MIL-N-81604C(AS)
3 DECEMBER 1976
Supersedes
MIL-N-81604B(AS)
9 September 1970

MILITARY SPECIFICATION

NAVIGATION SET, INERTIAL

AN/ASN-92(V)

This specification has been approved by the Naval Air Systems Command, Department of the Navy.

1. SCOPE

1.1 Scope - The equipment covered by this specification shall provide aircraft navigation functions (by means of inertial measurement and computer control) after a rapid inertial alignment.

1.2 Classification - The equipment covered by this specification shall consist of the following items:

I terns	Type Designation	Applicable Paragraph
Inertial Measuring Unit	CN-1263/ASN-92(V)	3.5.1
Mount , Inertial Measuring Unit	MT-4100/ASN-92(V)	3.5.2
Power Supply	PP-6188/ASN-92(V)	3.5.3
Computer, Air Navigation	CP-964/ASN-92(V)	3.5.4
Control-Indicator	C-7883/ASN-92(V)	3.5.5
Mounting Base, Electrical Equipment	MT-4375/ASN-92(V)	3.5.6
Converter-Amplifier	CV-2566/ASN-92(V)	Appendix I
Mounting Base, Electrical Equipment	MT-4276/ASN-92(V)	Appendix I

COMMENTS OR RECOMMENDATIONS WHICH MAY BE OF USE IN IMPROVING THIS DOCUMENT MAY BE SENT TO THE PREPARING ACTIVITY WHEN A sELF-ADDRESSED STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL (DD FORM 1426) APPEARS AT THE END OF THIS DOCUMENT, OR BY LETTER ADDRESSED TO THE COGNIZANT ACTIVITY.

FSC-5826

1.3 Associated Equipment - This equipment shall operate with the. associated equipment listed in 6.6.

1.4 Appendix - Appendix I is included in this specification for * information, except as required by contract, as to the application of the CAINS equipment in the E-2C aircraft.

2. APPLICABLE DOCUMENTS

2.1 General - The following documents form a part of this specification to the extent specified herein. Listed are the issue of the documents in effect for the previous procurement. However in lieu of the issue listed, the contractor shall use the latest issue in effect of these documents where feasible. If the use of the latest issue will affect design performance or interchangeability of any replaceable part, then the issue of the document listed below shall be used.

SPECIFICATIONS

Military

MIL-B-5087	Bonding, Electrical for Aerospace Systems	*
MIL-C-172C Amendment 2	Cases, Bases, Mounting; and Mounts, Vibration (For use with Electronic Equipment in Aircraft)	*
MIL-C-6781B	Control Panel; Aircraft Equipment, Rack or Console Mounted	*
MIL-D-81124B	Digital Data Communications Set AN/ASW-25B	*
MIL-D-81170B	Digital Data Communication Set, AN/ASN-27(*)	*
MIL-E-17555G	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of	*
MIL-E-5400K	Electronic Equipment Aircraft, General Specification for	*

MIL-I-46058	Insulating Compound, Electrical	*
MIL-M-7793	Meter, Time Totalizing	*
MIL-N-18307D	Nomenclature and Nameplates for Aeronautical Electronic and Associated Equipment	*
MIL-P-7788D	Panels, Information, Integrally Illuminated	*
MIL-T-18303B	Test procedures; Preproduction and Acceptance for Aircraft Electronic Equipment, Format for	*
MIL-T-23103	Thermal Performance Evaluation, Airborne Electronic Equipment, General Requirements for	*
MIL-T-5422E	Testing, Environmental, Aircraft Electronic Equipment	*
MIL-W-5088C	Wiring; Aircraft, Installation of	*
NAVORD WS 6118	Design Specification for Wire, Electrical Wire Wrap, Insulated and Uninsulated	*
NAVORD WS 6119	Process Specification for Connector Electrical, Solderless Wrapped	*
WR-28A	Mfg Stds for AN/USC-2, or equivalent Time Div Data Transmission Sys., Ru Weps Naval Weapons Requirements	*

Naval Air Systems Command

AR-5	Microelectronic Devices Used in Avionics Equipment, Procedures for Selection and Approval of
AR-8 Amendment 1	Versatile Avionic Shop Test System, Avionic System Compatibility, General Requirements for
AR-9 Amendment 1	VAST Test Programs, General Requirements for

Para 2.1 (cont)

Naval Air Systems Command (cont)

AR-10A	Maintainability of Avionics Equipment and Systems, General Requirements for	
AR- 15	Programmable Airborne Computer Data	
AR- 34	Failure Classification for Reliability Testing, General Requirements for	*
AR-57A	Shipboard Alignment Specification	*
AR-65	CAINS E-2C Computer Performance Specification	*
XAS-1233A	Calibration and Maintenance Console	*

STANDARDS

Military

MIL-STD-275	Printed Wiring for Electronic Equipment	
MIL-STD-461B	Electromagnetic Interference Characteristics, Requirements for Equipment	
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of	
MIL-STD-463	Definitions and Systems of Units, Electromagnetic Interference Technology	
MIL-STD-470	Maintainability Requirements	
MIL-STD-704A	Electric Power, Aircraft, Characteristics and Utilization of	
MIL-STD-781B	Reliability Tests, Exponential Distribution	*
MIL-STD-794A	Parts and Equipment, Procedures for Packaging and Packing of	*
MIL-STD-785	Roliability Program for Systems and Equipment Development and Production	

Para 2.1 (cont)

Military (cont)

MIL-STD-810B	Environmental Test Methods	*
MIL-STD-1130	Connection, Electrical Solderless Wrapped	*
MS-17322D	Meter, Time Totalizing Miniature Digital 115V 400 Cycle	*

2.1.1 Avilability of Document. When requesting specifications, standards drawings, and publications, refer to both title and number. Copies of this specification and applicable specifications required by contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Publications and Forms Center, Code 105 Tabor Avenue, Philadelphia, Pennsylvania 19120.

3. REQUIREMENTS

3.1 Preproduction - This specification makes provision for preproduction testing.

3.2 Parts and Materials - In the selection of parts and materials, fulfillment of major design objectives shall be the prime consideration. In so doing, the following shall govern:

a. Microelectronic technology shall be considered and microelectronic items shall conform to requirements specified herein.

b. Other parts and materials requirements shall conform to MIL-E-5400.

c. Nonreparable subassemblies shall be used in accordance with Specification AR-10 and as outlined in MIL-E-5400. *
(Refer to 6.5.) *

d. When previously produced models of this equipment did not use nonreparable subassemblies, the design shall not be changed to employ nonreparable assemblies without the approval of the procuring activity.

3.2.1 Nonstandard Parts and Materials Approval - Approval for the use of nonstandard parts and materials (including electron tubes, transistors and diodes) other than microelectronic devices shall be obtained as outlined in MIL-E-5400. Microelectronic devices shall be approved as outlined in AR-5. *

3.2.2 Microelectronic Modular Assemblies - When used, microelectronic modular assemblies shall meet the requirements of AR-5. Conformal coatings, encapsulant, embedments, or potting materials used with modular assemblies (designated as reparable) containing integrated circuits and discrete parts shall be easily removable without damage to the assembly. *

3.2.3 Modules - The electronic portions of the equipment shall be functionally modularized in accordance with AR-10 when practicable. When previously produced models of this equipment do not incorporate AR-10, the design shall not be changed to incorporate AR-10 without the approval of the procuring activity. *

3.3 Design and Constrction - The equipment shall conform with all applicable requirements of MIL-E-5400 for design, construction, and workmanship, except as otherwise specified herein. *

3.3.1 Total Weight. - The total weight of the equipment, excluding cables, the CAU, and the CAU mount, shall be a minimum consistent With good design and shall not exceed 103.6 pounds with 12K words of computer memory. For the maximum WRA weights, refer to 3.5. For CAU weight, refer to Appendix I. *

3.3.2 Reliability - A Reliability Plan shall be provided in accordance withl MIL-STD-785.

3.3.2.1 Operational Stability - The equipment shall operate with satisfactory performance continuously or intermittently for a period of at least 700 hours without the necessity for readjustment of any control other than that required to initiate an equipment recalibration sequence. The equipment shall not reguire calibrator, more frequently than every 300 operational hours to meet the equipment performance requirements specified herein. Shipboard recalibration shall be performed with equipment designed in accordance with XAS-1233, or equivalent. *

3.3.2.2 Operating Life. - The equipment shall have a total operating life of 10,000 hours with reasonable servicing and replacement of parts. Parts requiring scheduled replacement shall be specified by the contractor and approved by the procuring activity before use in the equipment design.

3.3.2.3 Reliability in Mean-Time-Between-Failures (MTBF) - The equipment, including any built-in-test (BIT) provisions and the battery associated circuitry (charging circuit and changeover circuit), shall have a specified reliability of 700 hours mean (operating) time between failures when tested in accordance with MIL-STD-781B. The reliability apportionment (minimum MTBF/unit) shall be as shown in table I.

TABLE 1. RELIABILITY APPORTIONMENT

Unit	MTBF (Minimum)
Inertial Measuring Unit (IMU)	1,800 hours
Air Navigation Computer Unit (ANCU)	2,000 hours
Control Indicator Unit (CIU)	13,200 hours
Power Supply Unit (PSU)	17,300 hours
Converter AmPlifier Unit (CAU)	4,175 hours

3.3.2.4 Elapsed Time Indicators- Each unit listed in 1.2, exceept for mounts, shall contain an electromechanical elapsed time indicator which shall meet the requirements of MIL-M-7793 and conform to MS-17322D. The indicators shall be located so that they may be read without removing covers or any other parts from the units. The indicators shall be energized during all equipment "ON: time periods. “ON” time is defined as any operating mode, including BIT.

3.3.3 Cables and Connections -

3.3.3.1 Cables and Connectors - The equipment shall provide for the use of external cables and connectors in accordance with MIL-E-5400. Where possible, all cable connectors shall be electrically bonded in accordance with MIL-B-5087.

3.3.3.2 Interconnection Cabling. - The equipment shall be capable of satisfactory operation using external wiring in accordance with the applicable requirements of MIL-W-5088. The external wiring shall be unshielded, except that a minimum number of the individual wires may be shielded when demonstrated as necessary to meet interference control requirements, and provided that the assembly of the cable to its plugs may be easily accomplished. External cables and that portion of the connectors attached to the cables shall not be supplied as part of the equipment. The equipment shall be designed to operate utilizing the maximum cable lengths specified in table II.

TABLE II. EQUIPMENT CABLE LENGTHS

Signal Transmission	Cable Length (Maximum)
1. ANCU to IMU	60 feet
2. ANCU to CIU	60 feet (see notes)
3. ANCU to ASW-27	60 feet
4. ANCU to ASW-25	20 feet
5. ANCU to CAU	60 feet
6. IMU to CAU	60 feet
7. IMU to XAS-1233 Test set	15 feet
8. PSU to IMU	60 feet (see notes)
9. PSU to ANCU	60 feet (see notes)

NOTES

1. The power connectors shall contain a sufficient number of pins to allow transmission of power over uniform continuous cables up to 30 feet in length.
2. Power transmission over cables longer than 30 feet shall be accomplished by the use of aircraft cabling techniques which provide impedances no greater than the continuous 30 foot cables described in note 1. For example, a transition to a larger wire size or an increased number of wires may be used for cables longer than 30 feet.

3.3.3.3 Unit Interconnection - Figure 1 identifies the connectors, signal interconnection, and pin assignments of the equipment.

3.3.3.4 Internal Wiring - The use of wire wrap solderless connections shall meet or exceed the requirements of and be in accordance with MIL-STD-1130, Class A and CODE IDENT 10001 NAVORD WS 6118 and WS 6119. *

3.3.4 Control Panels - All rack or console mounted control panels shall conform to the applicable requirements of MIL-C-6781. The configuration of all panels must be approved by the procuring activity prior to preproduction testing.

3.3.5 Interchangability - The equipment shall meet the interchangeability requirements of MIL-E-5400.

3.3.6 Interference Control - The generation of radio interference by the equipment and the vulnerability of the equipment to radio interference shall meet the requirements of MIL-STD-461, MIL-STD-462, and MIL-STD-463. The electrical bonding requirements of MIL-B-5087 shall be implemented throughout the design assembly and integration.

3.3.7 Provisions for Maintainability - Built-in test equipment, construction and packaging, provisions for test points, and other maintainability parameters shall be as specified in AR-10. (Refer to 3.4.1 and 3.5.4.6.)

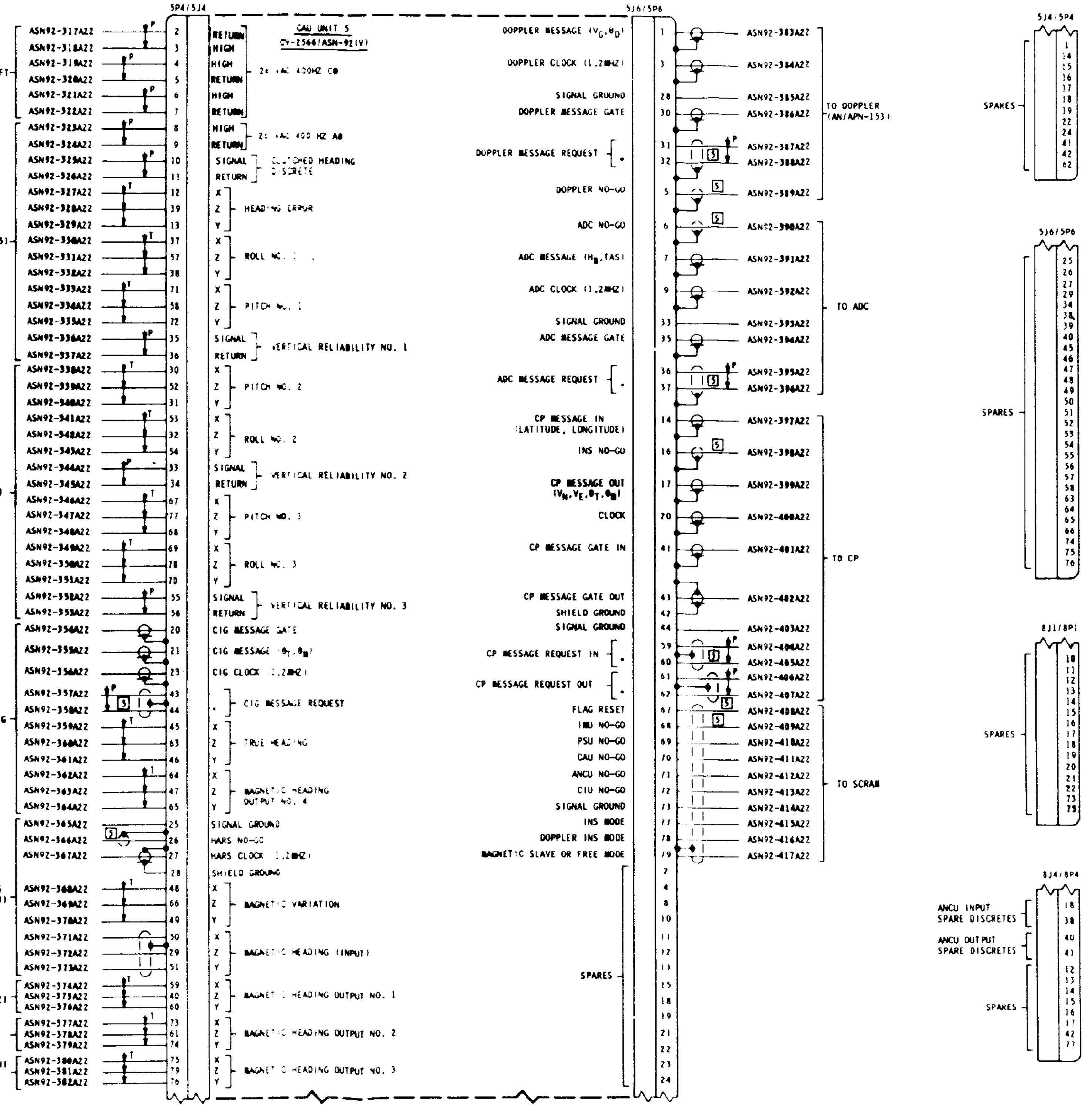
3.3.7.1 Maintainability Requirement. The maintainability requirements for the AN/ANN-92(v) WRA’s for the intermediate level are as shown in table III and are based on a 95th percentile projection. The repair times in table III exclude test periods required by VAST or other special test equipments.

3.3.7.2 Compatibility with VAST - The equipment, except the IMU, shall be compatible with the Versatile Avionic Shop Test (VAST) and shall meet the requirements of AR-8. When required by contract VAST Test Programs shall be furnished in accordance with AR-9. If VAST Test Programs exist for the equipment, and changes to the equipment are made which will affect the fault diagnosis procedure, changes to the existing Test Program shall be prepared as part of the equipment changes in accordance with AR-9.

3.3.7.3 Compatibility with special IMU Test Equipment. - The design of the IMU shall be compatible with test equipment designed in accordance with xAS-1233 or equivalent, and the design shall be subject to approval by the procuring activity.

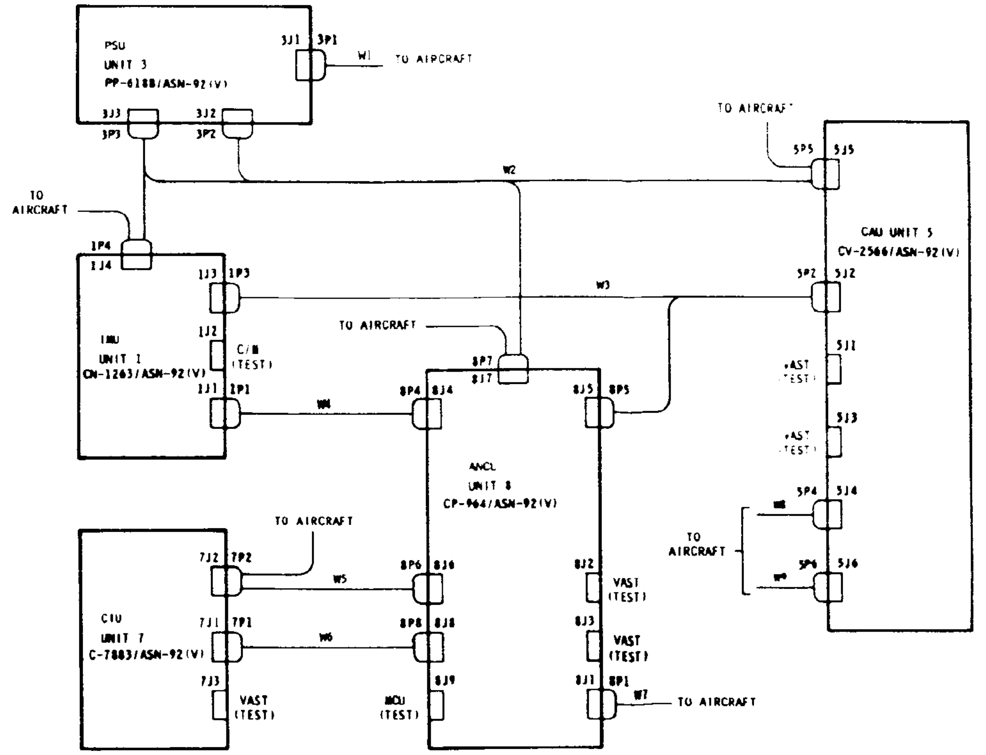
3.3.8 Nomenclature, Nameplate and Identification Marking - Nomenclature and serial number assignment, nameplate approval, and identification marking shall be in accordance with MIL-N-18307.

Figure 1. Interconnecting Diagram (Sheet 1 of 2)



WIRE TABLE - 1 (VOLTAGE DROP LIMITATION)			
CONNECTOR PIN	SIGNAL NAME	CURRENT [12] (AMPERES)	MAXIMUM ALLOWABLE VOLTAGE DROP
7J2-K	+5VDC RETURN	5.5 (TOTAL)	0.100V
7J2-L	+5VDC RETURN		0.100V
7J2-M	+5VDC RETURN		0.100V
7J2-N	+5VDC RETURN		0.100V
7J2-P	+5VDC RETURN		0.100V
7J2-R	+5VDC RETURN		0.100V
7J2-S	+5VDC RETURN		0.100V
7J2-T	+5VDC RETURN		0.100V
7J2-G	+5VDC (LOGIC)	2.2 (TOTAL)	0.080V
7J2-H	+5VDC (LOGIC)		0.080V
7J2-J	+5VDC (LOGIC)		0.080V
7J2-U	+5VDC (LOGIC)		0.080V
7J2-V	+5VDC (LAMPS)	3.3 (TOTAL)	0.165V
7J2-W	+5VDC (LAMPS)		0.165V
7J2-X	+5VDC (LAMPS)		0.165V
3J2-B	+32VDC UNREG (A)	6.0 (TOTAL)	0.45V
3J2-C	+32VDC UNREG (A)		0.45V
3J2-E	+32VDC UNREG (B)	1.7	0.25V
3J2-D	+28VDC	0.5	0.075V
3J2-S	-28VDC	1.0	0.15V
3J2-H	+5 VDC AUX	100 MA	0.1V
3J2-P	ANCU RETURN NO. 1	8.0 (TOTAL)	0.3V
3J2-X	ANCU RETURN NO. 2		0.3V
3J2-T	ANCU RETURN NO. 3		0.3V
3J2-F	ANCU RETURN NO. 4		0.3V
3J3-B	+28VDC	6.0 (TOTAL)	0.3V
3J3-C	+28VDC		0.3V
3J3-D	+28VDC		0.3V
3J3-E	-28VDC	5.0 (TOTAL)	0.375V
3J3-S	-28VDC		0.375V
3J3-K	IMU RETURN NO. 1	5.0 (TOTAL)	0.25V
3J3-V	IMU RETURN NO. 2		0.25V
3J3-M	IMU RETURN NO. 3		0.25V
3J3-G	+32VDC UNREG (C)	3.3 (TOTAL)	0.25V
3J3-T	+32VDC UNREG (C)		0.25V
3J3-H	+28VDC	1.0 (TOTAL)	0.075V
3J3-J	+28VDC		0.075V
3J3-U	-28VDC	0.6	0.09V
3J3-N	CAU RETURN NO. 1	4 (TOTAL)	0.15V
3J3-P	CAU RETURN NO. 2		0.15V
3J3-R	CAU RETURN NO. 3		0.15V
3J3-X	CAU RETURN NO. 4		0.15V

GLOSSARY	
ABBREVIATION	DEFINITION
ANCU	AIR NAVIGATION COMPUTER UNIT
CAU	CONVERTER AMPLIFIER UNIT
CIU	CONTROL INDICATOR UNIT
IMU	INERTIAL MEASURING UNIT
PSU	POWER SUPPLY UNIT
AFCS	AUTOMATIC FLIGHT CONTROL SYSTEM
HARS	HEADING ATTITUDE REFERENCE SYSTEM
INS	INERTIAL NAVIGATIONAL SYSTEM
CIC	COMBAT INFORMATION CENTER
CIG	CONTROL INDICATOR GROUP
SCRAM	SIGNAL COMMAND, READOUT, AND ALARM MODULE
ADC	AIR DATA COMPUTER
BDHI	BEARING DISTANCE HEADING INDICATOR
BITE	BUILT IN TEST EQUIPMENT
RAI	REMOVE ATTITUDE INDICATOR
C/M	CALIBRATION AND MAINTENANCE
CP	COMPUTER PROGRAMMER
S/D	SYNCHRO TO DIGITAL
VAST	VERSATILE AVIONIC SHOP TEST
MCU	MANUAL CONTROL UNIT



UNIT	REF DESIG	UNIT CONNECTOR	REF DESIG	MATING CONNECTOR
IMU	1J1	903196 - 3	1P1	MS27484T20-35SC
	1J2	903196 - 2	1P2	MS27484T18-35S
	1J3	903196 - 1	1P3	MS27484T14-35S
	1J4	903196 - 4	1P4	MS27484T20-16S
PSU	3J1	MS27478Y10D5P	3P1	MS27484T10-5S
	3J2	MS27508E22B21SA	3P2	MS27484T22-21PA
	3J3	MS27508E22B21SB	3P3	MS27484T22-21PB
CAU	5J1	MS27508E24B35S	5P1	MS27484T24-35P
	5J2	MS27508E22B35SC	5P2	MS27484T22-35PC
	5J3	MS27508E24B35SA	5P3	MS27484T24-35PA
	5J4	MS27508E20B35PA	5P4	MS27484T20-35SA
	5J5	MS27508E22B21PB	5P5	MS27484T22-21SB
	5J6	MS27508E20B35PB	5P6	MS27484T20-35SB
CIU	7J1	MS27508E16B35P	7P1	MS27484T16-35S
	7J2	MS27508E22B21P	7P2	MS27484T22-21S
	7J3	MS27508E22B35SB	7P3	MS27484T22-35PB
ANCU	8J1	MS27508E20B35SA	8P1	MS27484T20-35PA
	8J2	MS27508E22B35SA	8P2	MS27484T22-35PA
	8J3	MS27508E22B35S	8P3	MS27484T22-35P
	8J4	MS27508E20B35SB	8P4	MS27484T20-35PB
	8J5	MS27508E20B35P	8P5	MS27484T20-35S
	8J6	MS27508E22B21S	8P6	MS27484T22-21P
	8J7	MS27508E22B21PA	8P7	MS27484T22-21SA
	8J8	MS27508E16B35S	8P8	MS27484T16-35P
	8J9	903017 - 9	8P9	HUGHES 1018362-1S

[16] SHIELDED WIRE IS ONLY REQUIRED WHEN SHIELDS ARE NOT USED.

[15] WITH AN IMU ORIENTATION SUCH THAT THE IMU CONNECTORS ARE FACING LEFT IN THE AIRCRAFT, THE FOLLOWING EXTERNAL WIRES SHOULD BE REVERSED ON THE NOTED IMU OUTPUT SIGNALS:
S4 WITH S2,
S3 WITH S1,
AND X WITH Y

14. WITH AN IMU ORIENTATION SUCH THAT THE IMU CONNECTORS ARE FACING RIGHT IN THE AIRCRAFT, THE FOLLOWING SYNCHRO AND RESOLVER CONVENTIONS APPLY:

FOR ZERO DEGREES	E(S4-S2) = E(S8-S6) = E(Y-X) = 0 VOLTS; E(S1-S3), E(S5-S7) AND E(Z-X) ARE IN PHASE WITH E(H1-RET) EXCITATION VOLTAGE
FOR INCREASING POSITIVE ANGLES	E(S4-S2), E(S8-S6) AND E(Y-X) ARE IN PHASE WITH E(H1-RET) EXCITATION VOLTAGE
POSITIVE HEADING	CLOCKWISE FROM TRUE NORTH
POSITIVE PITCH	NOSE UP
POSITIVE ROLL	RIGHT WING DOWN

[13] FOR TEST ONLY. DO NOT CONNECT IN AIRCRAFT.

[12] SEE WIRE TABLE 1 LISTING THE VOLTAGE DROP LIMITATIONS. THE TOTAL CURRENT FOR ANY GIVEN VOLTAGE OR RETURN SHALL BE EQUALLY DIVIDED BETWEEN THE WIRES WHICH ARE CONNECTED TO THE GIVEN VOLTAGE OR RETURN.

11. * DENOTES THE COMPLEMENT LINE OF A COMPLEMENTARY DIFFERENTIAL SIGNAL.

10. ALL CABLE CONNECTORS SHALL BE PROCURED WITH AN ELECTRICALLY CONDUCTIVE FINISH TO ENSURE COMPLIANCE WITH MIL-B-5087B BONDING REQUIREMENTS.

9. THE SHIELDS OF ALL SHIELDED CABLING SHALL BE TERMINATED VIA ATTACHMENT TO THE CONNECTOR BACKSHELL AT BOTH SOURCE AND LOAD ENDS.

8. ALL CABLE CONNECTORS CONTAINING SHIELDED WIRING SHALL EMPLOY R F I BACKSHELLS FOR SHIELDED TERMINATIONS. THE BACKSHELL ADAPTERS SHALL BE GLENAIR SERIES, G3304 OR EQUIVALENT.

7. ALL COAX TO BE GC875S-1 OR EQUIVALENT.

6. ALL SHIELDED TWISTED PAIR CABLING SHALL BE RAYCHEM TYPE 782400130-9 (24 AWG) OR EQUIVALENT.

[5] THE NOTED SHIELDS ARE NOT REQUIRED IF ONLY MIL-STD-461B EMI REQUIREMENTS ARE IMPOSED.

4. WHEREVER SHIELDED PAIRS, TRIADS OR QUADS ARE DESIGNATED, SUCH WIRING SHALL BE TWISTED.

3. ALL CABLE RUNS, EXCEPT THOSE LISTED IN WIRE TABLE-1, SHALL BE RESTRICTED TO A MAXIMUM LENGTH OF 60 FEET. CABLES CONTAINING THOSE WIRES LISTED IN WIRE TABLE-1 SHALL BE RESTRICTED TO MEET THE VOLTAGE DROP LIMITATIONS.

2. THE HIGHEST WIRE CODE NUMBER USED IS ASN92-397. NOT USED: ASN92-272 AND ASN92-290 THRU ASN92-309.

1. INSTALLATION OF WIRING SHALL CONFORM TO SPECIFICATION MIL-W-5088.

NOTES: UNLESS OTHERWISE SPECIFIED.

Figure 1. Interconnecting Diagram (Sheet 2 of 2)

TABLE III. MAINTAINABILITY REQUIREMENTS

Unit	MTTR/Hrs	MAXTTR/Hrs
IMU	1.0	1.5
ANCU	0.5	0.7
PSU (Excluding Battery Charge)*	0.4	0.6
CIU	0.4	0.6

*Maximum recharge interval after one 10-second discharge shall be two hours if the limit switch (17.0 volts) is operating properly and prevents the battery from discharging to a level lower than 17.0 volts. Maximum recharge interval on a battery which is completely discharged shall be 20 hours. The 20-hour recharge interval reflects the time required to recharge its battery if the limit switch fails permitting the battery to discharge completely. *

3.3.9 <u>Standard Conditions</u> - The following conditions shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests.

Temperature	Room ambient (25°C ±5°C)
Altitude	Normal ground
Vibration	None
Humidity	Room ambient up to 90 percent relative humidity
Input power voltage	115 ±1.0 VAC 400 Hz and 27.5 ±0.5 VDC

3.3.10 <u>Service Conditions</u> - The equipment shall operate satisfactorily under any of the environmental service conditions or reasonable combinations of these conditions as specified in MIL-E-5400. Class 2X requirements shall apply to the IMU, ANCU, and to the PSU with the listed exceptions. See figures 20, 21, 22, 25, 26, 28, and 29. Class 1 requirements shall apply to the CIU. IMU intermittent operation as specified in MIL-E-5400 shall *

Para 3.3.10 (cont)

be limited to 160°F. The high temperature requirements for the PSU battery shall be limited as stated in 3.3.10.2. *

3.3.10.1 Vibration - The airborne equipment shall operate satisfactorily when subjected to the vibration requirements of Curves I and 11 of MIL-E-5400, with Curve I extended to 2,000 Hz at the ±10g level.

3.3.10.2 Temperature - For MIL-E-5400, Table 1, Column II intermittent operation,the IMU accuracy may be degraded for inlet cooling air conditions outside the design criteria specified in figures 20 and 21. High temperature requirements for the PSU battery shall be limited to the following maximum temperatures: *

a. Equipment Operating

Continuous/intermittent:	+68°C (154.4°F)
Temperature shock:	+68°C (154.4°F)

b. Equipment Operating (Battery Charge Only)

Continuous/intermittent:	+60°C (140°F)
Temperature shock:	+60°C (140°F)

c. Equipment Nonoperating

Temperature extremes:	+71°C (162.5°F)
Temperature shock:	+71°C (162.5°F)

3.3.11 Alignment Time - The equipment shall have an inherent capability to warm up and align to meet the specified navigation accuracy requirements within 5 minutes. System alignment time may vary as a function of the computer alignment software mechanization utilized. Using the Maximum Likelihood-Kalman filter (MLF-K) type of alignment software mechanization, the mean time required for the system to align under various conditions shall be as follows:

a. Under carrier operational conditions where ambient temperature exceeds 50°F, the alignment time shall be less than 10 minutes and may increase linearly to 12 minutes dwn to 65°F. The Ships Inertial Navigation System (SINS) shall operate within the requirements of AR-57A with a data validity of 99.5 percent throughout the alignment period.

Para 3.3.11 (cont)

b. For shore-based operational aircraft conditions, the alignment time shall be less than 8 minutes under all ambient temperature conditions down to -65°F.

c* For laboratory test conditions, the alignment time shall not exceed 5 minutes where the ambient temperature is 0°F or above.

3.3.12 Input Electrical Power

3.3.12.1 Operating Power - The equipment shall meet all applicable requirements of MIL-STD-704 and shall give specified performance when energized from the following power sources having characteristics and limits as defined in MIL-STD-704. The aircraft power required shall not exceed the specified amounts:

IMU

a. AC Power (single phase), 115V, Category B, 1.5 VA, Power Factor >0.9

b. AC Power (three phase), 115/200V, Category B, 1987 VA, Power Factor >0.9

c. AC Power (single phase), 26V, Category B, 6VA, Power Factor >0.25

Psu

a. AC Power (single phase) , 115V, Category B, 90 VA, Power Factor >0.9

b. AC Power (three phase), 115V, Category B, 810 VA, Power Factor >0.9

ANCU

a. AC Power (single phase), 115V, Category B, 1.5 VA, Power Factor >0.9

b. AC Power (single phase), 26V, Category B, 0.2 VA, Power Factor >0.25

CIU

a. AC Power (single phase), 115V, Category B, 1.5 VA, Power Factor >0.9

Lighting Power - Input power for lighting shall require not more than 1.4 amperes at 5 volts, a-c or d-c.

3.3.13 Cooling - Cooling required shall conform to the cooling curves presented herein.

a Cooling System Failure

The AN/ASN-92(V) equipment shall contain the thermal cutout protection necessary to prevent damage to the equipment. Maximum temperature shall be determined by curves generated in conformance to MIL-T-23103.

The equipment shall continue to operate for a limited period with air conditioning system failures resulting in a complete loss of cooling air flow, occurring with ambient temperatures up to 160°F.Proving that the CAINS equipment has been operating for 15 minutes (minimum) with 80°F (or cooler) inlet cooling air at specified flow rates, the equipment will continue to meet specified performance for a period of five minutes. The equipment will also operate yielding degraded performance for an additional 15 minutes before overtemperature controls initiate shutdown.

3.3.14 Printed Wiring Boards - Design and construction of printed boards shall meet the design guide of MIL-STD-275, with the listed additions to take advantage of the simplicity of construction and weight reduction provided by “fineline” circuitry:

a. Minimum conductor width - 0.005 inches

b. Minimum conductor spacing - 0.005 inches

c. Minimum copper thickness of plated-through holes 0.0015 inches

d. Plated-through holes shall be filled with solder or filled with epoxy with properties which meet the requirements of MIL-I-46058.

e. Maximum 30° temperature rise at conductor hot spot.

3.4 Performance Characteristic - The given requirements apply to both standard and extreme service conditions.

3.4.1 Operation - The equipment shall continuously provide the required functions, at all latitudes, rwith the required accuracies specified herein under any natural combinations of mission conditions listed in table IV and environmental conditions listed in 3.3.10. To provide the modes of operation described in 3.4.1.1, the following externally supplied inputs are required:

a. Magnetic Heading - The characteristics of the required magnetic input will be a function of the particular CAU being used and will be provided via the ANCU/CAU serial interface channel. This input is required for all navigation modes except Free.

b. True Airspeed and Barometric Altitude .- The characteristics of these inputs will be a function of the particular CAU being used and will be provided via the ANCU/CAU serial interface channel. These inputs are required for air data navigation and wind computation only.

c. Droppler Radar Required to Derive Ground Speed and Drift Angle - The characteristics of these inputs will be a function of the particular CAU beinq used and will be provided via the ANCU/CAU serial interface channel. These inputs are required for doppler inertial or doppler navigation and in-air alignment only.

d. Data link information (for carrier alignment only)

e. Taxi discrete

f. Weight-on-wheels discrete

The equipment shall conduct self-test which provides a 90 percent probability of detecting a failure and a 90 percent probability of isolating a failure to the WRA level. In-Flight Performance Monitoring (IFPM) self tests shall be in continuous operation in all modes except Off unless inhibited by a malfunction. *

3.4.1.1 Modes of Operation - The CIU MODE switch shall have the following positions:

a. BIT (Built In Test)

b. OFF

c. NORM (normal)

Para 3.4.1.1 (cont)

d. INS (Inertial)

e. MAG SLV (Magnetic Slaved)

f. FREE (Platform Free)

g. EM MAG (Emergency Magnetic)

The equipment shall be capable of operating in any mode without restriction as to having first been in any other particular mode, except that the equipment must be switched to OFF prior to entering NORM or INS from the MAG SLV, FREE, or EM MAG modes. It shall be possible to switch modes, including the BIT mode, without damaging the equipment. There shall be detents which require the CIU mode switch to be pulled out when switching from OFF to BIT, from NORM to OFF, and from INS to MAG SLV. *

TABLE IV. MISSION CONDITIONS ENVELOPE

Parameter	Range
Latitude Range (degrees)	S90 to N90
Longitude Range (degrees)	W180 to E180
Groundspeed Range (ft/see)	0 to 3000
Aircraft Roll Attitude (degrees)	-180 to +180
Aircraft Pitch Attitude (degrees)	-90 to +90
Aircraft Heading (degrees)	0 to 360
Roll Angular Rate (degrees/see)	0 to 300
*Pitch Angular Rate (degrees/see)	0 to 60
Yaw Angular Rate (degrees/see)	0 to 200
Roll Angular Acceleration (degrees/sec^2)	0 to 1500
Pitch Angular Acceleration (degrees/sec^2)	0 to 200
Yaw Angular Acceleration (degrees/sec^2)	0 to 200
Linear Acceleration Range (ft/sec^2)	0 to 307.2
Mission Duration (hours)	0 to 6.0

*Within 15° of the zenith and nadir, the maximum pitch angular rate shall be 35° per second.

3.4.1.1.1 BIT Mode - This test shall be selected by placing the CIU MODE switch in the BIT position. The length of the time required to complete the tests in this mode, excluding the navigate test, shall be less than 1.5 minutes.

a. Navigate Test. An "on deck" navigate run may be performed for IMU evaluation while in the BIT mode.

b. Malfunction Indicators Test. The BIT mode shall also test the ANCU controlled BIT indicators. The ANCU, CIU, CAU, and IMU malfunction flags and/or lamps shall indicate a failure for the first 10 seconds in BIT mode and will return to the normal IFPM malfunction display thereafter. *

c. IFPM. In addition, all continuous in-flight performance monitoring tests (refer to 3.4.1.2) shall be performed in this mode. *

3.4.1.1.1 Off Mode - In the OFF mode, the +32 VDC unregulated and the ±28 VDC regulated PSU outputs shall be turned off. Also the aircraft 115 volt 400 Hz power used in the IMU shall be disconnected, internally to the IMU. A maximum of 15 watts power for power Supply control and battery charging may be used in this mode. Aircraft panel lighting power, +5V, will be utilized to illuminate the CIU front panel. A discrete shall be provided that will indicate a power off condition to all associated equipment.

3.4.1.1.3 NORM Mode -The NORM position of the MODE switch shall place the selection of the alignment and navigation modes under computer control. It shall include the following sutmodes to be selected automatically: *

a. Align Submode. The equipment shall be capable of performing carrier, ground, and in-air alignment. This mode shall be initiated by placing the CIU MODE switch in the NORM position. Upon completion of the equipment coarse alignment phase, which is common to all alignment modes, the IMU accelerometer axes shall be aligned to the proper orientation by computer control. An indication shall be provided on the CIU when alignment is in progress and another indication when alignment is complete. The equipment shall be mechanized so that the aircraft may be taxied any time one minute after equipment turn-on at ambient * * *

Para 3.4.1.1.3a
(cont)

temperatures above 0°F, and two minutes after *
system turn-on at ambient temperatures between
0°F and 65°F. In the event that taxi maneuvers
are executed during alignment, the allowable re-
action time, as specified in 3.3.11, shall be *
increased by taxi time plus 20 seconds for each
taxi interval. See figure 2. These taxi intervals *
shall be defined to be periods during which the
taxi discrete is open. Refer to 3.4.3.2b. The *
computer shall automatically select one of the
types of alignments listed below depending upon
whether the aircraft is on land, on an aircraft
carrier, or in flight. Alignment on board an
aircraft carrier shall be accomplished using SINS
reference data in accordance with AR-57.While *
on the ground, alignment shall continue until the *
aircraft moves. (refer to 3.4.3.2b.) While on a *
carrier, alignment shall continue until the air-
craft moves (Refer to 3.4.3.2b.) as long as valid *
data link information is still available.

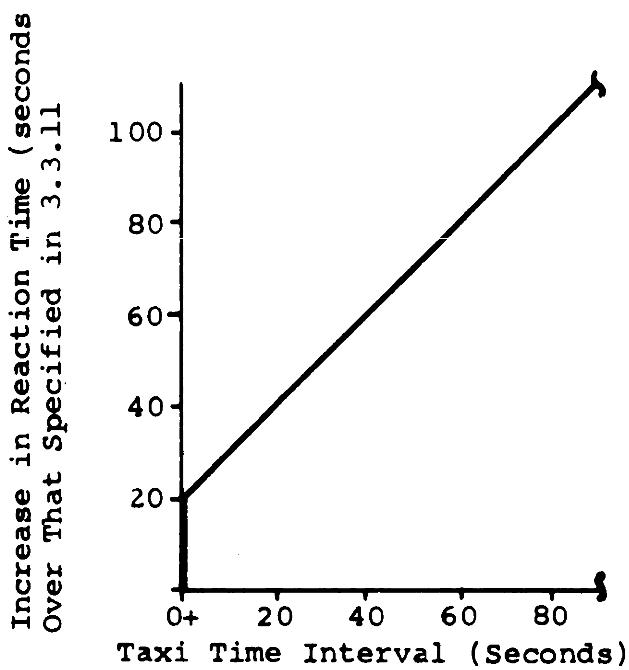


Figure 3. Effect of Aircraft Taxi on Reaction Time

Para 3.4.1.1.3a
(cont)

Carrier Alignment - This is the alignment submode for the equipment aboard an aircraft carrier. This mode shall be initiated by placing the CIU MODE switch in the NORM position while on an aircraft carrier with valid data link information available. While in this suhnode, the alignment sequence will be performed automatically. The controlling computer will receive ship's signals in accordance with AR-57. In the event that data link information is lost during alignment, the allowable reaction time, as specified in 3.3.11, shall be increased by an amount equal to the total of the lost data link intervals plus 20 seconds. Refer to figure 3. Waypoint information may be received from the data link when requested. * *

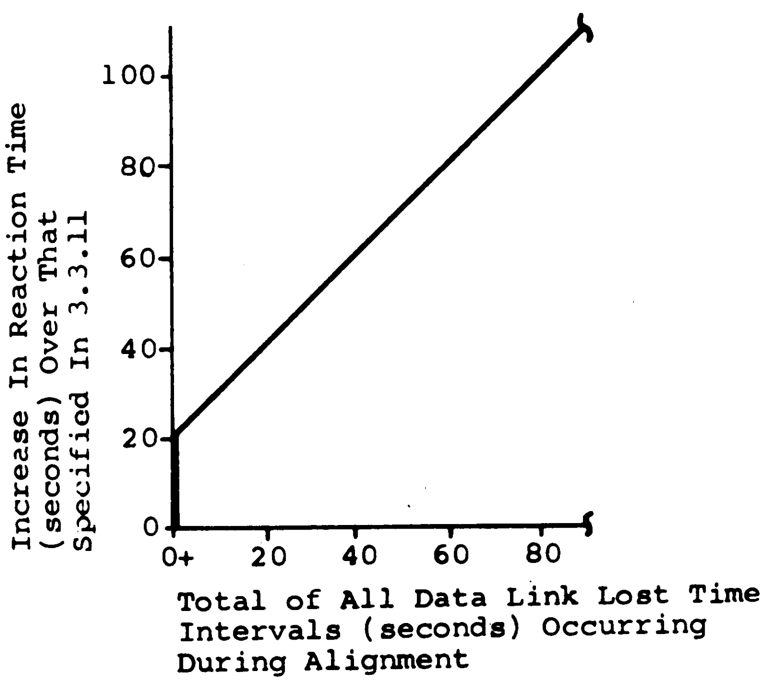


Figure 3. Effect of Data Link Loss on Reaction Time

Para 3.4.1.1.3a
(cont)

(2) Ground Alignment - This submode shall be initiated by placing the CIU MODE switch in the NORM position while on the ground. Provisions for setting latitude and longitude manually shall be provided by the CIU. *

(3) In-Air Alignment - This submode shall be initiated by placing the CIU MODE switch in the NORM position while airborne with valid doppler information available.This submode may be selected automatically by the computer * if the aircraft becomes airborne prior to the completion of ground or carrier alignment and valid doppler information is available. While performing in-air alignment, the computer shall operate in a doppler-inertial navigation mode. Refer to 3.4.1.1.3b(1). * During the early phases of in-air alignment, the doppler data will be used predominately for navigation, while later in the alignment, the inertial data will assume more importance. Loss of doppler data during alignment will cause the computer to switch automatically to free inertial navigation with resulting navigation accuracy which is a function of the phase of alignment at which doppler information was lost. In the event that doppler information is lost, the operator may manually select air data navigation and backup attitude reference by switching to MAG SLV or FREE.

b. Navigate Submode - The equipment may operate in one of four navigate submodes:doppler-inertial, inertial, droppler, or air data.The best available mode of navigation will be selected automatically by the computer depending upon which navigation aids are aviable. This submode commences upon satisfactory completion of one of the alignment submodes if the aircraft is in flight or taxiing (Refer to 3.4.3.2b.) An indication shall be provided on the CIU denoting which navigate submode is available or is being implemented. If a doppler system is not part of the aircraft *

Para 3.4.1.1.3b
(cont)

avionics equipment, then the equipment is restricted to operating in the non-doppler modes.

(1) Droppler Inertial - This shall be the primary navigation mode when the inertial equipment is aligned and operational, and a valid dopplersignal is present. The computer shall determine the doppler validity.Droppler information, when available, shall be used to damp the inertial leveling loops; otherwise, these loops are in an undamped Schuler configuration.

(2) Intertial - In this mode the equipment shall operate under computer control as an unaided inertial set with-performance characteristics as specified in table V. This mode may be selected automatically by the computer if the CIU MODE switch is set to NORM with an operating aligned IMU and no valid doppler signals available.

TABLE V. INS PERFORMANCE AT 45° LATITUDE AND 45° TRUE HEADING

Characteristic	Requirement
Heading	3.0 arcminutes, 1ó, and 0.02°\hr, 1ó
X8 Platform Heading Resolver Linearity*	0.75 arcminutes, 1ó
Position Error Rate	0.75 nautical miles\hour, CEP
Pitch and Roll	2.5 arcminutes, 1ó
X, Y, Z Velocity	3.0 feet/second, 1ó
Alignment Time from 50°F	Minutes.elapsed time: 10 (carrier), 8 (ground), 5 (laboratory)
Alignment Time from -65°F	Minutes elapsed time: 12 (carrier), 8 (ground)

*Defined as the deviation of any one point on the heading error curve from the best straight line fit to the heading error curve.

Para 3.4.1.1.3b (cont)

(3) Droppler - This mode shall be selected automatically by the computer if the CIU MODE switch is in the NORM position, a valid doppler signal is present, and self-test determines that inertial navigation is no longer possible. *

(4) Air data - The mode shall arise in the NORM position when self-test determines that inertial navigation is no longer possible, a valid doppler signal is not available, and valid air data information exists.

c. Attitude/Heading Backup Submde - Attitude and/or heading information shall be provided in the event of an ANCU malfunction which precludes inertial navigation.

(1) Magnetic Slaved - In this mode, the IMU shall operate as an attitude and heading reference only. The IMU level shall be maintained by controlling the level gyro axes with the information from the level accelerometers. The IMU shall provide roll and pitch and platform heading reference.Magnetic heading from the aircraft shall be used, along with gyro-stabilized IMU heading, to develop a smoothed magnetic heading output within the CAU. True heading shall be derived by correcting the magnetic heading with the last computed or manually inserted magnetic variaction. The IMU azimuth gyro shall be controlled in this mode by the CAU. A maximum azimuth rate of 100 deg/hr shall be available. The CAU true and magnetic heading outputs shall be slewed to approximately the correct angles within the CAU. The IMU heading reference shall be used primarily to provide smoothing. This mode shall be entered automatically if the computer should lose the capability to provide inertial navigation at latitudes between 70 degrees south and 70 degrees north. Navigation outputs shall be provided in this mode if the computer is capable of navigation and mode control, and

Para 3.4.1.1.3c
(cont)

if valid doppler or air data information is available. If valid doppler information is available, the doppler mode of navigation shall be selected. If no valid doppler information is available, air data navigation using wind computed previously from doppler or inertial velocities shall be selected. Provisions shall be made for manually inserting wind information at this time from the CIU. Only attitude and heading information will be provided by the equipment in the event of a computer failure which inhibits navigational computer. This mode is provided only if mechanization is completed within the aircraft unique CAU for which this mode is a specific aircraft requirement. Otherwise, the equipment shall provide an attitude reference only.

