Nomenclature	Remarks
VHF AM/FM Radio/ARC-186	Provides VHF AM and FM voice or data communications capability.
Intercommunications Set/ AIC-18	Possible replacement of ASQ-19 intercom with separate system.
Global Positioning System	Highly accurate, three-dimensional, space located, world-wide, position-fixing system.
Vinson/KY-58	Replacement for Parkhill/KY-28 Secure System.
APR-38 Enhancement Program	Expansion of current ECM Receiving System (Wild Weasel) Capability. This is not completely formulated/approved as yet.
JTIDS	Time Division Multiple Access to the Communicating System

222

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Aircraft and avionics configuration data assembled by ARINC Research, principally in the form of copies of applicable sections, tables, and figures from the aircraft and equipment Technical Orders listed at the end of this section
- Avionics Planning Baseline Document - October 1978
- McDonnell Report 8738: Environmental Design Requirements and Test Procedures - Aircraft Electronic Equipment, 5 April 1962, Rev. 1 July 1964.
- Information supplied by Ogden ALC
- ARINC Research Informal Report: Technical Report, Preliminary JTIDS Configuration Data Analyses, May 1978

Inventory of Technical Orders

T.O. Number	Subject	Change Number	Date
1F-4G-1	Flight Manual		9/15/78
1F-4G-2-1	Aircraft General		12/15/77
1F-4G-2-22	System Integration		1/15/78
1F-4G-501	Group B Installation for APR-38	1	1/20/77
1F-4G-600	F-4E to F-46 Conversion		
	Including Group A Installation for APR-38		Final Draft Copy

223

AVIONICS INTERFACE DATA SUMMARY
FOR
F-15A

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

224

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

Record of Changes			
Change	Subject	Date Entered	Initials

226

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF FIGURES AND TABLES (continued)

LIST OF FIGURES AND TABLES (continued)

1. INTRODUCTION

This document contains configuration data relevant to the integration of additional avionics into the F-15A aircraft.

This document will be periodically revised as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

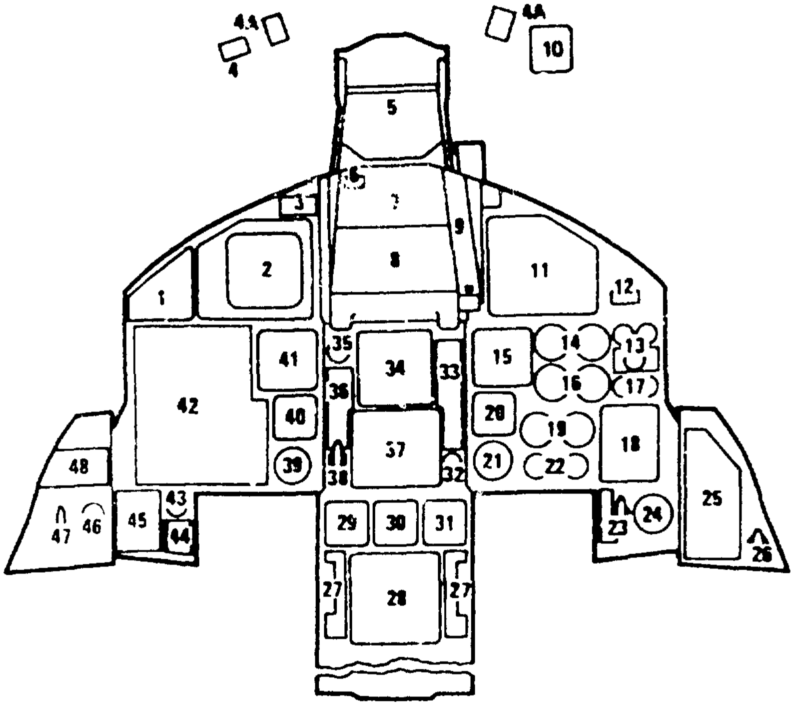
The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable technical orders are included in the references listed in Section 10.

2. COCKPIT SPACE

There is space available for controls within the F-15A cockpit (Figures 2-1, 2-2, and 2-3). On the right console there is a single blank panel approximately 1.91" × 5.75". On the left console there are five blank panels. The total amount of space available is 12.1" × 5.75"; with proper alterations, most of this space can be utilized.



MAIN PANEL AREA

1. FIRE WARNING/EXTINGUISHING PANEL
2. VERTICAL SITUATION DISPLAY (VSD)
3. RADIO CALL PANEL
4. AIR REFUELING READY LIGHT
4A. LOCK/SHOOT LIGHTS (SOME AIRCRAFT)
5. HEAD UP DISPLAY COMBINING GLASS
6. MASTER CAUTION LIGHT
7. MAIN COMMUNICATIONS CONTROL PANEL
8. HEAD UP DISPLAY CONTROL PANEL
9. GUN SIGHT CAMERA CONTROL PANEL
10. STANDBY MAGNETIC COMPASS
11. TEWS DISPLAY UNIT
12. CANOPY UNLOCKED WARNING LIGHT
13. HYDRAULIC PRESSURE INDICATORS
14. ENGINE TACHOMETERS
15. ALTIMETER
16. FAN TURBINE INLET TEMPERATURE INDICATORS
17. ENGINE OIL PRESSURE INDICATORS
18. FUEL QUANTITY INDICATOR
19. ENGINE FUEL FLOW INDICATORS
20. VERTICAL VELOCITY INDICATOR
21. EIGHT DAY CLOCK
22. ENGINE EXHAUST NOZZLE POSITION INDICATORS
23. JET FUEL STARTER CONTROL HANDLE
24. CABIN PRESSURE ALTIMETER
25. CAUTION LIGHTS PANEL
26. EMERGENCY VENT CONTROL HANDLE
27. CIRCUIT BREAKER PANELS
28. COCKPIT COOLING AND PRESSURIZATION OUTLET
29. STANDBY AIRSPEED INDICATOR
30. STANDBY ATTITUDE INDICATOR
31. STANDBY ALTIMETER
32. RUDDER PEDAL ADJUST RELEASE KNOB
33. MASTER MODE CONTROLS/MARKER BEACON PANEL
34. ATTITUDE DIRECTOR INDICATOR
35. EMERGENCY JETTISON SWITCH
36. STEERING MODE PANEL
37. HORIZONTAL SITUATION INDICATOR
38. EMERGENCY BRAKE/STEERING CONTROL HANDLE
39. ACCELEROMETER
40. ANGLE OF ATTACK INDICATOR
41. AIRSPEED/MACH INDICATOR
42. ARMAMENT CONTROL PANEL
43. PITCH RATIO INDICATOR
44. PITCH RATIO SELECT SWITCH
45. LANDING GEAR CONTROL HANDLE
46. FLAP POSITION INDICATOR
47. EMERGENCY LANDING GEAR HANDLE
48. ARRESTING HOOK CONTROL SWITCH

Figure 2-1. COCKPIT, MAIN INSTRUMENT PANEL, F-15A

232

RIGHT CONSOLE AREA

1. OXYGEN REGULATOR
2. ECS PANEL
3. TEMPERATURE PANEL
4. CANOPY CONTROL HANDLE
5. INTERIOR LIGHTS CONTROL PANEL
6. TEWS POD CONTROL PANEL
7. OXYGEN HOSE STOWAGE FITTING
8. BLANK
9. ENGINE START FUEL SWITCHES
10. UTILITY LIGHT
11. STOWAGE COMPARTMENT
12. OXYGEN/COMMUNICATION OUTLET PANEL
13. COMPASS CONTROL PANEL
14. TEWS POWER CONTROL PANEL
15. NAVIGATION CONTROL PANEL
16. ENGINE CONTROL PANEL

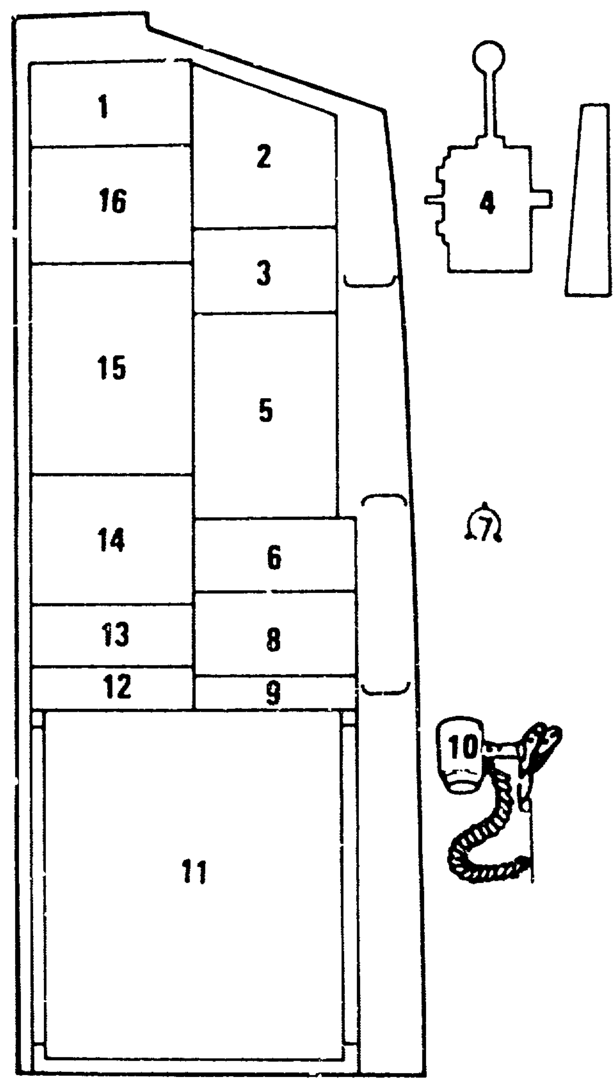


Figure 2-2. COCKPIT, RIGHT CONSOLE AREA, F-15A

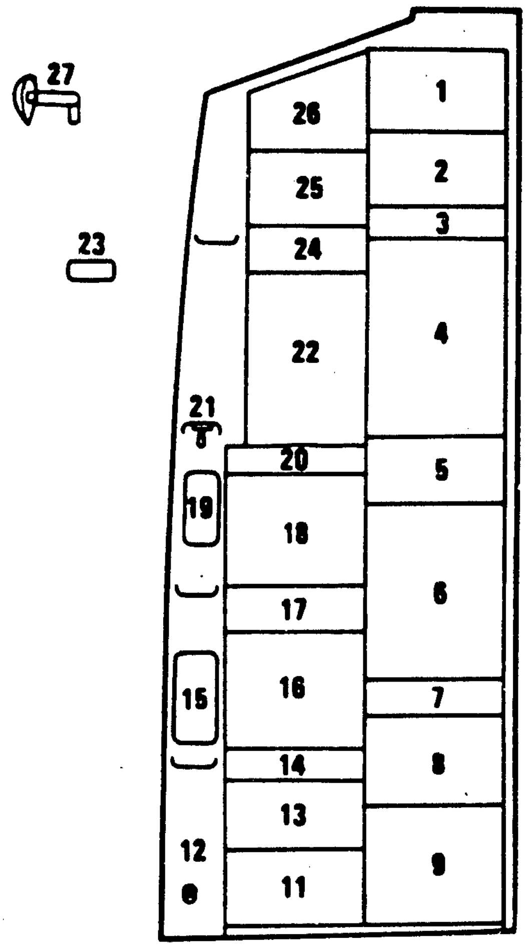
233

LEFT CONSOLE AREA

1. ILS/TACAN CONTROL PANEL
2. CONTROL AUGMENTATION SYSTEM CONTROL PANEL
3. BLANK
4. THROTTLE QUADRANT
5. EXTERIOR LIGHTS CONTROL PANEL
6. INTEGRATED COMMUNICATIONS CONTROL PANEL
7. BLANK, (F); TAKE COMMAND/ICS CONTROL PANEL, (TF)
8. BLANK
9. ANTI-G PANEL
10. BOARDING STEPS POSITION INDICATOR
11. BLANK
12. ARMAMENT SAFETY OVERRIDE SWITCH
13. GROUND POWER PANEL
14. BLANK
15. EMERGENCY AIR REFUELING HANDLE
16. BIT PANEL
17. INTERROGATOR CONTROL PANEL
18. IFF CONTROL PANEL
19. IFF ANTENNA SELECT SWITCH
20. TEWS PANEL
21. SEAT ADJUST SWITCH
22. RADAR CONTROL PANEL
23. VMAX SWITCH
24. BLANK
25. FUEL CONTROL PANEL
26. MISCELLANEOUS CONTROL PANEL
27. CANOPY JETTISON HANDLE

NOTE

1 (F) 77-0061 AND UP;
(TF) 77-0154 AND UP.



10

Figure 2-3. COCKPIT, LEFT CONSOLE AREA, F-15A

3. AVIONICS SPACE

Currently there are 20.8 cubic feet of equipment space in the F-15A located in six different areas (Figure 3-1 and Table 3-1). Table 3-1 lists possible spaces where new equipment may be installed. Some candidate avionics for these spares are listed also. With the tail area there are two large areas that will require coding. The irregular interior of the space in Section B may complicate equipment installation.

Additional new avionics or ECPs (listed in Tables 5-1 and 9-1) that are not already shown as candidates for the spaces shown in this section are not expected to have any impact on these spaces. A possible exception may be SEEK TALK which is still in preliminary planning. The engine diagnostics system listed in Table 5-1 is currently planned for aircraft F-105 through F-110 only.

Table 3-1. F^2E SUMMARY - F-15A

F^2 E Criteria	Potential Available Space			
Location Reference and Description	A Aft Cockpit Bay 5	A Bay 5 Next to Rear Wall	B Canopy Shelf Above Bay 5	C Access Door 10R
Rectangular Size* (H, W, D) Volume	24" 21-1/2" 32" 9.6 ft^3	15" 10" 10" 0.9 ft^3	8.5" 16.5" 34" 2.8 ft^3	6" 3" 9" 0.3 ft^3
Type Cooling Available	Convection and Forced Air	Normal Cockpit Cooling	Normal Cockpit Cooling	Convection
Temperature-Altitude Vibration	Cont. Op. -540° to 71°C at 70k Ft, 30 min. +95°C at 50k Ft ±2 g Maximum Endurance 9.5 gs 50 to 2,000 Hz	Class 2, MIL-E-2400 50 to 1,000 Hz 0.019 g^2/Hz Performance 0.067 g^2/Hz Endurance	Class 2, MIL-E-2400 50 to 1,000 Hz 0.019 g^2/Hz Performance 0.067 g^2/Hz Endurance	Class 2, MIL-E-2400 50 to 1,000 Hz 0.019 g^2/Hz Performance 0.067 g^2/Hz Endurance
Possible Candidates for the Space	TEWS Threat Update	None Known	Video Tape Recorders	None Known
Remarks				

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.

Best Available Copy

236

Table 3-1. (continued)

F^2 E Criteria	Potential Available Space			
Location Reference and Description	D Access Door 6R	D Access Door 6R	E Access Door 47L	E Access Door 47R
Rectangular Size * (H, W, D) Volume	4.5" 4" 5" 0.05 ft^3	2.25" 6.5" 7 0.06 ft^3	7" 6.5" 21" 0.9 ft^3	7" 10.25" 21" 0.9 ft^3
Type Cooling Available	Forced Air Available	Forced Air Available	Convection	Convection
Temperature-Altitude Vibration	Class 2, MIL-E-2400 50 to 1,000 Hz 0.019 g^2/Hz Performance 0.067 g^2/Hz Endurance	Class 2, MIL-E-2400 50 to 1,000 Hz 0.019 g^2/Hz Performance 0.067 g^2/Hz Endurance	Class 2, MIL-E-2400 50 to 1,000 Hz 0.019 g^2/Hz Performance 0.067 g^2/Hz Endurance	Class 2, MIL-E-2400 50 to 1,000 Hz 0.019 g^2/Hz Performance 0.067 g^2/Hz Endurance
Possible Candidates for the Space	None Known	None Known	None Known	Tail Warning Set
Remarks	Small	Small	Space contains dead-ended cabling	Existing

Table 3-1. (continued)

F^2 E Criteria	Potential Available Space		
Location Reference and Description	E Access Door 48R	F Bay 155L	F Bay 155R
Rectangular Size * (H, W, D) Volume	10.5" 14" 10.25" 0.9 ft^3	6.5" 12.25" 16." 0.8 ft^3	7" 12" 20.5" 1.0 ft^3
Type Cooling Available	Convection	Convection	Convection
Temperature-Altitude Vibration	Cont. Op. -54° to 71°C at 70k Ft. 30 min, 95°C of 50k Ft. ±2 g Maximum Endurance 9.5 gs 50 - 2kHz	Cont. Op. -54° to 71°C at 70k Ft. 30 min, 95°C of 50k Ft. ±2 g Maximum Endurance 9.5 gs 50 - 2kHz	Cont. Op. -54° to 71°C at 70k Ft. 30 min, 95°C of 50k Ft. ±2 g Maximum Endurance 9.5 gs 50 - 2kHz
Possible Candidates for the Space	ALE-40 Chaff Disp. Set	None Known	Tail Warning Set
Remarks	Rounded, Not Rectangular	Existing	Existing

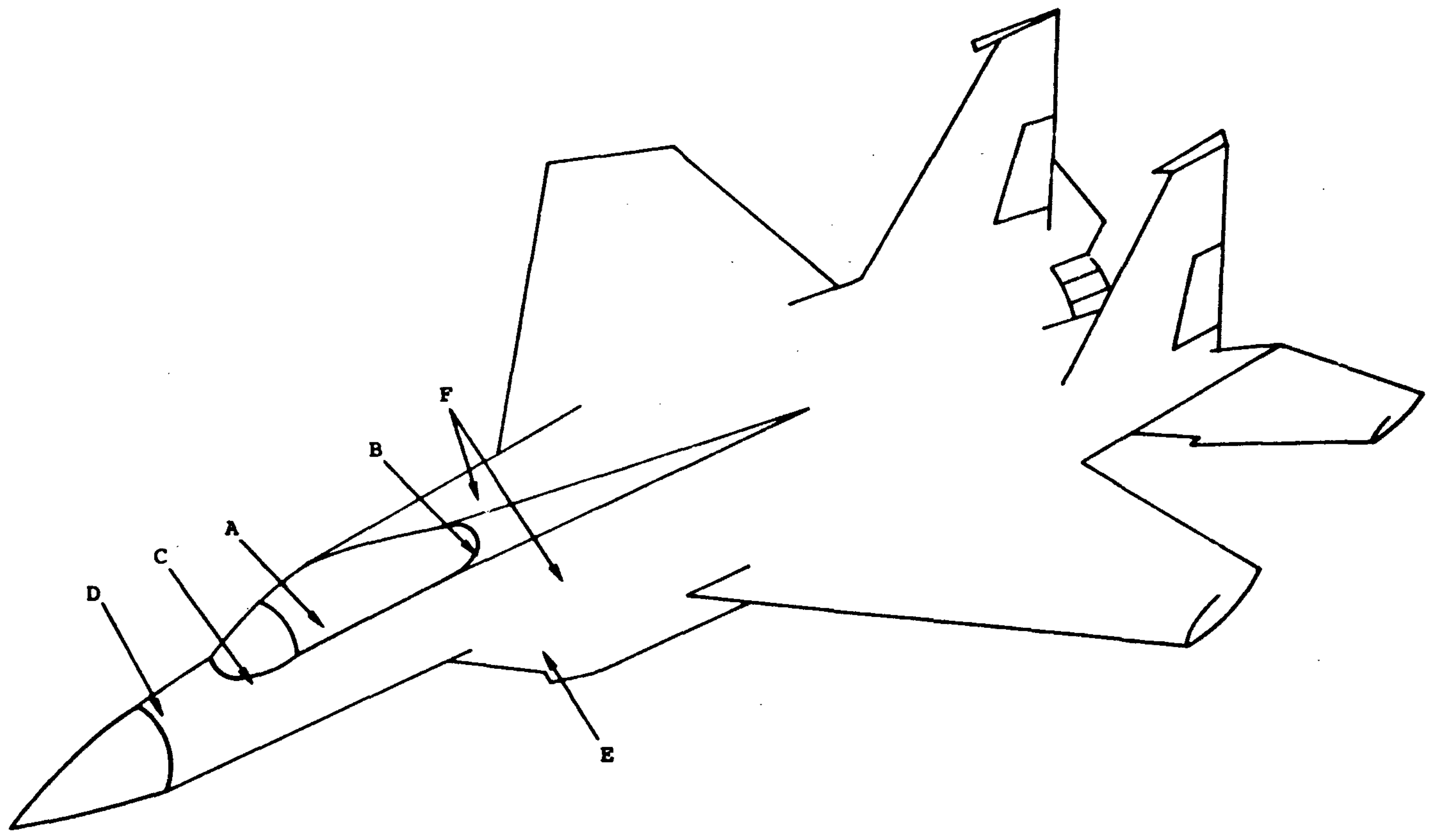


Figure 3-1. **F-15A GROWTH VOLUME**

4. ELECTRICAL POWER

4.1 Main Power System

The main electrical power system is made up principally of two 40/50 kVA, 115 Vac, 3-phase, 400 Hz, constant-speed drive generators. These two generators are connected in split-bus nonsychronous operation to supply the essential and emergency/essential buses. This generating system consists of the following:

- Integrated Drive Generator
- Generator Control Unit
- Current Transformer Assembly
- Bus Tie Fuses
- Line Contactor
- GEN OUT Caution Light

4.2 Emergency Power Supply System

If the main power system breaks down, the emergency power system will provide ac and dc power to the essential loads of the aircraft. This system will supply power to fuel control valves during engine start or shutdown.

The following components make up this system:

- Emergency generator
- Emergency generator-hydraulic motor
- Emergency generator/stabilator selector valve
- Emergency generator control unit
- Engine control bus relay
- Emergency/essential relay
- Emergency/essential bus lock-in relay
- Essential power control relay
- Ac present relay
- Essential ac contactor
- Essential dc contactor
- EMERG GEN switch
- EMER GEN ON light

4.3 Power Conversion and Distribution System

This system supplies and distributes power to various aircraft systems, converts 115 Vac 3-phase to 28 Vdc, and converts 115 Vac to 26 Vac. To perform these operations, there is a need for a left, right, and essential 115 Vac, 400 Hz, 3-phase bus system, and a low-voltage ac and dc bus system. Normally the left and right buses are operated in a split-bus condition, and the essential 115 Vac, 3-phase bus is powered from the left bus via the deenergized contacts of the essential ac contactor.

241

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The F-15A Environmental Control System (ECS) employs a conventional bootstrap air cycle that is augmented by a regenerative heat exchanger to provide cooling air to the avionics and electrical equipment, as well as to the cabin. A liquid cooling system is used to cool the radar transmitter.

5.2 Cabin Cooling

The Air-Cycle Air Conditioning System (ACACS) provides conditioned air to both the cabin and the avionics; the cabin airflow requirements have priority over the conditioned air required for avionics cooling. If cabin cooling requirements cause a decrease in the avionics airflow, the entire ACACS is automatically adjusted until the airflow requirements of both the cabin and avionics can be satisfied the nominal airflow rate into the cabin is 13 lb./min. with a maximum capability of 25 lb./min.

5.3 Avionics Cooling

The ECS is designed to provide sufficient cooling airflow to limit the equipment bays' total mixed-air discharge temperature to a maximum of 160°F with the Internal Countermeasures Set (ICS) "ON" or 140°F with the ICS "OFF". The cooling airflow is provided to the various equipments by the ECS via ducting. The desired airflow rates and temperature levels are controlled by the avionics air circuit controller (AACC) which can manipulature hot and cold air modulating valves to control airflow temperature.

The AACC is set to maintain the airflow temperature at 82.5°F (±2.5°) at altitudes less than 34,500 feet and at 53°F (±3°) at altitudes greater than 34,500 feet. The two different airflow temperatures are used to avoid moisture condensation in the avionics compartments at low altitudes and to minimize bleed air requirements at high altitudes.

The total cooling airflow required is established by the AACC. The actual airflow is controlled by a ground-selected schedule to provide the flow rate necessary to maintain the equipment bay's total mixed-air discharge temperature requirements of 160°F or 140°F. There are five such flow-rate schedules. The specific schedule selected operates within tolerence band rather than to a set curve. The flow-rate tolerence bands vary within the five schedules from 63 to 90 lb./min. at 85°F for Schedule 1 to 83 to 109 lb./min. at 85°F for Schedule 5. The AACC will maintain the airflow nominal altitude-dependent temperatures of 82.5°F or 53°F as long as the ECS has the capability to deliver air temperatures as low as the control temperatures.

A liquid cooling system is used to cool the radar transmitter. The present liquid cooling load is approximately 6,350 watts.

5.4 Avionics Forced-Air Cooling Power

The avionics cooling air allocations are illustrated in Table 5-1. Table 5-1 may be summarized as follows:

Installed Avionics Required Cooling Power -	19,828.4 watts
Approved ECPs Required Cooling Power -	4,999.0 watts
Pending ECPs Required Cooling Power -	496.0 watts
Equipment Provisions Required Cooling Power -	1,650.0 watts
Total Required Cooling Power	26,973.4 watts
Present F-15A Total Available Forced-Air - Cooling Power (Not including Aerodynamic heating growth of 464 watts)	25,394.4 watts
Deficit Cooling Power	1,579 watts

The present F-15A ECS capacity cannot meet the cooling requirements of the planned equipment installations throughout the airplane operating envelope. Approximately 1,050 watts of cooling power presently held in reserve may be added to the available cooling power, which will reduce the deficit to 529 watts. Additionally, an investigation is underway into changing the airflow temperature and flow schedules. These changes have the possibility of adding up to 7,000 watts of additional cooling power to the airplane.

243

Table 5-1. AVIONICS COOLING-AIR ALLOCATIONS FOR F-15A			
Compartment	Cooling Power (Watts)	Airflow at 85°F (Lb./Min.)	
		ICS On*	ICS Off**
Installed Avionics			
Bay 1 Left	4,891.5	15.462	21.085
Bay 1 Right	2,281.1	7.211	9.833
Bay 2 Left	1,224.0	3.871	5.278
Bay 2 Right	573.5	1.813	2.473
Bay 3 Left	878.4	2.778	3.788
Bay 3 Right	1,322.2	4.184	5.705
ICS Bay (Aft cockpit - Bay 5)	7,849.0† 1,046.5††	24.810† -	 4.491#
Aft Bays	460.2	1.475	1.987
Right Rear Cockpit	348.5	1.100	1.500
Subtotal	19,828.4	62.704	56.140
Approved Engineering Change Proposals			
TEWS Threat Update CCP-120-ICS/MWR Bands (ICS Bay)	4,954	15.654	1.566#,##
Video Tape Recorder ECP 1045 VTR (Aft Bay)	45	0.142	0.194
Subtotal	4,999	15.796	1.760
Pending Engineering Change Proposals			
ECP TWS	396	1.251	1.706
Engine Diagnostics System	100	0.316	0.431
Subtotal	496	1.567	2.137
Anticipated Additional Avionics			
TISEO	950	3.002	4.094
IR Tail Warning	600	1.896	2.586
ALE-40(V) Chaff Dispenser	100	0.316	0.431
Subtotal	1,650	5.214	7.1'1
Total	26,973.4	85.281	67.148

*Airflow required to limit average total mixed air discharge temperature to a maximum of 160°F.
**Airflow required to limit average total mixed air discharge temperature to a miximum of 140°F.
†Cooling power for ICS on.
††Cooling power for ICS in standby. Total cooling power based on ICS on.
#Based on cooling power for ICS in standby. Included in ICS off totals.
##Approximate value.

244

6. CURRENT AVIONICS

Tables 6-1 through 6-22 contain LRU data relating to the F-15A avionics systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

245

Table 6-1. F-15A AVIONICS CONFIGURATION DATA: AN/ARC-164 UHF RADIO NSN:* (REPLACES AN-ARC-109)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Main R/T	RT-1168/ARC-164	Door 3R	4.87	5.75	8.62	242	9.25	400Hz 5V	27.5V	110W TX Mode 35W RX Mode	Convection	Console
Guard R/T	RT-1145/ARC-164	Door 3R	4.73	4.98	8.25	194	8.10	27.5V	27.5V		Convection	Console
Control	C-9533/ARC-164	Cockpit	4.87	5.75	5.34	150	4.32				Convection	Console
Indicator	ID-1961/ARC-164	Cockpit	2.25	2.38	5.90	31.6	0.9				Convection	Panel
Antenna Selector	C-4808/ARC-164	Cockpit									Convection	Console

*ARC-164/V13: 5821-01-008-4600; V14: -4601; V15: -4599; V24: -4603; V3: -4604; V4: -4598.

246

Best Available Copy

Table 6-2. F-15A AVIONICS CONFIGURATION DATA: AN/ARC-109 UHF RADIO NSN: 5821-00-496-9236 (BEING REPLACED BY AN/ARC-164)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF Antenna (Low)	AS-2817/ARC-109	Door 3L										Hard
Auxiliary UHF Receiver	R-1789/ARC-109	Door 3R	5.59	6.40	11.9		63.3	0.136		0.25 lb/min at 40° C	Forced Air	
UHF Radio	RT-967/ARC-109	Door 3R	6.78	8.84	14.8		28.7				Forced Air	Shock Tray
UHF Antenna Selector	C-9634/ARC-109	Door 3R										
UHF Antenna (Low)	AS-2817/ARC-109	Door 6R										
Control	C-9015/ARA	Cockpit										

Table 6-3. F-15A AVIONICS CONFIGURATION DATA. KY-28 COMMUNICATIONS SPEECH SECURITY SET

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Crypto	TSEL/KY-28 NSN: TBD	Door 3R	7.8	5.0	9.1	155	25.0		28V 0.04kW	100 BTU/hr	Convection	
Control	C-90011/ARA NSN: TBD	Cockpit		5.75					28V		Convection	Panel

245

Best Available Co

Table 6-4. F-15A AVIONICS CONFIGURATION DATA: OA-8639/ARD UHF-ADF

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Amplifier	AM-0440/ARD	Door 3R	4.5	5.5	7.0		5.6					
Control Unit		Cockpit										
Antenna	AS-2701/ARD NSN: 5826-00-262-5022	Nose Radome										

Table 6-5. F-15A AVIONICS CONFIGURATION DATA: AN/AJN-18 FLIGHT DIRECTOR SYSTEM NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Flight Director Adapter	MX-9119/AJN-18	Door 3R										

250

Table 6-6. F-15A AVIONICS CONFIGURATION DATA: AN/ASK-6 CADC NSN: 6610-00-295-2454*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Air Data Computer	AN/ASK-6	Door 3R										
Airspeed Mach Indicator	AVU-25/A	Cockpit										
Altitude Indicator	ID-1818/ASN	Cockpit										
Left AOA Transponder	T-1217/AR	Door 5L										
Right AOA Transponder	T-1217/AR	Door 5R										
Vertical Speed Indicator	AAU-29/A	Cockpit										

*Also 6610-00-506-1798.

Table 6-7. F-15A AVIONICS CONFIGURATION DATA: AN/ASN-109 INERTIAL NAVIGATION SYSTEM

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Inertial Measurement Unit	CN-1376/ASN-109 NSN: 6605-00-[illegible]9-1837	Door 3R										
Navigation Control Indicator Panel	C-8849/ASN-109 NSN: 6605-00-304-2454	Cockpit										

252

Table 6-8. F-15A AVIONICS CONFIGURATION DATA: AN/ASN-108 ATITUDE-HEADING REFERENCE SYSTEM NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Gyro	CN-1375/ASN-108	Door 6R	7.05	7.0	8.6		13.9					
Gyro Amplifier	AM-6435/ASN-108	Door 6R	6.10	7.75	9.75		13.9					

Table 6-9. F-15A AVIONICS CONFIGURATION DATA: AN/ARN-112 INSTRUMENT LANDING SYSTEM

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
ILS Receiver	R-1755/ARN-112 NSN: 5826-00-279-6334	Door 3R	5.0	3.75	10.0		6.8		0.02			
Integrated Navigation Air Control Panel	C-9014/ARN-112 NSN: 3130-00-367-6298	Cockpit										
Glide slope/ Localizer Antenna	A5-2704/ARN-112 NSN: TBD	Door 1										
Marker Beacon Antenna	A5-28961/ARN-112 NSN: TBD											

254

Table 6-10. F-15A AVIONICS CONFIGURATION DATA: AN/ARN-118 TACAN NSN: 5826-01-015-0834 (REPLACES AN/ARC-111)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver Transmitter	RT-1159/ARN-118	Door 3R	6.8	7.5	14.6	745	26.5	400Hz 115V 0.250Kw 1φ	28V	100W	Convection	Shock
Receiver Transmitter Adapter	MX-9577/ARN-118		6.78	1.73	13.1	154	5.0	26V 400Hz		10W	Convection	Shock
Control	C-9014/ARN-118	Cockpit	2.3	5.8	5.5	73.4	2.0			35W	Convection	Console

255

Table 6-11. F-15A AVIONICS CONFIGURATION DATA: AN/ARN-111 TACAN SYSTEM NSN: TBD (BEING REPLACED BY AN/ARC-118)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver	RT-1045/ARN-111	Door 3R	6.86	6.85	16.7							

256

Table 6-12. F-15A AVIONICS CONFIGURATION DATA: CENTRAL COMPUTER

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Computer	CP-1075/AYK NSN: 4730-00-142-1418	6L										
Data Processor	CP-111/AVQ-20 NSN: 5910-00-030-2834	6L										
Data Processor	CP-1088P NSN; TBD	6L										

257

Table 6-13. F-15A AVIONICS CONFIGURATION DATA: INTERFERENCE BLANKER MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Interference	MX-9287/A	Door 3R										

268

Table 6-14. F-15A AVIONICS CONFIGURATION DATA: AN/APX-101 IFF TRANSPONDER NSN: 5895-01-016-6739

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
R/T Unit	RT-1063/APX-101	Door 3R	5.8	6.0	10.82	377	14.3		0.0635	55W	Convection	Special
Control Panel	C-6280A/APX	cockpit	5.25	5.75	3.1	94	3.0	6V 1A	28V 0.2A	30W		Console

254

Table 6-15. F-15A AVIONICS CONFIGURATION DATA: AN/APX-76 IFF INTERROGATOR NSN: 5895-00-115-7813*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
R/T Unit	RT-868A/APX-76	Door 3R	7.63	5.0	19.37	737.2	19.0	0.230	0.024		Forced Air	Mt-4024
Control Unit	C-7959/APX-76	Cockpit	2.87	5.75	2.25						Convection	Panel
Evaluator	MX-9147/APX-76	Door 3R										
Computer Interrogator	KIR-1A/APX-76	Door 3R	6.0	6.7	10.0	402.0	11.0	0.03		30W	Convection	
Switch Amplifier	SA-1568A/APX-76	TBD	6.0	5.125	11.5	349.0	10.0	115V 0.1A 400Hz	28V 0.2A		Convection	MT-3829
Electronic Synchronizer	SN-416A/B	TBD	6.0	5.125	9.[illegible]		7.25	0.24A	1A		Convection	MT-3923

*Also 5895-00-702-4040.

260

Table 6-16. F-15A AVIONICS CONFIGURATION DATA: AN/APG-63 FIRE CONTROL/ACQUISITION RADAR NSN: 5841-01-060-0616

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Radar S/T Antenna	AS-2712/APG-63	Nose Radome	36.0	36.0	23.23		110					
Integrating Gyro		Nose Radome										
Radar Horn Antenna	AS-2711/APG-63	Nose Radome										
Radar Target Data Processor	MX-9100/APG	Door 3L										
Radar Power Supply	PP-6682/APG	Door 3L										
Radar Data Processor	MX-9099/APG	Door 3L										
Radar Transmitter	T-1208/APG-63	Door 3L										
R F Oscillator	O-1620/APG-63	Door 3L										
Radar Receiver	R-1765/APG	Door 3L										

261

Table 6-17. F-15A AVIONICS CONFIGURATION DATA: AN/ALQ-128 RADAR WARNING SYSTEM NSN: 5865-00-209-3961

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
ICS Radar	AN/ALQ-128											
Sum and Difference Diplexer	LO-2101/ALQ-128	Door 3R										
Switch	SA-1985/ALQ-128	Nose Radome										
Antenna	AS-2958/ALQ-128	Nose Radome										
Radar Warning	OR-132/ALQ-128	Door 3R										

Table 6-10. F-15A AVIONICS CONFIGURATION DATA: AN/ALR-56 RADAR WARNING SET NSN: 5865-00-209-3955

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver	R-1866/ALR-56	Door 6R										
Power Supply	PP-6968/ALR-56	Door 6R										
TEWS Antenna	AS-2934/ALR-56	Nose Landing Gear Door										

Table 6-19. F-15A AVIONICS CONFIGURATION DATA: AN/ALQ-135 ELECTRONIC COUNTERMEASURES NSN: 5865-00-209-3962*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
ICS Antenna	AS-2903/ALQ-135	Door 3L										
ICS Antenna	AS-2903/ALQ(v)	Door 6R										
Summing Network	CU-2081/ALQ-135	#5 Bay L.										
R F Amplifier	AM-6597/ALQ-135	#5 Bay L.										
Oscillator Control	C-9341(p)/ALQ-135(v)	#5 Bay L.										
Oscillator Control	C-9362(p)/ALQ-135	#5 Bay L.										
R F Amplifier	AM-6598/ALQ-135	#5 Bay L.										

*NSN given for AN/ALQ-135(V).

264

Table 6-20. F-15A AVIONICS CONFIGURATION DATA: ARMAMENT CONTROL SET NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
AUG-20												
Programmer	CV-3080/AWG-20 NSN: TBD	6L										
Control	C-9358/AWG-20	Cockpit										

265

Table 6-21. F-15A AVIONICS CONFIGURATION DATA: KIT-A IFF CRYPTO NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Crypto Unit	TSEL/KIT-1A	TBD	6.5	5.0	8.2			1φ 0.03		30W		
Control	TBD	Cockpit	3.375	5.75	≈4.0		≈2.0				Convection	Shock

266

Table 6-22. F-15A AVIONICS CONFIGURATION DATA: MISCELLANEOUS

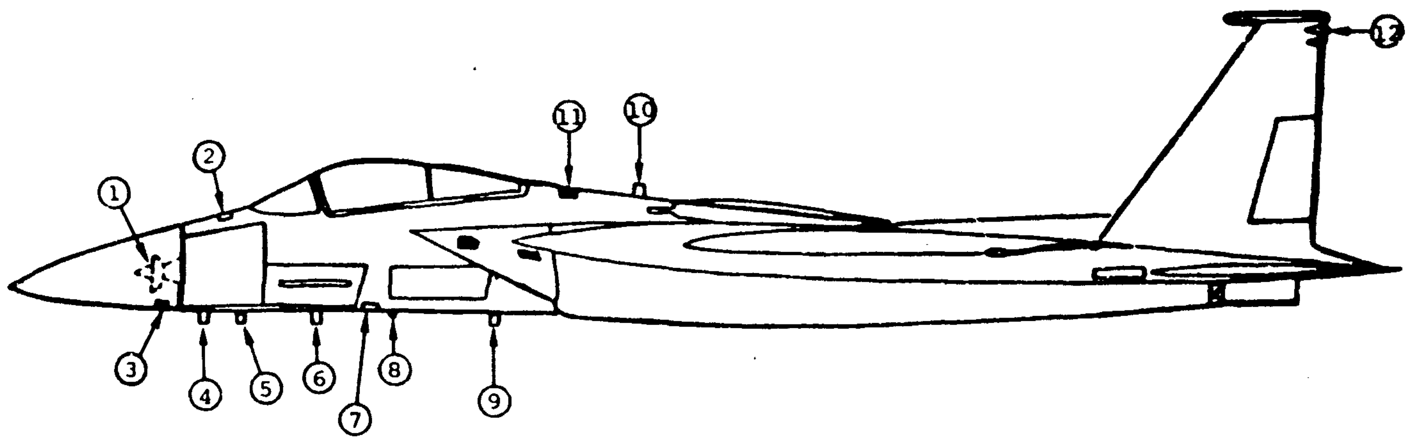
Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Interference Blanker	MX-9287/A	Door 3R										
Electronic Counter	ABJ-K7/AJ7J-8 NSN: TBD	Door 6R										
Lead Computing Gyro	CN-1377/AWG NSN: 1270-00-516-9059	Door 10R										
Sign l Data Receiver	AN/ASH-28 NSN: TBD											
Visual Site Display	OD-60A NSN: TBD											

7. ANTENNA LOCATIONS

Figure 7-1 shows the approximate location of the antennas on the F-15A.

The nomenclature for the antennas, as shown on the figure, is as follows:

Location	Antenna	Nomenclature or Part Number
1	Radar/IFF	AS-2712/APG
2	ADF Antenna	AS-2701/ARD
3	Glide Slope/Localizer	AS-2740/ARN
4	TACAN/UHF	AS-2817/ARC
5	ILS Transmit	AS-2903/ALQ-135
6	UHF/IFF	AS-2817/ARC
7	Marker Beacon	AS-2796/ARN
8	Radar Warning	AS-2903/ALQ-135
9	ICS Transmit	AS-2903/ALQ-135
10	Upper TACAN	AS-2799/ARN
11	UHF/IFF	AS-2817/ARC
12	Radar Warning	AS-2959/ALQ-128



1. Radar/IFF Antenna
2. ADF Antenna
3. Glideslope/Localizer Antenna
4. TACAN/UHF Antenna
5. ILS Transmit Antenna
6. UHF/IFF Antenna
7. Marker Beacon Antenna
8. Radar Warning Antenna
9. ICS Transmit Antenna
10. TACAN Antenna
11. UHF/IFF Antenna
12. Radar Warning Antenna (both sides)

Figure 7-1. F-15A ANTENNA LOCATIONS

269

8. INTERFACE DATA

This section contains examples of interface signal characteristics and a description of the F-15A Multiplex bus requirements. These data were extracted from applicable sections of the Interface Control Document (ICD) for integration of GPS User Equipment in the F-15 aircraft.

Each signal characteristic sheet discusses a particular signal. The top line contains the signal name, type of signal (digital, analog, discrete, or synchronous), signal source and load, and whether the signal is an input or output of the GPS user equipment. A functional description follows, together with a description of the signal's characteristics.

The general requirements of the F-15A data bus, were originally extracted from a report (H009) dated 12 March 1969 entitled *F-15 Multiplex Data Bus*. A copy of the preliminary draft of that report is included in this section, beginning on page 8-2.

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Bearing	Digital	0	UE	Flight Director Adapter

<u>Functional Description</u>

Provides angular information, in digital format, of the relative bearing of the aircraft's present position to a selected waypoint. The relative bearing is the difference, in degrees, between the lubber line and the bearing pointer as read from the compass card.

<u>Signal Characteristics</u>

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 1 and Appendix III, Paragraph 2.2.2

<u>Electrical Characteristics</u>

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

<u>Interconnection Data</u>

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011
10-2

271

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance	Digital	0	UE	Flight Director Adapter

Functional Description

Provides the distance from the aircraft's present position to the next selected waypoint.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 2 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: IF-15A-2-18
Report H009

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-011
SCALE	REV	SHEET 10-3

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Course Set	Digital	0	Flight Director Adapter	UE

Functional Description

Provides an electrical reference signal of the course manually selected by the Course Set Control on the HSI. This signal will be used by the UE as a reference for positioning the course deviation and To-From indicators on the HSI.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARDS: See Table IA, Item 3 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011 10-4

273

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation	Digital	0	UE	Flight Director Adapter

Functional Description

Provides a variable signal that indicates the displacement of the aircraft to the left or right of a selected course. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. The indicating device may display angular displacement (e.g., 10° for a TACAN approach: 2.5° for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 2-6 miles full scale, (b) Terminal: 1-2 miles full scale and (c) Approach: 600-3000 feet full scale. Choice of presentation (distance/degrees) and scales are TBD-3.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 4 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-011
SCALE	REV	SHEET 10-5

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation	Digital	O	UE	Flight Director Adapter

Functional Description

Provides a variable signal that indicates the displacement of the aircraft above or below a desired flight path. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. The indicating device may display angular displacement (e.g., 0.5° for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffice Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 200 to 2000 feet full scale, (b) Terminal: 60-200 feet full scale and (c) Approach: 40-100 feet full scale. Choice of presentation (distance/degrees) and scales are TBD-3.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 5 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011

SHEET 10-6

275

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
To-From	Digital	0	UE	Flight Director Adapter

Functional Description

Provides a digital signal which indicates direction aircraft is flying in relation to the selected waypoint. If the aircraft is flying toward the waypoint and has not intercepted a reference line perpendicular to the aircraft ground track and through the waypoint, the indication will be To. Once past the waypoint reference line, the indication will be From, as long as the same waypoint is selected.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: Logic 1 = From
Logic 0 = To

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011 10-7

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Flag	Digital Discrete	O	UE	Flight Director Adapter

Functional Description

Provides a digital discrete signal to the Flight Director Adapter to operate the HSI distance warning flag. The flag is normally out of view when the range indicator is operating and the range data is valid. The flag covers the range indicator when the distance information is not valid or the device supplying the distance data is not operating.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: Logic 1 = Valid
Logic 0 = Invalid

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011
REV SHEET 10-8

277

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation Flag	Digital Discrete	0	UE	Flight Director Adapter

Functional Description

Provides a digital discrete signal to the Flight Director Adapter to operate the HSI and ADI deviation warning flags or circuits when the deviation data is unreliable or a malfunction has occurred in the course deviation circuitry.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: Logic 1 = Valid
Logic 0 = Invalid

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A | | ICD-GPS-011
10-9

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation Flag	Digital Discrete	O	UE	Flight Director Adapter

Functional Description

Provides a digital discrete signal to the Flight Director to advise the ADI when the UE vertical deviation signal is not reliable.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: Logic 1 = Valid
Logic 0 = Invalid

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Rerort H009

A | | ICD-GPS-011
| | 10-10

279

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Latitude	Digital	0	UE	Flight Director Adapter

Functional Description

Provides present position latitude in digital format to Flight Director Adapter for transfer to the Central Computer.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 6 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-011
SCALE	REV	SHEET 10-11

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Longitude	Digital	O	UE	Flight Director Adapter

Functional Description

Provides present position longitude in digital format to the Flight Director Adapter for transfer to the Central Computer.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 7 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011
10-12

281

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
North-South Velocity	Digital	O	UE	Flight Director Adapter

Functional Description

Provides north-south velocity in digital format to the Flight Director Adapter for transfer to the Central Computer.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 8 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011 10-13

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
East-West Velocity	Digital	O	UE	Flight Director Adapter

Functional Description

Provides east-west velocity in digital format to the Flight Director Adapter for transfer to the Central Computer.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 9 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011 10-14

283

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Velocity	Digital	O	UE	Flight Director Adapter

Functional Description

Provides vertical velocity in digital format to the Flight Director Adapter for transfer to the Central Computer.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 10 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-011
SCALE	REV	SHEET 10-15

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
BIT Acknowledge	Discrete	O	UE	BIT Control Panel

Functional Description

Discrete is sent to BIT Control Panel during the time the UE is in a BIT routine as a result of receiving a BIT Initiate discrete (see page 10-32). from the BIT Control Panel.

Signal Character'stics

TBD-2

Electrical Characteristics

TBD-2

Interconnection Data

TBD-2

A/C: F-15A
REF: T.O. 1F-15A-2-17
T.O. 1F-15A-2-18

A ICD-GPS-011 10-16

285

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Antenna Fail	Discrete	O	UE	Avionics Status Panel

Functional Description

An Antenna Fail discrete is sent to the Avionics Status Panel when a UE antenna failure is detected by UE BITE circuits after a BIT Initiate discrete is received from the BIT Control Panel (see page 10-32).

Signal Characteristics

TBD-2

Electrical Characteristics

TBD-2

Interconnection Data

TBD-2

A/C: F-15A
REF: T.O. 1F-15A-2-17
T.O. 1F-15A-2-18

A ICD-GPS-011
10-17

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Preamplifier Fail	Discrete	0	UE	Avionics Status Panel

Functional Description

A Preamplifier Fail discrete is sent to the Avionics Status Panel when a UE preamplifier failure is detected by UE BITE circuits after a BIT Initiate discrete is received from the BIT Control Panel (see page 10-32).

Signal Characteristics

TBD-2

Electrical Characteristics

TBD-2

Interconnection Data

TBD-2

A/C: F-15A
REF: T.O. 1F-15A-2-17
T.O. 1F-15A-2-18

A ICD-GPS-011 10-18

297

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Receiver Fail	Discrete	O	UE	Avionics Status Panel

Functional Description

A Receiver Fail discrete* is sent to the Avionics Status Panel when a UE receiver failure is detected by UE BITE circuits after a BIT Initiate discrete is received from the BIT Control Panel (see page 10-32).

*A separate discrete will be provided for each receiver LRU.

Signal Characteristics

TBD-2

Electrical Characteristics

TBD-2

Interconnection Data

TBD-2

A/C: F-15A
REF: T.O. 1F-15A-2-17
T.O. 1F-15A-2-18

A		ICD-GPS-011
		10-19

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
CDU/NCI Fail	Discrete	O	UE	Avionics Status Panel

Functional Description

A CDU/NCI Fail discrete is sent to the Avionics Status Panel when a CDU/NCI failure is detected by UE BITE circuites after a BIT Initiate discrete is received from the BIT Control Panel (see page 10-32).

Signal Characteristics

TBD-2

Electrical Characteristics

TBD-2

Interconnection Data

TBD-2

A/C: F-15A
REF: T.O. 1F-15A-2-17
T.O. 1F-15A-2-18

A | ICD-GPS-011 | 10-20

287

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
GPS No-Go	Discrete	O	UE	BIT Control Panel

Functional Description

A GPS No-Go discrete is sent to the BIT Control Panel when a GPS UE failure is detected by UE BITE circuitry after receipt of a BIT Initiate discrete from the BIT Control Panel (see page 10-32).

Signal Characteristics

TBD-2

Electrical Characteristics

TBD-2

Interconnection Data

TBD-2

A/C: F-15A
REF: T.O. 1F-15A-2-17
T.O. 1F-15A-2-18

A ICD-GPS-011
SHEET 10-21

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Magnetic Heading	Digital	I	Flight Director Adapter	UE

Functional Description

Provides magnetic heading in digital format to the GPS UE.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 11 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2., 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A		ICD-GPS-011
		10-22

291

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
True Air Speed	Digital	I	Flight Director Adapter	UE

Functional Description

Provides true air speed in digital format to the GPS UE.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 12 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: A-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011

SHEET 10-23

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulse	Pulse	I	Blanker	UE

<u>Functional Description</u>

The blanking pulse blocks the input to the UE preamplifier when other selected equipments, such as IFF, are transmitting.

<u>Signal Characteristics</u>

SIGNAL TYPE: Positive Pulse
AMPLITUDE: 0 to +40 volts
FREQUENCY RANGE: 20,000 PPS (max.)
DUTY CYCLE: 15% (max.)
LOGIC ONE LEVEL (SUPPRESSION): +20 to +40 volts
LOGIC ZERO (NON-SUPPRESSION): 0 ±0.5 volts
START TIME: See next page
STOP TIME: See next page

<u>Electrical Characteristics</u>

SOURCE: IFF (AN/APX-101), Receiver-Transmitter RT-1063B/APX-101(V), R = 100 Ohms ± 10%
LOAD: 300 to 2,200 Ohms shunted by 1850 Pf

<u>Interconnection Data</u>

WIRE TYPE: RG-58C/U Coaxial Cable

A/C: F-15A
REF:

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-011
SCALE	REV	SHEET 10-24

293

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulse (continued)	Pulse	I	Interference Blanker	UE

Signal Characteristics (continued)

START TIME: The suppression pulse shall rise to 7.5 volts minimum at least 0.5 usec but not more than 3.0 usec before the RF output pulse has reached 10% of its amplitude. For auxiliary trigger and Mode 4 replies, the pulse shall rise to 7.5 volts minimum less than 0.5 usec before the RF output pulse has reached 10% of its amplitude. Maximum rise time (10-90%) shall be 0.5 usec.

STOP TIME: The suppression pulse shall be less than 1.0 volt, 3.0 usec after the 10% amplitude point of the trailing edge of the last RF framing pulse of the reply pulse train or after the 10% amplitude point of the trailing edge of each RF output pulse resulting from the auxiliary trigger input.

A/C: F-15A
REF:

A		ICD-GPS-011
	REV	SHEET 10-25

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Barometric Altitude	Digital	I	Flight Director Adapter	UE

Functional Description

Provides barometric altitude in digital format to the GPS UE.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 13 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011
SHEET 10-26

295

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Pitch	Digital	I	Flight Director Adapter	UE

Functional Description

Provides pitch in digital format to the GPS UE.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 14 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011
10-27

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Roll	Digital	I	Flight Director Adapter	UE

Functional Description

Provides roll in digital format to the GPS UE.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 15 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011 10-2A

297

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
True Heading	Digital	I	Flight Director Adapter	UE

Functional Description

Provides true heading in digital format to the GPS UE.

Signal Characteristics

WORD/FRAME STRUCTURE: See Appendix III, Paragraph 2.2
INFORMATION IDENTIFIER: See Appendix III, Paragraph 2.2.1
TIMING TOLERANCES: See Appendix III, Paragraph 3.2.1
DATA STANDARD: See Table IA, Item 16 and Appendix III, Paragraph 2.2.2

Electrical Characteristics

See Appendix III, Paragraphs 3.2.2, 4.2.1, 4.2.2

Interconnection Data

See Appendix III, Paragraph 4.0

A/C: F-15A
REF: T.O. 1F-15A-2-18
Report H009

A ICD-GPS-011
10-29

ABSTRACT

This report contains specifications defining the standard interface between the central computer complex and associated peripheral equipment via multiplex buses to be used in the F-15 Avionics System.

Attachment A of Appendix III
ICD-GPS-011
Reproduced from H009,
12 March 1969, F-15
Multiplex Data Bus

30-3

279

TABLE OF CONTENTS

20-4

30-5

301

LIST OF FIGURES

302

1.0 <u>SCOPE</u>

This report defines the operating characteristics and standard format for multiplexed digital data transmission between the Central Computer Complex (P.S. 68-870060) and associated peripheral units in the F-15 avionics system. Included are detail performance requirements of standard interface units required to transmit, receive and process the multiplexed digital data. Detail contents of the standard digital words will be as defined by the input/output digital data table contained in individual procurement specifications for specific sub-system components affected.

30-7

303

2.0 OPERATING CHARACTERISTICS

2.1 General - Digital data transmission between peripheral avionic system components and the Central Computer Complex (CCC) shall be in a word serial, bit serial time division multiplex (TDM) format over standard buses. The transmission of standard messages shall be accomplished using half duplex (two way transmission, but not simultaneous) operation controlled by the CCC. A continuous system timing reference (clock) signal, originating in the CCC, shall be distributed to all multiplex terminals in the peripherals to allow bit synchronous data transmission. Two identical transmission lines (one data line and one clock line) shall constitute a multiplex bus. Two multiplex buses, providing system selectable standby redundancy, will be routed to each peripheral. Interfacing units will be connected to the buses in parallel (party line) fashion; therefore, all units connected to a bus will see all data on the bus.

2.2 Standard Message and Word Format - All data transmitted over multiplex buses interfacing with the CCC shall be transmitted as standard messages. A standard message shall be composed of a "Select" word originating in the CCC and one or more (15 maximum) "Data" words transmitted to or from a single peripheral. All select words and data words shall be composed of 17 bits: 16 bits of information (bits 0 through 15) plus a 17th (bit 16) bit providing odd "ones" parity. See Figure 1.

The content and detail format of all messages, select words, and data words will be specified in the input/output digital data table for the related peripheral.

2.2.1 Select Words - Select words shall be used to initiate all data exchanges (messages) and shall originate only in the CCC. A select word shall provide one of three functions; request data transmission from a peripheral, command a peripheral to take some action other than to transmit data, or identify data to be transmitted from the CCC to a peripheral. A select word shall be composed of three separate fields; a four bit equipment address field (bits 0 through 3), 30-8

304

a single bit command indicator (bit 4), a six bit control field (bits 5 through 10), a single bit T/R indicator (bit 11), and a four bit word count field (bits 12 through 15). The 17th bit (bit 16) provides odd "ones" parity. The equipment address field shall contain a unique code identifying the unit on the bus to which the communications are being directed. The command indicator identifies whether it is a command or data message. The control field shall identify the data to be transmitted by the CCC or by a peripheral following the select word, or for a command message, the command which causes the peripheral to take some action other than transmit data. The command indicator (bit 4 in the select word) shall be a logical "one" if the select word is a command which requires no specific data from a peripheral except to acknowledge receipt of the command. Bit 11 in the select word shall be a transmit/receive (T/R) indicator with a logical "one" indicating the peripheral must transmit the data word(s), or a logical "zero" indicating the computer will transmit the data word(s). The word count field shall specify the number of data words to follow the select word by a four bit binary number (LSB = bit 15) in bits 12 through 15. If the select word is a command the T/R bit shall be a logical "one" and the word count shall equal one.

Select words shall always be preceded by a no-data period (no signals on the data transmission line) equal to or greater than 8 periods of the reference clock signal. This no-data period shall identify the word following as a select word and the start of a message (see Figure 1). Bit 0 shall be transmitted first and parity (bit 16) transmitted last.

2.2.2 Data Words - Data words shall originate either in the CCC or a peripheral unit and contain the data identified by the control field of the select word. If the control field of the select word identifies a block of data, individual words within the block shall be identified by their relative position in the message, i.e., word number one follows the select word in the serial bit stream, and word number two follows word number one, etc. All data words regardless of content shall be composed of a 16 bit data field (bits 0 through 15) plus a 17th bit (bit 16) providing odd "ones" parity. The content and format of all data words shall be approved by MDC. The general rules for data word formatting follow.

If the select word indicates a command message, the peripheral shall acknowledge receipt of the command by transmitting one data word which is identical to the select word received.

If the select word indicates a data message, the peripheral shall transmit or receive the data words. In general, each data word shall contain only one numerical parameter. The numerical value of the parameter shall be represented using a true binary/two's complement notation. The most significant bit (MSB) (bit 0) shall be transmitted first with the remaining less significant bits (bits 1 through 15) following in descending order of their value. The number of bits used to define the numeric shall be consistant with the resolution or accuracy required. If more than 16 bits are necessary to achieve the required resolution or accuracy, the less significant bits which cannot be included in the 16 bit word shall be transmitted as a part of the next data word in the message, starting at the beginning of the word with the remaining less significant bits following in descending order of their

30-10

306

value. If less than 16 bits are required, the unused bit positions shall be transmitted as logical "C" bits unless discrete bits are to be included in the word according to the ground rules established in a later paragraph of this section.

minus the LSB

The binary value of a numerical data word shall be capable of ranging from (-) MAX to (+) MAX. Each bit in the word transmitted as a logical "1" shall have a sign and value associated with it. The MSB (bit 0) shall have the sign of (-) and the value of (MAX) and each bit following shall have the sign of (+) and the value of $MAX/_2n$, where n is the bit number; thus, bit 1 has the value (+) $MAX/_2 1$, bit 2 has the value (+) $MAX/_2 2$, etc. For nonangular quantities, MAX shall be an exact power of two (i.e., $MAX=2^i$, where i is an integer) in the units of the parameter. For angular quantities which require the full 360° angular range, such as bearing angles, MAX shall have the value 180° (i.e., the angular range shall be -180° to +180°). For angular ranges less than ± 180°, MAX shall have the value $180°/2^i$, where i is an integer chosen such that the binary data word is capable of representing the entire range of the parameter. In all cases, the MSB has the sign and value of (-MAX) with each subsequent bit having the sign and value of $(+MAX/_2n)$, where n is the bit number.

Discrete functions, i.e., data functions which can assume only one or two states (such as an ON-OFF) shall be transmitted as single discrete bits within a data word, or as combinations of single discrete bits which represent a uniquely recognizable code or straight binary number. Discrete functions directly related to an individual numeric parameter such as special "validity bits", or mode definition functions for the parameter shall be included in the word with the numerical value of the parameter if unused bit positions are available. Other unrelated discretes shall be formatted into a special "discrete function" data word unless the total quantity of these discretes in the message is such that they all can be

30-11

included in the unused portion of one data word. If the quantity of unrelated discretes in the message is greater than 16 or some multiple of 16, and the remaining bits can all be combined in the unused portion of one data word they may be "packed" into that word. In summary only one data word carrying a numerical parameter in any message can include unrelated discretes.

Multi-position switch functions, i.e., data representing one out of n switch positions, shall, in general, be binary encoded such that the number of bits used to represent the switch position shall be the smallest value of 2^i, where i is an integer.

In summary, the above formatting rules for data words are general guidelines. Detailed formats for specific subsystem input/output signals will be contained in the individual procurement specifications for the subsystems and are all subject to final MCAIR approval.

2.3 Bus Control - The CCC will select which of the data buses will be used for data transmission and will initiate a data exchange by transmitting the appropriate select word over the selected bus. No peripheral shall be required to receive or transmit over more than one bus at a time. Data words transmitted by the CCC shall be transmitted on the same bus as the initiating select word. Peripheral units shall transmit or accept the data defined by the select word over the same bus which carried the select word and the clock signal. When a bus is shut down, either because it has failed or because it is a back up bus, the data line and clock line are disabled by the CCC. All terminals operating from a bus that is shutdown during operation shall resynchronize their terminal data processing functions regardless of their operating mode, either transmitting or receiving.

Add

2.3.1 Data Transmission From Peripherals - A peripheral shall transmit only after the receipt of a valid select word requiring data transmission and only when it is operating normally and is capable of initiating the data word exactly 5 clock periods after receipt of the last bit of the select word, or after transmitting the last bit of the previous data word. A valid select word requiring data transmission from a peripheral shall meet the following criteria.

a) A no-data period equal to or greater than 8 clock periods shall have been detected on the data transmission line prior to receipt of the first bit of the select word.

b) The code represented by the address field (bits 0 through 3) shall compare to the address code preset in the peripheral unit.

c) The code represented by the control field (bits 5 through 10) shall be recognized as one of the data word or command word codes assigned to the peripheral.

30-13

309

d) The T/R bit (bit 11) shall be a logic "one".

e) The parity bit (bit 16) shall produce an odd "ones" count.

f) No data dropouts shall have occured during the 17 clock periods immediately following the start of the select word.

2.3.2 Data Acceptance By a Peripheral - A peripheral shall accept data only after the receipt of a valid select word indicating data to be transmitted by the CCC to the peripheral. The validating criteria for a select word directing a peripheral to accept data shall be the same as that directing transmission, except that the T/R bit shall be a logical "zero".

If a parity error or dropout is detected by the peripheral during reception of a data word, that word shall be invalidated.

2.3.3 Data Acceptance By The CCC - If no data word is detected by the CCC from a peripheral 5 clock periods after transmission of a select word requiring a response (i.e., a request for data or a command) the CCC will internally flag a no response condition. This no-response condition indicates that one of the following conditions exists:

a) The peripheral failed to recognize the select word as valid due to a signal dropout, a transmission error, or a momentary malfunction producing a parity error.

b) The peripheral was not operating normally and was unable to reply within the required 5 clock periods.

c) The communications link between the CCC and the peripheral has failed.

d) The peripheral has failed.

When a no-response condition is recognized by the CCC after 5 clock periods, the CCC may, at the option of the program, reinterrogate the peripheral by retransmitting the same select word after the required 8 clock periods of "no data". The computer may also, at the program option, switch

30-14

to the standby bus and repeat the interrogation process, or ignore the no responce condition and go on.

If a parity error or dropout is detected by the CCC during the reception of a data word, the CCC may request a repeat transmission over the same bus or over the back-up bus by retransmitting the select word after the required 8 clock periods of "no data".

30-15

311

3.0 SIGNAL AND TRANSMISSION LINE CHARACTERISTICS

3.1 Multiplex Bus - A multiplex bus shall be composed of two transmission lines. One line carries the 1 MHz clock reference signal from a master multiplex system clock in the CCC to all terminals on the bus and the other line carries digital data signals at a 1 Megabit rate to and from the CCC-I/O and the peripheral unit terminals. All terminal units on a single bus will be connected to the transmission lines comprising that bus in parallel, such that the physical removal of the unit from the line will not interrupt the continuity of the lines. Transmission lines shall be driven and terminated in a balanced to ground configuration to minimize the effects of ground plane noise. Transmission line shields will be grounded at each terminal.

Two redundant multiplex buses (4 transmission lines total) will interface with each peripheral unit.

3.1.1 Transmission Line Characteristics - The transmission line used for data and reference clock signal transmission shall be of shielded twisted pair construction having a characteristic impedance of approximately 68 ohms. The shielded twisted pair shall have a line to line capacitance of less than 30 pf per foot and a line to ground capacitance of less than 50 pf per foot.

3.2 Signal Characteristics

3.2.1 Reference Clock Signal - The clock signal shall be a bipolar differential sinusoidal signal at a nominal frequency of 1 MHz ± ~~1%~~ 0.1%. Long term variations shall not exceed ± ~~1%~~ 0.1% of the nominal frequency. The positive going zero crossing shall define the start of a clock period. Short term variations, i.e. cycle to cycle variations in the clock period, shall not exceed 5 nanoseconds.

The reference clock signal shall be generated and transmitted by the CCC I/O to all multiplex terminal on the buses. All terminals shall receive the clock signal via the clock receiver in the terminal unit. The clock signal transmitter shall

30-16

312

have the same characteristics as those specified for the transmit mode of the receiver/transmitter except the mode switching capability (see paragraph 4.2). The clock transmitter shall be transmitting the reference clock signal whenever a particular multiplex bus has been enabled by the CCC.

3.2.2 Data Signal - The data signals shall be bipolar differential signals which are "bi-phase level: coded and smoothed. The harmonic content shall be limited such that frequency components at 2.5 MHz and above are at least - 24 Db (referenced to the peak amplitude of the signal) and components in the frequency band 0.5 to 1.5 MHz are essentially unaffected. A logical "one" (data bit one) shall be transmitted as a coded bipolar 1,0 signal, i.e. a positive going pulse followed by a negative going pulse resulting in a signal which is in phase with the reference clock signal. A logical "zero" (data bit zero) shall be transmitted as a coded bipolar 0,1 signal, i.e. a negative going pulse followed by a positive going pulse resulting in a signal which is 180° out of phase with the reference clock signal (see Figure 2). No signals shall be generated on the data line during the intervals between words (no-data periods).

30-17

3/3

4.0 MULTIPLEX TERMINAL

The standard multiplex terminal shall be incorporated as an integral part of each equipment item serviced and shall provide an interface between the standard multiplex bus and the digital circuitry of the component serviced.

The functions performed by the multiplex terminal in the receive mode shall be to accept standard format data and clock signals from the multiplex bus, to detect and decode the incoming data using the incoming system clock signal as a reference, to convert the data to signals which are compatible with the subsystem component logic, and to generate the control signals necessary to supply the incoming data to the peripheral serviced with proper identification.

The functions performed by the multiplex terminal in the transmit mode shall be to accept signals from the subsystem component logic, to convert these signals to the standard transmission format using the incoming clock signal as a reference, and to transmit these signals at the proper time.

The multiplex terminals shall include a data receiver/transmitter, a clock receiver, data presence detection circuitry, and the necessary logic to provide control signals to interpret select words and regulate the operation of the terminal unit. The terminal units shall be designed such that no single component failure in a terminal, except the coupling transformer, degrades the transmission line or results in unwanted data transmissions. Redundant portions of the terminal shall be sufficiently isolated so that a failure of one transmission line does not degrade the performance of the other bus coupled to the unit.

4.1 Clock Receiver - The clock receiver shall be coupled to the clock signal transmission line through a transformer with grounded center taps. The coupling transformer shall have a narrow pass band which rejects noise at frequencies above and below the clock signal frequency, but passes the clock signal with

30-18

314

minimum attenuation and phase distortion. The impedance reflected onto the transmission line through the coupling transformer shall be 10,000 ohms or greater line to line, shall be essentially resistive, and shall be balanced to ground to within 1%. These impedance requirements shall apply even when terminal power is off. The clock receiver shall produce signals suitable for use in the terminal and for transferring data to the digital equipment in the interfacing unit. The clock receiver shall operate with input signal amplitudes in the range of ± 1 volt to ± 7 volts peak line-to-ground (± 2 volts to ± 14 volts peak line-to-line) and shall be capable of withstanding over voltage inputs without permanent damage to the receiver. Over voltage protection shall be consistent with that provided for other input signal lines in the equipment item serviced.

4.2 Data Receiver/Transmitter - The data receiver/transmitter shall be coupled to the data signal transmission line through a transformer with grounded center taps. The coupling transformer shall have a narrow pass band which passes the data signal with a minimum of attenuation and phase distortion. The impedance reflected onto the transmission line through the transformer shall be essentially resistive and balanced to ground to within 1% in both modes of operation, even when terminal power is off. When power is off, the magnitude of the reflected impedance shall be 10,000 ohms or greater line-to-line.

4.2.1 Receiving Mode - When operating in the receiving mode the magnitude of the impedance reflected onto the data transmission line shall be 10,000 ohms or greater, including any effects of the transmitter in the terminal. The receiver shall be capable of operating with input signal amplitudes in the range of ± 1 volt to ± 7 volts line to ground, and shall be capable of withstanding over voltage inputs without permanent damage to the unit. The receiver shall be capable of detecting and indicating the presence of bi-phase coded data, and of decoding the bi-phase data (i.e. identifying a logical "one" or logical "zero" code) by comparison with the reference clock signal, even though the incoming data lags the clock by as much as 200 nanoseconds. The receiver shall also have the capability of recognizing improperly coded signals, or a data dropout, occurring during reception of a word, and of producing an error signal indicating that an invalid word has been received.

