TECHNICAL MANUAL

ORGANIZATIONAL LEVEL

RING LASER GYRO NAVIGATOR INERTIAL NAVIGATION SYSTEM, AN/WSN-7(V)1, -7(V)2, -7(V)3, PART NUMBERS CN-1695/WSN-7(V), CN-1696/WSN-7(V), and CN-1697/WSN-7(V); OPERATION AND MAINTENANCE, WITH PARTS LISTS

Northrop Grumman Corporation
Sperry Marine
1070 Seminole Trail
Charlottesville, VA 22901-2827

N00024-95-C-4095

N65236-02-D-3823

SUPERSEDURE NOTICE: THIS MANUAL SUPERSEDES TMIN S9427-AN-MMO-010, REVISION 1, DATED 30 SEPTEMBER 2001, WITH CHANGE A, DATED 15 SEPTEMBER 2003 AND CHANGE B, DATED 24 MARCH 2005.

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PUBLISHED BY DIRECTION OF COMMANDER NAVAL SEA SYSTEMS COMMAND

0910- LP- 102- 7705

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0910-LP-102-7705

26 MARCH 2007

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Dates of issue for original and changed pages are:

Original........0........26 MARCH 2007

Total Number of pages in this manual is 405 consisting of the following:

Page No.	Change No.	Page No.	Change No.	Page No.	Change No.	Page No.	Change No.
Cover	0	2-19	0	3-25	0	5-25	0
Title	0	2-20	0	3-26	0	5-26	0
B	0	2-21	0	3-27	0	5-27	0
Change Record 1/(change Record 2 Blank)	0	2-22	0	3-28	0	5-28	0
i	0	2-23	0	3-29	0	5-29	0
ii	0	2-24	0	3-30	0	5-30	0
iii	0	2-25	0	3-31	0	5-31	0
iv	0	2-26	0	3-32	0	5-32	0
v	0	2-27	0	3-33	0	5-33	0
vi	0	2-28	0	3-34	0	5-34	0
vii	0	2-29	0	3-35	0	5-35	0
viii (Blank)	0	2-30	0	3-36	0	5-36	0
ix	0	2-31	0	3-37	0	5-37	0
x (Blank)	0	2-32	0	3-38	0	5-38	0
a	0	2-33	0	3-39	0	5-39	0
(blank/1-0)	0	2-34	0	3-40	0	5-40	0
1-1	0	2-35	0	3-41	0	5-41	0
1-2	0	2-36	0	3-42	0	5-42	0
1-3	0	2-37	0	3-43	0	5-43	0
1-4	0	2-38	0	3-44	0	5-44	0
1-5	0	2-39	0	3-45	0	5-45	0
1-6	0	2-40	0	3-46	0	5-46	0
1-7	0	2-41	0	4-1	0	5-47	0
1-8	0	2-42 (Blank)	0	4-2	0	5-48	0
1-9	0	3-1	0	5-1	0	5-49	0
1-10	0	3-2	0	5-2	0	5-50	0
1-11	0	3-3	0	5-3	0	5-51	0
1-12	0	3-4	0	5-4	0	5-52	0
1-13	0	3-5	0	5-5	0	5-53	0
1-14	0	3-6	0	5-6	0	5-54	0
2-1	0	3-7	0	5-7	0	5-55	0
2-2	0	3-8	0	5-8	0	5-56	0
2-3	0	3-9	0	5-9	0	5-57	0
2-4	0	3-10	0	5-10	0	5-58	0
2-5	0	3-11	0	5-11	0	5-59	0
2-6	0	3-12	0	5-12	0	5-60	0
2-7	0	3-13	0	5-13	0	5-61	0
2-8	0	3-14	0	5-14	0	5-62	0
2-9	0	3-15	0	5-15	0	5-63	0
2-10	0	3-16	0	5-16	0	5-64	0
2-11	0	3-17	0	5-17	0	5-65	0
2-12	0	3-18	0	5-18	0	5-66	0
2-13	0	3-19	0	5-19	0	6-1	0
2-14	0	3-20	0	5-20	0	6-2	0
2-15	0	3-21	0	5-21	0	6-3	0
2-16	0	3-22	0	5-22	0	6-4	0
2-17	0	3-23	0	5-23	0	6-5	0
2-18	0	3-24	0	5-24	0	6-6	0

*Zero in the Change No. column indicates an original page.

LIST OF EFFECTIVE PAGES - Continued

Page No.	Change No.	Page No.	Change No.	Page No.	Change No.	Page No.	Change No.
6-7	0	7-1	0	7-51	0	A-5	0
6-8	0	7-2	0	7-52	0	A-6	0
6-9	0	7-3	0	7-53	0	A-7	0
6-10	0	7-4	0	7-54	0	A-8	0
6-11	0	7-5	0	7-55	0	A-9	0
6-12	0	7-6	0	7-56	0	A-10	0
6-13	0	7-7	0	7-57	0	A-11	0
6-14	0	7-8	0	7-58	0	A-12(Blank)	0
6-15	0	7-9	0	7-59	0	B-1	0
6-16	0	7-10	0	7-60	0	B-2	0
6-17	0	7-11	0	7-61	0	B-3	0
6-18	0	7-12	0	7-62	0	B-4	0
6-19	0	7-13	0	7-63	0	B-5	0
6-20	0	7-14	0	7-64	0	B-6	0
6-21	0	7-15	0	7-65	0	B-7	0
6-22	0	7-16	0	7-66 (Blank)	0	B-8	0
6-23	0	7-17	0	8-1	0	B-9	0
6-24	0	7-18	0	8-2	0	B-10	0
6-25	0	7-19	0	8-3	0	B-11	0
6-26	0	7-20	0	8-4	0	B-12	0
6-27	0	7-21	0	8-5	0	B-13	0
6-28	0	7-22	0	8-6	0	B-14	0
6-29	0	7-23	0	8-7	0	B-15	0
6-30	0	7-24	0	8-8	0	B-16	0
6-31	0	7-25	0	8-9	0	B-17	0
6-32	0	7-26	0	8-10	0	B-18	0
6-33	0	7-27	0	8-11	0	B-19	0
6-34	0	7-28	0	8-12	0	B-20	0
6-35	0	7-29	0	8-13	0	B-21	0
6-36	0	7-30	0	8-14	0	B-22	0
6-37	0	7-31	0	8-15	0	B-23	0
6-38	0	7-32	0	8-16	0	B-24	0
6-39	0	7-33	0	8-17	0	B-25	0
6-40	0	7-34	0	8-18	0	B-26	0
6-41	0	7-35	0	8-19	0	B-27	0
6-42	0	7-36	0	8-20	0	B-28	0
6-43	0	7-37	0	8-21	0	B-29	0
6-44	0	7-38	0	8-22	0	B-30	0
6-45	0	7-39	0	8-23	0	B-31	0
6-46	0	7-40	0	8-24	0	B-32	0
6-47	0	7-41	0	8-25	0	B-33	0
6-48	0	7-42	0	8-26	0	B-34	0
6-49	0	7-43	0	8-27	0	B-35	0
6-50	0	7-44	0	8-28	0	B-36	0
6-51	0	7-45	0	8-29	0	B-37	0
6-52	0	7-46	0	8-30 (Blank)	0	B-38	0
6-53	0	7-47	0	A-1	0	B-39	0
6-54	0	7-48	0	A-2	0	B-40	0
6-55	0	7-49	0	A-3	0	B-41	0
6-56	0	7-50	0	A-4	0	B-42	0

LIST OF EFFECTIVE PAGES - Continued

Page No.	Change No.	Page No.	Change No.	Page No.	Change No.	Page No.	Change No.
B-43	0	B-46	0	INDEX-1	0	INDEX-4(Blank)	0
B-44	0	GLOSSARY-1	0	INDEX-2	0		
B-45	0	GLOSSARY-2	0	INDEX-3	0		

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TECHNICAL MANUAL CERTIFICATION SHEET

CERTIFICATION APPLIES TO: NEW MANUALS ☒ REVISION ☐ CHANGE ☐

APPLICABLE TMINS/PUB. NO.	PUBLICATION DATE (day, month, year)	READING GRADE LEVEL (RGL)
S9427-AN-OMP-010/WSN-7	26 MARCH 2007	N/A

TITLE

TECHNICAL MANUAL, ORGANIZATIONAL LEVEL, RING LASER GYRO NAVIGATOR INERTIAL NAVIGATION SYSTEM, AN/WSN-7(V)1, -7(V)2, -7(V)3, PART NUMBERS CN-1695/WSN-7(V), CN-1696/WSN-7(V), AND CN-1697/WSN-7(V); OPERATION AND MAINTENANCE WITH PARTS LISTS

TMCR/TMSR/SPECIFICATION NUMBER

NDMS-030225-000

CHANGES AND REVISIONS:

PURPOSE

This technical manual replaces TMIN S9427-AN-MMO-010/WSN-7 Revision 1 with Changes A and B. This manual changes the location of inertial navigation theory to Chapter 3; incorporates detailed information on external interface devices; incorporates significant changes to the format of Scheduled Maintenance, Troubleshooting, and Corrective Maintenance procedures; and revises and updates Chapter 7 parts list tables and associated illustrations.

EQUIPMENT ALTERATION NUMBERS INCORPORATED

N/A

TMDER/ACN NUMBERS INCORPORATED

N/A

Continued on additional pages as needed.

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	NAME	SIGNATURE	ORGANIZATION	CODE	DATE
ACQUISITION	R. Jones	R Jones	PEO	IWS6LOG2	4/19/07
TECHNICAL	L. Roehrs	L Roehrs	SPAWARSYSCEN	834LR	4/19/07
PRINTING RELEASE	K. Barrale	K. Barrale	SPAWARSYSCEN	J834KB/SEA	4/19/07

NAVSEA 4160/8 (Rev 7-2003)

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RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	VALIDATING OFFICER SIGNATURE

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TABLE OF CONTENTS

Chapter		Page
FRONT MATTER		
	TABLE OF CONTENTS	i
	LIST OF ILLUSTRATIONS	v
	LIST OF TABLES	vi
	FOREWORD	vii
	SAFETY SUMMARY	ix
1	**GENERAL INFORMATION AND SAFETY PRECAUTIONS**	**1-1**
1.1	SAFETY PRECAUTIONS.	1-1
1.1.1	AN/WSN-7 General Safety Precautions.	1-1
1.1.2	Dangers, Warnings, and Cautions.	1-1
1.2	INTRODUCTION.	1-4
1.2.1	General Equipment Function.	1-4
1.2.2	Normal Operation.	1-4
1.2.3	Test Features.	1-4
1.2.4	Power.	1-4
1.3	AN/WSN-7(V) CONFIGURATIONS AND INTERFACES.	1-4
1.3.1	Configurations.	1-4
1.3.2	External Data Interfaces.	1-4
1.4	UNITS AND ASSEMBLIES.	1-5
1.4.1	DSVL Interface Modification.	1-5
1.4.2	ATM Interface Modification.	1-5
1.5	INS INTERFACE SYSTEMS.	1-5
1.5.1	AN/WSN-7(V) Master to AN/WSN-7(V) Slave.	1-5
1.5.2	IP-1747/WSN Control Display Unit (CDU).	1-5
1.6	TROUBLESHOOTING AND MAINTENANCE CONCEPT.	1-5
1.7	LIST OF APPLICABLE DOCU-MENTS.	1-5
1.8	EQUIPMENT AND ACCESSORIES.	1-5
2	**OPERATION**	**2-1**
2.1	INTRODUCTION.	2-1
2.2	CONTROLS AND INDICATORS.	2-1
2.2.1	Keypad Controls and Menu Display.	2-1
2.2.2	Key Functions.	2-1
2.2.3	Menu Selections.	2-1
2.3	OPERATING PROCEDURES.	2-1
2.3.1	Turning on the RLGN.	2-1
2.3.2	Operating Modes.	2-2
2.3.2.1	Align Mode States.	2-2
2.3.2.2	Alignment References.	2-2
2.3.2.3	Operating in Align Modes.	2-2
2.3.2.4	Align Methods.	2-2
2.3.2.5	Selecting the Navigate Mode.	2-5
2.3.2.6	Switching Between Navigate and Align Modes.	2-6
2.3.3	Transverse Coordinates Reference and Display.	2-7
2.3.3.1	Use of Transverse Coordinates Reference System.	2-7
2.3.3.2	Modes for Use in Transverse Coordinates Reference System.	2-7
2.3.4	Accepting and Entering Position Fixes.	2-7
2.3.4.1	Applying Fix Data as a Slew.	2-7
2.3.4.2	Position Updates.	2-8
2.3.4.3	Accepting or Rejecting Fixes.	2-8
2.3.4.4	INS Processing of a Position Fix.	2-8
2.3.4.5	Criteria for Acceptance of a Position Fix.	2-8
2.3.4.6	Enhanced Performance Position Accuracy (EP^2A).	2-8
2.3.4.7	Reset Modes and Operator Acceptance of a Position Fix.	2-8
2.3.4.8	Automatic Entry of a Position Fix.	2-9
2.3.4.9	Manual Entry of a Position Fix.	2-9
2.3.4.10	Manual Fix Entry Procedure.	2-9
2.3.4.11	Manual Position Slew Procedure.	2-10
2.3.4.12	Review Reset Data Procedure.	2-11
2.3.5	Selecting the Velocity Damping Mode, Source, and Filter.	2-11
2.3.5.1	Selecting Damped or Undamped Operation.	2-11
2.3.5.2	Selecting the Horizontal Velocity Damping Reference.	2-12
2.3.5.3	Selecting the Horizontal Velocity Damping Filter.	2-12
2.3.6	Selecting Data for Display.	2-12
2.3.7	Operating Under Interfering Conditions.	2-12
2.3.7.1	Acknowledging and Identifying Fault Conditions.	2-12
2.3.7.2	Operating with System Faults.	2-12
2.3.7.3	Source Alternating Current (AC) Power or Synchro Reference Fault.	2-13
2.3.7.4	Indexer Faults (Code **043** or **044**).	2-13
2.3.7.5	Speed Data Source Faults (Codes **036**, **056**, **057**, **060**, **061**, **222**, and **223**).	2-13
2.3.7.6	GPS or GPS I/O Faults (Codes **368** through **383**).	2-13
2.3.7.7	Position Fix and Velocity Reference Error Faults (Codes **209**, **210**, **211**, and **212** through **217**).	2-13
2.3.7.8	External Serial Interface or I/O Processor Faults (Codes **240** through **246**, **248**, **250**, **251**, **253** through **257**, **259**, **262**, **264**, **266**, **338**, **347** through **351**).	2-14
2.3.7.9	Common RAM Test Pattern Faults (Codes **019** and **252**).	2-14
2.3.7.10	Casualty Mode Faults (Codes **033**, **100**, **101**, **102**, **109**, **188**).	2-14
2.3.8	Turning off the INS.	2-14
2.4	OPERATOR'S MAINTENANCE.	2-15
2.4.1	Off-Line Test Mode.	2-15
2.4.2	On-Line NTDS Interface Ports Selection and Configuration.	2-15
2.4.2.1	NTDS Port Configuration Settings.	2-15
2.4.2.2	Super Channel Settings (Applicable to IDS 13)	2-15
2.4.2.3	ATM Port Configuration Settings.	2-15
2.4.3	On-Line Log Calibration.	2-16
2.4.3.1	Changing Log Bias Calibration Tables.	2-16
2.4.4	On-Line Log Calibration (Semi-Automatic Procedure).	2-16
2.4.4.1	Procedure.	2-16
2.4.4.2	System Damping.	2-16
2.4.5	On-Line Log Calibration (Automatic Procedure).	2-16
2.4.5.1	Monitoring and Clearing Log Bias Values.	2-17
2.4.5.2	LogCal Mode.	2-17
2.4.5.3	Maintaining Log Bias Values.	2-17
2.4.6	On-Line System Performance Monitor Function.	2-17
2.4.6.1	Operation While Monitoring Performance.	2-17
2.4.6.2	Conditions for Monitoring Perfor-mance.	2-17
2.4.7	Turning On the Performance Monitoring Function.	2-17
2.4.8	Turning Off the Performance Monitoring Function.	2-17
2.4.9	Performance Monitoring Fault Codes.	2-17
2.4.10	On-Line Attitude Comparison Limit and Filter Time Constant Adjustment.	2-18
2.4.10.1	Purpose of Functions.	2-18
2.4.10.2	Operator Advisory Fault Codes.	2-18
2.4.11	DR Data Output Function.	2-18
2.4.12	Viewing Memory Contents.	2-18
2.4.13	On-Line Simulated Attitude, Velocity, and Position Outputs.	2-18
3	**THEORY AND FUNCTIONAL DESCRIPTION**	**3-1**
Section I	INERTIAL THEORY	3-1
3.1	INTRODUCTION.	3-1
3.2	BASIC INERTIAL NAVIGATION PRINCIPLES AND THEORY.	3-1
3.2.1	Conventional vs. Strapdown Inertial Navigation Systems.	3-1
3.2.2	Inertial Navigation Systems.	3-1
3.2.2.1	Simplest (Single Axis) Inertial Navigator.	3-1
3.2.2.2	Addition of Vehicle Pitch Motion.	3-1
3.2.2.3	Moving Along the Meridian of a Spherical Non-Rotating Earth.	3-2
3.2.2.4	Single-Axis Schuler-Tuned Gimbaled System.	3-2
3.2.2.5	Single-Axis Schuler-Tuned Strapdown System.	3-2
3.2.2.6	Undamped Schuler-Tuned System Error Propagation.	3-2
3.2.2.7	Effect of the Earth's Rotation.	3-2
3.2.2.8	Torquing Rates (or Coordinate Frame Rates).	3-3
3.2.2.9	North Position Error.	3-3
3.2.3	Velocity Damping of the Vertical (Schuler-Tuned) Loop.	3-3
3.2.3.1	Other Real World Considerations.	3-3
3.2.3.2	Damping the Schuler Loop.	3-3
3.2.3.3	External Velocity Damped Vertical Loop.	3-3
3.2.4	Strapdown Processing.	3-3
3.2.5	Navigation Processing.	3-3
3.2.5.1	Vertical Loops.	3-3
3.2.5.2	Earth Loop.	3-4
3.2.5.3	Vertical Velocity Loop.	3-4
3.2.6	Kalman Filter.	3-4
3.2.6.1	General.	3-4
3.2.6.2	Kalman Filter Computations.	3-4
3.2.6.3	Kalman Filter Matrix Definitions.	3-4
3.2.7	Position Fix and Position Slew.	3-5
3.2.7.1	Fix Reset Processing by the Kalman Filter.	3-5
3.2.7.2	Manual Fix Entry.	3-5

TABLE OF CONTENTS - Continued

Chapter		Page
3.2.7.3	Fix Reset Checks.	3-5
3.2.7.4	Position Slews.	3-5
3.2.8	Vertical Loop Damping.	3-5
3.2.9	Sensor Errors and Calibration.	3-6
3.2.9.1	Factory Calibration.	3-6
3.2.9.2	Operational Calibration – Self-Align/Calibrate.	3-6
3.2.9.3	Self-Align/Calibrate.	3-7
3.2.9.4	Summary.	3-7
3.2.10	Kalman Filter Reinitialization.	3-7
3.2.10.1	Automatic Reinitialization of the Kalman Filter.	3-7
3.2.10.2	Manually Selected Reinitialization of the Kalman Filter.	3-7
3.2.11	Sensor Block Indexing.	3-7
3.2.12	Basics of Polar Navigation.	3-7
3.2.12.1	Relationships Between True and Transverse Coordinates.	3-8
3.2.12.2	Operating in Polar Mode.	3-8
3.2.13	Normal/Transverse Operation.	3-8
3.2.13.1	Coordinate Mode Selection.	3-8
3.2.13.2	Synchro Heading Output Selection.	3-8
3.2.14	Review of Trigonometric Functions.	3-8
3.2.15	Inertial Navigation Vectors.	3-8
3.2.16	Concepts of Statistical Estimation, Overview of Kalman Filter.	3-8
3.2.16.1	Statistics and Variance.	3-8
3.2.16.2	Philosophy of Kalman Filter.	3-9
3.2.17	Global Positioning System (GPS) Blending	3-10
3.2.17.1	Global Positioning System/Inertial Navigation System Filter.	3-10
3.2.17.2	INS Reset Smoothing.	3-10
3.2.17.3	INS/GPS Filtering and Reset Smoothing Together.	3-10
3.2.17.4	Lever Arm Corrections.	3-10
Section II	EQUIPMENT DESCRIPTION	3-11
3.3	RLGN FUNCTIONAL DESCRIPTION.	3-11
3.3.1	Basic Description of Ring Laser Gyro Operation.	3-11
3.3.2	Basic RLG Design Criteria.	3-11
3.3.2.1	Gas Flow.	3-11
3.3.2.2	Frequency Locking.	3-11
3.3.2.3	Path Length Control.	3-11
3.3.2.4	Random Drift Improvement.	3-11
3.3.3	General Description of Functions.	3-11
3.3.3.1	Nav Processor.	3-12
3.3.3.2	I/O Processor.	3-12
3.3.3.3	Support Electronics.	3-12
3.3.3.4	IMU.	3-12
3.4	FUNCTIONAL DESCRIPTION OF RLGN ASSEMBLIES.	3-12
3.4.1	Power Distribution and Emergency Power Switching.	3-12
3.4.2	Platform Indexing.	3-13
3.4.2.1	Platform Indexing and Stabilization Control Circuits.	3-13
3.4.2.2	Sensor Rotation During Normal System Operation.	3-13
3.4.2.3	Sensor Rotation During Off-Line Testing.	3-13
3.4.3	System Timing and Navigation Processing.	3-13
3.4.3.1	Nav Processor-IMU Processor Timing.	3-14
3.4.3.2	Nav Processor-IMU Processor Data Transfer.	3-14
3.4.4	External Data Interfacing.	3-14
3.4.5	Internal Data Interfacing.	3-14
3.4.6	Position Sensing and Processing.	3-14
3.4.6.1	Gyro Power and Power Control Functions.	3-14
3.4.6.2	Gyro Control and Signal Processing Functions.	3-15
3.4.6.3	Accelerometer Control and Signal Processing Functions.	3-15
3.4.7	Synchro Attitude and Velocity Data Interface.	3-15
3.4.8	Hardware Monitoring and Fault/Status Output.	3-15
3.4.9	Built-In Test (BIT) and Status.	3-16
3.4.9.1	Off-Line Tests.	3-16
3.4.9.2	System Confidence Test.	3-16
3.4.9.3	Operator Response to Advisories and Faults.	3-16
3.4.9.4	Source AC Power or Synchro Reference Fault.	3-16
3.4.10	NAV and I/O Processors.	3-16
3.4.11	Synchro Data Conversion and SBA Descriptions.	3-17
3.4.11.1	Synchro Converter CCAs (1A1A38), (1A1A39), and (1A1A40).	3-17
3.4.11.2	Synchro Buffer Amplifiers (SBAs) 8 VA (1A1A41) and (1A1A42).	3-17
3.4.11.3	Synchro Buffer Amplifiers (SBAs) 32 VA (1A1A43) and (1A1A44).	3-17
4	**SCHEDULED MAINTENANCE**	**4-1**
4.1	INTRODUCTION.	4-1
4.2	BATTERY ASSEMBLY (1A1A5) SCHEDULED MAINTENANCE.	4-1
4.2.1	Battery Assembly (1A1A5) Storage Procedure.	4-1
4.2.2	Battery Charging.	4-1
4.2.2.1	Internal Method for Battery Assembly (1A1A5) Charging.	4-1
4.2.2.2	Preferred External Method for Recharging Battery Assembly (1A1A5).	4-1
4.2.2.3	Alternate External Method for Recharging Battery Assembly (1A1A5).	4-1
4.2.3	Restoring Configuration Data in Memory After Battery Power Has Been Interrupted.	4-1
4.3	PERIODIC BATTERY ASSEMBLY (1A1A5) OPERATIONAL CHECK.	4-1
4.4	PERIODIC SYSTEM RECALIBRATION.	4-2
5	**TROUBLESHOOTING**	**5-1**
5.1	INTRODUCTION.	5-1
5.2	FAULT ASSESSMENT.	5-2
5.3	TEST MODE TURN-ON.	5-2
5.4	FAULT CODE TROUBLESHOOTING.	5-2
5.4.1	Fault Code Identification.	5-2
5.4.2	On-Line Fault Code Isolation.	5-2
5.4.3	Off-Line Fault Code Isolation.	5-3
5.4.4	Display Shutdown Fault Codes.	5-3
5.5	DISPLAY-RELATED FAULT TROUBLESHOOTING.	5-3
5.5.1	Identify Display-Related Faults.	5-3
5.5.2	Display Assembly (1A1A10) and Data Entry Keyboard (1A1A9) Fault Isolation.	5-3
5.5.3	Display Assembly Self-Test.	5-4
5.5.4	Display Assembly Wraparound Test.	5-4
5.6	LED AND LIGHT INDICATOR SURVEY.	5-5
5.7	SELECTING MENUS AND OFF-LINE TEST FUNCTIONS.	5-6
5.8	SYSTEM CONFIDENCE TEST.	5-6
5.9	SLIP RING TROUBLESHOOTING.	5-6
5.10	FAULT SCENARIO TROUBLESHOOTING.	5-7
5.10.1	Power System Fault Scenario Troubleshooting.	5-7
5.10.2	Simulated Attitude, Velocity, and Position Outputs.	5-8
6	**CORRECTIVE MAINTENANCE**	**6-1**
6.1	GENERAL CORRECTIVE MAINTENANCE INFORMATION.	6-1
6.1.1	Introduction.	6-1
6.1.2	Electrostatic Discharge Sensitivity.	6-1
6.1.3	Cable Harness Lacing and Tie-Wrapping Techniques.	6-1
6.1.4	Opening the Processor Cabinet for Maintenance.	6-1
6.1.5	Tools, Test Equipment and Support Items.	6-1
6.1.6	Personnel.	6-1
Section I.	ADJUSTMENT AND ALIGNMENT	6-2
6.2	ESTABLISHING SYSTEM CONFIGURATION SETTINGS AFTER MAINTENANCE.	6-2
6.2.1	Restoring Installation Configuration Parameters.	6-2
6.2.1.1	Preliminary Information.	6-2
6.2.1.2	Restore RLGN Configuration Parameters.	6-2
6.2.2	Restore RLGN Calibration Data.	6-3
Section II.	REMOVAL AND REPLACEMENT	6-4
6.3	CORRECTIVE MAINTENANCE (UPPER CABINET).	6-4
6.3.1	Upper Cabinet Access.	6-4
6.3.1.1	Maintenance Turn Off.	6-4
6.3.1.2	Release Upper Cabinet Door.	6-4
6.3.1.3	Secure Upper Cabinet Door.	6-4
6.3.1.4	Release Cable Harness and Tie Wraps.	6-5
6.3.1.5	Secure Cable Harness and Tie Wraps.	6-5
6.3.2	Cable Replacement.	6-5
6.3.2.1	Remove Ribbon Cable.	6-5
6.3.2.2	Install Ribbon Cable.	6-5
6.3.2.3	Remove Serial Coaxial Cable.	6-5
6.3.2.4	Install Serial Coaxial Cable.	6-5
6.3.2.5	Remove Serial Fiber Optic Cable.	6-5
6.3.2.6	Install Serial Fiber Optic Cable.	6-5
6.3.3	CCA Replacement.	6-6
6.3.3.1	Release Wedge Locks.	6-6
6.3.3.2	Secure Wedge Locks.	6-6

TABLE OF CONTENTS - Continued

Chapter		Page
6.3.3.3	Remove CCA.	6-6
6.3.3.4	Install CCA.	6-6
6.3.3.5	Interchange CCAs to Track Fault.	6-7
6.3.3.6	Interchange CCAs to Return to Original Configuration.	6-7
6.3.3.7	Replace Nav Processor CCA (1A1A13).	6-7
6.3.3.8	Field Change Nav Processor CCA (1A1A13).	6-8
6.3.3.9	Replace or Field Change I/O Processor CCA (1A1A21).	6-8
6.3.3.10	Replace Status and Command CCA (1A1A15).	6-8
6.3.3.11	Replace IMU Processor (1A1A32) PROM.	6-8
6.3.3.12	Transfer IMU Processor CCA (1A1A32) PROM.	6-9
6.3.4	Backplane Replacement.	6-9
6.3.4.1	Access Backplane.	6-9
6.3.4.2	Remove Nav Processor Backplane Assembly (1A1A11) or I/O Processor Backplane Assembly (1A1A12).	6-9
6.3.4.3	Install Nav Processor Backplane Assembly (1A1A11) or I/O Processor Backplane Assembly (1A1A12).	6-9
6.3.4.4	Remove Support Electronics Backplane Assembly (1A1A30).	6-10
6.3.4.5	Install Support Electronics Backplane Assembly (1A1A30).	6-10
6.3.5	Power Assemblies Replacement.	6-10
6.3.5.1	Fuse Replacement.	6-10
6.3.5.2	Remove Power Line Filter (1A1A1).	6-10
6.3.5.3	Install Power Line Filter (1A1A1).	6-11
6.3.5.4	Remove Inverter Assembly (400 Hz) (1A1A2).	6-11
6.3.5.5	Install Inverter Assembly (400 Hz) (1A1A2).	6-11
6.3.5.6	Remove Vital Bus CCA (1A1A3).	6-11
6.3.5.7	Install Vital Bus CCA (1A1A3).	6-11
6.3.5.8	Power Supply (1A1A6) Replacement.	6-12
6.3.5.9	Battery Charger (1A1A7) Replacement.	6-12
6.3.5.10	Power Module (1A1A8) Replacement.	6-12
6.3.5.11	Synchro Buffer Amplifier (8 VA) (1A1A41) Replacement.	6-13
6.3.5.12	Synchro Buffer Amplifier (8 VA) (1A1A42) Replacement.	6-13
6.3.5.13	Synchro Buffer Amplifier (32 VA) (1A1A43) Replacement.	6-13
6.3.5.14	Synchro Buffer Amplifier (32 VA) (1A1A44) Replacement.	6-14
6.3.5.15	Battery Assembly (1A1A5) Replacement.	6-14
6.3.6	Display Assembly Replacement.	6-15
6.3.6.1	Remove Display Assembly (1A1A10).	6-15
6.3.6.2	Remove Vacuum Fluorescent Display (1A1A10A1) from Display Assembly (1A1A10).	6-15
6.3.6.3	Remove Panel Interface Assembly (1A1A10A2).	6-15
6.3.6.4	Remove Display Electromagnetic Interference Window.	6-15
6.3.6.5	Remove Data Entry Keyboard (1A1A9).	6-16
6.3.6.6	Install Data Entry Keyboard (1A1A9).	6-16
6.3.6.7	Install Display Electromagnetic Interference Window.	6-16
6.3.6.8	Install Panel Interface Assembly (1A1A10A2).	6-16
6.3.6.9	Install Vacuum Fluorescent Display (1A1A10A1) to Display Assembly (1A1A10).	6-17
6.3.6.10	Install Display Assembly (1A1A10).	6-17
6.4	CORRECTIVE MAINTENANCE (LOWER CABINET).	6-17
6.4.1	Lower Cabinet Access.	6-17
6.4.1.1	Remove IMU Cabinet Front Panel.	6-17
6.4.1.2	Remove Inertial Measuring Unit (1A2A1).	6-18
6.4.1.3	Remove Magnetic Shield from Sensor Block Assembly.	6-18
6.4.1.4	Install Magnetic Shield on Sensor Block Assembly.	6-19
6.4.1.5	Install Inertial Measuring Unit (1A2A1).	6-20
6.4.1.6	Install IMU Cabinet Front Panel.	6-20
6.4.2	Power Supply Replacement.	6-21
6.4.2.1	Remove High Voltage Power Supply Assembly (1A2A1A1A4).	6-21
6.4.2.2	Installation of High Voltage Power Supply Assembly (1A2A1A1A4).	6-21
6.4.3	Gyrocompass Replacement.	6-21
6.4.3.1	Gyro “A” (1A2A1A1A1) Replacement.	6-21
6.4.3.2	Gyro “B” (1A2A1A1A2) Replacement.	6-22
6.4.3.3	Gyro “C” (1A2A1A1A3) Replacement.	6-23
6.4.4	Accelerometer Replacement.	6-24
6.4.4.1	Remove Accelerometer.	6-24
6.4.4.2	Install Accelerometer.	6-25
6.4.5	Accelerometer Stimulus Assembly Replacement.	6-25
6.4.5.1	Remove Accelerometer Stimulus Assembly (1A2A1A1A9A1).	6-25
6.4.5.2	Install Accelerometer Stimulus Assembly (1A2A1A1A9A1).	6-25
6.4.6	Slip Ring Replacement.	6-25
6.4.6.1	Slip Ring Assembly (1A2A1A1A10) Replacement.	6-25
6.4.6.2	Slip Ring Assembly (1A2A1A1A11) Replacement.	6-26
6.4.6.3	Slip Ring Assembly (1A2A1A1A12) Replacement.	6-27
6.4.6.4	Slip Ring Assembly (1A2A1A1A13) Replacement.	6-27
Section III.	PRECAUTIONS FOR SHIPMENT	6-29
6.5	GENERAL PROCEDURES FOR SHIPPING LRUs.	6-29
6.5.1	Packing and Shipment of Ring Laser Gyro Navigator.	6-29
6.5.2	Packing and Shipment of Inertial Measuring Unit.	6-29
6.5.3	Packing and Shipment of Battery Assembly.	6-29
6.5.4	Packing and Shipment of Ring Laser Gyro Assemblies.	6-29
6.5.5	Packing and Shipment of Circuit Card Assemblies.	6-29
6.5.6	Packing and Shipment of Chassis-Mounted Electronic Subassemblies.	6-29
7	**PARTS LISTING**	**7-1**
7.1	INTRODUCTION.	7-1
7.2	PARTS TABLES DESCRIPTIONS.	7-1
7.3	MANUFACTURERS.	7-1
8	**INSTALLATION**	**8-1**
8.1	INTRODUCTION.	8-1
8.2	WELDING RESTRICTIONS.	8-1
8.3	EQUIPMENT REQUIRED FOR INSTALLATION AND OPTICAL ALIGNMENT.	8-1
8.3.1	Equipment Suggested for Optical Alignment.	8-1
8.3.2	Tools, Drawings and Support Items Required for Installation.	8-1
8.3.3	Installation Materials Supplied with Equipment.	8-2
8.4	SHIPBOARD PRE-INSTALLATION REQUIREMENTS.	8-2
8.5	INSTALLATION OF INS ASSEMBLIES.	8-2
8.5.1	Uncrating and Preparation of Equipment for Installation.	8-2
8.5.2	Cabinet Installation Procedure.	8-2
8.5.3	Installation of Inertial Measuring Unit (1A2A1) in Measurement Cabinet Assembly.	8-3
8.5.4	Installation of Calibration PROMs Associated with the IMU.	8-3
8.5.5	Verification of Powered Operation.	8-3
8.6	DETERMINING CALIBRATION AND CONFIGURATION DATA.	8-4
8.6.1	Optical Measurement of Cabinet Azimuth, Pitch, and Roll Alignment Correction.	8-4
8.6.2	Determining Convention for Azimuth, Pitch, and Roll Output Data.	8-5
8.6.3	Determining Lever Arms for INS Mounting Location and Position and Velocity Output Locations.	8-5
8.6.4	Determining Lever Arms for Position and Velocity Sensors.	8-5
8.7	ENTERING INSTALLATION AND CONFIGURATION DATA.	8-5
8.7.1	Store Function.	8-5
8.7.2	Input/Output Function Selections.	8-5
8.7.3	Reference Devices Function Selections.	8-6
8.7.4	Operator Configuration Function Selections.	8-6
8.7.5	Ship Configuration Function Selections.	8-6
8.7.6	Alignment Function Selections.	8-7
8.7.7	Synchro Output Function Selections.	8-7
8.8	DETERMINING VELOCITY REFERENCE BIAS CALIBRATION VALUES.	8-7

TABLE OF CONTENTS - Continued

Chapter		Page
8.9	DSVL INTERFACE MODIFICATION KIT INSTALLATION	8-8
8.9.1	DSVL Interface Cable Connections	8-8
8.9.2	DSVL Installation Configuration	8-8
APPENDIX A	BIT TEST CABLES	A-1
A.1	INTRODUCTION	A-1
A.2	CABLE PARTS LISTING	A-1
APPENDIX B	LIST OF FAULT CODES	B-1
B.1	INTRODUCTION	B-1
B.2	FAULT CODES NOT RESULTING IN FAILURES	B-1
B.3	FAULT CODES FOR DEBUGGING SOFTWARE	B-1
B.4	FAULT RELAYS	B-1
B.5	ON-LINE FAULT CATEGORIES	B-1
B.5.1	CATEGORY 0 (Operator Advisory)	B-1
B.5.2	CATEGORIES 1 through 3 (Fault Advisory K3; System Fail K1; Malfunction K2)	B-1
B.5.3	CATEGORY 4 (System Malfunction)	B-1
B.5.4	CATEGORY 5 (Shutdown Status)	B-1
B.5.5	CATEGORY 6 (Reset Fault BIT)	B-1
B.5.6	CATEGORY 7 (Delay NVRAM Update)	B-1
B.5.7	CATEGORY 8 (I/O or ATM Processor Shutdown)	B-1
B.5.8	CATEGORY 9 (Ignore Fault)	B-1
B.6	SOFTWARE ERROR WORDS	B-1
GLOSSARY		**GLOSSARY-1**
GLOSSARY	LIST OF ACRONYMS AND ABBREVIATIONS	GLOSSARY-1
INDEX		INDEX-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-2.	Typical System Configuration	1-13
2-1.	Front Panel Controls and Indicators	2-31
2-2.	Keypad Controls	2-31
2-3.	Menu Status/Mode Indications	2-32
2-4.	Identifying Operation Menus and Data Entry	2-33
2-5.	Dockside Align Settle States	2-35
2-6.	Slave Align Settle States	2-36
2-7.	At-Sea Align Settle States	2-37
2-8.	Mode Transition Diagram	2-38
2-9.	Earth Coordinates References	2-38
2-10.	Position Fix, Data Entry and Review Functions	2-39
2-11.	Enhanced Performance Position Accuracy (EP^2A) Block Diagram	2-39
2-12.	Position Estimate Accuracy vs. Time without Position Update	2-40
2-13.	EM Log Calibration Functions	2-40
2-14.	Time RMS (TRMS) Position Error Calculation Method	2-41
3-1.	Simple Strapdown System	3-19
3-2.	Simple Gimbal Stabilization of the Accelerometer	3-19
3-3.	Single-Axis Schuler-Tuned Gimbaled System	3-20
3-4.	Single-Axis Schuler-Tuned Strapdown System	3-20
3-5.	Schuler Oscillations in an Undamped Inertial Navigator	3-21
3-6.	Effect of Earth's Rotation on Local Vertical	3-21
3-7.	Earth Rate Components	3-22
3-8.	North Position Error	3-22
3-9.	Block Diagram of External Velocity Damped Vertical Loop	3-23
3-10.	Strapdown Processing Block Diagram	3-24
3-11.	Kalman Filter Functional Block Diagram	3-25
3-12.	INS/GPS Filtering and Reset Smoothing	3-25
3-13.	Using Light to Measure Rotation	3-26
3-14.	Simplified Block Diagram	3-27
3-15.	Battery Charger and Emergency Power Switching Control (Power Supply Rev A through F)	3-28
3-16.	Battery Charger and Emergency Power Switching Control (Power Supply Rev G)	3-29
3-17.	Power Fault Detection and Power Control Functions	3-30
3-18.	Platform Indexing Control	3-31
3-19.	Platform Indexing Orientations	3-32
3-20.	Display and Display Interface	3-33
3-21	System Timing and Navigation Processing	3-34
3-22.	I/O Processing and Interface	3-36
3-23.	Gyro High Voltage	3-38
3-24.	Ring Laser Gyros: Dither	3-39
3-25.	Ring Laser Gyros: PLC and RDI	3-40
3-26.	Ring Laser Gyros: Accelerometers, Rotation	3-41
3-27.	Synchro Data - Heading, Total Velocity	3-42
3-28.	Synchro Data - Roll/Pitch	3-43
3-29.	Synchro Data - Velocity	3-44
3-30.	Status and Command, Functional Diagram	3-45
3-31	Performance Monitoring and Built-In Test (BIT), Functional Diagram	3-46
5-1.	Maintenance Turn-On and Test Selection Sequence	5-28
5-2.	Status LEDs and EEPROM Write Enable Switch Identification	5-28
5-3.	Display Test Switches, Location and Function	5-29
5-4.	Display Functions, Troubleshooting Logic Diagram	5-29
5-5.	Internal Cables, Distribution and Identification Diagram	5-30
5-6.	Main 3-Phase AC and Non-Vital 1-Phase Synchro, Power Distribution Diagram	5-33
5-7.	+25 VDC and Internally-Generated 115 VAC, 400 Hz, Power Distribution Diagram	5-34
5-8.	-25 VDC and Low Voltage Power Supply A8 Output, Power Distribution Diagram	5-36
5-9.	Backplanes A11 and A12, Power Distribution Diagram	5-38
5-10.	Power Fault Detection and Power Control Functions Diagram	5-41
5-11.	Support Electronics Backplane (**1A1A30**) and IMU Cabinet (**1A2**), Low Voltage Power Supply	5-42
5-12.	Ring Laser Gyros, High Voltage Power Distribution and Monitoring Diagram	5-44
5-13.	Roll (Outer) and Azimuth (Inner) Gimbal, Synchro and Torquer Loop Diagram	5-45
5-14.	Ring Laser Gyros, Path Length Control and Random Drift Improvement Control Functions Diagram	5-47
5-15.	Ring Laser Gyros, Dither Control Function Diagram	5-49
5-16.	Ring Laser Gyros, Rotation Sensor Function Diagram	5-50
5-17.	Accelerometers, Acceleration Output Function Diagram	5-51
5-18.	Gyro and Accelerometer Temperature Sensing Function Diagram	5-52
5-19.	Parallel Bus Data, Address and Control Functions, Distribution Diagram	5-53
5-20.	RS-422 Serial Data Interface Functions Diagram	5-58
5-21.	System Synchro Format (Heading, Roll, Pitch, and Velocity) Outputs Diagram	5-59
5-22.	Synchro Format Speed (EM Log) Inputs Diagram	5-62
5-23	BIT Fault Monitoring Functions Diagram	5-63
6-1.	Typical Maintenance Tools	6-48
6-2.	Battery-Backed Configuration Data	6-48
6-3.	Identification of Calibration PROMs on IMU Processor CCA	6-49
6-4.	Removal of Backplane Wiring Assemblies	6-50
6-5.	Replacement of Battery Assembly (**1A1A5**)	6-50
6-6.	Replacement of Display Assembly (**1A1A10**)	6-51
6-7.	Replacement of Data Entry Keyboard (**1A1A9**)	6-51
6-8.	Replacement of Vacuum Fluorescent Display (**1A1A10A1**)	6-52
6-9.	Inertial Measuring Unit in Measurement Cabinet Assembly	6-52
6-10.	Removal of Inertial Measuring Unit from Measurement Cabinet Assembly	6-53
6-11.	Mounting of Magnetic Shield on Sensor Block Assembly (**1A2A1A1A9**)	6-53
6-12.	Gyro and Circuit Board Mounting Locations and Orientation	6-54
6-13.	Location of Ring Laser Gyro Attachment Points	6-54
6-14.	Accelerometers Mounting Locations and Orientation	6-55
6-15.	Location of Slip Rings in Inertial Measuring Unit	6-56
7-1.	Processor Cabinet Assembly (**1A1**) (Unit 1)	7-54
7-2.	Processor Cabinet Assembly (**1A1**) (Unit 1) Side Views	7-55
7-3.	Processor Cabinet Assembly (**1A1**) (Unit 1) Internal Components	7-56
7-4.	Processor Cabinet Assembly (**1A1**) (Unit 1) Topside	7-57
7-5.	Installation: Mounting Arrangement	7-58
7-6.	Front Panel: Display Assembly (**1A1A10**)	7-59
7-7.	IMU: Measurement Cabinet Assembly (**1A2**) (Unit 2)	7-60
7-8.	IMU: Subassembly Identification (**1A2A1A1**)	7-61
7-9.	IMU: Subassembly Identification (**1A2A1A1**)	7-62
7-10.	IMU: Subassembly Identification (**1A2A1A1**)	7-63
7-11.	IMU: Sensor Block Assembly (**1A2A1A1A9**)	7-64
7-12.	High Voltage Power Supply Assembly (**1A2A1A1A4**)	7-65
8-1.	Sample Installation Data Sheet (Sheet 1 of 5)	8-11
8-1.	Sample Installation Data Sheet (Sheet 2 of 5)	8-11
8-1.	Sample Installation Data Sheet (Sheet 3 of 5)	8-12
8-1.	Sample Installation Data Sheet (Sheet 4 of 5)	8-12
8-1.	Sample Installation Data Sheet (Sheet 5 of 5)	8-13
8-2.	Polarity Definitions for Frame Mirrors	8-13
8-3.	Bias Calibration Graph Example	8-14
8-4.	RLGN to DSVL Interface Cable Connections	8-14
8-5.	Mounting Base Orientation and Mounting Holes Location Diagram	8-15
8-6.	Identifying IMU Mirrors to be used for Optical Alignment of the Cabinet	8-16
8-7.	Optical Measurement of Cabinet Mounting Misalignment	8-17
8-8.	Determining Ship's Azimuth, Pitch, Roll Convention	8-18
8-9.	Determining INS Lever Arms	8-19
8-10.	Determining Position and Velocity Sensors Lever Arms	8-20
8-11.	Determining GPS Velocity Sensors (VGPS) Lever Arms	8-21

LIST OF ILLUSTRATIONS - Continued

Figure	Title	Page
8-12.	Identifying Installation Configuration Menus and Configuration Data Entry Required	8-22
8-13.	Sample Speed Bias Calibration Worksheet	8-23
8-14.	Installation Guidance Mounting Arrangement	8-24
A-1.	NTDS Type A Interface BIT Test Cable 1981552-1	A-4
A-2.	NTDS Type D and E Interface BIT Test Cable 1981552-6 and -7	A-5
A-3.	RCDU Data Interface BIT Test Cable 1981552-8	A-6
A-4.	IMU Interface BIT Test Cable 1981552-10	A-7
A-5.	Display Unit BIT Test Cable 1981552-11	A-8
A-6.	INS-INS Data Interface BIT Test Cable 1981552-14	A-9
A-7.	DSVL Interface BIT Test Cable 1860241	A-10
A-8.	ATM Interface BIT Test Cable 1900239	A-11

LIST OF TABLES

Number	Title	Page
1-1.	Design and Physical Characteristics	1-6
1-2.	Digital (RS-422A) Data Interface	1-6
1-3.	Analog Synchro Input/Output and Reference Characteristics	1-7
1-4.	Summary of AN/WSN-7(V) Units and Assemblies	1-7
1-5.	AN/WSN-7(V) NTDS I/O Configurations	1-9
1-6.	Documents Required but Not Supplied	1-10
1-7.	Documentation Supplied	1-11
1-8.	Equipment and Accessories Supplied	1-11
1-9.	Equipment Required but Not Supplied	1-12
1-10.	Field Changes and Factory Changes	1-12
2-1.	Keypad Control Functions	2-19
2-2.	Operating Menus/Functions Description	2-19
2-3.	Identification of Port Type and Physical Location	2-28
2-4.	Identification of NTDS Port Interface Design Specification	2-29
2-5.	Simulated Outputs Description	2-29
3-1.	Trigonometric Functions	3-18
3-2.	Sample Data Calculations Illustrating Concept of Variance	3-18
4-1.	AN/WSN-7(V) Planned Maintenance System Requirements	4-2
5-1.	Test Menus/Functions Description	5-9
5-2.	CCA LEDs and Power Indicators Illumination Survey	5-26
5-3.	Simulated Outputs Description	5-27
5-4.	Display Wraparound Test, Characters Display	5-27
6-1.	Summary of Corrective Maintenance Procedures	6-29
6-2.	Tools, Test Equipment and Support Items	6-30
6-3.	Slip Ring Assembly Mounting Information	6-32
6-4.	Packaging Instructions for Ring Laser Gyro Navigator	6-33
6-5.	Packaging Instructions for Inertial Measuring Unit	6-34
6-6.	Alternate Packaging Instructions for Inertial Measuring Unit	6-35
6-7.	Packaging Instructions for Battery Assembly 1981554	6-36
6-8.	Packaging Instructions for Ring Laser Gyros 1812594-n	6-37
6-9.	Packaging Instructions for Nav, I/O, and ATM Processor Assemblies	6-38
6-10.	Packaging Instructions for Support Electronic Assemblies	6-39
6-11.	Packaging Instructions for Vital Bus Assembly 1978322	6-40
6-12.	Packaging Instructions for 400 Hz Inverter Assembly 1982618	6-41
6-13.	Packaging Instructions for Power Supply 1979342	6-42
6-14.	Packaging Instructions for Battery Charger 1810853	6-43
6-15.	Packaging Instructions for Power Module 1205050-3	6-44
6-16.	Packaging Instructions for Display Assembly 1979344	6-45
6-17.	Packaging Instructions for Synchro Buffer Amplifiers 1976545 and 1976547	6-46
6-18.	Packaging Instructions for High Voltage Power Supply 1979045	6-47
7-1.	List of Major Assemblies	7-2
7-2.	Parts List by Reference Designator Order	7-4
7-3.	Parts List by Diagram Location Order	7-17
7-4.	Parts List by Part Number Order	7-35
7-5.	Manufacturers List	7-53
8-1.	Tools and Support Items Required for Installation	8-9
8-2.	Installation Materials and Bit Cables Kit 03956-1812650-var	8-9
8-3.	Common Installation Materials Kit 03956-1812807	8-9
8-4.	Factory (As Shipped) NTDS Configurations	8-10
8-5.	Identification of NTDS Port Interface Design Specification	8-10
8-6.	DSVL Interface Modification Kit Application	8-10
A-1.	Applicable Built-In Test Cables	A-1
A-2.	Built-In Test Wraparound Cables Parts List	A-1
B-1.	Fault Code Descriptions and Fault Isolation	B-2

FOREWORD

This technical manual describes the basic organization and procedures for organizational-level operation and maintenance of the CN-1695/WSN-7(V), CN-1696/WSN-7(V), and CN-1697/WSN-7(V) Inertial Navigation Systems. The purpose of this manual is for the training of and use by personnel responsible for the operation and maintenance of the AN/WSN-7(V).

This technical manual replaces TMIN S9427-AN-MMO-010/WSN-7 Revision 1 with Changes A and B. This manual changes the location of inertial navigation theory to Chapter 3; incorporates detailed information on external interface devices; incorporates significant changes to the format of Scheduled Maintenance, Troubleshooting, and Corrective Maintenance procedures; and revises and updates Chapter 7 parts list tables and associated illustrations.

The manual is a standard eight-chapter technical manual. It is printed in 11”x17” flat format with no foldouts and four columns per page. Tables and illustrations are at the end of each chapter, and display shots in Chapter 2 are provided, where necessary, without figure numbers.

This is an Extensible Mark-Up Language (XML) document provided for printing in a Portable Document Format® (PDF®) file. If users are viewing the electronic version of this manual, they can navigate to a specific figure, table, or paragraph using the PDF-generated bookmarks and/or the links located within the textual content that appear highlighted in red. If users are viewing a paper copy of this manual, the links will appear as bold-face text. Additionally, bold text is used to indicate switch positions, keypad controls, screen displays, and reference designator numbers.

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This technical manual is under the overall cognizance and maintenance philosophy of an In-Service Engineering Agent (ISEA) assigned to:

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- Telefax (757) 462-7657
- Send e-mail to: keith.barrale@navy.mil.

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SAFETY SUMMARY

GENERAL SAFETY INSTRUCTIONS.

This manual describes physical processes that may cause injury or death to personnel, or damage to equipment if not properly followed. This safety summary includes general safety precautions and instructions that must be understood and applied during operation and maintenance to ensure personnel safety and protection of equipment. Before performing any task, the DANGERs, WARNINGs, CAUTIONs, and NOTEs included in that task shall be reviewed and understood. These safety procedures supplement the procedures in OPNAVINST 5100.19 (Series) *Navy Safety Precautions for Forces Afloat*.

DANGERS, WARNINGS, CAUTIONS, AND NOTES.

DANGERS, WARNINGs, and CAUTIONs are used in this manual to highlight operating or maintenance procedures, practices, conditions, or statements considered essential to protection of personnel (DANGER, WARNING) or equipment (CAUTION). Specific dangers, warnings, and cautions applying to the AN/WSN-7(V) Inertial Navigation System are summarized in **Paragraph 1.1**. These dangers, warnings, and cautions are repeated elsewhere in the manual following paragraph headings and immediately preceding the text to which they apply. DANGERs, WARNINGs, and CAUTIONs consist of four parts: heading (DANGER, WARNING, or CAUTION); a statement of the hazard; minimum precautions; and possible result if disregarded. NOTEs are used in this manual to highlight operating or maintenance procedures, practices, conditions, or statements that are not essential to protection of personnel or equipment. NOTEs may precede or follow the step or procedure, depending on the information to be highlighted. The headings and their definitions are as follows:

DANGER

Highlights an essential operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in immediate injury to, or death of, personnel, or threaten the primary mission of the ship.

WARNING

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

CAUTION

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

SAFETY PRECAUTIONS.

The following safety precautions shall be observed while performing procedures in this manual:

PERSONNEL SAFETY.

The Ring Laser Gyro Navigator (RLGN) in the AN/WSN-7(V) Inertial Navigation System contains voltages up to 120 VAC and 50 VDC; both voltage types are dangerous. Always observe standard safety practices and the following when working on the equipment:

- Personal Attire. Wear dry clothing. Never wear rings or other jewelry.
- Electrical Power Application. Do not work on equipment with power applied. Disconnect ship's connectors and attach warning notices to the appropriate ship's power circuit breaker ON switch and to the AN/WSN-7(V) RLGN.
- Electrical Power Interrupting Devices. Do not rely solely on switching devices to interrupt power, since they can be defective. When in doubt, measure the circuit with a voltmeter.
- Troubleshooting Conditions. When troubleshooting, avoid touching any surface that can conduct electricity.
- Capacitor Discharge. Discharge power circuit capacitors using an approved shorting device when working on circuits with more than 24 Volts (V).
- Warning Signs. Observe warning signs on and around the equipment being worked on and those that appear in this manual.

DO NOT REPAIR OR ADJUST ALONE.

Under no circumstances should repair or adjustment of energized equipment be attempted alone. The immediate presence of someone capable of rendering aid is required. Before making adjustments, be sure to protect against grounding. If possible, adjustments should be made with one hand, while the other hand is free and clear of equipment. Even when power has been removed from equipment circuits, dangerous potentials may still exist due to retention of charges by capacitors. Circuits must be grounded and all capacitors discharged before attempting repairs.

TEST EQUIPMENT.

Make certain test equipment is in good condition. If a test meter must be held, ground the case of the meter before starting measurement; do not touch live equipment or personnel working on live equipment while holding a test meter. Some types of measuring devices should not be grounded; these devices should not be held when taking measurements.

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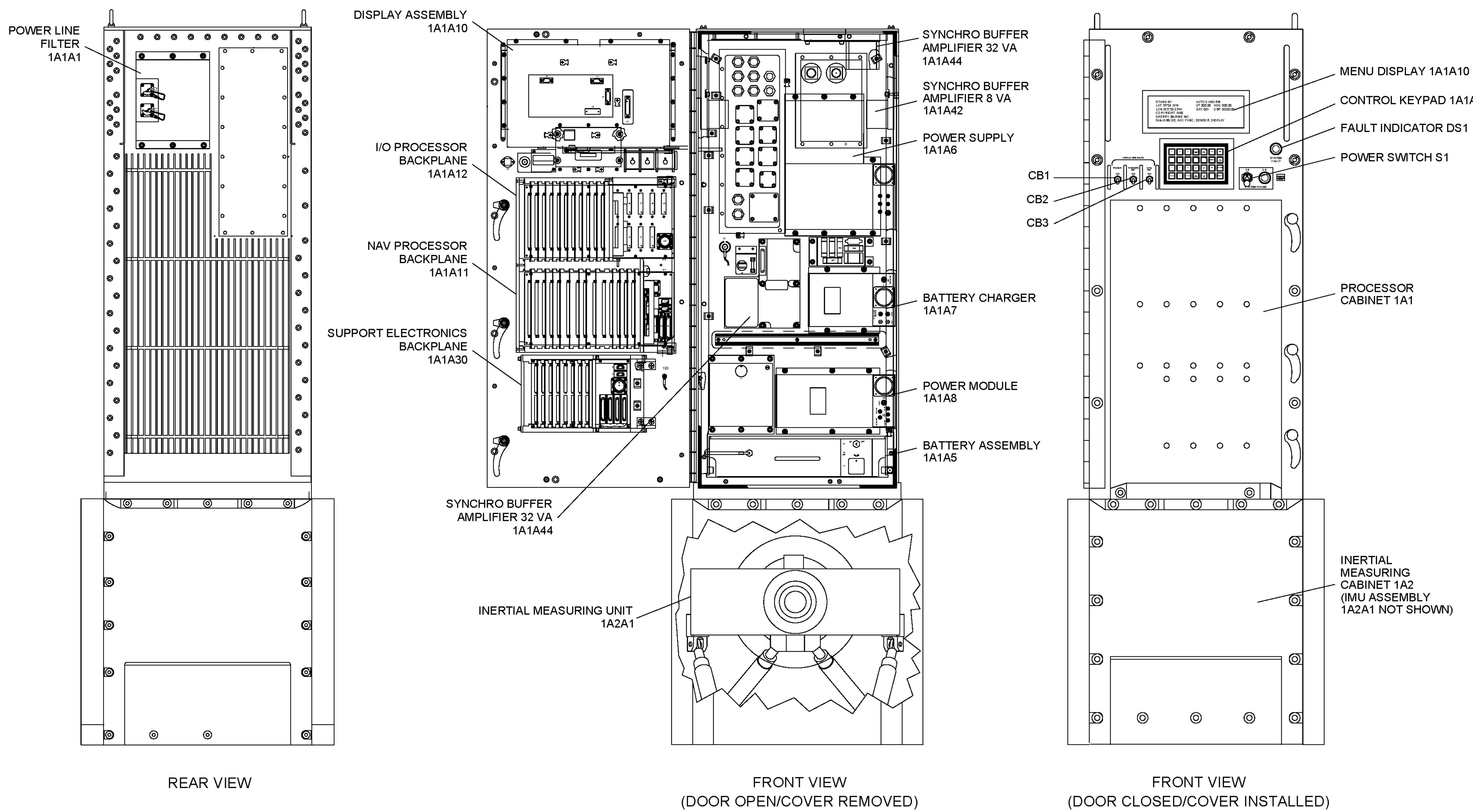


Figure 1-1. PART NUMBERS CN-1695/WSN-7(V), CN-1696/WSN-7(V), and CN-1697/WSN-7(V);

CHAPTER 1
GENERAL INFORMATION AND SAFETY PRECAUTIONS

1.1 SAFETY PRECAUTIONS.

Normal precautions concerning electronic equipment should be followed for installation, operation, maintenance, and troubleshooting for the AN/WSN-7(V) Inertial Navigation System (INS). The safety summary located in the front matter of this technical manual lists general precautions applicable to this equipment.

1.1.1 AN/WSN-7 GENERAL SAFETY PRECAUTIONS. When working on the AN/WSN-7 INS, observe the following safety precautions specific to the equipment:

- Exposed Relays and Contacts. The INS contains exposed relays and contacts which can carry deadly current. Use care when working inside the Electronic Control Unit (ECU) with the system energized.
- Batteries. The INS batteries are designed to supply power to the system if ship's power to the system is lost. To remove battery power from the system, turn off and unplug both batteries.
- Inertial Measuring Unit. The Inertial Measuring Unit (IMU) produces high voltage during normal operation. Do not perform maintenance on the IMU while it is energized.
- Heavy Components. Some components of the INS, including the batteries and IMUs, are heavy and can cause injury if they are lifted or carried improperly. Use additional personnel and/or mechanical aids to remove or install these components.

1.1.2 DANGERS, WARNINGS, AND CAUTIONS. The following **DANGERs** appear in the text of this manual and are repeated here for emphasis:

DANGER

The Processor Cabinet Assembly has 115 VAC power present at circuit breakers on the cabinet door and at relays mounted in the cabinet even when the SYSTEM POWER switch is turned Off.

DANGER

When troubleshooting, do not touch any live or exposed circuits inside the AN/WSN-7(V). 115 VAC and deadly current are present until power input to the RLGN is removed.

DANGER

When performing corrective maintenance, ensure that all ship's power to the AN/WSN-7(V) is turned off and tagged out in accordance with ship's instructions.

The following **WARNINGs** appear in the text of this manual and are repeated here for emphasis:

WARNING

The test menu prompts the operator to disconnect the cable from the jack on the Inverter Assembly and then press the ENTER key to initiate the test. 115 VAC, 400 Hz is present at this connector. Use care when disconnecting and reconnecting the cable.

WARNING

The cables that carry ship's AC power and synchro reference are attached directly to jacks J1 and J2 on the outside back of the AN/WSN-7(V) cabinet.

WARNING

When Display Assembly (**1A1A10**) is removed, the processor cabinet door locking arm must be removed, allowing unrestricted door movement. This could become a dangerous condition in heavy seas. When the bracket is removed, the cabinet door should be tied down to restrict movement.

WARNING

The IMU weighs 162 lbs (73 kg). Two persons are required to remove the IMU from its cabinet and place it for servicing or shipment.

WARNING

The Battery Assembly (**1A1A5**) weighs 58.2 lbs (26.4 kg). To prevent injury to personnel or damage to equipment, two persons are required to remove or install it. The handle on the front of the Battery Assembly is intended to be used only for sliding the assembly into or out of the cabinet. Do not lift or carry the assembly by this handle.

WARNING

The Power Supply Assembly (**1A1A6**) weighs approximately 51 lbs (23 kg). To prevent injury to personnel or damage to equipment, two persons are required to remove or install it.

WARNING

The IMU weighs 162 lbs (73 kg). Two persons are required to install this assembly in the cabinet. Be sure that the inner gimbal is rotated parallel to the outer gimbal frame to prevent the outer synchro or torquer motor from hitting the top of the cabinet during installation. Do not slide the IMU directly into the cabinet from the floor. Lift the assembly until the bottom of the mounting plate is even with the base of the cabinet and slide it into position.

The following **CAUTIONs** appear in the text of this manual and are repeated here for emphasis:

CAUTION

If PDIG is used as the sensor and degrades beyond a Figure of Merit (FM)-03, then the performance monitoring function will be disabled.

CAUTION

Forcing an incorrect reset will introduce a position error proportional to the reset error. This position error will propagate through the undamped Earth loop into position and attitude errors. Large position or attitude errors may cause the vertical loops to undamp and oscillate over a period of 84 minutes due to velocity errors.

CAUTION

Depending on the review mode selected, a rejected fix may be entered by the operator. These functions allow the operator to force the acceptance of a good fix to correct system errors. This is useful if a fix is rejected as a result of errors in the system's estimate of position. Care should be taken when manually entering or accepting a fix that has been rejected. Acceptance of an unreasonable fix introduces position errors and will cause calculations of position and velocity to diverge.

CAUTION

The RLGN will reject the manual fix if the reset exceeds the error limits described in Paragraph 2.3.4.5. Care must be taken when manually accepting a fix that has been rejected by the RLGN. Forcing acceptance of an unreasonable fix introduces position errors and will cause the system calculations of position and velocity to diverge.

CAUTION

In either of these fix error estimate options, the Sigma values must reflect the true position fix accuracy. Assigning a large Sigma to an accurate fix will not disturb the INS, but the reset will have only a small correction on the system. On the other hand, assigning a small Sigma to an inaccurate fix will disturb the system and result in position and velocity divergence.

CAUTION

Forced acceptance of correct position fix data over a period of time will restore the INS to full navigation data accuracy; however, forced acceptance of incorrect position fix data will quickly degrade navigation performance. It may be necessary to realign the INS to restore navigation accuracy if acceptance of an invalid position fix has been force-accepted.

CAUTION

Do not leave Battery Assembly (**1A1A5**) off charge for extended periods of time. If the AN/WSN-7(V) is scheduled to be turned off for more than 30 days, disconnect Battery Assembly (**1A1A5**) and check the open circuit voltage monthly until the AN/WSN-7(V) is placed back in operation. Recharge the battery prior to installing it back into the AN/WSN-7(V) from an auxiliary source if its open circuit voltage drops below 28.5 volts.

CAUTION

Fully charge the Battery Assembly (**1A1A5**) prior to placing it in storage to successfully hold a charge until the first maintenance recharge.

CAUTION

After the Battery Assembly (**1A1A5**) connector is reconnected, perform Test Mode Turn-On procedure, then restore RLGN Configuration Parameters.

CAUTION

Do not perform the Battery Assembly (**1A1A5**) operational check after the system has settled and is in use for navigation. This test should be scheduled to be performed at dockside and at the beginning of system operation or calibration. Excessive battery discharge during this test can result in unexpected shutdown of the system and loss of the calibration data stored in the battery-backed RAM, requiring 72 hours to achieve Navigate mode again.

CAUTION

Do not completely discharge Battery Assembly (**1A1A5**) during the periodic battery operational check. Complete battery discharge will cause the AN/WSN-7(V) to shut down, and calibration data in battery-backed RAM will be lost.

CAUTION

After KF Reinit has been selected, do not turn the system off until the 72-hour calibration period has completed and the system enters the NAVIGATE mode, as indicated by the word NAVIGATE in the upper left corner of the DISPLAY. If the system is turned off before the 72-hour calibration has completed, the system will restart the calibration from the beginning and will require an additional 72 hours before it will enter NAVIGATE after power is again restored.

CAUTION

Do not perform this test unless problems are suspected in Nav Processor CCA (**1A1A13**). Performing this test causes the configuration parameters stored in battery-backed RAM on CCA (**1A1A13**) to be erased. After the test is performed, battery-backed RAM must be reloaded from EEPROM (KENV) on Status and Command CCA (**1A1A15**) and a 72-hour settle period is required to reestablish accuracy.

CAUTION

If the NTDS Type E Assembly is replaced, use care not to bend the coax cables (T968912) excessively or damage the connectors on the NTDS CCA.

CAUTION

If the battery cells in Battery Assembly (**1A1A5**) are shorted to the battery chassis, replace the Battery Assembly before replacing Battery Charger (**1A1A7**). Failure to do so will damage the replacement Battery Charger.

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

CAUTION

Configuration data changes are not saved in EEPROM (KENV) on Status and Command CCA (**1A1A15**) nor battery-backed RAM on Nav Processor CCA (**1A1A13**) until the Store function is complete. Configuration data updates can be aborted by repeated pressing of the **<CLEAR>** key.

CAUTION

The jacks for fiber optic connectors are extremely fragile. Be careful not to overtighten the connector, or damage to the jack may occur.

CAUTION

Wedge locks provide a thermal path from the board to the heat sink. If the wedge locks are not tightened, then a loose board may rattle and may also develop hot spots that can reduce reliability.

CAUTION

The AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN) contains Electrostatic Discharge Sensitive (ESDS) devices on various circuit cards and subassemblies. These cards and subassemblies require special care during handling and storage when they are removed from the system. As a precaution, wear a grounding strap when performing maintenance, and follow all standard practices applicable to testing, handling, and storage of ESDS devices whenever any subassembly is removed from the system.

CAUTION

Do not force the CCA to seat into its backplane assembly connector; forcing the CCA may bend or break the CCA's connector pins and cause the system to fail.

CAUTION

Prevent damage to the PROMs during extraction and installation by using a PROM chip extractor.

CAUTION

Ensure switch S1 on Battery Assembly (**1A1A5**) is set to OFF before connecting harness connector plug P5 to jack A5J1 on Battery Assembly.

CAUTION

Panel Interface Assembly (**1A1A10A2**) contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting parts sensitive to damage by ESD.

CAUTION

An electromagnetic interference (EMI) shielding gasket is installed between the EMI window bezel and the outside surface of the door. Use care during removal and replacement of the bezel to prevent damage to the EMI gasket. If the gasket becomes torn, it must be replaced with a new gasket.

CAUTION

An EMI shielding gasket is installed between the Data Entry Keyboard and the outside surface of the door. Use care during removal and replacement of the Data Entry Keyboard to prevent damage to the EMI gasket. If the gasket becomes torn, it must be replaced with a new gasket. Be sure that gasket is positioned correctly when installing the Data Entry Keyboard. Incorrect positioning of the gasket will short the printed wiring on the CCA and cause improper operation of Keyboard functions.

CAUTION

The lower surface of the IMU mounting plate and the upper surface of the cabinet mounting plate contain precision-machined surfaces that are used to support and align the IMU in the cabinet. When removing and replacing the IMU in the cabinet, use care not to damage these surfaces. When the IMU is removed from the cabinet, place the IMU on a smooth, 4 ft. x 4 ft. sheet of clean plywood or two layers of heavy cardboard to prevent scratching of the mounting surfaces on the bottom side of the unit.

CAUTION

It is important to maintain a correct record of configuration data, so the System Configuration Menu can be reinitialized if stored data is lost. Immediately after installing a new IMU and associated PROMs, read the new cabinet-mounting alignment values and record them on the Installation Data Record Sheet retained with the INS. These misalignments are specific for the new IMU. Use of the previous IMU's misalignment values will result in alignment errors being introduced into the system.

CAUTION

Gyros are susceptible to ESD damage if contact is made with pins of jacks A12J1, A12J2, A13J1, or A13J2. Cover these jacks with ESD-approved protective caps any time they are exposed.

CAUTION

Be sure that the inner gimbal is rotated parallel to the outer gimbal frame to prevent the inner synchro or torquer motor from hitting the top of the cabinet during removal. Do not slide the IMU directly out of the cabinet onto the floor. Slide the IMU out far enough for access, then lift the assembly and place it onto a clean smooth surface.

CAUTION

When removing, replacing, or storing the shield during maintenance, ensure that the shield components are not dented or bent. Dropping or striking a shield segment can result in degradation of the magnetic shielding characteristics of the metal. Damage to the shield could result in improper fit, causing balance and acoustic noise problems, as well as degradation of the magnetic shielding properties.

CAUTION

During removal or replacement of the magnetic shield, use caution when rotating the Sensor Block with partially assembled segments to prevent the edge of a segment from capturing and damaging the slip ring harnesses routed inside the inner gimbal frame.

CAUTION

Use a standard Allen-head wrench. Use of a ball-end Allen-head wrench could cause damage to the screw.

CAUTION

The screws used to align the mounting plate in the cabinet base are made of nylon. These screws should be tightened just sufficiently to ensure firm contact between the machined alignment surfaces (5 to 7 in-lbs). Excessive tightening of these screws may cause them to break.

CAUTION

Use care during the removal and replacement of High Voltage Power Supply Assembly (**1A2A1A1A4**). Misalignment of the IMU in the isolators can occur if care is not taken. A 72-hour alignment/calibration should be performed following the removal and replacement of the High Voltage Power Supply to compensate for IMU misalignment.

CAUTION

Ring Laser Gyros are ESDS devices. Handle in accordance with ESD procedures. Gyros are shock sensitive. Use great care when handling and storing gyros.

CAUTION

The surfaces on Sensor Block Assembly (**1A2A1A1A9**) for mounting the RLGs and accelerometers, as well as the mounting surfaces of the gyros and accelerometers, are precision-machined surfaces. Be careful not to damage these surfaces when performing repairs. Place gyros and accelerometers in a protective ESD bag and store these subassemblies in a safe place to prevent them from being damaged while they are removed from the system.

CAUTION

The attachment screws on each Ring Laser Gyro (RLG) should be evenly tightened to approximately the specified torque. Since the torque recommendations primarily ensure that screws are sufficiently tightened without being stressed or broken by over tightening, and since some mounting screws are inaccessible using some torque measuring devices, it is acceptable to tighten these screws based on the feel of effort required to tighten the screw.

CAUTION

Accidentally touching the bare pins of receptacle J1 on the RLG may result in the failure of its internal electronics. Therefore, after disconnecting P1 from the RLG, it is good practice to cover J1 with the electrostatic protective cover removed from the new device being installed. Reuse the same packaging materials that came with the new RLG to return the defective RLG for repair. Handle in accordance with ESD procedures.

CAUTION

Loosen each gyro receptacle connector retaining screw alternately to prevent the screws from stripping and the connector from breaking.

CAUTION

To prevent the connector from breaking, do not attempt to torque the gyro receptacle connector retaining screws after they are fully seated against the gyro connector.

CAUTION

Tighten each gyro receptacle connector-retaining screw alternately to prevent the screws from stripping and the connector from breaking.

CAUTION

If more than one accelerometer is removed during maintenance and will be reinstalled, record the serial number of the accelerometer and match it with its mounting location. Be sure to replace each accelerometer in its original mounting location and orientation on Sensor Block Assembly (1A2A1A1A9) during reassembly. Accelerometer connectors are not keyed. Attach a temporary label to each accelerometer cable harness plug to identify its correct jack. Use care to connect plug on each accelerometer cable to the corresponding marked jack mounted on Sensor Block Assembly.

CAUTION

Use care when cutting cable ties so that wires are not damaged.

CAUTION

To prevent damage to the alignment surfaces on the bottom of the IMU mounting plate when the IMU is removed from the packing crate, keep the IMU mounted to the plywood shipping base prior to installation in the Measurement Cabinet Assembly.

CAUTION

The RLGN cabinet without the IMU installed, weighs approximately 675 lbs. (306 kg). Use proper rated hoisting equipment when installing the cabinet. To prevent damage to the surface of the mounting foundation or mounting surfaces on the bottom of the cabinet, do not attempt to slide the cabinet on the mounting foundation without lifting the cabinet. Be sure that the cabinet is positioned on the mounting foundation in correct orientation prior to removal of hoisting rig.

CAUTION

The lower surface of the IMU mounting plate and the upper surface of the cabinet mounting plate contain precision-machined surfaces, which are used to support and align the IMU in the cabinet. When installing the IMU in the cabinet, use care not to damage these surfaces.

CAUTION

Always: Review, record, and save misalignment values immediately after installing a new IMU with associated PROMs; record misalignment values to the INS Installation Data Record Sheets where the IMU is installed; use the IMU specific values recorded on the Installation Data Record Sheet to reinitialize the System Configuration menu after loss of stored data.

CAUTION

No welding or welding cables are permitted within three feet of the IMU.

CAUTION

If Fault **115** is indicated, the system should not be left on for more than 30 minutes as this may result in the HVPS overheating.

1.2 INTRODUCTION.

The AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN) (Figure 1-1) is part of the AN/WSN-7(V) INS. Each RLGN is a self-contained unit that employs an Inertial Measuring Unit (IMU) using three single-axis Ring Laser Gyros (RLGs) and three accelerometers as the inertial reference to determine ship's position, velocity, heading, roll and pitch. The system continuously accepts ship's speed information from a speed log and/or Global Positioning System (GPS), and periodically accepts ship's position information from an external navigation reference (GPS), manually via a keypad and display on the RLGN control panels, or from the IP-1747/WSN Control Display Unit (CDU).

As shown in Figure 1-2, sheet 1 and Figure 1-2, sheet 2, each RLGN is part of a dual system that provides ship's heading, log speed and distance, ship's velocities, pitch, roll, attitude rates, position and time data to other ship's systems and indicators. The AN/WSN-7(V) INS comprises two single-enclosure AN/WSN-7(V) RLGNs and a single IP-1747/WSN CDU, supported by a GPS Navigator interface and a Speed Log data interface. Only the RLGN and the power and signal interface to the RLGN are covered in this technical manual. The IP-1747/WSN is Unit 4 of the RLGN, but it has a separate technical manual. Refer to appropriate technical manuals for details on installation, operation, and maintenance of the CDU, GPS, Doppler Sonar Velocity Log (DSVL), and other support equipment. (See Table 1-6.)

1.2.1 GENERAL EQUIPMENT FUNCTION. Table 1-1 lists the major design and physical characteristics of the AN/WSN-7(V) RLGN. The RLGN requires external ship's speed input and periodic input of position data. The RLGN uses ship's log speed or velocities obtained from a GPS or DSVL to provide damping of vertical gyro loops. Position data from a GPS is used to calibrate gyro drifts and to provide position resets to the inertial navigation function. The inertial reference, speed, and filtered position reset data are processed to generate continuous and accurate position and velocity data in addition to heading, roll, and pitch reference. The RLGN transfers data to and from Battle Force Tactical Trainer (BFTT) equipment via the Asynchronous Transfer Mode (ATM) interface.

1.2.2 NORMAL OPERATION. The RLGN is designed to operate automatically after application of power and acceptance of the first position reset and requires minimum operator intervention during normal operation. A 6-line, 40-character display and 28-key keypad provide display and operating controls for selection of a wide range of functions. These functions can be accessed for monitoring and modifying operating parameters, for evaluating system performance, and for selecting test and calibration modes.

1.2.3 TEST FEATURES. A Built-In Test (BIT) function incorporating both hardware and software tests continuously monitors operation and periodically performs self-tests to determine the integrity of the AN/WSN-7(V) RLGN and its inputs/outputs. Faults are automatically announced, and fault codes that indicate the type of fault detected are displayed on the local/remote control panels.

1.2.4 POWER. In the configuration described in this technical manual, the RLGN requires 115 Volts, Alternating Current (VAC), 60 Hertz (Hz), 3 phase power and 115 VAC, 400 Hz, single-phase synchro reference. An internal battery and inverter provide emergency power for operation with digital output and limited synchro outputs (vital heading and synchro velocities) for approximately 30 minutes in the event of failure of the system power.

1.3 AN/WSN-7(V) CONFIGURATIONS AND INTERFACES.

1.3.1 CONFIGURATIONS. The AN/WSN-7(V) INS is available in three configurations. CN-1695/WSN-7(V) is installed on selected surface combatants. CN-1696/WSN-7(V) is installed on selected cruisers and LHA-1 class ships. CN-1697/WSN-7(V) is installed on aircraft carriers and LHD-1 class ships.

1.3.2 EXTERNAL DATA INTERFACES. The basic external data interface to each RLGN consists of Naval Tactical Data System (NTDS) Standard Type A parallel slow, NTDS Standard Type D high level serial, and Type E low level serial interfaces. These interfaces are Circuit Card Assemblies (CCAs) located in the Input/Output (I/O) Card Rack Assembly. The combat systems suite or aircraft alignment aboard the ship on which the RLGN system is installed determines the specific configuration of NTDS interface circuit cards.

CN-1695/WSN-7(V)

NTDS Type A	3 ea
NTDS Type D	1 ea
NTDS Type E	4 ea

CN-1696/WSN-7(V)

NTDS Type A	5 ea
NTDS Type D	1 ea
NTDS Type E	2 ea

CN-1697/WSN-7(V)

NTDS Type A	7 ea
NTDS Type E	1 ea

The basic external data interface also consists of a 1-pulse per second timing interface, which provides time synchronization in a dual-system configuration; an RS-422 serial data interface, which exchanges position, velocity, and status information in a dual-system configuration; an RS-422 interface to an external CDU; and an ATM interface to External Local Area Network (LAN). Heading, roll, pitch, north-south velocity, east-west velocity and total velocity are output as analog (synchro) data. Synchro amplifiers are provided for the heading, roll and pitch outputs. **Table 1-2** outlines the serial interface and data message characteristics. **Table 1-3** lists the synchro output characteristics and defines the synchro reference requirements.

1.4 UNITS AND ASSEMBLIES.

As shown in **Figure 1-1**, the RLGN Cabinet consists of an upper Cabinet Assembly and a lower Measurement Cabinet Assembly, which are separated by a heat shield. The upper cabinet houses power supplies, synchro amplifiers, and rack-mounted circuit cards that contain the interface, control, and data processing circuits. The lower cabinet contains the IMU components. **Table 1-4** lists the units and assemblies that make up the AN/WSN-7(V) RLGN. Some assemblies contain programmed devices. Other assemblies are calibrated by installation of an associated Programmable Read-Only Memory (PROM), which contains calibration parameters that are determined at factory test and are specific to the assembly with which the PROM is supplied. These assemblies are identified with a programmed part number, which specifies the hardware with the programmed configuration, and with a hardware part number, which identifies only the hardware without the programmed device. Normally, only the programmed part number is applicable for identifying replaceable assemblies. The RLGN contains the following functional elements:

- IMU (**1A2A1**)
- IMU support electronics
- Navigation (Nav) Processor (**1A1A13**), I/O Processor (**1A1A21**), ATM Processor (**1A1A4**), and interface electronics
- Power Supplies (**1A1A6**), (**1A1A8**) and Battery (**1A1A5**) for emergency power generation
- Keypad (**1A1A9**) and Display Panel (**1A1A10**)
- IP-1747/WSN CDU

Consult the Allowance Parts List (APL) for the appropriate revision level of each assembly.

1.4.1 DSVL INTERFACE MODIFICATION. The DSVL interface (part of RLGN Field Change 1) uses I/O Channel No. 2 on Dual Panel Interface Circuit Card Assembly (CCA) (**1A1A14**) (previously an unused spare). This data I/O channel is wired from I/O Backplane connector J9 to an added connector 1J23 on the back of the cabinet using an added harness assembly T969380. I/O Central Processor (**1A1A21**) and the Navigation Central Processor (**1A1A13**) are replaced with a later part revision containing software support for the DSVL data interface function.

1.4.2 ATM INTERFACE MODIFICATION. (Part of RLGN Field Change 1) The ATM interface assembly consists of the ATM Processor Assembly **1A1A4A1A1** and the Peripheral Component Interface (PCI) Mezzanine **1A1A4A1A2**. This data I/O channel is cabled, using fiber optic cable, from the front of the PCI Mezzanine to an added connector 1J22 on the back of the cabinet using harness assembly (**1A1W7**).

1.5 INS INTERFACE SYSTEMS.

The AN/WSN-7(V) INS interfaces with numerous ship systems using digital and analog communications.

Additional and hull-specific interface information is available in the Combat Systems Technical Operation Manual (CSTOM) and Combat Systems Operational Sequencing System (CSOSS) and in Navigation (System) Operating Procedures (NOPs) for each ship class. (See **Table 1-6**.)

1.5.1 AN/WSN-7(V) MASTER TO AN/WSN-7(V) SLAVE. A synchronous interface occurs between RLGNs in an AN/WSN-7(V) navigation suite with two RLGNs. This interface exchanges position, velocity and status information between the RLGNs.

1.5.2 IP-1747/WSN CONTROL DISPLAY UNIT (CDU). The CDU is the primary man-machine interface to/from the RLGN. The CDU is part of the AN/WSN-7 INS and is identified as Unit 4 of the system. It can monitor and control the RLGNs from a separate installation location from the RLGNs. This interface sends INS Super Channel data to the CDU. Additionally, the Remote Control Display Unit (RCDU) function, which simulates the display and keypad for the RLGN, is displayed on the CDU and enables remote operation of the RLGN from the CDU. Although the CDU is part of the AN/WSN-7(V) INS, operation and maintenance instructions for the CDU are not contained in this technical manual. (See **Table 1-6** for information on the CDU technical manual.)

1.6 TROUBLESHOOTING AND MAINTENANCE CONCEPT.

The AN/WSN-7(V) RLGN is designed for ease of maintenance through replacement of failed Lowest (or Line) Replaceable Units (LRUs) with replacements drawn from On-Board Repair Part (OBRP) stock. All LRUs, including power supplies and circuit boards, use plug and jack connectors for ease of replacement. The organizational level of maintenance will use the self-contained capability of system BIT and the diagnostic software program to identify faults to the LRU. RLGN alignment and configuration data are stored in Non-Volatile Random Access Memory (NVRAM) and Electrically Erasable Programmable Read-Only Memory (EEPROM). Calibration information associated with the attitude and acceleration sensors is stored in PROM chips, which allow maintenance to be performed on the RLGN without the need for mechanical or electrical realignment after repairs have been performed.

1.7 LIST OF APPLICABLE DOCUMENTS.

Table 1-6 provides a list of technical manuals and specifications associated with the AN/WSN-7(V) INS, but not supplied. These documents provide operation, maintenance, and installation information; Interface Design Specifications (IDSs), which describe the various message types that can be selected for data transfer between the RLGNs and external equipment; and the NTDS digital interface specifications, which describe timing, communication protocol, and transmission characteristics of the NTDS I/Os.

Table 1-7 describes the document supplied with the equipment.

1.8 EQUIPMENT AND ACCESSORIES.

Table 1-8 provides a list of equipment and accessories supplied with the equipment. **Table 1-9** provides a list of equipment required, but not supplied. **Table 1-10** provides the Field and Factory Changes applicable.

Table 1-1. Design and Physical Characteristics

ENVIRONMENTAL CHARACTERISTICS		
Temperature	Storage:	-40° to 75° C (-40° to 167° F)
	Operating:	0° to 50° C (32° to 122° F)
	Extreme Operating:[1]	-6.7° to 65° C (20° to 149° F)
Humidity	Humidity (relative):	0 to 95%
Barometric Pressure	Storage:	0.5 to 30 psi
	Operating:	10 to 30 psi
Shock	Meets the requirements of MIL-STD-901D. System functions may be interrupted during application of the shock.	
Vibration	Meets the requirements of MIL-STD-167-1 for Type 1.	

1 The AN/WSN-7(V) RLGN is capable of withstanding environmental extremes with no interruption of system functions. The RLGN returns to operating condition at full accuracy following restoration of applicable environment and performance of a reset cycle.

Table 1-1. Design and Physical Characteristics - Continued

ENVIRONMENTAL CHARACTERISTICS			
Linear Acceleration	Operating:	Horizontal:	±0.5 g peak
		Vertical:	1.0 g ±0.5 g peak
PHYSICAL/ELECTRICAL CHARACTERISTICS			
Size	Height:	169.7 cm (66.8 in)	
	Width:	59.7 cm (23.5 in)	
	Depth:	73.3 cm (28.9 in)	
Weight	381 kg (840 lbs)		
Power requirements[2]	105-125 VAC, 50, 60 or 400 Hz, 3-phase, 600 Volt Amps (VA) (max)		
Heat dissipation	600 Watts (max)		

2 The main power fault detector is configured to match input power frequency by switch S1 on Vital Bus CCA (1A1A3). The AN/WSN-7(V) is configured for 60 Hz main power input from the manufacturer.

Table 1-2. Digital (RS-422A) Data Interface

I/O PORT	DATA CHARACTERISTICS	
RLGN to RLGN Interface (J6)	Data Rate − 38,400 bits/second	
	Transmitted Character Format:	
	1 start bit	
	8 data bits	
	1 stop bit	
	Bits total: 10	
	Least significant bit is transmitted first	
	Signal Polarity (Output signals are referenced to INS ground):	
	MARK:	RS-422 + High, RS-422 - Low
	SPACE:	RS-422 + Low, RS-422 - High
Display-Control Unit Interface (J5)	Data Rate − 9,600 bits/second	
	Transmitted Character Format:	
	1 start bit	
	8 data bits	
	1 stop bit	
	Bits total: 10	
	Least significant bit is transmitted first	
	Signal Polarity (Output signals are referenced to INS ground):	
	MARK:	RS-422 + High, RS-422 - Low
	SPACE:	RS-422 + Low, RS-422 - High

Table 1-2. Digital (RS-422A) Data Interface - Continued

I/O PORT	DATA CHARACTERISTICS	
DSVL Interface (J23)	Data Rate − 9,600 bits/second	
	Transmitted Character Format:	
	1 start bit	
	8 data bits	
	1 stop bit	
	Bits total: 10	
	Least significant bit is transmitted first	
	Signal Polarity (Output signals are referenced to INS ground):	
	MARK:	RS-422 + High, RS-422 - Low
	SPACE:	RS-422 + Low, RS-422 - High

Table 1-3. Analog Synchro Input/Output and Reference Characteristics

SYNCHRO INPUT (SHIP'S LOG)	
Reference	115 VAC, 400 Hz; 90 V L-L Synchro
Scaling[1]	20 - 125 Kt/Rev
Fore/Aft Gradient[2]	90/10 or 50/50 percent
TRANSMITTERS OUTPUT: (HEADING, ROLL, PITCH)	
Type/Signal Format	Amplifier: Equivalent to synchro 115 VAC 11CX4
Output Power	Heading: Total (Vital + Non-vital) = 32 VA max (400 ma/leg)
	Vital = 2.5 VA max (100 ma/leg)
	Roll/Pitch: 8 VA max (100 ma/leg)
Two Speed (Heading) Format	Fine 36:1 (10°/revolution)
	Coarse 1:1 (360°/revolution)

1 Selectable at installation based on Speed Log output.

2 Selectable at installation.

Table 1-3. Analog Synchro Input/Output and Reference Characteristics - Continued

Two Speed (Roll and Pitch) Format	Fine 36:1 (10°/revolution)
	Coarse 2:1 (180°/revolution)[2] or 1:1 (360°/revolution)
Synchro Velocity Output: (V_n, V_e, and V_t)	
Output Power	2 VA max (20 ma/leg)
Two Speed (V_t) Format	Fine 10:1 (10 kt/revolution)
	Coarse 1:1 (100 kt/revolution)
Two Speed (V_n, V_e) Format	Fine 10:1 (±10 kt/revolution)
	Coarse 1:1 (±100 kt/revolution)
Reference Voltage (Non-Vital): Synchro reference voltage is applied to each RLGN. Reference is always derived from own ship's 400 Hz main power. The reference voltage and the synchro signals are affected in amplitude and frequency by variations in the reference voltage.	
Voltage/Frequency	115 Volts, 400 Hz
Power capacity	3 VA
Power factor	≥0.9
Grounding	Must not be grounded

Table 1-4. Summary of AN/WSN-7(V) Units and Assemblies

ASSEMBLY	NOTES	ASSEMBLY PART NO.	NAME/FUNCTION
Unit 1		1981101-6	AN/WSN-7(V) Ring Laser Gyro Navigator (CN-1695/WSN-7)
		1981101-2	AN/WSN-7(V) Ring Laser Gyro Navigator (CN-1696/WSN-7)
		1981101-3	AN/WSN-7(V) Ring Laser Gyro Navigator (CN-1697/WSN-7)
(**1A1**)		1981539-var	Processor Cabinet Electrical Equipment Assembly
(**1A1A1**)		1981532	Filter, Power Line
(**1A1A2**)	1, 11	1982618	Inverter Assembly, 400 Hz
(**1A1A3**)	11	1978322	Vital Bus CCA
(**1A1A4**)	11, 12, 13	1900040	AN/WSN-7(V) ATM Processor Computer Software Configuration Item (CSCI)
(**1A1A5**)		1981554	Battery Assembly
(**1A1A6**)		1979342	Power Supply
(**1A1A7**)		1810853	Battery Charger
(**1A1A8**)		1205050-3	Power Module
(**1A1A9**)		1859873	Membrane Keypad
(**1A1A10**)		1979344	Display Assembly

Table 1-4. Summary of AN/WSN-7(V) Units and Assemblies - Continued

ASSEMBLY	NOTES	ASSEMBLY PART NO.	NAME/FUNCTION
(**1A1A11**)	11	1981660	Backplane Assembly, Nav Processor
(**1A1A12**)		1981534	I/O Processor, Backplane Assembly
(**1A1A13**)	2, 12, 13	1812590-XX	Nav Processor CCA (Programmed Navigation Processor)
(**1A1A14**)		1977455	Dual Panel Interface CCA (RLGN-to-RLGN)
(**1A1A15**)		1980513	Status and Command CCA
(**1A1A16**)		1977455	Dual Panel Interface CCA
(**1A1A17**)		1977538-0	IMU Interface CCA
(**1A1A18**)		1977569	Torquer CCA (Roll)
(**1A1A19**)		1977569	Torquer CCA (Azimuth)
(**1A1A20**)		1980488-2	Bus Interface CCA
(**1A1A21**)	3, 12, 13	1812591-XX	I/O Processor CCA (Programmed I/O Processor)
(**1A1A23**)	11	1980486-2	Dual Port Memory CCA
(**1A1A30**)	11	1981572	Support Electronics, Backplane
(**1A1A31**)		1981570	I/O Control Built-in Test Equipment (BITE) and Filter CCA
(**1A1A32**)	4, 11	1811791	IMU Processor CCA

Table 1-4. Summary of AN/WSN-7(V) Units and Assemblies - Continued

ASSEMBLY	NOTES	ASSEMBLY PART NO.	NAME/FUNCTION
(1A1A33)		1979023	Repositioning Interface CCA
(1A1A34)		1979047	Analog-to-Digital (A/D) Multiplexer CCA
(1A1A35)		1979046	Accelerometer and Sensor Electronics Assembly
(1A1A36)		1979348	Gyro Support Electronics CCA
(1A1A37)		1979057	Support Electronics Power Supply
(1A1A38)		1979087-3	Synchro Converter CCA
(1A1A39)		1979087-3	Synchro Converter CCA
(1A1A40)		1979087-3	Synchro Converter CCA
(1A1A41)		1976545-3	Synchro Buffer Amplifier (8 VA)
(1A1A42)		1976545-3	Synchro Buffer Amplifier (8 VA)
(1A1A43)		1976547-4	Synchro Buffer Amplifier (32 VA)
(1A1A44)		1976547-4	Synchro Buffer Amplifier (32 VA)
(1A1A51) through (1A1A58)	5, 10, 11	1981087	NTDS Interface, Type A (See Table 1-5)
		1981561	NTDS Interface, Type D
		1981559	NTDS Interface, Type E
(1A1DS1), (1A1DS2)	11	FF200CW600-28V-P or FF200-0CW-028B	Lamp
(1A1MP3)		1981510	Upper Card Rack Assembly, Navigation and I/O
(1A1MP4)		1979347	Card Rack Assembly, Support Electronics
(1A1MP2)		1891448	Heat Shield Assembly
(1A1MP6)	11	1983105	Connector Plate (CN-1695/WSN-7)
	11	4800307	Connector Plate (CN-1696/WSN-7)
	11	1983108	Connector Plate (CN-1697/WSN-7)
(1A2)		1981548	Measurement Cabinet Electrical Equipment Assembly
(1A2A1)	6	1812593 or 4300859	IMU MX-11681/WSN-7 or MX-11681A/WSN-7A(V) Assembly (Matched Set, with all EPROMs)
1A1A32U13	6	1810807	IMU Assembly Calibration PROM
1A1A32U03	6	1812809	IMU Assembly Calibration PROM
(1A2A1A1)		1981549 or 4800592	IMU Assembly
(1A2A1A1A1)	7	1812594-3	RLG Assembly (Matched Set) (Gyro A)
1A1A32U15	7	1810563	RLG Calibration PROM

Table 1-4. Summary of AN/WSN-7(V) Units and Assemblies - Continued

ASSEMBLY	NOTES	ASSEMBLY PART NO.	NAME/FUNCTION
(1A2A1A1A2)	7	1812594-2	RLG Assembly (Matched Set) (Gyro B)
1A1A32U02	7	1810563	RLG Calibration PROM
(1A2A1A1A3)	7	1812594-1	RLG Assembly (Matched Set) (Gyro C)
1A1A32U04	7	1810563	RLG Calibration PROM
(1A2A1A1A4)	11	1979045	High Voltage Power Supply (HVPS)
(1A2A1A1A4A1)		1980509	HVPS “A” and “B” CCA
(1A2A1A1A5)	8	1810720	Calibrated Accelerometer (Matched Set) (Accel. A)
1A1A32U12	8	1810562	Accelerometer Calibration PROM
(1A2A1A1A6)	8	1810720	Calibrated Accelerometer (Matched Set) (Accel. C)
1A1A32U01	8	1810562	Accelerometer Calibration PROM
(1A2A1A1A7)	8	1810720	Calibrated Accelerometer (Matched Set) (Accel. B)
1A1A32U14	8	1810562	Accelerometer Calibration PROM
(1A2A1A1MP1)		1979356	Frame Assembly, Inner
(1A2A1A1MP2)		1979354	Frame Assembly, Outer
(1A2A1A1A9A1)		1980596	Accelerometer Stimulus CCA
(1A2A1A1A9W1)		T968693	Harness Assembly
(1A2A1A1A10)		1810553-1	Slip Ring Assembly (Electrical Contact Ring Capsule Assembly)
(1A2A1A1A11)		1810553-2	Slip Ring Assembly (Electrical Contact Ring Capsule Assembly)
(1A2A1A1A12)		1810553-3	Slip Ring Assembly (Electrical Contact Ring Capsule Assembly)
(1A2A1A1A13)		1810553-4	Slip Ring Assembly (Electrical Contact Ring Capsule Assembly)
(1A2A1A1B1)		1979358	Motor, Direct Current, Torquer (Outer Gimbal)
(1A2A1A1B2)		1979358	Motor, Direct Current, Torquer (Inner Gimbal)
(1A2A1A1B3)		1243107-2	Synchro Transmitter, Multispeed (Outer Gimbal)
(1A2A1A1B4)		1243107-2	Synchro Transmitter, Multispeed (Inner Gimbal)
(1A2A1A1M1)		1975362-6	Meter, Time Totalizing

Table 1-4. Summary of AN/WSN-7(V) Units and Assemblies - Continued

ASSEMBLY	NOTES	ASSEMBLY PART NO.	NAME/FUNCTION
CABLE ASSEMBLIES			
1W1		T968889	Harness Assembly
1W2		T968890	Cable Assembly
1W3		T968891	Cable Assembly
1W4		T968892	Cable Assembly
(**1A1W1**)	9, 11	T969420	Main Cabinet Cable and Harness Assembly
(**1A1W2**)		T968840	Cable Assembly (Door Cable and Harness Assembly)
(**1A1W3**)		T967883	Ribbon Cable Assembly
1A1W4		T968841	Cable Assembly
1A1W5		T968842	Cable Assembly
1A1W6		T968894	Harness Assembly
(**1A1W7**)	11	1900013-1	Cable Assembly, Fiber Optic ATM/Synchronous Optical Network (SONET) Interface
1A1W10 through 1A1W26	5	(See **Table 1-5**)	(See Table 1-5)
P/O **1A1W1**	11	T969380	Harness Assembly for DSVL
Unit 2	Same as Unit 1		

Table 1-4. Summary of AN/WSN-7(V) Units and Assemblies - Continued

ASSEMBLY	NOTES	ASSEMBLY PART NO.	NAME/FUNCTION

NOTE

1. Inverter Assembly P/N 1982618 is manufactured with high reliability screened parts. This assembly is directly interchangeable with P/N 1980379.
2. Nav Processor CCA, 1812590-XX, is the programmed part number of unprogrammed Central Processing Unit (CPU)/Memory assembly part number 1981127. After assembly part number 1981127 is programmed with the stored program assembly, it is reidentified as part number 1812590-XX.
3. I/O Processor CCA, 1812591-XX, is the programmed part number of unprogrammed CPU/Memory assembly part number 1983195. After assembly 1983195 is programmed with the stored program assembly, it is reidentified as part number 1812591-XX.
4. IMU Processor CCA, 1811791, is the programmed part number of unprogrammed Bus Control Electronics assembly part number 1979021. After assembly 1979021 is programmed with the stored program assembly, it is reidentified as part number 1811791.
5. CCAs (**1A1A51**) through (**1A1A58**) and associated cables are selected based on the NTDS interface requirements for each installation. The assemblies and cables installed are defined by the Unit 1 part number. Refer to **Table 1-5** for applicability.
6. The IMU Assembly part number includes two PROMs (serialized to the IMU Assembly) programmed during factory calibration with correction parameters which are used by the system to compensate for mechanical offsets in the IMU normal and inverted positions.
7. Each RLG Assembly part number includes a PROM (serialized to the RLG) programmed during factory calibration with correction parameters which are used by the system to compensate for mechanical offsets in the RLG.
8. Each Accelerometer Matched Set part number includes a PROM (serialized to the accelerometer) programmed during factory calibration with correction parameters which are used by the system to compensate for mechanical offsets in the Accelerometer.
9. If the RLGN has Field Change 1 (DSVL Interface), then the Harness Assembly (**1A1W1**) part number is T969420.
10. Part Number 1981087 (Rev A) is unacceptable if Programmable Array Logic (PAL) chip U11 part number is 1812652 (Rev A). Acceptable PAL U11 part number is 1812652 (Rev B).
11. Part of Field Change 1.
12. Part of Field Change 2 or 3.
13. Part of Field Change 4.