Platform Free - In this mode, the IMU shall operate as a heading and attitude reference only. The IMU level shall be maintained by controlling the level gyro axis with the information from the level accelerometers. The equipment shall provide pitch, roll, and grid heading. No navigation capability is available. Inertially smoothed grid heading shall be made available from the CAU. The IMU azimuth gyro shall be controlled in this mode by the CAU. A maximum azimuth rate of 100 deg/hr shall be available. The grid heading output of the CAU may be slewed to a new reference by using the HEADING SLEW switch on the CIU to slew the CAU at a high rate rather than the IMU. The IMU heading reference shall be used primarily to provide smoothing This mode shall be entered automatically if the computer should lose the capability to provide inertial navigation at latitude above 70 degree north and 70 degrees south.This mode provided only if mechanization is completed within the aircraft unique CAU for which this mode is a specified aircraft requirement. Otherwise, the equipment shall provide an attitude reference only.

Para 3.4.1.1.3C
(cont)

(3) Emergency Magnetic - A magnetic heading synchro output shall be available which follows the ML-1 (or operational equivalent or better) remote compass transmitter input, corrected for magnetic deviation. This mode shall be entered in the event of an equipment failure not involving the magnetic heading servo hardware and its associated excitation. This mode shall be provided entirely within the aircraft unique CAU for applications where it is a specified aircraft requirement. I

3.4.1.1.4 Ins Mode - The selection of this position shall pro-
Vide a means to override doppler or doppler-aided navigation *
manually, should operational conditions warrant such action. *
This position of the CIU MODE switch shall provide all of the
automatic mode switching described for the NORM position, except
hat all modes utilizing doppler information are disallowed. *

.4.1.1.5 MAG SLV Mode - The selection of this position shall
provide a means to select the magnetic slaved attitude reference *
mode manually, should operational conditions warrant such action.
this mode will take the IMU out of ANCU control of the gyros and
Place it in the magnetic slaved attitude reference mode. This *
mode shall operate as described in 3.4.1.1.3c(1).

.4.1.1.6 Free Mode - The selection of this position shall pro-
ide a means to select the platform free attitude reference mode *
anually, should operational conditions warrant such action. This *
ode will take the IMU out of ANCU control of the gyros and place
t in the platform free attitude reference mode. This mode shall
perate as described in 3.4.1.1.3c(2). *

.4.1.1.7 EM MAG Mode. - The selection of this position shall
rovide a means to select the emergency magnetic heading refer- *
should operational conditions warrant such *
This mode will select the flux valve followup mode of
peration which is described in 3.4.1.1.3c(3). *

.4.1.2 In-Flight Performace Monitoring - In-Flight Performance
onitoring (IFPM) is performed in all modes except OFF, unless
inhibited by malfunction. When the computer is operational,
iagnostic tests shall be performed which will exercise the
computer controlled portions of the IMU,ANCU, CAU, and CIU to

Para 3.4.1.2 (cont)

establish whether or not they are functioning properly. These tests along with the monitoring circuits, the malfunction flags, and the special tests performed only in the BIT mode shall provide a 90 percent probability of isolating a failure to the WRA level. In addition, built-in test equipment shall be provided which tests equipment voltages and those portions of the equipment which are used in the backup modes selected when the ANCU is inoperative.

3.4.1.3 Aircraft Power Failure - Navigation performance shall not be degraded by voltage transients or total power drop out of duration up to, but not exceeding, 10 seconds in flight and five seconds on the ground, except for functions which depend upon 26 VAC supplied by the aircraft (i.e., synchro and converter excitation). A battery will be used for this purpose, and it shall be part of the Power Supply Unit. The equipment shall be *
designed to accommodate power interrupts which, in cumulative total, equal 10 seconds of time in any two hours of equipment operation. Refer to 3.5.3.4. *

3.4.2 Equipment Accuracy

3.4.2.1 Inertial Navigation Set Accuracy - The INS shall operate for up to six hours mission time, within the performance limits specified in table V, for the alignment times and conditions specified in 3.3.11. Refer to 3.4.1.1.3a(1) and 3.4.1.1.3a(2). The specified align periods assume the availability of continuous power during the initial warm-up phase and the availability, during carrier alignment, of alignment reference data as specified by AR-57. This performance may be achieved by means of thermal modeling of inertial set errors, rapid warm-up of the inertial set, or any combination of methods that provides the required performance. For alignment and navigation accuracies in modes other than unaided free inertial, refer to appropriate AR documents; (e.g., AR-65 for E-2C).

3.4.2.2 Attitude Reference Mode Accuracy - In this backup mode, the components within the IMU shall contribute a level reference error of no greater than 7 minutes (one sigma). The additional level error due to aircraft dynamics and earth rate may be calculated from the curve shown in figure 4. The components within *
the IMU shall contribute an uncompensated heading drift error of no greater than 0.5 degrees/hour (one sigma). The sine latitude/ magnetic slaved heading error input, when provided by the CAU as as described in 3.4.1.1.3c(1) and (2), has a scale factor

Para 3.4.2.2 (cont)

accuracy, of 1 percent (1 sigma). This analog input may be used, within the scale factor accuracy, to compensate for the uncompensated heading drift error. For accuracies of back-up modes, refer to appropriate AR documents (e.g. , for E2C, refer to AR-65). * *

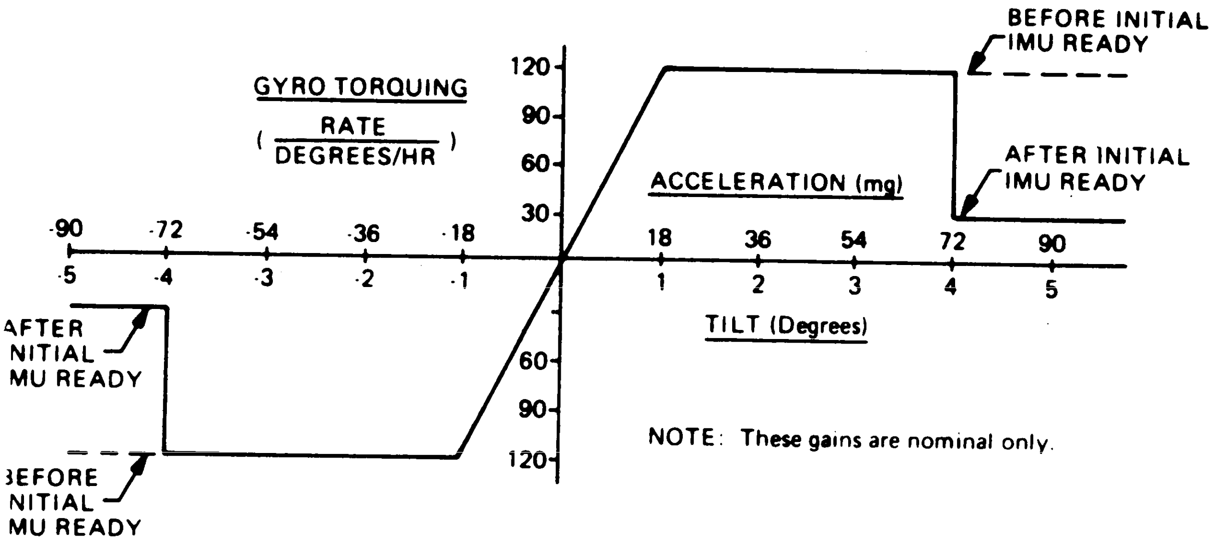


Figure 4. IMU Attitude Reference Gain

3.4.3 Equipment External Interface

3.4.3.1 CAU/External - Refer to Appendix I

3.4.3.2 ANCU/External

a. Data Link Interface - The ANCU shall be capable of accepting information from either the AN/ASW-25 (MIL-D-81124) or the AN/ASW-27 (MIL-D-81170) in accordance with WR-28.

(1) The message format shall be as defined by AR-57.

Para 3.4.3.2a
(cont)

(2) The ANCU shall output a "Data Link Discrete" to the aircraft. When this discrete is true (+28 VDC), the ANCU shall accept align data from the data link receiver. When the Data Link Discrete is false, the ANCU shall accept waypoint data from the data link receiver.

True = +28 VDC ±5% at 150 ma max
False = open circuit (nominally >100K ohms)

(3) The ANCU shall accept information from the AN/Asw-25 over 43 lines, consisting of 42 parallel data lines (format in accordance with documents specified in (1) above) and one data ready line. The data ready line' becomes a binary O for 200 ±10 μs while the data on the data lines are changing, and is a binary 1 at other times. The data change each 16 ms nominally. Binary 1 and binary O are defined as follows: *

*
*

Binary O = open circuit: nominally 56 μa max at 28 VDC *

Binary 1 = ground: nominally +1V max at 10 ma max *

(4) The ANCU shall accept information from the AN/ASW-27 over 2 lines, the serial data line, and the data ready line, and shall provide a clock to the ASW-27 over the clock line. Each 16 ms (nominally), the data ready line shall become a binary O for 200 μs. Otherwise it is a binary 1. Within 1.0 ms, the ANCU must clock in the 42 bits of data from the AN/ASW-27 at a maximum rate of 1.0 MHz. The clocking is accomplished on the transition from a binary O to a binary 1. The clock pulse width shall be greater than 400 nsec. Binary 1 and binary O on the serial data line and the data ready line from the ASW-27 are defined as follows: *

*

Binary 0 = open circuit: nominally 56 μa max at 28 VDC *

Para 3.4.3.2a
(cont)

Binary 1 = ground: nominally +1 VDC max at 100 ma max *

Binary 1 and O on the clock line to the AN/ASW-27 are defined as follows:

Binary 0 = open circuit: nominally 1000 to ∞ ohms at +12 to +28 VDC *

Binary 1 = ground: nominally +1 VDC max at 10 ma max *

b. Taxi Discrete - This taxi discrete will be supplied to the ANCU from the aircraft as an indication to the computer that the aircraft is moving relative to the ground or the aircraft carrier deck.

The two wire input shall be a short circuit for aircraft not moving and open otherwise. The ANCU input circuit shall be a Type B receiver.

c. Weight on Wheels Discrete - This discrete shall be supplied as an indication to the computer that the aircraft is not airborne. The two wire signal shall be a short circuit for weight on wheels and an open circuit otherwise. One of these wires shall be grounded in the ANCU and the other shall provide the signal input to a type B receiver. In addition, the signal wire shall be routed through the ANCU to the Psu The two-wire signal shall be a short circuit for the weight on wheels condition, regardless of the presence or absence of aircraft power, and an open circuit otherwise. * *

3.4.3.3 IMU/External - The IMU shall output two signals which hay be used to operate an external air valve to control flow of cooling air through the IMU heat exchanger. Refer to 3.5.1.8.4 he signals shall be transmitted over two lines; an open circuit will be provided to indicate a closed valve is required. The valve open signal is 115 VAC, 400 Hz half-wave rectified, positive d-c at 250 milliamps maximum. * *

The 250-milliapere load may be either resistive or inductive; if nductive, the switching transient must be suppressed. nverse rating on the rectified output is 400 volts peak. The *

3.4.3.4 Aircraft Electrical Power - The equipment shall utilize aircraft electrical power as stated in 3.3.12.

3.4.3.5 CIU Entry/Display - Refer to 3.5.5.4.

3.4.4 Equipment Internal Interface - The CAINS interface of signals between the units is presented in figure,5. Table VI. (receiver) and VII (driver) describe interface circuit types A through E referenced in the following paragraphs.

3.4.4.1 IMU/ANCU Interface - Digitally, the IMU shall supply incremental velocity and clock pulses to the ANCU, along with status discretes and calibration data. Accoordingly, the ANCU shall perform the required platfom management by supplying binary gyro torquing pulses and control discretes to the IMU. Transfer of all digital data between the IMU and the ANCU shall be controlled by the computer program. The IIMU and the ANSU SHALL pitch and roll in synchro form and heading in resolver form to the ANCU. In addition, the IMU shall be mechanized to output *
temperature monitor signals in d-c form.

a. Platform Discrete Outputs (IMU to ANCU) - The IMU shall provide five discrete outputs to the ANCU which denote the operational status of the platform. In addition, two programmable spare Type B receivers *
in the ANCU may be utilized if necessary.

(1) Accelerometer Coarse Heater On - This discrete output from the IMU to the ANCU shall go to the true (high, open, or IMU power off) state to indicate that the accelerometer coarse heater is on. The line driver in the IMU and the line receiver in the ANCU shall be Type B circuits.

(2) Gyro Coarse Heater On - This discrete output from the IMU to the ANCU shall go to the true (high, open, or IMU power off) state to indicate that the gyro coarse heater is on. The line driver in the IMU and the line receiver in the ANCU shall be Type B circuits.

(3) Gyro Float Temperature - This discrete output from the IMU to the ANCU shall go to the true (high, open, or IMU power off) state to indicate that the gyro float is up to operating temperature. The line driver in the IMU and the line receiver in the ANCU shall be Type B circuits.

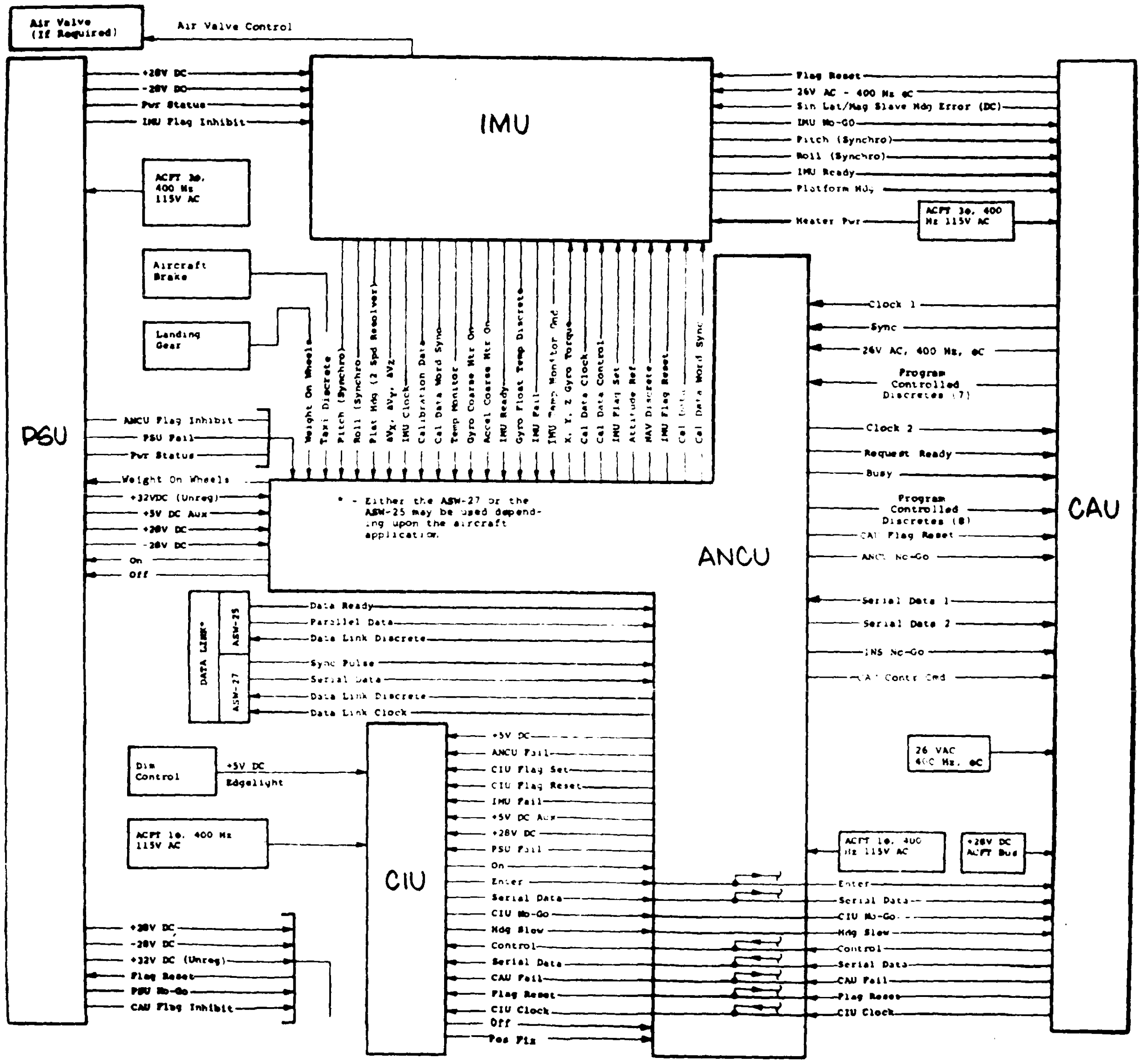


Figure 5. Interface Block Diagram

Figure VI. INTERFACE CIRCUIT TYPES (RECEIVERS)

Receiver Input Characteristics	Differential Inputs			Common Mode Input		V_{High}	V_{Low}	Input Current (ma)	Input Impedance (Ohms) *
	Voltage (Volts)	Capacitance (Pf)	Impedance (Ohms)	Maximum Voltage (Volts)	Impedance (Ohms)				
Type A (Medium Speed Complementary Signals	≤±0.5	≤30	125 ±40%	>±14	≥1.25K	Not applicable	Not applicable	Not specified	Not applicable
Type AA	≤±0.5	≤100	125 ±40%	N/A	N/A	N/A	N/A	≤2 at 4.5V ≤2 at 0V	N/A
Type B (+15 volt Discrete Signals)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	9.5V ≤ V_{high} ≤20V (Inputs shall reach +15V ±5% for driver in high state)	0V ≤ V_{Low} ≤ 6.5V	≤-5.5 at 0V *	3.9K ±20%
Type C (+15V High Drive Discrete Signals)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	6.5V ≤ V_{High} ≤20V	0V ≤ V_{Low} ≤ 4V **	At 0V ≤ -1 ma: At 13.5V ≤3.75 ma *	With power off: ≥2.75K
Type D (High Speed Complementary Signals)	≤±0.2	≤30	77 ±5%	>±5	>300	Not applicable	Not applicable	Not specified	Not applicable
Type E (+28 Volt Discrete Signals)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Threshold Voltage Range: +4V to +20V †		At 0V ≤-5 ma *	Not specified

*Current convention is negative out, positive in.

**Output should indicate a low input if input is left open.

†Must operate satisfactorily with type E driver. Only one receiver may be used for each driver. The receiver may clamp a driver to any voltage in the threshold range when the driver is in the high state.

TABLE VII. INTERFACE CIRCUIT TYPES (DRIVERS)

Driver Output Characteristics	V_{Diff}	V_{High}	V_{Low}	Rise and Fall Time	Output Impedance (V_{High})	Differential Delay
Type A (Medium Speed Complementary Signals)	$\geq \pm 1.4V$ at 100 Ohms differential load impedance	$4.5V > V_{High} > 1.8V$ at 0 to -14 ma	$0V < V_{Low} < 0.4V$ at 0 to 16 ma	≤ 30 nsec	Not specified	≤ 30 nsec
Type AA	$\geq 1.4V$	1.8 to 4.5 at 0 to -2 ma	0 to 0.4V at 0 to 2 ma	≤ 1.2 μsec	Not specified	Not specified
Type B (+15 Volt Discrete Signals)	Not applicable	Up to 20V (High state voltage is determined by receiver)	$0V < V_{Low} < 1.8V$ at 0 to 5.5 ma	≤ 20 μsec	High or Off: >100K	Not applicable
Type C (+15V High Drive Discrete Signals)	Not applicable	$13.5V \leq V_{High} \leq 16.5V$ at 0 to -15 ma	$0V \leq V_{Low} < 0.4V$ at 0 to 15 ma	≤ 20 μsec	Not specified	Not applicable
Type D (High Speed Complementary Signals)	$\geq \pm 1.4V$ at 100 Ohms differential load impedance	$4.5V > V_{High} > 1.8V$ at 0 to -14 ma	$0V < V_{Low} < 0.4V$ at 0 to 16 ma	≤ 30 nsec	Not specified	12 ±7 nsec
Type E (+28 Volt Discrete Signals)	Not applicable	Determined by receiver	$0V < V_{Low} < 2V$ at 0 to 5 ma	<20 μsec	7.5K ±20% to +28V DC ±5%	Not applicable

Para 3.4.4.1a
(cont)

(4) IMU Ready - This discrete output from the IMU to the ANCU shall go to the false (high, open, or IMU power off) state to indicate that the IMU is not ready to accept computer control or the IMU is not level in the attitude reference MODE. The true state of this discrete shall be used to indicate that the platform is ready to accept computer control or the platform is level when in the attitude reference mode. while in the attitude reference mode, the IMU shall maintain analog control of the gyros even after the IMU Ready discrete goes true. This discrete shall go true, when indicating that the computer should accept control, at 41 ±2 seconds from ambient temperatures above -10°F. This time may be extended linearly to 96 seconds at -65°F. The line driver in the IMU and the line receiver in the ANCU shall be Type B circuits.

(5) IMU Fail - This discrete output from the IMU to the ANCU shall go to the true (low, open, or IMU power off) state to indicate that the IMU malfunction flag has been set to the no-go state. This occurs whenever the IMU hardware BIT circuitry detects an IMU malfunction or when the ANCU detects an IMU malfunction. The signal shall be sent to the ANCU software and also routed through the ANCU to the CIU to illuminate the IMU malfunction indicator when in the true state. When the IMU is in a go state, the IMU fail discrete shall supply a high output. The line driver in the IMU and the line receivers in the CIU and ANCU shall be Type C circuits. *

b. ANCU Discrete Outputs (ANCU to IMU) - The ANCU shall provide four discrete outputs to the IMU. In addition, two programmable spare Type B drivers in the ANCU may be utilized if necessary. * *

Para 3.4.4.1b
(cont)

(1) Navigate - The true (high,open, or ANCU power off) state of this discrete shall be supplied from the ANCU to the IMU during the navigate mode of operation (as opposed to the align mode of operation) This discrete in its false state shall cause the quantizer scale factor to change to 0.004 feet/second/pulse on the IMU X and Y level velocity outputs.The discrete in its true state shall cause the quantizer X and Y level velocity output scale factor to change to 0.032 feet/second/pulse. The z axis velocity scale factor shall remain at 0.032 feet/second/pulse at all times.This scale factor change provides the capability of better velocity resolution during alignment.The line driver in the ANCU and the line receiver in the IMU shall be Type B circuits. * * *

(2) Attitude Reference Mode - This discrete output from the ANCU shall be supplied to the IMU in a true, high, open, or ANCU power off) state to cause the IMU to switch into the attitude reference mode of operation. The true state shall be supplied when: the MAG SLV or the FREE attitude reference mode is selected while under computer mode control, the ANCU built-in-test detects a malfunction which prevents proper inertial navigation, or when the ANCU power is shut down. When the IMU receives the true state of this discrete, computer control of the gyros shall be discontinued and analog leveling signals shall be supplied to the level gyros. The input to the azimuth gyro shall be supplied from the CAU and shall be either the magnetic slaved heading error signal in the MAG SLV mode or earth rate in the FREE mode. The line driver in the ANCU and the line receiver in the IMU shall be Type B circuits.

(3) IMU Flag Set - The true (low, open, or ANCU power off) state of this discrete shall be supplied from the ANCU to the IMU to set the IMU malfunction flag to the failed state (white).

Para 3.4.4.lb
(cont)

This signal shall be a minimum of 20 milliseconds in duration. The line driver in the ANCU and the line receiver in the IMU shall be Type C circuits.

(4) IMU Flag Reset - The true (low, open, or ANCU power off) state of this discrete shall be supplied from the ANCU to the IMU to reset the IMU malfunction flag to the go state (black). Also, this discrete shall prevent the IMU Flag Set signal from setting the IMU flag. This signal shall be a minimum of 20 milliseconds in duration. The line driver in the ANCU and the line receiver in the IMU shall be Type C circuits.

c. IMU Clock - This 9.6-KHz clock output from the IMU to the ANCU shall serve two functions. It shall be used by the ANCU for gating the incremental velocity pulses into the velocity input registers.In addition, it shall be used in the ANCU to develop the synchronous gyro torquing pulses. This clock is therefore, synchronous with both the incremental velocity pulses and the gyro torquing pulse. See figure 6 for timing diagram. The line driver in the IMU and the line receiver in the ANCU shall be Type A circuits. The IMU line driver shall also be capable of operation with the Type AA receiver defined in table VI.

d. Velocity Pulses - The IMU shall provide increments of inertially derived velocity to the ANCU. See figure 7 for definition of the coordinate system. See figure 6 for interface timing.

+Delta v_x - The output from the IMU to the ANCU shall be an incremental pulse train with each pulse representing an increment of inertially derived velocity. When the Navigate discrete is true, each pulse shall represent 0.032 feet/second. When the Navigate discrete is false, each pulse shall represent 0.004 feet/second. In either mode, the pulses shall be developed in sync with the IMU 9.6-KHz clock

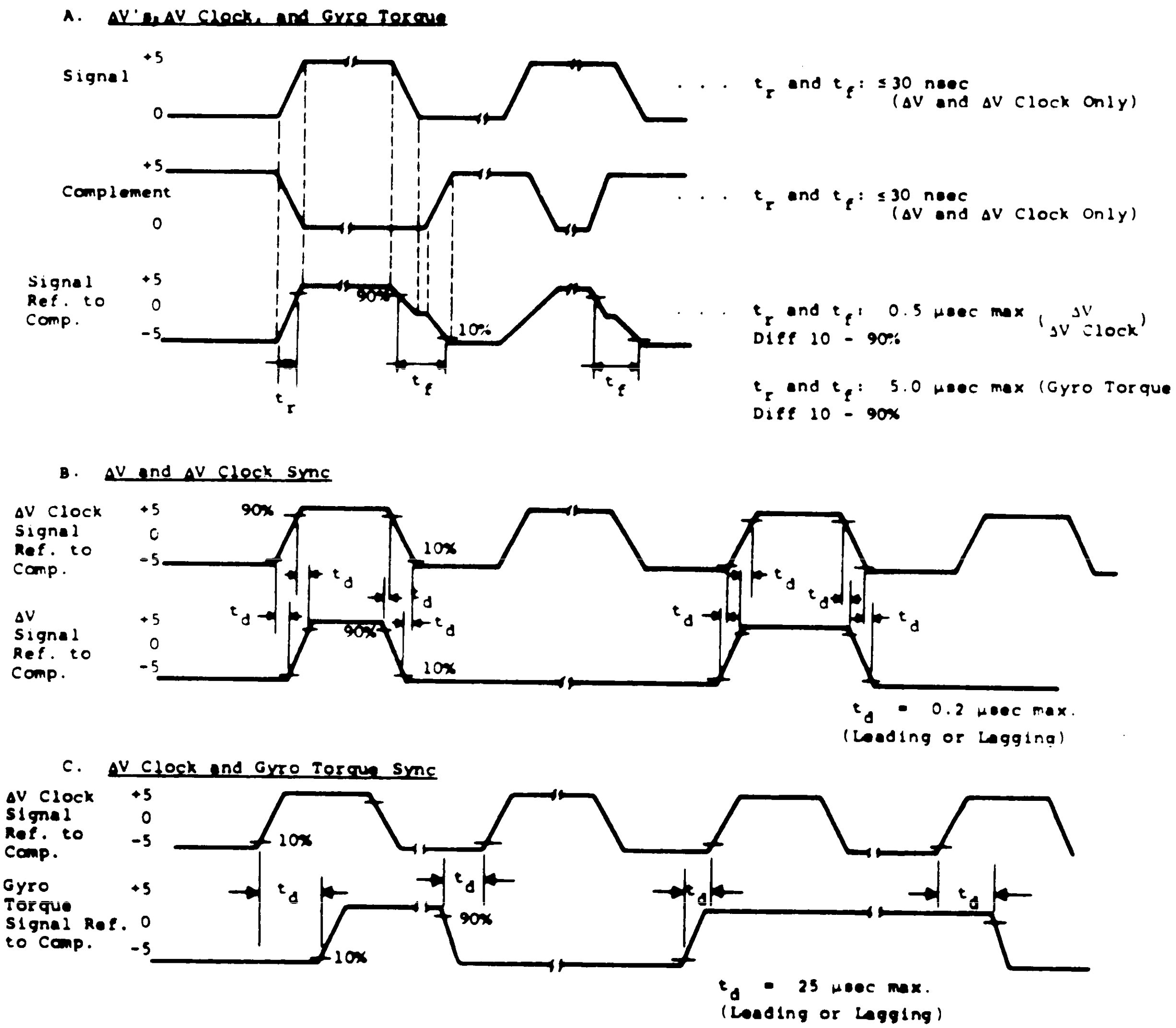


Figure 6. ANCU/IMU Interface Timing Diagram

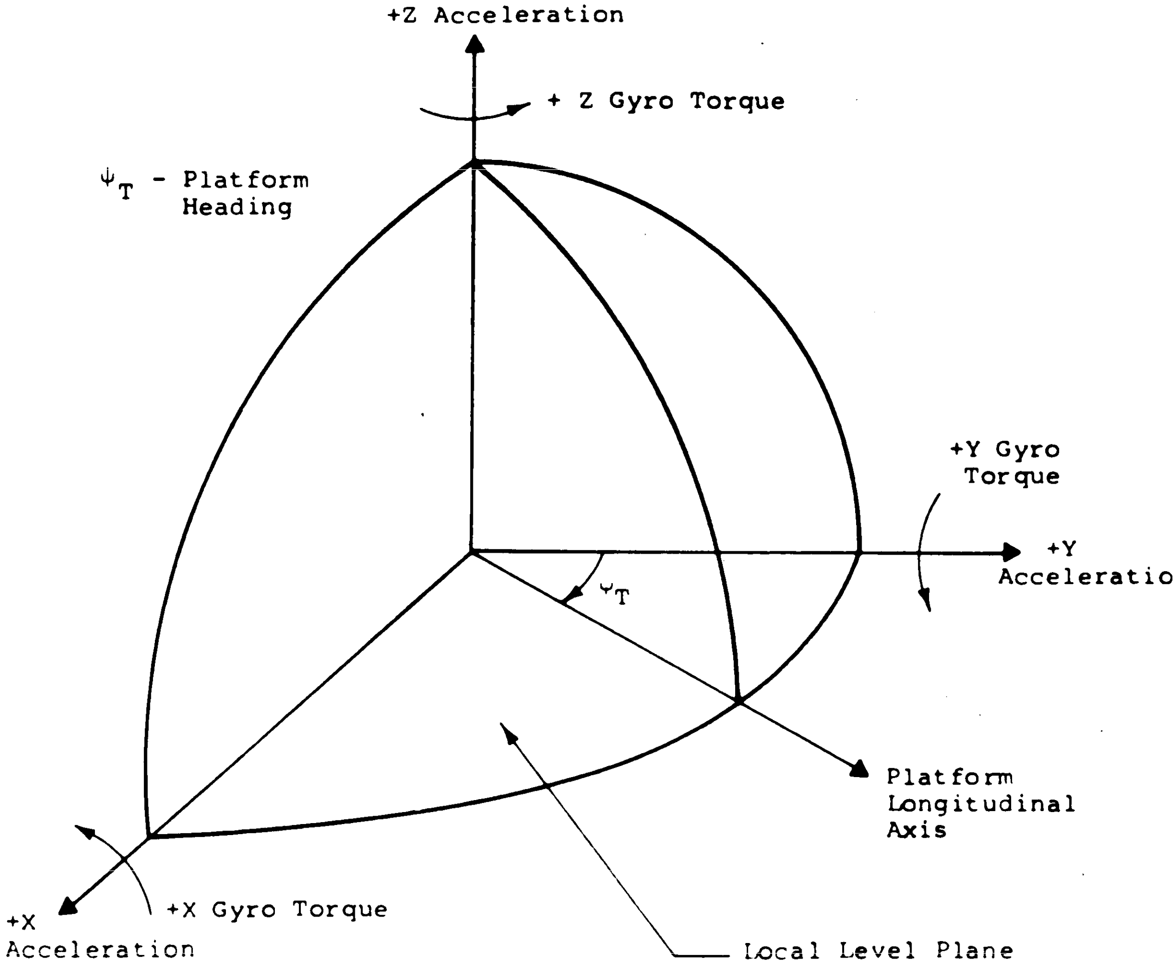


Figure 7. Navigation Coordinate System

Para 3.4.4.1d
(cont)

and, therefore, have a maximum repetition rate of 9.6 KHz. This will allow a maximum acceleration level in Navigate of 307.2 feet/second². The pulse width shall be 1/19.2 msec. A pulse present shall be represented by a high state into the line receiver. This output from the IMU shall provide the ANCU with velocity pulses representing acceleration along the positive X-axis. The line driver in the IMU and the line receiver in the ANCU shall be Type A

Para 3.4.4.1d
(cont)

circuits. The IMU line driver shall also be capable of operation with the Type AA receiver defined in table VI.

(2) - <u>Delta V_x</u> - This output from the IMU to the shall be identical in characteristics to + Delta V_x output, except that pulses on this output represent an acceleration along the negative X-axis. *

(3) <u>+ Delta V_Y</u> - This output from the IMU to the ANCU shall be identical in characteristics to the + Delta V_x output, except that pulses on on this output represent an acceleration along the positive Y-axis. *

(4) - Delta V_Y - This output from the IMU to the shall be identical in characteristics to the + Delta V_x output, except that pulses on this output represent an acceleration along the negative Y-axis. *

(5) + Delta V_z - This output from the IMU to the ANCU shall be identical in characteristics to the + Delta V_x output, except that pulses in this output represent an acceleration along the positive Z-axis. Also, the scale factor shall be always 0.032 feet/second/pulse and be unaffected by the Navigate discrete. *

(6) - Delta V_Y - This output from the IMU to the shall be identical in characteristics to the + Delta V_z output, except that pulses on this output represent an acceleration along the negative Z-axis. *

e. <u>Torquing Pulses</u> - The ANCU shall maintain the platform locally level by supplying appropriate torquing pulses to the IMU. See figure 7 for the definition of the coordinate system. See figure 6 for interface timing. *

(1) <u>X-Gyro Torque</u> - This output from the ANCU to the IMU shall cause the IMU stable element to

Para 3.4.4.1e
(cont)

rotate about the X-axis. The true (high) state shall cause the stable element to rotate in a positive sense about the X-axis at a rate of 60 degrees/hour. The false (low) state shall cause the stable element to rotate in a negative sense about the X-axis at a rate of 60 degrees/hour. The resolution shall be 0.2 arcseconds. The pulse widths shall be multipies of 1/300 second. In order to generate a zero torque rate, for example, a 150-Hz square wave would be provided. The synchronous gyro torquing pulses shall be gated in the IMU with the IMU 9.6-KHz clock in order to develop a precision pulse width. Transstition from the true to the false state and the false to the true state shall be coincident with the rising edge of the IMU clock. The line driver in the ANCU and the line receiver in the IMU shall be Type A circuits. The line receiver in the IMU shall also be capable of operation with the Type AA driver defined in table VII. *
*

(2) Y-Gyro Torque - This output from the ANCU to the IMU shall cause the IMU stable element to rotate about the Y-axis. The true (high) state shall cause the stable element to rotate in a positive sense about the Y-axis. All other specification are the same as for X-Gyro Torque.

(3) Z-Gyro Torque. - This output from the ANCU to the IMU shall cause the IMU stable element to rotate about the Z-axis. The true (high) state shall cause the stable element to rotate in positive sense about the Z-axis. All other specifications are the same as for X-Gyro Torque.

f. Calibration Data Memory - The calibration data memory shall contain 512 bits which shall be used to store up to 32 words of 16 bits each (15 bits of data plus 1 bit parity).The ANCU or test equipment designed in accordance with XAS-1233, or equivalent, shall control the serial transmission of the data.

Para 3.4.4.1f
(cont)

The particular word in memory to be loaded shall be
indicated by means of six label bits attached to *
the transmitted data (see format in figure 8). Bit
1 (MSB of label) shall be loaded with a logic zero.
The ANCU or test equipment designed in accordance
with XAS-1233, or equivalent, may load data in any
sequence since the label will establish the 16 core *
locations into which the data are to be loaded.

When reading the memory data, the ANCU shall receive
sequenced data, labels 0 thru 31. The label bits *
shall be determined by an address sequencer in the
IMU memory, which is reset to zero for a maximum
of 500 msec during power turn-on. Sequencing of *
the data shall repeat after the block of 32 words
is transmitted. A parity bit shall be assigned such
that the total number of one's transmitted in bits
1 thru 22 is odd. Figure 9 presents the timing
diagram for the serial transfer of IMU calibration
data between the ANCU and IMU.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

O	M S LABEL L B S B	S	M S CALIBRATION DATA L B S B	P

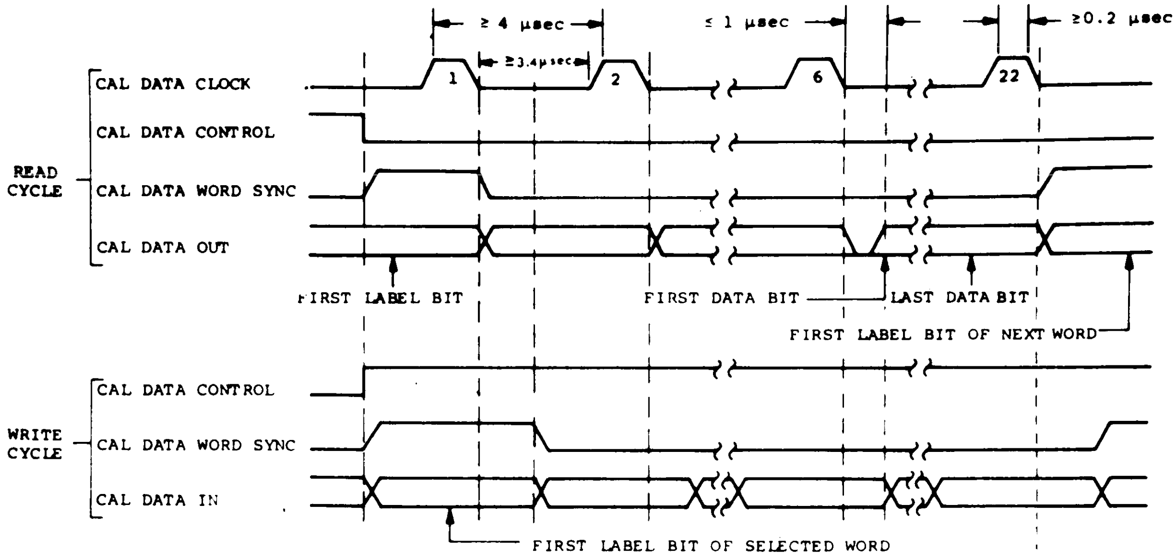
BIAS AND SCALE FACTOR CORRECTION DATA WORD FORMAT

Note: S = sign bit (O = plus)

P = parity

Figure 8. Calibration Data Word Format

(1) Calibration Data Clock - This clock input to
the IMU from the ANCU or test equipment designed
in accordance with XAS-1233, or equivalent,
shall be used for gating the calibration data *
in and out of the IMU. Any clock rate less
than or equal to 250 KHz may be supplied to
the IMU. The pulse width of the clock shall
be greater than 200 nanoseconds. The ANCU



NOTES:
1. The DATA and SYNC lines must not change state while the clock pulse is present during the write cycle, because the IMU calibration memory uses both the leading and trailing edge of the clock.
2. The leading edge of the clock should occur after CAL DATA CONTROL is in the proper state.
3. IMU memory is internally reset and will ignore clock pulses for 500 msec maximum after power is turned on.
4. Rise and fall times shall be less than 100 nsec.
5. Maximum skew between data and sync in or between data and sync out shall be 300 nsec maximum.

Figure 9. ANCU/IMU Calibration Data Timing Diagram

Para 3.4.4.1f(1) (cont)

shall supply a 250-KHz clock with a pulse width of 500 nanoseconds. The line driver in the ANCU and the line receiver in the IMU shall be Type A circuits.

(2) Calibration Data Control - The true (low, open, or ANCU power off) state of this discrete shall be supplied to the IMU to place the IMU calibration memory in a "read" state, thus allowing calibration memory data to be transmitted from the IMU. The false state of this discrete shall be supplied to the IMU from the ANCU or test equipment designed in accordance with

Para 3.4.4.1f(2)
(cont)

XAS-1233, or equivalent, to place the IMU calibration memory in a "write" state, thus allowing calibration memory data to be transmitted to the IMU. This discrete should be grounded in the aircraft as the preferred method of preventing accidental modification of the calibration memory. However, it is acceptable for the signal line to be left open as an alternate termination method. This discrete line may be connected to the ANCU while bench testing or on test equipment designed in accordance with XAS-1233, or equivalent. When this discrete input to the IMU is not connected, the calibration memory logic shall interpret this as a true state and go into the "read" state. The line driver in the ANCU and the line receiver in the IMU shall be Type C circuits. * * * * * *

(3) Calibration Data Word Sync (From the IMU) - This sync from the IMU shall be provided to the ANCU or test equipment designed in accordance with XAS-1233, or equivalent, and shall be true (high) coincident with the data label MSB. The line driver in the IMU and the line receiver in the ANCU shall be Type A circuits. The IMU line driver shall also be capable of operation with the Type AA receiver defined in table VI.

(4) Calibration Data (From the IMU) - The gyro biases and scale factors and the accelerometer biases and scale factors shall be transmitted from the IMU memory to the ANCU or test equipment designed in accordance with XAS-1233, or equivalent, where they shall be used to compensate for these IMU characteristics. The list of calibration data functions along with the label, range, LSB, and number of data bits is shown in table VIII. The line driver in the IMU and the line receiver in the ANCU shall be Type A circuits. The IMU line driver shall also be capable of operation with the Type AA receiver defined in table VI. * * * *

Para 3.4.4.1f
(cont)

(5) Calibration Data Word Sync (To the IMU - This sync pulse shall be provided for use in loading the IMU memory from the ANCU during bench test or from test equipment designed in accordance with XAS-1233, or equivalent. The sync pulse shall be true (high) coincident with the data label MSB. While in the aircraft, this line should be set low at all times in order to guard against inadvertent IMU memory modification. The line driver in the ANCU and the line receiver in the IMU shall be Type A circuits. *

(6) Calibration Data (To the IMU) - The gyro biases and scale factors and the accelerometer biases and scale factors shall be transmitted from the ANCU or test equipment designed in accordance with XAS-1233, or equivalent, to the IMU to load the IMU memory. This data line need not be connected to the ANCU in the aircraft. It may be connected to the ANCU while bench Testing. The list of calibration data functions along with the label range, LSB, and number of data bits is shown in table VIII. The gyro and accelerometer scale factor corrections (SFC) shall be used to derive the velocity (V) or angle (θ) represented by a number of pulses (N) as described in the following equation: V OR (N)(SF)(l+SFC) where S_F is the nominal weight/pulse. Scale factor corrections shall be defined as positive when the weight per pulse is greater than the nominal. The line driver in the ANCU and the line receiver in the IMU shall be Type A circuits. * * * * * * *

g. Platform Attitude and Heading - Prior to IMU Ready, the platform attitude and heading signals may be used in the IMU with internally supplied excitation. If this is done, the IMU synchro and resolver outputs that are used internally to the IMU shall be disconnected within the IMU and are, therefore, not available at this time. IMU synchro and resolver outputs which are not used internally shall be available externally to the IMU and will be excited by the IMU with frequencies other than 400 Hz at this time. Refer to table IX. Following IMU Ready, *

TABLE VIII. CALIBRATION DATA INPUTS AND OUTPUTS

Function	Octal Label	Range *	LSB	Data Bits
X Gyro Bias	0	±4.096°/hr	0.00025°/hr	15
Y Gyro Bias	1	±4.096°/hr	0.00025°/hr	15
Z Gyro Bias	2	±4.096°/hr	0.00025°/hr	15
X Gyro Scale Factor Correction	3	±10,240 ppm	0.625 ppm	15
Y Gyro Scale Factor Correction	4	±10,240 ppm	0.625 ppm	15
Z Gyro Scale Factor Correction	5	±10,240 ppm	0.625 ppm	15
X Accelerometer Bias	6	±0.131072 fps^2	0.000003 fps^2	15
Y Accelerometer Bias	7	±0.131072 fps^2	0.000008 fps^2	15
Z Accelerometer Bias	10	±0.131072 fps^2	0.000008 fps^2	15
X Accel Scale Factor Correction	11	±10,240 ppm	0.625 ppm	15
Y Accel Scale Factor Correction	12	±10,240 ppm	0.625 ppm	15
Z Accel Scale Factor Correction	13	±10,240 ppm	0.625 ppm	15
Spare Locations	14 ↕ 37			15

*The range in the plus (+) direction only shall be restricted to one LSB less than the range given.

Para 3.4.4.1g
(cont)

these signals may still be used internally to the IMU, as well as supplied externally, although the excitation shall be externally supplied as described in 3.4.4.2c. Table IX presents the IMU synchro and resolver characteristics. Table X presents the ANCU analog/digital converter characteristics.

(1) Pitch Angle - This three-wire signal shall be supplied from a synchro in the IMU to a synchro-to-digital converter in the ANCU.

(2) Roll Angle - This three-wire signal shall be supplied from a synscro in the IMU to a synchro-to-digital converter in the ANCUC

(3) Platform Heading (x1) - This four-wire signal shall be supplied from a resolver in the IMU to a resolver-to-digital converter in the ANCU.

(4) Platform Heading (X8) -This four-wire signal shall be supplied from a resolver in the IMU to a resolver-to-digital converter in the ANCU.

h. Temperature Monitor Signals - Four temperature monitor signals shall be supplied from the IMU to the ANCU as analog voltages which represent temperatures of the two gyros, the accelerometers, and the stable element. The analog voltages shall be converted to digital signals in the ANCU and may be used as the variables in the equations which compensate for temperature effects on the IMU during alignment. Refer to table X for ANCU analog/digital converter characteristics. The temperature monitor signal output impedance shall be less than 1 ohm. *

i. IMU Temperature Monitor Ground - This ground line shall be supplied to the ANCU for use in compensating for the ground differential between the IMU and the ANCU. The ground signal is converted in an ANCU analog-to-digital converter and supplied to the software which corrects the temperature monitor inputs for the ground difference between the two units. Refer to table X for ANCU analog/digital converter characteristics. †

Table IX. IMU SYNCHRO AND RESOLVER CHARACTERISTICS

	Pitch or Roll Synchro	Platform Heading Resolver	
		Coarse (X1)	Fine (X8)
Frequency (Hz)*	400	400	400
Input Voltage (Volts) rms	26.0	26	26
Output Voltage (Volts) rms ±15% (Max)	11.8	11.8	11.8
Phase Shift Lead (Degrees) ± 25% (Max)	8.0	12.5	45.0
DC Resistance (Ohms) ±10% (Max)			
Rotor	98	575	231
Stator **	23	370	365
Impedances (Ohms) ±20%			
ZRO	528	785 +j2550	235 +j250
ZSRS	34 +j4	495 +j85	430 +j130
Maximum Null Voltage (MV)	60	25	25
Maximum Electrical Error (Arc Minutes)	5.0	5.0	1.0
Minimum Impedance to Ground	2M Ω	2M Ω	2M Ω

*Prior to IMU Ready, Platform Heading (X8) outputs and the S1 and S3 output leads of Platform Heading (Xl) shall be available external to the IMU and may be internally excited by the IMU with 4.8 KHz excitation voltage. The load impedance across the resolver outputs shall not be less than 1K ohms at that frequency. *

**All external loads shall be connected to synchro or resolver stator leads.

TABLE X. ANALOG/DIGITAL CONVERTER CHARACTERISTICS

Function	Conversion Accuracy (arcmin 1σ)	Minimum Allowable Source Impedance To Ground (Ohms)	Equivalent Input Impedance (Ohms)		Normal Input Voltage Range (Volts rms)		Maximum Allowable Overvoltage (Volts rms)		Phase Shift Relative to 26 VAC 400 Hz Reference (Leading)	Maximum Null Voltage (mv rms)
			Line-to Line	Line-to Ground	Line-to Line	Line-to Ground	Line-to Line	Line-to Ground		
Roll S/D	2.5	1.5MΩ	3.6K Delta Equiv-alent	2.4K	11.8 ±15%	6.82 ±15%	20.4	11.8	$8^{o} \pm 2.0^{o}$	60
Pitch S/D	2.5	1.5MΩ	3.6K Delta Equiv-alent	2.4K	11.8 ±15%	6.82 ±15%	20.4	11.8	$8^{o} \pm 2.0^{o}$	60
Fine Heading (X8) R/D	0.75	1.5MΩ	13.4K	6.7K	11.8 ±15%	5.9 ±15%	20.4	11.8	$45^{o} \pm 11.25^{o}$	25
Coarse Heading (X1) R/D	20	1.5MΩ	13.4K	6.7K	11.8 ±15%	5.9 ±15%	20.4	11.8	$12.5^{o} \pm 3.125^{o}$	25
Temperature Monitor 1 thru 4 DC/D	50 mv	-	-	5K	-	-10 VDC to +10 VDC	-	-15 VDC to +15 VDC	-	-
Spare DC Signals 1 thru 6 DC/D	50 mv	-	-	5K	-	-10 VDC to +10 VDC	-	-15 VDC to +15 VDC	-	-
IMU Ground DC/D	50 mv	-	-	5K	-	-2 VDC to +2 VDC	-	-15 VDC to +15 VDC	-	-

Para 3.4.4.1
(cont)

j. Spare D-C Signals - The ANCU shall accept six spare d-c signals for digital conversion. * *

3.4.4.2 IMU/CAU Interface - This interface is necessary to provide IMU input/output signals for use in the various CAU configurations which may exist in different aircraft.

a. Discretes

(1) IMU Ready - This discrete output from the IMU to the CAU goes to the false (high, open, or IMU power off) state to indicate that the IMU is not ready to accept computer control or the IMU is not level in the attitude reference mode. The true state of this discrete shall be used to indicate that the platform is ready to accept computer control or the platform is level when in the attitude reference mode. While in the attitude reference mode, the IMU shall maintain analog control of the gyros even after the IMU READY discrete goes true. This discrete shall go true, when indicating that the computer should accept control, at 41 ±2 seconds from ambient temperatures above -10°F. This time may be extended linearly to 96 seconds at -65°F. The line driver in the IMU shall be a Type B circuit.