4.2.2 Transmitting Mode - When operating in the transmitting mode, the magnitude of the impedance reflected onto the data transmission line shall be 68 ohms ± 10%. The transmitter shall be capable of driving a load equivalent to 175 ohms line-to-line pure resistance to a peak amplitude of 5 volts ± 1 volt line to ground (10 volts ± 2 volts line to line). The output wave form will be similar to that shown in Figure 2 with its spectral content limited as defined in paragraph 3.2.3. The mid-period zero crossing of the data signal, with the transmitter operating with a 175 ohm resistive load, shall lag the mid-period zero crossing (negative going zero crossing) of the signal on the clock line by no more than 35 nanoseconds. The terminal shall be capable of driving a transmission line producing cap[illegible] which are equivalent to 19 ohms in series with 1850 pfd without ampl[illegible]ariations from the levels achieved with the 175 ohm resistive load. (Note: Line load cannot be simulated by a capacitance alone.)

4.2.3 Mode Switching - Switching of the receiver/transmitter unit between the receive mode and transmit mode shall be controlled by the terminal control logic based on the contents of the select word and system operating characteristics defined in Section 2. When a receiver/transmitter is operating in the transmit mode (68 ohm reflected impedance), it shall maintain the transmit mode impedance characteristic for a minimum of 3 clock periods (3 usec) after transmitting the last bit required and shall switch to a stabilized receive mode (10K ohm reflected impedance) within the next 2 clock periods (2 usec.) When the receiver/

30-20

316

transmitter is in the receive mode it shall switch to a stabilized transmit mode (68 ohms reflected impedance) within 2 clock periods (2 usec) after receiving the last bit required when transmission is indicated. Mode switching shall be accomplished without generating significant transients on the transmission line.

4.3 Terminal Control Functions - The terminal unit shall include control circuitry which regulates the operating mode of the Data Receiver/Transmitter (R/T) unit, identifies and selects the bus to be used for receiving or transmitting data, and identifies, decodes, and processes incoming and outgoing messages.

4.3.1 Receive/Transmit Mode Selection - Receiver/Transmitter units in the CCC-I/O terminals shall operate in the transmit mode at all times except when required to receive data from a peripheral as indicated by the presence of a logical "1" as bit 11 of the transmitted select word. The unit shall remain in the receive mode until all words contained in the message (the number indicated by the count field of the select word) have been received or a "no-data response" condition is recognized, i.e. no data word is received after the five "no-data" clock periods. When either of these two conditions occur, the receiver/transmitter shall resynchronize and switch to the transmit mode in preparation for transmitting the next select word.

Receiver/transmitter units in peripheral equipment terminals shall operate in the receive mode at all times except when requested to transmit data as indicated by the presence of a logical "1" as bit 11 of a valid select word. The unit shall remain in the transmit mode until all data words requested (the number indicated by the word count field of the select word) have been transmitted or the clock signal on the operating bus is shut down causing the terminal to resynchronize. After the last bit of the last word of the message has been transmitted, or the terminal is resynchronized, the receiver/transmitter unit shall switch to the receive mode.

4.3.2 Word and Message Identification and Synchronization - The terminal shall provide facilities for identifying incoming words as "Select" or Data" words based on the length of the no-data period following the preceding word. It shall provide a capability for counting both incoming and outgoing bits to define the end of a word. It shall check or generate the parity bit. It shall provide a capability for counting incoming or outgoing words to define the end of a message based on the value of the word count field of the select word. If a no-data period greater than 5 clock periods is detected after a word and before the end of a message, or the bus is shut down (i.e. the clock signal is interrupted) before the word counter has counted down to zero, the system shall resynchronize and prepare to receive the next select word. This condition results when the message being transmitted is not completed because of a failure, or the inability of the transmitting unit to supply the data to complete the message, or the bus is shut down by the CCC. It should be noted that a select word is always followed by at least one data word transmitted either by the CCC or a peripheral.

4.3.3 Select Word Decoding - When an incoming word is recognized as a select word and a valid parity check has been made, the terminal shall inspect the address field to determine if the address code compares to the address code which has been pre-set into the terminal. Provision shall be provided to set the terminal address code by physical connections (e.g. jumpers, patches, plugs etc.) which are made on the bench in a shop; flight line address code programming is not required or desired. The CCC-I/C is not required to recognize address codes.

When an address code is recognized, the terminal shall determine if the peripheral is required to supply data words, or accept data words, by inspection of the T/R bit (bit 11 in the select word). If the terminal is required to transmit data, the receiver/transmitter shall be switched to the transmit mode.

30-22

318

The terminal shall store the contents of the control field (bits 4 through 10) and the contents of the word count field (bits 12 through 15) of the select word, which in combination identify the data word(s) to be accepted or supplied by the peripheral.

4.3.4 Outputting Data Words - When a peripheral receives an indication that a data word must be supplied to the terminal for transmission, it shall select the data word (identified by the control field code and the word count) from its data storage and transfer that word to the terminal unit for transmission. After the data word is transfered to the terminal, and the required 5 clock periods have elapsed, the terminal shall transmit the data word, with the correct parity bit at the end of the word. After the data word and parity bit have been transmitted, the word counter shall be decremented one count. If the word count is not zero, the terminal shall again indicate to the peripheral that a data word is to be supplied for transmission. This process shall be repeated until all the data words required for the message have been transmitted, as indicated by a zero count of the word counter.

4.3.5 Inputting Data Words - When a peripheral receives an indication that a data word directed to it has been received by the terminal with correct parity, it shall transfer that data word into the storage or buffer location identified by the control field code and word count indicated. After the required 5 clock periods have elapsed the terminal shall inhibit transfer of data from the terminal to the using unit, and decrement the word counter one count. If the word count is not zero the terminal shall accept the next data word on the data transmission line. This process shall be repeated until all data words in the message have been received as indicated by a zero count of the word counter.

5.0 RELIABILITY

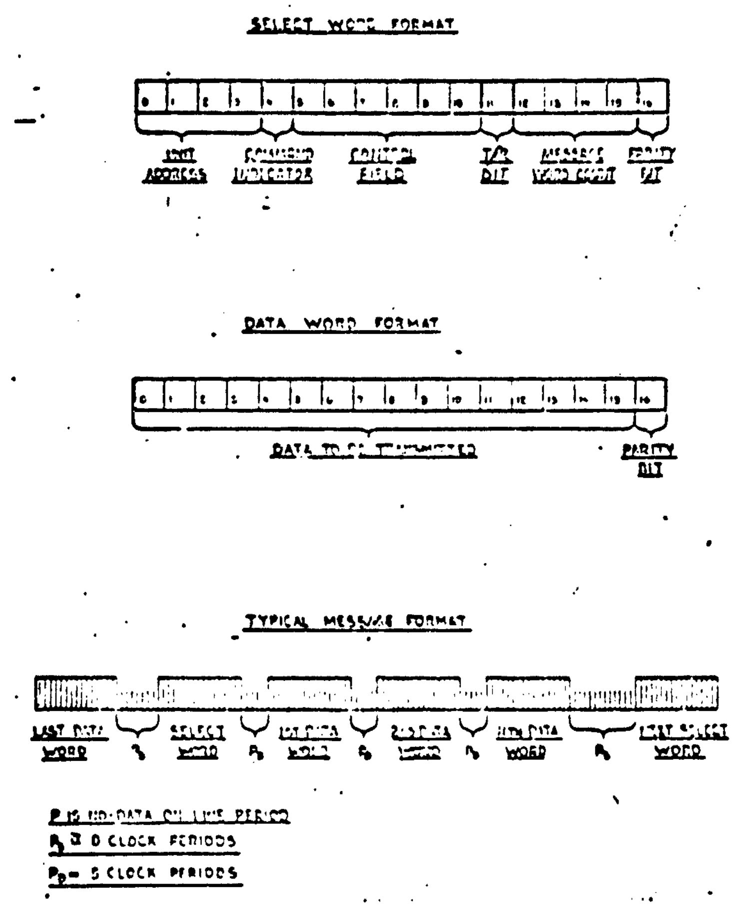
5.1 Reliability Data - Reliability data for the terminal equipment shall be combined with reliability data for the peripheral, such that the reliability of the peripheral shall include terminal reliability considerations exclusive of transmission line reliability.

30-24

320

FIGURE 1

STANDARD MESSAGE AND WORD FORMAT

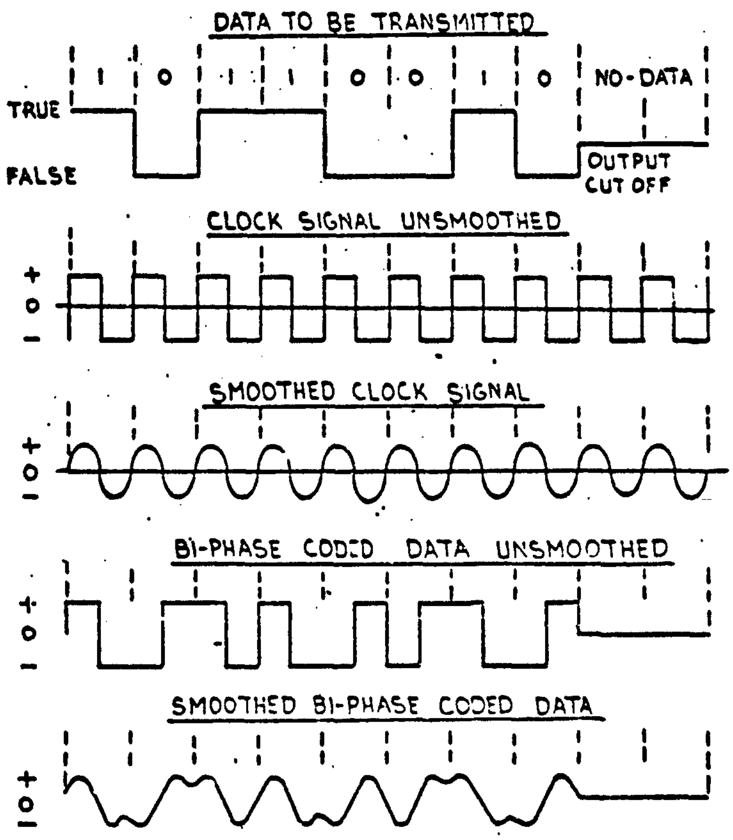


30-25

321

FIGURE 2

DATA AND CLOCK SIGNAL WAVE SHAPES



30-26

9. FUTURE MODIFICATIONS

Table 9-1 lists future modifications planned for the F-15A.

Table 9-1. FUTURE MODIFICATIONS

Terminology/Nomenclature	Remarks
HAVE QUICK	Interim AJ voice capability; now being developed; preliminary planning for F-15A.
SEEK TALK	AJ voice capability; under development by ESD; preliminary planning for F-15A.
Video Tape Recorder (ECP 1045 VTR)	Preliminary planning for F-15. Would use TEAC recorder. Awaiting ASD/AE development of new CCD camera to replace existing camera.
Programmable Signal Processor	Modification to F-15A radar to enhance capability. Item under development; preliminary planning for F-15 C/D aircraft.
ALE-40(V) Dispenser Set	Development contract expected shortly. Planned to retrofit all F-15As.
TEWS Threat Update (CCP 120-ICS)	R&D ECP now under way. Modification to ALR-56 to enhance capability. Add Band 3 to ICS system; modify Band 2 capability of ICS.
Tail Warning System (ECP TWS)	Two competing systems: ALQ-153 (Westinghouse) and ALQ-154 (AIL). Prototype contracts to be awarded mid-1978. McAIR to start Group A kit development October 1978. Installations starting in 1981 to 1982.
AN/ARC-186 VHF/AM Radio	Preliminary planning for F-15. VHF/UHF requirements being defined by TAC. Installation of dual ARC-164 UHF could be superseded by installation of single ARC-164 and single ARC-186.
UHF - Dual ARC-164	Replaces AN/ARC-109.
TACAN - AN/ARN-118	Replaces AN/ARN-111.
ECPs 899 and 900	Modifications to APG-63 radar software; AIMVAL and ACEVAL; 1100 words of computer memory.
GPS	Global Positioning System.

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Aircraft and avionics configuration data assembled by ARINC Research, principally in the form of copies of applicable sections, tables, and figures, form the aircraft and equipment Technical Orders listed at the end of this section.

- Avionics Planning Baseline Document - October 1978

- Requirements Analysis for a Multifunction, Multiband Airborne Radio System (MFBARS), March 1978, ARINC Research Corporation Publication 1935-11-01-1769

Inventory of Technical Orders

T.O. Number	Subject	Change Number	Date
IF-15A-01	List of Publications	Basic	4/15/77
IF-15A-1	Flight Manual	3	5/1/79
IF-15A-2-13	Weapons Control and Delivery System	9	8/1/77
IF-15A-2-16-1	Central Computer System	6	8/15/77
IF-15A-2-17	Air Data and Instrument System	11	7/15/77
IF-15A-2-18	Inertial Navigation, Site Indicator System	9	7/1/77
IF-15A-2-19	TACAN and Instrument Landing System	6	5/1/77
IF-15A-2-20	Auto Flight Control System	7	6/1/77
IF-15A-2-21	Auto Direction Finder	1	5/1/77
IF-15A-2-22	Identification and Recognition System	3	6/1/77
IF-15A-2-24	Head Up Display System	8	5/1/77
IF-15A-2-25	Radar System	1	9/15/77
IF-15A-2-26	Lighting System	6	8/15/77
IF-15A-2-27	Electrical Power Supply	8	9/1/77
IF-15A-2-28-1	Wiring Diagrams	6	9/1/77
IF-15A-2-28-2	Wiring Diagrams	5	9/15/77
IF-15A-4-4	Instrument and Electric, Electronic Systems	1	6/15/77

(continued)

324

Inventory of Technical Orders (continued)

T.O. Number	Subject	Change Number	Date
IF-15A-4-7	Parts Index	1	5/15/77
IF-15A-21	Equipment Inventory	Basic	6/15/77
IF-15A-34-1-1	Non Nuclear Weapon Delivery Manual	Basic	9/1/77
12P4-2APX101-2	Radio	Basic	9/1/75
12P4-2APX76-2	Interrogator Set	Changed	1/15/77
12P2-2APG63-2	Antenna	1	12/15/76
12R2-2ARC109-4	Radio Set	9	6/15/76
12R5-2ARN118-1	TACAN Navigational Set	Basic	10/15/76
12R2-2ARC164-2	Radio Set	Basic	6/20/76

AVIONICS INTERFACE DATA SUMMARY
FOR
F-16A

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

326

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

327

Record of Changes			
Change	Subject	Date Entered	Initials

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

321

LIST OF FIGURES AND TABLES (continued)

330

1. INTRODUCTION

This document contains configuration data relevant to the integration of additional avionics into the F-16A aircraft.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable technical orders are included in the references listed in Section 10.

331

2. COCKPIT SPACE

Table 2-1 summarizes the available cockpit space in the F-16A and provides references, as appropriate, to Figures 2-1, 2-2, and 2-3.

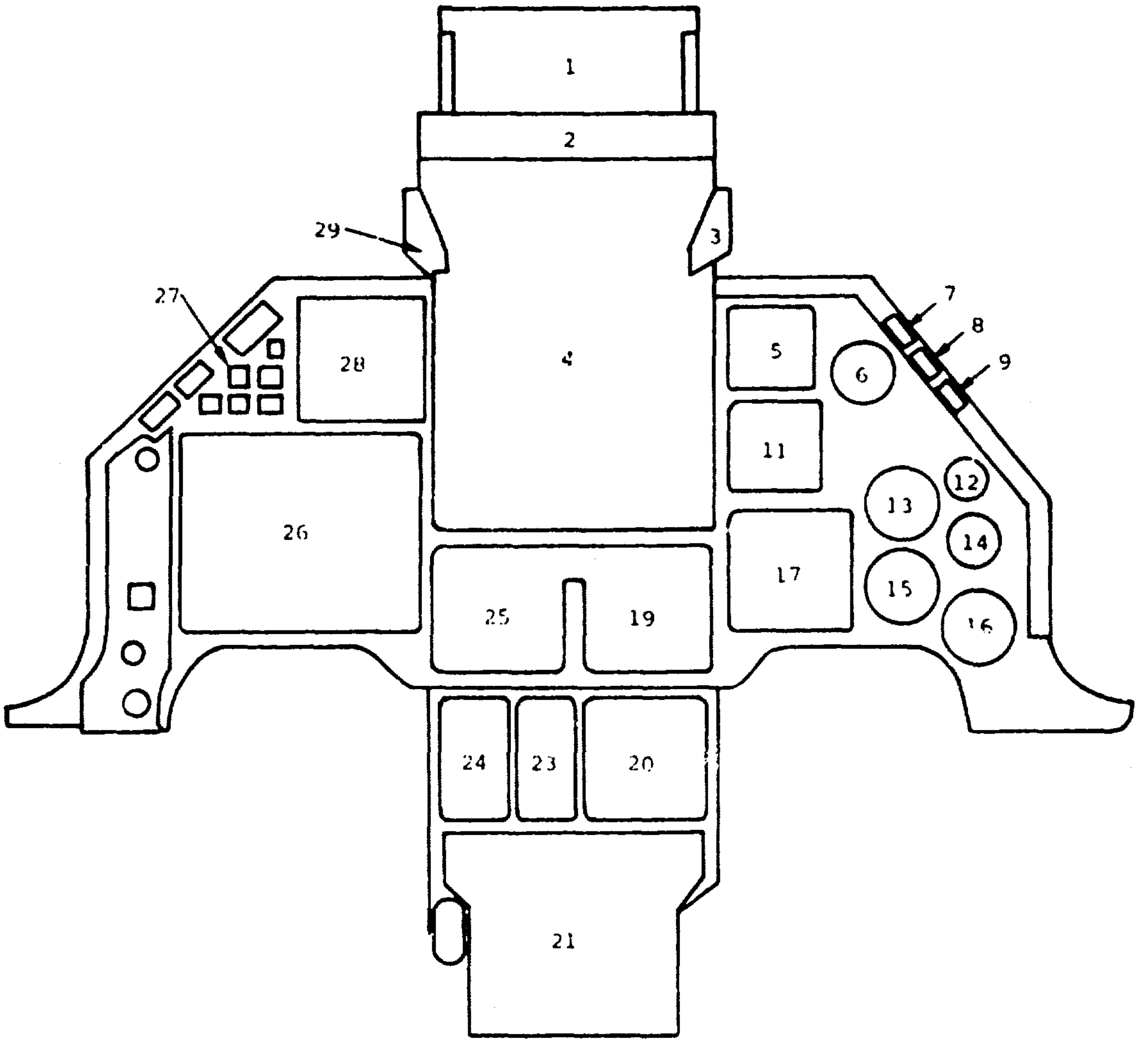
The F-16 program office is currently planning to relocate the cockpit Fire Control/Navigation Panel (FCNP) from the right console to the left console (ECP0076). No detailed information is currently available on this cockpit rearrangement except as shown in Figure 2-4 and in the ECP0076 overview that follows:

<u>ECP0076 (Relocate FCNP) Modifications for FOT&E</u>

- Modification will be made in accordance with formal retrofit engineering for FOT&E aircraft
- All modifications of approved ECP0076 configuration will be made:
  - Relocate FNCP (which necessitates moving other panels)
  - Relocate 3 Autopilot Switches
  - Delete Alternate Release Switch in F-16B Front Station
  - Relocate Selective Jettison Switch to the SM Panel
  - Reverse Gain and Symbology Controls on Radar/E-O Display
  - Increase Rotation of Manual Range Control
  - Rearrange Volume Control Knobs on COMM Panel
  - Change Intensity Control of AUX Console Gauges to the Instrument Control Knob
  - Reduce Intensity of AOA and NWS/AR Lights
  - Reverse the Switch Activation for Designate/Return-to-Search
  - Spring Load Speed Brake Switch in F-16B Rear Station
  - Additional Cockpit Utility Lights
  - Add the Roll, Pitch, Yaw, and Standby Gain Caution Lights to the Press-to-Self-Test Switch in the Crew Station

Table 2-1. F-16A AVAILABLE COCKPIT SPACE

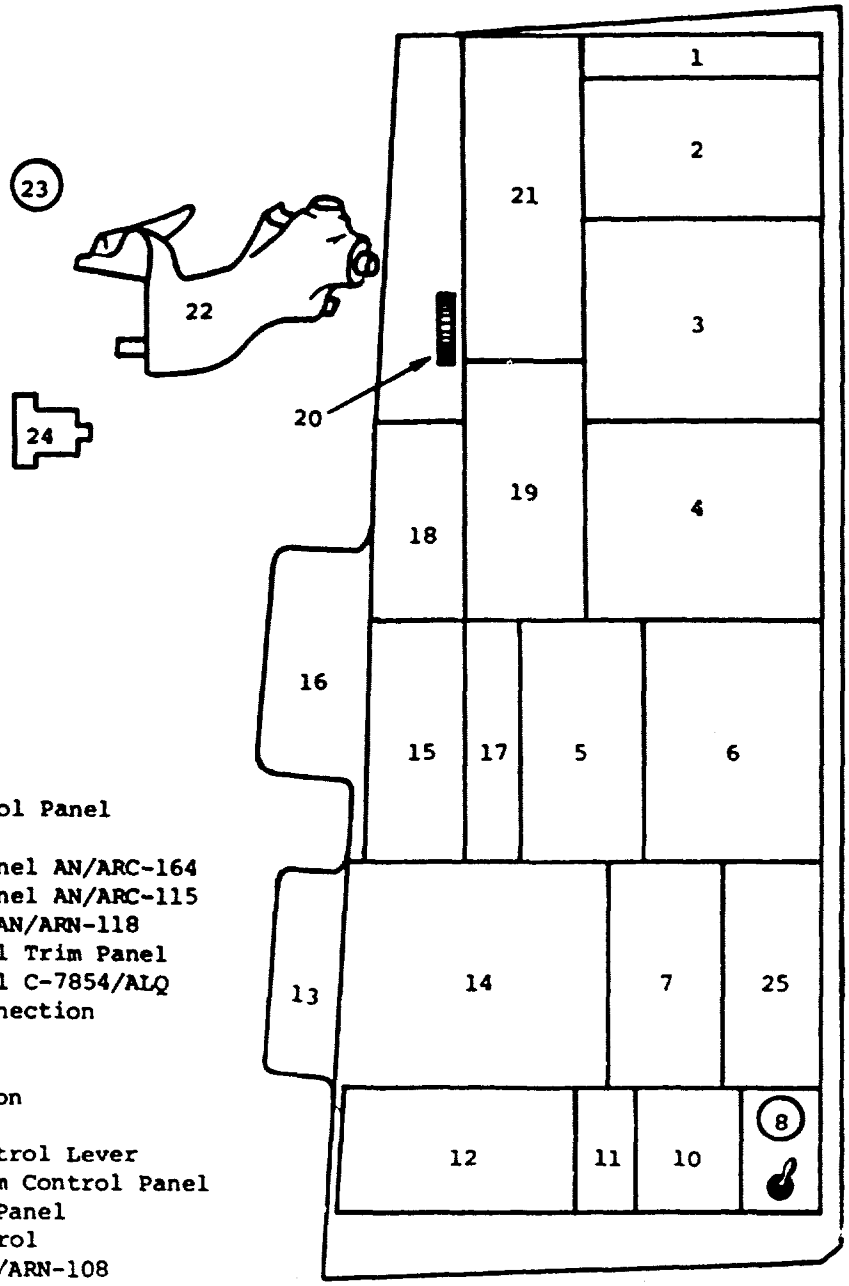
Unit	Figure Number	Item	Size (W, H, D)	Notes
INS Control (FCNP)	2-3	6	5-3/4" × 6" × 7"	To be relocated - ECP0076
Communications Panel	2-2	1		To be relocated - ECP0076
Anti-Ice/Antenna Select Panel	2-3	1 and 2	5-3/4" × 1-3/8"	To be relocated - ECP0076
Blank (reserved for video recorder)	2-2	25	5-3/4" × 2-1/4" × 7"	Growth space
Blank (reserved for video recorder)	2-3	16	5-3/4" × 2-5/8" × ≈7"	Growth space
Blank	2-2	11 and 18	5-3/4" × 9" × ≈4"	Growth space (extended to be inaccessible to pilot)
Blank	2-3	19	6" × 5" × 9-1/4"	Growth space
Stores Control Panel	2-1	26	6" × 5" × 9-1/4"	
Threat Warning Azimuth Indicator	2-1	28	3-1/4" × 3"	
Radar/EO Display	2-1	21		CRT size is 4" × 4"
ILS Control	2-2	17	5-3/4" × 1-1/2" × 8"	To be relocated - ECP0076
VHF Control/Radio	2-2	4	5-3/4" × 4-7/8" × 8"	To be relocated - ECP0076
UHF Control/Radio	2-2	3	5-3/4" × 4-7/8" × 8"	To be relocated - ECP0076
Radar Control	2-2	2		To be relocated - ECP0076
Interior Lights Panel	2-3	4	5-3/4" × 4-3/8"	



1. HUD Combiner Glass
2. Gun Camera
3. Air Refuel Status/NWS Indicator
4. HUD Control Panel
5. Standby Attitude Indicator
6. FUEL FLOW Indicator
7. DUAL FC FAIL Warning Lamp (Red)
8. HYD/OIL PRESS Warning Lamp (Red)
9. CANOPY Warning Lamp (Red)
10. Deleted
11. Vertical Velocity Indicator
12. Engine Oil Pressure Indicator
13. Tachometer
14. Nozzle Position Indicator
15. FTIT Indicator
16. Fuel Quantity Indicator
17. Altimeter
18. Deleted
19. Attitude Director Indicator (ADI)
20. Horizontal Situation Indicator (HSI)
21. Radar/EO Display
22. Deleted
23. Angle of Attack (AOA) Indicator
24. Instrument Mode Select Panel
25. Air Speed/Mach Indicator
26. Stores Control Panel
27. Threat Warning Indicator Control Unit
28. Threat Warning Azimuth Indicator
29. Angle of Attack (AOA) Indexer

Figure 2-1. INSTRUMENT PANEL

234



1. Communications Control Panel
2. Radar Control Panel
3. UHF Radio Control Panel AN/ARC-164
4. VHF Radio Control Panel AN/ARC-115
5. TACAN Control Panel AN/ARN-118
6. Flight Control Manual Trim Panel
7. ECM Pod Control Panel C-7854/ALQ
8. Anti-G Suit Hose Connection
9. Deleted
10. Oxygen Control Panel
11. Oxygen Hose Connection
12. Test Switch Panel
13. Windshield Defog Control Lever
14. Flight Control System Control Panel
15. Fuel System Control Panel
16. Canopy Jettison Control
17. ILS Control Panel AN/ARN-108
18. EPU Control Panel
19. Electrical System Control Panel
20. Throttle Lever Friction Control
21. Engine and Jet Fuel Starter Control Panel
22. Throttle Grip
23. Chaff/Flare Dispenser Button (on left vertical panel)
24. Reduced Idle Thrust
25. Reserved-Video Recorder

Figure 2-2. LEFT CONSOLE

335

1. Engine Anti-Ice Switch
2. Antenna Select Panel
3. Nuclear Consent Switch (Guarded)
4. Interior Lighting Control Panel
5. Pressure Suit Vent Switch
6. Fire Control/Navigation Control Panel (INS)
7. Deleted
8. Deleted
9. Air Conditioning Control Panel
10. Secure Speech Control Panel KY-28/TSEC
11. Growth Space
12. Chaff/Flare Dispenser Control Panel
13. Map and Data Stowage Bin
14. External Lighting Control Panel
15. Side Stick
16. Reserved for JTIDS
17. Oxygen Regulator Control Panel
18. Growth Space
19. Growth Space

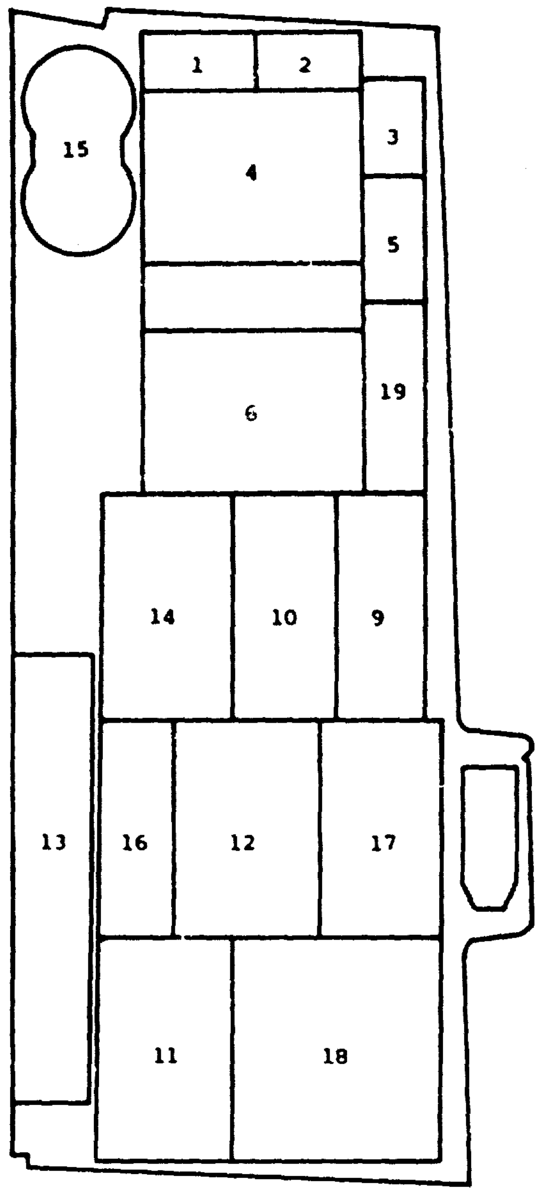


Figure 2-3. RIGHT CONSOLE

336

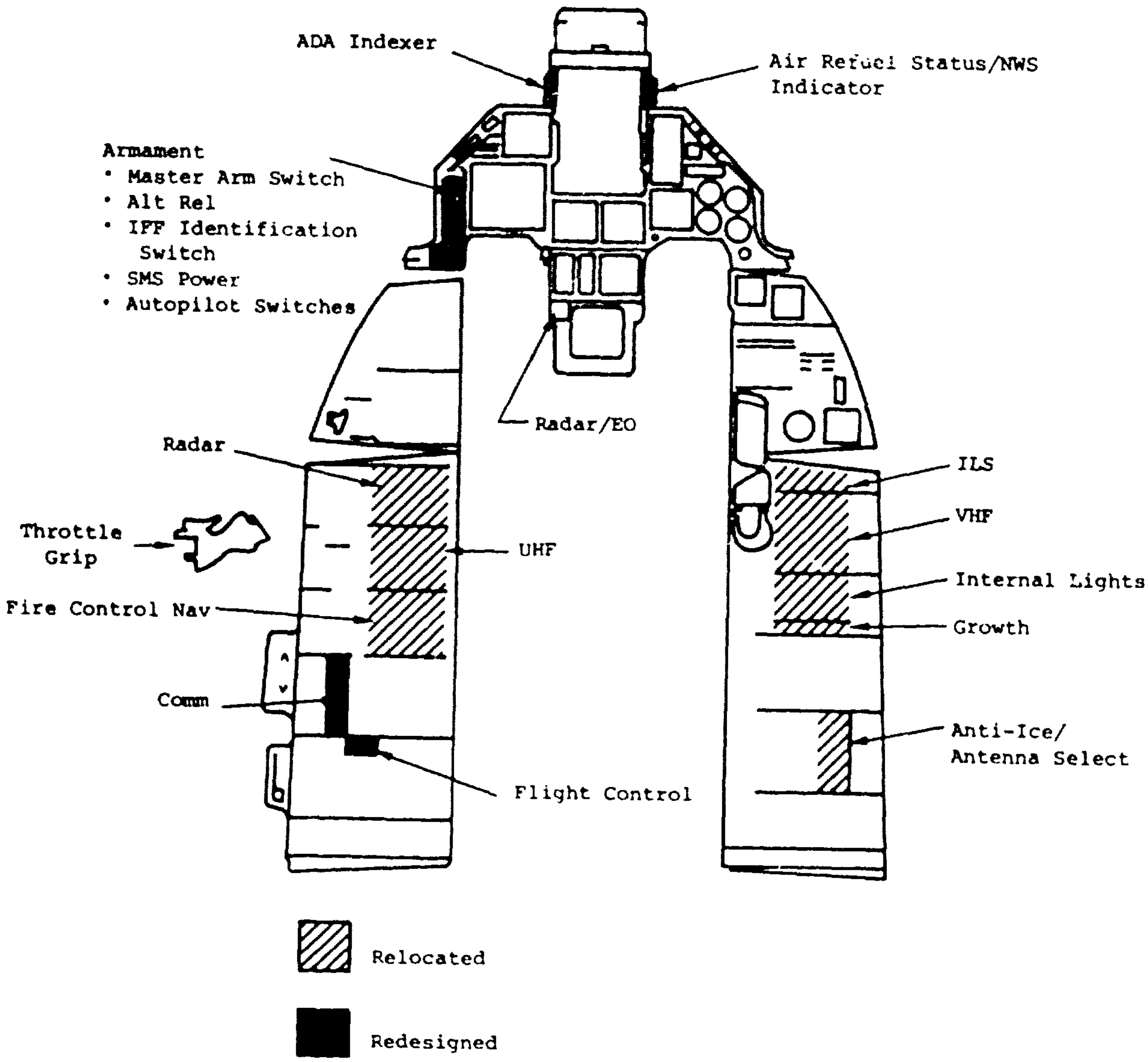


Figure 2-4. ECP0076 F-16A CREW STATION MODIFICATIONS

Best Availab...

337

3. AVIONICS SPACE

There are several areas that could become locations for additional avionics equipment (see Figure 3-1 and Table 3-1). Behind the seat there is an avionics growth space. This space is irregularly shaped. The nominal size is 12 inches H × 24 inches W × 24 inches D. If JTIDS took over TACAN, that space would also be available. There are also two spaces available that have either limited or no access. There is also a radar growth space available. Space A (Figure 3-1) has not been dedicated to any avionics equipment.

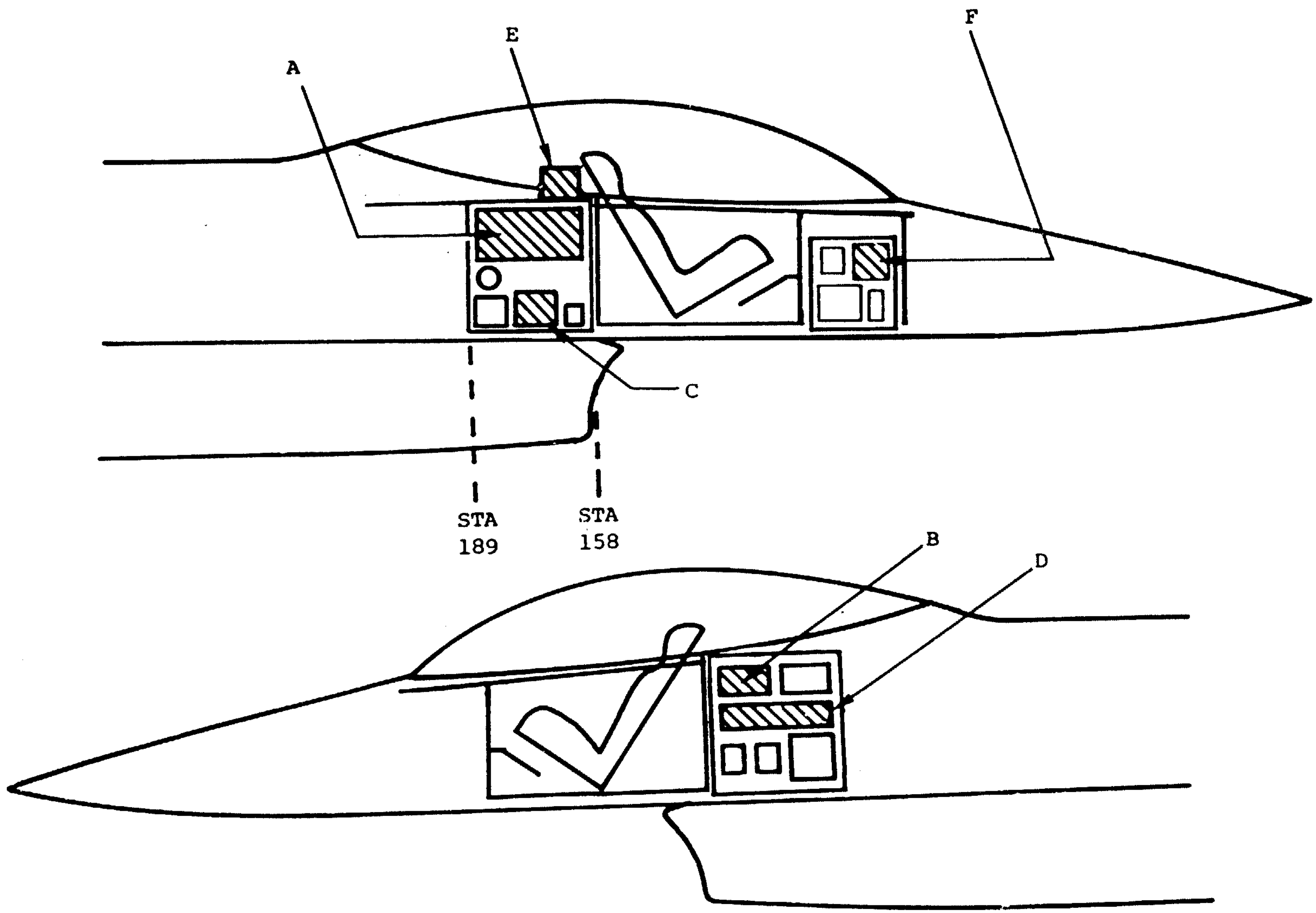


Figure 3-1. F-16A AVAILABLE AVIONICS SPACE

339

Table 3-1. F^2E SUMMARY - F-16A

F^2 E Criteria	Potential Available Space					
Location Reference and Description	A 2404 Bay, RH Door 2404	C 2202 Bay, RH, ARN-118 TACAN Door 2202	B 2404 Bay, LH No Direct Access	D 2404 Bay, LH Door 2101	E Shelf Above and Behind Seat Cockpit	F RH Fwd Bay (Radar) TBD
Rectangular Size (H, W, D – Inches) Volume (Ft^3)	12 × 24 × 24 4 Ft^3	8.9 × 11.7 × 20.5 1.2 Ft^3	10 × 11.2 × 5 0.3 Ft^3	4 × 15 × 9 0.3 Ft^3	6 × 5 × 17 0.3 Ft^3	6 × 9 × 8.2 0.3 Ft^3
Type of Cooling Available	Forced Air Available	Forced Air Available	Forced Air Available	Forced Air Available	Normal Cockpit Cooling	Forced Air Available
Temperature-Altitude Vibration	Class 2, MIL-E-5400 8-15G	Class 2, MIL-E-5400 8-15G	Class 2, MIL-E-5400 15-30G	Class 2, MIL-E-5400 15-30G	Class 1, MIL-E-5400 8-15G	Class 2, MIL-E 5400 8-15G
Possible Candidates for this Space	Not Known	GPS	Not Known	Not Known	Not Known	Radar (Dedicated Growth Space)
Remarks		IF JTIDS Performs TACAN	No Direct Access	Awkward Access	Awkward Form Factor	

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.

340

4. ELECTRICAL POWER SYSTEM

The electrical power system in the F-16A consists of a primary ac power generating system, an emergency ac power generating system, a dc power system, a flight control power supply system, and a power distribution and control system.

Normally, electrical power is supplied by a 40 kVA generator system, supplying 115/200 V 400 Hz to the two ac power panel essential and non-essential buses. The emergency back-up system supplies 5 kVA 115/200 V 400 Hz electrical power. This generator is driven by the emergency power unit accessory gear box. If this system fails, the permanent magnet generator section of the emergency generator will supply dc power to the four flight control power supplies.

A 24 V battery system and two ac-to-dc, 100-amp converters supply 28 Vdc power. The converters take the power from either the main generator or emergency generator and convert it to dc power.

Reported electrical power growth reserve in the F-16A aircraft is as follows:

- 50 kVA ac capability
  - 33.7 kVA load
  - 16.3 kVA growth
- 200 amp 28 Vdc capability
  - 120 amp load
  - 80 amp reserve (nonessential bus limited)

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The F-16A Environmental Control System (ECS) uses a regenerative, bootstrap open-air refrigeration system to provide cooling air to the cabin and to the various avionics and electrical equipments. The ECS uses bleed air from the seventh- and/or thirteenth-stage compressor bleed ports (depending on the available bleed pressures). The bleed air is cooled by the heat exchangers, passed through a water separator, then routed into two lines for cabin and avionics cooling.

5.2 Cabin Cooling

The ECS is designed to maintain a shirt-sleeve cockpit environment while cooling heat loads up to 7,834 BTU/hr or 2.296 kW. The cabin cooling air is discharged through the cabin pressure regulator into the forward equipment bay to aid in equipment cooling. In the forward equipment bay, the cabin air mixes with the discharge air from the forced air cooled equipment. The air mixture then flows aft through the under-floor and aft equipment bays, through the right-hand strake equipment bay, and is discharged overboard.

5.3 Avionics Cooling

The cooling air supplied by the ECS for force-cooled equipment is controlled at a nominal lower limit of 35°F, except during supersonic transients at high altitude when the cooling air temperature may be as low as 0°F. The ECS cooling air is maintained below 80°F at all times. The design cooling airflow is designed to vary with temperature. Minimum airflows of 1.69, 2.25, and 3.95 pounds per minute are required for temperatures of 0°F, 35°F, and 80°F respectively per kilowatt of electrical heat dissipated to the cooling air.

Those equipments which are not designed for forced-air cooling are cooled by convection to the surrounding air.

Table 5-1 illustrates the present ECS loads and anticipated load growth. Table 5-2 illustrates the ECS loads by compartments.

5.4 Cooling System Growth

Forced-air cooling system growth reserve is reported to be available to handle additional heat dissipation beyond current loads. Rated figures are as follows:

Capacity: 6.90 kW

Load: 5.43 kW

Reserve: 1.47 kW (this is forced-air cooling to avionics)

Identified Growth: 1.81 kW (see Tables 5-1 and 5-2)

342

Table 5-1. F-16A ECS LOADS (WATTS) AVIONICS AND ELECTRICAL EQUIPMENT*		
Equipment	Cooling Load	
	Forced-Air Cooled	Self-Cooled to Ambient
Production Equipment		
Fire Control	3,892	332
Navigation	292	244
Penetration Aids	372**	428
Commun-Ident	145**	197
Flight Control	225**	43
SLM and CTG Accel	--	139
Electrical	501	848
Other	7**	269
Total	5,434	2,500
Identified Growth		
CW Illuminator	1,380	--
Data Link	425	--
Video Recorder	--	32
Total	1,805	32
Total Load	7,239	2,532

*Data taken from General Dynamics Report 16 PR226A, 15 November 1976: *F-16A/B Environmental Control System Analysis*, with Table 3.1.2 revision dated 13 January 1978.

**Equipment is self-cooled. Forced-cooled listing results from equipment bay area cooling requirements.

Best Available Copy

343

Table 5-2. F-16A AVIONICS AND ELECTRICAL ECS LOADS (WATTS) BY COMPARTMENT

Compartment	Present Loads		Identified Growth		Total Heat Dissipation	
	Forced-Air Cooled	Self-Cooled to Ambient	Forced-Air Cooled	Self-Cooled to Ambient	Forced-Air Cooled	Self-Cooled to Ambient
Cabin	--	670	--	2	--	672
Radome	--	137	--	--	--	137
Forward Equipment Bay	3,157	16	--	--	3,157	16
Under Floor Bay	1,026	200	--	--	1,026	200
Aft Equipment Bay	436	1,009	1,805	30	2,241	1,039
Right-Hand Strake	240	375	--	--	240	375
Lower Equipment Bay	575*	93	--	--	575	93
Totals	5,434	2,500	1,805	32	7,239**	2,532

*Equipment is self-cooled. Forced-cooled listing results from equipment area cooling requirements.
**System forced-air cooling capacity is 6,900 units.

6. CURRENT AVIONICS

Tables 6-1 through 6-13 contain LRU data relating to the F-16 avionics systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

345

Table 6-1. F-16A AVIONICS CONFIGURATION DATA: UHF RADIO SET LRUS AN/ARC-164 NSN:*

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Receiver Transmitter:	RT-1168	Cockpit Left Console	4.9	5.8	8.6	244.4	9.3	400H 5Vac Panel light	27.5V	110W TX Mode 35W RX Mode	Convection	Console
Main Receiver**	R-1977											
Guard Receiver**	R-1976											
Transmitter**	T-1307											
Antenna Selector	C-4808/ARC	Right Lower Strake										
UHF Blade: Antennas		Co-located with IFF Antennas										
Anti-Ice Antenna Selector Panel		Cockpit										

*ARC-164/V13: 5821-01-008-4600; V14: -4601; V15: -4599; V24: -4603; V3: -4604; V4: -4598
**Included in RT-1168 data.

346

Table 6-2. F-16A AVIONICS CONFIGURATION DATA: VHF RADIO SET LRUS AN/ARC-115 NSN: 5821-00-431-9824

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Radio Set	AN/ARC-115	Cockpit Left Console	4.9	5.25	8.0	205.8	6.5		27.5V	85W TX Mode		Console
Comm.** System Control	C-6533/ARC or C-9533/ARC	Cockpit Left Console										Console
Channel/Frequency** Indicator (Electrical)		Cockpit Right Instrument Panel										Console

*Serial numbers 1-400: 5821-00-160-1710; serial numbers 401 and up: 5821-00-935-5072.
**Or equivalent needed for radio set. F-16A may have integrated communications control incorporating this requirement.
F-16 documentation alludes to separate frequency indicator to be shared by UHF and VHF sets.

Best Available Copy

Table 6-3. F-16 AVIONICS CONFIGURATION DATA: INTERCOMMUNICATIONS SET AN/AIC-18* NSN: 5831-00-116-6503

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Amplifier	AM-1963/AIC	Behind Pilot Seat	3.0	5.7	4.7	80.4	2.6				Convection	
Station Amplifier	C-6624/AIC-25	Ground Surface Compartment Lower Right of Engine Nacelle									Convection	
Warning Tone Generator		Right Console Below Exterior Lights Panel										
Intercommunication Relay Matrix Assembly		Behind Pilot Seat										
Control Panel		Left Forward Console										

*5831-00-116-6503 also

348

Table 6-4. F-16 AVIONICS CONFIGURATION DATA: FLIGHT INSTRUMENTS   NSN: VARIOUS

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Attitude Direction Indicator	Clifton [illegible]50C000-3 NSN: TBD	Cockpit Forward Instrument Panel	3.25	3.25	8.0	84.5	5.0	115V 10VA 5VA 5Vac			Convection	Console
Horizontal Situation Indicator	AQU-13A NSN: 6610-00-417-9220	Cockpit Center Pedestal	3.25	3.25	9.0	95.1	6.0	115V 15VA 5Vac 26Vac	26Vdc		Convection	Console
Magnetic Compass	[illegible]/A NSN: TBD	Cockpit Right Auxiliary Console	2.5	2.375	2.375	14.1	0.875	5Vac				
Self-Contained Attitude Indicator	ARU-42/A-1 NSN: 6610-00-1[illegible]-4773	Cockpit Right Side Forward Instrument Panel	2.4	2.4	7.61	43.8		5Vac	28Vdc 25W 9W		Convection	Console
Angle of Attack Indicator	C-1 3[illegible]-014-001 NSN: TBD	Cockpit Center Pedestal	1.438	3.25	5.375	25.1	1.1	115V 5VA 5V 2VA			Convection	Console
Rate Gyro Transmitter	T[illegible]A/A NSN: 5615-00-10[illegible]-1564	Forward Avionics Bay	2.8	2.875	4.75	38.2	2.5		28Vdc 15W 9W		Convection	Console
Clock	ABU-11/A NSN: [illegible]645-00-07[illegible]-3050	Cockpit Right Console	2.375	2.375	1.89	10.7	1.0	5Vac			Convection	Console

Best Available Copy

349

Table 6-5. F-16 AVIONICS CONFIGURATION DATA: CADC AND OTHERS NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Air Data Computer	Sperry 4025110-902	Forward Avionics Bay	6.94	6.2	12.5	537.9	17.5	115V 65W			Forced Air	Rack
Total Temperature Probe	MS27180-2 NSN: 6685-00-803-7705	Lower Left On Fuselage	N/A	N/A	N/A			115V 350W			N/A	Hard
Pitot Static Probe	Rosemount 855EG	Nose					2.5	115V 1700W			N/A	Hard
Angle of Attack Probe	Teledyne SLZ9695	One On Each Side Of Nose	N/A	N/A	N/A		2.7	26Vac 800Hz 115V 125VA+ 30VA			N/A	Hard
CADC Fail Lamp		Avionics Caution Panel Cockpit Right Console									Convection	Panel
Airspeed Indicator	AVU-8C/A NSN: TBD	Center Instrument Panel	3.25	3.25	6.62	69.9	2.5	5Vac			Convection	Console
Altimeter	AAU-34/A NSN: TBD	Center Instrument Panel	3.25	3.25	7.0	73.9	4.5	115V 25VA 5Vac 28V 2.5VA			Convection	Console
Vertical Velocity Indicator	AAU-18/A NSN: 6610-00-078-5694	Right Instrument Panel	5.25	2.375	2.375	29.6	1.75	5Vac			Convection	Console

350

Table 6-6. F-16A AVIONICS CONFIGURATION DATA: TACAN LRUS AN/ARN-118 NSN: 5826-01-015-0839

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Transceiver Unit	RT-1159/A	Right Strake Equipment Bay	6.8	7.5	14.5	745.5	26.5	115V 150W		100W	Internal Blower	Secured to mount with two captive nut latches
Digital-to-Analog Adapter	MX-9577/A	Right Strake Equipment Bay	6.8	1.7	13.0	159.1	5.0	26V* 40W		10W	Convection	Secured to mount with one captive nut latch
Mount	MT-4682/A	Right Strake Equipment Bay	2.1	11.7	20.5	503.7	7	28V 28VA			Convection	Shock
Control Unit	C-9603/A	Left After Cockpit Console	2.3	5.8	5.5	73.4	2	250VA** 115V 1φ 400H		35W	Convection	Console

*For analog indicators.
**Total system power required.

Best Available Co[py]

351

Table 6-7. F-16A AVIONICS CONFIGURATION DATA: INERTIAL NAVIGATION SYSTEM LRUS NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Inertial Navigation Unit	Singer-Kearfott Part No. K160A030	Forward Avionics Bay	7.6	7.5	15.2	866.4	34.0	300VA* 1φ 115Vac 400H 40VA 1φ 26Vac 400H		**	Forced Air	Quick Removal From INU/Batt Mount
Fire Control/ Navigation Panel	Singer-Kearfott Part No. K330A034	Cockpit Right Console	6.0	[illegible]	7.3	249.7	8.5	15VA 0-5Vac	28Vdc 50W		Convection	Console Mounted
INU Battery	Gulton Ind., Inc Part No. 16342	Forward Avionics Bay	5.0	9.1	15.6	709.8	5.1				Convection	Quick Removal From INU/Batt Mount

*1820 VA start-up, 3 φ 400 H. 1480 VA of this divides between 2 phases for heaters. Value shown is running prime power.
**Refer to cooling airflow requirements curve.

352

Best Availab[illegible]

Table 6-8. F-16 AVIONICS CONFIGURATION DATA: ILS SYSTEM LRUS AN/ARN-108 — NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Receiver	R-1871/ARN-108	Forward Avionics Bay	5.1	3.9	10.1	200.9	7		28V* 45W Max		Convection	
Control Panel	C-9445/ARN-108	Cockpit Left Console	1.5	5.4	4.7	38.1					Convection	Console
Diplexer		Forward Avionics Bay									Convection	
Glide Slope/ Localizer Antenna		Bottom of Nose Radome										Hard
Marker Beacon Antenna		Fuselage forward end of Engine Inlet										
Marker Beacon Lamp		Cockpit Forward Instrument Panel									Convection	
NOT PART OF JLS												
Angle of Attack Indexer	Grimes 65-0922-1	Cockpit Forward Instrument Panel	1.9	0.8	2.5		0.4		28Vdc 140Ms			Console

*Includes power for one beacon lamp. 23W maximum for receiver alone.

353

Table 6-9. F-16A AVIONICS CONFIGURATION DATA: IFF SYSTEM LRUS AN/APX-101 NSN: 5895-01-016-6739

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Transponder	RT-1063B	Left After Equipment Bay	5.8	6.0	10.8	375.8	14.3		28V 63.5W	65W	Convection	Rack
Control Panel	C-6280A(P)	Cockpit Left Forward Console	5.25	5.75	3.1	93.6	3.0	6Vac	0.2A 28V		Convection	Console
Transponder Computer	KIT-1A/TSEC	Left After Equipment Bat	6.522	5.010	8.212	266.5	11.0	1ϕ	400Hz 30W	30W	Convection	Rack (no isolators)
Antenna Selector Switch		Cockpit Right Console										Console
Upper Antenna		Top Fuselage Forward of Vertical Stabilizer										Hard
Lower Antenna		Bottom Fuselage Forward of Front Wheel										Hard

354

Table 6-10. F-16A AVIONICS CONFIGURATION DATA: RADAR SYSTEM (WESTINGHOUSE # 646R483G01) MSN: TBD

Name	Nomenclature (Westinghouse Drawing Numbers)	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power* AC	DC	Heat Dissipation**	Cooling Method	Mounting
Antenna	16VE009001	Nose Radome					61.1	681VA		0.8	Forced Air at 27°C	Hard
Transmitter	16VE009002	Forward Equipment Bay Left	11.8	18.5	10.5	2292.2	69.2	1424VA	29W	3.6	Forced Air at 27°C	Rack
Low Power RF	16VE009003	Forward Equipment Bay Right	11.3	7.0	22.4	1771.8	52.7	603VA	207W	2.5	Forced Air at 27°C	Rack
Digital Signal Processor	16VE009006	Forward Equipment Bay Right	11.3	7.1	23.4	1877.4	63.4	1059VA		4.4	Forced Air at 27°C	Rack
Computer	16VE009004	Forward Equipment Bay Right	11.3	4.0	24.5	1107.4	30.5	348VA		1.2	Forced Air at 27°C	Rack
Radar Control Panel	16VE009005	Left Cockpit Console	3.8	5.8	6.5	143.3	3.8	5VA	12W		Convection	Console
Rack	16VE009007											

*All ac power is 115 v, 3 φ, 400 Hz; all dc power is 28 vdc.
**Heat dissipation is given in terms of pounds/minute of forced air.

Table 6-11. F-16A AVIONICS CONFIGURATION DATA: CRYPTOGRAPHIC EQUIPMENT NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Secure Voice Device	TSEC/KY-58		4.88	5.0	4.2		4.25		28V 7.5W	100 BTU 1 Hr	Convection	
Control Unit	C-7990/ARC		2.6	5.8	2.3			5V	28V		Convection	

Best Available Co[illegible]

356

Table 6-12. F-16A AVIONICS CONFIGURATION DATA: STORES MANAGEMENT SYSTEM LRUS

NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Armament Panel		Left Instrument Panel										
Stores Control Panel		Left Instrument Panel	5.0	6.0	9.3	279	6.5	20W				
Central Interface Unit	G-D Part No. 81755-16E1235-827	Left Forward Avionics Bay	9.0	13.5	12.0	1458	17.9	230W			Forced Air	
Nuclear Consent Switch		Right Cockpit Console	1.5	5.8								
Jettison and Release Remote Interface Units		Under Wings Between Pylons	2.0	3.2	13.25		2.3 4.5	7W			N/A	Hard
Conventional Weapons Interface Units		Under Wings On Appropriate Pylons	2.0	3.2	13.25		2.3 4.5	7W			N/A	Hard
Missle Remote Interface Units		Under Wings On Appropriate Pylons	2.0	3.2	13.25		2.3 4.5	7W			N/A	Hard
Emergency Stores Jettison Switch Panel		Left Forward Cockpit Console										

Table 6-13. F-16A AVIONICS CONFIGURATION DATA: WEAPONS CONTROL SYSTEM LRUS EXCLUDING RADAR AND INS SYSTEMS

MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Fire Control Computer	Delco Magic 362F-2	Right After Equipment Bay	7.8	5.0	20.0	780	24	192W			Forced Air	
Head-Up Display		Top Center Instrument Panel					35	[illegible]	60W		Convection	
Electro/Optical Display		Bottom Center Instrument Panel					10	40W			Convection	
Rao Electronics Unit	Kaiser PN 29500-30	Left Forward Avionics Bay	8.0	7.0	15.0	840	18	125W			Forced Air	
Head-Up Display Electronics Unit		Left Forward Avionics Bay	7.5	7.5	13.0	731.3	23	174W			Forced Air	
Rate Sensor Unit							7.5	35W			Convection	

358

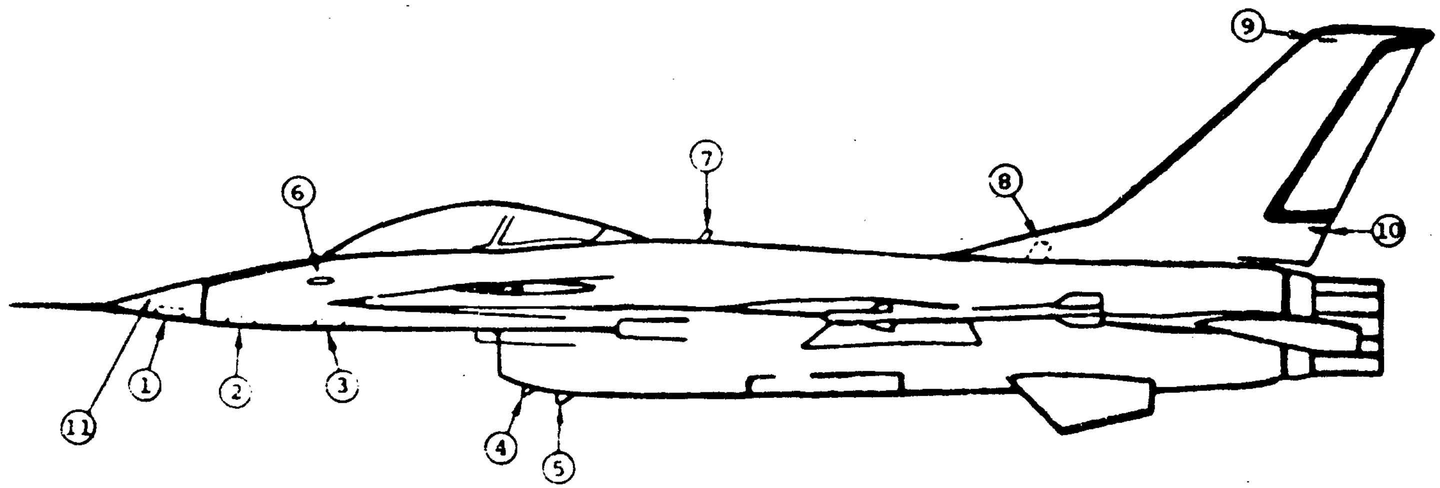
7. ANTENNAS

Figure 7-1 shows the antenna locations for the antennas of the F-16A aircraft.

The antenna functions and nomenclature are as follows:

1.	Glideslope Localizer	Collins No. 608-6929-001 Collins No. 608-6930-001
2.	TACAN (flush)	Transco No. 2282-2
3.	Marker Beacon	Transco No. 16F0-1500-1
4.	TWS	TBD
5.	UHF/IFF	Dorne and Margolin No. CN18-7
6.	TWS	TBD
7.	TACAN	Sensor Systems No. 565-5366-16L
8.	UHF/IFF	Dorne and Margolin No. CN18-7
9.	VHF	GD 16E130-3
10.	TWS	TBD
11.	Radar	Westinghouse, #646R483G01

359



1. Glideslope/Localizer Antenna
2. TACAN Antenna
3. Marker Beacon Antenna
4. Threat Warning Antenna
5. UHF/IFF Antenna
6. Threat Warning Antenna
7. TACAN Antenna
8. UHF/IFF Antenna
9. VHF Antenna
10. Threat Warning Antenna
11. Radar Antenna

Figure 7-1. **F-16A ANTENNA LOCATIONS**

360

8. INTERFACE DATA

This section contains examples of interface signal characteristics and a description of the F-16A-MIL STD 1E53 Multiplex bus requirements. These data were extracted from applicable sections of the Interface Control Document (ICD) for integration of GPS User Equipment in the F-16 aircraft.

Each signal characteristic sheet discusses a particular signal. The top line contains the signal name, type of signal (digital, analog, discrete, or syncronous), signal source and load, and whether the signal is an input or output of the GPS user equipment. A functional description follows, together with a description of the signal's characteristics.

The general requirements of the MIL STD 1553 data bus, as applied in the F-16A, are included in this section beginning on Page 8-9 These requirements are extracted from the Interface Control Document for the F-16 Avionics System, 16PP188(C) dated 27 July 1976.

361

INTERFACE SIGNAL CHARACTERISTIC SHEET

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation	Analog, d.c.	C	UE	IMSC

Functional Description

This signal provides a variable d.c. signal that indicates the displacement of the aircraft to the left or right of an approach course. The displacement represented by the indicating device will be controlled by UE software.

Signal Characteristics

Range: Typically $\pm$ 2.5° full scale angular deflection for localizer. For area navigation systems, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended a range of 600 to 3000 feet full scale* deflection for approach flight modes.
Index Reference: Desired approach course
Positive Direction Sense: Fly right (+ right)

Electrical Characteristics

Load: d.c. meter movement (two in parallel)
Impedance: 1000 + 30 ohms (one instrument)
Current: 2.5 ma for full scale deflection
Scale Factor: 2.2 ma for 0.875 inch deflection
Resolution: 106 μa (one bar width)
Accuracy: $\pm$ 7.5 percent

Interconnection Data

Wire Type: Two conductor, twisted
Wire Size: No. 22 AWG

Figure I-1b. F-16A Horizontal Deviation Interface Signal Characteristics

*Reference ARINC Characteristic 582-2

A		ICD-GPS-012
		35

362

INTERFACE SIGNAL CHARACTERISTIC SHEET

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation Flag	Discrete	0	UE	IMSC

Functional Description

Provides a discrete signal to operate the horizontal deviation warning flag or circuit when the deviation data is unreliable or a malfunction has occurred in the course deviation circuitry.

Signal Characteristics

Deviation signal valid or invalid

Electrical Characteristics

Load: d.c. meter movement (two in parallel)
Impedance: 1000 ± 30 ohms (one instrument)
Input Voltage: 245 to 500 mv = signal valid
<180 mv = signal invalid

Interconnection Data

Wire Type: Two conductor, twisted
Wire Size: No. 26 AWG

Figure I-1c. F-16A Horizontal Deviation Flag Interface Signal Characteristics

A ICD-GPS-012 36

INTERFACE SIGNAL CHARACTERISTIC SHEET

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation	Analog, d.c.	O	UE	IMSC

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft above or below a desired flight path. The displacement represented by the indicating device will be controlled by UE software. Deflection of the indicating device may represent angular displacement or distance.

Signal Characteristics

Range: Typically $\pm$ 0.5° full scale angular deflection for glideslope operation. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended a range of 40 to 100 feet full scale for approach flight modes.*

Electrical Characteristics

Load: d.c. meter movement (two in parallel)
Impedance: 1000 $\pm$ 30 ohms (one instrument)
Current: 2.5 ma for full scale deflection
Scale Factor: 2.2 ma for 0.875 inch deflection
Resolution: 106 ua (one bar width)
Accuracy: $\pm$ 7.5 percent

Interconnection Data

Wire Type: Two conductor, twisted
Wire Size: No. 26 AWG

Figure I-1d. F-16A Vertical Deviation Interface Signal Characteristics

*Reference ARINC Characteristic 582-2

A ICD-GPS-012 37

364

INTERFACE SIGNAL CHARACTERISTIC SHEET

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation Flag	Discrete	O	UE	INSC

Functional Description

Provides a discrete signal to operate the vertical deviation warning flag or circuit when the deviation data is unreliable or a malfunction has occurred in the vertical deviation circuitry.

Signal Characteristics

Deviation signal valid or invalid

Electrical Characteristics

Load: d. c. meter movement (two in parallel)
Impedance: 1000 $\pm$ 30 ohms
Input Voltage: 245 to 500 mv = signal valid
<180 mv = signal invalid

Interconnection Data

Wire Type: Two conductor, twisted
Wire Size: No. 26 AWG

Figure I-1e. F-16A Vertical Deviation Flag Interface Signal Characteristics

A | ICD-GPS-012 | SHEET 38

365

Attachment to Appendix IV
Reproduced from
Interface Control Document
For
The F-16 Avionics System
16PP188(C)
27 July 1976

3. REQUIREMENTS

3.1 General Requirements. The detailed interface requirements for the F-16 Avionic System shall be as specified in this document.

3.2 Electrical Interface

3.2.1 General. The signal interface for each subsystem is documented in the subsection covering tie-ins for the individual subsystem. Electrical signal specifications are included for signals routed "to", "from", and/or "within" the subsystem. The electrical signal specification number is assigned by using the convention outlined in Figure 1. This specification number is used as the "tie-in" sheet number.

Schematic diagrams, signal flow diagrams, and sketches of physical hook-ups are provided as supplementary sheets where required for clarification of interface requirements.

3.2.2 Signal Interface Definition

3.2.2.1 Signal Types. This paragraph contains a definition of the basic types of electrical signal interfaces and terms which describe signal characteristics. Signal types include:

1. Power Excitation and Reference - All 115 vac, 400 hertz, and 28 vdc power excitation and reference signals.

2. Analog - Synchro, AC, and DC analog signals.

3. Discrete - All two-state signals which are transmitted or received over one wire and a return. The return may be common to several discretes. It is also used for complementary two-state which are transmitted or received over two wires and a common return.

4. Serial Digital - All signals transmitted or received on the multiplex data bus in standard binary digital format; it includes status and control signals.

5. Video - All video and high frequency signals when coaxial or waveguide transmission lines are employed.

366

ELECTRICAL SIGNAL SPECIFICATION
IDENTIFICATION NUMBER

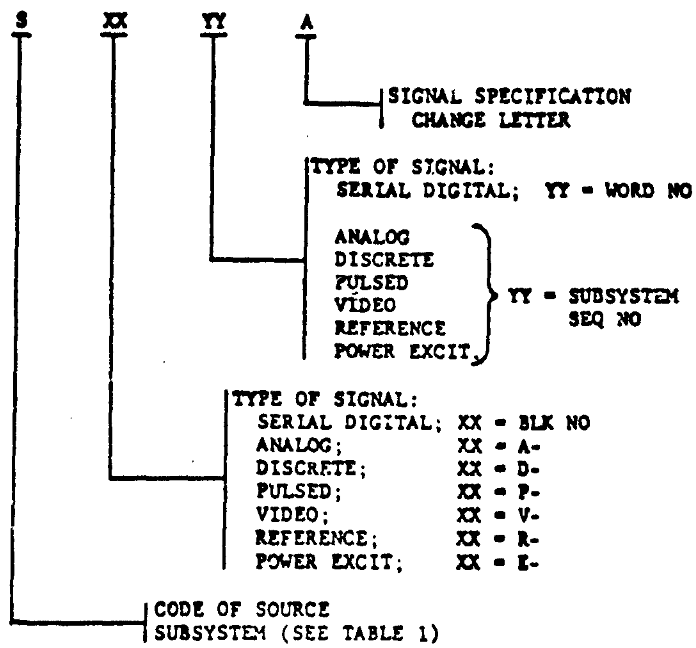


Figure 1 BREAKDOWN OF SIGNAL SPECIFICATION NUMBER

3.2.2.2 Signal Interface Specification Description Format. The format to be used for each of the above signal types and a definition of interface terms are presented in this paragraph.

3.2.2.2.1 Definition of Interface Terms. The interface terms are defined as follows.

ACCURACY - (ANALOG) - Unless otherwise specified, the accuracy shall be defined as the overall RMS error, in units of physical data, in the tie-in signals at the input of the receiving element. This accuracy does not include the error contributed by the receiving element, but it does include the loading effect of the receiver. Accuracy values are included under remarks section for reference only.

ACCURACY - (SERIAL DIGITAL) - Number of significant bits required to represent the value of the quantity, i.e., minimum number of bits needed to prevent degradation.

BANDWIDTH - The electrical bandwidth of the signal.

BINARY STATES - The True (T) state, logical "1" with voltage tolerances and the False (F) state, logical "0" with voltage tolerances.

BIT NUMBERS - Definition of the parameters of the data bits of a specified serial digital address.

BIT RATE - The rate at which bits are generated at the source (bits/second).

BLANKING INTERVAL - (VIDEO) - The interval during which blanking occurs.

CABLE TYPE - Type of interconnecting cable (i.e., wire size, twisted pair, twisted shielded triplet, coaxial, etc.)

COMPUTATION RATE (SERIAL DIGITAL) - The rate at which data is updated at the source.

DATE - Date of the last signal revision in the format: day, month, year.

DC REFERENCE LEVEL - (VIDEO) - Reference level of the video signal, at output of transmitting LRU.

DESTINATION - Set or interim distribution point which receives the tie-in signal.

DISTRIBUTION - Listings of all destinations receiving the tie-in signal.

ELECTRICAL SIGNAL SPECIFICATION - The specification number for a particular signal shall be of the form SXXYYA as shown in Figure 1. Each signal, from origin to destination, will have a distinct specification number.

ISOLATION - Type of isolation required at the destination load.

LSB VALUE - The value assigned to the least significant bit of the parameter data.

MAXIMUM LOAD CURRENT - The maximum signal current allowed in a receiver load.

MAXIMUM NOISE LEVEL - The maximum electrical noise level that can be tolerated on the circuit without degradation.