Table 1-5. AN/WSN-7(V) NTDS I/O Configurations

CCA	NAME/FUNCTION	AN/WSN-7(V)		
		CN-1695	CN-1696	CN-1697
Locations (**1A1A51**) through (**1A1A58**) are used for NTDS Standard Interface.				
(**1A1A51**)	NTDS Interface CCA, Type	E	E	E
(**1A1A52**)	NTDS Interface CCA, Type	E	A	A

Table 1-5. AN/WSN-7(V) NTDS I/O Configurations - Continued

CCA	NAME/FUNCTION	AN/WSN-7(V)		
		CN-1695	CN-1696	CN-1697
(**1A1A53**)	NTDS Interface CCA, Type	E	E	A
(**1A1A54**)	NTDS Interface CCA, Type	E	D	A
(**1A1A55**)	NTDS Interface CCA, Type	D	A	A

Table 1-5. AN/WSN-7(V) NTDS I/O Configurations - Continued

CCA	NAME/FUNCTION	AN/WSN-7(V)		
		CN-1695	CN-1696	CN-1697
(1A1A56)	NTDS Interface CCA, Type	A	A	A
(1A1A57)	NTDS Interface CCA, Type	A	A	A
(1A1A58)	NTDS Interface CCA, Type	A	A	A
Cables used with the NTDS interface are determined by the part number of the system.				
1A1W10	Coaxial Cable Assembly T968912	*	*	*
1A1W11	Coaxial Cable Assembly T968912	*	*	*
1A1W12	Coaxial Cable Assembly T968912	*	*	*
1A1W13	Coaxial Cable Assembly T968912	*	*	*
1A1W14	Coaxial Cable Assembly T968912	*	*	
1A1W15	Coaxial Cable Assembly T968912	*	*	
1A1W16	Coaxial Cable Assembly T968912	*	*	
1A1W17	Coaxial Cable Assembly T968912	*	*	
1A1W30	Coaxial Cable Assembly T968914	*	*	
1A1W10	Coaxial Cable Assembly T968914	*	*	
1A1W20	Cable and Harness Assembly T968913[1]	*	*	*
1A1W21	Cable and Harness Assembly T968913[1]	*	*	*
1A1W22	Cable and Harness Assembly T968913[1]	*	*	*
1A1W23	Cable and Harness Assembly T968913[1]	*	*	*
1A1W24	Cable and Harness Assembly T968913[1]			*
1A1W25	Cable and Harness Assembly T968913[1]			*
1A1W26	Cable and Harness Assembly T968913[1]			*

1 Part of Field Change 1.

Table 1-6. Documents Required but Not Supplied

DOCUMENT NO.	DESCRIPTION
NAVSEA Dwg. No. 7100680	Inertial Navigation System AN/WSN-7(V) Drawing List
NAVSEA Dwg. No. 7100681	Inertial Navigation System AN/WSN-7(V) Block Diagram
NAVSEA Dwg. No. 7100682	Inertial Navigation System AN/WSN-7(V) Summary List of Installation Materials
NAVSEA Dwg. No. 7100683	Inertial Navigation System AN/WSN-7(V) Input/Output Sheets
NAVSEA Dwg. No. 7100684	Inertial Navigation System AN/WSN-7(V) Cable Running Sheets
NAVSEA Dwg. No. 7100685	AN/WSN-7(V) Ring Laser Gyro Navigator Outline and Installation Drawing
MIL-STD-1397B(NAVY)	Military Standard Input/Output Interfaces, Standard Digital Data, Navy Systems
NAVSEA S9427-AN-IDS-010/WSN-7	Interface Design Specification, Super Channel to User for the AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN)
NAVSEA SE174-AB-IDS-010/GPS	Interface Design Specification for Shipboard External Computer and Navigation Satellite Timing and Ranging (NAVSTAR) Global Positioning System
NAVSEA T9427-AB-IDS-050/WSN-7	Interface Design Specification, Aircraft Carrier Navigation System (CVNS) to External Computer
EE17A-AA-OMI-010 (Windows software version) with Change A	Operator and Maintenance Manual, Organizational Level for Control Display Unit, IP-1747/WSN-7 and Secondary Control Display Unit, IP-1746/WSN-7A
EE17A-AA-OMI-A10 (Linux software version)	Operator and Maintenance Manual, Organizational Level for Control Display Unit, IP-1747/WSN-7 and Secondary Control Display Unit, IP-1746/WSN-7A
EE17A-AC-IEM-010/ EE17A-AD-IEM-010	IP-1747/WSN Control Display Unit and IP-1746/WSN-7A Secondary Control Display Unit Interactive Electronic Technical Manual and Interactive Courseware
NAVSEA S9427-AN-IDS-010/WSN-7	Interface Design Specification, Superchannel to User for the AN/WSN-7 Ring Laser Gyro Navigator (RLGN) System
NAVSEA S9427-AN-IDS-020/WSN-7	Interface Design Specification, Inertial Navigation System AN/WSN-7(V) to External Computer - for Low Level Serial (MIL-STD-1397B Type E) Digital Communication
NAVSEA S9427-AN-IDS-030/WSN-7	Interface Design Specification, Inertial Navigation System AN/WSN-7(V) to Users - for MIL-STD-1397 Type D Serial Channels No. 1 and No. 2
NAVSEA S9427-AN-IDS-040/WSN-7	Interface Design Specification, Inertial Navigation System AN/WSN-7(V) to External Computer in an Output Only Configuration - for Parallel Channels
NAVSEA S9427-AN-IDS-050/WSN-7	Interface Design Specification, Ring Laser Gyro Navigator (RLGN) System to External Computer
NAVSEA S9427-AN-IDS-070/WSN-7	Inertial Navigation System AN/WSN-7 External Computer for Parallel (MIL-STD-1397B Type A) Input/Output Digital Communication, Interface Design Specification
NAVSEA S9427-AP-IDS-010/RLGN	Navigation Operational Program Interface Design Specification for Use with the Ring Laser Gyro Navigator (RLGN)

Table 1-6. Documents Required but Not Supplied - Continued

DOCUMENT NO.	DESCRIPTION
NAVSEA S9427-AP-IDS-020/RLGN	Navigation Operational Program Interface Design Specification for Use with the Ring Laser Gyro Navigator (RLGN)
NAVSEA S9427-AP-IDS-030/RLGN	Navigation Operational Program Interface Design Specification for Use with the Ring Laser Gyro Navigator (RLGN)
NAVSEA S9427-AP-IDS-040/RLGN	Navigation Operational Program Interface Design Specification for Use with the Ring Laser Gyro Navigator (RLGN)
NAVSEA S9427-AN-IDS-080/WSN-7	Interface Design Specification for the AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN) to user via ATM Local Area Network (LAN)
03956 SCM-25417	Interface Design Specification for the AN/WQN-2 Doppler Sonar Velocity Log (DSVL) to AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN) Interface
Part Number 03956-JA17-6608	DSVL Data Interface Supplement for CN-1695(V)/WSN-7(V) Ring Laser Gyro Navigator (RLGN)
03956-PL1813788-Var	DSVL Interface Field Change Kit Parts List
NAVSEA SE178-A2-MMM-010	Doppler Sonar Velocity Log (DSVL), AN/WQN-2(V)2 through 2(V)7, Electronic Equipment, Operation and Maintenance Instructions
03956-4300201-1	ATM Interface Field Change Kit
S9427-AN-FCB-001/WSN-7	AN/WSN-7/7A(V) Field Change Bulletin 1
S9427-AN-FCB-002/WSN-7	AN/WSN-7/7A(V) Field Change Bulletin 2
S9427-AN-FCB-003/WSN-7	AN/WSN-7/7A(V) Field Change Bulletin 3
S9427-AN-FCB-004/WSN-7	AN/WSN-7/7A(V) Field Change Bulletin 4
S9427-AN-FCB-006/WSN-7	AN/WSN-7/7A(V) Field Change Bulletin 6
S9427-AN-FCB-009/WSN-7	AN/WSN-7/7A(V) Field Change Bulletin 9

Table 1-7. Documentation Supplied

TMIN/VID NO./ IDENTIFICATION NO.	NSN	TITLE/DESCRIPTION	QTY.
Technical Manuals			
S9427-AN-OMP-010/WSN-7, Rev 1	0910-LP-102-7705	Technical Manual, Organizational Level, Ring Laser Gyro Navigator Inertial Navigation System, AN/WSN-7(V)1, -7(V)2, -7(V)3, Part Numbers CN-1695/WSN-7(V), CN-1696/WSN-7(V), and CN-1697/WSN-7(V); Operation and Maintenance with Parts Lists	1 ea
CD-ROMs			
S9427-AN-IEM-010/REV1	0913-LP-101-6143	Interactive Electronic Technical Manual and Interactive Courseware for Navigation Unit, Ring Laser Gyro Navigator, AN/WSN-7(V)1, (V)2, (V)3 Inertial Navigation System	

Table 1-8. Equipment and Accessories Supplied

QTY	ITEM NAME OR NOMENCLATURE	UNIT NUMBER	OVERALL DIMENSIONS			WEIGHT AND VOL-UME
			HEIGHT	WIDTH	DEPTH	
1	Ring Laser Gyro Navigator (RLGN) CN-1695/WSN-7(V), CN-1696/WSN-7(V), CN-1697/WSN-7(V)	1, 2	66.8 in.	23.5 in.	28.9 in.	840 lb.
1	Processor Cabinet Electrical Equipment Assembly	(1A1)				
1	Inertial Measurement Cabinet Assembly	(1A2)				

Table 1-9. Equipment Required but Not Supplied

SUBCATEGORY (SCAT) CODE	TEST EQUIPMENT CATEGORY	TEST EQUIPMENT MODEL NUMBER	EQUIPMENT TEST PARAMETERS	APPLICATION
–	Digital Multimeter	89536-77/AN	– –	Continuity testing and analog signal and voltage checks
–	Wild T2 Theodolite(2 each)	– –	±0.5 arc seconds	Equipment Installation

Table 1-10. Field Changes and Factory Changes

CHANGE NUMBER	PURPOSE	DESCRIPTION
Field Change 1 (ECP N84-1) (ECOs 525, 526, 531, 539, 541, 546, 547, 548, 563, 577, 583, 588, 698, 702, 736, 802)	1. Adds a new fiber-optic I/O interface [ATM/Network Time Protocol (NTP)]. 2. Adds BFTT interface. 3. Adds AN/WQN-2 DSVL interface. 4. Revises the AN/WSN-7(V)2 I/O configuration. 5. Adds a feature for improving the RLGN position accuracy during periods of valid GPS data. 6. Adds support for the NTDS Type A I/O Interface. 7. Improves selected LRUs due to parts obsolescence or improvement of reliability. 8. Makes improvements to Navigation and I/O Operational programs.	1. Upgrades the revision level of the Nav Processor and I/O Processor CCAs. 2. Modifies the IMU High Voltage Power Supply. 3. Modifies the IP-1747/WSN CDU. 4. Modifies the NTDS Type A interface CCA. 5. Modifies the Navigation rack and Support Electronics backplane assemblies. 6. Changes the part number for two indicator lamps to improve reliability. 7. Adds the DSVL interface. 8. Alters the NTDS I/O configuration of the CN-1696/WSN-7 by removing one NTDS Type E interface and replacing it with an NTDS Type A interface. 9. Adds ATM hardware. 10. Updates the revision levels of the IMU, Vital Bus, 400 Hz Inverter Assembly, and Dual Port Memory CCAs.
Field Change 2 (ECP N84-2) (ECOs N84-814, -815, -816)	Upgrades firmware to enable AN/WSN-7(V) to interface with BFTT equipment, without the need for the external ATM switch.	Upgrades the revision level of the ATM, Nav Processor, and I/O Processor CCAs.
Field Change 3 (ECP N84-2) (ECOs N84-814, -815, -816)	Upgrades firmware to enable AN/WSN-7(V) to interface with BFTT equipment, without the need for the external ATM switch if Field Change 2 has not been installed.	Upgrades the revision level of the ATM, Nav Processor, and I/O Processor CCAs if Field Change 2 has not been installed.
Field Change 4 (ECOs N84-869, -870, -871)	1. Installs Nav Processor CCA P/N 1812590Rev-AB. 2. Installs I/O Processor CCA P/N 1812591Rev-W. 3. Installs ATM Processor CCA P/N 1900040Rev-C.	Upgrades the revision level of the ATM, Nav Processor, and I/O Processor CCAs.
Field Change 6	Installs MX-11681A/WSN-7 Inertial Measuring Unit	Sound isolates the Inertial Measuring Units to lessen structure-borne noise from the equipment to the ship's hull.
Field Change 9	1. Replaces NTDS Type D and NTDS Type E CCAs with NTDS Type A CCAs, P/N 1981087 2. Installs Connector Plate P/N 1983108	Converts AN/WSN-7(V)2 to AN/WSN-7(V)3

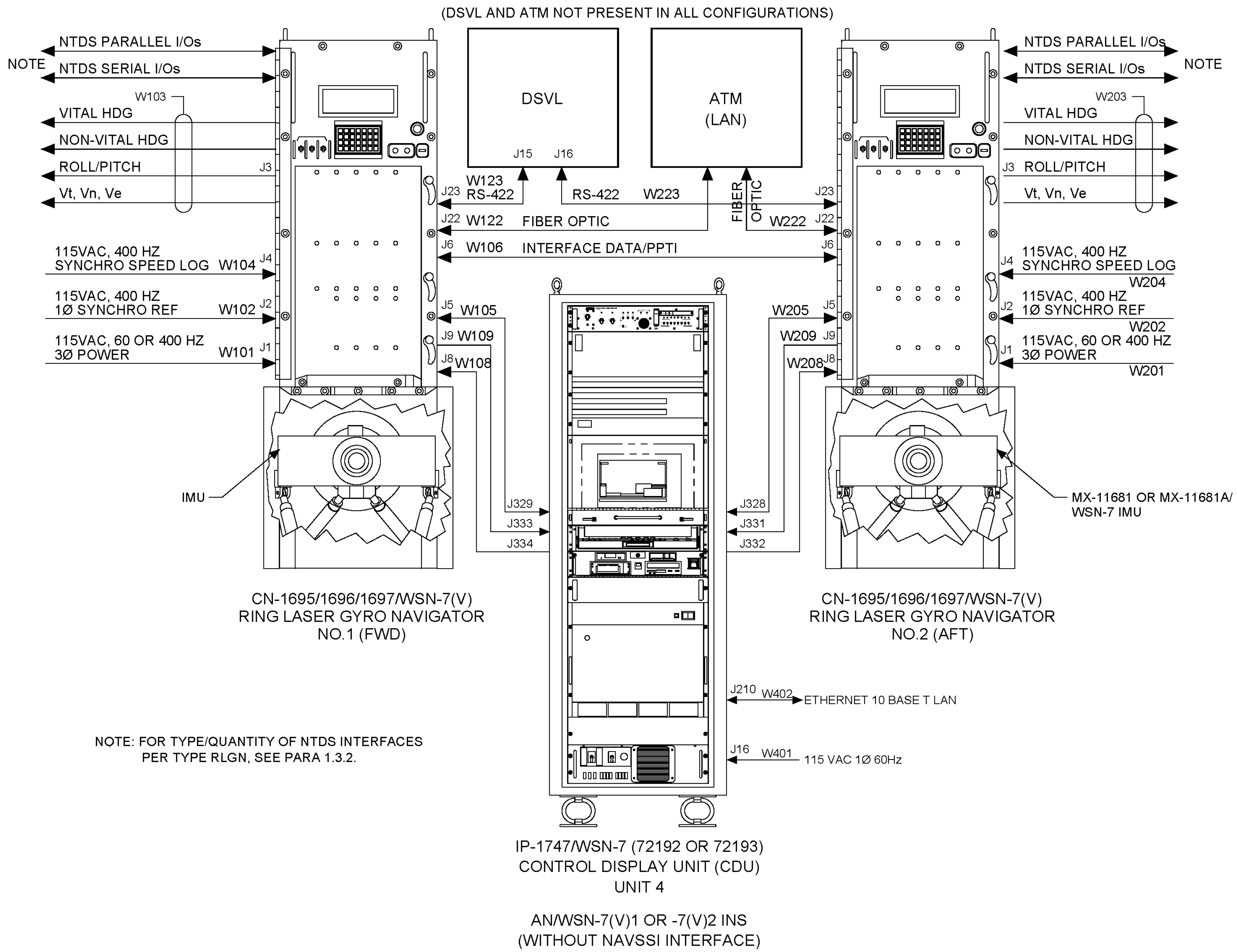
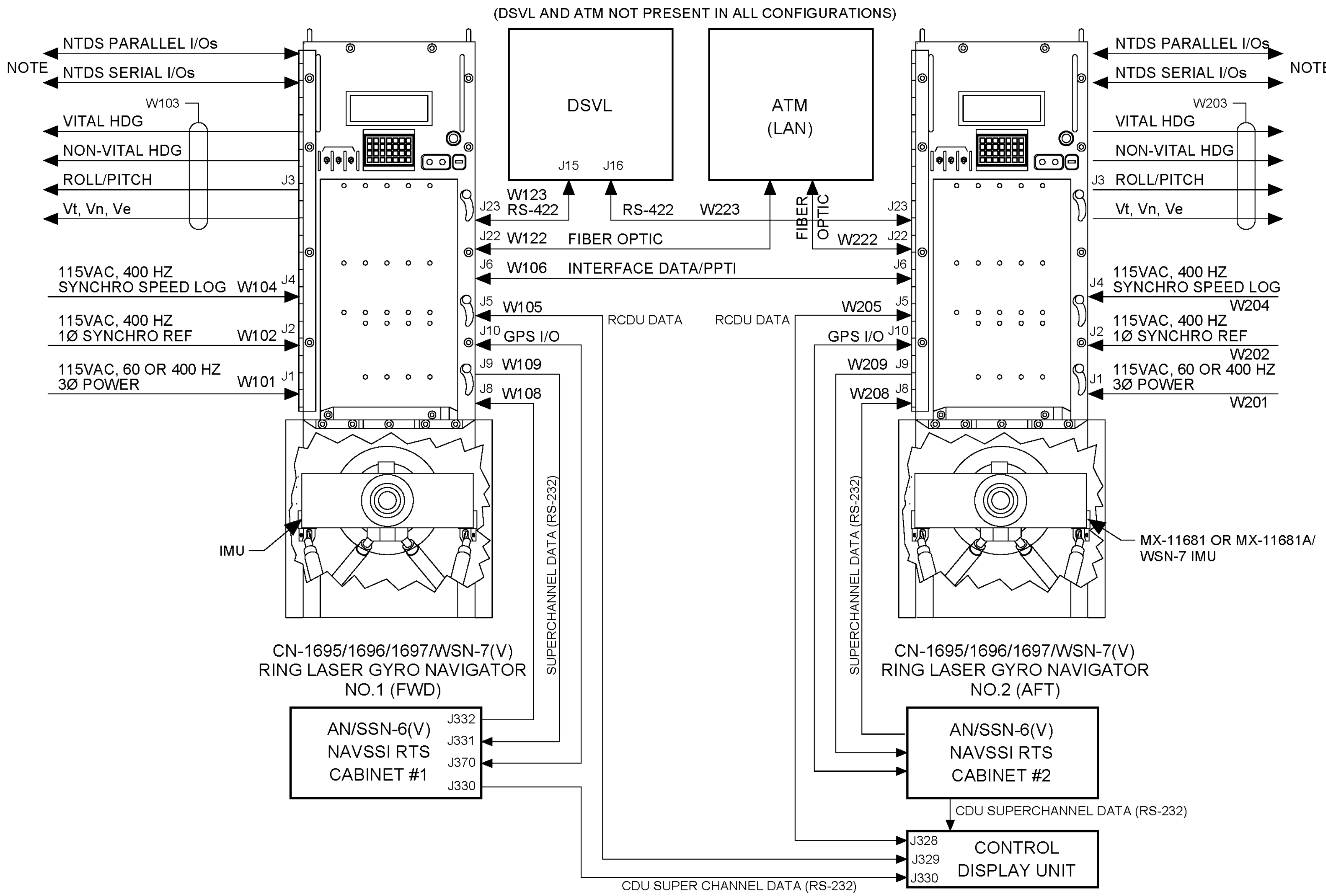


Figure 1-2. Typical System Configuration (Sheet 1 of 2)



NOTE: FOR TYPE/QUANTITY OF NTDS INTERFACES
PER TYPE RLGN, SEE PARA 1.3.2.

AN/WSN-7(V)1, -7(V)2, -7(V)3 INS
(WITH NAVSSI INTERFACE)

Figure 1-2. Typical System Configuration (Sheet 2 of 2)

CHAPTER 2
OPERATION

2.1 INTRODUCTION.

This chapter identifies all Ring Laser Gyro Navigator (RLGN) operator's control functions available through the Front Panel, describes their use, provides instructions for turning on and operating the RLGN, and presents information for identifying fault conditions. The Front Panel controls and indicators are shown in Figure 2-1.

When following operating procedures, note that the text appearing in bold between **<>** symbols refers to labeled keys on the keypad. For example, **<DISPLAY>**. Items in bold refer to text that appears in the display. For example: **NAV-C**.

Unnumbered images are provided in some of the procedures in this chapter to show how the display should look upon completion of the step preceding it.

NOTE

Either RLGN can be selected for operation from the IP-1747/WSN Control Display Unit (CDU).

Operator's procedures associated with testing, troubleshooting, optical alignment, and installation configuration of the AN/WSN-7(V) RLGN are included in the appropriate chapters later in this technical manual.

After power is turned on, the operation sequence and control for start-up self-test, reference alignment, and automatic input of position fix data is controlled by an internal microprocessor. Parameters set during installation identify sensor inputs and the installed configuration of the Inertial Navigation System (INS).

2.2 CONTROLS AND INDICATORS.

2.2.1 KEYPAD CONTROLS AND MENU DISPLAY. All operations, including mode control, sensor selection, data entry, and parameter display, as well as initiation of calibration, self-test, and installation setup, are performed using displayed menus and the keypad on the front of the RLGN.

2.2.2 KEY FUNCTIONS. The keypad, shown in Figure 2-2, is used in conjunction with the displayed menus to perform all control and data entry functions. The keys are divided into four categories: Menu Selection, Data Entry, Display Control, and Alarm Acknowledge. Some keys perform dual functions. The operation of these keys is automatically determined by the selected menu, mode, or operation being performed. The function of each key is listed in Table 2-1.

2.2.3 MENU SELECTIONS. Table 2-2 lists the functions included in the four menus associated with operation and presents a brief description of the control and data functions associated with each. Figure 2-3 identifies the general menu layout and data presentation for the operations-related menus and provides a listing of all mode and status indications that may be displayed on the top line of the Menu Display Panel. The top line indicates the system operating state, selected navigation aid, selected velocity reference, selected damping mode, selected coordinates (normal or transverse), and code for any detected fault. The next two lines display position, velocity, heading, day, and time. The last three lines present variable information and control functions, as determined by the selected menu and page. Figure 2-4 presents the full menu tree listing all functions available for display during normal operation.

2.3 OPERATING PROCEDURES.

NOTE

The following procedure assumes that the INS has been previously set up, all sensor inputs are configured, the sensors are turned on, and INS calibration has previously been performed.

The following sections outline the procedure for turning on and operating the RLGN in a normal situation.

2.3.1 TURNING ON THE RLGN. To turn on power and enter the STANDBY mode:

a. Clear any existing tags from 115 Volts, Alternating Current (VAC), 60 Hertz (Hz) and/or 115 VAC, 400 Hz power panels supplying the RLGN using standard safety tag-out procedures.

b. Set the switches at 115 VAC, 60 Hz or 115 VAC, 400 Hz power panels supplying the RLGN to ON.

c. On the RLGN, set the POWER, SYNCHRO REF, and VITAL REF circuit breakers to ON.

d. Set POWER switch to ON. Observe that POWER indicator lights.

e. Observe that display indicates STANDBY in the upper-left corner and no fault codes are displayed.

The unit will remain in STANDBY until the first valid position fix is accepted (either manually entered or from an external position reference source).

f. Press the **<DISPLAY>** key to select the Display menu.

g. Press the **<NEXT PAGE>** key until 4 of 4 appears in the lower right corner of the display.

h. Select Day/Time by pressing the **<1>** key. The Julian date will read 001, and the Greenwich Mean Time (GMT) will display the time elapsed since the RLGN was turned on.

i. Press the **<CLEAR>** key to reject the current day and time. The display will show the Julian day and prompt you to accept or reject the information.

j. Press the **<CLEAR>** key to reject the Julian day entry and enter the correct Julian day. Press the **<ENTER>** key to accept the entry. The display will show the GMT and prompt you to accept or reject the information.

k. Press the **<CLEAR>** key to reject the GMT entry and enter the correct time. Press the **<ENTER>** key to accept the entry. The display will show the Julian day and GMT.

l. Press the **<SENSOR>** key to select the Sensor menu.

m. Select **DOCK ON**, **PDIG ON**, or **SLAVE ON** and press the **<ENTER>** key to select Align mode.

Manually enter position (if DOCK ON selected) or select other position and velocity reference(s) as appropriate for the start-up environment. Refer to **Paragraphs 2.3.2.2** and **2.3.2.4**.

2.3.2 OPERATING MODES. Three Operating Modes are associated with start-up, settling, and normal on-line operation. These are: **STANDBY**, **ALIGN**, and **NAVIGATE**.

2.3.2.1 Align Mode States. The Align mode has four possible states. The indication for each of these states is:

- **ALIGN** – Coarse Align currently being performed.
- **ALIGN-C** – Coarse Align complete, Fine Align currently being performed.
- **ALIGN-F** – Fine Align complete, ready to enter Navigate mode.
- **NAV-C** – Coarse Align complete, Fine Align currently being performed with system in Navigate mode supplying reduced accuracy position and velocity data.

The actual time required for the system to settle to within specification accuracy is determined by several factors. These include: geographic position, heading and speed of the ship, time of entry and accuracy of first position reset, the alignment method selected, and whether or not the navigation system has been previously calibrated. Regardless of the align method selected, a previously calibrated system requires between 16 and 20 hours to reach specified full navigational accuracy. A system that has not previously completed calibration requires between 68 and 72 hours to reach specified full navigational accuracy. The sequence of alignment and settling states, and the minimum and maximum time required to complete each state and settle to specified accuracy are indicated in **Figures 2-5** through **2-7**.

2.3.2.2 Alignment References. The RLGN requires velocity and position data to be provided while it is in the Align mode. The data may come from external sources, such as speed and position sensors installed on the ship, or from manual or automatic entries. The available data sources, or alignment references, vary depending on the ship's RLGN configuration. The alignment reference sources on page 1 of the Sensor menu determine the alignment references that are used. There are three reference sources used to align the system: DOCKside, PDIG, and SLAVE. To select a reference source, perform the appropriate procedure described in **Paragraph 2.3.2.4**.

DOCKside – The system sets the horizontal velocity to zero and requires manual entry of a position fix. The position data is used as the reference while the ship remains stationary at dockside. When the ship is stationary, Dockside Align is the preferred and most accurate method of alignment, as it uses a fixed position and a velocity of zero.

PDIG – This system uses a digital position source such as Global Positioning System (GPS) to provide the position reference. Velocity data comes from an installed velocity reference source or from manual entry. At-Sea Align using GPS resets is the second most accurate method of alignment, but is the preferred method if the ship is moving.

SLAVE – The other RLGN provides both position and velocity reference data during alignment. For SLAVE to be selected, the other RLGN must first be turned on and settled. Slave Align is the least accurate method of alignment as it will never be more accurate than the master system that is the source of position and velocity. The resulting alignment will not be as accurate as a Dockside or At-Sea (using GPS resets) alignment.

2.3.2.3 Operating in Align Modes. Once a reference source has been selected, the RLGN changes from STANDBY mode to ALIGN mode. In the first few minutes of this period, it determines roll and pitch attitude and displays the mode word "ALIGN." During ALIGN, the INS aligns heading by aligning the inertial platform with respect to the earth's rotation. Once the heading is coarse aligned, the mode word changes from "ALIGN" to "ALIGN-C." At ALIGN-C, the RLGN attitude outputs are of gyrocompass quality and can be used for stabilization or steering purposes. The RLGN continues to align to the accuracy required for an inertial navigator (Fine Align). When heading is fine aligned, the mode word transitions from "ALIGN-C" to "ALIGN-F." During a DOCKSIDE align, once ALIGN-F has been reached, the RLGN can be put into NAVIGATE mode by deselecting DOCKSIDE as a reference. If DOCKSIDE is deselected while coarse aligned (ALIGN-C is displayed), the RLGN will continue to align with available position and velocity data. While underway (At-Sea Align) and with a PDIG reference such as GPS selected, the RLGN will automatically transition into NAVIGATE mode once ALIGN-F has been reached. If the RLGN is operating from calibration values stored in battery-backed Random Access Memory (RAM), ALIGN-F should be reached in 20 hours or less. If the calibration values stored in battery-backed RAM have been lost due to maintenance on the RLGN, or if the Kalman filter has been reinitialized in order to perform a new dockside calibration, then ALIGN-F should be reached in 72 hours or less. Analog synchro attitude outputs are continuously provided from the RLGN during align. For example, the heading synchro output will slew as the RLGN slews its calculated heading during ALIGN. By the time ALIGN-C has been reached, the heading synchro output will represent ship's heading. The Not Ready (Fail) relay indicates that the RLGN is not ready in the deenergized state (so that the RLGN is Not Ready if power is turned off). On power-up, the processor initializes the Status and Command Assembly to keep the relay in the deenergized state. When ALIGN-C has been reached, the relay is energized, indicating that the RLGN is ready to deliver attitude data. If the on-line Built-In Test (BIT) detects a critical failure, as detailed in Fault Code **Table B-1**, the relay will be deenergized.

2.3.2.4 Align Methods. The align methods determine the alignment references that the RLGN will use. Three align methods are available for selection by the operator: Dockside, At-Sea, and Slave.

2.3.2.4.1 Dockside Align. Dockside Align is preferred if the ship will remain stationary for at least four hours after the system is turned on and Slave Align cannot be performed because the other navigator is not currently settled in the Navigate mode. Dockside Align is the most accurate as it uses a fixed position source and a velocity of zero. The 72-hour calibration should be performed in Dockside to get the best calibration and the best navigation performance. The 20-hour align is also better if performed in Dockside. If the ship must be moved during a Dockside Align, change to At-Sea or Slave, as available, to complete the entire 72-hour calibration. The first 24 hours of a 72-hour calibration are the most critical part of the calibration and should always be performed in Dockside, then the RLGN can be taken out of Dockside to another align mode. Always come out of Dockside before the ship is moved, or the alignment will be corrupted. Refer to **Figure 2-5** when performing Dockside Align, and proceed as follows:

a. Press the **<SENSOR>** key, and then press the **<1>** key to select **DOCK ON** and enter Dockside Align. Observe that the display shows the GMT and prompts the operator to accept or reject the time shown.

b. Press the **<ENTER>** key to accept the time or the **<CLEAR>** key to reject and reset the time. The display will show the "Vertical Deflection North" with a value of 00.0 arc sec and prompt the operator to accept or reject it.

c. Press the **<ENTER>** key to accept the Vertical Deflection North Value. The display will show the "Vertical Deflection East" with a value of 00.0 arc sec and prompt the operator to accept or reject it.

d. Press the **<ENTER>** key to accept the Vertical Deflection East value. The display will show the latitude and prompt the operator to accept or reject the latitude value.

e. Accept or reject the latitude value. If the displayed value is incorrect, enter the ship's latitude within 0.01 Nautical Mile (nm) accuracy. The display will show the longitude and prompt the operator to accept or reject the longitude value.

f. Accept or reject the longitude value. If the displayed value is incorrect, enter the ship's longitude within 0.01 nm accuracy. The display shows the ship's fix and prompts the operator to accept or reject the information.

g. If the information is correct, press the **<ENTER>** key. The RLGN checks the values for reasonableness and then enters the Dockside Align mode. **ALIGN** is displayed in the mode field (upper left) and **DOCK** is the displayed Navigation Aid (NAVAID).

2.3.2.4.2 Slave Align. Slave Align is used only if the ship is at sea and an At-Sea Align using GPS resets cannot be performed. Slave Align requires the other RLGN to be in the Navigate mode and available to provide a velocity and position source. A Slave Align will never be more accurate than the master system that is the source of position and velocity, so the resulting alignment will not be as good as an At-Sea Align using GPS resets. Although Slave Align can be used at dockside, the preferred method is Dockside Alignment. (Refer to Paragraphs 2.3.2.4.1 and 2.3.2.4.4.) Refer to Figure 2-6 when performing Slave Align and proceed as follows:

a. Press the **<SENSOR>** key, and then select **SLAVE ON** to enter Slave Align.

NOTE

When Slave Align is selected, velocity and position resets and velocity damping reference input is provided by the other navigator.

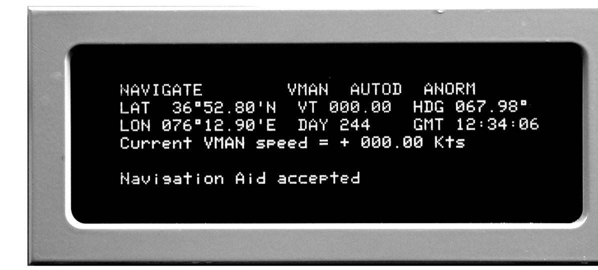
b. During Coarse Align, verify that **ALIGN** and **SLAVE** appear in the upper-left fields of the display.

c. Upon completion of Coarse Align, verify **ALIGN-C** appears in the upper-left field of the display, indicating performance of Fine Align.

d. Upon completion of Fine Align, verify **ALIGN-F** appears in the upper-left field of the display, indicating completion of Fine Align.

e. Press the **<SENSOR>** key to access the Sensor menu. Manually select the Navigate mode by selecting **SLAVE OFF** and then selecting a valid velocity-damping source.

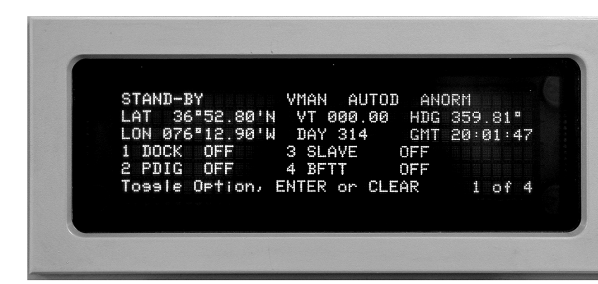
f. Verify that **NAVIGATE** appears in the upper-left field of the display, indicating entry into the Navigate mode.



2.3.2.4.3 At-Sea Align. At-Sea Align is the preferred method if the ship is moving or will be leaving dockside within four hours of RLGN initial start up. When in At-Sea Align using GPS position resets, the resulting alignment will only be as good as the GPS position. GPS positions are normally very accurate and consistent, so the At-Sea alignment will be quite good, though, it will not be as good as a Dockside Align. At-Sea Align should be used to complete an alignment if the ship must be moved after starting the RLGN in Dockside Align.

Refer to Figures 2-6 and 2-7 when performing At-Sea Align, and proceed as follows:

a. Press the **<SENSOR>** key. If DOCK ON has been previously selected, select DOCK OFF.



b. Press the **<SENSOR>** key and select PDIG ON.

c. Press the **<ENTER>** key. The display will change to show digital position reference options.

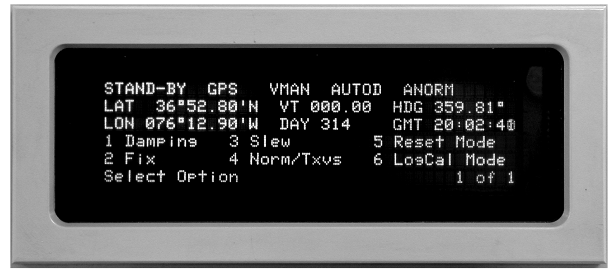
d. Press the **<1>** key to select GPS as the digital position reference.

e. Press the **<ENTER>** key. The display will change to show that the GPS has been accepted as a position reference.

NOTE

Automatic acceptance or operator review of position fix data prior to acceptance of position fixes by the RLGN is selectively controlled by setting the Reset function on the Mode menu. Selection of the Reset function is a matter of operation preference. A suggested method is to set the Reset function to **Review** and manually review the first fix from the navigation aid. Then set the Reset function to **Auto** to allow all subsequent fixes to be automatically accepted/rejected without operator intervention. Operator advisory faults will alert the operator of bad fix data.

f. To select a RESET mode, press the **<MODE>** key to select the Mode menu.



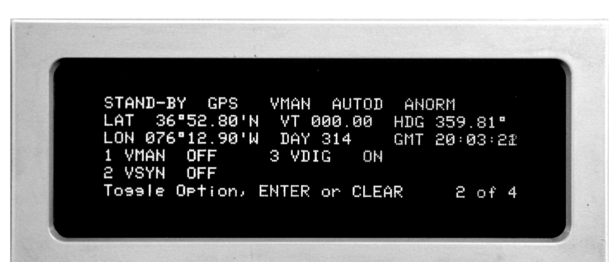
g. Press the **<5>** key to select RESET mode.

h. Press the **<NE+>** key or the **<SW−>** key to select REVIEW or AUTO mode.

i. Press the **<ENTER>** key.

j. Select the velocity reference by pressing the **<SENSOR>** key and selecting Page 2 of the Sensor Menu.

k. To select the GPS as the velocity reference, press the **<3>** key.



l. Press the **<ENTER>** key. The display will change to show digital velocity reference options.

m. If VGPS is not displayed, press the **<1>** key to toggle the options until VGPS is displayed as the Digital Source and press the **<ENTER>** key. The display will show the current GPS North, East, and Vertical velocities.

n. Press the **<ENTER>** key again to accept the GPS as the Digital Velocity source. The system will display notification that it has accepted the velocity reference.

o. The system will automatically sequence to the Navigate mode upon completion of **ALIGN-F**.

2.3.2.4.4 Preferred Align Method. Dockside Align provides the most accurate method of alignment and is the preferred alignment method if the ship is not moving and will not move for at least four hours. If the ship is moving or will move after four hours in Dockside Align, the preferred method is At-Sea Align using GPS resets. Slave Align is the least accurate and should only be used when Dockside or At-Sea and GPS is unavailable.

2.3.2.4.5 Coarse vs. Fine Align. In all align methods, the settling sequence consists of a Coarse Align state, followed by a Fine Align state. During settling, the system continually examines system variances. When the examined values settle to within specified levels, the alignment state is automatically changed and all outputs that have become valid (within specified limits) become available for reference purposes. Upon completion of Coarse Align, heading, roll, and pitch references are valid. Upon completion of the Fine Align state, position and velocity data are valid. Each of these states must be achieved before the system will enter the Navigate mode.

Upon completion of Dockside Fine Align, the system must be manually selected to enter Navigate mode by selection of a velocity damping reference source. Upon completion of At-Sea Coarse Align, at four hours, the system automatically switches to the NAV-C mode and continues to use the currently selected velocity damping and position references. The system continues to settle in the NAV-C mode for an additional 16 hours while supplying position and velocity data at less than full-specification accuracy during a portion of that time interval. During the NAV-C mode of operation, Navigation Digital Data will be available to some users. Because the Navigation Bit is not set, some user systems that require full accuracy will not receive Navigation Data until full Navigate mode is entered.

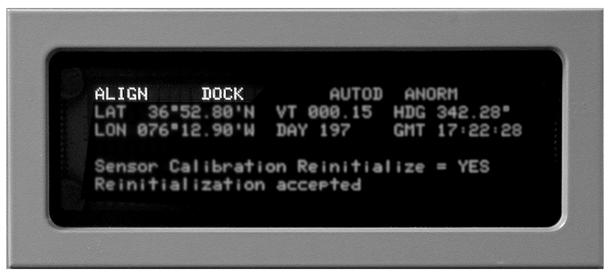
a. Align Method Steps. The align method is chosen based on ship's operating schedule and available position and velocity data references. The basic operating sequence is as follows:

NOTE

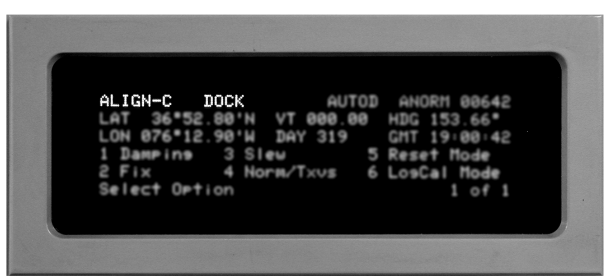
The first mode is entered when the POWER Switch is turned on. While Standby mode is active, the word **STANDBY** appears in the upper-left area of the display.

(1) **STANDBY mode -** Turn Power switch ON and note the word STANDBY on the display. Standby mode is exited by pressing the **<SENSOR>** key and then selecting an Align mode on Page 1 of the Sensor Menu and entering a valid position fix. The Standby mode is active for a minimum of 20 seconds and remains active until an Align mode is selected.

(2) **Coarse ALIGN (Dockside)** - To select Dockside Alignment, select **DOCK ON** on Page 1 of the Sensor menu, then enter a time and position fix within 0.01 nm accuracy. While Coarse Align in Dockside is being performed, the words **ALIGN** and **DOCK** appear in the upper-left fields of the display.



The time that Coarse Align mode is active depends on whether or not the system has been previously calibrated, and on latitude. When Coarse Align has been completed, the word **ALIGN** changes to **ALIGN-C**, indicating that the system has completed Coarse Align and has entered Fine Align.

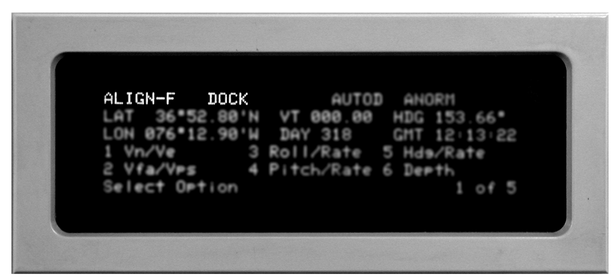


(3) **Coarse ALIGN (Slave) -** To select Slave Alignment, select **SLAVE ON** on Page 2 of the Sensor menu. To select Slave Align, the other navigation system must be settled in Navigate mode and the Ship's Inertial Navigation System (SINS)-SINS data interface must be configured and selected ON. While Coarse Align in Dockside is being performed, the words **ALIGN** and **SLAVE** appear in the upper-left fields of the display.

The time that Coarse Align mode is active depends on whether or not the system has been previously calibrated, and on latitude. When Coarse Align has been completed, the word **ALIGN** changes to **ALIGN-C** indicating that the system has completed Coarse Align and has entered Fine Align.

(4) **Fine ALIGN (Dockside or Slave) -** Upon completion of Coarse Align, Fine Align is automatically entered. While Fine Align is being performed, **ALIGN-C** appears in the upper-left field of the display. When Fine Align is entered, the heading, roll, and pitch references are valid.

Minimum settle time in Fine Align before the Navigate mode can be entered is either 20 hours or 72 hours, depending on whether or not the system has been previously calibrated. After the Fine Align sequence is completed in either Dockside or Slave, the word **ALIGN-C** changes to **ALIGN-F**, indicating that the system has completed Fine Align and is ready for the operator to manually select conditions to enter the Navigate mode.



(5) **NAVIGATE (Selected from Dockside or Slave) -** If the system has been selected to align at Dockside or Slave, the Fine Align (**ALIGN-F**) mode remains active until the Navigate mode is manually selected by the operator.

To change the system to NAVIGATE from Dockside or Slave, remove Dockside or Slave Align reference (select DOCK OFF or SLAVE OFF), and then select a valid velocity damping reference. When the Navigate mode is entered, the word **ALIGN-F** changes to **NAVIGATE**.

A velocity reference must be selected at this time to provide velocity damping. A position reference may be selected to continue operation with position resets. If no valid position reference is selected, the system will continue to operate in NAVIGATE, using the last valid position reset.

(6) **Coarse ALIGN (At-Sea) -** To select Align At-Sea, select **PDIG ON** on Page 1 of the Sensor menu. Valid ship's speed and position reference input must be available and selected. While Coarse Align At-Sea is being performed, the words **ALIGN** and **PDIG** (or other selected position reference) appear in the upper-left fields of the display.

NOTE

Regardless of the Reset mode selected, all fixes will be automatically accepted by the system during the first 128 minutes when the system is being aligned at sea.

As with Dockside Align, settle time in Coarse Align depends on whether or not the system has been previously calibrated, and on ship's latitude, heading, and speed. When Coarse Align has been completed, the word **ALIGN** changes to **ALIGN-C**, indicating that the system has completed Coarse Align and has entered Fine Align.

(7) **Fine ALIGN (At-Sea) -** Upon completion of Coarse Align, Fine Align is automatically entered. While Fine Align is being performed, **ALIGN-C** appears in the upper-left field of the display. When Fine Align is entered, the heading, roll, and pitch references are valid.

Minimum settle time in Fine Align before the Navigate mode can be entered is either 4 hours or 72 hours, depending on whether or not the system has been previously calibrated. After the Fine Align sequence is completed, the system automatically switches through the ALIGN-F state to either the transitional **NAV-C** settle state or directly to the full accuracy **NAVIGATE** mode.

(8) **NAV-C/NAVIGATE (At-Sea) -** When a previously calibrated navigation system has been selected to align At-Sea, the transition from Fine Align mode to **NAV-C** mode is automatic. This reduced accuracy Navigation mode is implemented after four hours, when specified minimum accuracy requirements are met.

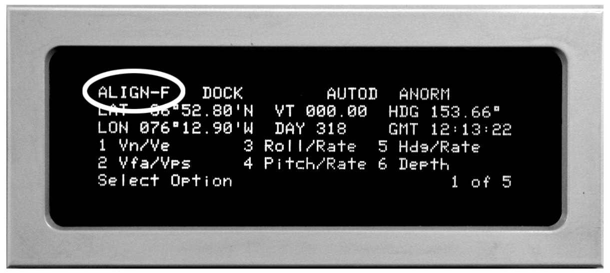
When the system enters NAV-C, the navigation processing function sets internal status indications. The I/O processing function translates these indications from data output messages that inform users that the reduced-accuracy NAV-C mode is currently active. This function allows external equipment to use navigation data before the specified full accuracy NAVIGATE mode is entered at the end of the 20-hour period.

At the end of the 20-hour period, a previously calibrated system automatically exits **NAV-C** and enters **NAVIGATE** mode, and the status indications in the data output messages are set to inform users that full accuracy navigation data is currently available.

If the navigation system has not previously completed a 72-hour calibration, the system remains in the Fine Align mode until the 72-hour calibration has been completed and then switches directly from Fine Align (**ALIGN-C** indication) to **NAVIGATE** mode. No valid position or velocity data is provided as an output until the system enters NAVIGATE mode. Other than selecting mode transitions as shown in Figure 2-8, the operator has no control over selection of the NAV-C and NAVIGATE states.

2.3.2.5 Selecting the Navigate Mode. (Refer to Figure 2-8). Once the RLGN has settled to Fine Align state in the At-Sea Align mode, the RLGN switches automatically from Fine Align to the Navigate mode when error estimate criteria are met. If the RLGN has settled to Fine Align state (ALIGN-F indication) using the Dockside reference (DOCK ON), the operator must remove the selected reference (DOCK OFF) and select a velocity reference. The RLGN will then switch from Fine Align to the Navigate mode. The RLGN will determine position by dead reckoning until a position reference source is selected. In the same manner, when SLAVE is selected as the reference, SLAVE must be deselected to enter the Navigate mode. To enable the transition from Dockside or SLAVE Fine Align to Navigate mode, proceed as follows:

a. Observe that display indication has changed from ALIGN-C to ALIGN-F.



b. Check that velocity and position reference sources are operating.

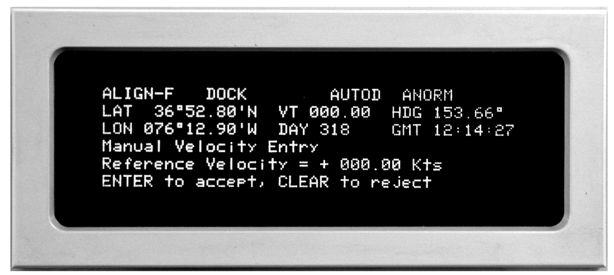
c. Press the **<SENSOR>** key on the keypad.

d. Press the **<1>** key to select DOCK OFF.

e. Press the **<ENTER>** key and observe the Horizontal Reference menu.

f. Press the **<1>** key to select VMAN ON.

g. Press the **<ENTER>** key and observe Manual Velocity Entry.



h. Verify that 000.00 knots is displayed. If not, press the **<CLEAR>** key and enter 000.00.

i. Press the **<ENTER>** key. Verify that Navigation Aid is accepted.

j. Verify that the system has entered Navigate mode by observing NAVIGATE in the top left of the display.

2.3.2.6 Switching Between Navigate and Align Modes. Once the RLGN is operating in the Navigate mode, the RLGN can be switched to an alignment mode without having to recycle power. This capability is useful when the ship returns to dockside and the INS will be left operating.

If the ship is to remain docked for more than 20 hours, use the following procedure to select Align at dockside (DOCK ON) and enter the ship's position on each RLGN. The RLGN will exit the Navigate mode and return to the Align mode. Maintaining INS operation in Align at dockside eliminates any parameter drift if the navigation aid (GPS) and/or velocity reference is turned off. Twenty hours is required to realign the INS to full accuracy.

IMPORTANT - If the ship will remain at dockside for less than 20 hours, continue operation in the Navigate mode. Continue accepting position fixes from selected position sensor, or periodically enter position fixes manually if the position sensor is not operational.

NOTE

Selecting ALIGN while at dockside (DOCK ON) will down mode the RLGN. Navigation data will not be available to various digital users, for example, user systems that require full NAVIGATE mode for operation. Verify with all users of digital navigation data prior to selecting DOCK ON.

To switch from Navigate mode to Align at dockside mode:

a. Press the **<SENSOR>** key. Observe that Position Reference menu is displayed.

b. Press the **<1>** key to select DOCK as the navigation aid, and observe that DOCK ON is displayed.

c. Press the **<ENTER>** key and observe that the correct GMT is being updated.

d. Press **<ENTER>** key. Observe that VERTICAL DEFLECTION NORTH is displayed.

e. If Vertical Deflection North displays 00.0 arc seconds, press the **<ENTER>** key. If it does not, press the **<CLEAR>** key. Enter +00.0.

f. Press the **<ENTER>** key. Observe that VERTICAL DEFLECTION EAST is displayed.

g. If Vertical Deflection East displays 00.0 arc seconds, press the **<ENTER>** key. If it does not, press the **<CLEAR>** key. Enter +00.0.

h. Press the **<ENTER>** key. Observe that the LATITUDE is displayed.

i. Press the **<CLEAR>** key and enter the Dockside Latitude.

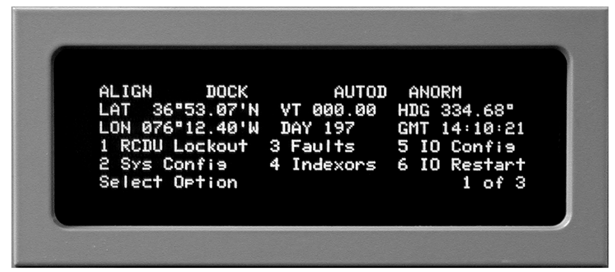
j. Press the **<ENTER>** key. Observe that the LONGITUDE is displayed.

k. Press the **<CLEAR>** key and enter the Dockside Longitude.

l. Press the **<ENTER>** key and verify that the displayed position is correct.

m. If the displayed position is correct, press the **<ENTER>** key again. The RLGN checks the entry for reasonableness and accepts it.

Within a few minutes, ALIGN is displayed in the upper left-hand field and DOCK is the displayed NAVAID.



n. The RLGN will automatically sequence through the align modes. Upon completion of Coarse Align, ALIGN-C will be displayed in the upper left-hand field. Approximately 20 hours after align is initiated, the display will transition from ALIGN-C to ALIGN-F, indicating that Fine Align is complete.

To switch from Align mode back to Navigate mode, proceed as follows:

a. Check that the position sensor and velocity reference sources are operating.

b. Press the **<SENSOR>** key, select **DOCK OFF**, and select position sensor (PDIG ON).

c. Press the **<SENSOR>** key, select Page 2 of **Sensor Menu**, and select applicable horizontal velocity damping source ON.

NOTE

If in ALIGN-F, the RLGN will automatically enter Navigate mode, and the display will change to indicate NAVIGATE.

2.3.3 TRANSVERSE COORDINATES REFERENCE AND DISPLAY.

NOTE

If the INS operates near a geographic pole for an extended period of time, the internal estimate of heading error will increase in accordance with expected Root Mean Square (RMS) heading error. If the internal estimate of heading error exceeds a limit after the system has achieved NAVIGATE mode, and current latitude is less than 84 degrees, then operator advisory Fault Code 49 will be announced. To realign heading and reduce the 24-hour heading oscillation and subsequent navigation errors, the operator should enter position fix data as available. A sequence of at least three position fixes is required with an approximate three- to eight-hour interval between fixes. Additional position fixes (10-12) will provide improved realignment. GPS position fixes are generally the most accurate position source for realignment. This realignment method will have minimal impact on system availability.

2.3.3.1 Use of Transverse Coordinates Reference System. In a gyro-stabilized platform, torque values based on the tangent (tan) and secant (sec) of latitude are used in system control loops. While the INS is a strapdown system based on ring lasers, calculations involving these functions are also used. As the INS approaches 90 degrees latitude, these values become indeterminate (approach infinity) and are no longer valid for calculations. In addition, at high latitudes, the magnitude of east/west vectors has less validity. For this reason, an alternate (Transverse) Earth coordinates reference system is used when the INS is operating at latitudes greater than approximately 85 degrees. The Transverse north pole is located at the intersection of the geographic 180-degree meridian and the equator. The geographic 90-degree and 270-degree meridians become the Transverse equator, and the geographic equator becomes the Transverse 90-degree and 270-degree meridians. (Refer to Figure 2-9.)

2.3.3.2 Modes for Use in Transverse Coordinates Reference System. Three modes are available for selecting operation using Transverse coordinates reference. These modes – AUTO, MNORM, and MTXVS – are selected from Page 1 of the Mode menu. Select AUTO under normal conditions. When AUTO is selected, the INS automatically switches from normal to Transverse coordinates reference when the INS crosses 86 degrees north/south latitude. The INS switches back to normal coordinates when the INS crosses back through 84 degrees. Select MNORM to force the INS to continue using the normal (geographic) reference regardless of operating latitude. Select MTXVS to force the INS to use Transverse coordinates reference regardless of operating latitude and longitude. The selected mode and the operating mode presently being used by the INS is displayed in the COORDinates field of the display (see Figure 2-3). Displayed indications are as follows:

- **ANORM** - AUTO selected, normal coordinates being used
- **ATXVS** - AUTO selected, Transverse coordinates being used
- **MNORM** - Normal coordinates manually selected
- **MTXVS** - Transverse coordinates manually selected

In addition to the operating mode, the position and heading can be displayed in either normal or transverse coordinates regardless of the selected INS operation reference. Select the position display from the **AUX FUNC menu, Page 2, Normal/Transverse** function. This function is a toggle selection. When Transverse position and heading are being displayed, the Latitude (LAT), Longitude (LON), and Heading (HDG) indications are replaced by Transverse Latitude (TLT), Transverse Longitude (TLN), and Transverse Heading (THD), respectively.

2.3.4 ACCEPTING AND ENTERING POSITION FIXES. INS position resets are based on inertial position, an uncertainty area (system accuracy) defined by INS sigma latitude (SN), sigma longitude (SE), and position fix data. The estimated values of SN and SE increase with time but are decreased by the application of a position fix. Entry of valid fix data with suitable fix variances should always improve system accuracy.

CAUTION

Forcing an incorrect reset will introduce a position error proportional to the reset error. This position error will propagate through the undamped Earth loop into position and attitude errors. Large position or attitude errors may cause the vertical loops to undamp and oscillate over a period of 84 minutes due to velocity errors.

2.3.4.1 Applying Fix Data as a Slew. For conditions where the system has operated for an extended term without a position update, the system sigma latitude and longitude values will have increased. Application of a single accurate fix will produce a position reset that is approximately equal to the fix error and will correct drift parameters. A single fix may not update the position completely. If application of successive fixes and gradual convergence of the Kalman filter to the correct position over time are not acceptable for tactical reasons, then the fix data should be applied again as a slew.

2.3.4.2 Position Updates. Position updates are handled by the Kalman filter and can be applied as either position fix resets or position slews, and are described as follows:

a. **Position Fix.** A position fix will reset both position and drift coefficients; however, the amount of position movement will depend on the weighting given to the fix. This calculation is based on the system's internal estimate of position and the fix data. The effect of the fix is calculated by the Kalman filter and can be displayed for review before acceptance. Fixes can be received via the data interfaces from an external source, such as GPS, or can be entered manually by the operator. Whether accepted automatically or entered manually, **once the fix reset is applied, its effects cannot be undone**.

b. **Position Slew.** A position slew allows the operator to enter position data to update system position without causing a reset using the **Mode menu, Slew** function. This process resets the navigator's position only to the entered fix position but does not change Kalman filter parameters or underlying system drifts. Position slews can only be entered manually by the operator.

2.3.4.3 Accepting or Rejecting Fixes. The reset mode allows the operator to select how automatic fixes are accepted or rejected, enables review of last accepted fix data, and enables review and manual acceptance of pending fixes that the system has rejected as unreasonable. The Fix Review mode can be selected from the **Mode menu, Reset Mode** function. The mode selected on this menu determines how the system involves the operator in the review and acceptance of fixes from external position sensors. Manual fixes can be entered into the system at any time using the **Mode menu, Fix** function. When fixes are entered manually, the system checks the fix data for reasonableness in the same manner as for fixes received from external position sensors. If the manually entered fix data is determined to be invalid, an appropriate fault code and a Reset Data menu are displayed. This menu allows the operator to review the entered fix data and either force acceptance or discard the data. At any time, the operator can review the data for the last position fix accepted by the system. This function is selected from the **Display menu, Page 3, Reset Data** function. Figure 2-10 presents an outline of the various states associated with the position fix functions.

2.3.4.4 INS Processing of a Position Fix. When a fix is entered, either manually or automatically from a navigation aid such as GPS, the Kalman filter compares the inertially derived position with the available position reference (fix) data. It operates on these measurements to generate corrections to the modeled system states. The process attributes navigational errors to sensor or system drifts, and then modifies the Kalman parameters to neutralize the error pattern. Corrections are made to latitude, longitude, velocities, tilts, heading, gyro biases, non-reversing rotation rate biases, scale factors, misalignments, and horizontal accelerometer biases. The Kalman filter operates on the fix as entered. Fix processing within the Kalman filter calculates the latitude and longitude resets using the difference between system position and fix position. The Kalman filter calculates a weighting based on the estimate of system accuracy (SN and SE) as compared to the fix accuracy, defined by Fix Sigma North (FSN) and Fix Sigma East (FSE). This weighting is used to determine the proportion of the difference in position to be applied as the position reset. If a fix is entered with a small sigma value (high accuracy), then a large percentage of the difference in position will be applied as a reset.

The difference between the INS (system) position and the fix position does not determine the weighting. The weighting is determined by the estimated system accuracy and fix accuracy. The estimated value of system error increases with time, but is decreased by the application of fix data as a reset. This method results in a higher weighting being given to fix data following a long navigate period, as compared to fix data entered at relatively short intervals. The latitude and longitude weighting or gain (K) is calculated using the system sigma values at the time of fix and the fix sigma values [or the sigma values calculated from Radial Position Error (RPE) data], which are used as entered:

- K = (system sigma)^2/[(system sigma)^2 + (fix sigma)^2]
- FSN and FSE = 0.40854 x RPE

The north and east distances that the reset will move the INS position (DN and DE) are given by:

- Reset = K x (fix position - system position)

2.3.4.5 Criteria for Acceptance of a Position Fix. When a position fix is entered, the Kalman filter checks the fix using the following limits:

(Position error)^2 = (system lat - fix lat)^2 + [(system lon-fix lon) x cos(fix lat)]^2

Error limit = 9 x (SN^2 + FSN^2 + SE^2 + FSE^2) + K (offset)

If (Position Error)^2 is greater than the error limit, then an operator advisory (Fault Code 209) is announced, and the fix is rejected and may be held for review. The INS resets for latitude, longitude, velocity, and various system feedback parameters are also checked using appropriate limits similar to the above limit on fix position error. If a reset exceeds an error limit, then an operator advisory (Fault Codes 212 through 217) will be declared. The operator is alerted (using Fault Codes 218 through 222) to fix data or a reset outside acceptable bounds. If the fix data is unreasonable or if a reset exceeds a specified limit, the operator should then review the reset DN and DE (the north and east distances the reset will move the system solution) and either correct the fix data or, if the fix data is known to be accurate, accept it and force the reset.

2.3.4.6 Enhanced Performance Position Accuracy (EP^{2}A). (Refer to Figure 2-11) The EP^{2}A feature of the INS addresses the residual errors that remain in the INS position solution. The INS errors are characteristically slowly varying; e.g., the 84.4-minute Schuler period and the 24-hour earth loop. In contrast, the errors in the GPS aiding source are short period, typically on the order of seconds to minutes, and are more random in nature; e.g., ionospheric and multipath errors. The INS uses EP^{2}A to estimate the current value of the slowly varying INS error and to "average out" the short-period GPS errors to provide a Real-time estimate of the correction to the Kalman-derived INS position:

EP^{2}A is automatically applied to the INS position solution whenever the following conditions are satisfied:

- GPS is the selected position reference source.
- The GPS position is lever-arm corrected to the aiding INS.
- The INS operating mode is NAV or NAV-C.
- INS latitude is less than 89°.
- The INS reset mode is AUTO or AUTO/REVIEW.
- The INS is receiving continual GPS updates.

In the absence of GPS fixes, or if the GPS position diverges from the INS position estimate by more than 200 meters, the EP^{2}A filter is allowed to decay back to the Kalman filter position estimate. After a period of approximately 12½ minutes without GPS fixes, the EP^{2}A correction decays to zero, giving an INS estimated position that is equal to the Kalman filter estimate.

The Kalman filter solution is independent of, and unaffected by, the EP^{2}A algorithm. The EP^{2}A estimate is applied to the INS estimated position after the Kalman filter. The Kalman filter itself and other parameters estimated by the Kalman filter, such as velocity and attitude, are not affected by EP^{2}A.

2.3.4.7 Reset Modes and Operator Acceptance of a Position Fix. The Reset mode (**MODE Menu, Reset Mode** function) defines the conditions for fix entry and is set by the operator. The effect of the fix is calculated and can be displayed for review before acceptance; but once the reset is applied, its effects cannot be undone. The operator may select from the following reset modes:

NOTE

Regardless of the Reset mode selected, all fixes will be automatically accepted by the system during the first 128 minutes when the system is being aligned At-Sea.

a. <u>**REVIEW** Reset mode</u>. An operator's acceptance/rejection is required after review of the reset data. When a position fix is received, the RLGN will prompt the operator by announcing a fault and by displaying Fault Code 221. To review and either accept or reject the fix data, select **DISPLAY menu, Page 3, Reset Data** function.

NOTE

The fix must be either accepted or rejected or the RLGN will not process new fix data for 10 minutes.

b. <u>**AUTO REVIEW** Reset mode</u>. Position fixes or resets that meet the error limit criteria are applied without operator review. Position fixes or resets that do not meet the error limit criteria are held for operator review. When a position fix or reset is rejected, the RLGN will prompt the operator by announcing a fault and by displaying a fault code. To review the out of limit fix data, select **DISPLAY menu, Page 3, Reset Data** function. If the fix is not reviewed within 10 minutes, the fix data is discarded. Additional fixes received during this time are not processed and may be overwritten by later fixes.

c. AUTO Reset mode. Position fixes or resets that do not meet the error limit criteria are not applied. Position fixes that do meet the error limit criteria are applied to the INS without operator review.

CAUTION

Depending on the review mode selected, a rejected fix may be entered by the operator. These functions allow the operator to force the acceptance of a good fix to correct system errors. This is useful if a fix is rejected as a result of errors in the system's estimate of position. Care should be taken when manually entering or accepting a fix that has been rejected. Acceptance of an unreasonable fix introduces position errors and will cause calculations of position and velocity to diverge.

NOTE

Any position fix for which the resulting radial position reset exceeds 5 NM should be reviewed closely before acceptance. Any fix that exceeds the range of the latitude and longitude reset (DN and DE) display (± 100 NM) is immediately suspect.

2.3.4.8 Automatic Entry of a Position Fix. Fixes may be entered automatically via the Naval Tactical Data System (NTDS) data interface from a navigation aid such as the GPS. Using **SENSOR menu**, Page 1, toggle **PDIG** to **ON**. Depending on the Reset mode selected at the **MODE menu, Reset mode** function, these fixes will be automatically accepted or rejected by the INS, or the operator will be prompted to review the fix data and manually accept or reject the fix (see above).

NOTE

Automatic position or speed inputs are not allowed when the INS is operating in Dockside mode.

2.3.4.9 Manual Entry of a Position Fix.

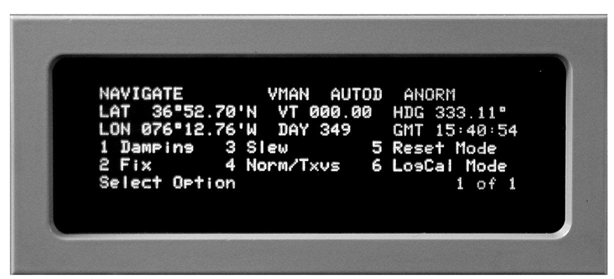
CAUTION

The RLGN will reject the manual fix if the reset exceeds the error limits described in Paragraph 2.3.4.5. Care must be taken when manually accepting a fix that has been rejected by the RLGN. Forcing acceptance of an unreasonable fix introduces position errors and will cause the system calculations of position and velocity to diverge.

A manual position fix may be entered at any time when the RLGN is in the Navigate mode, even when navigation aids are selected for automatic entry of position fixes. To perform a manual position reset (i.e., to enter a fix), the operator must enter fix time, latitude, longitude, and estimate of fix accuracy (Sigma value of the fix) in nautical miles. After the fix data is entered through the display, the RLGN will not immediately use the data for reset, but will first calculate the system parameters based on the fix data. The operator must review the calculated effect of accepting the fix by examining the delta (DN and DE) and sigma (FSN and FSE) latitude and longitude values. The operator then accepts or rejects the fix data using the procedure described in Paragraph 2.3.4.10. If the operator does not accept or reject the fix data, the RLGN will retain only the last accepted fix.

2.3.4.10 Manual Fix Entry Procedure.

a. Press the **<MODE>** key and select **Fix**.



b. Current time is displayed and may be accepted by pressing the **<ENTER>** key

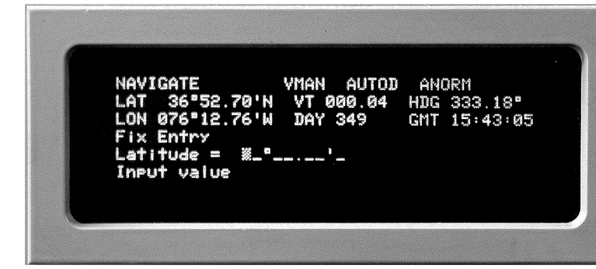
c. To enter any other time (up to a maximum of one hour in the past) press the **<CLEAR>** key and enter the fix time in HH:MM:SS format.

d. Use the **<BACK SPACE>** key to eliminate keypunch errors.

e. Press the **<ENTER>** key to accept the entry.

f. The display will now prompt for entry of fix latitude. Current system latitude is displayed, and may be accepted by pressing the **<ENTER>** key.

g. To enter a different value, press the **<CLEAR>** key and enter fix latitude in DD°MM.mm′ format. Press the **<NE+>** key to enter the North Hemisphere, or the **<SW−>** key to enter the South Hemisphere.



h. Press the **<ENTER>** key to accept the entry.

i. The display will now prompt for entry of fix longitude. Current system longitude is displayed, and may be accepted by pressing the **<ENTER>** key.

j. To enter a different value, press the **<CLEAR>** key and enter fix longitude in DD°MM.mm′ format. Press the **<NE+>** key to enter the East Hemisphere, or the **<SW−>** key to enter the West Hemisphere.

k. Press the **<ENTER>** key to accept the entry.

l. The display will now present two options for entry of fix error estimate, 1/North and East Error or 2/Radial Position Error.

Select one of the following options:

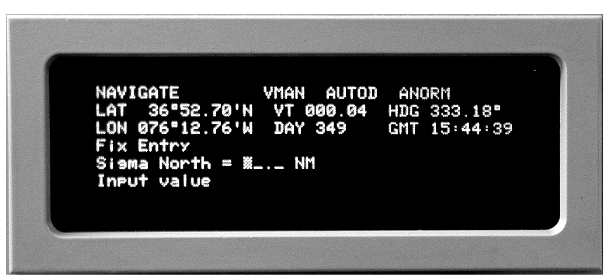
CAUTION

In either of these fix error estimate options, the Sigma values must reflect the true position fix accuracy. Assigning a large Sigma to an accurate fix will not disturb the INS, but the reset will have only a small correction on the system. On the other hand, assigning a small Sigma to an inaccurate fix will disturb the system and result in position and velocity divergence.

(1) North and East Error:

(a) Press the **<1>** key to select North and East Error format. The display will now prompt for entry of fix Sigma North. Current Sigma North (SN) is displayed and may be accepted by pressing the **<ENTER>** key.

(b) To enter a different value, press the **<CLEAR>** key and enter fix Sigma North (SN) in xx.x NM format.



Press the **<ENTER>** key to accept the entry. The display will now prompt for entry of fix Sigma East (SE). Current Sigma East (SE) is displayed and may be accepted by pressing the **<ENTER>** key.

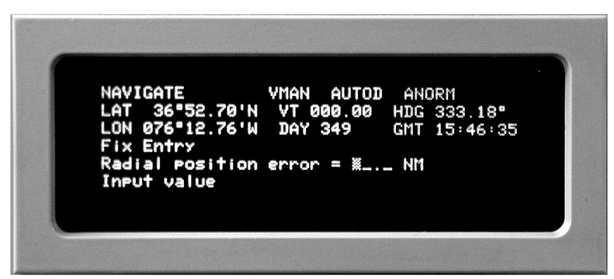
(c) To enter a different value, press the **<CLEAR>** key and enter fix Sigma East (SE) in xx.x NM format. Press the **<ENTER>** key to accept the entry.

(2) Radial Position Error:

(a) Press the **<2>** key to select Radial Position Error (RPE) format. RPE is equal to 95% Circular Error Probable (CEP). The CEP defines that circular area within which the actual ship's position exists with a certain defined probability. The RPE defines that probability as 95% (i.e., the size of the CEP is defined by RPE such that there is a 95% probability that the ship's position exists within the CEP). The display will now prompt for entry of RPE.

Current INS RPE is displayed and may be accepted by pressing the **<ENTER>** key.

(b) To enter a different value, press the **<CLEAR>** key and enter fix RPE in xx.x NM format. Press the **<ENTER>** key to accept the entry. The INS now uses the RPE to calculate FSN and FSE.



m. The display will now show the complete fix data, and prompt the operator to enter the fix by pressing the **<ENTER>** key or reject by pressing the **<CLEAR>** key.

n. When the fix data is correct, press the **<ENTER>** key and the RLGN will calculate and display the reset parameters.

o. If the fix parameters are within the error limits, the RLGN will prompt the user with "REASONABLE."

If outside the error limits, the RLGN will prompt the user with "UNREASONABLE." In either case, choose one of the following options:

(1) Accept the fix by pressing the **<ENTER>** key.

(2) Reject the fix by pressing the **<CLEAR>** key.

(3) Do nothing and allow the fix to be overwritten by the next incoming fix.

NOTE

The RLGN maintains a history of position data to allow fix computations using the data obtained up to 60 minutes prior to the current time. Fault Code 218 will be declared if the fix data is more than 60 minutes old.

2.3.4.11 Manual Position Slew Procedure.

a. Press the **<MODE>** key and press the **<5>** key to select **RESET MODE**.

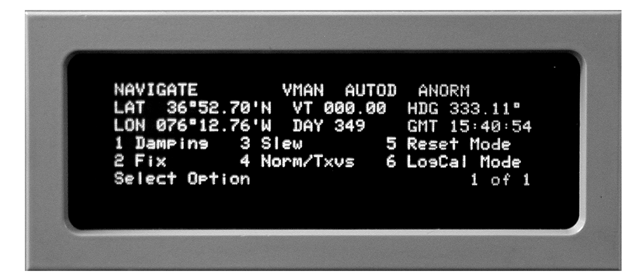
b. Use the **<NE+>** key or **<SW−>** key to toggle the reset mode to REVIEW.

c. Take a position fix using the best available reference, usually a GPS fix. Take a mark of position and note the exact GMT of the mark.

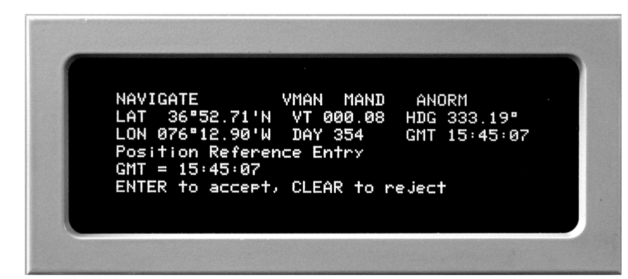
NOTE

Perform the following steps as soon as possible following the fix taken in Step c. Accuracy of the slew will be degraded by time and ship's maneuvering.

d. At the AN/WSN-7(V) keypad, press the **<MODE>** key.



e. Press the **<3>** key to select SLEW. Observe that GMT is displayed.



f. Press the **<CLEAR>** key. Enter GMT from Step c.

g. Press the **<ENTER>** key. Observe that LATITUDE is displayed.

h. Press the **<CLEAR>** key. Enter Latitude from Step c.

i. Press the **<ENTER>** key. Observe that LONGITUDE is displayed.

j. Press the **<CLEAR>** key. Enter Longitude from Step c.

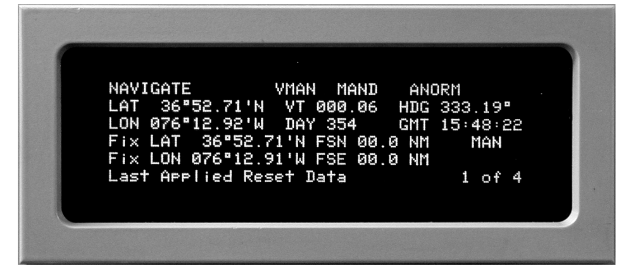
k. Press the **<ENTER>** key. Observe that the new position as entered is displayed.

l. To reject the new position, press the **<CLEAR>** key. To accept the new position, press the **<ENTER>** key. Observe that Position is accepted.

2.3.4.12 Review Reset Data Procedure. You can review reset data for the most recent fix, including fix data, type of fix (manual or GPS), and date and time of fix.

a. Press the **<DISPLAY>** key and press the **<NEXT PAGE>** key until **3 of 5** appears in the lower right corner of the display.

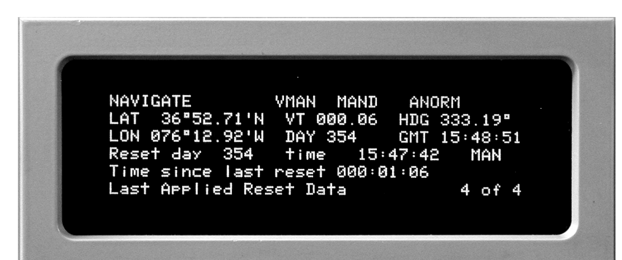
b. Press the **<5>** key and select RESET DATA. The fix latitude and longitude will be displayed, along with the fix accuracy (FSN and FSE), and the type of fix taken.



c. Press the **<NEXT PAGE>** key. The fix day and time will be displayed.

d. Press the **<NEXT PAGE>** key again to display the system accuracy (SN and SE) and the difference in position (DN or DE).

e. Press the **<NEXT PAGE>** key again to display the time since the last reset.



2.3.5 SELECTING THE VELOCITY DAMPING MODE, SOURCE, AND FILTER. Velocity reference data is used by the Kalman filter to provide damping for the vertical (Schuler-tuned) loops. The velocity reference to be used by the system is selected by the operator and is available from external sources (speed logs or GPS receivers) via the data interfaces, or it can be entered manually. The selected velocity reference provides the Kalman filter with water speed or ground speed reference data in the ship's coordinates (fore/aft and port/starboard) or geographic coordinates (north and east). If the port/starboard water speed is not available (as in the case of a single-axis speed log), an estimate of the port/starboard water speed is calculated using the inertial fore/aft velocity, heading rate, and side-slip coefficient. If the Dockside mode is selected, the fore/aft and port/starboard ground speed used by the Kalman filter is set to 0.0 knots. The selected velocity reference (after log bias, lever arm, and side-slip corrections are applied) is resolved into appropriate components and compared with the inertial-derived velocities. The differences are multiplied by optimal gains in the Kalman filter and corrections are fed back into the vertical loops to achieve optimally damped loops. The Kalman filter controls the automatic selection of damping or undamping during turns or backing, or when there is a significant discrepancy between log and inertial solutions. Automatic undamping and redamping are accomplished by applying accept/reject criteria to the filtered inertial reference velocity differences.

2.3.5.1 Selecting Damped or Undamped Operation. Based on the selection of the damping mode (MODE menu, Damping function), damping of the horizontal velocity loops will either be automatically selected based on the filtered velocity or will be manually selected to fully damped or fully undamped operation.

a. When Auto damping is selected, the system automatically selects damped (**AUTOD** displayed) or undamped (**AUTOU** displayed) mode based on comparison of the reference velocity with the system's inertial velocity. As long as this corrected difference does not exceed the inertial limit, the system uses reference velocity to damp inertial velocities. If the corrected difference between the reference velocity and inertial velocity exceeds an internal limit, the system will automatically switch to undamped mode. Automatic damping (Auto selected) is the preferred mode since it provides velocity damping and minimizes the effects of ship's speed reference errors due to ship maneuvers or other sources.

b. When **Man Damp** is selected, the system is forced into the damped mode (**MAND** displayed) regardless of the reference comparison. The operator can use this function to force the system to accept data from the velocity source and keep the system damped. Selection of **Man Damp** can be used as an operator-selected reset if advisory Fault Code 223 is displayed, indicating that the system has remained undamped for an excessive period of time with **Auto** damping selected. **Man Damp** can also be used as an operator-selected reset when ship's speed is being manually entered. Refer to Paragraph 2.3.7.5.

c. In addition, selection of **Man Damp** may be necessary whenever the ship is operating in an area of large gravity anomalies. Selecting **Man Damp** will prevent the system from going into undamped operation, induced by gravity changes in the system's inertial velocity estimate.

d. When **Man Undamp** is selected, the system is forced into the undamped mode (**MANU** displayed) and velocity damping is inhibited regardless of the reference comparison. This function is useful if the system is in NAVIGATE mode and damping velocity is incorrect or not available from the selected device. An example of this condition would be the case where an Electromagnetic (EM) Log with a retractable sword is the selected damping source, but it cannot be used until operating depth permits. Another example of when **Man Undamp** is used is during ship high speed maneuvers.

2.3.5.2 Selecting the Horizontal Velocity Damping Reference. When automatic damping is selected, damping and undamping of the velocity loop is determined by the filtered velocity differences. The system periodically tests the criteria for determining the damping mode, and it switches from damped to undamped operation whenever the filtered velocity difference exceeds the set criteria.

The transition from undamped operation to damped operation will occur whenever the filtered velocities' differences have settled to within the set criteria. The available speed reference for velocity damping is determined by the system configuration. The speed reference is selected on **SENSOR Menu, Page 2**. When multiple speed references are available, the selection for best operation is the following (in order):

1. Two- or three-axis GPS (best source)
2. Two- or three-axis Speed Log (water speed)
3. Single-axis Speed Log (water speed)
4. Manual speed (entered in the event of loss of all valid speed references)

2.3.5.3 Selecting the Horizontal Velocity Damping Filter. This function, selected from **AUX FUNC menu Page 1, Sys Config**, allows the operator to choose either Kalman or Third Order as the horizontal velocity filter. The default filter type is selected as an off-line configuration. If Third Order is configured, Kalman can be selected on-line, or vice versa. The filter type selected on-line will remain selected only as long as the system is turned on. If the system is turned off, the configured default filter type will be automatically selected for use when the system is turned on again. Both the Kalman filter and the Third Order filter compare the difference between the inertial and reference velocity and generate a feedback, which is used to damp horizontal velocity errors at Schuler-tuned frequencies.

Each filter type provides essentially the same function when operating in Navigate mode, with the exception that Kalman provides light damping of Earth loop errors. Since Kalman provides the feedback for system align and calibration, regardless of the configuration, Kalman is automatically selected at start-up and remains active until the system enters the Navigate mode. If Third Order is configured as the default filter or is selected by the operator using this function, the system will switch to Third Order only when it has settled and enters the Navigate mode. If the system exits Navigate mode while Third Order is selected, the Kalman filter will automatically be selected during the time that the Align mode is active. When the system returns to Navigate mode, Third Order will then be automatically reselected.

2.3.6 SELECTING DATA FOR DISPLAY.

NOTE

Data on the **DISPLAY menu, Page 3**, is associated with the position fixes. This data is useful for reviewing parameters prior to selecting the **Reset Data** function to accept or reject fix data when **Review** or **Auto Review** is selected for the Reset mode.

The operator can select any display of parameters and data in addition to the normal position, heading, velocity, day and time display. Display of additional parameters is not necessary for normal operation; however, selection of these display functions is useful for manually verifying data transmitted to external systems. Data is selected for display by pressing the **<DISPLAY>** key and selecting the PAGE with the parameters to be displayed. (See Table 2-2.)

2.3.7 OPERATING UNDER INTERFERING CONDITIONS. During on-line operation of the RLGN, interfering conditions such as fault conditions associated with hardware and software functions, I/O bus data input checks, I/O bus wrap-around testing, and Inertial Measuring Unit (IMU) functions may occur that require certain actions to be performed.

2.3.7.1 Acknowledging and Identifying Fault Conditions. At start-up and during operation, the RLGN BIT function continually monitors hardware and software functions and checks calculation results for reasonableness. In addition, the RLGN checks data input on the I/O bus and performs wrap-around testing of I/O outputs. Any fault condition detected by BIT is announced by a visual alarm. Each detected condition results in the generation of a fault code, which is stored in battery-backed RAM if the fault is still active when acknowledged for display and review. Based on the type of fault code displayed, the operator may acknowledge the fault by pressing the **<ALARM ACK>** key and choosing to continue system operation, or he may take the RLGN out of service for navigation. Certain faults automatically shut down the RLGN and cannot be overridden by the operator. The following list outlines the major fault classifications of interest to the operator:

1. **Operator advisory** fault codes inform the operator that manual intervention is required to review data or to select functions related to system operation. An example of an operator advisory is Fault Code 221 (Position Fix Waiting for Review).

2. **Non-critical** fault codes indicate that a fault condition exists that may be bypassed by changing operation modes or selecting other sensors, or by manual entry of data. Non-critical codes generally result from conditions which allow continued operation at reduced capability or at degraded performance levels. Non-critical faults may also result from a fault condition in the I/O, data messages, or in equipment external to the INS. An example of a non-critical code is Fault Code 45 (Loss of Vital Heading Synchro Reference).

3. **Critical** fault codes indicate that a fault condition exists that makes the INS unusable as a reference source. Critical faults may or may not result in automatic shutdown of the RLGN.

Appendix B provides a table listing all of the possible BIT fault codes and associated fault/status relay settings. Table B-1 indicates the source of the fault and the fault classifications. The table also provides diagnostic information and references off-line BIT to be performed to verify and troubleshoot the fault condition. In addition to the valid fault codes, several spare code numbers are listed. Spare codes are reserved for future expansion and will not be announced for fault conditions.

Fault and status indicators may also be installed external to the system. These can be controlled by fault and status relays (K1, K2, K3, and K7) to either illuminate or extinguish upon detection of the fault or status condition. (Refer to Figure 5-5, sheet 1.) Relay K1 functions as both a status and a fault relay. This relay initially remains reset when the system is in STANDBY to provide an external indication that the system is not ready, and then sets when the system enters the Align mode. The relay remains set unless a fault condition occurs.

2.3.7.2 Operating with System Faults. If a fault is detected during operation, the visual alarm is activated, and the fault code generated by the BIT function is displayed in the upper-right corner of the display. Before acknowledging each fault, first record the displayed fault code number. For each fault condition, determine the fault type and proceed as follows:

NOTE

The fault codes are to be recorded in the event that the fault is intermittent. Only faults that are active at the time of acknowledgment are stored in battery-backed RAM; as such, they are available for review at another time.

Operator Advisory. Acknowledge advisory and perform required action.

Non-critical fault.

a. Acknowledge the fault by pressing the **<ALARM ACK>** key, and observe navigation system operation to determine if the fault is cleared or if the fault condition is again announced.

b. If the fault condition is repeated, acknowledge the fault and determine operating status or alternate mode for continued operation.

c. Record the fault code(s) displayed for future troubleshooting reference.

Casualty fault.

NOTE

Faults in this category are associated with Inertial Measuring Unit functions. If a casualty fault is announced, the system will continue to operate using Dead Reckoning but will have degraded accuracy and functionality.

a. Acknowledge the fault by pressing the **<ALARM ACK>** key and observe RLGN operation to determine if the fault is cleared or if the fault condition is again announced.

b. If the fault condition is repeated, the system can continue operating for limited use.

c. Acknowledge the fault and determine operating status or alternate mode for continued operation.

d. Record the fault code(s) displayed for future troubleshooting reference.

e. Shut down the system and perform fault testing as soon as situation status allows.

Critical fault.

NOTE

Faults in this category indicate that further operation of the system is not advised.

a. Record all fault code(s) displayed for future troubleshooting reference. Turn off System Power switch and tag the RLGN OUT OF OPERATION.

b. Perform fault testing. (Refer to **Chapter 5**.)

RLGN automatic shutdown.

NOTE

Faults in this category automatically cause system power to be turned off.

a. Turn off System Power Switch and main Power Circuit Breaker and tag the RLGN OUT OF OPERATION.

b. Perform fault testing. (Refer to **Chapter 5**.)

The following paragraphs outline the recommended operator's action with selected non-critical and casualty faults.

2.3.7.3 Source Alternating Current (AC) Power or Synchro Reference Fault. The RLGN contains an internal Power Supply (**1A1A6**), which provides an output of +25 Volts, Direct Current (VDC) power during normal operation from the ship's AC power source. The +25 VDC is distributed via the Terminal Junction System (TJS) to all end users. The Battery Charger (**1A1A7**) produces -25 VDC power using the +25 VDC as its input power under all conditions. The -25 VDC is also distributed via the TJS to all users on the bus. The Battery Charger also maintains the charge on the Battery Assembly (**1A1A5**) using the +25 VDC output from the Power Supply. The Inverter Assembly (**1A1A2**), which operates from the +25 VDC bus, generates 115 VAC, 400 Hz for the components on the vital synchro reference circuit as long as the RLGN is energized. In the event that the ship's main power bus is interrupted or out of tolerance, the Battery Assembly, working through the Battery Charger, provides emergency ±25 VDC power for continuous operation. BIT functions on the Vital Bus Circuit Card Assembly (CCA) (**1A1A3**) monitor main AC power and non-vital reference supplied to the RLGN, and provide control that automatically turns off all non-vital synchro outputs in the event that a source power or non-vital synchro reference fault is detected. When the external power is reestablished within the correct limits, the RLGN automatically switches back to AC operation and restores non-vital synchro outputs.

2.3.7.3.1 Fault Code 034. In the event of loss of main 3-phase AC power, the RLGN can operate from its internal battery for approximately 30 minutes. To conserve battery power, the RLGN will discontinue output of synchro roll, pitch, and non-vital heading, but will continue to supply synchro Vital Heading and synchro Velocity (V_t, V_n and V_e) data and reference to the vital repeater(s) and velocity users.

2.3.7.3.2 Fault Code 037. Fault Code 037 indicates that the internal battery voltage is low. If the RLGN has been turned off for an extended period of time, allow it to operate for at least two hours to recharge the battery. If Fault Code 037 is detected during normal operation, or if the battery fails to charge to its normal level, the battery may require replacement. The RLGN will operate properly with this fault; however, it may not continue to operate in the event of a fault in the 3-phase AC power source.

2.3.7.3.3 Fault Code 045. A fault in the internally generated vital synchro reference Inverter Assembly (**1A1A2**) will result in loss of heading output to the synchro Vital Heading repeaters. Non-vital synchro heading, roll, and pitch output will continue to be valid; however, external systems that use synchro heading data from the vital reference will be affected.

2.3.7.3.4 Fault Code 046. In the event of loss of the non-vital synchro reference input, the RLGN will continue to operate normally from 3-phase AC power. The RLGN will discontinue output of synchro roll, pitch, and non-vital heading, but will continue to supply synchro Vital Heading and synchro Velocity (V_t, V_n and V_e) data and reference to the vital repeater(s) and velocity users.

2.3.7.4 Indexer Faults (Code 043 or 044). An internal circuit fault, which results in loss of correct control of either the inner (azimuth) or outer (roll) indexer, causes the affected control loop to shut down. Since indexer rotation is provided primarily for alignment and mechanical canceling of drift offsets, the RLGN will continue to operate in a strapdown mode. In the event that Fault Code 043 or 044 is displayed, select the **AUX FUNC Menu, Indexers** function and reselect indexer operation. If the fault is repeated, Fault Codes 043 and 044 can be ignored until the RLGN can be turned off for repair conveniently. The RLGN will operate with a degradation of system performance.

NOTE

Attitude Comparison Limit Faults (Codes 384 through 386) may be announced if one RLGN in a dual system is operating with an indexer fault. Refer to **Paragraph 2.4.10**.

2.3.7.5 Speed Data Source Faults (Codes 036, 056, 057, 060, 061, 222, and 223). Loss of speed data or unreasonable speed input will cause the system to switch to undamped operation. Loss of log data can result from the selected velocity reference or speed sensor equipment being turned off or switched to a Test mode at the source. In installations where more than one synchro speed reference can be externally selected to provide the synchro speed input to the INS (such as synchro input from Rod 1 and Rod 2), loss of log may result from changing the external selection without the current externally selected source being selected at the INS.

If any of the indicated fault codes is displayed, it may be necessary to select a different velocity reference source or select manual entry of ship's speed. If the system is operating with **Auto** damping selected, and if the computation of percent time undamped during the current 128-minute period exceeds 75% undamped, an operator advisory (**Fault Code 223**) will be displayed. This code alerts the operator to take corrective action. If the operator does not change the damping selection, the system will automatically go into the forced damped mode (**AUTOD** displayed) for the next 128 minutes using the currently selected speed data source as the velocity reference.

If Code **223** is displayed, the operator should review the status of the selected velocity reference source. If the selected velocity reference is found to be accurate, then the operator may elect to manually select forced damping of the system (select **Man Damp**) for approximately two hours and then return to **Auto** damping. If the operator finds that the selected velocity reference is not sufficiently accurate to provide velocity damping, then the operator should select **SENSOR Menu, Page 2**, and select a different source as the velocity reference. The operator should then select **Man Damp** for approximately two hours, or force undamping of the system (select **Man Undamp**). Undamp should be selected when velocity reference is not valid. Selecting either **Man Damp** or **Man Undamp** will reset the 128-minute comparison timer. If a correct data input source cannot be reestablished, select manual damping of the system (select **Man Damp**), select **SENSOR Menu, Page 2**, **VMAN ON** and manually input ship's forward water speed from the keypad. Ship's speed should be monitored by the operator, and the manually entered value should then be changed whenever the ship's speed changes by more than ±10 percent from the set value or whenever manually entered speed is selected as the velocity reference source.

2.3.7.6 GPS or GPS I/O Faults (Codes 368 through 383). Failure of the GPS position sensor input to the INS will result in slow degradation in the accuracy of the estimate of position. Position performance degrades approximately as a function of the square root of time as shown in **Figure 2-12**. INS performance can be maintained by selecting a different position sensor (if configured for additional position sensor) or by periodically entering a position fix manually. To manually enter position fix data, select **MODE menu, Fix** function (refer to **Figure 2-4**). The chart in Figure 2-12 is shown for illustration of proportion only; no units are implied.

2.3.7.7 Position Fix and Velocity Reference Error Faults (Codes 209, 210, 211, and 212 through 217).

2.3.7.7.1 Fault Code 209. Fault Code 209 indicates that the position fix data does not agree with the RLGN-calculated position within the system reasonableness bounds.

CAUTION

Forced acceptance of correct position fix data over a period of time will restore the INS to full navigation data accuracy; however, forced acceptance of incorrect position fix data will quickly degrade navigation performance. It may be necessary to realign the INS to restore navigation accuracy if acceptance of an invalid position fix has been force-accepted.

2.3.7.7.2 Fault Codes 210 and 211. These fault codes indicate that the reference velocity data does not agree with the RLGN-calculated velocity within the system reasonableness bounds.

2.3.7.7.3 Fault Codes 212 through 217. These fault codes indicate that a potential reset resulting from either position or reference velocity data is outside the system reasonableness bounds. If position data is outside the system reasonableness bounds and the position fix was processed in a Review or Auto/Review mode, then the operator should review the data for correct latitude, longitude, fix time, and fix variance. If the data is found to be incorrect, then the operator can reject the fix. If the data is found to be correct, then the operator can force acceptance of the fix. The error codes will occur again on a forced acceptance of the position fix. If reference velocity data is outside the system reasonableness bounds, the operator should review the provided velocity data during the time when faults are being reported (only multiple fault occurrences will degrade navigation performance). The RLGN may undamp if Auto damping is selected (refer to Paragraph 2.3.5.1). If reference velocity data is found to be invalid or noisy, then another velocity reference should be selected (refer to Paragraph 2.3.5.2). If reference velocity is found to be continuously valid, then the INS should be manually damped for approximately two hours, then returned to Auto damping. If the faults recur, the INS may need realignment using Dockside Align mode to restore full navigation accuracy.

2.3.7.8 External Serial Interface or I/O Processor Faults (Codes 240 through 246, 248, 250, 251, 253 through 257, 259, 262, 264, 266, 338, 347 through 351). Detection of a fault that results in any of the listed fault codes will cause the I/O Processor to shut down. While the RLGN may continue to operate normally and provide local display of data outputs of synchro format data, communications between the two RLGNs, input of GPS data, and all other input and output NTDS data messages will be halted. To restart the I/O Processor, proceed as follows:

NOTE

If the I/O Processor restart is successful, the "Enabled" message will change from flashing to non-flashing. If the restart is not successful, the "Enabled" message will continue flashing.

a. Clear the fault code(s).

b. Press the **<AUX FUNC>** key and select **I/O Restart**.

c. Set the I/O Processor to Enabled.

d. If the fault condition is cleared by restarting the I/O Processor, normal operation can be resumed. If the fault condition recurs, press the **<AUX FUNC>** key and select **I/O Config** (refer to Paragraph 2.4.2), disable all interface ports, and then select the **I/O Restart** function to enable the I/O Processor.

e. If the fault condition is cleared, enable each interface port (one at a time), and check operation to determine if the fault is in the I/O communications interface port or in an external device.

f. If the condition cannot be corrected by use of the above procedures, shut down the RLGN (refer to Paragraph 2.3.8) and restart in the off-line Test mode so that troubleshooting can be performed to isolate and correct the fault condition. (Refer to Chapter 5.)

2.3.7.9 Common RAM Test Pattern Faults (Codes 019 and 252). Communication between the Navigation Processor and the I/O Processor functions are periodically checked by the exchange of a test pattern through the common RAM on Dual Port Memory CCA (1A1A23). The test patterns are alternately written into the common memory by the I/O Processor and read by the Navigation Processor, or written by the Navigation Processor and read by the I/O Processor. If the Navigation Processor detects a pattern error, Fault Code 019 is announced. If the I/O Processor detects a pattern error, and I/O data transfer capability permits, Fault Code 252 is announced. A repeated occurrence of either of these fault codes may indicate a bit fault in the common RAM or intermittent cable problems. I/O communication problems may exist which will be confirmed by the occurrence of other I/O message-related fault codes.

2.3.7.10 Casualty Mode Faults (Codes 033, 100, 101, 102, 109, 188). The Casualty mode is defined as the occurrence of a fault that would normally cause system shutdown, but is not due to any processor error or condition that could prevent processor execution. If a fault occurs that sets the casualty mode bit, the Navigation Processor will continue to execute selected tasks to perform the Dead Reckoning function. Dead Reckoning computation is done using the operator-selected speed reference and the best available attitude data, which is RLGN attitude data when valid, or any gyrocompass data otherwise. Position data is not valid during Align/Calibrate or during operation in the Casualty mode. Output of attitude, velocity, and position will be provided from the Dead Reckoning function using input from external gyro heading and attitude reference and ship's speed references.

When RLGN position data is valid (RLGN operating in Navigation mode), the RLGN position is used to update the Dead Reckoning position as a slew every 1.024 minutes and manual position data or data from a selected position reference is not used to correct the Dead Reckoning position. When the RLGN position data is not valid (RLGN operating in Align/Calibrate or Casualty mode), manually entered position data and position data from a selected position reference will be used to correct the Dead Reckoning position with manual position data having priority.

2.3.7.10.1 Faults Causing Casualty Mode Detection. If a casualty fault condition is detected at system power-up, the system will start up in the Casualty mode. Detection of any of the following faults will result in automatic selection of Casualty mode operation:

1. **Fault Code 033**. Loss of lower unit (IMU) synchro reference; (115 VAC, 400 Hz from Inverter Assembly 1A1A2).

2. **Fault Code 100**. IMU Calibration Programmable Read-Only Memory (PROM) Checksum error at system start-up 1A1A32U13.

3. **Fault Code 101**. Navigation Processor has detected two consecutive input errors in data from IMU Processor [I/O Control (BITE) and Filter CCA (1A1A31)].

4. **Fault Code 102.** Gyro dither frequency error (any gyro).

5. **Fault Code 109.** IMU synchro (1X and 36X inner gimbal or 1X and 36X outer gimbal) angles disagree by more than 5 degrees.

6. **Fault Code 188.** Failure of IMU Processor to re-enter background processing [Assembly (1A1A31)].

2.3.8 TURNING OFF THE INS. To de-energize the AN/WSN-7(V), proceed as follows:

NOTE

System serial numbers are read from calibration [Electrically Erasable Programmable Read-Only Memory (EEPROM)] each time the system is turned on and are compared with previously stored values. If numbers are different [indicating that service has been performed that changed one of the calibrated Lowest Replaceable Units (LRUs)], the system automatically reverts to uncalibrated status and performs a 72-hour self-calibration. Refer to Figures 2-5 through 2-7. Default settings for operation are determined by selections set on the Operator Configuration menu in the Installation Configuration; refer to Figure 8-12. The system reverts to Kalman as the default for velocity damping during alignment.

a. Note any fault codes indicated on the Display.

b. On the RLGN, set the SYSTEM POWER switch to OFF. Observe that the POWER indicator extinguishes.

When the SYSTEM POWER switch is set to Off, the RLGN saves all valid data and menu settings in battery-backed RAM to be used when it is again turned on. These include:

Last position (latitude/longitude and Transverse latitude/longitude)

System self-calibration (72-hour calibration) values

Log Calibration Table values

Kalman filter calibration data

Installation configuration data

System serial numbers

c. On the RLGN, set the POWER, SYNCHRO REF, and VITAL REF circuit breakers to OFF.

d. If significant maintenance is to be performed on the RLGN and personal safety is a factor, secure 115 VAC 60 Hz and 115 VAC 400 Hz power to the RLGN at the ship's power panels, and tag out these breakers following standard tag-out procedures.

2.4 OPERATOR'S MAINTENANCE.

2.4.1 OFF-LINE TEST MODE. This mode is selected by turning off the RLGN and then setting the SYSTEM POWER switch to ON while the **<TEST>** key is held depressed. When Test mode is selected, the RLGN cannot be used for navigation. Selection of the Test mode, available menus and associated built-in test functions is covered in **Chapter 5**. Installation Menus selected via this mode are described in **Chapter 8**.

2.4.2 ON-LINE NTDS INTERFACE PORTS SELECTION AND CONFIGURATION. This function, selected from **AUX FUNC** menu, **I/O Config**, is similar to the off-line **I/O Bus Configuration** (refer to **Chapter 8**). Available menus allow the active status and operation parameters of the individual NTDS and Asynchronous Transfer Mode (ATM) input and output ports to be reconfigured during on-line operation. For an NTDS or ATM port to be reconfigured, the port must have been previously selected, as fitted in the off-line configuration. Changes to port configurations selected in the on-line I/O Config function are maintained in battery-backed memory when the system is turned off. The selected configuration settings are used when the system is again turned on.

2.4.2.1 NTDS Port Configuration Settings. The following listing outlines the selection and modification of each NTDS port configuration setting:

NOTE

The letter prefix on each port designation identifies the physical location of the NTDS I/O board that contains the port set. Refer to **Table 2-3**.

"_1" ports are NTDS Type D or Type E serial input or Type A or Type B parallel I/O or ATM I/O port.

"_2" ports are NTDS Type D or Type E serial output ports.

a. NTDS Port = (port designation). Step function selects port to be enabled/ disabled or reconfigured (up to 16 maximum available).

b. Page 1:

(1) Port nn = ENBL/DSBL. Enables or disables selected port. The options listed on Pages 1, 2, and 3 of the menu function allow specific message protocol and data fields to be selected or enabled for each fitted port, even if the port is selected as disabled.

(2) IDS = 00 through 31. The number displayed in this field is a code that indicates the NTDS Interface Design Specification (IDS) assigned to the port during system installation configuration. Data in this field cannot be changed from this on-line I/O Configuration mode. The number 00 in this field indicates that the selected port is not fitted. Refer to **Table 2-4** for the Port Specification and Type indicated by each IDS number. Refer to **Chapter 8** for the number listing of factory-configured I/O ports and settings.

(3) Retries = ENBL/DSBL. **(Applicable to IDS 08, 09, and 10)** If ENBL is selected, the I/O processor will repeat the output message one time if acknowledge is not received. If DSBL is selected, output message is transmitted only once.

(4) Secondary = ENBL/DSBL. **(Applicable to IDS 14 and 15)** For redundant I/O interface function, ENBL selected sets a message bit that identifies status of the selected port (and data) to the receiving equipment as secondary.

c. Page 2:

(1) Day = ENBL/DSBL. **(Applicable to IDS 11)** If ENBL is selected, allows the RLGN to transmit Julian Day data to the OU-174/WSN-5 Data Converter Group. If DSBL is selected, the RLGN will not transmit Julian Day data over this connection.

(2) P Sen Fmt = AR57A/AS130. **(Applicable to IDS 11)** This setting determines the format (AR57A or AS130) for transmitting position change senescence data to the OU-174/WSN-5 Data Converter Group.

(3) Forced External Function (EF) = ENBL/DSBL. **(Applicable to IDS 04, 08 and 11)** If receiving equipment does not implement an EIE line to indicate that it is ready to receive data, selecting ENBL causes the parallel output data message to be transmitted regardless of EIE status.

(4) Parity = ENBL/DSBL. **(Applicable to IDS 07, 09, and 10)** Enables or disables message parity bit checking protocol for serial output.

d. Page 3:

(1) Nav Msg = ENBL/DSBL. **(Applicable to IDS 04, 08, 09, and 10)** Enables or disables the Navigation Data Periodic message transmitted at 1 Hz in the output data.

(2) Precision = HIGH (NORM). **(Applicable to IDS 04, 07, 08, 09, and 10)** Sets position data in the Navigation Data Periodic message precision to high or normal precision.

(3) Attd Msg = ENBL/DSBL. **(Applicable to IDS 04, 08, 09, and 10)** Enables or disables the Attitude Data Periodic message output data.

(4) Msg Rate = 8 Hz (16 Hz). **(Applicable to IDS 04, 08, 09, and 10)** Changes transmit rate for Attitude Data message.

2.4.2.2 Super Channel Settings (Applicable to IDS 13)

a. Page 1:

(1) Port nn = ENBL/DSBL. Enables or disables selected port. The options listed on Pages 1, 2, and 3 of the menu function allow specific message protocol and data fields to be selected or enabled for each fitted port, even if the port is selected as disabled.

(2) IDS = 13. The number displayed in this field is a code that indicates the Super Channel IDS assigned to the port during system installation configuration. Data in this field cannot be changed from this on-line I/O Configuration mode. Refer to **Table 2-4** for the Port Specification and Type indicated by each IDS number. Refer to **Chapter 8** for the listing of factory-configured I/O ports and settings.

(3) Ext Fix = ENBL/DSBL. If ENBL is selected, allows RLGN to accept a fix from an external computer, other than GPS, over the Super Channel interface. If DSBL is selected, no external computer fixes will be accepted.

(4) GPS Fix = ENBL/DSBL. If ENBL is selected, allows RLGN to accept GPS fixes over the Super Channel interface. If DSBL is selected, no GPS fixes will be accepted.

b. Page 2:

(1) Rmt Cntrl = ENBL/DSBL. If ENBL is selected, allows the RLGN to accept Remote Control input over the Super Channel interface. If DSBL is selected, no Remote Control input will be accepted.

(2) Vref Input = ENBL/DSBL. If ENBL is selected, allows RLGN to accept reference velocities over the Super Channel interface. If DSBL is selected, velocity references will not be accepted over the Super Channel interface.

(3) Attd Data = ENBL/DSBL. If ENBL is selected, allows the RLGN to accept backup attitude data over the Super Channel interface. If DSBL is selected, no backup attitude data will be accepted over the Super Channel interface.

(4) Waypoint = ENBL/DSBL. This setting is currently not in use. Should be set to DSBL.

c. Page 3:

(1) Depth = ENBL/DSBL. This setting is not used on surface vessels. Should be set to DSBL.

(2) Fcn 8 = ENBL/DSBL. Reserved. Should be set to DSBL.

(3) Fcn 9 = ENBL/DSBL. Reserved. Should be set to DSBL.

(4) Fcn 10 = ENBL/DSBL. Reserved. Should be set to DSBL.

2.4.2.3 ATM Port Configuration Settings.

a. ATM Port = I. Step function selects port to be enabled/disabled or reconfigured.

b. Page 1:

(1) Port I = ENBL/DSBL. Enables or disables selected port. The options listed on Pages 1, 2, and 3 of the menu function allow specific message protocol and data fields to be selected or enabled for each fitted port, even if the port is selected as disabled.

(2) IDS = 16. Number displayed in this field is a code that indicates the ATM IDS assigned to the port during system installation configuration. Data in this field cannot be changed from this on-line I/O Configuration mode. The number 00 in this field indicates that the selected port is not fitted. Refer to **Table 2-4** for the Port Specification and Type indicated by each IDS number. Refer to **Chapter 8** for the listing of factory-configured I/O ports and settings.

(3) Ext Fix = ENBL/DSBL. If ENBL is selected, allows RLGN to accept a fix from an external computer, other than GPS, over the ATM interface. If DSBL is selected, no external computer fixes will be accepted.

(4) GPS Fix = ENBL/DSBL. If ENBL is selected, allows RLGN to accept GPS fixes over the ATM interface. If DSBL is selected, no GPS fixes will be accepted.

c. Page 2 :

(1) Fcn 3 = ENBL/DSBL. Reserved. Should be set to DSBL.

(2) Vref Input = ENBL/DSBL. If ENBL is selected, allows RLGN to accept reference velocities over the ATM interface. If DSBL is selected, velocity references will not be accepted over the ATM interfaces.

(3) Attd Data = ENBL/DSBL. If ENBL is selected, allows the RLGN to accept backup attitude data over the ATM interface. If DSBL is selected, no backup attitude data will be accepted over the ATM interface.

(4) Fcn 6 = ENBL/DSBL. Reserved. Should be set to DSBL.

d. Page 3:

(1) Depth = ENBL/DSBL. If ENBL is selected, allows RLGN to accept depth inputs via the ATM interface. If DSBL is selected, depth will not be accepted over the ATM interface.

(2) Battle Force Tactical Training (BFTT) Input = ENBL/DSBL. If ENBL is selected, RLGN will accept BFTT data over the ATM interface and will distribute simulated data to NTDS I/O as instructed by BFTT port selection. If DSBL is selected, RLGN will not accept BFTT simulated data. Users will only receive real data.

(3) Grav Grad = ENBL/DSBL. If ENBL is selected, RLGN will accept Gravity Gradient data for vertical deflection compensation over the ATM interface. If DSBL is selected, gravity gradient data will not be accepted over the ATM interface.

(4) Sea/Submarine Launched Cruise Missile (SLCM) Input = ENBL/DSBL. If ENBL is selected, RLGN will accept the SLCM enable/disable message over the ATM interface. SLCM enable/disable is applicable to submarine systems only.

2.4.3 ON-LINE LOG CALIBRATION. (Refer to **Figure 2-4**.) Like other configuration and calibration data, log bias data entered using the off-line functions associated with calibration of the Electromagnetic (EM) Log(s) is initially stored and maintained in EEPROM (KENV) on Status and Command CCA (**1A1A15**). Unless changed, the values (stored in two log bias calibration tables) are maintained as the backup values for initializing the system. Copies of this data are also stored in two log bias calibration tables, which are maintained in battery-backed RAM on Nav Processor CCA (**1A1A13**). The data maintained in the battery-backed RAM is used by the Navigation Processor to correct speed data received from the selected EM Log during operation. On-line functions allow the values stored in battery-backed RAM to be examined, cleared, or selectively changed using on-line log calibration functions.