(2) IMU No-Go - This output from the IMU shall be supplied to indicate that the IMU no-go flag has been set. When the flag is in a set (no-go) state, an open circuit shall be supplied. When the flag is in a reset (go) state, a ground shall be supplied. The contact rating of this switch shall be 250 ma resistive or 100 ma inductive at 28 volts d-c. * * * *

(3) Flag Reset - The true (high) state of this input to the IMU shall reset the IMU malfunction flag to the no-fault state. The false (low or open) state shall cause restoration of the fault indicator circuit to its normal fault monitoring condition. The false respond in this manner to true or false states

Para 3.4.4.2a(3)
(cont)

which occur for a minimm of 20 milliseconds. The line receiver in the IMU shall be a Type C circuit.

b. Platform Attitude and Heading - Table,IX presents the synchro and resolver characteristics.

(1) Pitch Angle - This three-wire signal shall be supplied from the same synchro in the IMU which supplied the pitch angle in 3.4.4.1g(1) . The load applied to this synchro output must, therefore, be consistent with the synchro output described in table IX and the converter input described in table X. * * * * *

(2) Roll Angle - This three-wire signal shall be supplied from the same synchro in the IMU which supplied the roll angle in 3.4.4.1g(2). The load applied to this synchro output must, therefore, be consistent with the synchro output described in table IX and the converter input described in table X. * * * * *

(3) Platform Heading (X1) - This four-wire signal shall be supplied from the same resolver in the IMU which supplied the heading angle in 3.4.4.1g(4). The load applied to this resolver output must, therefore, be consistent with the resolver output described in table IX and the converter input described in table X. * * * *

(4) Platform Heading (X8) - This four-wire signal shall be supplied from the same resolver in the IMU which supplied the heading angle in 3.4.4.1g(4). The load applied to this resolver output must, therefore, be consistent with the resolver output described in table IX and the converter input described in table X. * * * *

c. Synchro Excitation - Excitation shall be provided to the IMU pitch and roll synchros and the heading resolver. The excitation shall be 26 VAC, 400 Hz. Refer to 3.4.4.3.4. *

Para 3.4.4.2
(cent)

d. Sin Lat/Mag Slave Hdg Error - This input to the IMU is an analog d-c signal from the CAU which causes the stable element to torque in azimuth when the equipment is in the backup attitude reference mode (magnetic slave or free). This input shall only affect the IMU when the Attitude Reference discrete is in the true state. Earth rate times the sine of latitude should be provided in the Free mode, and magnetic slaved heading error should be provided in Magnetic Slaved mode. The receiver in the IMU shall be a differential amplifier with a differential impedance of 40K ohms (minimum). Either input to the receiver shall have an impedance to ground of no less than 20K ohms. For linear operation, the receiver shall accept a maximum of ±10 volts d-c. The input scale factor shall be 10 degrees/hour/volt ±1 percent (1 sigma). Zero volts shall be zero degrees/hour. A positive voltage shall cause the platform heading angle to increase.

3.4.4.3 ANCU/CAU Interface

3.4.4.3.1 Serial Interface - There shall be two modes of operation of this interface: Data mode and ANCU request mode. Clocking for data transmission between units in this interface shall be supplied by the CAU. This clock after being received and restored in the ANCU shall be retransmitted to the CAU to be used for clocking data received by the CAU from the ANCU. All data transmission between units shall be under control of the CAU. Negative number output from the ANCU shall be in two's complement form. The ANCU/CAU serial interface timing diagram is presented in figure 10. Figures 11 and 12 present the ANCU data mode and ANCU request mode timing diagrams, respectively.

a. Data Mode - There shall be three different operations that can occur in this mode. The first shall be transmission from CAU to ANCU of a 12-bit word causing the interface to interrupt the computer to a specified address. The second shall be transmission from the CAU to the ANCU of 40 bits consisting of a 12-bit command-address word followed by 28 bits of data. This operation shall cause the 28 bits of data to be interleaved into memory at the location specified by the address. The third

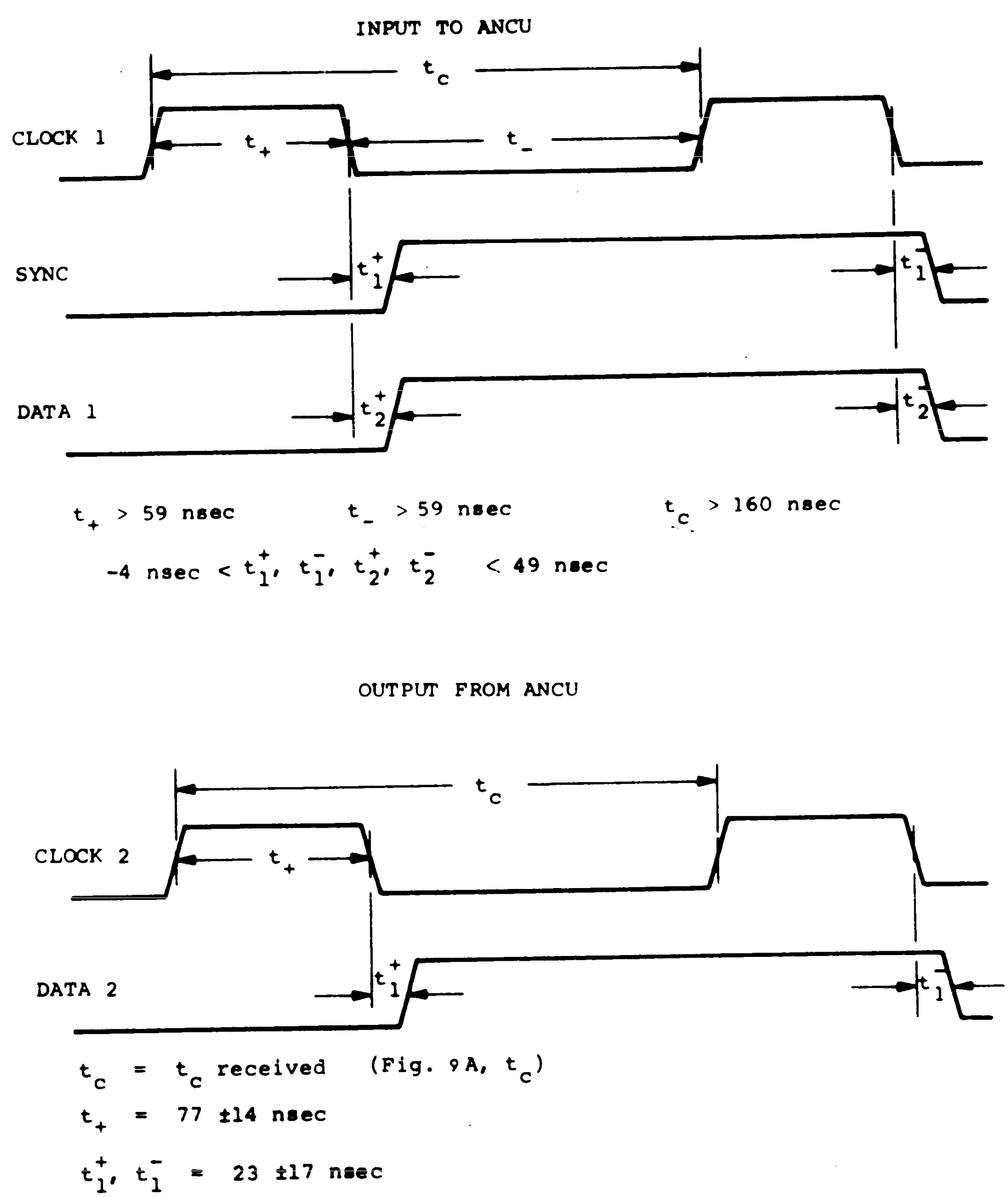
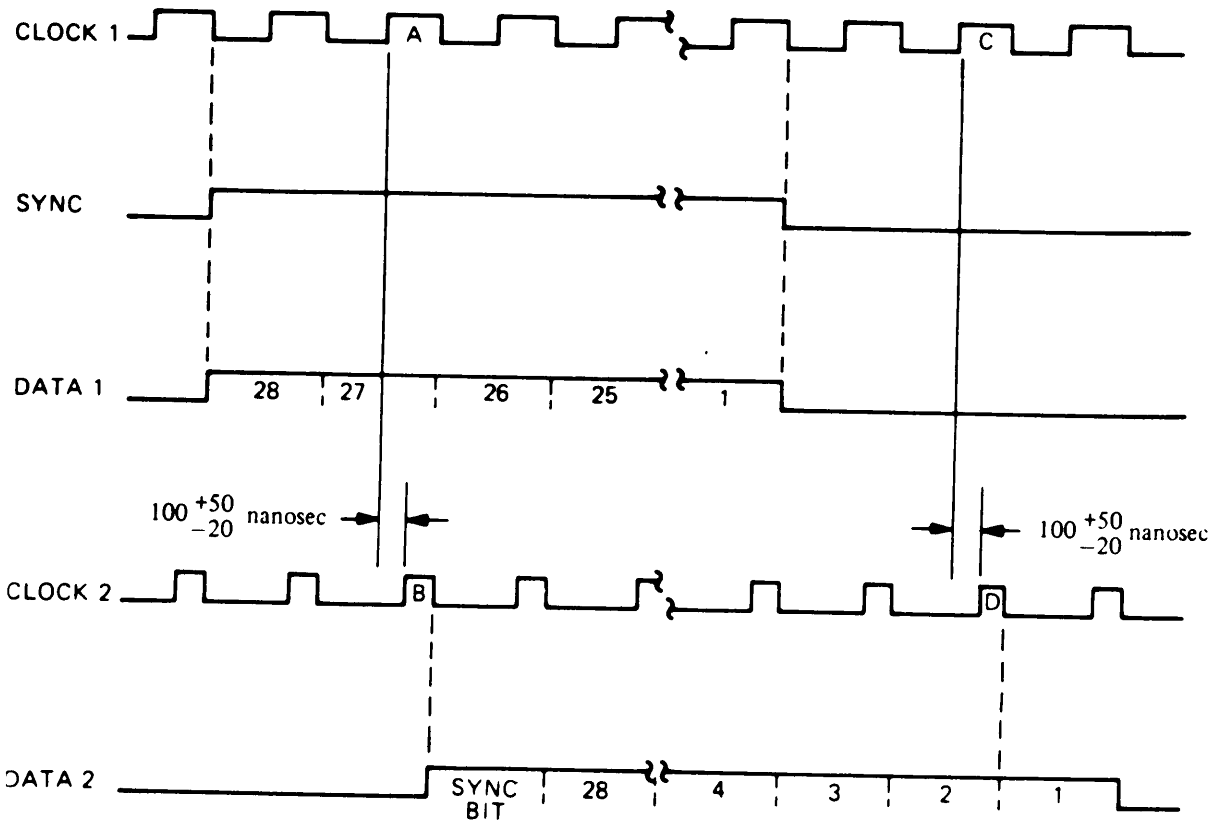


Figure 10. ANCU/CAU Interface Timing Diagram



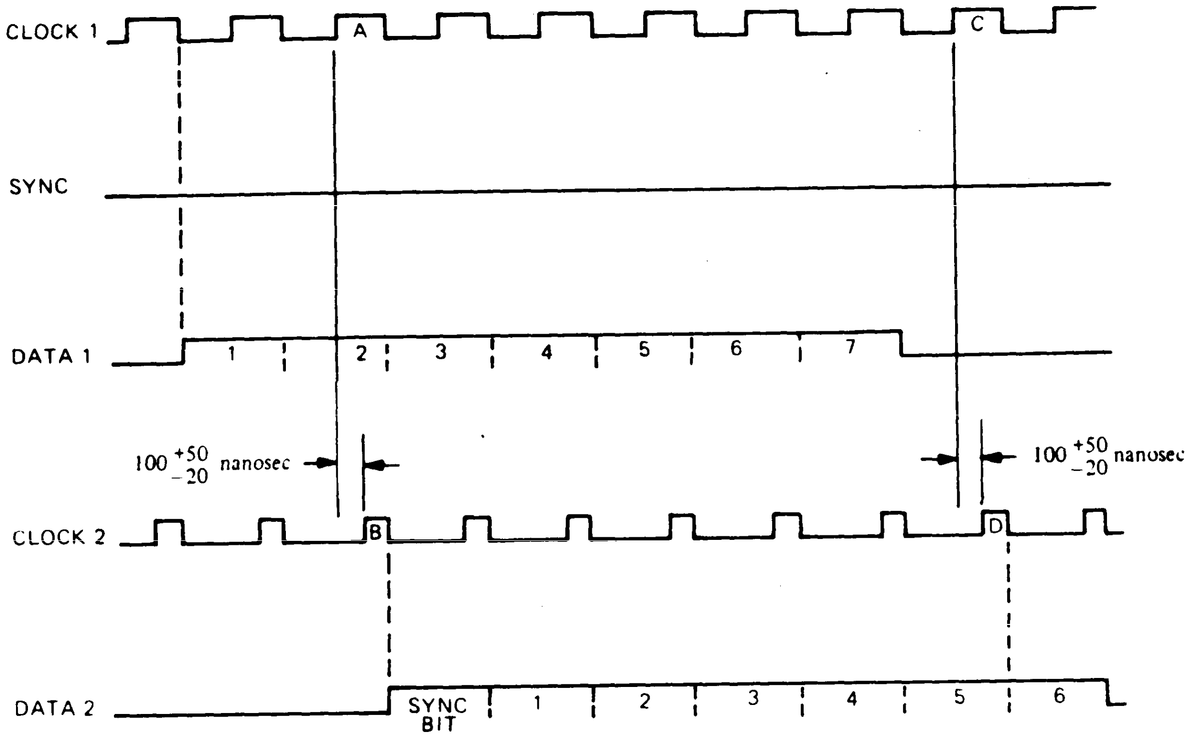
1. The sync bit is available on the trailing edge of clock pulse "B" of clock 2. The leading edge of clock pulse "B" of clock 2 lags the leading edge of clock pulse "A" of clock 1 by 100 nanoseconds +50 ns, -20 ns. Clock pulse "A" is the second clock 1 pulse after the Sync envelope goes high. The last data bit on data 2 is available on the trailing edge of clock pulse "D" of clock 2. The leading edge of clock "D" of clock 2 lags the leading edge of clock pulse "C" of clock 1 by 100 nanoseconds +50 ns, -20 ns. Clock pulse "C" is the second clock 1 pulse after the Sync envelope goes low.

2. All times are nominal.

Figure 11. ANCU Timing Diagram (Data Mode)

Para 3.4.4.3.1a (cont)

operation shall be interleave read. This operation, initiated by the CAU sending a 12-bit command-address word via Data 1 to the ANCU, shall cause the data stored in memory at the location specified by the address to be loaded into the ANCU Data Register.



1. The sync bit is available on the trailing edge of clock pulse "B" of clock 2. The leading edge of clock pulse "B" of clock 2 lags the leading edge of clock pulse "A" of clock 1 by 100 nanoseconds +50 ns, -20 ns. Clock pulse "A" is the second clock 1 pulse after the Data 1 envelope goes high. The last data bit on data 2 is available on the trailing edge of clock pulse "D" of clock 2. The leading edge of clock "D" of clock 2 lags the leading edge of clock pulse "C" of clock 1 by 100 nanoseconds plus 50 ns, minus 20 ns. Clock pulse "C" is the first clock 1 pulse after the Data 1 envelope goes low.
2. All times are nominal.

Figure 12. ANCU Timing Diagram (ANCU Request Mode)

Para 3.4.4.3.1a
(cont)

Later, a second envelope on Sync of 28 bits must be sent to the ANCU to cause these 28 bits of data to be shifted out via Data 2. These may also be done in combination. That is, on the second envelope sent to retrieve the information in the Data Register, a new command may be transmitted on Data 1 to the ANCU. * * *

Para 3.4.4.3.1a. (cont)

In the data mode, whenever the sync signal to the ANCU goes true, the ANCU shift registers shall shift. As long as a signal is present on sync, data shall shift into either the Command-Address Register or the Data Register in the ANCU. At the same time, the previous contents of the Data Register shall be transmitted on Data 2 to the CAU. During the first 12-bit times of the envelope on sync, the data (new command-address) received on Data 1 shall be shifted into the Command-Address Register. At the same time, the original data (old command-address) in the Command-Address Register shall be shifted into the Data Register as the Data Register is being shifted out on Data 2. All subsequent data within the envelope shall be shifted into the Data Register directly. *

In order to allow the CAU to know when returned data have arrived, a "1" shall precede the leading edge of the data transmitted on Data 2. At the end of the envelope received on the sync lines, the contents of the Command Register shall be analyzed in the ANCU. When the envelope on the sync lines first appears, a Busy discrete shall be sent to the CAU. This Busy signal shall remain until interleave or interrupt, if one is specified, is complete. *

The address in the command-address word from the CAU shall be nine bits in length. The least significant five bits are controlled by the CAU and the most significant four bits are controlled by the ANCU. No address information placed in the four most significant bits by the CAU will be used by the ANCU. This will allow the ANCU program to select those 32 location blocks of memory into which and from which the CAU may interleave. *

b. ANCU Request Mode - The ANCU request mode shall provide a signal to the CAU indicating that the computer has data available or that the computer is requesting data. The computer shall initiate this mode by loading the

Para 3.4.4.3.1b (cont)

Request Register with an address which tells the CAU what to do. In addition, at this time, the Request Ready discrete shall go to the true (high) state.

The CAU can then, under its own controll call for the contents of the Request Register. This is accomplished by holding Sync = 0 and transmitting a 6 or 7 bit-time envelope on Data 1. Under control of this envelope, the Request Register is shifted out on Data 2. Again a "l" shall be added to the leading edge of the data transmitted on Data 2. Upon completion of this transmission (end of the envelope consisting of Data 1 and Sync not) the Request Ready discrete shall be removed.

c. Signal Description - The ANCU/CAU timing dia- *
qrams are presented in figures 10, 11, and 12. *
Figure 13 depicts the ANCU/CAU serial data format and signal relationships.

(1) Clock 1 (CAU to ANCU) - A clock between 1 and 6 MHz may be supplied to the ANCU. The ANCU line receiver shall be a Type D circuit.

(2) Clock 2 (ANCU to CAU) - This clock shall be a retransmitted version of the clock from the CAU and shall be used for gating the serial data into the CAU. The ANCU line driver shall be a Type D circuit.

(3) Sync (CAU to ANCU) - The true state of this sync signal shall be the envelope from the CAU which shall be used for gating information into and out of the ANCU in the data mode. The ANCU line receiver shall be a Type D circuit.

(4) Data 1 - Data 1 shall be the serial data line the CAU to the ANCU. See
figure 13 for a description of the serial *
data word format. The particular information which is transmitted is a function

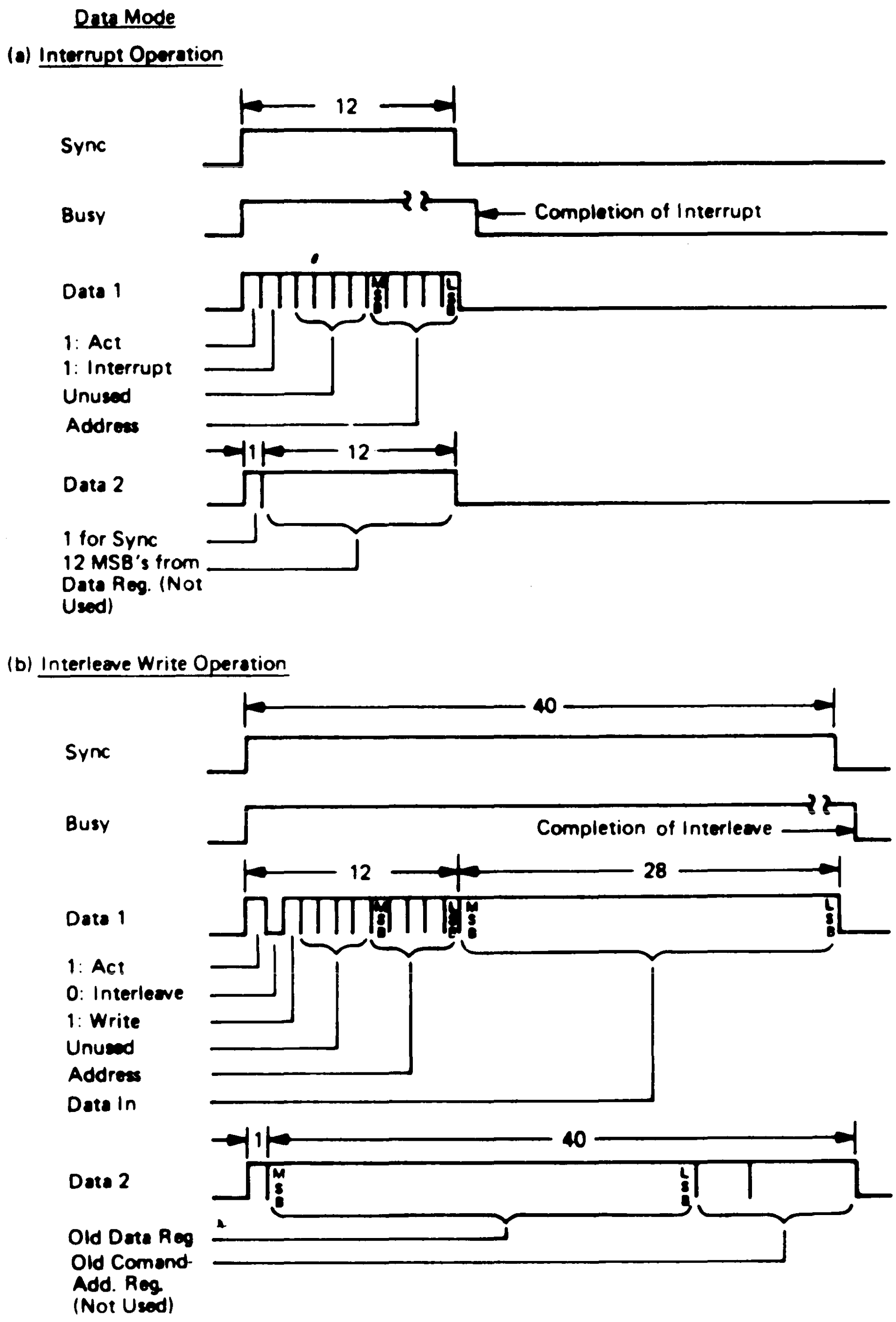


Figure 13. ANCU Serial Data Word Format (Sheet 1 of 3)

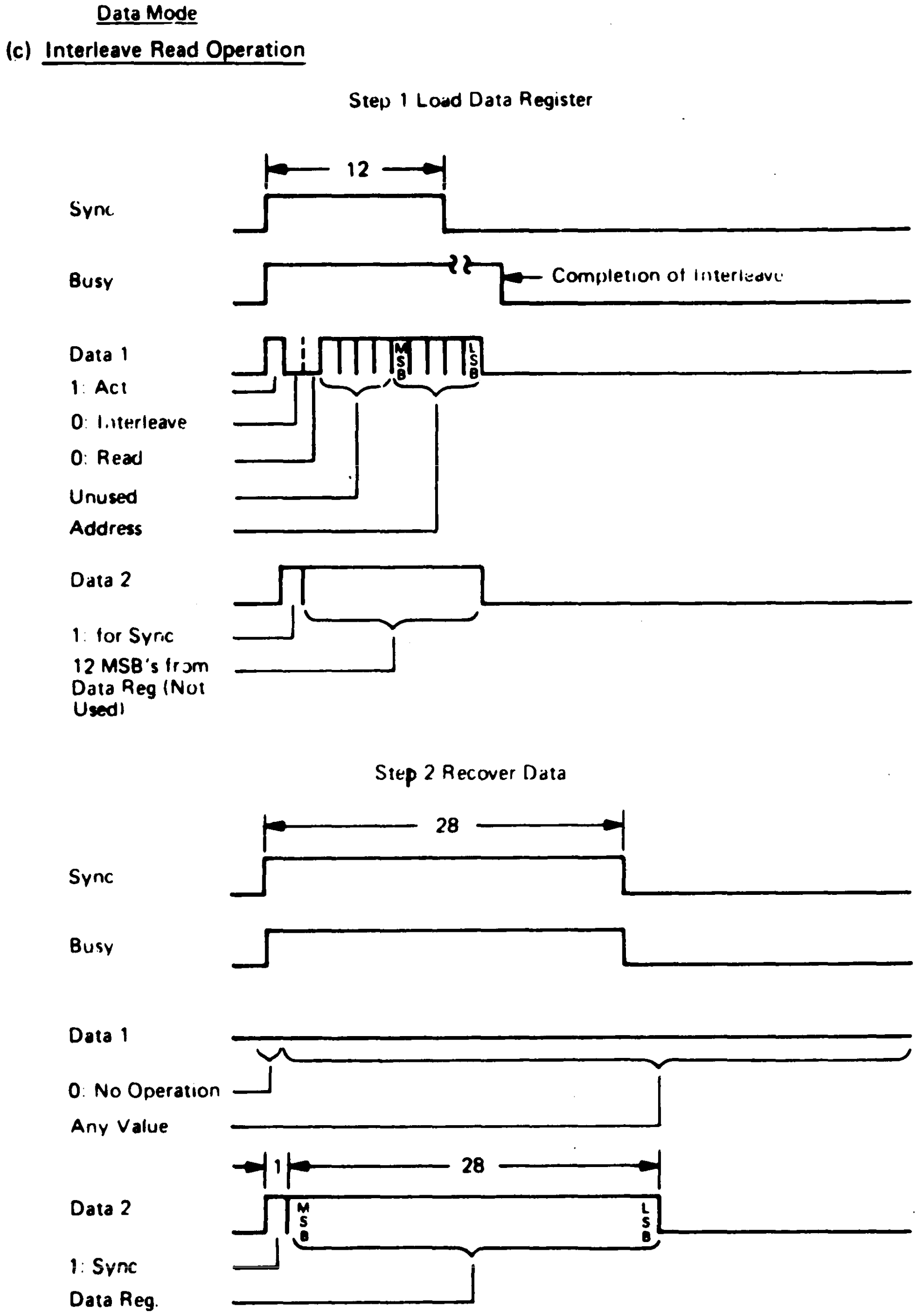


Figure 13. ANCU Serial Data Word Format (Sheet 2 of 3)

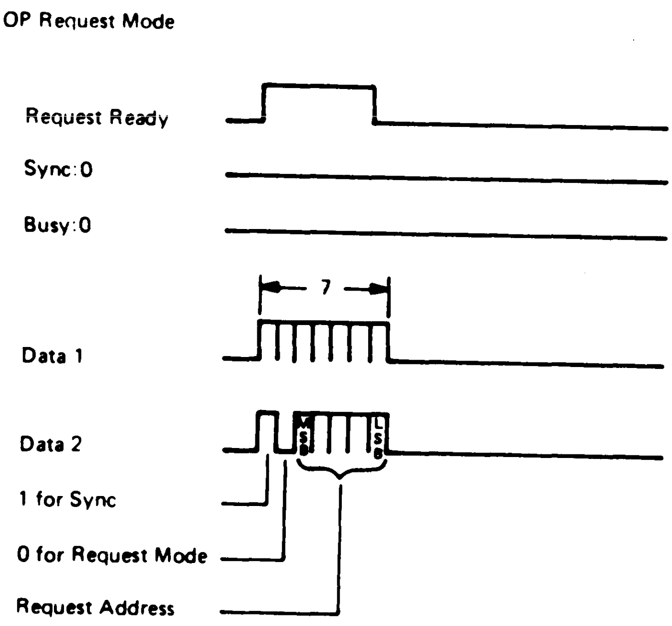


Figure 13. ANCU Serial Data Word Format (Sheet 3 of 3)

Para 3.4.4.3.1c(4)
(cont)

of the particular aircraft requirements and the program in the ANCU.

The following are examples of the type of information which may be transmitted.

(a) Doppler information

(b) Air data computer information

(c) Radar position fix information

(d) Magnetic heading

(e) Built-in-test information

The ANCU line receiver shall be a Type D circuit.

(5) Delta 2 - Data 2 shall be the serial data line from the ANCU to the CAU. See figure 13 for a description of the serial data word format. The particular information which is transmitted is a function

Para 3.4.4.3.1c(5)
(cont)

of the particular aircraft requirements and the program in the ANCU.

The following are examples of the type of information which may be transmitted: *

(a) Inertially-derived velocity *

(b) Aircraft heading *

(c) Present position latitude *

(d) Magnetic variation *

(e) CAU mode control *

(f) Built-in-test information

The ANCU line driver shall be a Type D circuit.

(6) Busy - The true state of this signal shall inform the CAU that the ANCU is busy with interleave or interrupt. The ANCU line driver shall be a Type A circuit.

(7) Request Ready - The true state of this signal shall inform the CAU that the ANCU has information ready to send or that the ANCU desires information. The ANCU line driver shall be a Type A circuit.

3.4.4.3.2 ANCU Output Discretes

a. Programmed Discretes - There shall be eight discrete outputs from the ANCU which are controlled separately from the computer progrm. Their function depends upon the particular program which is contained in the ANCU. The eight discrete outputs shall be Type B circuits.

b. CAU Control Command - This discrete from the ANCU to the CAU shall go to a true (high, open, or ANCU power off) state to indicate that the CAU should take control of the CIU and that the CAU should take control of mode determination and supply sine latitude/magnetic slave heading error torquing to the IMU azimuth gyro if the magnetic

Para 3.4.4.3.2b (cont)

slave and free backup modes are a specific aircraft requirement. The signal shall go to a true state in the event that the computer determines that it is incapable of navigation and mode determination. The ANCU line driver shall be a Type B circuit.

c. INS No-Go - This output from the ANCU to the CAU goes to a true (high, open, or ANCU power off) state to indicate that CAINS navigation information is not valid. The signal will go to a true state if the computer self-test detects that navigation information is not valid. The ANCU driver shall be a Type B circuit.

d. CAU Flag Reset - The true (low, open, or ANCU power off) state of this discrete shall be supplied from the ANCU to the CAU at any time that the ANCU self-test determines that the ANCU can no longer supply a trustworthy CAU flag set signal. This discrete, when in the true state for a minimum of 20 milliseconds, shall cause the CAU flag to go to the reset (go) state if the flag had been set by *
the CAU flag set signal. In addition, this discrete shall continue to prevent the CAU flag set signal from setting the CAU flag as long as reset *
is present. The false (high) state shall enable control of the flag from CAU flag set, but shall cause no change in state of the flag directly. The line driver in the ANCU and the line receiver in the CAU shall be Type C circuits.

e. ANCU No-Go - This output from the ANCU shall be supplied to indicate that the ANCU malfunction flag has been set. When the flag is in a set (no-go) state, a ground shall be supplied. When *
the flag is in a reset (go) state, an open cir- *
cuit shall be supplied. The contact rating of this switch shall be 250 ma resistive or 100 ma inductive at 28 volts d-c. *

3.4.4.3.3 ANCU Input Discretes

a. Programmed Discretes - There shall be seven discrete inputs to the ANCU which are transmitted directly to the computer for use by the program. The ANCU line receivers shall be Type B circuits.

b. Flag Reset - The true (high) state of this input to the ANCU shall reset the ANCU malfunction flag to the no-fault state. The false (low, open, or CAU power off) state shall respond in the fault indicator circuit to its normal fault monitoring condition. The ANCU shall respond in this manner to true or false states which occur for a minimum of 20 milliseconds. The line receiver in the ANCU shall be a Type C circuit.

c. CAU Fail - This Output from the CAU to the ANCU is also routed through the ANCU to the CIU and shall go to a true (ground or open) state to perform the following two functions: (1) cause the CAU malfunction indicator on the CIU to illuminate , and (2) notify the computer that a CAU malfunction has occurred. The line receivers in the CIU and ANCU shall be Type C circuits. *

3.4.4.3.4 Synchro Excitation - Excitation shall be provided from the CAU (if part of the system) or aircraft fot the use as areference on the ANCU A/D converters. The excitation shall be 26, VAC, 400 Hz. This reference signal must be in phase and from the same source as the excitation provided to the excitation *

3.4.4.3.5 CIU Back Up Signals - In the event that the ANCU is unable to communicate with the CIU, signals listed below shall allow the CAU to provide limited CIU control. See fig. 14 for the serial communication timing diagram. * * *

a. CIU Clock - Refer to 3.4.4.4a(1). This signal shall be received from the CAU and retransmitted by the ANCU. The line receiver in the ANCU shall be a Type A circuit. *

b. Control - Refer to 3.4.4.4a(2). This signal shall be received from the CAU and retransmitted by the ANCU. The line receiver in the ANCU shall be a Type A circuit. *

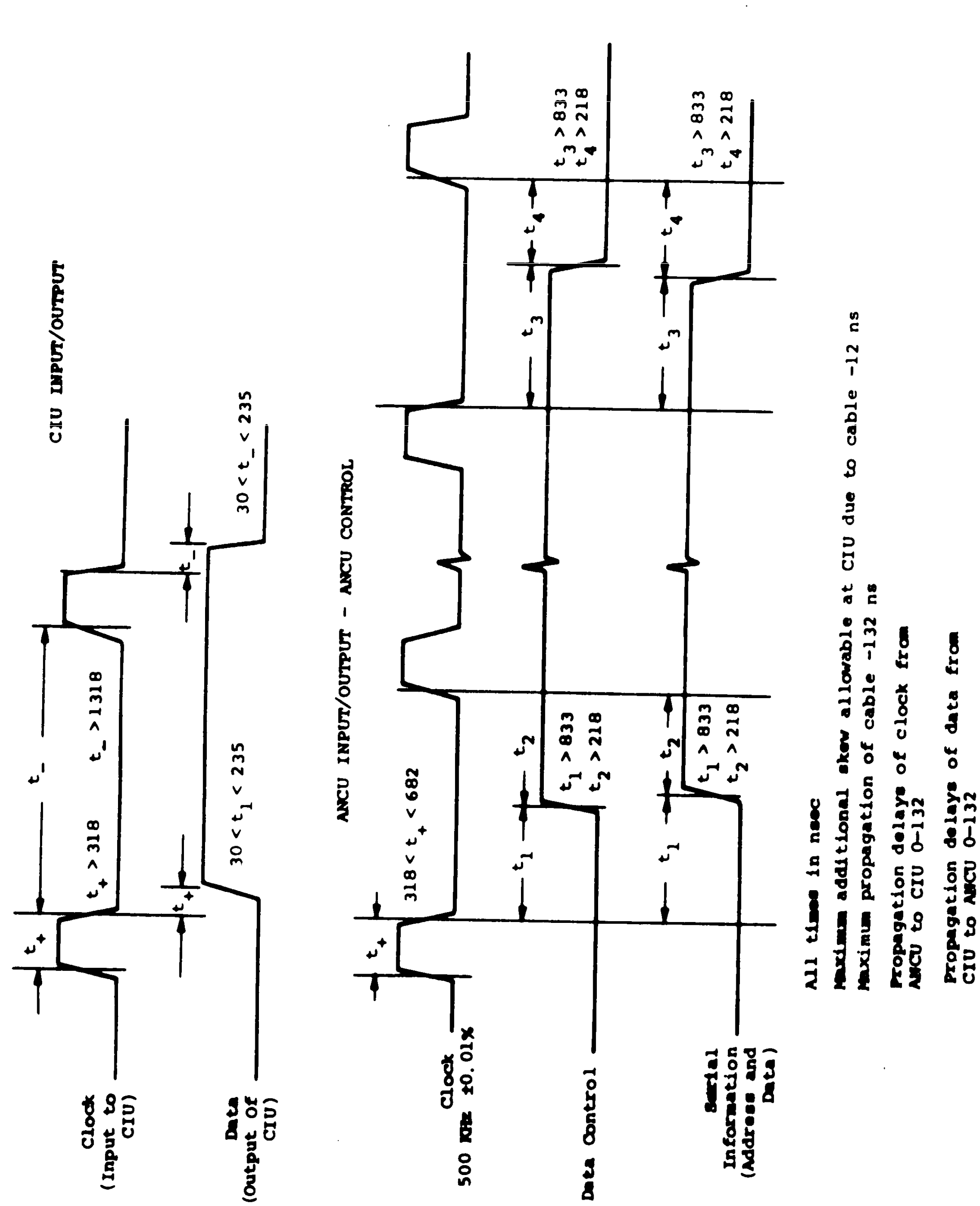


Figure 14. CIU Serial Communication Timing Diagram (Sheet 1 of 2)

*

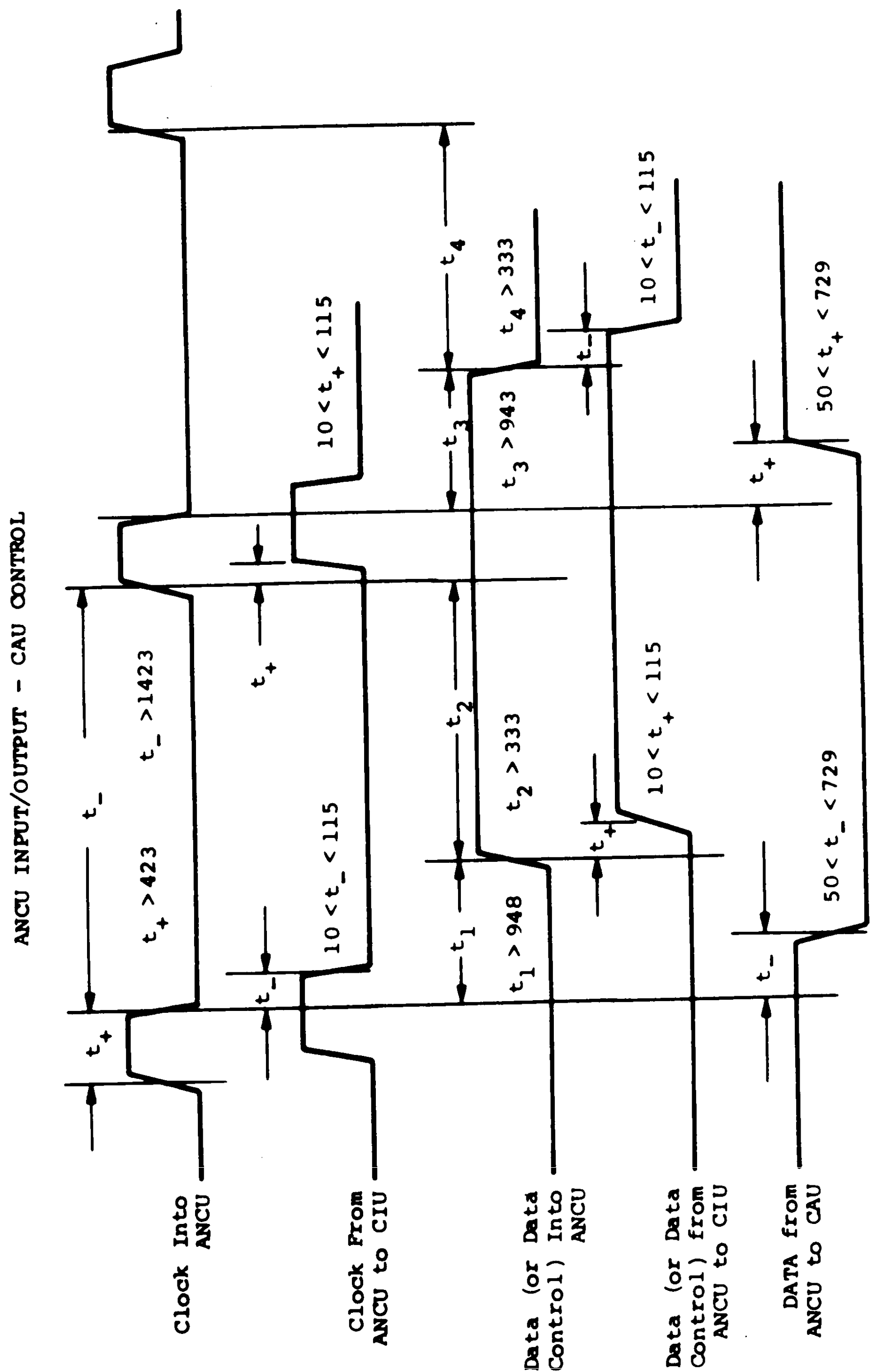


Figure 14. CIU Serial Communication Timing Diagram (Sheet 2 of 2)

Para 3.4.4.3.5
(cont)

c. Serial Data to CIU - Refer to 3.4.4.4.a(3). This " signal shall be received from the CAU and retransmitted by the ANCU. The line receiver in the ANCU shall be a Type A circuit.

d. Serial Data from CIU - Refer to 3.4.4.4a(4).This signal shall be received and retransmitted to the CAU by the ANCU. The line driver in the ANCU shall be a Type A circuit.

e. Enter - Refer to 3.4.4.4d. This signal shall be received and retransmitted to the CAU by the ANCU. The line driver in the ANCU shall be a Type A circuit. *

3.4.4.3.6 CIU No-Go - Refer to 3.4.4.4c. This signal shall be routed through the ANCU from the CIU. *

3.4.4.3.7 Heading Slew - Refer to 3.4.4.4b. This signal shall be routed through the ANCU from the CIU. *

3.4.4.4 CIU Interface - Except where noted, the CIU shall be under control of the ANCU or the CAU. The ANCU shall control the CIU whenever self-test determines that the ANCU is capable of proper control. The CIU shall communicate with the CAU through line receivers and line drivers in the ANCU in order to enter and display latitude and magnetic variation in the attitude reference modes when the ANCU is inoperative. The CIU to CAU transmission path through the ANCU shall be operational even when all ANCU power is off, except for +5 VDC power to the CIU

a. Serial Communication- Digital data shall be transmitted between the CIU and the ANCU or CAU consisting of BCD data words for numeric displays (e.g. , latitude) a discrete data word for switch positions (Command Word), and a discrete data word for annunciator lamps (Status Word). See figure 14 for the serial communication timing diagram. See figure 15 for the serial data format. * *

(1) CIU Clock - This clock input to the CIU shall be supplied by the controlling unit. It shall be a continuous clock with a frequency no greater than 500 KHz from the ANCU and no greater than

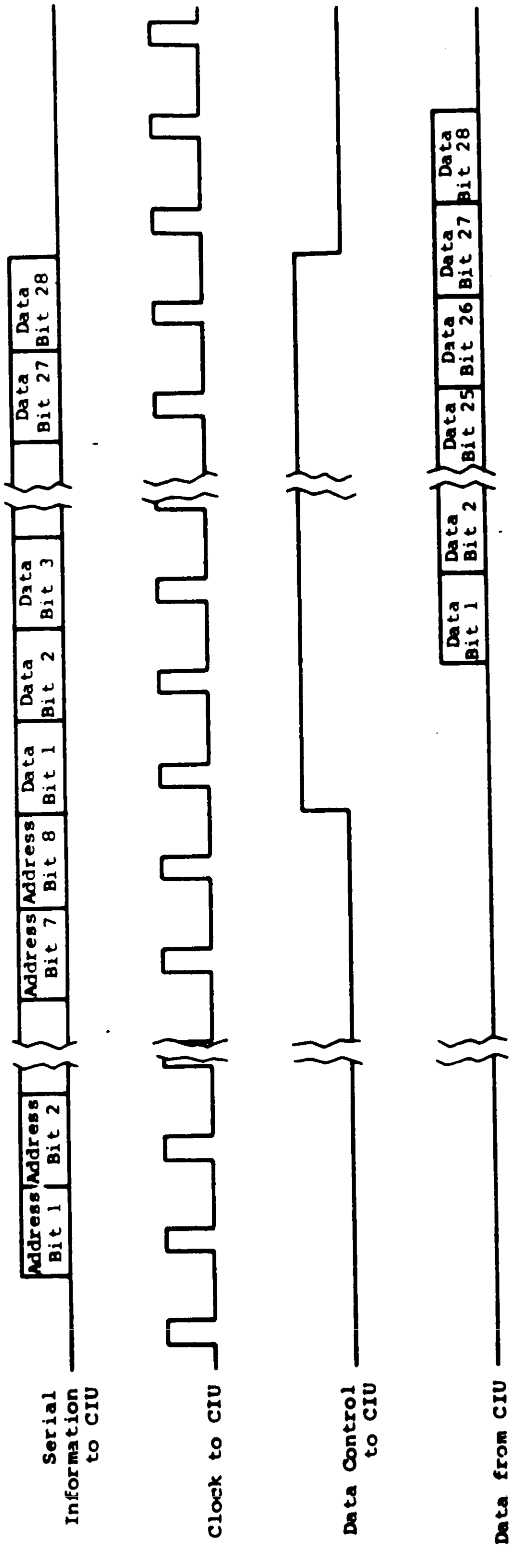


Figure 15. CIU Serial Data Format

*

Para 3.4.404a(1)
(cont)

250 KHz from the CAU. The line driver in the ANCU and the line receiver in the CIU shall be Type A circuits.

(2) Control - This control input to the CIU shall be supplied by the controlling unit. It shall go true (high) for 28 clock periods to indicate to the CIU that data are to be taken in, sent out, or taken in and sent out. The true (high) state shall enable transmission. The line driver in the ANCU and the line receiver in the CIU shall be Type A circuits. *

(3) Serial Data to CIU - This data line shall transmit 8 bits of address plus 28 bits of data (Status or Display Word) LSB first from the CAU or ANCU. The Status Word shall contain the bits which control the LINK, ALN, FREE, MS, EM, INS, DOP, AD, POS FIX, CLEAR, and ENTER lamps. Each of these lamps shall have one bit in the Status Word (see table XI). * There shall be one Data Word assigned to each of the two displays (see table XII). The sign and punctuation of the Display Words shall be contained within the Status Ward. The 8 bits of address for the Status Word and two Display Words shall conform to table XIII. The line * driver in the ANCU and the line receiver in the CIU shall be Type A circuits.

(4) Serial Data from CIU - This data line shall transmit 28 bits of data (Command or Display Word) LSB first to the ANCU or CAU. The Command Word bits shall represent the position of the DATA switch (12 bits), MODE switch (6 bits), WAYPOINT selector (4 bits), CLEAR pushbutton (1 bit), and ENTER mode selector (2 bits) (see table XVV.The two Display Words, left * or right, shall contain the data to be entered (see table XII). The 8 bits of address for the * Command and two Display Words shall conform to table XIII. The line driver in the CIU and the * line receiver in the ANCU shall be Type A circuits.

Table XI. BIT POSITION ASSIGNMENTS FOR THE STATUS WORD

Bit	Function
1 (LSB)	Right Sign Enable
2	Left Sign Enable
3	Degree Sign Following LSD, Right Display
4	Decimal Following 2nd LSD, Right Display
5	Degree Sign Following 4th LSD, Right Display
6	Spare Punctuation Right Display
7	Degree Sign Following LSD, Left Display
8	Decimal Following 2nd LSD, Left Display
9	Degree Sign Following 4th LSD, Left Display
10	Spare Punctuation Left Display
11	FIX Lamp
12	ENTER Lamp
13	CLEAR Lamp
14	FREE Lamp
15	MS Lamp
16	EM Lamp
17	INS Lamp
18	DOP Lamp
19	AD Lamp
20	LINK Lamp
21	ALN Lamp
22	Spare
23 - 28	Not Used

TABLE XII. BIT POSITION ASSIGNMENTS FOR THE DISPLAY WORDS

Left Display Word		Right Display Word	
Bit	Function	Bit	Function
1 (LSB)	Digit 1, 1 Bit	1 (LSB)	Digit 1, 1 Bit
2	Digit 1, 2 Bit	2	Digit 1, 2 Bit
3	Digit 1, 4 Bit	3	Digit 1, 4 Bit
4	Digit 1, 8 Bit	4	Digit 1, 8 Bit
5	Digit 2, 1 Bit	5	Digit 2, 1 Bit
6	Digit 2, 2 Bit	6	Digit 2, 2 Bit
7	Digit 2, 4 Bit	7	Digit 2, 4 Bit
8	Digit 2, 8 Bit	8	Digit 2, 8 Bit
9	Digit 3, 1 Bit	9	Digit 3, 1 Bit
10	Digit 3, 2 Bit	10	Digit 3, 2 Bit
11	Digit 3, 4 Bit	11	Digit 3, 4 Bit
12	Digit 3, 8 Bit	12	Digit 3, 8 Bit
13	Digit 4, 1 Bit	13	Digit 4, 1 Bit
14	Digit 4, 2 Bit	14	Digit 4, 2 Bit
15	Digit 4, 4 Bit	15	Digit 4, 4 Bit
16	Digit 4, 8 Bit	16	Digit 4, 8 Bit
17	Digit 5, 1 Bit	17	Digit 5, 1 Bit
18	Digit 5, 2 Bit	18	Digit 5, 2 Bit
19	Digit 5, 4 Bit	19	Digit 5, 4 Bit
20	Digit 5, 8 Bit	20	Digit 5, 8 Bit
21	Don't Care	21	Digit 6, 1 Bit
22	Don't Care	22	Digit 6, 2 Bit
23	Don't Care	23	Digit 6, 4 Bit
24	Don't Care	24	Digit 6, 8 Bit
25	Digit 7, Don't Care	25	Digit 7, Don't Care
26	Digit 7, Don't Care	26	Digit 7, Don't Care
27	Digit 7, Don't Care	27	Digit 7, Don't Care
28 (MSB)	Digit 7, Sign Bit	28 (MSB)	Digit 7, sign Bit

TABLE XIII. CIU SERIAL TRANSMISSION ADDRESS ASSIGNMENTS

*

LSB	Function
01 011 100	Load Status Word
01 011 101	Load Right Display
01 011 110	Load Left Display
11 011 100	Load and Read Status Word
11 011 101	Load and Read Right Display
11 011 110	Load and Read Left Display
11 011 111	Read Command Word

1. Address shall be transmitted LSB first.
2. The trailing edge of the eighth address bit shall coincide with the leading edge of the control pulse.