MAXIMUM POWER - The maximum source signal power available from the transmitting element.

MAXIMUM PRF - The maximum pulse repetition frequence of the element from which the RF energy is originally transmitted.

MAXIMUM SOURCE CURRENT - The maximum current the source must be capable of providing.

MAXIMUM VOLTAGE - The maximum signal voltage encountered on a particular conductor (maximum steady-state voltage allowed by MIL-STD-704A at -65°).

MAXIMUM VSWR - The maximum ratio occurring between the standing wave maximum voltage and the standing wave minimum voltage measured along a particular RF conductor.

MINIMUM VOLTAGE - The minimum steady-state source signal voltage encountered on a particular conductor.

369

MSB VALUE - The value assigned to the most significant bit of the parameter data.

NO. OF BITS - Number of bits utilized for a particular parameter or the number of complementary bits required to transfer the specified data the tie-in represents.

NOMINAL VOLTAGE - (POWER EXCITATION AND REFERENCE) - Value of voltage with tolerances. This value is specified at the output of the transmitting equipment.

OFFSET VALUE - Value of a constant that is added to actual engineering data to represent the data.

PHASE - (POWER AND REFERENCE) - This term is used to identify phase for AC signals.

PHASE SHIFT - (ANALOG) - The nominal phase angle between the reference voltage and the voltage in question. Phase shift is referenced to the A/C bus Phase A. If the tie-in voltage leads the referenced voltage, the phase shift is defined as positive.

PHASING - (ANALOG) - Phase relationship between the analog signal and the physical data (i.e., +A$\emptyset$ for east values, CCW rotation for increasing north latitudes, etc.). The red wire (R_1) on all synchro control transmitters will be excited by A/C bus Phase A. Synchros shall be zeroed and installed in accordance with ARINC unless otherwise noted.

PIN NUMBER - The identifying character(s) for the termination contact.

RATE - (DISCRETE)(PULSES) - The maximum number of pulses occurring in one second.

(STEADY-STATE) - Maximum rate of change of the tie-in signal in terms of units of physical data per unit time at which the tie-in signal will maintain full accuracy (maximum rate at which the discrete can change state).

RECEIVER LOAD - The impedance characteristics of the tie-in signal termination at 25°C.

REMARKS - Additional information, specification, etc. not covered by the format.

370

REPETITION PERIOD - (VIDEO) - Time required for a repetitive cycle in the various fields of view.

RESOLUTION - The minimum increment by which a parameter changes.

SCALE FACTOR - (ANALOG) - The nominal ratio of the incremental change in analog signal to the incremental change in physical data (i.e., - volts/knot, - volts/foot, - volts/degree, etc.). In general, the absolute scale factor will change with changes in primary input voltage, but the ratios will remain constant. Scale Factor is not applicable to switching signals.

SCALE FACTOR - (DIGITAL) - The number of places and direction that the binary point is shifted in converting a binary quantity to its fractional representation in the interface data word (left shift positive, right shift negative).

SENSITIVITY - (SYNCHRO) - Applicable only to control type synchro tie-ins. The nominal voltage gradient as measured at the rotor of the reference synchro under total configuration as per synchro chain drawings (defined as the voltage at maximum coupling times the sine of one degree). Unless otherwise specified on a particular interface sheet, the tolerance on the sensitivity resulting from the transmitting element is +5 percent. An additional tolerance of +5 percent can result from MIL-STD-704A line voltage variation.

SENSITIVITY - (ANALOG) - The minimum increment by which a parameter changes.

SHIELD - The subcontractor shall define the termination of the shield (i.e., Ground, Float, Connector pin number for carry through).

SIGNAL INTERVAL - (VIDEO) - The time interval during which video is present.

SIGNAL LABEL - The unique signal label which is utilized as an abbreviation to represent the signal name.

SIGNAL NAME - Name of the electrical signal.

SIGNAL RANGE - The upper and lower set of values which physical data may assume.

371

SIGNAL TYPE - The distinct type of signal being generated.

SOURCE - The subsystem from which a particular signal originates.

SOURCE CODE - A single alphanumeric character used in the signal specification to designate the source (see Table 1).

SOURCE IMPEDANCE - Output impedance of the transmitting element.

SUBADDRESS - Identification of block of word(s) to be transmitted/received over the data bus.

TRANSMISSION RATE - The rate at which a parameter shall be transmitted from the origin to the destination.

UNITS - Parameter measure, e.g., ft/second, semicircles, degrees.

VOLTAGE RANGE - The variation in voltage required in representing the physical range of the signal.

3.2.3 Avionic serial digital interface description. Digital communication between avionic subsystems shall be in a bit serial, word serial format, over time division multiplexed serial data buses. All serial digital communication between avionic subsystems shall conform to the detail requirements delineated in this section. These requirements were generated utilizing MIL-STD-1553 dated 30 August 1973 for reference.

3.2.3.1 Serial digital functional interface. The serial digital data bus shall function asynchronously in a command/response mode, and transmission shall occur in a half-duplex manner. Sole control of information transmission shall reside with the bus controller, which shall initiate all transmissions. The information flow on the data bus shall be comprised of messages which are, in turn, formed by three types of words (command, data and status) as defined in 3.2.3.3.7. All elements of the avionic subsystem interfaces shall conform to the electromagnetic interference and electromagnetic compatibility requirements specified in paragraph 3.2.7.

372

SUBSYSTEMS ABBREVIATION AND CODE

CODE	ABBREV	SUBSYSTEM	CODE	ABBREV	SUBSYSTEM
F	FCC	FIRE CONTROL COMPUTER	A	API	AUTO PILOT
R	FCR	FIRE CONTROL RADAR	B	ILS	INSTRUMENT LANDING SYSTEM
H	HUD	HEAD UP DISPLAY	D	KBC	KB-26 CAMERA
S	SMS	STORES MANAGEMENT SUBSYSTEM	G	LGP	LANDING GEAR CONTROL
Z	REO	RADAR/EO DISPLAY SET	J	LCP	LIGHTING CONTROL PANEL
I	INU	INERTIAL NAVIGATION UNIT	O	VDR	VIDEO RECORDER
P	FCN	FIRE CONTROL/NAVIGATION PANEL	T	ISC	INSTRUMENT MODE SELECT COUPLER
C	ADC	CENTRAL AIR DATA COMPUTER			
E	TSL	TARGET IDENTIFICATION SET, LASER	U	FQC	FUEL QUANTITY CONTROL UNIT
M	THR	THROTTLE GRIP	N	ICS	INTERCOM SYSTEM
5	FTC	SIDE STICK CONTROLLER	L	PPL	POWER PANEL
Ø	ADI	ATTITUDE DIRECTOR INDICATOR	X	HSI	HORIZONTAL SITUTATION INDICATOR
1	BLK	BLANKER			
2	CPL	CAUTION PANEL			
8	CWL	CREW STATION WARNING LIGHTS			
3	ECS	ENVIRONMENTAL CONTROL SYSTEM	K	GSR	GROUND SENSING RELAY
4	EOS	EO SENSOR			
7	FFT	FUEL FLOW TRANSMITTER			

Table 1 SUBSYSTEMS ABBREVIATION AND CODE

3.2.3.2 Communication modes. The serial digital data bus shall employ three modes of information transfer: (1) bus controller to avionic subsystem transfer, (2) avionic subsystem to bus controller transfer, and (3) avionic subsystem to avionic subsystem transfer. Two special functional command modes shall also be employed: (1) dedicated function commands transmitted to individual avionic subsystems and (2) broadcast function commands issued to all subsystems simultaneously. These modes shall operate as described in paragraph 3.2.3.3.8.

3.2.3.3 Data transmission characteristics

3.2.3.3.1 Data form. Digital data shall be transmitted in a form compatible with the message and word formats defined herein. A 2's complement representation of negative numbers shall be assumed for the transmission of numerical data unless otherwise specified. Any unused bit positions in a word shall be transmitted as logic zero.

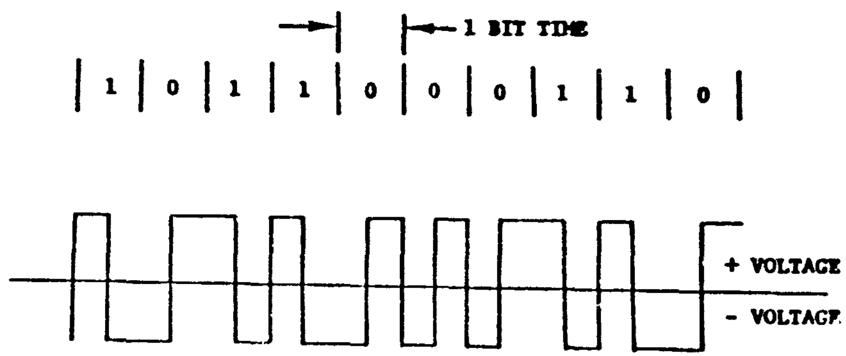
3.2.3.3.2 Bit priority. The most significant bit shall be transmitted first with less significant bits following in descending order of value. The number of bits required to define a quantity shall be consistent with the resolution or accuracy required. In the event double precision quantities (information accuracy or resolution requiring more than 16 bits) are transmitted, the most significant half shall be transmitted first, followed by the least significant half.

3.2.3.3.3 Modulation. The signals shall be transferred over the data bus in serial digital pulse code modulation form.

3.2.3.3.4 Data code. The data code shall be Manchester biphase level as defined in MIL-STD-442B. A logic "one" shall be transmitted as a bipolar coded signal 1/0 (i.e., a positive pulse followed by a negative pulse). A logic "zero" shall be bipolar coded signal 0/1 (i.e., a negative pulse followed by a positive pulse). A transition through zero occurs at the midpoint of each bit time (see Figure 3).

3.2.3.3.5 Data rate. The data transmission rate on the bus shall be 1.0 megabit per second with a long term stability of ±0.01 percent (i.e., ±100 Hz). The short term stability (i.e., stability over a 1.0 second interval) shall be at least 0.001 percent (i.e., ±10 Hz).

374



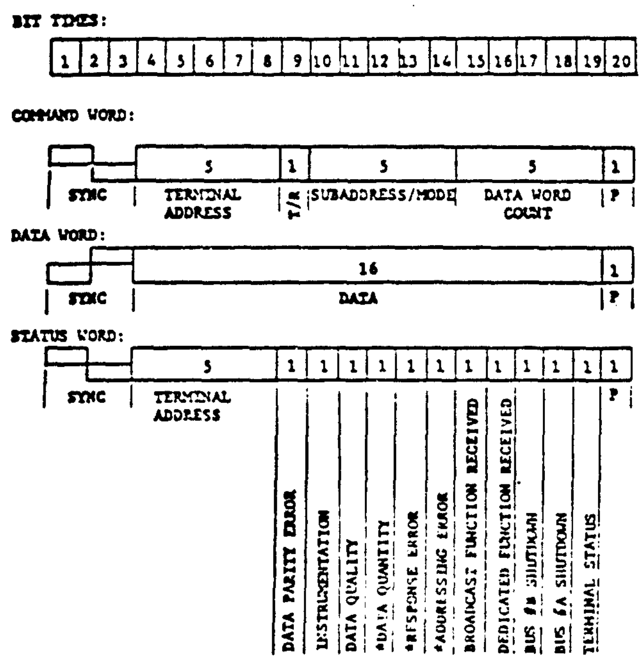
NOTES: MANCHESTER II BI-PHASE LEVEL
"1" REPRESENTED BY PLUS/MINUS
"0" REPRESENTED BY MINUS/PLUS

Figure 3 DATA CODE

3.2.3.3.6 Word size. The word size shall be 16 bits plus the sync waveform and the parity bit.

3.2.3.3.7 Word formats. The word formats shall be as shown in Figure 4 for the command, data, and status words.

3.2.3.3.7.1 Command word. A command word shall be comprised of a sync waveform, subsystem address, transmit/receive bit, subaddress/mode, data word count, and a parity bit (see Figure 4).



*Used only by FCC for internal status information.

Figur 4. WORD FORMATS

376

3.2.3.3.7.1.1 Sync. The command sync waveform shall be an invalid Manchester waveform as shown on Figure 5. The width shall be three bit times, with the waveform being positive for the first one and one-half bit times, and then negative for the following one and one-half bit times. If the next bit following the sync is a logic zero, then the last half of the sync waveform will have an apparent width of two clock periods due to the Manchester encoding.

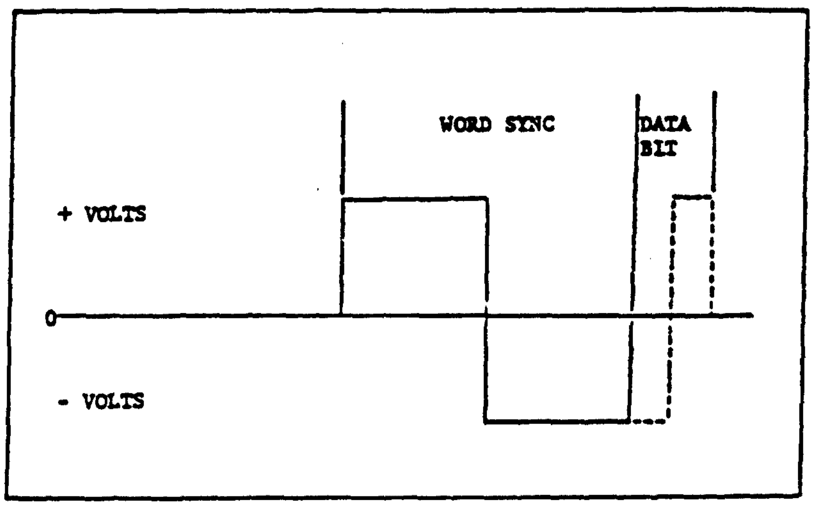


Figure 5 COMMAND AND STATUS SYNC

377

3.2.3.3.7.1.2 Address. The next five bits following the sync shall be the subsystem address. The most significant bit of the address shall be transmitted first.

3.2.3.3.7.1.2.1 Unique addresses. The unique address assigned to each subsystem shall be as defined in Table 2. In order to permit the use of multiple subsystems of a given type on a single bus in expanded system configurations, each subsystem shall be capable of decoding a minimum of two addresses. Selection of the specific address shall be determined by the presence or absence of continuity between pins on the subsystem input-output connector. The presence or absence of continuity shall be established in the airplane wiring.

3.2.3.3.7.1.2.2 Universal address. In addition to its unique address, each subsystem shall decode and respond to decimal address 31 (all 1's) as described in paragraph 3.2.3.3.8.5. This address is used only for broadcast function commands. Separate decoding of the transmit/receive bit and the subaddress field of the command word is not required when the command word terminal address field contains all ones.

3.2.3.3.7.1.3 Transmit/receive. The next bit following the address shall be the transmit/receive bit, which shall indicate the action required of the subsystem. A logic zero shall indicate receive, and a logic one shall indicate transmit. The transmit/receive bit shall be set to a logic one in broadcast and dedicated function command words.

3.2.3.3.7.1.4 Subaddress/mode. The next five bits following the transmit/receive bit shall be utilized for either subsystem subaddresses or to indicate function commands.

3.2.3.3.7.1.4.1 Subaddresses. Any value in the subaddress/mode field other than all ones shall be interpreted by a subsystem as the subaddress of a block of words to be received or transmitted by the subsystem. Subaddress assignments shall be indicated in Table 3.

3.2.3.3.7.1.4.2 Mode. A value of all ones in the subaddress/mode field shall indicate that the command word is a function command and that data is not to be transmitted or received.

3.2.3.3.7.1.5 Word count. The next five bits following the subaddress/mode field shall be used to indicate either the quantity of data words to be sent or received by the subsystem or the particular function command to be executed.

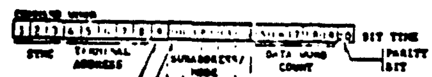
378

Table 2 AVIONIC SUBSYSTEM TERMINAL ADDRESSES

Subsystem	Bit Time	Terminal Address 4	5	6	7	8
FCC		0	0	0	X	X
FCR		1	0	1	0	X
HUD		0	1	1	0	X
SMS		1	1	0	0	X
REO		1	0	0	0	X
INU		0	0	1	0	X
FCNP		0	1	0	0	X
CADC		1	1	1	0	X
TISL		1	0	0	1	X

NOTE: The "X's" shown in the five bit binary address field indicate connector programmable bits (reference paragraph 3.2.3.3.7.1.2.1). In the baseline system the bits shown as "X's" will all be set to logic "zero's." (All five bits of the terminal address field may be connector programmable.)

TABLE 3. COMMAND WORD SUBADDRESS CODE



TRANSMIT/RECEIVE
"1" = TRANSMIT
"0" = RECEIVE

ALWAYS "1" FOR INSTRUMENTED AIRCRAFT (Used by Instrumentation/Data Processor to indicate WORD is: "1" = COMMAND and "0" = STATUS)

T/R		SUBADDRESS/MODE	WORD	SUBSYSTEM
0	1	0 0 0 0 0	F03	FIRE CONTROL RADAR
0	1	0 0 0 1 1	I03	
0	1	0 0 1 1 0	S04	
0	1	0 0 1 1 1	Z01	
1	1	0 0 0 0 0	R01	
1	1	0 0 0 0 1	R02	
1	1	0 0 0 0 0	R03	
1	1	0 0 0 1 0	R04	
1	1	0 0 1 1 1	SPARE	
0	1	1 1 0 1 1	C02	HEAD UP DISPLAY
0	1	1 1 1 1 0	F08	
0	1	1 1 0 0 0	F09	
0	1	1 0 0 1 1	F10	
0	1	1 0 1 1 0	I04	
0	1	1 0 1 1 1	R03	
0	1	1 1 1 0 0	S02	
1	1	0 0 0 1 1	H01	
0	1	0 0 0 0 0	F07	STORES MANAGEMENT SUBSYSTEM
0	1	1 0 0 1 1	R02	
1	1	0 0 0 0 0	S01	
1	1	0 0 0 0 0	S02	
1	1	0 0 0 0 0	F03	
1	1	0 0 0 0 0	S04	
0	1	0 1 0 1 1	F05	RADAR/ED DISPLAY SET
0	1	0 1 1 1 0	F11	
0	1	0 1 1 1 1	F13	
0	1	0 1 0 0 0	R04	
0	1	0 0 1 1 1	S03	
1	1	0 0 0 1 1	Z01	
1	1	0 0 1 1 0	Z02	
0	1	0 0 1 1 1	C03	INERTIAL NAVIGATION UNIT
0	1	0 1 0 0 0	F01	
0	1	0 0 0 0 1	F02	
0	1	0 1 1 1 0	F12	
0	1	0 1 0 1 1	F16	
0	1	0 0 1 1 0	F17	
0	1	0 1 1 0 0	R02	
1	1	0 0 0 1 0	I01	
1	1	0 0 0 1 1	I02	
1	1	0 0 0 0 1	I03	
1	1	0 0 0 0 0	I04	
1	1	0 0 0 0 0	I05	
0	1	0 0 0 0 0	F04	FIRE CONTROL/NAVIGATION PANEL
0	1	0 0 0 0 0	I03	
1	1	0 0 0 0 0	F01	
1	1	0 0 0 0 0	F02	
1	1	0 0 0 0 0	C01	CENTRAL AIR DATA COMPUTER
1	1	0 0 0 0 0	C02	
1	1	0 0 0 0 0	C03	
0	1	0 0 0 0 0	F14	TARGET IDENTIFICATION SET, LASER
1	1	0 0 0 0 0	Z01	

380

If the subaddress/mode field contains all logic ones, the word count field shall be decoded by the subsystem to determine the function command to be executed. If the subaddress/mode field contains any value other than all ones, the word count field shall be decoded to indicate the quantity of words to be transmitted or received.

3.2.3.3.7.1.5.1 Data transfer. A maximum of 32 data words may be transmitted or received in any one message block. All ones shall indicate a decimal count of 31, and all zeros shall indicate a decimal count of 32.

3.2.3.3.7.1.5.2 Function modes. The word count field shall contain a bit pattern that identifies the function or functions to be performed if the subaddress/mode field contains all logic ones. Word count field bit patterns common to all subsystems shall be as shown in Table 4. If a subsystem receives a function command with the word count field all zeros or with a bit pattern in the word count field which that subsystem is not mechanized to execute, the subsystem shall reset/initialize its receiver logic and respond with its status word in accordance with the requirements of paragraphs 3.2.3.3.7.3, 3.2.3.3.8.4, and 3.2.3.3.8.5.

Table 4 FUNCTION WORD COMMANDS COMMON TO ALL SUBSYSTEMS

Word Count Field						Command Interpretation
Bit Time	15	16	17	18	19	
	0	0	0	0	1	Reset Timer

3.2.3.3.7.1.6 Parity. The last bit in the word shall be used for parity over the preceding 16 bits. Odd parity shall be utilized.

3.2.3.3.7.2 Data word. A data word shall be comprised of a sync waveform, data bits, and a parity bit (see Figure 4).

3.2.3.3.7.2.1 Sync. The data sync waveform shall be an invalid Manchester waveform as shown on Figure 6. The width shall be three bit times, with the waveform being negative for the first one and one-half bit times, and then positive for the following one and one-half bit times. Note that if the bits preceding and following the sync are logic ones, then the apparent width of the sync waveform will be increased to four bit times.

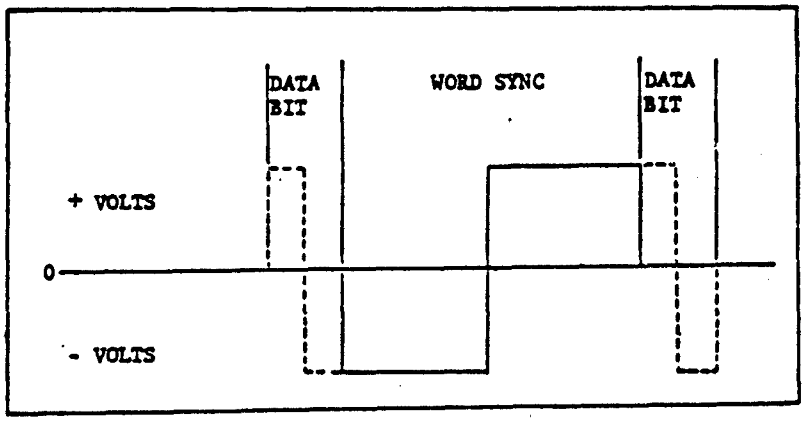


Figure 6 DATA SYNC (INVALID MANCHESTER WAVEFORM)

3.2.3.3.7.2.2 Data. The 16 bits following the sync shall be utilized for data transmission as specified in 3.2.3.3.2.

3.2.3.3.7.2.3 Parity. The last bit shall be utilized for parity as specified in 3.2.3.3.7.1.6.

3.2.3.3.7.3 Status word. A status word shall be comprised of a sync waveform, subsystem address, failure/status bits, and a parity bit (see Figure 4). Subsystems shall reset to zero all status word failure/status bits following each status word transmittal.

3.2.3.3.7.3.1 Sync. The status sync waveform shall be as specified in 3.2.3.3.7.1.1.

3.2.3.3.7.3.2 Subsystem address. The next five bits following the sync shall contain the address of the subsystem which is transmitting the status word.

382

3.2.3.3.7.3.3 Parity error. The first bit after the address, bit 9, shall be utilized to indicate a parity error in one or more words of a preceding message. A logic one shall indicate the presence of a data word parity error; a logic zero shall indicate its absence. This bit shall be reset to its logic zero state upon receipt of a valid command word.

3.2.3.3.7.3.4 Instrumentation bit. Bit 10, the first bit after the parity error bit, shall always be set to a logic zero.

3.2.3.3.7.3.5 Data quality bit. Bit 11 shall be used to indicate the occurrence of a data word validation error or errors in a preceding message. A logic one shall indicate a data validation error as described in paragraph 3.2.3.3.10.5. A logic zero shall indicate the absence of any of these fault conditions in the previously received data block. This bit shall be reset to its logic zero state upon receipt of a valid command word.

3.2.3.3.7.3.6 Data quantity bit. Bit 12 shall not be used by any subsystem acting as a remote terminal. The bit shall be transmitted over the bus as a logic zero. The bit shall be used for internal status information by the Fire Control Computer when the FCC is acting as a bus controller. A logic one shall indicate an improper data word quantity in a data transmission from a remote terminal. A logic zero shall indicate proper data quantity.

3.2.3.3.7.3.7 Response bit. Bit 13 shall not be used by any subsystem acting as a remote terminal. The bit shall be transmitted over the bus as a logic zero. The bit shall be used for internal status information by the Fire Control Computer when the FCC is acting as a bus controller. A logic one shall indicate that a remote terminal did not respond to a command in the proper time allowed. A logic zero shall indicate that a remote terminal response was received.

3.2.3.3.7.3.8 Addressing bit. Bit 14 shall not be used by any subsystem acting as a remote terminal. The bit shall be transmitted over the bus as a logic zero. The bit shall be used for internal status information by the Fire Control Computer when the FCC is acting as a bus controller. A logic one shall indicate that the terminal address received in a status word did not match with the associated terminal address in a command word. A logic zero shall indicate that no addressing error condition occurred.

3.2.3.3.7.3.9 Broadcast function command received bit. Bit 15 shall be used to indicate the receipt of a broadcast function command. A logic one shall indicate the receipt of a broadcast function command. A logic zero shall indicate that no broadcast function command has been received since the previous status word transmittal.

3.2.3.3.7.3.10 Dedicated function command received bit. Bit 16 shall be used to indicate the receipt of a dedicated function command. A logic one shall indicate the receipt of a dedicated function command. A logic zero shall indicate that no dedicated function commands have been received since the previous status word transmittal.

3.2.3.3.7.3.11 Bus B shutdown bit. Bit 17 shall be used to indicate that a transmission on bus B was terminated due to (1) receipt of a valid command word on bus A during a transmission on bus B or (2) detection of an abnormal transmission as described in paragraph 3.2.3.3.11.2. A logic one shall indicate a transmission termination. A logic zero shall indicate that no transmission termination has occurred since the previous status word transmittal.

3.2.3.3.7.3.12 Bus A shutdown bit. Bit 18 shall be used to indicate that a transmission on bus A was terminated due to (1) receipt of a valid command word on bus B during a transmission on bus A or (2) detection of an abnormal transmission as described in paragraph 3.2.3.3.11.2. A logic one shall indicate a transmission termination. A logic zero shall indicate that no transmission termination has occurred since the previous status word transmittal.

3.2.3.3.7.3.13 Terminal status bit. Bit 19 shall be used to indicate the existence of subsystem fault conditions which might affect the validity of data from that subsystem.

3.2.3.3.7.3.14 Parity. The last bit shall be utilized for parity as specified in 3.2.3.3.7.1.6.

3.2.3.3.8 Message formats. The messages transmitted on the data bus shall be in accordance with the formats shown in Figure 7. The maximum and minimum response times shall be as stated in 3.2.3.3.11.1.

3.2.3.3.8.1 Controller to subsystem transfers. The controller shall issue a receive command followed by the

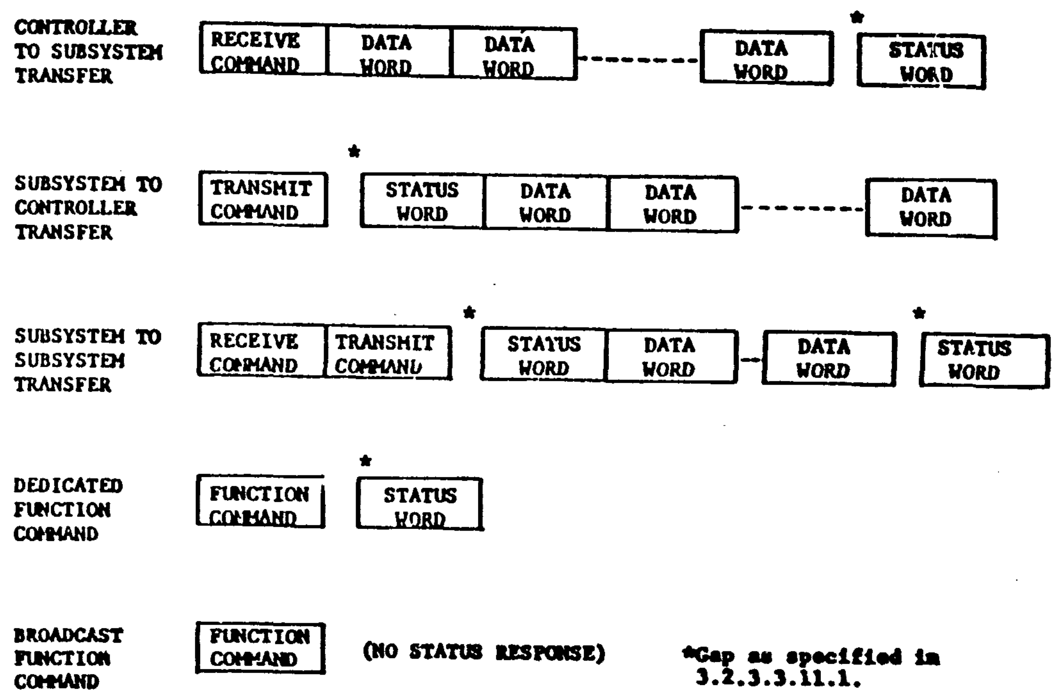


Figure 7 MESSAGE FORMATS

385

specified number of data words. The subsystem shall, after message validation, transmit a status word back to the controller. The command and data words shall be transmitted in a continuous fashion with no interword gaps.

3.2.3.3.8.2 Subsystem to controller transfers. The controller shall issue a transmit command to the subsystem. The subsystem shall, after verification, transmit a status word back to the controller, followed by the specified number of data words. The status and data words shall be transmitted in a continuous fashion with no interword gaps.

3.2.3.3.8.3 Subsystem to subsystem transfers. The controller shall issue a receive command to subsystem "A", followed by a transmit command to subsystem "B". Subsystem "B" shall then transmit the data as specified in 3.2.3.3.8.2 and subsystem "A" shall receive the data as specified in 3.2.3.3.8.1.

3.2.3.3.8.4 Dedicated function commands. The controller shall issue a dedicated function command to the subsystem. The subsystem shall, after execution of the action required by the function word, transmit a status word back to the controller.

3.2.3.3.8.5 Broadcast function commands. The controller shall issue a broadcast function command to all subsystems utilizing the universal address specified in paragraph 3.2.3.3.7.1.2.2. Subsystems shall execute the command indicated in the word count field. No status word shall be transmitted. The broadcast function word received bit described in paragraph 3.2.3.3.7.3.9 shall be retained for a subsequent status word transmittal.

3.2.3.3.9 Transmission line. The data bus shall utilize, as the transmission media, a twisted, shielded, wire pair.

3.2.3.3.9.1 Cable. The cable used shall be a two conductor, twisted shielded, jacketed cable with a distributed capacitance of no greater than 50 picofarads per foot.

3.2.3.3.9.2 Characteristic impedance. The characteristic impedance shall be between 63 ohms and 77 ohms at a frequency of 1 MHz.

3.2.3.3.9.3 Cable attenuation. The cable loss shall be 1 dB/100 feet or less.

336

3.2.3.3.9.4 Cable length. The cable length may be up to 300 feet long.

3.2.3.3.9.5 Cable shield termination. The cable shield shall be terminated to air vehicle ground at every break point and the length of the termination shall not exceed 2 inches. Insulation resistance shall be no less than 2 megohms.

3.2.3.3.9.6 Cable termination. The cable shall be coupled to the subsystem as shown in Figure 8. A long stub is defined as any stub greater than 1 foot in length while a short stub is defined as any coupling cable 1 foot or less in length. The length of any stub shall not exceed 20 feet. The two ends of the cable shall be terminated with a resistance equal to the cable characteristic impedance.

3.2.3.3.10 Subsystem/bus interface circuits

3.2.3.3.10.1 Circuit configuration. The subsystem input/output circuits shall contain two coupling transformers. Isolation resistors shall be provided as specified in 3.2.3.3.10.2.

3.2.3.3.10.2 Fault isolation. An isolation resistor shall be provided with a value of 54 ohms plus or minus 5 percent in series with each output lead of the subsystem signal input-output circuit coupling-transformer. The isolation resistors shall be located in the aircraft harness between the subsystem connector and the transmission cable. The impedance reflected on the cable shall be no less than 103 ohms for any failure of the coupling-transformer or transmitter-receiver circuit.

3.2.3.3.10.3 Subsystem output characteristics

3.2.3.3.10.3.1 Output power. The subsystem signal output circuitry shall be capable of driving the cable specified in 3.2.3.3.9.1 and not less than 33 other subsystem inputs, as specified herein, each attached to the cable by means of a cable stub of length specified in 3.2.3.3.9.6. The output circuitry shall maintain the specified operation with the exception of a 25 percent maximum reduction of the data bus signal amplitude in the event that one of the subsystems has a fault that causes it to reflect the fault impedance specified in 3.2.3.3.10.2.

3.2.3.3.10.3.2 Output voltage. The subsystem signal output shall be ±12 volts ±10 percent peak line-to-line when measured at the subsystem connector (point "B" on Figure 8). (This requirement should be tested with the subsystem operating into a 143 ohm ± 1 percent resistive load.)

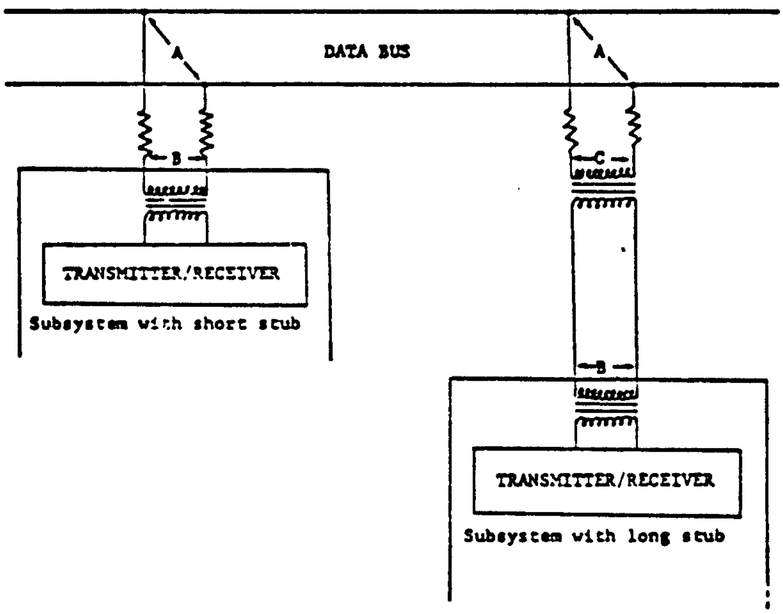


Figure 8 DATA BUS INTERFACE

398

3.2.3.3.10.3.3 Output waveform. The waveform seen at the point specified in 3.2.3.3.10.3.2 shall be as specified in 3.2.3.3.4. The rise and fall times of this waveform shall be 120 nanoseconds, plus or minus 80 nanoseconds, when measured at the 10 percent and 90 percent points of the signal voltage limits specified in 3.2.3.3.10.3.2. Any distortion of the waveform including overshoot and ringing shall not exceed 1.2 volts peak-to-peak, line-to-line, as measured at the point specified in 3.2.3.3.10.3.2.

3.2.3.3.10.3.4 Output noise. Any noise transmitted to the data bus when the subsystem is receiving, or has power removed, shall not exceed a value of 40.0 millivolts peak-to-peak, line-to-line, as measured at the point specified in 3.2.3.3.10.3.2.

3.2.3.3.10.4 Subsystem input characteristics

3.2.3.3.10.4.1 Input waveform compatibility. The subsystem shall be capable of receiving and operating with the incoming signals specified herein, and shall accept waveforms varying from a squarewave to a sine wave. The subsystem shall respond to an input signal whose positive or negative peak amplitude, line-to-line, is within the range of 4.0 volts to 0.6 volts. The subsystem shall not respond to an input signal with a positive or negative peak amplitude, line-to-line, within the range of 0.45 volts to 0.0 volts. The subsystem shall operate as specified in 3.2.3.3.10.4.2 with an input signal level in the range of 4.0 volts to 1.5 volts peak, line-to-line. All voltages are with respect to the subsystem input point cited in 3.2.3.3.10.3.2.

3.2.3.3.10.4.2 Noise rejection. The subsystem shall exhibit a maximum bit error rate of one part in 10^7, prior to the validation checks specified in 3.2.3.3.10.5, when operating with a signal-to-noise ratio of +14 dB. The signal-to-noise ratio shall be determined with $\pm$1.5 volt peak, line-to-line sync and data signals as specified herein, and with white gaussian noise distributed over the frequency band of 1.0 KHz to 4.0 MHz. All measurements are relative to the subsystem input point specified in 3.2.3.3.10.3.2. For purposes of computing bit error rate, each failure of the subsystem to make a bit decision and each incorrect bit decision, i.e., a logic one interpreted to be a logic zero or a logic zero interpreted to be a logic one, shall be counted as a bit error. (Testing of this requirement shall be accomplished with a $\pm$1.5 volt peak, line-to-line signal having the rise time characteristics specified in paragraph 3.2.3.3.10.3.3 and additive white gaussian noise having an RMS amplitude of 300 millivolts.)

389

3.2.3.3.10.4.3 Common mode rejection. The subsystem shall not respond, i.e., the subsystem logic shall not indicate the receipt of sync or data bits, when any signals from dc to 2.0 MHz, with amplitudes equal to or less than +25.0 volts peak, line-ground, are applied at point A of Figure 8. Any signals, with amplitudes equal to or less than $\pm$50.0 volts peak, similarly applied, shall not damage or permanently impair the operation of the subsystem.

3.2.3.3.10.4.4 Input impedance. The subsystem input impedance, when the subsystem is not transmitting, or has power removed, shall be a minimum of 2000 ohms within the frequency range of 100 KHz to 1.0 MHz. This impedance is that measured line-to-line at point "B" of Figure 8.

3.2.3.3.10.5 Data validation. Logic shall be provided in each subsystem to recognize improperly coded signals, data dropouts, or excessively noisy signals. Each word shall conform to the following minimum validating criteria:

a. The word begins with a valid sync field

b. The bits are in a valid Manchester II code.

c. The word has 16 bits plus parity.

d. The word parity is odd.

Where a word fails to conform to the preceding criteria, the word shall be considered invalid and shall not be used by the receiving subsystem. If an invalid word sync occurs, or if the number of words in a received data block is different from the value encoded in the word count field of the command word associated with the data block, the subsystem shall inhibit its status word transmission and reset/initialize its receiver logic.

3.2.3.3.11 Terminal operation. Each avionic subsystem shall operate in response to commands received from the bus controller. Data transferred from the controller to the subsystem shall be held on a message basis until the last data word is properly received by the subsystem, at which time the entire block of data words shall be utilized by the subsystem. Subsystems containing a central memory element may store the data words of a message in that central memory and indicate any errors to the processing element of the subsystem if such errors should occur. The subsystem shall be capable of receiving a command word at any time on a bus

390

except when it is transmitting on that bus. A second command word sent to a subsystem after it is already operating on one shall invalidate the first command and cause the subsystem to begin operation on the second command. Receipt of a valid command word (including a broadcast function command word) shall reset/initialize terminal logic, i.e., it shall clear any previous command to the subsystem to receive data which has not been executed.

3.2.3.3.11.1 Response time. The subsystem shall respond to a valid transmit data command during the time period 2.0 to 5.0 microseconds after receipt of the last bit of the command word except for the condition described in 3.2.3.4.2. The subsystem shall respond to a valid receive data command during the time period 2.0 to 5.0 microseconds after receipt of the last bit of the last data word. The subsystem shall respond to a valid dedicated function command during the time period 2.0 to 5.0 microseconds after receipt of the last bit of the command word except for the condition described in 3.2.3.4.2.

3.2.3.3.11.2 Subsystem interface fail-safe operation. The subsystem shall contain the self-test circuitry necessary to detect erroneous transmission of data on to the data bus. This circuitry shall include a transmission time-out which will preclude signal transmission periods of excessive duration. When the self-test circuitry detects any such erroneous transmission, it shall automatically shut down the transmitter portion of the subsystem during the time period 0.66 to 1.0 milliseconds after the transmission was initiated. The transmitter shut down shall be reset following receipt of a valid command word on the shut down bus.

3.2.3.3.11.3 Time coherence. Each subsystem shall be responsible for maintaining the time coherence of information it transmits over the bus. The subsystem design shall provide mutually consistent samples of information and deterministic transport lags.

3.2.3.3.11.3.1 Sample consistency. The subsystem design shall ensure that messages transmitted over the bus by the subsystem contain only mutually consistent samples of information. Different words used to transmit multiple precision parameters shall all be members of the same sample set. Functionally related parameters updated at the same rate shall all be members of the same sample set. Suitable buffering and transmission control logic shall be provided to prevent the transmission of a partially updated message that would contain mutually inconsistent data.

391

3.2.3.3.11.3.2 Transport lag. The subsystem design shall provide for the transmission of data with deterministic transport lags. Since an individual subsystem cannot control the transmission time of information over the bus, it shall (1) provide time tags that can be used to determine when a set of parameters was sampled or a message established, (2) accept synchronizing function word commands from the bus controller and maintain a repeatable operation sequence, or (3) use a combination of time tagging and synchronization to establish deterministic transport lags. Unless specifically excepted by General Dynamics, each subsystem shall provide a 16-bit timer in the subsystem that can be used to time tag designated parameters or messages. The timer shall have a resolution of 64 microseconds per count and shall be capable of being reset by a function word command.

3.2.3.4 Redundancy. The avionic serial digital interface architecture shall be as depicted in Figure 9. Dual redundancy shall exist in (1) the transmission cables, (2) the interface electronics of each avionic subsystem, and (3) the bus control function.

3.2.3.4.1 Transmission cables. Two separately routed transmission cables having the characteristics specified in paragraph 3.2.3.3.9 shall be utilized to provide signal path redundancy.

3.2.3.4.2 Interface electronics. Each subsystem having an avionic serial digital data bus interface shall be capable of receiving command words over either of the two buses and transmitting/receiving data over either bus. A subsystem shall respond to commands to transmit or receive data only over the bus on which a command is received. If a subsystem is transmitting data on one data bus and a valid transmit/receive command is received on the other bus, the subsystem shall terminate its communication on the first bus and respond to the command received on the second bus. When a subsystem is commanded to terminate a communication, it shall do so word synchronous. That is, turn off shall occur at the end of a word, not mid-bit or mid-sync or mid-word. In this mode, if a subsystem response is expected, the response gap time may be as long as 25 microseconds following the command word. Command words transmitted over both buses will not overlap.

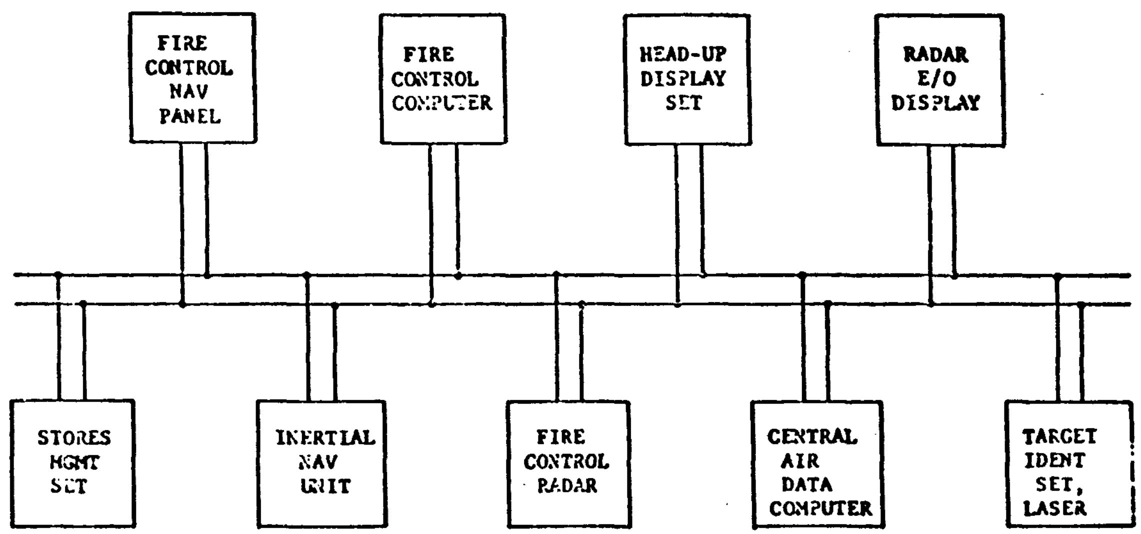


Figure 9 F-16 AVIONIC SERIAL DIGITAL INTERFACE

393

3.2.3.4.3 Bus controllers. The primary bus control function shall reside in the Fire Control Computer. In the event that the Fire Control Computer becomes unable to perform bus control, the Inertial Navigation Subsystem shall assume the responsibility for bus control. A discrete from the Fire Control Computer to the Inertial Navigation Subsystem shall indicate when the Inertial Navigation Subsystem is to perform the bus control function. The discrete logic shall be such that when the Fire Control Computer is disabled (powered down) the Inertial Navigation Subsystem is commanded to perform bus control.

3.2.3.5 Bus control. The bus control function shall be accomplished by either the Fire Control Computer or the Inertial Navigation Subsystem as specified in paragraph 3.2.3.4.3. The bus control function shall (1) supervise all serial digital data transmissions and (2) manage the data bus redundancy.

3.2.3.5.1 Transmission supervision. The bus control function shall initiate all communication sequences by issuing command words over the data bus requesting subsystems to transmit or receive data or to execute special functions. The sequence of these commands shall be established by operational software in the subsystem providing the bus control function. The bus control function shall also monitor each communication sequence and initiate corrective action for command words which are not properly executed.

3.2.3.5.2 Redundancy management. The bus controller shall manage the serial digital data bus redundancy. The bus controller may use one bus for all communications or it may interleave communications on the two buses, i.e., complete a communication on one bus and use the other bus for the next communication.

394

3.2.4 <u>Standard Discrete Signal Interface Definition</u>. The characteristics of standard Low Level Complementary and High Level discrete signals are defined in this section.

3.2.4.1 <u>Standard Definition for Low Level Complementary Discretes</u>

<u>Driver</u> (See Figure 10)

Type: Differential

Voltage: Differential = ± 2.0 volts
Logic "1" Output = +2.4 to 5.5 VDC @ I_{OH} = -10ma
Logic "0" Output = .4 VDC maximum @ I_{OL} = 20ma

Output Impedance: Active, 15-30 ohms typical

Short Circuit Protection: Infinite duration short to ground.

Output Noise: The driver while under normal load Impedance (i.e., receiver connected) shall not generate any spurious outputs greater than $\pm$450 MVDC differential for more than 200 microseconds when in the process of being turned off or turned on.

Output Low-clamp Voltage: -1.5 VDC max @ I_{OLC} = -40 ma

<u>Receiver</u> (See Figure 10)

Type: Differential

Voltage: Logic "1" input = +2.0 VDC differential min
Logic "0" input = -2.0 VDC differential min or open Circuit or powered down driver having the characteristics above

Input Load Current: 2.0 Ma maximum

Filtering: The receiver shall operate normally without degradation within all the EMC requirements (including paragraph 3.3.2.2(a)) of the CEI specification. The logical delay caused by the receiver filtering to meet this requirement shall be subject to General Dynamics approval and shall be specified on the interface sheet for each individual signal. In addition, the spurious output produced by the driver and having the characteristics stated above for the driver shall not produce false triggering of the receiver.

Figure 10 STANDARD LOW-LEVEL COMPLEMENTARY DISCRETE INTERFACE

Input Protection: The receiver shall not be damaged by a short circuit on the input to ground.

3.2.4.2 Standard Definition for High Level Single Ended Discretes. The characteristics of high level single ended discretes are described below and in Figure 11:

Receiver

Type: High Level

Voltage: Logic "1" input - The receiver shall operate normally, i.e., produce a logic "1" when the input voltage is in the range of 22.5 volts min to 30 volts max.

Logic "0" input - open circuit

Input Load Current: 6 ma maximum

Input Protection: Short circuit to ground

Input Logic "0" voltage: This voltage which appears at the input of each receiver during open circuit shall be nominally 0 volts (.5 volts maximum). Other receivers having the above characteristics may be connected to the same input (see Figure 11). This condition shall not degrade the performance of any receiver connected to the line.

Filtering - The receiver shall operate normally without degradation for any transient input voltage spike of less than 50 microseconds duration within the limits of paragraph 3.2.7 of MIL-E-6051D dated 7 September 1967. The receiver shall also operate normally within all the EMC requirements (including paragraph 3.3.2.2(a)) of the applicable item specification. The logical delay caused by the receiver filtering to meet this requirement shall be subject to GD approval and shall be specified on the interface sheet for each individual signal.

Transients - The receiver shall not be damaged for any input voltage spike within limits 1 and 4, Figures of MIL-STD-704A, dated 9 August 1966.

3.2.5 Electrical Connectors. Electrical connectors shall be in accordance with 16PP008 "Electrical Connector Selection and Requirements for the F-16", 17 March 1975.

3.2.6 Circuit Classification Requirements. This subsection contains circuit classifications and grounding, shielding, and wire grouping requirements for all signal types contained within

397

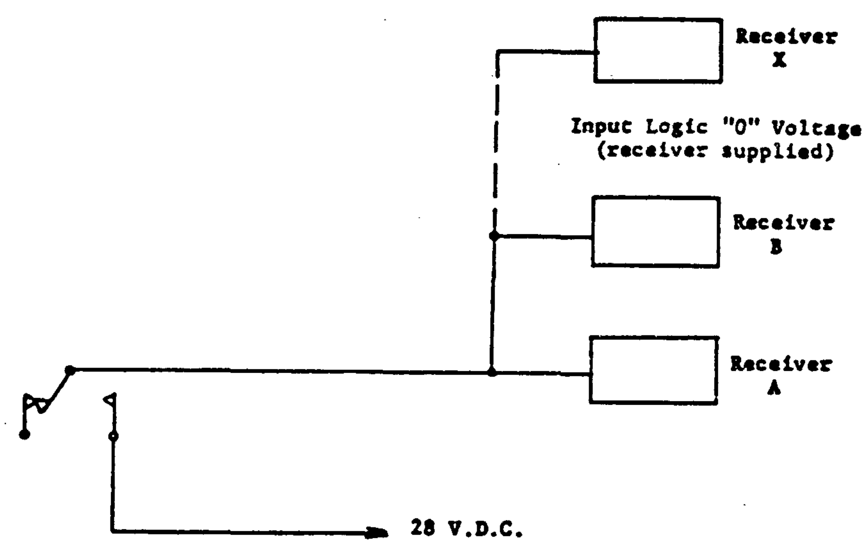


Figure 11 HI LEVEL DISCRETE INTERFACE

the F-16 system. These requirements, in addition to the requirements of MIL-W-5088E and MIL-E-5400P, must be met within all equipment as well as the airframe to be compatible with electromagnetic requirements. Wire and cable grouping within equipments shall be such that airframe wiring may comply with the following requirements.

3.2.6.1 Circuit Type Definition. Aircraft wiring is made up of individual wiring circuits combined into wiring harnesses. These individual circuits will range from the simplicity of a system's power input to the complexities of multiplexing. Some of these typical aircraft circuits are defined and described below.

1. A. C. Power Circuit - Any circuit in which 115/200 volt 400 hertz power is supplied by the aircraft or ground power sources.

2. D. C. Power Circuit - Any circuit operated by D. C. voltage with the current in excess of 1/2 ampere.

3. A. C. Control Circuit - Any circuit in which A. C. power is used for control purposes.

4. Audio Circuit - An audio frequency circuit is defined as a circuit carrying information in the frequency range of from 0 to 15,000 hertz.

5. Video Circuit - An extremely wide band information circuit.

6. Synchro Circuit - A circuit which transmits three-wire, variable-voltage shaft position signals between synchronous devices.

7. Discrete - A circuit for the purpose of transmitting a single valued word.

8. Analog Circuit - A circuit for AC or DC variable voltage signals.

9. R. F. Circuit - A circuit operating in the frequency range above 15,000 hertz.

10. Digital Circuit - A circuit which transmits a series of information bits at a predetermined voltage amplitude.

11. Multiplexing Circuit - A circuit used to transmit a large quantity of signals over a single path by using time sharing and/or frequency division methods.

12. Weapons Control Circuit - A circuit transmitting signals that arm and/or release weapons.

13. Antenna Circuit - A circuit carrying high level R. F. signals to be transmitted outside the airplane or low level signals from the antenna to a receiver. These are usually coaxial cables.

14. Secure Communications Circuits - An information circuit from which undesired signal data emanations are reduced to the point that unauthorized information detection is not possible.

15. AMAC Circuit - A circuit defined by Sandia Drawing 185475.

3.2.6.2 Circuit Classification. Each circuit in the airborne weapon system shall be considered in terms of a specific classification. The classifications shall be established on basis of the closest similarity to one of the types described in the following paragraphs.

3.2.6.2.1 Class I - Power and Control Circuits. This classification includes primary A. C. power circuits, D. C. power circuits, switching circuits, and any other interference producing circuit not susceptible to power line frequencies and transients.

3.2.6.2.2 Class II - High Level Susceptible Circuits. This classification includes audio circuits, video circuits, synchro circuits, digital circuits, and other semi-high-level signal circuits.

3.2.6.2.3 Class III - Low Level Susceptible Circuits. This classification includes low level analog circuits and other low level susceptible circuits.

3.2.6.2.4 Class IV - Antenna Cables. This classification includes any cable carrying an R. F. signal to an antenna for transmission from the aircraft or carrying a received signal from an antenna to a receiver.

3.2.6.2.5 - Class V - Electro-Explosive Device Circuits. This classification includes all circuits used to energize/detonate electro-explosive devices.

3.2.6.2.6 Class VI - AMAC Circuits. All nuclear weapon circuits defined by Sandia Drawing 185475 shall be isolated from all other circuits.

3.2.6.2.7 Class VII - Secure Circuits. A secure circuit is an information circuit from which undesired signal data emanations are reduced so that unauthorized information detection is not possible.

3.2.6.3 Wire Grouping. Wires in each of the above circuit classifications should be grouped together into harnesses. To maintain maximum isolation between different circuit classifications, the different circuits should terminate at the avionic units and intermediate points in separate connectors. If it becomes necessary to include more than one circuit class in a single connector, each class will be separated by a row of ground contacts. Class VI and VII circuits should not be routed through connectors with wires of any other class.

3.2.6.4 Airframe Cable Routing. In the interest of eliminating cross talk and co-channel interference from coupling of signals between wires and harnesses, it is mandatory to maintain the proper degree of isolation between different circuit classifications. In wiring layout and routing, the maximum practical separation must be maintained in accordance with the general rules described below. A two-inch separation between cable types is arbitrarily set as a minimum design goal.

3.2.6.4.1 Power and Control Circuits. Routing and channeling of power circuits shall maintain maximum spacing from low level circuits. If multiple A. C. power sources are available, a complete set shall be provided power from only one of these sources.

3.2.6.4.2 High Level Susceptible Circuits. High level susceptible circuits shall be isolated from power and other high level interference circuits. Low level interference wiring may be routed with high level susceptible circuits, providing isolation is maintained through the proper shielding and/or twisting of wires.

3.2.6.4.3 Low Level Susceptible Circuits. Low level susceptible circuits shall be isolated from power and other interference

401

circuits. Low level susceptible circuits may be routed with low interference Class II circuits provided proper isolation is maintained through use of shields, shield terminations, and connectors as described in this document.

3.2.6.4.4 Antenna Cables. Antenna coaxial cables shall comply with the requirements of MIL-W-5088E(i.e., they shall be separated from any other antenna cable or cable group).

3.2.6.4.5 AMAC Circuits. AMAC circuits shall be isolated from all other circuits carrying electrical power. In the routing of AMAC circuits, maximum spacing shall be maintained. Connectors used for AMAC circuits shall be such as to preclude any mismating to any other circuit connectors.

3.2.6.4.6 Secure Circuits. Secure circuits shall be completely isolated from all other aircraft wiring.

3.2.7 Electromagnetic Interference and Compatibility. The subject equipment shall be designed to meet MIL-STD-461A, Notice 3, and shall be tested in accordance with MIL-STD-462, Notice 2. The EMC plan in accordance with MIL-STD-461A(3) shall be the controlling document for EMIC design.

3.2.7.1 Design Requirements. The generation of and susceptibility to electromagnetic interference shall be controlled in all units of electrical/electronic equipment. These units shall meet MIL-STD-461A, Notice 3 requirements as specified and/or modified below. The specific requirements and modifications of MIL-STD-461A and Notice 3 are as follows:

TEST METHOD

CE01 (7)	CS02	CS06	RS03
CE03 (1)	CS03 (2)	RE02	
CE06 (2)	CS04 (2)	RE03 (4)	
CS01	CS05 (2)	RS02 (5)	

The numbers in parentheses above refer to the notes which follow:

412

(1) Change frequency range to .10 MHz to 50 MHz. Data shall be collected from .014MHz to .10MHz for information purposes only.

(2) Applies to communication and radar equipment only.

(3) Deleted

(4) Applies for radar only and only in the frequency range from 8 GHz to 15 GHz.

(5) The procedures and limits of Method RS02 (a) and (b) shall apply except that the voltage E of Part (b) shall be 400 volts across 5 ohms.

(6) Deleted

(7) This test shall be performed for data purposes only.

In addition, the following EMC requirements shall apply.

1. Transient (impulse) susceptibility. No change in indications, malfunction, or degradation of performance shall be indicated in any equipment and/or its load when exposed to an impulse type electromagnetic field generated by a type MS25271 relay (or an acceptable equivalent) when wired for continuous operation with a switch in series with the positive side of the line from a 28 volt DC power source. No suppression components (shielding, diodes, etc.) shall be attached to the relay or its wiring. The unshielded positive lead leaving the switch shall be laid over three sides of the test sample and then connected to the relay. The unshielded return lead from the relay shall be taped to and in parallel with input power leads, signal leads, and interconnecting leads. The total length of each external wiring harness paralleled with the relay circuit shall not be less than 60 inches. The 28 volt input shall be reversed and the transient repeated.

2. Magnetic susceptibility. Display equipment shall not be affected by a magnetic field which has a magnitude of 4 gauss at the equipment envelope and a gradient of 20 gauss per foot.

3.2.7.2 Bonding. All electrical and electronic units shall have a designed bonding interface and this interface will be shown on ICDs. Each unit shall exhibit a DC impedance of 2.5 milliohms or less from the unit case to the aircraft structure

403

ground and shall be bonded in accordance with MIL-B-5087B, Class R. The equipment mounting fixtures shall comply with the same requirement except that suitable jumpers may be used across any necessary vibration isolators.

3.2.7.3 Grounding. Grounding shall be as follows:

1. Input power returns shall be brought out of the equipment on separate connector pins or connections.

2. Signal grounds within the equipment shall be electrically connected to each other and to chassis at multiple points. The length of ground wires to chassis shall be held to a minimum.

3. Chassis ground shall be brought out of the equipment on a separate connector pin or connection. Chassis shall always have a defined bond path to air vehicle structure and this bond path shall be shown on ICDs.

3.2.7.4 Shielding. Wire shields shall not be used as a signal return, except for coaxial, and shall not be used to conduct power currents. All wire shields shall be covered by a layer of insulation. All shielded wire shall be multiple point grounded to the signal ground system or chassis. Coaxial cables shall have the shield grounded at each end. The requirement for multiple shielded cables for EMI protection shall be held to a minimum.

9. FUTURE MODIFICATIONS

For production, the following systems and modifications may be incorporated:

- ECP0036 - Compass Sail/Compass Tie (ALR-69)
- ECP0076 - Relocation of Fire Control/Navigation Panel (after ≈30 aircraft)
- Airborne Video Tape Recorder
- AN/ARC-186 - VHF - AM/FM Radio Set
- High Technology Ejection Seat
- PAVE PENNY Group A provisions (no impact on avionics space -- pylon-mounted)

The following systems have been mentioned as possible additions to the F-16 aircraft, but no definitive plans have been formulated and no space-power-cooling factors are defined for the F-16.

- Engine Diagnostic System - in PMD as a growth system
- Global Positioning System - in PMD as a growth system
- Joint Tactical Information Distribution System - in PMD as a growth system
- Internal Electronic Countermeasures - decision on implementation is expected shortly. Form-fit-function factors could be frozen by 1981 to 1982.
- AIM-7 Radar Missile - in PMD as a growth system. (Requires CW illuminator box space in avionics bay.)
- Airborne Laser Designator - in PMD as a growth system
- SEEK TALK UHF Radio Improvement

Data relevant to these possible changes are given in Table 9-1.

405

Table 9-1. AN/ARC-186 - VHF - AM/FM RADIO SET

Description

For the production F-16 aircraft, the AN/ARC-186 VHF - AM/FM radio set will be supplied rather than the AN/ARC-115 VHF-AM Radio Set. The only technical description available on the AN/ARC-186 is:

Frequency Band:		30 to 88 MHz FM 108 to 115.975 MHz FM - receive only 116 to 152 MHz AM
Power:	**Input:**	28 Vdc to 50 W maximum - receive mode 28 Vdc to 150 W maximum - transmit mode
	RF:	10 W - both bands (16 W maximum on FM)
	Lighting:	5 Vac or 28 Vac

Sensitivity: 0.5 microvolts FM at 10 dB s/n

Weight: <9.0 lbs.

Specification: ENAC Technical Exhibit 77-25

Antenna: To be developed (adds extended frequency range for VHF-FM band)

Physical Data: Dimensions are the same as AN/ARC-164 and AN/ARC-115

Interface Schematic: Same as AN/ARC-115

406

10. DATA SOURCES

The following data sources were used to compile this summary:

- T.O. 1F-16A-1, Flight Manual, 8 July 1977
- F-16A Aircraft Configuration Data for JTIDS, 10 February 1978
- Preliminary JTIDS Configuration Data Analysis, May 1978
- GPS Phase II User Equipment Interface Requirement for the F-16A Aircraft, 15 November 1977

AVIONICS INTERFACE DATA SUMMARY
FOR
F-111A

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

418

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Divison (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

409

Record of Changes			
Change	Subject	Date Entered	Initials

4/0

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF FIGURES AND TABLES
(continued)

412

1. INTRODUCTION

This document contains configuration data relating to the integration of additional avionics into the F-111A aircraft.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable Technical Orders are included in the references listed in Section 10.

2. COCKPIT SPACE

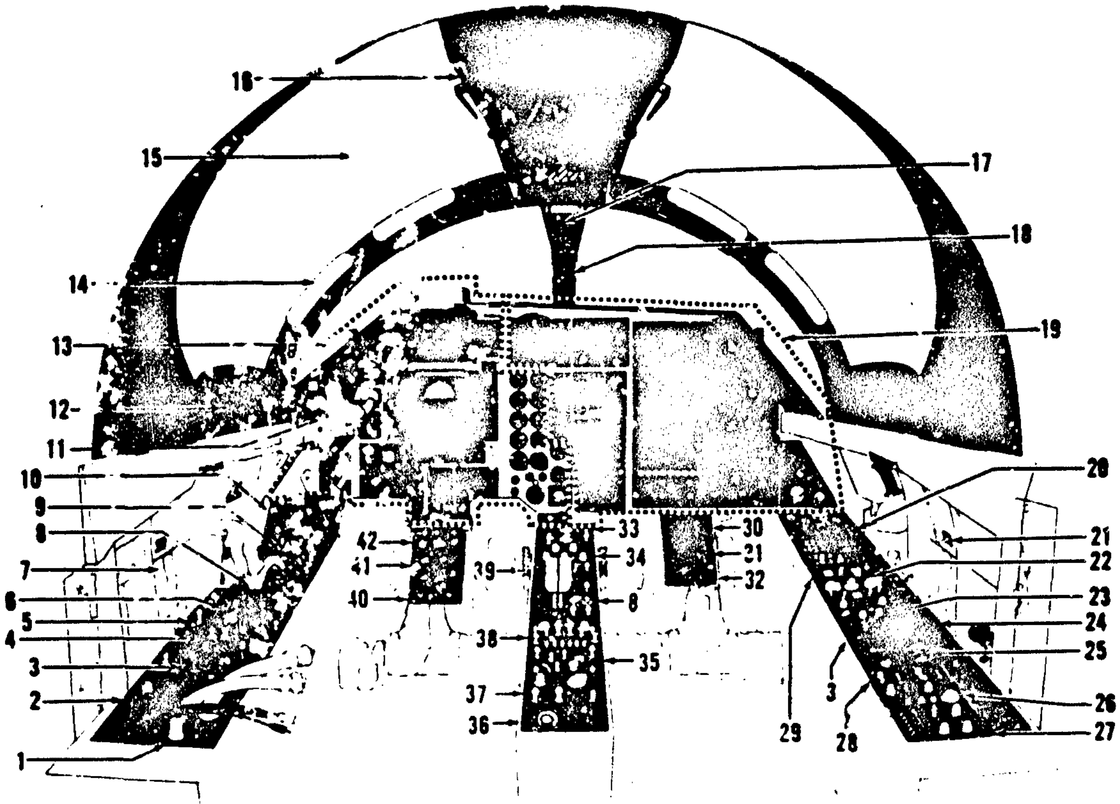
Figures 2-1 through 2-3 depict the consoles and instrument panels for the F-111A. The available F-111A cockpit control panel space is very limited, and several modification programs will be competing for control panel space.

As shown in Figure 2-1, there is a 5-5/8 inches high by 5-3/4 inches wide blank panel in the left console. This blank panel is located between legend number 1 (Left Station Oxygen-Suit Control Panel) and legend number 3 (Interphone Panel). According to GD document FZM-12-13968, page 40, Figure E-7, a portion of this panel space is reserved for Data Link.

Certain configurations of the F-111A have some blank panel space in the right console, rather than the full complement of camera and ECM control panels, shown as legend numbers 24 through 28 in Figure 2-1. GD document FZM-12-13968, page 40, Figure E-7 identifies growth space in the right console.

The AN/AJQ-20 Bomb Nav Control Panel, legend number 17 or Figure 2-3 in the Right Main Instrument Panel, will be replaced by a smaller Digital Bomb/Nav Computer Control Panel. PAVE TACK is a competitor for the new space generated by this change.