2.4.3.1 Changing Log Bias Calibration Tables. Currently, two functions are available for changing the log bias calibration tables. These are a semi-automatic procedure and a fully automatic procedure.

2.4.3.1.1 Semi-Automatic Procedure. The semi-automatic Log Calibration procedure requires at-sea calibration runs, which prompt changes to ship's heading and speed. Correctly followed, this procedure generates log bias calibration values at four-knot increments for the selected EM Log. After being accepted, these values remain fixed and are used for calibrating input speed during all subsequent operation.

2.4.3.1.2 Fully Automatic Procedure. The fully automatic Log Calibration mode can be selected to continuously generate bias calibration values for the selected EM Log. This mode continuously changes the values stored in battery-backed RAM based on speed and heading data processed by the Kalman filter. Bias data is updated automatically and current data is used for calibrating input speed at any given time. Once a manual calibration has been accomplished as in **Paragraph 2.4.3.1.1**, then this is the preferred mode (refer to **Paragraph 2.4.5.2**).

2.4.3.1.3 Battery-Backed RAM. Whether the semi-automatic or the automatic Log Calibration procedure is used, if the system is turned off, values stored in battery-backed RAM are used when the system is again turned on. To ensure against loss of the bias values if the battery is removed (loss of 6 VDC to the battery-backed memory), the contents of the log bias calibration tables in battery-backed RAM can be transferred to the non-volatile EEPROM (KENV) (refer to **Paragraph 6.2**).

2.4.4 ON-LINE LOG CALIBRATION (SEMI-AUTOMATIC PROCEDURE). (Refer to **Figure 2-13**.)

NOTE

When performing this procedure, the system must be settled and damped with the EM Log to be calibrated selected as velocity input. During each calibration run, the ship must maintain a steady course at the calibration speed for at least four minutes; it must then perform a heading change between 80 and 280 degrees; and it must then maintain the new course at the calibration speed for at least four additional minutes. Up to 10 speed calibration bias values may be determined and stored by repeating this procedure.

This function, selected from **AUX FUNC menu Page 2, Log Cal**, is similar to the bias calibration selected from the off-line **Velocity Reference Devices** configuration (refer to **Chapter 8**). The difference is that menus are provided that prompt the sequence for entry of run speeds, time, and heading changes during the bias calibration procedure, and the system calculates the bias value for correcting the input data for each selected speed. This function operates independently of the Velocity Bias Calibration, which is used in the off-line System Configuration to manually enter calibration bias values for the EM Log(s). When Log Cal is selected and performed on-line, the on-line copy of the calibration bias tables for the selected EM Log (Rod 1 or Rod 2) velocity references can be changed.

2.4.4.1 Procedure. To perform the on-line Log Calibration, proceed as follows:

a. With either Rod 1 or Rod 2 selected as the Velocity Reference Device, press the **<AUX FUNC>** key.

b. Press the **<NEXT PAGE>** key until Page 2 is displayed.

c. Press the **<5>** key to select the Log Cal function.

d. When the ship has reached the first calibration run speed, manually enter the ship's current speed for the calibration run.

e. Maintain steady course at the selected speed, and press the **<ENTER>** key to start the measurement for the first phase of the calibration run.

f. After four minutes, the menu will prompt a heading change. Turn to a new heading at least 80 degrees (but less than 280 degrees) from the current heading.

g. When the ship is settled on the new heading, press the **<ENTER>** key to start the measurement for the second phase of the calibration run.

h. After four minutes, the menu will display the Log Bias for the calibration speed. At this point the bias value can either be accepted by pressing the **<ENTER>** key, or rejected by pressing the **<CLEAR>** key.

i. Repeat the calibration for up to 10 different speeds that incrementally cover the operating speed range of the ship.

NOTE

In the event that a calibration is performed on the EM Log, and the Bias potentiometers are adjusted, the AN/WSN-7(V) LogCal Biases need to be zeroed, or a new on-line EM Log calibration must be performed to maintain system performance.

2.4.4.2 System Damping. The system must be damped while the Log Calibration is collecting data. If the system is undamped upon entry, an alarm will be generated and the calibration will be aborted. If the system becomes undamped before phase two is started, an alarm will be generated and the calibrate function will wait until the system becomes damped before permitting phase two to be started. The system may go undamped before phase two begins due to the required maneuver. During on-line Log Calibration, an alarm will be generated and the calibration will be aborted if the operating parameters are outside certain limits. Conditions that will cause an alarm and abort the calibration could be any of the following:

1. Actual speed differs by more than two knots on the two legs.

2. Heading change not within the range of >80 and <280 degrees.

3. Heading change greater than 5 degrees during 4-minute period while calibration data is being taken.

4. More than 15 minutes elapsed between end of first measurement period and start of second measurement period.

2.4.5 ON-LINE LOG CALIBRATION (AUTOMATIC PROCEDURE). (Refer to **Figure 2-13**) This function, selected from **MODE menu, LogCal Mode**, generates EM Log bias calibration values by using the Kalman filter to process data from the selected speed sensor (Rod 1 or Rod 2). Calibration bias values generated by the online LogCal mode modify the speed calibration bias tables in battery-backed RAM. These values overwrite any values previously stored in the log bias calibration tables, including those generated using the semi-automatic LogCal function described in **Paragraphs 2.4.4**, **2.4.4.1**, and **2.4.4.2**.

2.4.5.1 Monitoring and Clearing Log Bias Values. (Refer to **Figure 2-13**) The log bias values for Rod 1 and Rod 2 currently stored in battery-backed RAM can be examined at any time by selecting **Show Biases ROD1(2)** functions on the **DISPLAY, page 2, Log Biases** menu. If it is determined that existing stored log bias values are grossly in error, all values in the log bias calibration tables can be independently cleared of all bias data by selecting the **Clear Biases ROD1(2)** functions.

2.4.5.2 LogCal Mode. Unlike the bias values that have been determined and entered in the calibration bias tables as a result of running planned maneuvering and speed calibration runs, the automatic LogCal mode continuously monitors ship's speed and heading. Using filtered values, the mode continuously updates the bias values for those speeds at which valid data samples are available. This log calibration mode provides the advantage that when the LogCal mode is selected, the bias calibration is optimized for the speeds at which the vessel most normally operates. The drawback is that log bias calibration values are not generated for speed ranges at which the vessel has not been operated during the time when the LogCal mode is selected. For this reason, it may be advisable to initially correct the log bias calibration values as near as practical for the full range of ship's speeds using off-line function for manual data entry or to perform the on-line semi-automatic procedure. The ship can then be successfully operated in the LogCal mode.

2.4.5.3 Maintaining Log Bias Values. The last stored log bias values generated by this mode are maintained in battery-backed RAM when the system is turned off or when the LogCal mode is selected Off. These values are used when the system is again turned on.

2.4.6 ON-LINE SYSTEM PERFORMANCE MONITOR FUNCTION. This function, selected from **AUX FUNC menu Page 3, Performance Monitor**, allows navigation performance to be monitored periodically while the system is operating on-line in a dynamic environment. The function provides menus for setting the length of time that the monitoring function is enabled, and for presenting calculated system performance parameters as a percentage of the specified performance.

2.4.6.1 Operation While Monitoring Performance. Running the Performance Monitor function does not affect the navigational performance of the system during the monitoring period; however, the first position fix after the Performance Monitor function is activated is applied as a position slew to update the system's position to the reference position. Additional position fix data received by the system during the time that the Performance Monitor function is active is only used for comparison with system-determined position and is not applied as a position fix update.

2.4.6.2 Conditions for Monitoring Performance. The Performance Monitor function is normally selected with the ship at dockside (DOCK ON) and the dockside position data is used as the performance comparison reference during the monitoring time. The Performance Monitoring function can also be selected while the ship is operating at sea, provided that the operating environment permits accurate position data to be received at least once every 10 minutes during the time that the Performance Monitor function is to be active. If position data is not received by the system within the time limit, the Performance Monitor function will automatically terminate and advisory **Fault Code 399** will be displayed.

2.4.7 TURNING ON THE PERFORMANCE MONITORING FUNCTION. Proceed as follows:

NOTE

Ensure that all external position sensors on Page 1 of the **SENSOR** menu are selected to OFF prior to turning on the performance monitoring function.

a. Press the **<AUX FUNC>** key.

b. Press the **<NEXT PAGE>** key until Page 3 is displayed.

c. Press the **<2>** key to select **Mon Perform**.

d. Press the **<2>** key to select **Monitor Data**.

e. When the Performance Monitor function is selected, make the following menu selections to start the monitoring mode:

(1) Select **AUX FUNC menu Page 3, Performance Monitor**. The display will change to Performance Monitor menu.

(2) Press the **<1>** key to select **MONITOR = ON**. The function will toggle ON only when the system is fully calibrated, aligned, and in damped Navigate mode, with a valid velocity reference selected. When the monitor function is turned on, a menu will be displayed which allows the operator to enter the length of time that the monitor function will run.

(3) **Length of Time to Monitor:** (1-336) HRS - Press the **<CLEAR>** key to clear time and then enter new value in the specified range.

f. After Length of Time has been entered, select **SENSOR menu Page 1** and select the position reference sensor. **DOCK ON, PDIG**, and **SLAVE** are the only choices indicated when the Position Monitor function is turned on. DOCK ON should be selected only when navigating at dockside.

CAUTION

If PDIG is used as the sensor and degrades beyond a Figure of Merit (FM)-03, then the performance monitoring function will be disabled.

g. To monitor system performance data, again select **AUX FUNC menu Page 3, Performance Monitor**. Then select **2 Monitor Data**. While the Performance Monitoring function is active, three pages of performance data with the following information are provided:

Page 1:

Monitor Start Time

Monitor Elapsed Time – Total time that Performance Monitor function has been running.

Page 2:

POS SOURCE – Indicates Position Source selected on **SENSOR** menu when the Performance Monitor function was initiated.

TRMS position error – Indicates the Time Root Mean Square (RMS) value of the position error, as calculated from the start time of the Performance Monitor function, as a percentage of a normalized system specification value. For an explanation of TRMS calculation method, refer to **Figure 2-14**.

Page 3:

RMS Velocity North – Indicates RMS value of the north/south velocity for the elapsed monitor period as a percentage of a normalized system specification value.

RMS Velocity East – Indicates RMS value of the east/west velocity for the elapsed monitor period as a percentage of a normalized system specification value.

NOTE

RMS Velocity will only be calculated for DOCK reference.

2.4.8 TURNING OFF THE PERFORMANCE MONITORING FUNCTION. The Performance Monitor function will end automatically when the selected elapsed time has been completed. To turn off the Performance Monitor function at any time, select **AUX FUNC menu, Page 3, Performance Monitor**, and set **MONITOR = OFF**. When the Performance Monitor function is terminated, the **MODE** function **Reset mode** selection defaults to **AUTO/REVIEW** (AUTO accept of reasonable position fixes and operator REVIEW of unreasonable position fixes) and the selected position reference remains valid. All further valid position fix data are applied to the system as position fixes.

2.4.9 PERFORMANCE MONITORING FAULT CODES. If the position reference becomes invalid or is not selected when the Performance Monitor function is selected, or if system performance is determined to be out of specification during running of the function, fault codes will be announced. These codes are Operator Advisory and do affect system operation. Possible fault codes are as follows:

- **Fault Code 395**. Position variance greater than normalized specification value.
- **Fault Code 396**. RMS East-West Velocity greater than normalized specification value.
- **Fault Code 397**. RMS North-South Velocity greater than normalized specification value.
- **Fault Code 398**. TRMS Position greater than normalized specification value.

- **Fault Code 399**. No Position Reference available.

2.4.10 ON-LINE ATTITUDE COMPARISON LIMIT AND FILTER TIME CONSTANT ADJUSTMENT. These functions, selected from **AUX FUNC menu, Page 1, Key 2** and **menu, Page 3, Key 1**, allow the operator to change the threshold and filter settings used for determining the difference allowed in attitude output between the two inertial navigators in a dual installation. These functions override the default settings selected at installation through the Operator Configuration Function Selections (refer to **Paragraph 8.7.4**). Values set on-line by the operator remain in effect only until the system is turned off. Whenever the system is turned off and is then restarted, the installation-selected values are restored as the default settings.

2.4.10.1 Purpose of Functions. These functions are provided so that the threshold can be changed to prevent false alarms from being announced as a result of the installation values being set at too tight a tolerance for current ship dynamics, such as during heavy weather conditions.

2.4.10.2 Operator Advisory Fault Codes. Due to flexing of the ship and different local dynamics resulting from mounting position with respect to the ship's heading, roll, and pitch axis, if the Attitude Comparison Threshold is set too low or if the Filter Time Constant is too short, attitude difference fault codes may be announced even though both inertial navigators are operating independently within specification. These codes are Operator Advisory and do not affect system operation. Possible fault codes are as follows:

- **Fault Code 384**: Heading; RLGN No. 1 and No. 2 disagree by greater than Attitude Comparison Threshold.
- **Fault Code 385**: Roll; RLGN No. 1 and No. 2 disagree by greater than Attitude Comparison Threshold.
- **Fault Code 386**: Pitch; RLGN No. 1 and No. 2 disagree by greater than Attitude Comparison Threshold.

2.4.11 DR DATA OUTPUT FUNCTION. The Dead Reckoning (DR) data output function is selected from **AUX FUNC menu, Page 3**. This function allows the operator to select either navigation system inertial data (NAV) (normal operation), or DR data as the output to data users. The inertial navigator defaults to NAV inertial data output whenever the system is turned on. This is the data output that normally remains selected.

Three menu control/display functions are provided. These functions allow the operator to:

1. View the current DR data and review its validity **(Display menu, Page 4, DR Data)**.
2. Select output of either NAV inertial data from the selected navigation system, or, select DR data output to users **(AUX FUNC menu, Page 3, NAV/DR Out)**.
3. Reset the DR position either to the navigation system position, or, to manually enter a DR position reset **(AUX FUNC menu, Page 3, DR Position Reset)**.

Depending on the system configuration, an external heading reference is input to the inertial navigator either directly as synchro heading from a gyrocompass, or, as digital (IDS 020) data from the Ship's Control System (SCS) via a NTDS Type B interface. When available, the external heading reference source is used to resolve the selected velocity for DR data calculation. Regardless of whether DR data is currently selected for output, the navigation system continually calculates DR data from the selected velocity resolved about the heading. If GPS is selected as the velocity reference (surface operation) then the DR is driven from the GPS V_n and V_e velocity.

When DR data is selected for output, heading, roll, and pitch outputs are passed through the navigation system from the external gyro source. If an external heading source is not available, the navigation system calculates DR data from the selected velocity resolved about its own inertial generated heading. Heading, roll, and pitch outputs will also be the inertial quantities. Since inertial attitude is not valid until the navigation system reaches ALIGN-C, DR data cannot be calculated under this condition until ALIGN-C is reached.

The first time that DR data is selected for output, an asterisk will be displayed on the DR Data function. This indicates that the DR position has not been initialized. If an asterisk is displayed at any time when DR Data output is selected, the operator must select the DR Position Reset function and initialize the DR position data. Once initialized, the DR data will remain valid until there is no valid heading reference (or loss of GPS input if GPS is the selected velocity reference). If DR data becomes invalid, an asterisk will again be displayed.

NOTE

During SLAVE align, the source of Vref from the system being slave aligned will always be V_n and V_e from the other system and not from EM Log resolved about heading.

2.4.12 VIEWING MEMORY CONTENTS. The contents of each memory location in the Navigation Processor can be inspected while the system is operating on-line. This function, selected from **AUX FUNC menu Page 2**, is incorporated into the operating program primarily to assist software development and has no operation or maintenance significance for the level of information addressed by this technical manual. To inspect Navigation Processor memory, proceed as follows:

NOTE

The contents of memory locations cannot be changed using this function.

a. Press the **<AUX FUNC>** key.

b. Press the **<NEXT PAGE>** key until Page 2 is displayed.

c. Press the **<6>** key to select **Mem Inspect**.

d. Follow menu prompts to select the memory type (16- or 32-bit).

e. Enter the address (in hexadecimal) of the first memory location to be inspected.

f. To step up or down sequentially through the memory address, press the **<NE+>** key or **<SW−>** key.

g. To change to a new starting address, press the **<CLEAR>** key, select the change address function, and enter a new starting address.

2.4.13 ON-LINE SIMULATED ATTITUDE, VELOCITY, AND POSITION OUTPUTS. The on-line Simulated Outputs function is similar to the off-line Simulated Outputs function described in **Chapter 5**. This function provides a means of generating static output data values from the RLGN while the unit is operating in a normal mode. This function is available for checking the operation of external systems that receive data from the RLGN. The simulated values are applied on all applicable configured synchro and digital I/O functions. When the Simulated Outputs function is selected, a status bit is set in all output NTDS messages and simulate relay 1K6 is set (energized) to indicate to the receiver that the data is simulated. To select and enable the simulated outputs functions, proceed as follows:

a. Press the **<AUX FUNC>** key.

b. Press the **<NEXT PAGE>** key until Page 3 is displayed.

c. Press the **<1>** key to select **Simulated Outputs**.

d. Observe that the Simulated Outputs Menu is displayed.

NOTE

This menu provides an enable/disable toggle function for the simulated outputs and provides three categories of menus which may be selected for setting the output data values. Displayed functions are:

- **Enable** Simulated Outputs = ON (or OFF)
- **Modify Attitude** Output
- **Modify Velocity** Output
- **Modify Position** Output

e. At the Simulated Outputs Menu, if Enable Simulated Outputs is set to OFF, press the **<1>** key to toggle the selection to ON.

f. Select the applicable category of operation functions the **<2>** key, **<3>** key, or **<4>** key.

g. When any category of operation functions is selected, a list of associated parameters will be displayed. To change the value of any parameter, press the number key corresponding to the number of the parameter. (The display will indicate the currently set data value for the parameter and the bottom line will display "ENTER to accept, CLEAR to reject.") To change the data, press the **<CLEAR>** key. (The data value will change to a data entry field to allow entry of a new value and the operator entry will be echoed directly into the field). After the new value has been entered, press the **<ENTER>** key.

Table 2-5 provides a brief outline of the simulated output settings associated with each of these functions.

Table 2-1. Keypad Control Functions

KEY	FUNCTION
Menu Selection keys consist of:	
MODE	Selects Page 1 of Mode Menu.
AUX FUNC	Selects Page 1 of Auxiliary Functions Menu.
SENSOR	Selects Page 1 of Sensor Menu.
DISPLAY	Selects Page 1 of Display Menu.
TEST	Selects Page 1 of Self-Test Functions Menu. (Functions only during power-up)
NEXT PAGE	Sequentially selects display of additional menu pages for each function.
Data Entry keys consist of:	
0 through 9	Selects numbered function on displayed menu and used to enter numeric data.
A through F	Alternate function reserved for entry of hexadecimal values. (Hexadecimal entry is not active in normal operating modes.)
CLEAR	Clears displayed or manually entered data without entering the value.
ENTER	Accepts displayed or manually entered data for entry into selected function.
BACK SPACE	Erases last entered numeric character for re-entry.
N/E+	Enter North (N) or East (E) for position or positive (+) for numeric values requiring sign.

Table 2-2. Operating Menus/Functions Description

PAGE	FUNCTION	BRIEF DESCRIPTION
NOTE In the following table, functions indicated with an asterisk (*) are displayed on the menu when Field Change 3 has been accomplished, but are not available for use until Field Change 4 has been accomplished. Items with a double asterisk (**) are displayed on the menu only if installation configuration settings indicate that the function is installed and is available for use. Refer to Chapter 8 for installation configuration setup. Items with a triple asterisk (***) are displayed on the menu only if Field Change 4 has been accomplished.		
SENSOR Functions SENSOR control functions are associated with selecting the alignment reference source upon startup, selecting and/or manually entering the position reference, and selecting and/or entering the speed and depth references. SENSOR control functions are presented and accessed via three display menu pages.		
Page 1 of the SENSOR menu provides control functions associated with selecting the RLGN alignment source.		
1	1. **DOCK**	**OFF**: Disables Dockside data as the position.

Table 2-1. Keypad Control Functions - Continued

KEY	FUNCTION
S/W–	Enter South (S) or West (W) for position or minus (-) for numeric values requiring sign.
Display Control keys consist of:	
TRACK/HOLD	Toggle on/off function used to freeze display of any continuously changing data which is selected for viewing.
BRIGHT	Increases display illumination.
DIM	Decreases display illumination.
ALARM ACK	Removes the fault code from the display and clears the Advisory Relay and the Malfunction Relay when a fault condition is detected.
The general procedure for key/menu operation is: 1. Press a Menu Selection key (MODE, AUX FUNC, SENSOR or DISPLAY) to select the menu with desired function. 2. If selected menu has more than one page, press the **<NEXT PAGE>** key to step through pages (page display sequence cycles back to Page 1 after last page is displayed). 3. When function is located, press the Number key corresponding to number beside function to select the function. 4. If data entry is required, either press the **<ENTER>** key to accept displayed value or press the **<CLEAR>** key to clear displayed value for entry of new value. 5. Enter value using Data Entry keys and press the **<ENTER>** key to accept value. Correct error during data entry using the **<CLEAR>** key or the **<BACK SPACE>** key.	

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
		ON: Enables Dockside data as the position and inputs zero velocity reference.
	2. **PDIG**	**OFF**: Disables GPS input (PDIG) (via dedicated NTDS interface), and allows data from an External Computer (selected NTDS interface data from port other than GPS interface) as the digital position sensor source. **ON**: Enables GPS input (PDIG) (via dedicated NTDS interface) as the digital position sensor source.
	3. **SLAVE**	**OFF**: Disables the second RLGN as the position reference for the first RLGN. **ON**: (after alignment of second RLGN): Enables the second RLGN as the position reference for the first RLGN. **ON**: (prior to alignment of second RLGN): Initiates at-sea alignment within the second RLGN.
	4. **BFTT OFF/ON***	**OFF**: Disables operator command to “quickly abort” transmission of BFTT Simulated data. **ON**: Enables operator command to “quickly abort” transmission of BFTT Simulated data.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
Page 2 of the SENSOR menu provides control functions associated with selecting the RLGN's velocity reference used to damp the velocity loop.		
2	1. **VMAN**	Displays current value set for manually entered ship's speed. **OFF**: Disables manual speed input to the navigation processor. **ON**: Enables manual entry or change of fore or aft speed value.
	2. **VSYN**	**OFF**: Disables a configured synchro velocity input to be selected as the speed data source. **ON**: Enables a configured synchro velocity input to be selected as the speed data source. **NOTE** If more than one synchro velocity source is available (e.g., Rod1 and Rod2 EM Log), it may be necessary to switch external equipment to provide the correct data to the RLGN synchro velocity input.
	3. **VDIG** **	**OFF**: Disables a configured, digital velocity input as the speed data source. **ON**: (INS configured for digital speed input via NTDS or ATM interface): Enables a configured, digital velocity input as the speed data source.
Page 3 of the SENSOR menu (normally configured only for submarine installations) provides control functions associated with selecting the depth sensor source and vertical velocity reference to be used.		
3	1. **DMAN** **	Displays current value set for manually entered ship's keel depth below the surface. **MAN OFF**: Disables the manual depth input to the navigation processor. **MAN ON**: Enables manual depth data input and change to the navigation processor.
	2. **DDIG** **	**OFF**: Disables depth data input from digital depth sensor for RLGNs configured to accept digital depth input. **ON**: Enables depth, data input from digital, depth sensor for RLGNs configured to accept digital depth input.
	3. **Vert**ical **Vel**ocity	**OFF**: Disables vertical velocity input on RLGNs configured for a three-axis, digital speed and depth input. Enables or disables the vertical velocity input. **ON**: Enables vertical velocity input on RLGNs configured for a three-axis, digital speed and depth input. Enables or disables the vertical velocity input. Horizontal velocity inputs are not affected.
Functions on Page 4 of the SENSOR menu are used for selecting a heading source and entering heading data during High Latitude ALIGN.		

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
4	1. **HMAN OFF/NORM/TXVS** ***	Operator may manually specify a normal or transverse coordinate heading. Used if no other heading source is available. Manual input of heading may be necessary during High Latitude ALIGN, if the backup compass is providing attitude data via synchro interface (no digital source of heading available) and the other RLGN is inoperative. Manual heading will be taken as a single heading measurement at the time of operator pressing **ENTER** key.
	2. **SINS2 OFF/ON** ***	Turn on if secondary RLGN is operative during High Latitude ALIGN. Status word in RLGN/RLGN interface indicates valid/invalid and normal/transverse.
	3. **HDIG OFF/ON** ***	Turn on during High Latitude ALIGN if external digital heading source is available. Status word in Super Channel interface indicates valid/invalid.
MODE Functions MODE control functions are associated with the position filter and navigation calculation modes. MODE control functions are presented and accessed via one display menu page. The MODE menu provides control functions associated with the position filter and navigation calculation modes.		
1	1. **Damping**	**Auto**: INS is automatically switched between damped and undamped operation depending upon reference velocity data validity and ship's dynamics, such as turn rate. **Man Damp**: When selected, system is forced to remain damped, regardless of velocity input or ship dynamics. Change to **Man Undamp** for undamped operation can only occur when manually selected. **Man Undamp**: When selected, system is forced to remain undamped. Change to **Man Damp** for manually damped operation can only occur when manually selected.
	2. **Fix**	Displays present **Fix Entry** and GMT. **ENTER**: Accepts present Fix values. **CLEAR**: Enables manual position fix data entry via the keypad. Position data is used to correct the INS estimate of position and to update the Kalman filter. Other Kalman filter parameters are not reset when fix is entered via this function.
	3. **Slew**	Displays present slew **Position Reference** and GMT. **ENTER**: Accepts Position Reference values. **CLEAR**: Enables manual position slew to be entered via the keypad. Position data is used to reset INS estimate of position only.
	4. **Norm/Txvs**	1. **System normal/transverse mode**: Provides three control function options for selecting Earth coordinates reference used to calculate position and heading.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
		AUTO: When selected, INS automatically switches between normal and transverse coordinates reference when normal coordinates latitude is approximately +85°. (Transverse mode should be used above 85°.) **MNORM**: When selected, INS remains in normal coordinates mode regardless of latitude. **MTXVS**: When selected, INS remains in transverse coordinates mode regardless of latitude. 2. **Synchro heading**: Provides three control function options for synchro heading output formats, which may be selected independently from **System normal/transverse mode**. **Follow system mode**: When selected, synchro heading output automatically provides transverse heading when the system is operating in transverse coordinates reference, and provides normal heading when the system is operating in normal reference mode. **Normal coordinates**: When selected, the synchro heading output is always displayed in normal coordinates regardless of whether the system is operating in transverse or in normal reference mode. **Txvs coordinates**: When selected, the synchro heading output is always displayed in transverse coordinates regardless of whether the system is operating in transverse or in normal reference mode.
	5. **Reset Mode**	Provides three control function options for accepting navigation aid position fixes. **Review**: Requires that the operator review fix data and either accept or reject each position fix. With this mode selected, when a position fix is received from the navigation aid, the operator is prompted by display of Code 221. The operator must then select the Reset Data function (**DISPLAY, Page 3, Reset Data**) to review the fix values. **Auto Review**: Similar to Review mode except that the INS automatically accepts valid fixes and allows the operator to review fixes that do not meet valid criteria. If the operator does not accept or reject the fix within 10 minutes, the fix data is discarded and the fix is rejected by the INS. **Auto**: INS automatically accepts or rejects each position fix from the navigation aid without prompting the operator to review the fix. Display of accepted, last rejected, or pending fix is available in the Reset data display.
	6. **LogCal Mode**	Provides two control function options for disabling and enabling Electromagnetic Logs (EM Logs). **Not Selected**: Disables automatic EM Log (Rod 1 or Rod 2) calibration during normal vessel operation. **Selected**: Enables automatic EM Log (Rod 1 or Rod 2) calibration during normal vessel operation. Also, the selected EM Log's calibration tables are automatically updated with Kalman filter bias calibration values.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
AUXiliary **FUNC**tions		
AUXiliary FUNCtions control functions are associated with changing configuration settings, displaying stored fault codes, performing display self-test, setting display update rate, selecting output of simulated position, heading, and velocity, calibrating the speed log data, monitoring system performance, and transferring waypoints. Changes to settings made using the AUX FUNC menus override defaults set by Installation Configuration as long as the AN/WSN-7(V) remains turned on. Except for changes made to speed log calibration tables, all selections return to installation defaults upon completion of the Normal Shutdown procedure. AUX FUNC control functions are presented and accessed via three display menu pages.		
Page 1 of the AUX FUNC menu provides control functions associated with the Remote Control Display Unit (RCDU), System Configuration, Faults, Indexers, I/O Configuration, and I/O Restart.		
1	1. **RCDU Lockout**	The RCDU Lockout control function is associated with controlling AN/WSN-7(V) operation from a separate control unit. **RCDU Locked =** **Yes**: Locks out interface port to CD-125/WSN-7 RCDU or IP-1747/WSN CDU so that the AN/WSN-7(V) can be controlled solely from its control/display. The CDU still works to collect data across the Super Channel. **No**: Enables interface port to CD-125/WSN-7 RCDU or IP-1747/WSN CDU so that the AN/WSN-7(V) can be controlled from the RCDU or CDU.
	2. **Sys**tem **Config**uration	**Sys**tem **Config**uration control functions are associated with velocity damping filters, mode functions menu configuration, attitude comparison, faults, Indexers, I/O configuration. These System Configuration control functions are presented and accessed via six display menu pages.
	(Page 1 of 6)	Sys Config (Page 1) is associated with setting system "Master" status and velocity damping filter control functions. Velocity damping filters are explained in Paragraph 2.3.5.3. 1. **This RLGN Master =** **No**: Disables the AN/WSN-7(V) as the Master system. **Yes**: Enables the AN/WSN-7(V) as the Master system and affects only a status word output in the NTDS interface messages. Does not affect system master/slave timing protocol as it relates to clock and position reset functions. 2. **Velocity damping =** **KALMAN**: Enables Kalman filter velocity damping. **THIRD ORDER**: Enables Third Order velocity damping. System must be in Navigate mode for Third Order to be selected.
	(Page 2 of 6)	Sys Config (Page 2) is associated with setting the control function options that the operator will be able to review and select via the Mode function menu's **Norm/Txvs** control function. 1. **Normal/Transverse =**

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
		AUTO/MANUAL: Enables and presents to the operator both the AUTO and the MANUAL control function options. **MANUAL ONLY**: Disables and replaces AUTO/MANUAL, and enables and presents the MANUAL ONLY control function option. 2. **Reset Mode =** **AUTO, AUTO/REVIEW, REVIEW**: Enables and presents to the operator all three **Reset Mode** control function options. **AUTO/REVIEW, REVIEW**: Enables and presents to the operator the **AUTO/REVIEW** and the **REVIEW** control function options only. **REVIEW**: Enables and presents to the operator the **REVIEW** control function option only.
	(Page 3 of 6)	Sys Config (Page 3) is associated with setting attitude comparison control function options. 1. **Att Comp Threshold**: On dual system installations, allows the alarm threshold setting for difference in attitude (heading, roll, and pitch) output to be set from the on-line menu to temporarily override the default value set at installation. 2. **Att Comp Filter Constant**: On dual system installations, allows the time constant setting, used by the system for determining the difference in attitude, to be set from the on-line menu to temporarily override the default value set at installation.
	(Page 4 of 6)	Sys Config (Page 4) is associated with setting the system Subnet Mask and Internet Protocol (IP) addresses. 1. Subnet Mask = xxx.xxx.xxx.xxx 2. IP Address = xxx.xxx.xxx.xxx
	(Page 5 of 6)	Sys Config (Page 5) is associated with setting the system ARP address. 1. ARP Address = xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
	(Page 6 of 6)	Sys Config (Page 6) is associated with setting the system NTP address. 1. NTP Address = xxx.xxx.xxx.xxx
	3. **Faults**	The Faults control function menu displays a list of active faults, which persist after pressing the **<ALARM ACK>** key to acknowledge the fault. The Faults control function is presented and accessed via one display menu page.
	4. **Indexers**	The Indexers control function menu is associated with inner and outer gimbal torquer settings. The Indexers control function is presented and accessed via one display menu page. Torquers are normally enabled and this function is not used during normal operation. Torquers can be enabled without removing system power in the event that they are automatically disabled as a result of detection of a fault in the torquer loop. 1. **Inner indexer**:

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
		On: Enables the inner (azimuth) torquer (**1A2A1A1B2**). **OFF**: Disables the inner (azimuth) torquer (**1A2A1A1B2**). 2. **Outer indexer**: **On**: Enables the outer (roll) torquer (**1A2A1A1B1**). **OFF**: Disables the outer (roll) torquer (**1A2A1A1B1**).
	5. **I/O Config**uration	The I/O Config control function menu is associated with NTDS/ATM, INS and DSVL digital I/O settings. These I/O Config control functions are presented and accessed via three display menu pages.
	(Page 1 of 3)	I/O Config Page 1, **I/O Port**, is associated with system, NTDS, digital I/O settings. NTDS ON/OFF – Allows the operator to select each NTDS, Super Channel, or ATM port, turn the port on or off, and selectively activate or deactivate message data fields. From I/O Config page 1, choose NTDS Super Channel, or ATM to edit I/O configuration settings. **NOTE** IDS configuration may be changed in Off-Line Test mode only. **The NTDS Configuration Settings control function menu** lists control function options on three display menu pages, which allow specific message protocol and data fields to be selected or enabled for each fitted port, even if the port is selected as disabled. **NOTE** The letter prefix on each port designation identifies the physical location of the NTDS I/O board that contains the port set. Refer to **Table 2-3**. a. NTDS Port = (port designation). Step function selects port to be enabled/disabled or reconfigured (up to 16 maximum available). b. **NTDS Port Configuration Settings, Page 1**: (1) Port nn = **DSBL**: Disables the selected NTDS port. **ENBL**: Enables the selected NTDS port. (2) IDS = Applicable to IDS 00 through 31. (3) Retries = Applicable to IDS 08, 09, and 10. **DSBL**: Disables I/O processor output message retries. Message is transmitted only once, even when acknowledgement is not received. **ENBL**: Enables the I/O processor output message to repeat once, if acknowledgement is not received. (4) Secondary = Applicable to IDS 14 and 15. **DSBL**: Disables a message bit setting that identifies the selected port's status and data to the receiving equipment as secondary when redundant I/O interface functionality is implemented.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
		ENBL: Enables a message bit setting that identifies the selected port's status and data to the receiving equipment as secondary when redundant I/O interface functionality is implemented. c. **NTDS Port Configuration Settings, Page 2**: (1) Day = ENBL/DSBL. (Applicable to IDS 11) If ENBL is selected, allows the RLGN to transmit Julian Day data to the OU-174/WSN-5 Data Converter Group. If DSBL is selected, the RLGN will not transmit Julian Day data over this connection. (2) P Sen Fmt = AR57A/AS130. (Applicable to IDS 11) This setting determines the format (AR57A or AS130) for transmitting position senescence data to the OU-174/WSN-5 Data Converter Group. (3) Forced EF = ENBL/DSBL. (Applicable to IDS 04, 08 and 11). If receiving equipment does not implement an EIE line to indicate that it is ready to receive data, selecting ENBL causes the parallel output data message to be transmitted regardless of EIE status. (4) Parity = ENBL/DSBL. (Applicable to IDS 07, 09 and 10). Enables or disables message parity bit checking protocol for serial output. d. **NTDS Port Configuration Settings, Page 3**: (1) Nav Msg = ENBL/DSBL. (Applicable to IDS 04, 08, 09, and 10). Enables or disables the Navigation Data Periodic message transmitted at 1 Hz in the output data. (2) Precision = HIGH (NORM). (Applicable to IDS 04, 07, 08, 09, 10). Sets position data in the Navigation Data Periodic message precision to high or normal precision. (3) Attd Msg = ENBL/DSBL. (Applicable to IDS 04, 08, 09, and 10). Enables or disables the Attitude Data Periodic message output data. (4) Msg Rate = 8 Hz (16 Hz). (Applicable to IDS 04, 08, 09, and 10). Changes transmit rate for Attitude Data message. **The Super Channel configuration settings control function menu** lists control function options on three display menu pages, which allow specific message protocol and data fields to be selected or enabled for each fitted port, even if the port is selected as disabled. a. **Super Channel Port Configuration Settings, Page 1:** (1) Port nn = ENBL/DSBL. Enables or disables selected port. The options listed on Pages 1, 2, and 3 of the menu function allow specific message protocol and data fields to be selected for each fitted port, even if the port is selected as disabled. (2) IDS = 13. The number displayed in this field is a code that indicates the Super Channel IDS assigned to the port during system installation configuration. Data in this field cannot be changed from this on-line I/O Configuration mode. Refer to **Table 2-4** for the Port Specification and Type indicated by each IDS number. Refer to **Chapter 8** for the listing of factory-configured I/O ports and settings.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
		(3) Ext Fix = ENBL/DSBL. If ENBL is selected, allows RLGN to accept a fix from an external computer, other than GPS, over the Super Channel interface. If DSBL is selected, no external computer fixes will be accepted. (4) GPS Fix = ENBL/DSBL. If ENBL is selected, allows RLGN to accept GPS fixes over the Super Channel interface. If DSBL is selected, no GPS fixes will be accepted. b. **Super Channel Port Configuration Settings, Page 2:** (1) Rmt Cntrl = ENBL/DSBL. If ENBL is selected, allows the RLGN to accept Remote Control input over the Super Channel interface. If DSBL is selected, no Remote Control input will be accepted. (2) Vref Input = ENBL/DSBL. If ENBL is selected, allows RLGN to accept reference velocities over the Super Channel interface. If DSBL is selected, velocity references will not be accepted over the Super Channel interface. (3) Attd Data = ENBL/DSBL. If ENBL is selected, allows the RLGN to accept backup attitude data over the Super Channel interface. If DSBL is selected, no backup attitude data will be accepted over the Super Channel interface. (4) Waypoint = ENBL/DSBL. This setting is currently not in use. Should be set to DSBL. c. **Super Channel Port Configuration Settings, Page 3:** (1) Depth = ENBL/DSBL. This setting is not used on surface vessels. Should be set to DSBL. (2) Fcn 8 = ENBL/DSBL. Reserved. Should be set to DSBL. (3) Fcn 9 = ENBL/DSBL. Reserved. Should be set to DSBL. (4) Fcn 10 = ENBL/DSBL. Reserved. Should be set to DSBL. **The ATM Port, configuration settings, control function menu** lists control function options on three display menu pages, which allow specific message protocol and data fields to be selected or enabled for each fitted port, even if the port is selected as disabled. a. ATM Port = I. Step function selects port to be enabled/disabled or reconfigured. b. **ATM Port Configuration Settings, Page 1**: (1) Port I = ENBL/DSBL. Enables or disables selected port. The options listed on Pages 1, 2, and 3 of the menu function allow specific message protocol and data fields to be selected or enabled for each fitted port, even if the port is selected as disabled. (2) IDS = 16. Number displayed in this field is a code which indicates the ATM Interface Design Specification (IDS) assigned to the port during system installation configuration. Data in this field cannot be changed from this on-line I/O Configuration mode. The number 00 in this field indicates that the selected port is not fitted. Refer to **Table 2-3** and **Table 2-4**.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
		(3) Ext Fix = ENBL/DSBL. If ENBL is selected, the RLGN will accept a fix from an external computer, other than GPS, over the ATM interface. If DSBL is selected, no external computer fixes will be accepted. (4) GPS Fix = ENBL/DSBL. If ENBL is selected, the RLGN will accept GPS fixes over the ATM interface. If DSBL is selected, no GPS fixes will be accepted. c. **ATM Port Configuration Settings, Page 2**: (1) Fcn 3 = ENBL/DSBL. Reserved. Should be set to DSBL. (2) Vref Input = ENBL/DSBL. If ENBL is selected, the RLGN will accept reference velocities over the ATM interface. If DSBL is selected, velocity references will not be accepted over the ATM interfaces. (3) Attd Data = ENBL/DSBL. If ENBL is selected, the RLGN will accept backup attitude data over the ATM interface. If DSBL is selected, no backup attitude data will be accepted over the ATM interface. (4) Fen 6 = ENBL/DSBL. Reserved. Should be set to DSBL. d. **ATM Port Configuration Settings, Page 3**: (1) Depth = ENBL/DSBL. If ENBL is selected, the RLGN will accept depth inputs via the ATM interface. If DSBL is selected, depth will not be accepted over the ATM interface. (2) BFTT Input = ENBL/DSBL. If ENBL is selected, the RLGN will accept BFTT data over the ATM interface and will distribute simulated data to NTDS I/O, as instructed by BFTT port selection. If DSBL is selected, RLGN will not accept BFTT simulated data. Users will only receive real data. (3) Grav Grad = ENBL/DSBL. If ENBL is selected, the RLGN will accept Gravity Gradient data for vertical deflection compensation over the ATM interface. If DSBL is selected, gravity gradient data will not be accepted over the ATM interface. (4) SLCM Input = ENBL/DSBL. If ENBL is selected, the RLGN will accept the SLCM enable/disable message over the ATM interface. SLCM enable/disable is applicable to submarine systems only.
	(Page 2 of 3)	I/O Config Page 2, **INS = ON/OFF**, is associated with INS to INS interfacing in dual AN/WSN-7(V) installations. **On**: Enables INS-INS interfacing. **Off**: Disables INS-INS interfacing.
	(Page 3 of 3)	I/O Config Page 3, **DSVL = ON/OFF**, is associated with navigation systems that interface with a DSVL. **On**: Enables the data port for DSVL interfacing. **Off**: Disables the data port for DSVL interfacing.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
	6. **I/O Restart**	The I/O Restart control function menu is associated with I/O and ATM processor settings. I/O Restart is used to enable an I/O or ATM Processor disabled by BITE when a fault condition is detected. This control function does not require INS power to be cycled for the processor to be enabled. This control function is enabled by default when the INS is turned on. **Enable**: Restarts (enables) I/O or ATM Processor operation without recycling power.
Page 2 of the AUXILIARY FUNC menu provides control functions associated with the Display Test, Display Rate, Display Normal/Txvs, KF Reinitialize, Log Calibration, and Memory Inspection.		
2	1. **Display Test**	The Display Test control function initiates a dynamic self-test of the display. Test continues until one of the display menu keys is pressed.
	2. **Display Rate**	The Display Rate control function selects display update rate. **1 Hz**: Updates display data once every second. **2 Hz**: Is the default rate, and updates display data once every two seconds.
	3. **Normal/Txvs**	The Display Normal/Txvs control function selects coordinates format for position and heading display. This function affects display format only and does not affect calculation mode. **Normal**: Renders coordinate format as **LAT** XXX.XX **N** and **LON** XXX.XX **W**. **Txvs**: Renders coordinate format as **TLT** XXX.XX **S** and **TLN** XXX.XX **W**.
	4. **KF Reinit**ialize	The KF Reinitialize control function is not used for normal INS operation. This control function should be used ONLY when INS performance is verified as outside of specification and when it is certain that Kalman Filter reinitialization will realign and restore INS attitude and position accuracy.
	5. **Log Cal**ibration	The Log Calibration control function presents an operator interface that enables data entry during a controlled calibration run. Refer to **Paragraphs 2.4.3**, **2.4.4**, and **2.4.5**.
	6. **Mem Inspt**	The Memory Inspection (Mem Inspt) control function enables the operator to observe the data values currently stored in memory. This function allows each memory address location to be selected and to be sequentially stepped up or down. This function is intended primarily as a software development tool.
Page 3 of the AUXILIARY FUNC menu provides control functions associated with Simulated Output, Monitor Performance, Auxiliary Panel, NAV/DR Out, Digital-to-Synchro (D/S) Test, and DR Reset.		

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
3	1. **Sim**ulated **Output**	The Simulated Output control function is associated with producing and transmitting simulated values. This menu lists control function options on four display menu pages, which allows the operator to select a simulation mode for system data output and to enter simulated values for heading, roll, pitch, position, and velocity on all outputs. Selection of this function and output of simulated values does not affect system operation. Digital data messages contain status bits which are set to indicate that output data is simulated. Relay K6 is set to provide indication that analog outputs are simulated when this mode is active. When this mode is exited, the system remains in the Simulate mode for a short period of time while system output parameters are being slewed back to correct values. When all values are reset, the system reverts automatically to normal output. a. Enable On/Off **On**: Enables simulated system data output, and enables the Modify Attitude, Modify Velocity, and Modify Position control functions to be selected and edited. **OFF**: Disables simulated system data output, and disables the Modify Attitude, Modify Velocity, and Modify Position control functions. b. **Modify Attitude** – Enable On/Off control function must be set to On to select and edit. (1) **Roll**: Displays and enables editing of current **Roll** data via the display keypad. (2) **Pitch**: Displays and enables editing of current **Pitch** data via the display keypad. c. **Modify Velocity** – Enable On/Off control function must be set to On to select and edit. (1) **VN**: Displays and enables editing of current Velocity North (**VN**) data via the display keypad. (2) **VE**: Displays and enables editing of current Velocity East (**VE**) data via the display keypad. d. **Modify Position** – Enable On/Off control function must be set to On to select and edit. (1) **Lat**: Displays and enables editing of current latitude (**Lat**) data via the display keypad. (2) **Lon**: Displays and enables editing of current longitude (**Lon**) data via the display keypad.
	2. **Mon**itor **Perform**ance	The Monitor Performance control function is associated with dynamic system performance testing while the system is operating in the Navigate mode. This menu lists control function options on two display menu pages.
	(Page 1 of 2)	1. **Monitor On/Off**: Presents the option to control the monitoring of the dynamic system performance test. **On**: Enables monitoring of dynamic system performance test.
		Off: Disables monitoring of dynamic system performance test.
	(Page 2 of 2)	2. **Monitor data**: Presents data monitoring options on three menu pages. **Page 1 – Monitor Start Time**: Displays dynamic system performance test start time and enables start time editing. **Page 1 – Monitor Elapsed Time**: Displays elapsed time since the dynamic system performance test's start time. **Page 2 – Position Sensor**: Displays position sensor source. **Page 2 – TRMS Position Error**: Displays TRMS position error data as a percentage of system performance specification. **Page 3 – RMS Vel North**: Displays Velocity North data as a percentage of system performance specification. **Page 3 – RMS Vel East**: Displays Velocity East data as a percentage of system performance specification.
	3. **Aux**iliary **Panel**	The Auxiliary Panel control function is associated with indicating when an IP-1747/WSN Control Display Unit (CDU) or Factory Interface Monitor (FIM) is installed and interfacing with the INS. **Monitor**: Indicates an IP-1747/WSN CDU is installed and is interfacing via the system's I/O interface port. **FIM**: Indicates an FIM is installed and is interfacing with the INS. This value may be toggled to Monitor, thereby forcing the system's I/O interface open and enabling CDU operation without requiring the INS power to be cycled.
	4. **NAV/DR Out**	The NAV/DR Output control function is associated with INS NAV and DR data output to users. **NAV**: (Default) Enables NAV inertial data to be output from the INS to users. **DR**: Disables NAV inertial data output, and enables DR data output from the INS to users.

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
	5. **D/S Test**	The D/S Test control function is associated with a short loop, on-line wraparound test of the digital synchro converters. a. **Periodic**: **On**: Enables the automatic testing of the D/S converters at periodic intervals. **Off**: Disables the automatic testing of the D/S converters at periodic intervals, and sets the test to be performed ONLY when the INS is started. b. **On Demand Test**: **On**: Enables manual testing of the D/S converters at any time. **Off**: Disables manual testing of the D/S converters.
	6. **DR Reset**	The DR Reset control function is associated with determining the validity of, and resetting, DR position values. If the DR data menu shows asterisks, the DR solution is invalid and the operator should enter this menu and reset the DR position. **Reset DR to Inertial**: Resets DR data to inertial position values. **Reset DR to Manual**: Enables DR latitude and longitude values to be manually entered.
DISPLAY Functions The Display Functions control functions are associated with INS parameters and output data, and their presentation for review. Output data available for review includes position, velocity, heading, and day/time information. Display control functions are presented and reviewed via five display menu pages. Select Display Functions by pressing the **<DISPLAY>** key. Select the menu page by pressing the **<NEXT PAGE>** key. Select the parameter to be displayed by pressing the number key corresponding to the number of the parameter.		
Page 1 of the DISPLAY functions menu provides control functions associated with velocity, roll, pitch, heading and depth.		
1	1. **V_n/V_e**	**V_n**: Displays the ship's North/South inertial velocity in Knots (KTS). **V_e**: Displays the ship's East/West inertial velocity in Knots (KTS).
	2. **Vfa/Vps**	**Vfa**: Displays the ship's fore/aft inertial velocity in Knots (KTS). **Vps**: Displays the ship's port/starboard (stbd) inertial velocity in Knots (KTS).
	3. **Roll/Rate**	**Roll**: Displays the ship's roll angle. **Rate**: Displays the ship's roll rate in Degrees per Second (°/SEC).
	4. **Pitch/Rate**	**Pitch**: Displays the ship's pitch angle. **Rate**: Displays the ship's pitch rate in Degrees per Second (°/SEC).
	5. **Hdg/Rate**	**Hdg**: Displays the ship's heading. **Rate**: Displays the ship's turn rate in Degrees per Second (°/SEC).
	6. **Depth ***	On INS configured with a selected depth input source, displays depth in Feet (FT).

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
Page 2 of the DISPLAY functions menu provides control functions associated with reference velocities, divergence values in heading, roll, and pitch, ship course, and log biases.		
2	1. **Ref V_n/V_e**	**Ref V_n**: Displays the ship's North/South components of the selected reference velocity in Knots (KTS). **Ref V_e**: Displays the ship's East/West components of the selected reference velocity in Knots (KTS).
	2. **Ref Vfa/Vps**	**Ref Vfa**: Displays the ship's fore/aft components of the selected reference velocity in Knots (KTS). **Ref Vps**: Displays the ship's port/starboard (stbd) components of the selected reference velocity in Knots (KTS).
	3. **Vk/Ref Vk**	**Vk**: Displays the vertical component of ship's velocity (Vk) in Knots (KTS). **Ref Vk**: Displays the selected reference velocity (Ref Vk) in Knots (KTS).
	4. **Divergence** (Page 1 of 2)	With dual INS installations, displays the difference between the heading, roll, and pitch values as determined by each navigation system. **Hdg**: Displays heading (Hdg) for each INS in minutes. **Roll**: Displays roll for each INS in minutes. **Pitch**: Displays pitch for each INS in minutes.
	(Page 2 of 2)	With dual INS installations, displays the difference between the position values as determined by each navigation system. **Lat**: Displays latitude (Lat) for each INS in minutes. **Lon**: Displays longitude (Lon) for each INS in minutes.
	5. **Course**	Displays ship's present direction of motion without regard to ship's heading. Display range 0.00° to 359.99°.
	6. **Log Biases**	Displays up to ten log biases at speed values for Rod 1 and Rod 2 speed sources. **Clear Biases Rod 1**: Enables the operator to erase Rod 1's bias values as stored in memory. **Show Biases Rod 1**: Enables the operator to review Rod 1's bias values as stored in memory. **Clear Biases Rod 2**: Enables the operator to erase Rod 2's bias values as stored in memory. **Show Biases Rod 2**: Enables the operator to review Rod 2's bias values as stored in memory.
Page 3 of the DISPLAY functions menu provides control functions associated with position and velocity variance and divergence, ocean current velocities, reset data and RLGN designation.		

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
3	1. **Sigma N/E**	Displays position variance estimates.
		Sigma N: Displays 1-sigma estimate for North (N) velocity in Nautical Miles (NM).
		Sigma E: Displays 1-sigma estimate for East (E) velocity in Nautical Miles (NM).
		RPE: Displays 1-sigma estimate for Radial Position errors (RPE) in Nautical Miles (NM).
	2. **Sigma $V_n/_e$**	Displays velocity variance estimates.
		Sigma V_n: Displays 1-sigma estimate for North (N) velocity in Knots (KTS).
		Sigma V_e: Displays 1-sigma estimate for East (E) velocity in Knots (KTS).
	3. **DVn/DVe**	Displays the difference between INS inertial velocity and selected reference velocity.
		DVn: Displays the difference between North (n) INS inertial velocity and selected reference velocity in Knots (KTS).
		DVe: Displays the difference between East (e) INS inertial velocity and selected reference velocity in Knots (KTS).
	4. **OCn/OCe**	Displays the estimated ocean currents velocities. Displayed values are only true if a water speed velocity reference is selected.
		OCn: Displays the estimated North (n) ocean currents velocities in Knots (KTS).
		OCe: Displays the estimated East (e) ocean currents velocities in Knots (KTS).
	5. **Reset Data**	Displays the last received fix values to allow the operator to review the fix data. This menu should be selected by the operator to review the fix data to be within acceptable limits prior to accepting or rejecting the fix, when either Review or Auto/Review is selected for entry of fix reset data.
		FixLAT: Displays the last received Latitude (LAT) fix value to allow the operator to review, and accept or reject the fix data.
		FixLON: Displays the last received Longitude (LON) fix value to allow the operator to review, and accept or reject the fix data.
		FSN: Displays the last received FSN fix value to allow the operator to review, and accept or reject the fix data.
		FSE: Displays the last received FSE fix value to allow the operator to review, and accept or reject the fix data.
		GPS: Displays the last received Global Positioning System (GPS) fix value to allow the operator to review, and accept or reject the fix data.
	6. **RLGN Designation**	Displays the RLGN's designation when part of a dual RLGN INS without requiring the RLGN to be shut down and restarted in Test mode. The RLGN designation is used by some IDS users.
		This RLGN 1: Identifies the RLGN as number 1 in a dual RLGN INS.
		This RLGN 2: Identifies the RLGN as number 2 in a dual RLGN INS.
Page 4 of the DISPLAY functions menu provides control functions associated with date/time settings, system part identification numbers, accelerometer and gyro bias data, DR data, and BFTT data.		
4	l. **Day/Time**	Displays and allows the date and time to be edited.
		Day: Displays the Julian day and time and allows values to be changed.
		Time: Displays the time in military 24-hour format.
	2. Part No.	This control function displays six menu pages containing: serial numbers and information for the RLGN and its sensor block components and assemblies; part numbers and revision numbers for RLGN programs; vendor ID numbers; and network information.
	(Page 1 of 6)	Presents Accelerometer identification information.
		A Accel SN: Displays the A Accelerometer's serial number.
		B Accel SN: Displays the B Accelerometer's serial number.
		C Accel SN: Displays the C Accelerometer's serial number.
	(Page 2 of 6)	Presents Gyro identification information.
		A Gyro SN: Displays the A Gyro's serial number.
		B Gyro SN: Displays the B Gyro's serial number.
		C Gyro SN: Displays the C Gyro's serial number.
	(Page 3 of 6)	Presents INS identification information.
		Platform SN: Displays the RLGN's platform serial number.
		Sensor Block SN: Displays the RLGN's IMU sensor block serial number.
		Serial Number AN/WSN-7(V): Displays the RLGN's serial number.
	(Page 4 of 6)	Presents processor and IMU program identification information.
		Nav Prog PN: Displays the Nav Processor's program part number.
		IMU Prog PN: Displays the IMU program part number.
		IO Program PN: Displays the IO Processor's program part number.
	(Page 5 of 6)	Presents ATM program and Peripheral Component Interface (PCI) identification information.
		ATM Prog PN
		PCI Vendor ID
		PCI Device ID
		PCI Class Code

Table 2-2. Operating Menus/Functions Description - Continued

PAGE	FUNCTION	BRIEF DESCRIPTION
	(Page 6 of 6)	Presents PCI subsystem and Media Access Control (MAC) address identification information.
		PCI Subsystem Vendor
		PCI Subsystem ID
		MAC Address
	3. **Accel**erometer **Bias**	Displays accelerometer bias estimates.
		A Accel °/Hr: Displays A accelerometer (Accel) bias estimates in micro gravities within a range of plus or minus (±) 9999 micro-g.
		B Accel °/Hr: Displays B accelerometer (Accel) bias estimates in micro gravities within a range of plus or minus (±) 9999 micro-g.
		C Accel °/Hr: Displays C accelerometer (Accel) bias estimates in micro gravities within a range of plus or minus (±) 9999 micro-g.
	4. **Gyro Bias**	Displays gyro bias estimates:
		A Gyro °/Hr: Displays A Gyro bias estimates in degrees within a range of plus or minus (±) 2.1333°/hour.
		B Gyro °/Hr: Displays B Gyro bias estimates in degrees within a range of plus or minus (±) 2.1333°/hour.
		C Gyro °/Hr: Displays C Gyro bias estimates in micro gravities within a range of plus or minus (±) 2.1333°/hour.
	5. **DR Data**	This on-line menu displays the DR data as calculated by the RLGN. This data includes latitude, longitude, total velocity and heading. The selection of output data (inertial or DR) has no effect on this display. If the DR data display shows asterisks, it indicates that the DR solution is invalid. The DR solution can become invalid, for example, if the DR position hasn't been initialized or heading reference is temporarily lost. A DR position reset is required. Once a DR reset is commanded, the DR data values will no longer be asterisks (assuming heading reference is not lost). (See AUXiliary FUNctions, Page 3, DR Reset.)
		LAT: Displays the DR latitude (LAT) calculated by the RLGN.
		LON: Displays the DR longitude (LON) calculated by the RLGN.
		V_t: Displays the DR total velocity (VT) calculated by the RLGN.
		HDG°: Displays the DR heading (HDG) calculated by the RLGN.
	6. **BFTT Data***	When the RLGN is in BFTT mode, displays the BFTT Simulated data being transmitted.
Page 5 of the DISPLAY functions menu provides control functions associated with Grid coordinates and Laser Intensity Monitor (LIM) Voltage.		
5	1. **Grid N/E*** **	**Grid = °/S**
		Grid = °/W
	2. **LIM Volts*** **	The LIM volts control function menu displays the LIM voltage for the A, B, and C gyro in an RLGN.
		A = Displays the LIM value for A gyro in volts (V). A LIM value greater than +1.1 volts indicate that the A gyro is within acceptable operating specification.
		B = Displays the LIM value for the B gyro in volts (V). A LIM value greater than +1.1 volts indicate that the B gyro is within acceptable operating specification.
		C = Displays the LIM value for the C gyro in volts (V). A LIM value greater than +1.1 volts indicate that the C gyro is within acceptable operating specification.

Table 2-3. Identification of Port Type and Physical Location

PORT SET	CCA LOCATION	RECORD BOARD TYPES AND IDS CODES INSTALLED (IN THIS SYSTEM)	
		NTDS I/O BOARD TYPE	IDS CODE
Part Number 1981101-6 AN/WSN-7(V)1			
A1/A2	(**1A1A51**)	Type E (Serial)	
B1/B2	(**1A1A52**)	Type E (Serial)	
C1/C2	(**1A1A53**)	Type E (Serial)	
D1/D2	(**1A1A54**)	Type E (Serial)	
E1/E2	(**1A1A55**)	Type D (Serial)	
F1/F2	(**1A1A56**)	Type A (Parallel)	
G1/G2	(**1A1A57**)	Type A (Parallel)	
H1/H2	(**1A1A58**)	Type A (Parallel)	
I1/I2	(**1A1A4**)	ATM	16

Table 2-3. Identification of Port Type and Physical Location - Continued

PORT SET	CCA LOCATION	RECORD BOARD TYPES AND IDS CODES INSTALLED (IN THIS SYSTEM)	
		NTDS I/O BOARD TYPE	IDS CODE
Part Number 1981101-2 AN/WSN-7(V)2			
A1/A2	(**1A1A51**)	Type E (Serial)	
B1/B2	(**1A1A52**)	Type A (Parallel)	
C1/C2	(**1A1A53**)	Type E (Serial)	
D1/D2	(**1A1A54**)	Type D (Serial)	
E1/E2	(**1A1A55**)	Type A (Parallel)	
F1/F2	(**1A1A56**)	Type A (Parallel)	
G1/G2	(**1A1A57**)	Type A (Parallel)	
H1/H2	(**1A1A58**)	Type A (Parallel)	
I1/I2	(**1A1A4**)	ATM	16

Table 2-4. Identification of NTDS Port Interface Design Specification

IDS CODE	NTDS TYPE	DIRECTION	SPECIFICATION
00	-	-	Not fitted
01	A	Input/Output	NAVSEA SE174-AB-IDS-010/GPS
02[1]	B	Input/Output	NAVSEA SE174-AB-IDS-010/GPS
03	A	Input/Output	T9427-AN-IDS-050/WSN-7
04	A	Input/Output	S9427-AN-IDS-070/WSN-7
05[1]	B	Input/Output	S9427-AP-IDS-010/RLGN
06[1]	B	Output	S9427-AP-IDS-020/RLGN
07	D	Input/Output	S9427-AN-IDS-030/WSN-7

1 IDS Code applies only to submarine installations.

Table 2-5. Simulated Outputs Description

SIMULATED FUNCTION	DESCRIPTION	ENTRY RANGE
2 Modify Attitude Output Functions (Select by pressing the **<2>** key)		
1 Roll	Sets a positive or negative roll angle, which is output from Synchro Buffer Amplifier 8 VA (**1A1A41**).	-45 to +44.99 degrees

Table 2-3. Identification of Port Type and Physical Location - Continued

PORT SET	CCA LOCATION	RECORD BOARD TYPES AND IDS CODES INSTALLED (IN THIS SYSTEM)	
		NTDS I/O BOARD TYPE	IDS CODE
Part Number 1981101-3 AN/WSN-7(V)3			
A1/A2	(**1A1A51**)	Type E (Serial)	
B1/B2	(**1A1A52**)	Type A (Parallel)	
C1/C2	(**1A1A53**)	Type A (Parallel)	
D1/D2	(**1A1A54**)	Type A (Parallel)	
E1/E2	(**1A1A55**)	Type A (Parallel)	
F1/F2	(**1A1A56**)	Type A (Parallel)	
G1/G2	(**1A1A57**)	Type A (Parallel)	
H1/H2	(**1A1A58**)	Type A (Parallel)	
I1/I2	(**1A1A4**)	ATM	16

Table 2-4. Identification of NTDS Port Interface Design Specification - Continued

IDS CODE	NTDS TYPE	DIRECTION	SPECIFICATION
08	A	Output	S9427-AN-IDS-040/WSN-7
09	E	Output	S9427-AN-IDS-020/WSN-7
10	E	Input/Output	S9427-AN-IDS-020/WSN-7
11	A	Output	T9427-AN-IDS-060/WSN-7
12	-	-	(Reserved)
13	E	Input/Output	S9427-AN-IDS-010/WSN-7 (Super Channel)
14[1]	B	Input/Output	S9427-AP-IDS-030/RLGN
15[1]	B	Input/Output	S9427-AP-IDS-040/RLGN
16	ATM	Input/Output	S9427-AN-IDS-080/WSN-7
17-31	-	-	(Reserved)

Table 2-5. Simulated Outputs Description - Continued

SIMULATED FUNCTION	DESCRIPTION	ENTRY RANGE
2 Pitch	Sets a positive or negative pitch angle, which is output from Synchro Buffer Amplifier 8 VA (**1A1A42**).	-45 to +44.99 degrees
3 Heading	Sets a heading angle, which is output from Synchro Buffer Amplifiers 32 VA (**1A1A43**) and 32 VA (**1A1A44**).	0 to 359.99 degrees

Table 2-5. Simulated Outputs Description - Continued

SIMULATED FUNCTION	DESCRIPTION	ENTRY RANGE
3 Modify Velocity Output Functions (Select by pressing the **<3>** key)		
1 Vel N (North Velocity)	Sets a north/south velocity value, which is output from Synchro Converter CCA (**1A1A38**) (in synchro data format) and in all applicable NTDS output data messages.	-128 to +127.99 knots
2 Vel E (East Velocity)	Sets an east/west velocity value, which is output from Synchro Converter CCA (**1A1A38**) (in synchro data format) and in all applicable NTDS output data messages.	-128 to +127.99 knots
4 Modify Position Output Functions (Select by pressing the **<4>** key)When entering latitude and longitude, the N/S field is set with the **<NE+>** key or **<SW−>** key.		
1 Latitude	Sets a latitude value, which is output in all applicable NTDS output data messages.	0 to 90 degrees 0 to 59.99 minutes
2 Longitude	Sets a longitude value, which is output in all applicable NTDS output data messages.	0 to 180 degrees 0 to 59.99 minutes

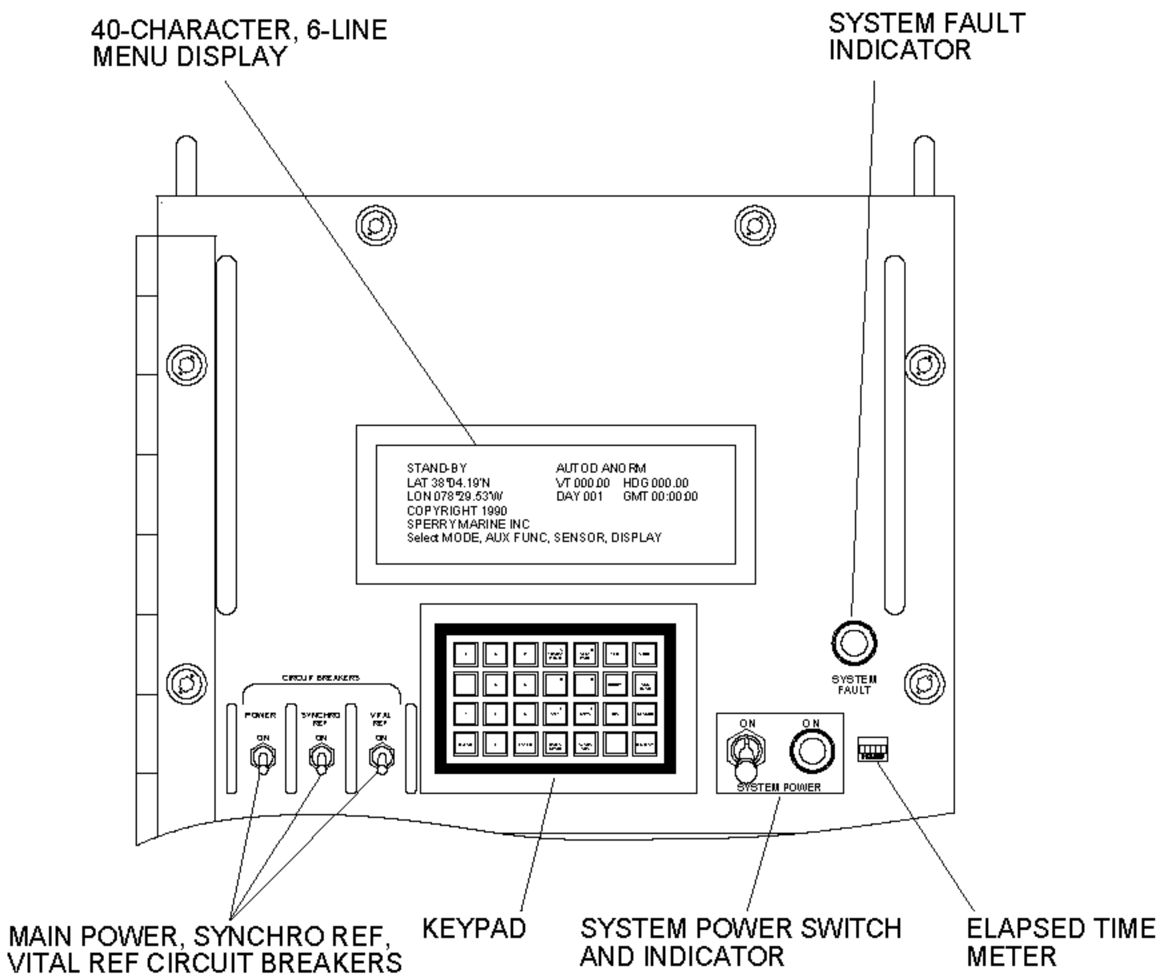


Figure 2-1. Front Panel Controls and Indicators

7	8	9	A TRACK/ HOLD	B NEXT PAGE	TEST	MODE
4	5	6	C	D	BRIGHT	AUX FUNC
1	2	3	E N/E/+	F S/W/ -	DIM	SENSOR
CLEAR	0	ENTER	BACK SPACE	ALARM ACK		DISPLAY

Figure 2-2. Keypad Controls

(MODE) (NAV AID) (VEL REF) (DAMPING) (COORD) (FAULT)
LAT 00°00.00'N VT 000.00 HDG 000.00°
LON 000°00.00'W DAY 001 GMT 00:00:00
(variable depending on menu and page)
(variable depending on menu and page)
(variable depending on menu and page)

POSSIBLE INDICATIONS DISPLAYED ON FRONT PANEL

(MODE)	(NAV AID)	(VEL REF)	(DAMPING)	(COORD)	(FAULT)
STANDBY	DOCK	VMAN	AUTOU	ANORM	(See Appendix B)
ALIGN	SLAVE (2)	ROD1 (2)	AUTOD	ATXVS	
ALIGN-C	PDIG (2)	ROD2 (2)	MANU	MNORM	
ALIGN-F	Other (2)	VGPS (2)	MAND	MTXVS	
NAV-C	BFTT	VDSVL (2)			
NAVIGATE		VNVE (2)			
CASUALTY		DUMMY (2)			
SHUTDOWN					
TEST (1)					
BFTT-D (BFTT Mode Dockside)					
BFTT-S (BFTT Mode At-Sea)					
SIMOUT					

LAT=Latitude
LON=Longitude
VT=Velocity
DAY=Day Number in the Year
HDG=Ship's Heading
GMT=Greenwich Mean Time
BLT (3)=BFTT Simulated Latitude
BLN (3)=BFTT Simulated Longitude
BVT (3)=BFTT Simulated Velocity (Dockside only)
BHD (3)=BFTT Simulated Heading (Dockside only)

1. TEST is displayed only when the RLGN is turned on in TEST Mode. Refer to Chapter 5.
2. Displayed Navigation Aids based on INS installation configuration.
3. These values replace LAT, LON, VT, and HDG when in BFTT Mode.

Figure 2-3. Menu Status/Mode Indications

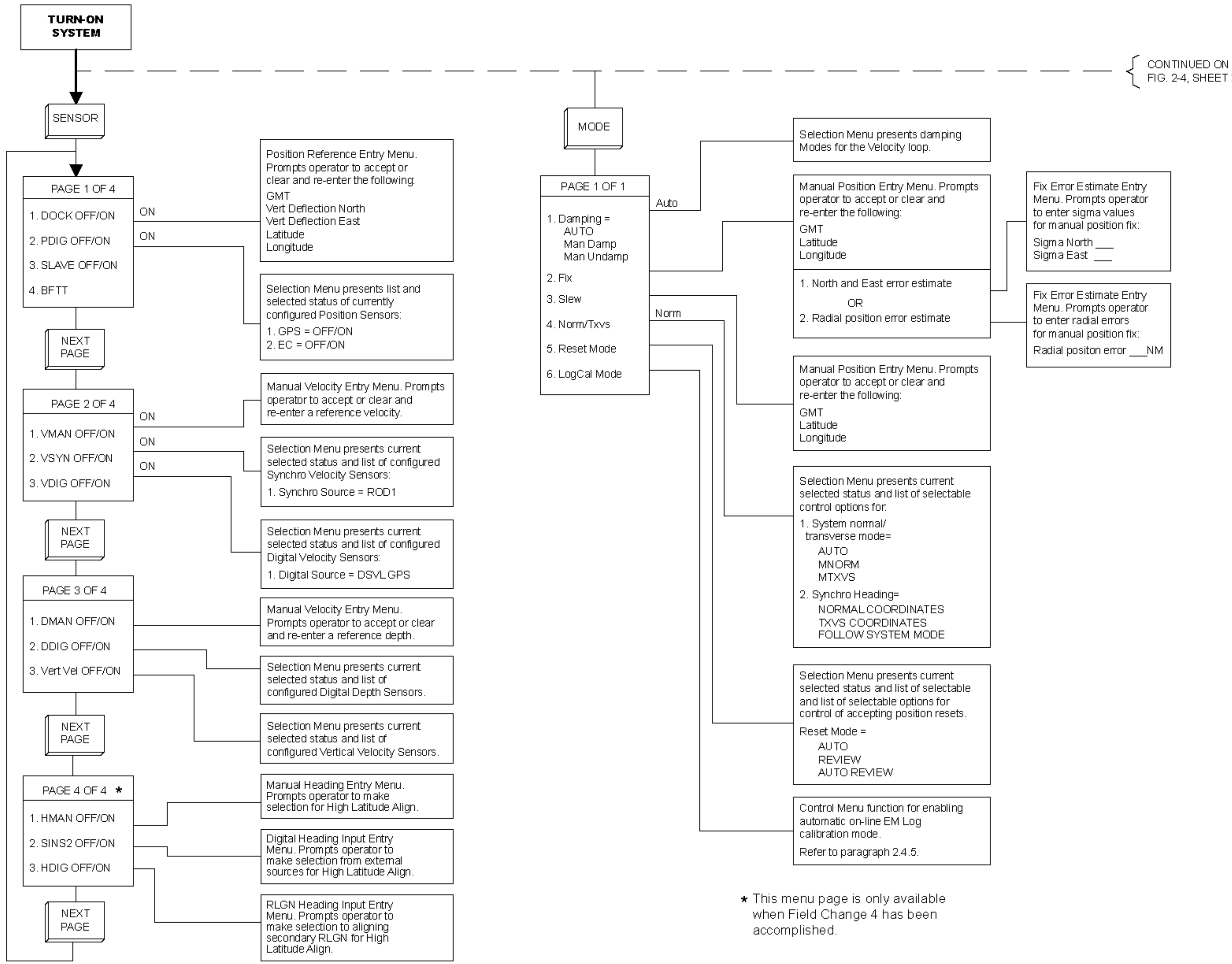


Figure 2-4. Identifying Operation Menus and Data Entry (Sheet 1 of 2)

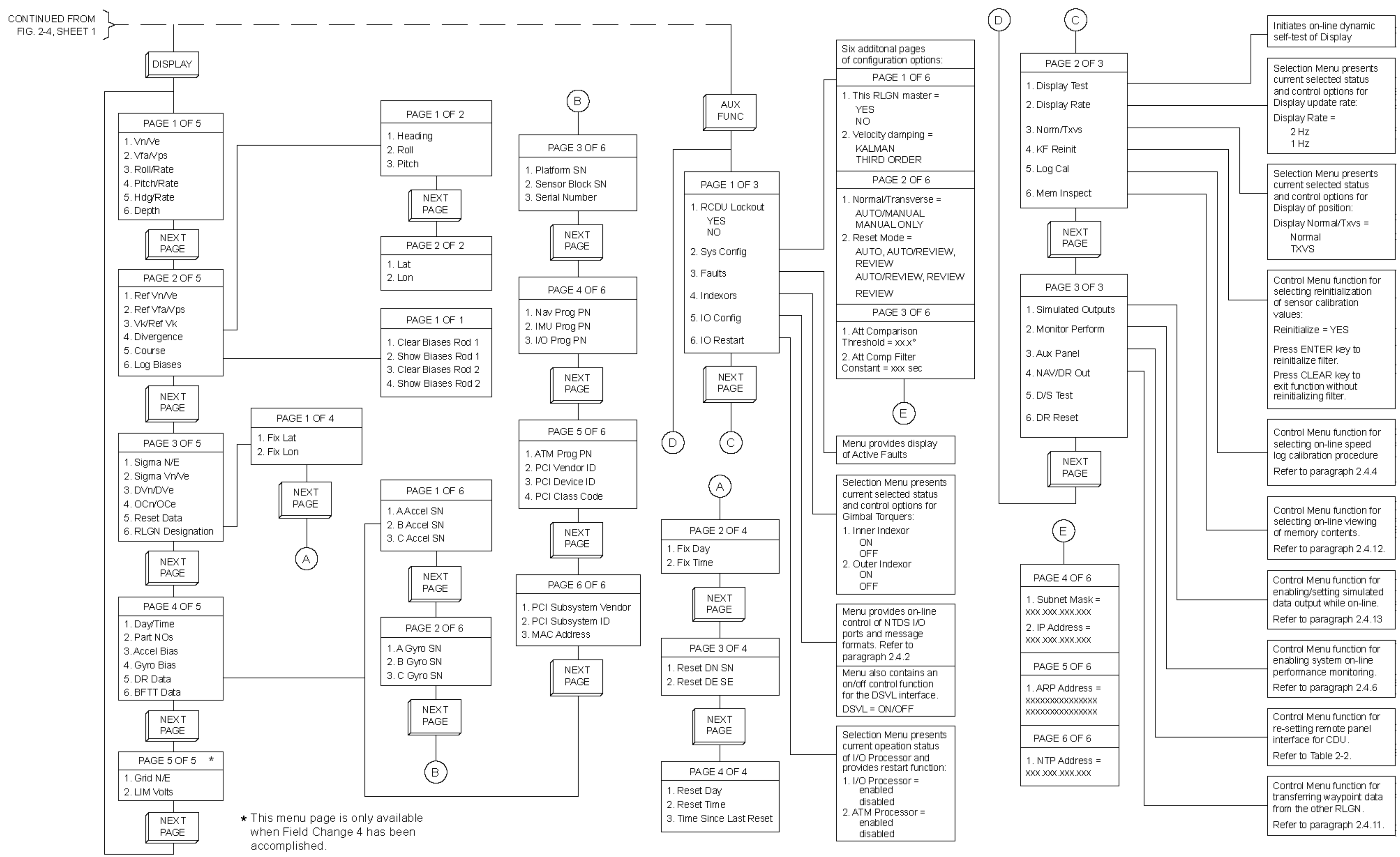
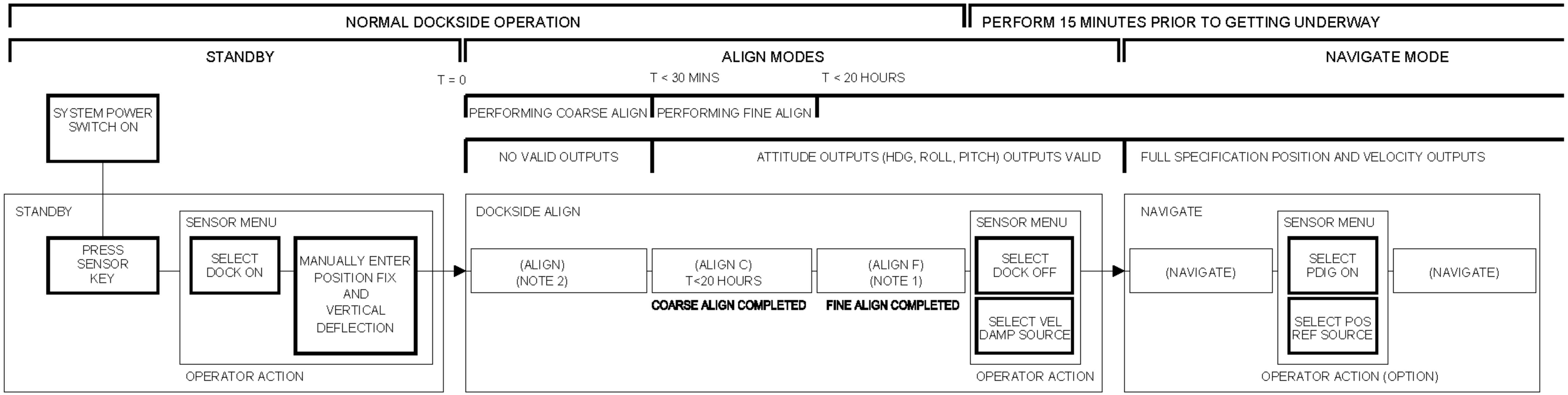
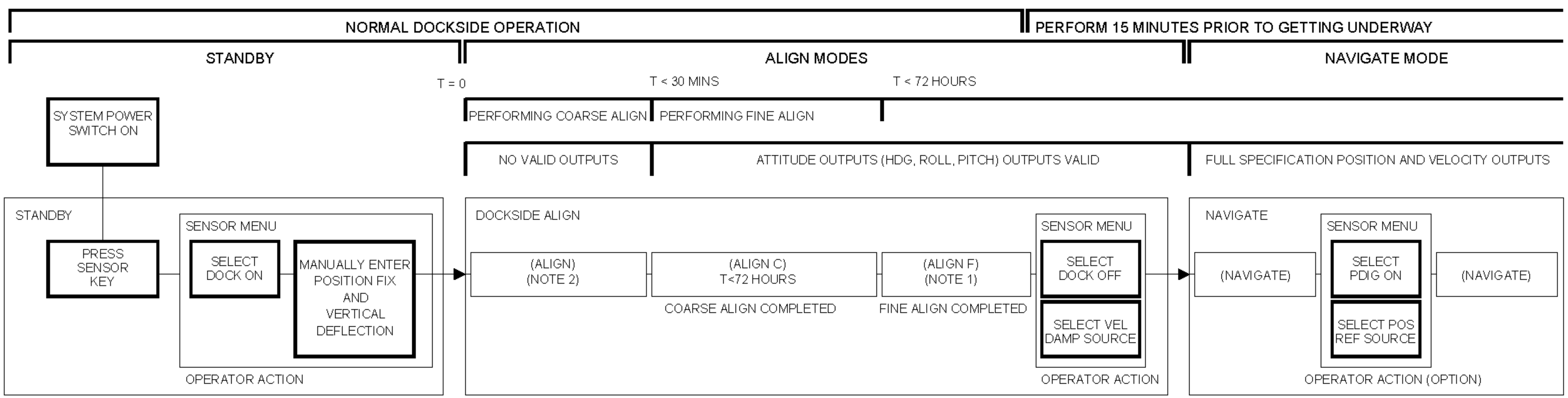


Figure 2-4. Identifying Operation Menus and Data Entry (Sheet 2 of 2)



DOCKSIDE ALIGN (PREVIOUSLY CALIBRATED SYSTEM)



DOCKSIDE ALIGN/CALIBRATION (NON-CALIBRATED SYSTEM)

NOTES:

1. SYSTEM REMAINS IN DOCKSIDE ALIGN-F UNTIL NAVIGATE SELECTED BY OPERATOR ACTION.
2. TIME THAT ALIGN MODE IS ACTIVE IS DEPENDENT ON WHETHER OR NOT SYSTEM HAS BEEN PREVIOUSLY CALIBRATED AND ON SHIP'S LATITUDE.

Figure 2-5. Dockside Align Settle States

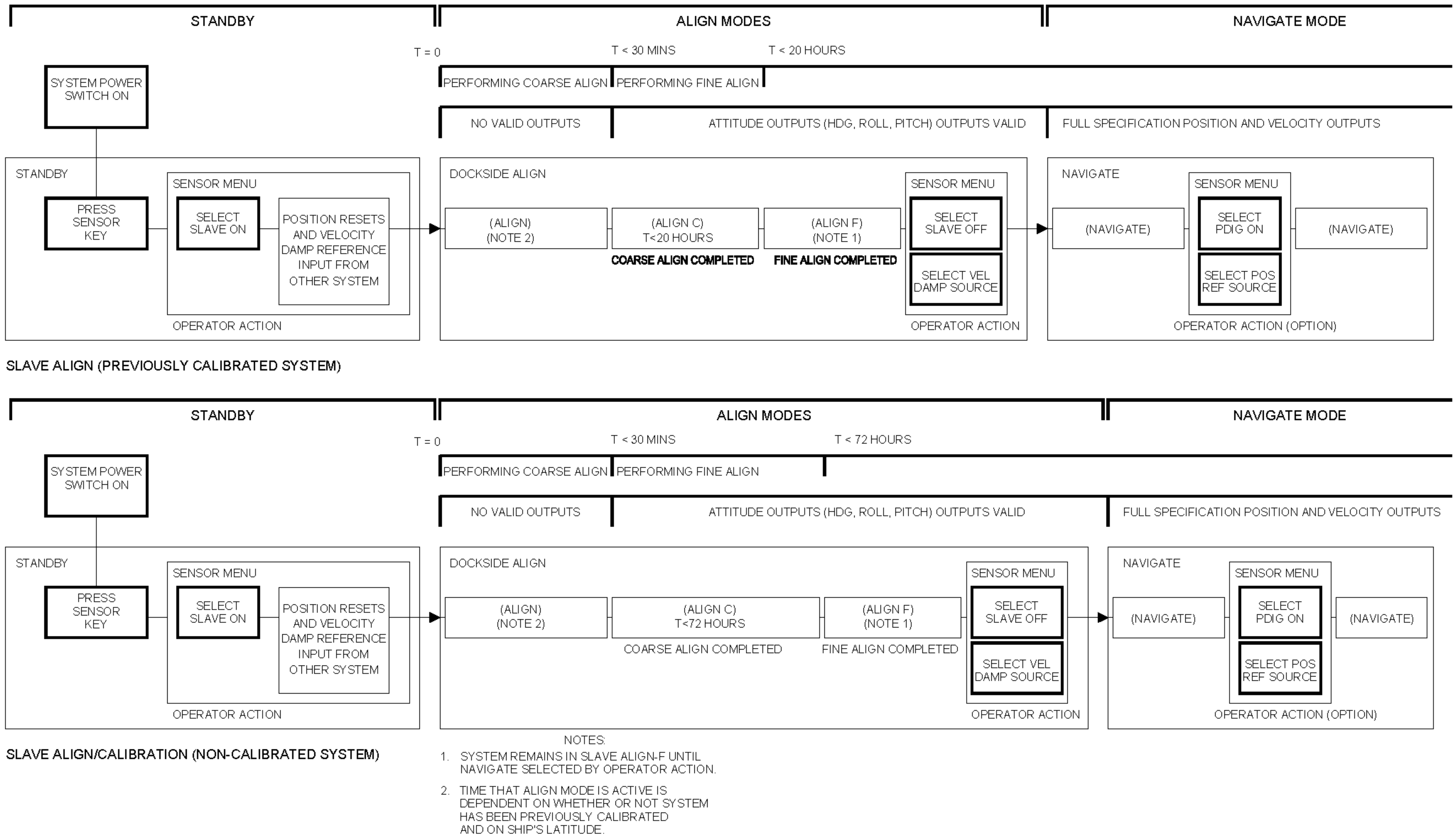
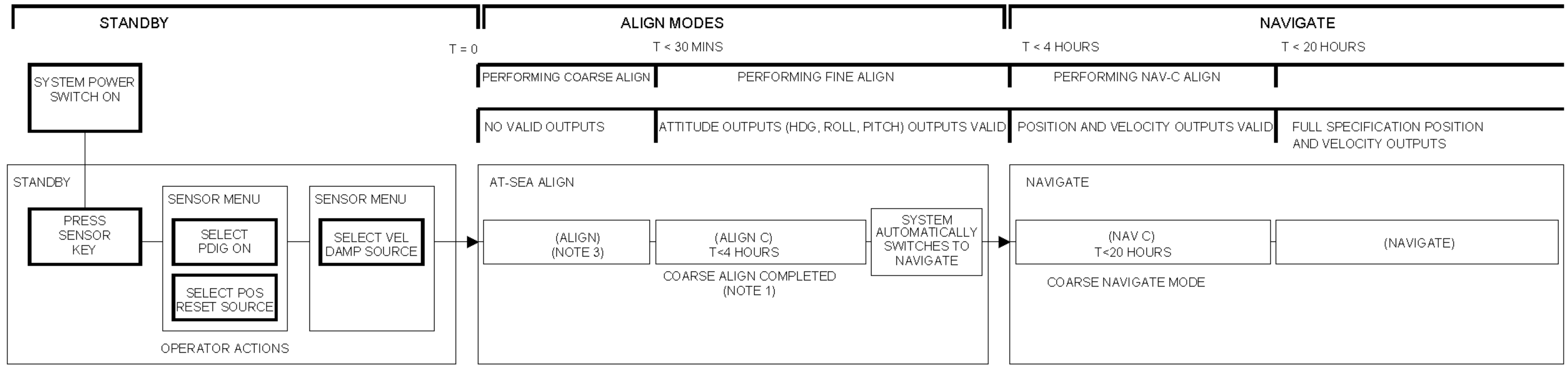
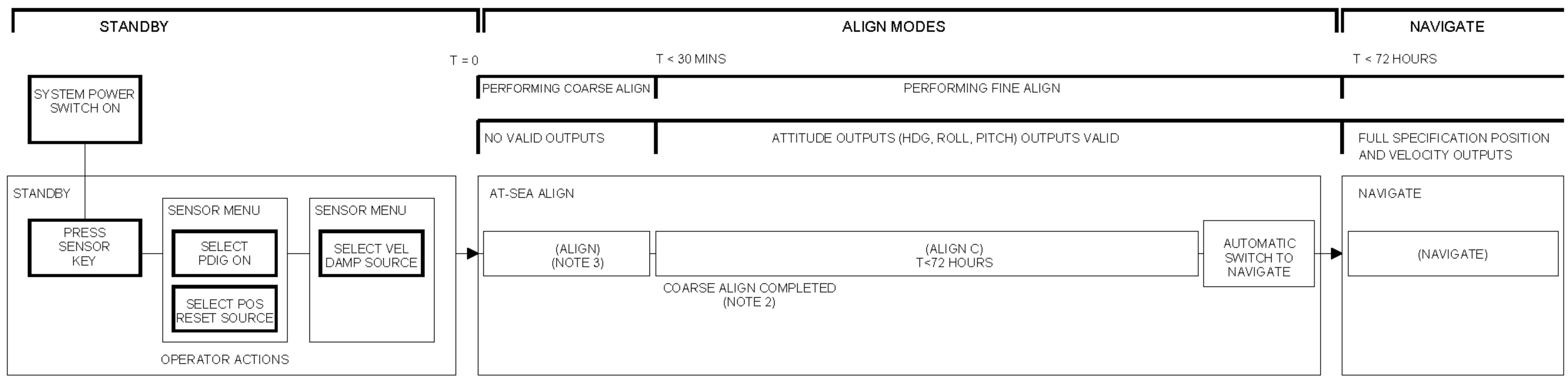


Figure 2-6. Slave Align Settle States



AT-SEA ALIGN (PREVIOUSLY CALIBRATED SYSTEM)



AT-SEA ALIGN/CALIBRATION (NON-CALIBRATED SYSTEM)

NOTES:

1. WHEN AT-SEA FINE ALIGN IS COMPLETE, SYSTEM AUTOMATICALLY SWITCHES TO COARSE NAVIGATE.
2. WHEN AT-SEA FINE ALIGN IS COMPLETE AT 72 HOURS, SYSTEM AUTOMATICALLY SWITCHES TO NAVIGATE.
3. TIME THAT ALIGN MODE IS ACTIVE IS DEPENDENT ON WHETHER OR NOT SYSTEM HAS BEEN PREVIOUSLY CALIBRATED, AND ON SHIP'S LATITUDE, HEADING, AND SPEED.

Figure 2-7. At-Sea Align Settle States

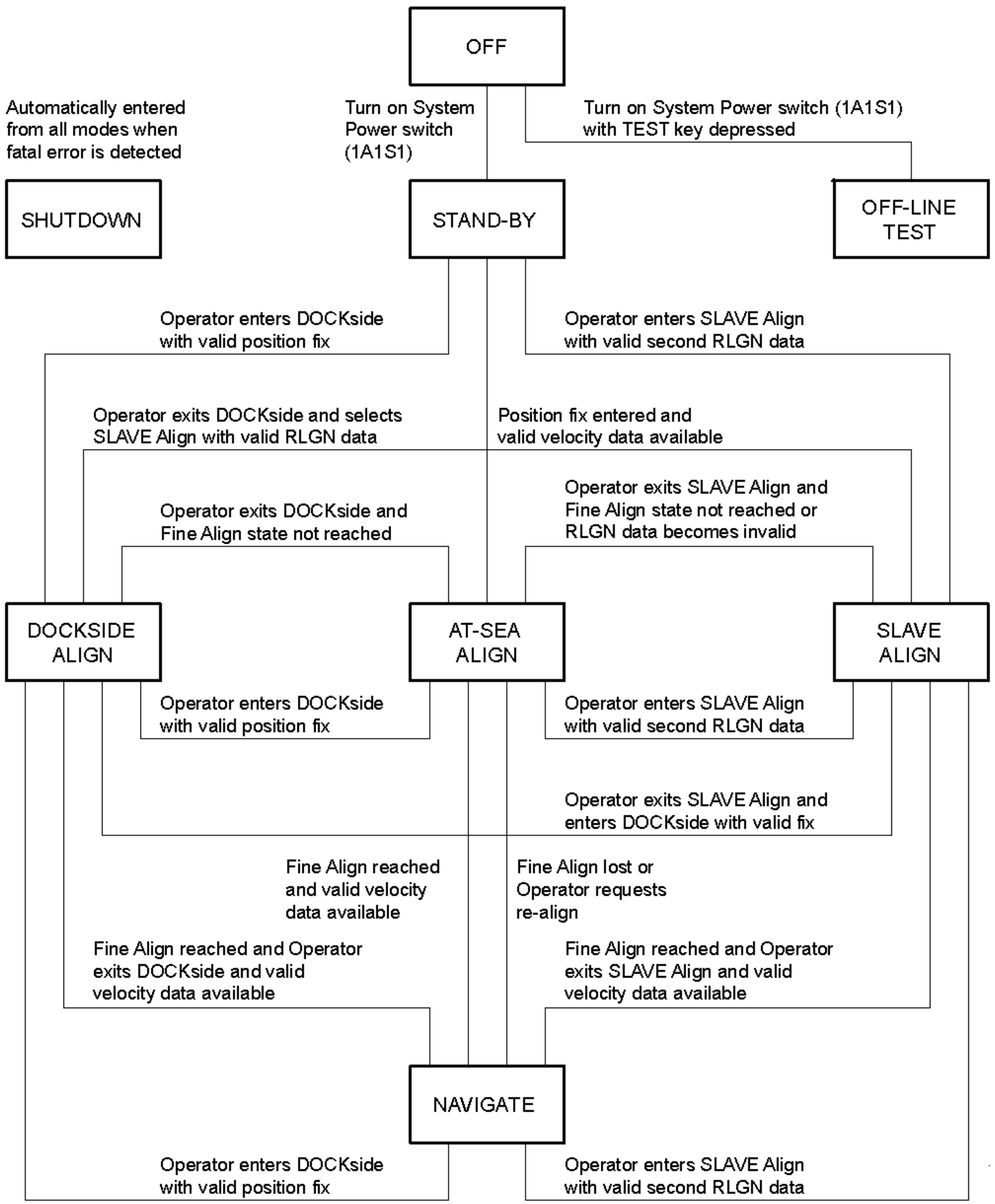


Figure 2-8. Mode Transition Diagram

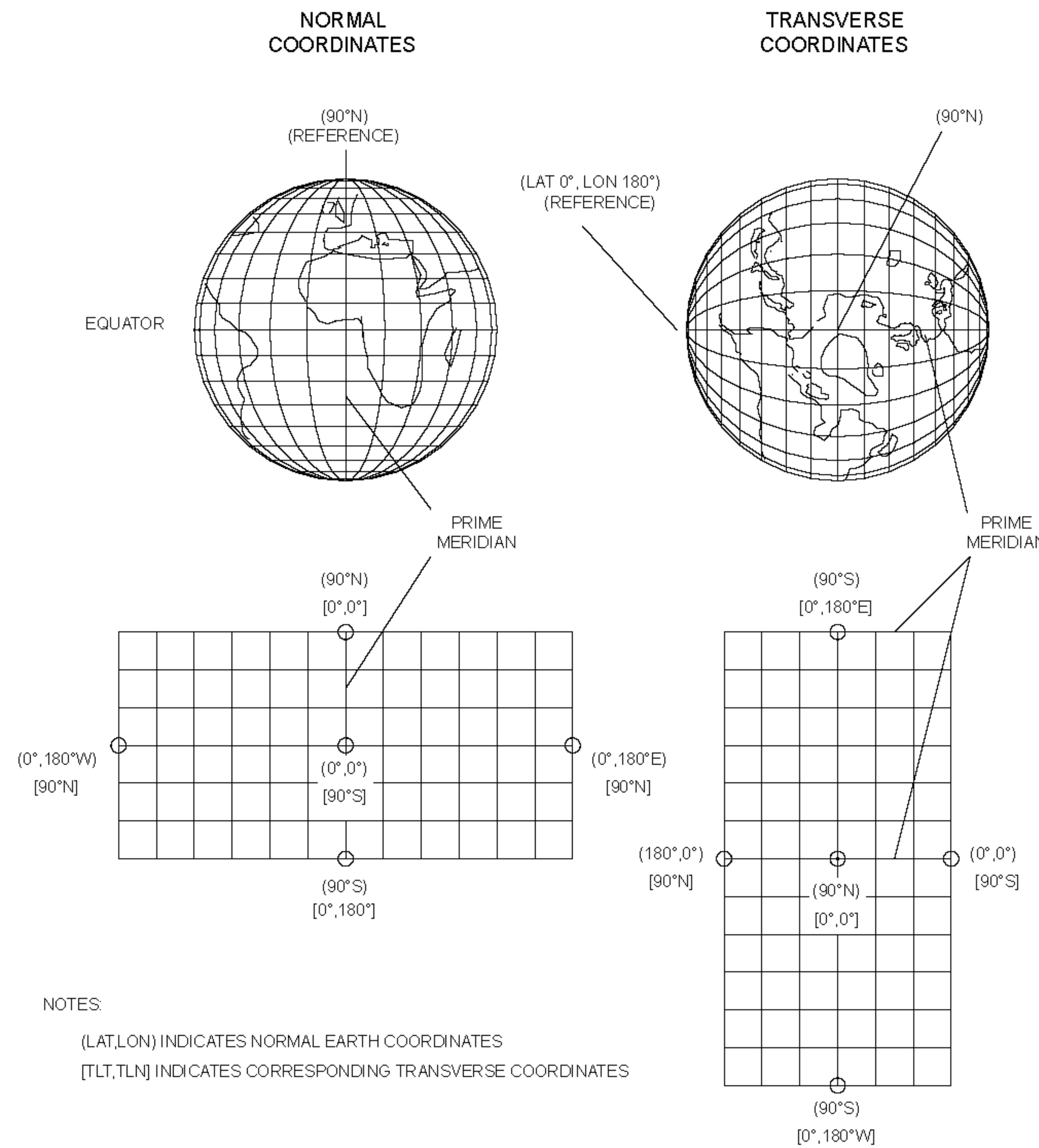
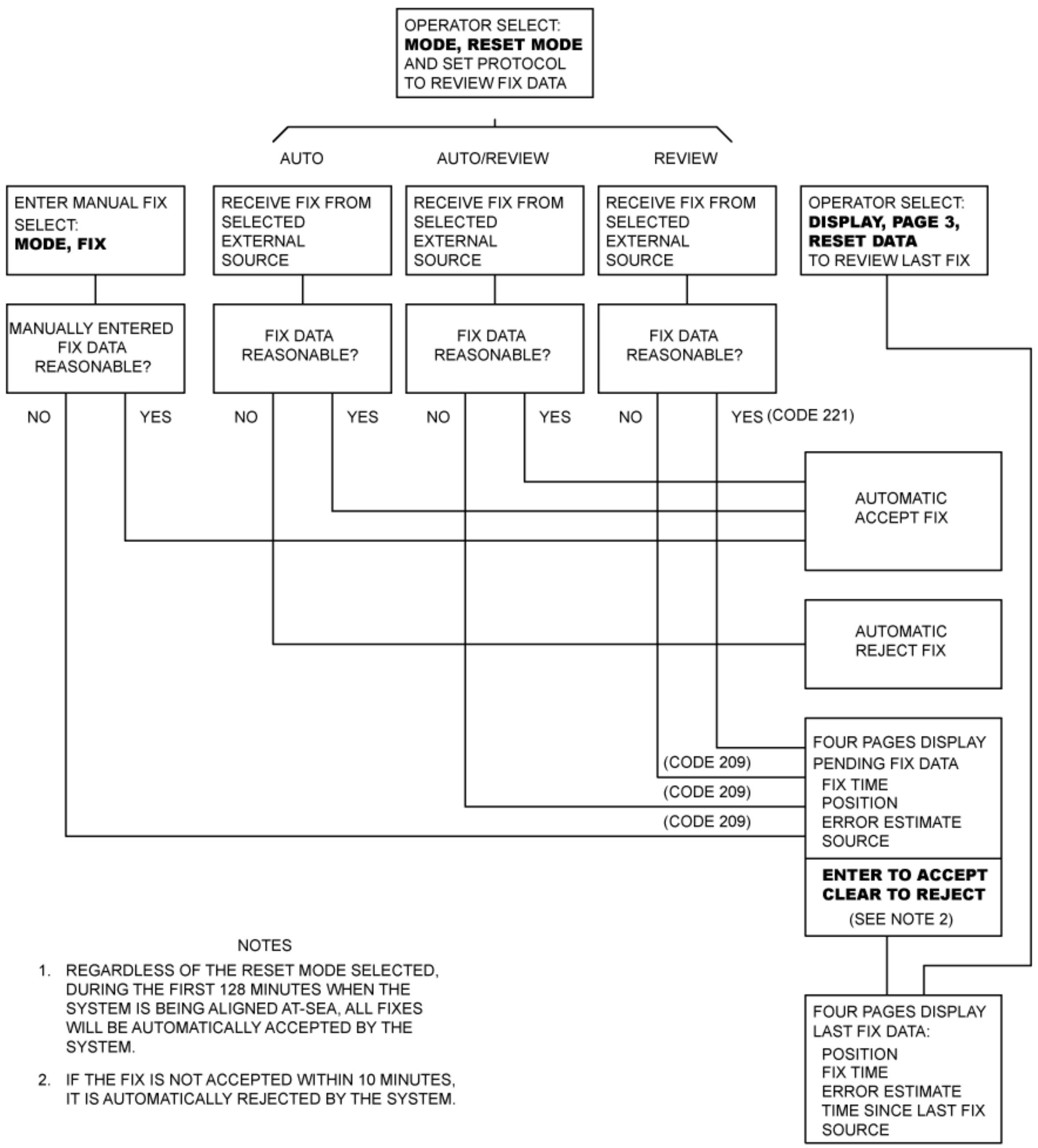


Figure 2-9. Earth Coordinates References



NOTES

1. REGARDLESS OF THE RESET MODE SELECTED, DURING THE FIRST 128 MINUTES WHEN THE SYSTEM IS BEING ALIGNED AT-SEA, ALL FIXES WILL BE AUTOMATICALLY ACCEPTED BY THE SYSTEM.
2. IF THE FIX IS NOT ACCEPTED WITHIN 10 MINUTES, IT IS AUTOMATICALLY REJECTED BY THE SYSTEM.