Para 3.4.4.4 (cont)

b. Heading Slew - This CIU output to the CAU shall be routed directly through the ANCU for use in developing grid heading in the free mode [3.4.1.1.3c(2)] . This switch output shall have a minimum current rating of 250 ma resistive and 100 ma inductive at 28 volts d-c. The line receivers in the CAU shall be Type B circuits. *

(1) Heading Slew Sign - In the CIU, the heading slew sign line shall be connected to the heading-slew return line when slewing in either the high or low DCR (decrease) direction. There shall be no break in the connection when switching from high to low DCR. * * *

(2) Heading Fast Slew - In the CIU, the heading fast slew line shall be connected to the heading slew return line when slewing at either the DCR or INCR (increase) high slew rates. Refer to Appendix I, as the slew rates are a function of the aircraft unique CAU. * * * *

TABLE XIV. BIT POSITION ASSIGNMENTS FOR THE COMMAND WORD

Bit	Function
1 (LSB)	Select LEFT ENTRY MODE
2	Select RIGHT ENTRY MODE
3	DATA Switch Position 1, WAY POINT
4	DATA Switch Position 2, FLYOVER
5	DATA Switch Position 3, OFFSET
6	DATA Switch Position 4, BRG/RNG
7	DATA Switch Position 5, STG/TMGO
8	DATA Switch Position 6, PRES POS
9	DATA Switch Position 7, TCK/GS
10	DATA Switch Position 8, HDG/ALT
11	DATA Switch Position 9, WIND
12	DATA Switch Position 10, NWPR/MV
13	DATA Switch Position 11, AUX
14	DATA Switch Position 12, Spare
15	WAYPOINT Thumbwheel 1 Bit
16	WAYPOINT Thumbwheel 2 Bit
17	WAYPOINT Thumbwheel 4 Bit
18	WAYPOINT Thumbwheel 8 Bit
19	MODE Switch Position 1, BIT
20	MODE Switch Position 3, NORM
21	MODE Switch Position 4, INS
22	MODE Switch Position 5, MAG SLV
23	MODE Switch Position 6, FREE
24	MODE Switch Position 7, EM MAG
25	CLEAR
26	"1"
27	"0" TEST PATTERN
28 (MSB)	"1"

Para 3.4.4.4b
(cont)

(3) Heading Slow Slew - In the CIU, the heading slow slew line shall be connected to the heading slew return line when slewing at either the DCR or INCR low slew rates. Refer to Appendix I, as the slew rates are a function of the aircraft unique CAU. * * *

c. CIU No-GO - This output from the CIU routed through the ANCU to the CAU shall be supplied to indicate that the CIU malfunction flag has been set. When the flag is in a set (no-go) state, a short circuit shall be supplied to the CAU. When the flag is in the reset (go) state, an open circuit shall be supplied to the CAU. This switch output shall have a minimum current rating of 250 ma resistive and 100 ma inductive at 28 volts d-c. * * *

d. Enter - Depressing the ENTER pushbutton shall generate a true (high) pulse which is two clock pulses in width. This pulse shall be used as an interrupt input to the ANCU. This pulse shall also be transmitted to the CAU. The line driver in the CIU and the line receiver in the ANCU shall be Type A circuits. *

e. Position Fix (POS FIX) - Depressing the POS FIX pushbutton shall generate a true (high) pulse which is two clock pulses in width. The pulse whiich used as an interrupt input to the ANCU. The CIU line driver and the ANCU line receiver shall be Type A circuits. *

f. Flag Reset - The true (high) state of this input to the CIU shall reset the CIU malfunction flag to the no-fault state. This signal shall be routed through the ANCU from the CAU. The false (low or open) state shall cause restoration of the fault indicator circuit to its normal fault monitoring condition. The CIU shall respond in this manner to true or false states which occur for a minimum of 20 milliseconds. The line receiver in the CIU shall be a Type C circuit.

Para 3.4.4.4
(cont)

g. Mode Switch On - The pole of the MODE switch shall provide a switch closure which is routed through the ANCU to turn on the PSU. The pole of the switch which is grounded external to the CIU, shall be connected to this MODE Switch On discrete in all switch positions except the OFF position. The switch shall have make before break contacts with a bounce no greater than 150 microseconds. The switch contacts shall have a minimum current rating of 1 ampere resistive and 0.5 amperes inductive at 28 volts d-c. The PSU line receiver shall be compatible and require a maximum input current of a 100 milliamperes.

h. Mode Switch Off - This discrete from the CIU to the PSU shall be connected to the externally grounded pole described in 3.4.4.4g to indicate that the CIU MODE switch is in the OFF position. This signal shall be used to initiate the PSU turn-off sequence. The signal shall be routed through the ANCU. The switch contact shall have a minimum current rating of 1 ampere resistive and 0.5 amperes inductive at 28 volts d-c. The PSU line receiver shall be compatible and require a maximum input current of 100 milliamperes.

i. PSU Fail - Refer to 3.4.4.5b(4).

j. IMU Fail - Refer to 3.4.4.1a(5).

k. CAU Fail - Refer to 3.4.4.3c.

l. ANCU Fail - This discrete output from the ANCU to the CIU shall indicate that the ANCU malfunction flag has been set. The flag shall be set at any time that self-test detects an ANCU malfunction. When the flag is in a reset (go) state, a short circuit shall be supplied to the CIU. When the flag is in a set (no-go) state, an open circuit shall cause the ANCU malfunction lamp on the CIU to illuminate. switch output shall have a minimum current rating of 250 ma resistive and 100 ma inductive at 28 volts d-c. The CIU line receiver shall be compatible with these switch contacts and shall require a maximum input current of 100 milliamperes.

Para 3.4.4.4
(cont)

m. CIU Flag Set - The true (high) state of this discrete shall be supplied from the ANCU to the CIU if the self test detects a malfunction in the CIU. This discrete, when in the true state for a minimum of 20 msec, shall cause the CIU flag to go to the set (no-go) state if the CIU flag reset is not present. The false (low, open, or ANCU power off) state shall cause.no change in state of the malfunction flag. The ANCU line driver and the CIU line receiver shall be Type C circuits.

n. CIU Flag Reset - The true (low, open, or ANCU power off) state of this discrete shall be supplied from the ANCU to the CIU at any time that ANCU self-test determines that the ANCU can no longer supply a trustworthy CIU Flag Set signal. This discrete, when in the true state for a minimum of 20 msec, shall cause the CIU flag to go to the reset (go) * state if the flag had been set by the CIU Flag Set signal. In addition, this discrete shall continue to prevent the CIU Flag Set signal from setting the CIU flag as long as reset is present. The false (high) state shall enable control of the flag from * CIU Flag Set, but shall cause no change in state of the flag directly. The line driver in the ANCU and the line receiver in the CIU shall be Type C circuits.

3.4.4.5 PSU Interface - Figure 16 presents the distribution of * power in the system.

a. Power - The PSU shall supply ±28 volts d-c and * +32 volts d-c to the ANCU, IMU, and CAU up to the * amount specified in 3.5.3. In addition, 60 ma maximum of +5 volts d-c. shall be provided to the * CIU in the event of a PSU malfunction. This +5 volt * auxiliary power shall be used in the CIU to illumi- * nate the PSU malfunction indicator. The +28 volts d-c * shall have a rise time no longer than 10 milliseconds. *

b. Discretes

(1) Power Status - For overvoltage of the ±28 volt * or undervoltages of the ±28 volt or +32 volt d-c * supplies, this discrete shall go low within one microsecond after initiation. High voltages of

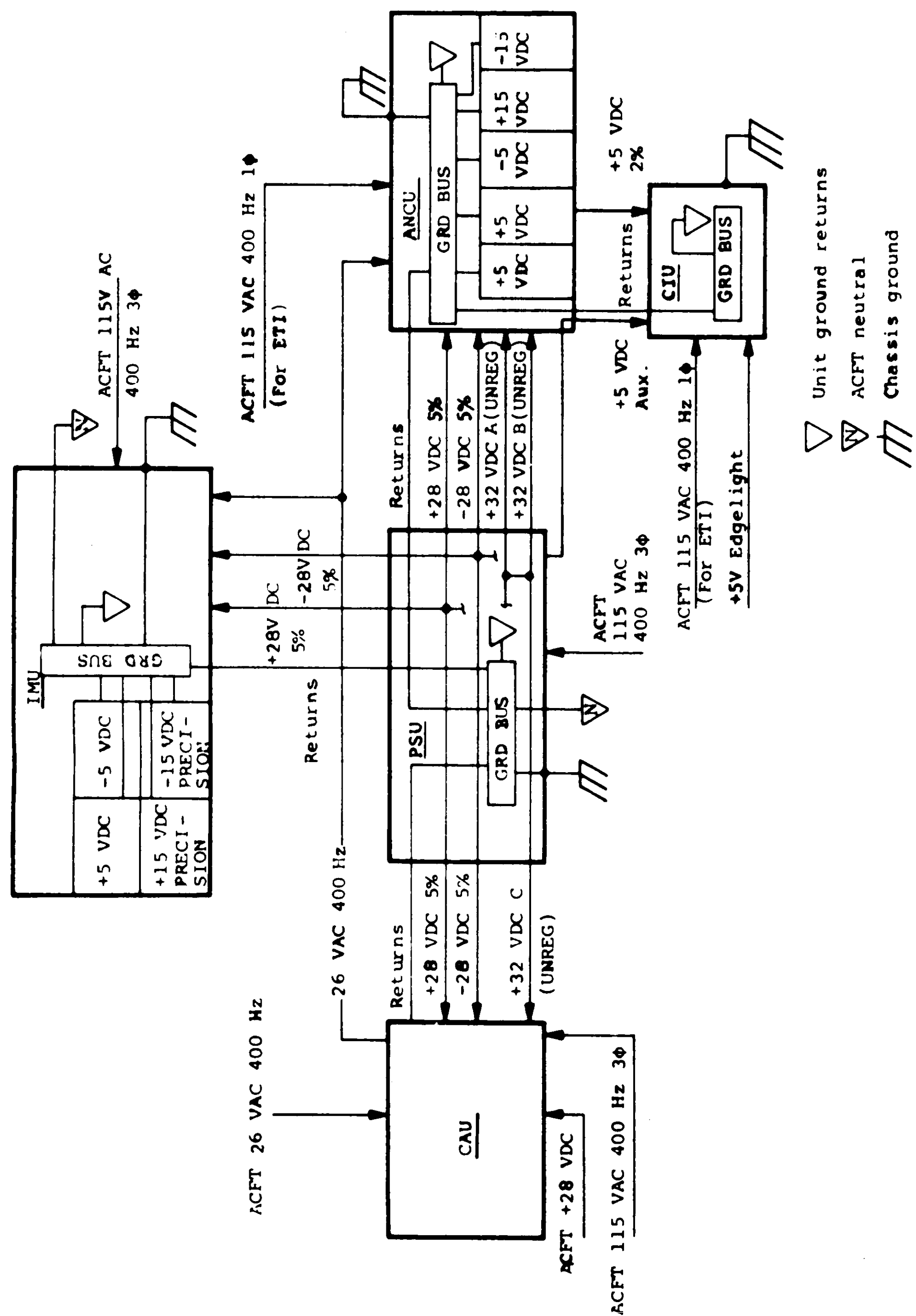


Figure 16. Power Distribution

Para 3.4.4.5b(1)
(cont)

±39 volts maximum and low voltages of ±21 volts minimum on the ±28 volt d-c supplies, or a low voltage of +16.5 volts minimum on the +32 volt d-c supply shall initiate this discrete. During power turn-on, this discrete shall go low within 5 milliseconds after the +28 volt d-c supply exceeds 6 volts. It shall remain low until the +28 volt d-c supply reaches 21 volts. During normal turn-off, this discrete shall go low no later than 2 milliseconds before the +28 volt supply to the IMU drops below +24 volts d-c. *

This signal shall be used to initiate the ANCU and IMU power sequence shutdown. The line drivers in the PSU and the line receivers in the ANCU and IMU shall be Type E circuits.

(2) Flag Inhibit - This discrete shall go to the true state (low) within one microsecond after initiation. The overvoltage and undervoltage conditions stated in (1) above shall initiate the signal. The signal shall also be initiated within 5 msec after a primary power drop out. The signal shall be used to inhibit the setting of the malfunction flags in the IMU, ANCU, and CAU whenever the PSU malfunctions or the PSU is turned off. In addition, it shall notify these units that aircraft primary power has dropped out. During power turn-on this discrete shall go low within 5 msec after the +28 volts supply exceeds 6 volts d-c. It shall stay low until the +28 volts supply reaches +21 volts d-c. During normal turn-off this discrete shall go low no later than 2 ,msec before the +28 volts supply to the IMU drops below +24 volts d-c. The line drivers in the PSU and line receivers in the ANCU and IMU shall be Type E circuits. *

(3) PSU No-Go - This discrete output from the PSU shall go to the true (open) state to indicate the PSU malfunction flag has been set to the no-go state. This occurs whenever the PSU *

Para 3.4.4.5b(3)
(cont)

self-test circuitry detects an over or under voltage condition as specified in (1) above. This may occur either in the event of a PSU malfunction or if a lengthy aircraft power interruption discharges the battery. This output shall provide a ground when the malfunction flag is in the go state. The switch minimum current rating shall be 250 ma resistive or 100 ma inductive at 28 volts d-c. * *

(4) PSU Fail - This discrete output from the PSU to the CIU shall be connected to ground to indicate that the PSU malfunction flag has been set to the no-go state. This occurs whenever the PSU self-test circuitry detects an over or under voltage condition as specified in (1) above. This may occur either in the event of a PSU malfunction or if a lengthy aircraft power interruption discharges the battery. The switch contact minimum current rating shall be 250 ma resistive or 100 ma inductive at 28 volts d-c. This output shall be an open circuit in the go state and a ground in the no-go state. This signal shall-switch to the go state when the mode switch OFF discrete is provided to the PSU with input power supplied to the PSU. This signal shall be routed through the ANCU to the CIU to illuminate the PSU malfunction indicator when in the no-go state. * * * * * * *

(5) Flag Reset - The true (high) state of this input to the PSU from the CAU shall reset the PSU malfunction flag to the no-fault state. The false (low, open, or CAU power off) state shall cause restoration of the fault indicator circuit to its normal fault monitoring condition. The PSU shall respond in this manner to true or false states which occur for a minimum of 20 milliseconds. The line receiver in the PSU shall be a Type C circuit.

(6) Mode Switch On - Refer to 3.4.4.4g.

(7) Mode Switch Off - Refer to 3.4.4.4h.

Para 3.4.4.5b
(cont)

(8) Weight on Wheels - This discrete from the ANCU shall be supplied to the PSU to limit the PSU battery discharge to 5.5 seconds ±1.5 seconds in the-event of a primary power interruption while the aircraft is on the ground. The true state of this discrete shall be ground, as described in 3.4.3.2c. The PSU input circuit shall require an input current no greater than -100 ma. This discrete shall not be dependent upon primary aircraft power (i.e. , the state of the signal shall not be affected by a primary power interrupt).

3.5 Detail Requirements

3.5.1 Inertial Measuring Unit (IMU)

3.5.1.1 Function - The IMU shall contain gimbal-mounted synchros which furnish unambiguous platform pitch, roll, and azimuth. Velocity increment signals shall be derived from three accelerometers orthogonally mounted on the stable element structure. The stable element shall be decoupled from aircraft motion by means of four gimbals. The gimbals shall be driven by torquer motors which are, in turn, driven by electronic servos whose input signals are derived from 2 two-degree-of-freedom gyros mounted on the stable element. The gyros, and therefore the stable element, shall be controlled by ANCU supplied torquing signals during normal system operation. A nonvolatile, refillable memory shall be contained within the IMU for the purpose of storing calibration data peculiar to a particular platform. The calibration data shall be used by the computer to correct the platform velocity outputs by providing compensating gyro torquing command inputs. The IMU shall be capable of providing attitude and heading reference information in the event of an ANCU malfunction. The backup heading reference shall be free gyro unless compensated by a sine latitude/ magnetic slave heading error signal generated by the CAU (3.4.2.2) where this is a specific aircraft requirement.

3.5.1.2 Sealing - The IMU shall be adequately sealed to prevent contamination of the unit. If the IMU requires external cooling air, it shall be cooled by thermal conduction into a convective heat exchanger chamber through which cooling air is forced, thus maintaining the integrity of the gimbal assembly seal.

3.5.1.3 Inertial Stabilized Platform - The mechanization of the inertial platform shall provide a compact, reliable design with attitude stabilization at high angular rates.

3.5.1.3.1 Gimbal Order - The gimbal arrangement from inside to out shall be: azimuth, inner roll, pitch, and outer roll. Outer roll and azimuth shall have full rotational freedom; pitch and inner roll may be instrumented to have ±100° and ±17° of freedom (minimum), respectively. The redundant inner roll gimbal shall provide angular isolation of the stable element during vehicle maneuvers around pitch angles of 90°. By this arrangement, the gimbal system shall provide all-attitude operation.

3.5.1.3.2 Gimbal Drive - The inertial platform shall use torquer motors of high torque capacity, such that the Platform will not impose any limitation on aircraft maneuverability as specified *
in table IV.

3.5.1.3.3 Gimbal Readouts - The pitch and outer roll gimbals shall have synchro transmitters mounted on their respective axes. The azimuth gimbal shall have a two-speed resolver mounted on its axis.

3.5.1.3.4 Azimuth Resolver - There shall be an additional resolver mounted on the azimuth gimbal for the purpose of resolving the level gyro pickoff output signals into pitch and roll axis coordinates.

3.5.1.3.5 Vibration and Shock Isolation - The gimbal system shall be designed to minimize the vibration effects which can degrade gyroscope and accelerometer performance. The basic requirements for the isolation system are that it have a low natural frequency, low resonant rise, and good decoupling at high frequencies.

3.5.1.4 Gtro/Torquing Performance Characteristics - The IMU gyro *
torquing performance characteristics shall, as a minimum require-
ment, conform to the parameters as set forth in table XV. *

3.5.1.5 Accelerometer\Quantizer Output Performance Characteristics -*
The IMU quantizer output performance characteristics shall, as a minimum requirement, conform to the parameters as set forth in
table XVI. *

TABLE XV. GYRO/TORQUING CHARACTERISTICS

Parameter	X & Y Gyro	Z Gyro
Torquer Scale Factor Accuracy	±0.1% (max)	±0.1% (max)
Torquer (long and short term) Scale Factor Stability	±0.023% (1σ)	±0.023% (1σ)
Mass Unbalance, Compensated	0.17°/hr/g (1σ)	0.17°/hr/g (1σ)
Bias Stability (Day-to-day)	0.0066°/hr (1σ)	0.016°/hr (1σ)
Random Drift (Correlation time 3 hrs)	0.004°/hr (1σ)	0.008°/hr (1σ)

TABLE XVI. ACCELEROMETER/QUANTIZER CHARACTERISTICS

Scale Factor Tolerance	
Accelerometer	±0.05% (max)
Quantizer	±0.06% (1σ)
Scale Factor Linearity	
Linear Term	150×10^{-6} g/g (1σ)
Quadratic Term	30×10^{-6} g/g^2 (1σ)
Bias Stability	
Short Term (accelerometer only, correlation time 2400 seconds)	10×10^{-6}g (1σ)
Long Term	100×10^{-6}g (1σ)
Threshold	5×10^{-6}g (1σ)
Repeatability	15×10^{-6}g (1σ)

3.5.1.6 Platform Electronics - The electronics required for the functional operation of the platform shall be contained within the IMU compartment.

3.5.1.6.1 Basic Functions - The internal IMU electronics shall include the following: stable element electronics, gimbal servo electronics, temperature control circuits, acceleration conversion circuits, gyro torquing circuits, oscillator countdown and mode sequencing circuits, built-in test circuits, and power supply module(s). The power supply shall provide the IMU electronics with regulated, short circuit and overvoltage-protected power.

3.5.1.6.2 ANCU Interfacing - In addition to the above functions, the platform electronics shall provide inertial velocity data output in digital format and receive digital torquing correction data inputs from the ANCU. (Refer to 3.4.4.1.) Analog alignment *
circuitry for leveling the platform in event of ANCU failure shall also be included.

3.5.1.6.3 Calibration Memory. Also included in the IMU is an additional section that will contain the calibration data storage module. This module shall provide for the storage of gyro and accelerometer parameters unique to each IMU. Refer to table VIII. Calibration data shall be filled at the intermediate maintenance level.

3.5.1.6.4 Shipboard Intermediate Level Maintenance - At-sea calibration and unit level maintenance of the IMU shall be performed by special test equipment as defined in XAS-1233, or equivalent.

3.5.1.6.5 VAST Compatibility - The IMU electronics external to the platform gimbal set shall conform to the requirements of AR-8, AR-9, and AR-10.

3.5.1.6.7 Power Requirement. - The IMU power requirements shall not *
exceed those shown in figures 17 and 18. The 115 volts rms, *
400-Hz , 3-phase power will be supplied from the aircraft. The *
PSU shall supply the ±28 volts d-c requirements of the IMU. The *
CAU shall supply 26 volts rms synchro excitation to the IMU *
(refer to 3.4.4.3.4).

3.5.1.8 Mechanical Design - Mechanical design shall, in general conform to the requirements of MIL-E-5400.

3.5.1.8.1 Weight - The IMU weight shall be no greater than 37.5 pounds.

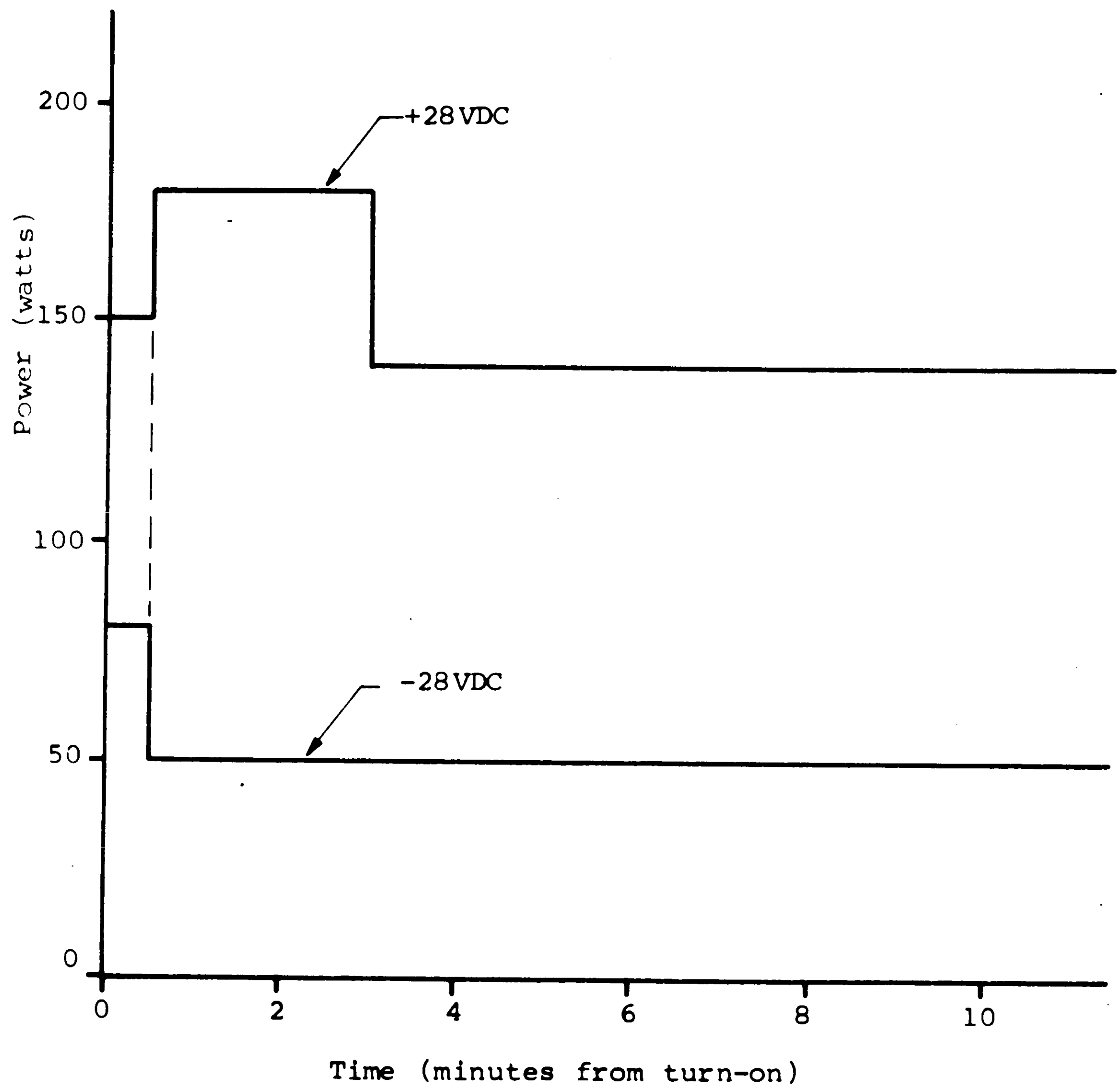


Figure 17. Maximum IMU D-C Power Requirements

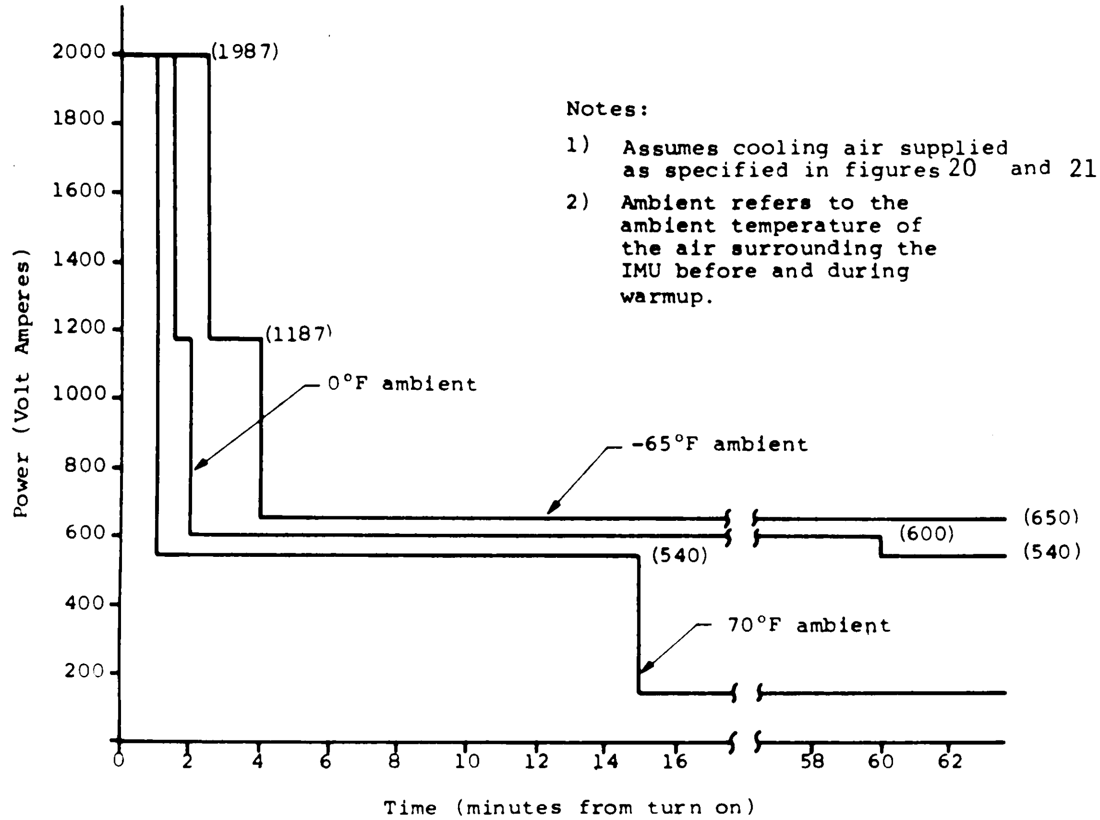


Figure 18. Maximum IMU 115-VAC, 400-Hz 3-Phase Power Requirements *

3.5.1.8.2 Size - The IMU shall conform to the outline and mounting drawing in figure 19. *

3.5.1.8.3 Cooling - Figures 20 thru 22 specify the cooling requirements and the pressure drop of the IMU. *

3.5.1.8.4 Cooling Air Valve - An air control valve may be required in the aircraft to control cooling air to the IMU whenever the flow rate/temperature operating points would otherwise fall above the maximum flow rate curves in figures 20 and 21. Flow rates above the maximum flow rate curve shall cause no damage, but may degrade accuracy and affect system response time. An electrical control signal for the valve will be provided by the * *

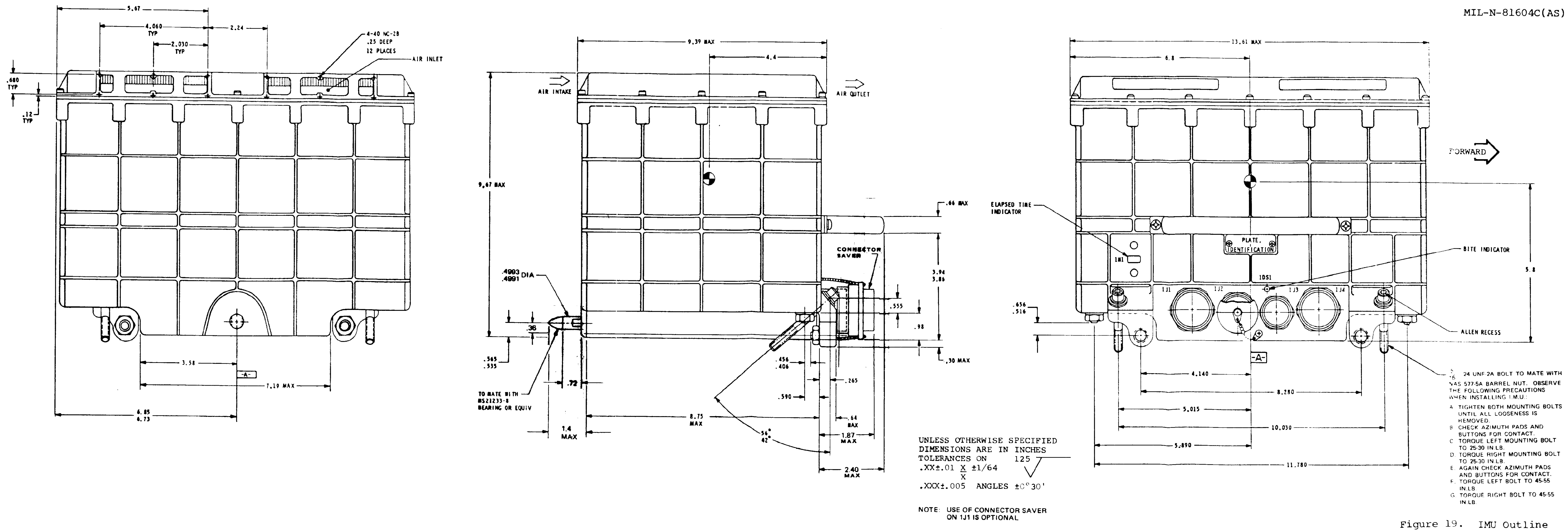


Figure 19. IMU Outline and Mounting

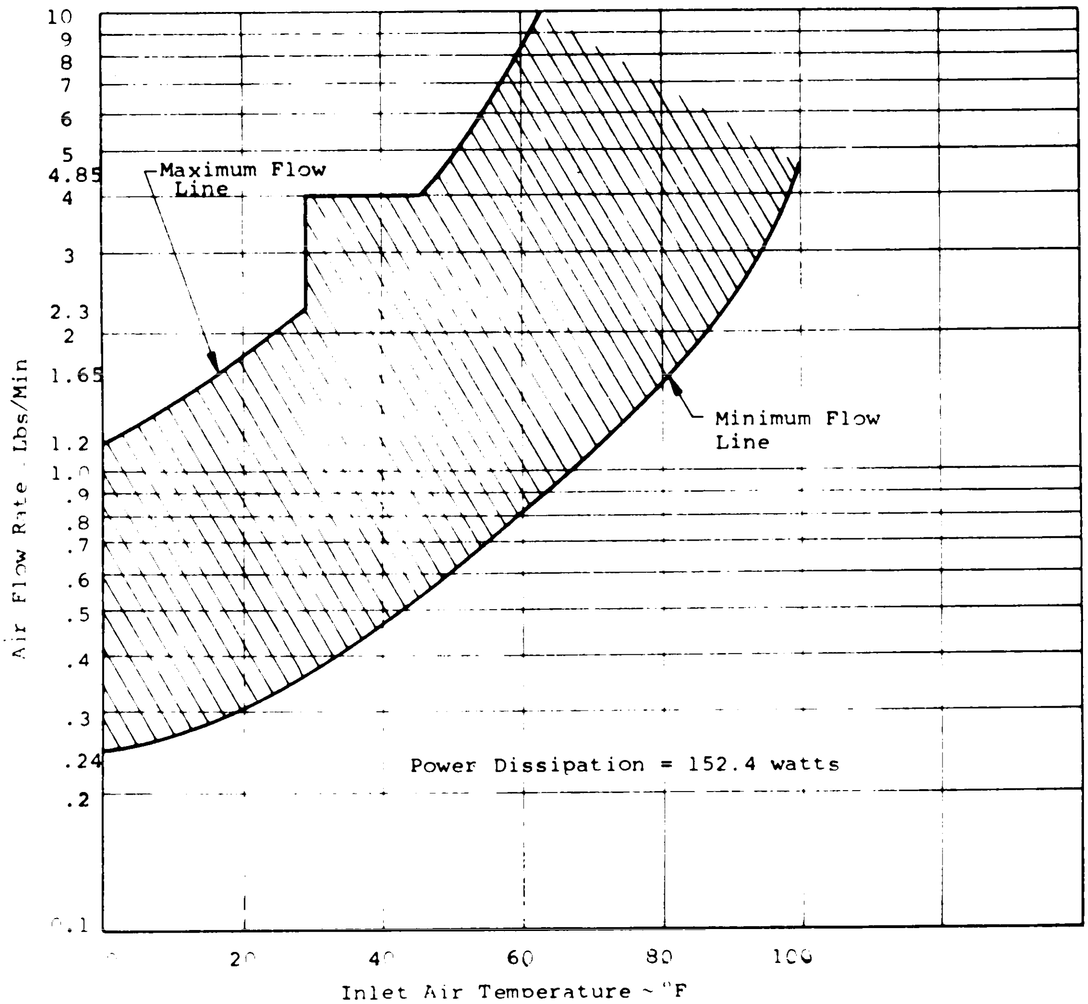


Figure 20. CAINS IMU Cooling Requirements (Forward Flow Direction) *

Para 3.5.1.8.4 (cont)

IMU as defined in 3.4.3.3. When provided with the specified signals, the air valve shall require no more than two minutes of time to complete the transition between extreme positions. *

3.5.1.8.5 Replacement - The IMU housing shall be mechanically compatible with the IMU mount specified herein. The IMU shall be removable from its mount and easily replaced with another unit without alignment or platform parameter calibrations or adjustments or changes or adjustments in associated external equipment.

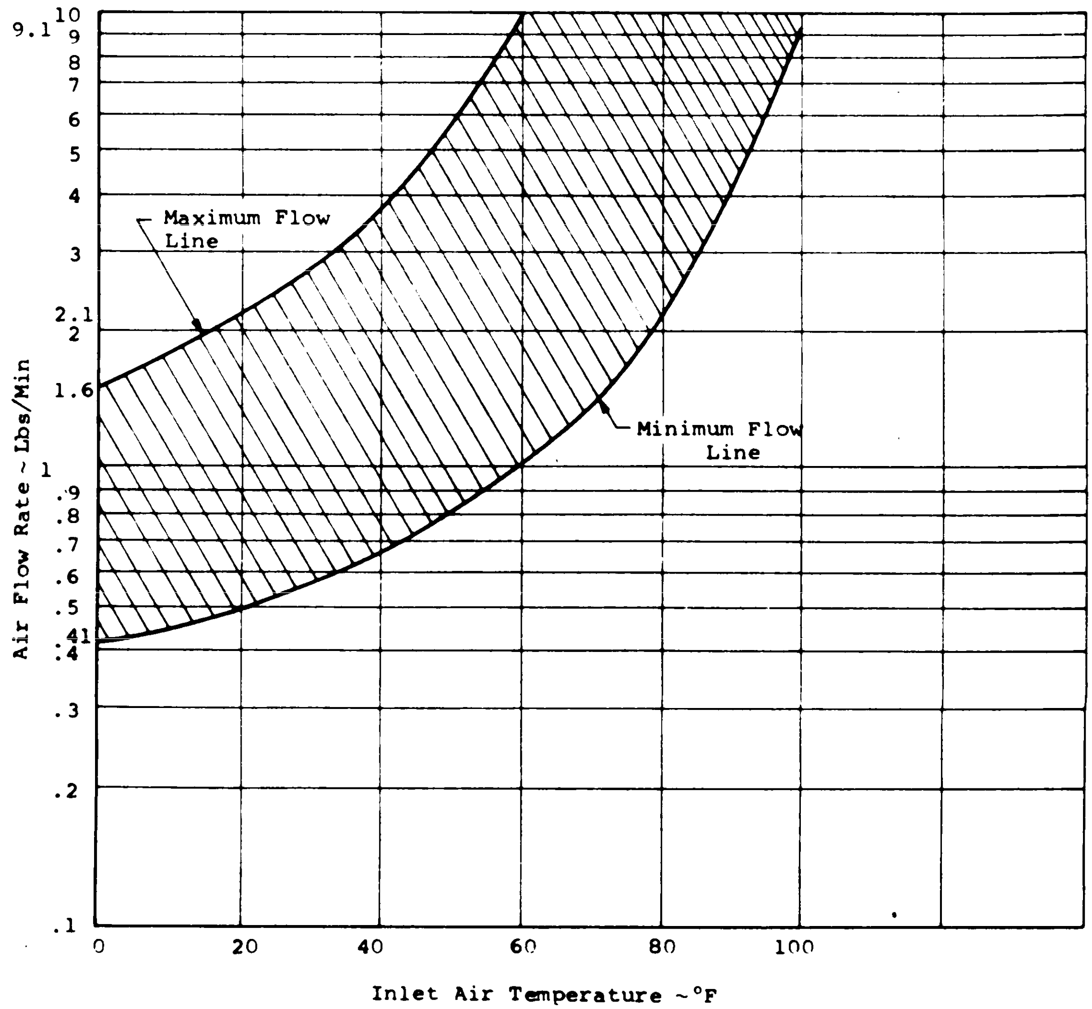


Figure 21. CAINS IMU Cooling Requirements (Reverse Flow Direction) *

3.5.1.9 <u>Test Equipment Compatibility</u> - The IMU shall be designed to be compatible with test equipment designed in accordance with XAS-1233, or equivalent. The IMU shall utilize the inputs and provide outputs which will maximize the speed and effectiveness of the test equipment in malfunction location or calibration of an IMU. The interface signals are listed in table XVII. These signals shall be in addition to the normal operational input/output signals which may be used by the test equipment. *

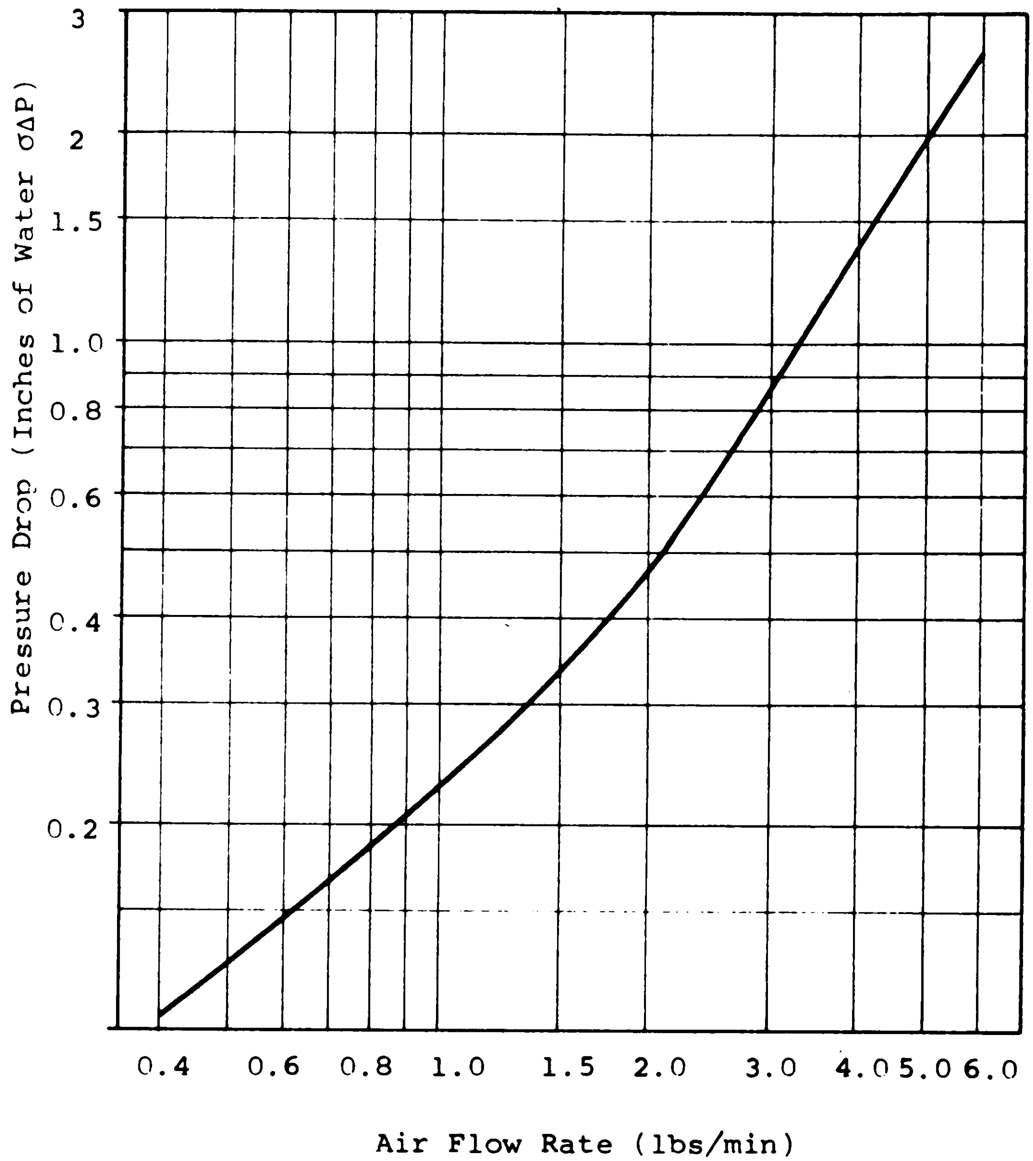


Figure 22. CAINS IMU Pressure Drop

TABLE XVII. TEST CONNECTOR 1J1

Pin No.		Pin No.	
1	Mode Status A	26	Pitch Servo Monitor (Resp. Line)
2	Mode Status B	27	I.R. Servo Monitor (Resp. Line)
3	Mode Status C	28	O.R. Servo Monitor (Resp. Line)
4	Mode Status D	29	Z Quantizer DC Amp Monitor
5	Overtemp No-Go (Malf Ind)	30	X Gyro Torquer T.P. (Resp. Line)
6	Servo No-Go (Malf Ind)	31	Y Gyro Torquer T.P. (Resp. Line)
7	Spin Supply No-Go (Malf Ind)	32	Z Gyro Torquer T.P. (Resp. Line)
8	Quantizer No-Go (Malf Ind)	33	4.8 KHz Clock (Resp. Line)
9	-15 VDC Memory Monitor (Resp. Line)	34	26 VAC Hi 4.8 KHz/400 Hz
10	+15 VDC Monitor (Resp. Line)	35	26 VAC Lo 4.8 KHz/400 Hz
11	-15 VDC Monitor (Resp. Line)	36	Mode Inhibit
12	+5 VDC Monitor (Resp. Line)	37	No-Go Control A (Stim. Line)
13	-5 VDC Monitor (Resp. Line)	38	No-Go Control B (Stim. Line)
14	+28 VDC Monitor (Resp. Line)	39	No-Go Inhibit (Stim. Line)
15	+70 VDC (Floating) Monitor (Resp. Line)	40	Ax (x Accel Out) (Resp. Line)
16	Gyro Spin DC Monitor (Resp. Line)	41	Ay (y Accel Out) (Resp. Line)
17	C&M Discrete Monitor	42	Az (z Accel Out) (Resp. Line)
18	4.8 KHz Power Supply No-Go (Resp. Line)	43	Signal Ground
19	Level Detector X	44	Power Ground
20	Level Detector Y	45	Gimbal Slew Discrete
21	Inner Roll Resolver S2	46	Az Slew Sense
22	Inner Roll Resolver S4	47	Slew Sense Return
23	Accel Shield Return	48	Roll Slew Sense
24	Cable Shield Return	49	Pitch Slew Sense
25	Az Servo Monitor (Resp. Line)	50-66	Spare Pins

3.5.1.9.1 IMU to Test Equipment Signals - The IMU shall provide the following listed output signals on the test connector.

a. Mode Indication - The IMU shall provide a four-line * discrete output code which shall identify the specific mode in which the IMU is currently operating. This output code shall include internal + submodes in the operation sequence.

(1) Mode Status A - This signal shall indicate the status or mode of operation of the IMU in conjunction with Mode Status B and * table XVIII. This output has a true state * of +3.8 ±1.4 volts d-c and a false state of * +0.25 ±0.25 volts d-c when looking into an open circuit.

(2) Mode Status B - This signal is identical in type and level with that of Mode Status A and indicates status or mode of the IMU in conjunction with Mode Status A and table XVIII. *

(3) Mode Status C - This is a spare status line. The output characteristics are the same as Mode Status A and B.

(4) Mode Status D - Same as Mode Status C.

TABLE XVIII. MODE INDICATION

	Mode Status A	Mode Status B
Cage	0	0
Coarse Level	0	1
Gyro Control	1	1

b. Malfunction Indication Output - The IMU shall provide four discrete output malfunction indications. These discretes shall isolate the malfunction to functional areas which will assist in repair action.

(1) Over-Temperature No-Go - The true state of this signal indicates an overtemperature condition in the IMU. The true or No-Go state shall be

indicated by +3.8 ±1.4 volts d-c and the normal operating temperature state shall be indicated by +0.25 ±0.25 volts d-c when looking into an open circuit. * *

(2) Servo No-Go - The true state of this signal indicates a malfunction in the servo amplifier circuitry in the IMU. The true or No-Go state shall be indicated by +0.25 ±0.25 volts d-c, while the Go condition shall be indicated by +3.8 ±1.4 volts d-c when looking into an open circuit. *

(3) Spin Supply No-Go - The true state of this signal indicates a malfunction of the gyro spin circuitry. Its operating conditions are the same as the Servo No-Go conditions and characteristics.

(4) Quantizer No-Go - The true state of this signal indicates a malfunction of the quantizer circuitry. Its operating conditions are the same as the Servo No-Go conditions and characteristics.

c. Standard Response Outputs
up to 25 output lines which will present the d-c voltage or logic level responses to the recommended stimulus pattern. The normal output of each response line for any stimulus combination shall be either +5 VDC, 0 VDC, -5 VDC, or analog d-c outputs between -15 and +15 volts.

The tolerances on IMU responses to ideal stimuli shall not require measurement to an accuracy more precise than 0.25 percent. The IMU may be designed so that some of the standard response output lines monitor power supply voltages properly divided to present +5 VDC or -5 VDC on the output line.