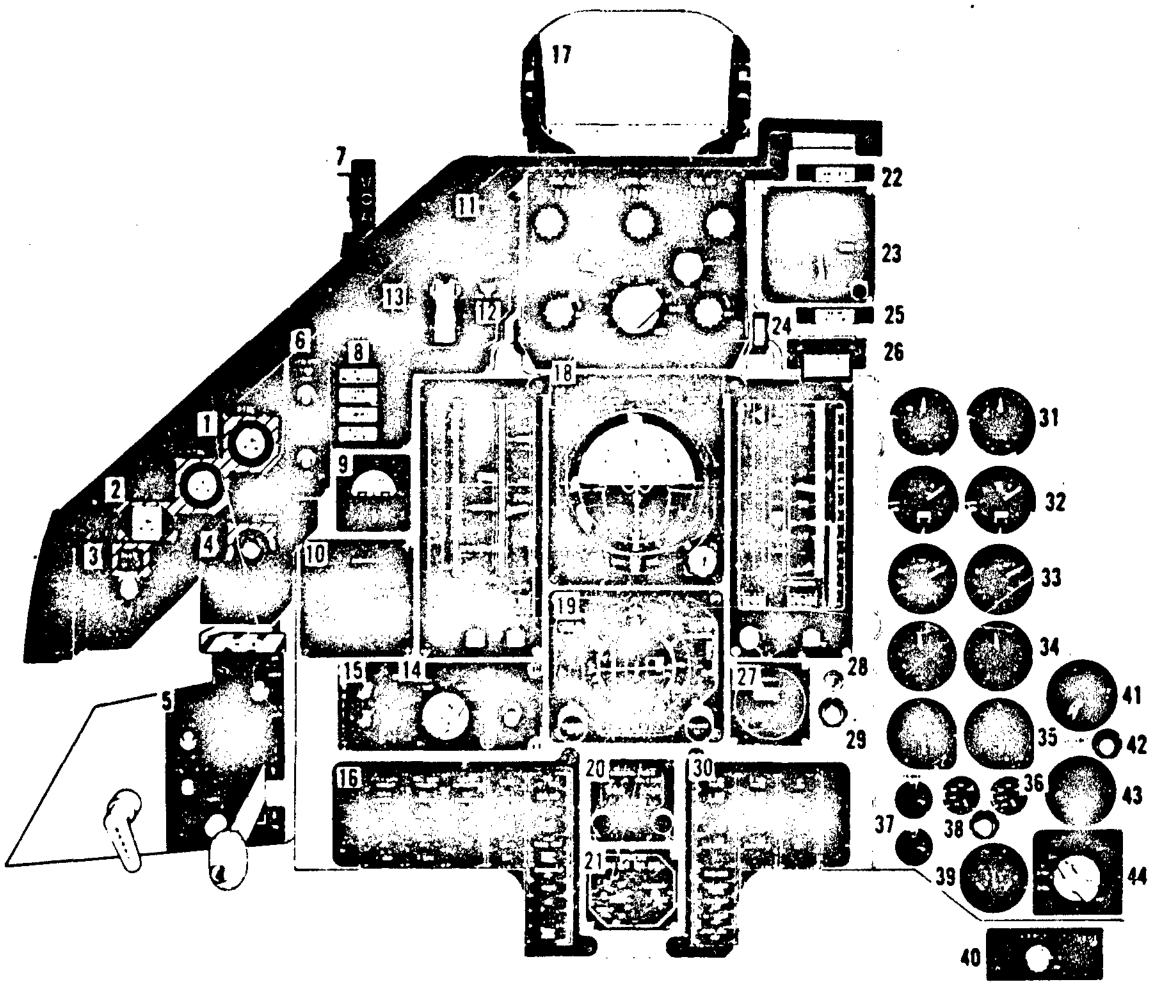
4/4



• See T O 1F-111A 1-2

1. Left Station Oxygen-Suit Control Panel (See fig 1-48)
2. Electrical Power Test Panel (See fig 1-15) (A)
   Oxygen Gage Panel (See fig 1-49) (E)
3. Interphone Panel (2) (See fig 1-58)
4. Auxiliary Flight Control Panel (See fig 1-28)
5. Flight Control Switch Panel (See fig 1-29)
6. Autopilot Damper Panel (See fig 1-30)
7. Left Sidewall (See fig. 1-21).
8. Throttle Panel (2) (See fig 1-4)
9. Miscellaneous Switch Panel (See fig. 1-61)
10. Auxiliary Gage Panel (See fig 1-17).
11. Self Contained Attitude Indicator
12. Internal Canopy Latch Handles (2)
13. Left Main Instrument Panel (See fig 1-5).
14. Mirrors (4).
15. Canopy.
16. Thermal Curtain (2)
17. Canopy Center Beam Assembly
18. Magnetic Compass
19. Right Main Instrument Panel (See fig 1-34)
20. Armament Select Panel (See fig. 1-68) (A)
    Weapons Control Panel (See fig. 1-71) (E)
21. Right Sidewall (See fig 1-45)
22. Attack Radar Control Panel (See fig 1-78)
23. HF Radio Control Panel (See figs 1-55 or 1-56)
24. Strike Camera Control Panel (See fig 1-74)
25. •ECM Control Panel
26. •CMRS Control Panel
27. •CMDS Control Panel
28. •ECM Pod Control Panel (A)
    Scope Camera Control Panel (See fig 1-76) (E)
29. •ECM Destruct Control Panel
30. Burst Control Panel (See fig 1-66)
31. TACAN Control Panel (See fig 1-59)
32. ILS Control Panel (See fig 1-60)
33. Fuel Control Panel (See fig 1-8)
34. TFR Control Panel (See fig 1-84)
35. Electrical Control Panel (See fig 1-11) (A)
    IFF Control Panel (See fig 1-62) (E)
36. Scope Camera Control Panel (See fig 1-76) (A)
    Air Conditioning Control Panel (See fig 1-43) (E)
37. Air Conditioning Control Panel (See fig 1-43) (A)
    Electrical Control Panel (See fig 1-11) (E)
38. IFF Control Panel (See fig 1-62) (A)
    •ECM Pod Control Panel (E)
39. Ejection Handles (2)
40. Antenna Select Panel (See fig 1-63)
41. Windshield Wash/Anti-Icing Control Panel (See fig 1-46)
42. Compass Control Panel (See fig 1-33)

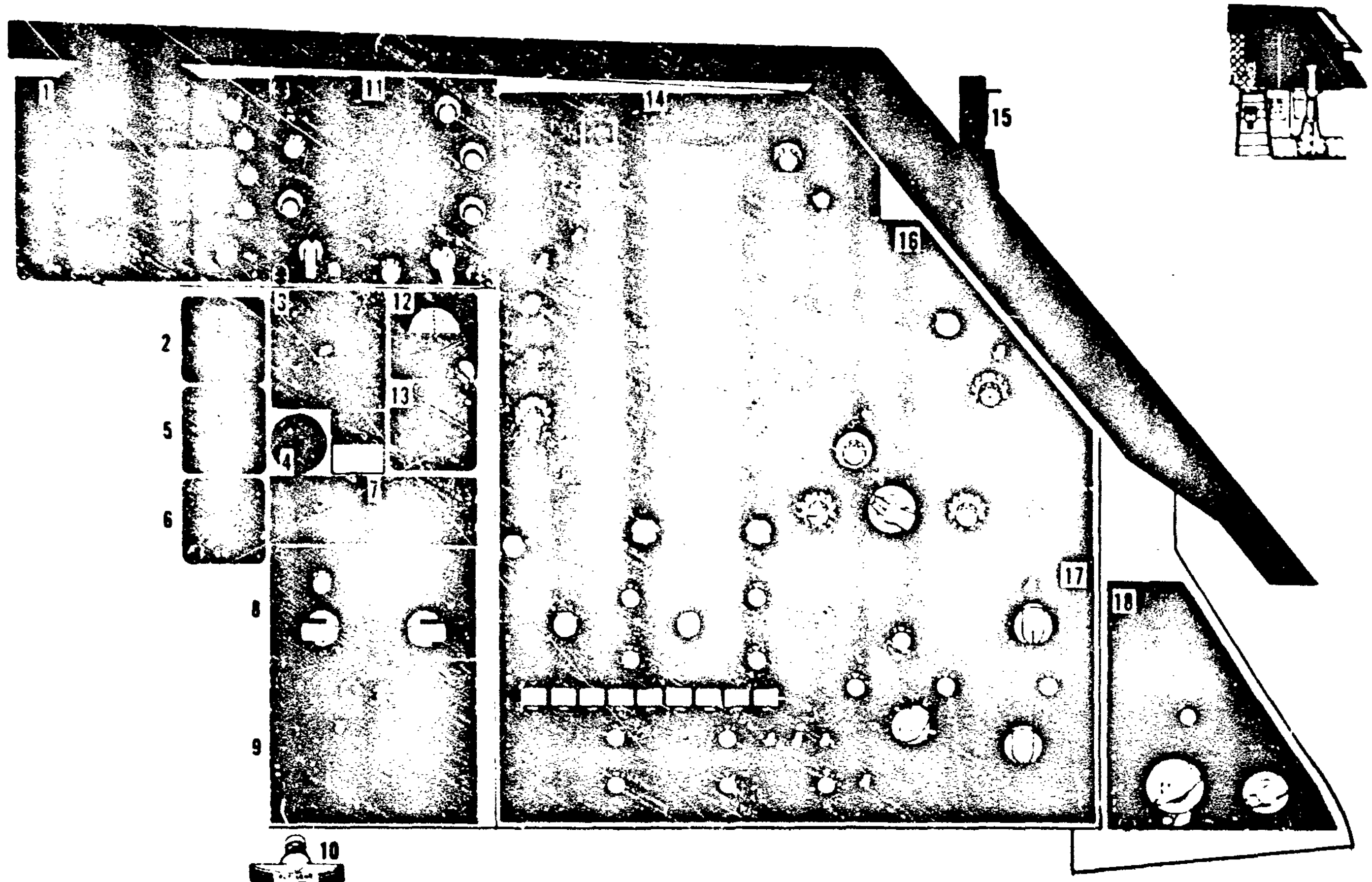
Figure 2-1. CREW STATION GENERAL ARRANGEMENT (TYPICAL)



1. Engine Fire Pushbutton Warning Lamps.
2. Fuselage Fire Pushbutton Warning Lamp.
3. Agent Discharge/Fire Detect Test Switch.
4. External Stores Jettison Button.
5. Landing Gear Control Panel (See fig. 1-18).
6. Pilot's ECM Pod Control Panel (See T.O. 1F-111A-1-2)
7. Angle-of-Attack Indexer.
8. Left Warning and Caution Panel
9. Self Contained Attitude Indicator
10. Wing Sweep Flap/Slat Position Indicator.
11. Upper Warning and Caution Panel.
12. Gun/Camera Control Switch.
13. Air/Air IR Missile Switch. (E) Rounds Counter. (A)
14. Instrument System Coupler Control Panel.
15. Landing Gear Position Indicator Lamps.
16. Left Main Caution Lamp Panel
17. Lead Computing Optical Sight and Control Panel. (See fig 1-89)
18. Upper Warning and Caution Lamp Panel
19. Integrated Flight Instruments, (See fig 1-35)
20. Dual Bombing Timer. (See fig 1-70)
21. Control Surface Position Indicator.
22. Nose Wheel Steering/Air Refueling Indicator Lamp
23. Radar Altimeter Indicator.
24. Stall Warning Lamp
25. Radar Altitude Low Warning Lamp
26. Master Caution Lamp
27. Bomb Nav Distance-Time Indicator
28. Takeoff Trim Indicator Lamp
29. Takeoff Trim Button
30. Right Main Caution Lamp Panel
31. Engine Tachometers.
32. Engine Turbine Inlet Temperature Indicators.
33. Engine Fuel Flow Indicators
34. Engine Nozzle Position Indicators.
35. Engine Pressure Ratio Indicators.
36. Engine Oil Pressure Indicators.
37. Hydraulic Pressure Indicators.
38. Oil Quantity Indicator Test Button.
39. Oil Quantity Indicator.
40. Air Refueling Receptacle Lights Control Knob.
41. Fuselage Fuel Quantity Indicator.
42. Fuel Quantity Indicator Test Button.
43. Total/Select Fuel Quantity Indicator.
44. Fuel Quantity Indicator Selector Knob

Figure 2-2. LEFT MAIN INSTRUMENT PANEL (TYPICAL)

416



1. Terrain Following Radar Scope Panel. (See fig. 1-85)
2. Standby Airspeed Indicator.
3. Bearing-Distance Heading Indicator.
4. True Airspeed Indicator.
5. Vertical Velocity Indicator.
6. Clock.

*7. SAM Sector Indicator/ECM Panel.
8. Offset Aimpoint Panel. (See fig. 1-65).
9. UHF Radio Control Panel. (See fig. 1-54).
10. Landing Gear Emergency Release Handle.
*11. Countermeasures Receiving Set Indicator Control Panel.
12. Standby Attitude Indicator.
13. Standby Altimeter.

*14. Countermeasures Receiving Set Threat Panel.
15. Angle-of-Attack Indexer.
16. Attack Radar Scope Panel (See fig. 1-80)
17. Bomb Nav Control Panel. (See fig. 1-64)
18. Nuclear Weapons Control Panel. (See fig. 1-69)

*Refer to T.O. 1F-111A-1-2

AE000000-F044C

Figure 2-3. RIGHT MAIN INSTRUMENT PANEL (TYPICAL)

3. AVIONICS SPACE

Current and future F-111A space availability are detailed in the F^2E Summaries, (Table 3-1 and Figure 3-1). The one space that exists currently is under door 1202; the dimensions of that space are 8.26" × 12.0" × 18.0", for a total volume of 1.08 ft^3. Other space possibilities (contingent on equipment modifications) are also outlined in the F^2E summary.

Table 3-1. F^2E SUMMARY - F-111A

F^2E Criteria	Potential Available Space		
Location Access	A Next to KIT-1A Door 1202	B APN-167 Dual Altimeter Door 1201	C ARC-112 HF Amp-Power Supply Door 1201
Rectangular* Size (H, W, D)	8.62 × 12.0 × 18.04	6.5 × 15 × 14.5	9.5 × 9.9 × 20.2
Volume ft^3	1.08 ft^3	0.85 ft^3	1.10 ft^3
Type of Cooling Available	Forced Air	Forced Air	Forced Air
Temperature - Altitude Vibration	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area
Possible Candidates for this Space	KY-28	None Known	None Known
Remarks	Current	Replace with 2 ARN-194 Altimeters, Stacked	Replace HF Comm with Single LRU in Location G

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.

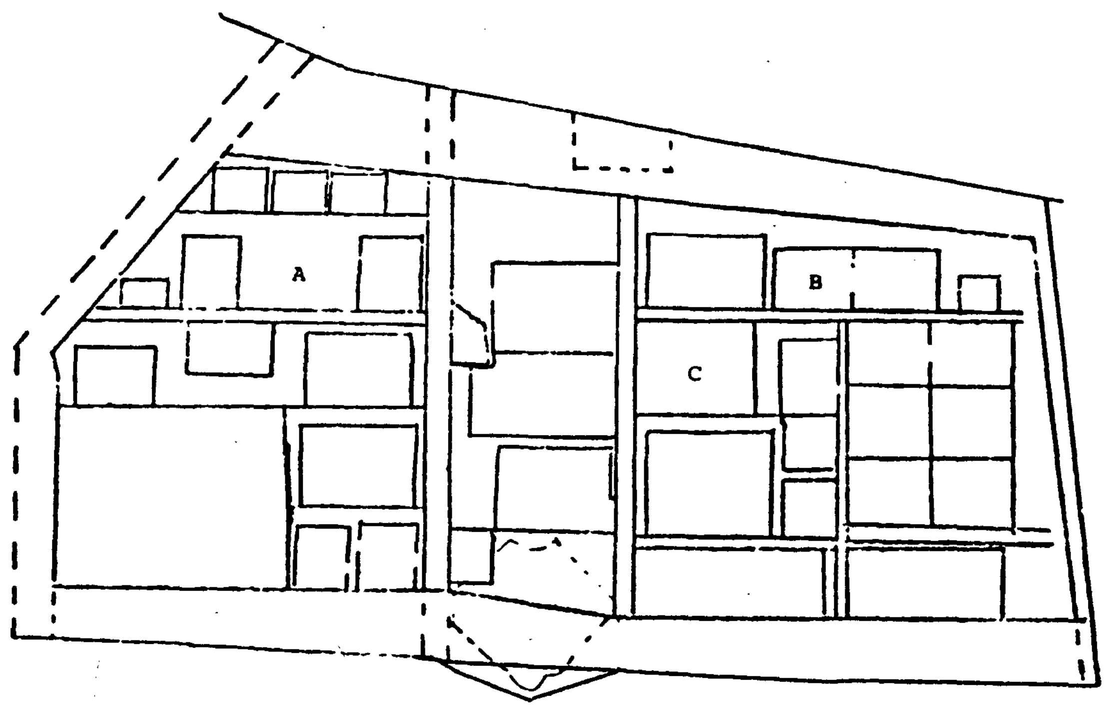


Figure 3-1. F-111A FORWARD RIGHT-HAND EQUIPMENT BAY SPACE LOCATIONS

4. ELECTRICAL POWER SYSTEM

4.1 Introduction

115/200 volt, three phase, 400 cycle ac power and 28 volt dc power are provided for the electrical power system in the F-111A. This power is generated by two 62.5 kVA ac generator drive assemblies, one mounted on each engine. These generators are supplemented by two 150 AMP transformer rectifier units that convert the ac power to 28 volts dc. An aircraft battery supplies 28 volts dc to the battery bus and the dc start busses. The electrical power system consists of the following systems:

- Main ac power system
- External ac power and monitor system
- Emergency ac power system
- Dc power system

4.2 Power Requirements

In the F-111A, there is a basic avionics electrical power requirement of 40 kVA.

4.3 Power Generation and Distribution

The main sources of electrical power are 62.5 kVA indirect drive generators. The control units for these generators are in the forward equipment bay. The electrical power distribution system has three ac busses: A left main ac bus, a right main ac bus, and an essential ac bus.

4.4 Emergency ac Power System

The emergency ac power system provides electrical power for operation of safety-of-flight equipment in the event the main ac power system fails or hydraulic power is applied to the aircraft without electrical power, or both. The emergency ac power generator is operated by the utility hydraulic system.

4.5 DC Power System

The dc power system supplies the aircraft with the necessary 28-volt direct current power. The main dc power system uses two ac-to-dc power converters to supply the main and essential dc busses. The aircraft battery ensures that standby power is available to power engine starts, aircraft position lights, and pylon refuel/defuel valves without external power units.

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The Environmental Control System (ECS) provides temperature controlled air for the cockpit and a temperature controlled flow of cooling air to the forward electronics bay and to the weapons bay. The ECS operates by ducting hot air from the sixteenth stage compressor of each engine through two air-to-air heat exchangers, an air-to-water heat exchanger, and a cooling turbine. The cooling turbine further cools the air to temperatures suitable for the cockpit and electronic equipment bays.

5.2 Cabin Air Conditioning

Cabin air conditioning is governed by a temperature controller that receives signals from temperature sensors and a cockpit control panel. The temperature controller allows hot air to mix with the cooled air stream to obtain air at the cockpit-selected temperature. Conditioned air flows from the cabin into the forward equipment bay.

5.3 Equipment Air Conditioning

Electronic equipment that is cooled by the ECS is grouped in the forward equipment area, cabin equipment area, aft(check) equipment area, main landing gear wheelwell area, and tail electronics area. The equipment is cooled by both area cooling and forced-air-flow cooling. Area cooling is achieved by supplying cold air to the equipment area as required to maintain the temperature at 150° (± 10°) F. In addition, a cold air flow can be forced over or into a single component or group of components.

6. CURRENT AVIONICS

Tables 6-1 through 6-27 contain LRU data relating to the F-111A avionics systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

423

Table 6-1. F-111A AVIONICS CONFIGURATION DATA: AN/ARC-112 HF COMMUNICATIONS SET* NSN: 5821-00-496-9235

Name	Nomenclature	Location	Dimensions (Inches) H	Dimensions (Inches) W	Dimensions (Inches) D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	Aircraft Power DC	Heat Dissipation	Cooling Method	Mounting
HF Comm	AN/ARC-112							1.1		1,100W		
Control Panel	C06454/ARC-112	Cockpit	2.62	5.75	5.0	73.5	2				Convection	Cockpit
Amp-PWR Sup	AM-4239/ARC-112**	Door 1201	8.5	9.25	17.87	1405	40	1.1			Forced Air	MT-3355
RCVR-TRANS	RT-759/ARC-112†	Door 1201	10.	11.62	16.0	42.5					Forced Air	MT-3356
Ant Coupler Set	AN/ARC-112 (OA-7149A)		6.0	5.0	12.62							
Ant Coup Cont	C-6455/ARC-112	Door 1201	15.25	6.5	1.75	173.5	7.4				Convection	MT-3357
Coupler	CU-1402/ARC-112	4471/2	10.25	10.0	12.75	1307	14.8				Convection	Hard
Antenna Dorsal Assy	12T501-XXX											Hard
Antenna Vertical Stabilizer Assy	12T010-XXX											Hard
Variable Capacitor	CB-17/ARC	Cover 3460									Convection	Hard

*See Table 6-2 for ARC-123 as a possible replacement system.
**AM-4239 installed on MT-3355: 9.5"H × 9.9"W × 20.2"L, 1,900 in^3.
†RT-759 installed on MT-3356: 11"H × 12.8"W × 18.4"L, 2,591 in^3.

424

Best Available Copy

Table 6-2. F-111A AVIONICS CONFIGURATION DATA: AN/ARC-123 HF RADIO AS A POSSIBLE REPLACEMENT SYSTEM FOR ARC-112 NSN: 5821-00-496-9234

Name	Nomenclature	Location	Dimensions (Inches) H	Dimensions (Inches) W	Dimensions (Inches) D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	Aircraft Power DC	Heat Dissipation	Cooling Method	Mounting
Control	C-7073/ARC	Cockpit	3.75	5.75	6.25	135	4				Convection	Panel
Rcvr-Xmtr	RT-822/ARC-123	Door 1201	7.62	3.62	13.6	375	13				Forced Air	MT-3660/ ARC-123
Amp.-Pwr. Sup.	AM-4573/ARC-123	Door 1201	7.62	4.87	17.2	638	23	1.1			Forced Air	MT-3660/ ARC-123
Shockmount Base	MT-3660/ARC-123	Door 1201	6.87	11.2	20.2	1554	8					
RT and AM Installed On Mount	RT-822/ARC-123 AM-4573/ARC-123 MT-3660/ARC-123	Door 1201	8.75 INCL. SWAY	11.2	20.2	1980	44	1.1		1100W	Forced Air	Shock Mount

Table 6-3. F-111A AVIONICS CONFIGURATION DATA: AN/ARC-109 UHF COMM SET AND ARC-164 AS A POSSIBLE REPLACEMENT SYSTEM NSN: 5821-00-496-9236

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF Comm	AN/ARC-109											
RCVR-Trans*	RT-749/ARC-109	Door 1202	6.78	8.84	14.81	888	29	0.37		370W	Forced Air	MT-3322/ ARC-109
Control	C-6364/ARC-109	Cockpit	4.87	5.75	6.87	192	4.5				Convection	Cockpit
Ant. Sel	C-4808	Door 1202	3.0	3.25	4.5	44	1.5				Convection	Hard
Antenna**	AS-1918	Upper & Lower	9.7	3.5	7.5		2					Hard
RF Switch	SA-521	Door 1202	2.8	3.2	3.2	29	0.6					Hard
Possible Replacement RT Incl. Control	RT-1168/ARC-164	Cockpit Repl. for C-6364/ ARC-109	4.87 Overall depth is 8.62", inc Controls	5.75	7.17	200	9.2		0.11	110W	Convection	Cockpit

*RT-749 installed on MT-3322, incl, SWAY: 7.2"H × 9.5"W × 17.5"D, 1,200 in^3.
**Antennas shared with TACAN.

426

Table 6-4. F-111A AVIONICS CONFIGURATION DATA: AN/AIC-25 INTERCOM NSN: 5831-00-457-5041

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Intercom Set	AN/AIC-25:	LH&RH	Each:						02			
Controls - 2 Required	C6567/AIC-25**	Cockpit Consoles	3.75	5.75	5.62	121	4.2			20W	Convection	Cockpit
Intercom Stations - 2 Required	C-6624/AIC-25	LH&RH Wheelwells	4.38	3.62	5.12	81	2.7					Hard

*C-6567 intercom control depth is 6.75 in including knobs.

Table 6-5. F-111A AVIONICS CONFIGURATION DATA: AN/ARA-50 UHF-ADF NSN: 5826-00-883-5777

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF-ADF	AN/ARA-50:		8	7.25	7	406	6.5	0.04	0.01	50W	Forced Air	Shock Mount
Amp. [illegible]. Assy.	AM-3624/ARA-50	Door 1202	Including Mount									
Installed [illegible] Mount	MT-1955/ARA-50											
Loop Ant.	AS-909/ARA-48	Door 1410	3.75	10.75	10.75	433	10				Convection	Hard

428

Table 6-6. F-111A AVIONICS CONFIGURATION DATA: INSTRUMENTS

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Instruments												
Attitude Dir Ind.	ARU-11/A NSN: 6610-424-8740	Cockpit	5.25	5.0	10.68	280.4	8.1			36/10W	Convection	Cockpit
Att. Ind.	ARU-42/A-2 NSN: 6670-00-200-8744	Cockpit	2.40	2.40	7.61	43.8	2.5	0.002	0.034/ 0.008	36/10W	Convection	Cockpit
Horizontal Siz Ind.	AQU4/A NSN: TBD	Cockpit	4.25	5.00	8.37	178	8.0			54W	Convection	Cockpit
Tot/Sel Fuel Quan.		Cockpit	2.0	Dia		3.14	1.5				Convection	Cockpit
Recorder Flt Load Type	HXK 316/A2 406 NSN: TBD	Door 1104									Forced Air	Shock
BDHI	E5165001400 NSN: TBD	Cockpit									Convection	Cockpit

Best Available Copy

Table 6-7. F-111A AVIONICS CONFIGURATION DATA: FLIGHT DIRECTOR COMPUTER NSN: 6610-00-179-5146

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Flight Director Computer	CPU-76/A	Door 1101	7.35	5.5	9.48	393	10.0	0.016	0.085	26W	Forced Air	Shock

Best Available Copy

430

Table 6-8. F-111A AVIONICS CONFIGURATION DATA: AN/APN-167 RADAR ALTIMETER NSN: 5841-00-772-1819

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Radar Alt.	AN/APN-167											
Rcvr-Trans Dual	RT-771/APN-167	Door 1201	6.5	15	14.5	14.14	26.0	086	0.01	192W	Forced Air	MT( )
Antenna	AS-1758/APN-167		4.5	4.5	9.25	187	1.1					Hard
Radar Alt Ind.	K5186000100	Cockpit					1.6/1.8*				Convection	Cockpit
Radar Alt.												
Low Warning Lamp		Cockpit									Convection	Cockpit

*Two indicators in aircraft.

431

Table 6-9. F-111A AVIONICS CONFIGURATION DATA: CADC

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Air Data Comp.	1903613-4 NSN: 6610-00-168-0544	Door 1101	8	14	19.25		47.5	115 Vac 1ø			Forced Air	1852714-3
Angle of Attack Trans.	12F4075-3	Door 1102									Forced Air	Shock
Control	12P0002-5	Cockpit									Convection	Panel
Angle of Attach Trans. Sync.	MS24378-2	Door 1102									Forced Air	Shock

432

Table 6-10. F-111A AVIONICS CONFIGURATION DATA: AN/ARN-52 TACAN NSN: TBD (BEFORE T.O. 1F-111-1140, AN/ARN-118 INSTALLATION)*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control	C-3928/ARN-52	Cockpit	3	5.75	4	69	2				Convection	Panel
Rcvr-Xmtr	RT-893/ARN-52	Door 1202	7.35	10 RT Only	16.9	12 42	43.25				Forced Air	MT-1729/ ARN-52
Antenna**	AS-1918	Upper & Lower	9.7	3.5	7.5	255	2					
RF Switch	SA-521/A	Door 1202	2.8	3.2	3.2	29	0.6				Convection	Hard
Rcvr-Xmtr Alternate	RT-384/ARN-52	Alternate System for Early Aircraft, Replaced by RT-873/ARN-52										
RT Installed on Mount	RT-893/ARN-52 MT-1729/ARN-52	Fwd., RH Bay Door 1202	9.00	11.00	21.44	2123	49	0.25	0.06	0.31 KW; 1lb/min Air at 71°C	Forced Air	Shock Mount

*See Table 6-11 for AN/ARN-118.
**Antennas are shared with UHF Comm.

Table 6-11. F-111A AVIONICS CONFIGURATION DATA: TACAN, AN/ARN-118 (AFTER T.O. 1F-111-1148, REPLACING AN/ARN-52) NSN: 5826-01-015-0839

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
TACAN Rcvr-Xmtr, D/A Converter, on Mount	AN/ARN-118* RT-1159/A MX-9577/A MT-4682/A	Door 1202	8.85 Including Handles and Sway	11.7	20.5	2123	38.5	0.20	0.03	0.23 KW No Forced Air Required	RT had internal Blower	Shock Mount
Control	C-10058/ARN-118	Cockpit	3	5.75 3.9 D Behind Front Panel	5.43	93	2				Convection	Panel

*These units replace AN/ARN-52 Rcvr-Xmtr, Mount, and Control listed in Table 6-10.

434

Table 6-12. F-111A AVIONICS CO 'IGURATION DATA: ILS AN/ARN-58 AND ARN-112 AS A POSSIBLE REPLACEMENT SYSTEM NSN: 5826-00-883-5795*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
ILS	AN/ARN-58											
Rcvr Localizer	R-843/ARN-58	Door 2204	7.75	6.87	5.59	298	8		0.02	20W	Convection	Hard
Rcvr Glide Slp/ MKR BCN	R-844/ARN-58	Door 2204	9.75	6.87	5.01	336	9		0.03	30W	Convection	Hard
Control	C-6176/ARN-58A		3.0	5.75	5.0	86	1.1				Convection	
MKR BCN Ant	16D00500						1.0					Hard
Glide Slope	P/O Radome	Nose Radome					.8					Hard
Localizer Antennas	P/O Doors	Doors 1102 and 1202										Hard
Possible Replacement System	R-1755/ ARN-112**	Door 2204 After Mechanical Mod of ILS Bay	5	3.75	11.5	216	7		0.02	20W	Convection	Hard

*For ARN-58A, NSN: 5826-00-498-3313.
**R-1755 functionally replaces R-843 and R-844 and provides 20 additional localizer channels.

435

Table 6-13. F-111A AVIONICS CONFIGURATION DATA: INS AN/AJQ-20A NSN: 6605-00-170-6701

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Inertial Nav. System	AN/AJQ-20A											
Stabilized Platform	MX-6767/AJQ-20	Door 1102					75.0			275W	Forced Air	Shock
XMTR Induct Type Flux Valve	TKU-79/A		4.0 dia.		2.0	25.1	1.8					
Nav Comp	CP-812/AJQ-20	Cockpit					77.8			281W	Convection	Panel
Ballistics Computer	CP-937/AJQ-20A											

436

Table 6-14. F-111A AVIONICS CONFIGURATION DATA: INTERFERENCE BLANKER NSN: 5865-00-813-5469

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Interference Blanker	MX-6770/U	Door 1102				TBD					Forced Air	Shock

437

Table 6-15. F-111A AVIONICS CONFIGURATION DATA: IFF TRANSPONDER AN/APX-64 NSN: 5895-00-115-7812

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
IFF Transponder	AN/APX-64	Door 1201	8.58 Including MT and SWAY	12.69	20.16	2195	30.0	0.18	0.02	200W	Internal Blower	Shock Mount
Rcvr-Xmtr on Mount	RT-728/APX-64 MT-3497											
Control	C-6717/APX-64	Cockpit	5.25	5.75	5.00	151	2.5			8W	Convection	Cockpit
Test Set Airborne	TS-1843/APX	Door 1201	3.15	3.25	7.81	80	3.0		0.01	10W	Convection	MT-3513
Antenna*	AS-1919	Upper and Lower					2.0					
Transponder Computer	KIT-1A/T SEC	Door 1202	8.62 Including MT and SWAY	6.6	14.25	810	12.0			30W		MT-4579/U
Replacement Rcvr-Xmtr	RT-1063B/APX-101**	Not Defined	5.8	6	10.8	376	14	64	64		Convection	Not Defined

*Antennas are shared with UHF data link.
**APX-101 will replace APX-64 per APR.

438

Table 6-16. F-111A AVIONICS CONFIGURATION DATA: TFR AN/APQ-110 PARTIAL LISTING NSN: 5841-00-772-1811

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
TF Radar Sys	AN/APQ-110											
TF Cmptr	CP-799/APQ-110	Door 1201					13.8				Forced Air	MT-3359
Ant Rcvr	AS-2138-128/APQ	Nose Radome					27.9			90W		
TF Ind	IP-773/APQ-110	Cockpit					23.7			126W	Convection	Cockpit
TF Radar Set Control	C-6456/APQ-110	Cockpit	3.0	5.75	7.31	126.1	2.6			11W	Convection	Cockpit
Amp-Pwr Supply	AM-4240/APQ-110	Door 1201	6.0	6.75	7.31	713	17.6				Forced Air	MT-3359
Sync-Rcvr	SN-379/APQ-110	Door /102					26.8				Forced Air	MT-3359
Ant. Rcvr	AS-1717/APQ											

439

Table 6-17. F-111A AVIONICS CONFIGURATION DATA: ATTACK RADAR SET APQ-113 MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)*			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna Assy	AS-1749/APQ-113	Nose Radome	26.0	35.0	32.0	29,120	53.0					
Antenna Pedestal	AB-502/APQ-113	Nose Radome	19.0	21.0	8.0	3,192	[illegible]					
Antenna Control	C-6498/APQ-113	Nose Radome	10.0	27.0	8.0	2,160	[illegible]			98W	Forced Air	MT-3384/APQ-113
Modulator Receiver Transmitter	MD-[illegible]/APQ-113	Door 1101	21.0	13.0	21.0	5,733	[illegible]			1kw	Forced Air	MT-3384/APQ-113
Electrical Synchronizer	SN-380/APQ-113	Door 1101	13.25	13.0	20.75	3,574	71.0			392W	Forced Air	MT-3384/APQ-113
Indicator Recorder	IP-777/APQ-113	Cockpit	9.25	16.25	30.5	4,585	[illegible]				Convection	Cockpit
Radar Set Control	C-6499/APQ-113	Cockpit	3.75	5.75	6.5	140	3.0				Convection	Cockpit
Antenna-Indicator Control	C-6500/APQ-113	Cockpit	8.75	5.0	3.5	153	2.0				Convection	Cockpit
Electrical Equipment Rack	MT-3384/APQ-113	Door 1101	34.25	13.25	25.75	9,870	6.0					

*Total system power dissipation is 1.637kW ac, 0.1kW dc.

44c

Table 6-18. F-111A AVIONICS CONFIGURATION DATA: INFARED RADAR AN/AAR-34 MEN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver Control	C-8250/AAR-34											
Search Track Scanner	CV-2630/AAR-34					Data for this equipment are Classified.						
Video Signal Processor	CM-389/AAR-34											

Best Available Copy 441

Table 6-19. F-111A AVIONICS CONFIGURATION DATA: RADAR WARNING ALR-23 PARTIAL LISTING NSN: 5865-00-104-9842

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
RCVR (IR) CM	AN/ALR-23						68.29	1.35	.12	729W		
Processor Video Sig.	CM-319 (xa-2)/ ALR-23	Door 1101	7.76	7.00	16.25	883	21.37			33W	Forced Air	CH-542/XA-1/ALR-23
Scanner Search/ Track	CV-1853/ALR-23 23(V)	Door 4491	7.63 dia.		15.45	185	27.02			60W		
Converter Cryogenic	MX-C378(xA-2)/ ALR-23	Door 4492	6.80 dia.		22.0	235						
Control, CM	C-6474/ALR-23	Cockpit	2.5	5.75	2.62	37.7	1.13			136W	Convection	Cockpit

442

Best Available Copy

Table 6-20. F-111A AVIONICS CONFIGURATION DATA: AN/APS-109 ECM NSN: 5865-00-813-5413

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna Band 3	AS-1781/APS-109	Radome										
Antenna Band 3	AS-1725/APS-109	Radome										
Antenna Band 1	AS-1723/APS-109	Radome										
Antenna	AS-1719/APS-109	Radome										
Receiver	R-1643/APS-109	TBD										MT-42251 APS-109
Vid. Sig. Proc	CM 392/APS-109		10	3.37	22.8			115 Vac				MT-4225/ APS-109
Indicator	SB-3355/APS-109											Panel

Best Available Copy

443

Table 6-21. F-111A AVIONICS CONFIGURATION DATA: ECM AN/ALR-39 NSN: 5865-00-432-6014

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver	R-1607l/ALR-39											
Power Suppl.	131297-000 (or) 216801-000											
Antenna Lo-Band Blade	AT-741/A			Details of AN/ALR-39 are Classified.								
Antenna	12E 2946-5											
Antenna	12E2949-803											
Antenna	12E2945-5											
Control	50-1311-1	Cockpit										
Data Analysis	UX-8369A1 ALR-39										Convection	Panel

444

Best Available Copy

Table 6-22. F-111A AVIONICS CONFIGURATION DATA: ECM AN/ALR-41 NSN: 5865-00-432-6015

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver	R-1633/ALR-41	Door 1202										
Ant. Rlvr.												
Ant. Low Band Blade						Details of An/ALR-41 are Classified.						
Power Supply	SC-1115-7	Door 1201										
Ant. Recr												
Control	12F0002-5	Cockpit		5.75								

Table 6-23. F-111A AVIONICS CONFIGURATION DATA: ECM AN/ALQ-41 NSN: 5865-00-432-6015

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
RIT	13840G1	Door 1101									Forced Air	Shock
Transmitter	13891G1	Door 1101									Forced Air	Shock
Power Supply	13892G1	Door 1101			Details of AN/ALQ-41 are Classified.						Forced Air	Shock
Control	C-3780/ALQ-41	Cockpit									Convection	Panel
Antenna												
Antenna												

446

Table 6-24. F-111A AVIONICS CONFIGURATION DATA: ECM AN/ALQ-94 NSN: 5865-00-890-0422

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Amp Mid Band	AM-4851/ALQ-94	Door 1101									Forced Air	MT-3878/ ALQ-94
Receiver Mid	R-1498/ALQ-94	Door 1101									Forced Air	MT-3878/ ALQ-94
Amp Low Band	AM-4850/ALQ-94	Door 1101									Forced Air	MT-3877/ ALQ-94
Receiver low	R-1497/ALQ-94	Door 1101			Details of AN/ALQ-94 are Classified.						Forced Air	MT-3877/ ALQ-94
Amp High Band	AM-4852/ALQ-94	Door 1201									Forced Air	MT-3879/ ALQ-94
Receiver High	R-1499/ALQ-94	Door 1201									Forced Air	MT-3879/ ALQ-94
Control	C-7410/ALQ-94	Cockpit									Convection	Panel
Ant. No. 3												
Ant. No. 5												
Ant. No. 7												
Ant. No. 9												
Ant. High												
Ant. Mid												
Ant. Low												

Table 6-25. F-111A AVIONICS CONFIGURATION DATA: CM DISP. SET (PARTIAL LISTING) AN/ALE-28 NSN: 5865-00-105-8987*

Item	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
CM Disp Set	AN/ALE-28							.15	.075	111W		
Control	C-6471/ALE-28	Cockpit	4.12	5.75	6.25	148	4.6			20W	Convection	Cockpit
Control Seq-Eject	C-6472/ALE-28		2.25	7.00	5.31	83.6	2.2					
Eject Force Disp	D-22/ALE-28		11.6	9.8	32.4	3,683	51			2.05W		
Disposables Cont. Panel		Cockpit	1.12	5.75	4.0	25.76	0.4	0.005	0.007	12W	Convection	Cockpit

*Also 5865-00-114-3146.

448

Table 6-26. F-111A AVIONICS CONFIGURATION DATA: RECORDER SET AN/A24U-6 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Rec. Mech. Assy	MXK-316/A24U-6			TBD								
Mag. Rec. Set	MXK-315/A 24U-6											

449

Table 6-27. F-111A AVIONICS CONFIGURATION DATA: AN/ASG-23 LEAD COMPUTING OPTICAL SIGHT SYSTEM MSN: 1276-00-244-6805

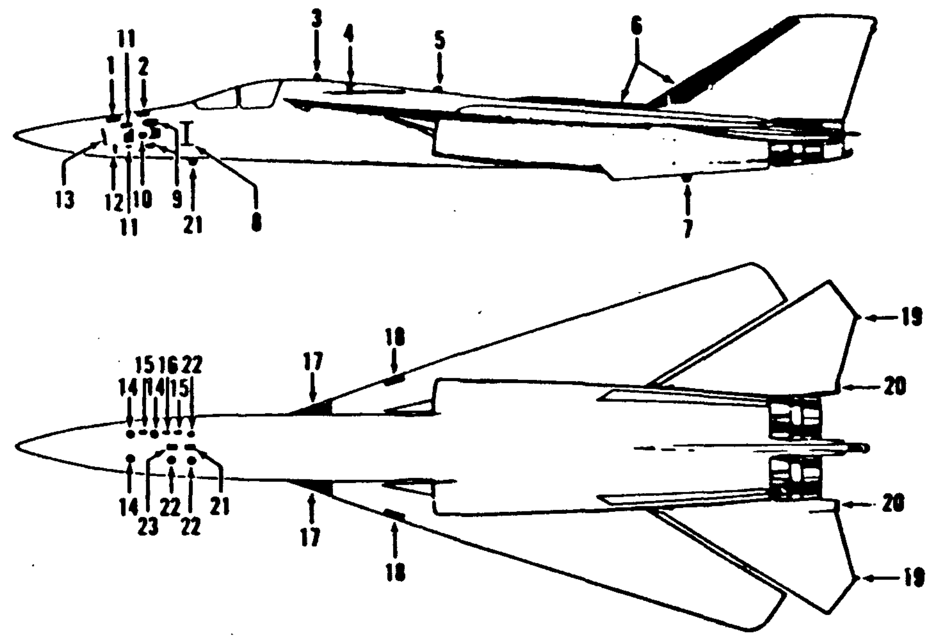
Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Optical Disp. Sight	SU-29/ASG-23	Cockpit	8.9	6.8	23	1,392	20.0				Convection	Cockpit
Lead and Launch Comp. Amp.	AM-4301/ ASG-23	Door 1102	4.9	8.02	15.2	597	20.0				Forced Air	Shock
Lead Computing Gyro	CN-1060/ASG-23	Door 1102	10.5	10.5	9.0	992	14.0				Forced Air	Hard
Amplifier Mounting Rack		Door 1102	1.0	8.35	15.7		1.0					

450

7. ANTENNA LOCATIONS

Figure 7-1 shows the approximate locations of the antennas on the F-111A. Antenna nomenclature from current technical orders is as follows:

	Antenna	Nomenclature or Part Number
1.	Glide Slope Strip	12Z519-7
	Glide Slope Plate	12Z517-1
2.	ADF	AS-909/ARA-48
3.	IFF (Upper) and UHF Data Link	11D020100-6
4.	Radio Beacon Set	AN/URT-27 or -33
5.	UHF No. 1 and TACAN Upper	11D020100-6
6.	HF Dorsal	12T501-807
	HF Vertical	12T010-849
7.	IFF Lower	AT-741B/A
8.	Localizer (2)	TBD
9.	Low and Medium Frequency Radar Homing (4)	LH Installation 12E2239-5
10.	Forward Radar Warning (2)	
11.	High Frequency Radar Homing (4)	RH Installation 12E2239-6
12.	Terrain Following Radar (2)	AS-2136/APQ-110
13.	Attack Radar	AS-1749/APQ-113
14.	AN/ALQ-94 ECM No. 3	12E2907-1
	AN/ALQ-94 ECM No. 5	12E2908-1
	AN/ALQ-94 ECM No. 7	12E2909-1
15.	Radar Altimeter	LG81G3
16.	AN/ALR-62	311190-1
17.	AN/ALQ-94 High Band Wing Glove (4)	12E2989-1
	AN/ALQ-94 Medium Band Wing Glove (2)	12E2987-1
	AN/ALQ-94 Low Band Wing Glove (4)	12E2988-1
	AN/ALQ-94 Mid Band, Transmit Wing Glove (4)	12E2999-1
18.	AN/ALR-62 (2)	12E2982-1
19.	Aft Radar Warning (2)	12E805-1
20.	AN/ALQ-94 ECM No. 9 LH Assembly (3 antennas per assembly)	12E2910-1
	AN/ALQ-94 ECM No. 9 RH Assembly (3 antennas per assembly)	12E2910-1
21.	UHF No. 2 and TACAN Lower	11D20100-3
22.	AN/ALQ-94 ECM No. 3	12E2907-1
	AN/ALQ-94 ECM No. 5	12E2908-1
	AN/ALQ-94 ECM No. 7	12E2909-1
23.	Marker Beacon	16D00500



1. Glide Slope.
2. ADF.
3. IFF (Upper) and UHF Data Link.
4. Radio Beacon Set.
5. UHF #1 and TACAN Upper.
6. HF.
7. IFF Lower.
8. Localizer (2).
9. Low and Medium Frequency Radar Homing (4).
10. Forward Radar Warning (2).
11. High Frequency Radar Homing (4).
12. TFR (2).
13. Attack Radar
14. AN/ALQ-94 (3).
15. Radar Altimeter.
16. AN/ALR-62.
17. AN/ALQ-94 (12).
18. AN/ALR-62 (2).
19. Aft Radar Warning (2).
20. AN/ALQ-94 (6).
21. UHF #2 and TACAN Lower.
22. AN/ALQ-94 (3).
23. Marker Beacon.

Figure 7-1. ANTENNA LOCATIONS (TYPICAL)

8. INTERFACE DATA

This section contains examples of interface signal characteristics. These data were extracted from applicable sections of the Interface Control Documents (ICDs) for integration of GPS user equipment in the F-111A aircraft. Each sheet discusses a particular signal. The top line contains the signal name, type of signal (digital, analog, descrete, or synchronous), signal source and load, and whether the signal is an input or output of the GPS user equipment. A functional description follows, together with a description of the signal's characteristics.

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Bearing	Synchro	0	UE	HSI and BDHI

Functional Description

Provides angular information to the bearing pointer* to display relative bearing of the aircraft's present position to selected waypoint. The relative bearing is the difference, in degrees, between the lubber line and the bearing pointer as read from the compass card.

*No. 1 pointer on BDHI

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^\circ$
INDEX REFERENCE: Aircraft Heading
POSITIVE DIRECTION SENSE: Increasing Bearing
SCALE FACTOR: $1^\circ = 1^\circ$
RESOLUTION: HSI $\pm$ 2.5°, BDHI $\pm$ 0.5°

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Bearing Pointer, 3-Wire Synchro, Bendix Type AY-500-5 or equal
2) BDHI, E5165001400, No. 1 Pointer, 3-Wire Synchro, Bendix Type AY-100 HY-59-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-18-1

A ICD-GPS-014 & 017
SHEET 10-2

454

ELECTRICAL CHARACTERISTICS

LOAD1	LOAD 2
HSI, AQU-4/A, Bearing Pointer, 3-Wire Synchro, Bendix Type AY-500-5 or equal	BDHI, E 5165001400, No. 1 Pointer, 3-Wire Synchro, Bendix Type AY-100 HY-59-A1 or equal

LOAD1

ROTOR

Input Voltage	26	Volts
Frequency	400	Cycles
Input Current	--	ma
Input Power	--	Watts
Resistance (DC)	530	Ohms

STATOR

Input Voltage	11.8	Volts
Input Current	20	ma
Input Power	0.090	Watts
Resistance (DC)	188	Ohms
Rotor Output Voltage	19	Volts
Phase Shift (S to R)	15	Degrees
Accuracy (Max)	15	Minutes
Null Voltage (Max)	50	mv

IMPEDANCE

Zso	222 + j470 Ohms
Zro	940 + J2260 Ohms
Zrss	1050 + j450 Ohms

LOAD 2

Primary Winding	Stator	
Primary Voltage (400 Hz)	11.8	Volts
Secondary Voltage	20.3	Volts
Input Current	.020	Amps
Input Power	.060	Watts
Max. Error Spread	±6	Minutes
Max. Null Voltage	30	mv
Zro	595 + J2130	
Zso	750 + J369	
Rotor DC Resistance	409	Ohms
Stator DC Resistance	1200	Ohms

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-3

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Units	Synchro	0	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the units digit in the range window. Displays aircraft present position distance to selected waypoint in 1 nm increments (0.5 nm indexed). Driven independently of other digits, but read in conjunction with them in order to provide the least significant digit.

Signal Characteristics

RANGE: 0 to 9 (0° to 360°)
ACCURACY: $\pm$ 0.1 ($\pm$ 3.6°)
INDEX REFERENCE: $\overline{0}$
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36° = 1 numeral
RESOLUTION: $\pm 3^{\circ}$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, 5516S001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-DD-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through 26 Vac common.

A/C: F-111A/E
REF: MIL-I-27848
T.O. 12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-18-1

A | ICD-GPS-014 & 017 | SHEET 10-4

456

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal	BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type, AY 080-DD-46-A1 or equal

Load 1

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	100	ma
Input Power	.54	Watts
Accuracy	30	Feet
Impedance, Zro	54 + j260	Ohms
Impedance, Zso	12 + j45	Ohms
Rotor DC Resistance	37	Ohms
Stator DC Resistance	12	Ohms
Phase Shift	8.5	Degrees

Load 2

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	187	ma
Input Power	1.1	Watts
Max. Error Spread	±1.25	Degrees
Impedance, Zro	32 ∓ j150	
Impedance, Zso	6.8 + j26	
Impedance, Zrs	57 + j14	
Rotor DC Resistance	24	Ohms
Stator DC Resistance	7.3	Ohms

A ICD-GPS-014 & 017

SHEET 10-5

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Tens	Synchro	0	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the tens digit in the range window. Displays aircraft present position distance to selected waypoint in 10 nm increments. Driven independently of other distance digits but read in conjunction with them.

Signal Characteristics

RANGE: 0 to 9 (0° to 360°)
ACCURACY: $\pm$ 0.1 ($\pm 3.6^{\circ}$)
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36° = 1 numeral
RESOLUTION: $\pm 3^{\circ}$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-DD-46-A1 or equal

SOURCE: (TPD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through 26 Vac common.

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-18-1

A ICD-GPS-014 & 017
SHEET 10-6

455

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal	BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY080-DD-46-A1 or equal

LOAD 1

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	100	ma
Input Power	.54	Watts
Accuracy	30	Feet
Impedance, Zro	54 + j260	
Impedance, Zso	12 + j45	
Rotor DC Resistance	37	Ohms
Stator DC Resistance	12	Ohms
Phase Shift	8.5	Degrees

LOAD 2

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	187	ma
Input Power	1.1	Watts
Max. Error Spread	±1.25	Degrees
Impedance, Zro	32 + j150	
Impedance, Zso	6.8 + j26	
Impedance, Zrs	57 + j14	
Rotor DC Resistance	24	Ohms
Stator DC Resistance	7.3	Ohms

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-7

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, ndreds	Synchro	0	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the hundreds digit in the range window. Displays aircraft present position distance to the selected waypoint in 100 nm increments. Driven independently of the other distance digits, but read in conjunction with them in order to provide the most significant digit for the distance value.

Signal Characteristics

RANGE: 0 to 9 (0^{o} to 360^{o})
ACCURACY: $\pm$ 0.1 ($\pm$ 3.6^{o})
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^{o} = 1 numeral
RESOLUTION: $\pm 3^{o}$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-DD-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through AC common.

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1E-111E-2-18-1

A		ICD-GPS-014 & 017
		10-8

46C

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal	BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY080-DD-46-A1 or equal

Load 1

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	100	ma
Input Power	.54	Watts
Accuracy	30	Feet
Impedance, Zro	54 + j260	
Impedance, Zso	12 + j45	
Rotor DC Resistance	37	Ohms
Stator DC Resistance	12	Ohms
Phase Shift	8.5	Degrees

Load 2

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	187	ma
Input Power	1.1	Watts
Max. Error Spread	±1.25	Degrees
Impedance, Zro	32 + j150	
Impedance, Zso	6.8 + j26	
Impedance, Zrs	57 + j14	
Rotor DC Resistance	24	Ohms
Stator DC Resistance	7.3	Ohms

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Flag	Discrete	O	UE	HSI & BDHI

Functional Description

Provides a discrete signal to operate the distance warning flag. The flag is normally out of view when the range indicator is operating and the range data is valid. The flag covers the range indicator when the distance information is not valid or the device supplying the distance data is not operating.

Signal Characteristics

RANGE: 28 Vdc applied, Flag out of view
28 Vdc not applied, Flag in view

Electrical Characteristics

LOAD: 1) HSI (AQU-4/A), distance shutter mechanism, 28 Vdc meter movement
2) BDHI (E5165001400), distance shutter mechanism, 28 Vdc meter movement, 625 Ohms $\pm$ 10%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-18-1

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-10

462

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Thousand, Digit	Discrete	0	UE	HSI

Functional Description

Provides a discrete output signal to operate the thousand digit of the HSI when the distance to a selected waypoint is greater than 999 nautical miles.

Signal Characteristics

Thousand Digit In View: 28 Vdc applied
Thousand Digit Out of View: 28 Vdc not applied

Electrical Characteristics

LOAD: HSI (AQU-4/A), thousand digit shutter
Input Voltage: 28 Vdc
Input Current: 150 ma

SOURCE: (TBD-1)

Interconnection Data

(TBD-3)

A/C: F-111A/E
REF: MIL-I-27848
T.O. 5F8-16-4-3

A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-11

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
To-From	Analog	0	UE	HSI

Functional Description

Provides a d.c. analog signal to drive the To-From indicator. If the aircraft is flying toward the waypoint and has not intercepted a reference line perpendicular to the aircraft ground track and through the waypoint, the indication will be To. Once past the waypoint reference line, the indication will be From as long as this waypoint is still selected.

Signal Characteristics

RANGE: To = +225 μa Max
Blank = no signal
From = -225 μa Max

Electrical Characteristics

LOAD: HSI (AQU-4/A), To-From Arrow, meter movement 200 Ohms ± 15 resistance

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
1F-111A-2-18-1
1F-111E-2-18-1

A ICD-GPS-014 & 017
10-12

464

INTERFACE SIGNAL CHARACTERISTIC

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation	Analog	O	UE	Flight Director Computer

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft to the left or right of a selected course. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 10° for a TACAN approach; 2.5° for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 2-6 miles full scale, (b) Terminal: 1-2 miles full scale and (c) Approach: 600-3000 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to ±150 μa
RESOLUTION: 3 μa
ACCURACY: ±10 μa
INDEX REFERENCE: Selected course
POSITIVE DIRECTION SENSE: Fly right (+)
SCALE FACTOR: 75 μa/dot on the indicator.
Distance/angular displacement scale factor (TBD-1)

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms ± 3%
SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848 ARINC Characteristic 582-5
MIL-C-83013
1F-111A-2-18-1
1E-111E-2-18-1

A ICD-GPS-014 & 017
10-13

415

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horzontal Deviation Flag	Discrete	O	UE	Flight Director Computer

Functional Description

Provides a discrete signal to operate the deviation warning flag or circuit when the deviation data is unreliable or a malfunction has occurred in the course deviation circuitry.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms, ± 3% resistance

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
MIL-C-83013
1F-111A-2-18-1
1F-111E-2-18-1

A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-14

466

INTERFACE SIGNAL CHARACTERISTIC

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation	Analog	0	UE	Flight Director Computer

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft above or below a desired flight path. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 0.5° for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 200 to 2000 feet full scale, (b) Terminal: 60-200 feet full scale and (c) Approach: 40-100 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to ± 150 μa
RESOLUTION: 3 μa
ACCURACY: ±10 μa
INDEX REFERENCE: Desired flight path
POSITIVE DIRECTION SENSE: Fly Down (+)
SCALE FACTOR: 75 μa/dot on the indicator.
Distance/angular displacement scale factor (TBD-1)

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms ± 3%
SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-C-83013
1F-111A-2-17-1
1F-111E-2-17-1
ARINC Characteristic 582-5

A | ICD-GPS-014 & 017 | 10-15

467

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation Flag	Discrete	O	UE	Flight Director Computer

Functional Description

Provides a discrete signal to the Flight Director Computer when the UE vertical deviation signal is unreliable. This signal is similar to glideslope flag signal.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv.

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms ± 3%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-C-83013
1F-111A-2-17-1
1F-111E-2-17-1

A | ICD-GPS-014 & 017 | SHEET 10-16

468

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Output Data	Digital	O	UE	IBNS

Functional Description

Provides position, velocity and time and other parameters (TBD-3) to the IBNS to update the Inertial Navigation Set and to aid in navigation and bombing solutions. (See Appendix II.)

Signal Characteristics

Word/Frame Structure: (TBD-3)
Information Identifier: (TBD-3)
Data Standard: (TBD-3)
Timing Tolerances: (TBD-3)

Electrical Characteristics

(TBD-3)

Interconnection Data

(TBD-3)

A/C: F-111A/E
REF:

A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-17

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	[illegible]	I/O	FROM	TO
Magnetic Heading	Synchro	I	AFRS-Electronic Control Amplifier	UE

Functional Description

Provides angular reference signal of aircraft heading relative to magnetic north.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: Magnetic North
POSITIVE DIRECTION SENSE: Nose Right
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: (TBD-3)

Electrical Characteristics (continued on next page)

SOURCE: Auxiliary Flight Reference System, Electronic Control Amplifier (ASK 25A/A24G-26), 3-Wire Synchro, Clifton CGH-8-A-7 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-C-38418
T.O. 1F-111A-2-12-1
T.O. 5F4-21-3
T.O. 5F4-21-4
T.O. 1F-111E-2-12-1

SIZE	CODE IDENT NO.	DRAWING NO.
A		ICO-GPS-014 & 017
SCALE	REV	SHEET 10-18

470

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Clifton Type CGH-6-A-7 or equal	
Input Voltage 115V 400Hz Input Current 29 ma Input Power 0.8 w Output Voltage (Max) 11.8V Sensitivity 206 mv/deg Phase Shift 11 deg DC Rotor Resistance 700 Ohms DC Stator Resistance 10.4 Ohms Impedance, Zro 950 + j3, 850 Ohms Impedance, Zso 10 + j36 Ohms Impedance, Zrss 1550 + j420 Ohms Max Null Voltage 75 mv Accuracy (Max Error Spread) 14 minutes	

SIZE A	CODE IDENT NO	DRAWING NO ICD-GPS-014 G 017
SCALE	REV	SHEET 10-19

471

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
True Airspeed	Synchro	I	Central Air Data Computer	UE

Functional Description

Provides an input of true airspee in synchro format.

Signal Characteristics

RANGE:
ACCURACY:
INDEX REFERENCE: (TBD-2)
POSITIVE DIRECTION SENSE:
SCALE FACTOR:
RESOLUTION:

Electrical Characteristics (continued on next page)

SOURCE: Central Air Data Computer, 1903633-4, 3-Wire Synchro, Bendix type AY 200S 16A7 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: 2 Shielded Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" ties to shield ground

A/C: F-111A/E
REF: T.O. 5F5-4-17-3
T.O. 1F-111A-2-16-1
T.O. 1F-111E-2-16-1

A ICD-GPS-014 & 017
10-20

472

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Bendix Type AY 300S 16A7 or equal	
Primary Winding — Rotor Input Voltage — 26 Vac, 400 Hz Input Current — 91 ma Input Power — 0.6 watts Output Voltage (Max) — 11.8V Phase Shift — 9.5° lead DC Rotor Resistance — 50 ohms DC Stator Resistance — 16 ohms Impedance, Zro — 70 + j305 ohms Impedance, Zso — 16.5 + j50 ohms Max Null Voltage — 30 mv Accuracy (Max error spread) — ±10 minutes	

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-21

473

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Barometric Altitude	Synchro	I	Central Air Data Computer	UE

Functional Description

Provides an input of barometric altitude in synchro format.

Signal Characteristics

RANGE:
ACCURACY:
INDEX REFERENCE: (TBD-2)
POSITIVE DIRECTION SENSE:
SCALE FACTOR:

Electrical Characteristics (continued on next page)

SOURCE: Central Air Data Computer, 1903633-4, 3-wire synchro
Bendix type AY 300C 43A1 or equal

LOAD: (TBDG)

Interconnection Data

Wire Type & No.: Shielded Pair and One Shielded Conductor
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: T.O. 5F5-4-17-3
T.O. 1F-111A-2-16-1
T.O. 1F-111E-2-16-1

A ICD-GPS-014 & C17

10-22

474

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulses	Pulse	I	Interference Blanker	UE

Functional Description

The interference blanker provides blanking pulses to prevent interference between systems operating in the same frequency spectrum.

Signal Characteristics (see pages 10-24 and 10-25)

Electrical Characteristics

SOURCE: Interference Blanker, MX-8103/A

LOAD: (TBD-1)

Interconnection Data

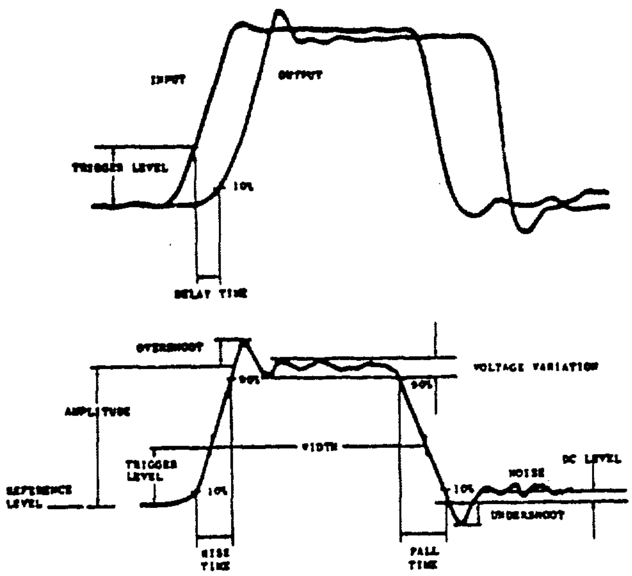
Wire Type & No.: Coaxial Cable, RG-58 C/U

A/C: F-111A/E
REF: T.O. 12P3-4-22-12
T.O. 1F-111A-2-22
T.O. 1F-111E-2-22

A ICD-GPS-014 & 017

SHEET 10-23

495



AMPLITUDE - AVERAGE DC-LEVEL OF THE PULSE TOP, OVERSHOOT EXCLUDED.

RISE TIME - TIME INTERVAL BETWEEN THE 10% AMPLITUDE LEVEL AND THE 90% AMPLITUDE LEVEL ON THE LEADING EDGE OF THE PULSE.

FALL TIME - TIME INTERVAL BETWEEN THE 90% AMPLITUDE LEVEL AND THE 10% AMPLITUDE LEVEL ON THE TRAILING EDGE OF THE PULSE.

WIDTH - TIME INTERVAL BETWEEN THE POINT WHERE THE PULSE CROSSES THE NOMINAL TRIGGER LEVEL ON THE LEADING EDGE OF THE PULSE AND THE POINT WHERE THE PULSE CROSSES THE NOMINAL TRIGGER LEVEL ON THE TRAILING EDGE OF THE PULSE.

VOLTAGE VARIATION - PEAK VALUE OF THE CHANGE IN VOLTAGE, GREATER OR LESS THAN THE AMPLITUDE LEVEL, THAT OCCURS ON THE DC COMPONENT PULSE.

OVERSHOOT - MAXIMUM POSITIVE VOLTAGE ATTAINED BY THE LEADING EDGE OF THE PULSE ABOVE THE AMPLITUDE LEVEL.

UNDERSHOOT - MAXIMUM NEGATIVE VOLTAGE ATTAINED BY THE TRAILING EDGE OF THE PULSE AS MEASURED FROM THE ZERO LINE.

NOISE - ALL DEVIATIONS IN VOLTAGE FROM THE DIRECT RESIDUAL LEVEL THAT OCCURS BETWEEN THE 10% LEVEL ON THE TRAILING EDGE OF ONE PULSE AND THE 10% LEVEL OF THE LEADING EDGE OF THE FOLLOWING PULSE, WITH THE EXCEPTION OF THE UNDERSHOOT AND THE LEADING AND TRAILING EDGES, SHALL BE CONSIDERED NOISE. FOR NOISE MEASUREMENTS THE LOW VOLTAGE INPUT PULSE RISE TIME SHALL NOT BE LESS THAN 20 NANOSECONDS AND THE FALL TIME SHALL NOT BE LESS THAN 40 NANOSECONDS.

TRIGGER LEVEL - THAT INPUT VOLTAGE BELOW WHICH THE OUTPUT OF A CHANNEL IS 0 AND ABOVE WHICH THE OUTPUT OF THE CHANNEL IS THE SPECIFIED VOLTAGE.

DELAY TIME - TIME INTERVAL BETWEEN THE NOMINAL TRIGGER LEVEL ON THE INPUT PULSE TO THE 10% LEVEL ON THE RESULTING OUTPUT PULSE LEADING EDGE.

Blanking Pulse Characteristics
(continued)

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 G 017
SCALE	REV	SHEET 10-24

476

CHARACTERISTIC	HIGH VOLTAGE INPUT CHANNELS	LOW VOLTAGE INPUT CHANNELS	HIGH VOLTAGE OUTPUT CHANNELS	LOW VOLTAGE OUTPUT CHANNELS
RISE TIME	20 OR MORE NANOSECONDS	2 OR MORE NANOSECONDS	LESS THAN 0.5 MICROSECOND	LESS THAN 20 NANOSECONDS
FALL TIME	40 OR MORE NANOSECONDS	3 OR MORE NANOSECONDS	LESS THAN 0.5 MICROSECOND	LESS THAN 40 NANOSECONDS
WIDTH				
MINIMUM	500 NANOSECONDS	100 NANOSECONDS		
MAXIMUM	DC COUPLED CIRCUITS LIMITED ONLY BY DUTY CYCLE	DC COUPLED CIRCUITS LIMITED ONLY BY DUTY CYCLE		
WIDTH VARIATION FROM INPUT PULSE			+1, -0.5 MICROSECOND	150 NANOSECONDS
AMPLITUDE				
MINIMUM	15 VOLTS	5 VOLTS	20 VOLTS	6 VOLTS
NOMINAL	35 VOLTS	7 VOLTS	25 VOLTS	7 VOLTS
MAXIMUM	70 VOLTS	9 VOLTS	30 VOLTS	8 VOLTS
VOLTAGE VARIATION ABOUT PULSE			±3 VOLTS	±0.75 VOLT
REPETITION RATE				
MINIMUM	DC (WITHIN DUTY CYCLE LIMIT)	DC (WITHIN DUTY CYCLE LIMIT)	DC (WITHIN DUTY CYCLE LIMIT)	DC (WITHIN DUTY CYCLE LIMIT)
MAXIMUM	1 MEGACYCLE	10 MEGACYCLES	1 MEGACYCLE	10 MEGACYCLES
DUTY CYCLE (ON/OFF TIME)	30% WITH 70 VOLT PULSES 75% WITH 30 VOLT PULSES	75% WITH 7 (±1) VOLT PULSES	SAME AS INPUT	SAME AS INPUT
UNDERSHOOT	0 TO -3 VOLTS	0 TO -0.7 VOLT	0 TO -2.5 VOLTS	-0.65 VOLT
OVERSHOOT	0 TO 6 VOLTS	0 TO 2 VOLTS	10 VOLTS	2 VOLTS
DC LEVEL BETWEEN PULSES			0 TO 1 VOLT	0 TO 0.3 VOLT
NOISE	0 TO ±0.5 VOLTS	0 (±0.9) VOLTS	±2.5 VOLTS	±0.8 VOLT
DELAY TIME				
HIGH VOLT INPUT			250 NANOSECONDS MAXIMUM	150 NANOSECONDS MAXIMUM
LOW VOLT INPUT			350 NANOSECONDS MAXIMUM	70 NANOSECONDS MAXIMUM
LOAD IMPEDANCE				
RESISTANCE	300 (±20%) OHMS	93 (±10%) OHMS	500 TO 2200 OHMS	93 (±10%) OHMS
CAPACITANCE			0 TO 1000 PICOFARADS	
TRIGGER LEVEL	10 (±3) VOLTS	3 (±1) VOLTS		

Blanking Pulse Characteristics
(continued)

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 C 017
SCALE	REV	SHEET 10-25

Best Available Copy

477

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Pitch	Synchro	I	AFRS	UE

Functional Description

Provides an input signal proportional to fuselage pitch attitude with respect to the earth's horizon. Signal amplitude is proportioned to amount of fuselage displacement from level flight and phase indicates direction of displacement

Signal Characteristics

RANGE: 0° to $\pm 90^{\circ}$
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: 0° Pitch
POSITIVE DIRECTION SENSE: Nose Up
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: (TBD-3)

Electrical Characteristics (continued on next page)

SOURCE: AFRS, 3-Wire Synchro, Clifton Type CGH-8-A-7 or equal
Electronic Control Amplifier (ASK-25A/A24G-26)

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: T.O. 1F-111A-2-12-1, T.O. 5F4-2-21-3, T.O. 5F4-2-21-4, MIL-C-38418 T.O. 1F-111E-2-12-1

A | ICD-GPS-014 & 017 | 10-26

478

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Clifton Type CGH-8-A-7 or equal	
Input Voltage 115V 400 Hz Input Current 29 ma Input Power 0.8w Output Voltage (Max) 11.8V Sensitivity 206 mv/deg Phase Shift 11° DC Rotor Resistance 700 Ohms DC Stator Resistance 10.4 Ohms Impedance Zro 950 + j3, 850 Ohms Impedance Zso 10 + j36 Ohms Impedance Zrss 1550 + j420 Ohms Max Null Voltage 75 mv Accuracy (max error spread) 14 minutes	

A ICD-GPS-014 & 017 10-27

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Roll	Synchro	I	AFRS	UE

Functional Description

Provides an input signal proportioned to fuselage roll attitude with reference to the earth's horizon. Signal amplitude is proportioned to amount of fuselage displacement from level flight and phase indicates direction of displacement

Signal Characteristics

RANGE: 0° to $\pm 90^{\circ}$
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: Zero Roll
POSITIVE DIRECTION SENSE: Right Wing Down
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: (TBD-3)

Electrical Characteristics (continued on next page)

SOURCE: Auxiliary Flight Reference System, Electronic Control Amplifier (ASK-25A/A24G-26), 3-Wire Synchro, Clifton CGH-8-A-7 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: T.O. 1F-111A-2-12-1, T.O. 5F4-21-3, T.O. 5F4-21-4, MIL-C-38418 T.O. 1F-111E-2-12-1

A | ICD-GPS-014 & 017 | 10-28

450

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Clifton Type CGH-8-A-7 or equal	
Input Voltage: 115V 400 Hz Input Current: 29 ma Input Power: 0.8w Output Voltage (max): 11.8V Sensitivity: 206 mv/deg Phase Shift: 11° DC Rotor Resistance: 700 Ohms DC Stator Resistance: 10.4 Ohms Impedance Zro: 950 + j3, 850 Ohms Impedance Zso: 10 + j36 Ohms Impedance Zrss: 1550 + j420 Ohms Max Null Voltage: 75 m Accuracy (max error spread): 14 minutes	

A		ICD-GPS-014 & 017
		10-29

481

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Input Data	Digital	I	IBNS	UE

Functional Description

Provides the UE with position, velocities, covariances and other parameters (TBD-3). (See Appendix II.)

Signal Characteristics

Word/Frame Structure: (TBD-3)
Information Identifier: (TBD-3)
Data Standard: (TBD-3)
Timing Tolerance: (TBD-3)

Electrical Characteristics

(TBD-3)

Interconnection Data

(TBD-3)

A/C: F-111A/E
REF:

A ICD-GPS-014 A 017 10-30

492

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Course Set	Synchro	I	HSI	UE

Functional Description

Provides an electrical reference signal of the course manually selected by the Course Set control on the HSI. This signal will be used by the UE as a reference for positioning the course deviation and To-From indicators on the HSI.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^\circ$
RESOLUTION: 1.0°
INDEX REFERENCE: Magnetic North
POSITIVE DIRECTION SENSE: Right Hand Increments
SCALE FACTOR: $1^\circ = 1^\circ$

Electrical Characteristics (Continued on next page)

SOURCE: HSI (AQU-4/A), Course Resolver, Kearfott Type CR40931013 or equal
LOAD: (TBD-1)

Interconnection Data

Wire Type & No. Seven single conductors (twisted)
Wire Size. No. 24 AWG

A/C: F-111A/E
REF: 1F-111A-2-18-1
MIL-I-27643
5F8-16-4-3
5F8-16-4-4

A | ICD-GPS-014 & 017 | SHEET 10-31

ELECTRICAL CHARACTERISTICS

SOURCE	
HSI, AQU-4/A, Course Resolver, Kearfott Type CR40931018 or equal	
Primary Winding — Rotor Input Voltage — 26 Vac Frequency — 400 Hz Input Current — 20 ma Input Power — 150 mw Input Impedance — 1680 $\angle 78.5^{\circ}$ ohms Output Impedance — 1400 $\angle 78^{\circ}$ ohms DC Resistance (rotor) — 190 ohms DC Resistance (stator) — 170 ohms Output Voltage — 22 Vac Sensitivity — 384 mv/deg Maximum null Voltage — 46 mv Maximum error from electrical zero — 10 minutes Transformation ratio — .846	

A ICD-GPS-014 : 017

10-32

484

9. FUTURE MODIFICATIONS

Table 9-1 lists the avionics suite expected to be installed in each of the F-111 family aircraft by 1985. This chart is useful for comparing the members of the F-111 family. Figures 9-1 and 9-2 show current and planned equipment bay space allocations. Here, the Ballistics Computer is shown removed in the planned arrangement. The KY-28 Secure Voice has been located in the right-hand equipment bay. Other systems added are AN/ALQ-137, AN/ALR-62, GPS, and AN/ARC-164.