Figure 2-10. Position Fix, Data Entry and Review Functions

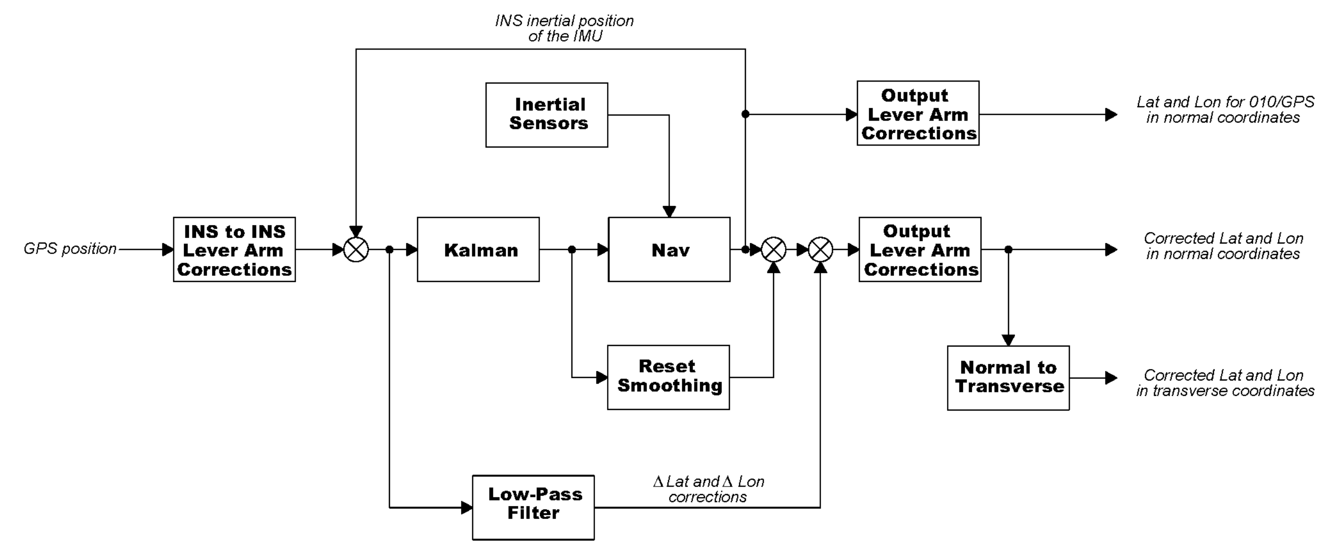


Figure 2-11. Enhanced Performance Position Accuracy (EP^{2}A) Block Diagram

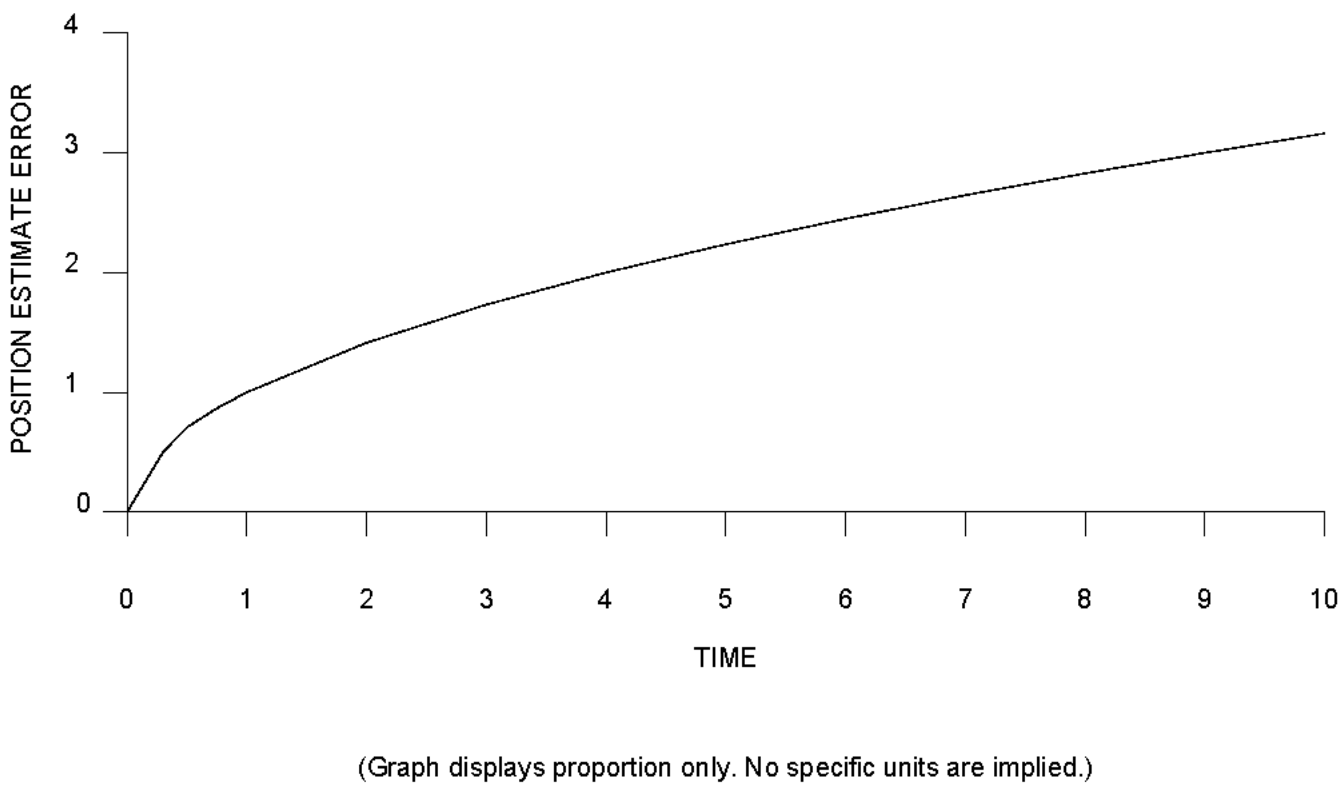


Figure 2-12. Position Estimate Accuracy vs. Time without Position Update

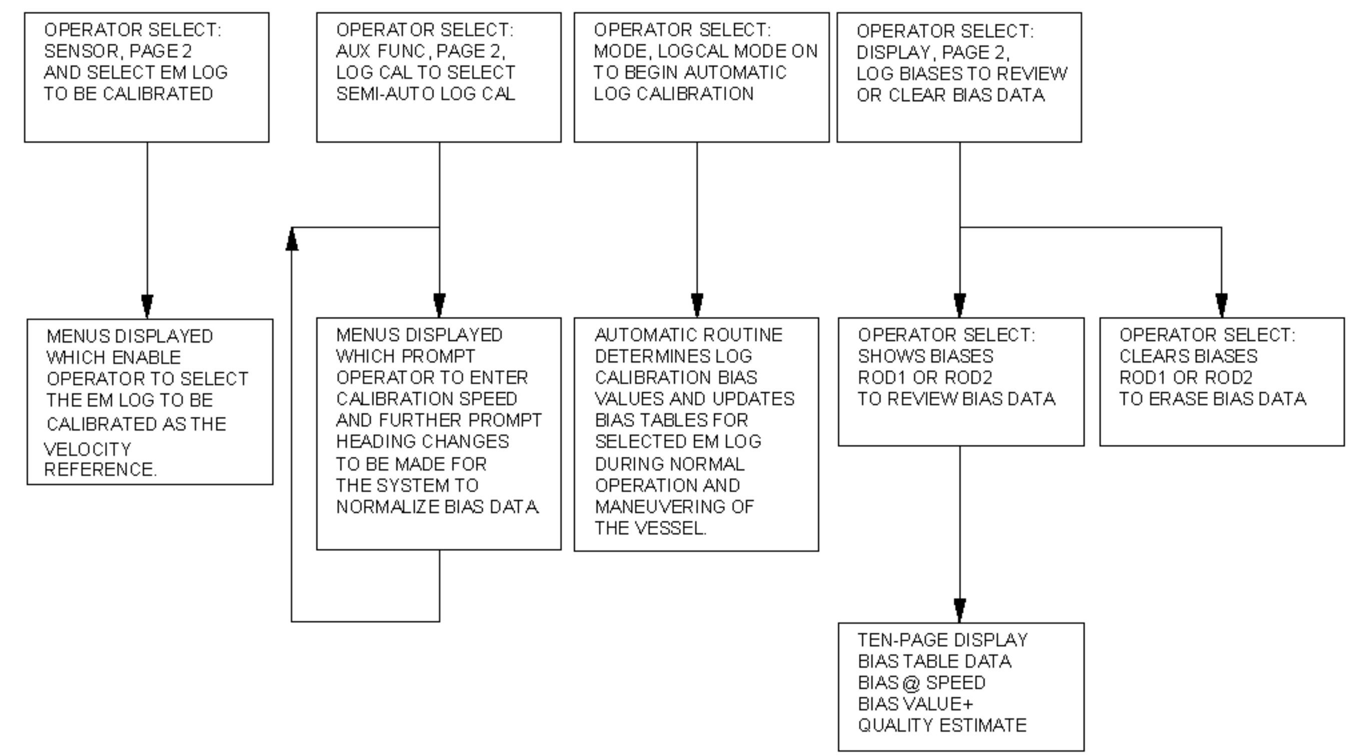
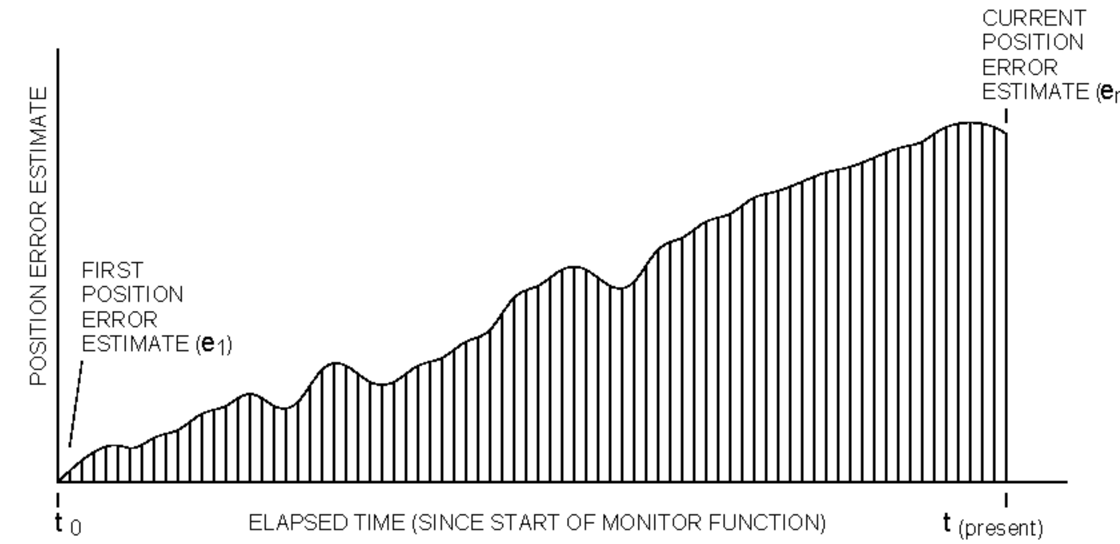


Figure 2-13. EM Log Calibration Functions



$$\text{TRMS (current value)} = \sqrt{\frac{e_1^2 + e_2^2 + e_3^2 \ldots\ldots\ldots + e_n^2}{N}}$$

WHERE N = TOTAL NUMBER OF POSITION ERROR SAMPLES
TAKEN SINCE START OF PERFORMANCE MONITORING

$$\text{DISPLAYED VALUE} = \frac{\text{TRMS (current value)}}{\text{TRMS (normalized specification limit)}} \times 100$$

Figure 2-14. Time RMS (TRMS) Position Error Calculation Method

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CHAPTER 3
THEORY AND FUNCTIONAL DESCRIPTION

SECTION I
INERTIAL THEORY

3.1 INTRODUCTION.

This chapter provides basic inertial navigation theory and system operational theory.

It describes the ways in which AN/WSN-7(V) functions support ship navigation and outlines the physically independent assemblies that work together to provide or support an AN/WSN-7(V), navigation-essential function.

Understanding AN/WSN-7(V) operational theory is essential to using the AN/WSN-7(V) following the procedures in later chapters.

This chapter is divided into two sections. Section I describes the theory used in inertial navigation systems. Section II describes the components and systems used in the AN/WSN-7(V) Ring Laser Gyro Navigator.

A detailed description of the physics, calculations, and compensation methods involved in the inertial navigation process requires extensive mathematical analysis, which is beyond the scope of this discussion.

3.2 BASIC INERTIAL NAVIGATION PRINCIPLES AND THEORY.

3.2.1 CONVENTIONAL VS. STRAPDOWN INERTIAL NAVIGATION SYSTEMS. There are two fundamental differences between the AN/WSN-7(V) and conventional inertial systems: strapdown and indexing.

In a conventional inertial system, the accelerometers are mounted on an inner stable platform which is held level by the gyroscopes inside three or four gimbals. This Base Motion Isolation (BMI) means that the accelerometers work in true level (Earth plane) and see only ship's positional movement, without any components caused by pitch and roll motion. The accelerometer readings are double integrated to give changes in latitude and longitude.

In a strapdown system, the gyros and accelerometers are hard-mounted and sense ship's motion, seeing pitch and roll components and their rates, as well as geographic movement. The composite rotation and acceleration measurements are fed into the system computer, which contains strapdown software. The strapdown software in the computer maintains a computer model true level from the gyro inputs, and uses a true Direction Cosine Matrix (DCM) to convert the accelerometer readings from deck plane to true.

Integration of the accelerometer readings after subtraction of Coriolis and gravity terms gives north (V_n), east (V_e) and vertical (Vk) velocities. Division of the V_n and V_e components by Earth's radius and integrating produces changes in system latitude and longitude.

The AN/WSN-7(V) Inertial Navigation System (INS) is a strapdown system based on the principle of using the standing waves generated in a closed path laser beam to detect angular rotation of an inertial reference platform. Three Ring Laser Gyros (RLGs or gyros) are mounted perpendicular to each other to detect rotation of an inertial platform about the X, Y, and Z axes. Three accelerometers, one mounted parallel to each axis of rotation, detect motion of the inertial platform in each axis. The rotation and acceleration motions are processed by an internal computer, which determines the orientation and velocity vector of the inertial platform.

The AN/WSN-7(V)'s three RLGs and three accelerometers are mounted on a sensor block. The sensor block is mounted in azimuth (inner) and roll (outer) gimbals which are controlled by direct drive torquer motors and slab synchros to provide sensor block stabilization and two-axis indexing. The sensor block is stabilized against ship motions in roll and pitch by outputs from the strapdown process. Indexing involves periodically rotating the sensor block cluster of gyros and accelerometers through ±90° or ±180° in roll or azimuth, in a specific sequence. The indexing cycle is designed to average out, or commutate, drifts in all directions. The ±90° shift in azimuth interchanges the A and B gyro orientation to enable an optimum averaging of gyro drifts and misalignments.

3.2.2 INERTIAL NAVIGATION SYSTEMS. An inertial navigator is any self-contained system that answers the basic questions:

- Where am I?
- Where am I going?

Depending on the configuration, the following questions can also be answered:

- How fast am I going?
- What is my attitude?
- What is my acceleration?
- What are my attitude rates?

3.2.2.1 Simplest (Single Axis) Inertial Navigator. The basic model (Refer to **Figure 3-1**) assumes a flat non-rotating Earth, constant normal g, and constrained path.

The inertial navigator extrapolates current position and velocity starting with a known position and velocity. An inertial navigator does not yield absolute position, just a change in position from some starting point. The initial conditions (Xo, Vo, θ_0 in simplest example) must be provided by external means or some combination of external systems and self-alignment.

All inertial system errors build up with time. For this simple example, accelerometer bias error AB yields:

$\delta x = \int^{t}_{0} t \, [\int^{t}_{0} \, dt] \, dt = ½ABt^2$

Error source categories in this simple system would include:

1. Instrumentation errors, including accelerometer (bias, scale factor, quantization, and environmental effects).
2. Accelerometer mounting misalignments.
3. Initial condition (position and heading) errors: (σXo, σVo, $\sigma\theta_0$).
4. Computing errors in the integrations.

3.2.2.2 Addition of Vehicle Pitch Motion. The accelerometer measures specific force = acceleration (a) - gravity (g). If pitched upward, obtain ax cos u + g sin u. For small u, obtain an acceleration error of g u, leading to a horizontal distance error = 1/2gut^2. Two basic approaches are used to correct for the effect of earth's gravity; these are:

1. Stabilized (Gimbaled) Platform.
2. Strapdown Conversion.

3.2.2.2.1 Gimbaled Stabilization. Assuming that the objective is to determine horizontal velocity and position, the accelerometer input axis can be maintained horizontal at all times, in spite of the vehicle pitch motions. This is accomplished by the addition of a gyroscope and a platform servo system.

The gyro Spin Reference Axis (SRA) wants to remain fixed in inertial space. If there were no gimbal friction, the platform would remain horizontal (in the non-rotating earth model). Because of friction, the platform will move off the horizontal. The gyro senses this motion about its input axis and yields a pickoff signal about its output axis. This signal drives the platform back to the horizontal via a fast reaction servo amplifier and gimbal torque motor. This is known as a local level orientation system.

Each additional element in the system introduces new instrumentation error sources. For example, a gyro bias drift produces a gyro pick-off output when there is no actual input motion. This propagates as shown in **Figure 3-2**, for this open-loop simple navigator. The gimbal servo also does not do a perfect job of nulling the effects of vehicle dynamics. In marine inertial navigators, gyroscopic drift error is much more critical for precision navigation than the accelerometer errors.

Considerations of the gimbaled system include:

Advantages:

1. High accuracy (North and East accelerometers do not see a component of gravity).
2. Self-alignment by gyrocompassing.
3. Sensor calibration by platform rotations.
4. Gimbal angle readout generally used to supply roll, pitch, and azimuth data.

Disadvantages:

1. Complexity and cost.
2. Reliability (bearings, slip rings, spinning mass gyroscopes, and torque motors).
3. Adds gyroscope and gimbal servo follow-up errors.
4. Gyro drift W_D creates platform tilt W_Dt, leading to acceleration error, or tilt-induced velocity, approximately equal to gW_Dt and position error:

   $\delta \cong 1/6 gW_Dt^3$

3.2.2.2.2 Strapdown Stabilization. In a pure strapdown system, the inertial sensors are strapped down to the vehicle without any gimbal isolation. The gyroscopes measure the vehicle rates (with respect to inertial space), which are integrated into the vehicle attitude (initial attitude must be predetermined). This is also the attitude of the accelerometers. The accelerometer measurements are transformed about the attitude (or Direction Cosine) matrix into the desired horizontal and vertical axis. Refer to **Figure 3-1**.

The advantages of the pure strapdown system are the reduced complexity and improved reliability of not having gimbals and gimbal servos. The disadvantages all stem from the loss of the isolation from vehicle motions that the gimbals and gimbal servos provide.

The strapdown gyros must measure very high rates (tens of degrees/second) compared to earth-rate levels (tens of degrees/hour) in gimbaled systems, while still contributing the same drift levels. The computer must be very high speed to integrate these vehicle rates accurately. In addition, the accelerometers must measure large components of gravity, instead of being continually horizontal, making scale-factor and misalignment errors more critical.

The Direction Cosine attitude matrix of the strapdown system can be looked at as a stabilized platform model. Attitude errors are analogous to the tilts of the stabilized platform model.

Considerations of the strapdown system include:

Advantages:

1. Simple structure; i.e., no gimbals, no gimbal servos.
2. Reliability.
3. Stabilized platform model is maintained in Direct Current (DC) matrix.
4. Pitch angle can be obtained from software.

Disadvantages:

1. Inertial components are not isolated from software.
2. More difficult to align.
3. More difficult to calibrate.
4. Computing rates for strapdown conversion must be very high; however, modern computer technology makes strapdown systems practical.

While the basic errors in a strapdown system propagate into navigational accuracy in the same manner as in a gimbaled system, the nature of the error sources and how they originate can be quite different.

Strapdown Error Propagation:

Gyro drift W_D integrates into computed pitch error $\delta P = W_Dt$

- $P_C = P_T + \delta P$

Attitude matrix is tilted off of true horizontal

- $\cos P_C \cong \cos P_T - \delta P \sin P_T$
  $\sin P_C \cong \sin P_T + \delta P \cos P_T$

Substitution in matrix transformation yields:

- $a_{HC} = a_H + (g \bullet \delta P)$
  $\delta a = g\delta P = gW_Dt$
- $\delta_{POSITION} = 1/6\ gW_Dt^3$ (same as for gimbaled system)

3.2.2.3 Moving Along the Meridian of a Spherical Non-Rotating Earth. As illustrated in **Figure 3-6**, if we extend the simple navigator closer to the real world by moving North along the meridian of a spherical non-rotating earth with radius R, the following three conditions apply:

1. A gimbaled system gyroscope whose Spin Reference Axis (SRA) was pointed along the intial veritical in inertial space would remain pointed in that direction.
2. The platform of the accelerometer would not remain horizontal. To maintain the platform horizontal with respect to the earth's surface, the gyroscope must be torqued at a transport rate (V/R).
3. The integration of the North pointing acceleration yields North velocity (V_n and the integration of V_n/R (after insertion of the initial latitude) yields the latitude position of the vehicle.

In a strapdown system, the gyro, which measures all rates with respect to inertial space, will measure this transport rate (V/R). An integration of this rate would indicate that the vehicle has a pitch angle when there is none. The V/R must be subtracted from the gyro-measured inertial rate to obtain the desired body rate with respect to the horizontal earth rate. This is analogous to torquing.

Since V in a pure inertial system is obtained from the integral of the accelerometer measurement, there is a V/R feedback loop created. This feedback loop is known as the Schuler-tuned loop.

3.2.2.4 Single-Axis Schuler-Tuned Gimbaled System. The Schuler-tuned loop yields the same equations of motion as that of an undamped pendulum having a length equal to that of the earth's radius (approximately an 84-minute period of oscillation). **This is also referred to as a vertical earth loop.**

3.2.2.5 Single-Axis Schuler-Tuned Strapdown System. As illustrated in the following figures: **Figure 3-3** and **Figure 3-4**, a strapdown system yields the same Schuler-tuned loop as that of a gimbaled system. The Direction Cosine attitude matrix is analogous to a stabilized platform model.

For small vertical error $g\sin\theta_y \cong g\theta_y$; and the characteristic differential equation is that of an undamped pendulum having a length = R:

$$\frac{d^2\theta y}{dt^2} + \frac{g}{R}\theta y = 0$$

The characteristic Schuler period is:

$$T = 2\pi \sqrt{\frac{R}{g}} = 84 \textit{ minutes}$$

The chart shown in **Figure 3-5** represents data taken on a purely undamped inertial navigator. The 84-minute Schuler oscillations are clearly evident.

3.2.2.6 Undamped Schuler-Tuned System Error Propagation. An error analysis of the Schuler-tuned system for gyro bias drift and accelerometer bias error yields the propagation relationships shown below:

It is evident that the gyro bias drift causes a North distance error that builds up linearly with time, with a Schuler oscillation around the build-up. For times which are very short compared to the 84-minute Schuler period, the propagation relationship is the same as that previously given for the simple open-loop system.

The accelerometer bias errors yield a north distance error that is bounded in time with a Schuler oscillation. For times that are very short compared to the Schuler period, the propagation relationship is the same as that previously given for a simple open-loop system.

From the relationships of the time terms, it can be seen that the gyro precision is much more critical than that of the accelerometer.

3.2.2.7 Effect of the Earth's Rotation. If the analogy is extended further toward the real world by going to a rotating earth, it can be seen from the following two figures: **Figure 3-6** and **Figure 3-7**, that Earth rate is another rate with respect to inertial space that tends to move a gyro-stabilized platform off of the local level. An additional Earth rate torquing term is required to maintain a local level platform.

In a strapdown system, appropriate Earth rate terms must be subtracted from the gyro-measured rate with respect to inertial space to yield body rate with respect to an Earth horizontal frame.

As shown in **Figure 3-7**, the Earth rate along a polar axis can be broken down into a North component ($\Omega_e\cos L$) and a vertical-down component ($-\Omega_e\sin L$). The required torquing terms are thus functions of latitude. Since latitude is a double integration of acceleration, additional feedback loops are created when the Earth rate terms are applied. **The resultant feedback loop is called the Earth loop.**

North distance error δDN due to gyro bias drift:

For small t

$$DN = Rw_d \left[t - \sqrt{\frac{R}{g}} \sin \left(\sqrt{\frac{g}{R}}\, t\right) \right] \Rightarrow \tfrac{1}{6} gw_Dt$$

North distance error δDN due to accelerometer bias:

For small t

$$\delta DN = \frac{R}{g} AB \left[1 - \cos \left(\sqrt{\frac{g}{R}}\, t\right) \right] \Rightarrow \tfrac{1}{2} ABt^2$$

An additional Earth rate torquing term is required to maintain a local level platform. In strapdown systems, Earth rate must be subtracted from gyro inertial rate to yield body rate with respect to an Earth horizontal frame. These Earth rate terms are functions of latitude:

- $(\Omega_{EN} = \Omega_E \cos L; (\Omega_{EV} = -\Omega_E \sin L)$

These feedbacks create an undamped Earth loop.

3.2.2.8 Torquing Rates (or Coordinate Frame Rates). An extension to three axes is made to indicate the combined transport rates (vehicle moving over the earth) and Earth rates (earth moving with respect to inertial space) torquing terms required around each gyro axis to maintain a local level, North-slaved platform. This platform is physical in a gimbaled system and a stabilized model in a Direction Cosine Matrix of a strapdown system.

These rate terms can be derived by applying a right-hand rule to each rate. Thus, a positive North velocity of the vehicle yields a rate (W_E) of VN/R in the negative East direction. A positive East velocity at latitude L yields a rate (W_P) of V_e/R cosL along a polar direction. This polar axis rate can be broken down into a North component (V_e/R cosL) x cosL = V_e/R and a vertical (W_K) azimuth (k axis) component -(V_e/R cosL) x sinL = -V_e/R x tanL.

To maintain a local level, North-slaved platform (or a phantom DC matrix relative to N, E, D) (three-axis system):

$$W_N = \Omega_E \cos L + \frac{V_E}{R} = (\Omega_E + \lambda') \cos L$$

$$W_E = -\frac{V_N}{R} = -L'$$

$$W_K = -\Omega_E \sin L - \frac{V_E}{R} \tan L = -(\Omega_E + \lambda')\sin L$$

Where: L = Latitude, λ = Longitude,

L' = Latitude Rate, λ' = Longitude Rate

The transport rates can be expressed in terms of latitude rate and longitude rate in place of the V_n/R and V_e/RcosL.

Earth loop period:

$$T_E = \frac{2\pi}{\sqrt{\left(\Omega_E + \frac{V_E}{R \cos L}\right)^2}}$$

For marine case at normal latitudes this can be simplified to:

$T_E 2\pi/\Omega_E = 24$ *hours*

3.2.2.9 North Position Error. Figure 3-8 represents data from an AN/WSN-7(V). The 24-hour period Earth loop oscillation is evident.

3.2.2.9.1 Another Effect of Earth's Rotation and Transport Rates. Additional kinematic acceleration terms:

1. Accelerometers measure A-G, where A is kinematic acceleration with respect to inertial space.
2. Terms are a function of accelerometer axes orientation.
3. For north and east horizontal accelerometers, with no vertical velocity:

$$A_N = \frac{dV_N}{dt} + 2V_E\,\Omega_E \sin L + \frac{V_e^2}{R} \tan L$$

$$A_E = \frac{dV_E}{dt} - 2V_N\,\Omega_E \sin L - \frac{V_n}{R} V_E \tan L$$

4. The Coriolis acceleration terms (2V Ω_E sin L) and centrifugal type acceleration terms should be subtracted from the accelerometer data to yield:

   dV_N/dt and dV_E/dt

Note that these terms are functions of velocity and latitude, creating additional feedback loops.

3.2.3 VELOCITY DAMPING OF THE VERTICAL (SCHULER-TUNED) LOOP.

3.2.3.1 Other Real World Considerations. The real world is in the shape of a spherical ellipsoid, not a sphere. This flattening at the poles yields differences in earth radii and gravity as functions of latitude. The real world does not have an equal distribution of mass. This yields variations in the amplitude (gravity anomaly) and direction (verfical deflection) of gravity. If not compensated for, the vertical deflections (which act like gravity tilts) will create disturbances and errors in every inertial navigator. In a similar manner, large differences in local mass, such as underwater mountains or the edge of deep trenches, can cause local gravity anomalies.

3.2.3.2 Damping the Schuler Loop. In pure undamped inertial systems, certain errors; e.g., vertical tilt, will continuously oscillate at Schuler periods (84 minutes). Random noise sources lead to vertical errors, which build up with $\sqrt{t}$. These oscillations can be damped out. An undamped Schuler loop is dynamically exact; there are no errors caused by vehicle dynamics on a constant gravity earth (assuming no sensor errors).

1. Use of internal loop damping will sacrifice dynamics exactness.
2. Use of an external reference (external velocity reference) for damping preserves dynamic exactness; however, the external reference introduces errors due to inaccuracies in the velocity values obtained from the external reference.

3.2.3.3 External Velocity Damped Vertical Loop. The ship's Electromagnetic (EM) Log, or Doppler Sonar Velocity Log (DSVL) if so equipped, is typically used to provide reference velocity for the inertial navigation system damping. Damping parameters must be selected such that they balance log errors (e.g., ocean current variations) against inertial errors (e.g., vertical deflections) and achieve a good damped response. Figure 3-9 illustrates an External Velocity Damped Vertical Loop.

3.2.4 STRAPDOWN PROCESSING.

The AN/WSN-7(V) uses DCM transformations in its strapdown algorithms to convert between the reference frames in use. The AN/WSN-7(V) uses three basic coordinate frames:

1. Sensor block frame (b); a, b, c (RLG axes)
2. Earth reference frame (n); n, e, k (north, east, down)
3. Dock coordinate frame (l); x, y, z (forward, athwartships, down)

The gyro and accelerometer data is sampled by the Navigation (Nav) Processor at 50 Hz. This is the basic update rate for the strapdown process. A block diagram of the strapdown process is given in Figure 3-10.

The raw gyro data is compensated and corrected for various bias, scale-factor, linearity, and misalignment errors, including temperature effects and coning corrections. The corrected gyro rates represent all body motions with respect to inertial space. Earth rates and vehicle transport rates (due to the vessel's movement across the Earth surface) are subtracted from the gyro rates to yield body rates with respect to an Earth-fixed reference frame. These latter rates are then appropriately integrated to provide a Euler parameter and direction cosine representation of sensor block attitude relative to an Earth (n, e, and k) reference frame.

The raw accelerometer readings are similarly corrected, and the acceleration vector then transformed from the sensor block frame (b) into the Earth frame (n). After velocities and movements are computed, these are also used to update the Earth and transport rates, providing the coordinate frame rate feedback to the next iteration of the DCM inner element (BA) used to process RLG information.

Angular information is then converted back to the deck frame (l) in an outer DCM element (BD), which is driven by the sensor block angles for azimuth (Ga) and roll (Gr). The Euler angles (ship heading, roll, and pitch) are then extracted, and their rates derived and extrapolated. The smoothing and extrapolation algorithms operate at 800 Hz and provide filtered attitude rates that represent actual ship motion with negligible dynamic error, while attenuating spurious higher frequencies. The smoothing of extrapolated attitude data ensures that there are no step changes of output angle.

3.2.5 NAVIGATION PROCESSING.

The navigation software includes various lever arm corrections (to give velocities and position at desired locations), and a sideslip coefficient correction for lateral velocity.

The north, east, and vertical acceleration increments (An, Ae, and Av) from the strapdown function (refer to Figure 3-10) are corrected for gravity and Earth Coriolis, and integrated to yield inertial north (V_n) and east (V_e), and vertical velocities (Vk). V_n and V_e are divided by appropriate Earth radii to produce latitude and longitude vehicle rates, which are integrated to give the change in system latitude and longitude. The Earth rates (derived from latitude) and vehicle rates are fed back to the strapdown function where they are appropriately subtracted from gyro-measured rates used to modify sensor block attitude.

3.2.5.1 Vertical Loops. The vertical loops are defined as the control channels keeping the strapdown stabilized platform model DCM level, and in the local vertical.

The stabilized platform model carries out the same job as the stable table/base motion isolation in a conventional inertial system. Its "level" (and hence the system vertical) is established during gyrocompassing (coarse align) and then maintained by adjusting the angles contained in the DCM to offset any movement (rotational change), as measured by the individual gyros.

This "stabilized platform model" level can oscillate with the same 84-minute and 24-hour periods as a conventional inertial system. Its stability is a function of log damping and the accuracy of navigational fixes used for resets/updates. Log damping is incorporated to damp out oscillations about the vertical. Data from a ship's log is used to provide an independent source of velocity information. Automatic damping/undamping is controlled by the Kalman Filter (KF).

3.2.5.2 Earth Loop. The gyros measure all sensor block rotation rates with respect to inertial space, whether due to the earth, the ship, or the two-axis indexing. The Earth loop is a discrete feedback loop that corrects the gyro rates for the effects of Earth rotation basis. The Earth rates are derived from system latitude and are fed back and subtracted from the gyro rates prior to integration of the gyro rates to maintain the "stabilized platform model" (DCM).

Any latitude error (due to an accumulation of navigation errors, a fix error, or uncompensated system drift rates) causes incorrect computing of Earth rates. These incorrect Earth rates, which are fed back and subtracted from the gyro rates prior to attitude integrations, lead to an improper DCM, which yields improper heading and tilts. The DCM errors cause an improper transformation of accelerations, yielding errors in north and east velocities, which in turn produce errors in latitude and longitude. For marine velocities, if undamped, Earth loop error propagation involves 24-hour periodic oscillation terms. The Earth loop in the AN/WSN-7(V) is slightly damped by action of the Kalman filter corrections based on reference velocity measurements, depending on the error models employed for the log reference relative to the error models employed for the inertial sensors.

3.2.5.3 Vertical Velocity Loop. The vertical velocity loop is separate from the strapdown and Kalman operations, and handles the vertical acceleration (mostly from the C accelerometer), which is integrated once to give vertical velocity and then again to give depth change.

Accurate vertical velocity is obtained by operating on the inertial vertical velocity in a damped third-order loop configuration, using a depth reference (depth reference set = 0.0 for surface ships) or a reference vertical velocity. The integral of vertical velocity is matched against depth (or zero mean sea level for surface ships) to yield certain vertical axis bias and scale-factor calibrations.

3.2.6 KALMAN FILTER.

3.2.6.1 General. A Kalman Filter (KF) is a digital filter able to track the mean signal within noisy data. The AN/WSN-7(V) uses a 26-state KF with the Kalman parameters (K1 – K26) forming the inputs or corrections to many of the Nav Processor software processes. The KF has three main functions:

1. To monitor system parameters (especially gyro/accelerometer bias, scale factor, and misalignment) measured during alignment.
2. To process position updates.
3. To control log damping.

The KF also computes estimates of ocean current velocities and speed log biases.

Corrections are made to the various error states in the system (velocity errors, accelerometer errors, tilt-states, and gyro bias drifts). Estimates are also made of ocean currents and Log bias. A block diagram of the Kalman Filter operations is shown in Figure 3-11, and the equations used are listed in Paragraph 3.2.6.2..

3.2.6.2 Kalman Filter Computations. Time Extrapolation:

- X_{N+1} = PHI *X_N
- P_{N+1} = PHI * P_N * PHI^T + QP

Measurement Update:

- $X_{N+1} = X_{N-} + K_N * (Z - H * X_{N-})$
- $P_{N+} = P_{N-} - K_N * H * P_{N-}$

where:

- X = State Error Vector
- P = State Covariance Matrix
- PHI = State Transition Matrix from time T_N to T_{N+1}
- Q = System Noise Matrix
- QP = Integral of Q * dt from T_N to T_{N+1}
- dt = Kalman Filter Time Step = $T_{N+1} - T_N$
- Z = Measurement Vector
- H = Measurement Matrix
- K = Kalman Gains = $(P_{N-} * H^T) * (H * P_{N-} * H^T + R)^{-1}$
- R = Measurement Noise Matrix

Subscripts $_{N'\ N+1}$ refer to values at time T_N and T_{N+1}.

Subscript $_{N+}$ refers to the values after a measurement update cycle.

Subscript $_{N-}$ refers to the values before a measurement update cycle.

3.2.6.3 Kalman Filter Matrix Definitions. The various matrices employed in the Kalman Filter are defined as follows:

- The **X Matrix** is a listing of the **state variables** being involved in the KF.
- The **K Matrix** is the set of **optimal gains** used to multiply the measurement differences to generate the feedback corrections.
- The **H Matrix** is the set of **measurement factors** that relate the difference measurements (Z) being made to the error states (Z = HX).
- The **P Matrix** is the **state-covariance matrix**. This matrix represents the expected statistical errors of the state variables. The diagonal elements are the variances associated with each state and the off-diagonal elements are the covariances, which relate the expected values of the errors in one state to those in some other state.
- The **Po Matrix** is the **initial set of variances** associated with each state variable.
- The **Φ Matrix** is the state-transition matrix, which **relates the current values of the state variables to the value at a future time. Φ** is given by **Φ** = I + AΔ t, where I is the identity matrix (all diagonal terms equal 1) and the A matrix relates the derivatives of the state-variables to the state-variables (X=AX+N) (where N is the matrix of white-noise errors).
- The **R Matrix** is the diagonal matrix of the expected **Reference White-Noise Errors.** These would include expected Log Errors.
- The **Q Matrix** is the diagonal matrix of expected **System White-Noise Errors**. These would include expected gyro white-noise drifts.

The Kalman Filter process continually generates the best estimate (minimum variances) of the system state matrix X(t). To differentiate between the actual values of the system state variables and the KF estimates of these variables, the KF estimates are called X'(t). Since X'(t) represents the best estimate of what the system error states are at the time t, then – X'(t) would be a matrix of the corrections to be applied if the reset were to be made at that time. If a particular error state correction is applied, then the X'(t) is set to zero following the correction for those states. If the reset is held off or is never corrected (may not be feasible), the KF provides for the minimum variance propagation of X'(t).

The AN/WSN-7(V) employs the KF for optimal position fix reset as well as for optimal damping. Whenever an external position reference [e.g., Global Positioning System (GPS)] fix is acquired, the Kalman Filter:

1. Measures the difference between System Latitude and Reference Latitude, and between System Longitude and Reference Longitude.
2. Multiplies the difference by optimal gains.
3. Feeds corrections back to various system error states.

These operations follow the same general relationships described for optimal damping.

The AN/WSN-7(V) also employs the Kalman Filter during special 72-hour alignment/calibration periods to calibrate gyro bias drifts, A and B gyro scale factors, gyro misalignments, and A and B axis accelerometer biases. These state variables are made observable by indexing motions of the two-axis indexer. Advantage is made of the knowledge that average reference velocity is zero during a Dockside Align/Calibrate, or that accurate GPS fixes are occurring frequently during At-Sea Align/Calibrate.

The resultant overall AN/WSN-7(V) Kalman Filter contains 26 error states as delineated below. Several of these state variables are frozen after the align/calibrate process has completed.

Kalman Filter Error States:

- Velocity North
- Velocity East
- Tilt North
- Tilt East
- Heading
- Latitude
- Longitude X cos Lat
- A Gyro Bias Drift*
- B Gyro Bias Drift*
- C Gyro Bias Drift*
- North Bias Drift
- Azimuth Bias Drift
- A Accelerometer Bias
- B Accelerometer Bias
- A Gyro Scale Factor*
- AB Gyro Misalign*
- AC Gyro Misalign*
- B Gyro Scale Factor*
- BA Gyro Misalign*
- BC Gyro Misalign*

- CA Gyro Misalign*
- CB Gyro Misalign*
- North Ocean Current
- East Ocean Current
- Log Bias Fore/Aft
- Log Bias Port/Stbd

Gyro Bias Drifts, Misalignments, and Scale Factors will be unchanged when in Navigate.

3.2.7 POSITION FIX AND POSITION SLEW. Position updates are handled by the Kalman Filter and can be applied in two ways: either as **position fix resets** or as **position slews**.

1. **Position Fix** - A position fix will reset both position and drift coefficients; however, the amount of position movement will depend on the weighting given to the fix. This calculation is based on the system's internal estimate of position and the fix data. The effect of the fix is calculated by the KF and can be displayed for review before acceptance, but **once the fix reset is applied, its effects cannot be undone**. Fixes can be entered manually by the operator, or can be received via the data interfaces from an external source such as GPS.
2. **Position Slew** – A position slew allows the operator to enter position data to update system position without causing a reset. This process does not change KF parameters or underlying system drifts.

3.2.7.1 Fix Reset Processing by the Kalman Filter. System position is based on inertial calculations and an uncertainty area (system accuracy) defined by system sigma latitude [sigma north (SN)] and sigma longitude [sigma east (SE)]. The estimated values of SN and SE increase with time, but are decreased by the application of a fix.

When a fix is entered, either manually or received via the data interface, the Kalman Filter compares the inertially-derived position with the available position reference (fix) data and operates on these measurements to generate corrections to the modeled system states. The process attributes navigational errors to sensor or system drifts, and then modifies the Kalman parameters to neutralize the error pattern. Corrections are made to latitude, longitude, velocities, tilts, heading, gyro biases, non-reversing rotation rate biases, scale factors, and misalignments and horizontal accelerometer biases.

The Kalman Filter is very closely coupled to the Inertial Measuring Unit (IMU), and there is no easy distinction between raw and filtered positions. Earlier navigation systems stored several fixes and/or allowed data to be modified before the new filter was implemented. With the AN/WSN-7(V) this is not possible because the Kalman Filter operates on one fix, as entered. The effect of the fix is calculated and can be displayed for review before acceptance, but **once the fix reset is applied, its effects cannot be undone**.

When a fix is entered, the Kalman Filter checks that the fix data and resulting resets are within acceptable limits. The operator is alerted to fix data or a reset outside acceptable bounds by fault codes.

Fix processing within the Kalman Filter calculates the latitude and longitude resets using the difference between system position and fix position. The KF calculates weighting based on the estimate of system accuracy (SN and SE) as compared to the fix accuracy [fix sigma latitude (FSN) and longitude (FSE)]. This weighting is used to determine the proportion of the difference in position [reset north distance (DN) and reset east distance (DE)] to be applied as the position reset.

If a fix is entered with a small sigma value (high accuracy), then a large percentage of the fix error will be applied as a reset. The relative difference between the system position and the fix position does not determine the weighting; the weighting is determined only by the estimated system accuracy and fix accuracy. The estimated value of system accuracy increases with time, but is decreased by the application of fix data as a reset. This results in a higher weighting being given to fix data following a long navigate period as compared to fix data entered closely spaced in time.

Entry of valid fix data with suitable fix variances should always improve system accuracy, but forcing an incorrect reset will introduce a position error proportional to the reset error. This position error will propagate through the undamped Earth loop into position and attitude errors. **Large position or attitude errors may cause the vertical loops to undamp (period 84 minutes) due to velocity errors.**

For submarine applications where extended dive operations without an update have occurred, the system sigma latitude and longitude values will have increased. Application of a single accurate fix will produce a position reset that is approximately equal to the fix error and will correct drift parameters. A single fix may not update the position completely, but if this is necessary for tactical picture reasons, and **if application of successive fixes and gradual convergence of the Kalman to the correct position over time are not acceptable, then the fix should be applied again as a slew.**

3.2.7.2 Manual Fix Entry. When a fix is entered manually, the data entered includes time of fix, fix latitude and longitude, and fix accuracy. Fix accuracy is expressed either as separate sigma latitude (FSN) and sigma longitude (FSE) to one sigma confidence level (68% expected error limits), or as Radial Position Error (RPE) to 95% Circular Error Probability (CEP), with equal latitude and longitude error sizes, both to 0.1 NM.

When using RPE fix entry, the system calculates equivalent FSN and FSE values as follows:

FSN and FSE = 0.40854 x RPE

The latitude and longitude weighting or gain (K) is calculated using the system sigma values at the time of the calculations, and the fix sigma values (or the sigma values calculated from RPE data) which are used as entered:

K = (system sigma)^2 / (system sigma)^2 + (fix sigma)^2

E.g., for a system sigma of 0.45 NM and:

1. A fix sigma of 0.1 NM, then K = 0.9529
2. A fix RPE of 0.1 NM (fix sigma = 0.40854 x 0.1 NM), then K = 0.99992
3. A fix sigma of 0.0 NM, the default of 0.0005 NM gives K = 0.999998

The north and east distances the reset will move the system position (DN and DE) are given by:

Reset = K x (fix - system)

Manual entry of GPS data with a true CEP of 0.01 NM, using fix sigma of 0.0 NM will result in a system gain (and resulting reset) larger than justified. If the fix sigma value cannot be entered exactly, it should be rounded up. The difference in gain is small for a single fix, and application of multiple fixes will converge the system to the fix position even with reduced gains. This problem does not exist with fixes entered via the data interface because the GPS message format allows greater precision of fix variance.

3.2.7.3 Fix Reset Checks. When a fix is entered, the data is checked to be within the following limits:

1. (Position error)^2=(system Lat − fix Lat)^2 + ((system Lon − fix Lon) x cos(fix Lat))^2
2. Error limit = 9 x (SN^2 + FSN^2 + SE^2 + FSE^2)

If the position error squared is greater than the error limit, then Fault Code 209 will be declared. Additionally, the system resets for latitude, longitude, velocity, and various system feedback parameters are checked using appropriate limits similar to the above limit on position error. If a reset exceeds a specified limit, then fault codes in the range 212 to 217 will be declared.

If the fix data is unreasonable, or a reset exceeds a specified limit, the operator should then review the fix DN and DE (the North and East distances the reset will move the system solution), and either correct the fix data or, if the fix data is known to be accurate, accept it and force the reset.

NOTE

> Any position fix for which the resulting radial position reset exceeds 5NM should be reviewed closely before accepting the data for application. Any fix that exceeds the range of the latitude and longitude reset (DN and DE) display (±100 NM) is immediately suspect.

The AN/WSN-7(V) maintains a history of position data to allow fix computations using data obtained up to 60 minutes **prior to the current time**. Fault Code 218 will be declared if the fix data is more than one hour old.

3.2.7.4 Position Slews. The AN/WSN-7(V) provides a facility that enables the operator to slew (update) the system position without causing a system reset. This process does not change KF parameters or underlying system drifts.

When the slew entry facility is selected, the operator is prompted to enter the time of slew and the latitude and longitude to which the system position is to be slewed. When the slew data is entered and accepted, the system checks that the data is reasonable. If the data is reasonable, the system position is updated.

3.2.8 VERTICAL LOOP DAMPING. In the AN/WSN-7(V), reference velocity data is employed primarily to provide damping to the Schuler loops. Damping to the Schuler loop involves:

1. Measuring the difference between system velocity and reference velocity.
2. Multiplying this difference by appropriate gains and filtering operators.

3. Feeding back the multiplied differences as corrections to various system error states.

Examples of possible error states are accelerometer errors, vertical tilts, velocity errors, and gyro drifts.

The damping operation can be “a group of parameters” where the feedback gains are generally constant or Kalman Filter optimal damping can be employed.

If the difference velocity is fed back as a correction to the accelerometer output through an appropriate constant gain and high-pass filter, a third-order damped Schuler loop is obtained. This yields a good damped response and a zero steady-state system error in response to a constant bias error in the Log reference. The AN/WSN-7(V) employs third-order damping as an operator-selected optional mode.

The preferred damping mode in the AN/WSN-7(V) is Kalman Filter optimal damping. Kalman Filter Schuler loop damping is analogous to the previously described grouped parameter damping loop. The feedback gains are time-varying instead of constant. Depending on the expected errors of the inertial sensors and the reference velocity sensors, the feedback gains are optimally determined.

The velocity reference to be used by the system is selected by the operator. It is available from external sources (speed logs or GPS receivers) via the data interfaces or can be entered manually. The selected velocity reference provides the Kalman Filter with water speed or ground speed reference data in the ship water coordinates (fore/aft and port/starboard) or geographic coordinates (north and east). If the port/starboard water speed is not available (as in the case of a single-axis speed log), an estimate of the port/starboard water speed is calculated using the inertial fore/aft velocity, heading rate, and side-slip coefficient. If the Dockside mode is selected, the fore/aft and port/starboard ground speed used by the Kalman Filter is set to 0.0 knots.

The selected velocity reference (after log bias, lever-arm and side-slip corrections are applied) is resolved into appropriate components and compared with the inertial-derived velocities. The differences are multipled by optimal gains in the KF and corrections are fed back into the vertical loops to achieve optimally damped loops.

The KF controls the automatic selection of damping or undamping during turns, or when there is a significant discrepancy between log and inertial solutions. Automatic undamping and redamping are accomplished by applying accept/reject criteria to the filtered inertial reference velocity differences.

The KF damping control can be overriden by operator selection. The operator can force the system to operate continuously in ether an undamped or damped Schuler loop configuration. The damping modes that can be selected by the operator are:

1. Auto – The KF determines the damping status. Damping is automatically removed when the selected velocity reference accurace degrades as a result of maneuvers or signal loss. Damping is automatically reimposed when the velocity reference stabilizes or returns. **Fault Code 222** will be declared if the selected reference velocity is not available, and **Fault Code 223** will be declared if the system has been undamped for 84 minutes or longer.

2. **Manual Damped** – Velocity damping is applied continuously regardless of the quality of the selected velocity reference.

3. **Manual Undamped** – Velocity damping is inhibited.

3.2.9 SENSOR ERRORS AND CALIBRATION. Each individual RLG and accelerometer has a range of instrument errors. The principal errors are:

1. Scale factor (SF). The ratio of change in output to change in input.

2. Bias error. A steady output seen when no input is present.

3. Alignment error. The actual (measuring) axis of the instrument is displaced from the design-input axis defined by its mountings. The result is that the instrument is sensitive in other directions, and the actual output may include pick-up or cross coupling from other inputs.

Many of these errors are temperature-sensitive and are measured by the manufacturer during final production test of the particular sensor. The AN/WSN-7(V) uses a total of seven separate plug-in Programmable Read-Only Memory (PROM)s to hold the manufacturer’s calibration coefficients for each accelerometer and RLG and the IMU Assembly. The calibration PROMs are installed in the IMU Processor board during installation.

3.2.9.1 Factory Calibration. The factory calibration:

1. Normalizes every IMU such that field replacement, without any additional special calibration, is possible.

2. Normalizes the Sensor Block Assembly (SBA) and sensor mounting surfaces (gyro and accelerometer). This is critical to maintain attitude and velocity accuracy during indexing and ship’s motion.

3. Requires the use of special test equipment that may only be available at the manufacturer’s facilities.

4. Stores results on the IMU calibration PROM that is installed on the IMU Processor CCA.

3.2.9.2 Operational Calibration – Self-Align/Calibrate.

3.2.9.2.1 General. The system mathematically aligns inertial sensors with respect to gravity and earth’s rotation (gyrocompassing). The Kalman Filter estimates residual (the portion not already compensated for in either sensor PROM or IMU PROM) sensor biases, scale factors, and misalignments. The Self-Align calibration is key to achieving long-term navigation performance. The Kalman Filter estimates of residual errors make field replacement of sensors and the entire IMU possible.

3.2.9.2.2 Calibration Terms and Definitions. dTHB0 (Gyro A Bias), **dTHB1** (Gyro B Bias) and **dTHB2** (Gyro C Bias):

Axes 0 and 1 are nominally horizontal, and 2 is nominally vertical. These values, as displayed in Factory Interface Monitor (FIM), the Control Display Unit (CDU) (IP-1747) or PAGE 4 item 4 of the operation menu, are total values. This means they are initialized at the values of gyro PROMs and residual amounts are added or subtracted. These values are updated only during a 72-hour calibration; they are not affected during a 20-hour align or in navigate mode. To monitor the gyros, record the gyro bias values displayed on Page 4, item 4 of the operation menu at the beginning of a 72-hour calibration. The values will be stable at 24 hours into the calibration. Record the gyro bias values after 24 hours; a change from the PROM value of greater than 0.020°/hour is suspicious. This could indicate the gyro PROMs are in the wrong position, or the IMU was swapped without changing the PROMs. The estimation process for the C gyro bias is not as repeatable at the A and B gyro bias values. Nonetheless, for a given IMU, gyro biases should repeat to within 0.010°. The exact value of the bias is not very important to an indexed system, but the values may be used as a confidence check of the align/calibrate process.

dTHBN (residual IMU north bias) and **dTHBK** (residual IMU vertical bias):

These residual drifts in the geographic frame should be less than 0.004°/hour in magnitude, and should repeat to within 0.001°/hour. These values are adjusted during navigate after a fix. During align/calibrate, errors in reference latitude on the order of 0.005° or vertical deflections on the order of 20 arc seconds will cause significant shifts in the N and K estimates. These N and K shifts will balance a reference latitude or vertical deflection error and will not seriously affect navigation performance until a large change in latitude has been made. Variations toward the end of the estimation period are typically less than 0.0001°/hour.

KdVB0 (A accelerometer bias) and **KdVB1** (B accelerometer bias):

At the beginning of a 72-hour calibration, these values start at the PROM value just like the gyro biases. The Kalman Filter will begin estimating the horizontal accelerometer bias values about 20 minutes into the 72-hour calibration. Typically, these values settle to within 100-micro-gs of the PROM value. A difference in excess of 200 micro-gs is suspicious. Variation near the end of the calibration period is typically less than 5 micro-gs. Again, recording these values before and after a calibration is a good confidence check of the calibration process. These values are adjusted during a 20-hour align and with very low gain during navigate. Accelerometer biases can be seen at the display menu PAGE 4 item 3.

DVb3 (C accelerometer bias) and **DAM33** (C accelerometer scale factor):

These are calculated by the vertical velocity loop, not the Kalman Filter. The C axis values are only calculated in the dockside mode. Since there is no pitch gimbal, during navigate, the C accelerometer will not necessarily maintain a nominal vertical orientation. The C accelerometer bias should be within 200 micro-gs of the PROM value, and scale factor should stay within ±500 ppm. These quantities are estimated as soon as the system is put into the dockside mode. When the system is taken out of the dockside mode, any vertical velocity error remaining is put into a K bias (dVVBK). The C accelerometer bias value is not important to navigation performance, but will affect attitude and velocity noise with roll indexing.

DGM11 (A gyro scale factor), **DGM22** (B gyro scale factor) and **DGM33** (C gyro scale factor):

DGM11 and DGM22 are estimated by the Kalman Filter starting about an hour into the Align/Calibrate and are frozen after 24 hours. These values are not adjusted during a 20-hour align or in navigate. DMG33 is currently not used by the system. RLG scale factor is extremely stable; variations greater than ±10 ppm would be unusual. The Kalman Filter estimates the difference values between the factory PROM established values. The values should be less than 50 ppm in magnitude and are typically less than 10 ppm.

DGM12 (gyro A misalignment into B), **DGM13** (gyro A misalignment into C), **DGM21** (gyro B misalignment into A), **DGM23** (gyro B misalignment into C), **DGM31** (gyro C misalignment into A) and **DGM32** (gyro C misalignment into B):

These are the remaining deltas after factory calibration has corrected for sensor block mounting surfaces and gyro input axis corrections. These values are typically less than 100 micro radians and repeat within 20 micro radians. If a gyro is remounted, the value may change by more than 20 micro radians, but will tend to stay below 100 micro radians; this is also true if a gyro is replaced. These values are estimated beginning 1 hour after calibration begins and will be frozen after 24 hours. These values are not adjusted during a 20-hour align or in navigate.

3.2.9.3 Self-Align/Calibrate. When the system is started up, the contents of each calibration PROM are copied to the Nav Processor working area [Random Access Memory (RAM)].

The two-axis indexing pattern used in the AN/WSN-7(V) makes specific inertial sensor biases, misalignments and scale-factor errors observable against dockside and at-sea reference velocity and position data. To achieve this self-calibration capability, the following states are incorporated in the Kalman Filter:

- A Gyro bias
- A Gyro scale-factor
- A-to-B Gyro misalignment
- A-to-C Gyro misalignment
- B Gyro bias
- B Gyro scale-factor
- B-to-A Gyro misalignment
- B-to-C Gyro misalignment
- C Gyro bias
- C-to-B Gyro misalignment
- C-to-A Gyro misalignment
- A Accelerometer bias
- B Accelerometer bias

The Kalman Filter estimates and self-calibrates all the above states as their effects in response to indexing motions are observed. The C accelerometer bias and scale factor are monitored by the vertical velocity loop. The initial 72-hour dockside calibration align period after system installation is sufficient to self-calibrate all of these parameters to acceptable levels. A 20-hour align uses previously calculated values and does not modify those values, except the accelerometer bias values.

During Dockside Align, the system uses the roll and azimuth indexing motions to separately put the A, B, and C sensors into test positions. The Kalman Filter and vertical velocity loop can then measure the actual instrument bias, scale factor, and misalignment errors against known Earth rates and local gravity (by measurement in the vertical, then inversion and remeasurement), and develop additional refinements to the calibration coefficients provided by the sensor PROMs. The final calibrated values are stored in battery-backed RAM on the Nav Processor board and are applied thereafter to correct the (raw) sensor readings back to absolute (true) values on which navigational calculations can be based. Subsequent align periods can then be reduced to 20 hours. If an inertial component is replaced, or the battery-backed RAM data is lost or invalid, then another 72-hour calibration align period is required.

3.2.9.4 Summary.

The 72-hour calibration:

1. Is a true calibration mode.
2. Calculates and applies all bias values and scale factor corrections.
3. Is entered whenever no valid calibration data exists, after Kalman reinitialization, after IMU or sensor replacement, or after loss of memory (battery disconnected or Navigation Processor Memory CCA replaced). Calibration data may be retrieved from the other system if the INS-INS link is active, bypassing the need for a 72-hour calibration.
4. Should be initiated (time permitting) whenever operator believes previous calibration data may be corrupted.

The 20-hour align:

1. Is only an alignment mode, and uses previous calibration data.
2. Only adjusts the accelerometer bias values.

3.2.10 KALMAN FILTER REINITIALIZATION. Reinitialization of the Kalman Filter resets all sensor calibrations to their stored PROM values. A 72-hour calibration period is required following a KF reinitialization before the system is available for precision navigation. KF reinitialization can be automatic or can be manually selected by the operator.

3.2.10.1 Automatic Reinitialization of the Kalman Filter. The Kalman parameters from the last Dockside Align are held in battery-backed RAM on the Nav Processor board. If the Nav Processor board has been replaced, or if the system fails its battery-backed RAM checksum test during the initialization sequence, the stored sensor calibration parameters are not usable, and the system will automatically cause a KF reinitialization to occur.

If an inertial sensor has been replaced, various calibration parameters need to be redetermined. When the system is started up, the software compares the serial numbers of the calibration PROMs with the values stored in the battery-backed RAM. If any differences are detected, the system assumes that an RLG or accelerometer (or the complete IMU Assembly) has been replaced and automatically causes a KF reinitialization to occur.

If a 72-hour calibration has not been completed, optimum calibration of all parameters has not occurred. The system automatically causes a KF reinitialization to occur when the system is turned on or when Dockside Align mode is next selected.

3.2.10.2 Manually Selected Reinitialization of the Kalman Filter. The operator can manually select a KF reinitialization by following the appropriate menu procedures.

If an align process is not successful (as indicated after one hour in align by velocity differences greater than 0.05 knots in Dockside Align mode or KF faults), system recalibration should be carried out using an appropriate align mode and KF reinitialization. Full calibration will be restored by Dockside, Slave, or At-Sea Align 72-hour align.

If navigation performance shows abnormal errors (excessively large position errors or KF faults), recalibration should be carried out using an appropriate align mode and KF reinitialization. Full calibration will be restored by Dockside, Slave, or At-Sea Align 72-hour align.

3.2.11 SENSOR BLOCK INDEXING. The sensor block is periodically rotated within the Indexer Assembly in a specific sequence designed to enhance system performance by averaging out, or commutating gyro/accelerometer biases on all three axes and averaging out many other error sources. Reorientating the sensor block allows the software to correct for long-term errors and allows mechanical biases to be averaged out.

Roll and azimuth indexing is achieved by two servo-controlled loops. Overall control of the indexing sequence is carried out in the Nav Processor software, and this includes both the desired angle (the indexing sequence plan) and the comparator (feedback) function of generating servo drive signals during the movement phase.

For the first 80 seconds of operation following startup and initialization, the sensor block is positioned by being driven in roll and azimuth to null the synchro outputs before the indexing sequence is started.

There are 64 distinct indexing cycles (phases) to the indexing sequence. During the later stages of align and during Navigation, every 5.0 minutes the sensor block is moved through ±90° or ±180° in roll or azimuth. The sensor block passes through all 64 phases in 320 minutes and the sequence is then repeated. If the next phase in the profile specifies that a failed axis is to be slewed, the indexing is advanced again until a non-failed axis is slewed.

During indexing, the software checks for excessive azimuth and roll rates. If an excessive rate is identified, a fault is declared and the appropriate torquer is disabled. The software also checks for non-follow-up of torque commands. If non-follow-up is detected, a fault is declared and the appropriate torquer is disabled.

The periods between the indexing motions are referred to as the dwell periods. During dwell periods, the sensor block is maintained at the attitude specified by the indexing profile for a predetermined time before being indexed to a new orientation.

Roll motions are stabilized against ship motions by outputs from the strapdown process. This apparent coarse BMI is not vital to attitude or short-term navigation, but ensures ship motions do not negate an indexing move and unbalance the overall cycle, to the detriment of long-term performance.

If the indexer motions become faulty, each indexer can be disabled by the operator via the front panel. Loss of one (or both) indexer motions will not immediately affect navigational performance, because the gyros and accelerometers continue to monitor any changes in sensor block orientation; however, it would degrade long-term accuracy because some errors and drifts are no longer physically averaged out.

3.2.12 BASICS OF POLAR NAVIGATION. Use of the normal (true) coordinate system is impractical for navigation at the Earth's poles because:

1. True longitude and true heading are indeterminate
2. True longitude rate and true heading rate become infinite
3. True heading accuracy deteriorates (varies as sec L)

One solution is the use of a transverse coordinate system for polar region operation.

3.2.12.1 Relationships Between True and Transverse Coordinates. The following relationships between true and transverse coordinates are obtained by spherical trigonometry:

- cos LatT sin LonT = cos Lat sin Lon
- sin β cos Lat = sin LonT
- sin β cos LatT = sin Lon
- sin Lat = cos LatT cos LonT
- sin LatT = -cos Lat cos Lon
- cos Lat cos β = -cos Lon T sin LatT
- cos Lon sin Lat = cos LatT cos β

Where β is the angle between true north and transverse north from the current position.

Using the above relationships, one can obtain true latitude and longitude in terms of Transverse Latitude and Transverse Longitude and vice versa.

For example, the coordinates of SPAWARSYSCEN in Norfolk, Virginia, are:

Lat = 36° 55.14 NLatT = -11° 00.32 S

Lon = -76° 11.13 WLonT = -052° 16.21 W

Transverse Coordinate Frame Rates to Maintain Transverse North-Oriented, Local Level Platform

WNT = -WE cos IT sin LT + IT cos LT (1)

WET = -WE sin IT − LT (2)

WKT = -WE cos IT cos LT − IT sin LT (3)

3.2.12.2 Operating in Polar Mode. At high latitudes the AN/WSN-7(V) operates using a transverse coordinate system (Polar mode). The Polar mode can be selected to activate automatically when true latitude is greater than 86°, and to deactivate when latitude is less than 84°. The polar mode can also be manually selected.

In the vicinity of true pole, polar heading is decoupled from both transverse latitude and transverse longitude. A position fix will not correct polar heading and polar heading error builds up as integral of z-axis gyro drift. Because of two-axis indexing, which averages out z-axis bias drift, polar heading accuracy is inherently better in AN/WSN-7(V) than in other navigators. Polar heading error in AN/WSN-7(V) builds up as A_t, due to white noise random drift (which is not averaged out). In most other systems, polar heading error builds up as t or t^2.

Polar Mode Algorithms include the following operations:

1. Strapdown computations maintain attitude direction cosine matrix relative to a transverse frame.
2. Euler angle extraction of this matrix yields roll, pitch, and polar heading.
3. Accelerometer outputs are transformed by the transverse DC matrix, yielding transverse coordinate accelerations.
4. Transverse accelerations are integrated to yield transverse velocities.
5. Transverse velocities are integrated to yield transverse latitude and transverse longitude.
6. Earth rates and transport rates are obtained as functions of transverse parameters.
7. Kalman Filter operates in transverse coordinates with transverse position fix resets.
8. True coordinates are derived for display purposes.

The indexing sequence ensures that the sensor block (and C gyro/accelerometer) is either upright or inverted, and this is used to self-calibrate the C accelerometer bias and scale factor corrections. Indexing involves rotating the sensor block through eight possible orientations relative to vehicle frame.

3.2.13 NORMAL/TRANSVERSE OPERATION. The AN/WSN-7(V) can be operated either using the normal (true) coordinates of conventional latitude and longitude, or in transverse (polar) coordinate mode. The transverse mode is designed for use in polar regions with the transverse pole (imaginary pole) located on the equator at 180° E/W.

3.2.13.1 Coordinate Mode Selection. Selection of the required coordinate mode is made by the operator. Possible selections for the coordinate mode are:

1. **AUTO** − The system automatically changes mode based on geographic coordinates. This is the usual operating setting. The change from normal to transverse (polar) takes place at 86° going north, but reverts back to normal mode at 84° going south. This 2° hysteresis avoids excessive mode changes for vessels operating near the changeover latitude.
2. **MNORM** − The system is forced to operate in the normal mode. A fault is declared if the system latitude >86°.
3. **MTXVS** − The system is forced to operate in the transverse (polar) mode. A fault is declared if the system transverse latitude >86°.

The operator can elect to have position and heading information displayed in either normal or transverse (polar) coordinates regardless of the current coordinate mode without changing the system coordinate mode.

3.2.13.2 Synchro Heading Output Selection. AN/WSN-7(V) systems that are configured with synchro data output provide a facility which allows the operator to select a different reference coordinate frame for the synchro output of heading from that selected for digital heading output. The coordinate mode for synchro heading output can be set to follow the system coordinate mode, or can be set to normal or transverse independent of the system coordinate mode.

Navigate or At-Sea align: Only adjusts the accelerometer bias and residual north and vertical bias, with lower gain. Residual north and vertical bias are only adjusted with a fix.

3.2.14 REVIEW OF TRIGONOMETRIC FUNCTIONS. From Table 3-1 it can be seen that:

1. The value of functions that are affected is directly proportional as the Sin of latitude is minimum at the equator and will increase as latitude increases.
2. The value of functions that are affected is directly proportional as the Cos of latitude is maximum at the equator and will decrease as latitude increases.
3. The value of functions that are affected is directly proportional as the Tan of latitude is minimum at the equator, will increase as latitude increases, and become indeterminate at the north (or south) pole. This condition requires the use of a special navigation reference mode when operating at high latitudes.

3.2.15 INERTIAL NAVIGATION VECTORS. Vectors are parameters that have both magnitude and direction.

The vectors of importance to inertial navigation will be dealing with linear acceleration and angular rotation rate. Each of these vectors can be measured in practice by instruments that have their input axes directly along the axes of the coordinate frame in which the vector components are to be evaluated.

In the case of the angular rate vector, gyroscopes are used to measure each angular rate component. If the gyros utilized are single-axis sensing instruments, three gyros will be needed to measure each of the three X, Y, Z angular rate components along the axes of the selected coordinate frame.

In the case of the linear acceleration vector, accelerometers are utilized to measure the acceleration components. Typically, three accelerometers are utilized to measure each of the three X, Y, and Z components of the acceleration vector along the selected coordinate frame axes.

3.2.16 CONCEPTS OF STATISTICAL ESTIMATION, OVERVIEW OF KALMAN FILTER. Inertial navigators develop errors as a function of operating time. Errors result from initial misalignments or from physical (gyro) imperfections, which cause drift rates that can change with time. These output errors characteristically propagate in predictable patterns. To ensure that the output remains within accuracy requirements, it is necessary to periodically correct these outputs. This process of computing and applying the correction is called resetting.

The basic method developed and still in use for some inertial navigators is the three-fix reset technique. This method requires three fixes within a 24-hour period to compute the necessary corrections and makes the following assumptions: (1) the fixes are error free, and (2) the apparent drift rates of the gyros are essentially constant.

As the accuracy of inertial navigators increased, different reset techniques were developed. All of these were basically a refinement of the three-fix reset technique until 1960 when Doctor R. E. Kalman introduced his concept of optimum estimation. His approach has proven to be particularly well-suited for optimizing the performance of modern inertial navigation systems.

By adopting the Kalman Filter, measurement errors (errors in the fix) and system noise (random changes in the apparent gyro drift rates) can be compensated for when calculating reset computations. The purpose of this section is to discuss the basic concepts of the Kalman statistical estimation process.

3.2.16.1 Statistics and Variance. The averaging of quantities in an effort to obtain the true value and to reduce the effect of random error is the simplest form of statistical estimation. The following example of the use of averaging will illustrate some of the fundamental concepts of statistical estimation:

It is desired to use a tachometer to measure the rpm of a precision constant-speed electric motor, nominally rated at 100 rpm ±1 rpm. It is also known that the tachometer used has an error nominally in the range of ±3 rpm. As a result, a series of five rpm measurements might yield the following values:

(1) 103.0 rpm

(2) 101.2 rpm

(3) 98.0 rpm

(4) 96.0 rpm

(5) 101.0 rpm

All the measurements seem to be reasonable in view of the = 3.0 rpm error of the tachometer and the = 1.0 rpm uncertainty in the value of the motor speed. The average of the five tachometer measurements (99.84 rpm) would be considered the best estimate of the actual motor speed. If the true motor speed was exactly 100 rpm (constant for all five measurements), then the error in the estimate would be -0.16 rpm - a considerable improvement over the nominal tachometer error -3.0 rpm.

The averaged tachometer measurement of 99.84 rpm is considered the best estimate because it is implicitly assumed that (1) the tachometer errors are random in nature and that they tend to cancel each other if averaged, and (2) the motor speed is constant. This demonstrates an important principle: the use of any statistical estimation technique (of which averaging is one example) requires that something be known (or assumed) about (1) the statistics of the measurement errors (in the preceding example, the average value of the tachometer errors tends to become more accurate (and decrease) as the number of averaged measurements increases), and (2) the statistics of the variations in the value of the quantity being measured (in the preceding example, motor speed) is assumed constant.

The confidence that one has in the average value of a set of measurements depends upon the amount that the individual measurements differ relative to the average. The larger the differences, the greater the chance that the error in the average will be large. The sample variance is a measure of the range of variation of the measurements. The larger the sample variance, the more likely that the measured average value differs from the true value by a given amount.

The sample variance for the given set of motor speed measurements listed in column 1 of Table 3-2, is determined as follows

1. The average value of the set of measurement X_i is computed by summing the entries and dividing by the number of entries as in column 1. (The result is called the sample average as distinguished from the true average that one would obtain from an extremely large set of measurements made with many tachometers.)
2. The variation of each measurement $\Delta\sigma$ from the previously computed sample average is obtained next. It is given in column 2. (The average of the variations $\Delta\sigma_{avg}$ cannot be used to measure the range of the variation because it is generally near zero due to ± sign changes.)
3. The square of the variation is given in column 3. The average value of the square of the variation is known as the sample variance.
4. Because the square of the variation is always positive and because it is mathematically relatively easy to use, it is the conventional measure of the statistical variability of a single measurement. In the example given in Table 3-2, the sample variance $(\Delta\sigma)^2_{avg}$ is 5.636 rpm. The symbol σ^2 is used to designate variance $\sigma^2 = (\Delta\sigma)^2$.

The square root of the variance, σ is called the standard deviation. For the example, the sample standard deviation is 2.374, and, to a first approximation, 68 percent of all measurements of motor speed will be in the range 99.3 ±2.374 rpm.

NOTE

In the same way that the sample average is an approximation to the true average, the sample variance is an approximation to the true variance - that is, the average square deviation that one would obtain from an extremely large set of measurements taken with many instruments. Techniques are available to determine the number of measurements required to yield a computed variance which is within any desired accuracy of the true variance. In INS applications, past INS performance and careful experimentation are used to compute the variances of performance parameters.

The sample standard deviation can also be used to estimate the error in the measured average motor speed. The true motor speed can be expected, with about 95% confidence, to be within the range,

$$\left[\frac{2(\Delta\sigma)^2 \, avg}{n-1} \right]^{½}$$

where n is the number of measurements in the set used to determine X and $(\Delta\sigma)^2_{avg}$.

where n is the number of measurements in the set used to determine X and $(\Delta\sigma)^2_{avg}$.

For the example given in Table 3-2, the true motor speed lies in the range 99.3 ±1.119 rpm.

In the preceding example of the measurement of motor speed, however, not all of the information was used in the averaging method to arrive at its best estimate of motor speed. The information not used was (1) the nominal error (that is, the expected error) in any individual tachometer measurement was ±3.0 rpm, and (2) the nominal error of uncertainty (the expected error) in the motor-speed rating was ±1.0 rpm. In the Kalman Filter technique, this extra information is used to develop more valid estimates than would be possible by ordinary arithmetic averaging. Before describing the Kalman Filter technique (in terms of the preceding example of the measurement of motor speed), however, it is necessary to examine the nature of the expected errors as follows:

The values of the expected errors in the tachometer measurements and in the motor-speed rating are derived from a statistical analysis of tachometer errors and motor-speed variations, respectively. Reduced to its essentials, statistical analysis can be described as the tabulation (or plotting) of the relative frequencies - that is, the probabilities of the occurrence of events. To say that a particular event has a 25% probability indicates that, over a long enough period of time, the event will occur 25% of the time. In the case of the tachometer measurements, this would be the plotting of the relative frequencies of occurrence of values of tachometer errors.

3.2.16.2 Philosophy of Kalman Filter. The concept of the Kalman Filter can be explained by analogy to the simpler process of averaging. The Kalman filter will be shown to reduce to a form of averaging. Given the nominal rating of the motor speed (100.0 rpm) and the (first) tachometer reading of 103.0 rpm, an estimate of the actual value of the motor speed can be obtained by averaging the nominal rating and the tachometer reading of the motor speed. (Making an estimate in this way by averaging is reasonable because the expected error in the nominal rating is equal to, or smaller than, the nominal error in the tachometer measurements.) Thus,

(1)

$$rpm_2 = \frac{100.0\ rpm + 103.0\ rpm}{2} = 101.5\ rpm$$

Estimate rpm_2 is subscripted 2 because it is the second estimate of true value. The nominal rating is the first estimate of the value.

Equation (1) can be rearranged in the following manner to yield the same results.

(2)

$$rpm_2 = rpm_1 + ½\,[(rpm\ meas)_1 - rpm_1] = 101.5\ rpm = 100.0\ rpm + ½\,[103.0\ rpm - 100.0\ rpm] = 101.5\ rpm$$

The averaging factor is 1/(n+1). It can be shown that if the expected errors in tachometer readings and in nominal rating are the same, the Kalman weighting factor can be reduced to the form of the averaging factor.

In general, the estimates produced by averaging a series of quantities can be calculated by using a recursive (iterative) relationship. For the motor speed problem, this relationship is given as follows:

(3)

$$rpm_{n+1} = rpm_n + 1/(n+1)\,[(rpm\ meas)_n - rpm_n]$$

From the preceding discussion, it is apparent that the Kalman Filter technique is a recursive form of averaging, using a different weight factor. The Kalman weighting factor takes into account the facts known about the particular error statistics involved. (Conversely, the averaging factor can be said to be a Kalman weighting factor which assumes equal errors in measurement and nominal rating.) Note that the Kalman weighting factor used in the motor-speed example takes into account the relative inaccuracy of the tachometer because it gives weighting of 0.1 instead of 1/2 (that is 0.5). (The choice of 0.5 would imply that tachometer error and motor-speed variation have the same variance.)

These estimates are generated by a prediction process and then updated (correctly) by a measurement process. Based on either prior operating experience and/or engineering analysis, a prediction can be made of the nominal system values existing at a particular time. Thereafter, in the absence of information provided by external measurements, knowledge of the dynamics of the system is used to form a math model of the system. The math model is used to extrapolate the predictions - i.e., predict new values. The accuracy of these predictions (estimates) can be improved by use of external measurements. That is, if some or all of the system values at a particular time can be measured, the measurement can be compared with the prediction (estimate) of the system values for that time. The difference (called the measured error) between the measured and predicted values is a measure of the error in the predictions.

The application of the Kalman Filter enters at this point. Since both the prediction and the measurement process may be subject to error, neither the predicted nor the measured values may be the best estimate of the true values. The weighted average is the best estimate of the true value.

3.2.17 GLOBAL POSITIONING SYSTEM (GPS) BLENDING

3.2.17.1 Global Positioning System/Inertial Navigation System Filter. Inertial navigators exhibit position errors on the order of hours and days due to Schuler oscillations and the 24-hour Earth oscillation. In the short term, however, inertial navigators are quite stable. In contrast, the GPS provides excellent long-term stability, but a significant amount of short-term variation. Combining INS and GPS position information can yield an estimated position that is stable and accurate in all time scales.

The INS output position is revised by applying a correction based on the difference between INS estimated position and a GPS fix. Whenever the AN/WSN-7(V) fix mode is AUTO or AUTO/REVIEW and regular, frequent GPS fixes are available, the software continuously updates an estimate of the north and east INS/GPS position differences. By applying these differences to the INS positions after the final stage of the Kalman filter, the AN/WSN-7(V) is able to provide reliable Estimated Position (EP) that are within a few meters of GPS.

3.2.17.2 INS Reset Smoothing. Application of a GPS reset can result in a change of several tens of meters in the Kalman filter estimated INS position. This abrupt displacement can have a detrimental effect on systems which rely on receiving continuous, accurate, and smooth estimated positions. To mitigate these effects, application of the reset is applied gradually during the minute immediately following the Kalman update.

3.2.17.3 INS/GPS Filtering and Reset Smoothing Together. To illustrate the combined effects applying the INS/GPS filter and reset smoothing, refer to Figure 3-12. In Figure 3-12, view a, we see the behavior of a typical INS that is experiencing, for the purposes of illustration, an exaggerated V_n (north velocity) error. In Figure 3-12, view b, a reset has been applied which brought the INS EP nearly back to the GPS fix position. However, the continued V_n error causes the INS EP to walk back away from the ship's track. If this is continued, as in Figure 3-12, view c, a sawtooth effect is seen, where successive GPS fixes correct the INS EP, only to have the estimated position continue to diverge from the track.

In Figure 3-12, view d, we see the effects of reset smoothing. The dashed line is a representation of where the INS estimated position would have been if no reset had been applied; the V_n error would cause the EP to continue to diverge from the nominal track. With reset smoothing in effect, the magnitude and direction of the Kalman reset are calculated as in a typical INS. However, rather than immediately applying the complete reset, successively larger proportions of the reset are applied over the interval between fixes. As can be seen in Figure 3-12, view e, this has the effect of eliminating the sawtooth track of the EP.

Note, however, that velocity errors can result in an INS estimated position that differs from GPS. Nearly all of the remaining difference between the INS EP and GPS can be eliminated by measuring the residual INS/GPS north (and east) offset and then combining successive measurements into an estimate of the offset at the time of a new GPS fix. By incorporating a low-pass filter into the model of the estimator, both residual INS offset and high frequency (short time period) GPS position variations can be nearly eliminated, as illustrated by Figure 3-12, view g.

In Figure 3-12, view h, the Geographic Plot illustrates the ship's track, GPS fix position, and Smoothed INS/GPS track. For this example, the ship is on an approximate northerly course, turns clockwise, and steadies on an approximate southerly course. GPS fix data has variations throughout the example shown. By utilizing the smoothed reset data, the INS track closely approximates the true track of the ship, without the short-term variations of GPS. This provides gradual correction to the INS rather than stepped changes.

3.2.17.4 Lever Arm Corrections. In most surface AN/WSN-7(V) installations, one NTDS output channel of the ship's GPS receiver is routed to one of the two RLGN systems, typically the AFT RLGN. The second system receives GPS fix information by way of the RS-422 RLGN-RLGN data link. The GPS receiver is presented with lever arm distances and INS attitude information that allow it to correct its output position to the IMU of the controlling RLGN. That system then applies the necessary lever arm corrections for the other RLGN before placing the fix information onto the RLGN-RLGN link. As a result, each RLGN receives periodic position updates that are correct for, or referenced to, each IMU.

In the submarine AN/WSN-7A(V) configuration, the NTDS outputs from both GPS channels are routed to system 1 and system 2 independently. Lever arm corrections for unit 1 and unit 2 are applied by each of the system's processors for periodic position updates that are correct for, or referenced to, IMU 1 and IMU 2, respectively.

SECTION II
EQUIPMENT DESCRIPTION

3.3 RLGN FUNCTIONAL DESCRIPTION.

The AN/WSN-7(V) INS is based on the principle of using the standing waves generated in a closed path laser beam to detect angular rotation of an inertial reference platform. Three RLGs (or gyros) are mounted perpendicular to each other to detect rotation of an inertial platform about the X, Y, and Z axes. Three accelerometers, one mounted parallel to each axis of rotation, detect motion of the inertial platform in each axis. The rotation and acceleration motions are processed by an internal computer, which determines the orientation and velocity vector of the inertial platform.

Updated by receiving periodic position fixes from a navigation reference such as a GPS receiver, and ship's speed information, the RLGN provides continuous high accuracy geographic position, platform attitude, acceleration, and velocity data for use by other equipment which require these data as inputs.

3.3.1 BASIC DESCRIPTION OF RING LASER GYRO OPERATION. The following discussion is intended to provide a basic knowledge of the manner in which an optical device can be utilized to provide an inertial reference and to outline the design criteria which must be met to implement this function.

Using light to measure rotation is based on the principle that since the speed of light is constant, the time required for a light beam to traverse a given distance is independent of motion of the medium in which the light is traveling. For this reason, if the light beam were to travel around a circular pathway, the time required to complete one revolution (360 angular degrees) would be independent of whether the pathway were stationary or rotating.

As an analogy for using this effect to measure rotation, suppose that an observer on the pathway emits two beams of light in opposite directions and then measures the time required for each beam to complete one revolution and return to the observer's position. If the pathway is stationary, both beams would be received back at the observer's position at the same time. This condition is shown in **Figure 3-13**, A. If the pathway is rotating, however, the observer moves toward one beam and moves away from the other beam while the beams are traversing the pathway. If the pathway is rotating in the same direction as the light beam, the path length back to the observer is effectively lengthened. Conversely, if the pathway is rotating in the direction opposite to the light beam, the path length back to the observer is effectively shortened. The time difference between reception of the two beams would be a measure of the rate at which the path is rotating, and the sequence in which the beams are received would indicate the direction of rotation. This condition is shown in **Figure 3-13**, B. The rotation-induced difference in path length is referred to as the Sagnac effect.

In actual practice in an RLG, the circular path is replaced with a polygon path (triangular in the case of the INS) which is constructed using mirrors at each corner of the polygon. The pathway consists of a sealed channel, which is filled with a mixture of gasses that emit light when ionized. High voltage applied to electrodes in the channel ionizes the gas and causes lasing action. When the ring is stationary, lasing in the ring generates a standing light wave, which is analogous to two counter-propagated light beams. The interference between the beams generates a series of nodes (stationary points or points of minimum intensity) and antinodes (points of maximum oscillation) as shown in the left view in **Figure 3-13**, C. Because the frequency of the laser is very high, more than a million nodes and antinodes are generated in a path less than one-half meter in circumference.

When the frame to which the laser path is attached rotates, the standing wave in the path remains fixed in an inertial (non-rotating) frame of reference. In the analogy, an observer rotating with the ring would pass the nodes and antinodes of the standing wave as the path rotated. By counting the number of nodes passed (and by knowing the time and distance between nodes), the observer could accurately determine the rate and angle of rotation (right view in **Figure 3-13**, C).

3.3.2 BASIC RLG DESIGN CRITERIA. While the principles behind the RLG are rather simple, several problems must be addressed before these principles can be implemented in an actual rotation sensor. These problems and their solutions are outlined in the following paragraphs to provide a background for understanding the function and operation of circuits which are described later in this chapter.

3.3.2.1 Gas Flow. In an idealized gyro, the standing wave generated in the light beam would remain stationary when the path was not rotating. In actual practice, flow of the ionized gas inside the ring produces a bias effect which causes the standing wave to rotate even when the ring is stationary. The gas flow is a result of the high voltage between the cathode and anode used to ionize the gas. Electrons in the gas drift toward the positive anode and positive ions drift toward the negative cathode. This action induces net flow in the neutral atoms in the gas around the ring. To compensate for this effect, a balanced ionization circuit is used which consists of one cathode and two evenly spaced anodes placed on opposite sides of the ring. By measuring the current in each ionization path and controlling the ionization voltages, counter-rotating motions of the electrons and ions can be established which cancel the induced flow of gas in the ring.

3.3.2.2 Frequency Locking. Another problem is frequency locking of the standing wave. At low rotation rates, the standing wave tends to lock to the ring and move with the ring as the ring rotates. This effect is analogous to friction in a mechanical gyro. Frequency locking is caused by the backscatter of photons at the mirrors. If the mirrors were perfect reflectors, the laser beam would propagate around the path without any photons being reflected back along the incident path. In practice, a small percentage of the incident light wave is backscattered from the mirror surface and is 180 degrees out of phase with the incident wave. This phase shift causes the beam to "want" to reflect at a node on the mirror surface. At low rotation rates, the node generated at the mirror surface tends to move with the mirror, causing the standing wave to move with it. The effects of frequency locking are eliminated by mechanically rotating (dithering) the optical path back and forth at a high rate. This action maintains a high rate of motion in the gyro even when the platform is rotating at a very low rate. Since no net rotation is introduced by the dithering action, the effect of dithering is canceled in the processed signal.

3.3.2.3 Path Length Control. The intensity of a laser beam is dependent on the spacing of the reflective surfaces as a multiple of the wave length of the light. Ideally, if the positions of all mirror surfaces in a laser could be fixed so that the length of the lasing path was held constant at exactly some multiple of the wave length of the light, the laser would operate at maximum efficiency and intensity. Stability of the laser path length is maintained primarily by using a material for the laser which has a very low coefficient of expansion. In addition, the RLGs in the RLGN utilize dynamic mirror positioning known as Path Length Control (PLC) to adjust the path length. In this design, two of the mirrors are mounted on piezoelectric transducers which allow them to be moved inward or outward to adjust the path length. Circuits in the system constantly monitor laser intensity and apply bias voltages to the piezoelectric transducers which position the mirrors to maintain maximum intensity of the beam.

3.3.2.4 Random Drift Improvement. Mirror quality also affects operation of the gyro. In addition to using the most advanced techniques available to ensure high mirror quality, the RLGs used in the RLGN employ the dynamic positioning capability of the gyro mirrors to dynamically reposition the laser beam on the mirror surfaces. This is done by differential positioning of the two adjustable mirrors such that the laser ring is shifted in position across the mirror's surface without changing the total path length. This function, known as Random Drift Improvement (RDI) finds the best surface on the mirrors and reduces mirror degradation resulting from positioning of the beam at a static point on the mirror's surface.

3.3.3 GENERAL DESCRIPTION OF FUNCTIONS. (Refer to **Figure 3-14**.) The RLGN consists of a Display and Keypad Assembly, power switching and conditioning circuits, alarm relay circuits, electronic circuits associated with control data processing and Input/Output (I/O) functions, electronic circuits associated with position sensing functions, and the electronic circuits and subassemblies contained in the IMU. The RLGN can be controlled at either the Display and Keypad Assembly on the RLGN cabinet, or from the IP-1747/WSN CDU, which is remotely located from the RLGN cabinet. The Display and

Keypad Assembly, the subassemblies associated with power switching and DC power supply, the SBAs, and the fault relays are mounted directly to the RLGN cabinet. All other electronic subassemblies are mounted in three printed circuit card racks and are interconnected by backplane wiring boards. Each rack contains Circuit Card Assemblies (CCAs), which are grouped by the overall operating function performed by the collective circuits; these are:

1. Nav Processor
2. I/O Processor
3. IMU Support Electronics

All three card (CCA) racks are mounted on the inside of the Processor Cabinet Assembly door.

3.3.3.1 Nav Processor. The Nav Processor rack contains the RLGN central processor with control program memory and control program. All data is transferred between the central processor and functions contained on other CCAs in the Nav Processor via an address and data bus on the backplane. Data transfer and control functions performed by other circuits in the Nav Processor consist of: serial (RS-422A) interface to the local and remote Display and Keypad functions, dual port memory interface to the I/O Processor, and serial (RS-422A) data interface to the Support Electronics function.

In addition to the system control and navigation processing functions, circuits in the Nav Processor also perform the following:

- Monitor power and system fault status
- Control setting of status and alarm relays
- Provide synchro-to-digital conversion for synchro speed input
- Provide digital-to-synchro conversion of heading, roll, and pitch attitude data output to the SBAs
- Provide digital-to-synchro conversion for output of velocities
- Control the gimbal torquer motors to rotate the Sensor Block in the IMU

The Nav Processor rack consists of Wirewrap Backplane Assembly (**1A1A11**) and the following CCAs:

1. Nav/Central Processor CCA (**1A1A13**)
2. Status and Command CCA (**1A1A15**)
3. Dual Panel Interface CCA (**1A1A16**)
4. IMU Interface CCA (**1A1A17**)
5. Torquer CCA (**1A1A18**) (roll)
6. Torquer CCA (**1A1A19**) (azimuth)
7. Bus Interface CCA (**1A1A20**)
8. Asynchronous Transfer Mode (ATM) CCA (**1A1A4**)

RLGNs with synchro attitude (heading, roll, pitch) output, synchro velocity output, and synchro speed input also contain the following CCAs in the Nav Processor card rack:

1. Synchro Converter CCA (**1A1A38**) (1X/36X heading output, 1X/10X total velocity output, and synchro speed input)
2. Synchro Converter CCA (**1A1A39**) (2X/36X roll and 2X/36X pitch output)
3. Synchro Converter CCA (**1A1A40**) (1X/10X V_n and 1X/10X V_e velocity output)

3.3.3.2 I/O Processor. The I/O Processor rack contains a central processor with program memory and I/O control program. All data is transferred between the processor and functions contained on other CCAs in the I/O Processor via an address and data bus on the backplane. Data transfer and control functions performed by other circuits in the I/O consist of an RS-422A serial interface to communicate between two navigation systems and the dual port memory, which provides the data interface to the Nav Processor.

The basic I/O Processor rack with the digital (RS-422A) data interface consists of I/O Processor Backplane Assembly (**1A1A12**) and the following CCAs:

1. I/O Processor CCA (**1A1A21**)
2. Dual Panel Interface CCA (**1A1A14**)
3. Dual Port Memory CCA (**1A1A23**)

Depending on the system I/O requirements, up to eight Naval Tactical Data System (NTDS) standard interface assemblies can be installed in the I/O Processor card rack. The backplane is configured such that any type NTDS card can be installed in any NTDS location in the rack. Interface cards that provide parallel data (Type A) interconnect to a connector plate on the cabinet via corresponding jacks on the I/O Processor Backplane Assembly. Interface cards that provide serial data (Type E or Type D) interconnect to the connector plate directly via coaxial cables and edge connectors on the circuit cards.

3.3.3.3 Support Electronics. The Support Electronics rack consists of circuits associated with the following:

- Control of the sensor functions, processing, and conversion of data from the RLGs and accelerometers
- Detecting the rotational position of the Sensor Block Assembly from the gimbal synchros
- Detecting faults in the Support Electronics circuits
- Sensor functions and data communication with the Nav Processor

The Support Electronics rack contains a local DC power supply, which operates from 28 Volts, Direct Current (VDC) and supplies power to all other circuits and subassemblies in the Support Electronics rack and the IMU.

The Support Electronics consists of Support Electronics Backplane Wiring Assembly (**1A1A30**) and the following CCAs:

1. Support Electronics Power Supply (**1A1A37**)
2. IMU Processor CCA (**1A1A32**)
3. I/O Control (BITE) and Filter CCA (**1A1A31**)
4. Repositioning Interface CCA (**1A1A33**)
5. A/D Multiplexer CCA (**1A1A34**)
6. Accelerometer and Sensor Electronics Assembly (**1A1A35**)
7. Gyro Support Electronics CCA (**1A1A36**)

3.3.3.4 IMU. The lower Measurement Equipment Electrical Cabinet Assembly (**1A2**) contains the position sensing subassembly, which is called the IMU. This integrated assembly (**1A2A1A1**) consists of a base plate on which an outer support frame is mounted using a shock isolating structure. The outer frame supports a gimbal frame, which in turn supports the Sensor Block Assembly (**1A2A1A1A9**). The sensor elements (RLGs and accelerometers) are mounted on the Sensor Block Assembly, which by virtue of its mounting arrangement can rotate freely both in azimuth and in the roll axis of the cabinet.

The mechanical subassemblies that make up the IMU consist of:

1. Mounting and alignment base plate
2. Six shock isolation mounting struts
3. An outer shock-isolated frame, which supports an inner gimbaled frame
4. A Sensor Block Assembly

The inner gimbal frame is mounted to and supported in the outer frame by a torquer motor subassembly and a dual resolution synchro subassembly. The Sensor Block Assembly is mounted to and supported in the inner gimbal frame in a similar manner. Electrical connections and signals to the inner synchro, torquer motor, and subassemblies mounted on the Sensor Block Assembly are passed through the outer frame and gimbal frame using wiring harnesses, which are part of slip ring subassemblies. These subassemblies are mounted concentric to the rotation axis of each synchro and torquer motor.

The Sensor Block Assembly contains the RLGs and accelerometers, and a High Voltage Power Supply. Precision-machined mounting surfaces on the Sensor Block Assembly allow the RLGs and accelerometers to be removed and replaced during maintenance without the requirement for mechanical alignment.

The following subassemblies are mounted on the Sensor Block Assembly (**1A2A1A1A9**):

1. Ring Laser Gyro A (X axis) (**1A2A1A1A1**)
2. Ring Laser Gyro B (Y axis) (**1A2A1A1A2**)
3. Ring Laser Gyro C (Z axis) (**1A2A1A1A3**)
4. High Voltage Power Supply (**1A2A1A1A4**)
5. Accelerometer A (X axis) (**1A2A1A1A5**)
6. Accelerometer C (Y axis) (**1A2A1A1A6**)
7. Accelerometer B (Z axis) (**1A2A1A1A7**)
8. Accelerometer Stimulus (**1A2A1A1A9A1**)

3.4 FUNCTIONAL DESCRIPTION OF RLGN ASSEMBLIES.

3.4.1 POWER DISTRIBUTION AND EMERGENCY POWER SWITCHING. (Refer to **Figure 3-15**, **Figure 3-16**, **Figure 3-17**, **Figure 5-6**, **Figure 5-7**, **Figure 5-8**, and **Figure 5-9**.) The AN/WSN-7(V) uses 115 Volts, Alternating Current (VAC), 50/60 Hz, 3-phase ship's power as its supply source during normal operation. Each phase of the main Alternating Current (AC) power is applied to the Power Supply (**1A1A6**) and Vital Bus CCA (**1A1A3**) through a POWER circuit breaker (**1A1CB1**) and a SYSTEM POWER toggle switch (**1A1S1**) located on the front panel of the AN/WSN-7(V). As shown in **Figure 3-15**, the Power Supply contains a delta/wye transformer and a full-wave rectifier circuit, which converts the 115 VAC, 3-phase main power to produce an unregulated +25 VDC source power. The +25 VDC is distributed as the primary power source for generating all other power (other than non-vital synchro reference) used by the AN/WSN-7(V), and is applied to a DC inverter circuit in the Battery Charger (**1A1A7**) to maintain the charge on the internal 28-volt Battery (**1A1A5**).

The charging circuit on the Battery Charger (**1A1A7**) consists of an inverter drive oscillator circuit on subassembly 1A1A7A1, which controls application of the +25 VDC to the primary of transformer 1A1A7L6 through switching transistor 1A1A7Q4. The transformer output is rectified by diode 1A1A7CR3 and applied as the charging current to the battery. A Silicon Controlled Rectifier (SCR) 1A1A7Q3 in parallel with the charge current path prevents the battery voltage from being applied to the +25 VDC power circuit during normal operation. A separate transformer winding and rectifier circuit in the Power Supply produces a second +25 VDC power output (25 V Sense), which is used in the Battery Charger (**1A1A7**) to sense the presence of main AC power to the Power Supply.

In the event of an interruption of the main ship's power source, loss of the power fault detection signal (25 V Sense) from the Power Supply and the Battery Enable signal (Batten) from the Vital Bus Assembly causes circuits in the Battery Charger to generate a switching enable level on the gate of SCR 1A1A7Q3 in the Battery Charger. When 1A1A7Q3 is switched on, a circuit is completed that bypasses 1A1A7CR1 and applies the +28 VDC output power from the battery onto the +25 VDC circuit. System operation is then maintained without interruption. Loss of the 25 V Sense input indicates that either the main ship's AC power has failed, or that the AN/WSN-7(V) is turned off at either the POWER circuit breaker or at the SYSTEM POWER toggle switch (**1A1S1**).

To prevent the Battery Charger from switching to battery power when the system is manually turned off, the Battery Enable signal from the Vital Bus Assembly is present only when the SYSTEM POWER toggle switch (**1A1S1**) is set ON and a 5 VDC return is applied through the switch contacts (/PWR ON) to the Battery Enable logic on the CCA. The 5 VDC return is also applied through a set of contacts on the SYSTEM POWER toggle switch (**1A1S1**) when the switch is set OFF. This status level (/System Off) is applied to the circuits in the display and to circuits on CCAs in the Nav Processor card rack. Pull-up resistors in the circuits on the CCAs initiate various reset functions when this circuit is opened at system power-on. While operation of the power conversion circuits is independent of the frequency of the input power, frequency configuration switch 1A1A3S1 on Vital Bus CCA (**1A1A3**) must be set to correspond to the input power frequency. This switch selects the timing clock rate applied to the power fault detector circuits on the CCA. Incorrect setting of the switch will result in false detection of a power fault (Fault Code 34 will be displayed); however, the AN/WSN-7(V) will continue to operate.

In addition to the charging control and battery switching control functions, the Battery Charger contains a DC inverter circuit 1A1A7Q5, 1A1A7Q6, 1A1A7L7, 1A1A7L8 and associated diodes), which generates 25 VDC power used by other circuits in the AN/WSN-7(V). The Battery Charger will continuously produce -25 VDC via an internal inverter circuit in all power mode conditions. The -25 VDC is distributed to all -25 VDC users via the terminal junction system wiring bus.

3.4.2 PLATFORM INDEXING. (Refer to **Figure 3-18**.) The Sensor Block Assembly is mounted in a gimbal ring in such a manner that the Sensor Block is free to rotate without limits in azimuth. The gimbal ring is, in turn, mounted in the IMU frame such that the ring (and Sensor Block Assembly) can also rotate without limits in the pitch axis of the mounting reference. This design permits the orientation of the sensor axis for each gyro and accelerometer to be periodically reversed during operation. Periodic reversal of each sensor axis cancels the cumulative effects of small bias in the output signals.

3.4.2.1 Platform Indexing and Stabilization Control Circuits. The platform indexing function is implemented in each axis by a multispeed (1X and 36X) synchro capsule and a DC torquer motor, which are mounted concentrically with the gimbal axis. The gimbal's position data from the synchros is converted to digital data by synchro-to-digital (S/D) converter circuits and applied to the data bus through a digital data multiplexer on Repositioning Interface CCA (**1A1A33**), as shown in **Figure 3-18**. The synchro data is used by the Nav Processor to measure the offset of the gimbals from the synchro reference zero position. The Nav Processor uses this information to calculate the torque value and direction required to rotate the gimbal(s), or to maintain the gimbal(s) at the desired angle. A digital torque control data word is periodically transmitted from the Nav Processor CCA to the associated Torquer CCA (**1A1A18**) or (**1A1A19**). This data is latched and is processed by a digital-to-analog converter and amplifier on the Torquer Assembly to generate an analog signal, which is used to control the amplitude and direction of the current applied by the driver circuit. Differences in gain requirements of the roll (**1A1A18**) and azimuth (**1A1A19**) torquer circuits are compensated by jumper paths on Nav Processor Wirewrap Backplane Assembly (**1A1A11**). The analog signal is applied directly to the amplifier in CCA location (**1A1A18**) via jumper path between CCA pins C33 and C35. For CCA location (**1A1A19**), the analog signal is applied through a dropping resistor on the CCA via jumper path between pins C33 and C34.

The driver consists of a balanced circuit, which applies power from either the +25 VDC or -25 VDC source to one (power) input of the torquer motor. The other input (return) to the torquer motor is returned to 25 VDC ground on the Torquer Assembly. A voltage divider in the return path on the CCA samples the torquer motor current for feedback to the drive circuit. A monitoring circuit measures the average drive signal amplitude applied to the output stage. This circuitry takes the absolute value of the drive signal, applies a long time constant filter, compares this signal to a trip threshold (10 VDC), and latches the output stage off (disables the torquer) when the threshold has been exceeded.

The hardware torquer disabled status may be read by the processor via the torquer disabled status signal from the Torquer Assembly to the Status and Command Assembly. If the torquer is to be re-enabled under software control, the processor must first reset and then set the torquer enable command signal going from the Status and Command Assembly to the Torquer Assembly. An excessive drive signal causing a hardware disable will occur in the event of either an output short circuit or open circuit (i.e., any condition that prevents the current control loop on the Torquer Assembly from functioning normally). The effect of a high drive signal level on the monitoring circuit is cumulative. High drive signal levels coming too close together or for too long will trip the monitor circuit, but will not trip the monitor circuit if short enough and far enough apart.

3.4.2.2 Sensor Rotation During Normal System Operation. At power turn-on, the Sensor Coordinate Frame is initially set as shown in **Figure 3-19**. After the system enters the Align mode, the outer and inner gimbals are indexed (rotated) in a sequence of 64 rotations, which reposition the coordinate frame. The sequence of rotation of the coordinate frame allows the IMU Processor Memory Assembly to determine and compensate for errors associated with the system's gyro bias drifts and accelerometer bias errors, and also to determine and correct for errors introduced by offset of mechanical components within the system.

Since the gimbals are periodically rotated through a series of orientations, instantaneous heading, pitch, and roll orientation of the ship is determined by the Nav Processor and is not directly related to the actual orientation of the platform. The strapdown algorithm run by the Nav Processor maintains the mathematical description of the orientation of the sensor block with respect to a local level/north-oriented reference frame. The gimbal angles read by the inner and outer axis synchros allow the Nav Processor to sense where the base of the IMU is with respect to the Sensor Block. This allows the system to mathematically determine the ship's heading, roll and pitch. In the event of a failure of the platform indexing function, the platform torquers are turned off and the rotation sequence is halted. The system will continue to provide position and velocity output at an accuracy that will degrade over time. Unless there is a gimbal synchro failure, system roll and pitch output will also continue to be valid.

3.4.2.3 Sensor Rotation During Off-Line Testing. In the off-line Test mode, the capability to rotate the Sensor Coordinate Frame is used to dynamically test the accelerometers and RLGs. Accelerometer Test 329 sequentially changes the orientation of the accelerometers and checks the acceleration values introduced by the earth's gravity. RLG Tests 330 and 331 sequentially rotate the inner and outer gimbals at a fixed rate and check the RLG's count outputs. The orientation sequence for Accelerometer Test 329 is shown in **Figure 3-19**.

3.4.3 SYSTEM TIMING AND NAVIGATION PROCESSING. (Refer to **Figure 3-21**). Processing of the attitude and sensors data in the IMU Electronics is performed at a 50 Hz rate with updated data being available for transmission to the Nav Processor function at the end of every 20-millisecond period. Routines performed in the Nav Processor are primarily scheduled at an 800 Hz rate (1.25-millisecond periods), with different subroutines being performed during each 1.25-millisecond period under direction of the executive function of the Nav Processor control software. Input and processing of IMU data is interrupt-synchronized to occur every 20 milliseconds during a specific 1.25-millisecond period. In a similar manner, output of attitude data is interrupt-synchronized to the timing and transfer of data from the IMU Processor to the Nav Processor. Communication between the Nav Processor and the IMU Processor is accomplished through two-way serial data messages, which are synchronized to the completion of the signal/data processing that takes place in the IMU Electronics.

3.4.3.1 Nav Processor-IMU Processor Timing. Since system attitude data supplied by the IMU Electronics to the Nav Processor is time critical, input and processing of platform orientation and sensor data from the IMU Electronics is synchronized to the IMU data processing cycle. Synchronization of the Nav Processor to the IMU Processor is accomplished by an 800 Hz (1.25 millisecond) timing clock, which is generated from the 3.84 MHz signal (DF CLK) derived from the 7.68 MHz master clock on Accelerometer and Sensor Electronics Assembly (**1A1A35**). The 800 Hz clock is applied as an interrupt (IRQ5) to Nav Processor CCA (**1A1A13**) and to I/O Processor CCA (**1A1A21**).

In addition to the 800 Hz interrupt clock, a timing synchronization pulse (STROBE) is generated at a 50 Hz rate synchronous with every sixteenth 800 Hz clock pulse. The STROBE is gated by the SAMPLE output from the Accelerometer and Sensor Electronics Assembly (**1A1A35**). SAMPLE is set high when the gyro and accelerometer data sample is ready for output.

Synchronization of the Nav Processor to the IMU timing is performed through reading of a status bit set in memory on Dual Port Memory CCA (**1A1A23**). The 50 Hz strobe [Buffered Lower Unit Strobe (BLUS)] is applied via the IMU Processor Memory Assembly to set a strobe status bit in memory on the Dual Port Memory Assembly. The status bit follows the level of the STROBE signal. Each processor reads the strobe status every 1.25 milliseconds when the 800 Hz interrupt (IRQ5) is detected. Detection of the strobe status causes the processors to reset an internal software counter, which is then incremented every 1.25 milliseconds to synchronize the processing activities. This action allows the processors to anticipate the occurrence of the next strobe (and data sample) for synchronization of data transfer from the IMU with the Nav Processor operations. Calculation and output of system attitude data is also time critical. This data is calculated by the Nav Processor and is biased to compensate for processing and transmission delays.

To synchronize attitude data transmitted via the serial data output to the actual ship's dynamics, the serial data interface function is also synchronized to the 800 Hz clock and 50 Hz strobe from the IMU Electronics. In addition to being applied to the Nav Processor, the 800 Hz clock signal is routed through Bus Interface CCA (**1A1A20**) and Dual Port Memory CCA (**1A1A23**), and is applied as an interrupt (IRQ1) to the I/O Processor causing the I/O Processor to check the strobe status in the same manner as the Nav Processor.

3.4.3.2 Nav Processor-IMU Processor Data Transfer. Transmission of data from the IMU to the Nav Processor is initiated by a command word generated by the Nav Processor. In the correct 1.25-millisecond time period (synchronous to and immediately following the beginning of the 50 Hz strobe from the IMU), the Nav Processor transmits a command word (data request message) to the IMU Processor. The Nav Processor may request any one of up to 32 different possible messages (modes) via this command word. The mode selected by the Nav Processor determines the type of data to be transmitted back to the Nav Processor by the IMU Processor. The 50 Hz strobe is also applied as an interrupt (IRQ0) to the IMU Processor to initiate the data read and format operation.