(1) -15 VDC (Memory) Monitor - This signal shall be an analog test point output indicating the -15 volts d-c is being input to the IMU memory module. The -15 volts shall be divided down to a -5 volt d-c output within the IMU. The range on this output signal for a Go or true condition shall be -5.35 to -4.85 volts d-c when looking into an open circuit. * * * * *

Para 3.5.1.9.1c
(cont)

(2) +5 VDC Monitor - This shall bean analog test point signal monitoring the +5 volts d-c switching regulator output. The range on this output signal for a Go or true condition shall be +4.75 to +5.25 volts d-c when looking into an open circuit. * * *

(3) -5 VDC Monitor - This shall be an analog test point signal monitoring the -5 volt d-c switching regulator output. The range on this output signal for a Go or true condition shall be -4.75 to -5.25 volts d-c when looking into an open circuit. * * *

(4) +15 VDC Monitor - This shall be an analog test point signal output monitoring the +15 volt d-c regulator output. The +15 volts shall be divided down to a +5 volt d-c output within the IMU. The range on this output signal for a Go or true condition shall be +4.85 to +5.35 volts d-c when looking into an open circuit. * * * *

(5) -15 VDC Monitor - This shall be an analog test point signal output monitoring the -15 volt d-c regulator output. This signal shall be divided down and tolerance the same as the -15 volt d-c (memory) monitor. * *

(6) 4.8 KHz Clock (square Wave) - This signal shall be the output of the 4.8 KHz clock in the IMU. It shall be a square wave output at a frequency of 4.8 KHz ±0.02 percent, with output levels of +3.8 ±1.4 volts d-c and +0.25V ±0.25 volts d-c. * *

(7) Gyro Spin D-C Monitor - This signal shall monitor the output of the gyro spin d-c circuitry which will have two distinct operating states. The range, during the high state, for a Go or true condition shall be 4.1 VDC ±10% when looking into an open circuit. The range, during the low voltage state for a Go or true condition shall be +2.15 to +2.65 volts d-c when looking into an open circuit. * * * * *

Para 3.5.1.9.1c (cont)

(8) 70 VDC (Floating) Monitor - This signal shall monitor the output of the +70 volt d-c (floating) output of the gyro spin d-c circuitry which has two distinct operating states. The range, during the high voltage state, for a Go or true condition shall be +4.7 to +5.7 volts d-c when looking into an open circuit. The range, during the low voltage state, for a Go or true condition shall be +3.3 to +4.1 volts d-c when looking into an open circuit. * * * * * *

(9) C&M Discrete Monitor - This signal shall be a discrete indicating the state (high or low) of the gyro spin voltage, based on the gyro float temperature. The high level shall be indicated by -3.4 to -5.0 volts d-c. The low level is indicated by +3.4 to +5.0 volt d-c output. * *

(10) +28 VDC Monitor - This signal shall be an analog signal output which monitors the +28 volt d-c input from the test equipment. The range on this output signal for a Go or true condition shall be +4.4 to +5.4 volts d-c. * * * *

(11) X Accelerometer Out - This signal shall be an analog d-c test point output of the X accelerometer. The voltage out will normally be at zero when the IMU stable element is level. When oriented in a +1g field, the output of the signal shall be +1.03 volts d-c ±1 percent. In a -1g field, the output shall be -1.03 volts d-c ±1 percent. * * * *

(12) Y Accelerometer Out - This signal shall be identical to the X accelerometer test point output, but along the Y axis.

(13) Z Accelerometer Out - This signal shall be identical to the X accelerometer test point output, but along the Z axis, except that its normal position is in a +1g field with the IMU stable element level.

Para 3.5.1.9.1c
(cont)

(14) X Gyro Torquer Test Point - This test point
signal shall monitor the output of the X gyro
torquer pulse train, which has a nominal
frequency of 150 cycles Per second (zero rate).
For a full torque rate of +60°/hr, the signal *
shall be a d-c level of +150 ±25 millivolts
when looking into an open circuit. A full *
torque of -60°/hr results in a d-c voltage *
level of -150 ±25 millivolts when looking
into an open circuit. The pulse width charac-
teristics and scale factor per pulse is *
described more fully in 3.4.4.1e. *

(15) <u>Y Gyro Torquer Test Point</u> - This test point signal shall monitor the output of the Y gyro torquer pulse train which has a nominal frequency of 150 cycles per second (zero rate). The voltage levels are the same as for the X gyro torquer test point.

(16) <u>z Gyro Torquer Test Point</u> - This test point signal shall monitor the output of the Z gyro torquer pulse train, which has a nominal frequency of 150 cycles per second (zero rate). The voltage levels are the same as for the X gyro torquer test point.

(17) <u>Azimuth Servo Monitor</u> - This signal shall be
an analog d-c test point which monitors the *
output of the azimuth servo amplifier. It *
varies from a nominal zero volts to plus or
minus 5 volts at maximum output.

(18) <u>Pitch Servo Monitor</u> - This signal shall be an
analog d-c test point which monitors the output *
of the pitch servo amplifier with the same
characteristics as the Azimuth Servo Monitor.

(19) <u>Inner Roll Servo Monitor</u> - This signal shall
be an analog test point which monitors the
output of the inner roll servo amplifier *
with the same characteristics as the Azimuth
Servo Monitor.

Para 3.5.1.9.1c
(cont)

(20) Outer Roll Servo Monitor - This signal shall be an analog test point which monitors the output of the outer roll servo amplifier with the same characteristics as the Azimuth Servo Monitor. *

(21) 4.8 -KHz Power Supply No-Go - The true state of this signal shall indicate a malfunction in the 4.8-KHz power supply circuitry in the IMU. The true or no-go state is indicated by a +0.25 ±0.25 volts d-c, while the go condition is +3.8 ±1.4 volts d-c when looking into an open circuit. * * *

d. Special Analog Test Points

(1) Inner Roll Resolver Output - In order to monitor the inner roll resolver for fault isolation, the IMU shall provide the inner roll resolver (S2 and S4) output signals to the test equipment. The S4 line is grounded in the IMU. These two output lines provide a sine wave at a frequency of 4.8 KHz with the voltage variable from zero to a maximum of approximately 3.0 volts rms at ±17 degrees (gimbal stops). * *

(2) Resolver Reference Response Output - The IMU shall provide the test equipment with resolver and synchro excitation reference voltage. These two excitation lines provide a single-phase sine wave output with a voltage of 26 volts rms, at a frequency of 4.8 KHz in the cage and coarse level modes, and 400 Hz in gyro control mode. * * *

NOTE

The inner roll resolver does not change to 400 Hz in any mode, but is always excited by the 4.8 KHz frequency. *

Para 3.5.1.9.1d
(cont)

(3) Z Quantizer D-C Amplifier Monitor - This signal shall be the analog d-c output of the Z axis quantizer d-c amplifier. This output shall have a sawtooth waveform. The voltage will vary as the integral of Z acceleration. Positive acceleration will cause the voltage to change in a positive direction. When the voltage magnitude increases to approximately 4 volts d-c, the quantizer will output a delta V_z pulse and the d-c amplifier output will reset to a lower voltage level and then continue to integrate. Refer to 3.4.4.1d for quantizer scale factor information. *

(4) Level Detector X Monitor - This signal shall be the analog d-c output of the X axis level detector circuit. This signal shall be identical in characteristics to the Z quantizer d-c amplifier monitor, except that the reset level is 8 volts d-c rather than 4 volts d-c when in the navigate mode, and 1 volt rather than 4 volts when in the align mode. *

(5) Level Detector Y Monitor - This signal shall be the analog d-c output of the Y axis level detector circuit. This signal shall be identical in characteristics to the Level Detector X Monitor. *

e. IMU Ground - The IMU shall provide the following ground line outputs to the test connector:

(1) Signal Ground

(2) Power Ground

(3) Accelerometer Shield Return

(4) Cable Shield Return

(5) Slew Sense Return

3.5.1.9.2 Test Equipment to IMU Signals

a. Mode Control - The IMU mode shall be controlled by the test equipment through the normal computer control interface and the mode inhibit input.

(1) Mode Inhibit - This signal is a discrete input which, when true, shall cause the mode of the IMU operation, as controlled by internal sequencing circuitry to advance no further until the mode inhibit input becomes false. The true state shall be a ground and the false state shall be an open circuit.

b. Standard Stimulus Inputs - The IMU shall accept up to 15 voltage stimulus lines, each of which will be externally excited with +20 volts d-c, -20 volts d-c, or ground, in any combination. Each line may be internally divided, switched, or buffered to an appropriate level for component test in the IMU. Each input line shall have a minimum input impedance of 200 ohms. The regulation on each input stimulation shall be ±100 millivolts. * * *

(1) No-Go Control A - This signal is an input line which shall be used in conjunction with No-Go Control B to stimulate internal circuits for verification of output BITE monitors. The voltage applied shall be +20 volts d-c, -20 volts d-c, or ground. * *

(2) No-Go Control B - This signal is a separate line used in conjunction with No-Go Control A for the same basic function and with the same characteristics.

(3) No-Go Inhibit - This signal is an input line which shall be used for inhibiting certain No-Go indicators to aid in fault isolation within the IMU. A ground level on this line shall inhibit the IMU fail indicators. An open line is the noninhibiting condition.

c. IMU Slew Discrete - The IMU shall accept a slew discrete signal which, when switched to a ground level. (+0.25 ±0.25 volts d-c), places all three axes in the IMU in the IMU slew mode. An open or +5 volt d-c signal shall place the IMU in its * * *

Para 3.5.1.9.2c (cont)

normal modes as detemined by the computer control. This slew mode, when true, shall supersede the normal computer control modes and shall cause the IMU to accept the IMU slew sense inputs.

d. IMU Slew Sense Inputs - The IMU shall accept, when in the slew mode, slew sense inputs for each axis in the form of a pulse train excited by +5 volts d-c. This pulse train will have the characteristics of 150 Hz between levels of +5 volts. d-c and ground. For zero rate, equal plus and ground pulses will be applied. For full rate in the plus direction (decreasing roll, pitch, or azimuth output), a continuous +5 volt d-c signal is applied. For full rate in the minus direction, a continuous ground signal is applied. The test equipment shall supply rate limiting of this signal to prevent rates in excess of 1000 degrees per minute. The IMU with full slew applied shall have a rate of at least ±90 degrees per minute.

3.5.2 IMU Mount

3.5.2.1 Function - When installed in an aircraft, the IMU mount shall allow for angular adjustment of the CAINS IMU about all three axes. After initial adjustment, the shall be capable of being inserted or removed from the mount within 60 seconds exclusive of disconnecting cooling air supply.

3.5.2.2 Mechanical Design

3.5.2.2.1 Weight - The IMU mount shall weigh no more than 1.7 pounds. It may be constructed with aluminum, but all contact points shall be corrosion resistant hardened steel (Type 17-4PH H1050 COND or better).

3.5.2.2.2 Configuration - The IMU mount shall be cast aluminum in accordance with figure 23. A 0.50-inch diameter stud on the IMU shall mate with a spherical bearing in the mount to facilitate a blind mating, accurate indexing location. The index pads shall be positioned by a close tolerance sleeve pressed into and machined integral to the aluminum frame. The index pad shall be threaded internally and shall have wrench flats to torque the pad against the mount sleeve. Guiding surfaces shall be provided to facilitate indexing when mounting the IMU in a “blind mate application.” *

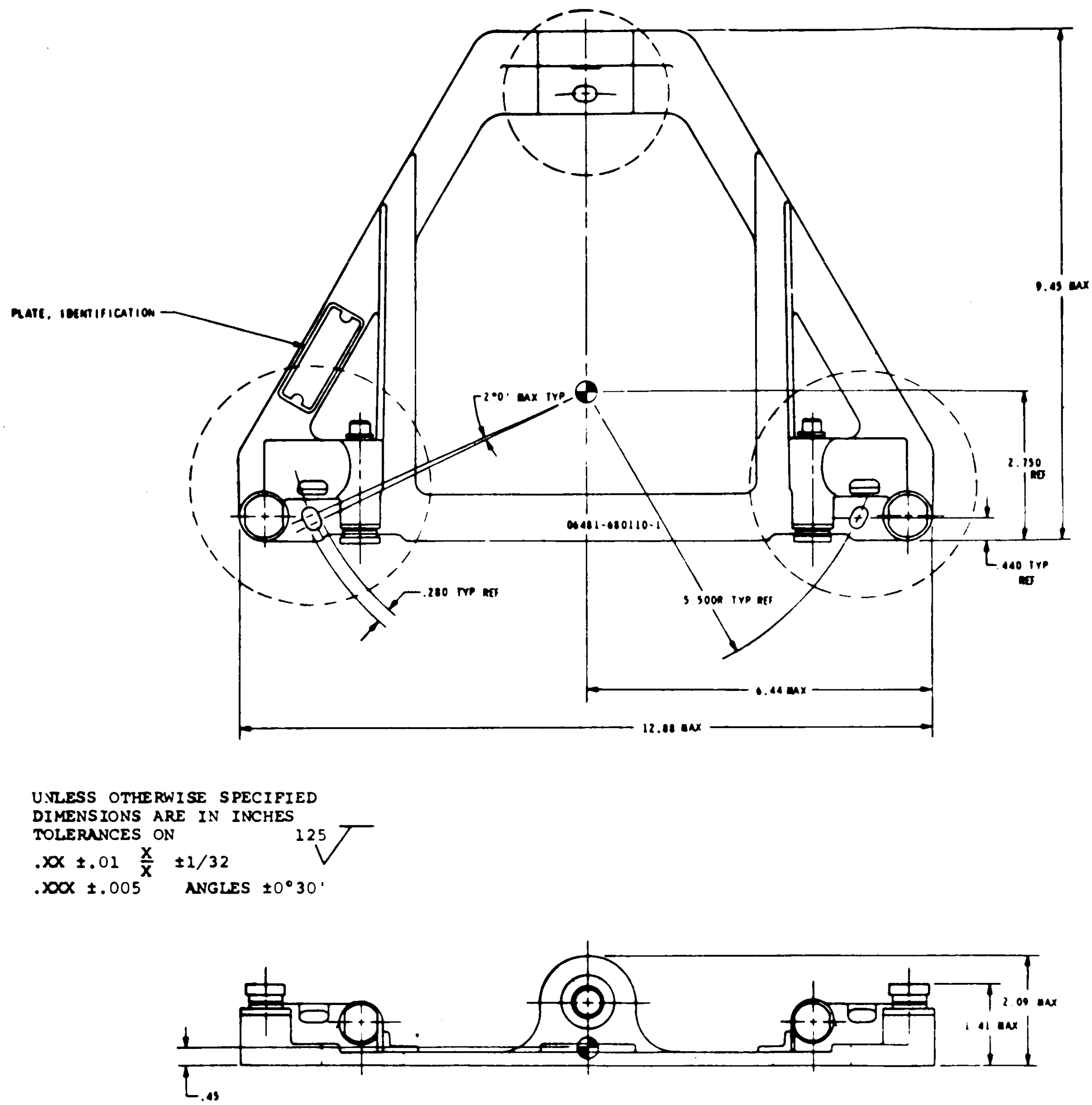


Figure 23. IMU Mount Outline and Mounting

Para 3.5.2.2.2
(cont)

The mount shall be attached to the airframe by three 1/4-inch bolts which shall have tensile properties of A286 stainless steel or better.

3.5.2.2.3 Accuracy - The IMU mount shall have adequate provisions for mechanically aligning the IMU in the aircraft about the three * major axes. Means shall be provided for an adjustment range of at least ±1° in each of the three axes and an adjustment accuracy * of 30 arcseconds. The 30-arcsecond accuracy shall include the * IMU inserted in the mount.

3.5.2.2.4 Adjustments - The coarse alignment of the mount is afforded through the use of slotted airframe attachment holes. The fine adjustment of the pitch, roll, or azimuth axis is accomplished by shimming between the index pad and the steel sleeve. Increments of 0.002 to 0.524 shall be available in accompanying shim kits.

3.5.2.2.5 Reinsertion Requirements - Provisions shall be made for the removal and re-insertion of the IMU to an accuracy of 20 arcseconds. *

3.5.3 Power Supply Unit (PSU)

3.5.3.1 Function - The function of the PSU shall be to convert primary aircraft power to the required equipment d-c voltages * (refer to table XIX). Provisions shall be made to incorporate a. * battery in the PSU. The battery shall provide power transient protection for the equipment and shall maintain equipment operation for 10 seconds after a power dropout in flight and for 5 seconds when the aircraft is on the ground or on a carrier deck.

3.5.3.2 Input Power - Input power shall conform to MIL-STD-704. Maximum steady-state input required, exclusive of the CAU, shall be 545 watts with transient peak power requirements of 740 watts for a duration of 30 seconds or less. In addition to steady-state loading by the PSU, the following switched loads shall not exceed the power as specified:

a. Battery Charger - Three-phase, 20-watt balanced resistive load. See table XX for the recharge interval required under different conditions:

Para 3.5.3.2
(cont)

b. Battery Heater - Single phase, 140-watts, resistive load whose duration is dependent upon the temperature of battery.

3.5.3.3 Output Power - The PSU shall furnish d-c output power for use by the CAINS equipment as shown in table XIX. Individual circuit breakers shall be provided for overload protection of each of +32 volt d-c line. Dynamic regulation of the +28 volt d-c supply shall be 5 percent for an incremental step load variation of two amperes. Regulation of the +32 volts d-c shall be ±6 volts with input power to the PSU defined by MIL-STD-704 steady state conditions. With input power defined by MIL-STD-704 transient conditions, +32 volt d-c overvoltage shall vary as the input power varies, while the undervoltage shall be governed by the PSU battery voltage. This undervoltage is subject to battery charge conditions but shall be limited to a minimum of 16.5 volts d-c at which point the PSU will turn off, indicating a no-go. Ripple on the regulated outputs shall not exceed 300 millivolts peak-to-peak. Ripple on the +32 volts d-c shall not exceed 5 volts peak-to-peak. Over and under voltage detection on the ±28 volt d-c supplies shall be provided. The maximum overvoltage detection level shall be ±39 volts d-c and the minimum under-voltage detection level shall be ±21 volts d-c. Activation of the overvoltage crowbar circuitry shall reduce the output voltage to less than ±2.5 volts d-c.

3.5.3.4 Battery Back-up Power - A fully charged battery in the PSU shall maintain the specified steady state average power levels for a period of up to 10 seconds in flight, and up to five seconds on the ground, in the event of an aircraft power interruption. The battery shall be capable of sustaining this power no later than 9 minutes after equipment turn-on at 0°F, no later than 17 minutes after equipment turn-on at -65°F, and no later than 1 minute after equipment turn-on above +104°F. (NOTE: The battery is continuously in the loop if power transient occurs outside the above conditions. However, duration of power transient protection during that period is unknown.)

To prevent accidental total discharge of the battery during any one interrupt, a built-in timer shall prevent battery discharge for time intervals greater than 5 ±2 seconds while on deck. The MODE switch must be recycled in order to reset the timer and allow additional power interruptions. If the power supply should shut down prior to the timer shutdown point during a power interruption,

TABLE XIX. PSU OUTPUT POWER

Power Condition	Voltages D-C	Power Furnished Cooling Provided at 60°F 0.77 lb/rein	 0.65 lb/rein
Steady State Average	Both +28 and -28 Total	5.7 amps max	5.7 amps max
Maximum Steady State Average	+28 ±5%	1.0 amp min 5.0 amps max	1.0 amp min 5.0 amps max
	-28 ±5%	1.0 amp min 4.0 amps max	1.0 amp min 4.0 amps max
	Both +28 and -28 Total	6.5 amps max	6.0 amps max
Transient Condition up to 30 sec or	+28 ±5%	1.0 amp min 7.5 amps max	1.0 amp min 7.5 amps max
	-28 25%	1.0 amp min 4.5 amps max	1.0 amp min 4.5 amps max
*up to 1.2 msec (reaction time to set circuit breaker)	Both +28 -28 Total	10.0 amps max 14.0 amps max*	9.0 amps max 14.0 amps max*
Maximum Steady State Average	+32 (unregulated) A	200 watts max	160 watts max
	+32 (unregulated) B	50 watts max	40 watts max
	+32 (unregulated) C	75 watts max	60 watts max
	+32 A, B, and C Total	310 watts max	185 watts max
Steady State Average	+32 A, B, and C Total	350 watts max	185 watts max

*

Para 3.5.3.4
(cont)

the PSU malfunction flag will be set. This will indicate that the battery has been totally discharged or the maximum allowable battery cell temperature reached. The battery shall be protected from damage due to overtemperature by internal circuitry which inhibits charging over 140°F and discharging above 155°F.

3.5.3.4.1 Interrupt Support Capability - The PSU battery shall be capable of sustaining equipment power requirements during power interrupts as indicated in table XX.

TABLE XX. INTERRUPT SUPPORT CAPABILITY *

Interrupt Duration	0.1 sec	1.0 sec	5.0 sec	10.0 sec (Note 2)
Recharge interval to completely recover from each interrupt. (Note 1)	72 sec	12 min	1 hour	2 hours
Number of interrupts (when completely charged) without requiring a recharge interval. (Note 1)	100	10	2	1

Note 1: The battery should be charged at temperatures less than +140°F and discharged at temperatures less than +155°F.

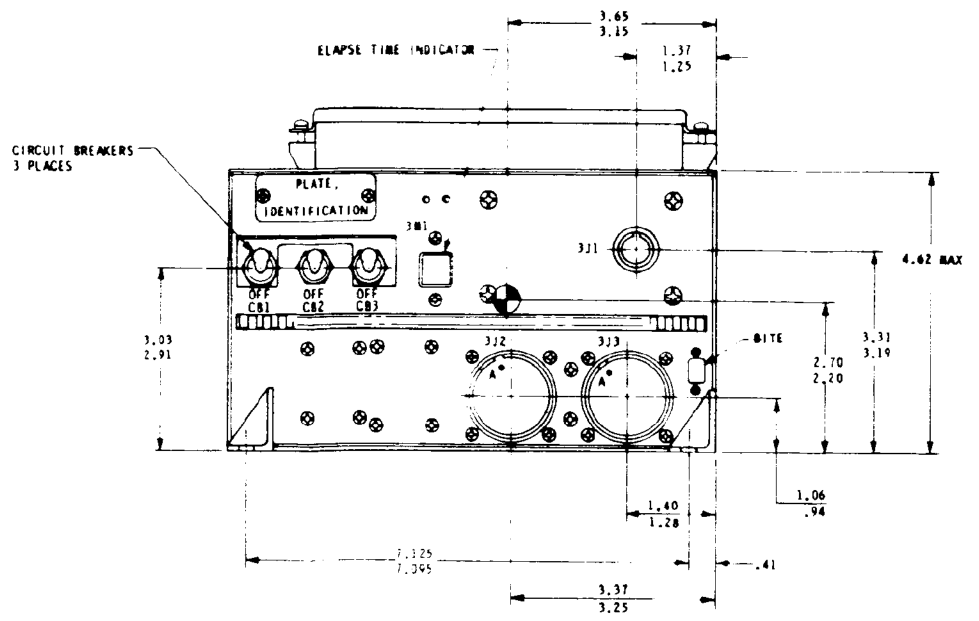
Note 2: In flight only.

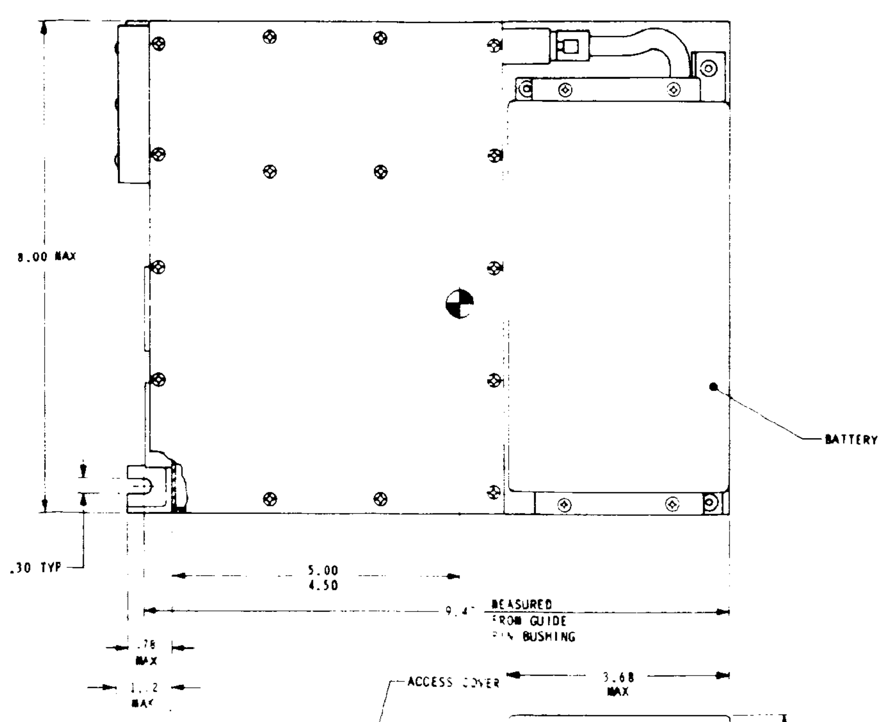
3.5.3.5 Mechanical Design

a. Weight - The PSU weight shall be no greater than than 17.8 pounds.

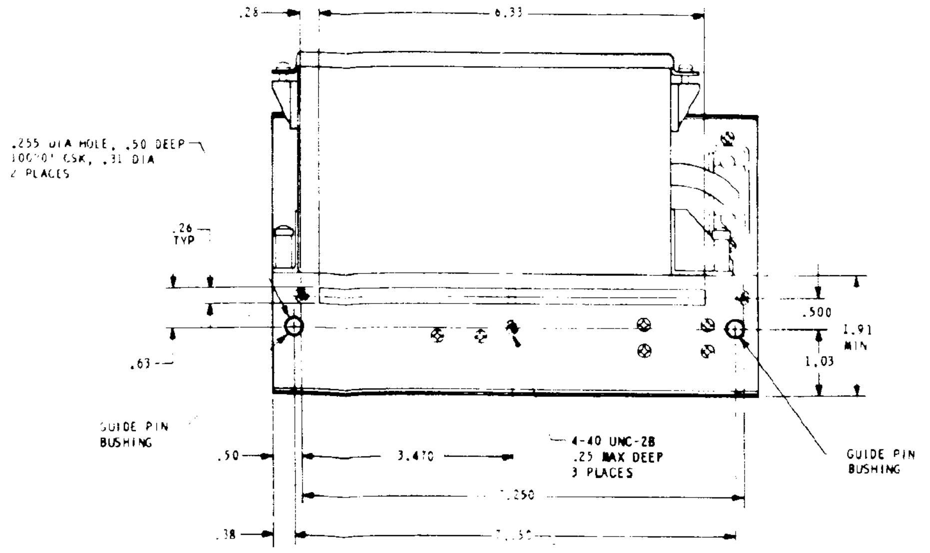
b. Size - The PSU shall conform to the outline and mounting drawing shown in' figure 24. *

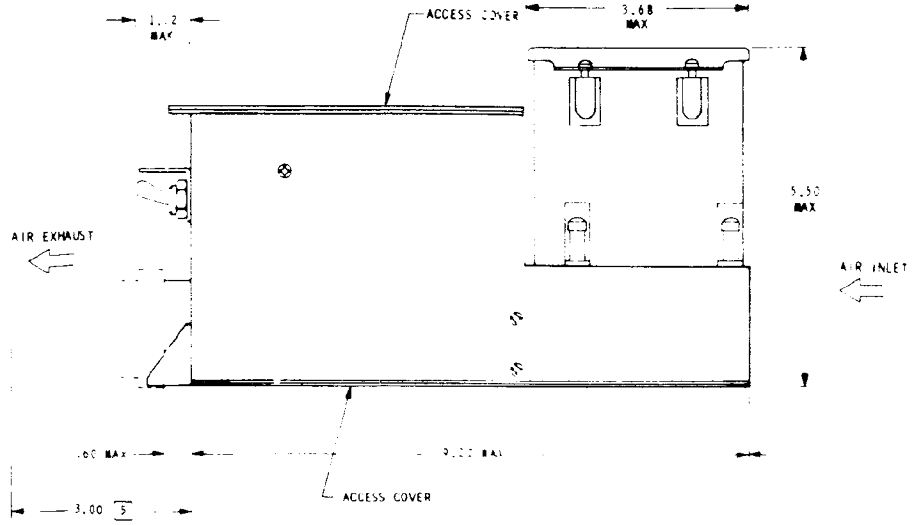
c. Cooling - Figures 25 and 26 specify the minimum PSU cooling air requirements and the cooling air pressure drop. *





CONNECTOR TABLE		
REF DES	CONNECTOR	MATING CONNECTOR
3J1	MS27478Y10D5P	JT06RE[illegible]SR
3J2	MS27508E22B21SA	JT06RE[illegible]SR)
3J3	MS27508E22B21SB	JT06RE[illegible]SR)





6. NOMINAL POWER DISSIPATION: [illegible] WATTS.
COOLING AIR REQUIRED: .63 LB MIN AT INLET TEMP OF [illegible] AND [illegible] = [illegible] IN. H_2O MAX.

5. CLEARANCE FOR REMOVAL OF MATING CONNECTOR.

4. ESTIMATED WEIGHT: [illegible] LB.

3. INDICATES CALCULATED CENTER OF GRAVITY.

2. ABBREVIATIONS PER MIL STD [illegible].

1. THIS DRAWING CONTAINS INFORMATION NECESSARY FOR MOUNTING PART NO. [illegible].

NOTES: UNLESS OTHERWISE SPECIFIED.

Figure 24. PSU Outline and Mounting

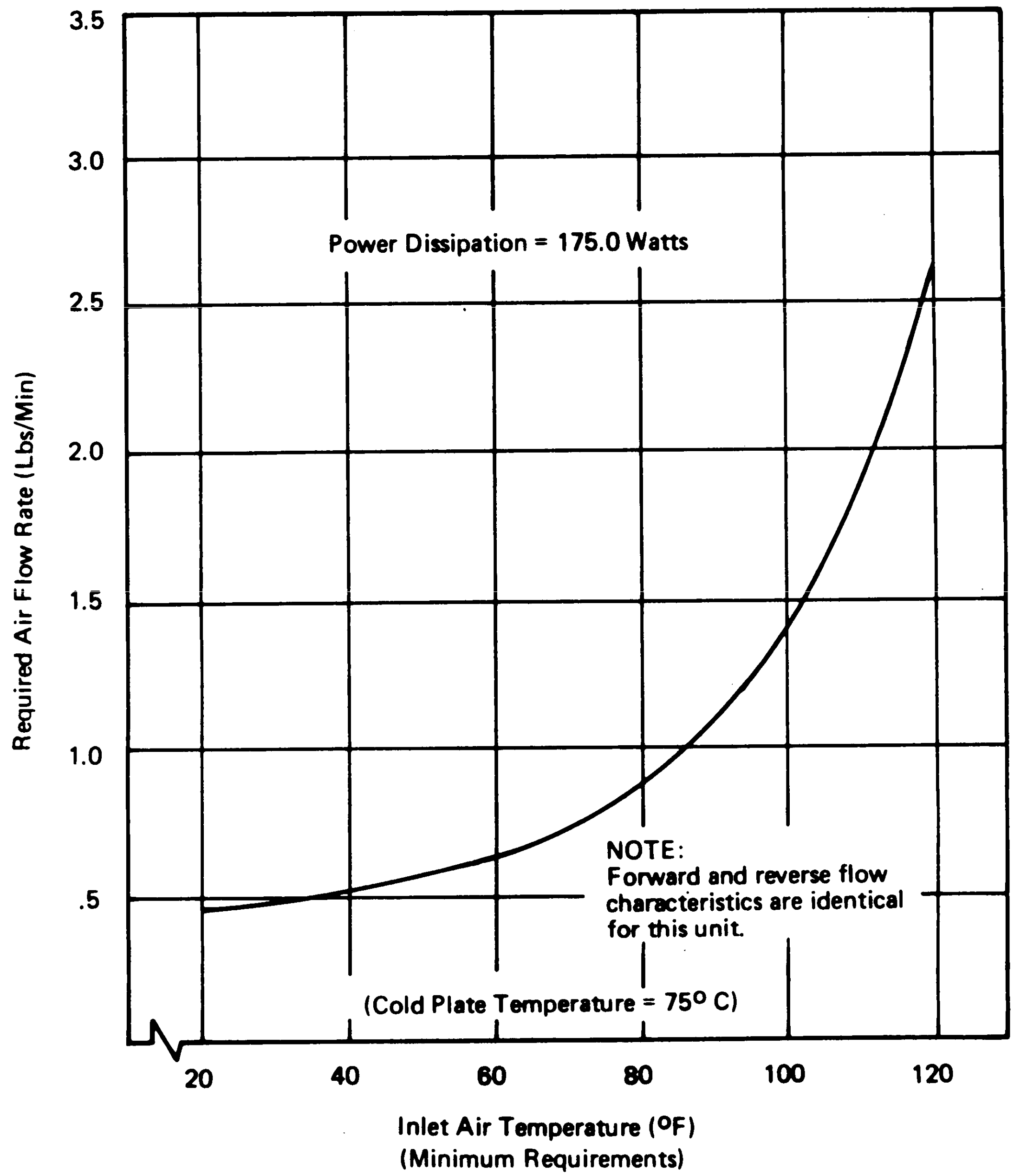


Figure 25. CAINS PSU Cooling Air Minimum Requirements (Cold Plate Temperature= 75°C)

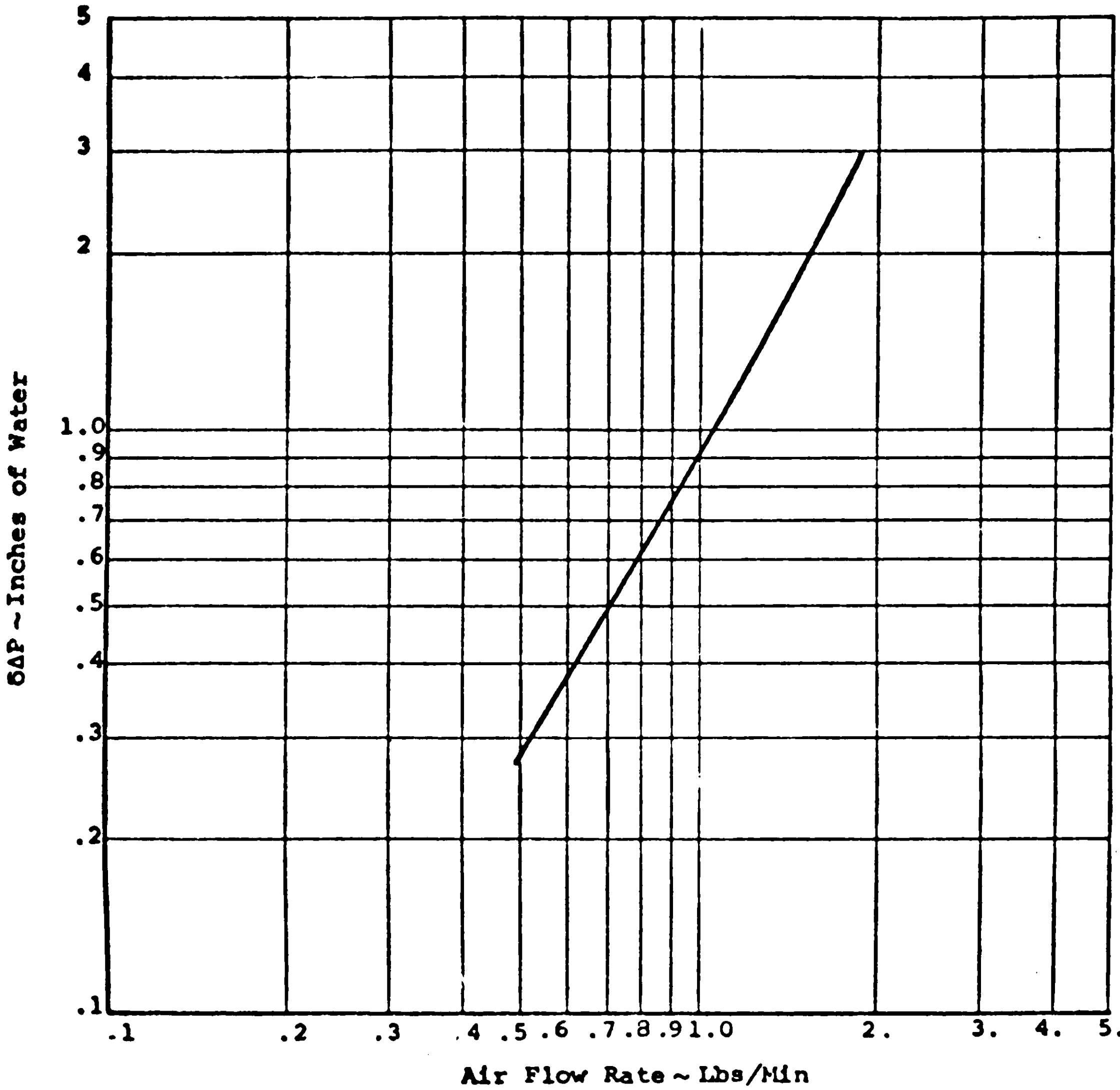


Figure 26. CAINS Power Supply Unit Cooling
Air Pressure Drop

Para 3.5.3.5
(cont)

d. Installation - The PSU shall be designed to meet the vibration requirements stated in 3.3.10.1 when installed as a "hard-mounted" unit. The unit shall be mounted horizontally and shall be retained in the rear by two 0.25-inch diameter guide pins which will recess in holes provided in the PSU chassis as shown in figure 24. Tabs will be provided on the front of the PSU which will accept no. 10 or 0.25-inch hold-down screws and washers. *

The battery shall be sealed nickel-cadmium cells with no requirement for external venting.

3.5.4 Air Navigation Computer Unit (ANCU)

3.5.4.1 Function - The ANCU shall provide the data processing capabilities of a general purpose digital computer. It shall accept inputs of pitch, roll, heading, velocity increments, temperature monitors, mode status, and calibration data from the IMU, manually initiated information from the CIU, data from external avionics via the CAU, and data directly from external avionics. The ANCU shall have the necessary control logic, memory, arithmetic and input/output capability to perform mode control, inertial alignment and the required navigation and steering computations. The ANCU shall furnish display information to the CIU, gyro torquing to the IMU, and the required outputs to external avionics via the CAU.

3.5.4.2 Memory - The memory capacity shall be a maximum of 12,288, 28-bit words internally expandable from 4096 words in 4096-word blocks. Memory cycle time shall not exceed four microseconds. The memory shall be nonvolatile, electrically alterable, and shall have the capability of inhibiting the write function in those words where the critical software program is stored except when interfacing with the program fill equipment. Direct access to the memory modules shall be available to external devices at the end of each instruction. Word length shall be 28 bits, including a sign bit.

3.5.4.3 Arithmetic Unit - The ANCU shall have the following . maximum computational speeds with a 28-bit operand:

Add time: 8 microseconds for primary instruction,
4 microseconds for secondary instruction

Multiply time: 58 microseconds

Divide time: 110 microseconds

The ANCU shall have a minimum clock rate of 2 MHz. Each instruction word shall contain two instructions which shall be executed as a sequential pair.

3.5.4.4 Input/Output - The I/O section of the ANCU shall provide the buffering and control of data and addresses required for computer communication defined in 3.4.4.1 (IMU), 3.4.4.4 (CIU), 3.4.4.3 (CAU), 3.4.3.2 (External), and 3.4.4.5 (PSU interface) . As a minimum, the I/O unit shall contain the following functional components:

a. A 28-bit (minimum) output buffer register which communicates serially or in parallel with the required units.

b. A 10-bit (minimum) external device address register which receives the device address from the computer.

c. A 15-bit (minimum) parallel address input channel to the memory address register for memory access either of interrupt instructions or of interleave data.

d. A 28-bit (minimum) parallel data input channel to the memory buffer register for memory interleave input data.

e. A 28-bit (minimum) parallel data output channel from the memory buffer register for memory interleave output data.

f. A real time counter which is capable of being set or read from the output buffer register.

3.5.4.5 Computer Program - The performance characteristics and requirements as stated in 3.4 will be achieved and controlled with a computer program uniquely designed to accommodate specific hardware, aircraft, and mission combinations. The program will be designed to complement the rapid alignment techniques employed by the IMU. The program will control the alignment and self-test of the equipment, as well as the navigation and display functions. The program may be mechanized to utilize uniquely available sensors such as doppler radar, air data computert and magnetic compass. Special noise handling techniques such as Kalman filtering may be used to effect minimum reaction times. The memory requirements shall be minimized and shall not exceed 8192 words of 28 bits in length, with two instructions per word. All operational computer programs developed for CAINS applications shall be documented in accordance with AR-15. *

3.5.4.6 Self-Test - The ANCU shall be capable of being programmed with a diagnostic test which is capable of detecting malfunctions and isolating to the ANCU with 90 percent confidence.

3.5.4.7 Power Requirement - The ANCU shall operate with the following voltages but shall not exceed the listed power levels:

+28 VDC ±5%: 14 watts

-28 VDC ±5%: 30 watts

+32 VDC (unregulated) A: 200 watts

+32 VDC (unregulated) B: 50 watts

The allowable variation in the +32 volts d-c is defined in 3.5.3.3. The above power levels include the power necessary to generate 4 amperes maximum steady state, or 6-ampere, 100-msec peak transient of +5.1 volts d-c ±2 percent which is required by the CIU. The ANCU shall receive 26 volts rms analog-to-digital converter reference from the CAU which shall be in phase with the IMU synchro excitation. Refer to 3.4.4.1g. In addition, the ANCU shall require no greater than two watts of 115 volt rms/400-Hz, single-phase power. The ANCU shall provide an orderly shutdown of power to protect the memory contents when a power status discrete is received from the PSU. *

3.5.4.8 Mechanical Design

a. Weight - The ANCU weight shall be no greater than 36.8 pounds with a 12K memory or 32.8 pounds with an 8K memory.

b. Size - The ANCU shall conform to the outline and mounting drawing shown in figure 27. *

c. Cooling - Figures 28 and 29 indicate the minimum cooling required and the pressure drop of the ANCU. *

d. Installation - Shock mounts are required for environment in excess of ±2g vibration and/or ±5g shock. The shock mounts shall meet the requirements of MIL-C-172 (refer to 3.5.6). *

3.5.5 Control Indicator Unit (CIU)

3.5.5.1 Function - The CIU shall provide the means to control and/or observe the operating mode of the equipment; to select desired navigation functions for display; and to enter or modify data. The CIU shall meet the requirements of MIL-C-6781. See figure 30 for a suggested front panel layout. *

3.5.5.2 Mode Selection - The CIU front panel shall contain a MODE switch which will allow the operator to select the equipment mode of operation. (Refer to 3.4.1.1). Except for the OFF *
position, each position shall be assigned to a bit in the Command Word. (Refer to 3.4.4.4 and table XIV.) *

3.5.5.3 Displays - In order to observe the various required *
variables (table XXI), the CIU front panel shall contain two *
separated displays (see figure 30); a left display and a right *
display. The left display shall be capable of displaying five digits and an N or an S. The right display shall be capable of
displaying six digits and an E or a W. The data to appear on the *
readouts shall be contained in the display words (table XII). *
Sign and punctuation of the data shall be under control of the
status word (table XI). The frequency of transmission of the *
display words is dependent upon the computer program (refer to
3.5.4.5). However, the selected words shall be updated no less *
than once every two seconds.

3.5.5.4 Entry/Display Selection - The DATA switch shall allow selection of the variable to be entered or displayed in the left and right displays. The required selectable variables, with

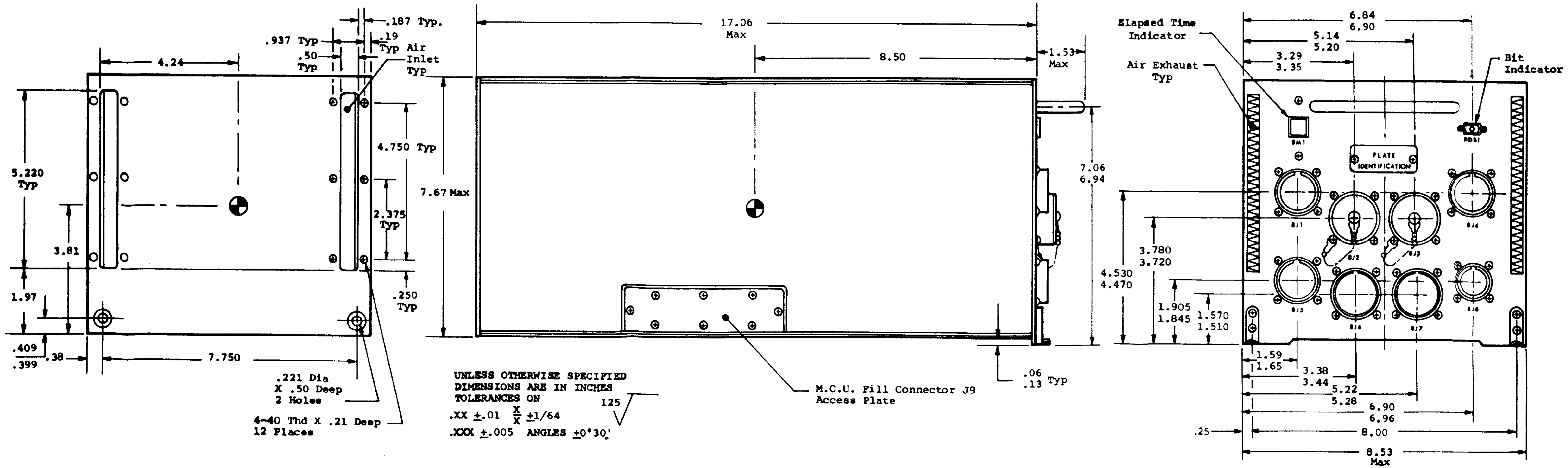


Figure 27. ANCU Outline and Mounting *

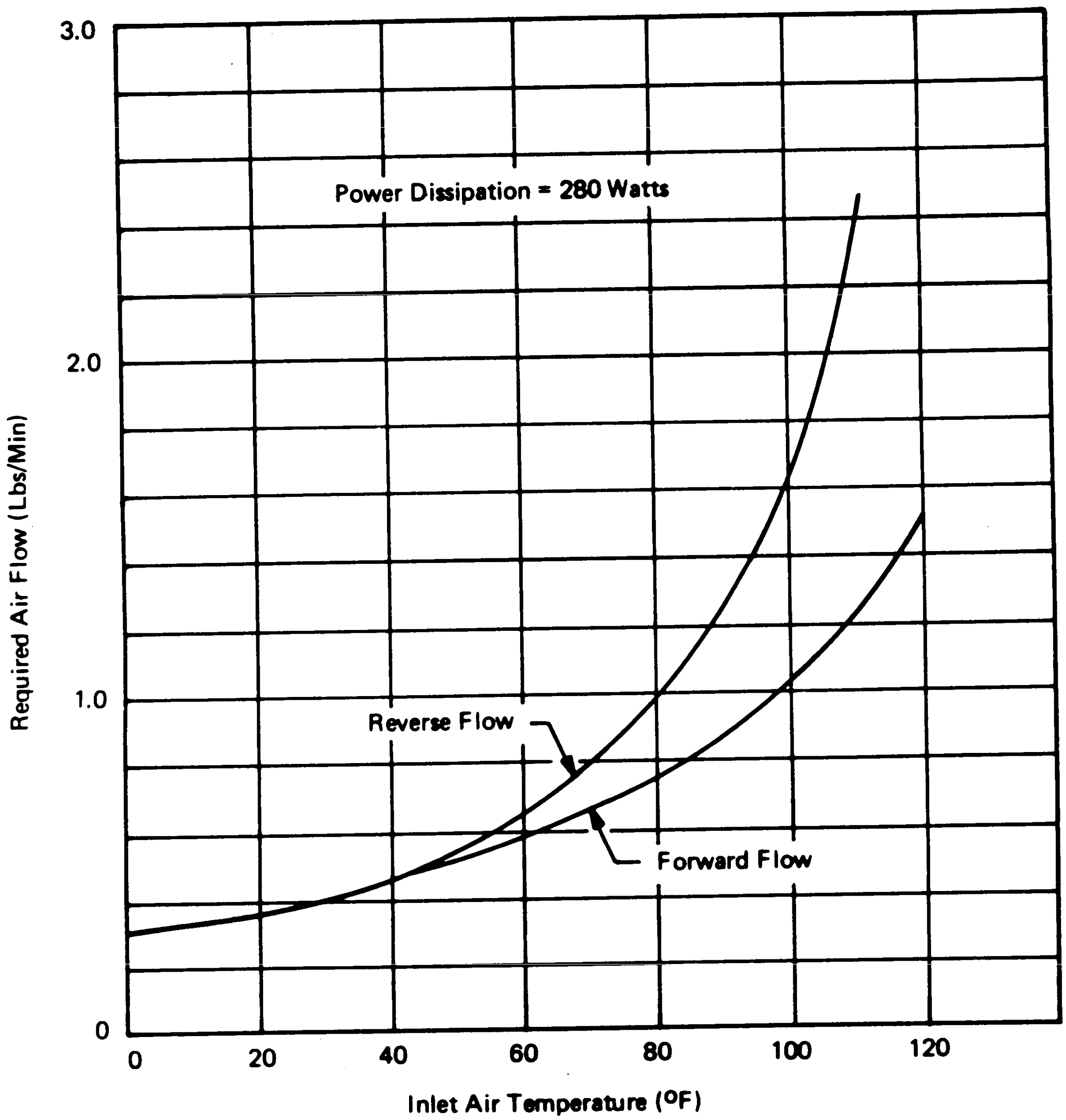


Figure 28. CAINS ANCU Cooling Minimum Requirements

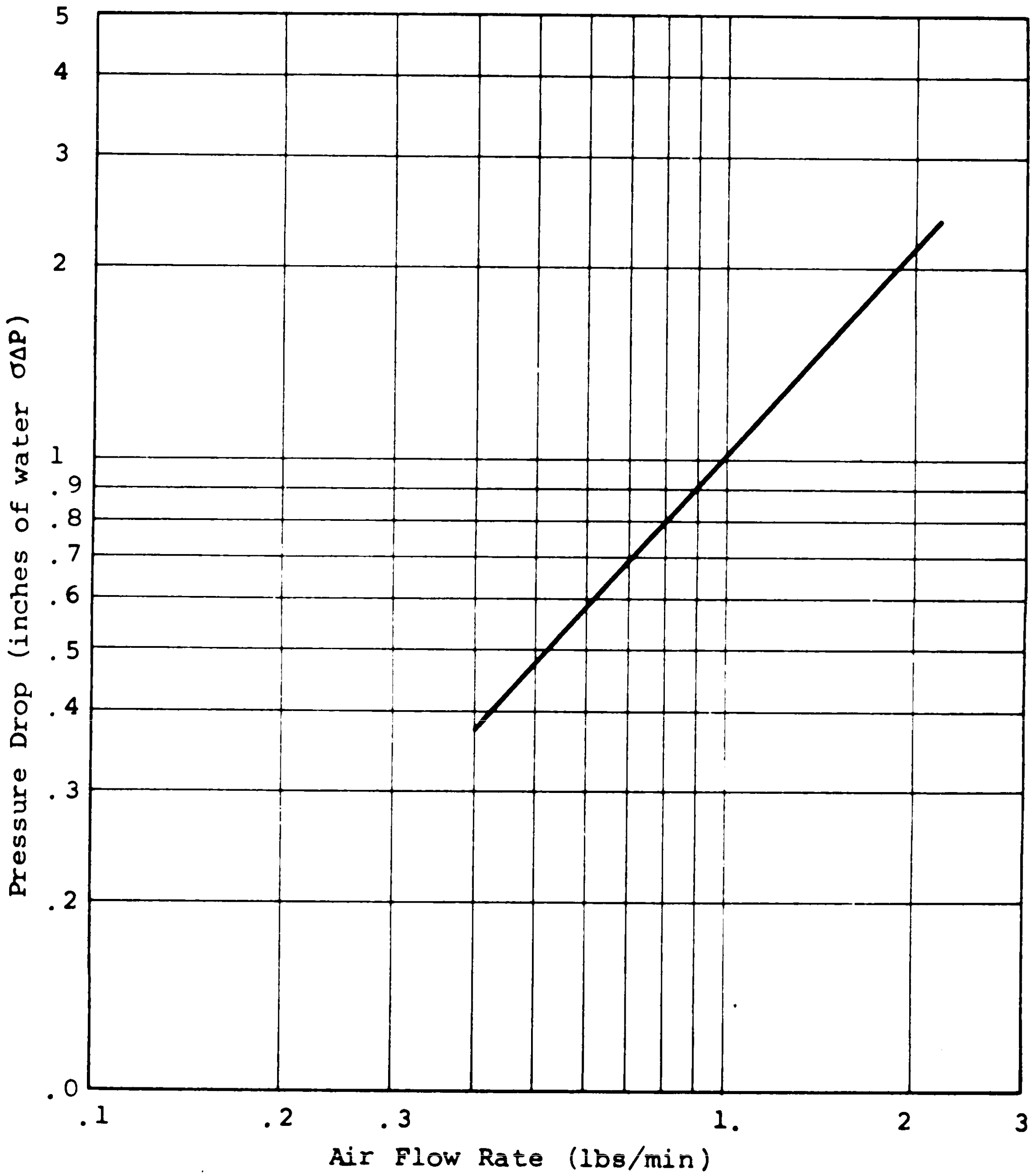


Figure 29. ANCU Cooling Air Pressure Drop

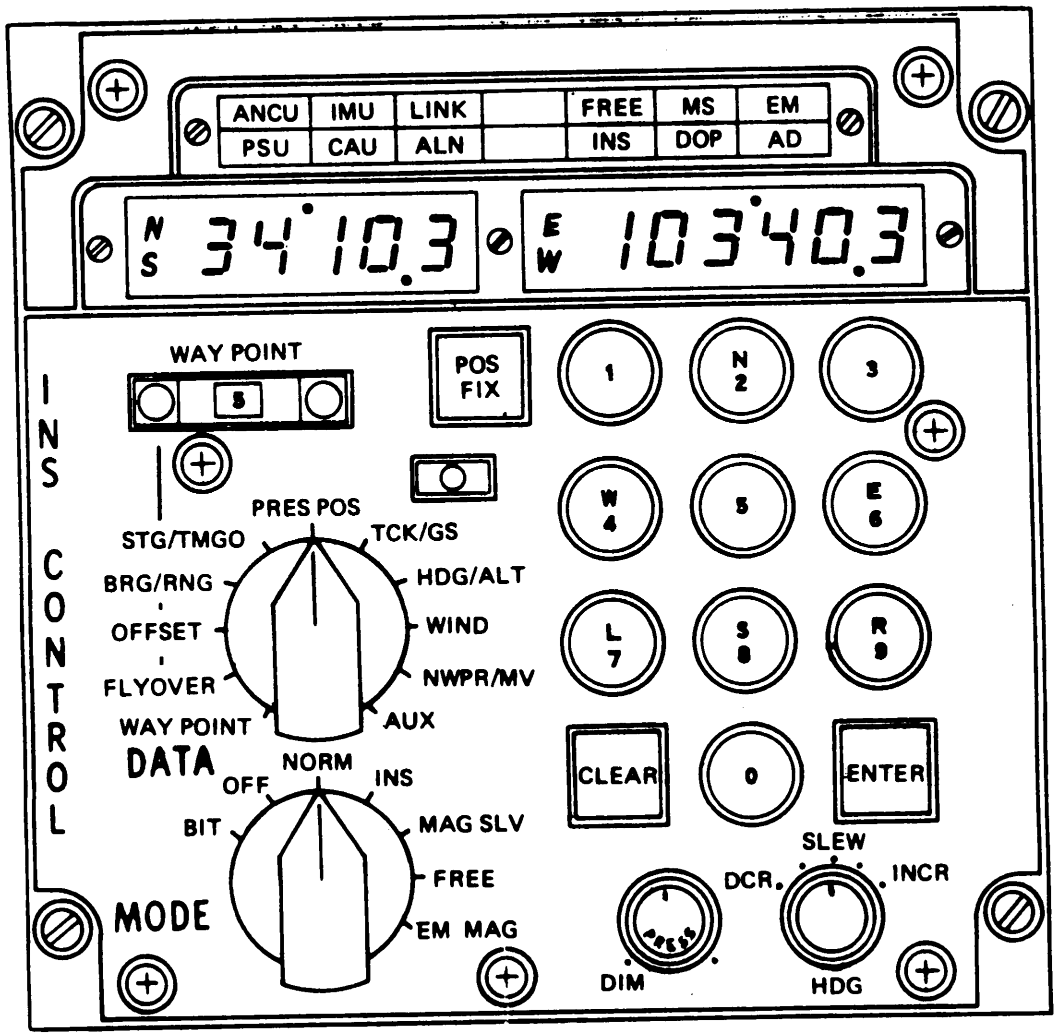


Figure 30. Control Indicator Unit Front Panel

TABLE XXI. CIU VARIABLES

Data Switch Position		Left Display: Range of Variable	Left Display: Units	Right Display: Range of Variable	Right Display: Units
WAY POINT		SB0°00.0 to S90°00.0 NB0°00.0 to N90°00.0	Deg and Min	WBB0°00.0 to W180°00.0 EBB0°00.0 to E180°00.0	Deg and Min
FLYOVER OR OFFSET	POS FIX	SB0°00.0 to S90°00.0 NB0°00.0 to N90°00.0	Deg and Min	WBB0°00.0 to W180°00.0 EBB0°00.0 to W180°00.0	Deg and Min
FLYOVER OR OFFSET	POS FIX	BB0 00.0° to BB3 59.9°	Degrees	BBBB B0.0 to BB99 99.9	Nautical Miles
BRG/RNG		BBB B0.0° to BB3 59.9°	Degrees	BBB B0.0 to B9999.9	Nautical Miles
STG/TMGO		Undefined	Undefined	BBBB B0.0 to BB99 99.9	Minutes
PRES POS	ANCU Control	SB0°00.0 to S90°00.0 NB0°00.0 to N90°00.0	Deg and Min	WBB0°00.0 to W180°00.0 EBB0°00.0 to E180°00.0	Deg and Min
PRES POS	*CAU Control	SBB B7 0° to NBB B9 0°	Degrees	BBBB BB B BBBB BB B	None
TCK/GS		BBB B0.0° to BB3 59.9°	Degrees	BBBB B0.0 to BB17 75.0	Knots

*This display is a function of the particular CAU being used and is used only in the attitude reference mode.