GPS UE will physically and functionally replace the AN/ARN-118 TACAN System. The GPS receiver will be installed at the present TACAN location under Door 1202. The antenna is installed above the forward, right-hand equipment bay.

The AN/ARC-164 is planned to replace the ARC-109 in most F-111As by 1985. The AN/ARC-164 Radio Set has two basic configurations, the console mount and the remote mount.

Table 9-1. PRINCIPAL AVIONICS TO BE INSTALLED IN THE F-111 FAMILY BY 1985

Equipment	F-111A	F-111D	F-111E	F-111F	EF-111A
UHF	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164
HF	ARC-112/123	ARC-123	ARC-123	ARC-123	ARC-112
Intercom	AIC-25	AIC-25	AIC-25	AIC-25	AIC-25
INS	AJQ-20 Digital Bomb Navigational	AJN-16	AJQ-20 (Maybe Digital Bomb Navigational)	AJN-16	AJQ-20 Digital Bomb Navigational
TACAN	ARN-118 (Maybe GPS)	ARN-52/118 (Maybe GPS)	ARN-52/118 (Maybe GPS)	ARN-84 (Maybe GPS)	ARN-118 (Maybe GPS)
ILS	ARN-58 (Maybe CAT II MLS)	ARN-58 (Maybe CAT II MLS)	ARN-58	ARN-58 (Maybe CAT II MLS)	ARN-58 (Maybe CAT II MLS)
UHF-DF	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)
Radar Altimeter	APN-167	APN-167	APN-167	APN-167	APN-167
TFR	APQ-110	APQ-128	APQ-110	APQ-146/128/134	APQ-110
Attack Radar	APQ-113	APQ-130	APQ-113	APQ-144/114	Demodify to Naval Radar
Lead Computer Sight	ASG-23	--	ASG-23	ASG-27/25	Demodify
Auto Gun	M61-A1	M61-A1	M61-A1	M61-A1	Demodify
IFF A/G	APX-64	APX-64	APX-64	APX-64	APX-64
IFF Crypto	KIT-1A	KIT-1A	KIT-1A	KIT-1A	KIT-1A
HSI	AQU-4/A	AQU-4/A	AQU-4/A	AQU-4/A	AQU-4/A
CADC	1903633-4	1903634-3	1903633-4	1903634-3	1903633-4
Flight Director System	CPU-76	--	CPU-76A	CPU-76A	CPU-76, ARU-11
Auxiliary Flight Reference System	A24G-26A	A24G-26A	A24G-26A	A24G-26A	A24G-26A
RHAW	APS-109	APS-109	APS-109	APS-109	ALR-62 (TTWS)
ECM Receivers	ALR-23 AAR-34	ALR-23 AAR-34	-- AAR-34	ALR-23 AAR-34	ALR-23 (TTWS) ALQ-137 (SPS)
Jamming Transmitters	ALQ-94, 41	ALQ-94	ALQ-94, 119	ALQ-94	ALQ-99E (JSS)
Interference Blanker	MX-6770	MX-8106	MX-6770A	MX-8103	MX-9879/A
Dispenser	ALE-28	ALE-28	ALE-28	ALE-28	ALE-28
Strike Camera	KB-18A	KB-18A	KB-18A	KB-18A	Demodify
Flight Control System	FC-11	FC-11	FC-11	FC-11	FC-11

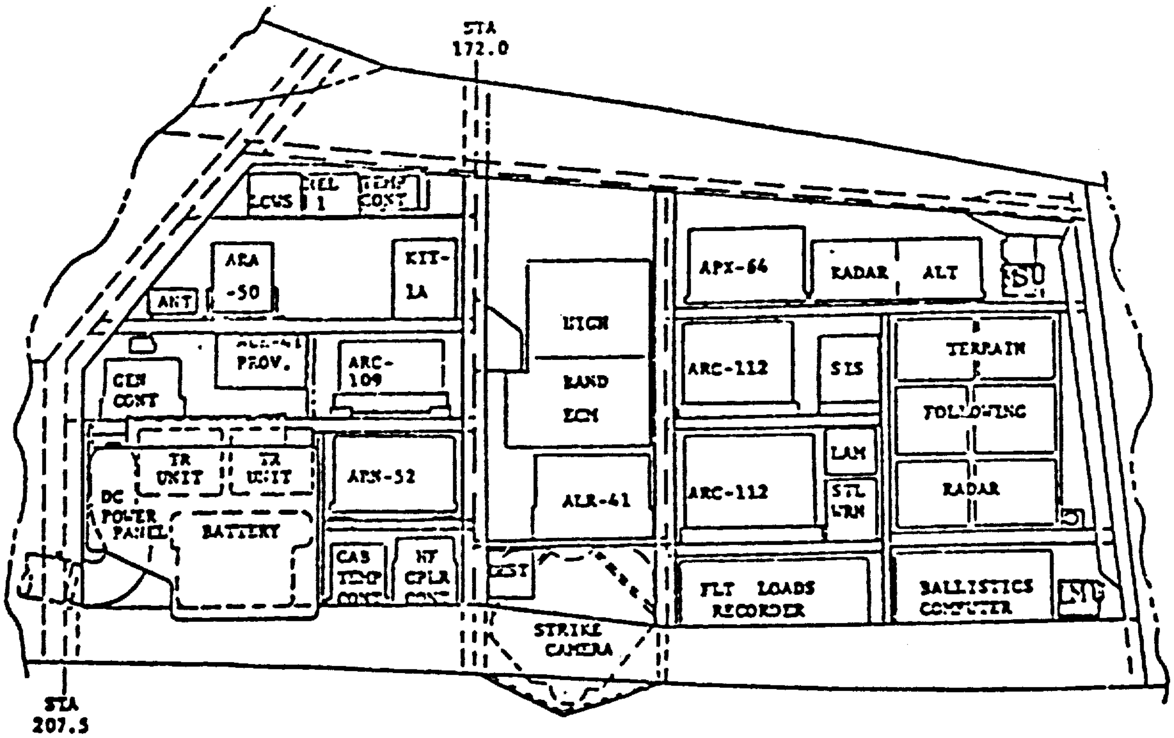
(continued)

486

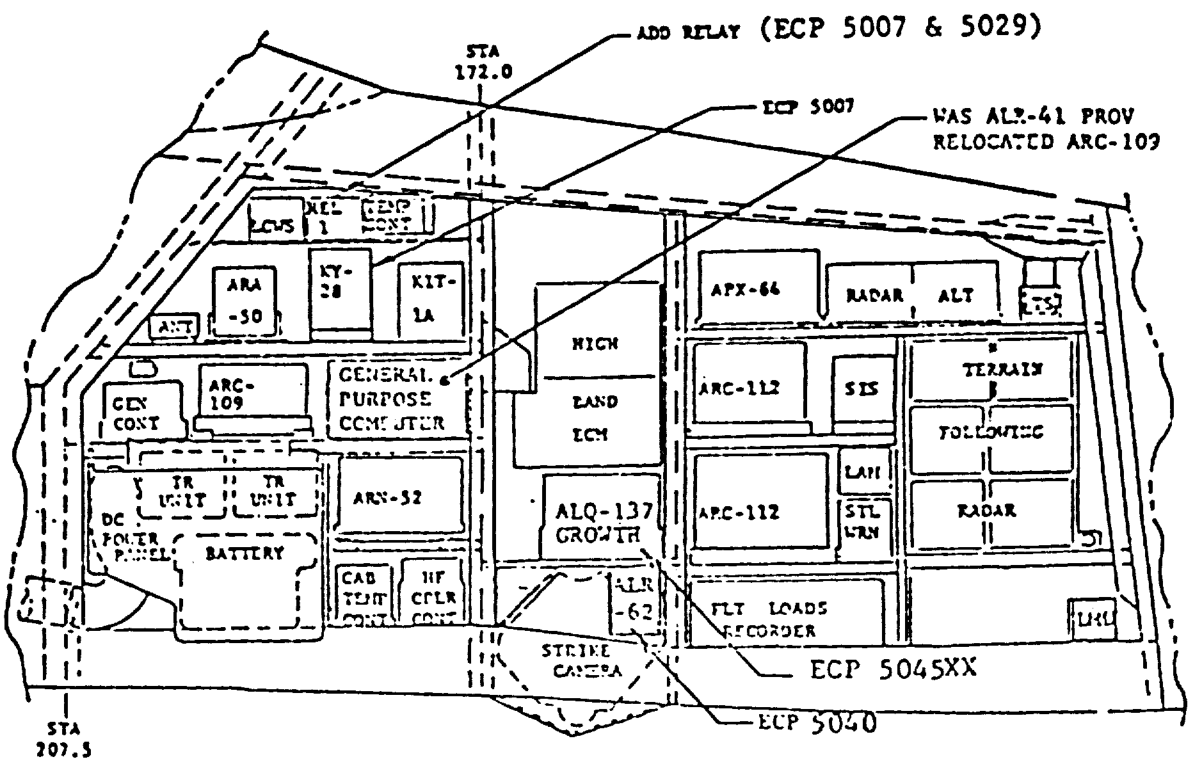
Table 9-1. (continued)

Equipment	F-111A	F-111D	F-111E	F-111F	EF-111A
Fuel and Trim Assembly	12C1154-879	12C1154-867	12C1154-879	12C1154-875	12C1154-879
Doppler	--	APN-189 (Maybe GPS)	--	--	--
Nav Data Entry Panel	--	ID-1764/AYK	--	--	--
Nav Data Display Panel	--	ID-1622/AYK	--	ID-1748/AYK	--
General Purpose Computer	--	AYK-6 (2)	--	AYK-6 (2)	--
Weapons Bay Gun System	--	?	?	--	Demodify
Multiplex Converter Unit	--	CV-2492/A	--	CV-2497/A	--
Horizontal Situation Display	--	AYN-3	--	--	--
Integrated Display Set	--	AVA-9	--	--	--
IFF Interrogator	--	APX-76	--	--	--
Computer Control Unit	--	--	--	C-8586/AYK	--
UHF Crypto	--	--	--	--	KY-28
Nav Radar	--	--	--	--	APQ-160 (Demodify)
Modifications					
F2824	Terrain Follow Radar	--	Terrain Follow Radar	--	--
F2930	ALQ-119 ECM (Some A/C)	ALQ-119 ECM (Some A/C)	ALQ-119 ECM	--	--
T13315A	SIS (Some A/C)	SIS (Some A/C)	SIS	SIS (Some A/C)	
T17305A	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	--
T17310A	LARA Override System	LARA Override System	LARA Override System	LARA Override System	--
T37063A	APQ-113 TFR (Some)	APQ-130 TFR	APQ-113 TFR	APQ-144 TFR	--
F2957	ALR-62 RWR (Some)	ALR-62 RWR	ALR-62 RWR	ALR-62 RWR	--
F0000	Jam System (Some A/C)	--	--	--	--
F15312B	--	AVA-9 IDS	--	--	--
T37236B	--	--	--	Multiplex Converter (Some A/C)	--
Planned Avionics					
Video Tape Recorder	--	CVTR	CVTR	CVTR	--

Best Available Copy



VIEW LOOKING INBD RH EQUIP BAY
F-111A NO. 103 - 159
CURRENT



VIEW LOOKING INBD RH EQUIP BAY
F-111A NO. 103 - 159

Figure 9-1. F-111A EQUIPMENT BAY CURRENT VS. PLANNED

488

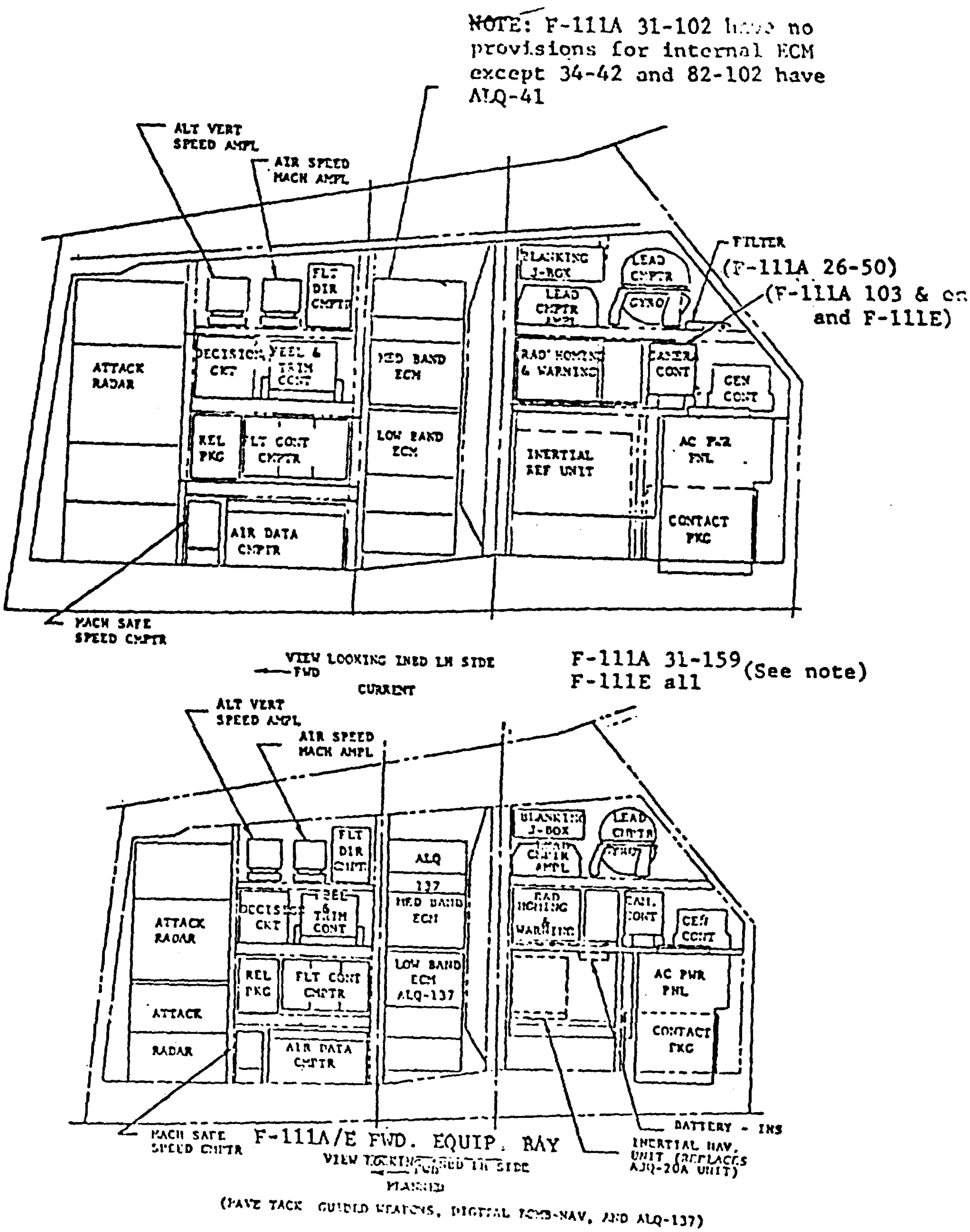


Figure 9-1. (continued)

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Aircraft and avionics configuration data assembled by ARINC Research, principally in the form of copies of applicable sections, tables, and figures from the aircraft technical orders, as well as from equipment technical orders listed at the end of this section.
- Avionics Planning Baseline Document - October 1978
- GPS Phase II User Equipment Interface Requirements for the F-111A Aircraft; 1 September 1977

List Of Technical Orders

T.O. #	Title	Change	Date
1F-111A-01	List of Publications		4/21/72
1F-111A-1	Flight Manual	5	12/1/78
1F-111A-1-1	Performance Data	1	9/19/75
1F-111A-2-1	General Info	27	12/24/76
1F-111A-2-3-1	Auto Flight Control	7	6/3/77
1F-111A-2-4-1	Flight Control System	8	8/26/77
1F-111A-2-5-1	Fire Power Control	4	9/12/75
1F-111A-2-12-1	Instrument Systems	18	1/5/77
1F-111A-2-13-1	Electrical Power & Lighting System	20	10/29/76
1F-111A-2-16-1	Air Data Systems	Basic	10/18/74
1F-111A-2-17-1	Communications and Instrument Landing Systems	10	10/24/75
1F-111A-2-18-1	Auto Direction Finder, Inter-Communications TACAN, IFF Systems	12	1/5/77
1F-111A-2-19	Attack and Terrain Following Radar Systems	17	11/7/75
1F-111A-2-22	Systems Integration	11	6/13/75
1F-111A-4-9	Auto Flight Control	11	2/4/76
1F-111A-4-10	Air Data Computer Systems	5	1/10/75
1F-111A-4-11	Instrument Systems	27	3/18/77
1F-111A-4-12	Power and Lighting Systems	26	2/11/77 (#25 miss)

List Of Technical Orders
(continued)

T.O. #	Title	Change	Date
1F-111A-4-14	Auto Direction Finder Communications TACAN, & IFF Systems	2	7/23/76
1F-111A-4-17	Penetration aids and Electronic Counter Measures	Basic	7/16/76
1F-111A-4-19	Parts Index	5	7/27/77
1F-111A-4-20	Armament Systems	2	2/11/77
1F-111A-4-21	Comm. and Instrument Landing	14	4/16/76
1F-111A-4-22	Fire Power Control Systems	1	10/15/76
1F-111A-4-23	Attack and Terrain Following Radar System	1	2/11/77
1F-111A-34-1	Non-Nuclear Munitions Delivery	Basic	2/6/76
1F-111A-34-1-1	Non-Nuclear Munitions Delivery	Basic	2/6/76
12P2-2APQ110-12	Terrain Following Radar Set	10	3/15/74
12P2-2APQ110-52	Terrain Following Indicator	3	3/22/74
12P2-2APQ13-12	Radar Set	Basic	1/28/77
12P4-2APX64-2	Radio Receiver Transmitters	17	11/22/77
12P5-2APN167-12	Altimeter Set	12	5/3/74
12R1-2ARA50-2	Direction Finder Group	2	2/1/72
12R2-2AIC25-2	Intercomm Set	10	12/1/76
12R2-2ARC109-4	Radio Set	9	6/15/76
12R2-2ARC109-42	Radio Receiver	2	6/1/77
12R2-2ARC112-42	Radio Set	6	12/1/76
12R2-2ARC123-2	Radio Set	15	10/15/76
12R5-2ARN52-2	TACAN	Changed	10/1/69
12R5-2ARN52-12	TACAN	4	2/15/73
12R5-2ARN58-2	Radio Receiving	6	5/13/77
12R5-2ARN118-1	TACAN	Basic	10/15/76
12R5-2URT27-2	Radio Beacon Set	10	6/1/77
12R2-2ARC164-2	Radio Set	Basic	6/20/76

— 491

AVIONICS INTERFACE DATA SUMMARY
FOR
F-111E

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

492

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis. Maryland under Contract F33657-79-C-0567.

Record of Changes			
Change	Subject	Date Entered	Initials

494

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF FIGURES AND TABLES (continued)

496

LIST OF FIGURES AND TABLES (continued)

497

1. INTRODUCTION

This document contains configuration data relating to the integration of additional avionics into the F-111E aircraft.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable Technical Orders are included in the references listed in Section 10.

498

2. COCKPIT SPACE

2.1 Available Control Panel Space

Figures 2-1 through 2-5 depict the consoles and instrument panels for the F-111E. In the present F-111E cockpit configuration, blank control panel space is limited. Two small blank panels exist, one on the left console and one on the right console.

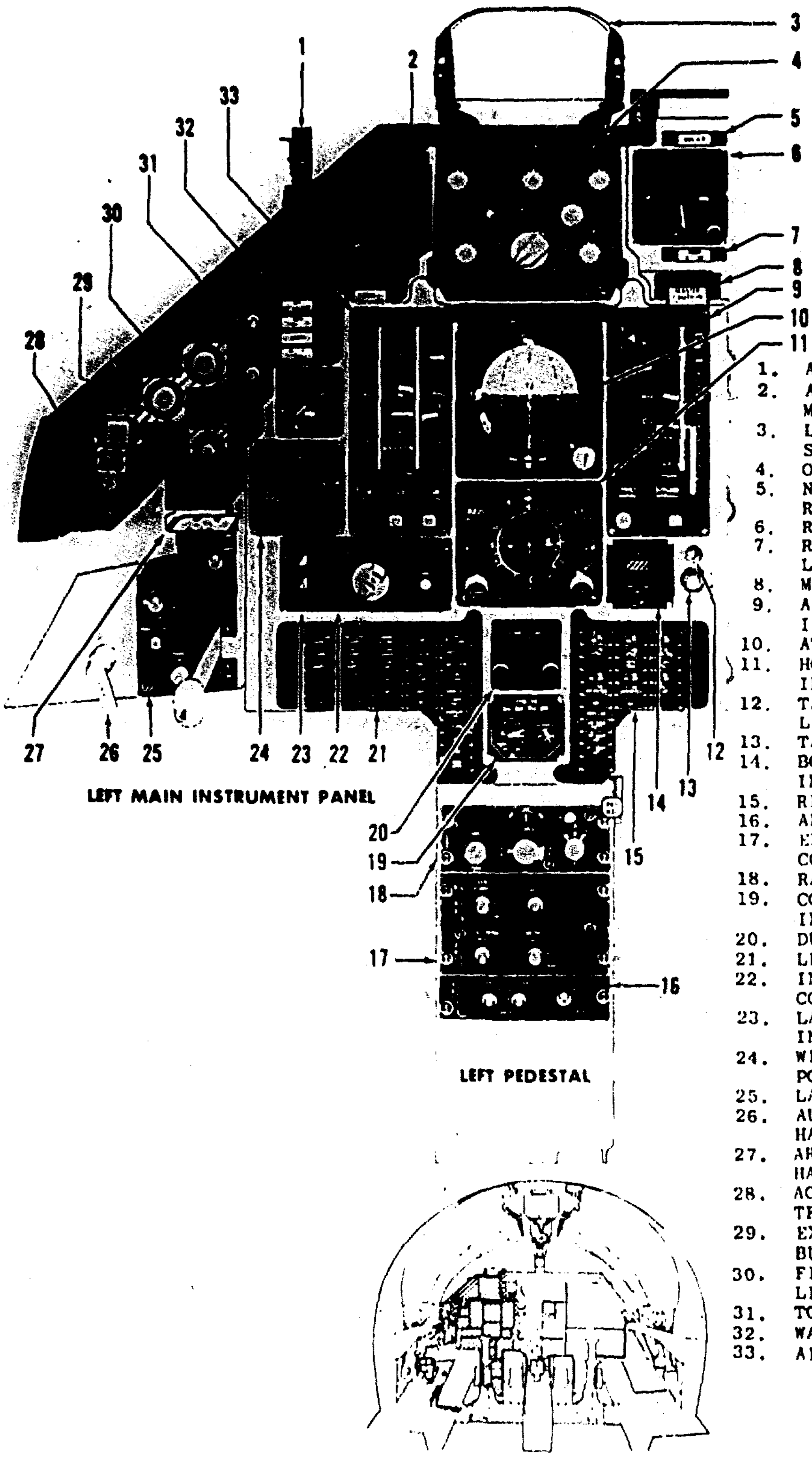
A 1-3/4 inch high by 5-3/4 inch wide space is available on the left console, between legend numbers 9 and 10 of Figure 2-3. This space is near the rear of the console.

On the right console, a 2-3/8 inch high by 5-3/4 inch wide blank space exists. This space is located between legend numbers 1 and 17 of Figure 2-5 and is within convenient reach of the Weapons Systems Officer.

2.2 Displays

Currently all of the F-111E oscilloscope displays are in the Right Main Instrument Panel (Figure 2-2, legend 1, 4, and 10, Terrain Following Radar Scope Panel, RHAW Scope Panel, and Attack Radar Scope Panel, respectively. The ASG-23 optical sight display does not have any alphanumeric characters or symbol capability potential.

499

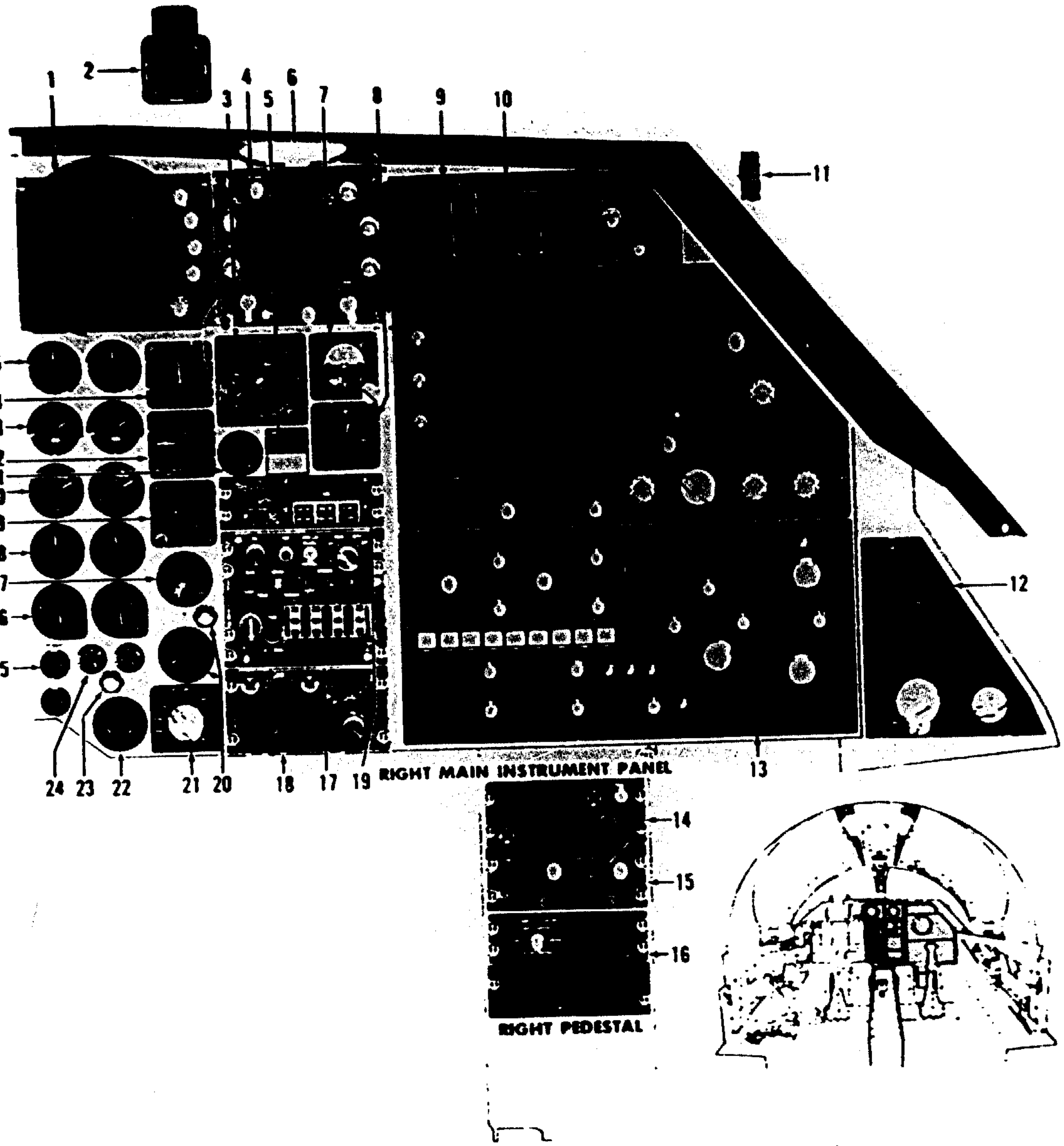


1. ANGLE-OF-ATTACK INDEXER
2. A/AIR MISSLE, GUN/CAMERA MASTER PANEL
3. LEAD COMPUTING OPTICAL SIGHT
4. OPTICAL SIGHT CONTROL PANEL
5. NOSE WHEEL STEERING/AIR REFUELING INDICATOR LAMP
6. RADAR ALTIMETER
7. RADAR ALTITUDE LOW WARNING LAMP
8. MASTER CAUTION LIGHT
9. ALTITUDE/VERTICAL VELOCITY INDICATOR
10. ATTITUDE DIRECTOR INDICATOR
11. HORIZONTAL SITUATION INDICATOR
12. TAKE-OFF TRIM INDICATOR LIGHT
13. TAKE-OFF TRIM TEST BUTTON
14. BOMB-NAV DISTANCE/TEST INDICATOR
15. RIGHT MAIN CAUTION PANEL
16. ANTENNA SELECT PANEL
17. EXTERNAL ENVIRONMENTAL CONTROL
18. RADIO COMPASS CONTROL PANEL
19. CONTROL SURFACE POSITION INDICATOR
20. DUAL BOMBING TIMER
21. LEFT MAIN CAUTION PANEL
22. INSTRUMENT SYSTEM COUPLER CONTROL PANEL
23. LANDING GEAR POSITION INDICATOR
24. WING SWEEP FLAP/SLAT POSITION INDICATOR
25. LANDING GEAR CONTROL PANEL
26. AUXILIARY (Parking) BRAKE HANDLE
27. ARRESTING HOOK RELEASE HANDLE
28. AGENT DISCHARGE/FIRE DETECT TEST SWITCH
29. EXTERNAL STORES JETTISON BUTTON
30. FIRE PUSHBUTTON/WARNING LIGHTS
31. TOTAL TEMPERATURE INDICATOR
32. WARNING LAMPS
33. AIRSPEED - MACH INDICATOR

A1100000-E188C

Figure 2-1. LEFT MAIN INSTRUMENT PANEL

500

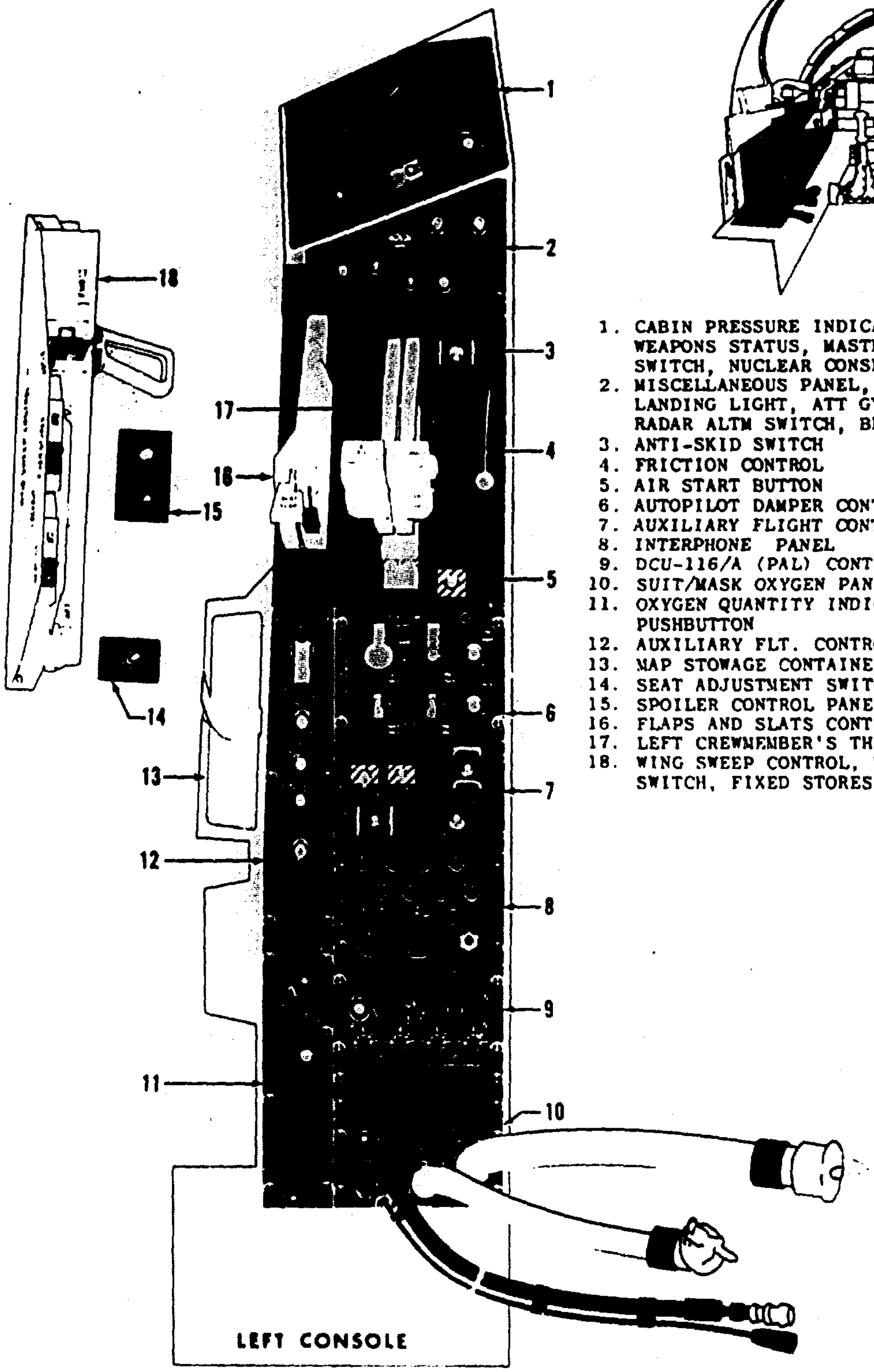


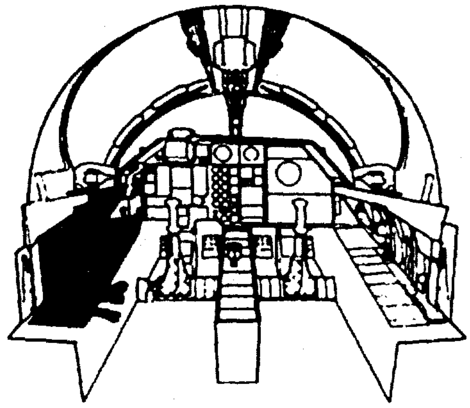
1. TERRAIN FOLLOWING RADAR DISPLAY
2. STANDBY MAGNETIC COMPASS
3. BEARING-DISTANCE-HEADING INDICATOR
4. RADAR HOMING AND WARNING CONTROL-INDICATOR PANEL
5. RADIO CALL
6. RADAR HOMING AND WARNING CONTROL-INDICATOR FILTER ASSY (Stowed position)
7. STANDBY ATTITUDE INDICATOR
8. STANDBY ALTIMETER
9. THREAT DISPLAY, INDICATOR, WARNING, AND CAUTION LIGHTS
10. ATTACK RADAR DISPLAY PANEL
11. ANGLE-OF-ATTACK INDEXER
12. NUCLEAR WEAPONS CONTROL PANEL AND CAUTION LIGHTS
13. BOMB-NAV CONTROL PANEL
14. ILS CONTROL PANEL
15. BURST CONTROL PANEL
16. AIM POINT TARGET ELEVATION
17. UHF RADIO CONTROL PANEL
18. TACAN CONTROL PANEL
19. SAM SECTOR PANEL
20. FUEL QUANTITY INDICATOR TEST BUTTON AND TOTAL SELECT FUEL QUANTITY INDICATOR
21. FUEL GAGE SELECT
22. OIL QUANTITY INDICATOR
23. OIL QUANTITY INDICATOR TEST BUTTON
24. ENGINE OIL PRESSURE INDICATOR (2)
25. HYDRAULIC PRIMARY AND UTILITY OIL PRESSURE INDICATOR
26. ENGINE PRESSURE RATIO (2)
27. FUSELAGE FUEL QUANTITY INDICATOR
28. NOZZLE POSITION INDICATOR (2)
29. CLOCK
30. ENGINE FUEL FLOW INDICATOR (2)
31. TRUE AIRSPEED INDICATOR
32. RATE-OF-CLIMB (Vertical velocity) INDICATOR
33. TURBINE INLET TEMPERATURE INDICATOR (2)
34. STANDBY AIRSPEED INDICATOR
35. ENGINE TACHOMETER (2)

A01300000-E2718

Figure 2-2. RIGHT MAIN INSTRUMENT PANEL

501



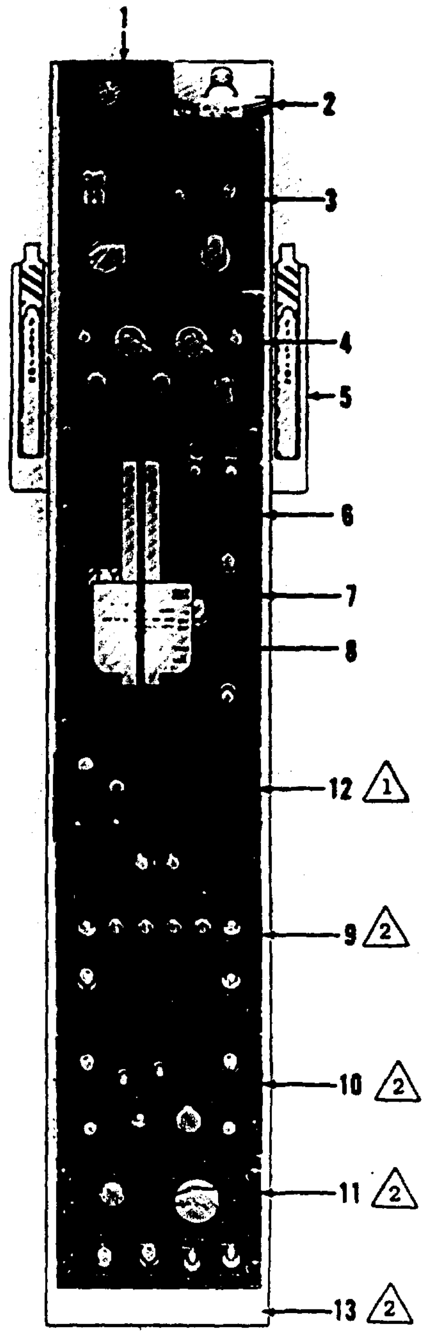


1. CABIN PRESSURE INDICATOR, AMMO STATUS, WEAPONS STATUS, MASTER ARM AND RELEASE SWITCH, NUCLEAR CONSENT SWITCH
2. MISCELLANEOUS PANEL, COMPRESSOR BLEED, LANDING LIGHT, ATT GYRO FAST ERECT BUTTON, RADAR ALTM SWITCH, BLEED OPEN SWITCH
3. ANTI-SKID SWITCH
4. FRICTION CONTROL
5. AIR START BUTTON
6. AUTOPILOT DAMPER CONTROL PANEL
7. AUXILIARY FLIGHT CONTROL PANEL
8. INTERPHONE PANEL
9. DCU-116/A (PAL) CONTROL PANEL
10. SUIT/MASK OXYGEN PANEL
11. OXYGEN QUANTITY INDICATOR AND TEST PUSHBUTTON
12. AUXILIARY FLT. CONTROL PANEL
13. MAP STOWAGE CONTAINER
14. SEAT ADJUSTMENT SWITCH
15. SPOILER CONTROL PANEL
16. FLAPS AND SLATS CONTROL
17. LEFT CREWMEMBER'S THROTTLES
18. WING SWEEP CONTROL, WEAPON LOCKOUT SWITCH, FIXED STORES LOCKOUT SWITCH

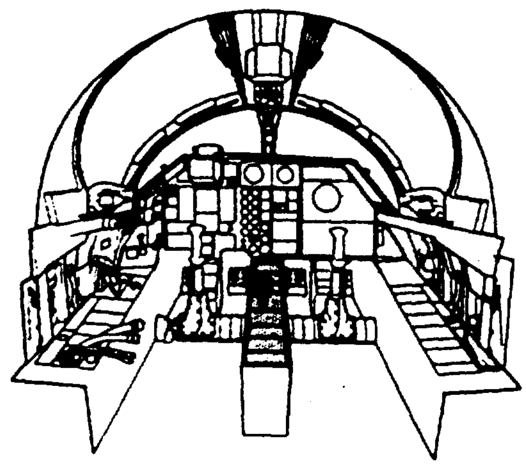
A0139000 1277D

Figure 2-3. LEFT CONSOLE

502



CENTER CONSOLE



1. AIR REFUEL RECEPTACLE LIGHT CONTROL KNOB
2. ALTERNATE GEAR DOWN HANDLE
3. FUEL CONTROL PANEL
4. TFR CONTROL PANEL
5. CREW MODULE EJECTION HANDLE (2)
6. SPIKE CONTROL PANEL
7. GROUND START SWITCH, AIR START BUTTON, RBS TONE SWITCH
8. RIGHT CREWMEMBERS THROTTLES
9. IFF CONTROL PANEL
10. ELECTRICAL CONTROL PANEL
11. AIR CONDITIONING CONTROL PANEL (AIR FLOW switch effective on AF S/N 68-030 thru 68-084 and on 67-115 thru 68-029 after T.O. 1F-111-687) (EMER position of AIR SOURCE switch is effective on AF S/N 68-070 thru 68-084 and on 67-115 thru 68-029 after T.O. 1F-111-572)

1 12. ECM CONTROL PANEL/ALQ-119

2 13. CONTROL PANEL SCOPE CAMERA

NOTES:

1 AFTER T.O. 1F-111E-521

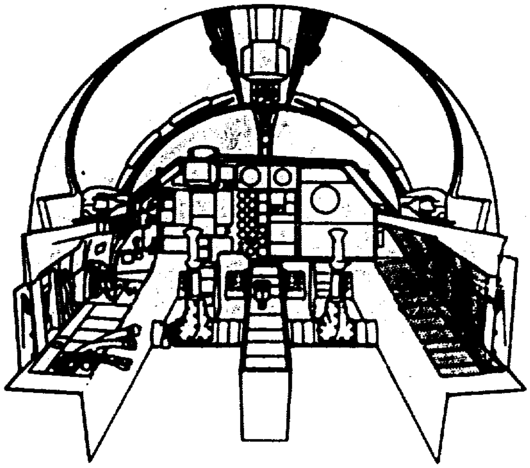
2 RELOCATED AFTER T.O. 1F-111E-521D

F-111-0309

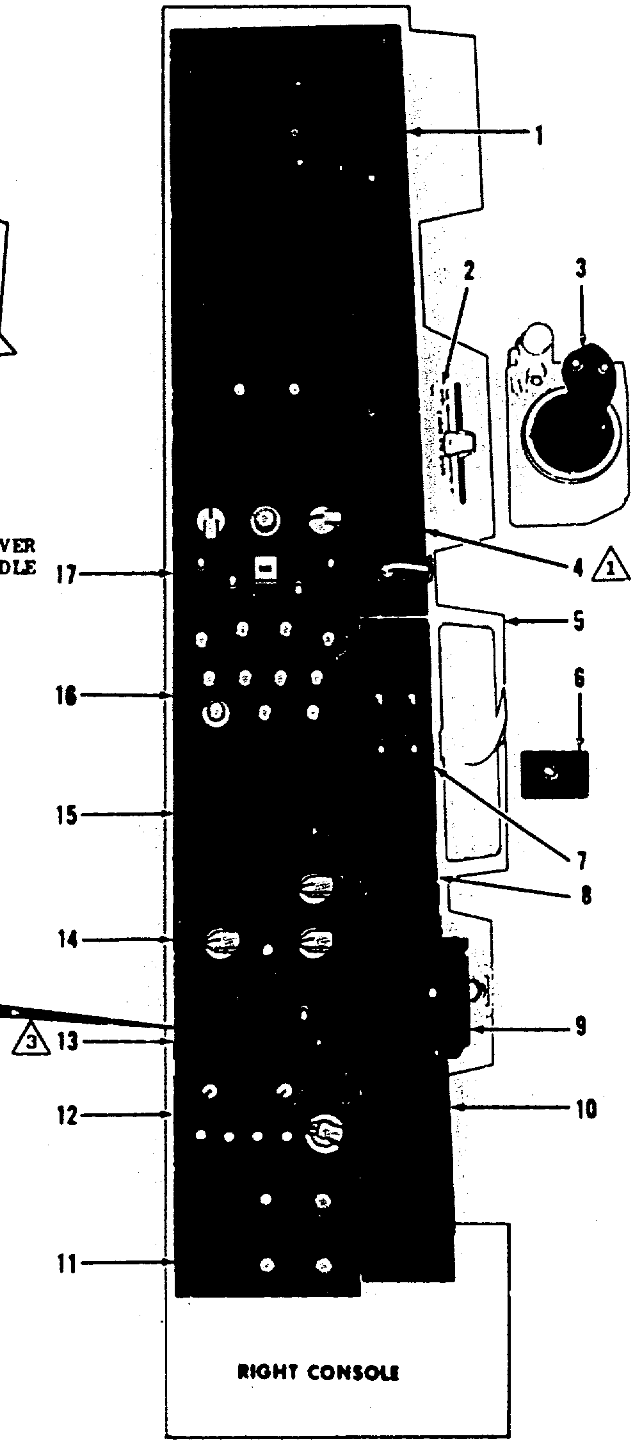
Figure 2-4. CENTER CONSOLE

Best Available

513



1. WEAPONS CONTROL PANEL
2. CABIN AIR DISTRIBUTION CONTROL LEVER
3. ATTACK RADAR TRACKING CONTROL HANDLE
4. RADIO BEACON SET (1)
5. MAP STOWAGE CONTAINER
6. SEAT ADJUSTMENT SWITCH
7. STRIKE CAMERA CONTROL PANEL
8. WEAPONS BAY TEMPERATURE INDICATOR
9. UTILITY LIGHT
10. STOWAGE
11. CMDS CONTROL PANEL
12. CMRS CONTROL PANEL
13. CONTROL PANEL SCOPE CAMERA (3)
14. ECM CONTROL PANEL/ALQ-94
15. INTERCOMMUNICATION PANEL
16. HF RADIO CONTROL PANEL
17. ATTACK RADAR CONTROL PANEL
18. ECM CONTROL PANEL ALQ-87 (2)



NOTES:

(1) PRIOR TO T.O. 1F-111-613

(2) PRIOR TO T.O. 1F-111E-521

(3) AFTER T.O. 1F-111E-521D

F-111-0308

Figure 2-5. RIGHT CONSOLE

Best Available C

504

3. AVIONICS SPACE

The avionics space availability in the F-111E is detailed in Table 3-1 and Figure 3-1. The only space that does not have a candidate equipment designated is under door 1201; that space has a volume of 0.82 cubic feet. This space is available only if two ARN-194 altimeters are employed in a stacked configuration.

505

Table 3-1. F^2E SUMMARY -- F-111E

F^2 E Criteria	Potential Available Space		
Location Reference and Description	A Right of SIS 3 Door 1201	B Left KIT-1A Door 1202	C Radar Altimeter Door 1201
Rectangular* Size (H, W, D)	8.62" X 6.6" X 14.25"	8.7" X 12.0" X 14.3"	6.5" X 15" X 14.5"
Volume	.469 Ft^3	.864 Ft^3	.818 Ft^3
Type Cooling Available	Forced-Air Cooled	Forced-Air Cooled	Forced-Air Cooled
Temperature-Altitude Vibration	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area
Possible Candidates for this Space	KIT 1A Relocation	Digital Scan Converter	None
Remarks	Exists	Exists	Replace with 2 ARN-194 Altimeters, Stacked

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.

Best Available

516

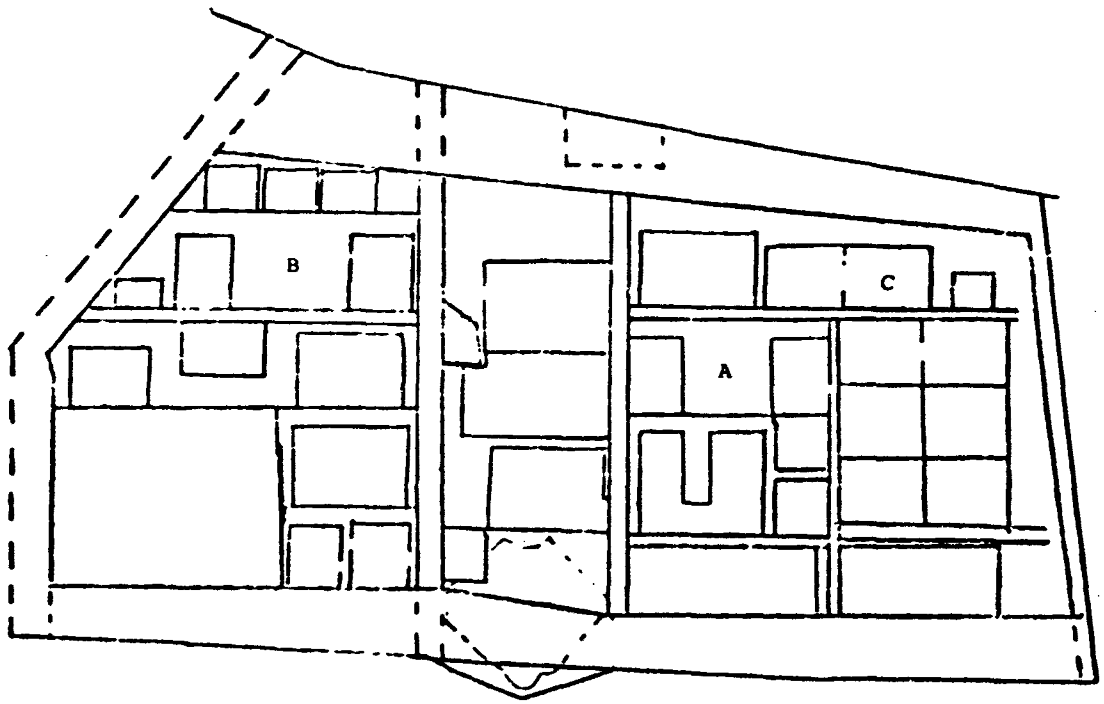


Figure 3-1. FORWARD RIGHT-HAND EQUIPMENT BAY SPACE LOCATIONS

517

4. ELECTRICAL POWER SYSTEM

4.1 Introduction

115/200 volt, three phase, 400 cycle ac power and 28 volt dc power is provided for the electrical power system in the F-111E. This power is generated by two 62.5 kVA ac generator drive assemblies, one mounted on each engine. These generators are supplemented by two 150 amp transformer rectifier units that convert the ac power to 28 volts dc. An aircraft battery supplies 28 volts dc to the battery bus and the dc start busses. The electrical power system consists of the following systems:

- Main ac power system
- External ac power and monitor system
- Emergency ac power system
- Dc power system

4.2 Power Requirements

In the F-111E, there is a basic avionics electrical power requirement of 40 kVA.

4.3 Power Generation and Distribution

The maj[illegible] of electrical power are 62.5 kVA indirect drive generators. Th[illegible]ol units for these generators are in the forward equipment bay. The electrical power distribution system has three ac busses: A left main ac bus, a right main ac bus, and an essential ac bus.

4.4 Emergency ac Power System

The emergency ac power system provides electrical power for operation of safety-of-flight equipment in the event the main ac power system fails or hydraulic power is applied to the aircraft without electrical power, or both. The emergency ac power generator is operated by the utility hydraulic system.

4.5 Dc Power System

The dc power system supplies the aircraft with the necessary 28-volt direct current power. The main dc power system uses two ac-to-dc power converters to supply the main and essential dc busses. The aircraft battery ensures that standby power is available to power engine starts, aircraft position lights, and pylon refuel/defuel valves without external power units.

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The Environmental Control System (ECS) provides temperature controlled air for the cockpit and a temperature controlled flow of cooling air to the forward electronics bay and to the weapons bay. The ECS operates by ducting hot air from the sixteenth stage compressor of each engine through two air-to-air heat exchangers, an air-to-water heat exchanger, and a cooling turbine. The cooling turbine further cools the air to temperatures suitable for the cockpit and electronic equipment bays.

5.2 Cabin Air Conditioning

Cabin air conditioning is governed by a temperature controller that receives signals from temperature sensors and a cockpit control panel. The temperature controller allows hot air to mix with the cooled air stream to obtain air at the cockpit-selected temperature. Conditioned air flows from the cabin into the forward equipment bay.

5.3 Equipment Air Conditioning

Electronic equipment that is cooled by the ECS is grouped in the forward equipment area, cabin equipment area, aft (check) equipment area, main landing gear wheelwell area, and tail electronics area. The equipment is cooled by both area cooling and forced-air-flow cooling. Area cooling is achieved by supplying cold air to the equipment area as required to maintain the temperature at 150° (±10°) F. In addition, a cold air flow can be forced over or into a single component or group of components.

519

6. CURRENT AVIONICS

Tables 6-1 through 6-23 contain LRU data relating to the F-111E avionics systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

510

Table 6-1. F-111E AVIONICS CONFIGURATION DATA: HF RADIO AN/ARC-123 NSN: 5821-00-496-9234

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control	C-7073/ARC	Cockpit		5.75							Convection	Panel
Receiver-Transmitter	RT-9[illegible]2/ARC-123	Door 1201	7.62	3.62	13.6	375	13.12				Forced Air	MT-3660/ ARC-123
Amplifier-Power Supply	AM-4573/ARC-123	Door 1201	7.62	4.87	17.2	638.3	23.13	115V 3ϕ			Forced Air	MT-3660/ ARC-123
Shockmount Base	MT-3660/ARC-123	Door 1201	6.87	11.2	20.2	1554	8.54					

Best Available C

511

Table 6-2. F-111E AVIONICS CONFIGURATION DATA: AN/ARC-109 UHF COMMUNICATIONS SET NSN: 5821-00-496-9236

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF Communications	AN/ARC-109						38.8	150		150W		
Receiver-Transmitter	RT-749/ARC-109	Door 1202	6.87	8.87	14.87	906.1	28.7				Forced Air	MT-3321/ARC-109
Control	C-6364/ARC-109	Cockpit	4.87	5.75	5.0	140	4.4				Convection	Cockpit
Antenna Selector	C-4808/ARC	Door 1202	3.0	3.25	4.5	43.9	1.5				Forced Air	MT-1932A
Antenna	AS-1918						1.0					Hard
Indicator	ID-1003/ARC											

512

Table 6-3. F-111E AVIONICS CONFIGURATION DATA: AN/AIC-25 INTERCOM NSN: 5831-00-457-5041

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Intercom Set	AN/AIC-25								02			
Control	C-6567/AIC-25	Cockpit	3.75	5.75	5.62	121.2	4.2			20W	Convection	Cockpit
Intercom Station	C-6624/AIC-25		4.38	3.62	5.12	81.2	2.7					

Table 6-4. F-111E AVIONICS CONFIGURATION DATA: UHF-ADF AN/ARA-50 NSN: 5826-00-883-5777

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF-ADF	AN/ARA-50							0.04	0.01	50W		
Amplifier Relay Assembly	AM-3624/ARA-50	Door 1202	6.6	7.1	8.0	375	5.4				Forced Air	MT-1955/ ARA-50
UHF/ADF Loop Antenna	AS-909/ARA-48		3.5	10.25	10.25	368	10					Hard

Table 6-5. F-111E AVIONICS CONFIGURATION DATA: INSTRUMENTS

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power.		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Instruments												
Attitude Directional Indicator	ARU-11/A NSN: 6610-00-424-8740	Cockpit	5.25	5.0	10.66	280.4	8.1			36/10W	Convection	Cockpit
Attitude Indicator	ARU-42/A-2 NSN: 6610-00-200-8744	Cockpit	2.40	2.40	7.61	43.8	2.5	0.002	0.034/ 0.008	36/10W	Convection	Cockpit
Horizontal Size Indicator	AQU4/A NSN: TBD	Cockpit	4.25	5.00	8.37	178	8.0			54W	Convection	Cockpit
Tot/Sel Fuel Quantity		Cockpit	2.0	Dia		3.14	1.5				Convection	Cockpit
Recorder Flight Load Type	HXK 316/A2 4U6 NSN: TBD	Door 1201									Forced Air	Shock
BDHI	E5165001400 NSN: TBD	Cockpit									Convection	Cockpit

515

Best Available

Table 6-6. F-111E AVIONICS CONFIGURATION DATA: FLIGHT DIRECTOR COMPUTER NSN: 6610-00-179-5146

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Flight Director Computer	CPU-76/A	Door 1101	7.53	5.5	9.48	393	10.0	0.016	0.085	26W	Forced Air	Shock

516

Table 6-7. F-111E AVIONICS CONFIGURATION DATA: RADAR ALTIMETER AN/APN-167 NSN: 5841-00-772-1819

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Radar Altimeter	AN/APN-167											
Receiver-Transmitter Dual	RT-771/APN-167	Door 1201	6.5	15	14.5	14.4	26.0	0.086	0.01	197W	Forced Air	MT( )
Antenna	AS-1[illegible]58/APN-167		4.5	4.5	9.25	187	1.1					Hard
Radar Altimeter Indicator	K5186000100	Cockpit					1.6/1.8*				Convection	Cockpit
[illegible] Warning Lamp		Cockpit									Convection	Cockpit

*Two indicators in aircraft.

517

Best Available Copy

Table 6-8. F-111E AVIONICS CONFIGURATION DATA: CADC

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Air Data Computer	1903633-4 NSN: 6610-00-168-0544	Door 1101	8	14	19.25		47.5	115 Vac 1ϕ			Forced Air	1852714-3
Angle of Attack Transmitter	12F4075-3	Door 1102									Forced Air	Shock
Control	12P0002-5	Cockpit									Convection	Panel
Angle of Attack Transmitter Sync.	MN24378-2	Door 1102									Forced Air	Shock

Table 6-9. F-111E AVIONICS CONFIGURATION DATA: AN/ARN-52 TACAN NSN: TBD (BEFORE T.O. 1F-111-1148; BEING REPLACED BY AN/ARN-118)

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Control	C-3928/ARN-52	Cockpit	3	5.75	4	69	2				Convection	Panel
Receiver-Transmitter	RT-893/ARN-52	Door 1202	7.35	10	16.9	12.42	43.25				Forced Air	MT-1729/ARN-52
Antenna	11D20100-1		9.7	3.5	7.5	255	2					Hard
RF Switch	SA-521/A	Cockpit	1.94	2.78	3.19	17.2	0.34				Convection	Panel
System								0.25	0.0616			

519

Table 6-10. F-111E AVIONICS CONFIGURATION DATA: AN/ARN-118 TACAN NSN: 5826-01-015-0839 (AFTER T.O. 1F-111-1148, REPLACING AN/ARN-52)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
TACAN	AN/ARN-118							0.250	0.0616	310W		
Receiver-Transmitter	RT-1159(A)/ARN-118		10	11.7	19.7	2300	25.0					MT-4682(A)/ARN-118
Control	C-10058/ARN-118											
Antenna RF Switch	SA521/A	Cockpit	2.7	3.2	3.2	27.7	0.6			28W		MT-1665/A
Antenna TACAN Blade	AS-1918	Door 1101					1					Hard

530

Table 6-11. F-111E AVIONICS CONFIGURATION DATA: ILS AN/ARN-58 NSN: 5826-00-883-5795*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
ILS	AN/ARN-58								0.02			
Receiver Localizer	R-843/ARN-58	Door 2204	7.75	6.87	5.01	267	7.9		220 mA	48W		Shock
Receiver	R-844/ARN-58	Door 2204	9.75	6.87	5.01	336	9.6			48W		Shock
Control	C-6376/ARN-58A		3.0	5.75	5.0	86.3	1.1				Convection	
Marker Beacon Antenna							1.0					Hard
Glide slope							0.8					Hard
Localizer Antennas												Hard

*For ARN-58A, NSN: 5826-00-498-3313.

521

Table 6-12. F-111E AVIONICS CONFIGURATION DATA: INS AN/AJQ-20A NSN: 6605-00-170-6701

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Inertial Navigational System	AN/AJQ-20A											
Stabilized Platform	MX-6767/AJQ-20	Door 1102					75.0			275W	Forced Air	Shock
Transmitter Induct Type Flux Valve	TRU-79/A		4.0 dia.		2.0	25.1	1.8					
Navigational Computer	CP-812/AJQ-20	Cockpit					77.8			281W	Convection	Panel
Ballistics Computer	CP-937/AJQ-20A											

Table 6-13. F-111E AVIONICS CONFIGURATION DATA: INTERFERENCE BLANKER NSN: 5865-00-813-5469

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Interference Blanker	MX-6770/V	Door 1102									Forced Air	Shock

523

Table 6-14. F-111E AVIONICS CONFIGURATION DATA: IFF TRANSPONDER AN/APX-64 NSN: 5895-00-115-7812

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
IFF Transponder	AN/APX-64							0.3	0.03			
Receiver-Transmitter	RT-728/APX-64	Door 1201	7.0	11.13	19.21		30.0	0.08		110W	Forced Air	MT-3497/ APX-64
Control	C-6717/APX-64	Cockpit	5.25	5.75	5.00	151	2.5			7.5W	Convection	Cockpit
Test Set Airborne	TS-1843/APX	Door 1201	3.15	3.25	7.81	79.9	3.0		0.[illegible]105	10.5W	Forced Air	MT-351[illegible]
Antenna Blade	AS-1919						2.0					
Transponder Computer	FIT-1A/T SEC	Door 1202	8.62	6.6	14.25	810.7	12.0	0.025	0.0[illegible]	30W	Forced Air	MT-4579/U

524

Table 6-15. F-111E AVIONICS CONFIGURATION DATA: TFR AN/APQ-110 (PARTIAL LISTING) NSN: 5841-00-772-1811

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
TF Radar System	AN/APQ-110											
TF Computer	CP-[illegible]/APQ-110	Door 1201					13.8				Forced Air	MT-3359
Antenna Receiver	AS-2136/APQ-128	Nose Radome										
TF Indicator	IP-773/APQ-110	Cockpit					23.7			126W	Convection	Cockpit
TF Radar Set Control	C-6476/APQ-110	Cockpit	3.0	5.75	7.31	126.1	2.6			11W	Convection	Cockpit
Amplifier-Power Supply	AM-4240/APQ-110	Door 1201	6.0	6.75	7.31	713.0	17.6				Forced Air	MT-3359
Sync.-Transmitter	SN-379/APQ-110	Door 1201					26.8				Forced Air	MT-3359
Antenna Receiver												

525

Best Availab

Table 6-16. F-111E AVIONICS CONFIGURATION DATA: ATTACK RADAR SET APQ-113 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power*		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna Assembly	AS-1743/APQ-113	Nose Radome	26.0	35.0	32.0	29,120	55.0					
Antenna Pedestal	AB-902/APQ-113	Nose Radome	19.0	21.0	8.0	3,192	37.0					
Antenna Control	C-6498/APQ-113	Nose Radome	10.0	27.0	8.0	2,160	38.0			98W		
Modulator Receiver Transmitter	MD-608/APQ-113	Door 1101	21.0	13.0	21.0	5,733	101.0			1kW	Forced Air	MT-3384/APQ-113
Electrical Synchronizer	SN-380/APQ-113	Door 1101	13.25	13.0	20.75	3,574	78.0			392W	Forced Air	MT-3384/APQ-113
Indicator Recorder	IP-777/APQ-113	Cockpit	9.25	16.25	30.5	4,585	63.0				Convection	Cockpit
Radar Set Control	C-6499/APQ-113	Cockpit	3.75	5.75	6.5	140	3.0				Convection	Cockpit
Antenna-Indicator Control	C-6500/APQ-113	Cockpit	8.75	5.0	3.5	153	2.0				Convection	Cockpit
Electrical Equipment Rack	MT-3384/APQ-113	Door 1101	34.25	13.25	25.75	9,870	6.0					

*Total system power dissipation is 1.637 kWac; 0.1 kWdc.

526

Table 6-17. F-111E AVIONICS CONFIGURATION DATA: INFRARED RADAR AN/AAR-34 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver Control	C-8250/AAR-34											
Search Track Scanner	CV-2630/AAR-34					DETAILS OF THE AN/AAR-34 ARE CLASSIFIED.						
Video Signals Processor	CM-389/AAR-34											

527

Best Available Copy

Table 6-18. F-111E AVIONICS CONFIGURATION DATA: ECM AN/APS-109 NSN: 5865-00-813-5413

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna Band 3	AS-1781/APS-109	Radome										
Antenna Band 3	AS-1725/APS-109	Radome										
Antenna Band 1	AS-1723/APS-109	Radome										
Antenna	AS-1719/APS-109	Radome				DETAILS OF THE AN/ALQ-94 ARE CLASSIFIED.						
Receiver	R-1643/APS-109	TBD										MT-4225/APS-109
Video Signal Processor	CM-392/APS-109											MT-4225/APS-109
Indicator	SB-3355/APS-109											Panel

Table 6-19. F-111E AVIONICS CONFIGURATION DATA: ECM AN/ALQ-94 NSN: 5865-00-890-0422

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Amplifier Mid Band	AM-4851/ALQ-94	Door 1101									Forced Air	MT-3878/ALQ-94
Receiver Mid	R-1498/ALQ-94	Door 1101									Forced Air	MT-3878/ALQ-94
Amplifier Low-Band	AM-4850/ALQ-94	Door 1101									Forced Air	MT-3877/ALQ-94
Receiver Low	R-1497/ALQ-94	Door 1101									Forced Air	MT-3877/ALQ-94
Amplifier High Band	AM-4852/ALQ-94	Door 1201									Forced Air	MT-3879/ALQ-94
Receiver High	R-1499/ALQ-94	Door 1201				DETAILS OF THE AN/APS-109 ARE CLASSIFIED.					Forced Air	MT-3879/ALQ-94
Control	C-7410/ALQ-94	Cockpit									Convection	Panel
Antenna No. 3												
Antenna No. 5												
Antenna No. 7												
Antenna No. 9												
Antenna High												
Antenna Mid												
Antenna Low												

529

Table 6-20. F-111E AVIONICS CONFIGURATION DATA: CM DISPENSER SET (PARTIAL LISTING) AN/ALE-28 NSN: 5865-00-105-8987*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
CM Dispenser Set	AN/ALE-28							0.15	0.075	111W		
Control	C-6471/ALE-28	Cockpit	4.12	5.75	6.25	148.0	4.6			20W	Convection	Cockpit
Control Sequence Eject	C-6472/ALE-28		2.25	7.00	5.31	83.6	2.2					
Eject Force Display	D-22/ALE-28		11.6	9.8	32.4	3,683.0	51.0			2.05W		
Disposables Control Panel		Cockpit	1.12	5.75	4.0	25.76	0.4	0.005	0.007	12W	Convection	Cockpit

*Also NSN: 5865-00-114-7146.