Upon receipt of the command word, the IMU Processor (**1A1A32**) immediately reads the necessary accelerometer and gyro data from the Accelerometer and Sensor Electronics Assembly (**1A1A35**), calculates and formats the requested data for each of the 32 words of the data message, and then transmits the complete message to the Nav Processor.

Because reception of the request message, reading and formatting of IMU data, transmission of the data to the Nav Processor, and processing of the data by the Nav Processor is performed in a single 1.25-millisecond period, data is transmitted between the processors at a 1 MHz bit rate. The command word and each word of the 32-word data message consists of 16-bits, which are Manchester encoded. The most significant bit of each word is transmitted first. The first word of the data message is a return copy of the command word received from the Nav Processor. The following 30 words contain IMU-related data, PROM data, and status and fault words. The last word in each data message is a checksum of the preceding 31 words.

3.4.4 EXTERNAL DATA INTERFACING. (Refer to **Figure 3-22**.) All system data interface takes place through the I/O Processor function. This function consists of Dual Port Memory CCA (**1A1A23**), I/O Processor CCA (**1A1A21**), Dual Panel Interface CCA (**1A1A14**), and the suite of NTDS Interface CCAs (**1A1A51** through **1A1A58**). The interface for input and output of digital data from the Nav Processor is controlled through I/O Processor CCA (**1A1A21**). All data transfer between the Nav Processor and the I/O processor takes place via the parallel data buses on the associated backplane assemblies, which communicate via a common access memory register located on Dual Port Memory CCA (**1A1A23**). Data for output from the AN/WSN-7(V) is transferred from the Nav Processor via Dual Port Memory to the I/O Processor where it is reformatted and is then output to the selected I/O assemblies. Timing for output of system data is synchronized by interrupts generated from the 800 Hz clock and STROBE signals generated in the IMU Electronics function. The I/O Central Processor provides the data output message formatting, input data message decoding, I/O Bit processing, and control for the I/O boards independent of the Nav Processor function. I/O functions performed by the I/O Processor are outlined in the following sections.

3.4.5 INTERNAL DATA INTERFACING. Nav Processor to Support Electronics Processor - The parallel bus data interface with the Nav Processor consists of local address decoding logic, 16-bit parallel data buffers, and flip-flop latching circuits that hold each output data word being transmitted, or that accumulate each input data word being received via a single-channel RS-422A serial data I/O interface port. The serial data interface to the Support Electronics consists of input and output shift registers and an RS-422A serial data interface circuit. Serial data is transferred asynchronously between the Nav Processor and Support Electronics functions. Timing information critical to processing the data from the Support Electronics and synchronizing external data I/O to the AN/WSN-7(V) is provided by an 800 Hz clock signal and a timing strobe that originate from the sensor sampling and synchronization logic on the I/O Control Assembly in the Support Electronics. These signals are passed directly through buffers on the IMU Interface Assembly to the Navigation Central Processor and to Bus Interface CCA (**1A1A20**).

3.4.6 POSITION SENSING AND PROCESSING. (Refer to **Figure 3-23**, **Figure 3-24**, **Figure 3-25**, and **Figure 3-26**.) The Position Sensing functions generate and process the inertial orientation and acceleration reference signals, which are processed by the Nav Processor. Functions include the following:

- Generation of angular rate and acceleration outputs from the RLGs and Accelerometers located on the IMU Sensor Block
- Conversion of the analog rate and acceleration signals to digital format
- Generation of the high voltage power for the RLGs
- Dynamic control associated with the RLGs
- Generation of the primary system timing reference

Except for high voltage power generation and control functions provided by the High Voltage Power Supply Assembly (**1A2A1A1A4**), all functions related to Position Sensing are located on circuit boards in the IMU Support Electronics card rack.

3.4.6.1 Gyro Power and Power Control Functions. Functions associated with high voltage power for the RLGs consist of high voltage power generation, laser current sensing, high voltage power switching, and current control. Circuits that perform these functions are located on the High Voltage Power Supply Assembly (**1A2A1A1A4**), which is located on the Sensor Block Assembly. Source power for the High Voltage Power Supply Assembly is supplied by +28 VDC from Support Electronics Power Supply CCA (**1A1A37**). The +28 VDC power is used for generation of the -930 VDC and +3500 VDC power (used for ionizing the laser gas in the gyros), and +280 VDC (used to supply the circuits that drive the piezoelectric transducers for the PLC and RDI functions).

High voltage DC generation functions consist of two separate power supply circuits. Transformer 1A2A1A1A4T1 and associated rectifier circuits generate 3500 VDC power, and transformer 1A2A1A1A4T2 and associated rectifier circuits generate both the -930 VDC and +280 VDC power. The +28 VDC input is regulated and applied to the input winding of each supply transformer. Each leg of the transformer's input winding is alternately switched by a common driver circuit to allow conduction through the transformer.

The 3500 VDC supply output is applied directly to the anode of each RLG. The -930 VDC supply output is applied to the cathode of each RLG through a transistor in a current control circuit. When the system is initially turned on, both 3500 VDC and -930 VDC power are applied to each gyro. As soon as lasing action in the RLGs causes current in the high voltage path of all three RLGs to increase to a predetermined level, a switching circuit removes the drive signal from the input winding of transformer 1A2A1A1A4T1, causing the 3500 VDC output to turn off. Completion of the circuit from -930 VDC through the RLGs back to ground via a diode in the 3500 VDC supply rectifier circuit maintains power necessary for continued laser action.

A direct feedback circuit from each gyro [1A2A1A1A4VR5, 1A2A1A1A4Q7 and 1A2A1A1A4Q8 for gyro (**1A2A1A1A1**)] monitors current in the laser cavity and maintains constant current by controlling the gain of the transistor [1A2A1A1A4Q9 for gyro (**1A2A1A1A1**)] in the -930 VDC supply path to the associated gyro. A comparator circuit in the current feedback circuit for each gyro detects excessively high or low current.

3.4.6.2 Gyro Control and Signal Processing Functions. Functions associated with control of the RLGs consist of gyro dither control, dynamic control of laser mirrors position, and detection and processing of rotation signals. Circuits for controlling and driving the gyro dither function are located on Gyro Support Electronics CCA (**1A1A36**) and Repositioning Interface CCA (**1A1A33**). These circuits are primarily free-running, positive-feedback loops that apply power to piezoelectric transducers located in the suspension-mounting axis of the associated RLG. One transducer (dither pickoff) supplies a signal to a driver circuit, which drives another set of transducers that rotate the gyro assembly. The three driver circuits are identical. Oscillation rate of each gyro is determined by the pickoff transducer.

Circuits associated with the laser PLC and RDI functions are located on Gyro Support Electronics CCA (**1A1A36**) and High Voltage Power Supply Assembly (**1A2A1A1A4**). Three identical circuits generate modulation signals, which are applied to the drive signals that drive the piezoelectric transducers. The transducers position the mirrors in the associated RLG. A current feedback (PWR DET) sample from the gyro is applied to a demodulator circuit, and the amplitude of the modulation signal is detected to determine the direction of mirror position, which produces an increase in laser current. This demodulated feedback is then used to control the level of the drive signal for the mirrors.

One modulator/demodulator function controls the position of both mirrors to increase or decrease the laser path length. The other modulator/demodulator function controls the position of both mirrors differentially so that the laser path is shifted without changing the total path length. Circuits associated with processing of the analog (count) rotation sensing signals from the RLGs are located on I/O Control (BITE) and Filter CCA (**1A1A31**) and Accelerometer and Sensor Electronics Assembly (**1A1A35**).

The circuits on (**1A1A31**) consist of a state logic decoder, which generates a pulse output for each transition of the up and down rotation signals. Depending on the phase relation of the up and down signal (direction of gyro rotation), the generated pulses are output on either the clockwise or counterclockwise pulse output. The sensor electronics on Accelerometer and Sensor Electronics Assembly (**1A1A35**) accumulates the clockwise and counterclockwise gyro rotation signals from the I/O Control and Filter Assembly in up/down counter functions at a 50 Hz sample rate to determine the rotation angle of each gyro during the sample period.

3.4.6.3 Accelerometer Control and Signal Processing Functions. The accelerometer signal processing circuits are contained on Accelerometer and Sensor Electronics Assembly (**1A1A35**). These circuits consist of three identical balanced bridge circuits, which operate from a precision voltage reference source on the CCA. The accelerometer signals are applied to these circuits, which sample the accelerometer current and convert the analog signal to a digital up or down count. The frequency of the count is directly proportional to the acceleration (accelerometer current), and the output (up count or down count) is determined by the direction of the measured acceleration (negative or positive current flow). The signal input from each accelerometer is also applied through an operational amplifier to the analog-to-digital (A/D) Multiplexer Assembly for accelerometer performance testing by the built-in test (BIT) function. The sensor electronics on Accelerometer and Sensor Electronics Assembly (**1A1A35**) accumulates the clockwise and counterclockwise gyro rotation signals from the Gyro Support Electronics CCA (**1A1A36**) in up/down counter functions at a 50 Hz sample rate to determine the rotation angle of each gyro during the sample period. In the same manner, the sensor electronics accumulate up and down counts from the accelerometer processing circuits on the CCA to determine acceleration. Upon completion of the data sample accumulation period, the processing logic 1A1A35U39 sets the SAMPLE output high. This action gates the STROBE output and the buffered 50 Hz (B 50HZ H) output from I/O Control (BITE) and Filter CCA (**1A1A31**) high, initiating the processing cycle for reading of the data by the IMU Processor. The resultant data is transferred as parallel digital words, which are transferred synchronously on the input data bus to the IMU Processor on IMU Processor CCA (**1A1A32**). The rotation rates are processed to develop the PLC Reset Disable (PLC RST DSBL) signal, which is applied to the PLC logic on Gyro Support Electronics CCA (**1A1A36**). This signal inhibits reset of the PLC control function while high rates are being detected. Self-testing of the CCA functions is controlled by the processor in IMU Processor CCA (**1A1A32**) through the sensor electronics function. The CPU on IMU Processor CCA (**1A1A32**) initiates a self-test at power-up, which checks operation of the CCA electronics. During self-test, the normal inputs from the gyros and accelerometers are replaced by inputs from the self-test circuits on the Accelerometer and Sensor Electronics Assembly.

3.4.7 SYNCHRO ATTITUDE AND VELOCITY DATA INTERFACE. (Refer to **Figure 3-27**, **Figure 3-28**, **Figure 3-29**, and **Figure 5-21**.) The AN/WSN-7(V) has capability for input of synchro format speed and depth data, and for output of synchro format heading, roll, pitch, and velocity data. All S/D conversion for input of synchro format speed and synchro format depth data, and all digital-to-synchro (D/S) data conversion for output of heading, roll, pitch, and velocity take place on identical Synchro Converter CCAs (**1A1A38**), (**1A1A39**), and (**1A1A40**). These CCAs operate in conjunction with four SBAs, which provide load drive capability and switching for output of vital and non-vital heading, and non-vital roll and pitch data. A relay multiplex network on each Synchro Converter Assembly allows alternate internal signal paths to be chosen to select the input to the S/D converter (U3) on each CCA. During normal operation, all relays in the multiplex network are deenergized and the synchro speed (or depth) input channel is switched to the S/D converter. During off-line self-test, the relays can be addressed (selected by a data word from the Nav Processor) to sequentially route each S/D converter output back into the D/S converter for comparison of the digital data values transmitted from the Nav Processor, with the values generated by the D/S converters. This action is performed in the synchro short loop wraparound tests 533, 535, 537, 539, 541, 543, 546, 547, 548, 549, 591, and 592. Alternately, the relays can select the synchro output from each SBA for conversion by the S/D converter for comparison of the digital data values transmitted from the Nav Processor, with the values output from the system on each synchro output channel. This action is performed in synchro wraparound tests 534, 536, 538, 540, 542, and 544. Each D/S converter channel on the Synchro Converter Assemblies converts the digital input to a two-wire AC output, which is scaled to the amplitude sine and cosine of the angle represented by the digital data from the Nav Processor. These sine/cosine outputs are applied to the SBAs, where power amplifiers and Scott-T transformers convert the signals to three-wire synchro format for driving external synchro loads. Each sine/cosine signal is also applied directly to a Scott-T transformer on the Synchro Converter Assembly. These transformers convert the sine/cosine signal directly to three-wire synchro data format for low output load applications.

The low power synchro outputs from channels 3 and 4 on Synchro Converter CCA (**1A1A38**) are used to provide 1X and 10X total velocity (V_t) synchro format data. The low power synchro outputs from channels 1 through 4 on Synchro Converter CCA (**1A1A40**) are used to provide 1X and 10X synchro format north-south velocity (V_n), and 1X and 10X east-west velocity (V_e). The data type output from each channel (heading, roll, pitch, or velocity) and the scaling (1X or 2X and 10X or 36X) from each channel is determined by the Nav Processor and is represented in the digital value applied to the D/S converter.

In addition to sine/cosine to three-wire synchro format conversion and power amplification, the SBAs contain switching relays in the output circuits. These relays are normally deactivated and are set by control signals from Vital Bus CCA (**1A1A3**) if a fault is detected in the system's primary power input. Whenever a primary power fault is detected and the AN/WSN-7(V) switches to internal battery power, Power Alarm 1 through 4 lines are set high, and the relays on each SBA are energized. This action opens the non-vital heading, roll, and pitch outputs to reduce system power requirements during the time when the AN/WSN-7(V) is operating from the battery.

A comparator circuit on each SBA provides BIT monitoring for the amplifiers function. If the output from any operational amplifier is outside a predetermined limit, the comparator circuit sets a solid state relay (two relays on SBAs (**1A1A41**) and (**1A1A42**)), which opens the input circuits and applies a ground to the amplifiers. This action prevents false data from being output from the AN/WSN-7(V) in the event of a failure in a SBA. Opening of one set of normally closed contacts on solid state relay 1A1A41U2 / 1A1A42U2 turns on a transistor 1A1A41Q2 / 1A1A42Q2, which activates a fault Light Emitting Diode (LED) on the SBA, and also sets the SBA Fail output line to Status and Command CCA (**1A1A15**) low, indicating to the BIT function that the SBA has failed.

3.4.8 HARDWARE MONITORING AND FAULT/STATUS OUTPUT. (Refer to **Figure 3-30**). In addition to monitoring the status of the IMU circuits and RS-422 I/O circuits via data generated by the IMU Processor and I/O Processor functions, the Nav Processor monitors the operation of certain power and control functions via a status data word which is generated by Status and Command CCA (1A1A15). This status information is processed along with all other BIT-related functions and software-generated flags to determine the operational and fault status condition of the AN/WSN-7(V). The Nav Processor, in addition to generating displayed Fault Codes, controls setting of relay contacts and switching of power for external status and alarm functions via the parallel bus and circuits on the Status and Command Assembly.

3.4.9 BUILT-IN TEST (BIT) AND STATUS. (Refer to Figure 3-31.) The BIT functions consist of software analysis of operational parameters, I/O transmission monitoring (message checksum, overrun, and time out errors), and comparison of signals, voltages, and status conditions with reasonableness limits. This combination of test functions consists of tests and monitoring, which are performed on-line at system power turn-on and during normal operation, and off-line tests, which are performed only in the Test mode. In addition, the system processors can be set to select wrap-around loops in an off-line Test mode, which checks I/O functions and synchro data output channels by comparing data output by the processor with data output by the function being tested.

During normal operation, the combination of information from the BIT functions is processed by the Nav Processor, which sets fault bits in error words in response to detection of fault conditions. These error words (FERRxx) are used to generate fault codes, which are presented in the upper-right corner of the display. In addition to generating fault codes, the Nav Processor controls the setting of fault status relays, which can be used to control external alarms or provide fault status to external equipment.

Basically, the BIT consists of test and monitoring functions from five sources:

1. Faults Detected by the I/O Processor.
2. Faults Detected by the IMU Processor.
3. Faults Detected by the Nav Processor.
4. Faults Detected by the ATM Processor.
5. Hardware-detected faults from the Status and Command Assembly
.

3.4.9.1 Off-Line Tests. Whether selected by the System Confidence Test or selected manually from the Select Tests menus, each off-line test performed by BIT automatically sets up an off-line test loop, which exercises a specific function or circuit and checks for an expected result. Some tests require manual operations such as setting circuit breakers, disconnecting cables, connecting test cables, and setting of a CCA-mounted switch during performance of the test. Wherever manual procedures are required, the display prompts the operator to perform the procedure, and the test pauses until completion of the procedure is detected.

If the test passes, the message TEST COMPLETE - TEST PASSED is displayed. If the test fails, the message TEST COMPLETE - FAILURE xxx is displayed (where xxx is a three-digit code which indicates the type of fault detected). Generally, the failure code provides more detailed information than is necessary to correct the fault, as the AN/WSN-7(V) is repaired by replacement of the faulty subassembly. The off-line tests are described in Table 5-1.

3.4.9.2 System Confidence Test. The System Confidence Test is an automatic battery of off-line, Test mode tests. Only one test, Display Test 201, requires operator intervention. The System Confidence Test conducts the following tests in the order shown over 12 minutes:

201 (Display, approx. 1 minute), 203, 204, 106, 209, 210, 212, 314, 315, 316, 117, 318, 220 (approx. 1 minute. If test 220 fails perform test 221), 322, 323, 424, 425 426, 427, 458, 459, 460, 461, 484, 485, 329 (approx. 3 minutes), 330 (approx. 4 minutes), 331 (approx. 1 minute), 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 546, 547, 548, 549, 591, 592. (Tests 424 through 485 are I/O port short loop tests. Test is performed for applicable I/O port only if the port is enabled and the IDS code is not 00.)

The System Confidence Test can only be selected and conducted when the AN/WSN-7(V) is operating in the off-line Test mode. The System Confidence Test is necessary because on-line Fault Codes do not always provide sufficient guidance for selecting individual off-line tests, which are necessary to verify a fault condition and isolate a faulty component. The System Confidence Test should be the first test performed when troubleshooting. Additionally, this test should always be selected and run after a suspect, faulty assembly has been replaced with a known good assembly. The AN/WSN-7(V) should be turned on in normal mode only after the System Confidence Test passes and confirms successful assembly replacement.

The System Confidence Test progresses through the off-line test battery until aborted by the operator. If individually selected, each test is performed for a time period of one second, and then the next test in the sequence is selected. If a fault is detected during the System Confidence Test, the fault is announced and the test procedure pauses to allow the operator to observe the Fault Code. Detecting a fault does not abort the test series, and the sequence resumes when the operator presses the **<ENTER>** key.

The System Confidence Test can be run by pressing the **<1>** key to select **Run Sys Conf Test** listed on the Main Menu. It can also be selected from the System Tests Menu by pressing the 00 on the keypad and then pressing the **<ENTER>** key.

3.4.9.3 Operator Response to Advisories and Faults. During on-line operation of the AN/WSN-7(V), interfering conditions such as fault conditions associated with hardware and software functions, I/O bus data input checks, I/O bus wraparound testing, and IMU functions may occur that require certain actions to be performed.

At startup and during operation, the AN/WSN-7(V) BIT function continually monitors hardware and software functions and checks calculation results for reasonableness. In addition, the AN/WSN-7(V) checks data input on the I/O bus and performs wraparound testing of I/O outputs. Any fault condition detected by BIT is announced by a visual alarm. Each detected condition results in the generation of a fault code, which is stored in battery-backed RAM if still active when acknowledged for display and review. Based on the type of fault code displayed, the operator may acknowledge the fault by pressing the **<ALARM ACK>** key and choose to continue system operation, or may take the AN/WSN-7(V) out of service for navigation. Certain faults automatically shut down the AN/WSN-7(V) and cannot be overridden by the operator.

Table B-1, Fault Code Descriptions and Fault Isolation, lists all of the possible BIT fault codes and associated fault/status relay settings. It indicates the source of the fault and the classification(s) of the fault. This Fault Code table also provides diagnostic information and references off-line BIT to be performed to verify and troubleshoot the fault condition. In addition to the valid fault codes, several spare code numbers are listed. Spare codes are reserved for future expansion and will not be announced for fault conditions.

Fault and status indicators may also be installed external to the system. These can be controlled by fault and status relays (K1, K2, K3, and K7) to either illuminate or extinguish upon detection of the fault or status condition. (Refer to Figure 5-5, sheet 1.) Relay K1 functions as both a status and a fault relay. This relay initially remains reset when the system is in STANDBY to provide an external indication that the system is not ready, and then sets when the system enters the Align mode. The relay remains set unless a fault condition occurs.

3.4.9.4 Source AC Power or Synchro Reference Fault. The AN/WSN-7(V) contains an internal Power Supply (1A1A6), which provides an output of +25 VDC power during normal operation from the ship's AC power source. The +25 VDC is distributed via the Terminal Junction System (TJS) to all end users. The Battery Charger (1A1A7) produces -25 VDC power using the +25 VDC as its input power under all conditions. The -25 VDC is also distributed via the TJS to all users on the bus.

The Battery Charger also maintains the charge on the Battery Assembly (1A1A5) using the +25 VDC output from the Power Supply. The Inverter Assembly (1A1A2), which operates from the +25 VDC bus, generates 115 VAC, 400 Hz for the components on the vital synchro reference circuit as long as the AN/WSN-7(V) is energized. In the event that the ship's main power bus is interrupted or out of tolerance, the Battery Assembly, working through the Battery Charger, provides emergency ±25 VDC power for continuous operation. BIT functions on the Vital Bus CCA (1A1A3) monitor main AC power and non-vital reference supplied to the AN/WSN-7(V), and provide control to automatically turn off all non-vital synchro outputs in the event that a source power or non-vital synchro reference fault is detected. When the external power is reestablished within the correct limits, the AN/WSN-7(V) automatically switches back to AC operation and restores non-vital synchro outputs.

3.4.10 NAV AND I/O PROCESSORS. The I/O Processor continuously monitors the operation of the RLGN-RLGN interface, the installed NTDS I/O boards, and the I/O messages being received or transmitted via the configured NTDS interface ports. The I/O Processor sets error bits in fault error words and then transmits the error words to the Nav Processor via the processor's data interface.

The I/O Processor provides two categories of fault indications. One category consists of faults that are directly related to the I/O boards or processor-I/O interface (FERR14 through FERR21). The second category consists of faults that are detected in input or output data message transfer or transfer timing protocol (FERR27 through FERR42). These faults may be related to the I/O board, external cabling, external equipment, or incorrect message format selection for the configured port(s).

If the I/O Processor detects a message-related error, it sets up and executes a short loop wraparound test of the I/O port to determine if the fault is port- or message-related. Further testing of I/O ports can be performed off-line by selecting a long loop test, which utilizes test wraparound cables. These off-line tests verify operation of the interface ports and all I/O cabling internal to the AN/WSN-7(V) cabinet.

The IMU BIT monitors IMU processor operation, IMU data interface, timing, and the function of IMU Electronics boards. Circuits on the boards in the IMU Electronics continuously monitor the analog signals associated with operation of the platform gimbal indexers and sensor elements via the A/D Multiplex board. Monitored signals include those associated with the RLGs, accelerometers, and High Voltage Power Supply. The IMU Processor sets error words FERR06 through FERR10 and then transmits the error words to the Nav Processor via the serial data interface.

In addition to the faults detected directly by the I/O Processor and IMU functions, the Nav Processor also monitors the data and data interface associated with the I/O and IMU, and sets faults associated with strapdown control, gyro and accelerometer rate limits, and IMU Processor and interface faults (FERR03, FERR04, and FERR05). I/O monitoring performed by the Nav Processor consists of GPS message and comparison of position and attitude data with that received from the other AN/WSN-7(V) (FERR22 and FERR23). In addition to the I/O and IMU functions monitored, the Nav Processor also monitors the reasonableness of navigation data and of position and velocity input data (FERR02).

The hardware status faults detected by various circuits are latched in a buffer in the Status and Command Assembly and are read as FERR01 by the Nav Processor. These faults are associated with operation of internal power supply functions, synchro output circuits, speed log input, and platform indexing control. Detection of loss of ship's main power and switching to battery operation is automatic and is controlled by circuits on the Vital Bus board without intervention by the Nav Processor.

After the Nav Processor CCA (**1A1A13**) has successfully completed the power-up self-tests, further monitoring of CPU operation is performed by a heartbeat detector function on Status and Command CCA (**1A1A15**). Nav Processor CCA (**1A1A13**) periodically addresses the heartbeat detector on (**1A1A15**), performing a reset which causes the associated heartbeat fault LED (**1A1A15**-DS2) on the board to remain turned off. If the CPU fails and is unable to address the heartbeat detector within a reasonable time limit, the detector circuit will time-out, causing the heartbeat fault LED to illuminate and a status bit to be set indicating a probable fault in Nav Processor CCA (**1A1A13**). If the fault is in the CPU, system operation will shut down and the LED will remain illuminated. If the fault is in the detector logic and not in the CPU, the system will continue to operate and Fault Code 042 will be displayed.

The Nav Processor and the I/O Processor periodically perform a test pattern write/read test on the common RAM (dual port memory) on Dual Port Memory CCA (**1A1A23**). This consists of the Nav Processor writing data into the common RAM, which is read by the I/O Processor and then written back into common RAM by the I/O Processor. The reflected data from the I/O processor is read by the Nav Processor and is then compared with the original pattern data to verify memory and data transfer integrity. The test is repeated in reverse order with the test pattern data originating from and compared by the I/O Processor. If the test initiated by the Nav Processor fails twice in a row, Fault Code 019 will be displayed. If the test initiated by the I/O Processor fails twice in a row, **Fault Code 252** will be displayed.

3.4.11 SYNCHRO DATA CONVERSION AND SBA DESCRIPTIONS.

3.4.11.1 Synchro Converter CCAs (1A1A38), (1A1A39), and (1A1A40). The digital-to-synchro converters convert digital angle values from the Central Processor to an analog output proportional to the sine and cosine of the synchro angle. The output (heading, pitch, or roll) data type is dependent on the rack location of the CCA. The Synchro Converter CCA in rack location (**1A1A38**) provides 1X and 36X (sine/cos) heading to SBAs 32 VA (**1A1A43**) and (**1A1A44**), respectively. The Synchro Converter CCA in rack location (**1A1A39**) provides 1X (or 2X) and 36X (sine/cos) roll output to SBA (**1A1A41**) and 1X (or 2X) and 36X (sine/cos) pitch output to SBA (**1A1A42**).

The coarse output is either 1X or 2X depending on the Synchro Output Function selections made on the System Configuration menu at installation. 2X output is selected for the AN/WSN-7(V).

Two of the digital-to-synchro converter channels on Synchro Converter CCA (**1A1A38**) are used to convert digital values from the Central Processor to provide direct output of ship's total velocity vectors formatted as 1X and 10X scaled synchro. All four of the digital-to-synchro converter channels on Synchro Converter CCA (**1A1A40**) are used to convert digital values from the Central Processor to provide direct output of ship's north-south and east-west velocity vectors formatted as 1X and 10X scaled synchro. Depending on the INS installation requirements, the synchro-to-digital input channels on each card can be used to convert any single-speed synchro input to a digital value for input to the Central Processor. In a standard AN/WSN-7(V) installation, the input to Synchro Converter CCA (**1A1A38**) is reserved for input of 1X speed data (fore-aft) and the input to Synchro Converter CCA (**1A1A39**) is reserved for input of 1X speed data (athwartships) from the ship's dual-axis speed log. The synchro-to-digital input channels on card (**1A1A40**) are not used.

3.4.11.2 Synchro Buffer Amplifiers (SBAs) 8 VA (1A1A41) and (1A1A42). SBAs 8 VA (**1A1A41**) and (**1A1A42**) are identical (8 volt-amp) output subassemblies and can be interchanged in the AN/WSN-7(V). SBAs amplify and convert the sine and cosine signals from the Synchro Converter Assemblies to three-wire synchro format for driving external synchro loads. The amplifiers contain two identical circuits, each comprising two solid-state amplifiers, a Scott-T output transformer, and output switching relays. The sine and cosine analog input signals from the associated converter channels on Synchro Converter CCA (**1A1A39**) are amplified and applied to the input windings of the channel's transformer. The output from each transformer is three-line synchro format signal. SBA (**1A1A41**) is used to output synchro format roll and SBA (**1A1A42**) is used to output synchro format pitch. Each synchro output line is applied to the contacts of switching relays in the SBA. During normal operation, the relays switch the synchro outputs to the system's external output connector.

In the event of a power failure (or during off-line tests), the relays are deenergized and all AN/WSN-7(V) external pitch and roll outputs from the SBAs are opened. The open circuit relay contacts switch the synchro roll and pitch outputs back to multiplexed inputs on Synchro Converter CCA (**1A1A39**), where they can be selected to provide wraparound of the synchro outputs during performance of off-line testing of the SBAs.

3.4.11.3 Synchro Buffer Amplifiers (SBAs) 32 VA (1A1A43) and (1A1A44). SBAs 32 VA (**1A1A43**) and (**1A1A44**) are identical (32 volt-amp) subassemblies and can be interchanged in the AN/WSN-7(V). These SBAs are similar in function to SBA 8 VA (**1A1A41**) and (**1A1A42**) but, because of differences in the configuration of the output switching circuits and power specifications, cannot be interchanged with them. The primary difference in output switching is that one synchro channel (designated for vital heading reference) is hard-wired to the amplifier output rather than being switched through relay contacts. In the event of a power failure, one channel from SBA (**1A1A43**) continues to output 1X vital heading and one channel from SBA (**1A1A44**) continues to output 36X vital heading to the system external output connector. The output from the second (non-vital) channel in each amplifier is switched off-line and wrapped back to Synchro Converter CCA (**1A1A38**) in the same manner as the synchro roll and pitch outputs.

Table 3-1. Trigonometric Functions

FUNCTION	RATIO OF	FUNCTION APPROXIMATE VALUE AT SELECTED ANGLES						
		0.0°	15°	30°	45°	60°	75°	90°
Sin θ	Y/r	0.00	0.259	0.5	0.707	0.866	0.966	1

Table 3-1. Trigonometric Functions - Continued

FUNCTION	RATIO OF	FUNCTION APPROXIMATE VALUE AT SELECTED ANGLES						
Cos θ	X/r	1	0.966	0.866	0.707	0.5	0.259	0.00
Tan θ	Y/X	0.00	0.268	0.577	1.0	1.732	3.732	INFINITY

Table 3-2. Sample Data Calculations Illustrating Concept of Variance

	MEASUREMENT REVOLUTIONS PER MINUTE (RPM) (Column 1)	VARIANCE FROM AVERAGE X (Column 2)	SQUARED VARIATION (Column 3)
I	X_i	$\Delta\sigma_i = X_i - X$	$(\Delta\sigma_i)^2 = (X_i - X)^2$
1	103.0	+3.7	13.69
2	101.2	+1.9	3.61
3	98.0	-1.3	1.69
4	96.0	-3.3	10.89
5	101.0	+1.7	2.89
6	101.2	=1.9	3.61
7	99.8	+0.5	0.25
8	100.0	+0.7	0.49
9	97.5	-1.8	3.24
10	95.3	-4.0	16.00
	X = 99.3 rpm	$\Delta\sigma_{avg}$ = 0.00 rpm	$(\Delta\sigma)^2_{avg}$ = 5.636 rpm^2

where: $X = \sum_{I=1}^{10} \frac{X_i}{10'}$ *the sample average*

$\Delta\sigma avg = \sum_{I=1}^{10} \frac{\Delta\sigma_i}{10'}$ *the average variation*

$(\Delta\sigma)^2 avg = \sum_{I=1}^{10} \frac{(\Delta\sigma_i)^2}{10'}$ *the average variation* σ^2

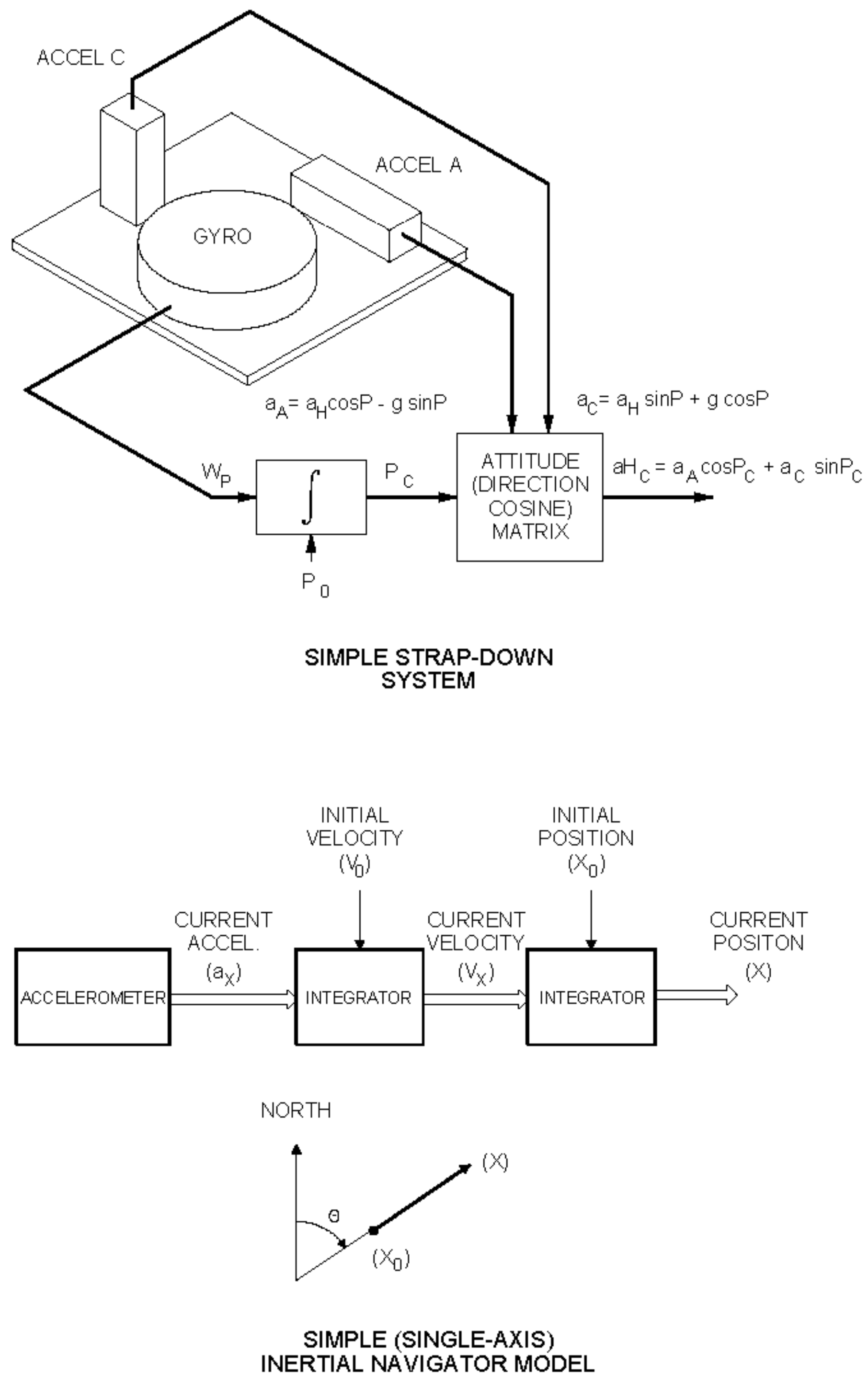


Figure 3-1. Simple Strapdown System

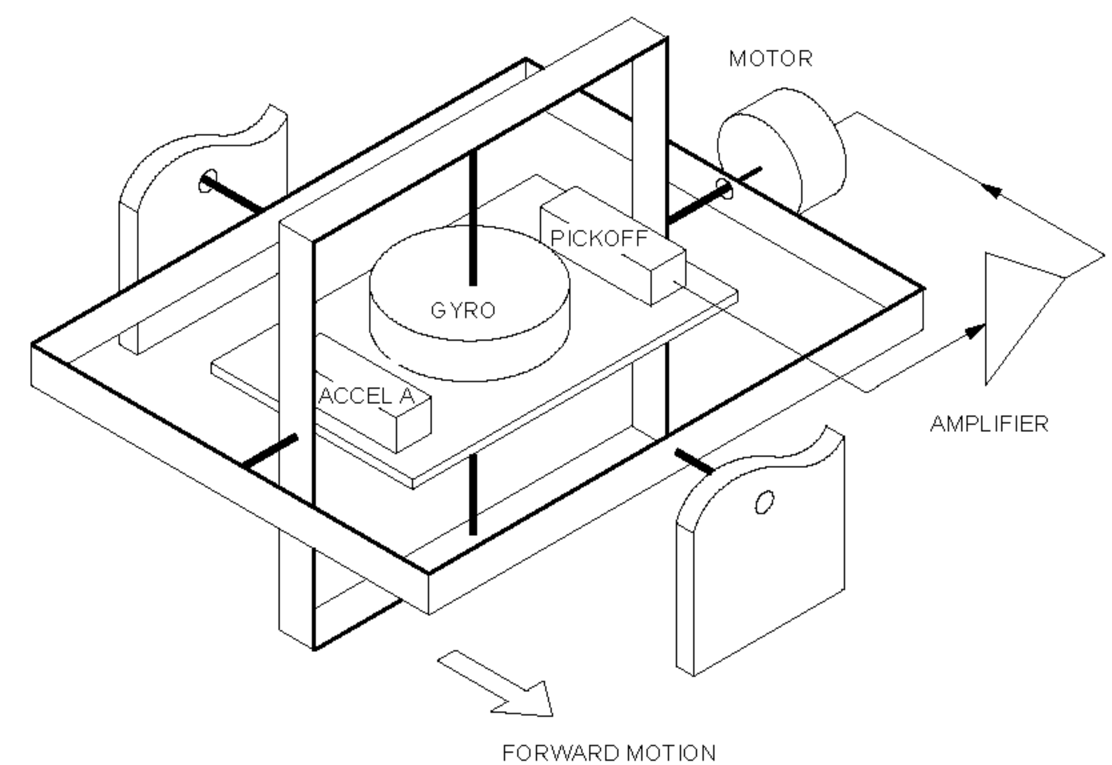


Figure 3-2. Simple Gimbal Stabilization of the Accelerometer

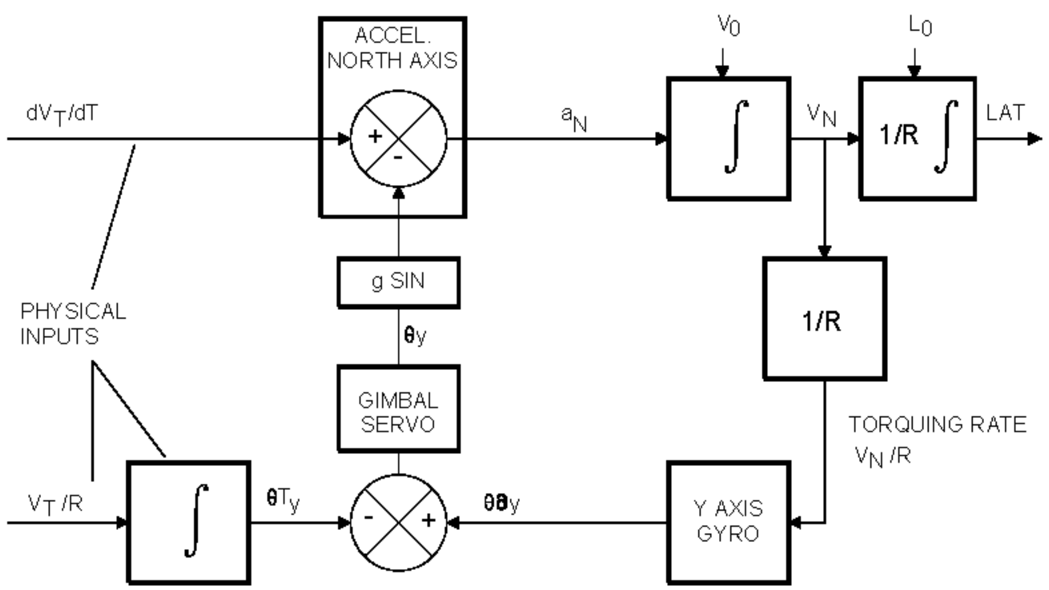


Figure 3-3. Single-Axis Schuler-Tuned Gimbaled System

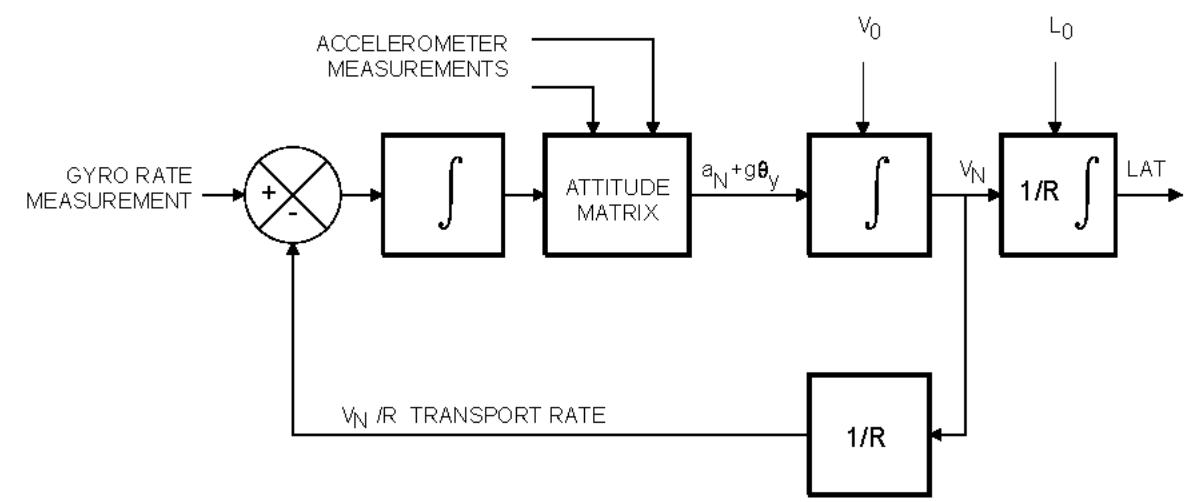


Figure 3-4. Single-Axis Schuler-Tuned Strapdown System

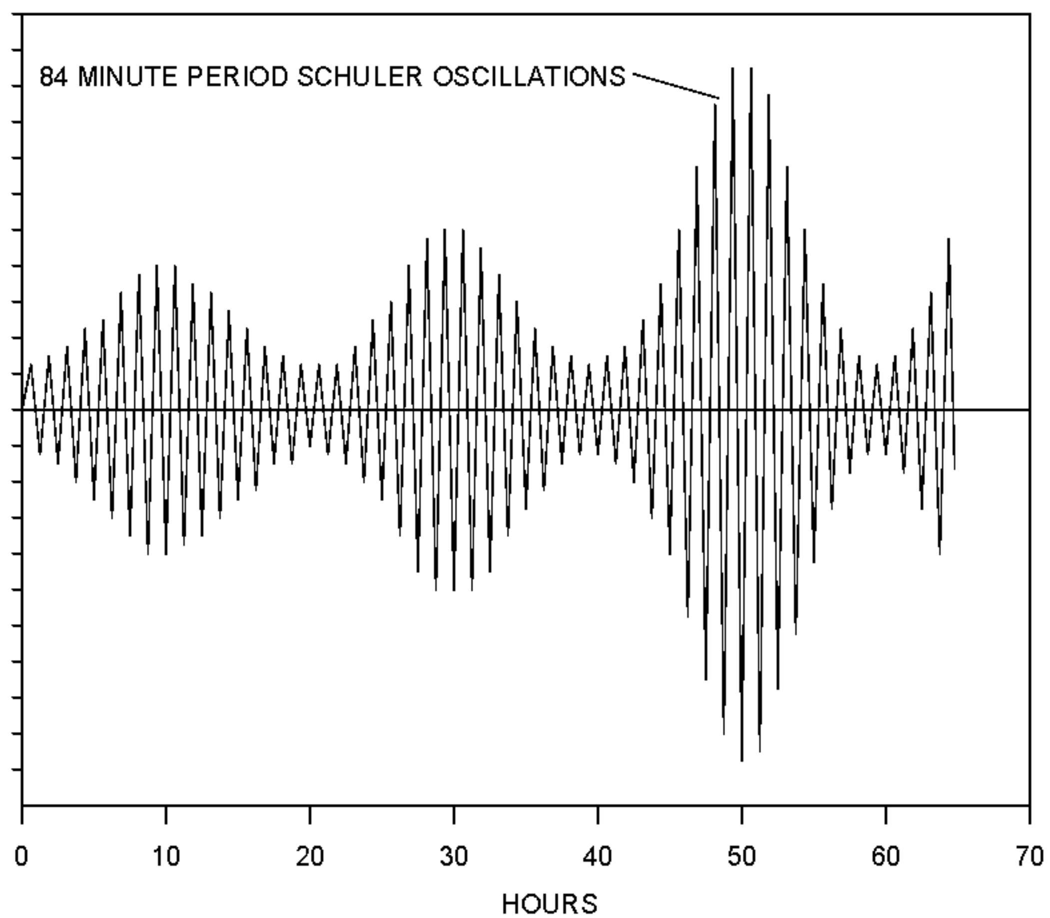


Figure 3-5. Schuler Oscillations in an Undamped Inertial Navigator

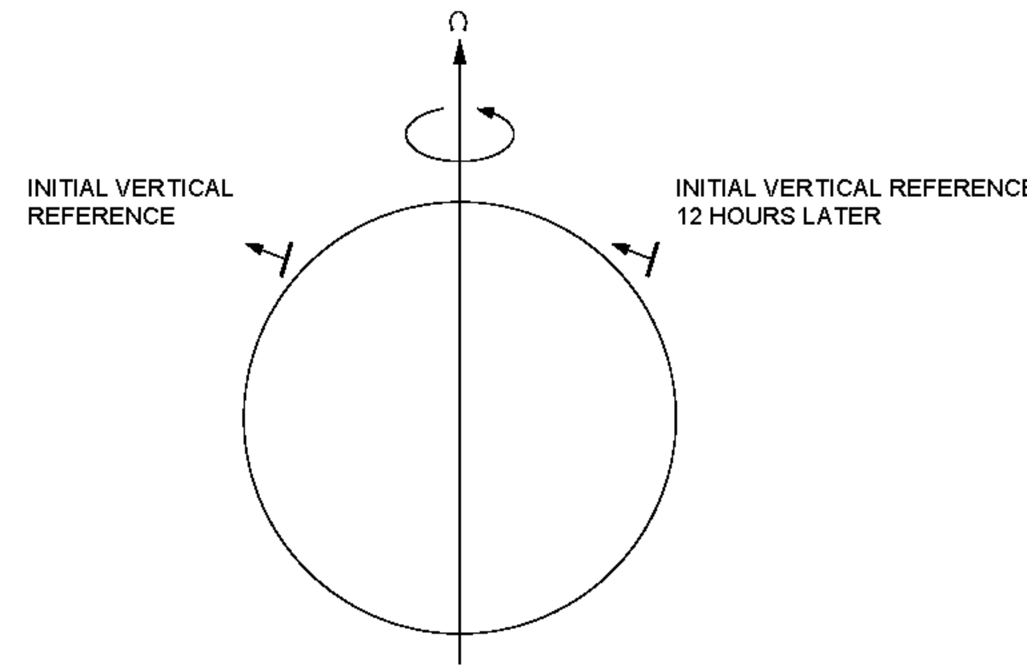


Figure 3-6. Effect of Earth's Rotation on Local Vertical

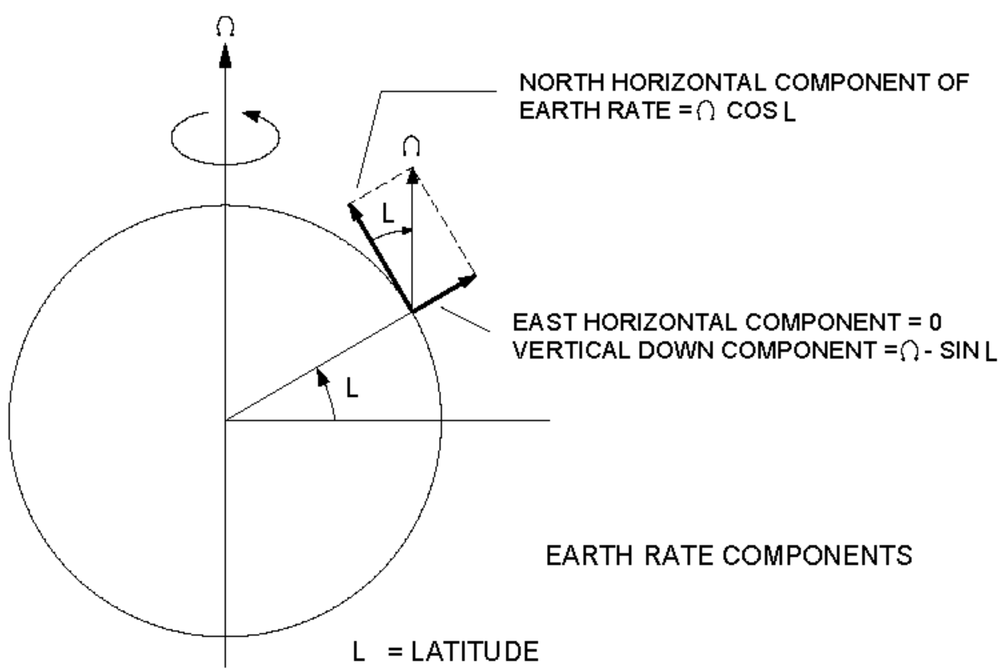


Figure 3-7. Earth Rate Components

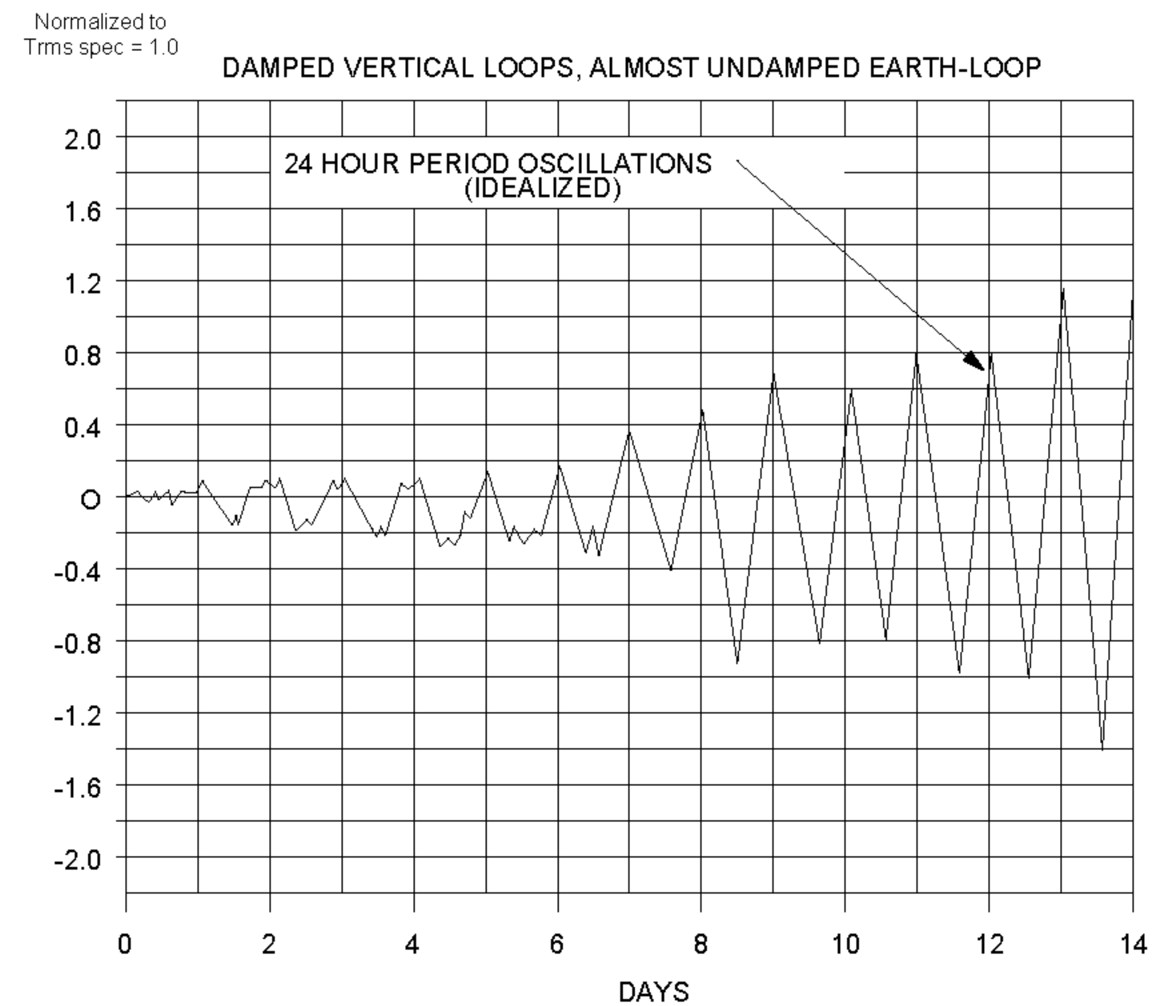
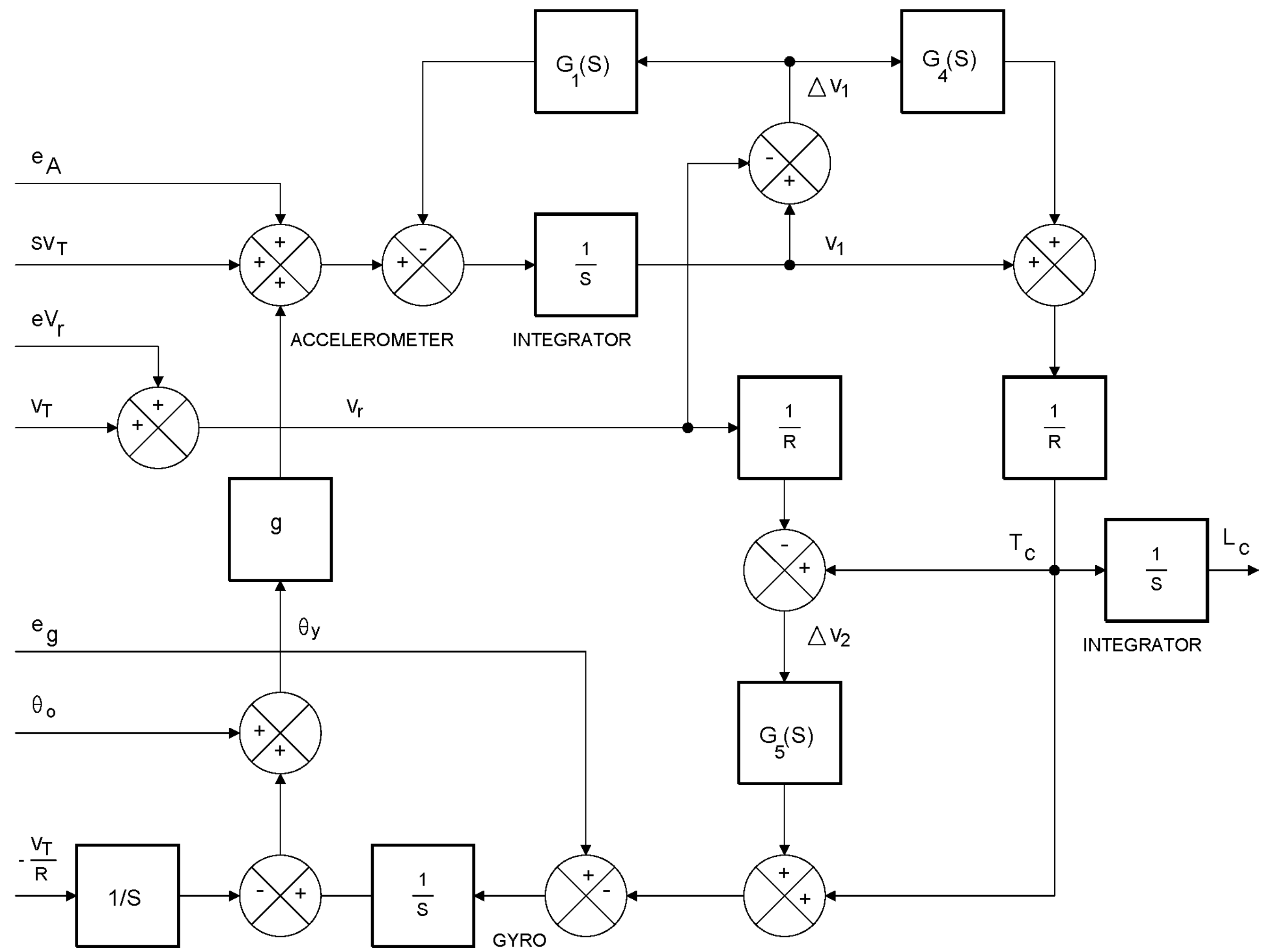


Figure 3-8. North Position Error



e_A = ACCELEROMETER ERROR
SV_T = TRUE ACCELERATION
V_1 = INERTIAL MEASURED VELOCITY
eV_r = REFERENCE VELOCITY ERROR (RVE)
V_T = SHIP'S VELOCITY (TRUE VELOCITY) INPUT
V_r = REFERENCE VELOCITY
e_g = GYRO ERROR
θ_o = INITIAL VERTICAL TILT
T_C = TORQUING FEEDBACK SIGNAL
L_c = COMPUTED LATITUDE
R = EARTH'S RADIUS
g = EARTH'S GRAVITY
$G_1(S)$, $G_4(S)$, $G_5(S)$, = TRANSFER FUNCTIONS

Figure 3-9. Block Diagram of External Velocity Damped Vertical Loop

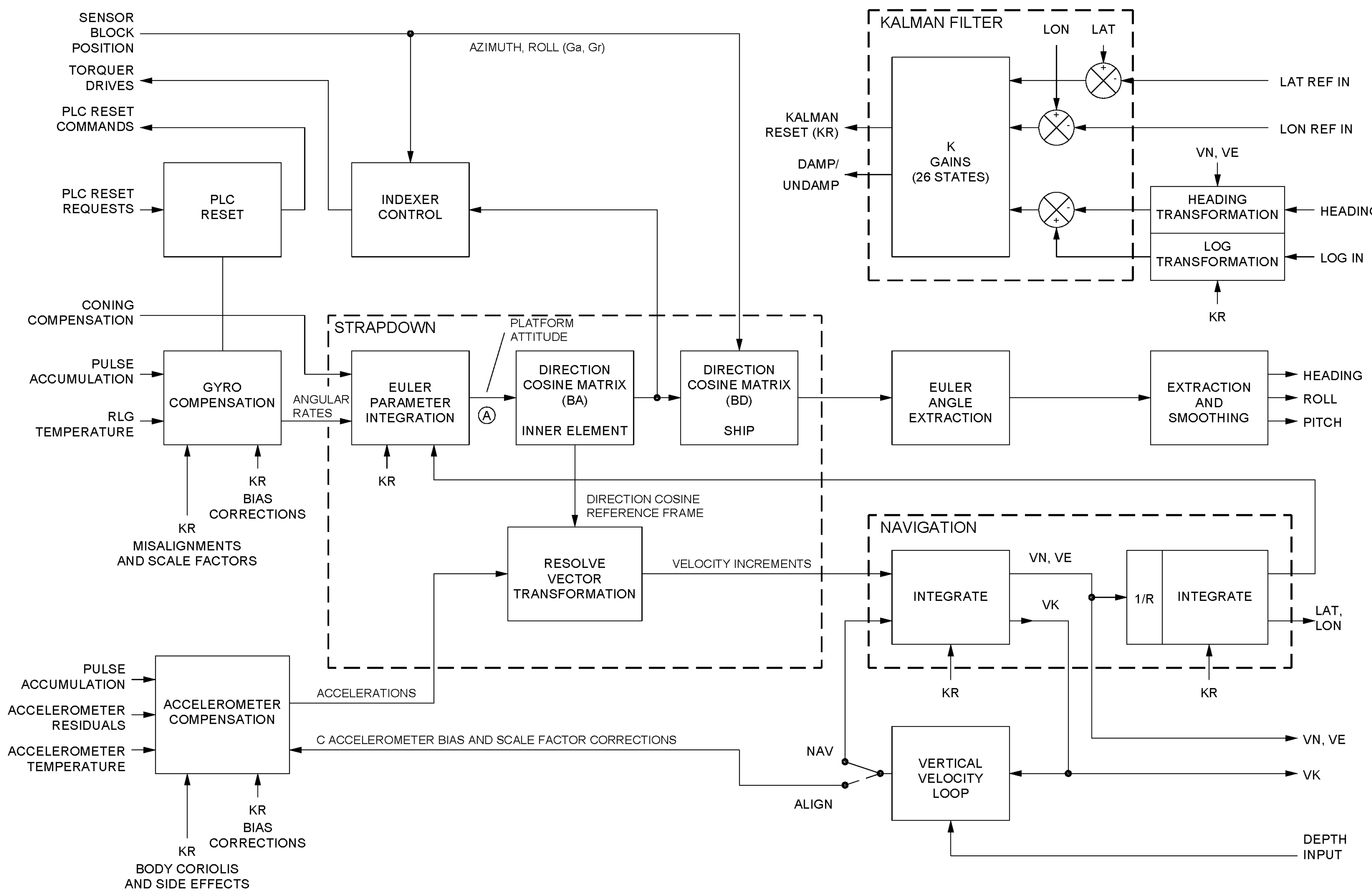


Figure 3-10. Strapdown Processing Block Diagram

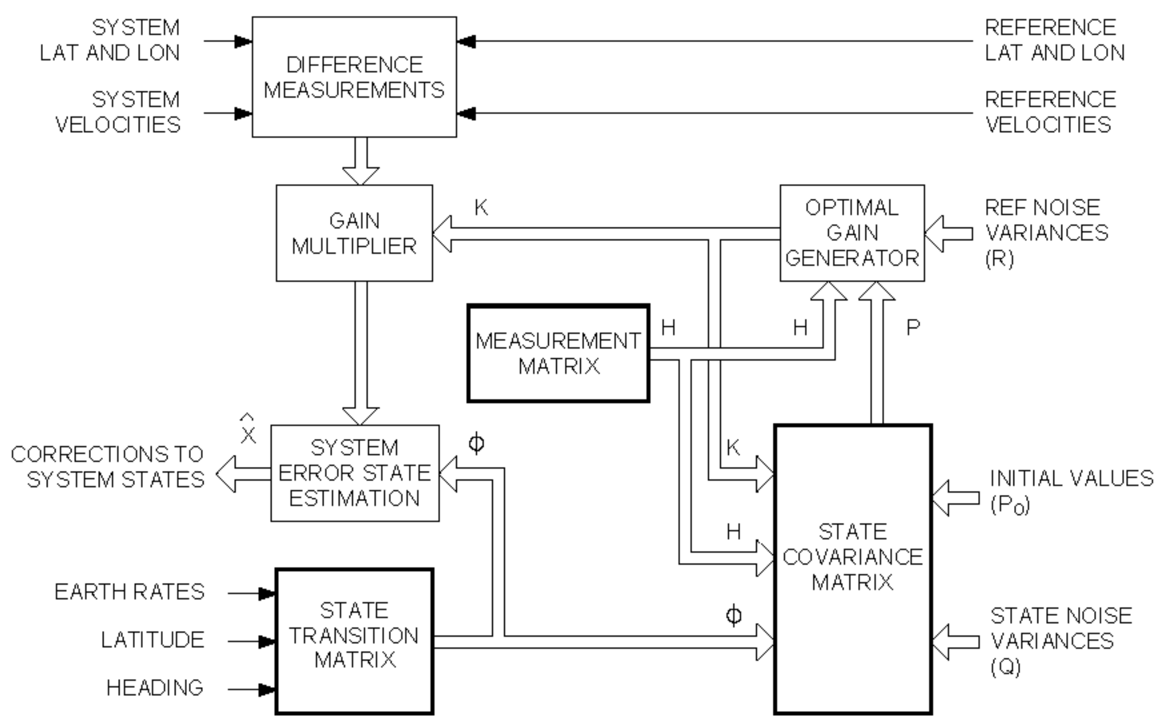


Figure 3-11. Kalman Filter Functional Block Diagram

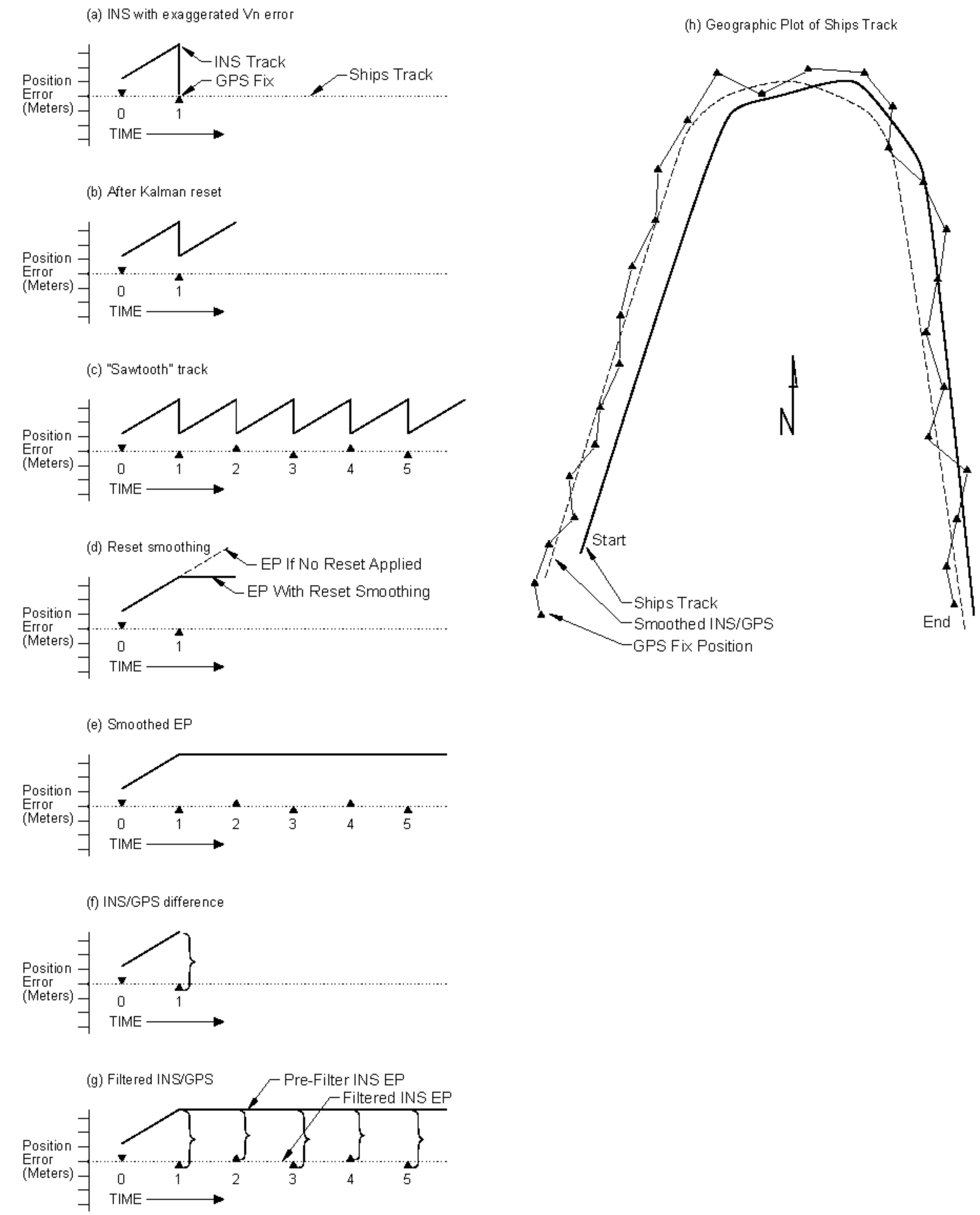


Figure 3-12. INS/GPS Filtering and Reset Smoothing

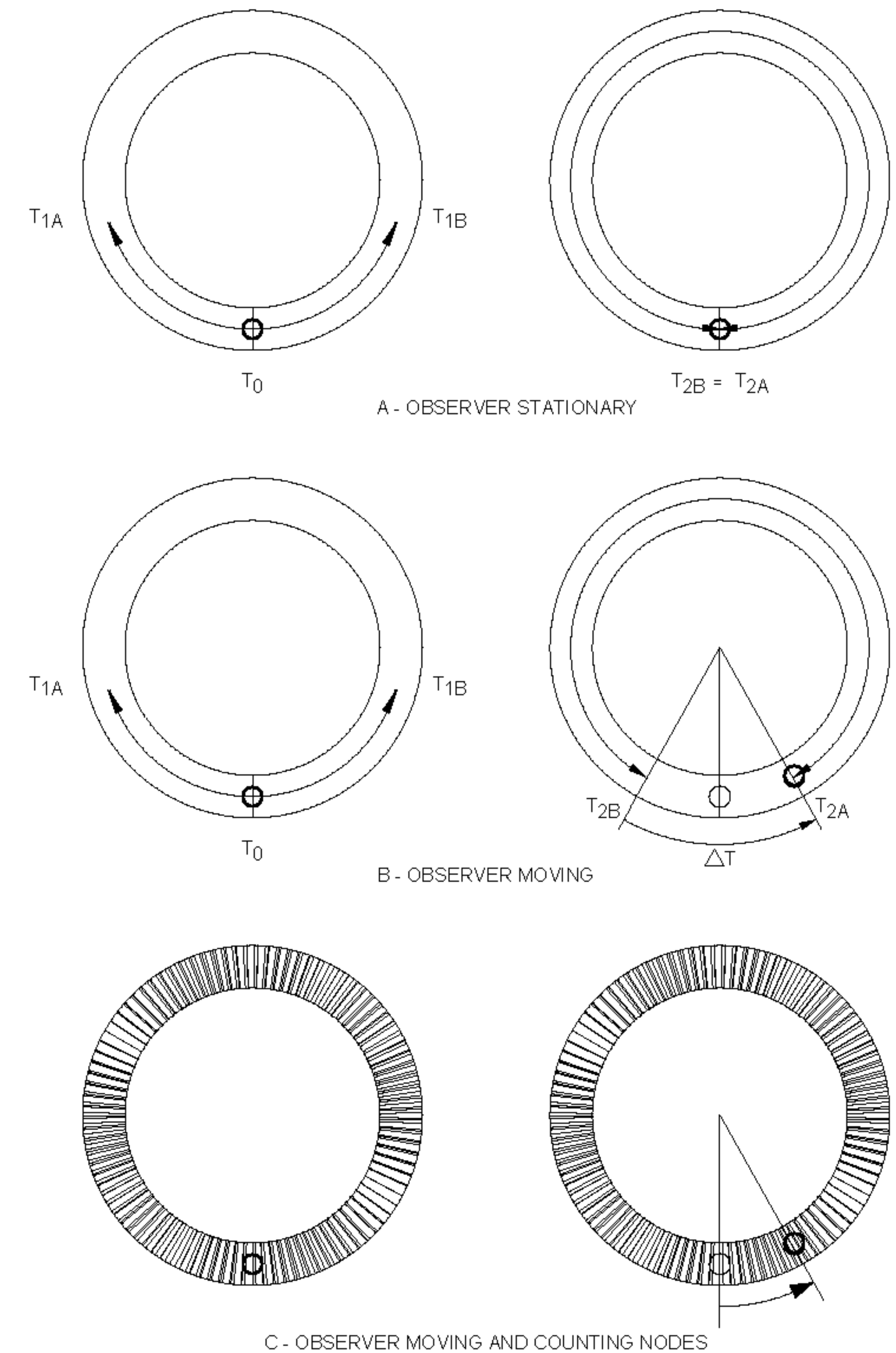


Figure 3-13. Using Light to Measure Rotation

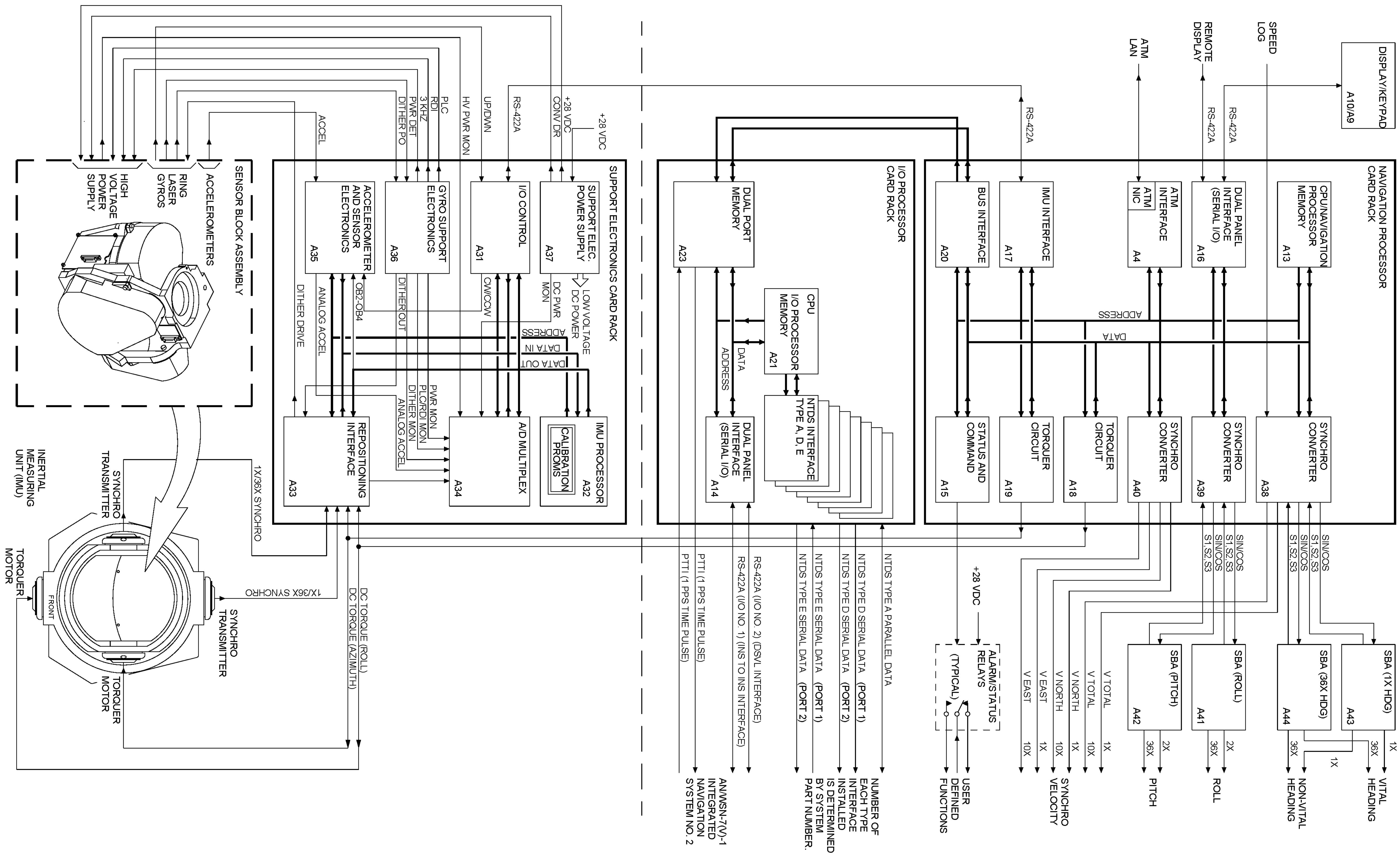


Figure 3-14. Simplified Block Diagram

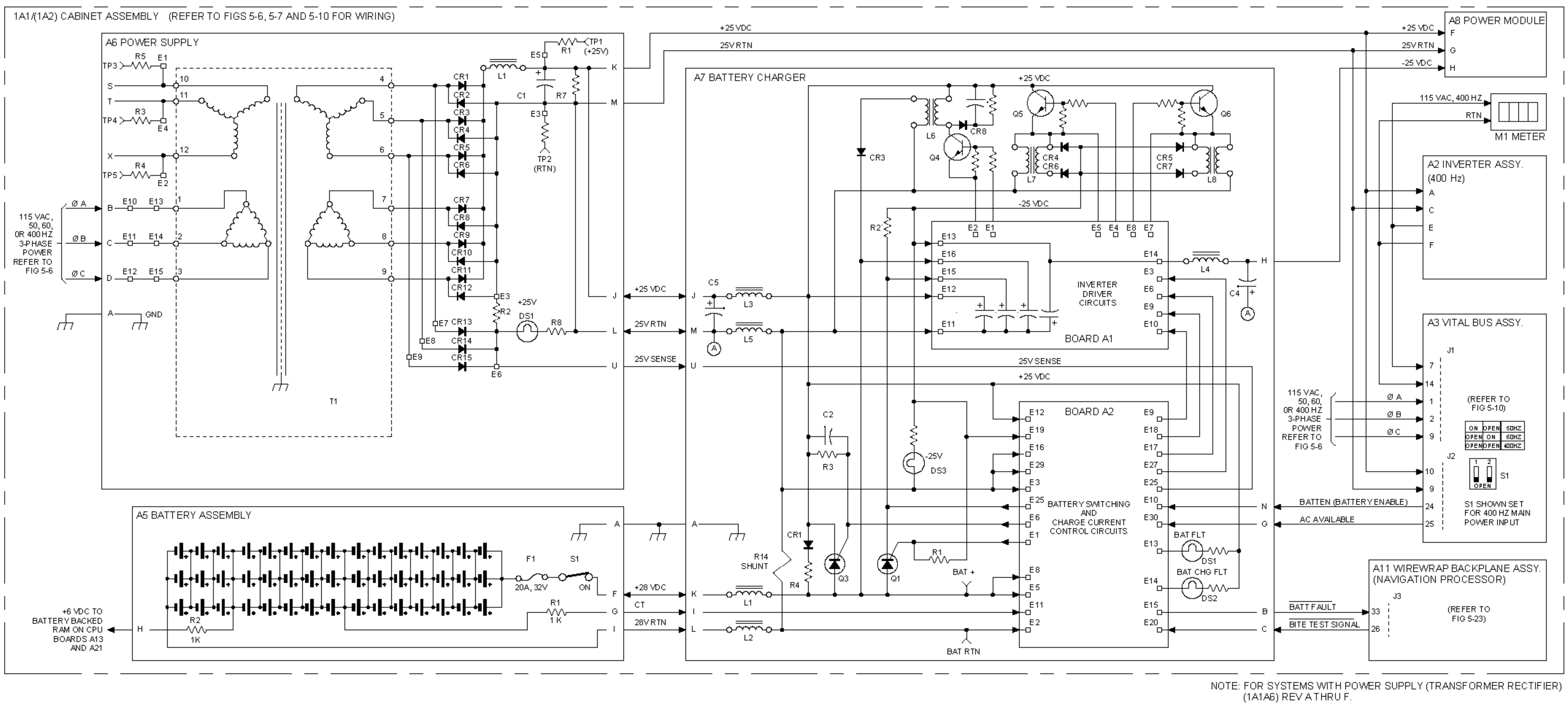


Figure 3-15. Battery Charger and Emergency Power Switching Control (Power Supply Rev A through F)

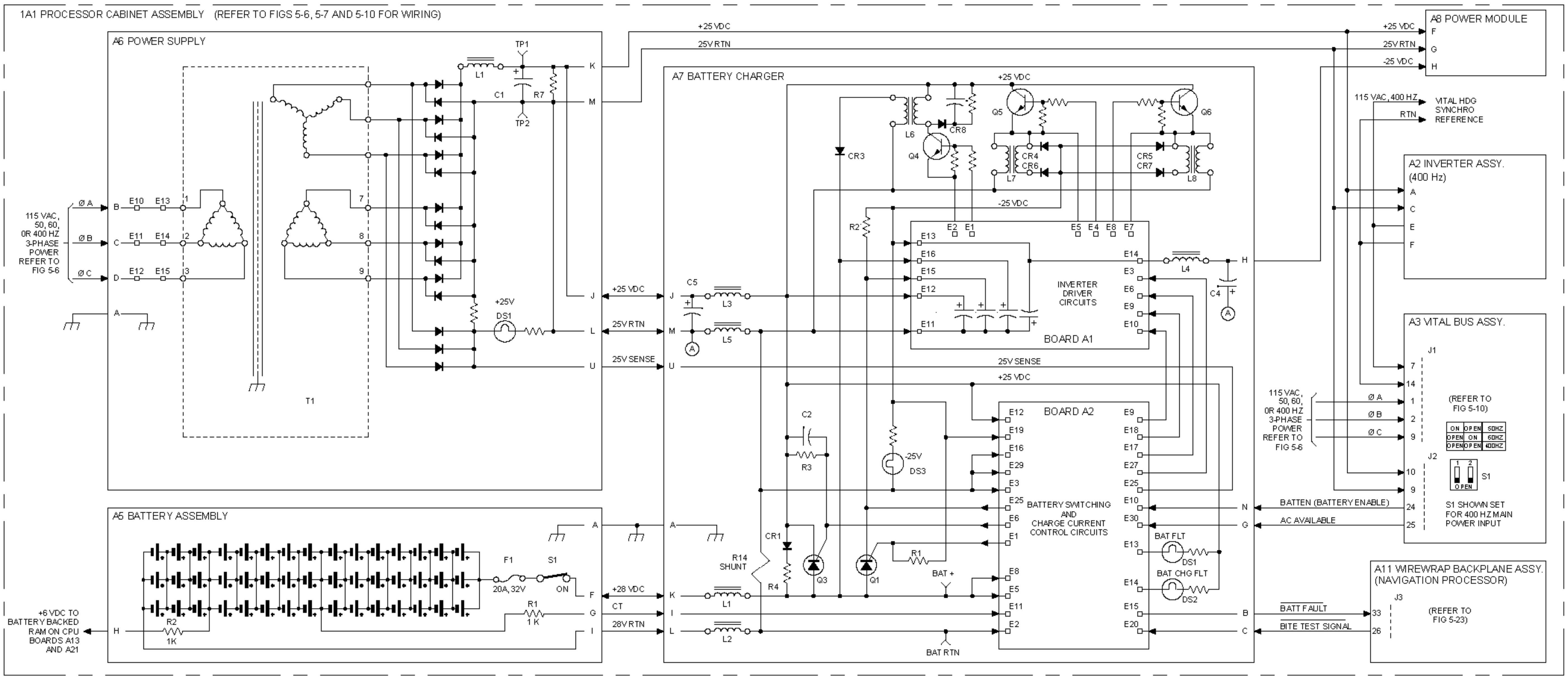
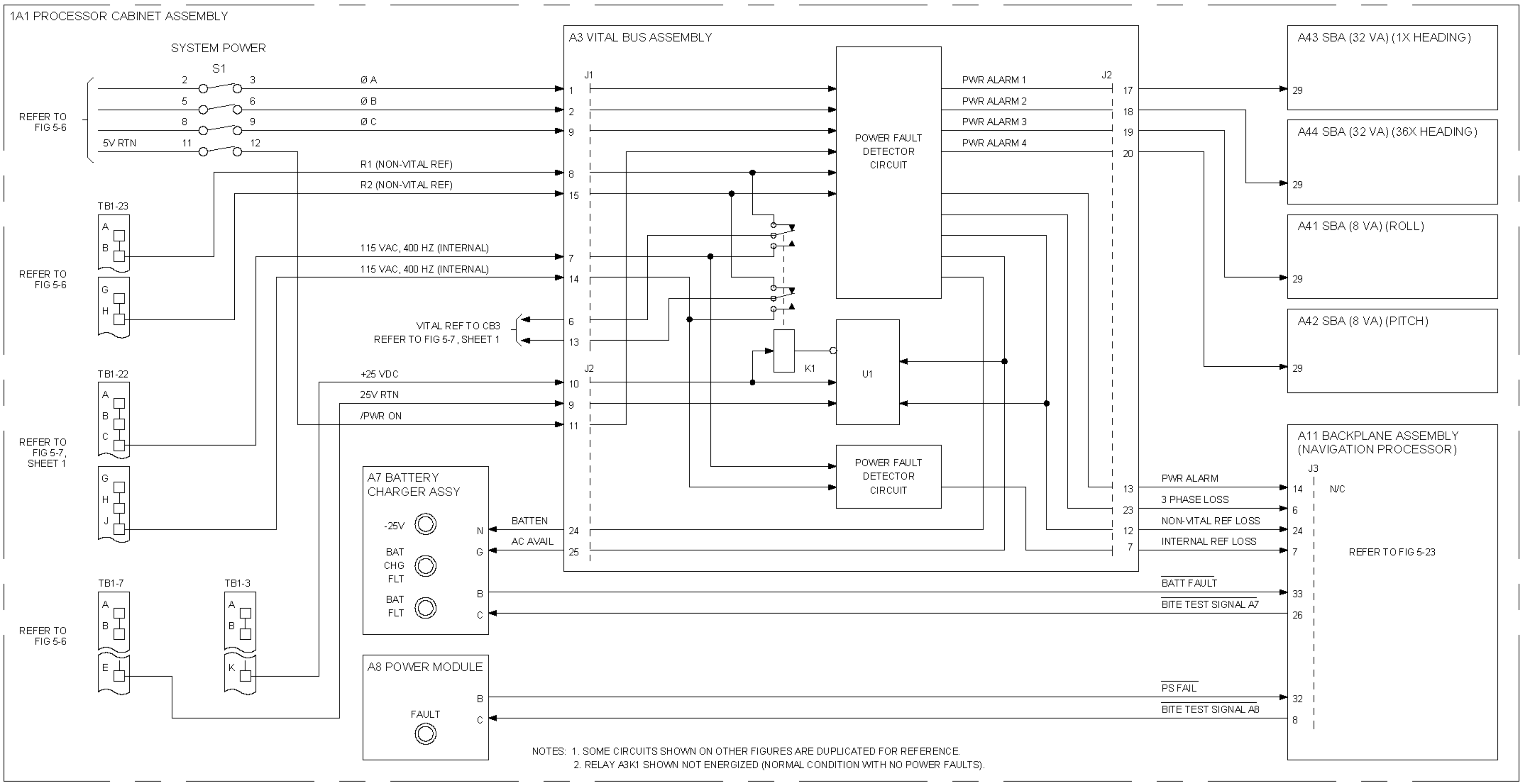


Figure 3-16. Battery Charger and Emergency Power Switching Control (Power Supply Rev G)



NOTES: 1. SOME CIRCUITS SHOWN ON OTHER FIGURES ARE DUPLICATED FOR REFERENCE.
2. RELAY A3K1 SHOWN NOT ENERGIZED (NORMAL CONDITION WITH NO POWER FAULTS).

Figure 3-17. Power Fault Detection and Power Control Functions

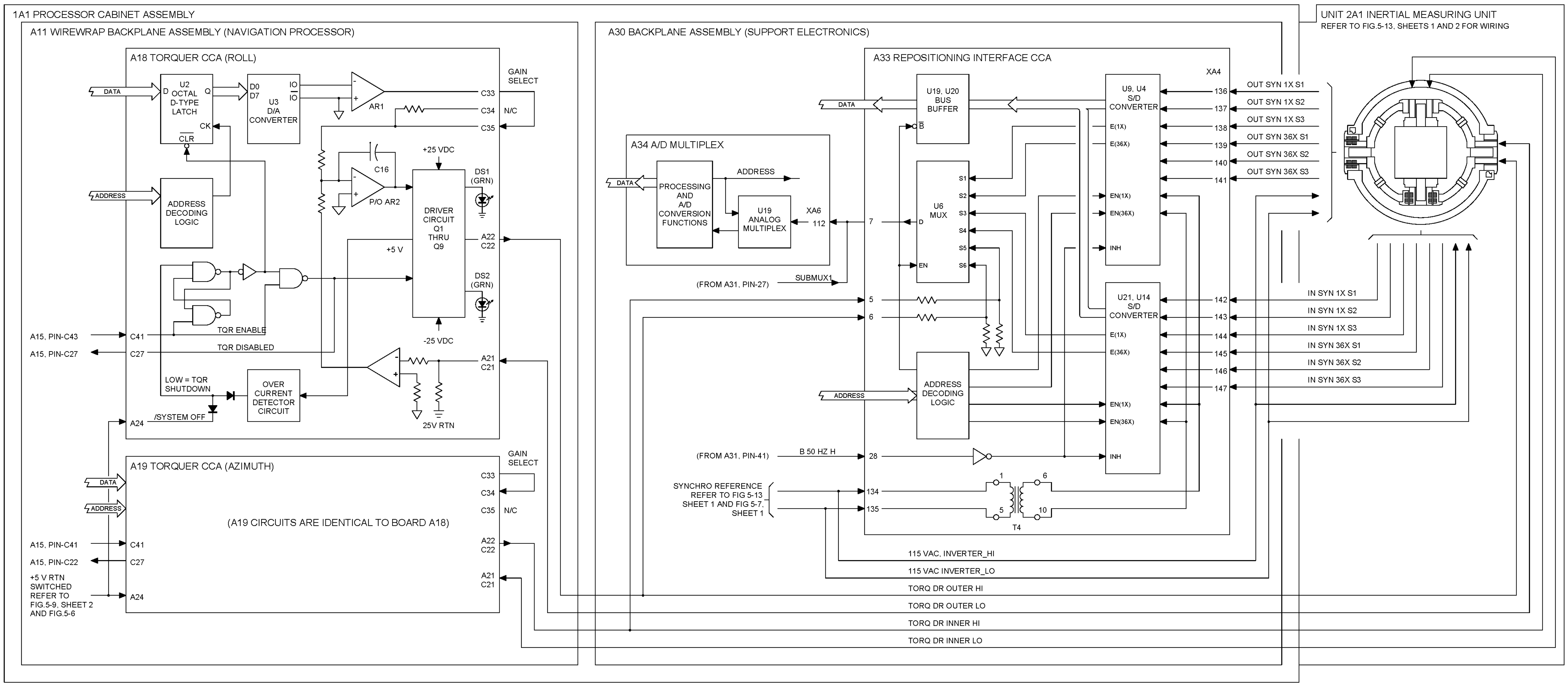
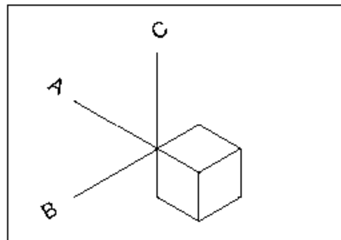
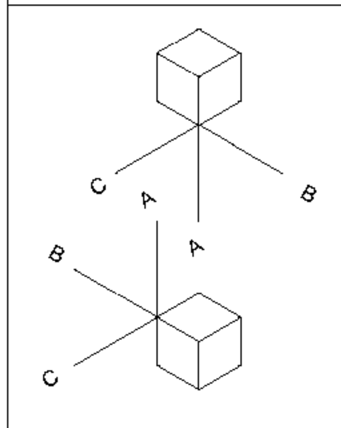
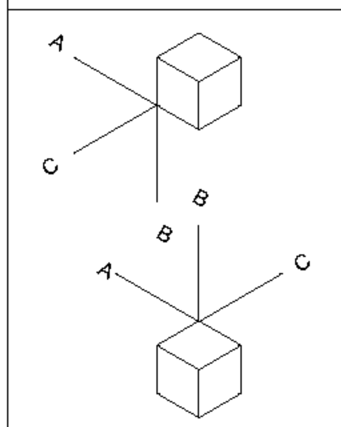
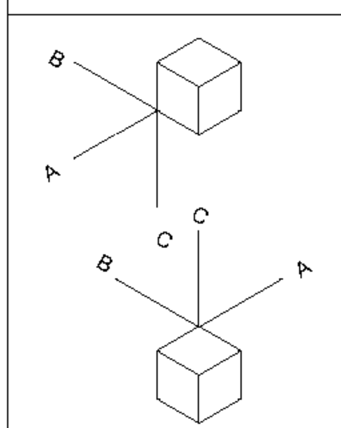
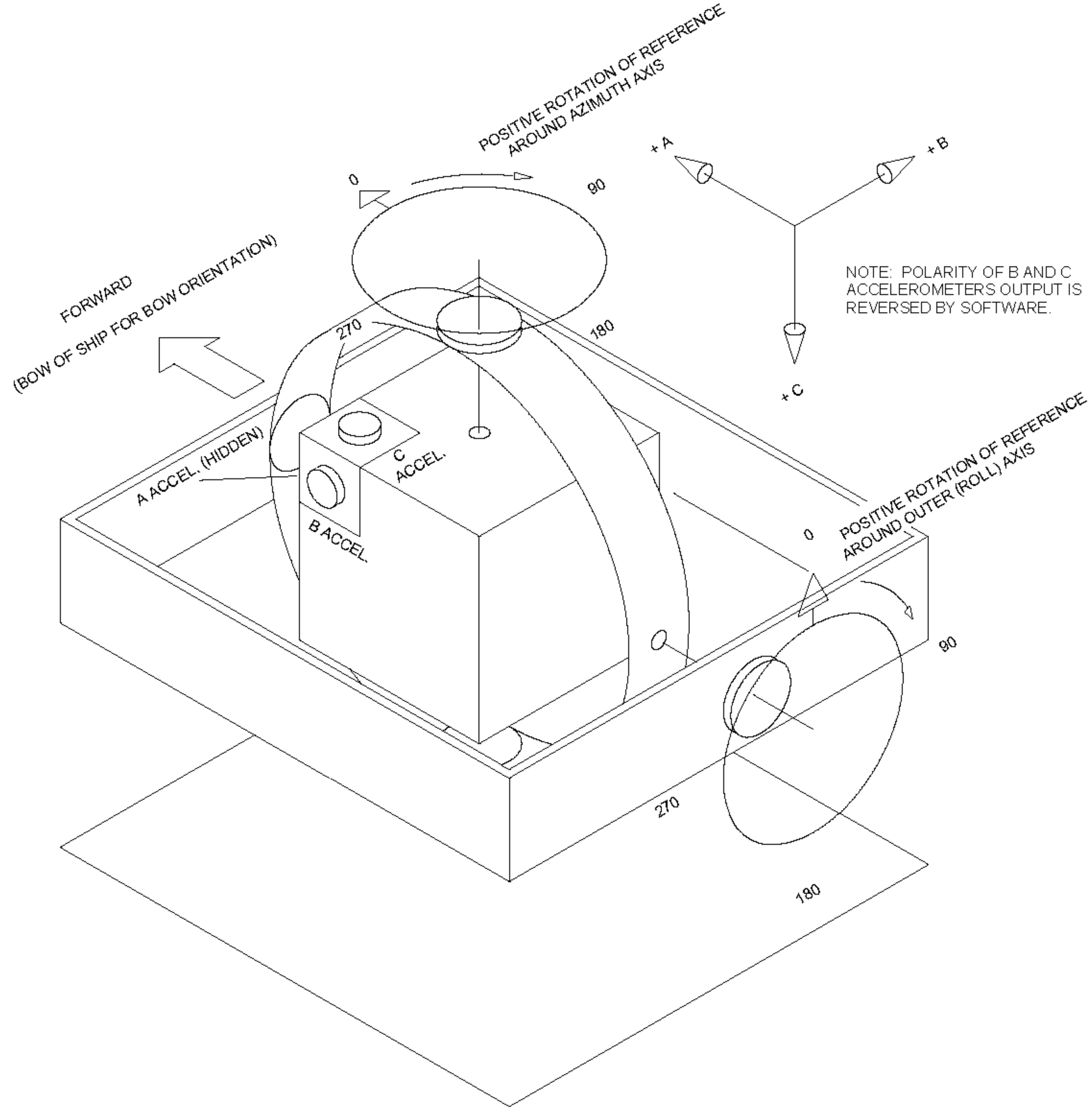


Figure 3-18. Platform Indexing Control

	INNER GIMBAL	OUTER GIMBAL	CHECK ACCELEROMETERS
	0	0	INITIAL POSITION
	270	270	A AND B
	90	270	A AND B
	0	270	B AND C
	0	90	B AND C
	90	180	C AND A
	90	0	C AND A

ACCELEROMETER PHYSICAL ORIENTATIONS DURING ACCELEROMETER TESTS



INERTIAL SENSOR COORDINATE FRAME ORIENTATION WITH SYNCHROS AT ZERO DEGREE NULL

Figure 3-19. Platform Indexing Orientations

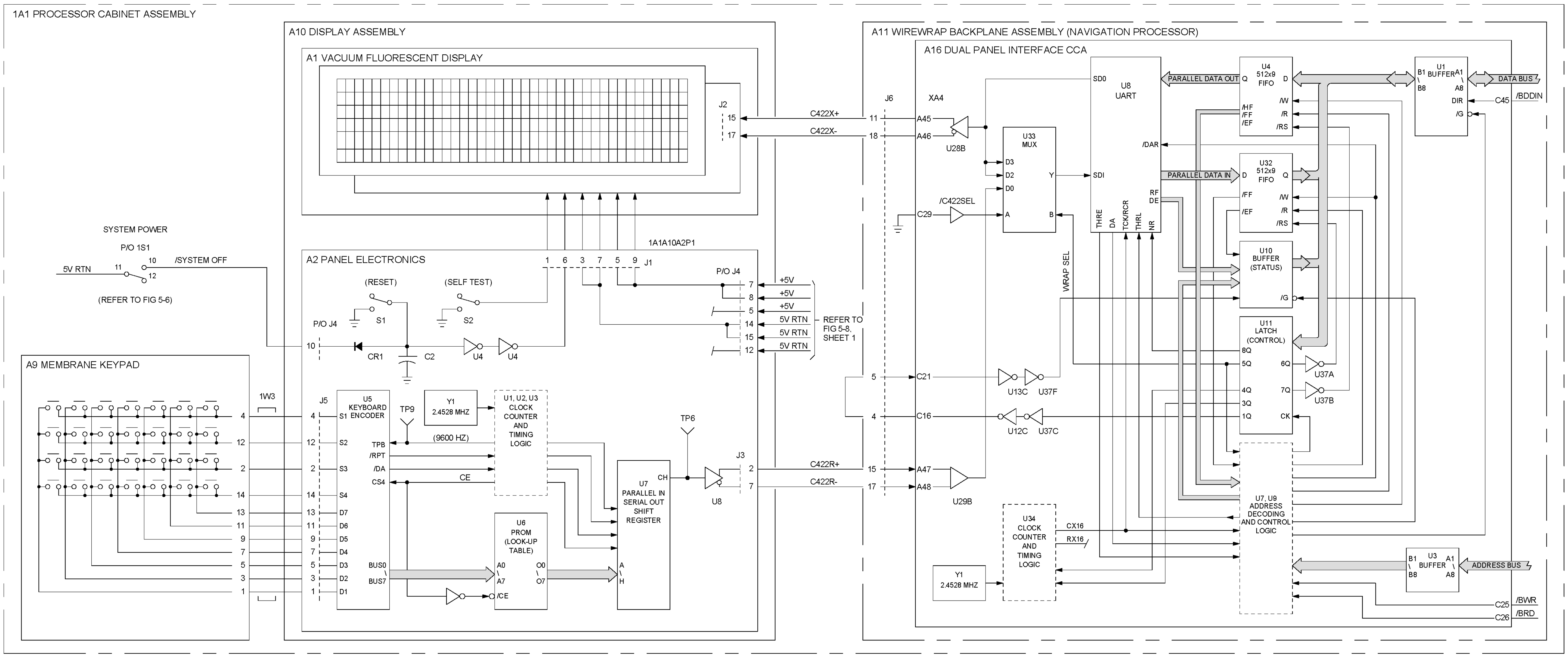


Figure 3-20. Display and Display Interface

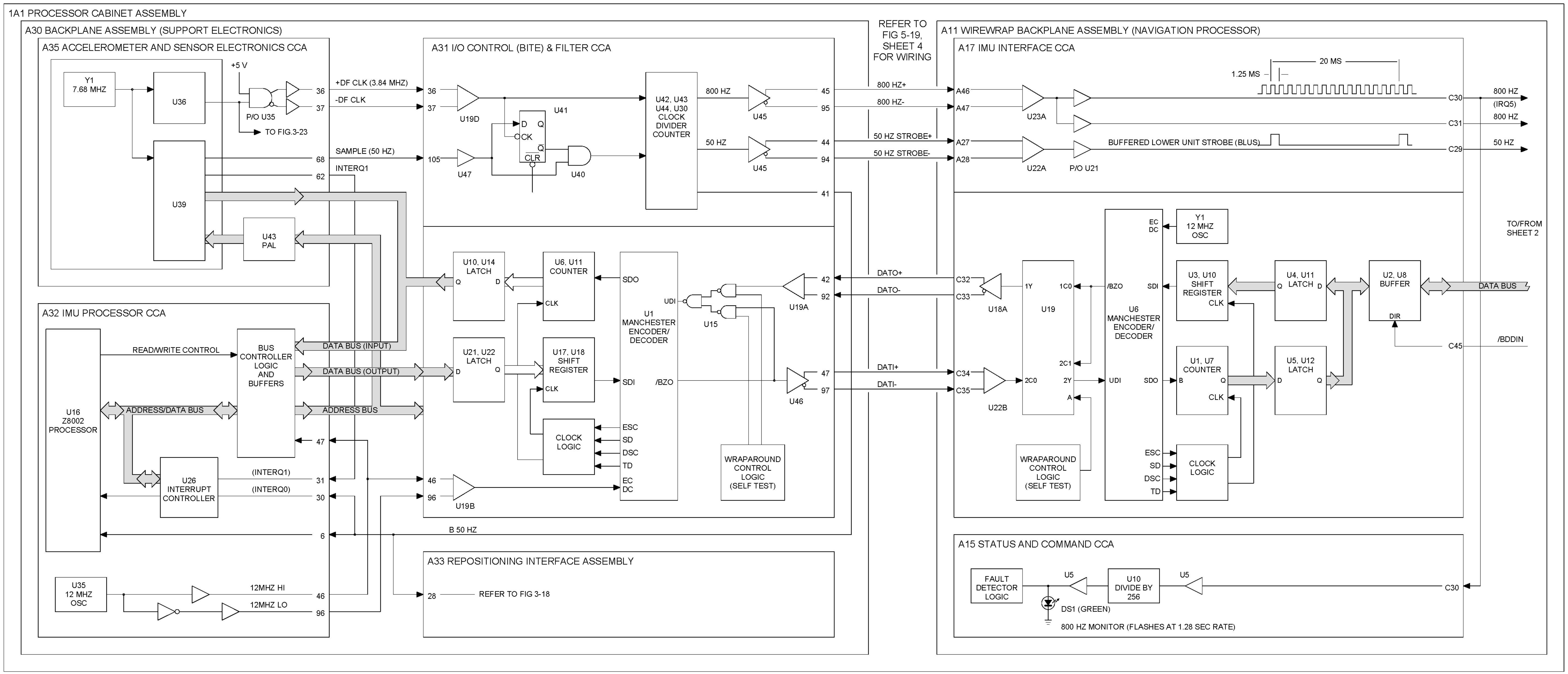


Figure 3-21 System Timing and Navigation Processing (Sheet 1 of 2)

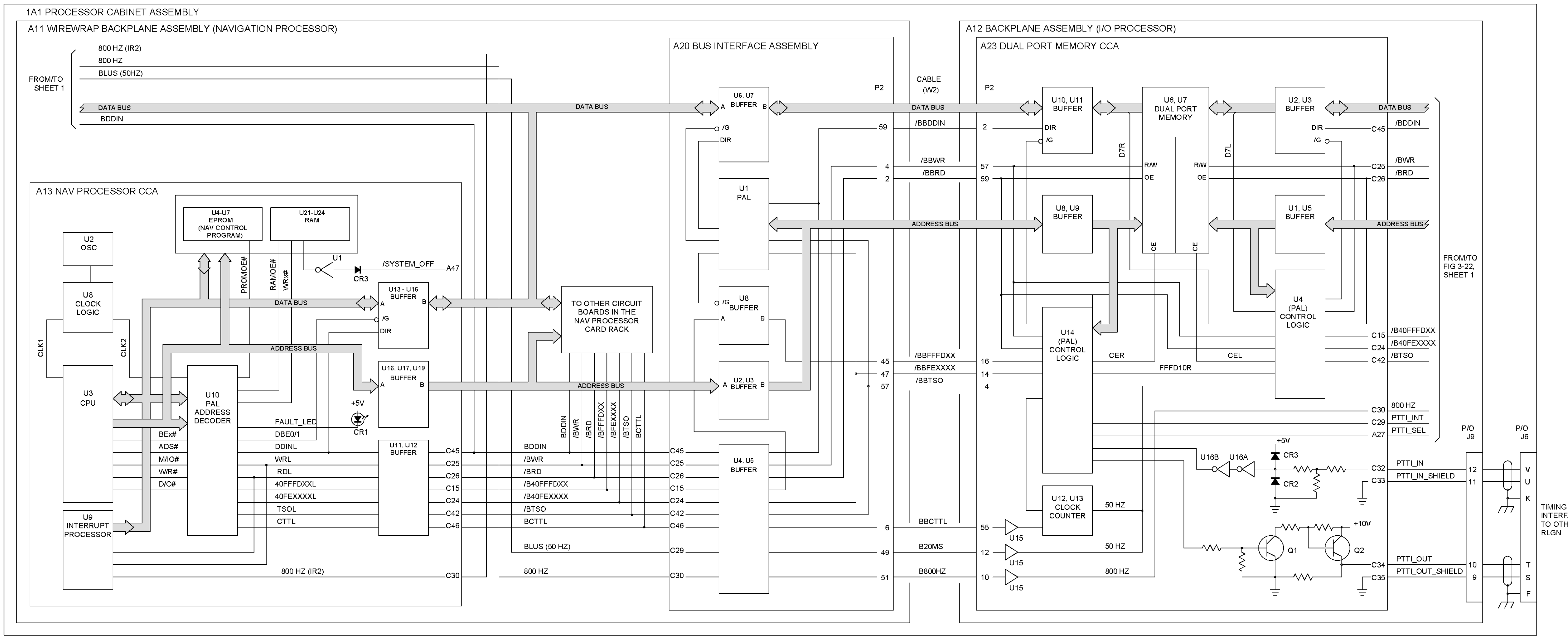


Figure 3-21 System Timing and Navigation Processing (Sheet 2 of 2)

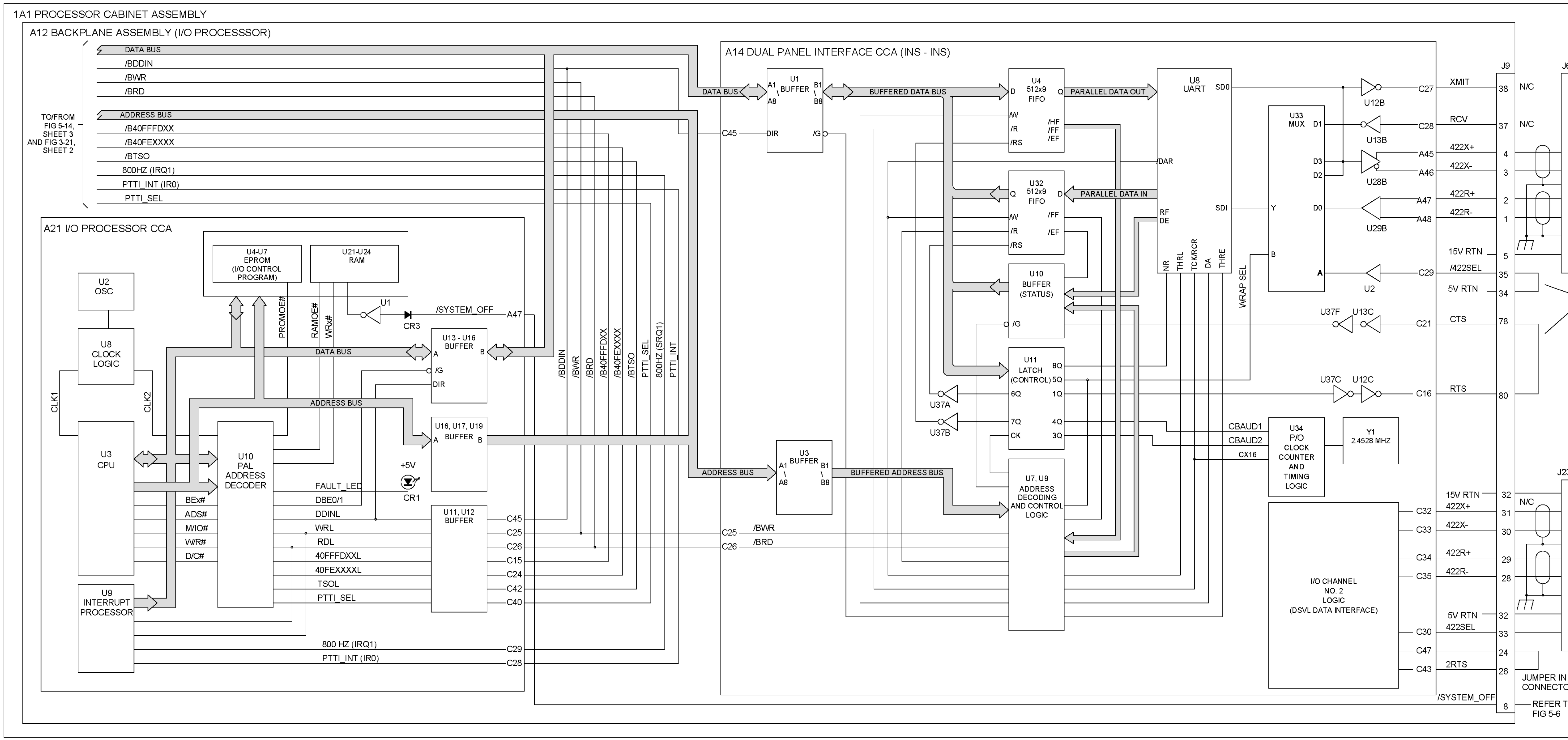
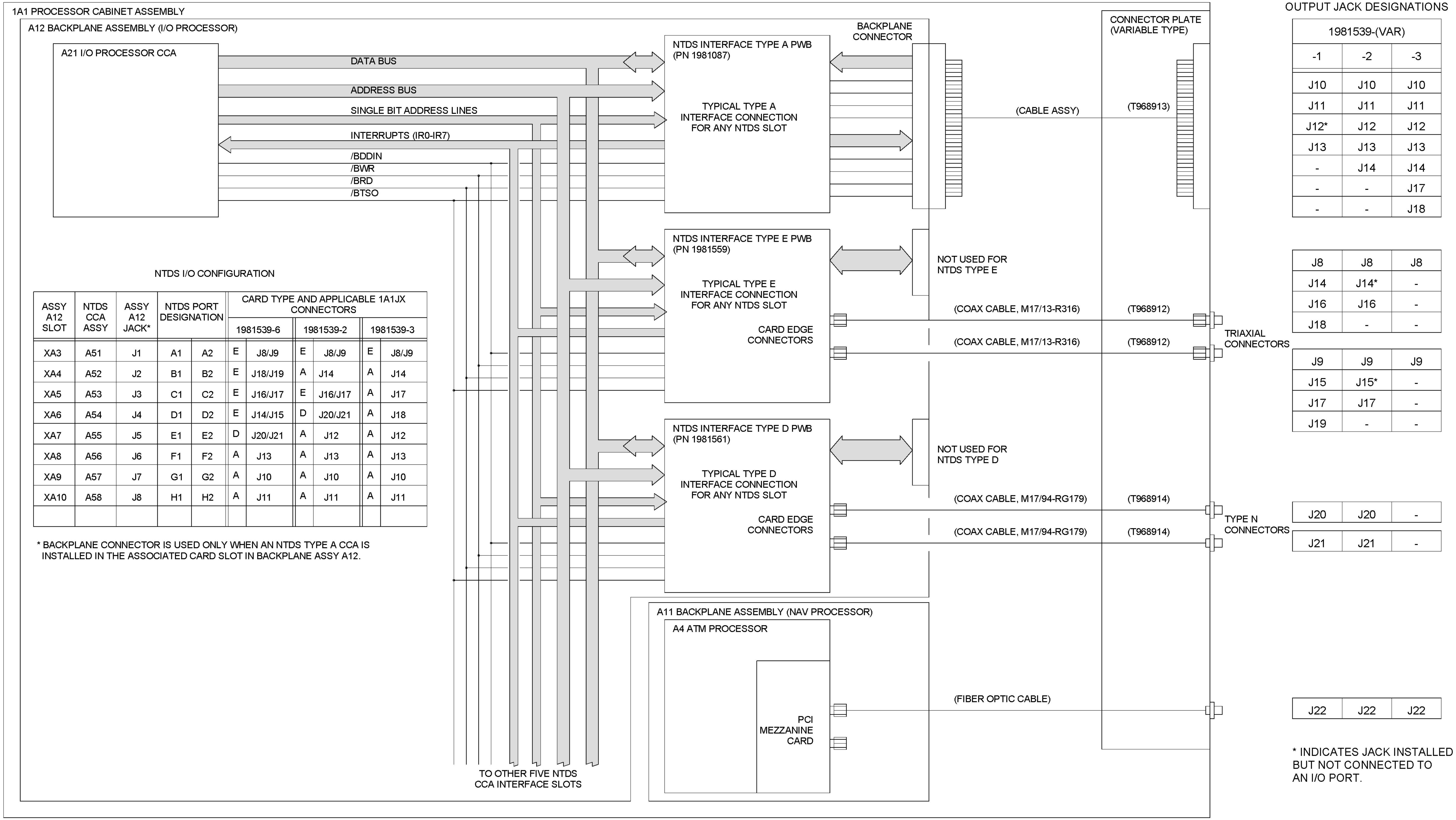


Figure 3-22. I/O Processing and Interface (Sheet 1 of 2)



NTDS I/O CONFIGURATION

ASSY A12 SLOT	NTDS CCA ASSY	ASSY A12 JACK*	NTDS PORT DESIGNATION		CARD TYPE AND APPLICABLE 1A1JX CONNECTORS					
					1981539-6		1981539-2		1981539-3	
XA3	A51	J1	A1	A2	E	J8/J9	E	J8/J9	E	J8/J9
XA4	A52	J2	B1	B2	E	J18/J19	A	J14	A	J14
XA5	A53	J3	C1	C2	E	J16/J17	E	J16/J17	A	J17
XA6	A54	J4	D1	D2	E	J14/J15	D	J20/J21	A	J18
XA7	A55	J5	E1	E2	D	J20/J21	A	J12	A	J12
XA8	A56	J6	F1	F2	A	J13	A	J13	A	J13
XA9	A57	J7	G1	G2	A	J10	A	J10	A	J10
XA10	A58	J8	H1	H2	A	J11	A	J11	A	J11

* BACKPLANE CONNECTOR IS USED ONLY WHEN AN NTDS TYPE A CCA IS INSTALLED IN THE ASSOCIATED CARD SLOT IN BACKPLANE ASSY A12.