Note 1: Blanked characters are indicated with a "B".

Note 2: The range of variables is a function of the computer program used and is described here for the E-2C program as specified in AR-65.

TABLE XXI. CIU VARIABLES (cont)

<table>
<tr><th rowspan="2" colspan="2">Data Switch Position</th><th colspan="2">Left Display</th><th colspan="2">Right Display</th></tr>
<tr><th>Range of Variable</th><th>Units</th><th>Range of Variable</th><th>Units</th></tr>
<tr><td colspan="2">HDG/ALT</td><td>BBB B0.0° to BB3 59.9°</td><td>Degrees</td><td>SBBB BB 0 to SBB1 00 0
NBBB BB 0 to NB40 94 0</td><td>Feet</td></tr>
<tr><td colspan="2">WIND</td><td>BBB B0.0° to BB3 59.9°</td><td>Degrees</td><td>BBBB B0.0 to BBB2 99.9</td><td>Knots</td></tr>
<tr><td rowspan="2">NWPR/ MV</td><td>ANCU Control</td><td>BBB BB 0 to BBB B1 0</td><td>None</td><td>WBBB B0.0° to WBB1 79.9°
EBBB B0.0° EBB1 79.9°</td><td>Degrees</td></tr>
<tr><td>*CAU Control</td><td>BBBBBB</td><td>None</td><td>E/W BB000.0° to E/W BB180.0°</td><td>Degrees</td></tr>
<tr><td>AUX</td><td>WAY-POINT 4 VERT LEVER ARM/TRUE HDG</td><td>N/S BBBB0 to N/S BB128</td><td>Feet</td><td>BB0°00.0 to 359°59.9</td><td>Deg and Min</td></tr>
<tr><td>AUX</td><td>WAY-POINT
0
1
2
3
5
6
7
8
9</td><td colspan="4">The AUX position on the DATA switch may be used to display or enter up to ten sets of auxiliary data selected by the WAYPOINT pushbutton. Self-test results, align status, navigation errors, or other desired ancillary parameters may be displayed if included in the computer program. This data switch position provides for expansion of operational capability by changing software only, without requiring CIU panel changes.</td></tr>
<tr><td colspan="6">*This display is a function of the particular CAU being used and is used only in the attitude reference mode.
Note 1: Blanked characters are indicated with a "B".
Note 2: The range of variables is a function of the computer program used and is described here for the E-2C program as specified in AR-65.</td></tr>
</table>

Para 3.5.5.4 (cont)

their ranges and units, shall correspond to table XXI. The functions on the left hand side of the DATA switch (steering/time-to-go, bearing/range, offset, flyover, and waypoint) as well as the AUX position shall be used in conjunction with the WAYPOINT pushbutton. Each position on the DATA switch and WAYPOINT pushbutton shall be assigned to a bit in the Command Word (table XIV). * * *

a. WAYPOINT - The WAYPOINT position of the DATA switch shall allow the entry and display of the coordinates of up to ten waypoints. The coordinates of way points 0 thru 9 may be displayed or entered depending upon the waypoint selected on the WAYPOINT pushbutton switch. The waypoint coordinates may be entered either manually or automatically via the Data Link (refer to 3.4.3.2). These waypoints may be used as destinations for steering or as checkpoints for performing a position fix. * * * * *

b. FLY OVER - The FLYOVER position shall provide manual position fix capability when visually flying over a known waypoint and also to provide a record capability when flying over an unknown target. * *

c. OFFSET - The function of the OFFSET switch position is very similar to that of the FLYOVER switch position, except that coordinates of the target to be recorded or the reference coordinates for performing a position fix shall be established by using an external reference (e.g., radar cursors) rather than a visual sighting. The characteristics of the offset data inputs will be a function of the particular CAU being used and will be provided to the ANCU via the ANCU/CAU serial interface channel.

d. BRG/RNG - The left display shall display magnetic bearing to the waypoint which has been selected on the WAYPOINT switch. This is independent of the waypoint to which the aircraft is steering. The right display

Para 3.5.5.4d
(cont)

shall be used to display the range in nautical miles from the aircraft present position to the waypoint selected on the WAYPOINT switch.

e. STG/TMGO - The left display shall be used to select and display the waypoint to which the aircraft can be steered under control from the CAINS system if automatic steering is required. The right display shall display the time-to-go from the aircraft present position to the waypoint selected on the WAYPOINT switch.

f. PRES POS - The PRES POS position shall allow the entry and display of the aircraft present position coordinates. Present position latitude shall be entered and displayed in the left display. Present position longitude shall be entered and displayed in the right display. If the ANCU is inoperative, the CAU CONTROL COMMAND shall be supplied from the ANCU to the CAU,thus causing the CAU to control the entry and display of latitude in the left display.

TCK/GS - Aircraft ground track relative to magnectic north shall be displayed in the left display, and aircraft ground speed shall be displayed in the right display.

h. HDG/ALT - Magnetic heading of the aircraft shall be displayed in the left display, and barometric altitude shall be displayed in the right display.

i. WIND - The WIND position shall allow the display and entry of wind direction relative to magnetic north in the left display and wind magnitude in the right display.

j. NWPR/MV - The function of this DATA switch position shall be to allow display of NWPR (Number of Waypoints Received) in the left display and to allow the entry and display

Para 3.5.5.4j
(cont)

of magnetic variation in the right display. The ANCU requests waypoint information from the Data Link (AN/ASW-27 or AN/ASW-25) during alignment and prior to computer control of the IMU. In order to allow the operator to check whether any waypoint information, in fact, has been received, a number from O to 10 shall appear in the left display to indicate the number of waypoints received.

k. <u>AUX</u> - The function of this DATA switch position shall be to take advantage of the flexibility of the ANCU's general purpose computer to provide new entry and display functions as desired without modifying the CIU. The AUX switch position shall be expanded into 10 entry and display positions by use of the WAYPOINT pushbutton to provide the 0 thru 9 selectable subpositions. Waypoint supposition 4 is dedicated to display carrier vertical lever arm in the CIU left display and aircraft true heading in the CIU right display.

3.5.5.5 <u>Keyboard</u> - The keyboard shall consist of 10 pushbuttons which are used for number entry, the CLEAR pushbutton, and the ENTER pushbutton. The L\7 and R/9 pushbuttons shall serve dual functions. At the start of any data entry cycle, one or the other of these pushbuttons must be depressed. This is a signal to the CIU that data are going to be entered in either the left (L) display or the right (R) display. The dual function of the N/2, W/4, E/6, and S/8 pushbuttons shall allow for selection of sign or direction.

The ENTER pushbutton shall be used to signal the computer that it should accept the entered keyboard data which has been temporarily stored in the CIU.

Depressing the CLEAR pushbutton shall be used to take the CIU out of the data entry mode if the data have not yet been inserted into the computer. This shall reject data entry and return the CIU to its normal display mode of operation without modifying computer memory locations. *

3.5.5.6 POS FIX Pushbutton - Depressing the POS FIX pushbutton shall establish the instant at which position fix data are to be temporarily stored in the CIU. This includes both aircraft present position and external radar information. The DATA switch must be in either the FLYOVER or OFFSET position in order to initiate, accept, or reject a position fix. To reject the position fix, the CLEAR pushbutton shall be used. Depressing the ENTER pushbutton shall cause the computer to accept the position fix and correct the aircraft present position. *

3.5.5.7 CIU Malfunction Flag - The CIU malfunction flag shall be set (white dot indicator visible) by the ANCU any time the ANCU detects a malfunction in the CIU. This flag shall be latched magnetically and, even with power removed from the CIU, shall continue to display the appropriate malfunction status of the CIU. In the event that the ANCU malfunctions in a manner such that it is incapable of determining whether the CIU is operational or not, the ANCU built-in-test hardware shall output a reset signal to the CIU flag, thus inhibiting the ANCU from erroneously setting it. The CIU flag may also be reset externally by the avionics, if desired. *

3.5.5.8 Equipment Status Indicators - The following discrete lamps shall indicate the system malfunction, align, navigation, and backup mode status:

a. LINK - The LINK lamp ON shall indicate data link information is being received.

b. ALN - The ALN lamp ON shall indicate the platform is being aligned.

c. FREE - The FREE lamp ON shall indicate the system is in the FREE attitude reference mode.

d. MS - The MS lamp ON shall indicate the equipment is in the magnetic slaved attitude reference mode.

e. EM - The EM lamp ON shall indicate the equipment is in the emergency magnetic heading reference mode.

f. INS - The INS lamp ON without the DOP lamp ON shall indicate the inertial navigation mode and, with the DOP lamp ON, the doppler-inertial navigation mode.

Para 3.5.5.8
(cont)

g. DOP - The DOP lamp ON without the INS lamp ON shall indicate the doppler navigation mode.

h .AD - The AD lamp ON shall indicate the air data mode.

i. Malfunction Lamps - The following malfunction lamps shall be controlled by the malfunction flags in the specified units: ANCU, IMU CAU, and PSU. Except for the PSU, these flags may be set under program control. The malfunction lamps shall indicate the detection of a failure in the unit.

3.5.5.9 DIM/TEST Control - The DIM/TEST control shall serve a dual function. When rotated, it shall control the intensity of the annunciator lamps, the display lamps, and the three Push buttons (POS FIX, Enter and CLEAR). When depressed, it shall initiate panel lamp test. *

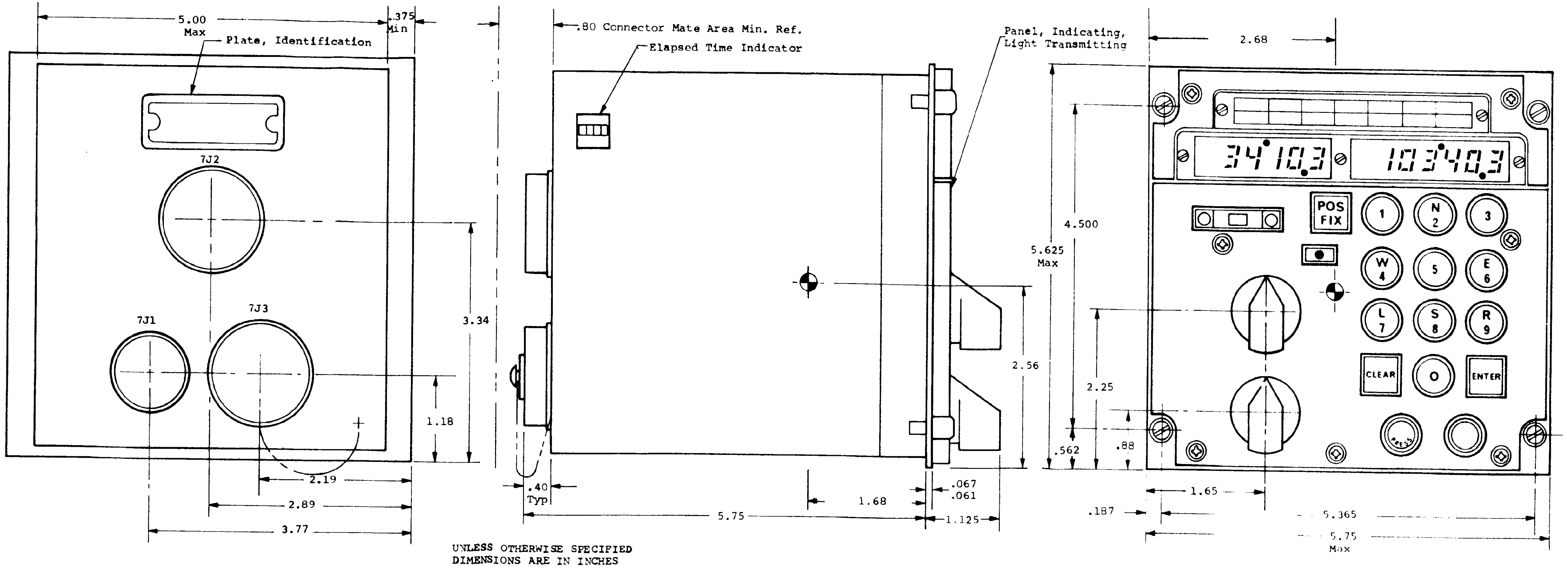
305.5.10 HDG SLEW - This shall be a five position rotary switch, spring-loaded to cause it to return to the center (no slew) position. It shall be used in the free attitude reference mode to slew the grid heading outputs from the CAU in an increasing or decreasing direction. Refer to appendix I. *

3.5.5.11 Power Requirement - The CIU shall require maximum of 4 amperes (maximum steady-state) or 6 amperes (100-msec peak transient) of +5 volts d-c ±2 percent (measured at the CIU external connector) from the ANCU. The ANCU shall supply 5.1 volts d-c (measured at the ANCU external connector) to the CIU to compensate for cable losses. The CIU shall require a maximum of 2 watts of aircraft 115 volts rms for the ETI, and a maximum of 10 watts of aircraft 5 volts rms or d-c for edgelighting. In addition, the CIU shall not require more than the transient current levels specified in 3.5.4.7. * * * * * *

3.5.5.12 Mechanical Design -

a. Weight - The CIU weight shall be no greater than 5.8 pounds.

b. Size - The CIU shall conform to the outline and mounting drawing shown in figure 31.



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
.XX ± .01   X/X ±1/32   125√
.XXX ±.005   ANGLES ±0°30'

Figure 31. CIU Outline and Mounting *

Para 3.5.5.12
(cont)

c. Cooling - The CIU shall require no cooling air.

3.5.6 Mounting Base, Electrical Equipment, Detailed Description

3.5.6.1 Function - The ANCU mounting base shall be used for restraint and to provide shock and vibration isolation for the ANCU. The mount shall also be designed with an integral transition device which will direct cooling air into the ANCU heat exchanger from a circular tube source.

3.5.6.2 Specification - The mounting base shall be designed in accordance with MIL-C-172.

3.5.6.3 Configuration - The mounting base shall be configured as indicated by the outline and mounting drawing, figure 32.

3.5.6.4 Weight - The weight of the ANCU mounting base, including the vibration isolators and the cooling air plenum, shall not exceed 4.0 1bs.

3.5.6.5 Installation - The mounting base shall be designed for installation on a horizontal shelf using 16 8-32 NC-2A or 10-32 NF-2A screws mounted through isolator flange holes. As indicated on the outline and mounting drawing (figure 32), cooling air shall be coupled to the air inlet side of the transition device using six 4-40 NC-2A screws. The sway space required under maximum dynamic conditions with the ANCU in place is also shown in figure 32.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibity for Inspection - Unless otherwise specified, the contractor is responsible for the performance of all test requirements as specified herein. Except as otherwise specified, the contractor may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the tests set forth in the specification where such tests are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Classification of Tests - Items covered by this specification shall be subjected to the following tests to determine compliance with all applicable requirements.

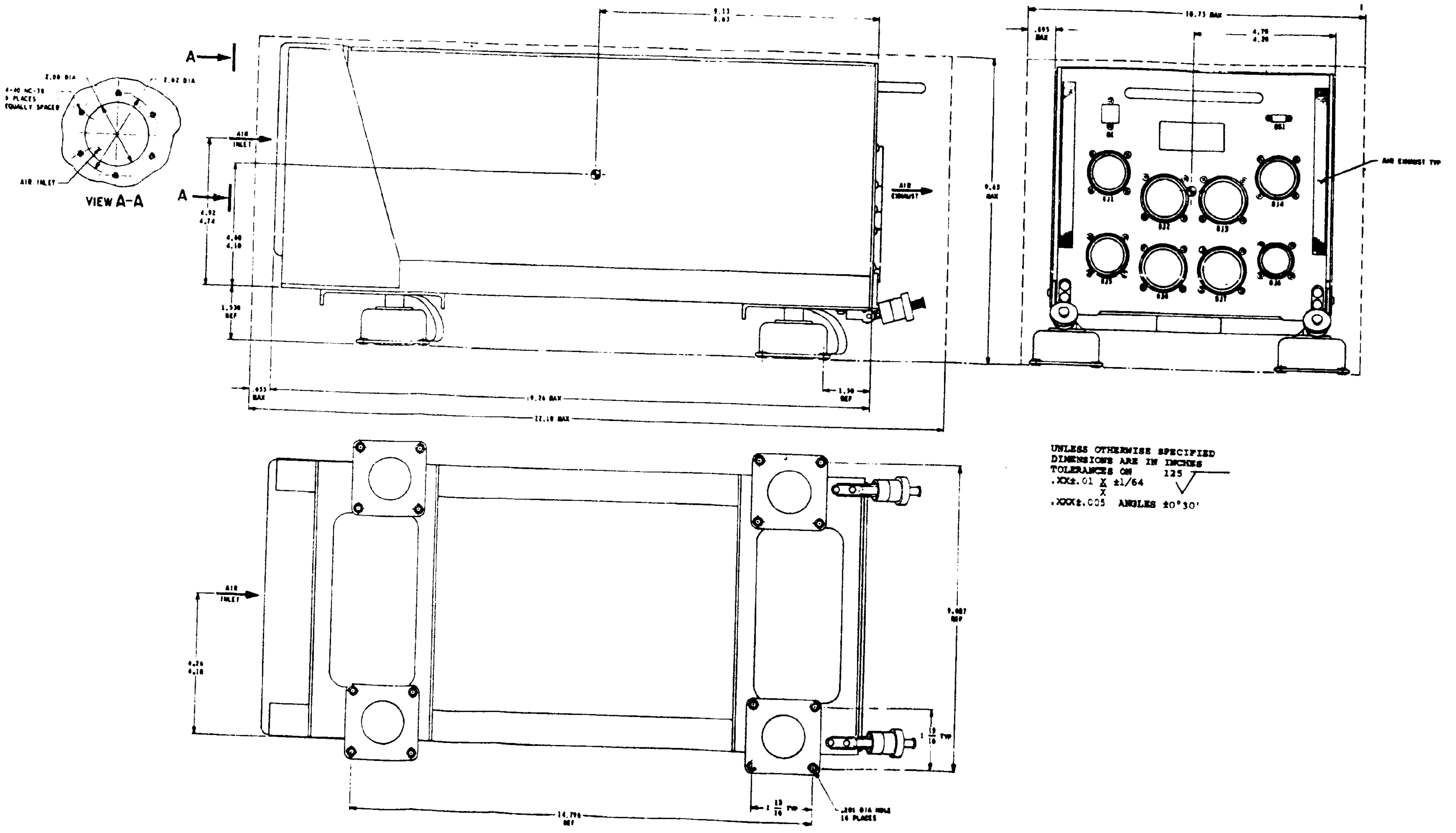


Figure 32. Outline and Mounting Drawing, ANCU Mounting Base (shown with ANCU in place) *

Para 4.1.1
(cont)

a. Preproduction (First Article) Tests *

b. Initial Production Tests *

co Acceptance Tests *

d. Life Tests *

4.2 Preproduction (First Article) Tests - Preproduction tests shall be conducted by the contractor on an equipment representative of the production equipments to be supplied under the contract. Preproduction tests shall be accomplished under the approved test procedure of 4.6. The Government inspector and the procuring activity shall be advised when tests are to be conducted so that a Government representative may be designated to witness or supervise the tests when so desired. Contractors not having adequate facilities to conduct all required tests shall obtain the services of a commercial testing laboratory acceptable to the Government.

4.2.1 Preproduction (First Article) Test Data - The contractor shall submit all data collected in conducting thest tests to the procuring activity for review.

4.2.2 Scope of Tests - Preproduction tests shall include all tests deemed necessary by the procuring activity to determine that the equipment meets all the requirements of this specification other applicable specifications and the contract. (Reproduction tests shall include environmental tests in accordance with the procedures of MIL-T-5422.) *

4.2.2.1 Vibration - At the contractor's option, an acoustic noise test may be substituted for vibration testing within the frequency range 500 to 2000 Hz. Such an acoustic noise test shall be performed in accordance with MIL-STD-810B, Method 515, Procedure I, Category A.

4.2.3 Preproduction (First Article) Approval - Approval of the preproduction sample shall be by the procuring activity upon satisfactory completion of all tests. No production equipments shall be delivered prior to the approval of the preproduction sample. Prefabrication of production equipment prior to the approval of the preproduction sample is at the contractor's risk. * The approved preproduction sample shall be retained by the contractor for his use in the fabrication and testing of equipment

Para 4.2.3
(cont)

to be submitted for acceptance. The preproduction sample shall not be considered as one of the equipments under the contract.

4.2.4 Production Equipments - Equipments supplied under the contract shall in all respects, including design, construction, workmanship, performance and quality, be equivalent to the approved preproduction sample. Each equipment shall be capable of successfully passing the same tests as imposed on the preproduction sample. Evidence of noncompliance with the above
shall constitute cause for rejection and, for equipment already *
accepted by the Government, it shall be the obligation of the contractor to make necessary corrections as approved by the procuring activity.

4.3 Initial Production Tests - One of the first ten production
equipments shall be selected and sent, at the contractor's ex- *
pense, to a designated Government laboratory for tests. This equipment shall be selected by the procuring activity after the equipment has successfully passed all individual tests. No other tests shall be conducted on equipment prior to starting
the initial production tests. The preproduction sample shall *
not be selected for this test.

4.3.1 Scope of Tests - This equipment may be subjected to any
and all tests which the procuring activity deems necessary to *
assure that the production equipment is equivalent to the pre-
viously approved preproduction sample in design, construction
workmanship, performance and quality, and that it meets all *
applicable requirements.

4.3.2 Accessory Material - In addition to the complete equipment
submitted for initial production tests, the contractor shall *
also submit any accessory material and data necessary to test *
the equipment.

4.3.3 Initial Production Sample Approval - Approval of the
initial production sample shall be by the procuring activity *
upon satisfactory completion of all tests. Any design, material, *
or performance defect made evident during this test shall be
corrected by the contractor to the satisfaction of the procuring
activity. Failure of the initial production sample to pass any *
of the tests shall be cause for deliveries of equipment under the contract to cease until proper corrective action is approved and accomplished. Corrective action shall also be accomplished on equipment previously accepted when requested by the procuring activity.

4.3.4 Reconditioning of Initial Production Test Sample - On completion of the initial production test, the equipment shall be reworked by the contractor by replacing all limited life or damaged items. After reworking, the contractor shall submit” the equipment for acceptance.

4.4 Acceptance Tests - The contractor shall furnish all samples and shall be responsible for accomplishing the acceptance tests. All inspection and testing shall be under the supervision of the Government inspector. Contractors not having adequate facilities for conducting all required tests shall engage the services of a * commercial testing laboratory acceptable to the procuring activity. The contractor shall furnish test reports showing quantitative results for all acceptance tests. Such reports shall be signed by an authorized representative of the contractor or laboratory, as applicable. Acceptance or approval of material during the course of manufacture shall not be construed as a guarantee of the acceptance of the finished product. Acceptance tests shall consist of the following:

a. Individual Tests *

b. Sampling Tests *

c. Reliability Assurance Tests *

d. Special Tests *

4.4.1 Individual Tests - Each equipment submitted for acceptance shall be subjected to the individual tests. These tests shall be adequate to determine compliance with the requirements of material, * workmanship, operational adequacy, and reliability. As a minimum, each equipment accepted shall have passed the following tests:

a. Examination of Product *

b. Operational Test *

c. Manufacturing Run-in Test *

4.4.1.1 Examination of Product - Each equipment shall be examined carefully to determine that the material and workmanship requirements have been met.

4.4.1.2 Operational Test - Each equipment shall be operated long enough to permit the equipment temperature to stabilize and to check sufficient characteristics and record adequate data to assure satisfactory equipment operation.

4.4.1.3 Manufacturing Run-in Test - Each equipment shall be operated under the conditions specified herein for a period of 10 hours without failure. A failure shall be defined as anything which causes malfunctioning of the equipment. Only those adjustments will be permitted which can be made using controls and adjustments which are accessible to the operator during the normal use of the equipment. This test shall be deleted if the reliability test includes a test on each equipment which consumes at least 10 hours of operation.

Temperature:	Ambient room
Humidity:	Ambient room
Vibration:	Any selected frequency within the range of 20 to 30 hz (excluding resonant points) and a minimum amplitude of ±3g

The equipment shall be vibrated (without vibration isolators) for a period of 10 minutes prior to the beginning of the 10-hour period of operation. Where feasible, the equipment shall be operated during this vibration period for the purpose of detecting flaws and imperfect workmanship. Operation within the specified limits of satisfactory performance is not necessarily required during the vibration period. The direction of vibration should be vertical to the normal mounting plane for five minutes and lateral to the plane for five minutes. Where it is not feasible to vibrate the equipment in two directions, the vertical direction shall be used. During the 10-hour period of operation following the 10-minute vibration period, the equipment shall be mechanically cycled periodically through its various phases of operation. Should a failure occur, it should be repaired and the test restarted, except that the 10-minute vibration period need not be repeated when it is certain that the failure was not a result of the vibration. Should repetitive failures occur, corrective action shall be taken to eliminate this defect from future equipment. A record shall be kept of all failures. The 10-hour period specified above may be composed of two five-hour periods to conform with standard working hours.

4.4.2 Sampling Tests - Equipments selected for sampling tests shall first have passed the individual tests. Equipments shall be selected for sampling tests by the Government inspector in accordance with the following:

Para 4.4.2
(cont)

Quantity of Equipments offered for Acceptance	Quantity to be Selected for Sampling Test
First 10	1 [1]
Next 50	1
Next 75	1
Next 100	1
	1 for each additional 200 or fraction thereof

*

4.4.2.1 Scope of Tests - As a minimum, each equipment selected for sampling tests shall be subjected to the following tests:

a. Complete operational test at ambient room conditions, making all necessary measurements to assure that all applicable specification requirements have been met.

b. Operational test at certain environmental conditions. The conditions may vary for each equipment tested and should be based on results of the preproduction, initial production, individual, and special tests.

c. Manufacturing run in test specified in 4.4.1.3, except that the test duration shall be 120 hours with no restriction on the number of failures. However, each failure shall be analyzed as to cause and remedial action necessary to reduce the possibility of its recurrence in future equipment. *

4.4.3 Relibility Assurance Tests - Reliability assurance tests * shall be conducted using MIL-STD-781. Tests as required by both the qualification phase-and the production acceptance (sampling) * phase shall be conducted. Classification of failure shall be in accordance with MIL-STD-781 and AR-34.

4.4.3.1 Qualification Phase - Prior to the acceptance of equipments under the contract or order, a minimum of three sets shall * be tested as outlined in MIL-STD-781, under the section entitled

[1] One out of first ten need not be selected and tested if initial * production tests are conducted. Sampling tests are not re- * quired when reliability assurance tests are conducted. *

Para 4.4.3.1
(cont)

"Qualification Phase of Production Reliability Tests". The maximum number of sets to be used shall be those listed in Table 5 of MIL-STD-781. For the qualification phase, Test Level E shall be used. The accept-reject criteria for Test Plan III shall be used. *

4.4.3.2 Reliability Production Acceptance Phase Tests - The equipment , throughout production, shall be tested as outlined in MIL-STD-781 (as modified herein) under the section entitled "Production Acceptance (Sampling) phase of Production Reliability Tests", except that all equipments produced shall be tested. Test Level E of MIL-STD-781 shall be used.

4.4.3.2.1 All Equipment Test - Each WRA produced shall be tested for 50 hours. Prior to the 50-hour test on each WRA, a burn-in period may be used at the option of the contractor. If the burn-in period is to be used, the details thereof must be included in the approved test procedures. To determine whether the MTBF is being met at any time during the contract, the operating test time in multiples of the specified MTBF, and the failures thereon (not including burn-in failures or burn-in operating time) shall be totaled and the results compared with the reject line of Test Plan II of MIL-STD-781. (Extend the line as necessary to accommodate the data.) To calculate the test time in terms of multiples of the specified MTBF, the test time shall be divided by the MTBF specified for the WRA under test. All test time and failures accumulating under the contract during the All Equipment Test shall be plotted on a single chart similar to that of 4.2.9.5 of MIL-STD-781. This chart shall combine the test data for various WRA's. These totals shall accumulate so that, at any one time, the experience from the beginning of the contract is included. At the conclusion of each month, the test results shall be sent to the Naval Air Systems Command, Attention: Avionics Division. At any time that the current totals of test hours and test failures plotted on Test Plan 11 curves show a reject situation, the procuring activity shall be notified. The procuring activity reserves the right to stop the acceptance of equipment at any time that a reject situation exists pending a review of the contractor' s efforts to improve the equipment, the equipment parts, the equipment workmanship, etc. , so that the entire compilation will show other than a reject decision. * * * * *

4.4.3.3 Test Details - The test details such as the length of the test cycle, the length of the heat portion of the cycle, the performance characteristics to be measured, special failure

Para 4.4.3.3
(cont)

criteria, preventive maintenance to be allowed during the test, etc., shall be part of the test procedures to be submitted and approved by the procuring activity prior to the beginning of qualification test phase of the reliability assurance tests. *

4.4.4 Special Tests - Special tests shall be conducted for the purpose of checking the effect of any design or material change on the performance of the equipment and to assure adequate quality control. The equipment selected for special tests may be selected from equipments previously subjected to the sampling or reliability assurance tests.

4.4.4.1 Special Test Schedule - Selection of equipments for special tests shall be made as follows:

a. On an early equipment after an engineering or material change. *

b. Whenever failure reports or other information indicate that additional tests are required. (This will be determined by the procuring activity.) *

4.4.4.2 Scope of Tests - Special tests shall consist of such tests as approved by the procuring activity. Test procedures previously approved for the preproduction tests shall be used where applicable. When not applicable, the contractor shall prepare a test procedure and submit it to the procuring activity for approval prior to conducting the tests.

4.4.5 Equipment Failure - Should a failure occur during either the sampling, reliability assurance, or special tests, the following action shall be taken:

a. The cause of failure shall be determined. *

b. Whether the failure is an isoolated case or design defect shall be determined. * *

c. Proposed corrective action intended to reduce the possibility of the same failure(s) occurring in future tests shall be submitted to the procuring activity. * * *

Para 4.4.5
(cont)

d. Where practical, a test shall be included in the individual test to check all equipment for this requirement until reasonable assurance is obtained that the defect has been corrected satisfactorily. *

4.5 Life Test - The contractor shall furnish all samples and shall be responsible for accomplishing the life tests. The test shall be of 300 hours duration and shall be conducted on equipments that have passed the individual test. The life test shall be performed under the conditions specified in 4.5.1. The life test sample shall be selected by the Government inspector in accordance with the following. (Equipments which have successfully passed the initial production test, Sampling tests, reliability tests, or special tests may be selected for life tests.) (Test life accumulated during the reliability test may be counted toward the life test provided the entire 300 hours is accumulated on a single equipment and equipment selected is in accordance with the table below.) *

Quantity of Equipments Offered for Acceptance	Quantity to be Selected for Life Test
First 25	1
Next 175	1
Next 300	1
	1 for each additional 500 or fraction thereof

4.5.1 Test Conditions - The life test shall be conducted under the following simulated service conditions:

Temperature	Normal room
Altitude	Normal ground (0-5000 ft.)
Humidity	Room ambient
A-c voltage	115 ±5 volts (at lowest applicable frequency) *
D-c voltage	27.5 ±2.0 volts *

4.5.2 Test Periods - The test may be run continuously or intermittently. Any period of operation shall be of sufficient duration to permit the equipment temperature to stabilize. Periodically, the equipment shall be turned on and off several times and cycled through its various phases of operation. *

4.5.3 Performance Check - At approximately eight hour intervals during the test, a limited performance check shall be made. The performance check proposed by the contractor shall be subject to approval by the procuring activity.

4.5.4 Test Data - The contractor shall keep a daily record of the performance of the equipment, making particular note of any deficiencies or failures. In the event of part failures, the defective part shall be replaced and the operation resumed for the balance of the test period. A record shall be kept of all failures throughout the test. This record shall indicate the fOllowing: .

a. Part type number

b. The circuit reference symbol number

c* The part function

d. Name of the manufacturer

e. Nature of the failure

f. The number of hours which the part operated prior to failure.

4.5.4.1 Failure Report - In the event of a failure, the Government inspector shall be notified immediately. A report shall be submitted to the procuring activity upon completion of test. In this report, the contractor shall propose suitable and adequate design or material corrections for all failures which occurred. The procuring activity will review such proposals and determine whether they are acceptable.

4.6 Test Procedures - The procedures used for conducting preproduction tests, acceptance tests, and life tests shall be prepared by the contractor and submitted to the procuring activity for review and approval. The right is reserved by the procuring activity or the Government inspector to modify the tests or require any additional tests deemed necessary to determine compliance with the requirements of this specification or the contract. Specification MIL-T-18303 shall be used as a guide for preparation of test procedures. When approved test procedures are available from previous contracts, such procedures will be provided and may be used when their use is approved by the procuring activity. However, the right is reserved by the procuring activity to require modification of such procedures, including additional tests, when deemed necessary.

4.7 Reconditioning of Tested Equipment - Equipment which has been subjected to initial production, acceptance, and life tests shall be reconditioned by the contractor by replacing all worn or damaged items. After reworking, the contractor shall resubmit the equipment for acceptance. *

4.8 Presubmission Testing - No item, part, or complete equipment shall be submitted by the contractor until it has been tested previously and inspected by the contractor and found to comply, to the best of his knowledge and belief, with all applicable requirements. * *

4.9 Rejection and Retest - Equipment which has been rejected may be reworked or have parts replaced to correct the defects and resubmitted for acceptance. Before resubmittal, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished to the Government inspector. * *

5. PREPARATION FOR DELIVERY

5.1 General - All major units and parts of the equipment shall be preserved, packaged, packed, and marked for the level of shipment specified in the contract or order in accordance with MIL-E-17555 and MIL-STD-794. In the event the equipment is not covered in MIL-E-17555, the method of preservation of Level A shall be determined in accordance with the selection chart in Appendix D) of MIL-STD-794.

5. NOTES

6.1 Intended Use - This Inertial Navigation Set shall be used as a standard unit for all carrier type aircraft.

6.2 Ordering Data - Purchasers should exercise any desired aptions offered herein, and procurement documents should specify the following:

a. Title, number, and date of this specification

b. Selection of applicable levels of packaging, and packing (refer to 5.1)

6.3 Precedence of Documents - When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence shall apply:

a. Contract - The contract shall have precedence over any specification.

b. This Specification - This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, shall be specifically approved in writing by the procuring activity.

c. Reference Specifications - Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.

6.4 Performance Objectives - Minimum size and weight, simplicity of operation, ease of maintenance, and an improvement in the performance and reliability of the specific functions beyond the requirements of this specification are objectives which shall be considered in the production of this equipment. Where it appears a substantial reduction in size and weight or improvement in simplicity of design, performance, ease of maintenance, or reliability will result from the use of materials, parts, and processes other than those specified in MIL-E-5400, it is desired that their use be investigated. When investigation shows advantages can be realized, a request for approval shall be submitted to the procuring activity for consideration. Each request shall be accompanied by complete supporting information.

6.5 Nonreparable Subassemblies - As a general rule, nonreparable * subassemblies should be encapsulated or hermetically-sealed. The number of connections internal to the subassembly should be held to a minimum. Detail parts tolerances and rating should be so selected that the life of the subassembly is greater than that of a similar reparable one. With few exceptions (such as high voltage power supplies), the nonreparable subassembly should evidence a mean-time-to-failure greater than 5000 hours and, for. many applications, this figure must be nearer 50,000 hours.

6.6 Associated Equipment - The following are optional items with which the software and CAU may be required to operate within specific aircraft applications (refer to Appendix I):

Bearing, Distance, Heading Indicator

Vertical Display

Head-up Display

Horizontal Situation Indicator

Airborne Missile Control System

Automatic Flight Control System

6.7 Revision Markings. For purposes of declassification and incorporation of modifications specified in Amendment 2 of MIL-N-81604B(AS) , this document was edited and retyped in entirety. Certain technical errors over and above the modifications of Amendment 2 were discovered and subsequently corrected. Such corrections are identified by a bar in the right hand margin opposite each change. Many minor changes of an editorial nature were made to enhance consistency and promote compliance with the requirements of MIL-STD-490. Editorial changes are identified by an asterisk (*) appearing in the right hand margin opposite each line in which alteration was made. Due to the extensiveness of the changes; bidders and contractors are Cautioned to evaluate the requirements of this document based on the entire content irrespective of previous issues.

Change identification has been done as a convenience only and the Government assumes no liability for any inaccuracies in these notations.

6.8 This specification is under the cognizance of AIR-53350E.

custodians
Navy (AS)

Preparing Activity:
Navy (AS)

(Project No. N143)

APPENDIX I

CONVERTER AMPLIFIER UNIT (CAU) *

10. SCOPE

10.1 General - The equipment covered by this Appendix shall provide the necessary elements for interfacing the Inertial Navigation Set, AN/ASN-92(V), with the E-2C Aircraft.

10.2 Classification - The E-2C Inertial Navigation Set, AN/ASN-92(V), shall consist of the equipment listed in MIL-N-81604C, paragraph 1.2 and the following items:

Items	Type Description	Applicable Paragraph
Converter-Amplifier	CV-2566/ASN-92(V)	30.5
Mounting Base, Electrical Equipment	MT-4376/ASN-92(V)	30.6

10.3 Associated Equipment - This equipment shall operate with the associated equipment listed in 60.1. *

20. APPLICABLE DOCUMENTS

20.1 General - The following documents and those listed in 2.1 are applicable to this Appendix to the extent specified. Listed are the issues of the documents in effect for the previous procurement. However, in lieu of the issue listed, the contractor shall use the latest issue in effect of these documents where feasible. If the use of the latest issue will affect design, performance, or interchangeability of any replaceable part, then the issue of the document listed below shall be used. *

SPECIFICATIONS

Military

MIL-A-23670A	Reference System, Heading and Attitude, AN/ASN-50

SPECIFICATIONS (cont)

Military

MIL-I-22075	Indicator, Bearing Distance Heading, ID-663/U
MIL-I-23085	Indicator, Remote Attitude, MM-4
MIL-I-9229	Indicator, Course, ID-387/ARN
MIL-N-22239B	Navigational Set, TACAN, AN/ARN-52
MIL-N-23407A-1	Radar, Doppler, AN/APN-153(V)

20.2 Availability of Documents - Refer to paragraph 2.1.1 of MIL-N-81604C(AS). *

30. REQUIREMENTS

30.1 Preproduction - Refer to 3.1. *

30.2 Parts and Materials - Refer to 3.2. *

30.3 Design and Construction - Refer to 3.3. *

30.3.1 Total Weight - The total weight of the Converter-Amplifier Unit (CAU), excluding cables, shall be a minimum consistent with good design and shall not exceed 30.0 pounds.