Best Available Copy

530

Table 6-21. F-111E AVIONICS CONFIGURATION DATA: PHOTOGRAPHIC EQUIPMENT

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
[illegible] Camera Still Picture	[illegible] NSN: 6720-00-051-0422	TBD										
Magazine Camera Still Picture	LB-16A NSN: 6760-00-051-9271	TBD										
Control Box Camera Still Picture	LB-17A NSN: 6760-00-052-7[illegible]	TBD										

531

Table 6-22. F-111E AVIONICS CONFIGURATION DATA: RECORDER SET AN/A24U-6 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Recorder Mechanical Assembly	MXX-316/A24U-6	TBD										
Magnetic Recorder Set	MXX-315/A24U-6	TBD										

Best Available Copy

532

Table 6-23. F-111E AVIONICS CONFIGURATION DATA: LEAD COMPUTING OPTICAL SIGHT SYSTEM AN/ASG-23 NSN: 1270-00-244-6805

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Optical Display Sight	SU-29/ASG-23	Cockpit	8.9	6.8	23.0	1,392	20.0				Convection	Cockpit
Lead and Launch Computer Amplifier	AM-4301/ASG-23	Door 1102	4.9	8.02	15.2	597	20.0				Forced Air	Shock
Lead Computing Gyro	CN-1060/ASG-23	Door 1102	10.5	10.5	9.0	992	14.0				Forced Air	Hard
Amplifier Mounting Rack		Door 1102	1.0	8.35	15.7		1.0					

533

Best Available Copy

7. ANTENNA LOCATIONS

Figure 7-1 shows the approximate locations of the antennas on the F-111E. Antenna nomenclature from the current technical orders is as follows;

	Antenna	Nomenclature or Part Number
1.	Glide Slope Strip	12Z519-7
	Glide Slope Plate	12Z517-1
2.	ADF	AS-909/ARA-48
3.	IFF (Upper) and UHF Data Link	11D020100-6
4.	Radio Beacon Set	AN/URT-27 or -33
5.	UHF No. 1 and TACAN Upper	11D020100-6
6.	HF Dorsal	12T501-807
	HF Vertical	12T010-849
7.	IFF Lower	AT-741B/A
8.	Localizer (2)	TBD
9.	Low and Medium Frequency Radar Homing (4)	LH Installation 12E2239-5
10.	Forward Radar Warning (2)	RH Installation 12E2239-6
11.	High Frequency Radar Homing (4)	
12.	Terrain Following Radar (2)	AS-2136/APQ-110
13.	Attack Radar	AS-1749/APQ-113
14.	AN/ALQ-94 ECM No. 3	12E2907-1
	AN/ALQ-94 ECM No. 5	12E2908-1
	AN/ALQ-94 ECM No. 7	12E2909-1
15.	Radar Altimeter	LG81G3
16.	AN/ALR-62	311190-1
17.	AN/ALQ-94 High Band Wing Glove (4)	12E2989-1
	AN/ALQ-94 Medium Band Wing Glove (2)	12E2987-1
	AN/ALQ-94 Low Band Wing Glove (4)	12E2988-1
	AN/ALQ-94 Mid Band, Transmit Wing Glove (2)	12E2999-1
18.	AN/ALR-62 (2)	12E2982-1
19.	Aft Radar Warning (2)	12E805-1
20.	AN/ALQ-94 ECM No. 9 LH (3)	12E2910-3
	AN/ALQ-94 ECM No. 9 RH (3)	12E2910-1
21.	UHF No. 2 and TACAN Lower	11D020100-3
22.	AN/ALQ-94 ECM No. 3	12E2907-1
	AN/ALQ-94 ECM No. 5	12E2908-1
	AN/ALQ-94 ECM No. 7	12E2909-1
23.	Marker Beacon	16D00500

534

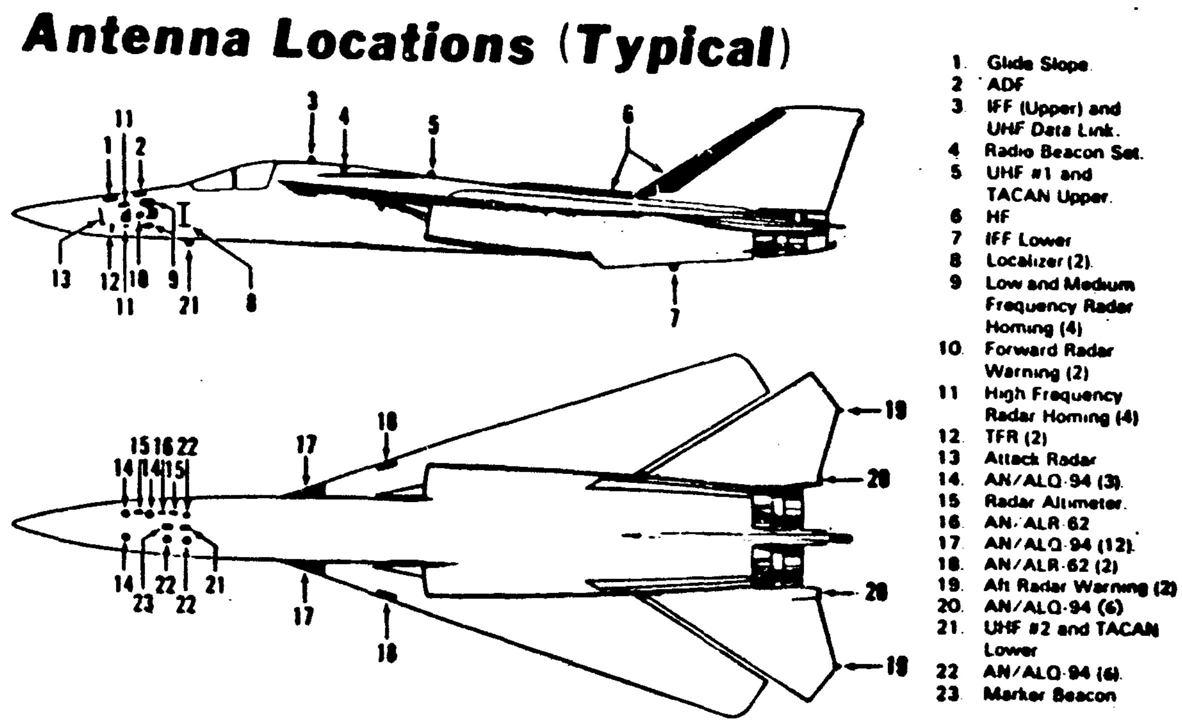


Figure 7-1. ANTENNA LOCATIONS (TYPICAL)

535

8. INTERFACE DATA

This section contains examples of interface signal characteristics. These data were extracted from applicable sections of the Interface Control Documents (ICDs) for integration of GPS user equipment in the F-111E aircraft.

Each sheet discusses a particular signal. The top line contains the signal name, type of signal (digital, analog, discrete, or synchronous), signal source and load, and whether the signal is an input or output of the GPS user equipment. A functional description follows, together with a description of the signal's characteristics.

536

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Bearing	Synchro	O	UE	HSI and BDHI

Functional Description

Provides angular information to the bearing pointer* to display relative bearing of the aircraft's present position to selected waypoint. The relative bearing is the difference, in degrees, between the lubber line and the bearing pointer as read from the compass card.

*No. 1 pointer on BDHI

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: Aircraft Heading
POSITIVE DIRECTION SENSE: Increasing Bearing
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: HSI $\pm 2.5^{\circ}$, BDHI $\pm 0.5^{\circ}$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Bearing Pointer, 3-Wire Synchro, Bendix Type AY-500-5 or equal
2) BDHI, E5165001400, No. 1 Pointer, 3-Wire Synchro, Bendix Type AY-100 HY-59-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-10-1

A ICD-GPS-014 & 017
10-2

537

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Bearing Pointer, 3-Wire Synchro, Bendix Type AY-500-5 or equal	BDHI, E 5165001400, No. 1 Pointer, 3-Wire Synchro, Bendix Type AY-100 HY-59-A1 or equal

LOAD 1

ROTOR

Input Voltage	26	Volts
Frequency	400	Cycles
Input Current	--	ma
Input Power	--	Watts
Resistance (DC)	530	Ohms

STATOR

Input Voltage	11.8	Volts
Input Current	20	ma
Input Power	0.090	Watts
Resistance (DC)	188	Ohms
Rotor Output Voltage	19	Volts
Phase Shift (S to R)	15	Degrees
Accuracy (Max)	15	Minutes
Null Voltage (Max)	50	mv

IMPEDANCE

Zso	222 + J470	Ohms
Zro	940 + J2260	Ohms
Zrss	1050 + J450	Ohms

LOAD 2

Primary Winding	Stator	
Primary Voltage (400 Hz)	11.8	Volts
Secondary Voltage	20.3	Volts
Input Current	.020	Amps
Input Power	.060	Watts
Max. Error Spread	±6	Minutes
Max. Null Voltage	30	mv
Zro	595 + J2130	
Zso	750 + J369	
Rotor DC Resistance	409	Ohms
Stator DC Resistance	1200	Ohms

A		ICD-GPS-014 & 017
		10-3

538

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Units	Synchro	0	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the units digit in the range window. Displays aircraft present position distance to selected waypoint in 1 nm increments (0.5 nm indexed). Driven independently of other digits, but read in conjunction with them in order to provide the least significant digit.

Signal Characteristics

RANGE: 0 to 9 (0^o to 360^o)
ACCURACY: $\pm$ 0.1 ($\pm$ 3.6^o)
INDEX REFERENCE: $\bar{0}$
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^o = 1 numeral
RESOLUTION: $\pm 3^o$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-DD-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through 26 Vac common.

A/C: F-111A/E
REF: MIL-I-27848
T.O. 12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-18-1

ELECTRICAL CHARACTERISTICS

LOAD 1			LOAD 2		
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal			BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type, AY 080-DD-46-A1 or equal		
Primary Winding	Rotor		Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts	Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts	Secondary Voltage	11.8	Volts
Input Current	100	ma	Input Current	187	ma
Input Power	.54	Watts	Input Power	1.1	Watts
Accuracy	30	Feet	Max. Error Spread	±1.25	Degrees
Impedance, Zro	54 + j260	Ohms	Impedance, Zro	32 ∓ j150	
Impedance, Zso	12 + j45	Ohms	Impedance, Zso	6.8 + j26	
			Impedance, Zrs	57 + j14	
Rotor DC Resistance	37	Ohms	Rotor DC Resistance	24	Ohms
Stator DC Resistance	12	Ohms	Stator DC Resistance	7.3	Ohms
Phase Shift	8.5	Degrees			

A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-5

540

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Tens	Synchro	0	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the tens digit in the range window. Displays aircraft present position distance to selected waypoint in 10 nm increments. Driven independently of other distance digits but read in conjunction with them.

Signal Characteristics

RANGE: 0 to 9 (0^{o} to 360^{o})
ACCURACY: $\pm$ 0.1 ($\pm 3.6^{o}$)
INDEX REFERENCE: $\bar{0}$
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^{o} = 1 numeral
RESOLUTION: $\pm 3^{o}$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-00-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through 26 Vac common.

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-18-1

A | ICD-GPS-014 & 017 | 10-6

541

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal	BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY080-00-46-A1 or equal

Load 1

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	100	ma
Input Power	.54	Watts
Accuracy	30	Feet
Impedance, Zro	54 + j260	
Impedance, Zso	12 + j45	
Rotor DC Resistance	37	Ohms
Stator DC Resistance	12	Ohms
Phase Shift	8.5	Degrees

Load 2

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	187	ma
Input Power	1.1	Watts
Max. Error Spread	±1.25	Degrees
Impedance, Zro	32 + j150	
Impedance, Zso	6.8 + j26	
Impedance, Zrs	57 + j14	
Rotor DC Resistance	24	Ohms
Stator DC Resistance	7.3	Ohms

SIZE		DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-7

542

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Hundreds	Synchro	0	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the hundreds digit in the range window. Displays aircraft present position distance to the selected waypoint in 100 nm increments. Driven independently of the other distance digits, but read in conjunction with them in order to provide the most significant digit for the distance value.

Signal Characteristics

RANGE: 0 to 9 (0° to 360°)
ACCURACY: $\pm$ 0.1 ($\pm$ 3.6°)
INDEX REFERENCE: 0
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36° = 1 numeral
RESOLUTION: $\pm 3^\circ$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY C80-DD-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)*
Wire Size: No. 22 AWG

Note: "Z" grounded through AC common.

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1E-111E-2-18-1

A ICD-GPS-014 & 017
10-8

543

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal	BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY080-OD-46-A1 or equal

LOAD 1

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	100	ma
Input Power	.54	Watts
Accuracy	30	Feet
Impedance, Zro	54 + j260	
Impedance, Zso	12 + j45	
Rotor DC Resistance	37	Ohms
Stator DC Resistance	12	Ohms
Phase Shift	8.5	Degrees

LOAD 2

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	187	ma
Input Power	1.1	Watts
Max. Error Spread	±1.25	Degrees
Impedance, Zro	32 + j150	
Impedance, Zso	6.8 + j26	
Impedance, Zrs	57 + j14	
Rotor DC Resistance	24	Ohms
Stator DC Resistance	7.3	Ohms

A ICD-GPS-014 & 017 10-9

544

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Flag	Discrete	O	UE	HSI & BDHI

Functional Description

Provides a discrete signal to operate the distance warning flag. The flag is normally out of view when the range indicator is operating and the range data is valid. The flag covers the range indicator when the distance information is not valid or the device supplying the distance data is not operating.

Signal Characteristics

RANGE: 28 Vdc applied, Flag out of view
28 Vdc not applied, Flag in view

Electrical Characteristics

LOAD: 1) HSI (AQU-4/A), distance shutter mechanism, 28 Vdc meter movement
2) BDHI (E5165001400), distance shutter mechanism, 28 Vdc meter movement, 625 Ohms ± 10%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
12R5-4-65-3
1F-111A-2-18-1
1F-111E-2-18-1

A ICD-GPS-014 & 017
SHEET 10-10

545

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Thousand, Digit	Discrete	O	UE	HSI

Functional Description

Provides a discrete output signal to operate the thousand digit of the HSI when the distance to a selected waypoint is greater than 999 nautical miles.

Signal Characteristics

Thousand Digit In View: 28 Vdc applied
Thousand Digit Out of View: 28 Vdc not applied

Electrical Characteristics

LOAD: HSI (AQU-4/A), thousand digit shutter
Input Voltage: 28 Vdc
Input Current: 150 ma

SOURCE: (TBD-1)

Interconnection Data

(TBD-3)

A/C: F-111A/E
REF: MIL-I-27848
T.O. 5F8-16-4-3

A | -GPS-014 & 017 | 10-11

546

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
To-From	Analog	O	UE	HSI

Functional Description

Provides a d.c. analog signal to drive the To-From indicator. If the aircraft is flying toward the waypoint and has not intercepted a reference line perpendicular to the aircraft ground track and through the waypoint, the indication will be To. Once past the waypoint reference line, the indication will be From as long as this waypoint is still selected.

Signal Characteristics

RANGE: To = +225 μa Max
Blank = no signal
From = -225 μa Max

Electrical Characteristics

LOAD: HSI (AQU-4/A), To-From Arrow, meter movement 200 Ohms ± 15 resistance

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
1F-111A-2-18-1
1F-111E-2-18-1

A | ICD-ФFS-014 & 017 | 10-12

547

INTERFACE SIGNAL CHARACTERISTIC

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation	Analog	O	UE	Flight Director Computer

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft to the left or right of a selected course. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 10^{0} for a TACAN approach; 2.5^{0} for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 2-6 miles full scale, (b) Terminal: 1-2 miles full scale and (c) Approach: 600-3000 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to ±150 μa
RESOLUTION: 3 μa
ACCURACY: ±10 μa
INDEX REFERENCE: Selected course
POSITIVE DIRECTION SENSE: Fly right (+)
SCALE FACTOR: 75 μa/dot on the indicator.
Distance/angular displacement scale factor (TBD-1)

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms ± 3%
SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
MIL-C-83013
1F-111A-2-18-1
1E-111E-2-18-1

ARINC Characteristic 582-5

A ICD-GPS-014 & 017

10-13

548

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horzontal Deviation Flag	Discrete	0	UE	Flight Director Computer

Functional Description

Provides a discrete signal to operate the deviation warning flag or circuit when the deviation data is unreliable or a malfunction has occurred in the course deviation circuitry.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms, ± 3% resistance

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-I-27848
MIL-C-83013
1F-111A-2-18-1
1F-111E-2-18-1

A ICD-GPS-014 & 017
10-14

549

INTERFACE SIGNAL CHARACTERISTIC

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation	Analog	O	UE	Flight Director Computer

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft above or below a desired flight path. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 0.5° for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 200 to 2000 feet full scale, (b) Terminal: 60-200 feet full scale and (c) Approach: 40-100 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to ± 150 μa
RESOLUTION: 3 μa
ACCURACY: ±10 μa
INDEX REFERENCE: Desired flight path
POSITIVE DIRECTION SENSE: Fly Down (+)
SCALE FACTOR: 75 μa/dot on the indicator.
Distance/angular displacement scale factor (TBD-1)

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms ± 3%
SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-C-83013
1F-111A-2-17-1
1F-111E-2-17-1
ARINC Characteristic 582-5

A ICD-GPS-014 & 017
10-15

556

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation Flag	Discrete	0	UE	Flight Director Computer

Functional Description

Provides a discrete signal to the Flight Director Computer when the UE vertical deviation signal is unreliable. This signal is similar to glideslope flag signal.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv.

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms ± 3%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size. No. 22 AWG

A/C: F-111A/E
REF: MIL-C-83013
1F-111A-2-17-1
1F-111E-2-17-1

A ICD-GPS-014 & 017

10-16

551

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Output Data	Digital	O	UE	IBNS

Functional Description

Provides position, velocity and time and other parameters (TBD-3) to the IBNS to update the Inertial Navigation Set and to aid in navigation and bombing solutions. (See Appendix II.)

Signal Characteristics

Word/Frame Structure: (TBD-3)
Information Identifier: (TBD-3)
Data Standard: (TBD-3)
Timing Tolerances: (TBD-3)

Electrical Characteristics

(TBD-3)

Interconnection Data

(TBD-3)

A/C: F-111A/E
REF:

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-17

562

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	[illegible]	I/O	FROM	TO
Magnetic Heading	Synchro	I	AFRS-Electronic Control Amplifier	UE

Functional Description

Provides angular reference signal of aircraft heading relative to magnetic north.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: Magnetic North
POSITIVE DIRECTION SENSE: Nose Right
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: (TBD-?)

Electrical Characteristics (continued on next page)

SOURCE: Auxiliary Flight Reference System, Electronic Control Amplifier (ASK 25A/A24G-26), 3-wire Synchro, Clifton CGH-8-A-7 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: MIL-C-38418
T.O. 1F-111A-2-12-1
T.O. 5F4-21-3
T.O. 5F4-21-4
T.O. 1F-111E-2-12-1

A	ICD-GPS-014 & 017
	10-18

553

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Clifton Type CGH-8-A-7 or equal	
Input Voltage 11?V 400Hz Input Current 29 ma Input Power 0.8 w Output Voltage (Max) 11.8V Sensitivity 200 mv/deg Phase Shift 1? deg DC Rotor Resistance 700 Ohms DC Stator Resistance 10.4 Ohms Impedance, Zro 950 + j3, 850 Ohms Impedance, Zso 10 + j36 Ohms Impedance, Zrss 1550 + j420 Ohms Max Null Voltage 75 mv Accuracy (Max Error Spread) 14 minutes	

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-19

564

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
True Airspeed	Synchro	I	Central Air Data Computer	UE

Functional Description

Provides an input of true airspeed in synchro format.

Signal Characteristics

RANGE:
ACCURACY:
INDEX REFERENCE: (TBD-2)
POSITIVE DIRECTION SENSE:
SCALE FACTOR:
RESOLUTION:

Electrical Characteristics (continued on next page)

SOURCE: Central Air Data Computer, 1903633-4, 3-Wire Synchro, Bendix type AY 300S 16A7 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: 2 Shielded Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" ties to shield ground

A/C: F-111A/E
REF: T.O. 5F5-4-17-3
T.O. 1F-111A-2-16-1
T.O. 1F-111E-2-16-1

A ICD-GPS-014 & 017 10-20

565

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Bendix Type AY 300S 16A7 or equal	
Primary Winding: Rotor Input Voltage: 26 Vac, 400 Hz Input Current: 91 ma Input Power: 0.6 watts Output Voltage (Max): 11.8V Phase Shift: 9.5° lead DC Rotor Resistance: 50 ohms X Stator Resistance: 16 ohms Impedance, Zro: 70 + j305 ohms Impedance, Zso: 16.5 + j50 ohms Max Null Voltage: 30 mv Accuracy (Max error spread): ±10 minutes	

A ICD-GPS-014 & 017

10-21

556

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Barometric Altitude	Synchro	I	Central Air Data Computer	UE

Functional Description

Provides an input of barometric altitude in synchro format.

Signal Characteristics

RANGE:
ACCURACY:
INDEX REFERENCE: (TBD-2)
POSITIVE DIRECTION SENSE:
SCALE FACTOR:

Electrical Characteristics (continued on next page)

SOURCE: Central Air Data Computer, 1903633-4, 3-wire synchro
Bendix type AY 300C 43A1 or equal

LOAD: (TBDG)

Interconnection Data

Wire Type & No.: Shielded Pair and One Shielded Conductor
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: T.O. 5F5-4-17-3
T.O. 1F-111A-2-16-1
T.O. 1F-111E-2-16-1

A ICD-GPS-014 & 017

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulses	Pulse	I	Interference Blanker	UE

<u>Functional Description</u>

The interference blanker provides blanking pulses to prevent interference between systems operating in the same frequency spectrum.

<u>Signal Characteristics</u> (see pages 10-24 and 10-25)

<u>Electrical Characteristics</u>

SOURCE: Interference Blanker, MX-8103/A

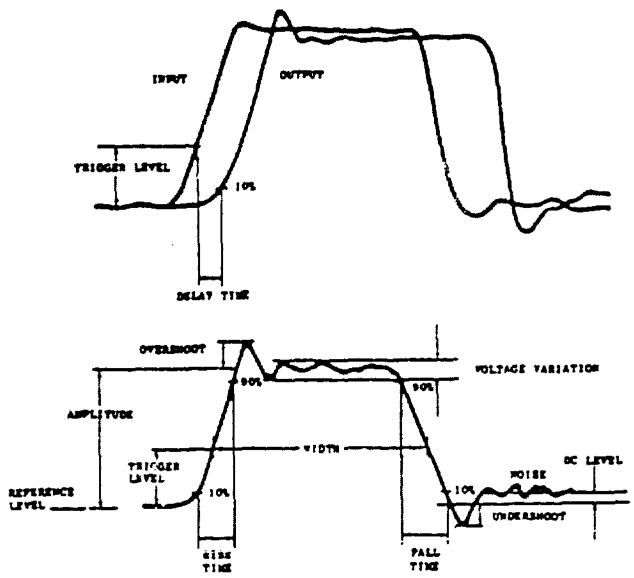
LOAD: (TBD-1)

<u>Interconnection Data</u>

Wire Type & No.: Coaxial Cable, RG-58 C/U

A/C: F-111A/E
REF: T.O. 12P3-4-22-12
T.O. 1F-111A-2-22
T.O. 1F-111E-2-22

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-23



AMPLITUDE - AVERAGE DC-LEVEL OF THE PULSE TOP, OVERSHOOT EXCLUDED.

RISE TIME - TIME INTERVAL BETWEEN THE 10% AMPLITUDE LEVEL AND THE 90% AMPLITUDE LEVEL ON THE LEADING EDGE OF THE PULSE.

FALL TIME - TIME INTERVAL BETWEEN THE 90% AMPLITUDE LEVEL AND THE 10% AMPLITUDE LEVEL ON THE TRAILING EDGE OF THE PULSE.

WIDTH - TIME INTERVAL BETWEEN THE POINT WHERE THE PULSE CROSSES THE NOMINAL TRIGGER LEVEL ON THE LEADING EDGE OF THE PULSE AND THE POINT WHERE THE PULSE CROSSES THE NOMINAL TRIGGER LEVEL ON THE TRAILING EDGE OF THE PULSE.

VOLTAGE VARIATION - PEAK VALUE OF THE CHANGE IN VOLTAGE, GREATER OR LESS THAN THE AMPLITUDE LEVEL, THAT OCCURS ON THE DC COMPONENT PULSE.

OVERSHOOT - MAXIMUM POSITIVE VOLTAGE ATTAINED BY THE LEADING EDGE OF THE PULSE ABOVE THE AMPLITUDE LEVEL.

UNDERSHOOT - MAXIMUM NEGATIVE VOLTAGE ATTAINED BY THE TRAILING EDGE OF THE PULSE AS MEASURED FROM THE ZERO LINE.

NOISE - ALL DEVIATIONS IN VOLTAGE FROM THE DIRECT RESIDUAL LEVEL THAT OCCURS BETWEEN THE 10% LEVEL ON THE TRAILING EDGE OF ONE PULSE AND THE 10% LEVEL ON THE LEADING EDGE OF THE FOLLOWING PULSE, WITH THE EXCEPTION OF THE UNDERSHOOT AND THE LEADING AND TRAILING EDGES, SHALL BE CONSIDERED NOISE. FOR NOISE MEASUREMENTS THE LOW VOLTAGE INPUT PULSE RISE TIME SHALL NOT BE LESS THAN 20 NANOSECONDS AND THE FALL TIME SHALL NOT BE LESS THAN 40 NANOSECONDS.

TRIGGER LEVEL - THAT INPUT VOLTAGE BELOW WHICH THE OUTPUT OF A CHANNEL IS 0 AND ABOVE WHICH THE OUTPUT OF THE CHANNEL IS THE SPECIFIED VOLTAGE.

DELAY TIME - TIME INTERVAL BETWEEN THE NOMINAL TRIGGER LEVEL ON THE INPUT PULSE TO THE 10% LEVEL ON THE RESULTING OUTPUT PULSE LEADING EDGE.

Blanking Pulse Characteristics
(continued)

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-24

569

Best Available Copy

CHARACTERISTIC	HIGH VOLTAGE INPUT CHANNELS	LOW VOLTAGE INPUT CHANNELS	HIGH VOLTAGE OUTPUT CHANNELS	LOW VOLTAGE OUTPUT CHANNELS
RISE TIME	20 OR MORE NANOSECONDS	7 OR MORE NANOSECONDS	LESS THAN 0.5 MICROSECOND	LESS THAN 30 NANOSECONDS
FALL TIME	40 OR MORE NANOSECONDS	3 OR MORE NANOSECONDS	LESS THAN 0.5 MICROSECOND	LESS THAN 40 NANOSECONDS
WIDTH				
MINIMUM	300 NANOSECONDS	100 NANOSECONDS		
MAXIMUM	DC COUPLED CIRCUITS LIMITED ONLY BY DUTY CYCLE	DC COUPLED CIRCUITS LIMITED ONLY BY DUTY CYCLE		
WIDTH VARIATION FROM INPUT PULSE			+1, -0.5 MICROSECOND	150 NANOSECONDS
AMPLITUDE				
MINIMUM	15 VOLTS	5 VOLTS	20 VOLTS	6 VOLTS
NOMINAL	25 VOLTS	7 VOLTS	25 VOLTS	7 VOLTS
MAXIMUM	70 VOLTS	9 VOLTS	30 VOLTS	8 VOLTS
VOLTAGE VARIATION ABOUT PULSE			13 VOLTS	±0.75 VOLT
REPETITION RATE				
MINIMUM	DC (WITHIN DUTY CYCLE LIMIT)	DC (WITHIN DUTY CYCLE LIMIT)	DC (WITHIN DUTY CYCLE LIMIT)	DC (WITHIN DUTY CYCLE LIMIT)
MAXIMUM	1 MEGACYCLE	10 MEGACYCLES	1 MEGACYCLE	10 MEGACYCLES
DUTY CYCLE (ON/OFF TIME)	30% WITH 70 VOLT PULSES 75% WITH 20 VOLT PULSES	75% WITH 7 (±1) VOLT PULSES	SAME AS INPUT	SAME AS INPUT
UNDERSHOOT	0 TO -2 VOLTS	0 TO -0.7 VOLT	0 TO -2.5 VOLTS	-0.65 VOLT
OVERSHOOT	0 TO 8 VOLTS	0 TO 2 VOLTS	10 VOLTS	2 VOLTS
DC LEVEL BETWEEN PULSES			0 TO 1 VOLT	0 TO 0.3 VOLT
NOISE	0 TO ±2.5 VOLTS	0 (±0.8) VOLTS	12.5 VOLTS	±0.6 VOLT
DELAY TIME				
HIGH VOLT INPUT			350 NANOSECONDS MAXIMUM	150 NANOSECONDS MAXIMUM
LOW VOLT INPUT			350 NANOSECONDS MAXIMUM	70 NANOSECONDS MAXIMUM
LOAD IMPEDANCE				
RESISTANCE	300 (±30%) OHMS	93 (±10%) OHMS	500 TO 2700 OHMS	93 (±10%) OHMS
CAPACITANCE			0 TO 1000 PICOFARADS	
TRIGGER LEVEL	10 (±3) VOLTS	3 (±1) VOLTS		

Blanking Pulse Characteristics
(continued)

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-25

Best Available Copy

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Pitch	Synchro	I	AFRS	UE

Functional Description

Provides an input signal proportional to fuselage pitch attitude with respect to the earth's horizon. Signal amplitude is proportioned to amount of fuselage displacement from level flight and phase indicates direction of displacement

Signal Characteristics

RANGE: 0° to $\pm 90^{\circ}$
ACCURACY: $\pm 0.5^{\circ}$
INDEX REFERENCE: 0° Pitch
POSITIVE DIRECTION SENSE: Nose Up
SCALE FACTOR: $1^{\circ} = 1^{\circ}$
RESOLUTION: (TBD-3)

Electrical Characteristics (continued on next page)

SOURCE: AFRS, 3-Wire Synchro, Clifton Type CGH-8-A-7 or equal
Electronic Control Amplifier (ASK-25A/A24G-26)

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: T.O. 1F-111A-2-12-1, T.O. 5F4-2-21-3, T.O. 5F4-2-21-4, MIL-C-38418 T.O. 1F-111E-2-12-1

A ICD-GPS-014 R 017
10-26

561

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Clifton Type CGH-8-A-7 or equal	
Input Voltage 115V 400 Hz Input Current 29 ma Input Power 0.8w Output Voltage (Max) 11.8V Sensitivity 206 mv/deg Phase Shift 11° DC Rotor Resistance 700 Ohms DC Stator Resistance 10.4 Ohms Impedance Zro 950 + j3, 850 Ohms Impedance Zso 10 + j36 Ohms Impedance Zrss 1550 + j420 Ohms Max Null Voltage 75 mv Accuracy (max error spread) 14 minutes	

A		ICD-GPS-014 & 017
	REV	10-27

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Roll	Synchro	I	AFRS	UE

Functional Description

Provides an input signal proportioned to fuselage roll attitude with reference to the earth's horizon. Signal amplitude is proportioned to amount of fuselage displacement from level flight and phase indicates direction of displacement

Signal Characteristics

RANGE: 0° to $\pm 90^\circ$
ACCURACY: $\pm 0.5^\circ$
INDEX REFERENCE: Zero Roll
POSITIVE DIRECTION SENSE: Right Wing Down
SCALE.FACTOR: $1^\circ = 1^\circ$
RESOLUTION: (TBD-3)

Electrical Characteristics (continued on next page)

SOURCE: Auxiliary Flight Reference System, Electronic Control Amplifier (ASK-25A/A24G-26), 3-Wire Synchro, Clifton CGH-8-A-7 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111A/E
REF: T.O. 1F-111A-2-12-1, T.O. 5F4-21-3, T.O. 5F4-21-4, MIL-C-38418 T.O. 1F-111E-2-12-1

A ICD-GPS-014 & 017 10-28

563

ELECTRICAL CHARACTERISTICS

SOURCE 1	
Synchro, Clifton Type CGH-8-A-7 or equal	
Input Voltage 115V 400 Hz Input Current 29 ma Input Power 0.8w Output Voltage (max) 11.8V Sensitivity 206 mv/deg Phase Shift 11° DC Rotor Resistance 700 Ohms DC Stator Resistance 10.4 Ohms Impedance Zro 950 + j3, 850 Ohms Impedance Zso 10 + j36 Ohms Impedance Zrss 1550 + j420 Ohms Max Null Voltage 75 m Accuracy (max error spread) 14 minutes	

A		ICD-GPS-014 & 017
SCALE	REV	SHEET 10-29

564

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Input Data	Digital	I	IBNS	UE

<u>Functional Description</u>

Provides the UE with position, velocities, covariances and other parameters (TBD-3). (See Appendix II.)

<u>Signal Characteristics</u>

Word/Frame Structure: (TBD-3)
Information Identifier: (TBD-3)
Data Standard: (TBD-3)
Timing Tolerance: (TBD-3)

<u>Electrical Characteristics</u>

(TBD-3)

<u>Interconnection Data</u>

(TBD-3)

A/C: F-111A/E
REF:

A ICD-GPS-014 A 017
10-30

565

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Course Set	Synchro	I	HSI	UE

Functional Description

Provides an electrical reference signal of the course manually selected by the Course Set control on the HSI. This signal will be used by the UE as a reference for positioning the course deviation and To-From indicators on the HSI.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^\circ$
RESOLUTION: 1.0°
INDEX REFERENCE. Magnetic North
POSITIVE DIRECTION SENSE: Right Hand Increments
SCALE FACTOR: $1^\circ = 1^\circ$

Electrical Characteristics (Continued on next page)

SOURCE: HSI (AQU-4/A), Course Resolver, Kearfott Type CR40921018 or equal
LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Seven single conductors (twisted)
Wire Size: No. 24 AWG

A/C: F-111A/E
REF: 1F-111A-2-18-1
MIL-T-27848
5F8-16-4-3
5F8-16-4-4

A		ICD-GPS-024 & 017
	REV	10-31

566

ELECTRICAL CHARACTERISTICS

SOURCE	
HSI, AQU-4/A, Course Resolver, Kearfott Type CR40931018 or equal	
Primary Winding — Rotor Input Voltage — 26 Vac Frequency — 400 Hz Input Current — 20 ma Input Power — 150 mw Input Impedance — 1680 /78.5° ohms Output Impedance — 1400 /78° ohms DC Resistance (rotor) — 190 ohms DC Resistance (stator) — 170 ohms Output Voltage — 22 Vac Sensitivity — 384 mv/deg Maximum null voltage — 46 mv Maximum error from electrical zero — 10 minutes Transformation ratio — .846	

A		ICD-GPS-014 ; 017
		0-32

577

9. FUTURE MODIFICATIONS

Modifications for the F-111E include the Airborne Video Tape Recorder, GPS, Digital Bomb Navigation System, Flex Ballistics Computer, and two ECM Systems (ALQ-137 improvements and ALR-62). Table 9-1 lists the present and future systems in the F-111 family. Figure 9-1 shows the changes in the forward equipment bays.

The ALR-62 Countermeasures Receiving Set is designed to intercept, detect, and analyze RF threat signals. The threat signals displayed show type of threat, direction, and lethality. Those signals are then forwarded to the Self-Protection Subsystem.

The five major CMRS LRUs are:

(1) Dual Channel Receiver (DCR)

(2) Multichannel Receiver (MCR)

(3) Digital Processor

(4) Control Indicator Unit

(5) Antenna Switching Unit (ASU)

The DCR is a dual-crystal video and superheterodyne receiver that detects both CW and pulsed RF signals. RF input is from the shared SPS low-band directional antennas (LF and RF). The direction of arrival detected in logarithmic amplifiers is fed on dual outputs to the Multichannel Receiver (MCR) for video combining with other MCR signals.

The MCR accepts inputs from six JSS directional antennas and four dedicated directional antennas. The inputs from two of the four dedicated antennas are combined into a single MCR input in the transmission line coupler. The RF signals are amplified and detected in logarithmic amplifiers, the angle of arrival is detected, and the video is combined and fed to the Digital Processor.

The Digital Processor processes the MCR video to identify threats and establish priorities on the basis of a stored program. The Digital Processor also provides display generation, interfacing with other systems, and self-testing.

The Control Indicator Unit provides a PPI display of the threat parameters on the 2.5-inch CRT (with alphanumeric and geometric symbols) and has a provision for operator control of the system.

The Antenna Switching Unit (ASU) interfaces between the MCR and six JSS antennas. In the direction finding mode, the ASU sequentially switches between the six signals. In the omni mode, all signals are processed simultaneously. ASU switching is controlled by the Digital Processor.

565

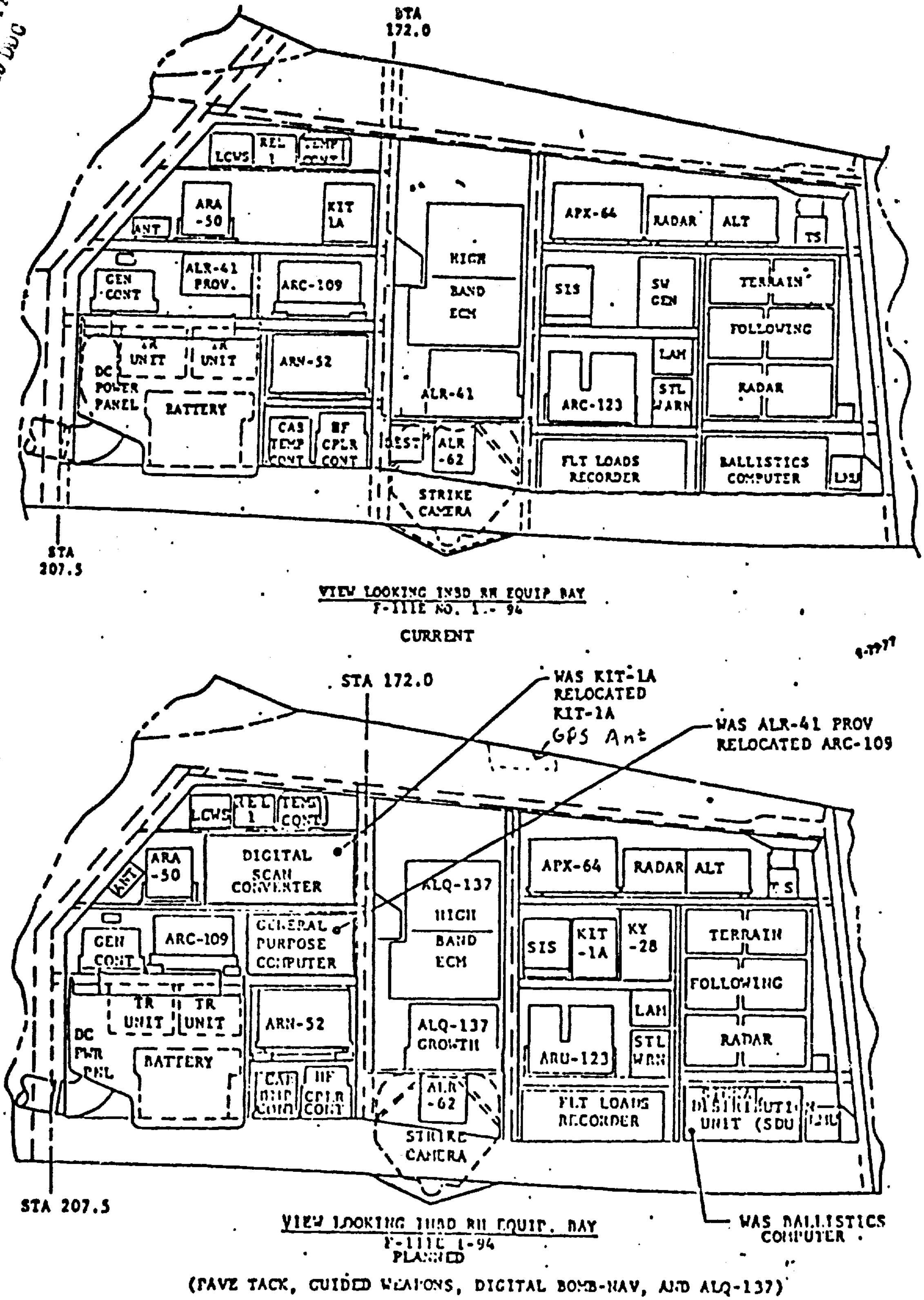


Figure 9-1. CURRENT VERSUS PLANNED LEFT-HAND AND RIGHT-HAND EQUIPMENT BAYS

569

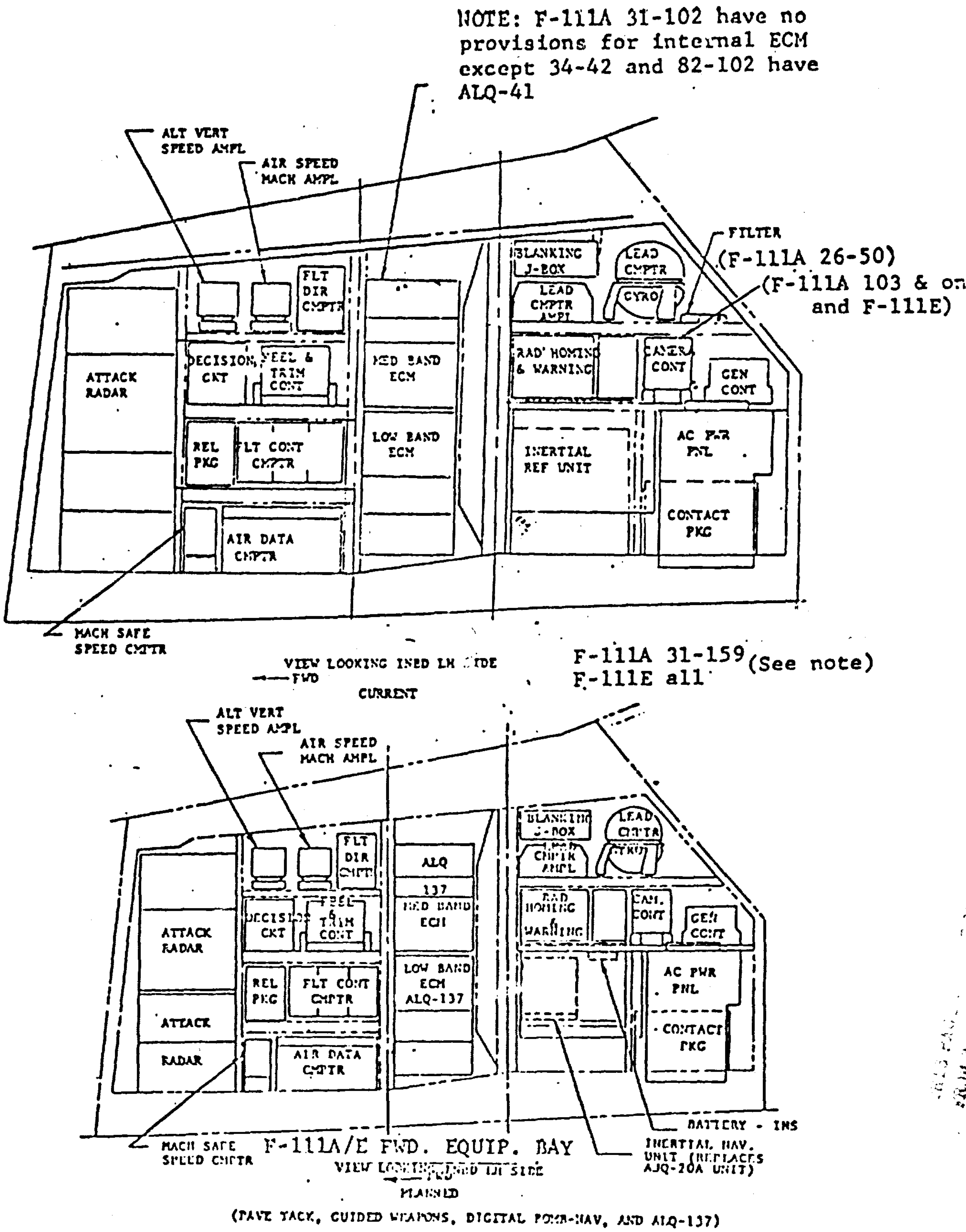


Figure 9-1. (continued)

Table 9-1. PRINCIPAL AVIONICS TO BE INSTALLED IN THE F-111 FAMILY BY 1985

Equipment	F-111A	F-111D	F-111E	F-111F	EF-111A
UHF	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164
VHF	ARC-112/123	ARC-123	ARC-123	ARC-123	ARC-112
Intercom	AIC-25	AIC-25	AIC-25	AIC-25	AIC-25
INS	AJQ-20 Digital Bomb Navigational	AJN-16	AJQ-20 (Maybe Digital Bomb Navigational)	AJN-16	AJQ-20 Digital Bomb Navigational
TACAN	ARN-118 (Maybe GPS)	ARN-52/118 (Maybe GPS)	ARN-52/118 (Maybe GPS)	ARN-84 (Maybe GPS)	ARN-118 (Maybe GPS)
ILS	ARN-58 (Maybe CAT II MLS)	ARN-58 (Maybe CAT II MLS)	ARN-58	ARN-58 (Maybe CAT II MLS)	ARN-58 (Maybe CAT II MLS)
UHF-DF	AFA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)
Radar Altimeter	APN-167	APN-167	APN-167	APN-167	APN-167
TFR	APQ-110	APQ-128	APQ-110	APQ-146/128/134	APQ-110
Attack Radar	APQ-113	APQ-130	APQ-113	APQ-144/114	Demodify to Naval Radar
Lead Computer Sight	ASG-23	--	ASG-23	ASG-27/25	Demodify
Auto Gun	M61-A1	M61-A1	M61-A1	M61-A1	Demodify
IFF A/G	APX-64	APX-64	APX-64	APX-64	APX-64
IFF Crypto	KIT-1A	KIT-1A	KIT-1A	KIT-1A	KIT-1A
HSI	AQU-4/A	AQU-4/A	AQU-4/A	AQU-4/A	AQU-4/A
CADC	1903633-4	1903634-3	1903633-4	1903634-3	1903633-4
Flight Director System	CPU-76	--	CPU-76A	CPU-76A	CPU-76, ARU-11
Auxiliary Flight Reference System	A24G-26A	A24G-26A	A24G-26A	A24G-26A	A24G-26A
RHAW	APS-109	APS-109	APS-109	APS-109	ALR-62 (TTWS)
ECM Receivers	ALR-23 AAR-34	ALR-23 AAR-34	-- AAR-34	ALR-23 AAR-34	ALR-23 (TTWS) ALQ-137 (SPS)
Jamming Transmitters	ALQ-94, 41	ALQ-94	ALQ-94, 119	ALQ-94	ALQ-99E (JSS)
Interference Blanker	MX-6770	MX-8106	MX-6770A	MX-8103	MX-9879/A
Dispenser	ALE-28	ALE-28	ALE-28	ALE-28	ALE-28
Strike Camera	KB-18A	KB-18A	KB-18A	KB-18A	Demodify
Flight Control System	FC-11	FC-11	FC-11	FC-11	FC-11

(continued)

571

Table 9-1. (continued)

Equipment	F-111A	F-111D	F-111E	F-111F	EF-111A
Fuel and Trim Assembly	12C1154-879	12C1154-867	12C1154-879	12C1154-875	12C1154-879
Doppler	--	APN-189 (Maybe GPS)	--	--	--
Nav Data Entry Panel	--	ID-1764/AYK	--	--	--
Nav Data Display Panel	--	ID-1622/AYK	--	ID-1748/AYK	--
General Purpose Computer	--	AYK-6 (2)	--	AYK-6 (2)	--
Weapons Bay Gun System	--	?	?	--	Demodify
Multiplex Converter Unit	--	CV-2492/A	--	CV-2497/A	--
Horizontal Situation Display	--	AYN-3	--	--	--
Integrated Display Set	--	AVA-9	--	--	--
IFF Interrogator	--	APX-76	--	--	--
Computer Control Unit	--	--	--	C-8586/AYK	--
UHF Crypto	--	--	--	--	KY-28
Nav Radar	--	--	--	--	APQ-160 (Demodify)
Modifications					
F2824	Terrain Follow Radar	--	Terrain Follow Radar	--	--
F2930	ALQ-119 ECM (Some A/C)	ALQ-119 ECM (Some A/C)	ALQ-119 ECM	--	--
T13315A	SIS (Some A/C)	SIS (Some A/C)	SIS	SIS (Some A/C)	
T17305A	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	--
T17310A	LARA Override System	LARA Override System	LARA Override System	LARA Override System	--
T37063A	APQ-113 TFR (Some)	APQ-130 TFR	APQ-113 TFR	APQ-1[illegible] TFR	--
F2957	ALR-62 RWR (Some)	ALR-62 RWR	ALR-62 RWR	ALR-62 RWR	--
F0000	Jam System (Some A/C)	--	--	--	--
F15312B	--	AVA-9 IDS	--	--	--
T37236B	--	--	--	Multiplex Converter (Some A/C)	--
Planned Avionics					
Video Tape Recorder	--	CVTR	CVTR	CVTR	--

GPS UE will physically and functionally replace the AN/ARN-118 TACAN system. The GPS receiver will be installed at the present TACAN location under door 1202. The antenna is installed above the forward equipment bays, as shown in Figure 7-1.

The function of the ALQ-137 is to detect hostile CW and the pulsed signals and automatically respond with programmed jamming against the following:

- Fire control radars of anti-aircraft artillery (AAA)
- Surface to air missiles (SAM)
- Airborne Interceptors (AI)
- Command Guidance missiles

The AN/ALQ-137 provides deception response in the E through J bands with four subsystems covering the low band, middle band, forward high band, and aft high band. Each of the four subsystems consists of a receiver and amplifier. Forward aft antennas are used to provide proper protection. Additional threat information is received from the ALR-62 Radar Warning Receiver.

The AN/ARC-164, scheduled to replace the ARC-109 in most planes by 1985, operates in the 225 MHz to 399.75 MHz military band. It provides a 7,000 channel tuneable UHF receiver; 243 MHz (nominal) auxiliary guard receiver; and a 7,000-channel, 10 watt carrier transmitter for voice communications. The AN/ARC-164 Radio Set has two basic configurations -- the console mount and the remote mount.

573

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Aircraft and avionics configuration data assembled by ARINC Research, principally in the form of copies of applicable sections, tables, and figures from the aircraft technical orders, as well as from equipment technical orders listed at the end of this section
- Avionics Planning Baseline Document -- October 1978
- GPS Phase II User Equipment Interface Requirements for the F-111A Aircraft; 1 September 1977

LIST OF APPLICABLE TECHNICAL ORDERS

Number	Title	Change Number	Date
1F-111E-01	LOAP	--	4/21/72
1F-111E-2-1	General Information	1	11/17/78
1F-111E-2-3-1	Auto Flight Control System	20	6/3/77
1F-111E-2-4-1	Flight Control Systems	22	8/26/77
1F-111E-2-5-1	Fire Power Control System	22	6/17/77
1F-111E-2-12-1	Instrument Systems	19	8/19/77
1F-111E-2-13-1	Electrical Power and Lighting Systems	19	7/22/77
1F-111E-2-15	Environmental Systems	21	8/19/77
1F-111E-2-16-1	Air Data Computer System	7	1/5/77
1F-111E-2-17-1	Communication and ILS	14	8/19/77
1F-111E-2-22	Systems Integration	20	6/24/77
5F5-4-17-2	Control Air Data Computer	1	9/30/76
12P2-2APQ110-12	TFR Set	10	3/15/74
12P2-2APQ110-52	TFR Indicator	3	3/22/74
12P2-APQ113-12	Radar Set	0	1/28/77
12P4-2APX64-2	Radio Receiver Transmitters	17	11/22/77
12P5-2APN167-12	Altimeter Set	12	5/3/74
12R2-2AIC25-2	Intercom Set	21	3/15/77
12R2-2ARC109-4	Radio Set	9	6/15/76
12R2-2ARC109-42	Radio Receiver	2	6/1/77
12R2-2ARC123-2	Radio Set	15	10/15/76
12R5-2ARN52-2	TACAN Set	changed	10/1/69
12R5-2ARN52-12	TACAN Set	4	2/15/73
12R5-2ARN58-2	Radio Receiver	6	5/13/77
12R5-2ARN118-1	TACAN Set	0	10/15/76
12R2-2ARC164-2	Radio Set	0	6/20/76

574

AVIONICS INTERFACE DATA SUMMARY
FOR
F-111F

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

576

Record of Changes			
Change	Subject	Date Entered	Initials

577

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

578

LIST OF FIGURES AND TABLES (continued)

579

LIST OF FIGURES AND TABLES (continued)

1. INTRODUCTION

This document contains configuration data relating to the integration of additional avionics into the F-111F aircraft.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

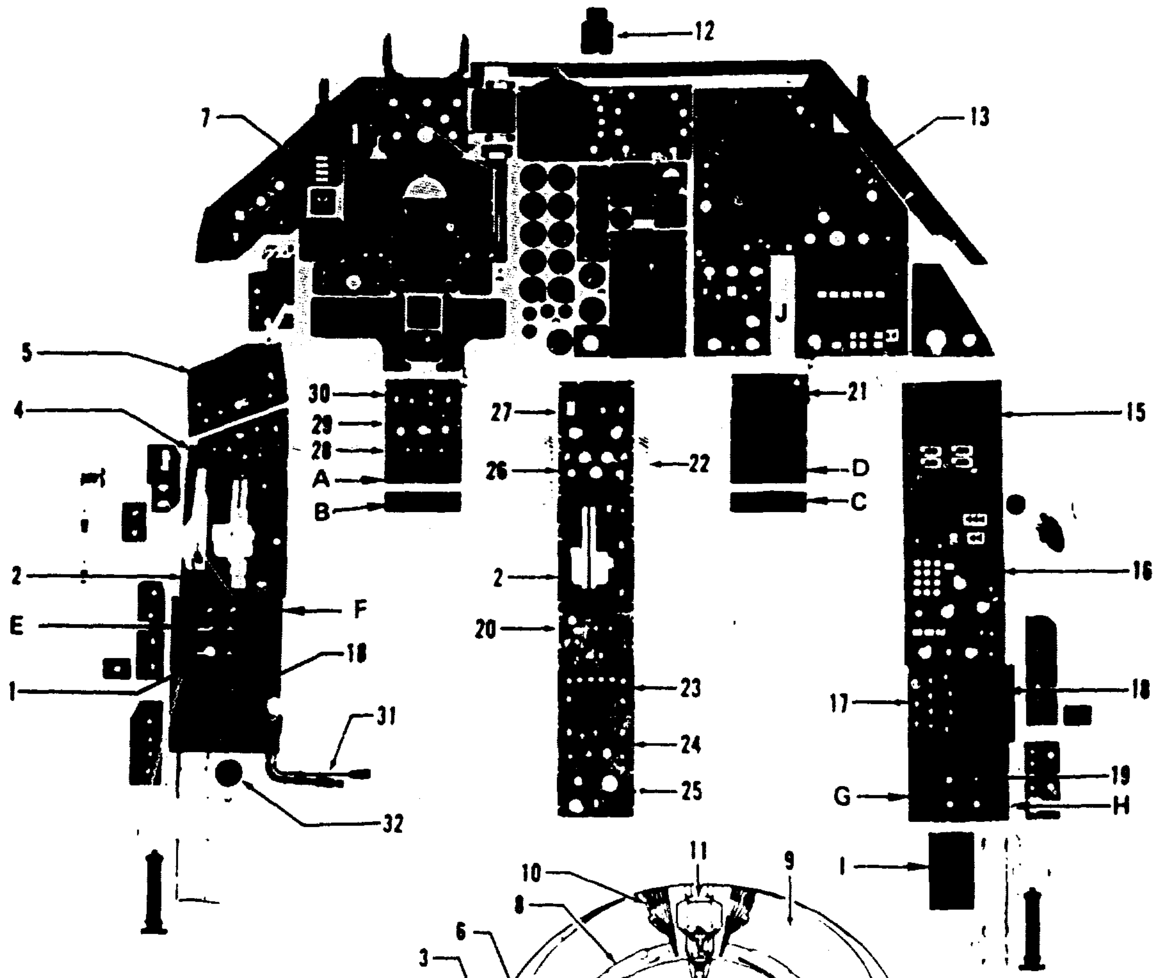
The applicable Technical Orders are included in the references listed in Section 10.

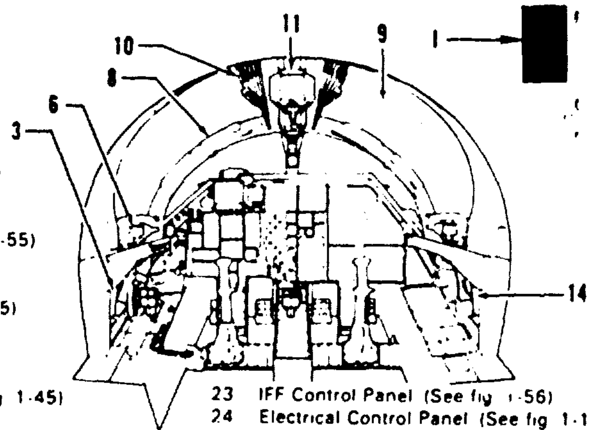
2. COCKPIT SPACE

Figures 2-1 through 2-5 depict the consoles and instrument panels for the F-111F. There is a relatively large amount of blank panel space in the present configuration of the F-111F cockpit, as illustrated in Figure 2-1. The general crew station arrangement of Figure 2-1 shows that blank panel space exists on the left and right vertical control panel consoles, as well as on the left- and right-side control panel consoles.

- There are two blank spaces at the bottom of the left vertical control panel console. The topmost blank, panel A, is 5-3/4"W × 1-3/4"H × 2"D. Below it is panel B, which is 5-3/4"W × 1-1/2"H × 2"D.
- There are two blank panels on the right vertical control panel console. Panel C is approximately the same size as panel B. Panel D is considerably larger. PAVE TACK and data link are proposed for the panel D area.
- Two blank panels exist on the left-side control panel console in spaces E and F, to the left and right of the autopilot damper control. Panel E is 5-3/4"W × 1-1/4"H × 4-3/4"D. Panel F, which is the proposed locations for ILS, is 5-3/4"W × 2-5/8"H × 7"D.
- The right-side control panel console contains three blank panel spaces. Panels G and H to the left and right of the CMDS control panel are approximately the same surface size as panels E and F. Panel I is 5-11/16"W × 3-5/16"H × 7-1/2"D and the proposed site for PAL Options II or III. Panel I is expandable to 7-11/16"W × 4-9/16"H × 7-1/2"D.
- A blank space, J, exists on the right main instrument panel just to the left of the navigation display. This space is 2"W × 7-5/8"H.

Figures 2-2 through 2-5 are illustrations of the left and right main instrument panels and the left and right sidewalls.





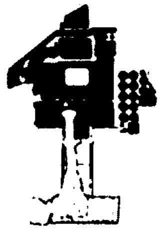
1 Autopilot/Damper Panel (See fig 1-25)
2 Throttle Panel (See fig 1-4)
3 Left Sidewall (See fig 1-18)
4 Miscellaneous Switch Panel (See fig 1-55)
5 Auxiliary Gage Panel (See fig 1-14)
6 Internal Canopy Latch Handles (2)
7 Left Main Instrument Panel (See fig 1-5)
8 Mirrors (4)
9 Canopy
10 Thermal Curtain (2)
11 Canopy Center Beam Assembly (See fig 1-45)
12 Magnetic Compass
13 Right Main Instrument Panel (See fig 1-29)
14 Right Sidewall (See fig 1-40)
15 Weapons Control Panel (See fig 1-61)
16 Computer Control Panel (See fig 1-60)
17 HF Radio Control Panel (See fig 1-50)
18 Interphone Control Panel (2) (See fig 1-52)
*19 CMDS Control Panel (See fig 1-78)
*20 ECM Pod Control Panel
21 ILS Control Panel (See fig 1-54)
22 Ejection Handles (2)
23 IFF Control Panel (See fig 1-56)
24 Electrical Control Panel (See fig 1-10)
25 Air Conditioning Control Panel (See fig 1-38)
26 TFR Control Panel (See fig 1-73)
27 Fuel Control Panel (See fig 1-8)
28 Antenna Select Panel (See fig 1-57)
29 Compass Control Panel (See fig 1-28)
30 Windshield/Anti-Icing Control Panel (See fig 1-41)
31 Left Station Oxygen-Suit Control Panel (See fig 1-44)
32 Oxygen Gage (See fig 1-44)

*See T O 1F-111F-1-3

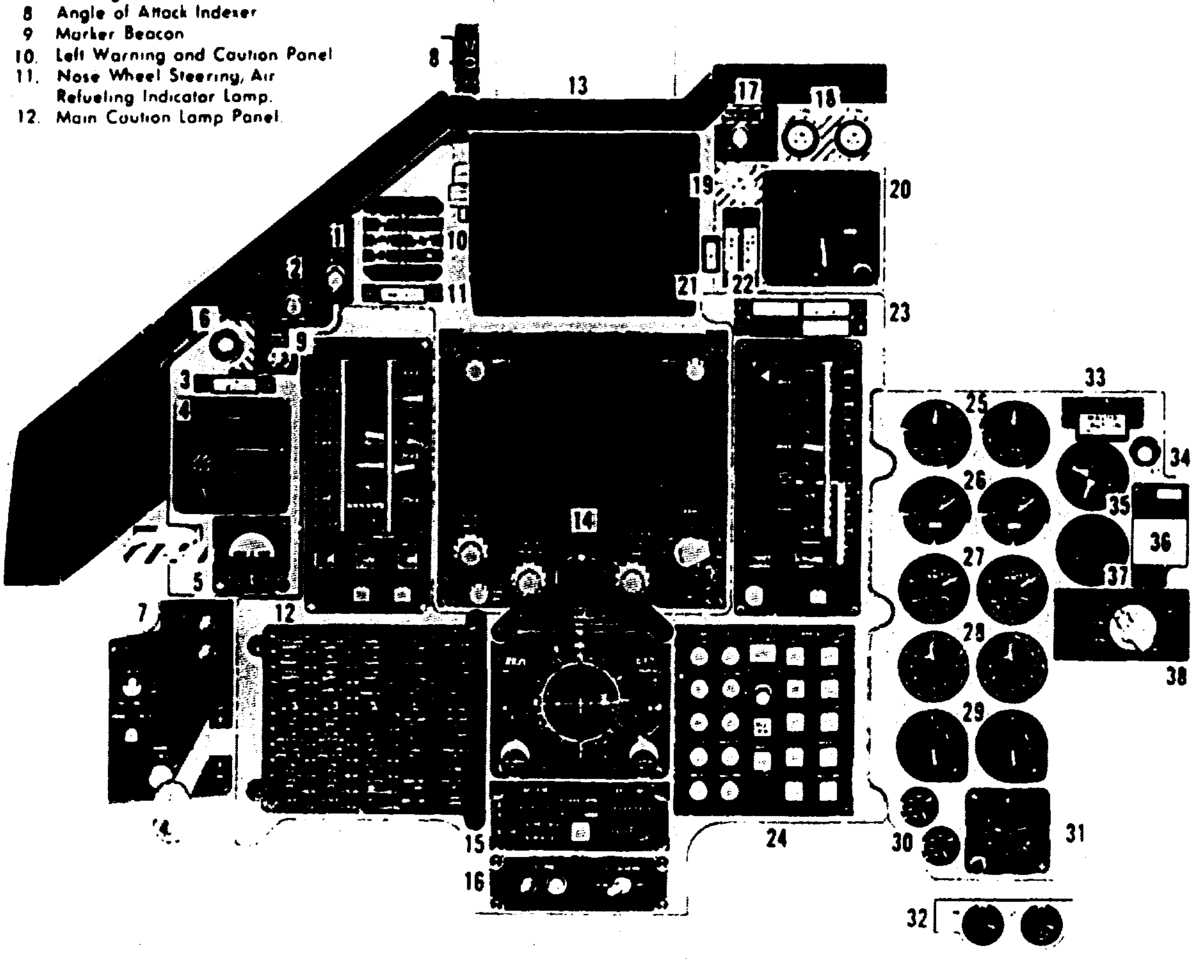
1-4

Figure 2-?. CREW STATION GENERAL ARRANGEMENT (TYPICAL)

583



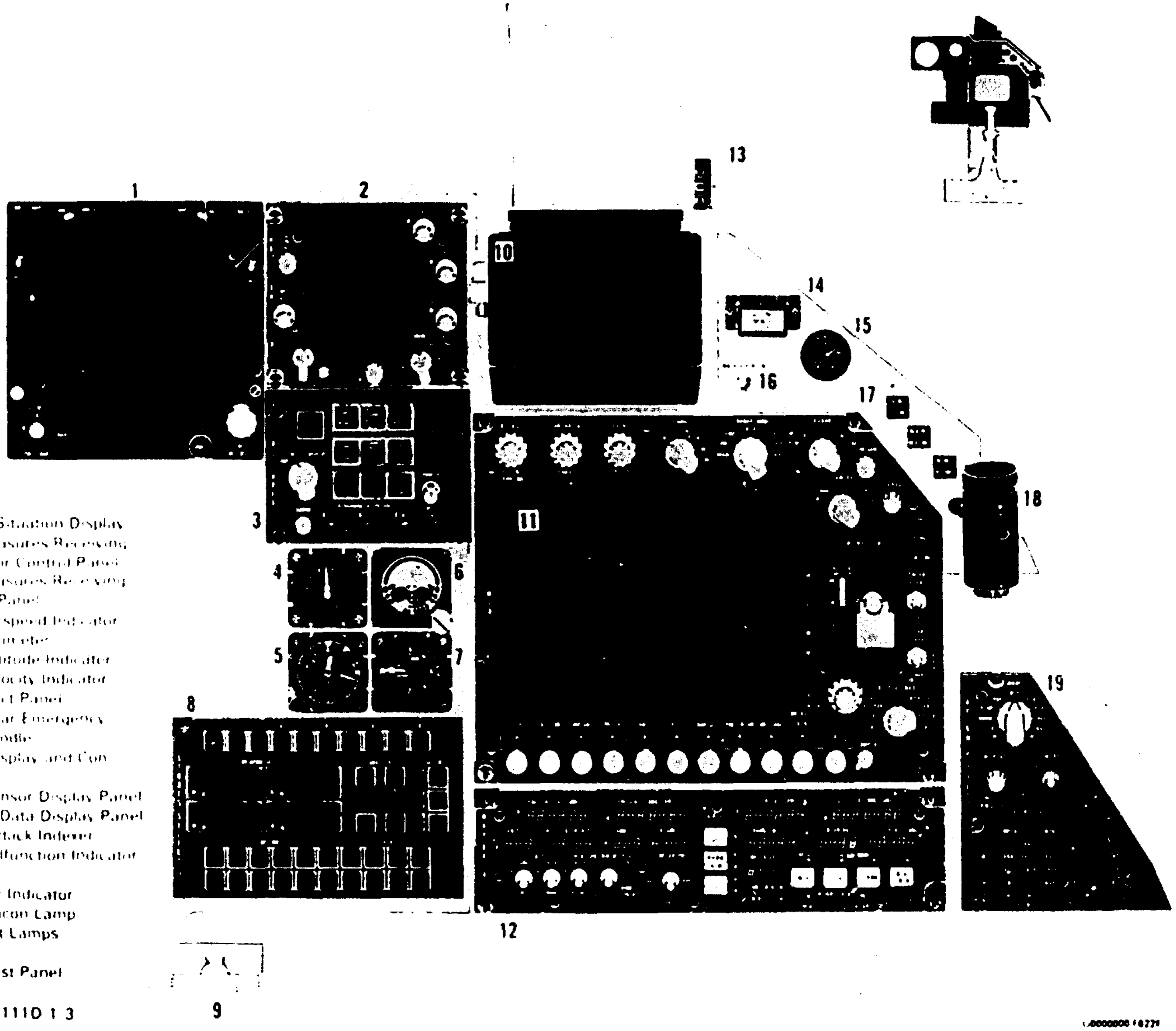
1. Air/Air IR Missile Switch.
2. Gun/Camera Control Switch.
3. Reference Not Engaged Caution Lamp.
4. Wing Sweep Flap/Slot Position Indicator.
5. Self-Contained Attitude Indicator.
6. External Stores Jettison Button.
7. Landing Gear Control Panel
8. Angle of Attack Indexer
9. Marker Beacon
10. Left Warning and Caution Panel
11. Nose Wheel Steering, Air Refueling Indicator Lamp.
12. Main Caution Lamp Panel.



13. Head Up Display and Control.
14. Integrated Flight Instruments.
15. Flight Data Panel.
16. T.O. Trim/HSI Bearing Panel.
17. Agent Discharge/Fire Detect Test Switch.
18. Engine Fire Pushbutton Warning Lamps.
19. Fuselage Fire Pushbutton Warning Lamp.
20. Radar Altimeter
21. Stall Warning Lamp
22. Canopy/Cabin Pressure Warning Lamps
23. Upper Warning and Caution Lamps
24. Mode Select Coupler Panel.
25. Engine Tachometers
26. Engine Turbine Inlet Temperature Indicators
27. Engine Fuel Flow Indicators
28. Engine Nozzle Position Indicators
29. Engine Pressure Ratio Indicators
30. Engine Oil Pressure Indicators
31. Clock.
32. Hydraulic Pressure Indicators.
33. Master Caution Lamp.
34. Fuel Quantity Indicator Test Button.
35. Fuselage Fuel Quantity Indicator.
36. Radio Call Panel
37. Total/Select Fuel Quantity Indicator.
38. Fuel Quantity Indicator Selector Knob.

Figure 2-2. LEFT MAIN INSTRUMENT PANEL (TYPICAL)

584

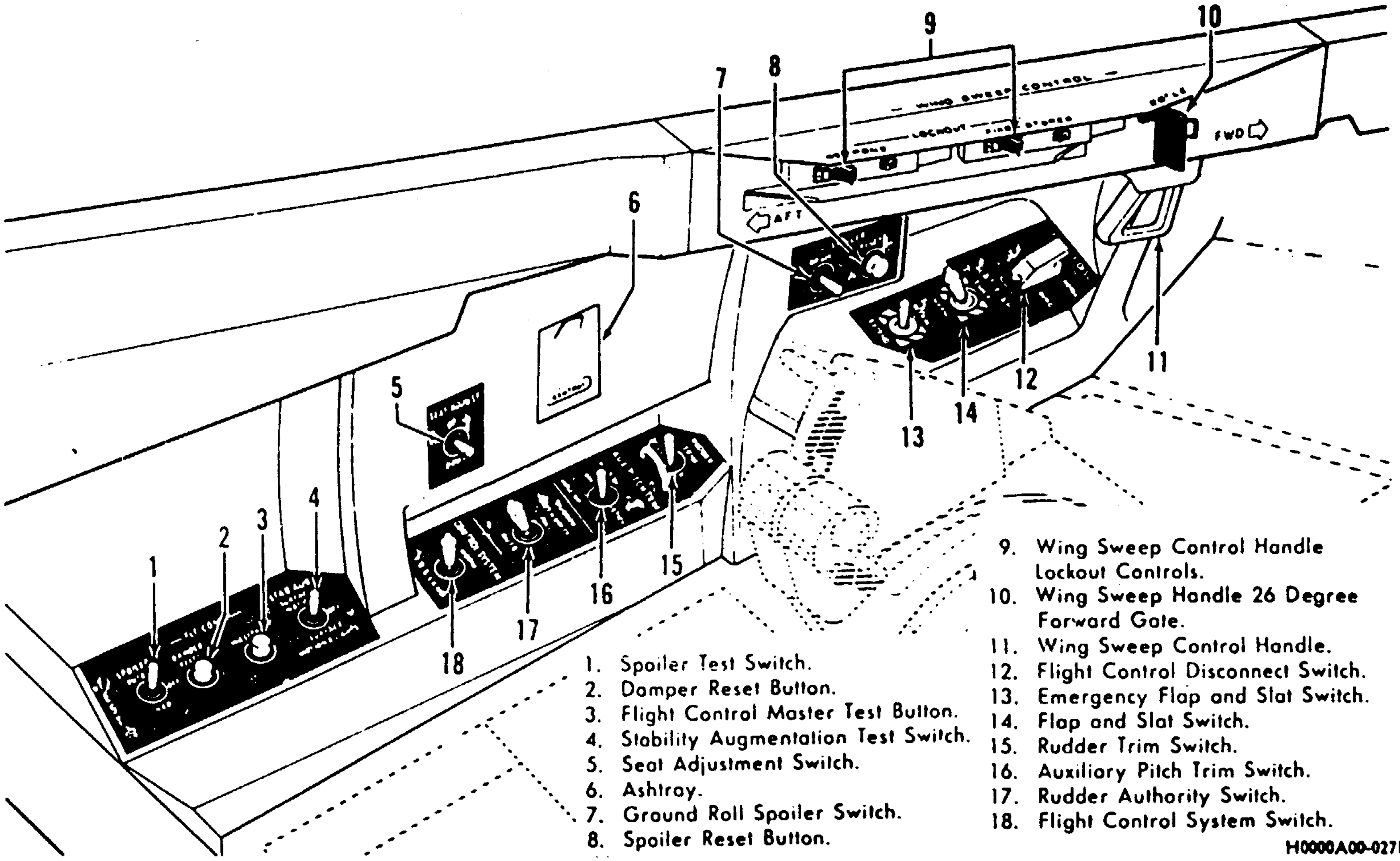


1 Horizontal Situation Display
*2 Countermeasures Receiving Set Indicator Control Panel
*3 Countermeasures Receiving Set Threat Panel
4 Standby Airspeed Indicator
5 Standby Altimeter
6 Standby Attitude Indicator
7 Vertical Velocity Indicator
8 Stores Select Panel
9 Landing Gear Emergency Release Handle
10 Head Up Display and Control
11 Multi Sensor Display Panel
12 Navigation Data Display Panel
13 Angle of Attack Indexer
14 Avionic Malfunction Indicator Lamp
*15 Sam Sector Indicator
16 Marker Beacon Lamp
*17 ECM Threat Lamps
18 Utility Light
19 Avionics Test Panel

*See T.O. 1F-111D-1-3

Figure 2-3. RIGHT MAIN INSTRUMENT PANEL (TYPICAL)

585



1. Spoiler Test Switch.
2. Damper Reset Button.
3. Flight Control Master Test Button.
4. Stability Augmentation Test Switch.
5. Seat Adjustment Switch.
6. Ashtray.
7. Ground Roll Spoiler Switch.
8. Spoiler Reset Button.
9. Wing Sweep Control Handle Lockout Controls.
10. Wing Sweep Handle 26 Degree Forward Gate.
11. Wing Sweep Control Handle.
12. Flight Control Disconnect Switch.
13. Emergency Flap and Slat Switch.
14. Flap and Slat Switch.
15. Rudder Trim Switch.
16. Auxiliary Pitch Trim Switch.
17. Rudder Authority Switch.
18. Flight Control System Switch.