OUTPUT JACK DESIGNATIONS

1981539-(VAR)		
-1	-2	-3
J10	J10	J10
J11	J11	J11
J12*	J12	J12
J13	J13	J13
-	J14	J14
-	-	J17
-	-	J18
J8	J8	J8
J14	J14*	-
J16	J16	-
J18	-	-
J9	J9	J9
J15	J15*	-
J17	J17	-
J19	-	-
J20	J20	-
J21	J21	-
J22	J22	J22

* INDICATES JACK INSTALLED BUT NOT CONNECTED TO AN I/O PORT.

Figure 3-22. I/O Processing and Interface (Sheet 2 of 2)

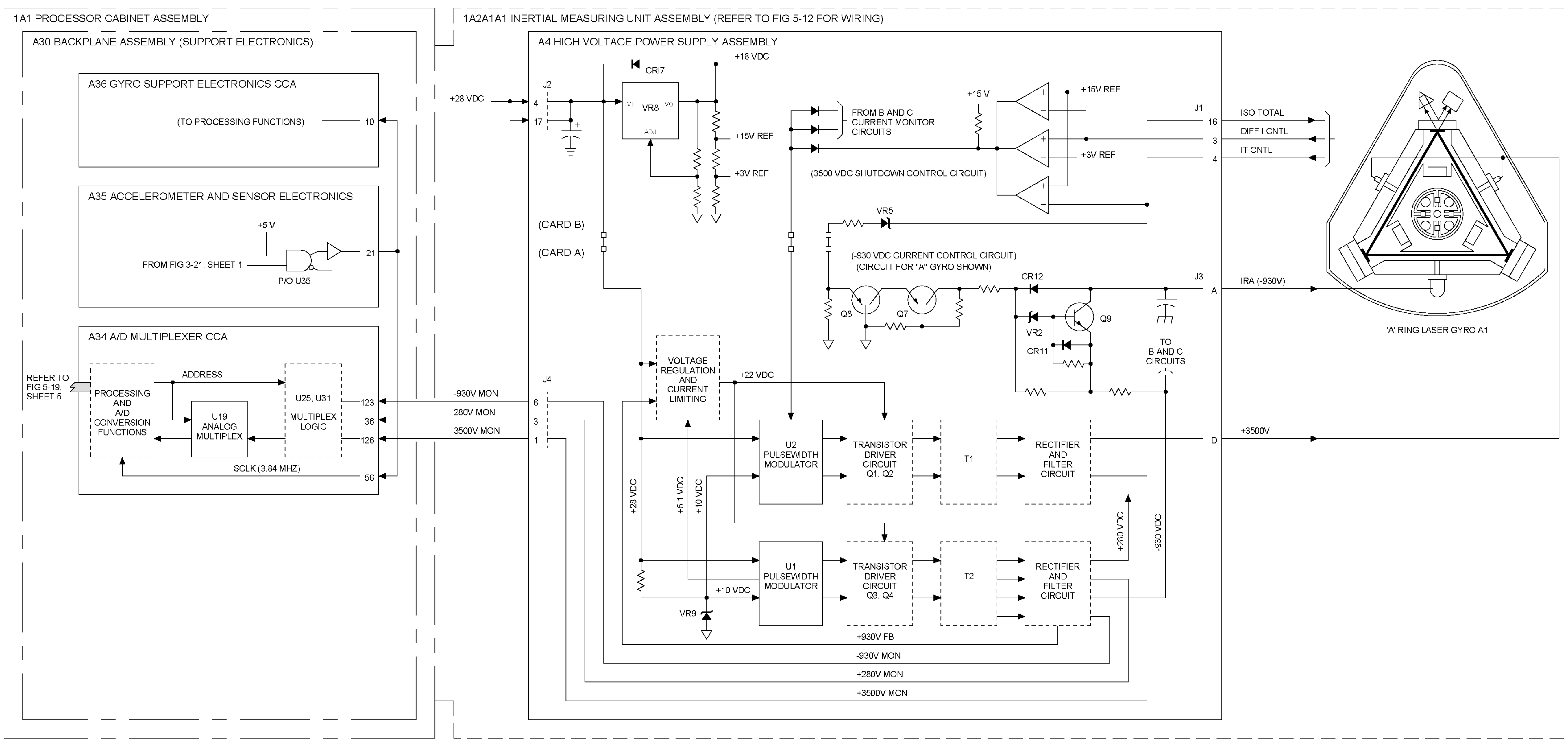
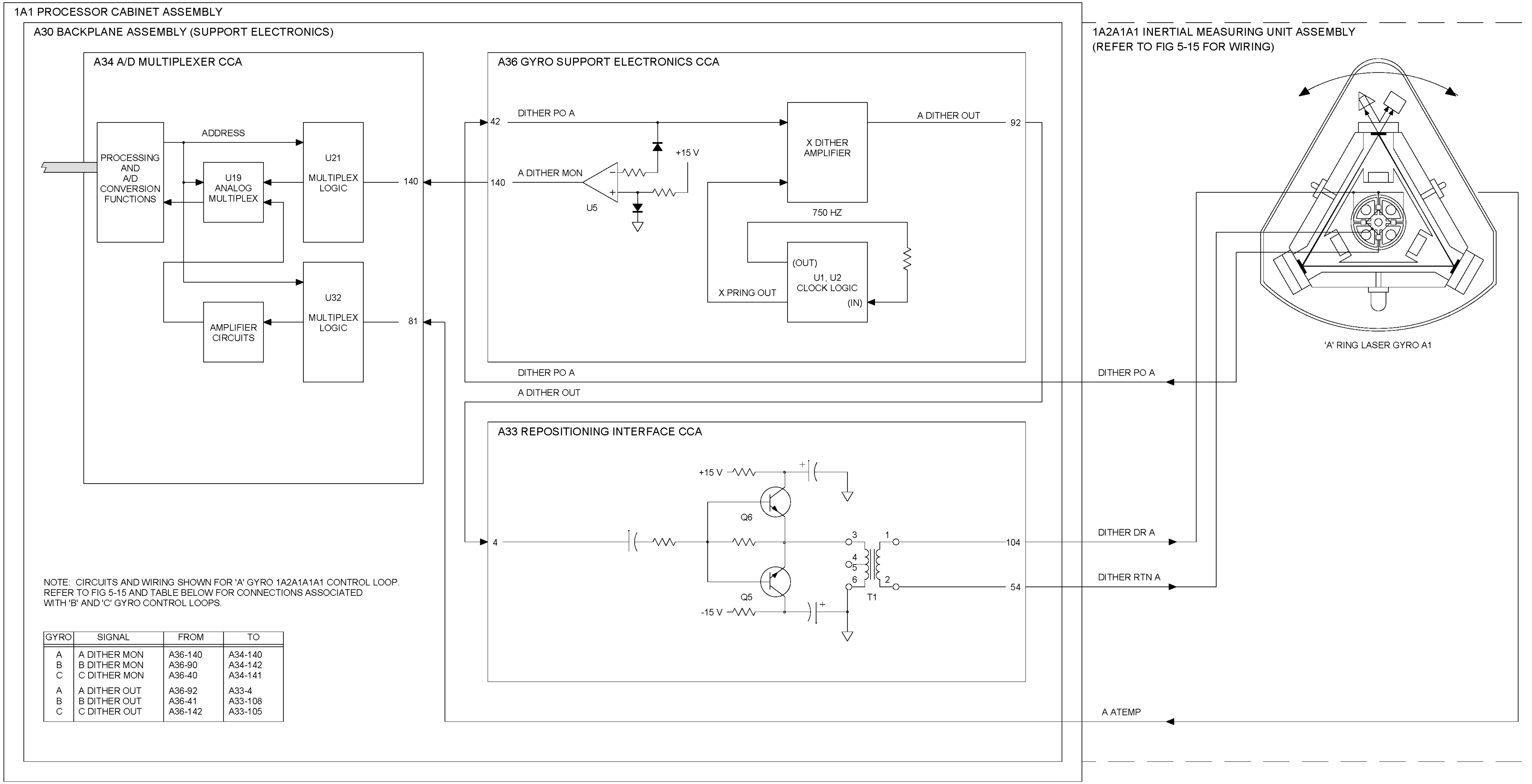
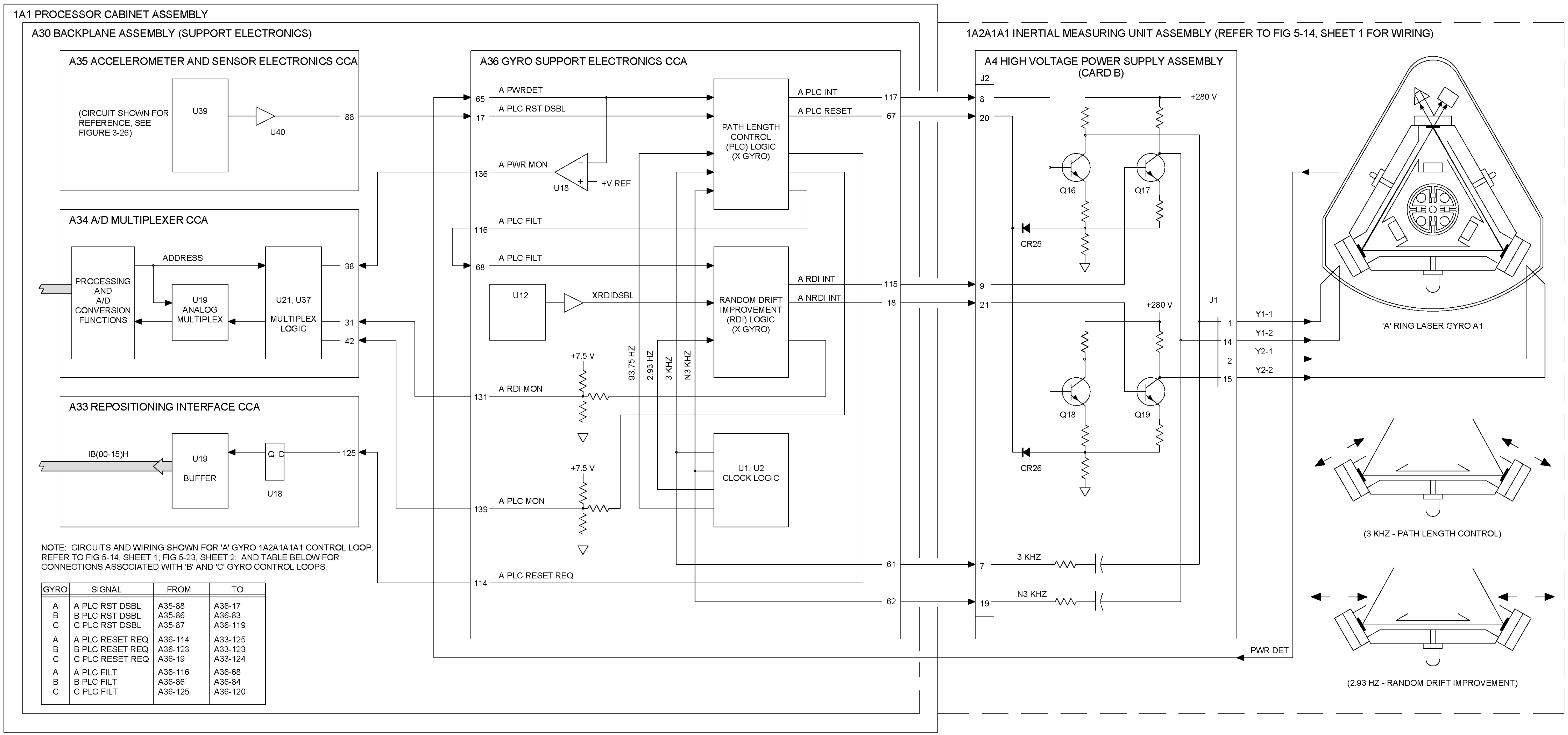


Figure 3-23. Gyro High Voltage



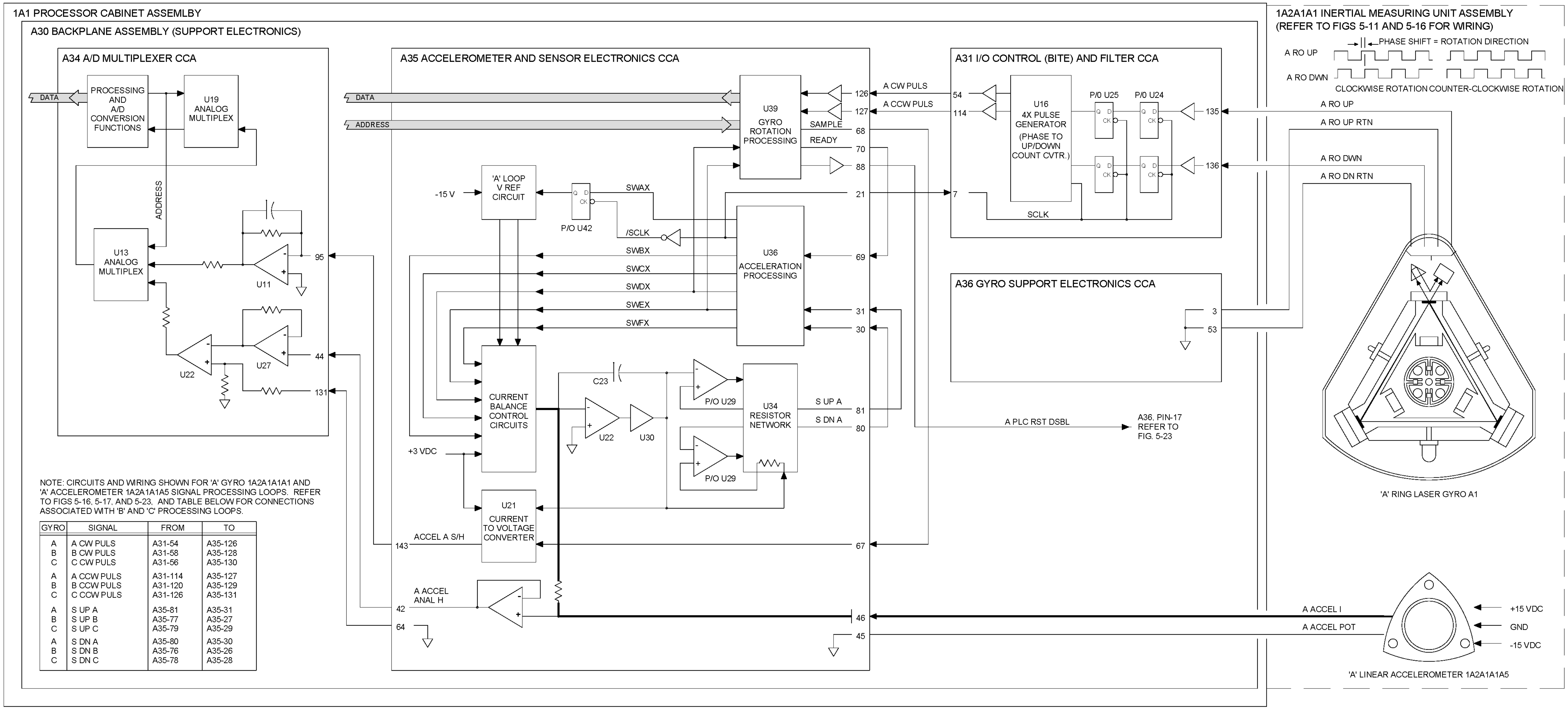
GYRO	SIGNAL	FROM	TO
A	A DITHER MON	A36-140	A34-140
B	B DITHER MON	A36-90	A34-142
C	C DITHER MON	A36-40	A34-141
A	A DITHER OUT	A36-92	A33-4
B	B DITHER OUT	A36-41	A33-108
C	C DITHER OUT	A36-142	A33-105

Figure 3-24. Ring Laser Gyros: Dither



GYRO	SIGNAL	FROM	TO
A	A PLC RST DSBL	A35-88	A36-17
B	B PLC RST DSBL	A35-86	A36-83
C	C PLC RST DSBL	A35-87	A36-119
A	A PLC RESET REQ	A36-114	A33-125
B	B PLC RESET REQ	A36-123	A33-123
C	C PLC RESET REQ	A36-19	A33-124
A	A PLC FILT	A36-116	A36-68
B	B PLC FILT	A36-86	A36-84
C	C PLC FILT	A36-125	A36-120

Figure 3-25. Ring Laser Gyros: PLC and RDI



NOTE: CIRCUITS AND WIRING SHOWN FOR 'A' GYRO 1A2A1A1A1 AND 'A' ACCELEROMETER 1A2A1A1A5 SIGNAL PROCESSING LOOPS. REFER TO FIGS 5-16, 5-17, AND 5-23, AND TABLE BELOW FOR CONNECTIONS ASSOCIATED WITH 'B' AND 'C' PROCESSING LOOPS.

GYRO	SIGNAL	FROM	TO
A	A CW PULS	A31-54	A35-126
B	B CW PULS	A31-58	A35-128
C	C CW PULS	A31-56	A35-130
A	A CCW PULS	A31-114	A35-127
B	B CCW PULS	A31-120	A35-129
C	C CCW PULS	A31-126	A35-131
A	S UP A	A35-81	A35-31
B	S UP B	A35-77	A35-27
C	S UP C	A35-79	A35-29
A	S DN A	A35-80	A35-30
B	S DN B	A35-76	A35-26
C	S DN C	A35-78	A35-28

Figure 3-26. Ring Laser Gyros: Accelerometers, Rotation

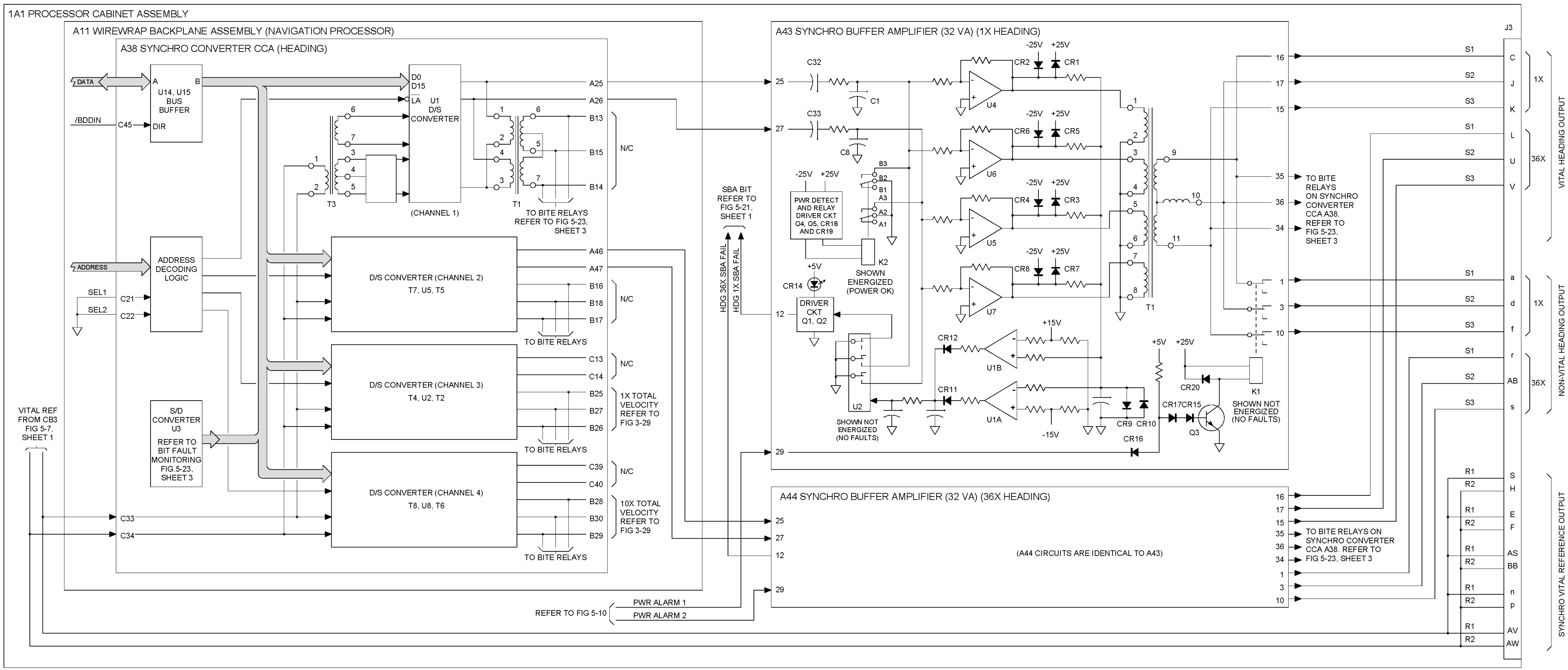


Figure 3-27. Synchro Data - Heading, Total Velocity

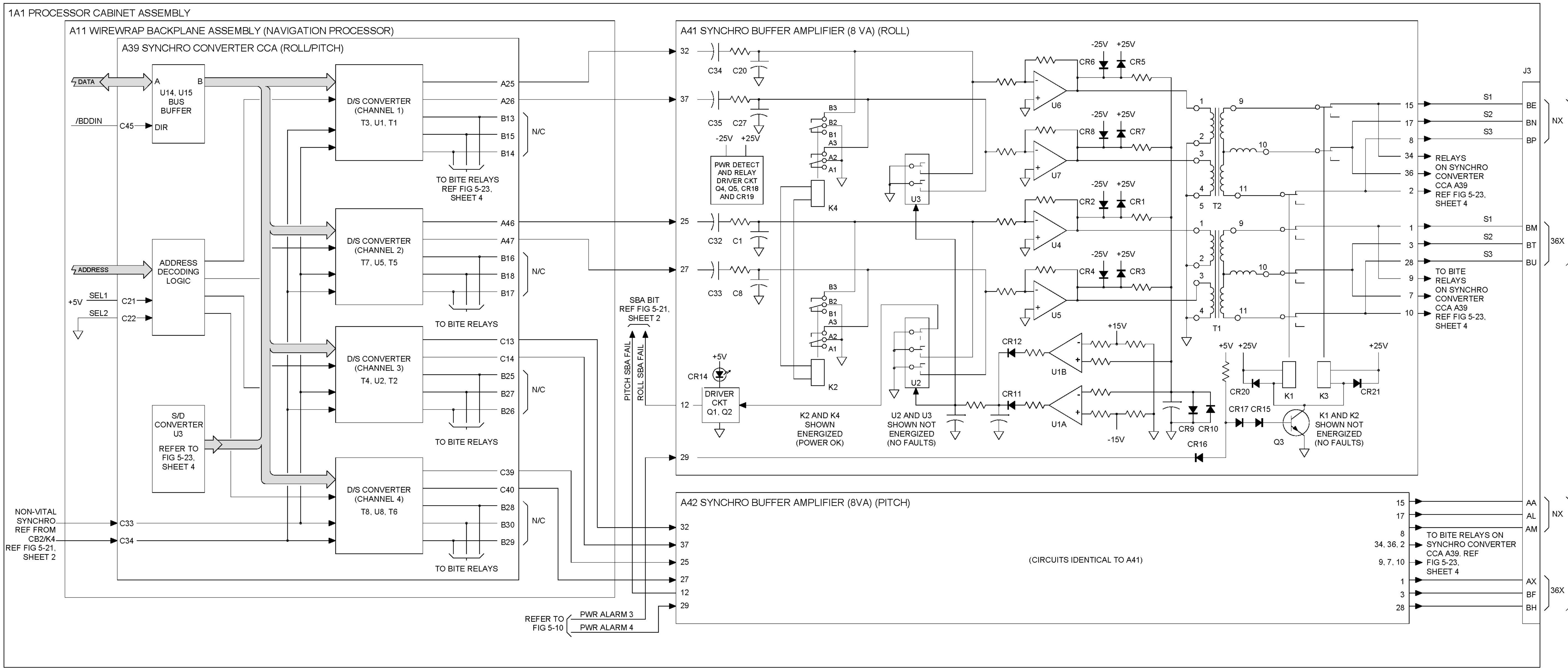


Figure 3-28. Synchro Data - Roll/Pitch

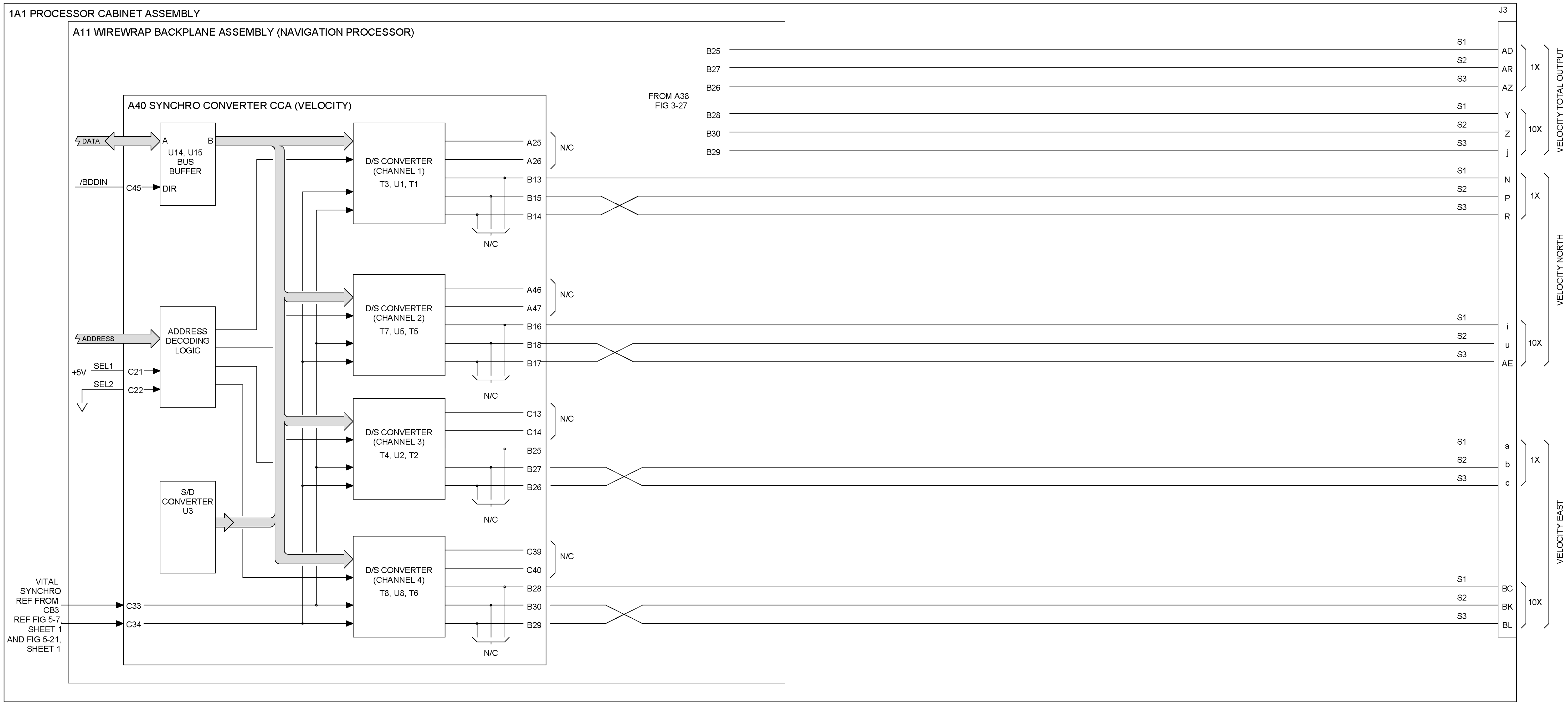


Figure 3-29. Synchro Data - Velocity

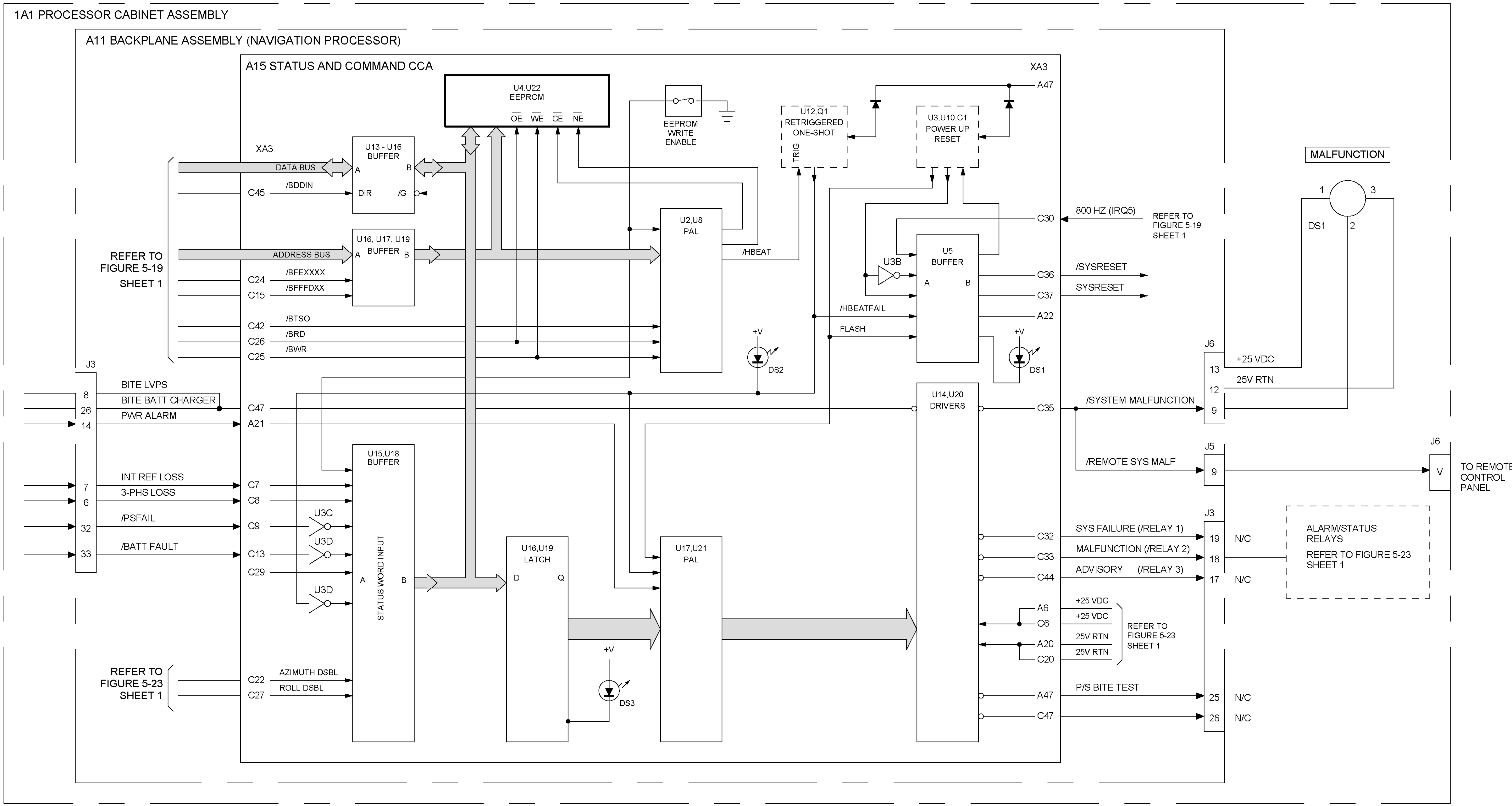


Figure 3-30. Status and Command, Functional Diagram

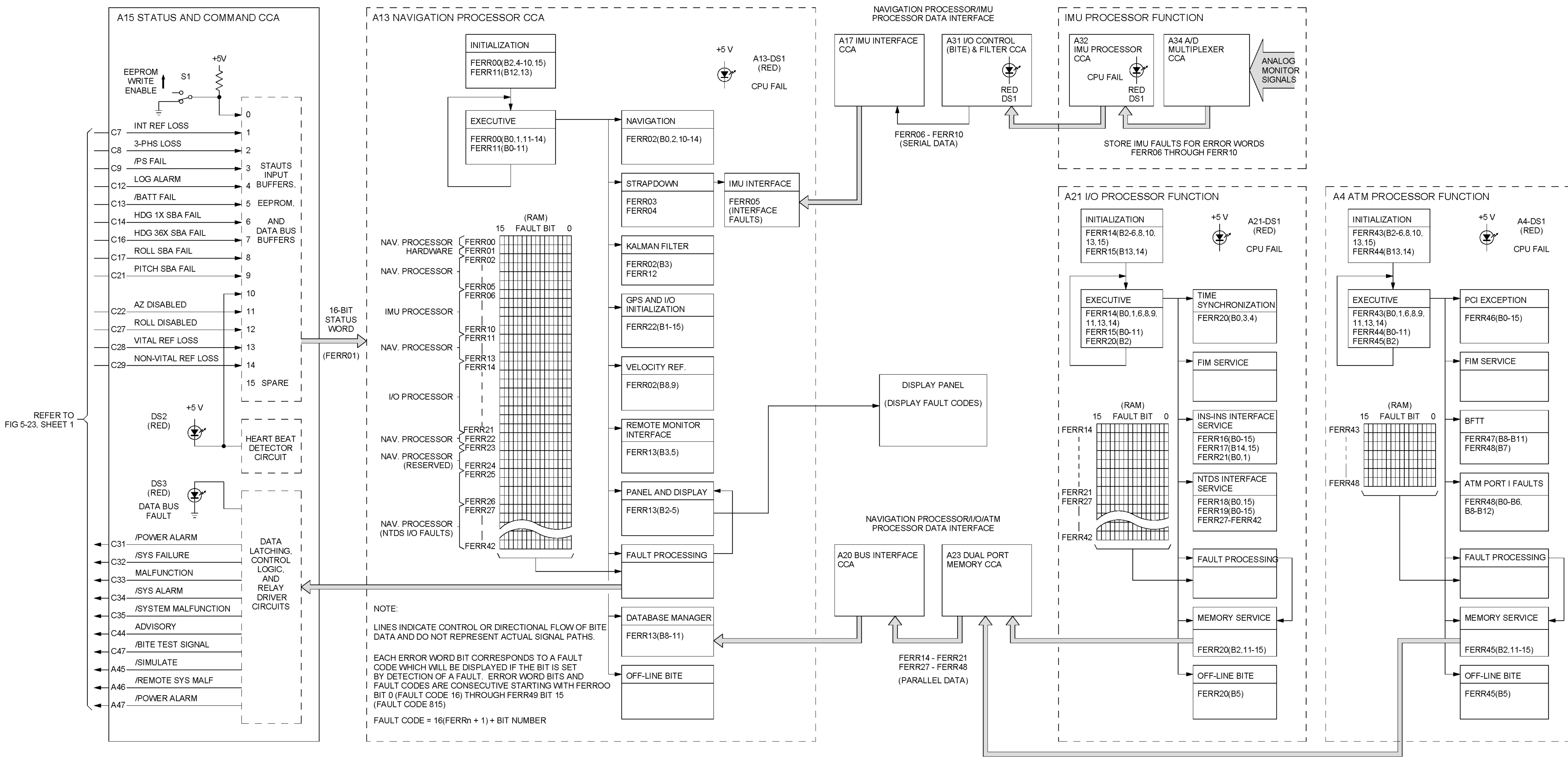


Figure 3-31 Performance Monitoring and Built-In Test (BIT), Functional Diagram

CHAPTER 4
SCHEDULED MAINTENANCE

4.1 INTRODUCTION.

This chapter contains information concerning scheduled maintenance on the AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN). Scheduled maintenance consists of maintenance accomplished in accordance with the Navy Maintenance and Material Management System (3M System) Planned Maintenance Subsystem (PMS). PMS for the RLGN has been issued in Maintenance Index Page (MIP) 4271/011. This chapter also includes maintenance guidelines that apply to the battery assembly storage and maintenance, not included in the current PMS procedures.

Since all electronic subassemblies in the AN/WSN-7(V) RLGN use solid-state digital circuitry, and all mechanical subassemblies are sealed and integrated into major mechanical assemblies, no alignment or adjustment is required as part of normal maintenance. The processors perform diagnostic self-tests each time power is turned on, and a processor-controlled built-in test function constantly monitors the system and message transfer to detect faults during operation. The primary maintenance concern is maintenance of the Battery Assembly (**1A1A5**) during storage.

Planned maintenance for the AN/WSN-7(V) is conducted in accordance with the Navy's PMS requirements. Table 4-1 provides a list of the MIP and Maintenance Requirement Cards (MRCs) that apply. If a conflict should occur between PMS and the procedures in this chapter, PMS procedures take precedence.

4.2 BATTERY ASSEMBLY (1A1A5) SCHEDULED MAINTENANCE.

To maintain optimum battery performance, the Battery Assembly (**1A1A5**) should never be allowed to become fully discharged either during storage or during extended periods when the unit is not being operated. Although a fully charged battery can be completely discharged during emergency use without damage, extended storage of a partially charged battery or discharging of a battery that has not been properly charged can cause deposits on the plates. This condition prevents the battery from accepting a full charge and greatly degrades its performance.

The following sections provide instructions for Battery Assembly (**1A1A5**) maintenance for various operating and storage conditions.

4.2.1 BATTERY ASSEMBLY (1A1A5) STORAGE PROCEDURE.

CAUTION

Do not leave Battery Assembly (**1A1A5**) off charge for extended periods of time. If the AN/WSN-7(V) is scheduled to be turned off for more than 30 days, disconnect Battery Assembly (**1A1A5**) and check the open circuit voltage monthly until the AN/WSN-7(V) is placed back in operation. Recharge the battery prior to installing it back into the AN/WSN-7(V) from an auxiliary source if its open circuit voltage drops below 28.5 volts.

CAUTION

Fully charge the Battery Assembly (**1A1A5**) prior to placing it in storage to successfully hold a charge until the first maintenance recharge.

Each Battery Assembly (**1A1A5**) is shipped fully charged. Battery Assemblies stored in stock, or in a non-operating AN/WSN-7(V), must be checked and recharged periodically.

Measure battery open circuit voltage between pins F (+28 VDC) and I [28 V Return (RTN)]. The voltage must be greater than 29.76 volts before the battery is placed in storage or into operation in the AN/WSN-7(V). If the open circuit voltage is below this level, recharge the Battery as specified in Paragraph 4.2.2.

While in storage, batteries must not be allowed to self-discharge below 28.5 volts. The open circuit voltage should be checked periodically and the battery recharged as necessary. For reference, the battery will typically self-discharge from 29.76 volts down to 28.5 volts (depending on storage temperature) at approximately the following rates:

- 300 days at 20°C (68°F)
- 190 days at 30°C (86°F)
- 60 days at 40°C (104°F)

The maintenance recharge schedule must be performed in a manner consistent with the allowable storage time.

4.2.2 BATTERY CHARGING.

4.2.2.1 Internal Method for Battery Assembly (1A1A5) Charging. After operation on emergency (battery) power, the system should be returned to normal operation immediately and the battery should be allowed to recharge in the unit from primary power. If this condition is not possible, the battery should be disconnected until primary power is restored. A discharged battery should never be allowed to remain in the discharged state for more than 15 days. If normal powered operation cannot be restored within 15 days, the battery should be recharged from an auxiliary source using either Paragraph 4.2.2.2 Preferred Method or Paragraph 4.2.2.3 Alternate Method for Recharging Battery Assembly (**1A1A5**).

4.2.2.2 Preferred External Method for Recharging Battery Assembly (1A1A5). The battery should be recharged using the external WSN-7 RLGN Battery Charger, Model No. 214-44E03201. Refer to the AN/WSN-7/-7A(V) Ring Laser Gyro Navigator Battery Charger Users' Guide (TMIN EE170-AS-GYD-010/WSN-7) for operating and charging instructions. To determine the nearest facility for acquiring the external WSN-7 RLGN Battery Charger, the ship should contact their assigned Regional Maintenance Center (RMC), or the In-Service Engineering Agent (ISEA) (see Foreword). Five days after recharging, battery open circuit voltage should measure above 29.9 volts between pins F (+28 VDC) and I (28 V RTN) on the connector.

4.2.2.3 Alternate External Method for Recharging Battery Assembly (1A1A5). If the external AN/WSN-7/-7A(V) RLGN Battery Charger, Model No. 214-44E03201 is not available, the battery should be recharged externally to the RLGN with another battery charger capable of a constant current of 450 milliamps for 48 hours. Five days after recharging, battery open circuit voltage should measure above 29.9 volts between pins F (+28 VDC) and I (28 V RTN) on the connector.

4.2.3 RESTORING CONFIGURATION DATA IN MEMORY AFTER BATTERY POWER HAS BEEN INTERRUPTED. When the Battery Assembly (**1A1A5**) connector is removed from the battery, +6 VDC battery power to Navigation (Nav) Processor Circuit Card Assembly (CCA) (**1A1A13**) is interrupted, causing loss of all configuration data stored in the battery-backed Random Access Memory (RAM) on the CCA. Setting switch S1 on the battery to OFF does not interrupt the +6 VDC battery power for maintaining configuration data in RAM.

CAUTION

After the Battery Assembly (**1A1A5**) connector is reconnected, perform Test Mode Turn-On procedure, then restore RLGN Configuration Parameters.

4.3 PERIODIC BATTERY ASSEMBLY (1A1A5) OPERATIONAL CHECK.

This check, performed according to MRC (Maintenance Requirement Card) LP12 N, determines if the Battery Assembly (**1A1A5**) condition can sustain equipment operation in the event of a power fault during normal operation of the system. The AN/WSN-7(V) should continue to operate for a minimum of 15 minutes without a low battery voltage fault being announced. Refer to the applicable MRC for performing preventive maintenance.

Perform this check on an average of once every 9 months, as system online operation schedules allow. To perform the operational check of the battery, turn the RLGN on for at least five minutes if it is not already operating. If the battery is not fully charged, run the RLGN for 16 hours to charge it before attempting the battery operational check. Then, set the <MAIN POWER> circuit breaker to OFF to force the RLGN to continue to operate using internal battery power. Allow the RLGN to continue to operate for a minimum of 15 minutes without a low-battery voltage fault being displayed. After completing the test, recharge the battery for at least 16 hours to ensure that it is fully charged and ready for continued operation.

CAUTION

Do not perform the Battery Assembly (**1A1A5**) operational check after the system has settled and is in use for navigation. This test should be scheduled to be performed at dockside and at the beginning of system operation or calibration. Excessive battery discharge during this test can result in unexpected shutdown of the system and loss of the calibration data stored in the battery-backed RAM, requiring 72 hours to achieve Navigate mode again.

CAUTION

Do not completely discharge Battery Assembly (**1A1A5**) during the periodic battery operational check. Complete battery discharge will cause the AN/WSN-7(V) to shut down, and calibration data in battery-backed RAM will be lost.

NOTE

The test should not be performed if the battery cannot be recharged fully within the next 15 days. Leaving a battery partially discharged for an extended period reduces the life of the battery.

To perform the Battery Assembly (**1A1A5**) operational check, proceed as follows:

If the RLGN is not operating, start the procedure at step **a**. If the RLGN is already operating, go to step **e**.

a. Set the AN/WSN-7(V) MAIN POWER Circuit Breaker (**1A1CB1**) to **ON**.

b. Set SYSTEM POWER toggle switch (**1A1S1**) to **ON** and observe that SYSTEM POWER Green Light Emitting Diode (**1A1DS2**) illuminates.

c. Select **DOCK ON** and enter a position fix within 0.01 nm accuracy. Observe that the AN/WSN-7(V) exits STANDBY mode. (Refer to **Paragraph 2.3.1**.)

d. Allow the AN/WSN-7(V) to operate from ship's power for at least five minutes. If the battery is not fully charged, run the system for 16 hours to charge the battery before attempting the test.

e. At the end of at least five minutes, set the main POWER circuit breaker to **OFF**. Observe that the SYSTEM FAULT LED **1A1DS1** illuminates and Fault Code 034 appears on the Display (**1A1A10A1**).

f. Allow the system to continue to operate from Battery Assembly (**1A1A5**) power for 15 minutes. Observe that the AN/WSN-7(V) continues to operate and that low-battery voltage fault (**Fault Code 037**) is not displayed.

g. At the end of the 15-minute period, set AN/WSN-7(V) MAIN POWER Circuit Breaker (**1A1CB1**) to **ON**. Observe that SYSTEM FAULT red LED (**1A1DS1**) goes out. Continue to operate the AN/WSN-7 for at least 16 hours to recharge the battery. If recharging is not possible within 15 days, do not perform the test.

h. If **Fault Code 037** is displayed during this test, the battery may have degraded capability and should be replaced. Charge the battery for at least 16 hours and then perform the operational test again. If the battery fails, it needs to be replaced. Refer to **Chapter 6** for battery replacement procedures.

4.4 PERIODIC SYSTEM RECALIBRATION.

On an average of once every 90 days, the system should be forced to perform a 72-hour calibration. This is done by clearing the system's stored calibration parameters. Refer to MRC LP10 N for periodicity. This procedure is best performed at dockside and should be scheduled so that the 72-hour calibration can be completed at dockside before the system is required for operational status. The battery operational check outlined in **Paragraph 4.3** should also be scheduled to be performed prior to performing this procedure. If ship's scheduling does not permit calibration at dockside, this procedure can be performed at sea with valid velocity inputs and position resets [Global Positioning System (GPS)] data available to the system. To force recalibration of the system at any time, select the **AUX**iliary **FUNC**tion menu, select **Page 2**, and then select **KF Reinit**. The system will revert to Coarse Align in whichever Settle mode has been selected, and will then perform a 72-hour calibration settle before entering the NAVIGATE mode.

a. Set SYSTEM POWER switch on and observe that SYSTEM POWER indicator lights.

b. Select DOCK ON and enter a position fix within 0.01 nm accuracy to cause the system to exit the STANDBY condition. (Refer to **Paragraph 2.3.1**.)

CAUTION

After KF Reinit has been selected, do not turn the system off until the 72-hour calibration period has completed and the system enters the NAVIGATE mode, as indicated by the word NAVIGATE in the upper left corner of the DISPLAY. If the system is turned off before the 72-hour calibration has completed, the system will restart the calibration from the beginning and will require an additional 72 hours before it will enter NAVIGATE after power is again restored.

c. Press the **<AUX FUNC>** key to select the Auxiliary Function menu.

d. Press the **<NEXT PAGE>** key until **2 of 3** appears in the lower right-hand corner of the display

e. Press the **<4>** key to select **KF Reint**. The system's stored calibration parameters will be reset and the system will enter a 72-hour calibration mode.

Table 4-1. AN/WSN-7(V) Planned Maintenance System Requirements

Maintenance Index Page (MIP) Control Number: 4271/011			
MAINTENANCE TYPE	MRC NO.	MAINTENANCE DESCRIPTION	PERIODICITY
Planned	LP10 N	1. Perform recalibration of RLGN 2. Perform Dockside Calibration Verification	Q-4R
	LP12 N	Test operate RLGN on battery	9M-1R
	LW52 N	Protect RLGN equipment from damage by magnetic fields	U-1

Table 4-1. AN/WSN-7(V) Planned Maintenance System Requirements - Continued

Maintenance Index Page (MIP) Control Number: 4271/011			
MAINTENANCE TYPE	MRC NO.	MAINTENANCE DESCRIPTION	PERIODICITY
Inactive Equipment	LP14 N	Lay-Up Maintenance: RLGN protective cover installation	LU-1
	LP16 N	Start-Up Maintenance: Removal of RLGN protective covering	SU-1

CHAPTER 5
TROUBLESHOOTING

5.1 INTRODUCTION.

This chapter provides troubleshooting information at the organizational level, based on maintenance of the equipment being performed at the assembly level.

Troubleshooting the AN/WSN-7(V) may be started by performing the fault assessment procedure (Refer to Paragraph 5.2 and Figure 5-1.) This procedure prompts the technician to evaluate the AN/WSN-7(V)'s operating or fault conditions.

Upon identifying the relevant operating or fault conditions, the procedure's dialogue suggests an initial troubleshooting approach. Troubleshooting the AN/WSN-7(V) may require:

- Fault code analysis
- Visual observation
- Setting circuit breakers
- Cycling AN/WSN-7(V) power
- Disconnecting and reconnecting cables and test cables (Reference Appendix A Identification Diagrams.)
- Setting Circuit Card Assembly (CCA)-mounted switches
- Automated, Built-In Testing (BIT) while the AN/WSN-7(V) is in Normal Operating mode
- Selective BIT while the AN/WSN-7(V) is in Test mode
- Faulty component isolation using fault scenarios and selective replacement
- Control Display Unit (CDU) operation

This chapter is organized according to the following troubleshooting areas:

- Test Mode Turn-On
- Fault Code Troubleshooting
- Display-Related Fault Code Troubleshooting
- LED and Light Indicator Survey
- Selecting Menus and Off-Line Test Functions
- System Confidence Test
- Slip Ring Troubleshooting
- Fault Scenario Troubleshooting

The tables at the end of this chapter contain the following data necessary for troubleshooting procedures:

- Test Menus/Functions Description
- CCA Light Emitting Diodes (LEDs) and Power Indicators Illumination Survey
- Simulated Outputs Description
- Display Wraparound Test, Characters Display

Figures 5-2 through 5-5 contain information that may be necessary during some troubleshooting procedures.

Fault code analysis is performed by reading the fault codes that are automatically generated by Built-In Test (BIT) when a fault condition is detected, and by manually selecting and interpreting the appropriate tests available using the offline BIT functions. The combination of the automatic online BIT and the offline test functions provides the means to isolate malfunctions to a replaceable circuit card, electronic module, or electromechanical subassembly without the need for external test equipment (other than supplied test cables), or for manual signal tracing.

Troubleshooting of the IP-1747/WSN-7 Control Display Unit (CDU) is covered in the IP-1747/WSN-7 CDU technical manual (Refer to Table 1-6.)

Since BIT also monitors the status and timing of the Naval Tactical Data System (NTDS) data interface messages, faults associated with data interface between the INS and external systems or equipment will be detected. Selecting tests which test and verify the operation of suspected interface channels will determine if the source of the fault is within the navigation system data interface, or if it is within cabling or other equipment which is not part of the INS.

If a fault condition is detected by BIT during normal operation, BIT generates one or more three-digit codes. The codes are based on the detected hardware fault, processing fault, or discrepancy in a monitored parameter. Whenever a fault occurs, a code is generated for the first detected fault condition.

Because of signal loss to other functions or ripple-through of control or logical errors, additional fault conditions may be detected, for which additional codes will be generated. When any fault is detected, the BIT processing function sets the appropriate status relays and the code generated for the first detected fault condition is immediately displayed.

When acknowledged, all active fault codes generated by BIT are automatically stored in the battery-backed Random Access Memory (RAM) on the Nav Processor CCA (1A1A13) for immediate or future review. The fault condition can be acknowledged and the complete listing of active codes generated by the fault can then be displayed sequentially. If the detected fault was the result of a transient condition, acknowledging the fault will reset the fault BIT (clear the fault) and allow normal operation to resume. If the fault is continuous, BIT will continue to detect the fault condition and continue to maintain it as an active fault.

Certain faults cause the navigation system to automatically shut down operation; these faults can be acknowledged to view the Fault Code listing, but the fault code(s) cannot be cleared. Faults of this type are classified as critical, and require that the malfunction be isolated and corrected before normal operation can resume.

If a fault condition that shuts down the navigation system is detected during operation, the fault code(s) generated by the fault processing BIT function will be automatically stored in battery-backed RAM on the Nav Processor CCA (1A1A13). These codes will remain stored, even when power is turned off, as long as circuit card 1A1A13 is not removed from the card rack. When power is applied again, with the navigation system started in Test mode, the system will provide a menu from which the operator can select and sequentially display the complete list of stored fault codes.

In addition to the fault codes generated by BIT, the BIT function performs a series of processor, memory pattern, software checksum, and Input/Output (I/O) wraparound tests on the processors and I/O functions each time the navigation system is turned on. These tests are performed one time, and if the tests pass successfully, the navigation system automatically enters the Standby mode. If any of these tests fail, a code is displayed indicating the fault condition.

If a fault condition is detected and a fault code is displayed during normal operation, proceed as follows: Determine the fault type and classification using information provided in Table B-1.

a. If the fault type allows continued operation, proceed as follows:

   (1) Operator advisory. Acknowledge advisory and perform required action.

   (2) Non-critical fault. Acknowledge the fault and observe navigation system operation to determine if the fault is cleared or if the fault condition is displayed again. If the fault condition is repeated, acknowledge the fault and determine operating status or an alternate mode for continued operation. Record the fault code(s) displayed for future troubleshooting reference.

b. If the fault does not allow continued operation, proceed as follows:

   (1) Critical fault - Record the fault code(s) displayed for future troubleshooting reference. Turn off the navigation system power. Restart the system in the Offline Test mode and perform offline fault testing.

   (2) System automatic shutdown - Turn off the navigation system power. Restart the system in the Offline Test mode and perform offline fault testing. Observe the Status LEDs at turn-on (see Table 5-2) to verify processor operation.

When following troubleshooting procedures, note that the text appearing in bold between the **< >** symbols refers to labeled keys on the keypad. For example: **<DISPLAY>**.

Refer to Built-In Test (BIT) and Status in **Chapter 3** of this technical manual to learn more about fault generation.

5.2 FAULT ASSESSMENT.

Use the following conditions to select the proper initial troubleshooting approach.

- If a suspect faulty assembly has been identified or replaced using the other troubleshooting approaches, proceed to **Paragraph 5.3**.
- If an operator advisory is displayed requiring action, a fault code is displayed, or a system shutdown has occurred and a fault code(s) is displayed, proceed to **Paragraph 5.4**.
- If the AN/WSN-7(V) Display Assembly is blank or the characters displayed are garbled, proceed to **Paragraph 5.5**.
- If a failure has occurred that prevents the AN/WSN-7(V) from starting in Test mode, proceed to **Paragraph 5.6**.
- If a combination of failed BIT, fault codes or other symptoms occurs, proceed to **Paragraph 5.10**.

5.3 TEST MODE TURN-ON.

Goal: To energize the AN/WSN-7(V) so that the AN/WSN-7(V) Power On Self Test may be evaluated, and to perform Test mode Select Tests on the Systems Confidence Test.

Time: 1 minute approximately

Tools: None

Prerequisites.

a. Schedule, notify and confirm with ship's personnel that the AN/WSN-7(V) will be turned on and testing will commence that requires power to be supplied to the AN/WSN-7(V).

b. Ensure that the INS has been previously installed, configured and calibrated, and all external sensor inputs are configured and transmitting data to the AN/WSN-7(V).

c. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

Procedure.

a. At the ship's relevant power panel(s), ensure AN/WSN-7(V) power is supplied by turning on 115 Volts, Alternating Current (VAC), 60 Hertz (Hz) and 115 VAC, 400 Hz circuit breakers that control power output/input to the AN/WSN-7(V).

b. Remove all tag outs from the AN/WSN-7(V) power output/input circuit breakers at the ship's panel, according to ship's instructions.

c. At left of the AN/WSN-7(V) Data Entry Keyboard (**1A1A9**), set the POWER (**1A1CB1**), SYNCHRO REF (**1A1CB2**), and VITAL REF (**1A1CB3**) circuit breakers to **ON**.

d. Press and hold the **<TEST>** key on AN/WSN-7(V) Data Entry Keyboard (**1A1A9**).

e. Set the SYSTEM POWER toggle switch (**1A1S1**), at right of the AN/WSN-7(V) Data Entry Keyboard (**1A1A9**), to **ON** while continuing to hold the **<TEST>** key.

f. Continue to hold the **<TEST>** key and observe the display panel. After the cursor goes out, hold the **<TEST>** key for another three seconds, then release it.

g. Observe and record any and all faults and functional failures that may occur as the AN/WSN-7(V) proceeds through the Power On Self Test at Test mode startup.

h. Verify that the following Test mode Main Menu options appear:

1) Run System Confidence Test

2) Select Tests

3) Simulated Outputs

4) System Configuration

Postrequisites.

a. If the Test mode Main Menu is not displayed or is garbled, and an assembly has not yet been replaced in an attempt to correct a display-related problem, perform Display-Related Troubleshooting as outlined in **Paragraph 5.5**.

b. If the Test mode Main Menu is displayed, and a suspect faulty assembly has not been identified, perform the System Confidence Test to confirm the hard fault and record any related faults.

c. If the Test mode Main Menu is displayed, and the System Confidence Test has been performed and confirmed a hard fault, select the appropriate test menu as outlined in **Paragraph 5.7** to isolate the faulty assembly.

d. If the Test mode Main Menu is displayed after replacing a suspect faulty assembly with a known good assembly, select the appropriate test menu as outlined in **Paragraph 5.7** for the known good assembly to confirm its full operation.

e. If the Test mode Main Menu is displayed, and full operation of a replacement known good assembly has been confirmed, perform the System Confidence Test to confirm the AN/WSN-7(V)'s full operation with the known good assembly.

f. If the Test mode Main Menu is displayed, and the AN/WSN-7(V) is being used to test cabling and interface between the AN/WSN-7(V) and other systems, perform Simulated Attitude, Velocity, and Position Outputs as outlined in **Paragraph 5.10.2**.

g. If the Test mode Main Menu is displayed, and full operation of a known good, Inertial Measuring Unit (IMU) with Programmable Read-Only Memory (PROM) (**1A2A1**) has been confirmed, restore the RLGN parameters.

5.4 FAULT CODE TROUBLESHOOTING.

5.4.1 FAULT CODE IDENTIFICATION.

Goal: To identify, define and evaluate AN/WSN-7(V) fault codes prior to performing fault isolation procedures.

Time: Various

Tools: None

Prerequisites.

a. Ensure that the AN/WSN-7(V) is turned on and entergized.

b. Ensure that the Display Assembly (**1A1A10**) appears to be functioning normally.

c. Verify that one of the following conditions exists prior to using fault indicator troubleshooting:

(1) An operator advisory is displayed requiring action.

(2) A fault code is displayed.

(3) System shutdown has occurred and at least one fault code is displayed.

Procedure.

Identify and record the fault type by referencing **Table B-1**, Fault Code Descriptions and Fault Isolation.

Postrequisites.

a. For Operator Advisory and Non-Critical Faults that allow continued AN/WSN-7(V) operation, perform the procedure described in **Paragraph 5.4.2**.

b. For Critical Faults and System Automatic Shutdown Faults that do not allow continued AN/WSN-7(V) operation, perform the procedure described in **Paragraph 5.4.3**.

5.4.2 ON-LINE FAULT CODE ISOLATION.

Goal: To isolate and resolve Operator Advisories and Non-Critical Faults that allow continued AN/WSN-7(V) operation.

Time: Various

Tools: None

Prerequisites.

a. Identify fault codes as outlined in **Paragraph 5.4.1**.

b. Ensure that the AN/WSN-7(V) is turned on and energized as indicated by a Display Assembly (**1A1A10**) that appears to be functioning normally.

Procedure.

a. Record the advisory or fault displayed for future troubleshooting.

b. Verify that the fault is either a Fault Advisory or Non-Critical Fault by using **Table B-1**, Fault Code Descriptions and Fault Isolation.

c. Acknowledge the advisory or noncritical fault by pressing the **<ALARM ACK>** key on the Data Entry Keyboard Assembly (**1A1A9**).

d. Perform the action required to clear the advisory or fault.

e. Observe AN/WSN-7(V) operation to verify that the advisory or fault clears.

f. If the advisory or fault recurs, record the advisory or fault's reoccurence for future troubleshooting.

g. Acknowledge the advisory or noncritical fault by pressing the **<ALARM ACK>** key on the Data Entry Keyboard Assembly (**1A1A9**)

Postrequisites.

Determine AN/WSN-7(V) operating status or alternate mode for continued operation.

5.4.3 OFF-LINE FAULT CODE ISOLATION.

Goal: To isolate and resolve Critical and System Automatic Shutdown Faults requiring the RLGN to be shut down and/or tested off-line.

Time: Various

Tools: Defined by referenced replacement procedures

Prerequisites.

a. Identify fault codes as outlined in **Paragraph 5.4.1**.

b. Ensure that the AN/WSN-7(V) is turned on and energized as indicated by a Display Assembly (**1A1A10**) that appears to be functioning normally.

c. Record the advisory or fault for future troubleshooting.

d. Verify that the fault is either a Critical Fault or System Automatic Shutdown Fault by using **Table B-1**, Fault Code Descriptions and Fault Isolation.

e. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

f. In accordance with ship's instruction, inform the appropriate personnel that corrective maintenance must be performed on the AN/WSN-7(V).

g. Turn on the RLGN in Test mode.

Procedure.

a. Select the appropriate test menu as outlined in **Paragraph 5.7** to isolate the fault to the most likely assembly.

b. Perform the replacement procedure for the suspected faulty assembly, installing a known good replacement assembly in its place.

c. Select the appropriate test menus outlined in **Paragraph 5.7** to determine if the fault persists.

(1) If the fault persists,

(a) Perform the replacement procedure for the known good replacement assembly, installing the previously suspected assembly.

(b) Perform the replacement procedure for the next most likely faulty assembly, installing a known good replacement assembly in its place.

(2) If the fault does not persist, proceed to the next step.

d. Perform the System Confidence Test procedure to confirm that the known good replacement assembly does not cause other system faults.

(1) If a fault occurs, identify the fault code and proceed from there.

(2) If no faults occur, the system should be operational. The assembly replaced in step 2 is faulty and should be processed for maintenance.

Postrequisites.

a. Once the RLGN has passed the System Confidence Test, turn it off using the procedure in **Paragraph 2.3.8**.

b. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

5.4.4 DISPLAY SHUTDOWN FAULT CODES.

Goal: To display a list of the shutdown Fault Codes previously stored in battery-backed Random Access Memory (RAM) when the AN/WSN-7(V) is operating in the Test mode.

Time: Various

Tools: None

Prerequisites.

Turn on the RLGN in Test mode.

Procedure.

a. At the Select Tests Menu, select System Tests by pressing the **<0>** key.

b. At the System Tests Menu, press the number "90" on the keypad to select the Display Shutdown Faults option, then press the **<ENTER>** key to enable the option.

c. Observe that a Shutdown Fault Codes list is displayed.

d. Press the **<CLEAR>** key to return to the Select Tests Menu or, press the **<MODE>** key to return directly to the Test mode Main Menu.

Postrequisites.

None.

5.5 DISPLAY-RELATED FAULT TROUBLESHOOTING.

5.5.1 IDENTIFY DISPLAY-RELATED FAULTS.

Goal: To identify, define and evaluate RLGN display-related faults prior to performing fault isolation procedures.

Time: Various

Tools: None:

Prerequisites.

Turn on the RLGN in Test mode.

Procedure.

a. Verify that power is applied to the AN/WSN-7(V) at the relevant power breaker boxes and switchboards.

b. Verify that all AN/WSN-7(V) power switches are turned on.

c. Observe and record initial indications that the AN/WSN-7(V) display might not be working correctly.

(1) If the AN/WSN-7(V) Display Assembly (**1A1A10**) or Data Entry Keyboard Assembly (**1A1A9**) does not appear to be operating correctly, presents garbled or similar indications, and/or presents display relevant fault codes, or is blank, perform the procedure in **Paragraph 5.5.4**.

(2) If Display Assembly (**1A1A10**) and Data Entry Keyboard Fault Isolation has been performed and failed to identify a suspected faulty assembly, perform the procedure in **Paragraph 5.6**.

Postrequisites.

None.

5.5.2 DISPLAY ASSEMBLY (1A1A10) AND DATA ENTRY KEYBOARD (1A1A9) FAULT ISOLATION.

Goal: To isolate and resolve Display Assembly and Data Entry Keyboard faults.

Time: Various

Tools: None

Prerequisites.

Display-Related Fault Identification has identified that the AN/WSN-7(V) Display Assembly (**1A1A10**), or Data Entry Keyboard Assembly (**1A1A9**), does not appear to be operating correctly, presents garbled or similar indications, presents display-relevant fault codes, or appears blank.

Procedure.

a. Verify that the AN/WSN-7(V) is receiving constant power and power is applied as indicated by a steady, non-blinking, illuminated system power, green Light Indicator (**1A1XDS2**).

(1) If the system power indicator is not illuminated or is blinking, perform the procedure in **Paragraph 5.10.1**.

(2) If the system power indicator is illuminated and steady, proceed to step **b**.

b. Verify that the system fault, red Light Indicator (**1A1XDS1**) is extinguished.

(1) If the system fault indicator is illuminated, perform the procedure described in **Paragraph 5.6**.

(2) If the system fault indicator is not illuminated, proceed to step **c**.

c. Verify that Display Assembly (**1A1A10**) illuminates or changes displayed information by pressing the **<BRIGHT>** key, followed by pressing the **<NEXT PAGE>** key on the Data Entry Keyboard (**1A1A9**).

(1) If pressing the keys does not cause display illumination or change, proceed to step **e**.

(2) If pressing the keys causes display illumination and change, but the menu lettering remains garbled or incomplete, perform the procedure described in **Paragraph 5.5.3**.

(3) If pressing the keys causes display illumination or change, and presents precise (non-garbled and complete) menu lettering, then discontinue troubleshooting. The Display Assembly (**1A1A10**) may not be defective. The Display Assembly (**1A1A10**) automatically turns off when it is not actively interfacing with Data Entry Keyboard (**1A1A9**).

d. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

e. Verify the following power values with a multimeter at the following Panel Interface CCA (**1A1A10A2**) test points (TPs):

(1) TP1 should measure approximately 2.5 Volts, Direct Current (VDC).

(2) TP2 should measure approximately 2.25 VDC.

(3) TP3 should measure approximately 4.5 VDC.

(4) TP4 should measure approximately 0 VDC.

(5) TP5 should measure approximately 4.5 VDC.

(6) TP6 should measure approximately 5 VDC.

(7) TP7 should measure approximately 0 VDC.

(8) TP8 should measure approximately 0 VDC.

(9) TP9 should measure approximately 2.5 VDC.

(10) TP10 should measure approximately 0 VDC.

(11) TP11 should measure approximately 2.5 VDC.

f. If incorrect/non-approximate power values are measured at some test points, replace the Panel Interface CCA as outlined in **Paragraphs 6.3.6.3** and **6.3.6.8**.

g. Confirm that Panel Interface CCA replacement has corrected the problem by repeating steps **a-d**.

h. If all power values are approximately correct at all test points, perform the Display Assembly Wraparound Test.

Postrequisites.

None.

5.5.3 DISPLAY ASSEMBLY SELF-TEST.

Goal: To isolate and resolve Vacuum Fluorescent Display (**1A1A10A1**) and Panel Interface CCA (**1A1A10A2**) faults under conditions when the Display Assembly (**1A1A10**) is responsive to Data Entry Keyboard (**1A1A9**) commands.

Time: Various

Tools: Defined by referenced replacement procedures

Prerequisites.

a. Turn on the RLGN in Test mode.

b. Display-Related Fault Identification indicates that the Display Assembly (**1A1A10**) might not be working correctly.

c. Display Assembly and Data Entry Keyboard Assembly Fault Isolation verifies that pressing the keys on Data Entry Keyboard (**1A1A9**) causes display illumination and change, but the menu lettering remains garbled or incomplete.

d. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure.

a. Set Panel Interface CCA Switch 1A1A10A2S1 to Clear, then release.

b. Verify that the display Panel Interface CCA (**1A1A10A2**) clears, then reappears.

c. Set Panel Interface CCA 1A1A10A2S1 to the down “Test” position.

d. Observe and record the display assembly’s self-test results as they appear in the following order.

(1) Observe: “connect E5 to E11 to exit.” (This is a carryover in the embedded test software for the Vacuum Fluorescent Display; do not respond.)

(2) Observe: Brightness Test, Bright Screen.

(3) Observe: Brightness Test, Dim Screen.

(4) Observe: Data baud rate and parity screen.

(5) Character set is cycled on a separate screen.

(6) Observe: Most recently received datalist (Hex numbers).

e. Upon observing the most recently received datalist test, set Panel Interface CCA Switch 1A1A10A2S2 to the up, “Normal” position.

f. Set Panel Interface CCA Switch 1A1A10A2S1 to Clear, then release.

g. Perform one of the following:

(1) If any test is not performed or completed, replace the Panel Interface Assembly as outlined in **Paragraphs 6.3.6.3** and **6.3.6.8** to confirm faulty assembly.

(2) If all tests are performed, but the display remains fuzzy or is forming incomplete letters or words in consistent locations on the display, replace the Vacuum Fluorescent Display as described in **Paragraphs 6.3.6.2** and **6.3.6.9** to confirm faulty assembly.

(3) If all tests are performed effectively, perform the Display Assembly Wraparound Test as described in **Paragraph 5.5.4**.

h. Upon replacing the suspected faulty assembly, repeat steps **a-g**.

(1) If the replacement assembly fails any test, perform the replacement procedure for the other assembly.

(2) If the replacement assembly(s) passes all tests completely and without fuzziness, proceed to step **i**.

i. If the RLGN passes the Display Assembly Self-Test, turn it off using the procedure in **Paragraph 2.3.8**.

Postrequisites.

a. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

b. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

5.5.4 DISPLAY ASSEMBLY WRAPAROUND TEST.

Goal: To isolate and resolve display Vacuum Fluorescent Display (**1A1A10A1**), Panel Interface CCA (**1A1A10A2**), Dual Panel Interface CCA (**1A1A16**) and display power faults under conditions when the Display Assembly (**1A1A10**) is not responsive to Data Entry Keyboard (**1A1A9**) commands.

Time: Various

Tools: Defined by referenced replacement procedures

Prerequisites.

a. Perform the Fault Assessment described in **Paragraph 5.2**.

b. Display-Related Fault Identification indicates that the AN/WSN-7(V) display might not be working correctly.

c. Display Assembly and Data Entry Keyboard Fault Isolation has verified that pressing the keys does not cause display illumination or change.

d. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

e. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure.

a. Verify, reseating as necessary, that the ribbon cable is connected to (**1A1A9**).

b. Verify, reseating as necessary, that cables are connected at 1A1A10A2J3 and 1A1A10A2J5.

c. Verify, reseating as necessary, that the cable is connected at 1A1A11J6.

d. Turn on the RLGN in Test mode.

e. Observe the Vacuum Fluorescent Display (**1A1A10A1**) and record its illumination or failure to illuminate, and the AN/WSN-7(V)’s ability to enter Test mode.

(1) If the display illuminates and is responsive to pressing keys on the Data Entry Keyboard (**1A1A9**), then perform the Display Assembly Self-Test.

(2) If the display does not illuminate or the AN/WSN-7(V) does not enter Test mode, proceed to step **6**.

f. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

g. Disconnect cable 1A10A2P3 from 1A1A10A2J3, and cable 1A10A1P2 from 1A1A10A1J2.

h. Connect Display Test Cable 03956-1981552-11 from 1A1A10A2J3 to 1A1A10A1J2.

i. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

j. Press the **<TEST>** key on Data Entry Keyboard (**1A1A9**) first.

k. Using **Table 5-4**, Display Wraparound Test, Characters Display, press each remaining key on the Data Entry Keyboard (**1A1A9**) in sequence, observing and recording the correct character’s appearance or nonappearance on the display.

l. Using **Table 5-4**, compare the position of all characters displayed to verify that each successive key pressed causes the corresponding key value to appear in the correct location.

(1) If the character “T” appears after the **<TEST>** key is pressed, and the AN/WSN-7(V) was not able to enter Test mode, and all remaining keys appear correctly as indicated in **Table 5-4**, then replace the Dual Panel Interface CCA (**1A1A16**), as described in **Paragraph 6.3.3**.

(2) If the character “T” does not appear after the **<TEST>** key is pressed, or all remaining characters do not appear correctly as indicated in **Table 5-4**, then replace the Display Panel Interface Assembly as described in **Paragraphs 6.3.6.3** and **6.3.6.8**.

(3) If the character “T” does not appear after the **<TEST>** key is pressed, and each displayed character appears correctly as indicated in **Table 5-4**, then replace the Vacuum Fluorescent Display as outlined in **Paragraphs 6.3.6.2** and **6.3.6.9**.

m. Upon replacing the suspect faulty assembly, perform steps **a–l**. The faulty assembly is confirmed if the system pases all of the steps without a reoccurence of the original fault.

(1) If the fault is not confirmed, perform the replacement procedure for the next suspected faulty assembly.

(2) If the fault is confirmed, proceed to step **n**.

n. When the RLGN has passed steps **a-l**, turn off the RLGN using the procedure in **Paragraph 2.3.8**.

o. Remove Display Test Cable 03956-1981552-11 from jacks 1A1A10A1J2 and 1A1A10A1J3.

p. Connect cable 1A10A2P3 to 1A1A10A2J3, and cable 1A10A1P2 to 1A1A10A1J2.

q. Turn on the RLGN in Test mode.

r. Perform BIT 202.

(1) If BIT 202 fails, follow the associated fault diagnosis procedures.

(2) If BIT 202 passes, proceed to step **s**.

s. If BIT 202 passes, perform the System Confidence Test.

t. When the RLGN has passed the System Confidence Test, turn off the RLGN using the procedure in **Paragraph 2.3.8**.

Postrequisites.

a. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

b. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

5.6 LED AND LIGHT INDICATOR SURVEY.

Goal: To identify, observe, record, compare and evaluate the CCA Light Emitting Diodes (LEDs) during normal and fault conditions.

Time: Various

Tools: None

Prerequisites.

a. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

b. Display-Related Fault Identification has been performed.

c. Confirm that one or more of the following conditions exists:

(1) The system fault indicator (**1A1XDS1**) is illuminated.

(2) A fault code can be further confirmed by observing CCA LED illumination.

(3) Display Assembly (**1A1A10**) and Data Entry Keyboard Fault Isolation failed to identify a suspect faulty assembly and Navigation (Nav) Processor CCA (**1A1A13**) needs to be isolated as a suspect assembly causing faulty display or keyboard function.

(4) The Nav, Input/Output (I/O), or IMU processor CCA operation needs to be evaluated because at least one of the following messages was displayed during Test mode startup:

Failed to establish I/O BIT

Failed to establish IMU BIT

Failed to establish Synchro BIT

Procedure.

a. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

b. Refer to **Figure 5-2**. Set SYSTEM POWER Toggle Switch (**1A1S1**) to ON and verify that the red LEDs (DS1) on the Nav Processor (**1A1A13**), I/O (**1A1A21**), and Asynchronous Transfer Mode (ATM) Processor (**1A1A4**) CCAs, and the red LED (DS3) on the Status and Command CCA (**1A1A5**), all light on system power-up and go off after approximately two seconds.

c. Use a copy of **Table 5-2**, CCA LEDs and Power Indicators Illumination Survey, to compare and record the status for all LEDs and light indicators during normal AN/WSN-7(V) operation with their observed LED status during RLGN fault conditions, as follows (The CCA LED listing below does not imply order of precedence, importance, or dependency):

(1) Nav Processor CCA (**1A1A13**), DS1 should be extinguished.

(2) IMU Processor CCA (**1A1A32**), DS1 should be extinguished.

(3) ATM Processor CCA (**1A1A4**), DS1 should be extinguished.

(4) I/O Processor CCA (**1A1A21**), DS1 should be extinguished.

(5) I/O Control (BITE) and Filter CCA (**1A1A31**), DS1 should be extinguished.

(6) Synchro Buffer Amplifier CCA (**1A1A41**), CR14 should be extinguished.

(7) Synchro Buffer Amplifier CCA (**1A1A42**), CR14 should be extinguished.

(8) Synchro Buffer Amplifier CCA (**1A1A43**), CR14 should be extinguished.

(9) Synchro Buffer Amplifier CCA (**1A1A44**), CR14 should be extinguished.

(10) Status and Command CCA (**1A1A15**), DS1 should be flashing green at 1.28-second intervals.

(11) Status and Command CCA (**1A1A15**), DS2 should be extinguished.

(12) Status and Command CCA (**1A1A15**), DS3 should be extinguished.

(13) Torquer CCA (Outer Roll) (**1A1A18**), DS1 should be illuminated green.

(14) Torquer CCA (Outer Roll) (**1A1A18**), DS2 should be illuminated green.

(15) Torquer CCA (Inner Azimuth) (**1A1A19**), DS1 should be illuminated green.

(16) Torquer CCA (Inner Azimuth) (**1A1A19**), DS2 should be illuminated green.

(17) Support Electronics Power Supply CCA (**1A1A37**), DS1 should be illuminated green.

(18) Support Electronics Power Supply CCA (**1A1A37**), DS2 should be illuminated green.

(19) Support Electronics Power Supply CCA (**1A1A37**), DS3 should be illuminated green.

(20) Support Electronics Power Supply CCA (**1A1A37**), DS4 should be illuminated green.

(21) Support Electronics Power Supply CCA (**1A1A37**), DS5 should be illuminated green.

(22) Power Supply (**1A1A6**) +25 V should be illuminated green.

(23) Battery Charger (**1A1A7**) -25 V should be illuminated green.

(24) Battery Charger (**1A1A7**) BAT CHG FLT should be extinguished.

(25) Battery Charger (**1A1A7**) BAT CHG should be extinguished.

(26) Power Module (**1A1A8**) FAULT should be extinguished.

Postrequisites.

a. Return to the troubleshooting procedure that required the LED and Light Indicator Survey to be completed.

b. Or, return to the replacement procedure that required the LED and Light Indicator Survey to be completed.

c. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3** if access to the LEDs is no longer needed.

5.7 SELECTING MENUS AND OFF-LINE TEST FUNCTIONS.

Goal: To initiate Built In Tests (BITs) while the AN/WSN-7(V) is in Test mode, in response to fault codes, to confirm system faults, to facilitate isolating and replacing suspect faulty components, and to confirm successful AN/WSN-7(V) operation after installing new components.

Time: Various depending upon the test

Tools: None

Prerequisites.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Turn on the RLGN in Test mode and confirm that either:

(1) Test mode Main Menu is displayed and the System Confidence Test has confirmed a hard fault, which requires a Select Test to isolate a faulty assembly.

(2) Or, Test mode Main Menu is displayed after replacing a suspect faulty assembly with a known good assembly, which requires a Select Test to confirm that the known good assembly returned the AN/WSN-7(V) to full operation.

Procedure.

a. If a fault is detected at Test mode Turn-on, press the **<ENTER>** key to continue testing.

b. Observe that at Test mode startup, the Nav Processor checks the I/O BIT, IMU BIT, and Synchro BIT functions and may fail in the process. If a fault message is displayed, testing can be continued within AN/WSN-7(V) operational limits.

At the Test mode Main Menu, observe the following selectable options:

1) Run System Confidence Test

2) Select Tests

3) Simulated Outputs

4) System Configuration

c. At the Test mode Main Menu, press the **<2>** key to enter the Select Tests Menu.

d. At Select Tests Menu,

(1) Enter the known 3-digit test code corresponding to the desired test outlined below.

(a) Press the keypad numbers corresponding to the 3-digit test code.

(b) Press the **<ENTER>** key to run the test. [For example, press the **<2><2><0>** keys to run the Torquer Loop Test #1. The first number pressed selects the test category (**2**. NAV Tests), and the second and third numbers select a test within that category (**20**. Torquer Loop Test #1).]

(2) If the 3-digit test code is not known, page through the Select Tests menus to identify test category and test desired.

(a) Press the number that corresponds to the desired test's category as listed below.

0) System Tests

1) Discrete Tests

2) NAV Tests

3) IMU Tests

4) I/O Tests

5) Synchro Tests

(b) At the selected test category's menu, press the **<NEXT PAGE>** key to step through pages to locate the required test. Observe: Page display sequence cycles back to Page 1 for the Test Category after last page is displayed.

(c) When the desired test is located, use the data entry keyboard to enter the 2-digit number corresponding to the test number.

(d) Press the **<ENTER>** key to run the test.

e. Use the data entry keyboard **1A1A9** to enter data required during the test, and press the **<ENTER>** key to accept data entered. Correct errors during data entry using the **<CLEAR>** key or the **<BACK SPACE>** key.

f. As necessary, press the **<CLEAR>** key to abort a test in progress.

g. When a test is complete, either:

(1) Select additional required tests from other categories by pressing the **<MODE>** key to return to Test mode Main Menu, and repeating the preceding steps.

(2) Or, perform another test from the same test category by pressing the 2-digit test number only, then pressing the **<ENTER>** key.

Postrequisites.

Completion status is pass or fail. When testing is complete, return to the troubleshooting procedure requiring this test for additional direction.

5.8 SYSTEM CONFIDENCE TEST.

Goal: To initiate the System Confidence test while the AN/WSN-7(V) is in Test mode, in response to Fault Codes, to confirm system faults, to facilitate isolating and replacing suspect faulty assemblies, and to confirm successful AN/WSN-7(V) operation after installing new assemblies.

Time: 15 minutes approximately

Tools: None

Prerequisites.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Turn on the RLGN in Test mode and confirm that either:

(1) Test mode Main Menu is displayed and the System Confidence Test is required to confirm a hard fault, prior to performing Select Test to isolate a faulty assembly.

(2) Or, Test mode Main Menu is displayed after replacing a suspect, faulty assembly, the assembly's specific, Select Test passes, and a System Confidence Test is required to confirm the AN/WSN-7(V)'s full operation.

Procedure.

a. If a fault is detected at Test mode startup, press the **<ENTER>** key to continue testing.

b. Observe that at Test mode startup, the Nav Processor (**1A1A13**) checks the I/O BIT, IMU BIT, and Synchro BIT functions and may fail in the process. If a fault message is displayed, testing can be continued within AN/WSN-7(V) operational limits.

At the Test mode Main Menu, observe the following selectable options:

1) Run System Confidence Test

2) Select Tests

3) Simulated Outputs

4) System Configuration

c. At the Test mode Main Menu, press the **<1>** key to initiate the System Confidence Test.

d. As the System Confidence Test progresses, enter data using the keypad and press the **<ENTER>** key to accept values as required. Correct errors during data entry using the **<CLEAR>** key or the **<BACK SPACE>** key.

e. If a fault is detected during performance of the System Confidence Test, record the fault while the test procedure is paused.

f. Resume the remaining tests that make up the System Confidence Test by pressing the **<ENTER>** key.

Postrequisites.

a. Select additional required tests as outlined in **Paragraph 5.7**.

b. Or, return to the troubleshooting or replacement procedure that required the System Confidence Test.

5.9 SLIP RING TROUBLESHOOTING.

Slip ring problems are among the most difficult and time consuming to troubleshoot. Almost all slip ring failures are intermittent, causing faults that only appear when the indexers are in a certain position. Faults may occur at 5, 10, or 15 minute intervals or longer, but will almost always appear as the indexers move.

When intermittent IMU faults occur, use the block diagrams in Chapters 3 and 5 to determine which slip rings carry the signals involved in the fault. Since most IMU signals pass through both the inner and outer axes, it may be necessary to disable the indexers by setting one indexer to OFF. If the fault no longer appears with an axis off, the intermittent fault is in that axis' slip rings. The indexers can also be disabled and turned by hand to force the fault to appear, though it can be difficult to position the gimbals in the exact spot where an intermittent fault occurs. It is also difficult to get slip ring faults to appear during Offline BIT tests, since the indexers don't stop at the exact same angles as when in the Navigate mode.

Velocity errors caused by accelerometer-related slip ring failures are usually accompanied by a spike in an accelerometer bias. Analyzing the bias graphs at the IP-1747/WSN CDU (unit 4) can help isolate the problem to one accelerometer and indicate the exact time the failure occurred. If the spikes occur at some multiple of five minutes, it is most likely a slip ring.

5.10 FAULT SCENARIO TROUBLESHOOTING.

5.10.1 POWER SYSTEM FAULT SCENARIO TROUBLESHOOTING.

Goal: To evaluate AN/WSN-7(V) internal, power-related faults and isolate to the following power-related assemblies: Battery Assembly (**1A1A5**), Power Supply (**1A1A6**), Battery Charger (**1A1A7**).

Conditions:

a. Ship's 115 VAC power is provided to the AN/WSN-7(V).

b. AN/WSN-7(V) circuit breakers (**1A1CB1**, **1A1CB2**, and **1A1CB3**) are in the Up/On position.

c. AN/WSN-7(V) system power toggle switch, (**1A1S1**), is in the Up/On position.

d. Fault Code 37 is announced.

e. BIT 106 failed.

f. System does not run on battery.

Time: 10 minutes approximately

Tools: Multimeter

Prerequisites.

a. Schedule, notify and confirm with ship's personnel that the AN/WSN-7(V) will be turned on and testing will commence that requires power to be supplied to the AN/WSN-7(V).

b. The INS has been previously installed, configured and calibrated, and all external sensor inputs are configured and transmitting data to the AN/WSN-7(V).

Procedure.

a. RLGN calibration data will be lost when Battery Assembly (**1A1A5**) does not power the system or is removed. The faulty RLGN's calibration data may be restored from Battery-backed RAM on the other RLGN's I/O Processor CCA (**1A1A21**).

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

d. Verify that the green light indicator on Power Supply (Transformer Rectifier) (**1A1A6**) is illuminated.

e. Using the multimeter, verify that voltage from +25 VDC to +28 VDC is present at Power Supply (**1A1A6**) between +25 VDC test point and 25 V RTN test point.

(1) If the green light indicator is not illuminated, and +25 VDC to +28 VDC is verified, replace the (**1A1A6**) green light indicator, then proceed to step **m**.

(2) If +25 VDC to +28 VDC is not verified, proceed to step **f**.

f. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

g. At Power Supply (Transformer Rectifier) (**1A1A6**), disconnect power cable P3 from connector 1A1A6J1.

h. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

i. Using the multimeter, verify that 115 VAC is present across power cable 1A1A6P3 pins B, C and D.

(1) If 115 VAC is not measured across pins B, C and D on 1A1A6P3, refer to **Figure 3-13** or **3-14**. Isolate and troubleshoot the following components between AN/WSN-7(V) 115 VAC power in connectors J1 and J2 1A1A6P3; Power Filter (**1A1A1**); Circuit Breaker (**1A1CB1**); and System Power Toggle Switch (**1A1S1**).

(2) If 115 VAC is measured across pins B, C and D on 1A1A6P3, suspect Power Supply (Transformer Rectifier) (**1A1A6**) and proceed to step **m** to isolate it.

j. Proceed from this step if +25 VDC and +28 VDC is measured at Power Supply (**1A1A6**) test points and its green indicator light is illuminated.

k. At Battery Charger (**1A1A7**), disconnect cable P4 from connector 1A1A7J1.

l. On Cable P4, identify pins J, M and U.

m. Using the multimeter, verify from +27 VDC to +29 VDC between pins J and M, and U and M.

(1) If +27 VDC to +29 VDC is not verified between pins J and M, and U and M, connect cable P4 to connector 1A1A7J1, then replace Power Supply (Transformer Rectifier) (**1A1A6**). If power is still not present, troubleshoot the cable.

(2) If +27 VDC to +29 VDC is verified between pins J and M, and U and M, proceed to step **n**.

n. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

o. At Battery Charger (**1A1A7**), connect cable P4 to connector 1A1A7J1.

p. At Battery Assembly (**1A1A5**), disconnect cable P5 from connector 1A1A5J1.

q. At Battery Assembly (**1A1A5**), place switch S1 to the Off position.

CAUTION

If the battery cells in Battery Assembly (**1A1A5**) are shorted to the battery chassis, replace the Battery Assembly before replacing Battery Charger (**1A1A7**). Failure to do so will damage the replacement Battery Charger.

r. At Battery Assembly (**1A1A5**), using the multimeter, verify the zero VDC (open) between the F1 fuse holder and the (**1A1A5**) case.

(1) If anything more than zero VDC is verified between the F1 fuse holder and the (**1A1A5**) case, the fuse holder and battery case are shorted. Replace Battery Assembly (**1A1A5**).

(2) If zero VDC is verified between the F1 fuse holder and the (**1A1A5**) case, the fuse holder and battery case are not shorted, proceed to step **t**.

s. At Battery Assembly (**1A1A5**), using the multimeter, verify zero ohms (short) between 1A1A5J1's pin A (Ground) and its case.

(1) If zero ohms is not verified between 1A1A5J1's pin A and its case, the case is not correctly grounded. Replace Battery Assembly (**1A1A5**).

(2) If zero ohms is verified between 1A1A5J1's pin A and its case, the case is correctly grounded. Proceed to step **u**.

t. At disconnected cable P5, identify pins I and F.

u. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

v. Place switch S1, on Battery Assembly (**1A1A5**), to the On position.

w. Using the multimeter, verify that voltage from +27 VDC to +32 VDC is present between pins I and F on cable P5.

(1) If +27 VDC to +32 VDC is not verified between pins I and F, connect cable P5 to connector 1A1A5J1, then replace Battery Charger (**1A1A7**).

(2) If +27 VDC to +32 VDC is verified between pins I and F, proceed to step **x**.

x. Verify that Battery Assembly switch S1 is in the ON position.

y. Using the multimeter, verify from +27 VDC to +32 VDC between pins I and F on 1A1A5J1.

(1) If +27 VDC to +32 VDC is not verified between pins I and F, replace Battery Assembly (**1A1A5**).

(2) If +27 VDC to +32 VDC is verified between pins I and F, proceed to step **z**.

z. Connect cable P5 to connector 1A1A5J1, and confirm Vital Bus CCA (**1A1A3**) operation by performing BIT 107 and 108.

Postrequisites.

a. Upon completing installation of a known good assembly in place of the suspected faulty assembly, turn on the RLGN in Test mode.

b. Perform BIT 106.

(1) If BIT 106 fails, perform selective replacement of remaining suspect assemblies.

(2) If BIT 106 passes, proceed to step **c**.

c. Perform the System Confidence Test.

(1) If System Confidence Test fails, perform troubleshooting procedure for the failed BIT.

(2) If System Confidence Test passes, turn off the RLGN using the procedure in **Paragraph 2.3.8**.

d. Restore RLGN configuration parameters as described in **Paragraph 6.2.1.1**.

5.10.2 SIMULATED ATTITUDE, VELOCITY, AND POSITION OUTPUTS.

Goal: To generate and apply simulated, static output data values from AN/WSN-7(V) I/O functions to test external systems and wiring operation.

Conditions: This procedure may be performed independent of a particular fault.

Time: 1 minute approximately

Tools: None

Prerequisites.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Turn on the RLGN in Test mode and confirm that either:

(1) Test mode Main Menu is displayed and simulated attitude, velocity, or position outputs are required to troubleshoot a faulty assembly.

(2) Or, Test mode Main Menu is displayed after replacing a suspect faulty assembly, and simulated attitude, velocity, or position outputs are required to confirm the AN/WSN-7(V)'s full operation.

Procedure.

a. At the Test Main Menu, select the Simulated Outputs tests **<3>** key.

b. Observe that the Simulated Tests Menu is displayed.

c. At the Simulated Test Menu, press the key corresponding to one of the following desired output options:

1) Enable Simulated Outputs = no (or yes)

2) Modify Attitude Output

3) Modify Velocity Output

4) Modify Position Output

d. If Simulated Outputs is selected, choose one of the following options by pressing the **<1>** key to toggle output settings:

(1) No = Default Setting, Simulated Outputs not enabled

(2) Yes = Enable Simulated Outputs

e. Relay 1K6 is set and energized when Simulated Outputs is toggled to Yes, Enable Simulated Outputs.

f. If Modify Attitude Output, Modify Velocity Output, or Modify Position Output is selected, press the number key corresponding to the parameter to be set.

g. Observe: The display presents the current parameter setting/data value and the following statement: "ENTER to accept, CLEAR to reject."

h. If required, change the parameter setting/data value by pressing the **<CLEAR>** key.

i. Observe: The parameter setting/data value changes to a blank data entry field.

j. Press the appropriate keys to enter the desired parameter setting/data value, then press the **<ENTER>** key to accept and enable the output.

k. Observe: The simulated data values are slewed at a controlled rate when changed to prevent rapid dynamic activity in equipment that may be using the AN/WSN-7(V)'s simulated outputs.

Postrequisites.

a. Observe that when the Simulated Outputs function is exited, a time delay will be observed while simulated output data values are slewed back to correspond with the non-simulated values.

b. Exit simulated output tests as required.

c, Restore installation configuration parameters and calibration data as outlined in **Paragraph 6.2.1**, as required.