30.3.2 Reliability - Refer to paragraph 3.3.2 of MIL-N-81604c. The MTBF of the CAU shall not be less than 4175 hours.

30.3.3 Cabling and Connections

30.3.3.1 Cables and Connectors - Refer to 3.3.3.1. *

30.3.3.2 Interconnection Cabling - Refer to 3.3.3.2. *

30.3.3.3 Unit Interconnection - Figure 33 presents the connectors, signal interconnection, and pin assignments of the E-2C CAU and the associated AN/ASN-92(V) system. *

30.3.3.4 Internal Wiring - Refer to 3.3.3.4. *

30.3.4 Control Panels - Not applicable.

30.3.5 Interchangeability - Refer to 3.3.5. *

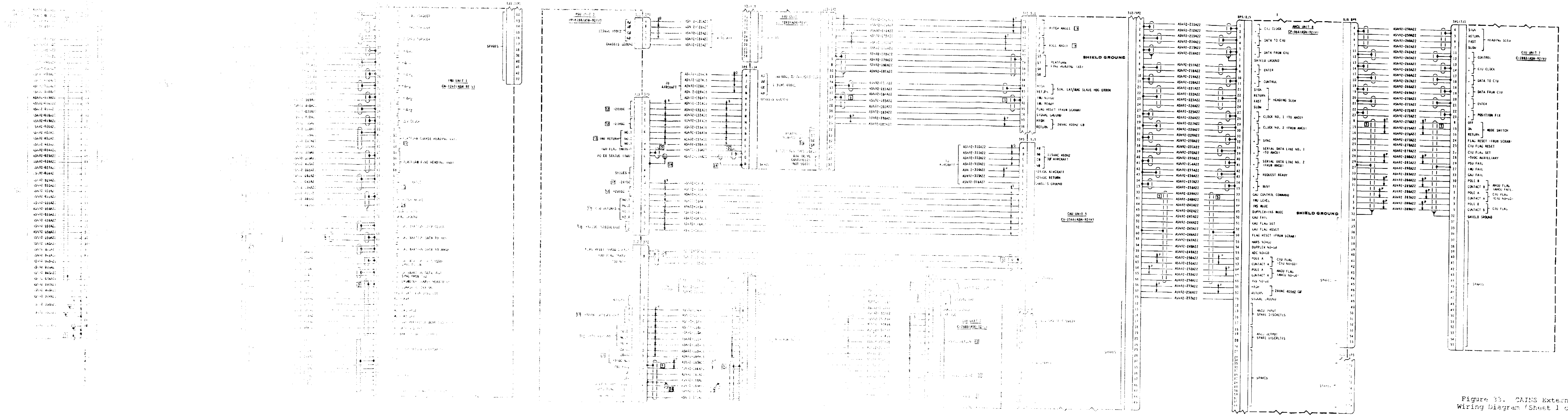
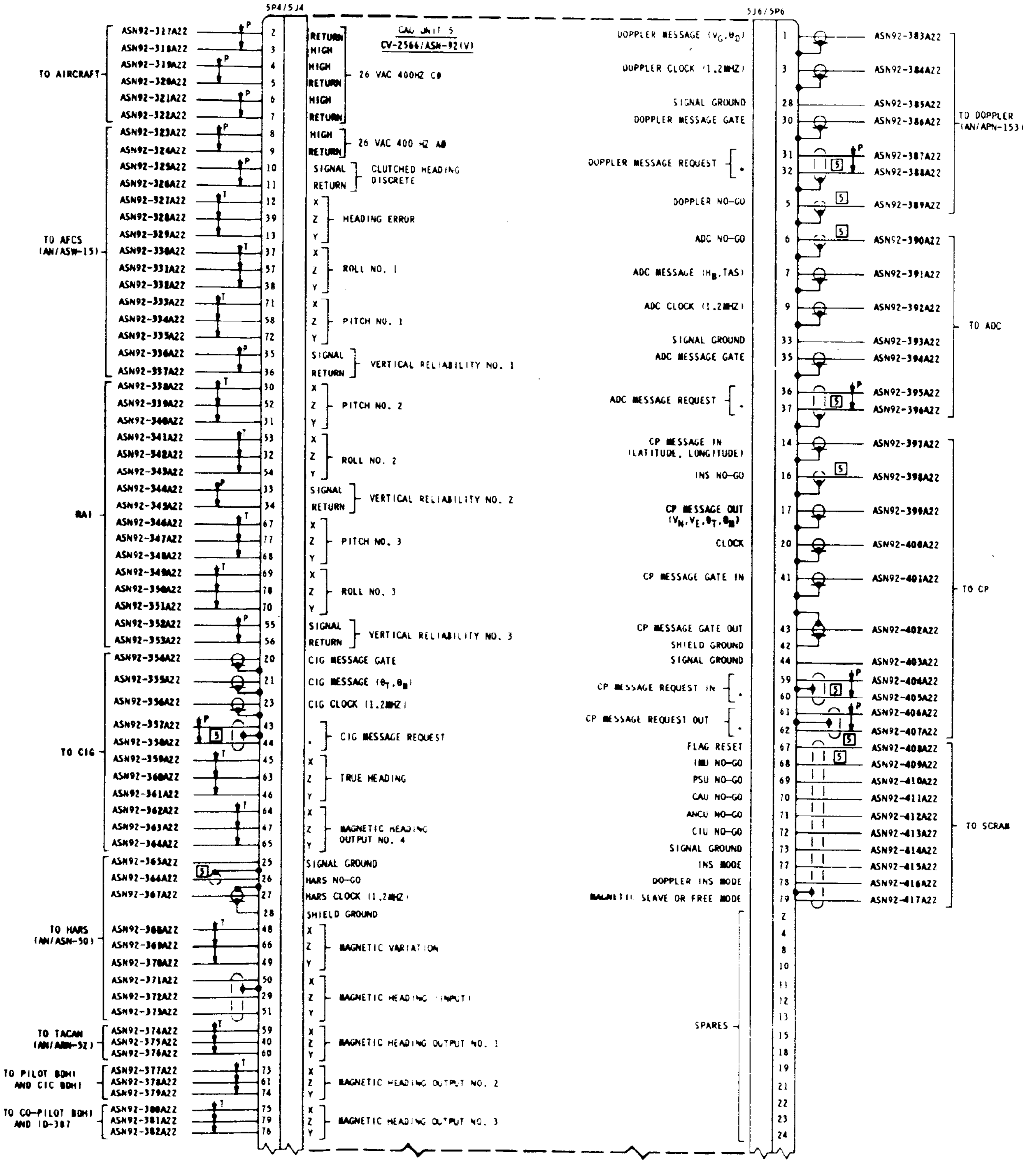
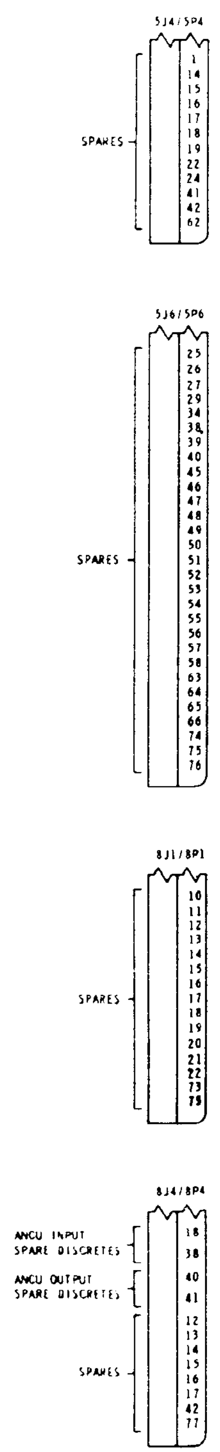


Figure 33. CAINS External Wiring Diagram (Sheet 1 of 2)

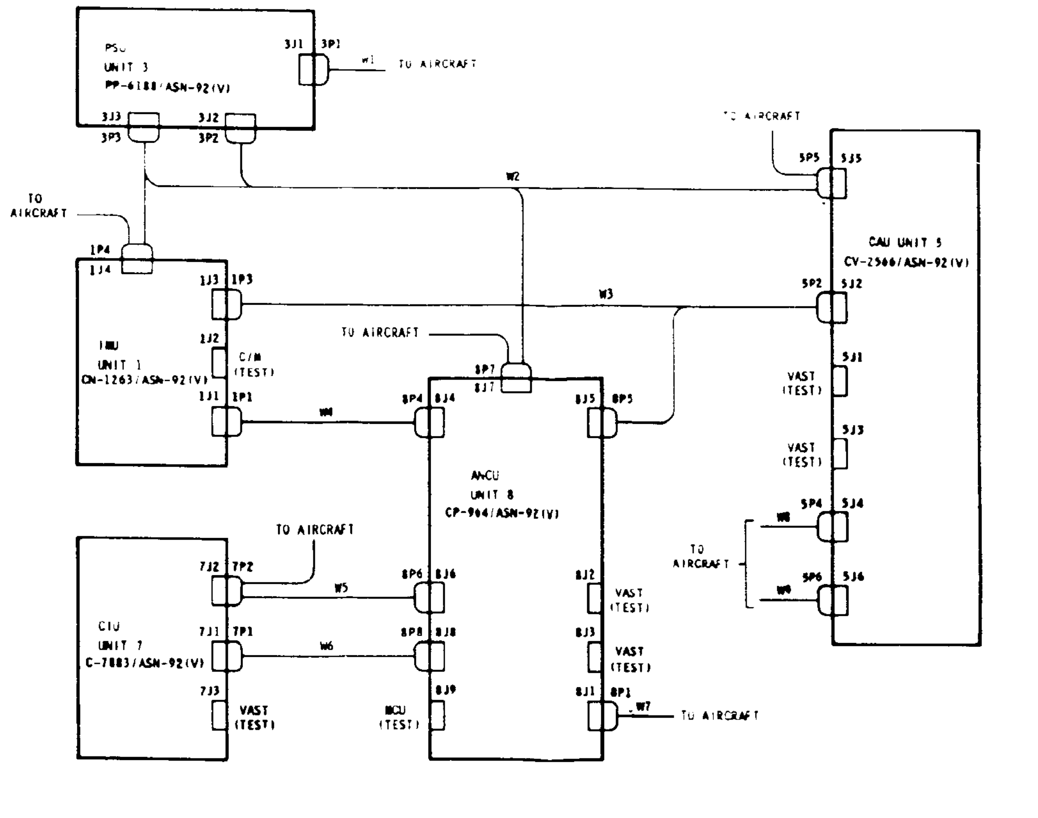




CONNECTOR PIN	SIGNAL NAME	CURRENT [12] (AMPERES)	MAXIMUM ALLOWABLE VOLTAGE DROP
	WIRE TABLE - I (VOLTAGE DROP LIMITATION)		
7J2-K	+5VDC RETURN	5.5 (TOTAL)	0.100V
7J2-L	+5VDC RETURN		0.100V
7J2-M	+5VDC RETURN		0.100V
7J2-N	+5VDC RETURN		0.100V
7J2-P	+5VDC RETURN		0.100V
7J2-R	+5VDC RETURN		0.100V
7J2-S	+5VDC RETURN		0.100V
7J2-T	+5VDC RETURN		0.100V
7J2-G	+5VDC (LOGIC)	2.2 (TOTAL)	0.080V
7J2-H	+5VDC (LOGIC)		0.080V
7J2-J	+5VDC (LOGIC)		0.080V
7J2-U	+5VDC (LOGIC)		0.080V
7J2-V	+5VDC (LAMPS)	3.3 (TOTAL)	0.165V
7J2-W	+5VDC (LAMPS)		0.165V
7J2-X	+5VDC (LAMPS)		0.165V
3J2-R	+32VDC UNREG(A)	6.0 (TOTAL)	0.45V
3J2-C	+32VDC UNREG(A)		0.45V
3J2-E	+32VDC UNREG(B)	1.7	0.25V
3J2-D	+28VDC	0.5	0.075V
3J2-S	-28VDC	1.0	0.15V
3J2-H	+5 VDC AUX	100 MA	0.1V
3J2-P	ANCU RETURN NO.1	8.0 (TOTAL)	0.3V
3J2-X	ANCU RETURN NO.2		0.3V
3J2-T	ANCU RETURN NO.3		0.3V
3J2-F	ANCU RETURN NO.4		0.3V
3J3-B	+28VDC	6.0 (TOTAL)	0.3V
3J3-C	+28VDC		0.3V
3J3-D	+28VDC		0.3V
3J3-E	-28VDC	5.0 (TOTAL)	0.375V
3J3-S	-28VDC		0.375V
3J3-K	IMU RETURN NO. 1	5.0 (TOTAL)	0.25V
3J3-V	IMU RETURN NO. 2		0.25V
3J3-W	IMU RETURN NO. 3		0.25V
3J3-G	+32VDC UNREG (C)	3.3 (TOTAL)	0.25V
3J3-T	+32VDC UNREG (C)		0.25V
3J3-H	+28VDC	1.0 (TOTAL)	0.075V
3J3-J	+28VDC		0.075V
3J3-U	-28VDC	0.6	0.09V
3J3-N	CAU RETURN NO. 1	4 (TOTAL)	0.15V
3J3-P	CAU RETURN NO. 2		0.15V
3J3-R	CAU RETURN NO. 3		0.15V
3J3-X	CAU RETURN NO. 4		0.15V

GLOSSARY

ABBREVIATION	DEFINITION
ANCU	AIR NAVIGATION COMPUTER UNIT
CAU	CONVERTER AMPLIFIER UNIT
CIU	CONTROL INDICATOR UNIT
IMU	INERTIAL MEASURING UNIT
PSU	POWER SUPPLY UNIT
AFCS	AUTOMATIC FLIGHT CONTROL SYSTEM
HARS	HEADING ATTITUDE REFERENCE SYSTEM
INS	INERTIAL NAVIGATIONAL SYSTEM
CIC	COMBAT INFORMATION CENTER
CIG	CONTROL INDICATOR GROUP
SCRAM	SIGNAL COMMAND, READOUT, AND ALARM MODULE
ADC	AIR DATA COMPUTER
BDHI	BEARING DISTANCE HEADING INDICATOR
BITE	BUILT IN TEST EQUIPMENT
RAI	REMOVE ATTITUDE INDICATOR
C/M	CALIBRATION AND MAINTENANCE
CP	COMPUTER PROGRAMMER
S/D	SYNCHRO TO DIGITAL
VAST	VERSATILE AVIONIC SHOP TEST
MCU	MANUAL CONTROL UNIT



UNIT	REF DESIG	UNIT CONNECTOR	REF DESIG	MATING CONNECTOR
IMU	1J1	903196 - 3	1P1	MS27484T20-35SC
	1J2	903196 - 2	1P2	MS27484T18-35S
	1J3	903196 - 1	1P3	MS27484T14-35S
	1J4	903196 - 4	1P4	MS27484T20-16S
PSU	3J1	MS27478Y10D5P	3P1	MS27484T10-5S
	3J2	MS27508E22B21SA	3P2	MS27484T22-21PA
	3J3	MS27508E22B21SB	3P3	MS27484T22-21PB
CAU	5J1	MS27508E24B35S	5P1	MS27484T24-35P
	5J2	MS27508E22B35SC	5P2	MS27484T22-35PC
	5J3	MS27508E24B35SA	5P3	MS27484T24-35PA
	5J4	MS27508E20B35PA	5P4	MS27484T20-35SA
	5J5	MS27508E22B21PB	5P5	MS27484T22-21SB
	5J6	MS27508E20B35PB	5P6	MS27484T20-35SB
CIU	7J1	MS27508E16B35P	7P1	MS27484T16-35S
	7J2	MS27508E22B21P	7P2	MS27484T22-21S
	7J3	MS27508E22B35SB	7P3	MS27484T22-35PB
ANCU	8J1	MS27508E20B35SA	8P1	MS27484T20-35PA
	8J2	MS27508E22B35SA	8P2	MS27484T22-35PA
	8J3	MS27508E22B35S	8P3	MS27484T22-35P
	8J4	MS27508E20B35SB	8P4	MS27484T20-35PB
	8J5	MS27508E20B35P	8P5	MS27484T20-35S
	8J6	MS27508E22B21S	8P6	MS27484T22-21P
	8J7	MS27508E22B21PA	8P7	MS27484T22-21SA
	8J8	MS27508E16B35S	8P8	MS27484T16-35P
	8J9	903017 - 9	8P9	[illegible]8362-1S

[16] SHIELDED WIRE IS ONLY REQUIRED WHEN [ ] SHIELDS ARE NOT USED.

[15] WITH AN IMU ORIENTATION SUCH THAT THE IMU CONNECTORS ARE FACING LEFT IN THE AIRCRAFT, THE FOLLOWING EXTERNAL WIRES SHOULD BE REVERSED ON THE NOTED IMU OUTPUT SIGNALS:
S4 WITH S2,
S3 WITH S1,
AND X WITH Y

14 WITH AN IMU ORIENTATION SUCH THAT THE IMU CONNECTORS ARE FACING RIGHT IN THE AIRCRAFT, THE FOLLOWING SYNCHRO AND RESOLVER CONVENTIONS APPLY.

FOR ZERO DEGREES	E(S4-S2) = E(S8-S6) = E(Y-X) = 0 VOLTS; E(S1-S3), E(S5-S7) AND E(Z-X) ARE IN PHASE WITH E(HI-RET) EXCITATION VOLTAGE
FOR INCREASING POSITIVE ANGLES	E(S4-S2), E(S8-S6) AND E(Y-X) ARE IN PHASE WITH E(HI-RET) EXCITATION VOLTAGE
POSITIVE HEADING	CLOCKWISE FROM TRUE NORTH
POSITIVE PITCH	NOSE UP
POSITIVE ROLL	RIGHT WING DOWN

[13] FOR TEST ONLY. DO NOT CONNECT IN AIRCRAFT.

[12] SEE WIRE TABLE I LISTING THE VOLTAGE DROP LIMITATIONS. THE TOTAL CURRENT FOR ANY GIVEN VOLTAGE OR RETURN SHALL BE EQUALLY DIVIDED BETWEEN THE WIRES WHICH ARE CONNECTED TO THE GIVEN VOLTAGE OR RETURN.

11. * DENOTES THE COMPLEMENT LINE OF A COMPLEMENTARY DIFFERENTIAL SIGNAL.

10. ALL CABLE CONNECTORS SHALL BE PROCURED WITH AN ELECTRICALLY CONDUCTIVE FINISH TO ENSURE COMPLIANCE WITH MIL-B-5087B BONDING REQUIREMENTS.

9. THE SHIELDS OF ALL SHIELDED CABLING SHALL BE TERMINATED VIA ATTACHMENT TO THE CONNECTOR BACKSHELL AT BOTH SOURCE AND LOAD ENDS.

8. ALL CABLE CONNECTORS CONTAINING SHIELDED WIRING SHALL EMPLOY R F I BACKSHELLS FOR SHIELDED TERMINATIONS. THE BACKSHELL ADAPTERS SHALL BE GLENAIR SERIES, G3304 OR EQUIVALENT.

7. ALL COAX TO BE GC8755-1 OR EQUIVALENT.

6. ALL SHIELDED TWISTED PAIR CABLING SHALL BE RAYCHEM TYPE 78240D130-9 (24 AWG) OR EQUIVALENT.

[5] THE NOTED SHIELDS ARE NOT REQUIRED IF ONLY MIL-STD-461B EMI REQUIREMENTS ARE IMPOSED.

4. WHEREVER SHIELDED PAIRS, TRIADS OR QUADS ARE DESIGNATED, SUCH WIRING SHALL BE TWISTED.

3. ALL CABLE RUNS, EXCEPT THOSE LISTED IN WIRE TABLE-1, SHALL BE RESTRICTED TO A MAXIMUM LENGTH OF 60 FEET. CABLES CONTAINING THOSE WIRES LISTED IN WIRE TABLE-1 SHALL BE RESTRICTED TO MEET THE VOLTAGE DROP LIMITATIONS.

2. THE HIGHEST WIRE CODE NUMBER USED IS ASN92-397. NOT USED: ASN92-272 AND ASN92-290 THRU ASN92-309.

1. INSTALLATION OF WIRING SHALL CONFORM TO SPECIFICATION MIL-W-5088.

NOTES: UNLESS OTHERWISE SPECIFIED.

Figure 33. CAINS External Wiring Diagram (Sheet 2 of 2)

30.3.6 Interference Control - Refer to 3.3.6. *

30.3.7 Provisions for Maintainability - Refer to 3.3.7, 3.3.7.1, and 3.3.7.2. The maintainability requirements for the AN/ASN-92(V) CAU for the intermediate level are 0.5 hours (MTTR) and 0.8 hours (MAXTTR), based on a 95th percentile projection. *

30.3.8 Nomenclature, Nameplates, and Identification Marking - Refer to 3.3.8.

30.3.9 Standard Conditions - Refer to 3.3.9.

30.3.10 Service Conditions - Refer to 3.3.10. Class 2X requirements shall apply to the CAU.

30.3.11 Warm-Up Time - Refer to 3.3.11.

30.3.12 Input Electrical Power - Refer to 3.3.12. Class 2x receives a-c and d-c power directly from the aircraft and d-c newer via PSU PP-6188/ASN-92(V) or an electrical equivalent. The maximum power requirements directly from the aircraft are as follows:

a. A-c power (three-phase), 115 volts, Category B, 30 VA, power factor > 0.9. *

b. A-c power (phase C), 26 volts, Category B, 74 VA, power factor > 0.25.

c. A-C power (phase A) , 26 volts~ Category B, 13.4 VA, power factor >0.25.

d. D-C power, 28 volts, Category B, 14 watts. *

The maximum power required from the PSU is as listed in 30.5.13.1. *

30.3.13 Cooling - Refer to 3.3.13. The CAU Cooling and pressure drop requirements shall conform to the curves presented in figures 34 and 35. *

30.3.14 Printed Wiring Boards - Refer to 3.3.14.

30.4 Performance - The given requirements apply to both standard and extreme service conditions.

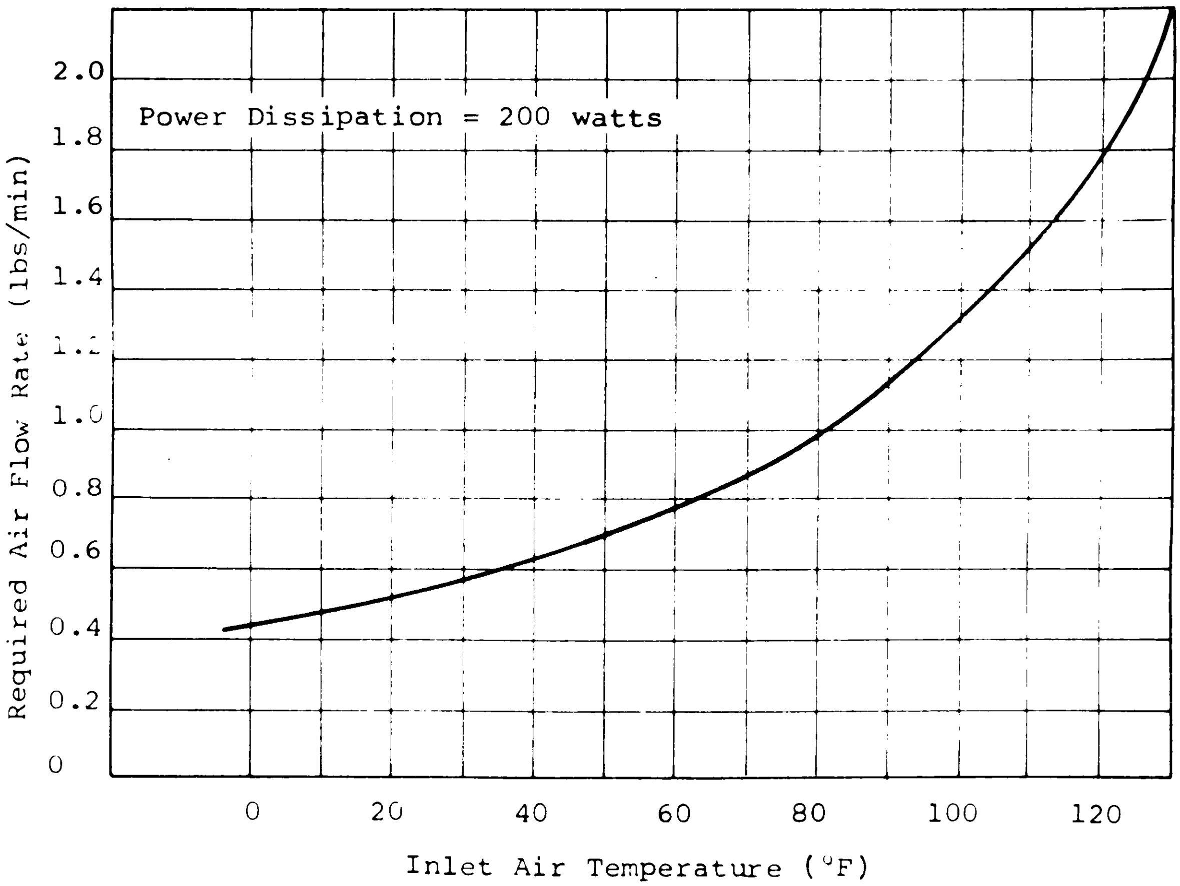


Figure 34. CAU Cooling Air Minimum Requirements

30.4.1 Operation - The CAU shall adapt the CAINS input/output signals to a form compatible with the E-2C Avionics equipment listed in 6.6. In addition, the CAU shall be mechanized to provide for the magnetic slaved and the platform free modes as described in 3.4.1.1.3c.

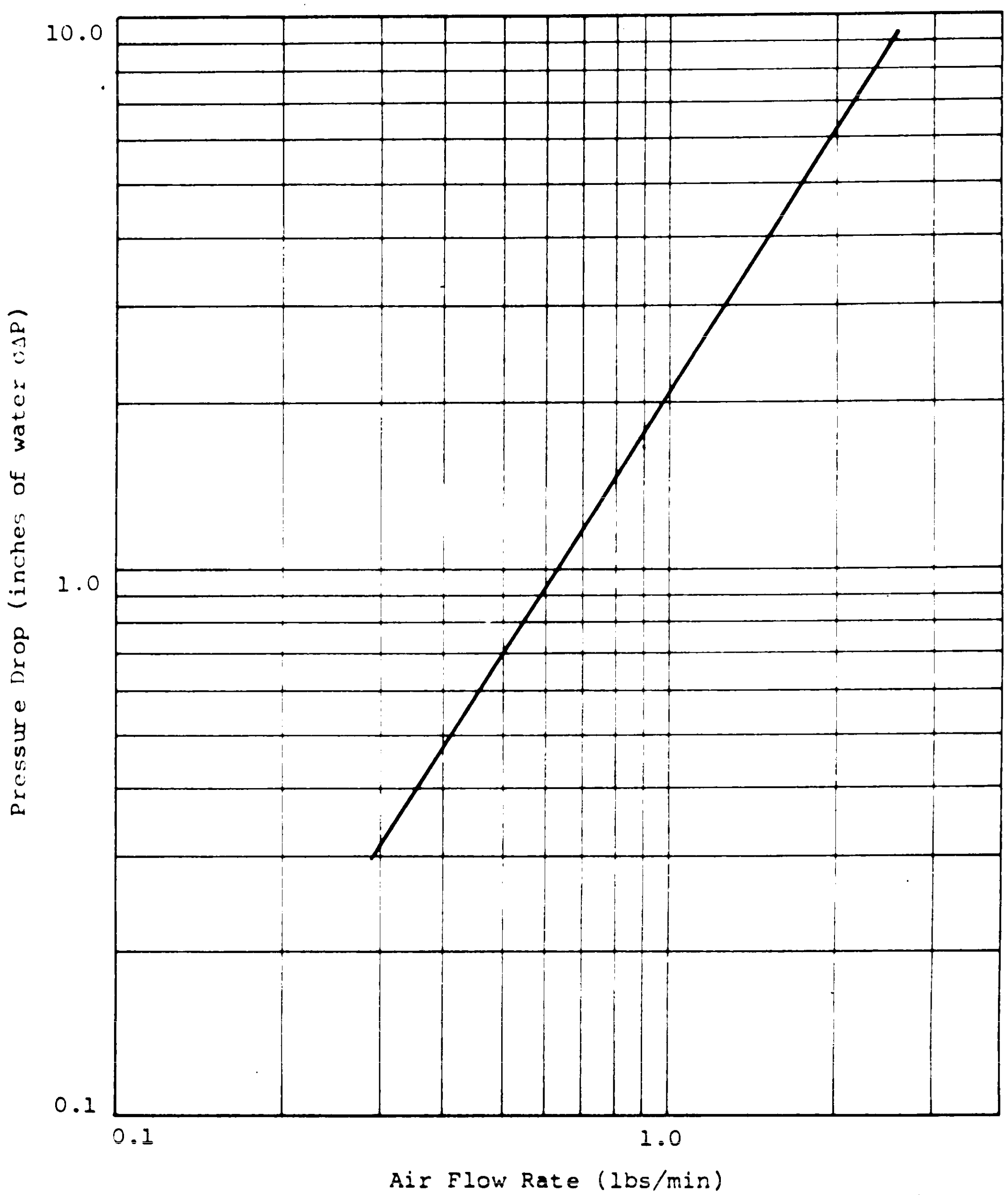


Figure 35. CAU Cooling Air Pressure Drop

30.4.1.1 E-2C Adapter Requirements - The CAU shall incorporate the following specific E-2C aircraft adapter requirements:

a. Adapt the ANCU serial input/output data lines to the E-2C Avionics digital format. Digitally, the AN/ASN-92 shall communicate with the Air Data Computer (ADC), the Computer Programmer (CP), the Control Indicator Group (CIG), and the Doppler Radar (DOPLR).

b. Provide platform pitch and roll synchro outputs and the vertical reliability discrete to the Automatic Flight Control System (AFCS) and two Remote Attitude Indicators (RAI 's).

c. Adapt ANCU serial input/output data to analog data outputs of true heading, heading error, magnetic heading, and magnetic variation.

d. Provide mode and malfunction discretes to the Signal Command Readout and Alarm Module (SCRAM).

e. Accept maqnetic heading as a synchro input from the Heading and Attitude Reference System (HARS) to allow continuous generation of magnetic heading/variation.

30.4.1.2 Back Up Mode Requirements - The CAU shall provide the following capability in order for the system to provide the magnetic slaved and platform free back-up modes of operation:

a. Provide communication with the CIU via the serial data path in order to enter and display latitude and magnetic variation when the ANCU is inoperative.

b. Provide a d-c analog output from the CAU to the IMU of earthrate times the sine of latitude or magnetic slave heading error, depending upon the operating mode. *

c. Provide automatic or manual mode control and display in the event that the ANCU is inoperative.

d. Provide for high speed initialization of the heading servos in the CAU to account for the difference between platform heading and the desired heading.

30.5 Detail Requirements

30.5.1 Function - Refer to 30.4.1. Figure 36 presents the functional block diagram of the CAU. *

30.5.2 Form Factor - The CAU shall conform to the outline and mounting drawing presented in figure 37. *

30.5.3 Weight - Refer to 30.3.1. *

30.5.4 Installation - A shock mount conforming to MIL-c-172 will be required for mounting the CAU. Refer to 30.6. *

30.5.5 Electrical Connections - See figure 33.

30.5.6 Contents - The CAU shall consist of a power supply module, an analog instrumentation servo system, analog digital and digital/analog converters, and digital logic for the serial interfaces and mode control.

30.5.6.1 Power Supply Module - This module shall contain the filtered and regulated supplies (+5 and ±15 volts d-c) necessary for CAU operation, along with voltage monitoring circuits. *

30.5.6.2 Pitch/Roll Servo Module - This module (two per unit) shall contain the capability to receive attitude signals from the IMU and transmit them to the aircraft avionics. *

30.5.6.3 True Heading Servo Module - This module shall combine platform heading with the true heading correction stored in the ANCU The resultant true heading shall be transmitted to aircraft avionics.

30.5.6.4 Magnetic Heading Sevo Module - This servo module shall have two modes of operation. In the normal mode, it shall repeat magnetic heading from HARS to other avionics. In the second mode (HARS failure) , handset magnetic variation and true heading shall be combined to drive the magnetic heading servo. *

30.5.6.5 Electronics Module - This module shall contain the BIT circuitry and the vertical reliability circuitry interface. It shall also supply servo motor excitation voltages. *

30.5.6.6 Tray Assembly - The CAU shall contain four electronic trays, (A1, A2, A3, and A4) with two laminates per tray.

a. 1A1 Laminate - This laminate shall contain the A/D converter electronics.

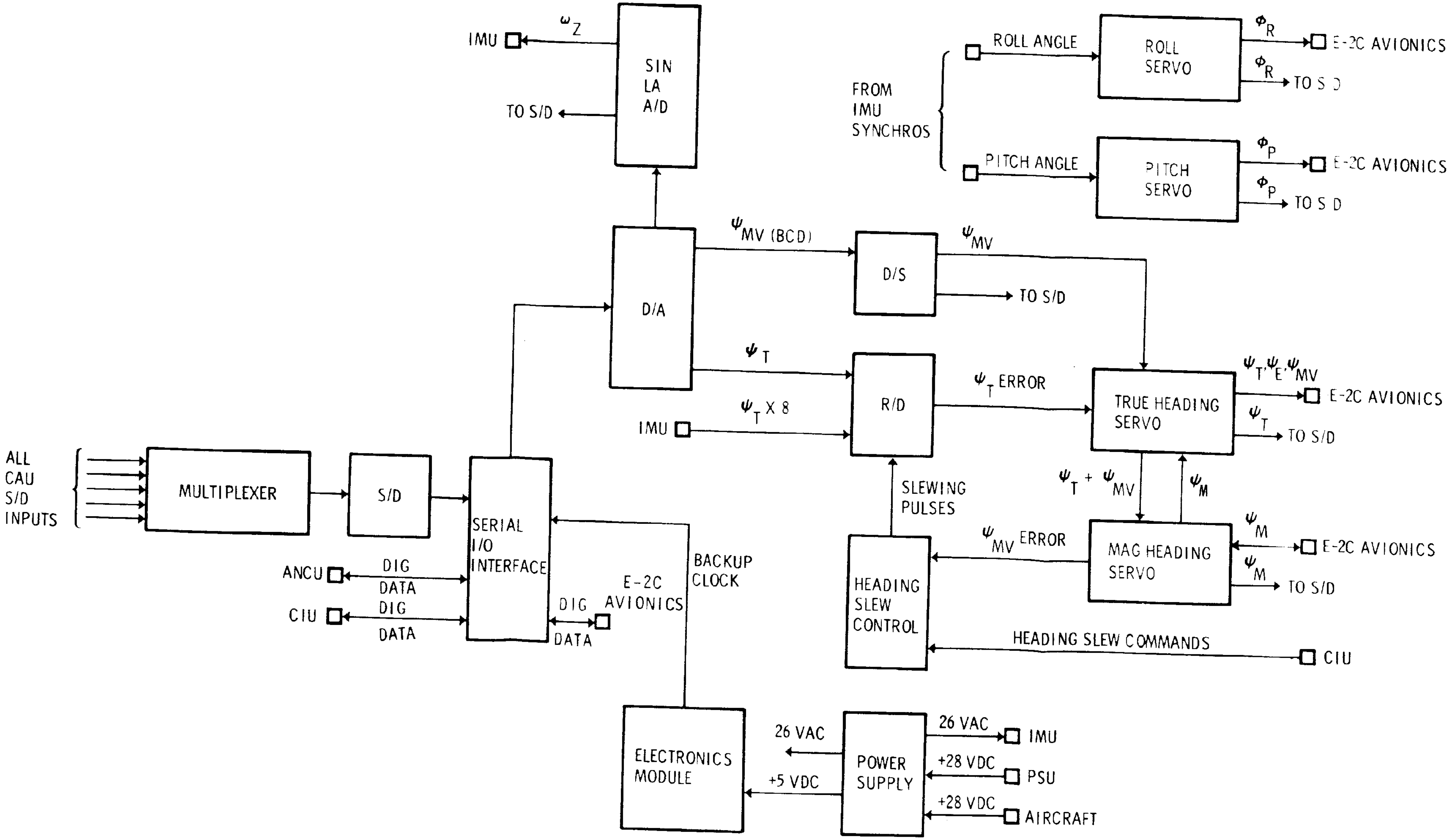


Figure 36. CAU E-2C Functional Block Diagram *

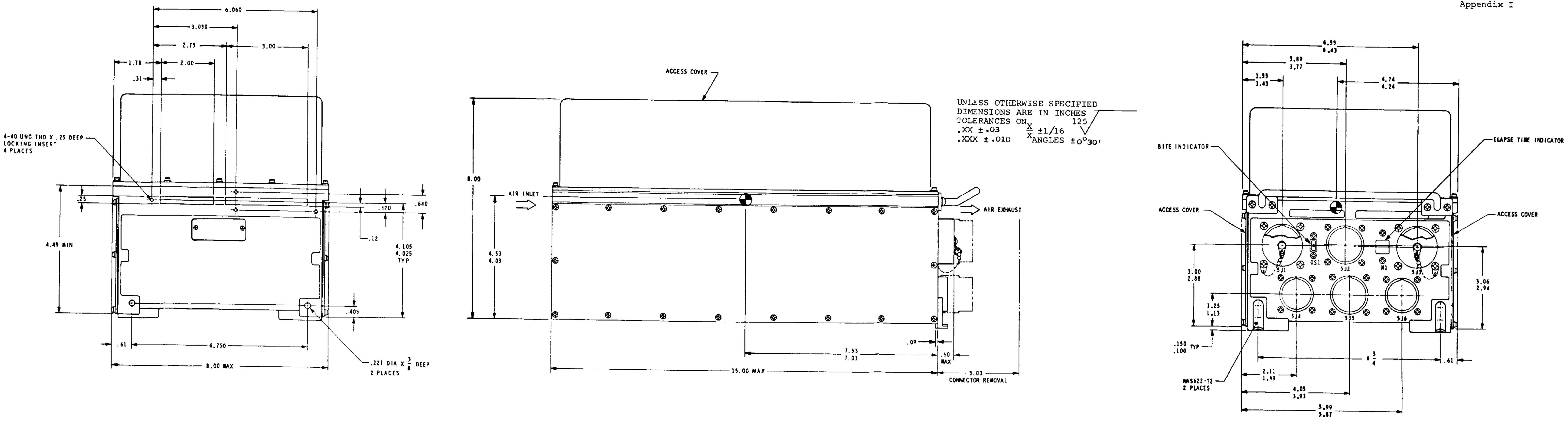


Figure 37. CAU Outline and Mounting *

Para 30.5.6.6
(cont)

b. 1A2 Laminate - This laminate shall contain the A/D digital logic and true heading logic.

c. 2A1 Laminate - This laminate shall contain the discrete signal circuitry with line drivers and receivers.

d. 2A2 Laminate - This laminate shall contain the true heading converter (D/A) electronics. *

e. 3A1 Laminate - This laminate shall contain the magnetic variation and sine latitude converter logic. *

f. 3A2 Laminate - This laminate shall contain the magnetic variation and sine latitude digital logic and the CIU interface.

g. 4A1 Laminate - This laminate shall contain the ANCU/Avionics serial interface message and control logic.

h. 4A2 Laminate - This laminate shall contain the ANCU/Avionics serial interface clock and registers.

30.5.7 CAU/Avionics Synchro Interface - Phasing of all inputs and outputs (except for roll and pitch no. 2 and no. 3 outputs) shall be as follows: For zero degrees, E(Y-X) = 0 volts and E(Z-X) is an in-phase voltage: for an increasing angle, E(Y-X) is an increasing in-phase voltage. Refer to Notes 14 and 15 of figure 33.

Phasing for roll and pitch no. 2 and no. 3 outputs shall be as follows: For zero degrees, E(Y-X) = O volts and E(Z-X) is an out-of-phase voltage: for an increasing angle, E(Y-X) is an increasing out-of-phase voltage.

30.5.7.1 Svnchro Input

Maanetic Heading - The HARS will provide the CAU with a synchro transmitter (CX) input (phase C excitation) of smoothed magnetic heading from Compass Adapter MX-6985/ASN-50. The maximum rate of change of the input will be 200 deg/sec. The CAU shall load the input with a control transformer (CT) equivalent to a 26V-08CT4C.

30.5.7.2 Synchro Outputs

a. Magnetic Heading No. 1 - The CAU shall supply a CX output (phase C excitation) of magnetic heading to the TACAN navigation set. The output source shall be a CX, equivalent to a 26V-11TX4c. The maximum rate of change of the output shall be 200 deg/sec. The accuracy shall be 15 arcminutes (lo) plus 0.2 arcminutes/deg/see, * assuming a perfect magnetic heading input (refer to 30.5.7.1). *

b. Magnetic Heading No. 2 - The CAU shall supply a CX output (phase C excitation) of magnetic * heading to two Bearing-Distance-Heading Indicators (BDHI's), ID-663/U (MIL-I-22075). The characteristics of this output shall be identical to magnetic heading no. 1 (refer to * 30.5.7.2a).

cm Magnetic Heading No. 3 - The CAU shall supply a CX output (phase C excitation) of magnetic heading to the Course Indicator and the co-pilots BDHI. The characteristics of this output shall be identical to magnetic heading no. 1 * (refer to 3005.7.2a). *

d. Magnetic Heading No. 4 - The CAU shall supply * a CX output (phase C excitation) of magnetic heading to the CIG. The characteristics of * this output shall be identical to magnetic * heading no. 1 (refer to 30.5.7.2a). *

e. Magnetic Variation - The CAU shall supply a synchro differential transmitter (CDX) output * of magnetic variation to HARS Adapter cv-()/AsN-50. The output source shall be a CDX equivalent to a 26V-08CDX4C. The maximum rate of change of the output shall be 200 deg/sec. The accuracy shall be 0.25 degrees (lo) in the normal mode. The accuracy in the magnetic slaved backup mode shall be 0.25 degree for | magnetic variation <45°, 0.5 degree for 45°< | magnetic variation] < 90°, and 1.0 degree for 90°< | magnetic variation] <1800(10). All of the accuracies assume a perfect magnetic heading input (refer to 30.5.7.1a).

Para 30.5.7.2
(cont)

g. True Heading - The CAU shall supply a CX output
(phase C excitation) of true heading to the CIG. *
The output source shall be a CX equivalent to a
26V-11-TX4C. The maximum rate of change of the
output shall be 200 deg/sec. The accuracy shall *
be 4 arcminutes (10) plus 0.3 arcminutes/deg/sec
not including stable element position errors.

h. Heading Error - The CAU shall supply a clutched
CX output (phase A excitation) of heading error
to the AFCS. The output source shall be a CX
equivalent to a 26V-08CX4C. The maximum rate
of change of the output shall be 200 deg\sec.
The range shall be -30 ±3 degrees to +30 ±3
degrees. The centering error shall be ±8. arc-
minutes maximum and the engage error shall be *
28 arcminutes maximum.

i. Pitch No. 1 - The CAU shall supply a CX output
(Phase A excitation) of pitch angle to the AFCS.
The output source shall be a CX equivalent to a
26V-08CX4C. The maximum rate of change of the
output shall be 60 deg/sec. The range shall be *
±90 degrees. The accuracy shall be 5 arcminutes
(lo) plus 0.1 arcminutes/deg/see, not including
stable element position errors.

j. Pitch No. 2 - The CAU shall supply a CX output
(phase C $\angle 180$ excitation) of pitch angle to
the RAI. The characteristics of this output
shall otherwise be identical to pitch no. 1 *
(refer to 30.5.7.2i).

k. Pitch No. 3 - This CAU output to the RAI shall
be identical to pitch no. 2 (refer to 30.5.7.2j). *

m. Roll No. 1 - The CAU shall supply a CX output
(phase A excitation) of roll angle to the AFCS.
The output source shall be a CX equivalent to a
26V-08CS4C. The maximum rate of change of the
output shall be 300 deg\sec. The range shall *
be O to 360 degrees. The accuracy shall be *
5 arcminutes (10) plus 0.1 arcminutes/deg/see,
not including stable element position errors.

n. Roll No. 2 - The CAU shall supply a CX output (phase C ∠180° excitation) of roll angle to the RAI. The characteristics of this output shall otherwise be identical to roll no. 1 (refer to 30.5.7.2m). *

p. Roll No. 3 - This CAU output to an RAI shall be identical to roll no. 2 (refer to 30.5.7.2n). *

q. Synchro Excitation - All synchros will be excited with 26 volts rms, 400-Hz, phase C except the output synchros to the AFCS which will be excited with 26 volts rms, 400 Hz, The aircraft will provide two separate inputs of 26 volts rms, 400 Hz, phase C excitation to the CAU (RAI excitation is phase C ∠180°). The AFCS will supply the 26 volts rms, 400 Hz, phase A to the CAU. * * *

30.5.8 CAU\Avionics Digital Interface -Refer to table XXII for operational range, word length, resolution and zero reference for the digital-data transmitted between the CAU and external avionics. *

TABLE XXII. CAU/AVIONICS DIGITAL INTERFACE *

Quantity	Operational Range	Word Length (Bits)	Resolution (LSB Value)	Zero Point
True Heading (θ_T)	0° to 360°	15	0.6592 arcminutes	0°
Magnetic Heading (θ_M)	0° to 360°	13	2.637 arcminutes	0°
Velocity North (V_N)	±1,638.2 ft/sec	15	0.1 ft/sec	0 ft/sec
Velocity East (V_E)	±1,638.2 ft/sec	15	0.1 ft/sec	0 ft/sec
Latitude	0° to ±90°	17	0.1 arc-minute	0°

TABLE XXII. CAU\AVIONICS DIGITAL INTERFACE (cent)

Quantity	Operational Range	Word Length (Bits)	Resolution (LSB Value)	Zero Point
Longitude	0° to ±180°	18	0.1 arc-minute	0°
Ground Speed (V_g)	0 to 1,638.2 ft/sec	14	0.1 ft/sec	0 ft/sec
Drift Angle (θ_D)	0° to ±90°	13	1.319 arc-minutes	0°
Barometric Altitude (Hp)	-1,000 to +40,940 ft	12	20 ft	0 ft
True Air Speed (V_{TAS})	75 to 450 kts.	13	0.1 kt	0 kts.

30.5.8.1 Standard Interfaces - All digital interfaces shall conform to one of the following definitions by which they must be designated:

a. Type 1 - A twisted pair of AWG 22 wires with one wire used for the signal and the other wire used for the complement of the signal.

(1) True state (l): +4 volts ±1.5 volts *
False state (0): 0 volts +0.5, -O volts *

(2) Noise Immunity: Minimum of ±5 volts common mode and a minimum of 0.3 volts line-to-line noise immunity. *

(3) Interconnecting cables: 60 feet maximum

(4) Rise and fall times: 0.15 µsec between 1096 and 9096 points.

(5) Receiver impedance: line-to-line impedance of 130 ohms ±10% and ≤ 100 picofarads shunt capacitance.

(6) Pulse width: ≥0.65 μsec at the 50% amplitude points.

b. Type 2 - Standard GC 875S-1 coaxial cable

(1) True state (l): +4 volts ±1.5 volts
False state (0): 0 volts +0.5, -0.0 volts

(2) Interconnecting cables: 60 feet maximum

(3) Rise and fall times (non-clock pulses): ≤0.15 μsec between 10% and 90% amplitudes with a pulse width of ≥0.65 μsec at the 50% amplitude points.

(4) Rise and fall times (1.2 MHz ±0.1% clock pulses): ≤ 25 nanoseconds with 100 ±25 nanoseconds pulse width at the 50% amplitude points.

(5) Termination: Characteristic impedance ±5%, shunt capacitance ≤ 100 picofarads.

c. Type 3 - Single AWG 22 wire for control signals.

(1) True state (l): +4 volts ±1.5 volts *
False state (0): O volts +0.5, -0.0 volts *

(2) Interconnecting cables: 60 feet maximum *

(3) Rise time (driver): 75 μsec ±25 μsec *

(4) Receiver impedance: ≥4K ohms and ≤100 picofarads per receiver. Each driver circuit shall be capable of driving a minimum of 4 receivers. *

The following is applicable to Type 1, 2, and 3 interfaces:

Waveforms are to be measured at sending end when specified cable length is terminated with the worst case specified terminating impedance.

30.5.8.2 CAU/CP Serial Interface - The CAU shall function as an intermediary data processor in sending data from the ANCU to the CP (velocity north, velocity east, true heading, and magnetic heading) (VN, VE, θT, and θM) or receiving data from

Para 30.5.8.2
(cont)

the CP (latitude, longitude) for transmission to the ANCU. Both types of operations are initiated in the ANCU-CAU serial interface whereby a 6-bit request code (EOP mode) is sent to the CAU from the ANCU to inform the CAU that the ANCU either has data to be sent by the CAU to the CP, or that it desires the CAU to obtain data from the CP. . These requests are referred to as CP-output type requests (CPO) or CP-input (CPI) type requests. The codes which the ANCU sends to the CAU via Data 2 are given in table XXIII. The CP input 1.2-MHz clock shall be used *
for clocking data to and from the CP.

TABLE XXIII. REQUEST CODES

Request Code MSB LSB	Type Request	CAU Data I/O
0 1 0 0 0 0	Platform Heading, Fine (ψ_{P8})	Output
0 1 0 0 0 1	Magnetic Heading	Output
0 1 0 0 1 1	True Heading, X8 (ψ_{T8})	Output
	True Heading Self Test (ψ_{T1})	
	Roll Self Test	
0 1 1 1 0 0	Pitch Self Test	Input
	Mag Var Self Test	
	Sin Lat Self Test	
	Mag Heading Self Test	
	True Heading Self Test	
	Roll Self Test	
0 1 0 0 1 0	Pitch Self Test	Output
	Mag Var Self Test	
	Sin Lat Self Test	
	Mag Heading Self Test	
0 1 1 0 0 0	Mode Control	Input
0 1 1 0 0 1	Mag Var (CIU Right Display)	Input
0 1 1 0 1 0	Latitude (CIU Left Display)	Input
0 1 1 1 1 0	True Heading Corr. Factor	Input
0 0 1 0 1 1	CP input - Latitude	Output

TABLE XXIII. REQUEST CODES (cont)

Request Code MSB LSB	Type Request	CAU Data I/O
0 0 1 0 1 0*	CP Input - Longitude	Output
0 0 1 1 1 1	CP Output - V_N	Input
0 0 1 1 1 0*	CP output - V_E	Input
0 0 1 1 0 1*	CP Output - θ_T and θ_M	Input
0 0 0 0 1 0	Doppler (Ground Speed & Drift Angle)	Output
0 0 0 1 0 0	ADC (Baro Alt and True Air Speed)	Output
0 0 0 1 1 1	Test to CAU (Bit)	Input
0 0 0 1 1 0*	Test to ANCU (Bit)	Output
*Program initiation not required by ANCU; generated automatically by CAU.		

Para 30.5.8.2
(cont)

a. CPO Requests - Upon initiation of a CPO request in the ANCU-CAU interface, data shall be loaded sequentially (V_N, V_E, θ_T, and θ_M) into the CP-CIG registers via Data 2 and the CAU serial data register. These data shall enter the CAU, MSB first, in the form of three 28-bit words in the format shown in table XXIV. *

V_N shall be loaded into CP-CIG register no. 1, V_E shall be loaded into CP-CIG register no. 2, and θ_T/θ_M shall be loaded into CP-CIG register no. 3. These data shall remain in the CP-CIG registers until updated from the ANCU (10 times per second minimum) or requested by the CP (20 times per second maximum). Upon initiation of the CP message request signal, the CAU shall respond within 600 microseconds with a 64-bit message gate to the CP along with 64 bits of data transmitted in sequence, MSB first, from CP-CIG data register no. 1, 2, and 3. The data shall be transmitted in the format shown in *

TABLE XXIV. CAU/ANCU SERIAL DATA ON DATA 2 (INTERLEAVE READ)

Output Device	Data 28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
CP	SIGN	MSB					Velocity North (V_N) (LSB = 0.1 feet/sec)								LSB													
CP	SIGN	MSB					Velocity East (V_E) (LSB = 0.1 feet/sec)								LSB													
CP or CIG	MSB						True Heading (θ_T) (LSB = 0.6592 arc minutes)								LSB	MSB					Mag Hdg (θ_M) (LSB = 2.637 arc minutes)							LSB
CAU	Command (Mode) Word (See Table XXIV)																											
CAU D/A	Mag Var (Right Display Word - See Table XXIII)																											
CAU D/A	Latitude (Left Display Word - See Table XXIII)																											
CAU D/A	SIGN	MSB					True Hdg Correction (X8) (LSB = 90 x 2^{-12} degrees)							LSB														
CAU A/D S.T.	MSB						True Hdg (X1) (LSB = 180 x 2^{-13} degrees)							LSB												0	1	0
CAU A/D S.T.	MSB						Roll (LSB = 180 x 2^{-13} degrees)							LSB												0	1	1
CAU A/D S.T.	MSB						Pitch (LSB = 180 x 2^{-13} degrees)							LSB												1	0	0
CAU A/D S.T.	MSB						Mag Hdg (LSB = 180 x 2^{-13} degrees)							LSB												1	0	1
CAU A/D S.T.	SIGN	MSB					Mag Var (LSB = 90 x 2^{-12} degrees)							LSB												1	1	0
CAU A/D S.T.	SIGN	NOT USED			MSB	Sin LAT (LSB = 2^{-6})				LSB																1	1	1
CAU Test	1	Test Word from ANCU																										

figure 38. The maximum delay of the leading edge of the first data bit with respect to the leading edge of the message gate shall be 200 nanoseconds. In addition, the message request signal shall return to its false state within 10 µs of the leading edge of the message gate. In the event that the CP message request appears concurrently with a CIG message request, the CP request shall have first priority. In addition, the ID code for this message shall be a "l" in bits 63 and 64. * *

b. CPI Requests - The CAU shall initiate two message requests to the CP as a result of receiving the proper 6-bit request code on ANCU Data 2 (table XXIII). The CP shall respond within 300 µs with a 32-bit message gate and message in response to each request. The message request signals shall return to their false state within 10 µs of the leading edge of their respective message gates. The second message request shall be generated automatically within 200 µs of the trailing edge of the first message gate. The message gates shall be synchronous with the CP selected clock which shall be used in clocking each 32-bit message into the CAU with the maximum delay of 200 ns from the leading edge of the first data bit with respect to the leading edge of the message gate. The messages shall be transmitted to the CAU, MSB first, in the format shown in figure 38. Each 32-bit message shall go through a three-bit delay in being shifted into the first 27-bit positions of the CAU serial data register. Each message will then be serially shifted out of the serial data register, MSB first, to the ANCU via Data 1 for interleave into memory. Refer to 3O.5.10.1. * *

c. CP Message Request In - This message request from the CP shall be answered by the CAU with a message gate and a message. Refer to 30.5.8.2a. The CAU line receiver shall be a Type 1 circuit. *

d. CP Message Gate Out - This message gate from the CAU shall bracket all bits in the CP Message out. Refer to 30.5.8.2a. The CAU line driver shall be a Type 2 circuit. *

Para 30.5.8.2
(cont)

e. CP Message Out - This message from the CAU shall contain velocity north, velocity east, true heading, and magnetic heading. Refer to 30.5.8.2a. The CAU line driver shall be a Type 2 circuit.

f. CP Message Request Out - This message request from the CAU shall be answered by the CP with a message gate and message. Refer to 30.5.8.2b. The CAU line driver shall be a Type 1 circuit.

g. CP Message Gate In - This message gate from the CP shall bracket all bits inthe CP Message In. Refer to 30.5.8.2b. The CAU line reciver shall * be a Type 2 circuit. *

h. CP Message In - This message from the CP shall contain latitude and longitude information Refer to 30.5.8.2b. The CAU line reciever shall be a Type 2 circuit.

i. CP Clock - The CP shall provide a continuous 1.2-MHz clock to the CAU for clocking data to and from the CP. The accuracy shall be ±0.1 percent. The CAU line receiver shall be a Type 2 circuit.