Figure 2-4. LEFT SIDEWALL (TYPICAL)

587

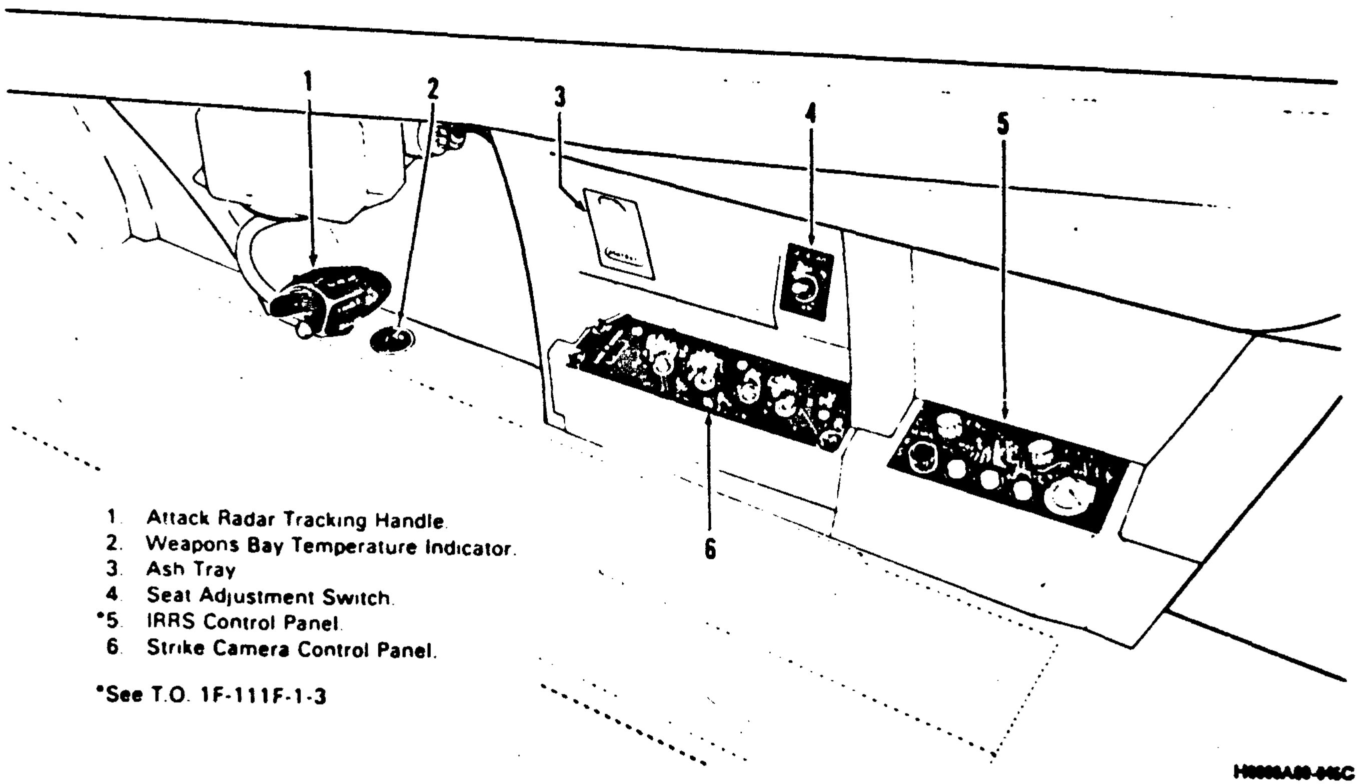


Figure 2-5. RIGHT SIDEWALL (TYPICAL)

3. AVIONICS SPACE

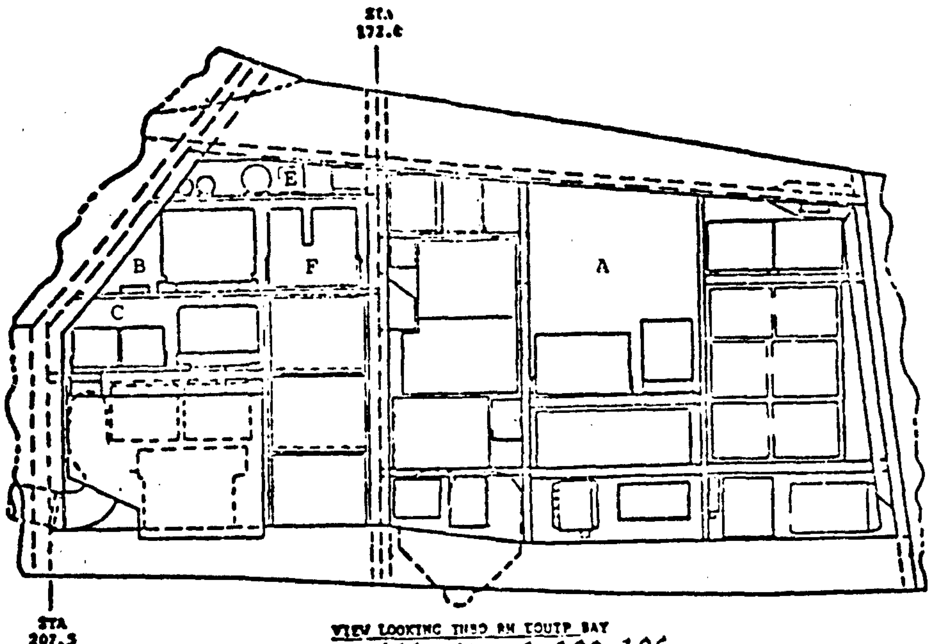
The F^2E summary (Table 3-1 and Figure 3-1) illustrates the avionics space availability in the F-111F. At present there are two unused spaces under door 1202 and one space available under door 1201. Another space under door 1101 would become available if the ARA-50 is removed and the optical sight unit is turned on end.

Table 3-1. F^2E SUMMARY - F-111F

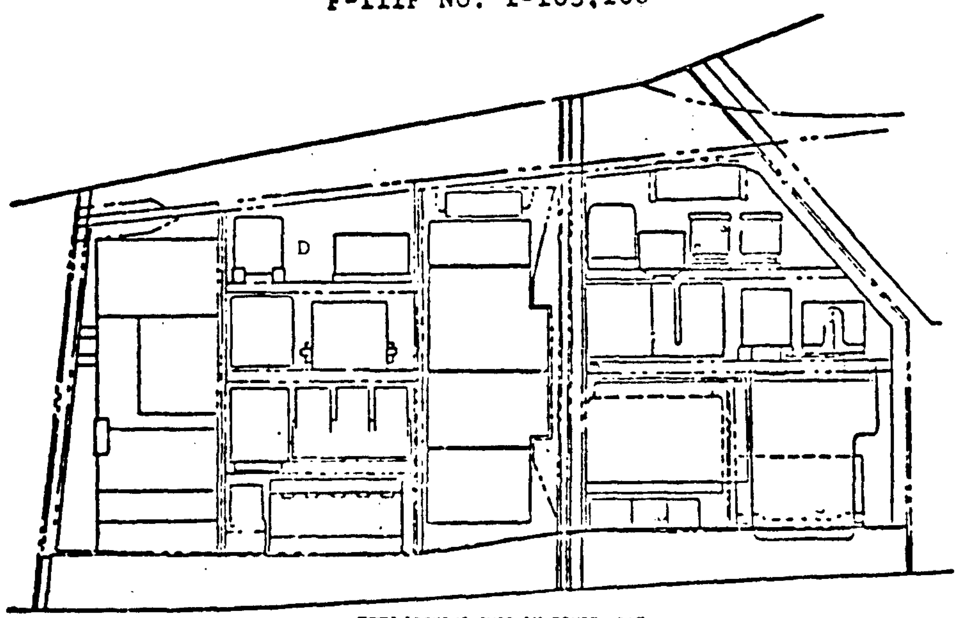
F^2E Criteria	Potential Available Space							
Location Reference and Description	A Door 1201 Above APX-64 Unit	B Door 1202 Next to TACAN	B ARC-109 Door 1202	C APX-64 IFF Door 1201	C Door 1201 Above Relay Packages	D Door 1101 AN/ARA-50	E TS-1843/APX	F ARC-112 HF Receiver-Transmitter Door 1201
Rectangular* Size (H, W, D – In.) Volume (Cu. Ft.)	15 × 17.5 × 12	Triangle (B, H, D) 6.5 × 8.25 × 20 0.31 ft³	7.2 × 9.5 × 17.5 0.69 ft³	8.6 × 12.6 × 20.2 0.88 ft³	2.75 × 10.5 × 20 0.334 ft³	7.5 × 13 × 14 0.790 ft³	3.2 × 1.3 × 7.8 0.05 ft³	11 × 12.8 × 18.4 1.50 ft³
Type Cooling Available	Forced Air Cooled	Forced Air Cooled	Forced Air Cooled	Forced Air Cooled	Forced Air Cooled	Forced Air Cooled	Forced Air Cooled	Forced Air Cooled
Temperature-Altitude Vibration	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area	Normal Equipment Area
Possible Candidates for this Space	PAVE TACK and KY-28 Secure Voice	None known	General Purpose Computer	None known	None known	None known	None known	None known
Remarks			RT-1168/ARC-164 in Cockpit volume of ARC-109 Control	Replace with APX-101 IFF Transponder or APX-100 Console Mounted IFF		Turn Optical Sight Unit on end and remove AN/ARA-50	If APX-64 is replaced with APX-101 or APX-100	Replace HF Comm. with Single LRU in Loc. F

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions are those of the available space.

589



VIEW LOOKING THRU RH EQUIP BAY
F-111F No. 1-103,106



VIEW LOOKING THRU LH EQUIP. BAY
F-111F #1-103,106

Figure 3-1. CURRENT AVIONICS SPACE AVAILABLE

590

4. ELECTRICAL POWER SYSTEM

4.1 Introduction

115/200 volt, three phase, 400 cycle ac power and 28 volt dc power are provided for the electrical power system in the F-111F. This power is generated by two 62.5 kVA ac generator drive assemblies, one mounted on each engine. These generators are supplemented by two 150 amp transformer rectifier units that convert the ac power to 28 volts dc. An aircraft battery supplies 28 volts dc to the battery bus and the dc start busses. The electrical power system consists of the following systems:

- Main ac power system
- External ac power and monitor system
- Emergency ac power system
- Dc power system

4.2 Power Requirements

In the F-111A, there is a basic avionics electrical power requirement of 40 kVA.

4.3 Power Generation and Distribution

The main sources of electrical power are 62.5 kVA indirect drive generators. The control units for these generators are in the forward equipment bay. The electrical power distribution system as three ac busses: A left main ac bus, a right main ac bus, and an essential ac bus.

4.4 Emergency ac Power System

The emergency ac power system provides electrical power for operation of safety-of-flight equipment in the event the main ac power system fails or hydraulic power is applied to the aircraft without electrical power, or both. The emergency ac power generator is operated by the utility hydraulic system.

4.5 Dc Power System

The dc power system supplies the aircraft with the necessary 28-volt direct current power. The main dc power system uses two ac-to-dc power converters to supply the main and essential dc busses. The aircraft battery ensures that standby power is available to power engine starts, aircraft position lights, and pylon refuel/defuel valves without external power units.

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The Environmental Control System (ECS) provides temperature controlled air for the cockpit and a temperature controlled flow of cooling air to the forward electronics bay and to the weapons bay. The ECS operates by ducting hot air from the sixteenth stage compressor and each engine through two air-to-air heat exchangers, and air-to-water heat exchanger, and a cooling turbine. The cooling turbine further cools the air to temperatures suitable for the cockpit and electronic equipment bays.

5.2 Cabin Air Conditioning

Cabin air conditioning is governed by a temperature controller that receives signals from temperature sensors and a cockpit control panel. The temperature controller allows hot air to mix with the cooled air stream to obtain air at the cockpit-selected temperature. Conditioned air flows from the cabin into the forward equipment bay.

5.3 Equipment Air Conditioning

Electronic equipment that is cooled by the ECS is grouped in the forward equipment area, cabin equipment area, aft (check) equipment area, main landing gear wheelwell area, and tail electronics area. The equipment is cooled by both area cooling and forced-air flow cooling. Area cooling is achieved by supplying cold air to the equipment area as required to maintain the temperature at 150° (±10°) F. In addition, a cold air flow can be forced over or into a component or group of components.

6. CURRENT AVIONICS

Tables 6-1 through 6-22 contain LRU data relating to the F-111F avionics systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

Table 6-1. F-111F AVIONICS CONFIGURATION DATA: HF RADIO AN/ARC-123 NSN: 5821-00-496-9234

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control	C-7426/ARC	Cockpit									Convection	Panel
Receiver-Transmitter	RT-822/ARC-123	Door 1202	7.62	3.62	13.6	375.0	13.12				Forced Air	MT-3660/ARC-123
Amplifier-Power Supply	AM-4573/ARC-123	Door 1202	7.62	4.87	17.2	638.3	23.13	115 V 3;			Forced Air	MT-3660/ARC-123
Shockmount Base	MT-3660/ARC-123	Door 1202	6.87	11.2	20.2	1554.0	8.54					

594

Table 6-2. F-111F AVIONICS CONFIGURATION DATA: UHF COMMUNICATION SET AN/ARC-109 NSN: 5821-00-496-9236

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF Communication	AN/ARC-109						38.8	150		150W		
Receiver-Transmitter	RT-749/ARC-109	Door 1202	6.87	8.87	14.87	906.1	28.7				Forced Air	MT-3327/ARC-109
Control	C-7425/ARC-109	Cockpit									Convection	Cockpit
Antenna Selector	C-4808	Door 1202	3.0	3.25	4.5	43.9	1.5				Forced Air	MT-1932A
Antenna	AS-1918						1.0					Hard

595

Table 6-3. F-111F AVIONICS CONFIGURATION DATA: INTERCOM AN/AIC-25 NSN: 5831-00-457-5041

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Intercom Set	AN/AIC-25								02			
Control	C-7424/AIC-25	Cockpit									Convection	Cockpit
Intercom Station	C-6624/AIC-25		4.38	3.62	5.12	81.2	2.7					

596

Table 6-4. F-111F AVIONICS CONFIGURATION DATA: UHF-ADF AN/ARA-50 NSN: 5826-00-883-5777

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
UHF-ADF	AN/ARA-50							0.04	0.01	50W		
Amplifier Relay Assembly	AM-3624/ARA-50	Door 1101	6.6	7.1	8.0	375	5.4				Forced Air	MT-1955/ ARA-50
UHF/ADF Loop Antenna	AS-909/ARA-48		3.5	10.25	10.25	368	10.0					Hard

597

Table 6-5. F-111F AVIONICS CONFIGURATION DATA: RADAR ALTIMETER AN/APN-167 NSN: 5841-00-772-1819

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Radar Altimeter	AN/APN-167											
Receiver-Transmitter Dual	RT-771/APN-167	Door 1202	6.5	15.0	14.5	14.14	26.0	0.086	0.01	192W	Forced Air	MT( )
Antenna	AS-1758/APN-167		4.5	4.5	9.25	187	1.1					Hard
Radar Altimeter Indicator	K5186000100	Cockpit					1.6/1.8*				Convection	Cockpit
Lo												

*Two indicators in aircraft.

Best Available Copy

598

Table 6-6. F-111F AVIONICS CONFIGURATION DATA: CENTRAL AIR DATA COMPUTER SYSTEM NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
CADC	1903634-3 NSN: 6610-00-116-4624	Door 1101	8.0	14.0	19.25	2156	47.5	115V 400Hz 1ϕ	28V			
Maximum Safe Mach Assembly	12C1006-817		4.5	4.5	6.57	133	2.5					
Angle of Attack Transmitter	SLZ 9370-4		4.5	4.5	6.57	133	2.5					
Total Temperature Indicator	B1508-6	Cockpit	2.25	2.25	6.47	32.7	12.5				Convection	Panel
Reduce Speed Warning Lamp	65-0478-1	Cockpit	0.5	3.68	3.2	5.89	0.24				Convection	Panel
Main Caution Light Panel	80-0170-5	Cockpit	6.1	6.6	3.94	159	4.8				Convection	Panel

Table 6-7. F-111F AVIONICS CONFIGURATION DATA: TACAN AN/ARN-84 NSN: 5826-00-357-2006
(AFTER T.O. 1F-111F-518)

Name	Nomenclature	Location	Dimension (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control	C-9475/ARN-84	Cockpit										
Receiver-Transmitter	RT-1127/ARN-84	Door 1202	9.0	10.5	20.0							MT-4616/ARN-84
Signal Data Converter	CV-3135/ARN-84											
Mount	MT-4617/ARN-84											
RF Switch	SA-521/A	Door 1202	1.94	2.78	3.19	17.2	0.34					

600

Table 6-8. F-111F AVIONICS CONFIGURATION DATA: TACAN AN/ARN-52 MSN: TBD
(PRIOR TO T.O. 1F-111F-518)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control	C-7712/ARN-52	Cockpit									Convection	Panel
Receiver-Transmitter	RT-893/ARN-52	Door 1202	7.35	17.0	16.9	12.42	43.25				Forced Air	MT-1729/ARN-52
Antenna	11020100-1		9.7	3.5	7.5	225.0	2.0					Hard
RF Switch	SA-521/A	Door 1202	1.94	2.76	[illegible]	17.2	0.34					
Receiver-Transmitter	RT-384/ARN-52											
System								0.25	0.0616			

601

Table 6-9. F-111F AVIONICS CONFIGURATION DATA: ILS AN/ARN-58 NSN: 5826-00-883-5795

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
ILS	AN/ARN-58								0.02			
Receiver Localizer	R-843/ARN-58	Door 2204	7.75	6.87	5.01	267	7.9		220mA	48W		Shock
Receiver	R-844/ARN-58	Door 2204	9.75	6.87	5.01	336	9.6			48W		Shock
Control	C-7422/ARN-93										Convection	
Marker Beacon Antenna							1.0					Hard
Glide Slope							0.8					Hard
Localizer Antennas												Hard

602

Table 6-10. F-111F AVIONICS CONFIGURATION DATA: INERTIAL NAVIGATION SYSTEM AJN-16 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Stabilized Platform	JX-8131/AJN-16	Door 1102	12.31	14.75	17.5	3178	70				Forced Air	Shock
Naval Computer	CP-945/AJN-16	Door 1101	8.0	6.5	19.75	1077	26				Forced Air	Shock
Control-Power Supply	C-7719/AJN-16	Door 1101	25.0	10.0	12.0	3000	14				Forced Air	Shock

Table 6-11. F-111F AVIONICS CONFIGURATION DATA: COMPUTER SYSTEM NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
General Purpose Computer	AN/AYK-6 NSN: 6605-00-166-2593	Door 1202	7.6	10.0	20.7	1573	47.4					MT-4006
Multiplexer Converter	CV-2797/A	Door 1202										MT-4006
Equipment Rack	MT-4400/A	Door 1202										
Control	C-8586/AYK											
Indicator	ID-1748/AYK											

604

Table 6-12. F-111F AVIONICS CONFIGURATION DATA: INTERFERENCE BLANKER NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Interference Blanker	MX-8103				Details of MX-8103 are classified.							

Best Available Copy

605

Table 6-13. F-111F AVIONICS CONFIGURATION DATA: IFF TRANSPONDER AN/APX-64 NSN: 5895-00-115-7812

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
IFF Transponder	AN/APX-64							0.3	0.03			
Receiver-Transmitter	RT-728/APX-64	Door 1202	8.58	11.13	19.31		30.0	0.08		110W	Forced Air	MT-3497/APX-64
Control	C-7483/APX-64	Cockpit									Convection	Cockpit
Test Set Airborne	TS-1843/APX	Door 1202	3.15	3.25	7.81	[illegible]	3.0		0.0105	10.5W	Forced Air	MT-3513
Antenna Blade	AS-1919						2.0					
Transponder Computer	KIT-1A/T SEC	Door 1102	2.62	6.6	14.25	810.7	12.0	0.025	0.012	30W	Forced Air	MT-4579/U

606

Table 6-14. F-111F AVIONICS CONFIGURATION DATA: TERRAIN FOLLOWING RADAR AN/APQ-128 NSN: 5841-00-104-9857

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Terrain Following Compute:	CP-917/APQ-128	Door 1201	5.3	7.3	16.1	623	16.4				Forced Air	MT-3917/APQ-128
Antenna Receiver	AS-2136/APQ-128	Nose Radome	13.5	12.7	14.3	2451	27.9					
Control	C-7510/APQ-128	Cockpit	3.0	5.8	6.3	110	2.6					
Amplifer-Power Supply	AM-4915/APQ-128	Door 1201	6.0	6.8	17.6	718	20.8				Forced Air	MT-3917/APQ-128
Synchronizer Transmitter	SN-519/APQ-128	Door 1201	6.0	7.8	17.6	8237	27.6				Forced Air	MT-3917/APQ-128
Mount	MT-3917/APQ-128	Door 1201	19.25	16.3	18.8	5899	24.8					

Table 6-15. F-111F AVIONICS CONFIGURATION DATA: ATTACK RADAR AN/APQ-114* AND AN/APQ-144

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna	AS-2123/APQ-114	Nose	26	35	32	29,120	56.5					
Antenna Control	C-7486/APQ-114		10	27	8	2,160	38.0					
Radar Control	C-7857/APQ-114	Nose	4	6	7	168	3.0					
Antenna Pedestal	AB-1035/APQ-114	Nose	19	21	8	3,192	38.0					
Radome	CW-790/APQ	Nose										
Elect-Synchronizer	SN-449/APQ-144	Door 1101	13	13	21	3,[illegible]	59.0				Forced Air	MT-3384/APQ-113
Modulator Receiver-Transmitter	MD-843/APQ-144	Door 1101	21	13	21	5,292	101.0				Forced Air	MT-3384/APQ-113
Control	C-8590/APQ-144		8	6	4	192	2.5					
Indicator Recorder	IP-948A/APQ-114A	Cockpit	9	16	31	4,464	65.0					
Equipment Rack	MT-3384/APQ-113	Door 1101	34	13	22	[illegible],724	6.0					

*AN/APQ-114: NSN: 5841-00-813-5412.

608

Table 5-16. F-111F AVIONICS CONFIGURATION DATA: ECM AN/APS-109 NSN: 5865-00-813-5413

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna Band 3	AS-1781/APS-109	Radome				Details of AN/APS-109 are classified.						
Antenna Band 3	AS-1725/APS-109	Radome										
Antenna Band 1	AS-1723/APS-109	Radome										
Antenna	AS-1719/APS-109	Radome										
Receiver	R-1643/APS-109	TBD										MT-4225/APS-109
Video Signal Processor	CM-392 [illegible]											MT-4225/APS-109
Indicator	S[illegible]/APS-109											Panel
Control	C-8361											

609

Table 6-17. F-111F AVIONICS CONFIGURATION DATA: ECM AAR-34 AND ALR-23 NSN: 5865-00-104-9842

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver Control	C-8289/AAR-34	Cockpit						Details of AAR-34/ALR-23 are classified.				
Search Track Scanner	CV-26301/AAR-34	Door 4492										
Cryogenics Converter Video Sig	MX-6708/ALR-23	Door 4491	6.8 dia.		22.0	2.35						
Video Signals Processor	CM-389/AAR-34	Door 1101										

610

Table 6-18. F-111F AVIONICS CONFIGURATION DATA: ECM AN/ALQ-94 NSN: 5865-00-890-0422

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Amplifier Mid Band	AM-4851/ALQ-94	Door 1101									Forced Air	MT-3878/ ALQ-94
Receiver Mid	R-1498/ALQ-94	Door 1101				Details of AN/ALQ-94 are classified.					Forced Air	MT-3878/ ALQ-94
Amplifier Low Band	AM-4850/ALQ-94	Door 1101									Forced Air	MT-3877/ ALQ-94
Receiver Low	R-1497/ALQ-94	Door 1101									Forced Air	MT-3877/ ALQ-94
Amplifier High Band	AM-4852/ALQ-94	Door 1201									Forced Air	MT-3879/ ALQ-94
Receiver High	R-1499/ALQ-94	Door 1201									Forced Air	MT-3879/ ALQ-94
Control	C-7940/ALQ-94	Cockpit									Convection	Panel
Antenna No. 3												
Antenna No. 5												
Antenna No. 7												
Antenna No. 9												
Antenna High												
Antenna Mid												
Antenna Low												

611

Table 6-19. F-111F AVIONICS CONFIGURATION DATA: CM DISPENSER SET (PARTIAL LISTING) AN/ALE-28 NSN: 5865-00-105-8987*

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
CM Dispenser Set	AN/ALE-28							0.15	0.075	111W		
Control	C-6471/ALE-28	Cockpit	4.12	5.75	6.25	148.0	4.6			20W	Convection	Cockpit
Control Sequence Ejector	C-7682/ALE-28											
Eject Force Dispenser	D-22/ALE-28		11.6	9.8	32.4	3683.0	51.[illegible]			2.05W		
Disposables Control Panel		Cockpit	1.12	5.75	4.0	25.76	0.4	0.005	0.007	12W	Convection	Cockpit

*Also NSN: 5865-00-114-3146.

612

Table 6-20. F-111F AVIONICS CONFIGURATION DATA: RECORDER SET AN/A24U-6 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Recorder Mechanical Assembly	MXK-316/A24U-6											
Magnetic Recorder Set	MXK-315/A24U-6											

Best Available Copy

613

Table 6-21. F-111F AVIONICS CONFIGURATION DATA: ANTENNA COUPLER GROUP OA-7149 MSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control	C-6455/ARC	Door 1202	15.25	6.5	1.75	173.5	7.4					MT-3357
Coupler	CU-1402/ARC		10.25	10.0	12.75	1307.0	14.8					
Capacitor	CB-17/ARC											

614

Table 6-22. F-111F AVIONICS CONFIGURATION DATA: MISCELLANEOUS MSN: TBD

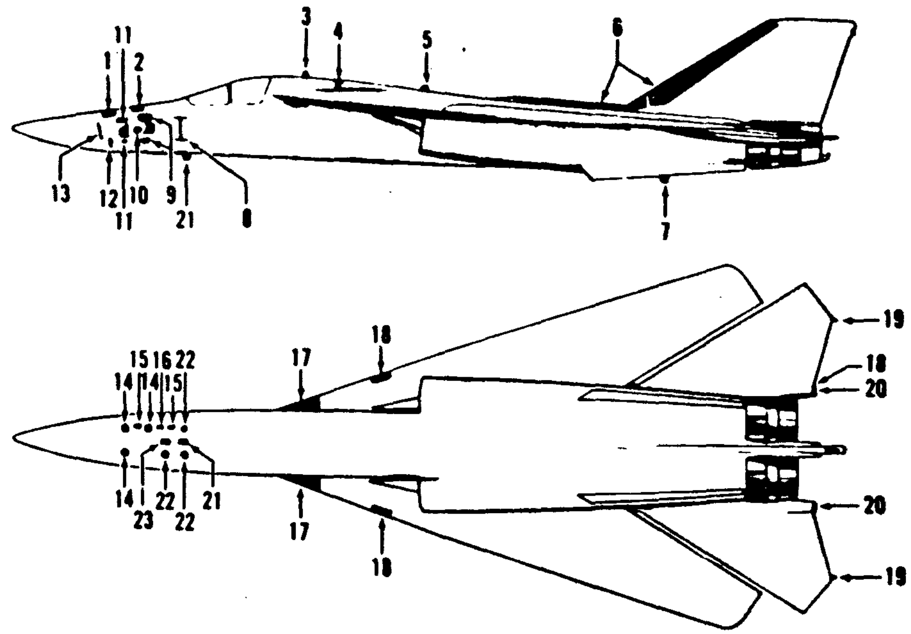
Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Horizontal Situation Display Indicator	IP-1030/AYN-4	Cockpit	7.7	7.7	20.0	1186	46.0				Convection	Panel
HSD Processor	MX-8751/AYN-4											
Amplifier-Power Supply	AM-4869/ASG-25											
Optical Display	SU-62/ASG-27											

6.15

7. ANTENNA LOCATIONS

Figure 7-1 shows the approximately locations of the antennas on the F-111F. Antenna nomenclature from the current technical orders is as follows:

	Antenna	Nomenclature or Part Number
1.	Glide Slope Strip	12Z519-7
	Glide Slope Plate	12Z517-1
2.	ADF	AS-909/ARA-48
3.	IFF (Upper) and UHF Data Link	11D020100-6
4.	Radio Beacon Set	AN/URT-27 or -33
5.	UHF No. 1 and TACAN Upper	11D020100-6
6.	HF Dorsal	12T501-807
	HF Vertical	12T010-849
7.	IFF Lower	AT-741B/A
8.	Localizer (2)	TBD
9.	Low and Medium Frequency Radar Homing (4)	LH Installation 12E2239-5
10.	Forward Radar Warning (2)	RH Installation 12E2239-6
11.	High Frequency Radar Homing (4)	
12.	Terrain Following Radar (2)	AS-2136/APQ-110
13.	Attack Radar	AS-1749/APQ-113
14.	AN/ALQ-94 ECM No. 3	12E2907-1
	AN/ALQ-94 ECM No. 5	12E2908-1
	AN/ALQ-94 ECM No. 7	12E2909-1
15.	Radar Altimeter	LG81G3
16.	AN/ALR-62	311190-1
17.	AN/ALQ-94 High Band Wing Glove (4)	12E2989-1
	AN/ALQ-94 Medium Band Wing Glove (2)	12E2987-1
	AN/ALQ-94 Low Band Wing Glove (4)	12E2988-1
	AN/ALQ-94 Mid Band, Transmit Wing Glove (2)	12E2999-1
18.	AN/ALR-62 (2)	12E2982-1
19.	AFT Radar Warning (2)	12E805-1
20.	AN/ALQ-94 ECN No. 9 LH (3) per assembly	12E2910-3
	AN/ALQ-94 ECM No. 9 RH (3) per assembly	12E2910-1
21.	UHF No. 2 and TACAN Lower	11D20100-3
22.	AN/ALQ-94 ECM No. 3	12E2907-1
	AN/ALQ-94 ECM No. 5	12E2908-1
	AN/ALQ-94 ECM No. 7	12E2909-1
23.	Marker Beacon	16D00500



1. Glide Slope.
2. ADF.
3. IFF (Upper) and UHF Data Link.
4. Radio Beacon Set (AN/URT-33).
5. UHF #1 and TACAN Upper.
6. HF.
7. IFF Lower.
8. Localizer (2).
9. Low and Medium Frequency Radar Homing (4).
10. Forward Radar Warning (2).
11. High Frequency Radar Homing (4).
12. TFR (2).
13. Attack Radar.
14. AN/ALQ-94 (3).
15. Radar Altimeter.
16. AN/ALR-62
17. AN/ALQ-94 (12).
18. AN/ALR-62 (2)
19. Aft Radar Warning (2).
20. AN/ALQ-94 (6).
21. UHF #2 and TACAN Lower.
22. AN/ALQ-94(3).
23. Marker Beacon.

Figure 7-1. ANTENNA LOCATIONS (TYPICAL)

617

8. INTERFACE DATA

This section contains examples of interface signal characteristics. These data were extracted from applicable sections of the Interface Control Documents (ICDs) for integration of GPS user equipment in the F-111F aircraft. Each sheet discusses a particular signal. The top line contains the signal name, type of signal (digital, analog, discrete, or synchronous), signal source and load, and whether the signal is an input or output of the GPS user equipment. A functional description follows, together with a description of the signal's characteristics.

6/8

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Bearing	Synchro	O	UE	HSI and BDHI

Functional Description

Provides angular information to the bearing pointer* to display relative bearing of the aircraft's present position to selected waypoint. The relative bearing is the difference, in degrees, between the lubber line and the bearing pointer as read from the compass card.

*No. 1 pointer on BDHI

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^\circ$
INDEX REFERENCE: Aircraft Heading
POSITIVE DIRECTION SENSE: Increasing Bearing
SCALE FACTOR: $1^\circ = 1^\circ$
RESOLUTION: HSI $\pm 2.5^\circ$, BDHI $\pm 0.5^\circ$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Bearing Pointer, 3-Wire Synchro, Bendix Type AY-500-5 or equal
2) BDHI, E5165001400, No. 1 Pointer, 3-Wire Synchro, Bendix Type AY-100 HY-59-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Triad
Wire Size: No. 22 AWG

A/C: F-111F
REF: MIL-I-27848
12R5-4-65-3
1F-111F-2-18-1

A ICD-GPS-015
10-2

619

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Bearing Pointer, 3-Wire Synchro, Bendix Type AY-500-5 or equal	BDHI, E 5165001400, No. 1 Pointer, 3-Wire Synchro, Bendix Type AY-100 HY-59-A1 or equal

LOAD 1

ROTOR

Input Voltage	26	Volts
Frequency	400	Cycles
Input Current	--	ma
Input Power	--	Watts
Resistance (DC)	530	Ohms

STATOR

Input Voltage	11.8	Volts
Input Current	20	ma
Input Power	0.090	Watts
Resistance (DC)	188	Ohms
Rotor Output Voltage	19	Volts
Phase Shift (S to R)	15	Degrees
Accuracy (Max)	15	Minutes
Null Voltage (Max)	50	mv

IMPEDANCE

Zso	222 + j470	Ohms
Zro	940 + J2260	Ohms
Zrss	1050 + j450	Ohms

LOAD 2

Primary Winding	Stator	
Primary Voltage (400 Hz)	11.8	Volts
Secondary Voltage	20.3	Volts
Input Current	.020	Amps
Input Power	.060	Watts
Max. Error Spread	±6	Minutes
Max. Null Voltage	30	mv
Zro	595 + j2130	
Zso	750 + j369	
Rotor DC Resistance	409	Ohms
Stator DC Resistance	1200	Ohms

620

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Units	Synchro	O	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the units digit in the range window. Displays aircraft present position distance to selected waypoint in 1 nm increments (0.5 nm indexed). Driven independently of other digits, but read in conjunction with them in order to provide the least significant digit.

Signal Characteristics

RANGE: 0 to 9 (0° to 360°)
ACCURACY: $\pm$ 0.2 ($\pm$ 7.2°)
INDEX REFERENCE: $\bar{0}$
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36° = 1 numeral
RESOLUTION: $\pm 3^\circ$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-DD-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through 26 Vac common.

A/C: F-111F
REF: MIL-I-27848
12R5-4-65-3
1F-111F-2-18-1

A		ICD-GPS-015
	REV	10-4

621

ELECTRICAL CHARACTERISTICS

LOAD 1			LOAD 2		
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal			BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type, AY 080-DD-46-A1 or equal		
Primary Winding	Rotor		Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts	Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts	Secondary Voltage	11.8	Volts
Input Current	100	ma	Input Current	187	ma
Input Power	.54	Watts	Input Power	1.1	Watts
Accuracy	30	Feet	Max. Error Spread	$\pm$1.25	Degrees
Impedance, Zro	54 + j260	Ohms	Impedance, Zro	32 $\mp$ j150	
Impedance, Zso	12 + j45	Ohms	Impedance, Zso	6.8 + j26	
			Impedance, Zrs	57 + j14	
Rotor DC Resistance	37	Ohms	Rotor DC Resistance	24	Ohms
Stator DC Resistance	12	Ohms	Stator DC Resistance	7.3	Ohms
Phase Shift	8.5	Degrees			

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-015
SCALE	REV	SHEET 10-5

622

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Tens	Synchro	0	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the tens digit in the range window. Displays aircraft present position distance to selected waypoint in 10 nm increments. Driven independently of other distance digits but read in conjunction with them.

Signal Characteristics

RANGE: 0 to 9 (0° to 360°)
ACCURACY: ± 0.2 ($\pm 7.2^\circ$)
INDEX REFERENCE: $\bar{0}$
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36° = 1 numeral
RESOLUTION: $\pm 3^\circ$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-DD-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through 26 Vac common.

A/C: F-111F
REF: MIL-I-27848
12R5-4-65-3
1F-111F-2-18-1

A ICD-GPS-015
SHEET 10-6

633

ELECTRICAL CHARACTERISTICS

LOAD 1	LOAD 2
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal	BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY080-DD-46-A1 or equal

LOAD 1

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	100	ma
Input Power	.54	Watts
Accuracy	30	Feet
Impedance, Zro	54 + j260	Ohms
Impedance, Zso	12 + j45	Ohms
Rotor DC Resistance	37	Ohms
Stator DC Resistance	12	Ohms
Phase Shift	8.5	Degrees

LOAD 2

Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts
Input Current	187	ma
Input Power	1.1	Watts
Max. Error Spread	±1.25	Degrees
Impedance, Zro	32 + j150	Ohms
Impedance, Zso	6.8 + j26	Ohms
Impedance, Zrs	57 + j14	Ohms
Rotor DC Resistance	24	Ohms
Stator DC Resistance	7.3	Ohms

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance, Hundreds	Synchro	O	UE	HSI & BDHI

Functional Description

Provides angular information to rotate the hundreds digit in the renge window. Displays aircraft present position distance to the selected waypoint in 100 nm increments. Driven independently of the other distance digits, but read in conjunction with them in order to provide the most significant digit for the distance value.

Signal Characteristics

RANGE: 0 to 9 (0^{o} to 360^{o})
ACCURACY: +0.2 ($\pm 7.2^{o}$)
INDEX REFERENCE: $\overline{0}$
POSITIVE DIRECTION SENSE: To decreasing values (distance to go)
SCALE FACTOR: 36^{o} = 1 numeral
RESOLUTION: $\pm 3^{o}$

Electrical Characteristics (continued on next page)

LOAD: 1) HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal
2) BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY 080-DD-46-A1 or equal

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Two Single Conductors (X, Y)
Wire Size: No. 22 AWG

Note: "Z" grounded through AC common.

A/C: F-111F
REF: MIL-I-27848
12R5-4-65-3
1F-111F-2-18-1

A ICD-GPS-015
SHEET 10-8

6 25

ELECTRICAL CHARACTERISTICS

LOAD 1			LOAD 2		
HSI, AQU-4/A, Distance Display, 3-Wire Synchro, Clifton Type CRC-8-A-1 or equal			BDHI, E5165001400, Distance Display, 3-Wire Synchro, Bendix Type AY080-DD-46-A1 or equal		
Primary Winding	Rotor		Primary Winding	Rotor	
Primary Voltage (400 Hz)	26	Volts	Primary Voltage (400 Hz)	26	Volts
Secondary Voltage	11.8	Volts	Secondary Voltage	11.8	Volts
Input Current	100	ma	Input Current	187	ma
Input Power	.54	Watts	Input Power	1.1	Watts
Accuracy	30	Feet	Max. Error Spread	$\pm$1.25	Degrees
Impedance, Zro	54 + j260	Ohms	Impedance, Zro	32 + j150	Ohms
Impedance, Zso	12 + j45	Ohms	Impedance, Zso	6.8 + j26	Ohms
			Impedance, Zrs	57 + j14	Ohms
Rotor DC Resistance	37	Ohms	Rotor DC Resistance	24	Ohms
Stator DC Resistance	12	Ohms	Stator DC Resistance	7.3	Ohms
Phase Shift	8.5	Degrees			

A ICD-GPS-015

10-9

636

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Distance Flag	Discrete	O	UE	HSI & BDHI

Functional Description

Provides a discrete signal to operate the distance warning flag. The flag is normally out of view when the range indicator is operating and the range data is valid. The flag covers the range indicator when the distance information is not valid or the device supplying the distance data is not operating.

Signal Characteristics

RANGE: 28 Vdc applied, Flag out of view
28 Vdc not applied, Flag in view

Electrical Characteristics

LOAD: 1) HSI (AQU-4/A), distance shutter mechanism, 28 Vdc meter movement
2) BDHI (E5165001400), distance shutter mechanism, 28 Vdc meter movement, 625 Ohms ± 10%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111F
REF: MIL-I-27848
12R5-4-65-3
1F-111F-2-18-1

A ICD-GPS-015 10-10

637

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Thousand, Digit	Discrete	0	UE	HSI

Functional Description

Provides a discrete output signal to operate the thousand digit of the HSI when the distance to a selected waypoint is greater than 999 nautical miles.

Signal Characteristics

Thousand Digit In View: 28 Vdc applied
Thousand Digit Out of View: 28 Vdc not applied

Electrical Characteristics

LOAD: HSI (AQU-4/A), thousand digit shutter
Input Voltage: 28 Vdc
Input Current: 150 ma

SOURCE: (TBD-1)

Interconnection Data

(TBD-3)

A/C: F-111F
REF: MIL-I-27848
5F8-16-4-3

A | | ICD-GPS-015
| | 10-11

628

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
To-From	Analog	O	UE	HSI

Functional Description

Provides a d.c. analog signal to drive the To-From indicator. If the aircraft is flying toward the waypoint and has not intercepted a reference line perpendicular to the aircraft ground track and through the waypoint, the indication will be To. Once past the waypoint reference line, the indication will be From as long as this waypoint is still selected.

Signal Characteristics

RANGE: To = +225 μa Max
Blank = no signal
From = -225 μa Max

Electrical Characteristics

LOAD: HSI (AQU-4/A), To-From Arrow, meter movement 200 Ohms ± 15%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111F
REF: MIL-I-27848
1F-111F-2-18-1

A ICD-GPS-015 SHEET 10-12

629

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horizontal Deviation	Analog	O	UE	Flight Director Computer

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft to the left or right of a selected course. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 10^{o} for a TACAN approach; 2.5^{o} for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 2-6 miles full scale, (b) Terminal: 1-2 miles full scale and (c) Approach: 500-3000 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to $\pm$ 150 μa
RESOLUTION: 3 μa
ACCURACY: $\pm$10 μa
INDEX REFERENCE: Selected course
POSITIVE DIRECTION SENSE: Fly right (+)
SCALE FACTOR: 75 μa/dot on the indicator.
Distance/angular displacement scale factor (TBD-1).

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms $\pm$3%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111F
REF: MIL-I-27848
MIL-C-83013
1F-111F-2-18-1
ARINC Characteristic 582-5

A

ICD-GPS-015

SHEET 10-13

630

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Horzontal Deviation Flag	Discrete	O	UE	Flight Director Computer

Functional Description

Provides a discrete signal to operate the deviation warning flag or circuit when the deviation data is unreliable or a malfunction has occurred in the course deviation circuitry.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv.

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms, ± 3%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111F
REF: MIL-I-27848
MIL-C-83013
1F-111F-2-18-1

A ICD-GPS-015
10-14

631

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation	Analog	O	UE	Flight Director Computer

Functional Description

Provides a variable d.c. signal that indicates the displacement of the aircraft above or below a desired flight path. The displacement represented by the indicating device will be controlled by UE software and will be dependent upon aircraft flight phase. Deflection of the indicating device may represent angular displacement (e.g., 0.5^{o} for ILS) or distance. For an area navigation system, the Area Navigation Subcommittee of the Air Transport Association's Air Traffic Control Committee has recommended the following ranges for the flight modes indicated: (a) Enroute: 200 to 2000 feet full scale, (b) Terminal: 60-200 feet full scale and (c) Approach: 40-100 feet full scale. Choice of presentation (distance/degrees) and scales are (TBD-1).

Signal Characteristics

RANGE: 0 to $\pm$150 μa
RESOLUTION: 3 μa
ACCURACY: $\pm$10 μa
INDEX REFERENCE: Desired flight path
POSITIVE DIRECTION SENSE: Fly down (+)
SCALE FACTOR: 75 μa/dot on the indicator.
Distance/angular displacement scale factor (TBD-1).

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms $\pm$3%
SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111F
REF: MIL-C-83013
1F-111F-2-17-1
ARINC Characteristic 582-5

A
ICD-GPS-015
10-15

632

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Vertical Deviation Flag	Discrete	0	UE	Flight Director Computer

Functional Description

Provides a discrete signal to the Flight Director Computer when the UE vertical deviation signal is unreliable. This signal is similar to glideslope flag signal.

Signal Characteristics

RANGE: Deviation signal valid: 245-500 mv.
Deviation signal invalid: <180 mv.

Electrical Characteristics

LOAD: Flight Director Computer, CPU-76/A, 1000 Ohms ± 3%

SOURCE: (TBD-1)

Interconnection Data

Wire Type & No.: Twisted Pair
Wire Size: No. 22 AWG

A/C: F-111F
REF: MIL-C-83013
1F-111F-2-17-1

A		ICD-GPS-015
		10-16

6.33

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Output Data	Digital	0	UE	IBNS Converter-Multiplexer

Functional Description

Provides the following digital data to update the INS and to aid in navigation and bombing solutions:

1) Latitude
2) Longitude
3) Velocities (x,y,z)
4) Direction Cosines (xx,yx,zx)
5) Time
6) Display data

Signal Characteristics

Serial digital data (see Appendix III)

Electrical Characteristics

Voltage levels: Logic 1 = +3.25 $\pm$0.75 volts
Logic 0 = -0.3 $\pm$0.7 volts

Current levels: Output drivers shall have a 20 ma current sink capability at logic 0 level and source 20 ma at logic 1 level

Interconnection Data

Wire Type & No.: 5 conductors; one shielded pair and one shielded triad
Wire Size: No. 22 AWG

A/C: F-111F
REF: 1F-111F-2-5-1
1F-111F-2-22
FZE-12-6073

A ICD-GPS-015 10-17

634

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Digital Input Data	Digital	I	IBNS Converter-Multiplexer	UE

Functional Description

Provides the UE with the following digital data to aid in acquiring satellites and improving AJ capabilities:

1) Latitude
2) Longitude
3) Velocities (N/S, E/W, Vertical)
4) Direction Cosines (xx,yx,zx)
5) Magnetic Heading
6) True Heading
7) True Airspeed
8) Barometric altitude
9) Attitude (pitch, roll)
10) Control data

Signal Characteristics

Serial digital data (see Appendix III)

Electrical Characteristics

Voltage levels: Logic 1 = +3.25 $\pm$0.75 volts
Logic 0 = -0.3 $\mp$0.7 volts

Current levels: Output drivers shall have a 20 ma current sink capability at logic 0 level and source 20 ma at logic 1 level

Interconnection Data

Wire Type & No.: 5 conductors; one shielded pair and one shielded triad
Wire Size: No. 22 AWG

A/C: F-111F
REF: 1F-111F-2-5-1
1F-111F-2-22
FZE-12-6073

A		ICD-GPS-015
	REV	SHEET 10-18

635

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Blanking Pulses	Pulse	I	Interference Blanker	UE

Functional Description

The interference blanker provides blanking pulses to prevent interference between systems operating in the same frequency spectrum.

Signal Characteristics

(See pages 10-20 and 10-21.)

Electrical Characteristics

SOURCE: Interference Blanker, MX-8103/A

LOAD: (TBD-1)

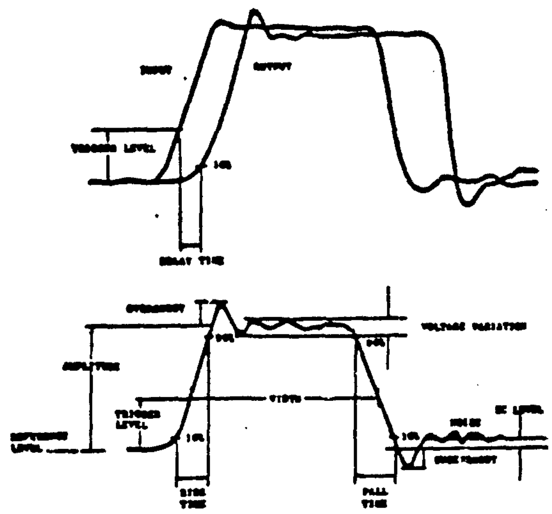
Interconnection Data

Wire Type & No.: Coaxial Cable, RG-58 C/U

A/C: F-111F
REF: T.O. 12P3-4-22-12
T.O. 1F-111F-2-22

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-015
SCALE	REV	SHEET 10-19

636



AMPLITUDE - AVERAGE DC-LEVEL OF THE PULSE TOP, OVERSHOOT EXCLUDED.

RISE TIME - TIME INTERVAL BETWEEN THE 10% AMPLITUDE LEVEL AND THE 90% AMPLITUDE LEVEL ON THE LEADING EDGE OF THE PULSE.

FALL TIME - TIME INTERVAL BETWEEN THE 90% AMPLITUDE LEVEL AND THE 10% AMPLITUDE LEVEL ON THE TRAILING EDGE OF THE PULSE.

WIDTH - TIME INTERVAL BETWEEN THE POINT WHERE THE PULSE CROSSES THE NOMINAL TRIGGER LEVEL ON THE LEADING EDGE OF THE PULSE AND THE POINT WHERE THE PULSE CROSSES THE NOMINAL TRIGGER LEVEL ON THE TRAILING EDGE OF THE PULSE

VOLTAGE - VARIATION PEAK VALUE OF THE CHANGE IN VOLTAGE, GREATER OR LESS THAN THE AMPLITUDE LEVEL, THAT OCCURS ON THE DC COMPONENT PULSE.

OVERSHOOT - MAXIMUM POSITIVE VOLTAGE ATTAINED BY THE LEADING EDGE OF THE PULSE ABOVE THE AMPLITUDE LEVEL

UNDERSHOOT - MAXIMUM NEGATIVE VOLTAGE ATTAINED BY THE TRAILING EDGE OF THE PULSE AS MEASURED FROM THE ZERO LINE

NOISE - ALL DEVIATIONS IN VOLTAGE FROM THE DIRECT RESIDUAL LEVEL THAT OCCURS BETWEEN THE 10% LEVEL OF THE TRAILING EDGE OF ONE PULSE AND THE 10% LEVEL ON THE LEADING EDGE OF THE FOLLOWING PULSE WITH THE EXCEPTION OF THE UNDERSHOOT AND THE LEADING AND TRAILING EDGES. SHALL BE CONSIDERED NOISE. FOR NOISE MEASUREMENTS THE LOW VOLTAGE INPUT PULSE RISE TIME SHALL NOT BE LESS THAN 20 NANOSECONDS AND THE FALL TIME SHALL NOT BE LESS THAN [illegible] NANOSECONDS.

TRIGGER - LEVEL THAT INPUT VOLTAGE BELOW WHICH THE OUTPUT OF A CHANNEL IS 0 AND ABOVE WHICH THE OUTPUT OF THE CHANNEL IS THE SPECIFIED VOLTAGE.

DELAY - TIME TIME INTERVAL BETWEEN THE NOMINAL TRIGGER LEVEL ON THE INPUT PULSE TO THE 10% LEVEL ON THE RESULTING OUTPUT PULSE LEADING EDGE.

Blanking Pulse Characteristics
(continued)

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-015
SCALE	REV	SHEET 10-20

637

CHARACTERISTIC	HIGH VOLTAGE INPUT CHANNELS	LOW VOLTAGE INPUT CHANNELS	HIGH VOLTAGE OUTPUT CHANNELS	LOW VOLTAGE OUTPUT CHANNELS
RISE TIME	30 OR MORE NANOSECONDS	3 OR MORE NANOSECONDS	LESS THAN 0.5 MICROSECOND	LESS THAN 50 NANOSECONDS
FALL TIME	40 OR MORE NANOSECONDS	3 OR MORE NANOSECONDS	LESS THAN 0.5 MICROSECOND	LESS THAN 40 NANOSECONDS
WIDTH				
MINIMUM	500 NANOSECONDS	100 NANOSECONDS		
MAXIMUM	DC COUPLED CIRCUITS LIMITED ONLY BY DUTY CYCLE	DC COUPLED CIRCUITS LIMITED ONLY BY DUTY CYCLE		
WIDTH VARIATION FROM INPUT PULSE			+1, -0.5 MICROSECOND	150 NANOSECONDS
AMPLITUDE				
MINIMUM	15 VOLTS	5 VOLTS	20 VOLTS	6 VOLTS
NOMINAL	25 VOLTS	7 VOLTS	25 VOLTS	7 VOLTS
MAXIMUM	70 VOLTS	9 VOLTS	30 VOLTS	8 VOLTS
VOLTAGE VARIATION ABOUT PULSE			13 VOLTS	±0.75 VOLT
REPETITION RATE				
MINIMUM	DC (WITHIN DUTY CYCLE LIMITS)	DC (WITHIN DUTY CYCLE LIMITS)	DC (WITHIN DUTY CYCLE LIMITS)	DC (WITHIN DUTY CYCLE LIMITS)
MAXIMUM	1 MEGACYCLE	10 MEGACYCLES	1 MEGACYCLE	10 MEGACYCLES
DUTY CYCLE (ON/OFF TIME)	30% WITH 70 VOLT PULSES 75% WITH 30 VOLT PULSES	75% WITH 7 (±1) VOLT PULSES	SAME AS INPUT	SAME AS INPUT
UNDERSHOOT	0 TO -3 VOLTS	0 TO -0.7 VOLT	0 TO -7.5 VOLTS	-0.65 VOLT
OVERSHOOT	0 TO 6 VOLTS	0 TO 2 VOLTS	10 VOLTS	2 VOLTS
DC LEVEL BETWEEN PULSES			0 TO 1 VOLT	0 TO 0.3 VOLT
NOISE	0 TO +3.5 VOLTS	0 (±0.5) VOLTS	±2.5 VOLTS	±0.5 VOLT
DELAY TIME				
HIGH VOLT INPUT			350 NANOSECONDS MAXIMUM	150 NANOSECONDS MAXIMUM
LOW VOLT INPUT			350 NANOSECONDS MAXIMUM	70 NANOSECONDS MAXIMUM
LOAD IMPEDANCE				
RESISTANCE	300 (±10%) OHMS	93 (±10%) OHMS	300 TO 2200 OHMS	93 (±10%) OHMS
CAPACITANCE			0 TO 1000 PICOFARADS	
TRIGGER LEVEL	10 (±2) VOLTS	3 (±1) VOLTS		

Blanking Pulse Characteristics
(continued)

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-015
SCALE	REV	SHEET 10-21

638

INTERFACE SIGNAL CHARACTERISTICS

SIGNAL NAME	TYPE	I/O	FROM	TO
Course Set	Synchro	I	HSI	UE

Functional Description

Provides an electrical reference signal of the course manually selected by the Course Set control on the HSI. This signal will be used by the UE as a reference for positioning the course deviation and To-From indicators on the HSI.

Signal Characteristics

RANGE: 0° to 360°
ACCURACY: $\pm 0.5^{\circ}$
RESOLUTION: 1.0°
INDEX REFERENCE: Magnetic North
POSITIVE DIRECTION SENSE: Right Hand Increments
SCALE FACTOR: $1^{\circ} = 1^{\circ}$

Electrical Characteristics (Continued on next page)

SOURCE: HSI (AQU-4/A), Course Resolver, Kearfott Type CR40931018 or equal

LOAD: (TBD-1)

Interconnection Data

Wire Type & No.: Seven single conductors (twisted)
Wire Size: No. 24 AWG

A/C: F-111D
REF: 1F-111D-2-18-1
MIL-I-27848
5F8-16-4-3

A ICD-GPS-015 SHEET 10-22

639

ELECTRICAL CHARACTERISTICS

SOURCE	
HSI, AQU-4/A, Course Resolver, Kearfott Type CR40931018 or equal	
Primary Winding — Rotor Input Voltage — 26 Vac Frequency — 400 Hz Input Current — 20 ma Input Power — 150 mw Input Impedance — 1680 $\angle 78.5^{\circ}$ ohms Output Impedance — 1400 $\angle 78^{\circ}$ ohms DC Resistance (rotor) — 190 ohms DC Resistance (stator) — 170 ohms Output Voltage — 22 Vac Sensitivity — 384 mv/deg Maximum null Voltage — 46 mv Maximum error from electrical zero — 10 minutes Transformation ratio — .846	

SIZE	CODE IDENT NO	DRAWING NO
A		ICD-GPS-015
SCALE	REV	SHEET 10-23

640

30. F-111F DIGITAL CHARACTERISTICS

The following section provides a brief description of the digital signal characteristics of the F-111F IBNS.

30.1 Word/Frame Structure. The serial digital data input and output of the converter set are in the form of a bit-serial, word-serial pulse train over data channels consisting of five lines each. One pair of lines transmits data in true (DATA) and in one's complement (DATA) form. The second pair of lines transmits synchronizing signals in true (SYNC) and in one's complement (SYNC) form. The fifth line serves as a signal return. Data words contain 26 bits on a non-return-to-zero (NRZ) basis. Synchronizing signals are pulse groups, each group containing 26 pulses which are concurrent with the data word, but are in a return-to-zero (RZ) format.

Each channel is capable of handling a maximum of 64 data words. Both the data word and the synchronizing pulse groups (SYNC) are separated by gaps that are equal to six pulses (60 microseconds). The sync pulses synchronize data bits and the pulse gap synchronizes data words. The data word content of each channel is processed cyclically, one word after another until all words are processed.

The waveform of an input or output serial digital word sync pulse group and the waveform and bit construction for an input or output serial digital word is shown in Figure III-1.

30.2 Information Identifier. Each word contains a 6 bit address field which identifies each word as one of 64 in each serial channel.

30.3 Timing Tolerances. The data transmission rate is 100 kilobits per second. The lead or delay of a serial data signal with respect to its data complement signal shall not exceed 0.250 μsec. The lead or delay is to be measured at the 50% amplitude of the rise and fall transitions of each signal. The lead or delay of a serial data clock synchronization signal with respect to its complement shall not exceed 0.250 μsec when measured at the 50% amplitude points.

30.4 Data Standards. Data standards for the F-111F are summarized in Table III-1.

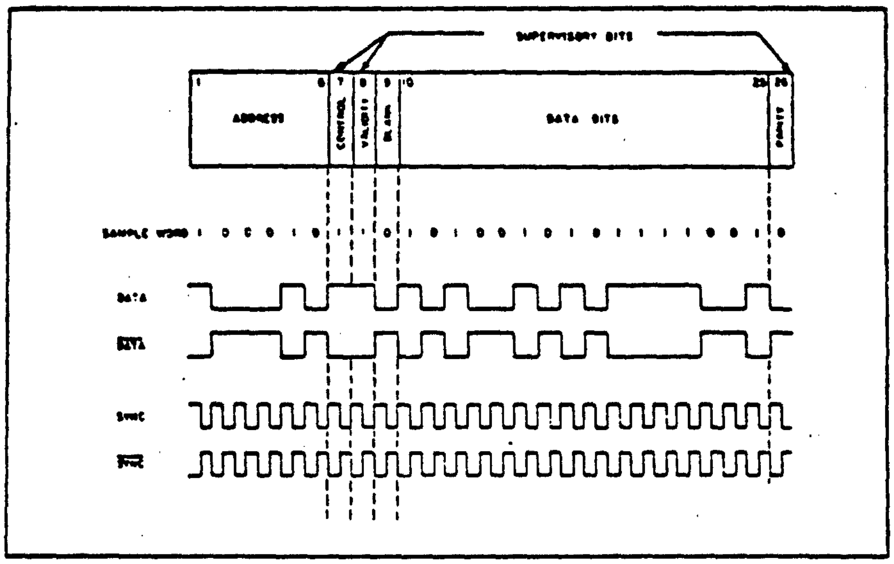


Figure III-1. Serial Digital Input or Output Data Word Channel Structure

A		ICD-GPS-015
SCALE	REV	SHEET 30-3

641

TABLE III-1. DIGITAL DATA STANDARDS

Signal Name	Units	Range	Resolution	Significant Bits
Latitude	(Calculated from other parameters)			
Longitude	Semicircle	± 1	1/1048576	22
V_x	ft/sec	± 2048	1/512	22
V_y	ft/sec	± 2048	1/512	22
V_z	ft/sec	± 2048	1/512	22
C_{xx}	Semicircle	± 1	1/1048576	22
C_{xy}	Semicircle	± 1	1/1048576	22
Time	(TBD-1)	(TBD-1)	(TBD-1)	(TBD-1)
Magnetic Heading	Degrees	0-360	360/4096	13
True Heading	Degrees	0-360	360/4096	13
True Airspeed	ft/sec	(TBD-2)	(TBD-2)	12
Baro Altitude	feet	(TBD-2)	(TBD-2)	12
Pitch Angle	Degrees	± 90	360/2048	12
Roll Angle	Degrees	± 180	360/2048	12
Control Data	(TBD-1)	(TBD-1)	(TBD-1)	(TBD-1)
Display Data	(TBD-1)	(TBD-1)	(TBD-1)	(TBD-1)

Source: FZE-12-6073

9. FUTURE MODIFICATIONS

Table 9-1 lists the avionics suite expected to be installed in each of the F-111-family aircraft by 1985. This chart is useful for comparing the members of the F-111 family. Figures 9-1 and 9-2 show current and planned equipment bay space allocations for the F-111F. Planned system additions for the F-111F include the ARC-164 UHF communications system, the ALQ-137, and the ALR-62 CMRS. Also planned for inclusion are GPS, PAVE TACK, Video Tape Recorder, PAL, and the KY-28 Secure Voice System.

The AN/ARC-164, scheduled to replace the ARC-109 in most aircraft by 1985, operates in the 225 MHz to 399.75 MHz military band. It provides a 7,000 channel tuneable UHF receiver, a 243 MHz (nominal) auxiliary guard receiver, and a 7,000-channel, 10-watt carrier transmitter for voice communications. The AN/ARC-164 Radio Set has two basic configurations -- the console mount and the remote mount.

The function of the ALQ-137 is to detect hostile CW and pulsed signals and automatically respond with programmed jamming against the following:

- Fire control radars of anti-aircraft artillery (AAA)
- Surface to air missiles (SAM)
- Airborne Interceptors (AI)
- Command Guidance missiles

The AN/ALQ-137 provides deception response in the E through J bands with four subsystems covering the low band, middle band, forward high band, and aft high band. Each of the four subsystems consists of a receiver and amplifier. Forward and aft antennas are used to provide proper protection. Additional threat information is received from the ALR-62 Radar Warning Receiver.

The ALR-62 is a countermeasures receiver set designed to intercept, detect, and analyze RF threat signals. Threat signals displayed show type of threat, direction, and lethality. The system uses a dual-channel receiver, a multichannel receiver, a digital processor, a control indicator unit, and an antenna switching unit.

The Global Positioning System will physically and functionally replace the ARN-84(V) TACAN System, and the ARA-50 UHF ADF System. The GPS receiver and mount will be installed in the forward equipment bay (RH), under door 1202, in the space presently occupied by the TACAN. The antenna will be installed above the equipment bay (Figure 9-1).

644

Table 9-1. PRINCIPAL AVIONICS TO BE INSTALLED IN THE F-111 FAMILY BY 1985

Equipment	F-111A	F-111D	F-111E	F-111F	EF-111A
UHF	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164	ARC-109 → ARC-164
HF	ARC-112/123	ARC-123	ARC-123	ARC-123	ARC-112
Intercom	AIC-25	AIC-25	AIC-25	AIC-25	AIC-25
INS	AJQ-20 Digital Bomb Navigational	AJN-16	AJQ-20 (Maybe Digital Bomb Navigational)	AJN-16	AJQ-20 Digital Bomb Navigational
TACAN	ARN-118 (Maybe GPS)	ARN-52/118 (Maybe GPS)	ARN-52/118 (Maybe GPS)	ARN-84 (Maybe GPS)	ARN-118 (Maybe GPS)
ILS	ARN-58 (Maybe CAT II MLS)	ARN-58 (Maybe CAT II MLS)	ARN-58	ARN-58 (Maybe CAT II MLS)	ARN-58 (Maybe CAT II MLS)
UHF-DF	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)	ARA-50 (Maybe GPS)
Radar Altimeter	APN-167	APN-167	APN-167	APN-167	APN-167
TFR	APQ-110	APQ-128	APQ-110	APQ-146/128/134	APQ-110
Attack Radar	APQ-113	APQ-130	APQ-113	APQ-144/114	Demodify to Naval Radar
Lead Computer Sight	ASG-23	--	ASG-23	ASG-27/25	Demodify
Auto Gun	M61-A1	M61-A1	M61-A1	M61-A1	Demodify
IFF A/G	APX-64	APX-64	APX-64	APX-64	APX-64
IFF Crypto	KIT-1A	KIT-1A	KIT-1A	KIT-1A	KIT-1A
HSI	AQU-4/A	AQU-4/A	AQU-4/A	AQU-4/A	AQU-4/A
CADC	1903633-4	1903634-3	1903633-4	1903634-3	1903633-4
Flight Director System	CPU-76	--	CPU-76A	CPU-76A	CPU-76, ARU-11
Auxiliary Flight Reference System	A24G-26A	A24G-26A	A24G-26A	A24G-26A	A24G-26A
RHAW	APS-109	APS-109	APS-109	APS-109	ALR-62 (TTWS)
ECM Receivers	ALR-23 AAR-34	ALR-23 AAR-34	-- AAR-34	ALR-23 AAR-34	ALR-23 (TTWS) ALQ-137 (SPS)
Jamming Transmitters	ALQ-94, 41	ALQ-94	ALQ-94, 119	ALQ-94	ALQ-99E (JSS)
Interference Blanker	MX-6770	MX-8106	MX-6770A	MX-8103	MX-9879/A
Dispenser	ALE-28	ALE-28	ALE-28	ALE-28	ALE-28
Strike Camera	KB-18A	KB-18A	KB-18A	KB-18A	Demodify
Flight Control System	FC-11	FC-11	FC-11	FC-11	FC-11

(continued)

645

Table 9-1. (continued)

Equipment	F-111A	F-111D	F-111E	F-111F	EF-111A
Fuel And Trim Assembly	12C1154-879	12C1154-867	12C1154-879	12C1154-875	12C1154-879
Doppler	--	APN-189 (Maybe GPS)	--	--	--
Nav Data Entry Panel	--	ID-1764/AYK	--	--	--
Nav Data Display Panel	--	ID-1622/AYK	--	ID-1748/AYK	--
General Purpose Computer	--	AYK-6 (2)	--	AYK-6 (2)	--
Weapons Bay Gun System	--	?	?	--	Demodify
Multiplex Converter Unit	--	CV-2492/A	--	CV-2497/A	--
Horizontal Situation Display	--	AYN-3	--	--	--
Integrated Display Set	--	AVA-9	--	--	--
IFF Interrogator	--	APX-76	--	--	--
Computer Control Unit	--	--	--	C-8586/AYK	--
UHF Crypto	--	--	--	--	KY-28
Nav Radar	--	--	--	--	APQ-160 (Demodify)
Modifications					
F2824	Terrain Follow Radar	--	Terrain Follow Radar	--	--
F2930	ALQ-119 ECM (Some A/C)	ALQ-119 ECM (Some A/C)	ALQ-119 ECM	--	--
T13315A	SIS (Some A/C)	SIS (Some A/C)	SIS	SIS (Some A/C)	
T17305A	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	APN-167 LARA (Some A/C)	--
T17310A	LARA Override System	LARA Override System	LARA Override System	LARA Override System	--
T37063A	APQ-113 TFR (Some)	APQ-130 TFR	APQ-113 TFR	APQ-144 TFR	--
F2957	ALR-62 RWR (Some)	ALR-62 RWR	ALR-62 RWR	ALR-62 RWR	--
F0000	Jam System (Some A/C)	--	--	--	--
F15312B	--	AVA-9 IDS	--	--	--
T37236B	--	--	--	Multiplex Converter (Some A/C)	--
Planned Avionics					
Video Tape Recorder	--	CVTR	CVTR	CVTR	--

646

Best Available Copy

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Aircraft and avionics configuration data assembled by ARINC Research, principally in the form of copies of applicable sections, tables, and figures from the aircraft technical orders, as well as for equipment technical orders listed at the end of this section.
- Avionics Planning Baseline Document -- October 1978
- GPS Phase II User Equipmebt Interface Requirements for the F-111F Aircraft; 1 September 1977

LIST OF TECHNICAL ORDERS

T.O. Number	Title	Change	Date
1F-111F-01	List of Publications		4/21/72
1F-111F-1-1	Flight Manual	Basic	10/20/78
1F-111F-2-1	General Information	25	4/16/77
1F-111F-2-5-1	Fire Power Control System	Basic	5/27/77
1F-111F-2-6-1	Air Data Computer System	12	1/5/77
1F-111F-2-12-1	Instrument Systems	22	8/19/77
1F-111F-2-15-1	Environmental Sciences	20	8/19/77
1F-111F-2-17-1	Comm. and Instrument Landing Systems	12	8/19/77
1F-111F-2-18-1	UHF/ADF, TACAN, IFF Systems	14	8/19/77
1F-111F-2-22	Systems Integration	18	11/11/77
12P2-2APQ114-2	Attack Radar Set	10	1/28/77
12P2-2APQ128-2	Terrain Following Radar		
12P3-2ALE28-2	Countermeasures Dispenser		
12P4-2APX64-2	Radio Receiver-Transmitter Transmitter	18	5/5/78
12P5-2APN167-12	Electronic Altimeter	12	5/3/78
12R1-2ARA50-2	Direction Finder Group	2	2/1/72
12E2-2AIC25-2	Intercom Set	10	12/1/76
12R2-2ARC109-2	Radio Set	1	4/26/77
12R2-2ARC109-4	IPB Radio Set		8/1/76
12R2-2ARC109-42	Radio Receiver	2	6/1/77
12R2-2ARC123-2	Radio Set		4/7/77
12R2-2ARC164-2	Radio Set		5/23/77
12R5-2ARN58-2	ILS	6	5/13/77
12R5-2ARN118-1	TACAN		10/15/76

647

AVIONICS INTERFACE DATA SUMMARY
FOR
RF-4C

October 1979

Issued by

The Deputy for Avionics Control
ASD/AX
A Joint AFSC/AFLC Organization

648

FOREWORD

This document is one of a series of reports that describe Avionics interfaces for various USAF aircraft. It was prepared for the Deputy for Avionics Control, Aeronautical Systems Division (ASD/AX), Wright-Patterson AFB, Ohio by ARINC Research Corporation, Annapolis, Maryland under Contract F33657-79-C-0567.