Table 5-1. Test Menus/Functions Description

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
SYSTEM TESTS Functions (Select by pressing the **<0>** key) The SYSTEM TESTS menu provides functions associated with the selecting of system self-test and displaying Fault Codes stored in battery-backed RAM during system (RLGN) shutdown.			
1	000/System Confidence Tests	Refer to **Paragraph 5.8**.	
	090/Display Shutdown Faults	Refer to **Paragraph 5.4.4**.	
DISCRETE TESTS Functions (Select by pressing **<1>** key) The DISCRETE TESTS menu provides two pages of test functions associated with the Fault Relays, Battery, Vital Bus, and 400 Hz Inverter circuit. Select the menu page by pressing the **<NEXT PAGE>** key. Select each test by pressing the Number key corresponding to the number code of the test and then follow instruction prompts. **NOTE** Tests 107 and 108 are not run as part of the System Confidence Test. These tests should be run individually if a problem is suspected in the emergency (battery power) function, or if repairs have been made to circuits included in this function.			
1	105/Fault Relay Assembly	Allows the operator to individually activate System Fail (Not ready) K1, Malfunction K2, and Advisory K3 fault relays, and to check the SYSTEM FAIL indicator on the Front Panel and the System Alarm indicator on the CDU. Each item is toggled by pressing the corresponding number key. The state control driver (ON or OFF) is displayed beside the menu item. FAULT INDICATION: Indicator and relay operation is verified by observing the status of the indicator, or by monitoring the status of the external function connected to the relay contacts.	**5-23 (sheet 1)**; **5-7 (sheet 2)**
	106/Battery Assembly and Battery Charger Assembly **NOTE** Perform this test before selecting tests 107 or 108.	This test checks the condition of the Battery Assembly (**1A1A5**) by performing a battery load test and verifying the function of the Battery Charger Assembly (**1A1A7**) fault circuits. A failure is reported if a "BATT FAULT" status bit is detected in the system status word. After checking the battery status, Bit 10 of the system command word is set to drive the Built-in Test Equipment (BITE) Test signal line low. This signal is routed from the Status and Command CCA (**1A1A5**) to the Power Module (**1A1A8**) and Battery Charger Assembly (**1A1A7**) to illuminate the fault lamps and activate the "BATT FAULT" signal in the system status word (bit 5).	**5-6**, **5-10**, **5-23 (sheet 1)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		Error codes reported are as follows: 1 – Battery Assembly (**1A1A5**) Battery Charger Assembly (**1A1A7**) failed. 2 – Status and Command CCA (**1A1A5**) or Battery Charger Assembly (**1A1A7**) failed. The fault lamps on the Battery Charger Assembly (**1A1A7**) should illuminate as soon as the test is initiated and remain on for 5 seconds. If either of the above failure codes are reported, the fault lamps will remain lit for 5 seconds after the failures are acknowledged. <u>Battery Load Test.</u> If the battery is suspected to be defective, then conduct the following battery load test: (1) Monitor the Battery Assembly voltage by connecting a multimeter to the test points on the Battery Charger Assembly (**1A1A7**). (2) With the system power on, the voltage on the multimeter should be approximately 32.9 volts. This is the normal voltage when the charger is in the trickle charge mode (fully charged battery). After a period of discharge, the battery charging voltage may be between 30 and 34.5 volts until full charge is restored. (3) Turn off the Alternating Current (AC) input power by switching off "Power" circuit breaker 1CB1 on the front panel. "System Power" toggle switch 1S1 must remain in the ON position. The RLGN should continue to operate. Observe that the voltage on the multimeter decreases to the normal battery voltage of 28V after about 1 minute. Allow operation to continue on battery for 3 minutes. If, while under load, the voltage remains under 28V, then suspect the Battery Assembly (**1A1A5**) to be defective.	
	107/Vital Bus CCA Test #1 **NOTE** Perform test 106 prior to running this test.	Checks Vital Bus CCA (**1A1A3**). Test checks primary fault detection and switching circuits, and verifies that the RLGN will switch to battery power and continue to operate when main 3 phase AC power is interrupted. Test menu prompts the operator to set POWER CIRCUIT BREAKER on front panel OFF, and then press the **<ENTER>** key to initiate the test. FAILURE CODE(S): 001 − Battery Charger Assembly failed 002 − Vital Bus CCA failed 003 − Multiple faults (Battery Charger Assembly and/or Vital Bus CCA)	**5-6**, **5-7 (sheet 1)**, **5-10**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	108/Vital Bus CCA Test #2 **NOTE** Perform test 106 prior to running this test.	Checks Vital Bus CCA (**1A1A3**). Tests BIT circuit on CCA (**1A1A3**) to verify fault is detected when 115 VAC, 400 Hz (vital reference) source from Inverter Assembly (**1A1A2**) is interrupted. **WARNING** The test menu prompts the operator to disconnect the cable from the jack on the Inverter Assembly and then press the ENTER key to initiate the test. 115 VAC, 400 Hz is present at this connector. Use care when disconnecting and reconnecting the cable. TEST FAIL: Vital Bus CCA (**1A1A3**) failed.	**5-7 (sheet 1)**, **5-10**
2	117/400 Hz Inverter	Checks fault detector BIT status for internally generated 115 VAC, 400 Hz (vital reference) to verify that Inverter Assembly (**1A1A2**) is operating properly. TEST FAIL: Inverter Assembly (**1A1A2**) failed.	**5-7 (sheet 1)**
NAV TESTS Functions (Select by pressing the **<2>** key) The NAV TESTS menu provides four pages of test functions associated with testing of the Navigation circuits. Select the menu page by pressing the **<NEXT PAGE>** key. Select each test by pressing the Number key corresponding to the number code of the test and then follow instruction prompts.			
1	201/Display pattern	Generates a character pattern that allows the display to be checked by observation for faulted segments. All printable characters including the alternate character sets are displayed sequentially. The test continues until each character has been displayed in each cell, or until the test is aborted by pressing the **<CLEAR>** key. TEST FAIL: Blank cell(s) or broken characters in a cell indicate a fault in Vacuum Fluorescent Display (**1A1A10A1**).	**3-20**
	202/Keypad and panel interface	Checks the Membrane Keypad (**1A1A9**) and key interface circuits on the display Panel Interface Assembly (**1A1A10A2**). After initiating test, pressing any key will cause the key's function to be displayed. TEST FAIL: Failure to display proper response for a key indicates a fault in Membrane Keypad (**1A1A9**) or in the interface logic on Panel Interface Assembly (**1A1A10A2**).	**3-20**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		Refer to **paragraph 5.5** to troubleshoot the Display Assembly.	
	203/Status and Command CCA test #1	Enables the wraparound from command register to status register on Status and Command CCA (**1A1A15**). Processor outputs a test pattern to command register and then checks the results set in status register. TEST FAIL: Status and Command CCA (**1A1A15**) failed. FAILURE CODE(s): 001 − Valid wrap pattern commanded but not recognized as valid. 002 − Invalid wrap pattern commanded but recognized as valid.	**5-19 (sheet 1)**
	204/Status and Command CCA test #2	Checks Electrically Erasable Programmable Read-Only Memory (EEPROM) and EEPROM buffer RAM on Status and Command CCA (**1A1A15**). PROCEDURE: If RAM and EEPROM checksum is OK, the operator is prompted to set write enable switch S1 on the card to enable writing to the EEPROM (set switch to up position). See **Figure 5-2**. After the switch has been set, the processor writes four test words into the EEPROM (selected such that checksum does not change) and then checks EEPROM. Set S1 to disable writing to EEPROM upon completion of test. FAILURE CODE(s): 001 − Memory Test failed on EEPROM's shadow RAM. 002 − EEPROM checksum failure. 003 − System status indicates operator has not enabled write to EEPROM. 004 − Test pattern written does not agree with pattern read back. Any above failure code indicates Status and Command CCA (**1A1A15**) failed.	**5-19 (sheet 1)**
2	209/Dual Panel Interface CCA, Display channel interface (short loop)	Checks Control Panel interface on Dual Panel Interface CCA (**1A1A16**) using internal wraparound circuit.	**5-20**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		FAILURE CODE(s): 001 − Output buffer was not filled. 002 − Overrun error. 003 − Framing error. 004 − Data read did not agree with data sent. 005 − Insufficient data in input buffer.	
		Any above failure code indicates Dual Panel Interface CCA (**1A1A16**) may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure.	
	210/Dual Panel Interface CCA, Remote/Monitor channel interface (short loop)	Checks Remote Panel interface on Dual Panel Interface CCA (**1A1A16**) using internal wraparound circuit. FAILURE CODE(s): 001 − Output buffer was not filled. 002 − Overrun error. 003 − Framing error. 004 − Data read did not agree with data sent. 005 − Insufficient data in input buffer. Any above failure code indicates Dual Panel Interface CCA (**1A1A16**) may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure.	**5-20**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	211/Dual Panel Interface CCA, Remote/Monitor channel interface (long loop) **NOTE** Do not connect test cable to 1A1J5 until prompted.	Checks Remote Panel interface on Dual Panel Interface CCA (**1A1A16**) using an external test cable to establish wraparound circuit for test. PROCEDURE: 1. Disconnect ship's cable from 1A1J5 on unit. 2. In the **NAV TEST MENU**, select test 11 (this is test 211). 3. Connect test cable 1981552-8 to 1A1J5 when prompted. 4. Press **<ENTER>** key; display reads "Enter Test Duration in Seconds." 5. Press **<CLEAR>** key. 6. Press **<1> <2> <0>**. 7. Press **<ENTER>** key; display reads "Test in Progress." When test is complete, display reads "Test Complete Test Pass." 8. Press **<ENTER>** key.9. Disconnect test cable 1981552-8 when prompted and reconnect external cable. FAILURE CODE(s): 001 − Output buffer was not filled. 002 − Overrun error. 003 − Framing error. 004 − Data read did not agree with data sent. 005 − Insufficient data in input buffer. 006 − Request To Send (RTS) did not result in Clear To Send (CTS). 007 − Data Terminal Ready (DTR) did not result in Data Set Ready (DSR). 008 − Data transfer occurred with RTS inactive. Any above failure code indicates Dual Panel Interface CCA (**1A1A16**) may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure.	**5-20**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	212/IMU Interface (short loop)	Checks IMU Interface CCA (**1A1A17**) using internal wraparound circuit. FAILURE CODE(s): 001 − Test pattern written does not agree with pattern read back. 002 − Fewer than 32 words available in input buffer 20 ms after writing to the output buffer. 003 − Output buffer not empty when time to write next pattern. Any above failure code indicates IMU Interface CCA (**1A1A17**) failed.	**5-19 (sheet 1)** and **(sheet 4)**
3	213/IMU Interface (long loop) **NOTE** Connect test cable between cable 1A1W5 and Backplane Assembly 1A30J6 before selecting this test.	Checks IMU interface on IMU Interface CCA (**1A1A17**) using an external test cable to establish wraparound circuit for test. PROCEDURE: 1. Set SYSTEM POWER switch OFF. 2. Disconnect cable 1A1W54 from A30J6. 3. Connect test cable 1981552-10 between 1A30P6 on cable and 1A30J6 on backplane. 4. Press and hold **<TEST>** key and set SYSTEM POWER switch ON. 5. Select test 213. 6. After completion of test, turn off power, remove test cable and reconnect cable 1A1W5. FAILURE CODE(s): 001 − Output buffer was not filled. 002 − Overrun error. 003 − Framing error. 004 − Data read did not agree with data sent. 005 − Insufficient data in input buffer. 006 − RTS did not result in CTS. 007 − DTR did not result in DSR. 008 − Data transfer occurred with RTS inactive. Any above failure code indicates IMU Interface CCA (**1A1A17**) failed.	**5-19 (sheet 1)** and **(sheet 4)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	220/Torquer loop (test #1)	This test checks the inner and outer torquer loop which consists of the synchros and torquer motors, and the circuits associated with synchro angle detection, torquer function enabling and torquer motor drive. The test is performed by rotating both torquer motors simultaneously through one revolution while monitoring the feedback voltages. FAILURE CODE(s): 001 − Status and Command CCA (**1A1A15**) failed. 002 − Inner Torquer CCA (**1A1A19**) failed. 003 − Outer Torquer CCA (**1A1A18**) failed. 004 − Repositioning Interface CCA (**1A1A33**) failed. 005 − Synchro-to-Digital (S/D) converter on CCA (**1A1A33**) failed. 006 − Inner torquer function; synchro (1A2A1B4), slip rings (**1A2A1A1A12**), or Motor (**1A2A1A1B2**) failed. 007 − Outer torquer function; synchro (1A2A1B3), slip rings (**1A2A1A1A11**), or Motor (**1A2A1A1B1**) failed.	**5-13 (sheet 1)** and **(sheet 2)**; **5-9 (sheet 1)**; **5-11 (sheet 1)**
	221/Torquer loop (test #2)	Checks torquer drive circuits by applying a sequence of constant voltages to drive each torquer motor one revolution in each direction while checking torquer feedback voltage and whether shutdown occurred. The average voltage determined for torquer revolution in one direction is compared with the average voltage determined during revolution in the other direction. Each averaged feedback voltage is also compared against high and low reasonableness limits. FAILURE CODE(s): 001 - Inner torquer function; Torquer Motor (**1A2A1A1B2**) or Slip Rings (**1A2A1A1A13**) failed. 002 - Inner Torquer CCA (**1A1A19**) failed. 003 - Outer torquer function; Torquer Motor (**1A2A1A1B1**) or wiring failed. 004 - Outer Torquer CCA (**1A1A18**) failed. **NOTE** If test fails for rotation in one direction only, the associated Torquer Circuit board is assumed to have failed. If identical failed voltages are detected for both directions of rotation, the Torquer Motor or wiring is assumed to have failed.	**5-13 (sheet 1)** and **(sheet 2)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	245/Heartbeat test	Checks operation of Heartbeat monitor (BIT function) on Nav Processor (**1A1A13**). **NOTE** To end this test, the SYSTEM POWER switch (1S1) must be turned off. This terminates the Test mode. If further tests are required, the Test mode must be reselected. TEST FAIL: Heartbeat monitor function on Nav Processor CCA (**1A1A13**) failed to detect loss of heartbeat signal from processor.	**5-19 (sheet 1)**
4	282/Continuous RAM test **CAUTION** Do not perform this test unless problems are suspected in Nav Processor (**1A1A13**). Performing this test causes the configuration parameters stored in battery-backed RAM on CCA (**1A1A13**) to be erased. After the test is performed, battery-backed RAM must be reloaded from EEPROM Keyboard Entry to Non-Volatile Memory (KENV) on Status and Command CCA (**1A1A15**) and a 72-hour settle period is required to reestablish accuracy.	When initiated, this test shall disable interrupts, and take direct control of the Display and produce the following message: TEST 282 Continuous RAM Test IN PROCESS Cycle power to quit RAM testing will be repeated over the range 0000,0A00 – 0060,0000 (RAM) on Nav Processor CCA (**1A1A13**) until an error is detected or system power is interrupted. When the end or RAM is reached, test will repeat. Each test writes a pattern to a RAM cell and reads it. If they agree, the test continues to write and read each RAM cell through the entire RAM address space; otherwise, it terminates and the failure is reported. TEST FAIL: If a failure is detected, the following display will be generated (with the indicated values replacing the x fields): TEST 282 Continuous RAM Test TEST FAILED ADDRESS = xxxxxx DATA WRITTEN = xxxxxxxx DATA READ = xxxxxxxx Cycle power to quit After this point, the test will stop and prevent any further processing, forcing the operator to cycle the power.	**5-19 (sheet 1)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		Upon completion of the test, whether or not Nav Processor (**1A1A13**) is replaced, it is necessary to reload system configuration data into the battery-backed RAM and then to run the system for a 72-hour settle period to reestablish full system accuracy. Refer to **Paragraph 6.2.1.1**.	
	283/Continuous PROM test	Run PROM checksum routine continuously until an error is detected or the operator terminates the test.	
IMU TESTS Functions (Select by pressing the **<3>** key) The IMU TESTS menu provides five pages of test functions associated with testing of the Inertial Measuring Unit and IMU support electronics circuits. Select the menu page by pressing the **<NEXT PAGE>** key. Select each test by pressing the Number key corresponding to the number code of the test and then follow instruction prompts. **NOTE** Accelerometer and Sensor Electronics CCA (**1A1A35**) provides a clock signal and reset control to other CCAs associated with IMU functions. If ambiguous faults are detected (faults associated with several different functions), CCA (**1A1A35**) may be faulty.			
1	314/A/D MUX	Checks Analog-to-Digital (A/D) Multiplexer CCA (**1A1A34**). Test fails if measured value of 0 VDC, +5 VDC, and +28 VDC test point inputs are out of tolerance, or if all outputs from any single submultiplexer on the CCA are identical and out of tolerance. TEST FAIL: A/D Multiplexer CCA (**1A1A34**) failed.	**5-23 (sheet 2)**
	315/Support Electronics Power Supply	Checks outputs from Support Electronics Power Supply (**1A1A37**). When the test is initiated as part of the System Confidence Test (Test 000), the voltage levels are checked to be within their acceptable ranges. If any voltage is out of range, a Failure Code is displayed. When this test is initiated manually, the voltage levels are continuously displayed and must be manually observed to determine operating status of Support Electronics Power Supply (**1A1A37**). Failure codes, supply outputs, and corresponding acceptable voltage ranges are listed below: **Code** / **Voltage** / **Upper Limit** / **Lower Limit** 001 / +5 VDC / +5.5v / +4.5v 002 / +15 VDC / +16.5v / +13.5v 003 / +25 VDC / +30v / +20v 004 / -15 VDC / -16.5v / -13.5v 005 / +28 VDC / +30v / +25v	**5-23 (sheet 2)**; **5-11 (sheet 1)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	316/IMU High Voltage Power Supply Tests	Checks outputs from High Voltage Power Supply (**1A2A1A1A4**). When the test is initiated as part of the System Confidence Test (Test 000), the voltage levels are checked to be within their acceptable ranges. If any voltage is out of range, a Failure Code is displayed. When this test is initiated manually, the voltage levels are continuously displayed and must be manually observed to determine operating status of High Voltage Power Supply (**1A2A1A1A4**). Failure Codes, supply outputs, and corresponding acceptable voltage ranges are listed below: (**1A2A1A1A4**) Voltages: Code / Voltage / Upper Limit / Lower Limit 001 / +280 VDC / +301v / +247v 002 / -930 VDC / -1017v / -832v	**5-12**
	318/Gyro and Accelerometer PROMs	Performs checksum of the calibration PROMs located on IMU Processor CCA (**1A1A32**). Board failure is announced if all PROMs checksum fail. FAILURE CODE(s): 001 – IMU Processor CCA (**1A1A32**) failed. 002 – Platform calibration PROM U3 or U13 failed. 003 – Gyro A calibration PROM U15 failed. 004 – Gyro B calibration PROM U02 failed. 005 – Gyro C calibration PROM U04 failed. 006 – Accel. A calibration PROM U12 failed. 007 – Accel. B calibration PROM U14 failed. 008 – Accel. C calibration PROM U01 failed.	**5-19 (sheet 5)**
2	322/Dither Loop	Processor compares gyro dither pickoff amplitude (A, B, C Dither Mon) input through A/D Multiplexer CCA (**1A1A34**) for all three gyros to a reasonableness threshold. FAILURE CODE(s): 001 – Repositioning Interface CCA (**1A1A33**), Gyro Support Electronics CCA (**1A1A36**), or Gyro A (**1A2A1A1A1**) failed. 002 – Repositioning Interface CCA (**1A1A33**), Gyro Support Electronics CCA (**1A1A36**), or Gyro B (**1A2A1A1A2**) failed.	**5-15**; **5-23 (sheet 2)**; **5-11**; **5-12**; **5-13**
		003 – Repositioning Interface CCA (**1A1A33**), Gyro Support Electronics CCA (**1A1A36**), or Gyro C (**1A2A1A1A3**) failed.	
	323/PLC and RDI	Checks Laser Intensity Monitor (LIM), Path Length Control (PLC), and Random Drift Improvement (RDI) control circuits on Gyro Support Electronics CCA (**1A1A36**). Test first sets a continuous path length reset command from Accelerometer and Sensor Electronics CCA (**1A1A35**) for 1 second to each PLC logic function on Gyro Support Electronics CCA (**1A1A36**), and checks that corresponding reset request is generated and PLC monitor voltages are within expected range. If the first part of the test passes, reset command is removed, and after 5 seconds, LIM power, PLC, and RDI MON voltages are checked for all gyros. If a gyro failure 003, 004, or 005 is announced, it may be due to either LIM power, PLC, or RDI. To determine which parameter is causing the failure, run test 373 to read LIM voltage and test 373 to read laser PLC and RDI. **NOTE** If the IMU Processor CCA (**1A1A32**) is Rev B or earlier, test 323 will fail for laser intensity less than 2.3 V. The gyros will function normally down to 1.1 V, so a failure of test 323 alone should not be interpreted as a failed gyro if the RLGN otherwise navigates normally. This is related to IMU Processor software program update of the online LIM alarm set point from Rev B to Rev C. Refer to the Online LIM Fault 163 description. FAILURE CODE(s): 001 – Accelerometer and Sensor Electronics CCA (**1A1A35**) failed. 002 – Gyro Support Electronics CCA (**1A1A36**) failed. 003 – Gyro A (**1A2A1A1A1**) or High Voltage Power Supply Assembly (**1A2A1A1A4**) failed. 004 – Gyro B (**1A2A1A1A2**) or High Voltage Power Supply Assembly (**1A2A1A1A4**) failed. 005 – Gyro C (**1A2A1A1A13**) or High Voltage Power Supply Assembly (**1A2A1A1A4**) failed. 006 – Gyro Support Electronics CCA (**1A1A36**) failed.	**5-14**; **5-23 (sheet 2)**; **3-25**; **5-11**; **5-12**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	329/Accelerometers (Test Sequence)	Analyzes data acquired from the accelerometers after having held each accelerometer oriented up, down, and in two opposing horizontal directions. The Sensor Block is sequentially rotated to six different orientations (phases). After stabilizing at each orientation, data is accumulated from one horizontal and one vertical accelerometer for 16 seconds. Phases are paired such that in the second phase of each pair, both tested accelerometers will be oriented 180° from that of the first phase. The test sequence requires approximately three minutes to complete. Accelerometer Orientation Test Phases are: Torquer Angle: Accel. Tested: Inner Outer Vert. Horiz. 270 270 A B 090 270 A B 000 270 B C 000 090 B C 090 180 C A 090 000 C A FAILURE CODE(s): 001 – Accelerometer A (**1A2A1A1A5**) failed. 002 – Accelerometer and Sensor Electronics CCA (**1A1A35**) "A" circuit function failed. 003 – Accelerometer B (**1A2A1A1A7**) failed. 004 – Accelerometer and Sensor Electronics CCA (**1A1A35**) "B" circuit function failed. 005 – Accelerometer C (**1A2A1A1A6**) failed. 006 – Accelerometer and Sensor Electronics CCA (**1A1A35**) "C" circuit function failed. 007 – Test aborted due to torquer shutdown.	**5-17**; **5-23 (sheet 2)**; **3-19)**
3	330/Gyros and Gyro Interfaces test #1	Sequentially rotates each gyro about its input axis one full revolution in each direction at 15°/second. During rotation, counts and coning correction counts for the gyro under test are accumulated for each direction, and failure reporting is based on the reasonableness of the accumulated counts. Board failure is announced if counts appear bad for all three gyros. FAILURE CODE(s): 001 – Accelerometer and Sensor Electronics CCA (**1A1A35**) failed. 002 – Gyro A (**1A2A1A1A1**) failed.	**5-16**; **5-23 (sheet 2)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		003 – Gyro B (**1A2A1A1A2**) failed. 004 – Gyro C (**1A2A1A1A3**) failed. 005 – Test aborted due to torquer shutdown.	
	331/Gyros and Gyro Interfaces test #2	Similar to test 330 except that a coning angle is introduced for testing the A and B gyros. By nature of the gimbal's design, Gyro C cannot be forced into coning motions. FAILURE CODE(s): 001 − Accelerometer and Sensor Electronics CCA (**1A1A35**) failed. 002 − Test aborted due to torquer shutdown.	**5-16**; **5-23 (sheet 2)**
	370/Gyros and Accelerometers Temperatures (Display)	Continuously displays the temperature of the Gyros and Accelerometers on the front panel. Limits with system stabilized at operating temperature are: 24.8°F to 167°F (-4°C to +75°C) Test is terminated by pressing the **<CLEAR>** key.	
	371/Raw Acceleration and Accelerometer Sample and Hold Voltage Signal Monitoring	Continuously displays the raw acceleration (ft/sec²) and accelerometer sample and hold (S&H) voltages. Note that the B channel clips at approximately 1/3 g in one direction. The S&H percentages should continually change during this test. S&H percentages measure accelerometer residuals. Test is terminated by pressing the **<CLEAR>** key.	

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
4	372/Gyro Dither and Laser Intensity Monitor Signal Monitoring	Continuously displays the voltages associated with gyro dither and Laser Intensity Monitor (LIM) on the front panel. Limits are: Dither (V) LIM (V) A (1.5 to 7.5) (1.1 to 7.5) B (1.5 to 7.5) (1.1 to 7.5) C (1.5 to 7.5) (1.1 to 7.5) Test is terminated by pressing the **<CLEAR>** key.	
	373/Gyro PLC and RDI Signal Monitoring	Continuously displays the voltages associated with gyro PLC and RDI on the front panel. Limits are: PLC (V) RDI (V) A (5.5 to 6.8) (4.9 to 6.0) B (5.5 to 6.8) (4.9 to 6.0) C (5.5 to 6.8) (4.9 to 6.0) Test is terminated by pressing the **<CLEAR>** key.	
	374/Torquer Drive and S/D Conversion Error Monitoring	Continuously displays the voltages associated with Torquer Drive and S/D conversion error. Test is terminated by pressing the **<CLEAR>** key.	
5	376/Continuous PLC RST DSBL Gyro A	Sets the logic level of the Path Length Control Reset (A PLC RST DSBL) signal from the Accelerometer and Sensor Electronics CCA (**1A1A35**) to the corresponding Path Length Control circuit on Gyro Support Electronics CCA (**1A1A36**) to maintain continuous Path Length Control reset status for the A Gyro. **NOTE** This test is intended to be used for factory-level test and does not return faults or display status. Test is terminated by pressing the **<CLEAR>** key.	**3-25**; **5-11**; **5-23**
	377/Continuous PLC RST DSBL Gyro B	Same as test 376 except that B PLC RST DSBL control line is set to maintain continuous Path Length Control reset status for the B Gyro.	
	378/Continuous PLC RST DSBL Gyro C	Same as test 376 except that C PLC RST DSBL control line is set to maintain continuous Path Length Control reset status for the C Gyro.	
	379/Synchro Angles Monitoring	Continuously displays the combined angle in degrees and raw (hex) values for the inner and outer gimbal synchros. Values are dependent on angle position of the gimbals. Test is terminated by pressing the **<CLEAR>** key.	

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
I/O TESTS Functions (Select by pressing the**<4>** key) The I/O TESTS menu provides six pages of test functions associated with testing of the Naval Tactical Data System (NTDS) and ATM interface functions. To perform long loop tests, it is necessary to connect a test wraparound cable on the connector associated with the channel being tested. The type of test cable used is determined by the I/O board type installed for the I/O channel. Select the menu page by pressing the **<NEXT PAGE>** key. Select each test by pressing the Number key corresponding to the number code of the test, and then follow instruction prompts. The following interface tests (both short loop and long loop) exercise the control, formatting, message decoding, interrupt enabling, timing, and handshake protocol for each type of interface board. The I/O Processor automatically selects the correct testing routine for the type of NTDS board installed in the location for the ports being tested. The ATM Processor automatically selects the correct testing routine for the ATM port being tested. The off-line fault test exercises the interface board using a wraparound circuit, which is established on the board. The long loop tests are identical to the short loop tests with the exception that a wraparound test cable is installed to verify data transfer through the backplane and internal data cables. Faults for the NTDS interfaces are announced to the I/O processor via two 16-bit status words, allowing up to 32 unique fault conditions to be reported. Announcing any one of these faults by a short loop test constitutes a fault in the NTDS board being tested. Faults for the ATM interfaces are announced to the ATM processor via two 16-bit status words, allowing up to 32 unique fault conditions to be reported. Announcing any one of these faults by a short loop test constitutes a fault in the ATM board being tested.			
1	424/NTDS A1, A2 short loop	Checks NTDS Interface CCA in location (**1A1A51**) (ports A1 and A2) using internal wraparound circuit. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Any of the following failure codes indicates that the NTDS Interface CCA may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure. FAILURE CODE(s) − NTDS Type A (Parallel) Board: 001 − External Interrupt Enable not set. 002 − External Function Acknowledge not set. 003 − Input Data Acknowledge not set. 004 − Input Data Request not set. 005 − External Interrupt Enable not cleared. 006 − External Function Acknowledge not cleared. 007 − Input Data Acknowledge not cleared. 008 − Input Data Request not cleared. 009 − Control mode data mismatch. 010 − Output block data mismatch. 011 − Input block data mismatch.	**3-22 (sheet 2)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		012 − Insufficient input data. 013 − Overabundant input data. 014 − Input Data Acknowledge clear timeout. 015 − Input Data Acknowledge set timeout. 016 − Input Data Request clear timeout. 017 − Input Data Request set timeout. 018 − Input zero count not set. 019 − Output zero count not set. 020 − Timeout Flag fail. 021 − Dual port RAM fail. 022 − Inappropriate response from I/O. 023 − No I/O acknowledge. 024 through 031 − Spare. 032 − Board not fitted. FAILURE CODE(s) − NTDS Type D or E (Serial) Board: (Port 1 faults) 001 − Output Control Information Word mismatch. 002 − Output data mismatch. 003 − Input Control Information Word mismatch. 004 − Input data mismatch. 005 − Have Control Information Word not set. 006 − Have data not set. 007 − Ready Control Information Word not set. 008 − Ready data not set. 009 − Output zero count fail. 010 − Input zero count fail. 011 − Output timeout fail. 012 − Insufficient input data. 013 − Overabundant input data. 014 − RAM test fail. 015 − Inappropriate response from I/O. 016 − No I/O acknowledge. (Port 2 faults) 017 − Output Control Information Word mismatch. 018 − Output data mismatch. 019 − Input Control Information Word mismatch. 020 − Input data mismatch. 021 − Have Control Information Word not set. 022 − Have data not set. 023 − Ready Control Information Word not set. 024 − Ready data not set. 025 − Output zero count fail. 026 − Input zero count fail. 027 − Output timeout fail. 028 − Insufficient input data. 029 − Overabundant input data. 030 − RAM test fail. 031 − Spare. 032 − Board not fitted.	
	425/NTDS B1, B2 short loop	Checks NTDS Interface CCA in location (**1A1A52**) (ports B1 and B2) using internal wraparound circuit. Tests performed and possible Failure Codes are the same as described for test 424.	**3-22 (sheet 2)**
	426/NTDS C1, C2 short loop	Checks NTDS Interface CCA in location (**1A1A53**) (ports C1 and C2) using internal wraparound circuit. Tests performed and possible Failure Codes are the same as described for test 424.	**3-22 (sheet 2)**
	427/NTDS D1, D2 short loop	Checks NTDS Interface CCA in location (**1A1A54**) (ports D1 and D2) using internal wraparound circuit. Tests performed and possible Failure Codes are the same as described for test 424.	**3-22 (sheet 2)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
2	458/NTDS E1, E2 short loop	Checks NTDS Interface CCA in location (**1A1A55**) (ports E1 and E2) using internal wraparound circuit. Tests performed and possible Failure Codes are the same as described for test 424.	**3-22 (sheet 2)**
	459/NTDS F1, F2 short loop	Checks NTDS Interface CCA in location (**1A1A56**) (ports F1 and F2) using internal wraparound circuit. Tests performed and possible Failure Codes are the same as described for test 424.	**3-22 (sheet 2)**
	460/NTDS G1, G2 short loop	Checks NTDS Interface CCA in location (**1A1A57**) (ports G1 and G2) using internal wraparound circuit. Tests performed and possible Failure Codes are the same as described for test 424.	**3-22 (sheet 2)**
	461/NTDS H1, H2 short loop	Checks NTDS Interface CCA in location (**1A1A58**) (ports H1 and H2) using internal wraparound circuit. Tests performed and possible Failure Codes are the same as described for test 424.	**3-22 (sheet 2)**

NOTE

The long loop tests of the I/O check the input and output buffers on the cards, I/O Backplane (**1A1A12**) wiring (for NTDS Type A ports only), and interconnecting cables which connect between the I/O Backplane or card edge connectors and the external connectors on Processor Cabinet (**1A1**). Before performing any long loop test, perform the short loop test for the suspect I/O ports. If the short loop test fails, replace the NTDS or ATM CCA. If the short loop test passes, but previously reported on-line fault codes indicating data transmission problems for the suspect port have been recorded, perform the long loop test to check the complete I/O path. If the long loop test also passes, the problem may be in the ship's data cables, or in the equipment with which the INS is communicating via the suspect I/O ports.

To perform any of the following long loops, a test cable or test adapter must be installed before running the test. The type of test cable or adapter required is dependent on the board installed for the port(s) being tested. Refer to **Figure 3-22, sheet 2**, to identify the port/assembly/output connector(s) associated with the NTDS interface.

a. For testing ports associated with an NTDS Type A CCA, remove the ship's parallel data cable from the associated jack on the Processor Cabinet and install test adapter 1981552-1 (supplied as part of the installation kit, see **Table A-1**) on the I/O jack before selecting the test.

b. For testing ports associated with an NTDS Type D CCA, remove the ship's coaxial data cables from the associated connectors on the Processor Cabinet and install test adapter cable 1981552-6 between the input and output port connectors before selecting the test.

c. For testing ports associated with an NTDS Type E CCA, remove the ship's triax data cables from the associated connectors on the Processor Cabinet and install test adapter cable 1981552-7 between the input and output triax connectors before selecting the test.

d. For testing ports associated with the Doppler Sonar Velocity Log (DSVL) interface, remove the ship's serial data cable from jack 1J23 on the Processor Cabinet and install test adapter 03956-1860241 on the I/O jack before selecting the test.

e. For testing ATM ports, remove the ship's Fiber data cable from J22 on the Processor Cabinet and install test adapter cable 03596 - 1900239 on the J22 I/O jack before selecting the test.

Table 5-1. Test Menus/Functions Description - Continued

CAUTION

If the NTDS Type E Assembly is replaced, use care not to bend the coax cables (T968912) excessively or damage the connectors on the NTDS CCA.

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
3	462/NTDS A1, A2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A51**) (ports A1 and A2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) PROCEDURE: To perform this test, first install Wraparound Test Adapter and then select test: 1. Disconnect operational cable(s) and connect appropriate test adapter for NTDS board in location (**1A1A51**). 2. Select test 462. 3. After completion of test, remove test adapter and reconnect operational cables. Any of the following failure codes indicates that the NTDS Interface CCA may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure. FAILURE CODE(s) − NTDS Type A (Parallel) Board: 001 − External Interrupt Enable not set. 002 − External Function Acknowledge not set. 003 − Input Data Acknowledge not set. 004 − Input Data Request not set. 005 − External Interrupt Enable not cleared. 006 − External Function Acknowledge not cleared. 007 − Input Data Acknowledge not cleared. 008 − Input Data Request not cleared. 009 − Control mode data mismatch. 010 − Output block data mismatch. 011 − Input block data mismatch. 012 − Insufficient input data. 013 − Overabundant input data. 014 − Input Data Acknowledge clear timeout. 015 − Input Data Acknowledge set timeout.	**3-22 (sheet 2)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		016 − Input Data Request clear timeout. 017 − Input Data Request set timeout. 018 − Input zero count not set. 019 − Output zero count not set. 020 − Timeout Flag fail. 021 − Dual port RAM fail. 022 − Inappropriate response from I/O. 023 − No I/O acknowledge. 024 through 031 − Spare. 032 − Board not fitted. FAILURE CODE(s) − NTDS Type D or E (Serial) Board: (Port 1 faults) 001 − Output Control Information Word mismatch. 002 − Output data mismatch. 003 − Input Control Information Word mismatch. 004 − Input data mismatch. 005 − Have Control Information Word not set. 006 − Have data not set. 007 − Ready Control Information Word not set. 008 − Ready data not set. 009 − Output zero count fail. 010 − Input zero count fail. 011 − Output timeout fail. 012 − Insufficient input data. 013 − Overabundant input data. 014 − RAM test fail. 015 − Inappropriate response from I/O. 016 − No I/O acknowledge. (Port 2 faults) 017 − Output CID mismatch. 018 − Output data mismatch. 019 − Input Control Information Word mismatch. 020 − Input data mismatch.	

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		021 − Have Control Information Word not set. 022 − Have data not set. 023 − Ready Control Information Word not set. 024 − Ready data not set. 025 − Output zero count fail. 026 − Input zero count fail. 027 − Output timeout fail. 028 − Insufficient input data. 029 − Overabundant input data. 030 − RAM test fail. 031 − Spare. 032 − Board not fitted.	
	463/NTDS B1, B2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A52**) (ports B1 and B2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Tests performed and possible Failure Codes are the same as described for test 462.	**3-22 (sheet 2)**
	464/NTDS C1, C2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A53**) (ports C1 and C2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Tests performed and possible Failure Codes are the same as described for test 462.	**3-22 (sheet 2)**
	465/NTDS D1, D2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A54**) (ports D1 and D2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Tests performed and possible Failure Codes are the same as described for test 462.	**3-22 (sheet 2)**
4	466/NTDS E1, E2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A55**) (ports E1 and E2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Tests performed and possible Failure Codes are the same as described for test 462.	**3-22 (sheet 2)**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	467/NTDS F1, F2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A56**) (ports F1 and F2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Tests performed and possible Failure Codes are the same as described for test 462.	**3-22 (sheet 2)**
	468/NTDS G1, G2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A57**) (ports G1 and G2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Tests performed and possible Failure Codes are the same as described for test 462.	**3-22 (sheet 2)**
	469/NTDS H1, H2 long loop **NOTE** Connect test cable/adapter before selecting this test.	Checks NTDS Interface CCA in location (**1A1A58**) (ports H1 and H2) using an external test adapter to establish wraparound circuit for test. (Failure Codes are dependent on NTDS board type installed for system hardware configuration.) Tests performed and possible Failure Codes are the same as described for test 462.	**3-22 (sheet 2)**
5	484/Dual Panel Interface, RS-422A Interface (INS to INS) (short loop)	Checks Interface No. 1 (INS to INS) on Dual Panel Interface CCA (**1A1A14**) using internal wraparound circuit. FAILURE CODE(s): 001 − Output buffer was not filled. 002 − Overrun error. 003 − Framing error. 004 − Data read did not agree with data sent. 005 − Insufficient data in input buffer. Any above failure code indicates Dual Panel Interface CCA (**1A1A14**) may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure.	**5-20**
	485/Dual Panel Interface, RS-422A Interface No. 2 (DSVL) (short loop)	Checks Interface No. 2 on Dual Panel Interface CCA (**1A1A14**) using internal wraparound circuit. FAILURE CODE(s): 001 − Output buffer was not filled. 002 − Overrun error. 003 − Framing error. 004 − Data read did not agree with data sent. 005 − Insufficient data in input buffer. Any above failure code indicates Dual Panel Interface CCA (**1A1A14**) may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure.	**5-20**
	486/Dual Panel Interface, RS-422A Interface (INS to INS) (long loop) **NOTE** Connect test cable to 1A1J6 before selecting this test.	Checks Interface No. 1 (INS to INS) on Dual Panel Interface CCA (**1A1A14**) using an external test cable to establish wraparound circuit for test. PROCEDURE: To perform this test, first install Wraparound Test Cable and then select test: 1. Disconnect cable from 1A1J6 on unit. 2. Connect test cable 1981552-14 to 1A1J6. 3. Select test 486. 4. After completion of test, remove test cable and reconnect external cable. FAILURE CODE(s): 001 − Output buffer was not filled. 002 − Overrun error. 003 − Framing error. 004 − Data read did not agree with data sent. 005 − Insufficient data in input buffer. 006 − RTS did not result in CTS. 007 − DTR did not result in DSR. 008 − Data transfer occurred with RTS inactive. Any above failure code indicates Dual Panel Interface CCA (**1A1A14**) may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure.	**5-20**
	487/Dual Panel Interface, RS-422A Interface (DSVL) (long loop) **NOTE** Connect test cable to (**1A1J23**) before selecting this test.	Checks Interface No. 2 on Dual Panel Interface CCA (**1A1A14**) using an external test cable to establish wraparound circuit for test. PROCEDURE: To perform this test, first install Wraparound Test Cable and then select test: 1. Disconnect cable from (**1A1J23**) on unit. 2. Connect test cable 1860241 to (**1A1J23**). 3. Select test 487. 4. After completion of test, remove test cable and reconnect external cable.	**5-20**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		FAILURE CODE(s): 001 – Output buffer was not filled. 002 – Overrun error. 003 – Framing error. 004 – Data read did not agree with data sent. 005 – Insufficient data in input buffer. 006 – RTS did not result in CTS. 007 – DTR did not result in DSR. 008 – Data transfer occurred with RTS inactive. Any above failure code indicates Dual Panel Interface CCA (**1A1A14**) may have failed. Momentary fault indications may occur during this test. If any of these faults cannot be cleared, then that fault will constitute a failure.	
6	488/ATM Serial Interface (short loop)	Checks ATM Interface on ATM Processor CCA (**1A1A4**) using internal wraparound circuit. FAILURE CODE(s): 001 – Could not initialize Peripheral Component Interface (PCI) Mezzanine Card (PMC)-ATM. 004 – Could not allocate memory for Test Message, Test NOT PERFORMED. 010 – Could not allocate memory for Control Structures, Test NOT PERFORMED. 011 – Could not compute Control Structure DMA Addresses. 012 – Could not allocate memory for TST013 – Could not create a TST. 014 – Could not allocate memory for Large RX Buffers. 015 – Could not compute Large Buffer DMA Addresses. 016 – Could not allocate memory for Small RX Buffers. 017 – Could not compute Small Buffer DMA Addresses. 020 – Test Message Transmission did not complete. 021 – Loop Test TX VCI is already “open”. 022 – Could not open the Loop Test TX VCI. 023 – Transmit SCQ is Full.	

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		030 – Timeout waiting for incoming message. 031 – Loop Test RX VPI is invalid. 032 – Loop Test RX VCI is invalid. 033 – Loop Test RX VCI is not configured. 034 – AAL 5 CRC Error on Incoming test message. 035 – Power Distribution Unit (PDU) Length field of AAL 5 Trailer is wrong. 036 – Control bytes of AAL 5 Trailer are wrong. 037 – Received Message data does not match Transmitted Message data. 119 – Loop Test must be done with AAL 5.	
	489/ATM Serial Interface (long loop)	Checks ATM Interface on ATM Processor CCA (**1A1A4**) using an external test cable to establish a wraparound circuit for test. PROCEDURE: 1. Disconnect cable from J22 on unit. 2. Connect test cable 1900239 to J22. 3. Select test 489. 4. After completion of test, remove test cable and reconnect external cable to J22. FAILURE CODE(s): 001 – Could not initialize PMC-ATM. 004 – Could not allocate memory for Test Message, Test NOT PERFORMED. 010 – Could not allocate memory for Control Structures, Test NOT PERFORMED. 011 – Could not compute Control Structure DMA Addresses. 012 – Could not allocate memory for TST013 – Could not create a TST. 014 – Could not allocate memory for Large RX Buffers. 015 – Could not compute Large Buffer DMA Addresses. 016 – Could not allocate memory for Small RX Buffers. 017 – Could not compute Small Buffer DMA Addresses. 020 – Test Message Transmission did not complete.	

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
		021 – Loop Test TX VCI is already "open". 022 – Could not open the Loop Test TX VCI. 023 – Transmit SCQ is Full. 030 – Timeout waiting for incoming message. 031 – Loop Test RX VPI is invalid. 032 – Loop Test RX VCI is invalid. 033 – Loop Test RX VCI is not configured. 034 – AAL 5 CRC Error on Incoming test message. 035 – PDU Length field of AAL 5 Trailer is wrong. 036 – Control bytes of AAL 5 Trailer are wrong. 037 – Received Message data does not match Transmitted Message data. 119 – Loop Test must be done with AAL 5.	
	493/ATM External Loop Back − on	When this test is performed, the ATM Processor CCA (**1A1A4**) will act as a "reflector" and will simply retransmit all ATM cells received over the fiber back out onto the fiber. NOTE: The RLGN must be directly connected to an ATM cell data source when running this test. NOTE: When the ATM Processor CCA (**1A1A4**) will remain in this mode until BIT 494, ATM External Loop Back – off, is performed. While in this mode, no other ATM related functions may be performed. FAILURE CODE(s): 001 − Could not initialize the ATM Processor CCA (**1A1A4**). 002 − Could not enable the Line Loopback feature.	
	494/ATM External Loop Back − off	Terminates the ATM External Loop Back test. FAILURE CODE(s): 002 − ATM External Loopback test is not currently in progress. 003 − Could not disable the Line Loopback feature.	

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
SYNCHRO TESTS Functions (Select by pressing the**<5>** key) The SYNCHRO TESTS menu provides five pages of wraparound test functions associated with testing of the synchro amplifiers and reference circuits. Select the menu page by pressing the **<NEXT PAGE>** key. Select each test by pressing the Number key corresponding to the number code of the test and then follow instruction prompts. **NOTE** The following tests utilize processor-controlled test relays on Synchro Converter CCAs (**1A1A38**) and (**1A1A39**) to switch signal paths for the wraparound tests. Ambiguous test results may result from failure of one of these test relays or the associated relay drivers on the active circuit board.			
1	532/External/Internal Reference Switch over	This is a two-part test. The first part verifies that relay 1A1A3K1 on Vital Bus CCA (**1A1A3**) energizes to switch internally generated AC power to Vital Ref circuit when loss of external reference occurs. The second part of this test verifies that the reference switches back when the external reference is restored. After test is initiated, operator is prompted to open the SYNCHRO REF circuit breaker (**1A1CB2**). When operator responds to prompt, BIT checks presence of Vital Ref power. TEST FAIL: Vital Bus CCA (**1A1A3**) failed. If first part of test passes, operator is prompted to remove connector from Inverter Assembly (**1A1A2**) and set SYNCHRO REF circuit breaker ON. **WARNING** The test menu prompts the operator to disconnect the cable from the jack on the Inverter Assembly and then press the ENTER key to initiate the test. 115 VAC, 400 Hz is present at this connector. Use care when disconnecting and reconnecting the cable. When the operator responds to prompt, the test is restarted and Vital Ref voltage is checked to verify that relay K1 has reset, and that external reference is restored. TEST FAIL: Vital Bus CCA (1A1A3) failed. Reconnect cable to Inverter Assembly (**1A1A2**) before proceeding with tests.	

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	533/Board A Channel 1 D/S to S/D wrap	Checks 1X Heading Sin and Cos output (channel 1) from D/S converter 1A1A38U1 on Synchro Converter CCA (**1A1A38**) by switching the Digital-to-Synchro (D/S) output through the multiplex relay circuit on the CCA to the input of Speed Log S/D converter 1A1A38U3. Nav Processor compares data output to 1A1A38U1 with data input from 1A1A38U3 to verify operation of Synchro Converter CCA (**1A1A38**). TEST FAIL: 1A1A38U1 or 1A1A38U3 on Synchro Converter CCA (**1A1A38**). Run test 535 to isolate fault.	**5-23 (sheet 3)**; **3-27**
	534/Board A Channel 1 SBA to S/D wrap	Checks 1X Heading (S1, S2, S3) output from Synchro Buffer Amplifier (SBA) (**1A1A43**) by switching the amplifier test output through the multiplex relay circuit on the Synchro Converter CCA (**1A1A38**) to the input of Speed Log S/D converter 1A1A38U3. Nav Processor compares data output to SBA (via 1A1A38U1) with test data input from 1A1A38U3 to verify operation of SBA (**1A1A43**). TEST FAIL: If test 533 passed, SBA (**1A1A43**) or wiring failed.	**5-23 (sheet 3)**; **5-21 (sheet 1)**; **3-27**
	535/Board A Channel 2 D/S to S/D wrap	Checks 36X Heading Sin and Cos output (channel 2) from D/S converter 1A1A38U5 on Synchro Converter CCA (**1A1A38**) by switching the D/S output through the multiplex relay circuit on the board to the input of Speed Log S/D converter 1A1A38U3. Nav Processor compares data output to 1A1A38U5 with data input from 1A1A38U3 to verify operation of Synchro Converter CCA (**1A1A38**). TEST PASS: If test 533 failed and this test passed, 1A1A38U1 on Synchro Converter CCA (**1A1A38**) failed. TEST FAIL: If test 533 passed, 1A1A38U5 on CCA (**1A1A38**) failed. If test 533 also failed, 1A1A38U3 on CCA (**1A1A38**) failed.	**5-23 (sheet 3)**; **3-27**
2	536/Board A Channel 2 SBA to S/D wrap	Checks 36X Heading (S1, S2, S3) output from SBA (**1A1A44**) by switching the amplifier test output through the multiplex relay circuit on the Synchro Converter CCA (**1A1A38**) to the input of Speed Log S/D converter 1A1A38U3. Nav Processor compares data output to SBA (via 1A1A38U5) with test data input from 1A1A38U3 to verify operation of SBA (**1A1A44**). TEST FAIL: If test 535 passed, SBA (**1A1A44**) or wiring failed.	**5-23 (sheet 3)**; **5-21 (sheet 1)**; **3-27**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
	537/Board B Channel 3 D/S to S/D wrap	Checks 2X[1] Pitch Sin and Cos output (channel 3) from D/S converter 1A1A39U2 on Synchro Converter CCA (**1A1A39**) by switching the D/S output through the multiplex relay circuit on the board to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to 1A1A39U2 with data input from 1A1A39U3 to verify operation of CCA (**1A1A39**). TEST FAIL: 1A1A39U2 or 1A1A39U3 on Synchro Converter CCA (**1A1A39**). Run test 539 to isolate fault.	**5-23 (sheet 4)**; **3-28**
	[1] Pitch and roll outputs are configurable for 1X and 36X, or for 2X and 36X. The convention for the U.S. Navy is 2X and 36X.		
	538/Board B Channel 3 SBA to S/D wrap	Checks 2X Pitch (S1, S2, S3) output from SBA (**1A1A42**) by switching the amplifier test output through the multiplex relay circuit on the Synchro Converter CCA (**1A1A39**) to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to SBA (via 1A1A39U2) with test data input from 1A1A39U3 to verify operation of SBA (**1A1A42**). TEST FAIL: If test 537 passed, SBA (**1A1A42**) or wiring failed.	**5-23 (sheet 4)** **5-21 (sheet 2)**; **3-28**
	539/Board B Channel 4 D/S to S/D wrap	Checks 36X Pitch Sin and Cos output (channel 4) from D/S converter 1A1A39U8 on Synchro Converter CCA (**1A1A39**) by switching the D/S output through the multiplex relay circuit on CCA to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to 1A1A39U8 with data input from 1A1A39U3 to verify operation of CCA (**1A1A39**). TEST PASS: If test 537 failed and this test passed, 1A1A39U2 on CCA (**1A1A39**) failed. TEST FAIL: If test 537 passed, 1A1A39U8 on CCA (1A1A39) failed. If test 537 also failed, 1A1A39U3 on CCA (1A1A39) failed.	**5-23 (sheet 4)**; **3-28**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
3	540/Board B Channel 4 SBA to S/D wrap	Checks 36X Pitch (S1, S2, S3) output from SBA (**1A1A42**) by switching the amplifier test output through the multiplex relay circuit on the CCA (**1A1A39**) to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to SBA (via 1A1A39U8) with test data input from 1A1A39U3 to verify operation of SBA (**1A1A42**). TEST FAIL: If test 539 passed, SBA (**1A1A42**) or wiring failed.	**5-23 (sheet 4) 5-21 (sheet 2)**; **3-28**
	541/Board B Channel 1 D/S to S/D wrap	Checks 2X Roll Sin and Cos output (channel 1) from D/S converter 1A1A39U1 on Synchro Converter CCA (**1A1A39**) by switching the D/S output through the multiplex relay circuit on the CCA to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to 1A1A39U1 with data input from 1A1A39U3 to verify operation of CCA (**1A1A39**). TEST FAIL: 1A1A39U1 on CCA (**1A1A39**) failed.	**5-23 (sheet 4) 3-28**
	542/Board B Channel 1 SBA to S/D wrap	Checks 2X Roll (S1, S2, S3) output from SBA (**1A1A41**) by switching the amplifier test output through the multiplex relay circuit on the Synchro Converter (**1A1A39**) to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to SBA (via 1A1A39U1) with test data input from 1A1A39U3 to verify operation of SBA (**1A1A41**). TEST FAIL: If test 541 passed, SBA (**1A1A41**) or wiring failed.	**5-23 (sheet 4) 5-21 (sheet 2)**; **3-28**
	543/Board B Channel 2 D/S to S/D wrap	Checks 36X Roll Sin and Cos output (channel 2) from D/S converter 1A1A39U5 on Synchro Converter CCA (**1A1A39**) by switching the D/S output through the multiplex relay circuit on the CCA to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to 1A1A39U5 with data input from 1A1A39U3 to verify operation of CCA (**1A1A39**). TEST FAIL: 1A1A39U5 on CCA (**1A1A39**) failed.	**5-23 (sheet 4) 5-21 (sheet 2)**; **3-28**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
4	544/Board B Channel 2 SBA to S/D wrap	Checks 36X Roll (S1, S2, S3) output from SBA (**1A1A41**) by switching the amplifier test output through the multiplex relay circuit on the Synchro Converter CCA (**1A1A39**) to the input of Depth S/D converter 1A1A39U3. Nav Processor compares data output to SBA (via 1A1A39U5) with test data input from 1A1A39U3 to verify operation of SBA (**1A1A41**). TEST FAIL: If test 543 passed, SBA (**1A1A41**) or wiring failed.	**5-23 (sheet 4) 5-21 (sheet 2)**; **3-28**
	546/Board C Channel 1 D/S to S/D wrap	Checks V_n 1X output (channel 1) from D/S converter 1A1A40U1 on Synchro Converter CCA (**1A1A40**) by switching the D/S output through the multiplex relay circuit on the board to the input of Speed Log S/D converter 1A1A40U3. Nav Processor compares data output to 1A1A40U1 with data input from 1A1A40U3 to verify operation of CCA (**1A1A40**). TEST FAIL: 1A1A40U1 or 1A1A40U3 on CCA (**1A1A40**). Run test 547 to isolate fault.	**5-21 (sheet 3)**; **3-29**
	547/Board C Channel 2 D/S to S/D wrap	Checks V_n 10X output (channel 2) from D/S converter 1A1A40U5 on Synchro Converter CCA (**1A1A40**) by switching the D/S output through the multiplex relay circuit on the board to the input of Speed Log S/D converter 1A1A40U3. Nav Processor compares data output to 1A1A40U5 with data input from 1A1A40U3 to verify operation of CCA (**1A1A40**). TEST PASS: If test 546 failed and this test passed, 1A1A40U1 on CCA (**1A1A40**) failed. TEST FAIL: If test 546 passed, 1A1A40U5 on CCA (**1A1A40**) failed. If test 546 also failed, 1A1A40U3 on CCA (**1A1A40**) failed.	**5-21 (sheet 3)**; **3-29**
	548/Board C Channel 3 D/S to S/D wrap	Checks V_e 1X output (channel 3) from D/S converter 1A1A40U2 on Synchro Converter CCA (**1A1A40**) by switching the D/S output through the multiplex relay circuit on the board to the input of Speed Log S/D converter 1A1A40U3. Nav Processor compares data output to 1A1A40U2 with data input from 1A1A40U3 to verify operation of CCA (**1A1A40**). TEST FAIL: 1A1A40U2 on CCA (**1A1A40**) failed.	**5-21 (sheet 3)**; **3-29**

Table 5-1. Test Menus/Functions Description - Continued

PAGE	TEST NO./FUNCTION	DESCRIPTION	FIG(s).
5	549/Board C Channel 4 D/S to S/D wrap	Checks V_e 10X output (channel 4) from D/S converter 1A1A40U8 on Synchro Converter CCA (**1A1A40**) by switching the D/S output through the multiplex relay circuit on the board to the input of Speed Log S/D converter 1A1A40U3. Nav Processor compares data output to 1A1A40U8 with data input from 1A1A40U3 to verify operation of CCA (**1A1A40**). TEST FAIL: 1A1A40U8 on CCA (**1A1A40**) failed.	**5-21 (sheet 3)**; **3-29**
	591/Board A Channel 3 D/S to S/D wrap	Checks V_t 1X output (channel 3) from D/S converter 1A1A38U2 on Synchro Converter CCA (**1A1A38**) by switching the D/S output through the multiplex relay circuit on the board to the input of Speed Log S/D converter 1A1A38U3. Nav Processor compares data output to 1A1A38U2 with data input from 1A1A38U3 to verify operation of CCA (**1A1A38**). TEST FAIL: 1A1A38U2 or 1A1A38U3 on CCA (**1A1A38**). Run test 592 to isolate fault.	**5-23 (sheet 3)**; **3-27**
	592/Board A Channel 4 D/S to S/D wrap	Checks V_t 10X output (channel 4) from D/S converter 1A1A38U8 on Synchro Converter CCA (**1A1A38**) by switching the D/S output through the multiplex relay circuit on the CCA to the input of Speed Log S/D converter 1A1A38U3. Nav Processor compares data output to 1A1A38U8 with data input from 1A1A38U3 to verify operation of CCA (**1A1A38**). TEST PASS: If test 591 failed and this test passed, 1A1A38U2 on CCA (**1A1A38**) failed. TEST FAIL: If test 591 passed, 1A1A38U8 on CCA (**1A1A38**) failed. If test 591 also failed, 1A1A38U3 on CCA (**1A1A38**) failed.	**5-23 (sheet 3)**; **3-27**

Table 5-2. CCA LEDs and Power Indicators Illumination Survey

Name	LED	Power -On	T = .5 Sec.	T = 2 Sec.	Expected Illumination Status	Observed Status Correct?		Expected Illumination Status	Observed Status Correct?	
						Yes	No		Yes	No
Nav Processor CCA (**1A1A13**)	DS1 <RED>	Extinguished	Illuminated	Extinguished	Extinguished			Illuminated		
IMU Processor CCA (**1A1A32**)	DS1 <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
ATM Processor CCA (**1A1A4**)	DS1 <RED>	Extinguished	Illuminated	Extinguished	Extinguished			Illuminated		
I/O Processor CCA (**1A1A21**)	DS1 <RED>	Extinguished	Illuminated	Extinguished	Extinguished			Illuminated		
I/O Control (BITE) and Filter CCA (**1A1A31**)	DS1 <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Synchro Buffer Amplifier CCA (**1A1A41**)	CR14 <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Synchro Buffer Amplifier CCA (**1A1A42**)	CR14 <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Synchro Buffer Amplifier CCA (**1A1A43**)	CR14 <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Synchro Buffer Amplifier CCA (**1A1A44**)	CR14 <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Status and Command CCA (**1A1A15**)	DS1 <GREEN>	Illuminated-Flashes	Illuminated-Flashes	Illuminated-Flashes	Illuminated-Flashes			Extinguished		
Status and Command CCA (**1A1A15**)	DS2 <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Status and Command CCA (**1A1A15**)	DS3 <RED>	Extinguished	Illuminated	Extinguished	Extinguished			Illuminated		
Torquer (Outer Roll) CCA (**1A1A18**)	DS1 <GREEN>	Extinguished	Extinguished	Extinguished	Illuminated			Extinguished		
Torquer (Outer Roll) CCA (**1A1A18**)	DS2 <GREEN>	Extinguished	Extinguished	Extinguished	Illuminated			Extinguished		
Torquer (Inner Azimuth) CCA (**1A1A19**)	DS1 <GREEN>	Extinguished	Extinguished	Extinguished	Illuminated			Extinguished		
Torquer (Inner Azimuth) CCA (**1A1A19**)	DS2 <GREEN>	Extinguished	Extinguished	Extinguished	Illuminated			Extinguished		
Support Electronics Power Supply CCA (**1A1A37**)	DS1 <GREEN>	Illuminated	Illuminated	Illuminated	Illuminated			Extinguished		
Support Electronics Power Supply CCA (**1A1A37**)	DS2 <GREEN>	Illuminated	Illuminated	Illuminated	Illuminated			Extinguished		
Support Electronics Power Supply CCA (**1A1A37**)	DS3 <GREEN>	Illuminated	Illuminated	Illuminated	Illuminated			Extinguished		
Support Electronics Power Supply CCA (**1A1A37**)	DS4 <GREEN>	Illuminated	Illuminated	Illuminated	Illuminated			Extinguished		
Support Electronics Power Supply CCA (**1A1A37**)	DS5 <GREEN>	Illuminated	Illuminated	Illuminated	Illuminated			Extinguished		
	Power Indicators									
Power Supply (**1A1A6**)	+25 <GREEN>	Illuminated	Illuminated	Illuminated	Illuminated			Extinguished		
Battery Charger (**1A1A7**)	-25 <GREEN>	Illuminated	Illuminated	Illuminated	Illuminated			Extinguished		
Battery Charger (**1A1A7**)	BAT CHG FL <RED>	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Battery Charger (**1A1A7**)	BAT CHG	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		
Power Module (**1A1A8**)	FAULT	Extinguished	Extinguished	Extinguished	Extinguished			Illuminated		

Table 5-3. Simulated Outputs Description

SIMULATED FUNCTION	DESCRIPTION	ENTRY RANGE	FIG(s)
2 Modify Attitude Output Functions (Select by pressing the **<2>** key)			
1 Roll	Sets a positive or negative roll angle which is output from Synchro Buffer Amplifier 8 VA (**1A1A41**).	-45 to +44.99 degrees	**Figure 5-21, sheet 2**
2 Pitch	Sets a positive or negative pitch angle which is output from Synchro Buffer Amplifier 8 VA (**1A1A42**).	-45 to +44.99 degrees	**Figure 5-21, sheet 2**
3 Heading	Sets a heading angle which is output from Synchro Buffer Amplifiers 32 VA (**1A1A43**) and 32 VA (**1A1A44**).	0 to 359.99 degrees	**Figure 5-21, sheet 1**
3 Modify Velocity Output Functions (Select by pressing the **<3>** key)			
1 Vel N (North Velocity)	Sets a north/south velocity value which is output from Synchro Converter CCA (**1A1A40**) (in synchro data format) and in all applicable NTDS output data messages.	-128 to +127.99 knots	**Figure 5-21, sheet 3**
2 Vel E (East Velocity)	Sets an east/west velocity value which is output from Synchro Converter CCA (**1A1A40**) (in synchro data format) and in all applicable NTDS output data messages.	-128 to +127.99 knots	**Figure 5-21, sheet 3**
4 Modify Position Output Functions (Select by pressing the **<4>** key). When entering latitude and longitude, the N/S and E/W fields are set with the **<NE+>** key and **<SW−>** key.			
1 Latitude	Sets a latitude value which is output in all applicable NTDS output data messages.	0 to 90 degrees 0 to 59.99 minutes	**Figure 5-20**
2 Longitude	Sets a longitude value which is output in all applicable NTDS output data messages.	0 to 180 degrees 0 to 59.99 minutes	**Figure 5-20**

Table 5-4. Display Wraparound Test, Characters Display

KEYPAD	DISPLAY		KEYPAD	DISPLAY	
KEY PRESSED	EXPECTED RESULT	OBSERVED RESULT	KEY PRESSED	EXPECTED RESULT	OBSERVED RESULT
1	1		D	D	
2	2		BRIGHT	G[1]	
3	3		AUX FUNC	X	
4	4		NE+(E)	E	
5	5		SW-(F)	F	
6	6		DIM	H[1]	
7	7		SENSOR	R	
8	8		ENTER	[2]	
9	9		BACKSPACE	[3]	
0	0		ALARM ACK	K	
TRACK HOLD (A)	A		[BLANK]	O[1]	
NEXT PAGE (B)	B		DISPLAY	V	
TEST	T (Note 1)		CLEAR	▓	
MODE	M				
C	C				

1 When key is held down, the character repeats until the key is released.

2 When key is pressed, the cursor returns to the beginning of the line (left of screen).

3 When key is pressed, the cursor moves left one space. If the cursor is at the beginning of a line, it moves up to the end of the previous line.

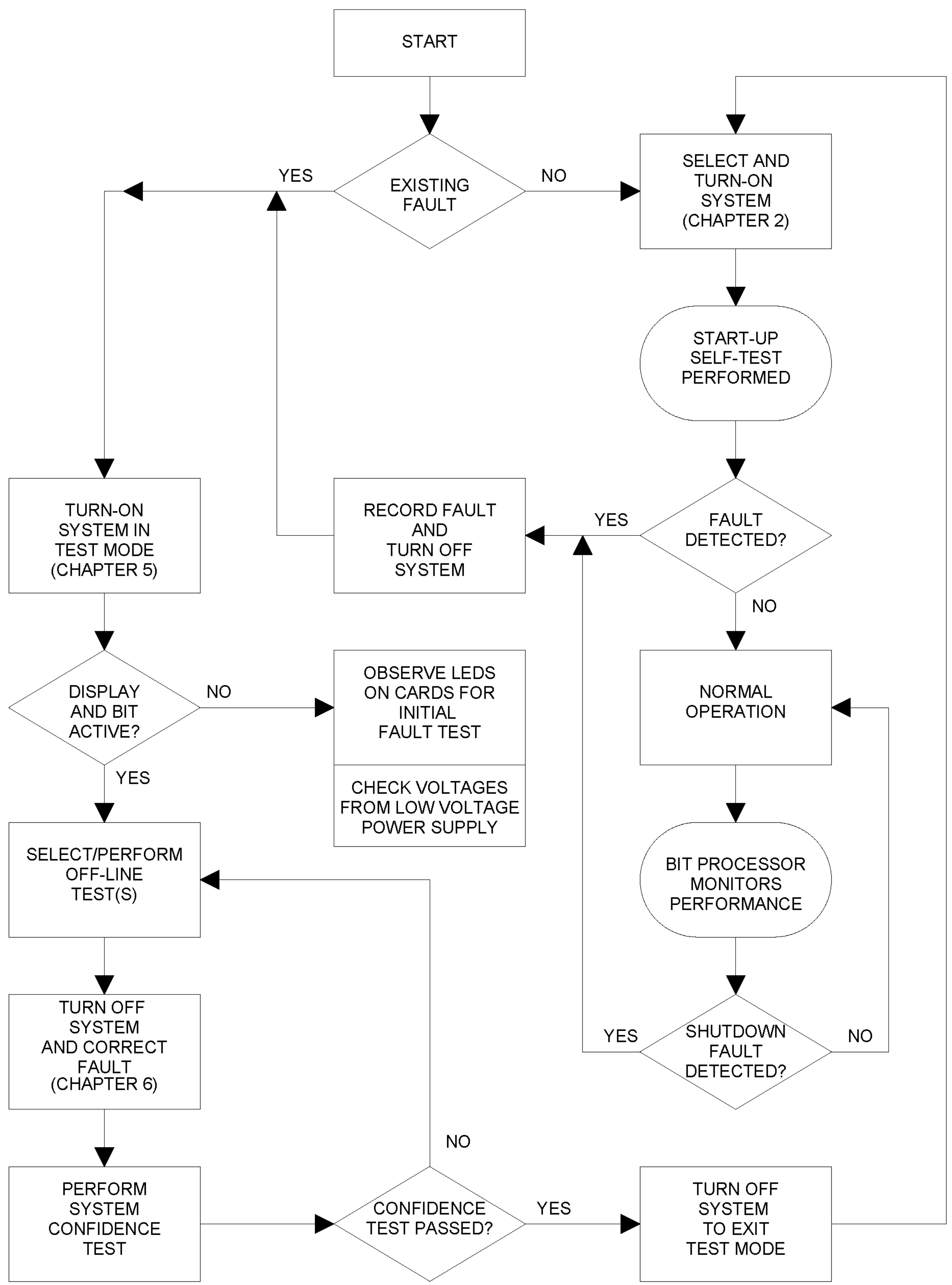
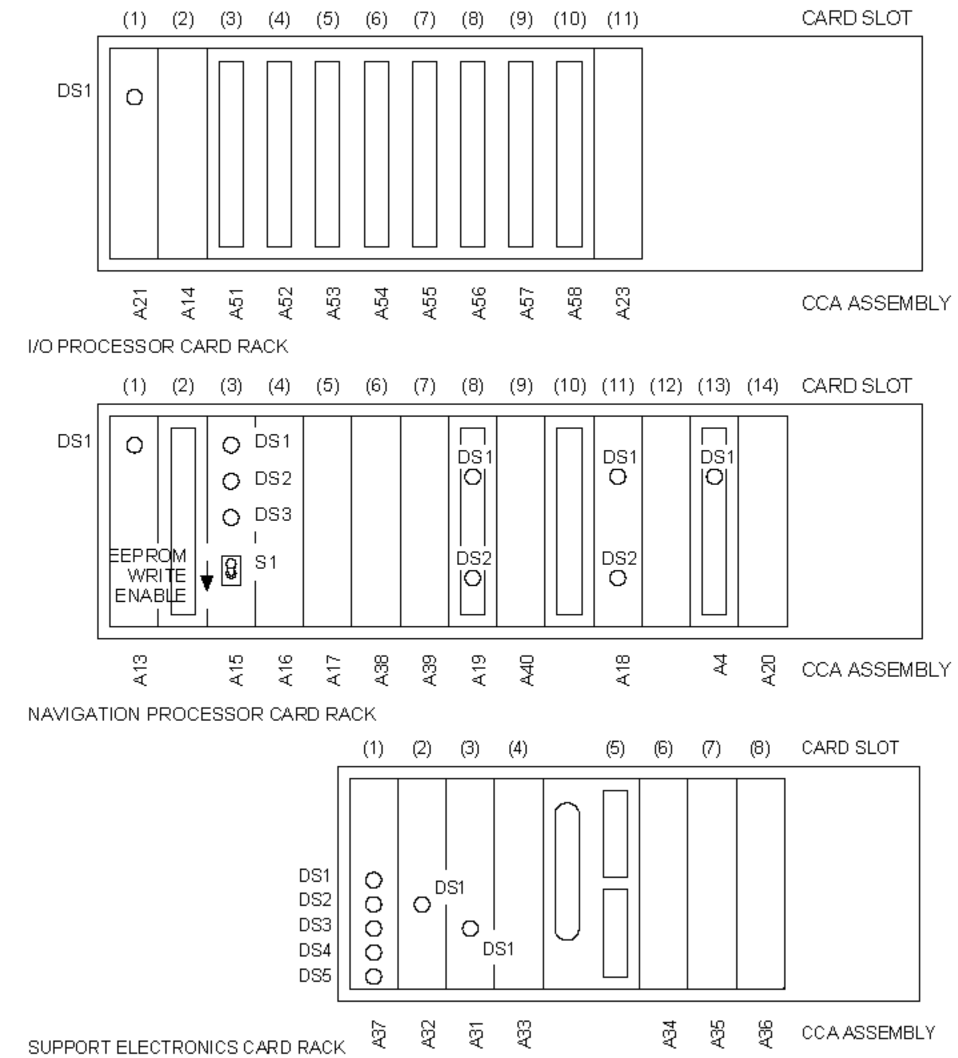


Figure 5-1. Maintenance Turn-On and Test Selection Sequence



INDICATOR	FUNCTION (TRUE WHEN ILLUMINATED)	REF. FIGURE(S)
A21-DS1	PROCESSOR FAULT (I/O PROCESSOR)	3-22(1), 3-31, 5-19(3)
A13-DS1	PROCESSOR FAULT (NAVIGATION PROCESSOR)	3-21(2), 3-31, 5-19(1)
A4-DS1	PROCESSOR FAULT (ATM PROCESSOR)	5-19(1)
A15-DS1	20 MS (800 HZ) PROCESSORS TIMING INTERRUPT MONITOR	3-21(1), 5-19(1)
A15-DS2	STATUS AND COMMAND BOARD (HEART BEAT) FAULT	3-31, 5-19(1)
A15-DS3	NAVIGATION PROCESSOR DATA BUS FAULT	3-31, 5-19(1)
A18-DS1	OUTER GIMBAL TORQUER ACTIVE (+25V ENABLED)	3-18, 5-13(2)
A18-DS2	OUTER GIMBAL TORQUER ACTIVE (-25V ENABLED)	3-18, 5-13(2)
A19-DS1	INNER GIMBAL TORQUER DRIVE ACTIVE (+25V ENABLED)	3-18, 5-13(2)
A19-DS2	INNER GIMBAL TORQUER DRIVE ACTIVE (-25V ENABLED)	3-18, 5-13(2)
A37-DS1	POWER OK	5-11(1)
A37-DS2	POWER SUPPLY +5VDC OUTPUT AVAILABLE	5-11(1)
A37-DS3	POWER SUPPLY +28VDC OUTPUT AVAILABLE	5-11(1)
A37-DS4	POWER SUPPLY -15VDC OUTPUT AVAILABLE	5-11(1)
A37-DS5	POWER SUPPLY +15VDC OUTPUT AVAILABLE	5-11(1)
A32-DS1	PROCESSOR FAULT (IMU PROCESSOR)	5-19(5)
A31-DS1	I/O CONTROL BOARD FAULT	5-19(5)

Figure 5-2. Status LEDs and EEPROM Write Enable Switch Identification

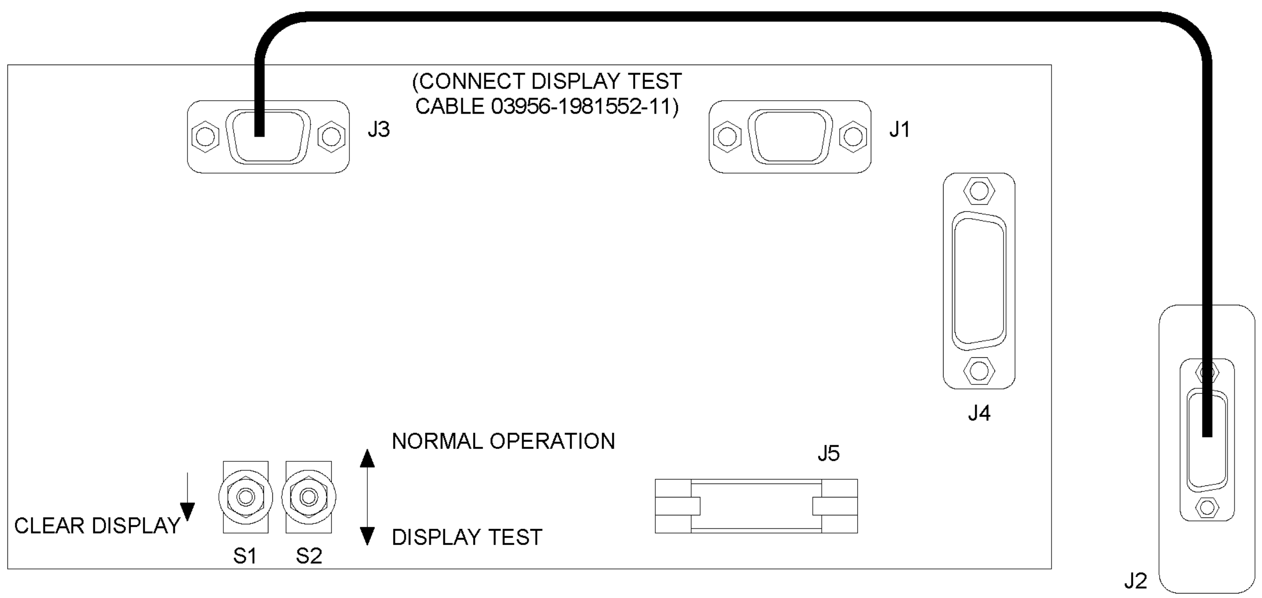


Figure 5-3. Display Test Switches, Location and Function

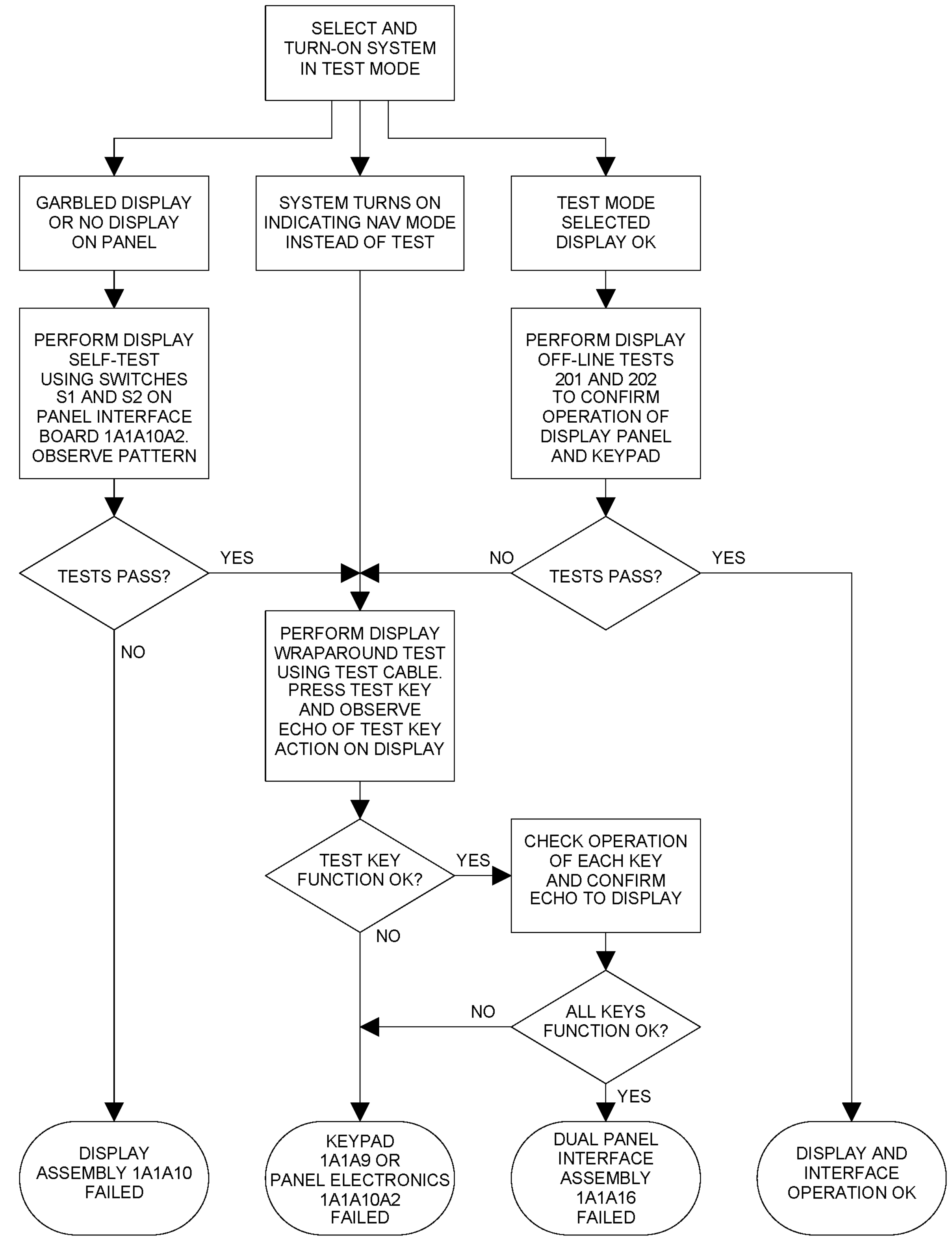


Figure 5-4. Display Functions, Troubleshooting Logic Diagram

CABLE PART NUMBERS

REF.	PART NO.	FUNCTION	NOTES
1W1	T968889	CABLE ASSEMBLY	
1W2	T968890	CABLE ASSEMBLY	
1W3	T968891	CABLE ASSEMBLY	
1W4	T968892	CABLE ASSEMBLY	
1A1W1	T968839	MAIN CABINET HARNESS	
1A1W2	T968840	RIBBON CABLE	
1A1W3	T967883	RIBBON CABLE	
1A1W4	T968841	RIBBON CABLE	
1A1W5	T968842	RIBBON CABLE	
1A1W6	T968894	DOOR CABLE ASSEMBLY	
1A1W7	1900013-1	ATM CABLE ASSEMBLY	
1A1W8	(NOT USED)		
1A1W9	(NOT USED)		
1A1W10	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W11	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W12	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W13	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W14	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W15	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W16	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W17	T968912	COAXIAL CABLE ASSEMBLY	1,2
1A1W18	(NOT USED)		
1A1W19	(NOT USED)		
1A1W20	T968913	CABLE AND HARNESS ASSY	1,3
1A1W21	T968913	CABLE AND HARNESS ASSY	1,3
1A1W22	T968913	CABLE AND HARNESS ASSY	1,3
1A1W23	T968913	CABLE AND HARNESS ASSY	1,3
1A1W24	T968913	CABLE AND HARNESS ASSY	1,3
1A1W25	T968913	CABLE AND HARNESS ASSY	1,3
1A1W26	T968913	CABLE AND HARNESS ASSY	1,3
1A1W27	(NOT USED)		
1A1W28	(NOT USED)		
1A1W29	(NOT USED)		
1A1W30	T968914	COAXIAL CABLE ASSEMBLY	1,4
1A1W31	T968914	COAXIAL CABLE ASSEMBLY	1,4

NOTES:

1. FOR NTDS INTERFACE BOARDS INSTALLED AND CONFIGURATION OF CABLES AND INTERFACE CONNECTORS, REFER TO FIGURE 3-22 (SHEET 2).
2. CABLE T968912 USED (2 REQUIRED) FOR EACH NTDS TYPE E INTERFACE CCA INSTALLED. TOTAL QUANTITY VARIES WITH UNIT PART NUMBER.
3. CABLE T968913 USED (1 REQUIRED) FOR EACH NTDS TYPE A INTERFACE CCA INSTALLED. TOTAL QUANTITY VARIES WITH UNIT PART NUMBER.
4. CABLE T968914 USED (2 REQUIRED) FOR EACH NTDS TYPE D INTERFACE CCA INSTALLED. TOTAL QUANTITY VARIES WITH UNIT PART NUMBER.
5. CABLE 03956-T969380 IS INSTALLED AS PART OF FIELD CHANGE 1 AND INTEGRATED WITH 1A1W1.

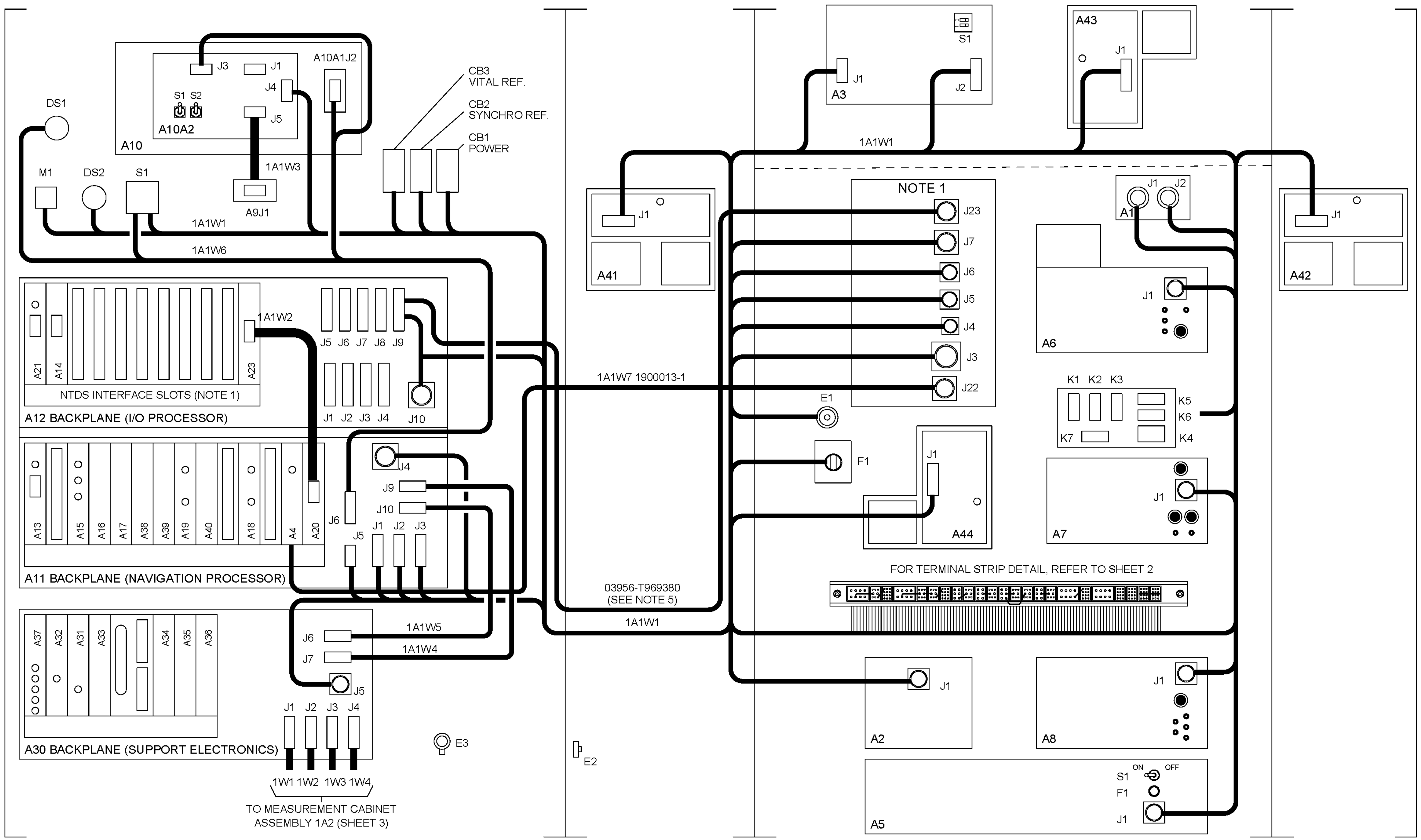


Figure 5-5. Internal Cables, Distribution and Identification Diagram (Sheet 1 of 3)

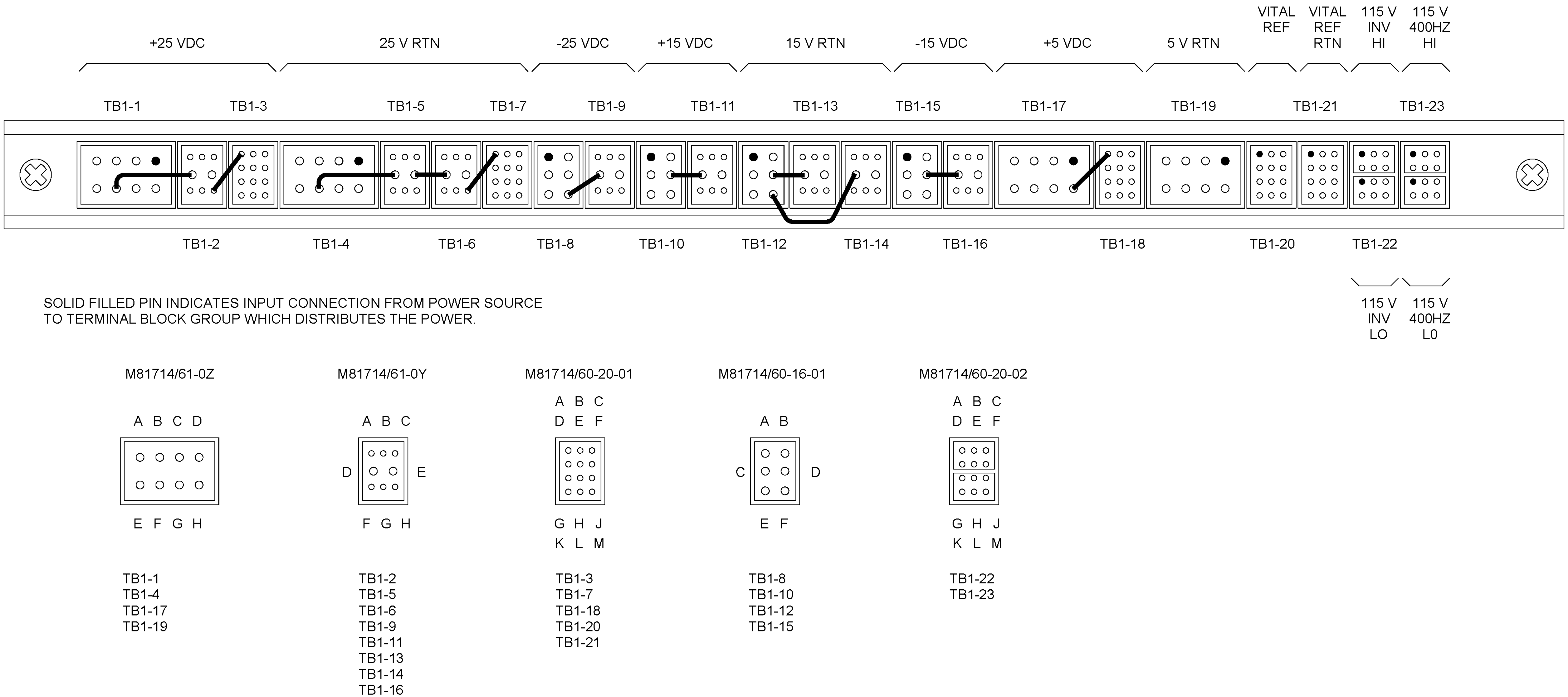
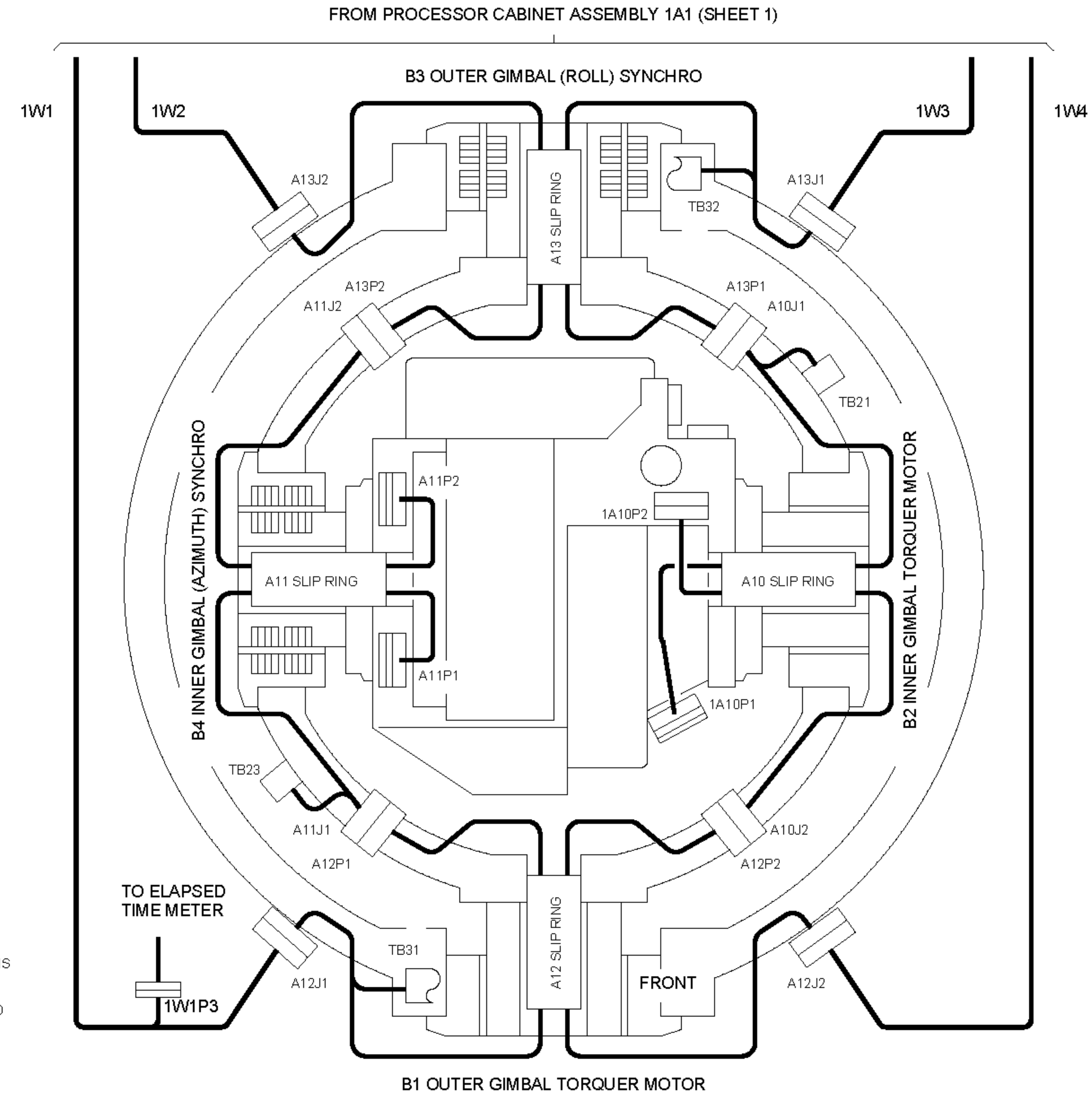


Figure 5-5. Internal Cables, Distribution and Identification Diagram (Sheet 2 of 3)



NOTE:

1. EXCEPT FOR CABLES W1 THRU W4, PREFIX ALL DESIGNATIONS ON THIS SHEET WITH 1A2A1.
2. INNER GIMBAL SHOWN ROTATED 90 DEGREES CLOCKWISE AS VIEWED FROM FRONT OF UNIT.