30.5.8.3 CAU/CIG Serial Interface - This interface shall be identical in operation to the CAU/CP serial interface for CPO *
type requests (refer to 30.5.8.2a) with the exception that only *
the true heading/magnetic heading data stored in the CP-CIG *
register no. 3 are transferred to the CIG upon the CIG request signal coming true. When this occurs (the CIG may request data up to 20 times per second), the 32 bits of data are transferred to the CIG in the format shown in figure 38 as well as being *
recirculated in CP-CIG register no. 3 to await CP request or *
update from the ANCU. In addition, the CP message request has first priority over the CIG message request, should the two occur concurrently. The CAU shall provide a 1.2-MHz clock for clocking data to the CIG.

a. CIG Message Request - This message request from the CIG shall be answered by the CAU with a message gate and a message. Refer to 30.5.8.3. *
The CAU line receiver shall be a Type 1 circuit.

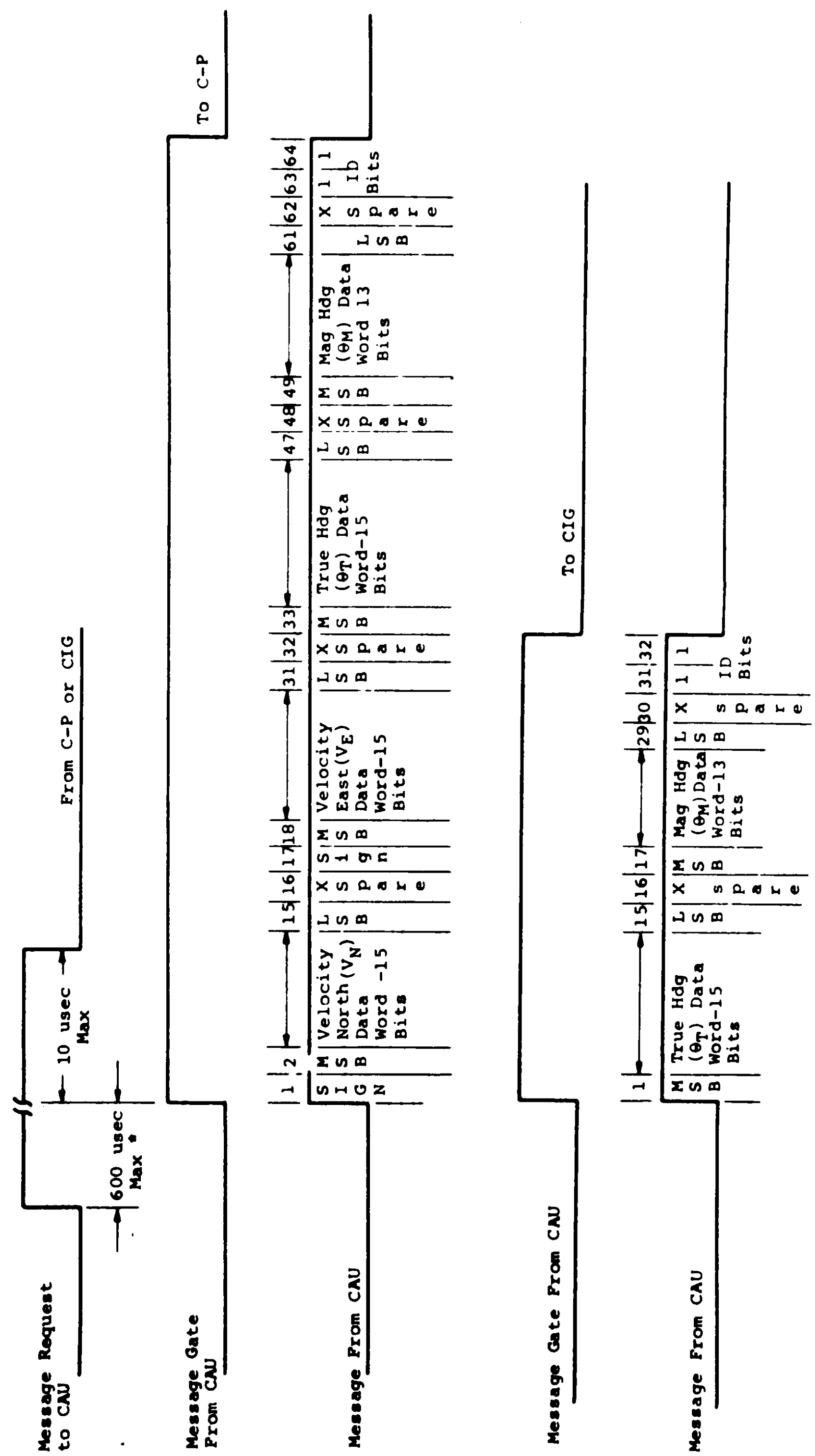


Figure 38. CAU-Avionics Format and Timing Diagram (Sheet 1 of 2)

*

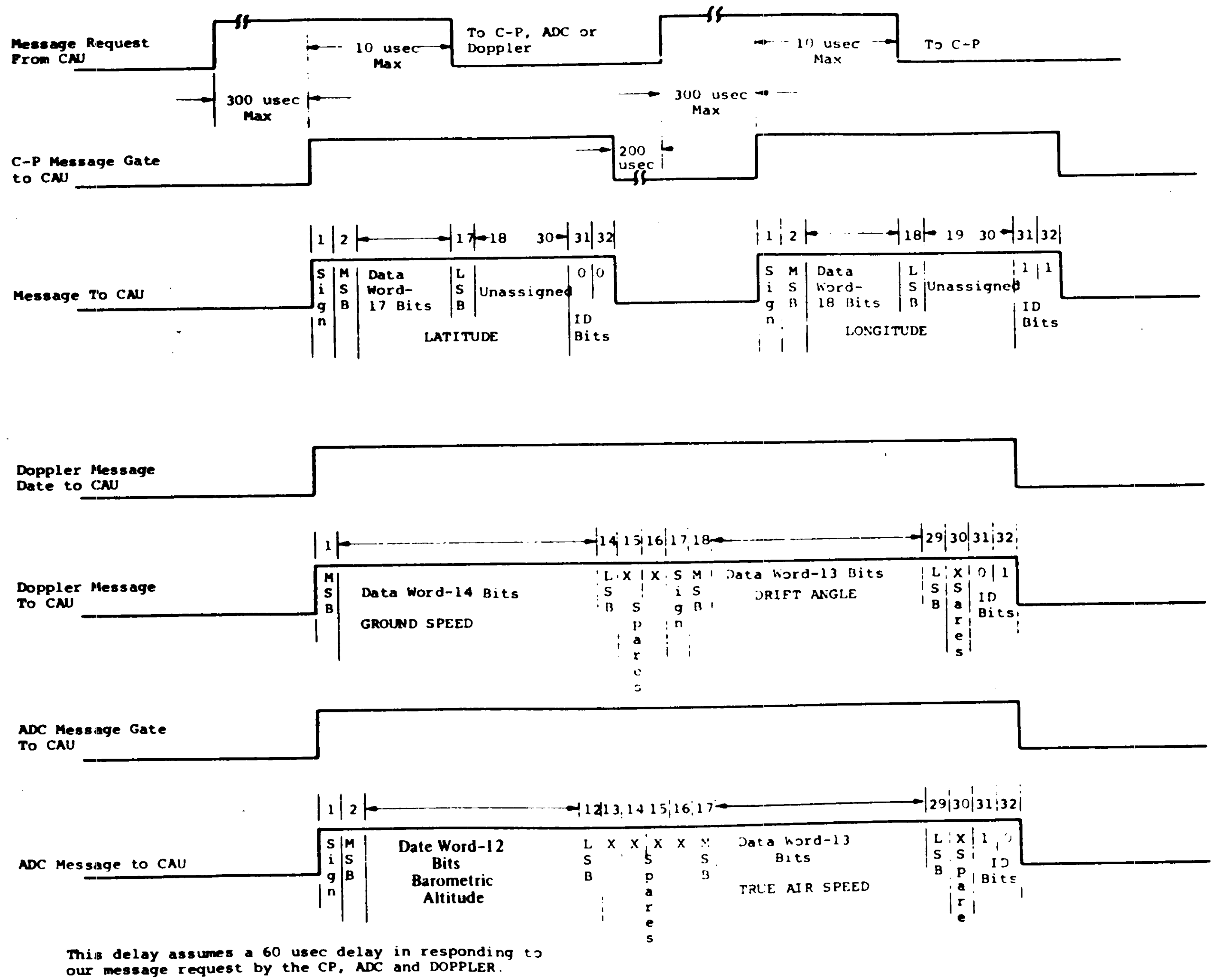


Figure 38. CAU-Avionics Format and Timing Diagram
(Sheet 2 of 2)

b. CIG Message Gate - This message gate from the CAU shall bracket all bits in the CIG message. Refer to 30.5.8.3. The CAU line driver shall be a Type 2 circuit. *

c. CIG Message - This message from the CAU shall contain true heading and magnetic heading. Refer to 30.5.8.3. The CAU line driver shall be a Type 2-circuit. *

d. CIG Clock - The CAU shall provide a 1.2-MHz clock to the CIG for clocking the CIG message. This clock shall always be available when aircraft power is on, regardless of a CAU power supply failure or a CIU off condition. The accuracy shall be ±0.1 percent and the pulse width shall be 100 ±25 nanoseconds. The CAU line driver shall be a Type 2 circuit.

30.5.8.4 CAU/DOPLR Serial Interface - The CAU shall initiate a message request to the doppler as a result of having received the proper six-bit request code from the ANCU (EOP mode) via * Data 2 (table XXIII). The DOPLR shall then respond with a 32-bit * message gate and message. The message request from the CAU shall return to its false state within 10 μs of the leading edge of the message gate. The CAU shall provide a 1.2-MHz clock for clocking data into the CAU. The leading edge of a data bit from the DOPLR with respect to the leading edge of the CAU clock shall be within 200 ns. The data from the DOPLR shall be transmitted, MSB first, in the format shown in figure 38. The 32-bit message shall go through a 3-bit delay in being shifted into the first 27-bit positions of the CAU serial data register. The DOPLR data shall then be shifted out, MSB first, of the serial data register to the ANCU via Data 1 for interleave into memory. * Refer to 30.5.10.1.

a. DOPLR Message Request - This message request from the CAU shall be answered by the DOPLR with a message gate and a message. Refer to * 30.5.8.4. The CAU line driver shall be a Type 1 circuit.

b. DOPLR Message Gate - This message gate from the DOPLR shall bracket all bits in the DOPLR message. Refer to 30.5.8.4. The CAU line receiver * shall be a Type 2 circuit.

Para 30.5.8.4
(cont)

c. DOPLR Message - This message from the DOPLR shall contain ground speed and drift angle information. Refer to 30.5.8.4. The CAU line receiver shall *
be a Type 2 circuit.

d. DOPLR Clock - The CAU shall provide a 1.2-MHz clock to the DOPLR for clocking the DOPLR message. This clock shall always be available when aircraft power is on, regardless of a CAU power supply failure or an off condition. The accuracy shall be ±0.1 percent and the pulse width shall be 100 ±25 nanoseconds. The CAU line driver shall be a Type 2 circuit.

30.5.8.5 CAU/ADC Serial Interface - The CAU shall initiate a
message request to the ADC as a result of having received the *
proper six-bit request code from the ANCU (EOP mode) via Data
2 (table XXIII). The ADC shall then respond with 32-bit mesage *
gate and message. The message request from the CAU shall return to its false state within 10 μs of the leading edge of the message gate. The CAU shall provide a 1.2-MHz clock for clocking data into the CAU. The leading edge of a data bit from the ADC with respect to the leading edge of the CAU clock shall be
within 200 ns. The data from the ADC shall be transmitted, MSB *
first, in the format shown in figure 38. The 32-bit message shall go through a 3-bit delay in being shifted into the first 27-bit positions of the CAU serial data register. The ADC data
shall then be shifted out, MSB first, of the serial data register *
to the ANCU via Data 1 for interleave into memory. Refer to 30.5.10.10

a. ADC Message Request - This message request from the CAU shall be answered by the ADC with a
message gate and a message. Refer to 30.5.8.5. *
The CAU line driver shall be a Type 1 circuit.

b. ADC Meseage Gate - This message gate from the ADC shall bracket all bits in the Am message.
Refer to 30.5.8.5. The CAU line receiver shall *
be a Type 2 circuit.

c. ADC Message - This message rom the ADC shall contain barometric altitude and true air speed information. Refer to 30.5.8.5. The CAU line receiver shall be a Type 2 circuit.

d. ADC Clock - The CAU shall provide a 1.2-MHz clock to the ADC for clocking the ADC message. This clock 'shall always be available when aircraft power is on, regardless of a CAU power supply failure or off condition. The accuracy shall be ±0.1 percent and the pulse width shall be 100 225 nanoseconds. The CAU line driver shall be a Type 2 circuit.

30.5.9 CAU/Avionics Discrete Interface

30.5.9.1 Discrete Inputs to CAU from Avionics

a. DOPLR No-Go - This discrete is not used in the CAU but is retransmitted to the ANCU. This CAU input from the DOPLR goes to a true (high) state to indicate that the DOPLR has malfunctioned or is in memory and that DOPLR data are therefore invalid. The CAU line receiver shall be a Type 3 circuit, except that line driver power off and a source impedance greater than 2000 ohms or a line driver input open shall be recognized as a true (no-go) state and pulled up to 7 ±1 volts.

b. ADC No-Go - This discrete is not used in the CAU but is retransmitted to the ANCU. This CAU input from the ADC goes to a true (high) state to indicate that the air data computer has malfunctioned and that ADC data are therefore invalid. The CAU line receiver shall be a Type 3 circuit.

c. HARS No-Go - This discrete is supplied to the CAU from the HARS for use in the CAU and retransmission to the ANCU. This CAU input from the HARS goes to a true (high) state to indicate that the HARS magnetic heading information is not valid or is unsoothed. The CAU line receiver shall be a Type 3 circuit.

d. Flag Reset - This discrete is supplied to the CAU from the SCRAM for use in the CAU and retransmission to the ANCU, CIU, PSU, and IMU to
reset the no-go flags in each of these units to *
the no-fault (go) state. The flag reset input *
from the SCRAM is a high (1) pulse, 250 ±25 *
msec in width. Absence of this pulse causes *

Para 30.5.9.1
(cont)

restoration of the fault indicator circuits to their normal fault seeking condition. The CAU line receiver shall be a Type 3 circuit.

e. Clutched Heading Discrete - This discrete from the AFCS shall go to a 28 volts d-c to engage the clutch to allow the rotor of ‘the heading error CX to follow the true heading servo. ‘When the discrete is at O volts d-c, the clutch shall be de-energized and the CX shall supply electrical zero. (Refer to 30.5.7.2h). * * * *

30.5.9.2 Discrete Outputs from CAU to Avionics - The output impedance to ground of these Type 3 discrete outputs from the CAU to avionics shall be approximately 100 ohms if CAU power is off.

a. ANCU No-Go - This discrete output from the CAU to the SCRAM shall be provided to indicate that the ANCU malfunction flag has been set. When the flag is in a set (no-go) state, a high shall be supplied. When the flag is in a reset state, a low shall be supplied. The CAU line driver shall be a Type 3 circuit.

b. CIU No-Go - This discrete output from the CAU to the SCRAM shall be provided to indicate that the CIU malfunction flag has been set. When the flag is in a set (no-go) state, a high shall be supplied. When the flag is in a reset state, a low shall be supplied. The CAU line driver shall be a Type 3 circuit. *

c. IMU No-Go - This discrete output from the CAU to the SCRAM shall be provided to indicate that the IMU malfunction flag has been set. When the flag is in a reset (go) state, an open relay contact shall be supplied. When the flag is in a set (no-go) state, a ground shall be supplied. The relay contacts shall have a 28-volt d-c, 0.5-ampere capacity. The common contact shall be connected to ground. * * *

d. PSU No-Go - This discrete output from the CAU to the SCRAM shall be provided to indicate that the PSU malfunction flag has been set. When the flag is in a reset (go) state, an open relay contact shall be supplied. When the flag is in

a set (no-go) state, a ground shall be supplied. *
The relay contacts shall have a 28-volt d-c, *
0.5-ampere capacity. The common contact shall
be connected to ground.

e. CAU No-Go - This discrete output from the CAU
to the SCRAM shall be provided to indicate that
the CAU malfunction flag has been set. When
the flag is in a reset (go) state, an open
relay contact shall be supplied. When the flag
is in a set (no-go) state, a ground shall be *
supplied. The relay contacts shall have a
28-volt d-c, 0.5-axnpere capacity. The common *
contact shall be connected to ground.

f. INS No-Go - This discrete output from the CAU
to the CP shall go to the true (high) state to
indicate than AN/ASN-92(V) velocity data are
not valid. The CAU line driver shall be a
Type 3 circuit.

g. INS Mode - This discrete output from the CAU
to the SCRAM shall go to the true (high) state
to indicate that the AN/ASN-92(V) is in the
inertial mode of navigation. The CAU line
driver shall be a Type 3 circuit.

h. Doppler-INS Mode - This discrete output from
the CAU to the SCRAM shall go to the true (high)
state to indicate that the AN/ASN-92(V) is in
the doppler-inertial mode of navigation. The *
CAU line driver shall be a Type 3 circuit.

i. MAG SLV or Free Mode - This discrete output *
from the CAU to the SCRAM shall go to the true
(high) state to indicate that the AN/ASN-92(V)
is in the magnetic slave or free attitude refer- *
ence mode. The CAU line driver shall be a
Type 3 circuit.

Vertical Reliability No. 1 - This discrete output
from the CAU to the AFCS shall be provided to
indicate the validity of the pitch and roll
outputs from the CAU. When the attitude outputs
are valid, a Pair Of closed relay contacts shall *
be supplied. When the attitude outputs are not
valid, a Pair of normally open relay contacts *
shall be supplied. The relay contacts shall have
a 28-volt d-c, 3-ampere capacity. *

k. Vertical Reliability No. 2 - This discrete output from the CAU to the RAI shall be identical * to vertical Reliability No. 1 (refer to 30.5.9.2j) except that the relay contacts shall * have a 26-volt rms, l-ampere capacity.

l. Vertical Reliability No. 3 - This discrete output from the CAU to the RAI shall be identical to Vertical Reliability No. 2 (refer to * 30.5.9.2k).

30.5.10 CAU/ANCU Interface

30.5.10.1 CAU/ANCU Serial Interface - Refer to 3.4.4.3.1 for a * description of the CAU/ANCU serial interface operation and signal description. Figure 39 describes the CAU serial interface timing * requirements.

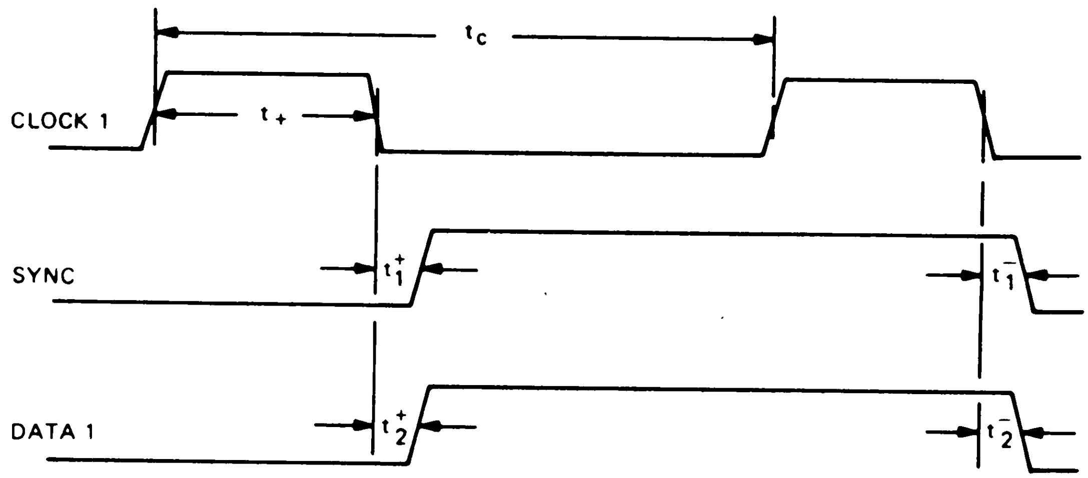
a. Clock 1 (CAU to ANCU) - A 6-MHz square wave clock (83 ±20 ns pulse width) from the CAU shall be supplied to the ANCU. The CAU line driver shall be a Type D circuit.

b. Clock 2(ANCU to CAU) - A restored 6-MHz clock from the ANCU to the CAU shall be derived for Clock 1. The CAU line receiver shall be a Type D circuit.

c. Sync (CAU to ANCU) - An envelope from the CAU to the ANCU shall be supplied for gating data to or from the ANCU. The CAU line driver shall be a Type D circuit.

d. Data 1 (CAU to ANCU) - Data (to be interleaved into the ANCU memory) shall consist of data words from internal CAU operations or external avionics. The data formats and address assignments of the 40-bit messages on Data 1 shall * conform to table XXV. Data to be interleaved out of the ANCU memory shall be initiated by the 12-bit command address messages on Data 1 * conforming to table XVI. The CAU line driver shall be a Type D circuit.

OUTPUT FROM CAU

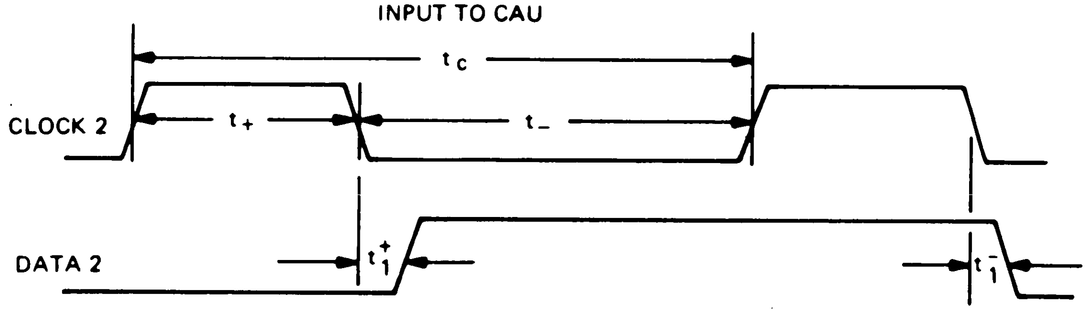


$t_+ = 83 \pm 20\ \eta sec$

$t_c = 1/6 \pm 0.1\%\ \mu sec$

$t_1^+, t_1^-, t_2^+, t_2^-, = 23 \pm 17\ \eta sec$

INPUT TO CAU



$t_c > 160$ nsec
$t_+ > 59$ nsec
$t_- > 59$ nsec
-4 nsec $< t_1^+, t_1^- < 49$ nsec

Figure 39. ANCU/CAU Timing Diagram

TABLE XXV. CAU/ANCU SERIAL DATA ON DATA 1 (INTERLEAVE WRITE)

Input Device	Command Address 40	39	38	37	36	35	34	33	32	31	30	29	28	Data 27–14	Data 13–4	3	2	1
CP	1	0	1	0	0	0	0	0	1	0	1	1	1	SIGN MSB ← Latitude → LSB (LSB = 0.1 arc minute)				
CP	1	0	1	0	0	0	0	0	1	0	1	0	1	SIGN MSB ← Longitude → LSB (LSB = 0.1 arc minute)				
Doppler	1	0	1	0	0	0	0	0	0	0	1	0	1	MSB ← Ground Speed → LSB (LSB = 0.1 ft/sec)	SIGN MSB ← Drift Angle → LSB (LSB = 1.319 arc minutes)			
ADC	1	0	1	0	0	0	0	0	0	1	0	0	1	SIGN MSB ← Baro. Alt. → LSB (LSB = 20 feet)	MSB ← True Air Speed → LSB (LSB = 0.1 knot)			
CAU A/D	1	0	1	0	0	0	0	1	0	0	0	0	1	MSB ← Plat. Hdg. (X8) → LSB (LSB = 180 x 2^{-13} degrees)				
CAU A/D	1	0	1	0	0	0	0	1	0	0	0	1	1	MSB ← Mag. Hdg. → LSB (LSB = 180 x 2^{-13} degrees)				
CAU D/A	1	0	1	0	0	0	0	1	0	0	1	1	1	MSB ← True Hdg. (X8) → LSB (LSB = 180 x 2^{-13} degrees)				
CAU A/D S.T.	1	0	1	0	0	0	0	1	0	0	1	0	1	MSB ← True Hdg. (X1) → LSB (LSB = 180 x 2^{-13} degrees)		0	1	0
CAU A/D S.T.	1	0	1	0	0	0	0	1	0	0	1	0	1	MSB ← Roll → LSB (LSB = 180 x 2^{-13} degrees)		0	1	1
CAU A/D S.T.	1	0	1	0	0	0	0	1	0	0	1	0	1	MSB ← Pitch → LSB (LSB = 180 x 2^{-13} degrees)		1	0	0
CAU A/D S.T.	1	0	1	0	0	0	0	1	0	0	1	0	1	MSB ← Mag. Hdg. → LSB (LSB = 180 x 2^{-13} degrees)		1	0	1
CAU A/D S.T.	1	0	1	0	0	0	0	1	0	0	1	0	1	SIGN MSB ← Mag. Var. → LSB (LSB = 90 x 2^{-12} degrees)		1	1	0
CAU A/D S.T.	1	0	1	0	0	0	0	1	0	0	1	0	1	SIGN Not Used MSB ← Sin Lat. → LSB (LSB = 2^{-6})		1	1	1
CAU Test	1	0	1	0	0	0	0	0	0	1	1	0	1	← Test word to ANCU (Same as test word for ANCU) →				

TABLE XXVI. CAU/ANCU SERIAL DATA ON DATA 1
(INTERLEAVE READ REQUEST)

Request Device	Command Address												Data Requested
	40	39	38	37	36	35	34	33	32	31	30	29	
CP	1	0	0	0	0	0	0	0	1	1	1	1	V_N
CP	1	0	0	0	0	0	0	0	1	1	1	0	V_E
CP or CIG	1	0	0	0	0	0	0	0	1	1	0	1	True Hdg - Mag Hdg
CAU	1	0	0	0	0	0	0	1	1	0	0	0	Command (Mode) Word
CAU D/A	1	0	0	0	0	0	0	1	1	0	0	1	Mag Var (BCD)
CAU D/A	1	0	0	0	0	0	0	1	1	0	1	0	Latitude (BCD)
CAU D/A	1	0	0	0	0	0	0	1	1	1	1	0	True Hdg Correction (X8)
CAU A/D S.T.	1	0	0	0	0	0	0	1	1	1	0	0	Self Test Data
CAU Test	1	0	0	0	0	0	0	0	0	1	1	1	Test Word from ANCU

Data 2 (ANCU to CAU) - The ANCU shall transmit either a 6-bit or 28-bit message to the CAU on Data 2. The 6-bit request codes, which provide the basis for CAU operation decisions, shall conform to table XXIII. The 28-bit data words, for internal CAU usage or retransmission to external avionics, shall conform to table XXIV. The CAU line receiver shall be a Type D circuit. * *

f. Busy - Refer to 3.4.4.3.1c(6). The CAU line receiver shall be a Type A circuit. *

g. Request Ready - Refer to 3.4.4.3.1c(7). The CAU line receiver shall be a Type A circuit. *

30.5.10.2 Discrete Inputs to CAU from ANCU - Four (a thru d) of the eight available ANCU programmable output discretes shall be utilized for the E-2C application.

a. IMU Level - This is a software developed discrete supplied from the ANCU to the CAU which goes true (high, open, or ANCU power off) to indicate that the platform is level. If the system has been switched into an attitude backup mode, and the ANCU is still functioning properly, the platform level signal will be equivalent to the IMU Ready. If the CAU control command discrete has been received by the CAU, this signal shall be ignored. When the ANCU is operating properly, this discrete may be used to develop the vertical reliability signal. The ANCU line driver and the CAU line receiver shall be Type B circuits. * * *

b. CAU Flag Set - This output from the ANCU to the CAU shall go to a true (high, open, or ANCU power off) state to indicate that the software has detected a malfunction in the CAU. This signal, when in the true state for a minimum-of 20 milliseconds, shall cause the CAU flag to go to the set (no-go) state if the CAU flag reset signal is not present. The ANCU line driver and the CAU line receiver shall be Type B circuits.

c. DOP-INS Mode - This software developed discrete output from the ANCU goes to a true (high, open, or ANCU power off) state to indicate that the CAINS system is in the doppler-inertial mode of navigation. The electrical interface is Type B circuitry. *

d. INS Mode - This software developed discrete output from the ANCU goes to a true (high, open, or ANCU power off) state to indicate that the CAINS system is in the inertial mode of navigation. The electrical interface is Type B circuitry.

e. CAU Control Command - Refer to 3.4.4.3.2b. The CAU line receiver shall be a Type B circuit. *

f. INS No-Go - Refer to 3.4.4.3.2c. The CAU line receiver shall be a Type B circuit. *

g. CAU Flag Reset - Refer to 3.4.4.3.2d. The CAU line receiver shall be a Type C circuit. *

h. ANCU No-Go - Refer to 3.4.4.3.2e. The CAU line receiver shall be a Type C circuit. *

30.5.10.3 Discrete Outputs from CAU to ANCU - Three of the seven available ANCU input discretes shall be utilized by the program for the E-2C application.

a. HARS No-Go - This discrete input to the ANCU goes to a true (high, open, or CAU power off) state to indicate that the HARS magnetic heading information is not valid or that it is unsoothed. The software would not use HAM magnetic heading information at this time, but would develop magnetic heading from inertially derived heading. This discrete is used both in the CAU and in the ANCU. The CAU line driver and the ANCU line receiver shall be Type B circuits.

Para 30.5.10.3
(cent)

b. Doppler No-Go - This discrete input to the ANCU goes to a true (high) state to indicate that the doppler has malfunctioned or is in the memory mode and, therefore, that the doppler groundspeed and drift angle information is not valid. The electrical interface is Type B circuitry. *

c. ADC No-Go - This discrete input to the ANCU goes to a true (high) state to indicate that the air data computer has malfunctioned and, therefore, that the ADC barometric altitude and airspeed information is not valid. The electrical interface is Type B circuitry. *

d. Flag Reset - Refer to 3.4.4.3.3b. The CAU line driver shall be a Type C circuit. *

e. CAU Fail - Refer to 3.4.4.3.3c. The CAU line driver shall be a Type C circuit. *

30.5.10.4 Converter Reference. The CAU shall provide an output of 26 volts rms, 400 Hz, phase C to the ANCU for use as a reference to the ANCU A/D converters. *

30.5.11 CAU/IMU Interface

30.5.11.1 CAU/IMU Discrete Interface

a. IMU Ready - Refer to 3.4.4.2a(1). The CAU line receiver shall be a Type B circuit.

b. IMU No-Go - Refer to 3.4.4.2a(2). The CAU load shall be a 40-ma relay coil with +28 volts d-c connected to the other end. *

c. Flag Reset - Refer to 3.4.4.2a(3). The reset pulse width shall be 250 ±25 msec. The CAU line driver shall be a Type C circuit.

30.5.11.2 CAU/IMU Analog Interface

a. Pitch Angle - Refer to 3.4.4.2b(1). The CAU shall load the pitch synchro from the IMU with a CT conforming to 26V-08CT4c. The impedance to ground shall be greater than 2 megohms. *

b. Roll Angle - Refer to 3.4.4.2b(2). The CAU shall load the roll synchro from the IMU with a CT conforming to 26V-08CT4C. The impedance to ground shall be greater than 2 megohms. *

c. Platform Heading (X8) - Refer to 3.4.4.2b(4). The CAU shall load the fine heading resolver from the IMU with an impedance to ground greater than 2 megohms. *

d. Sin Lat/Mag Slave Hdg Error - This output from the CAU to the IMU shall be switched automatically by the CAU to output the appropriate signal as a function of the backup mode. Sine latitude shall be supplied in the free mode and magnetic slave heading error shall be supplied in the magnetic slave mode. * * * *

(1) Sin Lat - This signal shall be proportional to the sine of the latitude angle and is only defined between S70° and S90° or N70° and N90°. The range of the signal shall be -1.413 to -1.504 volts d-c and +1.413 to +1.504 volts d-c and shall have an accuracy of ±10 millivolts (90°= +1.504 volts). This output shall be designed to drive a minimum impedance of 20K Ohms * *

(2) Mag Slave Hdg Error - This signal shall be proportional to the difference between the magnetic heading input from the HARS and the position of the magnetic heading servo. The range of the signal shall be ±13 volts d-c with an accuracy of ±1 volt d-c. The scale factor of the signal shall be 1 degree of heading error = 10 volts d-c. Zero volts = zero heading error. The output shall be a positive voltage when the magnetic heading from the HARS is greater than the magnetic heading derived within CAU. * * * * * *

e. Synchro Excitation - The CAU shall provide an output of 26 volts rms, 400 Hz, phase C to the IMU to be used as excitation to the IMU pitch and roll synchros and the heading resolver. This same excitation is also supplied as reference to the ANCU A/D converter, as well as internally to the CAU A/D converter. *

30.5.12 CAU-CIU Interface

30.5.12.1 CAU-CIU Serial Interface - In the normal mode of operation, the CAU receives CIU BCD display word data and command word data via Data 2 under control of the CAU-ANCU serial interface. *

The CAU shall take control of this interface from the ANCU when the CAU Control Command discrete from the ANCU to the CAU goes to the true state as defined in 3.4.4.3.2b. The CIU shall communicate with the CAU through line receivers and drivers in the ANCU which shall remain operational even with the loss of the internal ANCU power. Power from the CIU power source within the ANCU shall be sufficient to maintain this CIU/CAU communications link. Digital data shall be transmitted between the CIU and CAU in the backup modes (MAG SLV or FREE) consisting of BCD data for right and left displays (magnetic variation and latitude, respectively), a discrete data word for switch positions (command word), and a discrete data word for annunciator lamps (status word). The electrical interface for signals between units is Type A. Refer to 3.4.4.4 and 3.4.4.3.5. * * * *

a. CIU Clock - A 150-KHz clock with a pulse width of 833 ns shall be provided from the CAU to the CIU.

b. Enter - This discrete pulse, which goes to its true state for two bit times when the CIU ENTER pushbutton is depressed, shall be used to initiate an address word to the CIU.

c. Control - This signal shall be a 28 clock period envelope sent from the CAU to CIU to indicate to the CIU that serial data are to be taken in, sent out, or taken in and sent out. The true state of this signal shall enable serial transmission. *

d. Serial Data from CAU to CIU - This data line shall transmit 8 bits of data (status or display word) , LSB first, from the CAU. The status word shall contain the bits which control the ENTER, FREE, and MAG SLV lamps as well as the sign and punctuation lamps for the left and right display words. Each of these lamps shall have one bit in the status word as specified in table XI. There shall also be one data word assigned to each of the two display words * (refer to table III). The sign and punctuation of the display words shall be contained within the bits of the status word. The eight bits of address for the status word and two display words are specified in table XXVII. *

e. Serial Data from CIU to CAU - This data line shall transmit 28 bits of data (command or display word), LSB first, to the CAU. The command word bits are specified in table XXVII * and shall represent the data switch (PRES POS and NWPR/MV), mode switch (MAG SLV), ENTER mode selector (left and right) and "On Deck." The two display words, left or right, shall contain the data to be entered (refer to table * XXVII). The 8 bits of address for the command * word shall conform to table XXVIII. *

Basic timing relationships between these signals in the interface are specified in * figure 14.

30.5.12.2 Heading Slew Inputs - The heading slew inputs shall be enabled within the CAU only in the free mode of operation. * Refer to 3.4.4.4b.

a. Heading Slew Sign - The input shall be either open or connected to the heading slew return. * When the input is open, the true heading servo * shall slew in a direction to cause the true * heading output to increase in a positive * direction. When the input is connected to the heading slew return, the servo shall slew in * a decreasing direction.

b. Heading Slew Fast - When this input is connected to the heading slew return, the true * heading servo shall slew at the rate of 51 * degrees/second ±10 percent. *

c. Heading Slew Slow - When this input is connected to the heading slew return, the true * heading servo shall slew at the rate of 3.3 * degrees/second ±10 percent. *

TABLE XXVII. BIT POSITION ASSIGNMENT FOR DISPLAY WORDS *

Left Display Word (Latitude)		Right Display Word (Mag Var)	
Bit	Function	Bit	Function
1 (LSB)	Digit 1, 1 Bit	1 (LSB)	Digit 1, 1 Bit
2	Digit 1, 2 Bit	2	Digit 1, 2 Bit
3	Digit 1, 4 Bit	3	Digit 1, 4 Bit
4	Digit 1, 8 Bit	4	Digit 1, 8 Bit
5	Digit 2, 1 Bit	5	Digit 2, 1 Bit
6	Digit 2, 2 Bit	6	Digit 2, 2 Bit
7	Digit 2, 4 Bit	7	Digit 2, 4 Bit
8	Digit 2, 8 Bit	8	Digit 2, 8 Bit
		9	Digit 3, 1 Bit
		10	Digit 3, 2 Bit
		11	Digit 3, 4 Bit
		12	Digit 3, 8 Bit
		13	Digit 4, 1 Bit
28 (MSB)	Digit 7, Sign Bit	28 (MSB)	Digit 7, Sign Bit

TABLE XXVIII. BIT POSITION ASSIGNMENTS FOR THE COMMAND (MODE) WORD *

Bit	Function
1	Select Left Entry Mode
2	Select Right Entry Mode
3	Data Switch Pos 1, WAYPOINT
4	Data Switch Pos 2, FLYOVER
5	Data Switch Pos 3, OFFSET
6	Data Switch Pos 4, BRG/RNG
7	Data Switch Pos 5, STG/TMGO
8	Data Switch Pos 6, PRES/POS
9	Data Switch Pos 7, TCK/GS
10	Data Switch Pos 8, HDG/ALT
11	Data Switch Pos 9, WIND
12	Data Switch Pos 10, NWPR/MV
22	Mode Switch Pos 5, MAG SLV
23	Mode Switch Pos 6, FREE
24	On Deck*

*Only available during ANCU control.

30.5.13 CAU/PSU Interface

30.5.13.1 Power - The CAU power requirements shall not exceed

20 watts +28 volts d-c *

20 watts -28 volts dvc *

75 watts +32 volts d-c unregulated *

30.5.13.2 CAU/PSU Discrete Interface

a. Flag Reset - Refer to 3.4.4.5b(5). The pulse width shall be 250 ±25 msec. The line driver shall be a Type C circuit. *

b. PSU No-Go - Refer to 3.4.4.5b(3). The CAU load shall be a 40-ma relay coil with +28 volts d-c connected to the other end. *

c. CAU Flag Inhibit - Refer to 3.4.4.5b(2). The CAU line receiver shall be a Type E circuit. *

30.6 Mounting Base, Electrical Equipment, Detailed Description

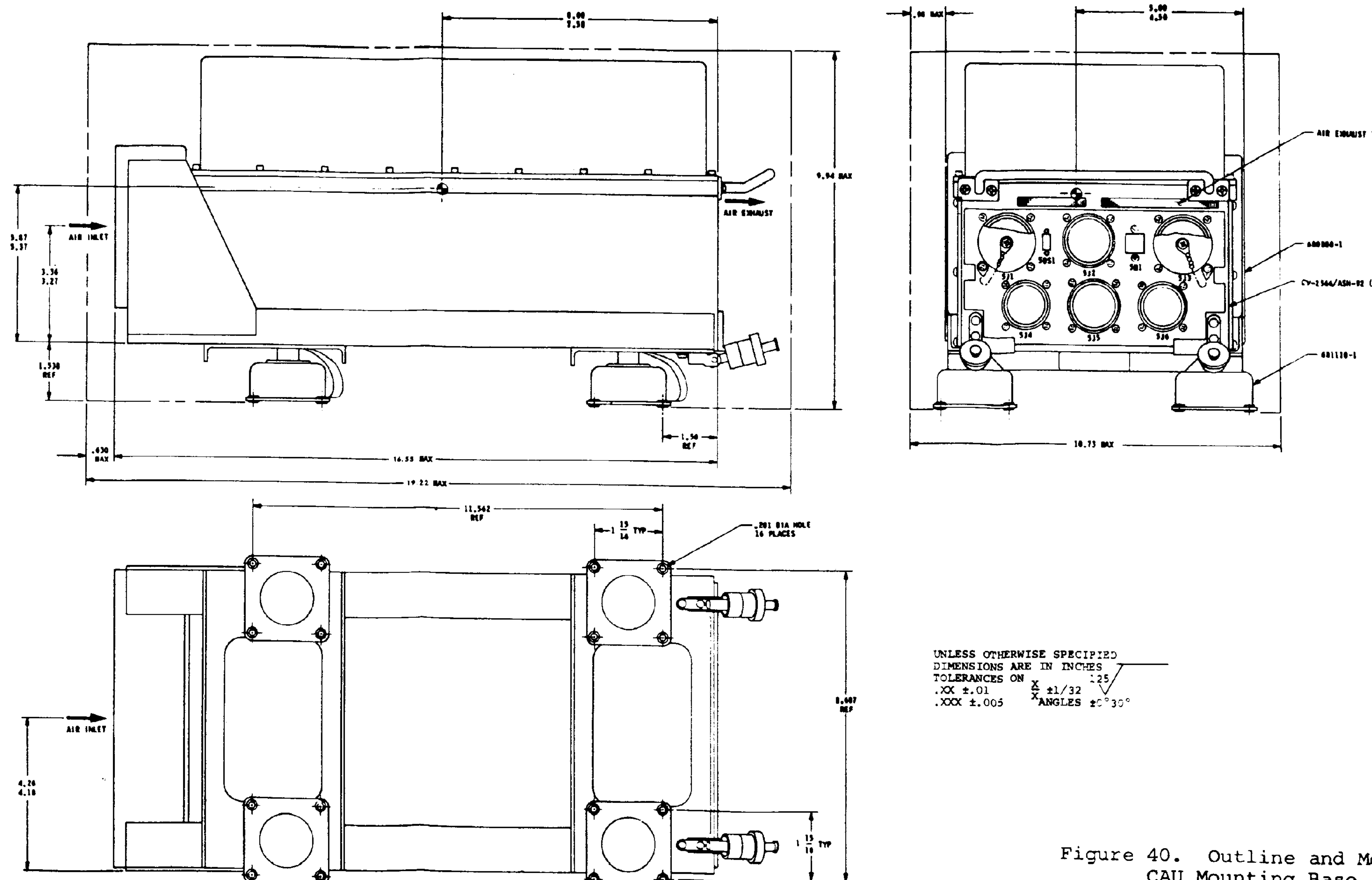
30.6.1 Function - The CAU mounting base shall provide shock and vibration isolation for Converter Amplifier Unit CV-2566/ASN-92(V). The mount shall be designed with an integral transition device which will direct cooling air into the CAU heat exchanger from a circular tube source.

30.6.2 Specification - The mounting base shall be designed in accordance with MIL-C-172 except as detailed herein.

30.6.5 Installation - The mounting base shall be configured as shown on the outline and mounting drawing, figure 40. *

30.6.4 Weight - The weight of the CAU mounting base, including vibration isolatoin, and cooling air plenum, shall not exceed 4.0 pounds.

30.6.5 Installation - The mounting base shall be designed for installation on a horizontal shelf using sixteen 8-32 NC-2A or 10-32 NF-2A screws mounted through isolator flange holes. As indicated on the outline and mounting drawing (figure 40), cool- *
ing air shall be coupled to the air inlet side of the transistor device using six 4-40 NC-2A screws. The sway space required under maximum dynamic conditions is also shown in figure 40. *



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON X ±1/32
.XX ±.01
.XXX ±.005 ANGLES ±0°30'

Figure 40. Outline and Mounting,*
CAU Mounting Base
(Shown With CAU in Place)

40. QUALITY ASSURANCE PROVISIONS

Refer to 4.

50. PREPARATION FOR DELIVERY

Refer to 5.

60. NOTES

Refer to 6.

60.1 Associated Equipment - The Converter Amplifier Unit specified in this appendix shall be designed to operate with the following list of associated equipments:

ITEMS	TYPE DESIGNATION
Inertial Measuring Unit	CN-1263/ASN-92(V)
Air Navigation Computer	CP-964/ASN-92(V)
Power Supply	PP-6188/ASN-92(V)
Control-Indicator	c-7883/ASN-92(V)
Automatic Flight Control System (AFCS)	AN\ASW-15
Remote Attitude Indicator (RAI)	MM- 4
Bearing Distance Heading Indicator (BDHI)	ID-663/u
Course Indicator (CI)	ID-387
Heading and Attitude Refer-ence System HARS)	AN/ASN-50
Tactical Air Navigation Set (TACAN)	AN/ARN-52(v)
HARS Signal Data Converter (HARS-SDC)	CV-(TBD)/ASN-50
Computer Progrmer (CP)	AN/ASA-(TBD)
Air Data Computer (ADC)	TBD
Control Indicator Group (CIG)	TBD
Signal Conmand Readout and Alarm Module (SCRAM)	TBD
Doppler Radar Signal Data Converter (DOPLR-SDC)	C-6689(TBD)/APN-153(V)

INDEX

INDEX ((cont)

INDEX (cont)

INDEX (cont)

INDEX (cont)

INDEX (cont)

INDEX (cont)

INDEX (cont)

INDEX (cont)

INDEX OF ILLUSTRATIONS

INDEX OF ILLUSTRATIONS (cont)

INDEX OF TABLES

INDEX OF TABLES (cont)

☆U.S. GOVERNMENT PRINTING OFFICE: 1977-703-020/4506

STANDARDIZATION DOCUMENT IMP .OVEMENT PROPOSAL

INSTRUCTIONS: This form is provided to solicit beneficial comments which may improve this document and enhance its use. DoD contractors, government activities, manufacturers, vendors, or other prospective users of the document are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity. A response will be provided to the submitter, when name and address is provided, within 30 days indicating that the 1426 was received and when any appropriate action on it will be completed.

NOTE: This form shall not be used to submit requests for waivers, deviations or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

DOCUMENT IDENTIFIER *(Number)* AND TITLE

MIL-N-81604C(AS) Navigation Set, Inertial AN/ASN-92 (V)

NAME OF ORGANIZATION AND ADDRESS OF SUBMITTER

☐ VENDOR ☐ USER ☐ MANUFACTURER

1. ☐ HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? ☐ IS ANY PART OF IT TOO RIGID, RESTRICTIVE, LOOSE OR AMBIGUOUS? PLEASE EXPLAIN BELOW.

A. GIVE PARAGRAPH NUMBER AND WORDING

B. RECOMMENDED WORDING CHANGE

C. REASON FOR RECOMMENDED CHANGE(S)

2. REMARKS

SUBMITTED BY *(Printed or typed name and address — Optional)*

TELEPHONE NO.

DATE

DD FORM 1426, 1 OCT 76

EDITION OF 1 JAN 72 WILL BE USED UNTIL EXHAUSTED.

FOLD

Naval Air Systems Command
Washington, D. C. 20360

POSTAGE AND FEES PAID

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

NAVAL AIR SYSTEMS COMMAND (AIR-52021)
DEPARTMENT OF THE NAVY
WASHINGTON, D. C. 20360

FOLD