649

Record of Changes			
Change	Subject	Date Entered	Initials

650

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

651

LIST OF FIGURES AND TABLES (continued)

652

LIST OF FIGURES AND TABLES (continued)

653

1. INTRODUCTION

This document contains configuration data relating to the integration of additional avionics into the RF-4C aircraft.

This document will be revised periodically as additional modifications are planned and incorporated into the aircraft. Queries regarding information contained herein should be addressed to:

The Deputy for Avionics Control
Code: ASD/AXP
Wright-Patterson AFB, Ohio

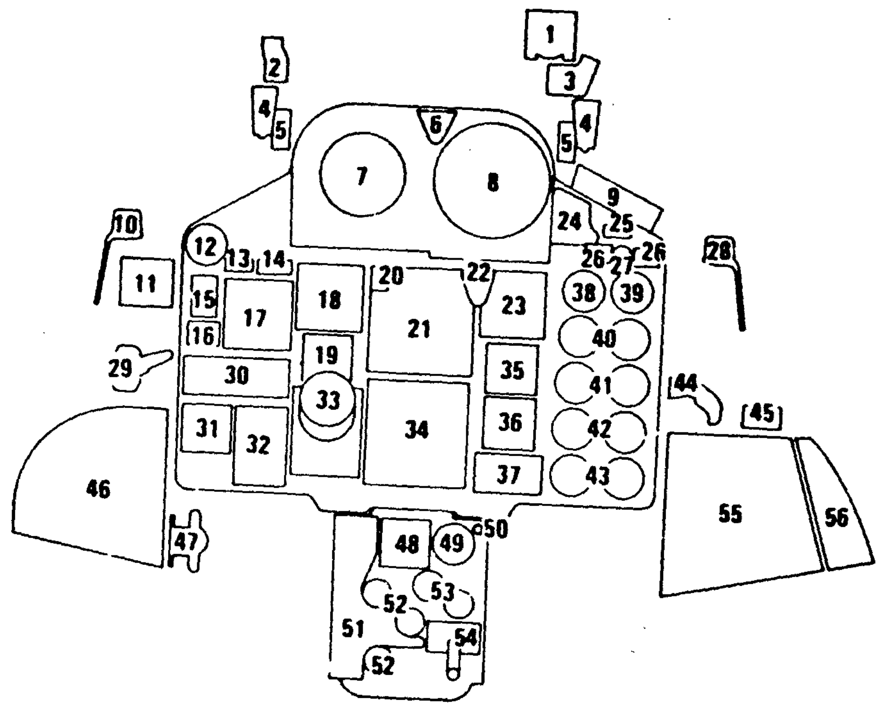
This document was compiled from Air Force source materials by ARINC Research Corporation under Contract F33657-79-C-0567.

The applicable Technical Orders are included in the references listed in Section 10.

654

2. COCKPIT SPACE

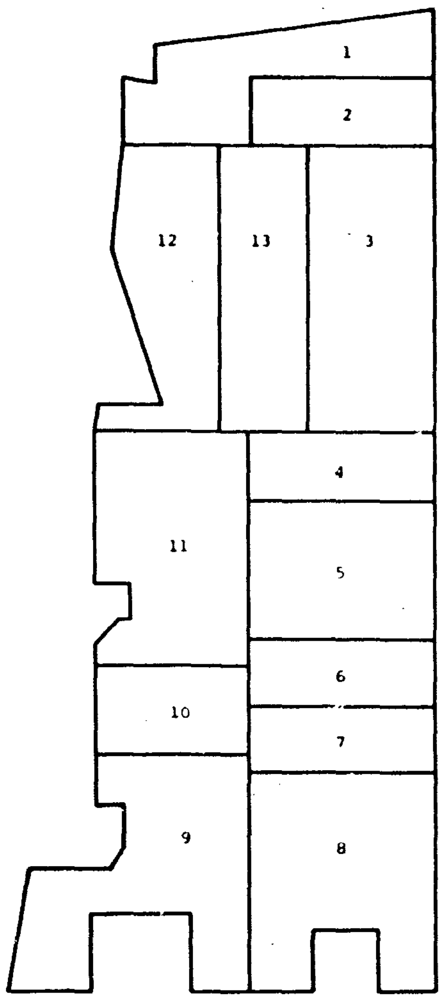
Figures 2-1 through 2-4 shows the front and rear cockpit panels and consoles. There are several locations currently unoccupied. On the forward cockpit left console (Figure 2-2) there are two blank panels. One is 3.4" × 5.75" (item 10) the other is irregular in shape but larger than a 5.75" × 5.75" panel (item 8). On the right console there are two more blank panels. The blank panel farthest back is 5.4 × 5.75 (item 23). The other blank panel is 2.6 × 5.75" (item 21).



1 STANDBY MAGNETIC COMPASS
2 PULL-UP LIGHT
3 EXTERNAL TANKS FULL LIGHTS
4 ANGLE-OF-ATTACK INDEXERS
5 AIR REFUELING INDICATOR LIGHTS
6 KY-28 MODE LIGHT PANEL
7 RADAR SCOPE
8 VIEWFINDER
9 ALR-31 THREAT DISPLAY PANEL
10 CANOPY EMERGENCY JETTISON HANDLE
11 EIGHT DAY CLOCK
12 TRUE AIRSPEED INDICATOR
13 LANDING GEAR WARNING LIGHT
14 RADIO CALL NUMBER
15 LANDING CHECKLIST
16 UHF REMOTE CHANNEL INDICATOR
17 RADAR (ELECTRONIC) ALTIMETER
18 AIRSPEED MACH INDICATOR
19 ANGLE OF ATTACK INDICATOR
20 REFERENCE SYSTEM SELECTOR SWITCH
21 ATTITUDE DIRECTOR INDICATOR
22 MARKER BEACON LIGHT
23 ALTIMETER
24 FLIGHT INSTRUMENT LIGHTS CONTROL PANEL
25 MASTER CAUTION LIGHT
26 FIRE-OVERHEAT WARNING LIGHTS
27 FIRE DETECTOR CHECK BUTTON
28 CANOPY MANUAL UNLOCK HANDLE
29 LANDING GEAR CONTROL HANDLE
30 THREAT DISPLAY PANEL
31 ACCELEROMETER
32 RECONNAISSANCE SELECTOR PANEL
33 STROBE DISPLAY SCOPE
34 HORIZONTAL SITUATION INDICATOR
35 VERTICAL VELOCITY INDICATOR
36 STANDBY ATTITUDE INDICATOR
37 NAVIGATION FUNCTION SELECTOR PANEL
38 FUEL QUANTITY INDICATOR
39 GROUND SPEED INDICATOR
40 FUEL FLOW INDICATORS
41 TACHOMETERS
42 EXHAUST GAS TEMPERATURE INDICATORS
43 EXHAUST NOZZLE POSITION INDICATORS
44 ARRESTING GEAR CONTROL HANDLE
45 FEED TANK CHECK SWITCH
46 LEFT SUB-PANEL
47 EMERGENCY BRAKE CONTROL HANDLE
48 BOMBING TIMER CONTROL PANEL
49 PNEUMATIC PRESSURE INDICATOR
50 VOR MODE LIGHT
51 BOMB CONTROL PANEL
52 HYDRAULIC PRESSURE INDICATORS
53 OIL PRESSURE INDICATORS
54 RUDDER PEDAL ADJUSTMENT CRANK
55 RIGHT SUB-PANEL
56 INSTRUMENT LIGHTS INTENSITY CIRCUIT BREAKER

Figure 2-1. FORWARD COCKPIT MAIN PANEL AREA, RF-4C

656



1. Left Utility Panel
2. Oxygen Control Panel
3. Engine Control Panel
4. VOR/ILS Control Panel
5. AFCS Control Panel
6. Intercom System Control Panel
7. Communications Selector Panel
8. Blank Panel
9. Anti-G Suit Control Valve
10. Blank Panel
11. Fuel Control Panel
12. Engine Control Panel (outboard)
13. Throttles
14. Master Caution Light Reset Button
15. Generator Control Panel
16. Communications Control Panel
17. Navigation Control Panel
18. IFF Control Panel
19. DLU-9/A Bomb Control Monitor Panel
20. Compass Control Panel
21. Blank Panel
22. KY-28 Control Panel
23. Blank Panel
24. Formation Lights Control Panel
25. Utility Electrical Receptacle
26. Spare Lamp Receptacle
27. Exterior Lights Control Panel
28. Cockpit Lights Control Panel
29. Cockpit Temperature Control Panel
30. Circuit Breaker Panel
31. Right Utility Panel

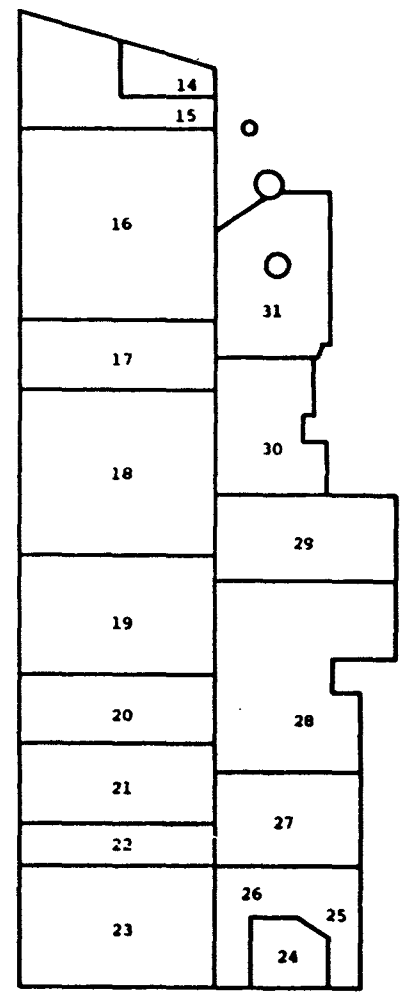
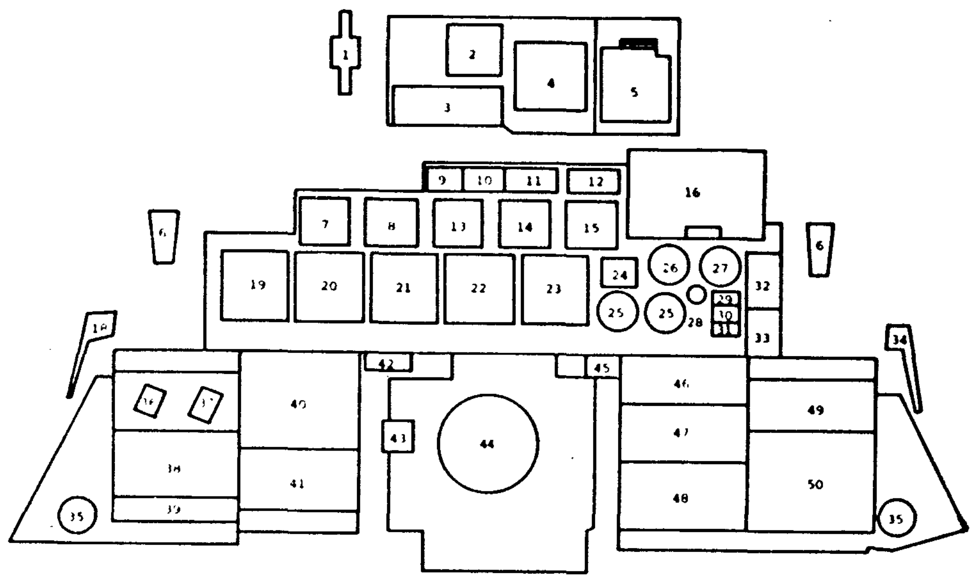


Figure 2-2. **RF-4C FORWARD COCKPIT CONSOLE LAYOUT**

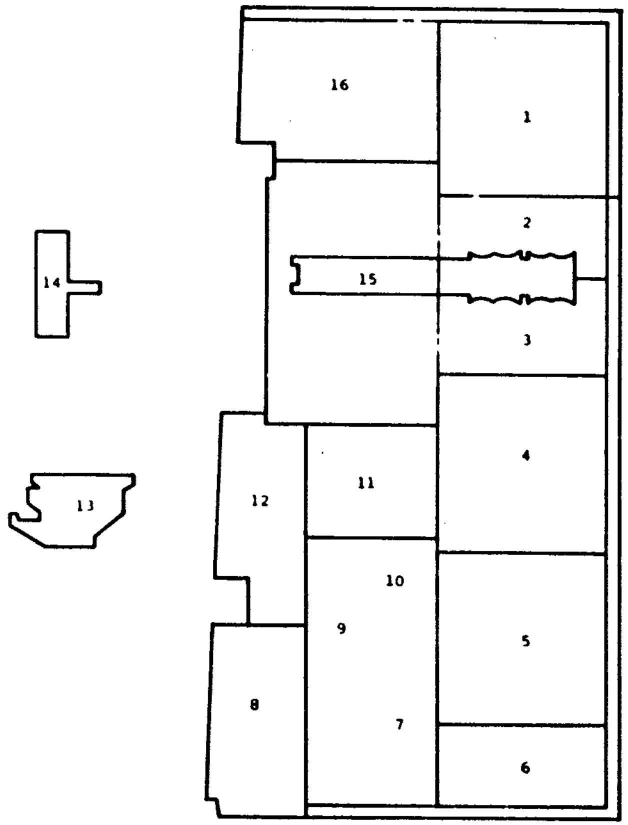
657



1 COMMAND SELECTOR VALVE
2 STANDBY MAGNETIC COMPASS
3 THREAT DISPLAY PANEL
4 STPOSN DISPLAY SCOPE
5 COURSE INDICATOR
6 ANGLE OF ATTACK INDEXERS
7 ANGLE OF ATTACK INDICATOR
8 VERTICAL VELOCITY INDICATOR
9 RADIO CALL NUMBER
10 UHF/VHF SELECT SWITCH
11 NAVIGATION MODE SELECT SWITCH
12 KY-28 LIGHT PANEL
13 EIGHT DAY CLOCK
14 ACCELEROMETER
15 TURN AND SLIP INDICATOR
16 SENSITIVITY CONTROL PANEL
17 MASTER CAUTION LIGHT
18 CANOPY EMERGENCY RELEASE HANDLE
19 RADAR (ELECTRONIC) ALTIMETER
20 ALTIMETER
21 ATTITUDE INDICATOR
22 AIRSPEED/MACH INDICATOR
23 BEARING - DISTANCE - HEADING INDICATOR
24 UHF REMOTE CHANNEL INDICATOR
25 TACHOMETERS
26 GROUND SPEED INDICATOR
27 TRUE AIRSPEED INDICATOR
28 EQUIPMENT COOLING RESET BUTTON
29 RADAR - CW COOL OFF WARNING LIGHT
30 INERTIAL NAVIGATOR OUT WARNING LIGHT
31 CANOPY UNLOCKED WARNING LIGHT
32 TAKEOFF CHECKLIST
33 LANDING CHECKLIST
34 CANOPY MANUAL UNLOCK HANDLE
35 AIR VENT NOZZLES
36 EMERGENCY LANDING GEAR CONTROL HANDLE
37 EMERGENCY BRAKE CONTROL HANDLE
38 OXYGEN CONTROL PANEL
39 BLANK PANEL
40 UTILITY PANEL
41 GEAR AND FLAP POSITION INDICATORS
42 EJECT LIGHT
43 DATA RECORDING CAMERA
44 RADAR SCOPE
45 FLR PRESSURE LOW LIGHT
46 SENSOR LIGHTS CONTROL PANEL
47 HF COMMUNICATION CONTROL PANEL
48 AN/ALR-31 DISPLAY CONTROL PANEL
49 AURAL STALL WARNING CONTROL KNOB
50 TELELIGHT PANEL

Figure 2-3. AFT COCKPIT MAIN PANEL AREA, RF-4C

658



1. Forward Looking Radar Control Panel
2. Intercom System Control Panel
3. Inertial Navigator Control Panel
4. Navigation Computer Control Panel
5. Communication Control Panel
6. Navigation Control Panel
7. Marker Beacon VOR/ILS Audio Control
8. Anti-G Suit Control Valve
9. Oxygen Quantity Gage
10. Cabin Altimeter
11. Camera Control Intervalometer
12. Nuclear Store Consent Switch
13. Emergency Flap Control Panel
14. Canopy Selector
15. Throttles
16. Digital Data Inserter
17. Film/Cart Remaining Indicator Panel
18. Blank Panel
19. Sensor Control Panel No. 1
20. Sensor Control Panel No. 2
21. Side Looking Radar Control Panel
22. IR Control Indicator
23. Cockpit Lights Control Panel
24. Blank Panel
25. Film/Mat Test Panel

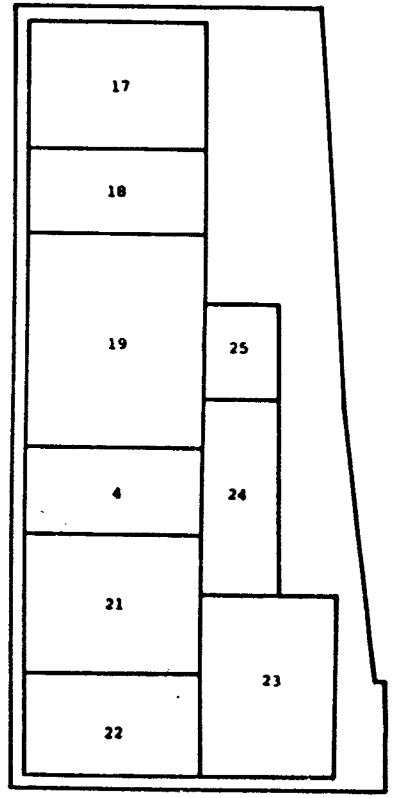


Figure 2-4. **RF-4C AFT COCKPIT CONSOLE LAYOUT**

659

3. AVIONICS SPACE

Some of the alternatives for providing space in the RF-4C are compiled in the Form, Fit, and Environmental (F^2E) Summary Table 3-1. Figure 3-1 shows the approximate locations of these spaces and is keyed to the Table 3-1. The temperature-altitude-vibration environmental data relative to the identified locations are presented in Table 3-2.

The following basic points should be made with respect to the data contained in the tables:

- A large space (A and B in Figure 3-1) with cooling and power will become available in most QSR aircraft with the APQ-102 Side Looking Radar (SLR) demod. However, TEREC and UPD-4 (APD-10) SLR equipped aircraft use the space already and would continue to occupy that space.
- A large space (C) apparently is available in the tail, but the severe temperature must be overcome and power must be provided. The amount of power and cooling required for candidate avionics be determined more precisely to determine the attractiveness of this space.
- Some space could become available in Area B through reduction in equipment size.
- The temperature data represent *uncontrolled* environmental conditions. Equipment installed in any area must be cooled to the extent necessary to meet Class 2 requirements.
- All space locations shown, excluding the tail area, have forced air cooling available. The tail area is not cooled currently and has a most severe temperature environment.
- The vibration data represent compartment conditions existing for any equipment mounted therein. The necessity for shock mounting can be determined from these data. Of the applicable regions examined, the lower forward fuselage has the most vibration in the 10-15 Hz band while, of the three regions examined, the upper avionics bay has the most severe vibration in the 2-23 Hz band.

660

Table 3-1. F^2E SUMMARY - RF-4C

F^2E Criteria	Potential Space Available			
Location Reference and Description	A Behind High Alt Camera Station Access Doors 506 R/L, 507 R/L Remove APQ-102 SLR	B Upper Avionics Bay Access Door 19 Remove Two APQ-102 LRUs: SIG GEN Recorder Control	B Upper Avionics Bay Door 19 Replacement of Amp-Power Supply-Aux Rcvr AM-2349/ASQ	C Tail Area Behind Access Door 61L
Rectangular Size* (H, W, D) Volume	TBD 19.3 ft^3 (Unconfirmed)	TBD	8.5" 6.4" 23.2" 0.7 ft^3 Current Unit Size	16" 18" 22" 16" 8" 22" Total – 5.3 ft^3
Type Cooling Available	Forced Air Conditioning (Cooling Flow Rate of APQ-102 Units is TBD)	Forced Air Conditioning (Cooling Flow Rate of APQ-102 Units is (TBD)	Forced Air Conditioning (Unit Cooling Air Flow TBD) Total CNI Elec. Central System Req Requires 3.2 Lb/Min.)	Currently Convection Only
McDonnell Report 8738* Temperature-Altitude Vibration**	C Conditions IV and VIII Region XIV	Condition VIII Region XIII	Condition VIII Region XIII	Condition II Region I
Possible Candidates for the Space	TEREC A/C and APD-10 (UPD-4) A/C Utilize this Space	ILS ARN-127 NAV ARN-101	Smaller Amp-Pwr Rcvr Unit	None Known
Remarks	Removal of SLR System Components is On-Going. Group A Wiring Remains.		Requirement Reduced with ARN-118 and ARC-164 Installed. Only needed for – Intercom – IFF Xponder – Aux UHF Rcvr Perhaps Gain Half of Vol.	Spaces Separated by Rib No Power Available

*Where LRU is currently installed, the dimensions given represent dimensions of LRU; when no LRU is installed, the dimensions given are those of the available space.
**See Table 3-2.

661

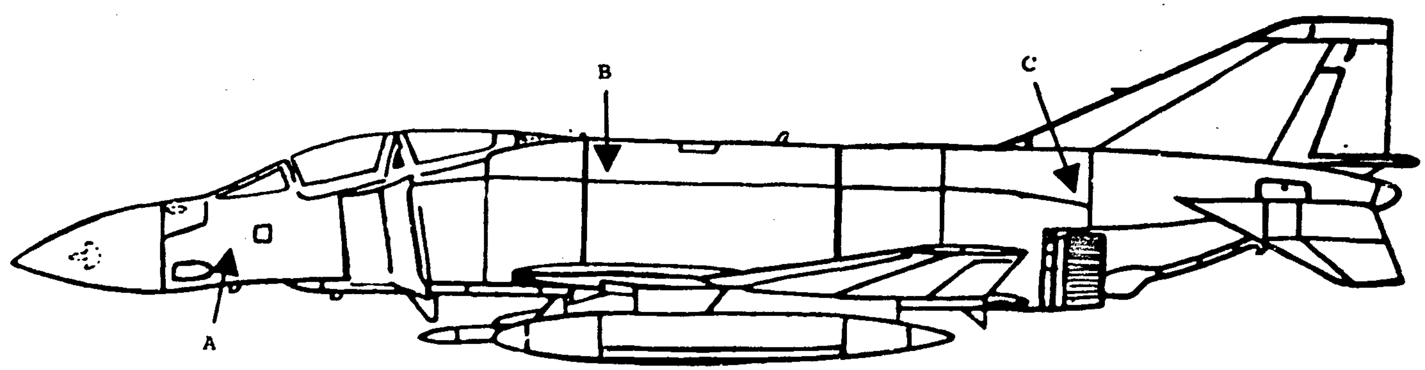


Figure 3-1. **F-4E/RF-4C SPACE LOCATIONS**

66-2

Table 3-2. RF-4C RAW ENVIRONMENTAL DATA SYNOPSIS

Temperature Data

Temperature-Altitude Conditions	Condition			
	II	IV	VII	VIII
Continuous	-54°C to +71°C, Sea level -54°C to +24°C, 60,000′	No Data in Report	-54°C to +29°C Sea level to 60,000′	-54°C to +71°C, Sea level -54°C to +24°C, 60,000′
30 Minutes	to +95°C, Sea level to +100°C, 60,000′		to +53°C, Sea level to +63°C, 60,000′	to +95°C, Sea level to +55°C, 60,000′
10 Minutes	to +109°C, Sea level to +170°C, 50,000′		to +58°C, Sea level to +77°C, 50,000′ (5 minutes) to +54°C, 70,000′ (5 minutes)	to +75°C, 50,000′ to +60°C, 50,000′

Vibration Data

Equipment Performance (double amplitude)	Region		
	I	XIII	XIV
5-10 Hz	0.060 inches	0.060 inches	0.060 inches
10-15 Hz	0.063 inches	0.064 inches	0.110 inches
15-20 Hz	0.036 inches	0.036 inches	0.036 inches
20-23 Hz	0.036 inches	0.050 inches	0.045 inches
23-50 Hz	0.036 inches	0.036 inches	0.036 inches
>50 Hz	±5g	±5g	±5g

4. ELECTRICAL POWER

4.1 Main Power Supply System

The RF-4C is powered by a 60 kVA power supply system. This power is generated by two 30 kVA generators in parallel. Each generator system consists of a 30 kVA 200/115 volt, 3 phase, 400 Hz generator, a constant speed drive, a generator control panel, and, on serial numbers 71-244 and up, an underfrequency protector. An ac power control box and a frequency and load control box are also utilized.

4.2 Power and Distribution System

The power conversion and distribution system is required to perform three operations: converting 115 Vac to 28 Vac; converting 115 Vac, 3 phase to 28 Vdc; and distributing this power to the appropriate systems. The power distribution system consists of the left, right, and an essential 115 Vac, 400 Hz, 3 phase bus system, and low voltage ac and dc bus systems. Under normal use the left and right 3 phase 115 Vac systems are in parallel. Two transformer/rectifier units supply 28 Vdc to the left, right, and essential dc buses.

4.3 Emergency Power System

The emergency power system is available if the main power system fails. Electrical power is developed by a 3kVA, 200/115 Vac, 400 Hz, 3 phase generator. This generator is run by a ram air turbine. The emergency ac generator powers only the essential loads.

664

5. ENVIRONMENTAL CONTROL SYSTEM

5.1 General

The aircraft air conditioning system is divided into two major systems, one for the cabin areas and one for reconnaissance and electronic equipment cooling. Both systems use high-temperature, high-pressure, seventeenth-stage engine compressor bleed air from either or both engines.

5.2 Cabin Air Conditioning

The Cabin Air Conditioning System (CACS) on the right side of the fuselage two air-to-air heat exchangers and other associated equipment. The CACS affords a selection of cabin conditioning temperatures, vent air temperatures, defogging, rain removal, and ram air operations.

5.3 Equipment Air Conditioning

The equipment air conditioning system on the left side of the fuselage suppliers cooling air to the reconnaissance and electronic equipment. The equipment air conditioner uses a cooling turbine and a compressor mounted on opposite ends of a common shaft and an air-to-air heat exchanger. Control of the system is entirely automatic; the temperature in the equipment cooling air circuit is controlled at approximately 84°F from seal level to 25,000 feet and at 39°F from 25,000 feet and up. The temperature in the camera compartment cooling circuit is controlled to maintain a compartment discharge temperature of 95°F. The compartment discharge temperature of the infared reconnaissance sensor cooling circuit is maintained at 75°F.

5.4 Equipment Auxiliary Air System

The equipment air conditioning system also supplies partially cooled air to the Equipment Auxiliary Air System (EAAS). The EAAS distributes partially cooled air from the air-to-air heat exchanger to the following systems:

- Anti-G system
- Canopy seal system
- Air data computer
- Radar transmitter
- Radar wave guide
- Radio receiver-transmitters
- SLR amplifier modulator
- SLR wave guide
- SLR wave guide antenna
- Fuel System pressurization
- Pneumatic system air compressor

665

6. CURRENT AVIONICS

Tables 6-1 through 6-22 contains LRU data relating to the RF-4C avionics systems that make up the current or near-term configuration. Where no entries are shown, the data were not available for this report. Data pertaining to future avionics modifications are presented in Section 9.

66.6

Table 6-1. RF-4C AVIONICS CONFIGURATION DATA: INTEGRATED ELECTRONIC CENTRAL (IEC) AN/ASQ-88( ) OR AN/ASQ-108*

Name	Nomenclature	Location	Dimensions (Inches) H	Dimensions (Inches) W	Dimensions (Inches) D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	Aircraft Power DC	Heat Dissipation	Cooling Method	Mounting
Amplifier Power Supply-Auxiliary Receiver	AM-2349( )/ ASQ-19 NSN: 5895-00-755-4528	Door 19	8.5	6.4	23.2	1262	36.0	115 V 400 Hz 3 ϕ TBS VA (Powers entire IEC system)	27.5 V TBS W		Forced Air 3.2 lb/min. Required for System.	
<u>Intercom Subsystem</u>												
Stations (2)	LS-460A NSN: TBD	Both Cockpits Left Console	2.25	5.75	8.2							
Microphone Switch												
<u>UHF Communication and ADF Subsystem</u>		Aft Cockpit Left Console					7.0					
Central Radio Control (One Each Cockpit)	C-6218/ASQ-88 NSN: 5895-00-017-8936 (or) C-6684/ASQ	Fwd Cockpit Right Console	6.4	5.75	5.[illegible]	184	6.0					
Receiver-Transmitter	RT-793( )/ ASQ-19 NSN: 5895-00-919-2121	Aft Cockpit Under Left Console	7.5	11.85	16.3	1449	38.0				Internal Blower	
ADF Antenna	AS-909A/ARA-48 NSN: 5826-00-849-0055	Doors 502 and 503	3.5	11.4	12.4	495	9.0					
UHF Filter		Aft Cockpit Behind Seat	1.0	2.1	4.0	8.4	0.6					
Antenna Selector Switch												
Coax Relay		Aft Cockpit Behind Seat	1.5	1.6	5.0							
UHF Antennas (2)												
Lower		Nose Gear Fwd Door		9.5 Blade			1.4					
Upper**		Fin Cap-Door 68	1.5	2.0	5.0	15	0.8					

*AN/ASQ-88B and AN/ASQ-108 have secure speech capability.
**Some upper UHF antennas on Door 48.

667

Table 6-1. (continued)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Frequency Channel Indicators (2)	ID-808/ASQ NSN: 5895-00-825-7334 (or) ID-1311/ASQ	Cockpit Instr. Panels	1.3	1.6	5.9	12	3.0					
TACAN Subsystem												
Controls (Pair in Each Cockpit)	C-6684/ASQ NSN: 5890-00-919-0400	Aft Cockpit	2.3	5.8	6.3	234	6.0					
	(or) C-6685/ASQ NSN: 5895-00-919-0410	Left Console										
		Fwd Cockpit Right Console	2.3	5.8	3.3	44	1.8					
Receiver-Transmitter	RT-736/ASQ-88 NSN: 5895-00-017-8935	Door 19	9.2	7.5	21.2	1463	40.0					
Pulse Decoder	KY-531/ASQ-88 NSN: 5895-00-919-0412	Door 19	10.5	6.5	22.5	1536	35.0					
Antennas (2)*		Door 135 and Aft Nose Gear Door										
Coax Switch		Door 19										
Antenna Selector		Door 19										
Identification Subsystem												
Coder-Receiver-Transmitter	KY-532( )/ASQ NSN: 5895-00-017-8933	Door 19	8.6	6.4	22.5	1238	26.0					
Transponder Control	C-6280A(P)APX NSN: 5895-00-089-4403	Fwd Cockpit Right Console	5.25	5.75	3.1	94	2.6					
Antenna		Door 19	(8.25 diameter)		1.7	90	0.75					
Computer	KIT-1A/TSEC NSN: TBD	Doors 502 and 503				244	11.0					

*On some aircraft the upper antenna is located on the top of the nose radome.

Table 6-2. RF-4C AVIONICS CONFIGURATION DATA: HF RADIO SET, AN/ARC-105 NSN: 5821-00-124-4517

Name	Nomenclature	Location	Dimensions (Inches) H	Dimensions (Inches) W	Dimensions (Inches) D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	Aircraft Power DC	Heat Dissipation	Cooling Method	Mounting
Radio Set Control	C-4958	Aft Cockpit Right Console*	2.65	5.75	4.9	75	1.8	115 V 3ϕ 400 Hz 1039 W max. Total System Power			Convection	Console
Receiver-Transmitter	RT-712	Door 511R	22.9	10.3	11.5	2712	65.0				Forced Air	Hard
HF-Comm. Panel		Fwd Cockpit Left Console									Convection	Console
HF-UHF Selector Switch		Aft Cockpit Instr. Panel									Convection	Panel
Vacuum Dielectric Variable Capacitors (2)	MX-6066	Doors 513L/R	4.1	5.9	8.0	194	6.5 (each)				Convection	Hard
Antenna Coupler	CU-1239	Photoflash Ejector Well Inboard Door	8.6	8.6	14.4	1065	18.0				Convection	Hard
Antenna Coupler Control	C-4959	Door 511L	3.7	7.7	14.5	1528	9.0				Forced Air	Hard
Antenna		Edge of Vertical Stabilizer, Feed Point Behind Door 512										
HF Comm/Loran D Panel**		Aft Cockpit Instr. Panel					10					Panel

*Located in the forward cockpit right console on a limited number of aircraft.
**Only on a limited number of aircraft.

669

Table 6-3. RF-4C AVIONICS CONFIGURATION DATA: SECURE COMMUNICATIONS SET, KY-28

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Unit	C-8057/ARC NSN: 5821-00-087-1504		2.6	5.75	2.3	34	1.0		28 V		Convection	Console
Remote Unit	TSEC/KY-28 NSN: TBD		7.8	5.0	9.1	335	15.0		28 V			

Table 6-4. RF-4C AVIONICS CONFIGURATION DATA: FLIGHT DIRECTOR GROUP

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Flight Director Computer	CPU-82A NSN: TBD	Aft Cockpit Right	7.8	6.25	9.6	468	11.0					
Mode Selector Control	C-8108/A NSN: TBD	Fwd Cockpit Main Instr. Panel	3.25	2.0	5.0	33	1.0					
Horizontal Situation Indicator	AP/A24J-1 NSN: TBD	Fwd Cockpit Main Instr. Panel	5.3	5.0	7.6	201	8.0					
HSI Amplifier		Fwd Cockpit Above Left Console	3.5	7.0	5.0	123	4.0					
Bearing Distance Heading Indicator	ID-633A/U NSN: TBD	Aft Cockpit Main Instr. Panel	3.25	3.25	7.75	82	3.0					
BDHI Mode Select Switch		Aft Cockpit Main Instr. Panel	1.3	0.6	2.3	1.8	0.1					

671

Table 6-5. RF-4C AVIONICS CONFIGURATION DATA: ELECTRONIC ALTIMETER SET, AN/APN-159 NSN: 5841-00-411-1662

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver-Transmitter	RT-708( )	Door 510L	6.3	7.5	24.0	1134	21.0					
Height Indicators (2)	ID-1162	Cockpit Instr. Panels	3.25	3.25	4.4	46	4.0 (each)					
Power Supply	PP-3889	Door 510L	8.0	4.1	4.2	138	4.0	400 Hz 115 V 0.8 A 28 V 1.0 A 14/28 V 0.4 A 5 V, 3 A	28 V 1.0 A			
Transmitter Antenna	AS-1521( )	Door 27R	2.4	7.5	10.3	185	2.7					
Receiver Antenna	AS-1522( )	Door 27L	2.4	7.5	10.3	185	2.7					

672

Table 6-6. RF-4C AVIONICS CONFIGURATION DATA: FLIGHT CONTROL GROUP, AN/ASA-32J

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Amplifier	C-6563( )/ ASA-32H NSN: TBD	Aft Cockpit Under Left Console	8.25	10.0	11.8	975	27.0				Convection	Shock
Engaging Controller	C-6564/ASA-32H NSN: 6615-00-907-0197	Fwd Cockpit Left Console	4.5	5.75	4.5	116	2.0				Convection	Console
Rate Gyros												
Pitch	CN-560/ASA-32 NSN: TBD	Door 89L	2.6	2.9	5.4	40	1.0				Convection	Hard
Roll	CN-558/ASA-32 NSN: TBD	Aft Cockpit Bulkhead Right	2.6	2.9	5.4		1.0				Convection	Hard
Yaw	CN-559/ASA-32 NSN: TBD	Door 89R	2.6	2.9	5.4		1.0				Convection	Hard
F-Limiting Accelerometer	MX-3423/ASA-32D NSN: 6615-00-600-1007	Fwd Camera Compartment	3.5	3.5	4.4	54	1.0				Convection	Hard
Lateral Accelerometer	MX-3421/ASA-32D NSN: 6615-00-600-0969	Under Aft Seat	3.5	3.5	4.4	54	1.0				Convection	Hard
Motional Pickup Transducer	TR-175/ASA-32D NSN: 6615-00-590-5172	Fwd Cockpit Control Stick	8.0	1.9	3.7	56	5.0				Convection	Hard

6.73

Best Available Copy

Table 6-7. RF-4C AVIONICS CONFIGURATION DATA: AIR DATA COMPUTER SET NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Computer	CPU-114/A or CPK-86/A24G-30 or CPK-69/ A24G-24	Aft Cockpit Left Side	7.5	12.0	16.75	1508	43.0				Convection	Rack
Altitude Encoder Unit	CVK-99A/A24G or CVK-99B/A24G	Door 502 Camera Bay Equipment	3.3	6.4	5.5	116	4.0				Forced Air	
Angle of Attack Transmitter	TRK-58/A24G-16	Mounted on Door 3R	(4.8 diameter)		7.1	128	2.0				Convection	Hard
Electrical Resistance Temperature Transmitter	TRK-64/A24G-19	Mounted on fwd nose gear door	5.0	3.6	2.5	45					Convection	Hard
Indicators		Cockpit Instr. Panels									Convection	Panel
True Airspeed Indicator	AVK-14/A24G-8		(2.0 diameter)		6.9	22	1.0				Convection	Panel
Angle of Attack Indicator	ARK-10A/A24G-8		(2.4 diameter)		6.5	29	1.8				Convection	Panel
Vertical Velocity Indicator	RCS601LO										Convection	Panel
Servoed Altimeter	AAU-19( )/A		(3.3 diameter)		8.8	75	4.5				Convection	Panel
Airspeed and Mach Number Indicator	MS851L										Convection	Hard
Stall Warning Vibrator	PN-35A520	Left Rudder Panel									Convection	Hard
Aural Tone Generator	O-1551/APN	Under Fwd Cockpit Pedestal	3.5	3.1	8.5	92	2.8				Convection	Hard
Pitot-Static Tube	855S-2	Nose Radome									Convection	Hard

Best Available Copy 674

Table 6-8. RF-4C AVIONICS CONFIGURATION DATA: NAVIGATIONAL COMPUTER SYSTEM, AN/ASN-46A NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)*			Volume (Cubic Inches)*	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Computer-Control	CP-723B	Aft Cockpit Left Console	7	7	11	539	12.0				Convection	Console Mounted
Amplifier Computer	AM-3734	Aft Cockpit Floor Left	9	9	11	891	17.0				Convection	Hard
Ground Speed Indicators (2)	ID-1126	Cockpit Main Instr. Panels Right	3	[illegible]	7	63	2.0 (each) ** 34.0	** 26 V 400 Hz 1 φ 25 VA ------- 115 V 400 Hz 1 φ 125 VA ------- 0-28 V Lighting Separate Source	** 24-29 V 45 W		Convection	Panel Mounted

*Crated dimensions.
**Total system weight and power.

675

Best Available Copy

Table 6-9. RF-4C AVIONICS CONFIGURATION DATA: INERTIAL NAVIGATION SET, AN/ASN-56

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power*		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Navigational Computer (Heading)	CP-779/ASN-56 NSN: 6605-00-999-2278	Aft Cockpit On Gyro Platform	6.4	15.0	7.9	758	17.0	115 V 400 Hz 3 φ 28 V 400 Hz 1 φ	28 V		Internal Blower w/Cabin Air Cond.	On Gyro Platform
Navigational Computer	CP-733/ASN NSN: 6605-00-050-7768	Aft Cockpit Under Right Console	7.3	9.8	26.1	1867	45.0				Solenoid Operated Intake/ Exhaust System	Shock
Navigation Set Control	C-4779/ASN NSN: 6605-00-987-6166	Aft Cockpit Left Console	2.2	5.7	4.3	53.9	1.5				Convection	Console
Attitude Computer	CP-780/ASN-56 NSN: 6605-00-915-9319	Aft Cockpit Under Right Console	14.4	6.2	23.9	2134	26.0				Convection	Shock
Gyro Stabilized Platform	MX-4839( )/ASN or MX-7299/ASN-74 NSN: TBD	Aft Cockpit Right Side	11.3	14.9	10.0	1684	31.0				Convection	Hard

*System power requirements.

676

Table 6-10. RF-4C AVIONICS CONFIGURATION DATA: ILS/VOR SYSTEM, AN/ARN-127

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Control Panel	C-10124 NSN: 594-00-917-4951	Fwd Cockpit Left Console	5.75	2.6	4.5	68	2.2		27.5 V		Convection	Console
Course Indicator	ID-351B/ARN NSN: TBD	Aft Cockpit Instr. Panel										Panel
GS VOR/ILS Antenna		Radome										Hard
Marker Beacon Antenna		Door 508										Hard
VOR/ILS Receiver	R-2032 NSN: 5950-00-415-4369	Door 19	5.1	7.2	12.6	463	10.0	26 V 400 Hz 1 A	27.5 V 2 A max.		Convection	

Best Available Copy

677

Table 6-11. RF-4C AVIONICS CONFIGURATION DATA: LORAN NAVIGATION SET, AN/ARN-92* NSN: 5826-00-498-3319**

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Navigation Computer	CP-898( )	Doors 507L and 508	7.8	10.75	24.0	2012	44.0	115 V 3 ϕ 400 Hz 28 V 400 hz 1 ϕ TBD VA (Powers entire system)	28 V TBD W		Internal Blower in Mount	Shock
Receiver	R-1503( )	Door 507R	7.6	7.5	19.1	1089	29.0				Internal Blower in Mount	Shock
W/Notch Filter	F-1265 or F-1266		3.5	4.4	6.9	106	2.0				Convection	Hard
Control Indicator	C-7417	Aft Cockpit Right Console	6.6	5.75	5.0	342	12.0				Convection	Console
Antenna Coupler	CU-1721	Door 49	1.7	3.7	5.3	33	18.0				Convection	Hard
Signal Conditioner		Door 508	5.5	7.7	9.0	381	11.0				Convection	Hard
Antenna		Upper Center Fuselage									Convection	Hard

*Effectivity: Aircraft 68-594 through 69-350. These aircraft are not expected to be JTIDS candidates.
**Also NSN: 5826-00-883-5755; for ARN-92V3, NSN: 5826-00-134-7054.

678

Table 6-12. RF-4C AVIONICS CONFIGURATION DATA: ATTITUDE HEADING REFERENCE SYSTEM, AN/ASN-55

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Indicator	ARU-11/A or ARU-31/A NSN: 6610-00-424-8740	Fwd Cockpit Instr. Panel	5.1	5.0	9.8	250	9.0				Convection	Panel
Remote Indicator	ARU-13A NSN: 6610-00-883-1034	Aft Cockpit Instr. Panel	3.3	3.3	9.8	107	3.7					
Compass Transmitter	ML-1 NSN: TBD	Door 95	2.3	3.5	4.9	39	1.5				Convection	Hard
Compass Adapter-Compensator	ADK-182( )/ A24G-1A NSN: 6615-00-9535	Aft Cockpit Left	4.1	5.1	9.6	201	7.0				Convection	
Compass Controller	C-6448 NSN: 6615-00-759-1435	Fwd Cockpit Instr. Panel	2.6	5.8	4.4	66	1.3				Convection	Panel
Rate Gyro Transmitter	T-751/AJB-3A or T-970/AJB-7 NSN: 6613-00-759-1367	Aft Cockpit Left	2.8	2.7	5.4	41	2.5				Convection	Hard
Switching Rate Gyro	CN-1050 NSN: 6615-00-759-1367	Aft Cockpit Left	2.7	1.8	4.8	23	1.1				Convection	
Directional Displacement Gyro	CN-990 NSN: 6615-00-567-7949	Door 504R	8.1	4.9	4.9	194	7.5				Convection	
Power Supply Amplifier	AM-4080 NSN: 6615-00-759-1434	Radome	4.3	4.6	4.6	91	4.0				Forced Air	
Roll and Pitch Displacement Gyro	MD-1 NSN: 6615-00-074-4036	Doors 502 and 503	4.7	4.9	9.6	221	9.0				Convection	

679

Table 6-[illegible]. RF-4C AVIONICS CONFIGURATION DATA: INTERFERENCE BLANKER UNIT NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Interference Blanker	53-87570	Bottom of Fuselage Behind Nose Wheelwell, Door 510R	5.75	4.0	10.5	241	10.0	115 V 1 ϕ 400 Hz			Convection	

Best Available Copy

690

Table 6-14. RF-4C AVIONICS CONFIGURATION DATA: RADAR MAPPING SET, AN/APD-10*

Name	Nomenclature	Location	Dimensions (Inches) H	W	D	Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power AC	DC	Heat Dissipation	Cooling Method	Mounting
Antennas	AS-2609 NSN: TBD	Door 506L	6.5	1.0	50.0	325	8.0	115 V 3 ϕ 400 3460 W (system)	28 V 160 W		Convection	Hard
	AS-2608	Door 506R	6.5	1.0	50.0	325	8.0					
Antenna Control Groups	OE-107 NSN: TBD	Door 506L	10.1	9.0	13.0	1182	27.0				Convection	
	OE-108 NSN: TBD	Door 506R	10.1	9.0	13.0	1182	24.0					
Antenna Controls	C-8721 NSN: TBD	Door 506L	5.0	9.7	10.6	514	10.0				Convection	
	C-8722 NSN: TBD	Door 506R	5.0	9.7	10.6	514	10.0					
Amplifier Modulator	AM-6401 NSN: 5841-00-186-2487	Door 507R	12.7	10.0	23.3	2959	97.0				Forced Air	
Frequency Converter Transmitter	CV-2831 NSN: TBD	Door 507R	12.4	8.9	23.0	2538	70.0				Forced Air	
Signal Data Generator Computer	CP-1060 NSN: TBD	Door 19	13.0	8.5	20.5	2265	47.0				Forced Air	
Distribution Box	J-2986 NSN: TBD	Door 19	10.2	16.8	8.5	1457	35.[illegible]				Convection	
Recorder	RO-399 NSN: TBD	Doors 502, 503, 504L	18.0	28.3	20.9	10646	229.0				Forced Air	
Recorder Magazine	LA-446A NSN: TBD	Within Recorder	9.5	12.3	6.4	748	14.0 (loaded)					
Radar Control Fault Locator	C-8720 NSN: TBD	Aft Cockpit Right Console	6.4	5.7	4.1	150	4.0				Convection	Console
	TS-3061 NSN: 5841-00-371-8399	Door 507L	17.1	7.0	11.3	1353	29.0				Convection	Hard

*Effectivity: Aircraft 69-360 through 69-375.

681

Best Available Copy

Table 6-15. RF-4C AVIONICS CONFIGURATION DATA: RADAR MAPPING SYSTEM, AN/APQ-102( )* NSN: 5841-00-411-1663**

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antennas	AS-1586	Door 506L	6.5	50	0.1	325	11.0	115/200 V 400 Hz 3 ϕ 2300 VA (system)	28 V 100 W		Convection	Hard
Antenna Controls	C-6067 C-6066	Door 506L Door 506R	5.0 5.0	9.7 9.7	10.6 10.6	514 514	10.0 10.0				Convection Convection	
Antenna Control Group	CA-6413 CA-6414	Door 506L Door 506R	10.1 10.1	9.0 9.0	13.0 13.0	1182 1182	25.0 25.0				Convection Convection	
Recorder Control	C-6068	Door 19	21.5	10.2	8.5	1864	32.0				Forced Air	
Radar Mapping Recorder	RO-249 or RO-276	Doors 507L 508	14.0	9.5	39.0	5187	107.0 108.0				Forced Air	
Computer-Reference Signal Generator	CP-758	Door 19	21.5	11.0	8.5	2376	42.0				Forced Air	
Frequency Converter-Transmitter	CV-1678	Door 507R	13.25	9.8	24.0	3116	57.0				Forced Air	
Amplifier-Modulator	AM-3950	Door 507R	13.7	10.0	23.25	3185	95.0				Forced Air	
Film Magazine	MA-12/APQ-103 or MA-14/APQ-102A	Contained in Recorder					6.0 8.0					

*Effectivity: All aircraft except those with APQ-10.
**This NSN for APQ-102(A).

Table 6-16. RF-4C AVIONICS CONFIGURATION DATA: RADAR SET, AN/APQ-99 NSN: 5841-00-411-1664

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Antenna-Receiver	AS-1451	Door 501	19.6	20.0	24.2	9486	41.0	115 V 3 φ 400 Hz 1350 VA (Total System Power)	28 V 200 W			Shock*
Transmitter	T-920	Door 501	6.8	16.6	10.3	1163	35.0					Shock
Power Supply-Programmer	PP-3814	Door 501	12.2	21.4	5.3	1384	37.0					Shock
Command Computer	CP-731	Door 501	2.8	10.2	7.5	214	7.0					Shock
Azimuth Range Indicators												
Fwd	IP-710	Above Instr. Panels	6.5	9.3	20.5	1239	26.0				Convection	Panel
Aft	IP-711		8.8	7.5	22.5	1485	31.0					
Radar Control	C-4751	Aft Cockpit Left Console	5.9	5.8	4.4	151	4.0				Convection	Console

*On Forward Mounting Assembly MT-3027 (30 lbs., 17.5" × 24.3" × 7.2").

683

Table 6-17. RF-4C AVIONICS CONFIGURATION DATA: RHAW SET, AN/ALR-47(V) NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Signal Processor	CM-442( )		7.6	5.0	14.6	555	25.0	115 V 400 Hz 2.5 A				
Counter-Measures Receiver	R-1854( )		4.0	6.0	10.8	259	8.2	1 ϕ 115 V 400 Hz 0.25 A				
Amplifier Detectors (4)	AM-6639		6.7	1.7	7.6	87	3.6 (each)		±12 V		Convection	
Indicator Controls (2)	ID-1902		5.1	1.8	4.25	39	2.0 (each)					
Azimuth Indicators (2)	ID-957/APR-36(V)		3.25	3.25	10.8	114	3.0 (each)					
Antennas (4)			5.5	2.6 (each)	4.0		1.0 (each)					

684

Table 6-18. RF-4C AVIONICS CONFIGURATION DATA: ECM PODS/STORES NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)		Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			Diameter	D			AC	DC			
ECM Pod*	ALQ-71(V)-2	Stations 2 and 4	10	91.4	7178	242					Uses Rack Adapter
	ALQ-71(V)-3	Wing Mounted	10	114.6	9001	350					
	ALQ-72	"	10	99	7775	237					
	ALQ-87	"	10.5	107	9265	300					
	ALQ-101	"	10	100	7854	232					
	ALQ-101(V)-8	"	10	157	12331	570					
	ALQ-119(V)-4	"	10	154	12095	565					
	ALQ-119(V)-7	"	10	154	12095	565					
	ALQ-119(V)-10	"									
	ALQ-119(V)-8	"		104	8158	307					
	ALQ-119(V)-11	"				392					
	ALQ-119(V)-12**	"				580					
	ALQ-119(V)-14**	"				406					

*Hardware to mount each pod weighs 167 pounds (LAU-17/A and Adapter 32G94672 and 2 fittings).
**Hardware to mount each pod weighs 161 pounds (LAU-17/A and Adapter 32G94672).

685

Best Available Copy

Table 6-19. RF-4C AVIONICS CONFIGURATION DATA: CHAFF DISPENSING CAPABILITY NSN: 5865-00-144-1858**

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Chaff Dispenser External Store	AN/ALF-38	Wing Stations 2 and 4					470 (Full) +2(4 Mounting Hardware (each)					
Chaff Cartridges* (not part of ALE-38)	RR-136B/ALE	Photo Flash Ejector Door										

*Loaded into and ejected by Photoflash Unit.
**NSN for ALE-38.

686

Table 6-[illegible]. RF-4C AVIONICS CONFIGURATION DATA: SOUND RECORDER SET, AN/ASQ NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Recorder	RO-254( )/ASQ	Aft Cockpit Under Seat	8.75	3.0	6.25	[illegible]	6.0	115 V 61 mA 400 Hz	28 V 30 mA		Convection (Cabin Environment)	Hard
Recorder Switch and Sensor Control		Aft Cockpit Instr. Panel									Convection	Panel

687

Table 6-21. RF-4C AVIONICS CONFIGURATION DATA: DATA DISPLAY SYSTEM, AN/ASQ-90( ) or AN/ASQ-134 NSN: TBD

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Digital Data Inserter	C-6383/ASQ-90	Aft Cockpit Left Console	3.25	3.25	3.4	30	2.0	115 V Φ A 28 V Φ C				
Signal Data Converter	CV-2656/ASQ-90B or CV-2694/ASQ-134	Aft Cockpit Behind Left Console	8.75	9.0	20.0	1575	60.0					
Digital Display Indicators (7)	IP-764/ASQ-90	Door 502 (KS-72 Camera)	(1.25 diameter)		4.5	5.6	1.0					
	IP-765	Aft Cockpit Instr. Panel										
	IP-766	Door 504L/R										
	IP-767	Door 509										
	IP-783	Door 503										
	IP-763	Door 507L										
	IP-770	Door 502 (KS-87 Camera)										

Best Available Copy

Table 6-22. RF-4C AVIONICS CONFIGURATION DATA: SENSOR CONTROL SYSTEM

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Aircraft Camera Parameter Control	LA-311( ) NSN: 6625-00-448-0457	Door 503	7.0	7.5	14.5	761	19.0	115 V 400 Hz 1 φ 50 VA	28 V 20 W			
Photo Control Junction Box	53-79511	Door 503										
Camera Control Photoflash Detector	LA-285A NSN: 6760-00-056-5874	Door 510L	(2.0 diameter)		6.5	20	1.7					
Aerial Mapping and Recon. Photo Viewfinder	LA-313A NSN: 6760-00-880-0842	Doors 504R and 515 and Fwd Cockpit	6.4	5.0	27.0	864	75.0					
Sensor Control Panels (2)		Aft Cockpit Instr. Panel					5.0					
Pilot Recon. Selector Panel		Fwd Cockpit Instr. Panel										
Film Remaining Panel		Aft Cockpit Instr. Panel										
Intervalometer Panel		Aft Cockpit Instr. Panel										
<u>Photographic Equipment</u>												
Low Altimeter Pan Camera	KA-56E NSN: 6720-00-499-4467	Door 503	8.6	23.7	18.8	3832	58.0	115 V 400 Hz 1 φ	28 V			
Framing Camera	KS-87B NSN: TBD	Door 502	10.3	16.0	23.0	[illegible]140	78.0	115 V 400 Hz 3 φ	28 V			
High Altimeter Pan Camera	KA-91B	Door 504L/R	18.0	28.0	24.0	12096	168.0	115 V 400 Hz 3 φ	28 V			
Cartridge Ejectors 4 Each	LA-307A or LA-308A NSN: 6625-00-064-5124	Aft Center Fuselage	13.0	7.0	16.75	1524	49.0	115 V 400 Hz 14/28 V	28 V			

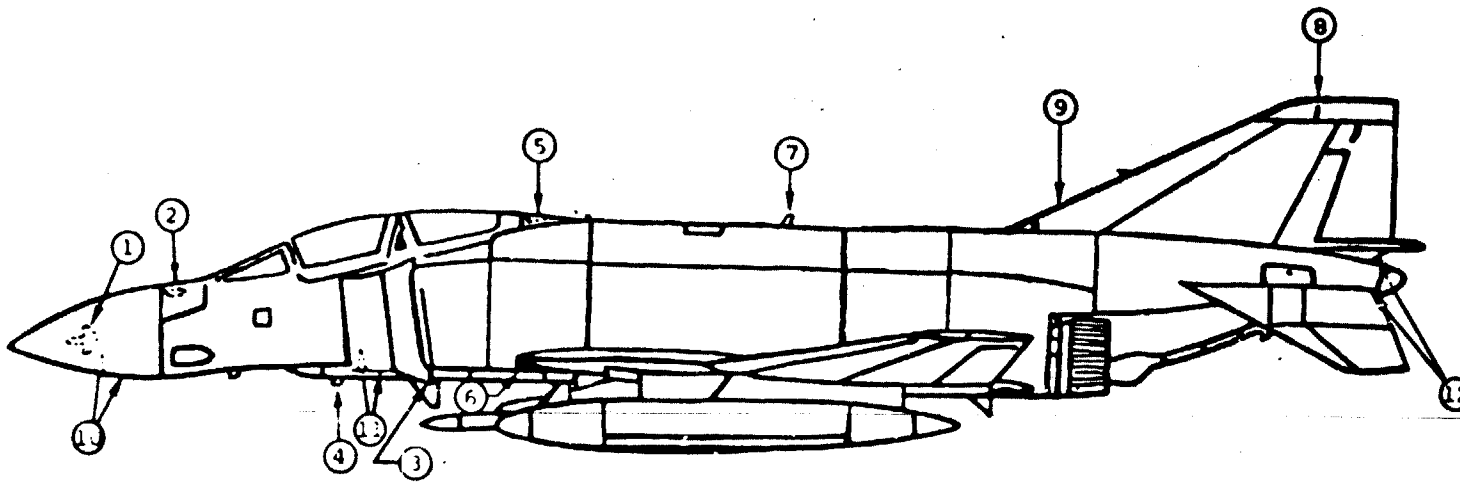
689

7. ANTENNA LOCATIONS

Figure 7-1 shows the approximate locations of the antennas on the RF-4C. Antenna nomenclature from current technical orders is as follows:

Antenna	Nomenclature or Part Number
1. Forward Looking Radar	AS-1451/APQ-99
2. UHF/ADF	AS-909A/ARA-48 or AS-1059/ASQ-19
3. TACAN/RHAW	TBD
4. Lower UHF	DM67-8
5. IFF	2285-1
6. Electronic Altimeter	Receiver: AS-1522A/APN-159 Transmitter: AS-1521A/APN-159
7. TACAN	DMNI-29
8. Upper UHF	6583-2
9. HF	TBD
10. Radar Homing and Warning (2)	TBD
11. Side Looking Radar (2)	Right Side: AS-1587/APQ-102 Left Side: AS-1586/APQ-102
12. Radar Homing and Warning (2)	TBD

690



1. Forward Looking Radar Antenna
2. UHF/ADF Antenna
3. TACAN/RHAW Antenna
4. Lower UHF Antenna
5. IFF Antenna
6. Electronic Altimeter Antenna
7. TACAN Antenna
8. Upper UHF Antenna
9. HF Antenna
10. RHAW Antennas (2)
11. Side Looking Radar Antennas (2)
12. RHAW Antennas (2)

Figure 7-1. **RF-4C ANTENNA LOCATIONS**

691

8. INTERFACE DATA

Data were not available for this section.

612

9. FUTURE MODIFICATIONS

Table 9-1 lists the known on-going or near-term RF-4C modifications. Table 9-2 presents some of the planned or tentative Class V modifications. The classified details of some modifications limit the content of this section.

Tables 9-3 through 9-5 contain pertinent LRU data for the ARC-164, ARN-118, and ARN-101 systems.

693

Table 9-1. ON-GOING AND NEAR-TERM MODIFICATIONS

Terminology/Nomenclature	Remarks
Medium Altitude Camera/ KA-91	Provides capability to select remotely the scan angle of the KA-91 camera from the rear cockpit.
ECM Chaff Capability	Provides individual cartridge ejection capability during normal operation of the photoflash ejection system.
Rivet BAT II/ALR-46	Provides improved radar warning system that alerts crew to radar/SAM tracking.
IR System/AAD-5	Provides improved IR reconnaissance system and replaces the AAS-18.
Laser Demod/AVD-2	Removes AVD-2 Laser Reconnaissance Set installed by Mod 2122 and returns aircraft to standard configuration (small number of aircraft involved).
Digital Navigation System/ ARN-101	Provides an all-altitude bombing system, an improved visual and blind weapon delivery, and LORAN grid targeting capability.
PAVE TACK/AVQ-26	Provides ARN-101-equipped aircraft with the capability to acquire targets and employ terminally guided direct attack weapons.
UHF Radio/ARC-164	Replaces appropriate UHF portion of ASQ-88 ()
TACAN/ARN-118	Replaces appropriate TACAN portion of ASQ-88 ().
VOR/ILS/ARN-127	Provides a VHF Omni Range Navigation System and an Instrument Landing System.
ECM Jamming Pod/ALQ-131	Replacement for ALQ-119 Pod Jammer. The system will by modularized to provide mission-tailored ECM jamming capability.
UHF Radio/ARC-164	Replaces appropriate UHF portion of ASQ-88 ( ) (Near completion)
TACAN/ARN-118	Replaces appropriate TACAN portion of ASQ-88 ( ). (Near completion)

694

Table 9-2. PLANNED AND TENTATIVE MODIFICATIONS	
Terminology/Nomenclature	Remarks
Global Positioning System	Space-based radio navigation system that provides worldwide, continuous, precise, three-dimensional location information.
TEREC/ALQ-125	Provides capability to detect, identify, locate, and record information from ground-based emitters.
Quick Strike Reconnaissance (QSR) System	Advanced real-time reconnaissance system integrating existing sensors and adding many new equipments within the RF-4C. Among some of the major additions are the ALQ-131 Microwave Data Link, the Digital Scan Converter Group Display and a video tape recorder and control system.
COMPASS TIE (ALR-69)	Planning funds only.

Table 9-3. RF-4C AVIONICS CONFIGURATION DATA: UHF RADIO SET LRUS AN/ARC-164 (TWO COMPLETE SYSTEMS MAY BE INSTALLED)

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Receiver-Transmitter (Remote)	RT-1145	†	4.7	5.0	8.25	194	8.1	400Hz 5Vac Panel Lights	27.5V 105W TX Mode 30W RX Mode		Forced Air	
Main* Receiver	R-1977											
Guard* Receiver	R-1976											
Transmitter*	T-1307											
Signal Data Converter*	CV-3297											
Radio Control Panel	C-9533** or C-10116	TBD	4.9	5.75	5.3	149	4.3	27.5V 10W			Convection	Console
Frequency/Channel Indicator	ID-1961** or ID-1994A	TBD	2.25	2.4	5.9	32					Convection	Console of Panel
ADF Amplifier Replay Assembly	AM-3624/ARA-50											

*Included in RT-1145 DATA.
**Configuration not yet decided.
†Anticipate likely installation in spaces vacated by Integrated Electronic Central UHF communications equipment. See Table F.

696

Best Available Copy

Table 9-4. RF-4C AVIONICS CONFIGURATION DATA: TACAN LRUS AN/ARN-118

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Transceiver	RT-1159/A	**	6.8	7.5	14.6	745	26.5	115V 400Hz 1Ø 250va Max			Internal Blower	Transceiver Mounted
Digital-to-Analog Adapter	MX-9577/A	**	6.8	1.7	13.1	151	6.0	26V* 400Hz			Convection	Adapter Mount
Transceiver Mount	MT-4926/A	**	2.1	11.[illegible]	20.5	504			28vdc 28va		Convection	Shock
Control Unit	C-10062/A	TBD	2.25	5.75	5.4	70	2.0				Convection	Console
Adapter Mount	MT-4927/A	**										Shock

*For Analog Indicators
**Installed in space vacated by Integrated Electronic Central TACAN equipment

 697

Table 9-5. RF-4C AVIONICS CONFIGURATION DATA: AN/ARN-101 COMPONENTS

Name	Nomenclature	Location	Dimensions (Inches)			Volume (Cubic Inches)	Weight (Pounds)	Aircraft Power		Heat Dissipation	Cooling Method	Mounting
			H	W	D			AC	DC			
Signal Data Converter, Unit 301	CV-3467/A	After Cockpit RH Console	9.34	7.61	9.25	635	16.9	138W				
Computer, Navigation, Unit 302	CP-1314/A	After Cockpit RH Console	11.88	11.02	7.60	966	38.7	320W				
Inertial Measurement Unit Buffer Unit 304	MX-9697/A	After Cockpit RH Console	6.58	9.31	6.08	372	12.0	83W				
Power Supply, Unit 305	PP-7428/A	After Cockpit LH Console	7.53	7.52	6.76	383	17.2	110W				
Keyer Control, Unit 306	C-9474/A	After Cockpit RH Console	6.50	5.75	7.87	256	7.9	77W				
Control, Navigation Computer, Unit 307	C-9472/A	After Cockpit LH Console	4.50	5.75	3.00	68	2.2	16W				
Indicator, Digital Display, Unit 308	ID-1942/A	After Cockpit Instrument Panel	5.75	5.75	3.00	86	2.8	45W				
Indicator, Auxiliary Digital Display, Unit 309	ID-1943/A	Forward Cockpit Instrument Panel	6.00	2.38	2.38	34	1.1	9W				
Receiver, Loran, Unit 310	R-2086A	Upper Equipment Bay Shelf	12.86	3.76	7.63	369	12.2	105W				
Antenna Coupler, Unit 311	CU-2150/A	Upper Equipment Bay	7.52	2.91	2.53	55	1.8	3W				
Course Select Panel, Unit 312		Forward Cockpit Instrument Panel	1.87	6.52	1.85	22.6	2.0	5W				
Relay Assembly* Unit 313	RE-1118/A	Upper Equipment Bay Door 19	8.25	4.72	4.37	155	6.0	75W				
Antenna, Loran, X-Y Axis, Unit 314	AS-4010/A	Center Fuselage Door 48	39.3	9.02	1.90	220	10.0	N/A				
Antenna, Loran, Z Axis, Unit 315	AS-4011/A	After Fuselage Vertical Tail Fin	6.19	1.75	9.19	71	4.0	N/A				
Target Insert Panel, Unit 316		After Cockpit LH Console	2.90	5.75	1.12	18.7	1.5	8W				
Data Transfer Module, Unit 317		Data TBD										

*Also referred to as Relay Box Unit (RBU)

698

10. DATA SOURCES

The following sources of data were used in preparing this summary:

- Information contained in the JTIDS Aircraft Configuration Data Summary - RF-4C. Published for ASD/XRE by ARINC Research Corporation, June 1978.
- Avionics Planning Baseline Document - October, 1978.
- McDonnell Report 8738. "Environmental Design Requirements and Test Procedures, Aircraft Electronic Equipment" 5 April 1962, Revised 15 July 1964.
- Proceedings of the Society of Photo-Optical Instrumentation Engineers (held 18-21 April), Volume 101, "Airborne Reconnaissance".
- ARINC Research Informal Report - Technical Report Preliminary JTIDS Configuration Data Analyses, May 1978

Inventory of Technical Orders

T. O. Number	Title	Change Order	Date
1F-4(R) C-1	Flight Manual	10	9/15/78
1F-4(R) C-2-1	General Information	15	4/15/79
1F-4(R) C-2-4	Flight Control Systems	20	12/15/77
1F-4(R) C-2-10	Fuel System	20	12/15/77
1F-4(R) C-2-11	Instrument Systems	20	12/15/77
1F-4(R) C-2-12	Air Data Set	18	12/15/77
1F-4(R) C-2-15	Navigation Systems	15	5/15/77
1F-4(R) C-2-16	Auto Flight Control	20	12/15/77
1F-4(R) C-2-18	Armament System	7	9/15/77
1F-4(R) C-2-22	System Integration	13	12/1/77
1F-4(R) C-2-25	Forward Looking Radar	14	9/15/77
1F-4(R) C-2-26	Radar Mapping	6	9/1/76
1F-4(R) C-2-29	I.R. and Laser Sets	12	3/15/76
1F-4(R) C-2-35	Radar Mapping	5	1/15/78
12R5-2ARN127-2	Radio Receiving	Basic	1/15/77
12P3-2ALR46-42	Signal Processor	4	12/31/77
12P3-2AAS18-42	Infared Detecting Set	19	8/1/77
12P5-2APN159-2	Altimeter Set	10	7/1/77