Figure 5-5. Internal Cables, Distribution and Identification Diagram (Sheet 3 of 3)

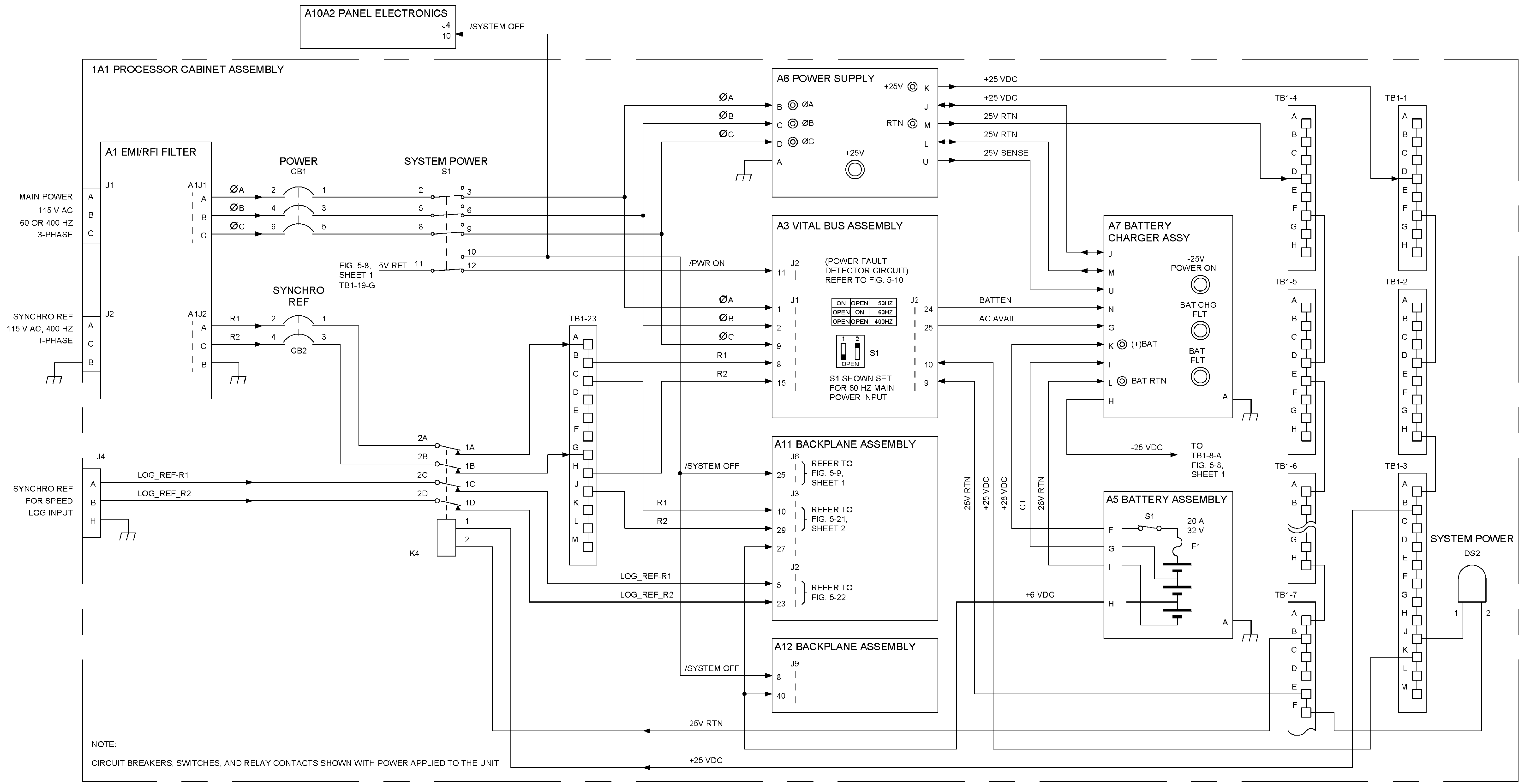


Figure 5-6. Main 3-Phase AC and Non-Vital 1-Phase Synchro, Power Distribution Diagram

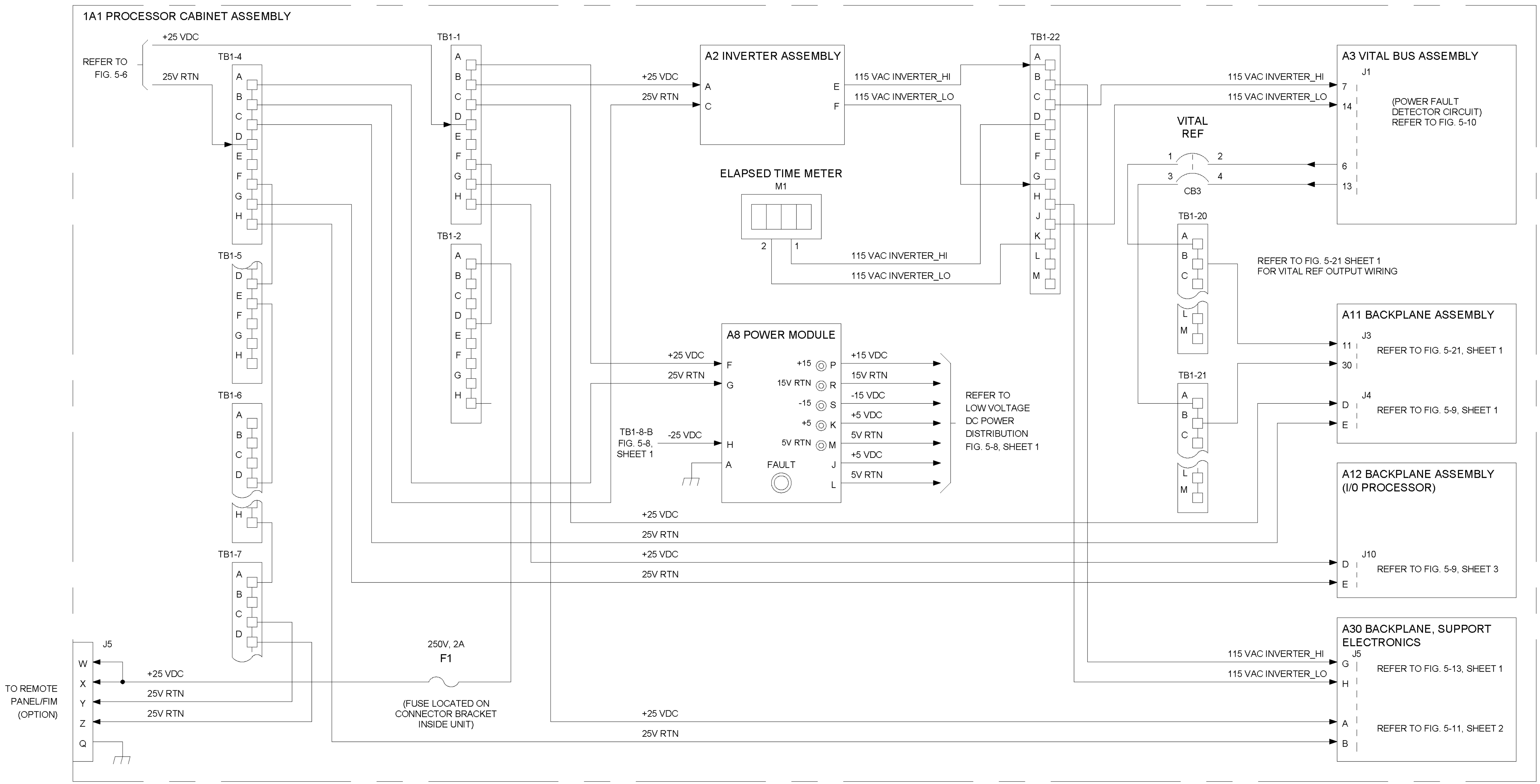


Figure 5-7. +25 VDC and Internally-Generated 115 VAC, 400 Hz, Power Distribution Diagram (Sheet 1 of 2)

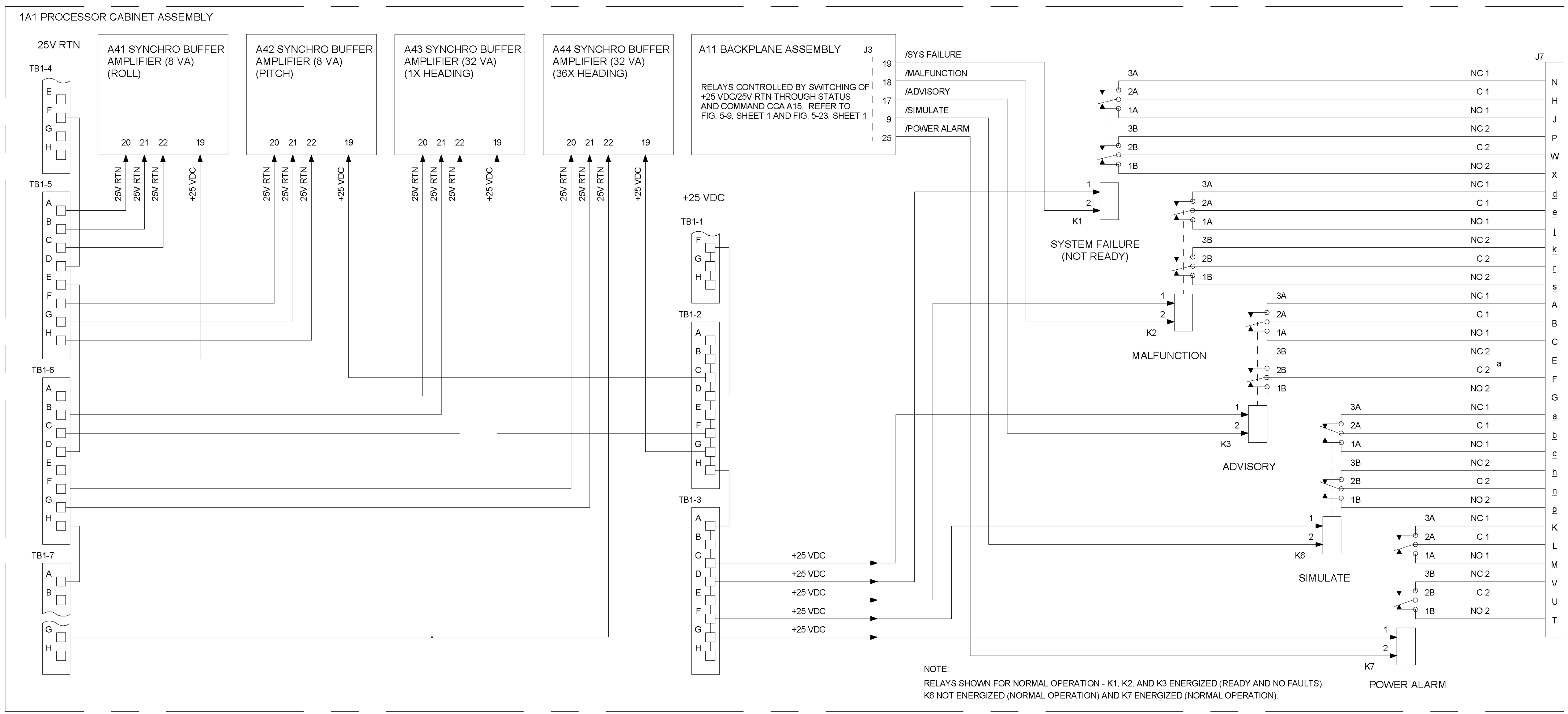


Figure 5-7. +25 VDC and Internally-Generated 115 VAC, 400 Hz, Power Distribution Diagram (Sheet 2 of 2)

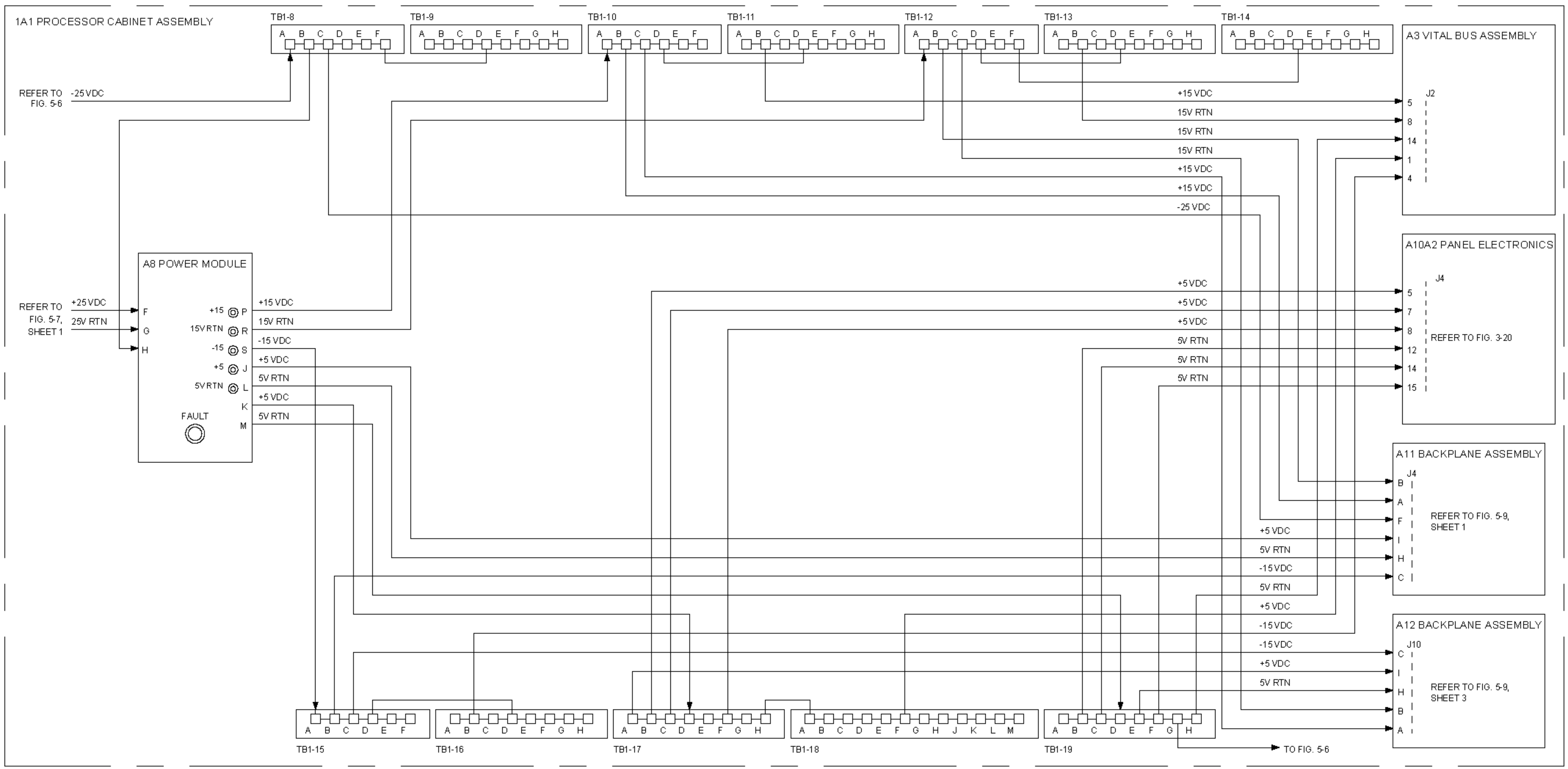


Figure 5-8. -25 VDC and Low Voltage Power Supply A8 Output, Power Distribution Diagram (Sheet 1 of 2)

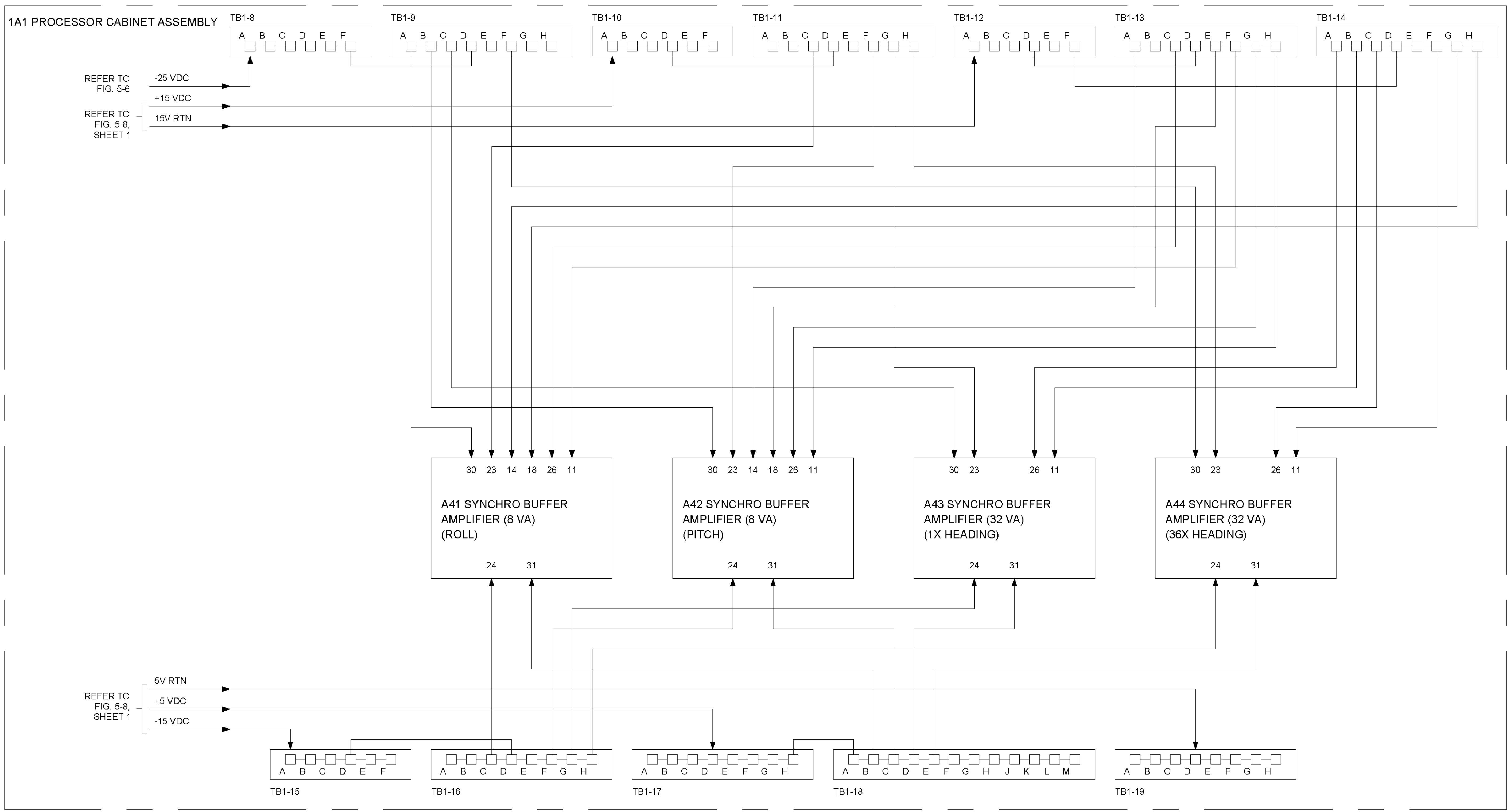


Figure 5-8. -25 VDC and Low Voltage Power Supply A8 Output, Power Distribution Diagram (Sheet 2 of 2)

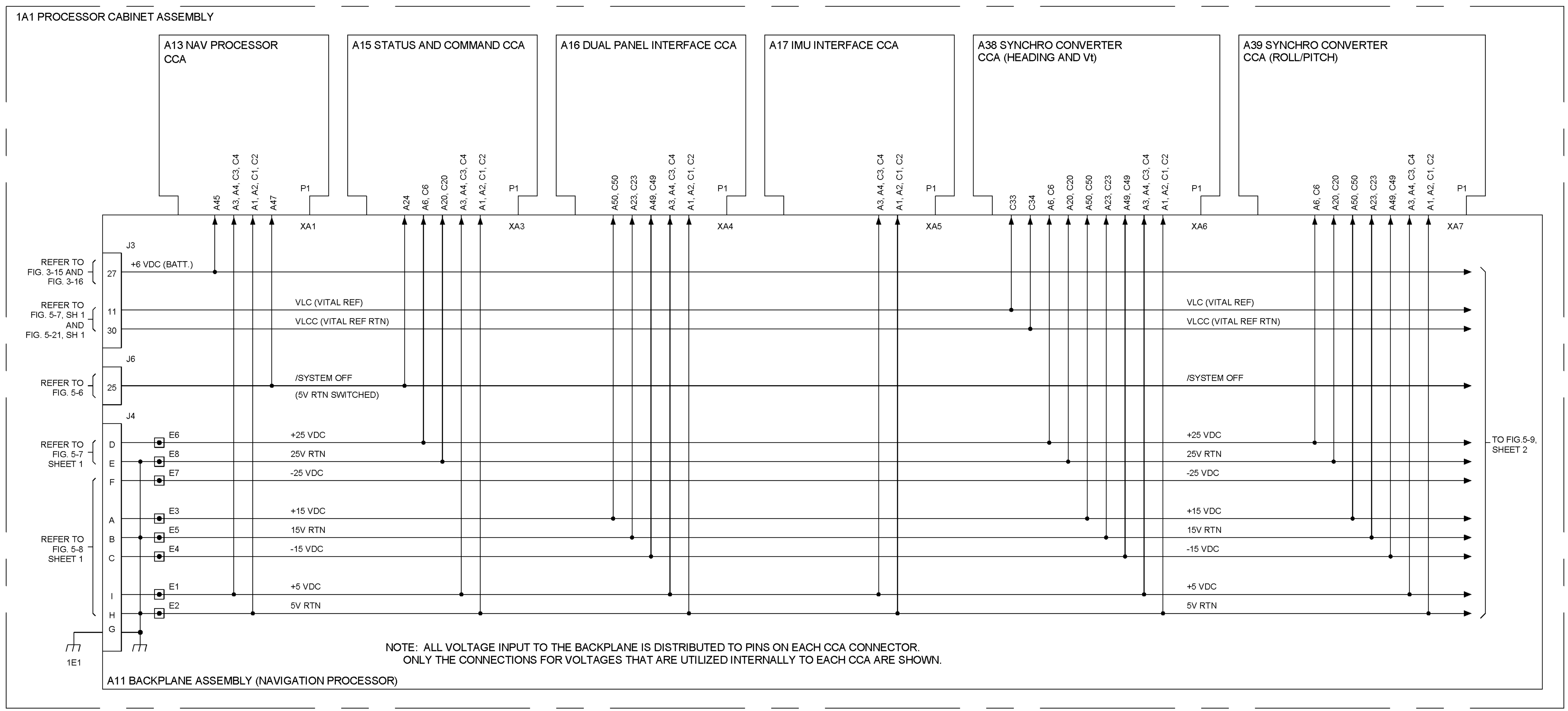


Figure 5-9. Backplanes A11 and A12, Power Distribution Diagram (Sheet 1 of 3)

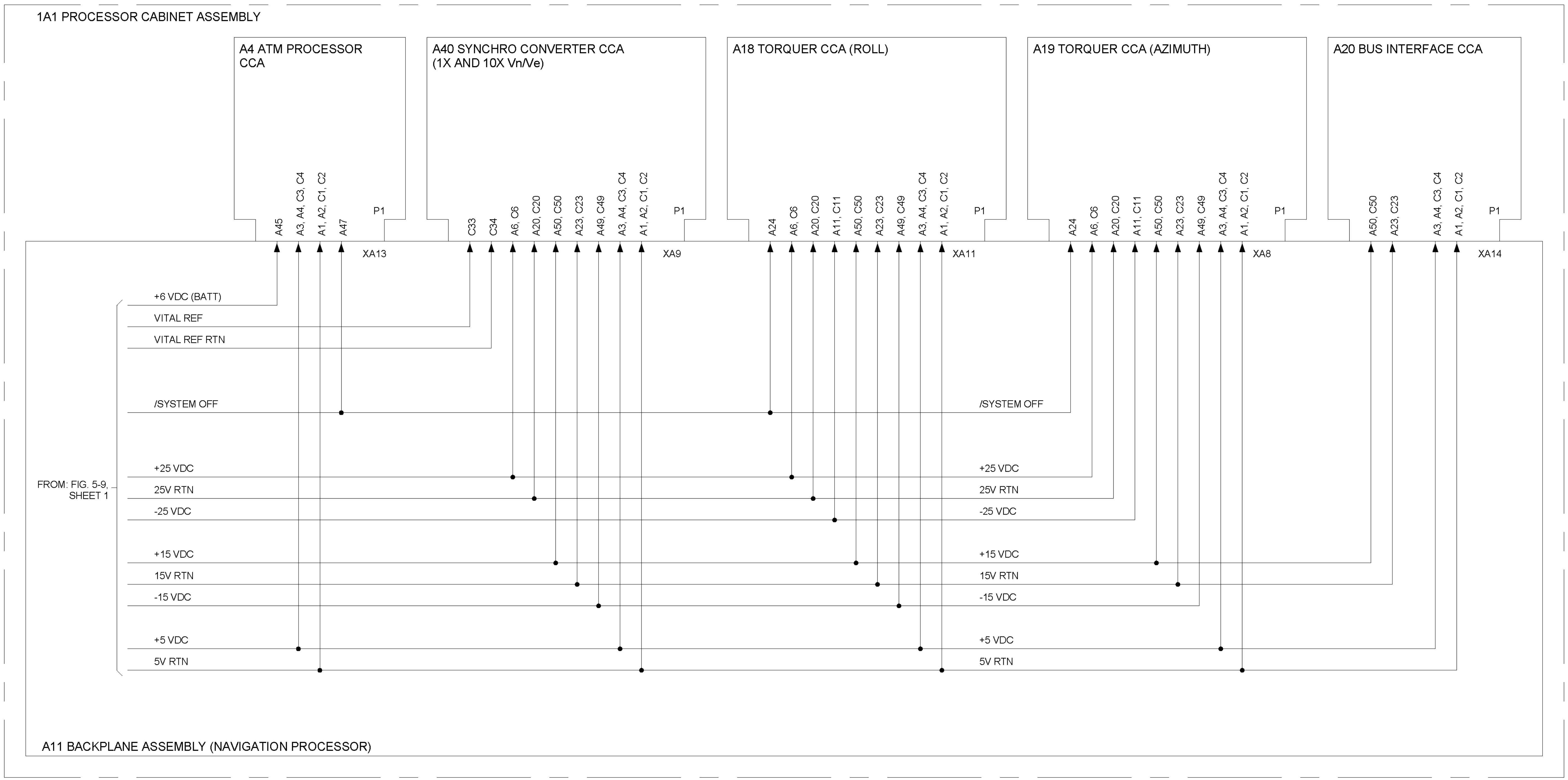


Figure 5-9. Backplanes A11 and A12, Power Distribution Diagram (Sheet 2 of 3)

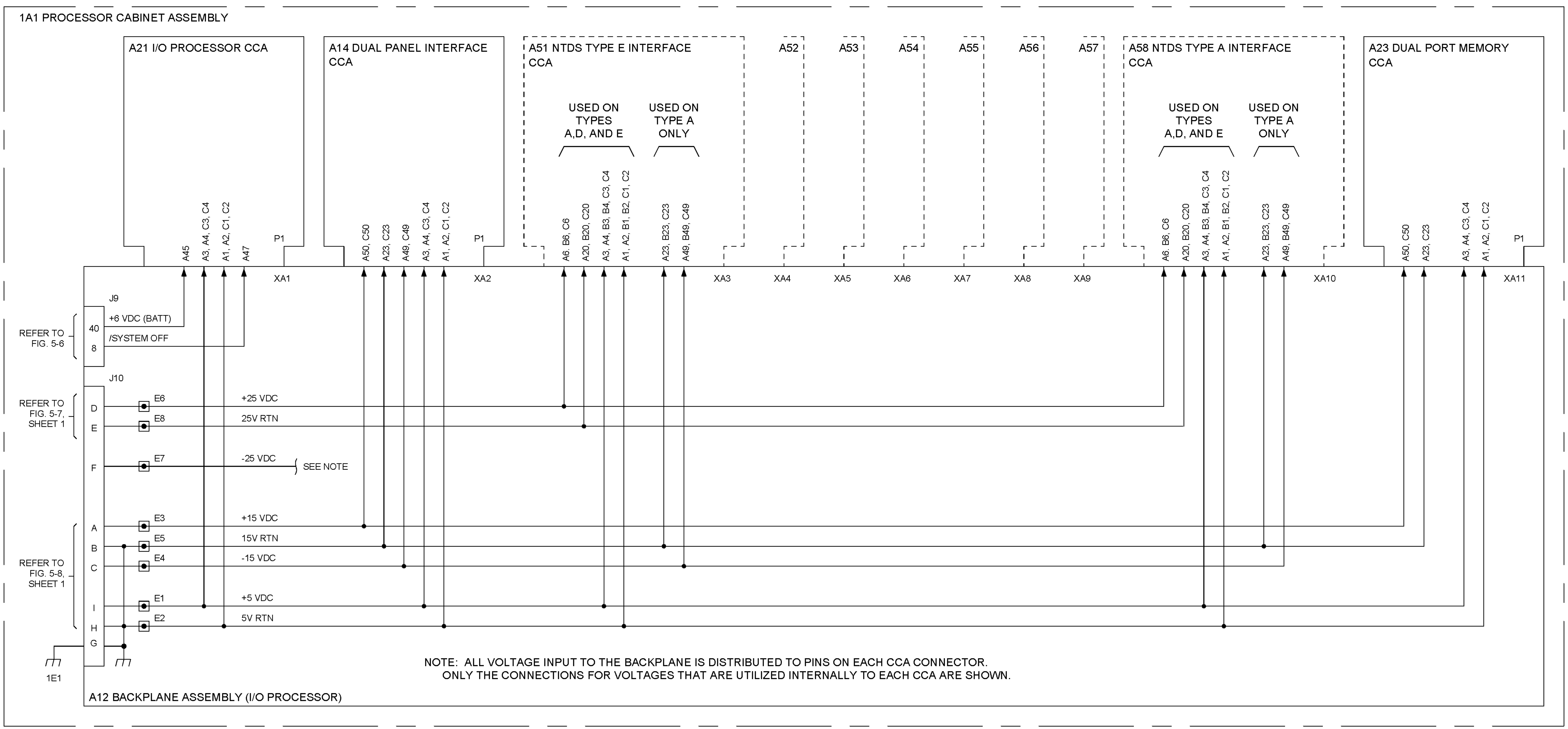
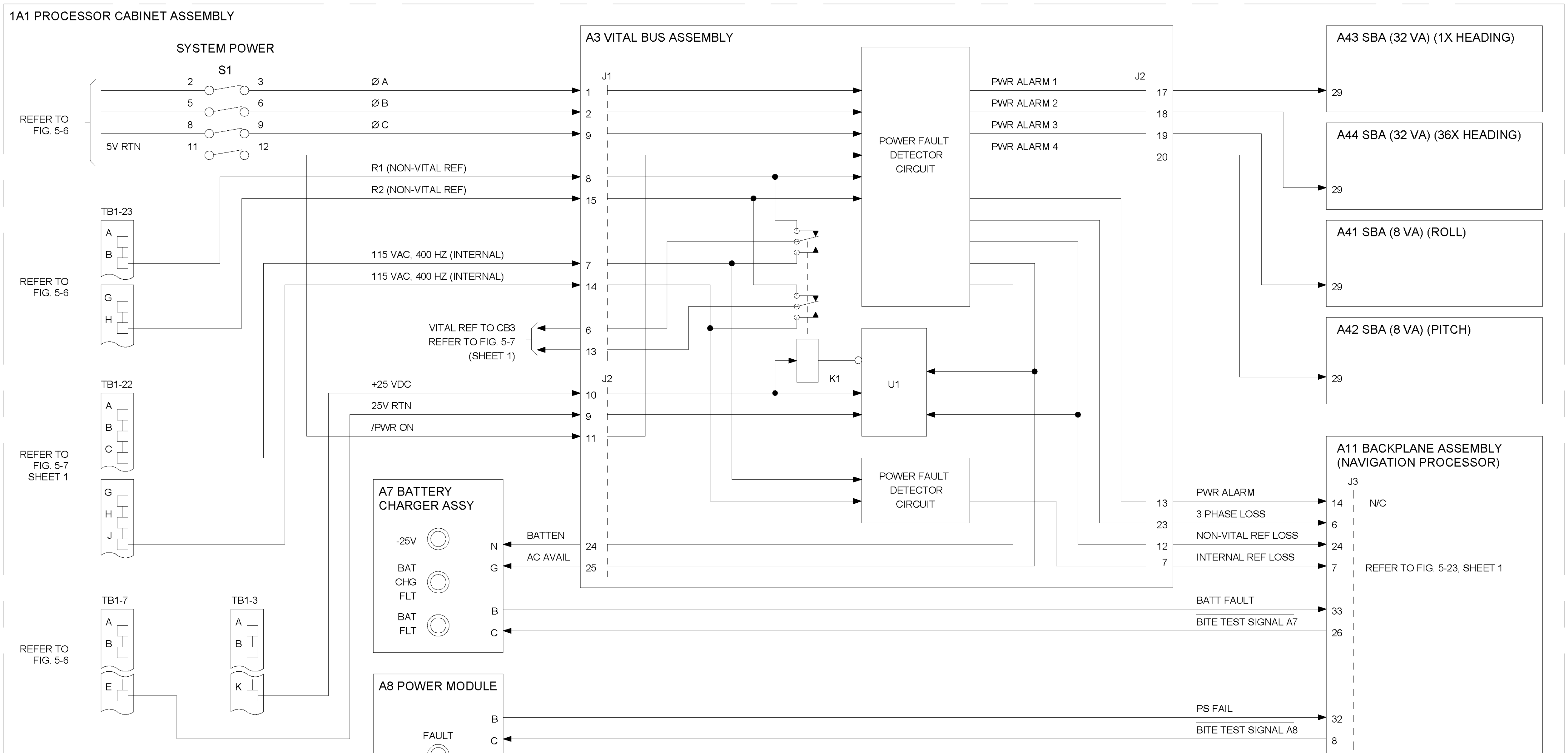
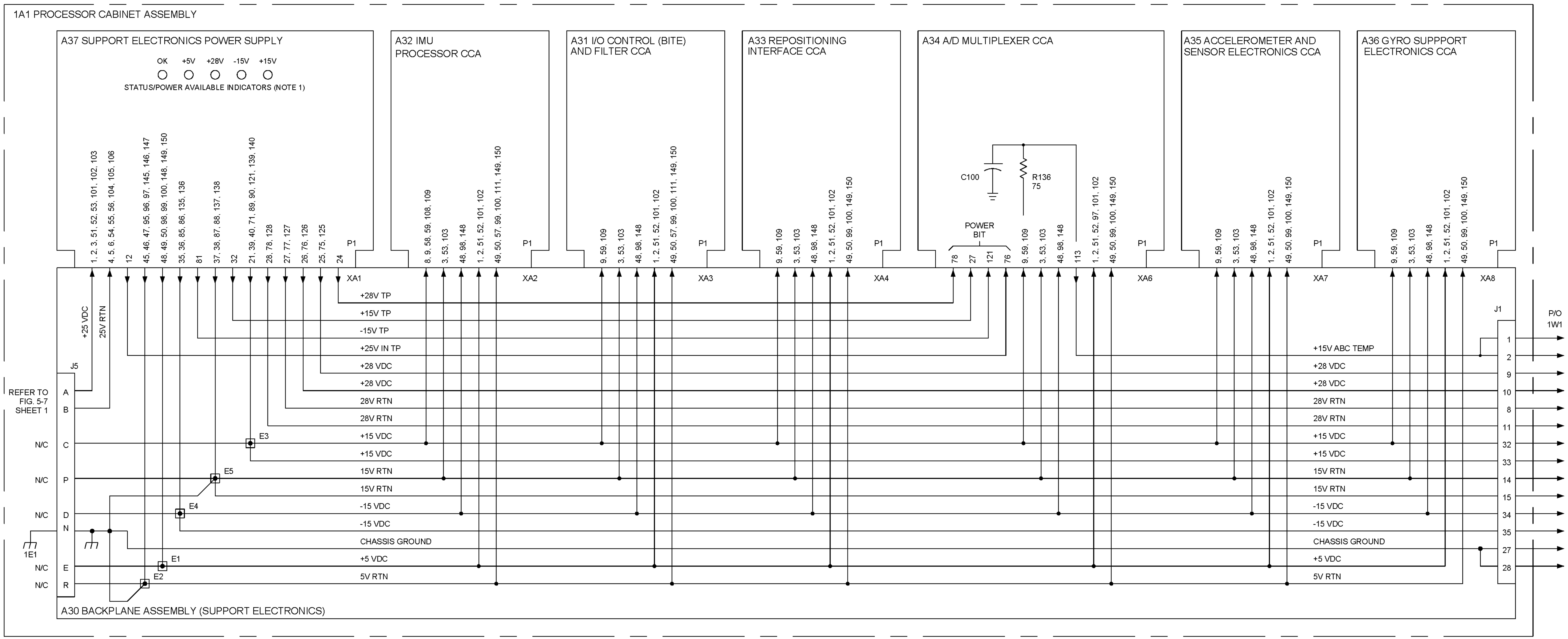


Figure 5-9. Backplanes A11 and A12, Power Distribution Diagram (Sheet 3 of 3)



NOTES: 1. SOME CIRCUITS SHOWN ON OTHER FIGURES ARE DUPLICATED FOR REFERENCE.
2. RELAY A3K1 SHOWN NOT ENERGIZED (NORMAL CONDITION WITH NO POWER FAULTS).

Figure 5-10. Power Fault Detection and Power Control Functions Diagram



NOTE 1: USE OFF-LINE BIT TEST #315 TO MEASURE SUPPORT ELECTRONICS POWER SUPPLY VOLTAGES (REFER TO TABLE 5-1).

Figure 5-11. Support Electronics Backplane (1A1A30) and IMU Cabinet (1A2), Low Voltage Power Supply (Sheet 1 of 2)

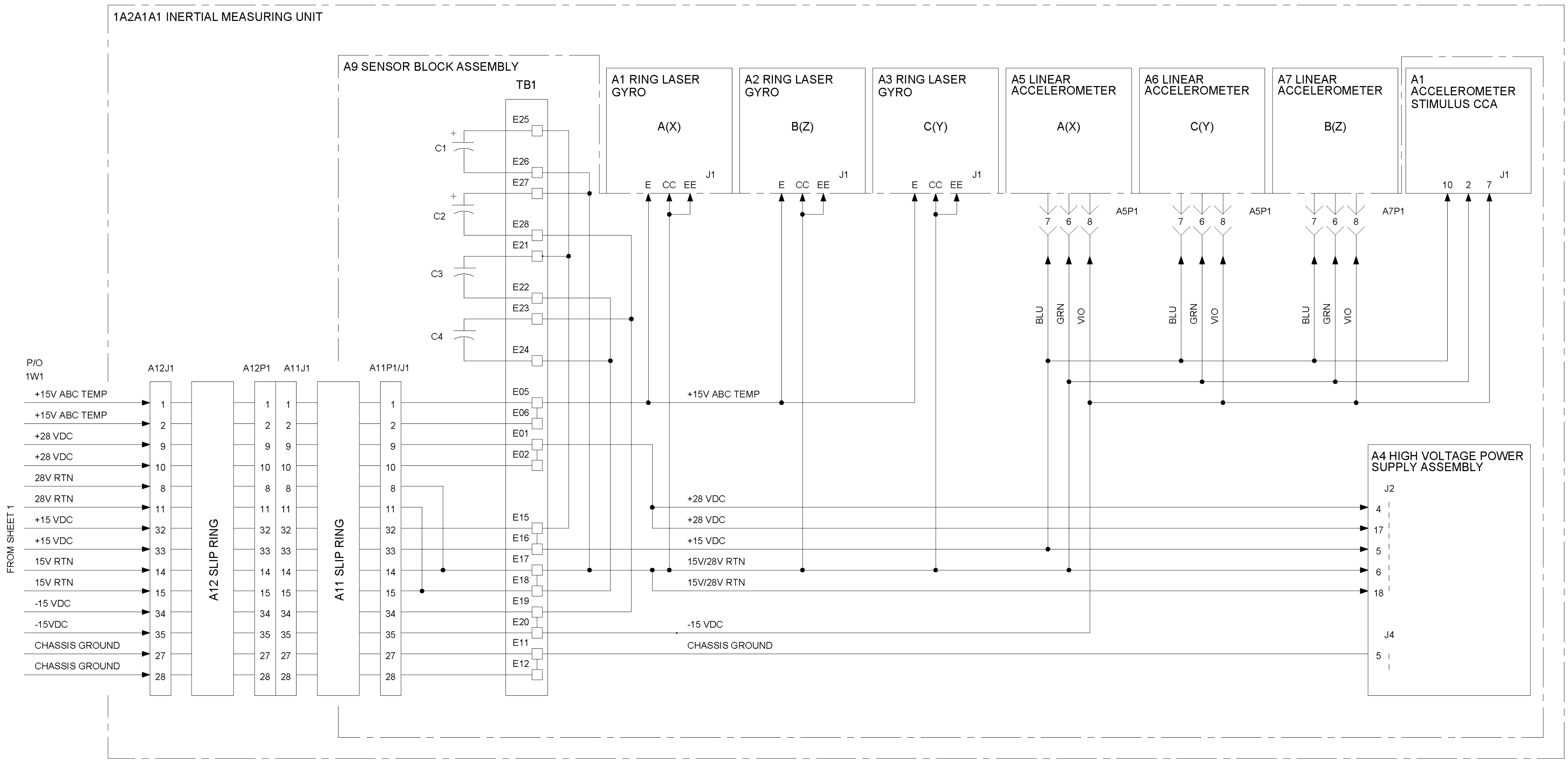
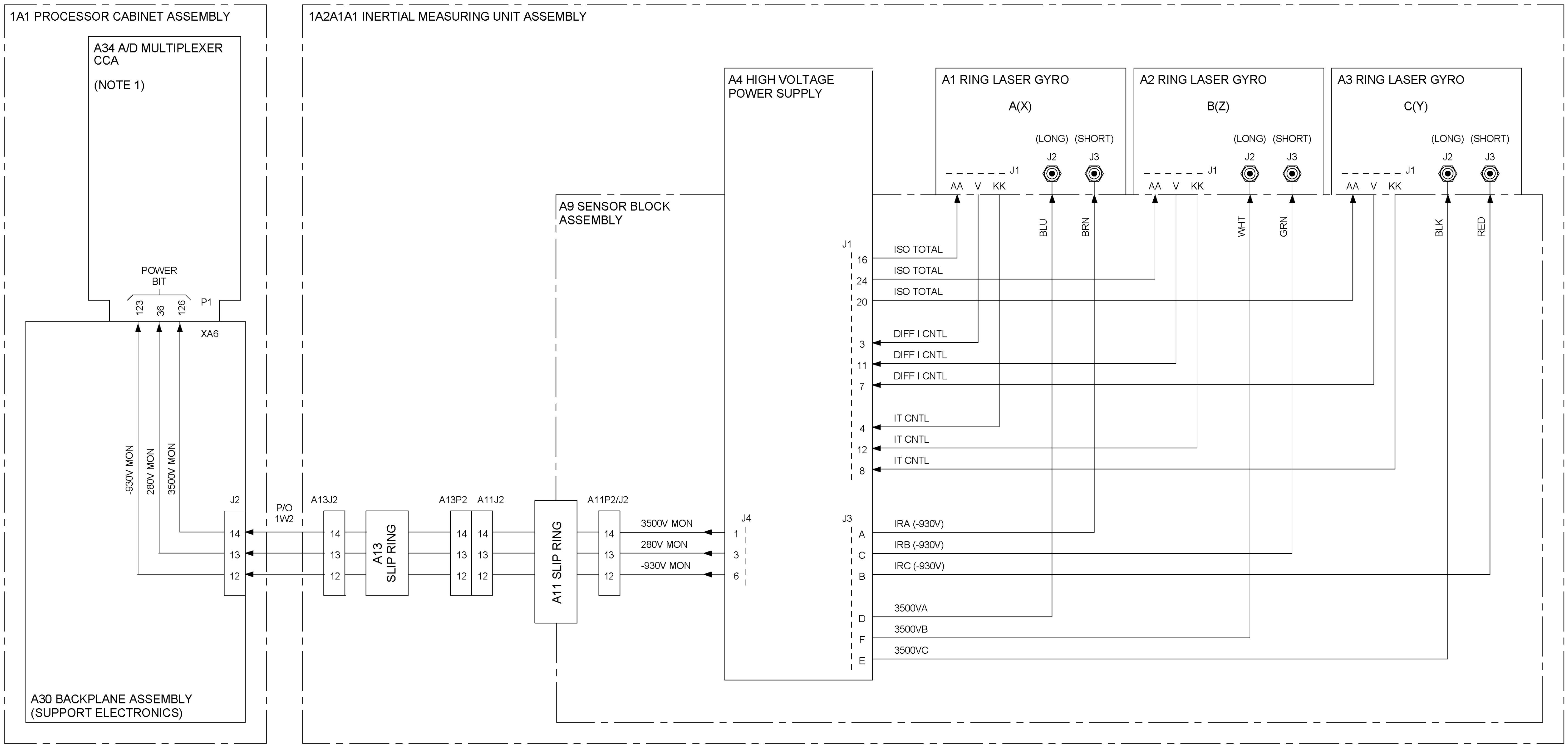
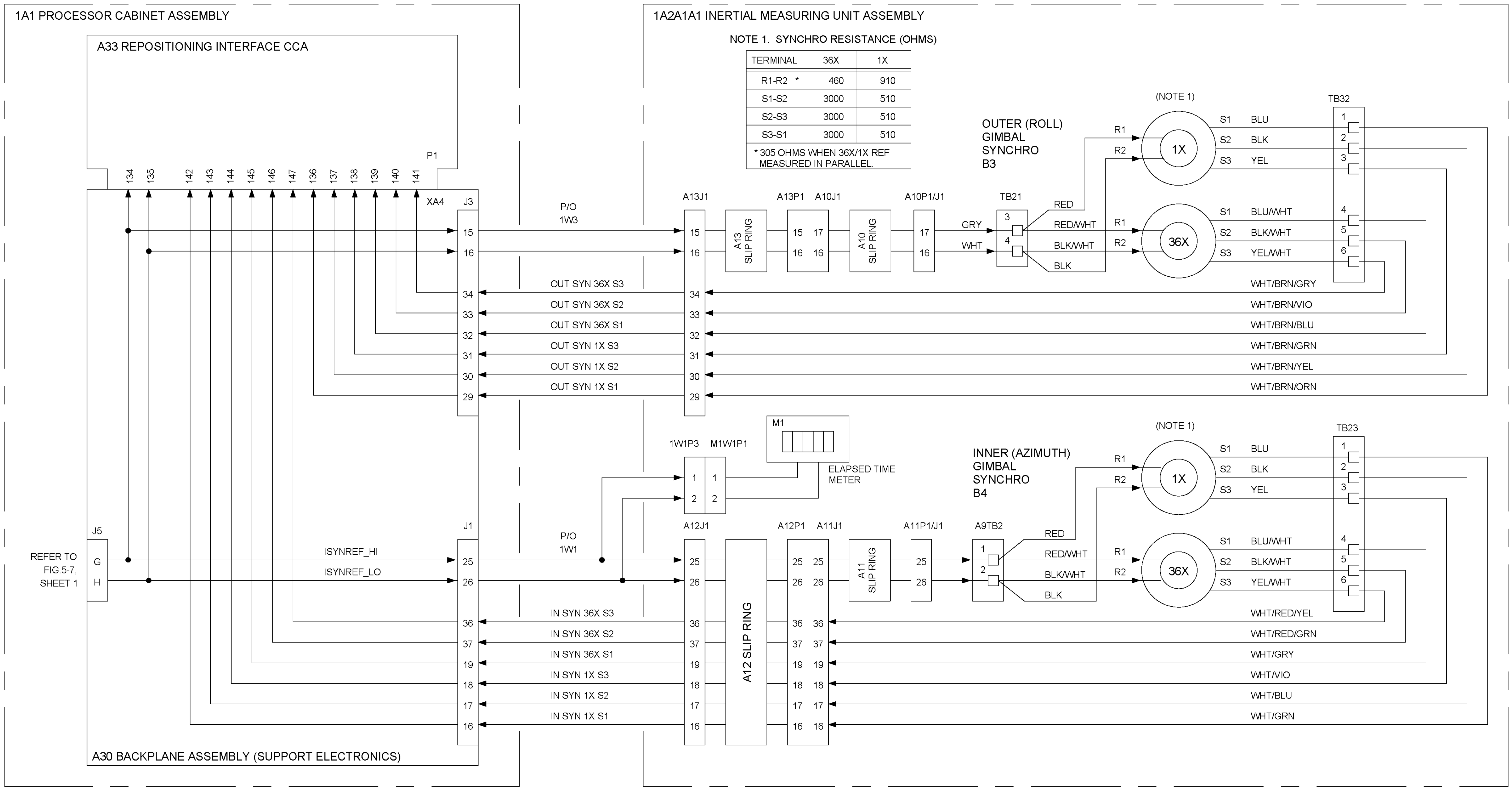


Figure 5-11. Support Electronics Backplane (1A1A30) and IMU Cabinet (1A2), Low Voltage Power Supply (Sheet 2 of 2)



NOTE: 1. USE OFF-LINE BIT TEST #316 TO MEASURE HIGH VOLTAGE POWER SUPPLY VOLTAGES (REFER TO TABLE 5-1).

Figure 5-12. Ring Laser Gyros, High Voltage Power Distribution and Monitoring Diagram



NOTE 1. SYNCHRO RESISTANCE (OHMS)

TERMINAL	36X	1X
R1-R2 *	460	910
S1-S2	3000	510
S2-S3	3000	510
S3-S1	3000	510

* 305 OHMS WHEN 36X/1X REF MEASURED IN PARALLEL.

Figure 5-13. Roll (Outer) and Azimuth (Inner) Gimbal, Synchro and Torquer Loop Diagram (Sheet 1 of 2)

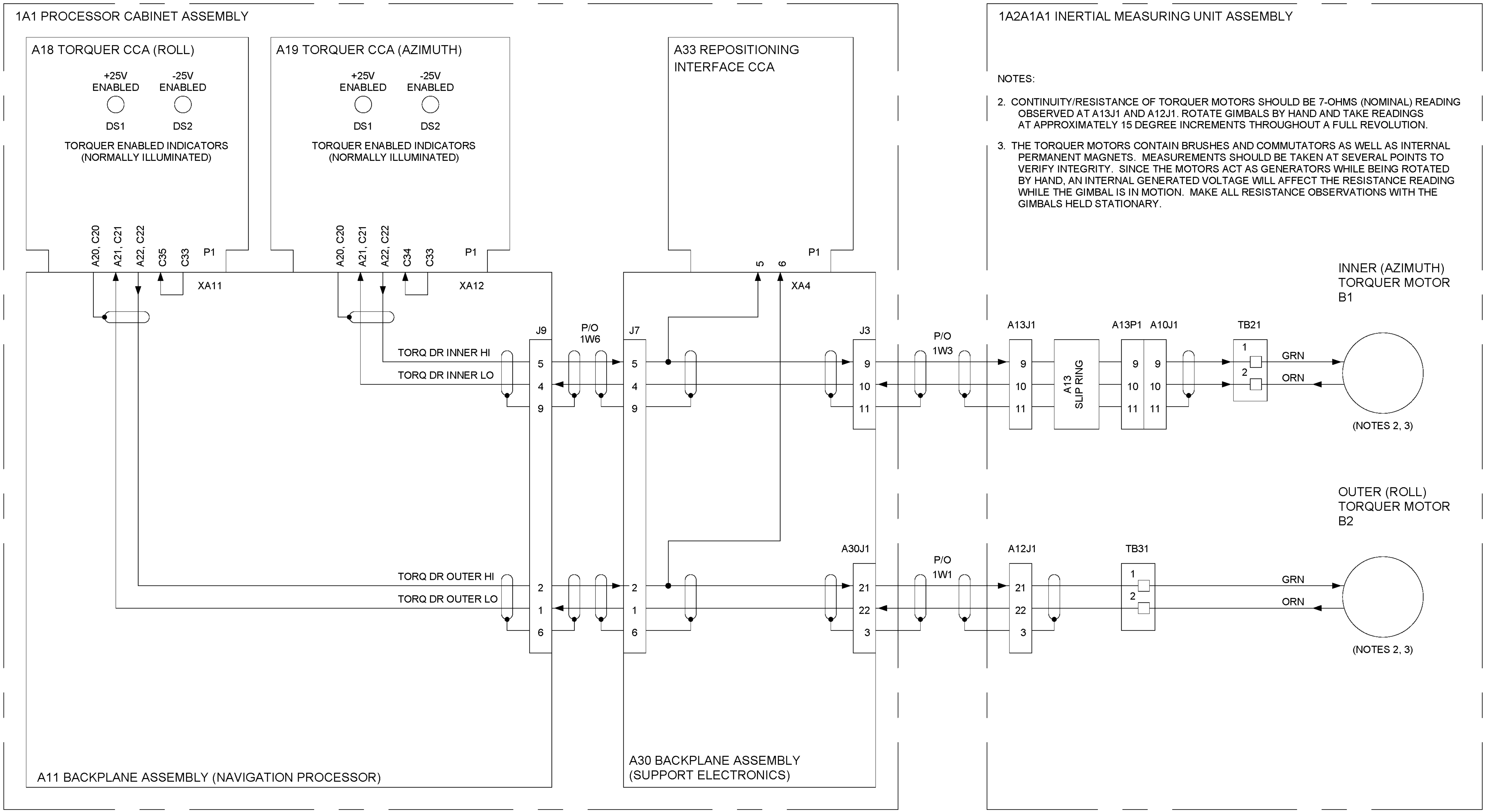


Figure 5-13. Roll (Outer) and Azimuth (Inner) Gimbal, Synchro and Torquer Loop Diagram (Sheet 2 of 2)

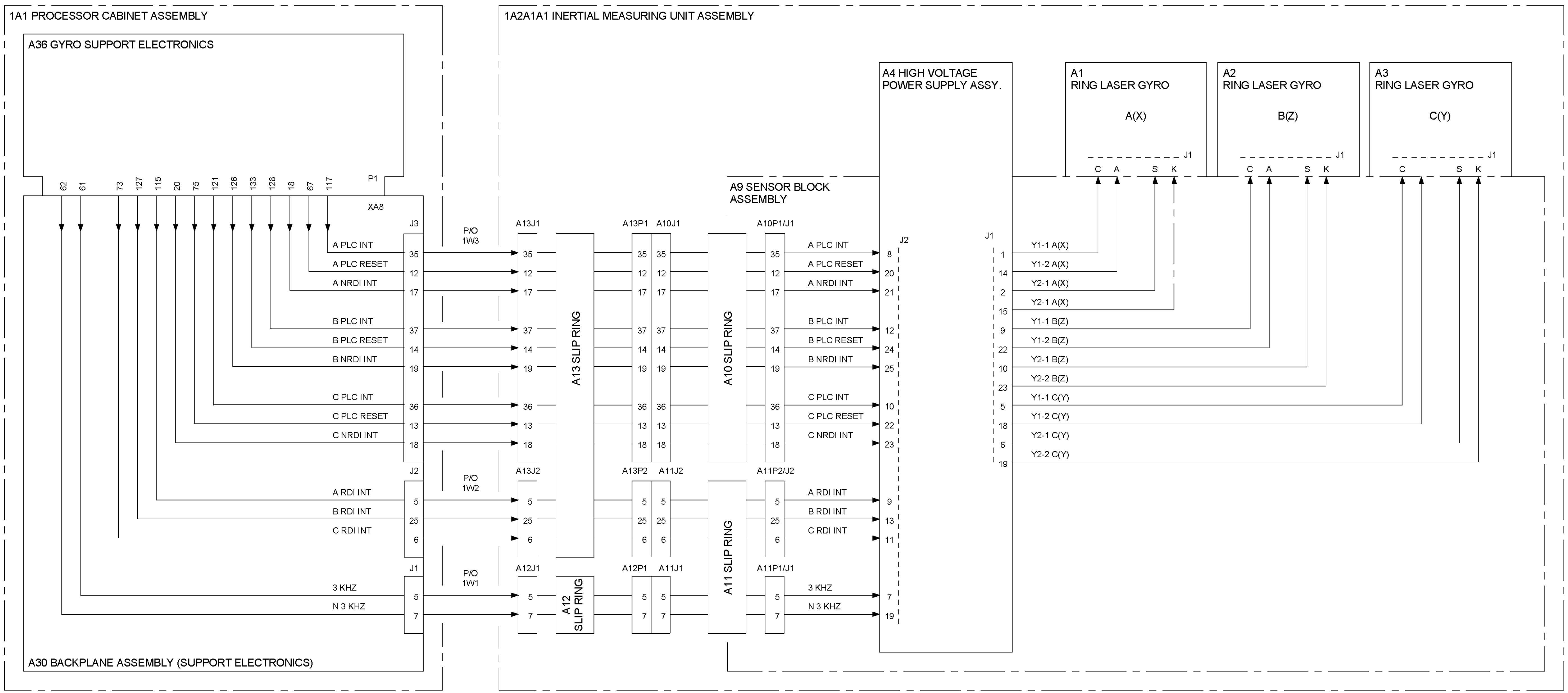


Figure 5-14. Ring Laser Gyros, Path Length Control and Random Drift Improvement Control Functions Diagram (Sheet 1 of 2)

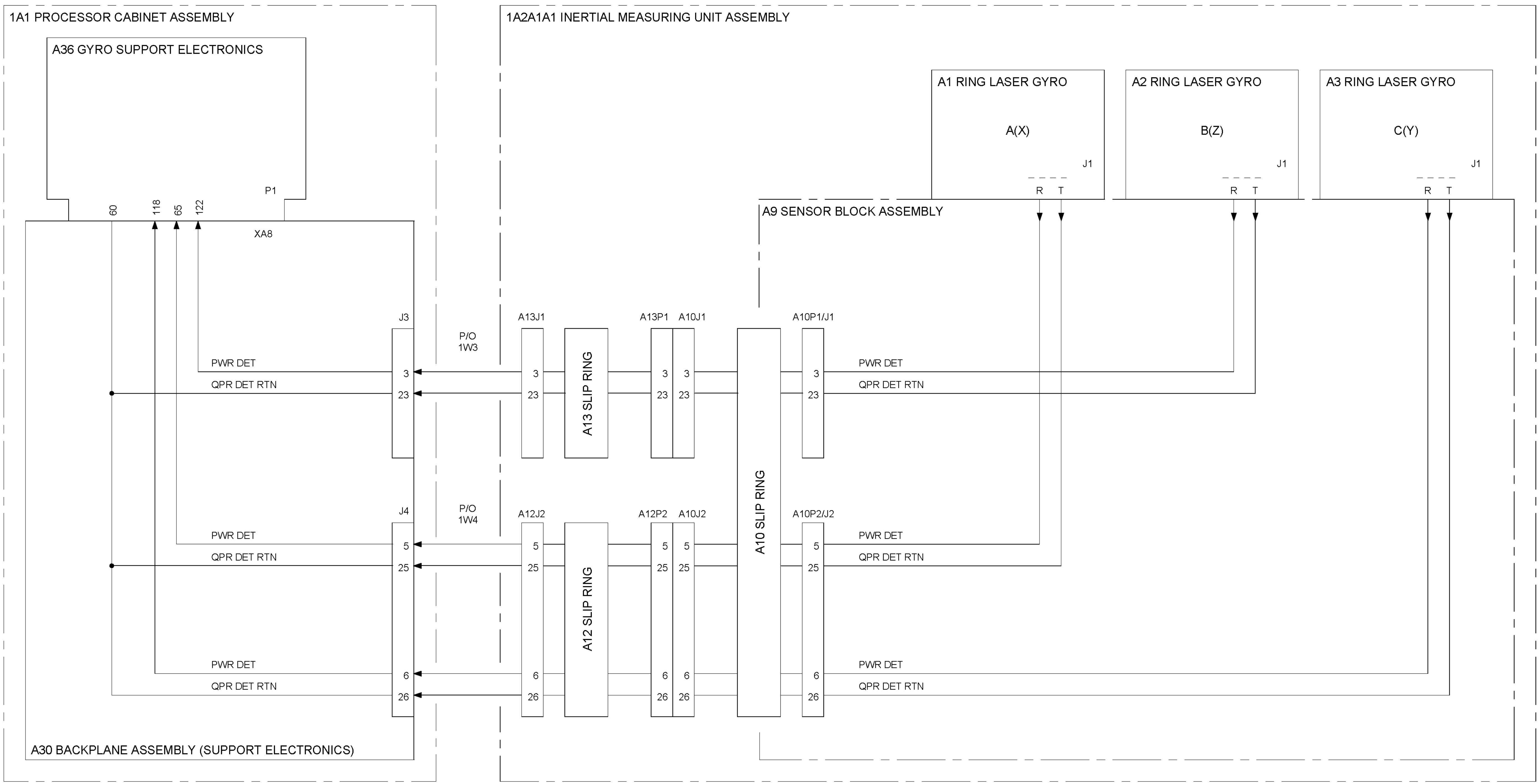


Figure 5-14. Ring Laser Gyros, Path Length Control and Random Drift Improvement Control Functions Diagram (Sheet 2 of 2)

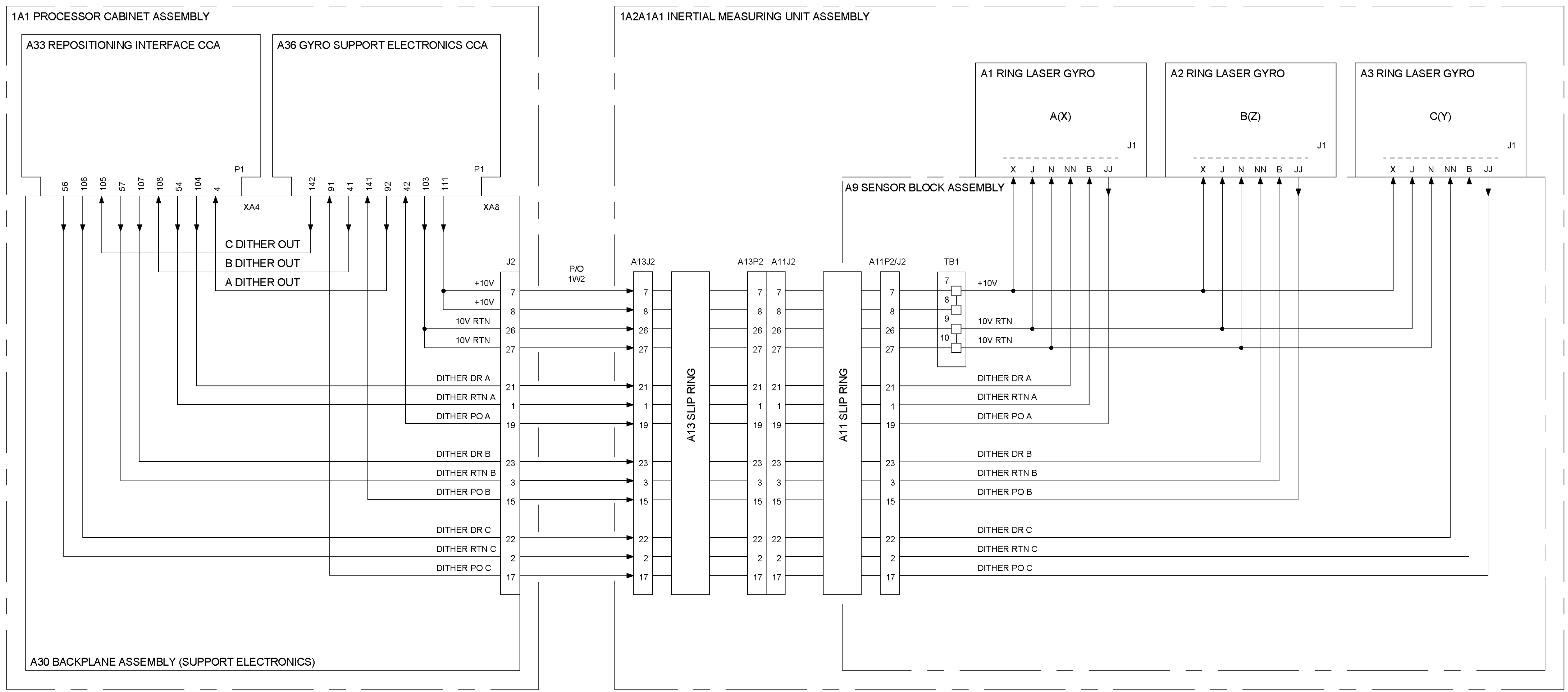


Figure 5-15. Ring Laser Gyros, Dither Control Function Diagram

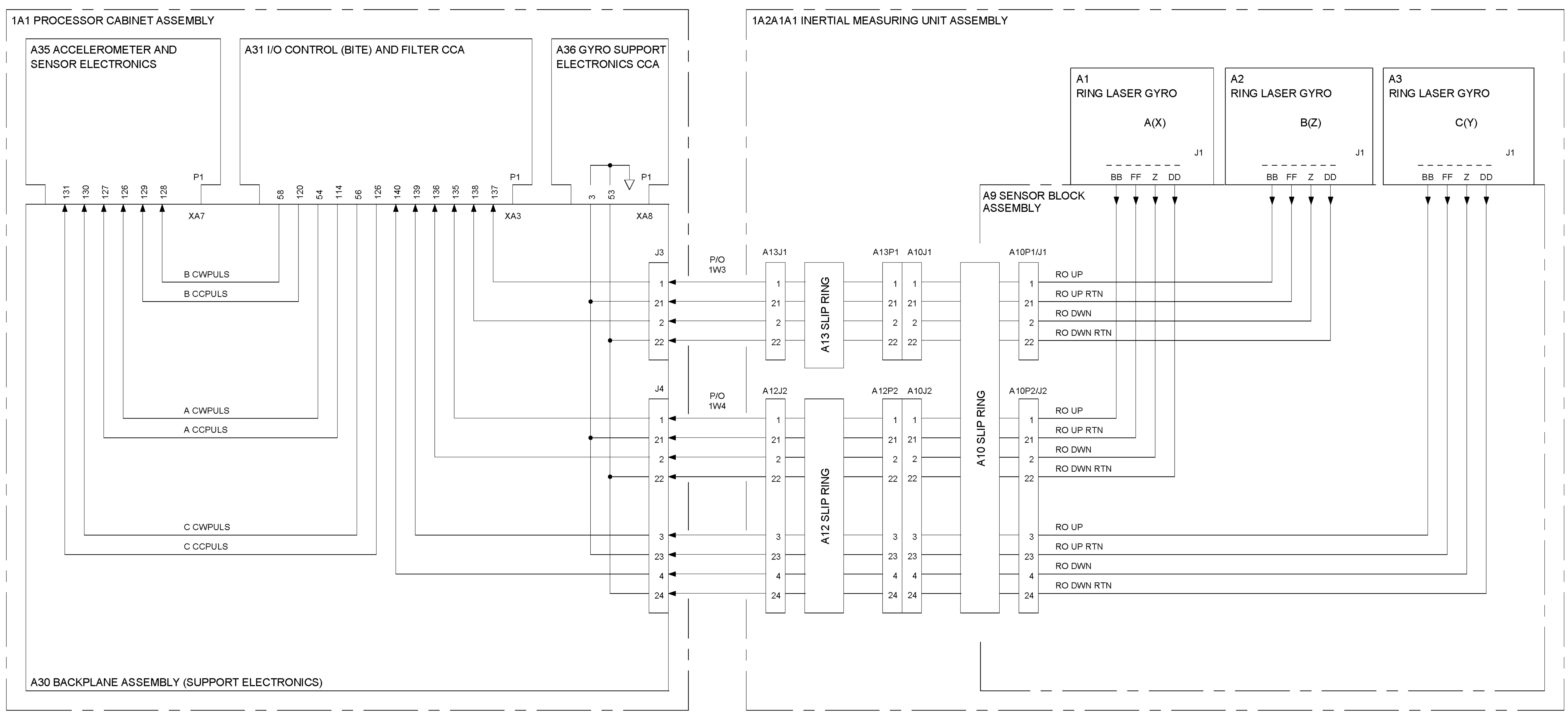


Figure 5-16. Ring Laser Gyros, Rotation Sensor Function Diagram

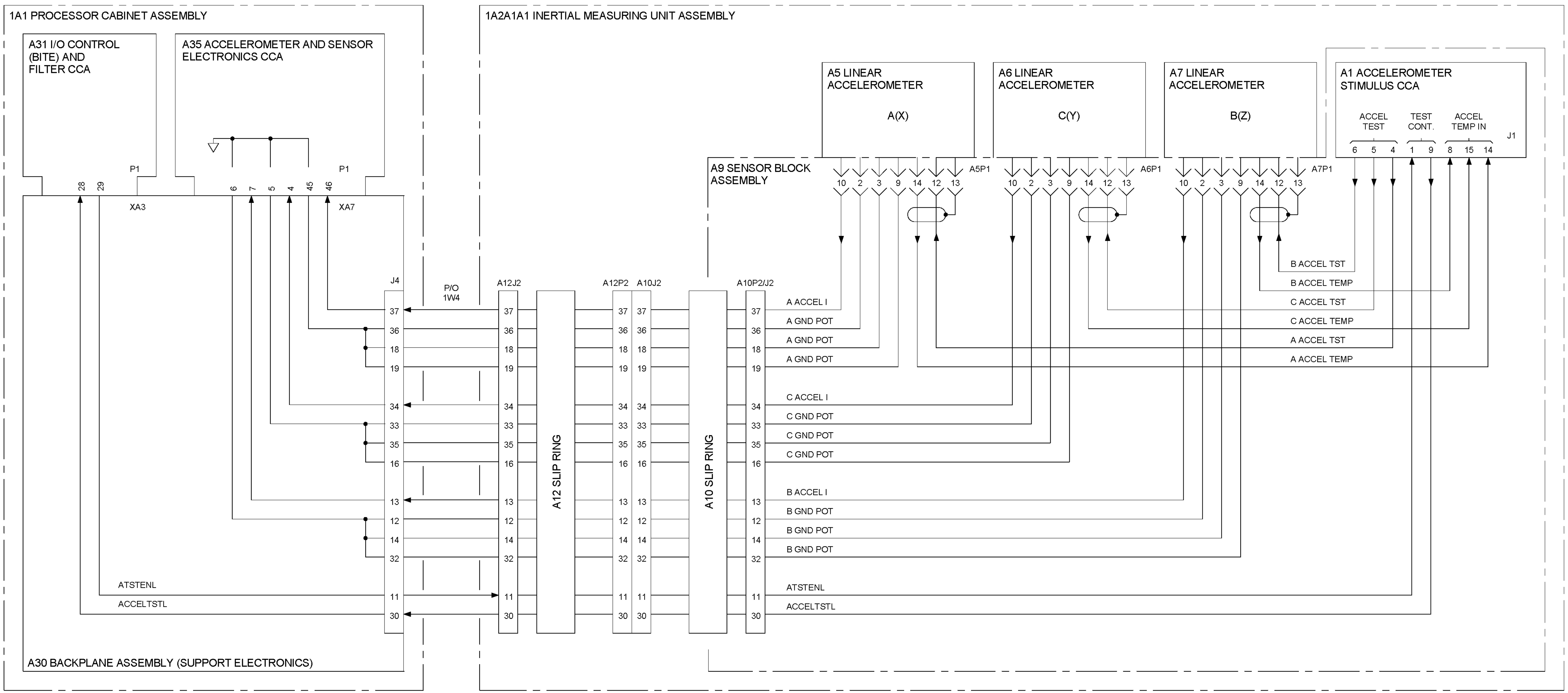


Figure 5-17. Accelerometers, Acceleration Output Function Diagram

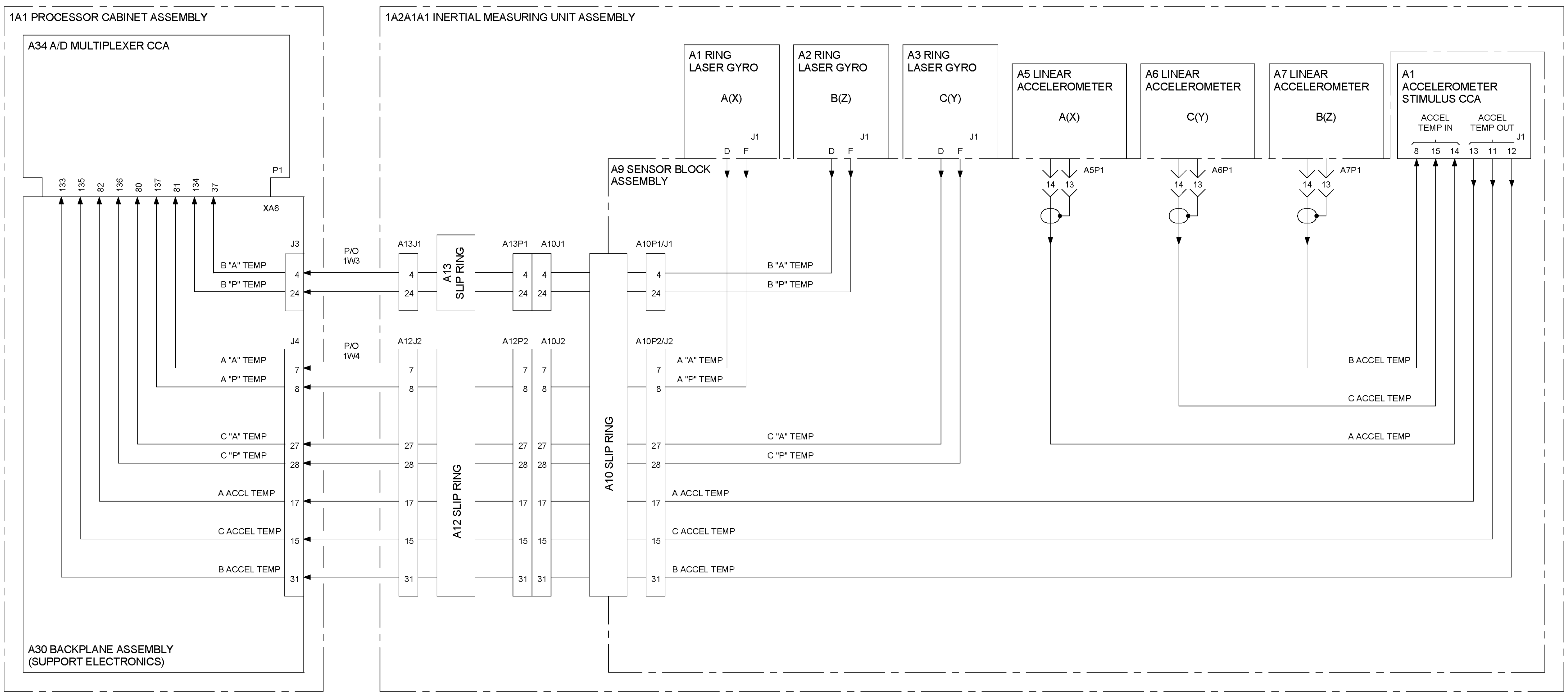


Figure 5-18. Gyro and Accelerometer Temperature Sensing Function Diagram

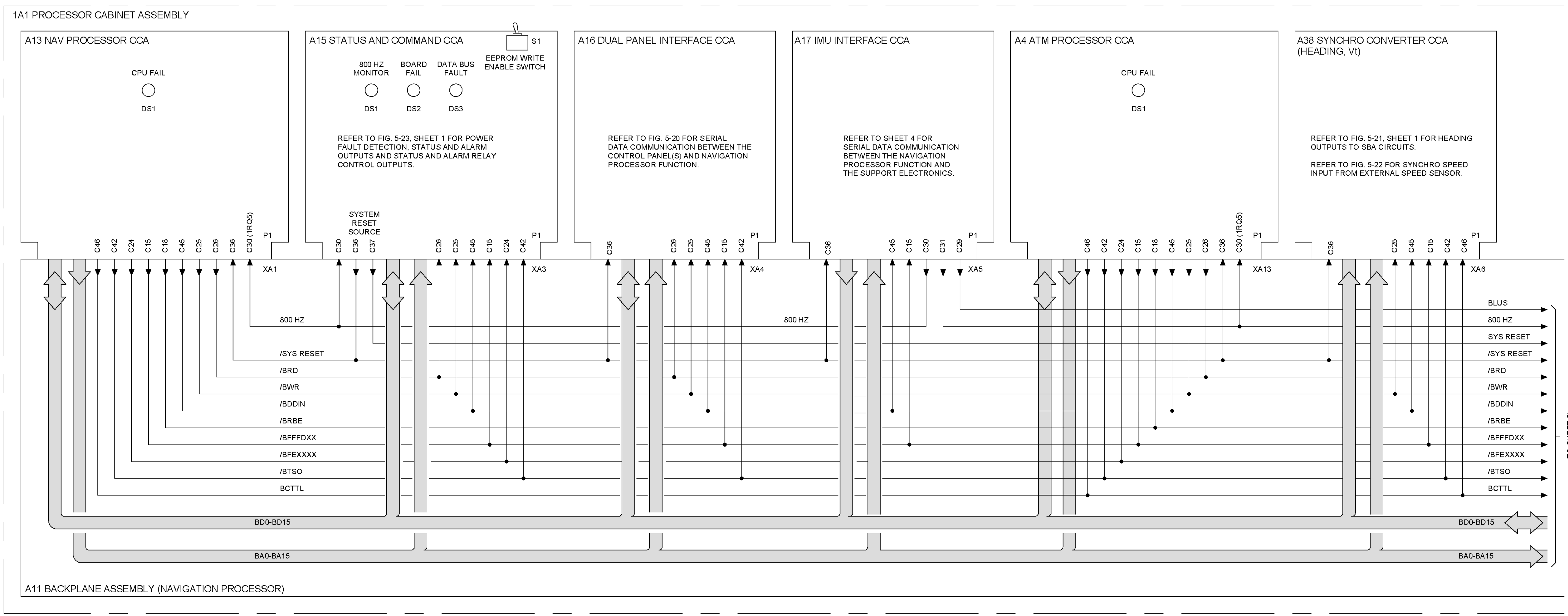


Figure 5-19. Parallel Bus Data, Address and Control Functions, Distribution Diagram (Sheet 1 of 5)

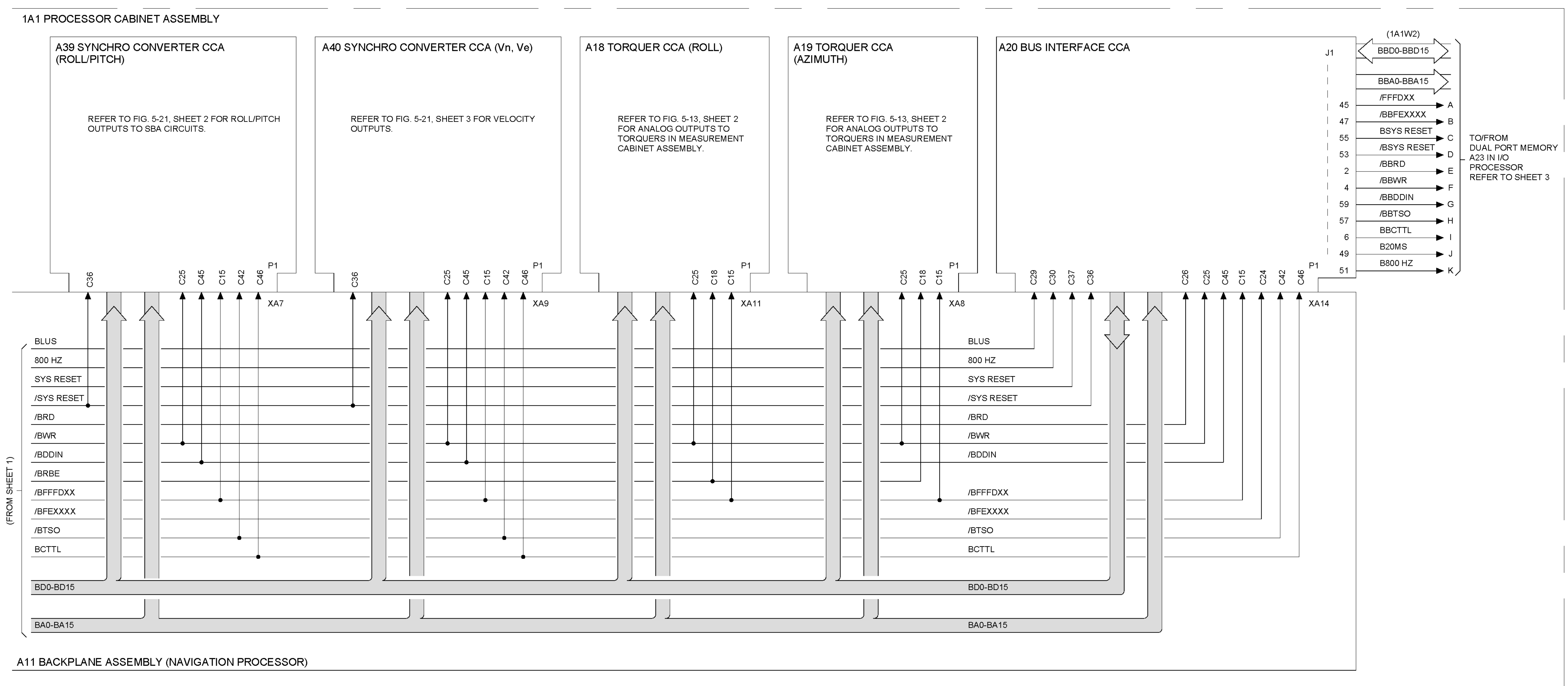


Figure 5-19. Parallel Bus Data, Address and Control Functions, Distribution Diagram (Sheet 2 of 5)

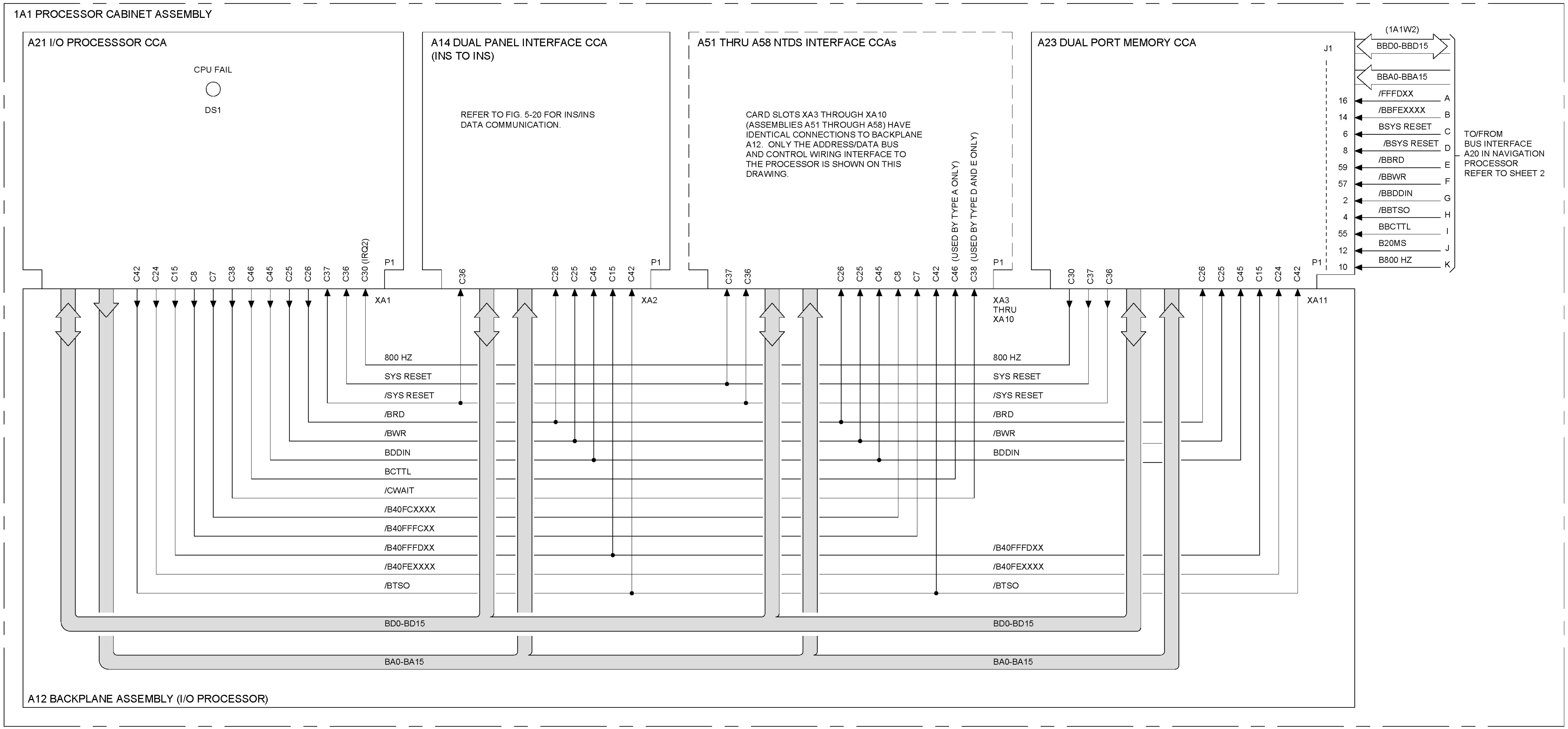


Figure 5-19. Parallel Bus Data, Address and Control Functions, Distribution Diagram (Sheet 3 of 5)

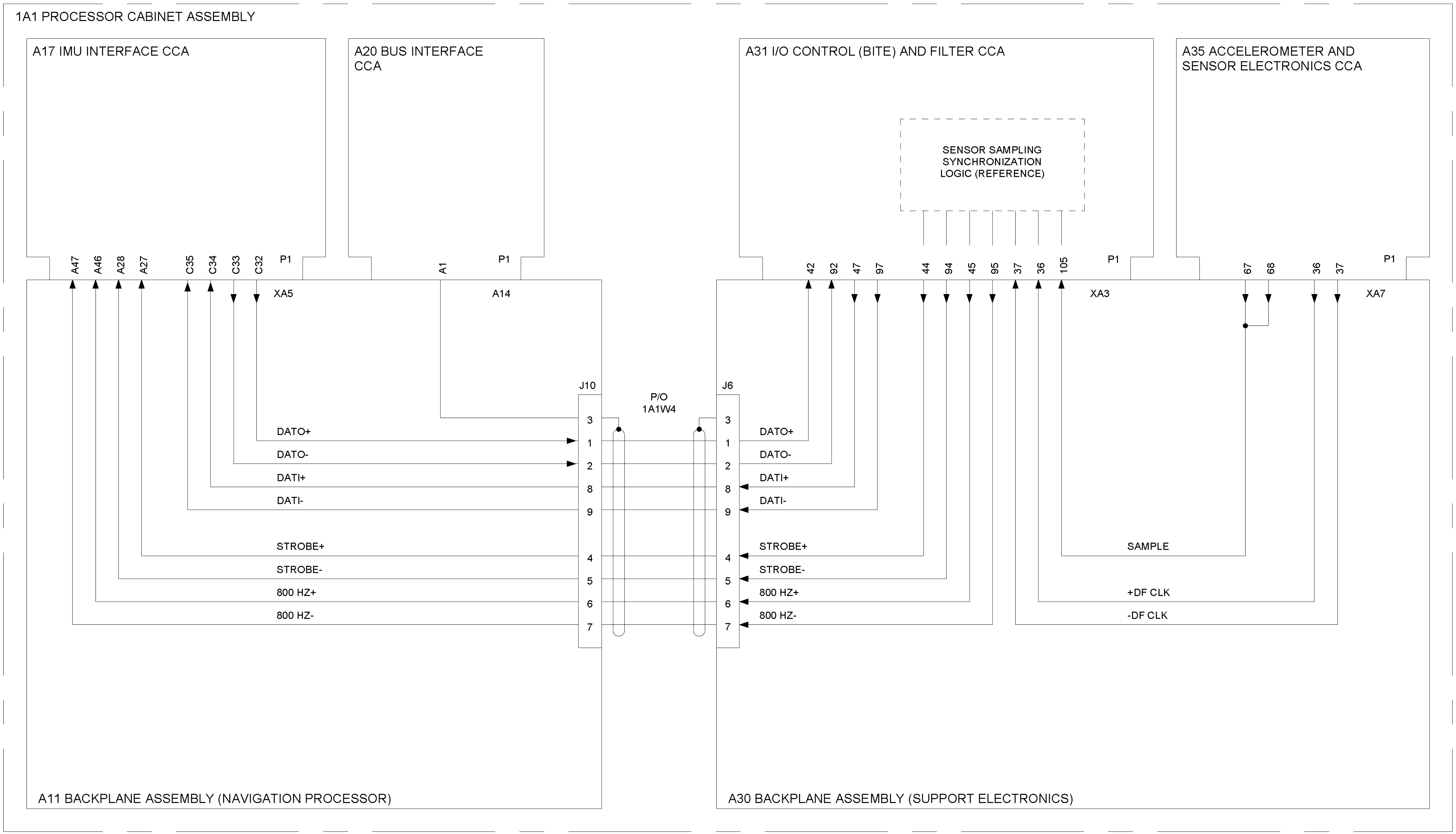


Figure 5-19. Parallel Bus Data, Address and Control Functions, Distribution Diagram (Sheet 4 of 5)

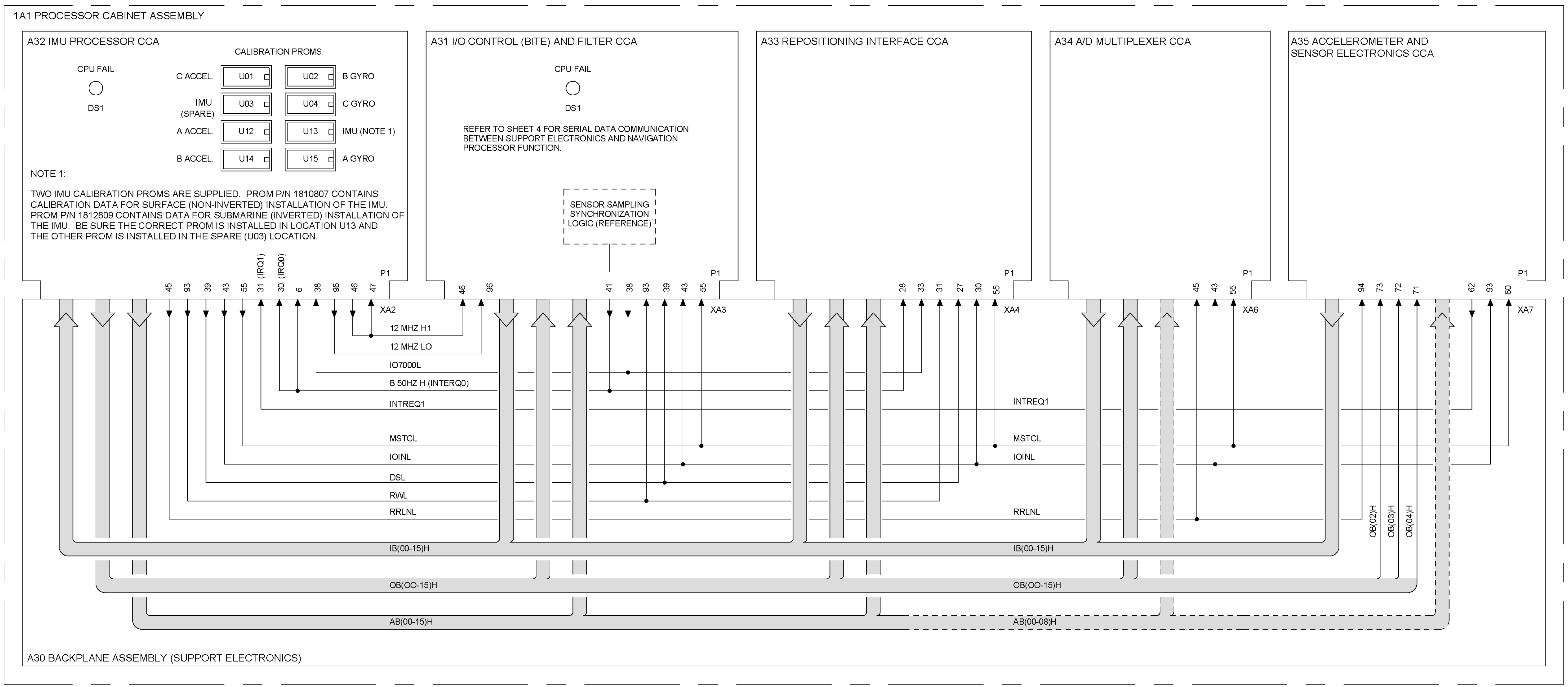


Figure 5-19. Parallel Bus Data, Address and Control Functions, Distribution Diagram (Sheet 5 of 5)

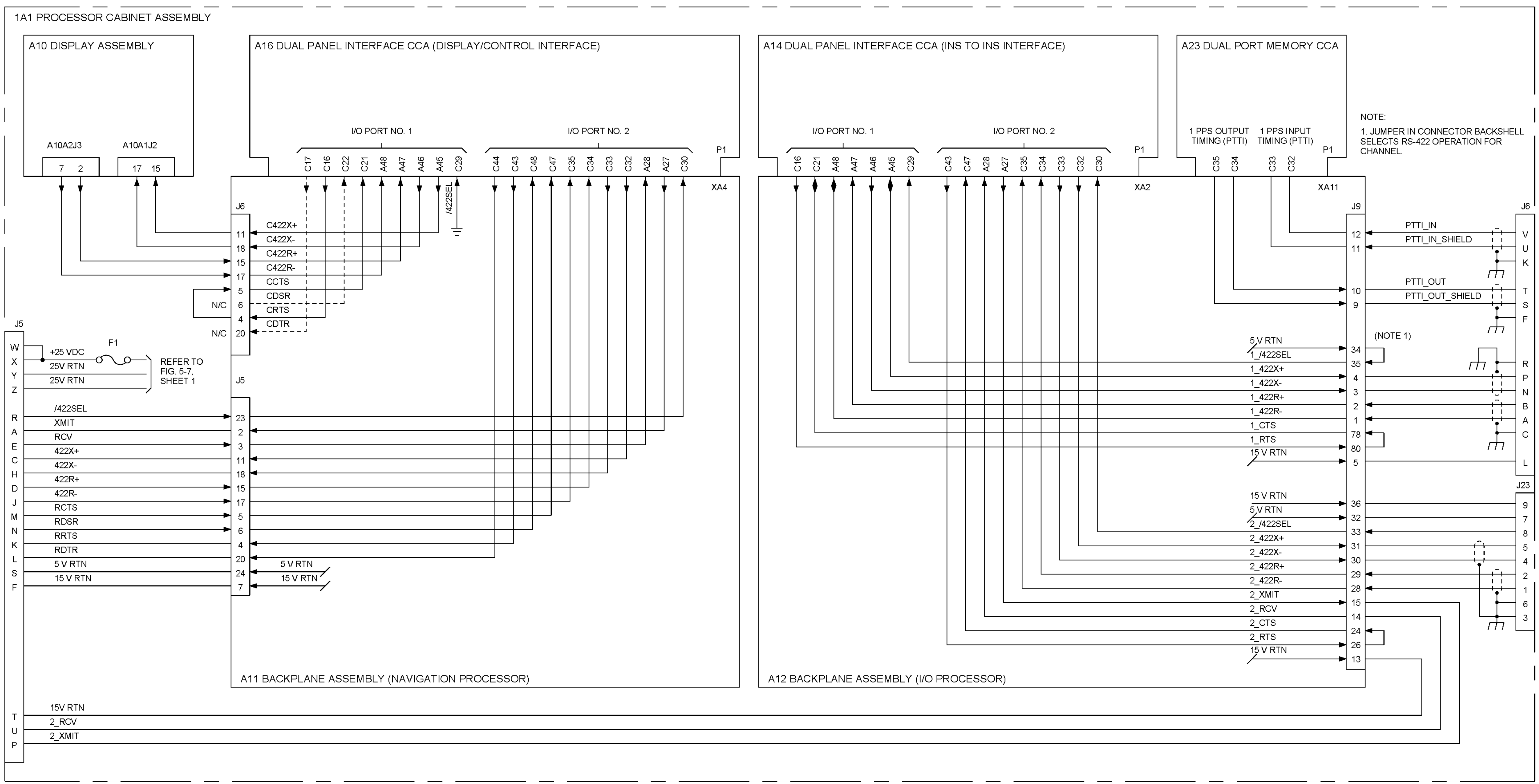


Figure 5-20. RS-422 Serial Data Interface Functions Diagram

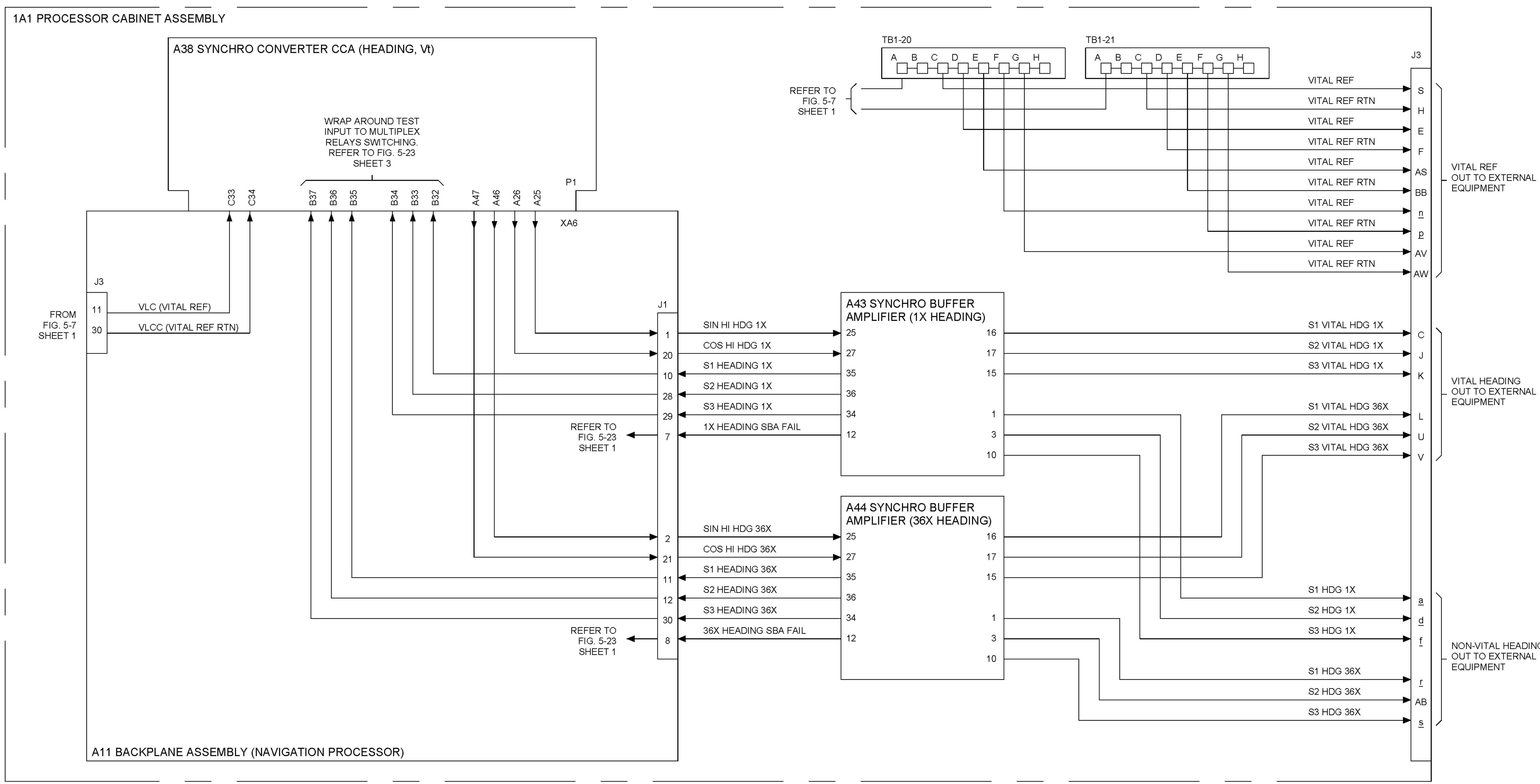


Figure 5-21. System Synchro Format (Heading, Roll, Pitch, and Velocity) Outputs Diagram (Sheet 1 of 3)

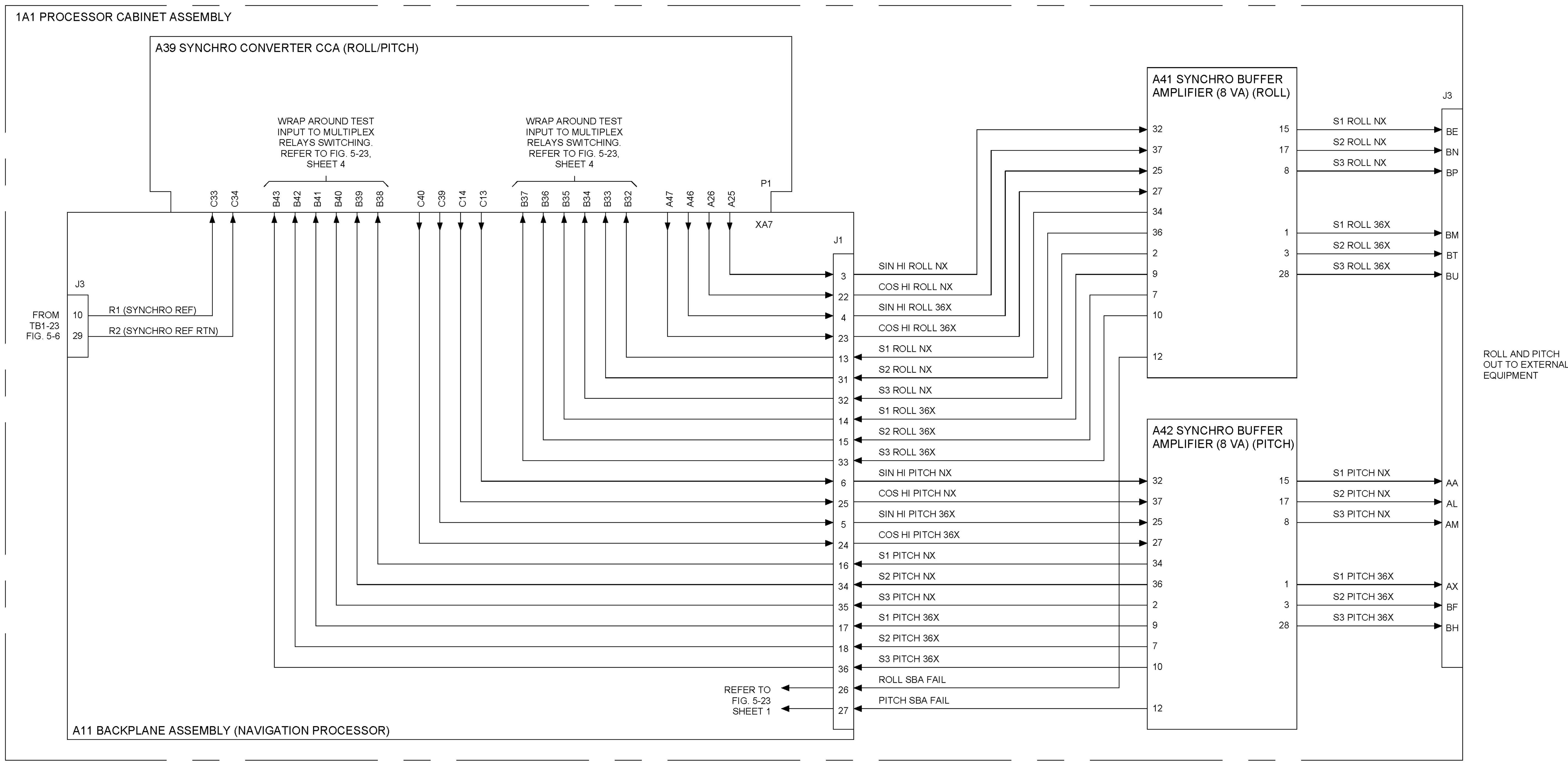


Figure 5-21. System Synchro Format (Heading, Roll, Pitch, and Velocity) Outputs Diagram (Sheet 2 of 3)

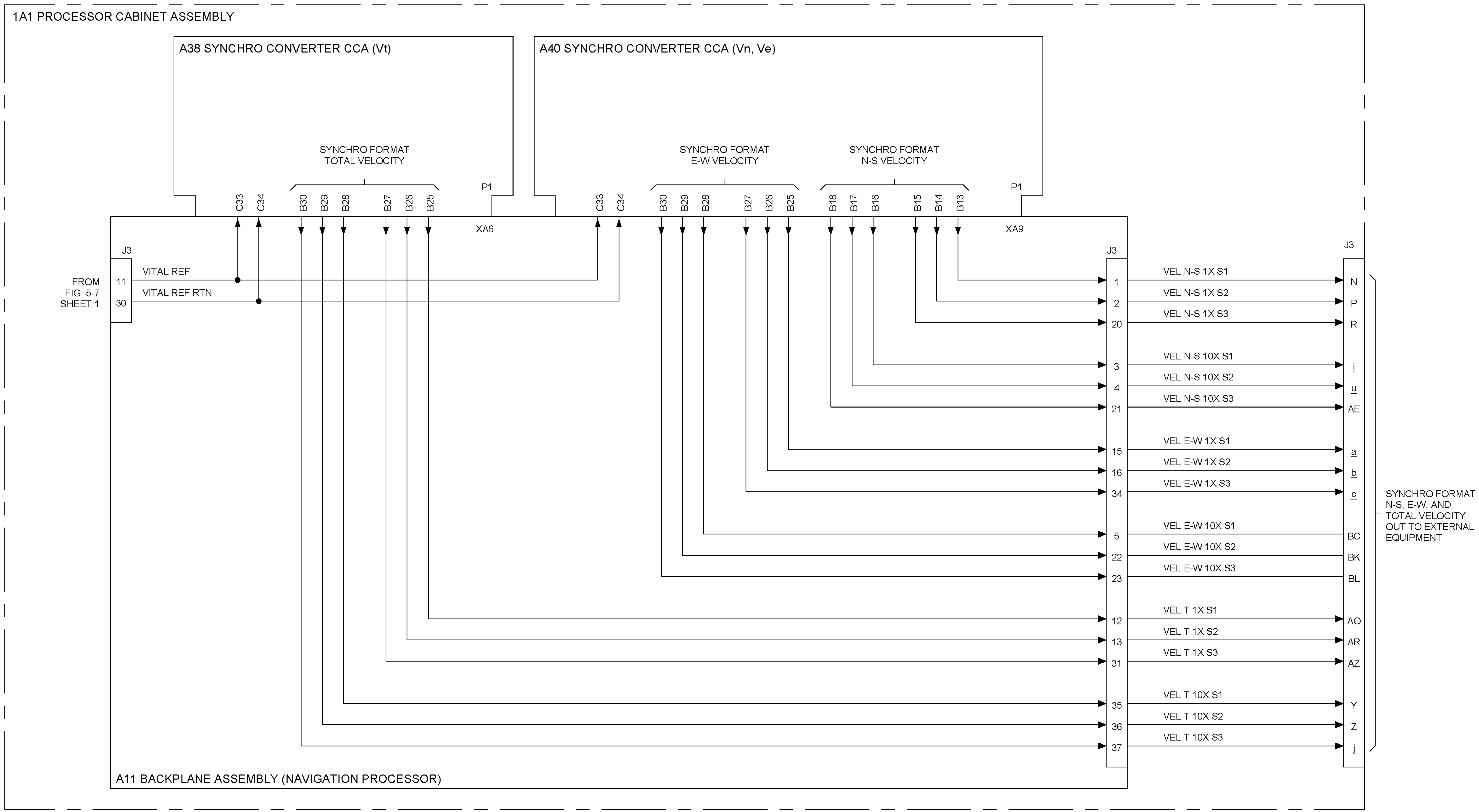


Figure 5-21. System Synchro Format (Heading, Roll, Pitch, and Velocity) Outputs Diagram (Sheet 3 of 3)

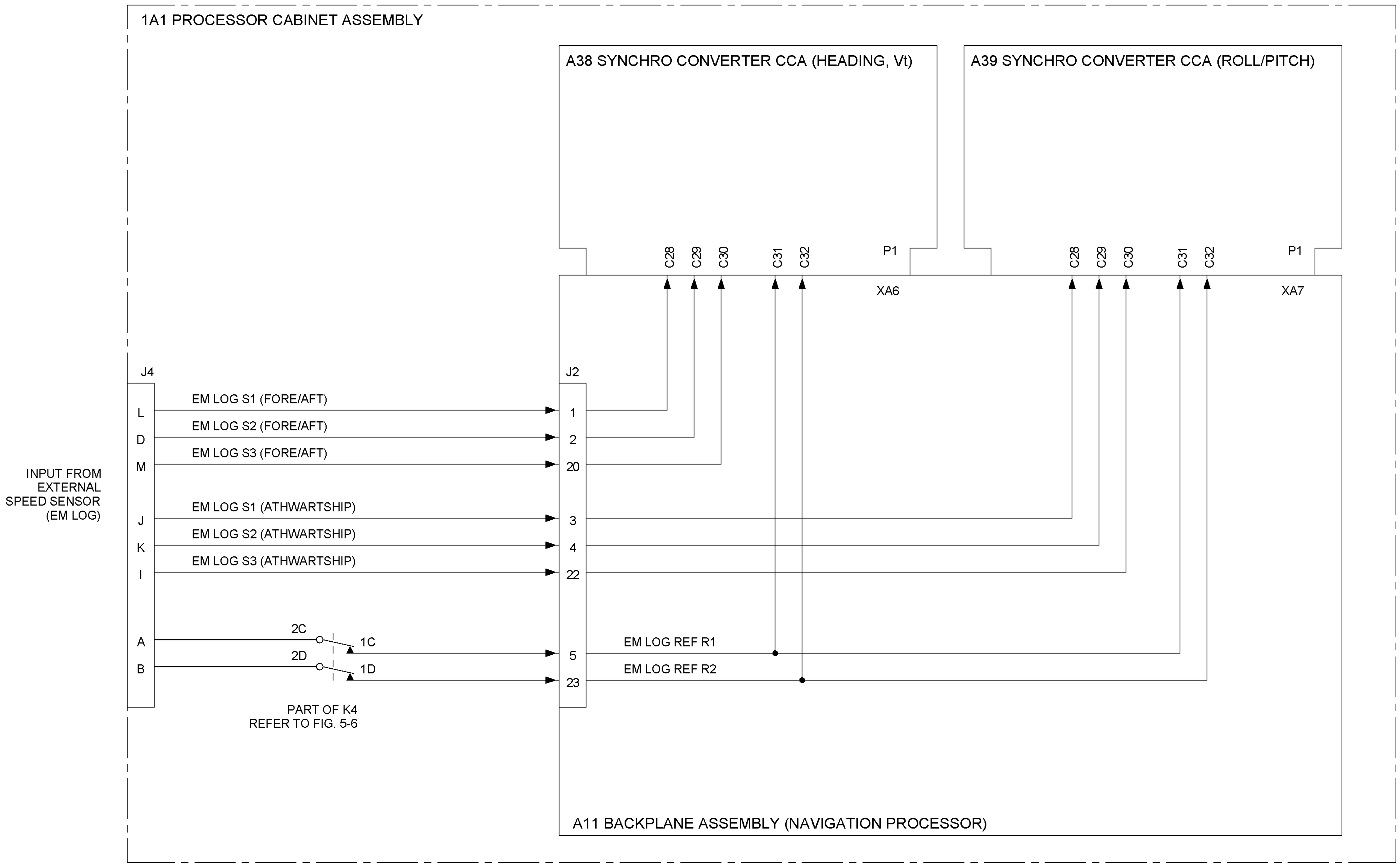


Figure 5-22. Synchro Format Speed (EM Log) Inputs Diagram

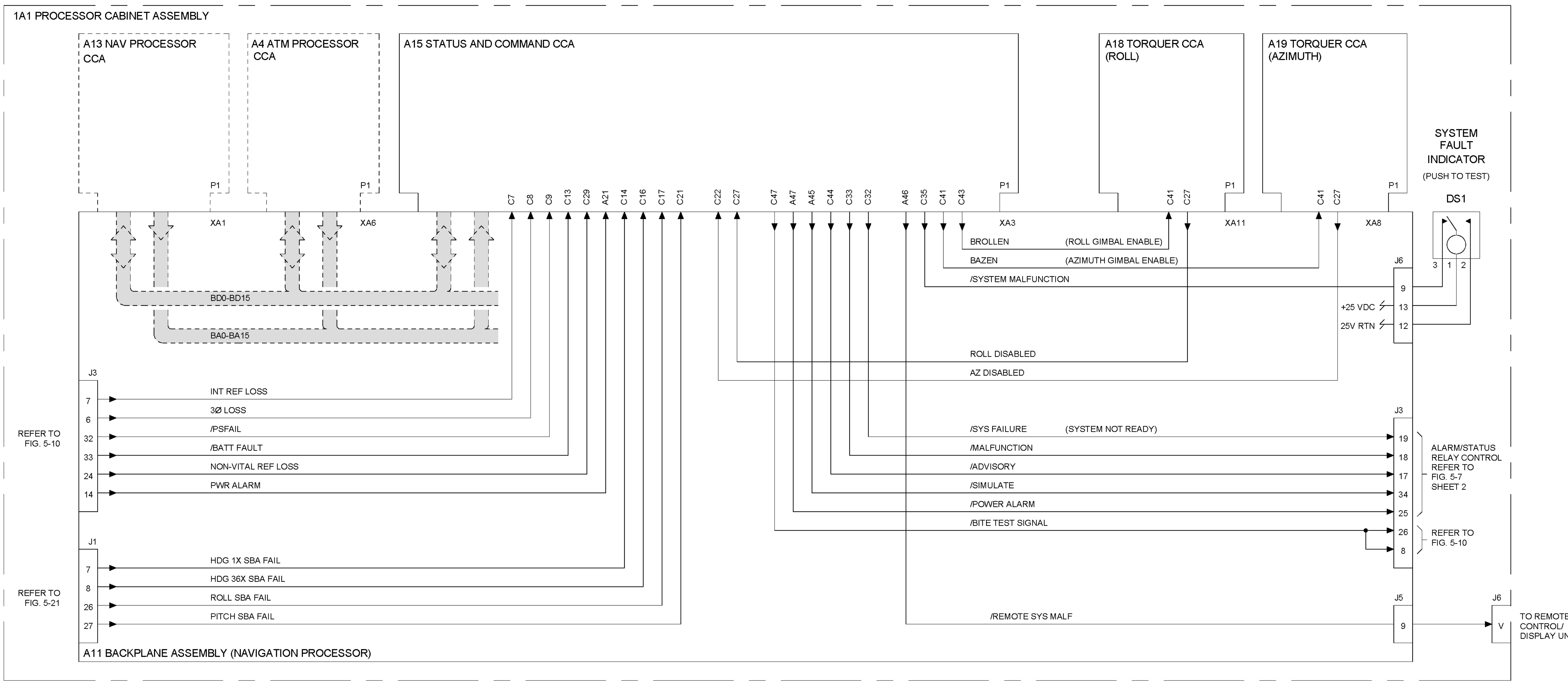


Figure 5-23 BIT Fault Monitoring Functions Diagram (Sheet 1 of 4)

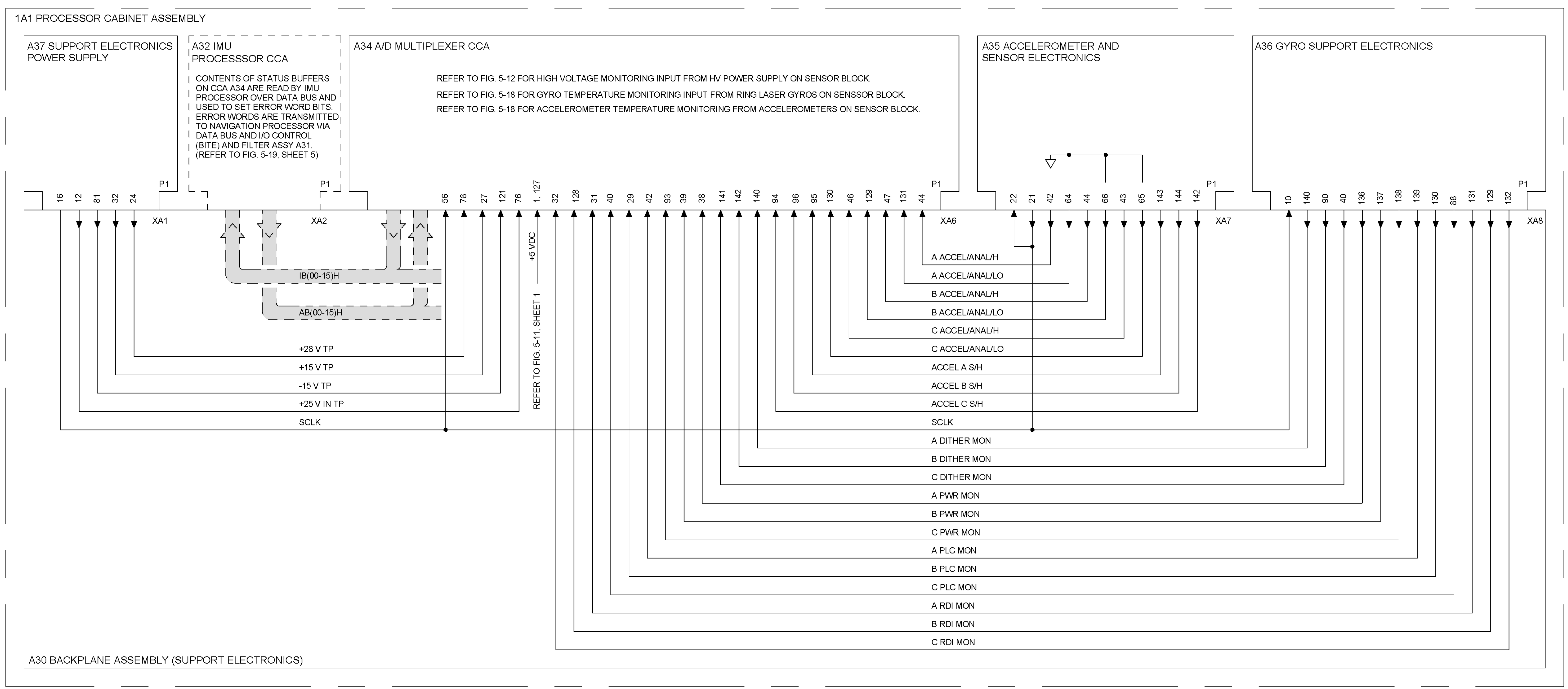


Figure 5-23 BIT Fault Monitoring Functions Diagram (Sheet 2 of 4)

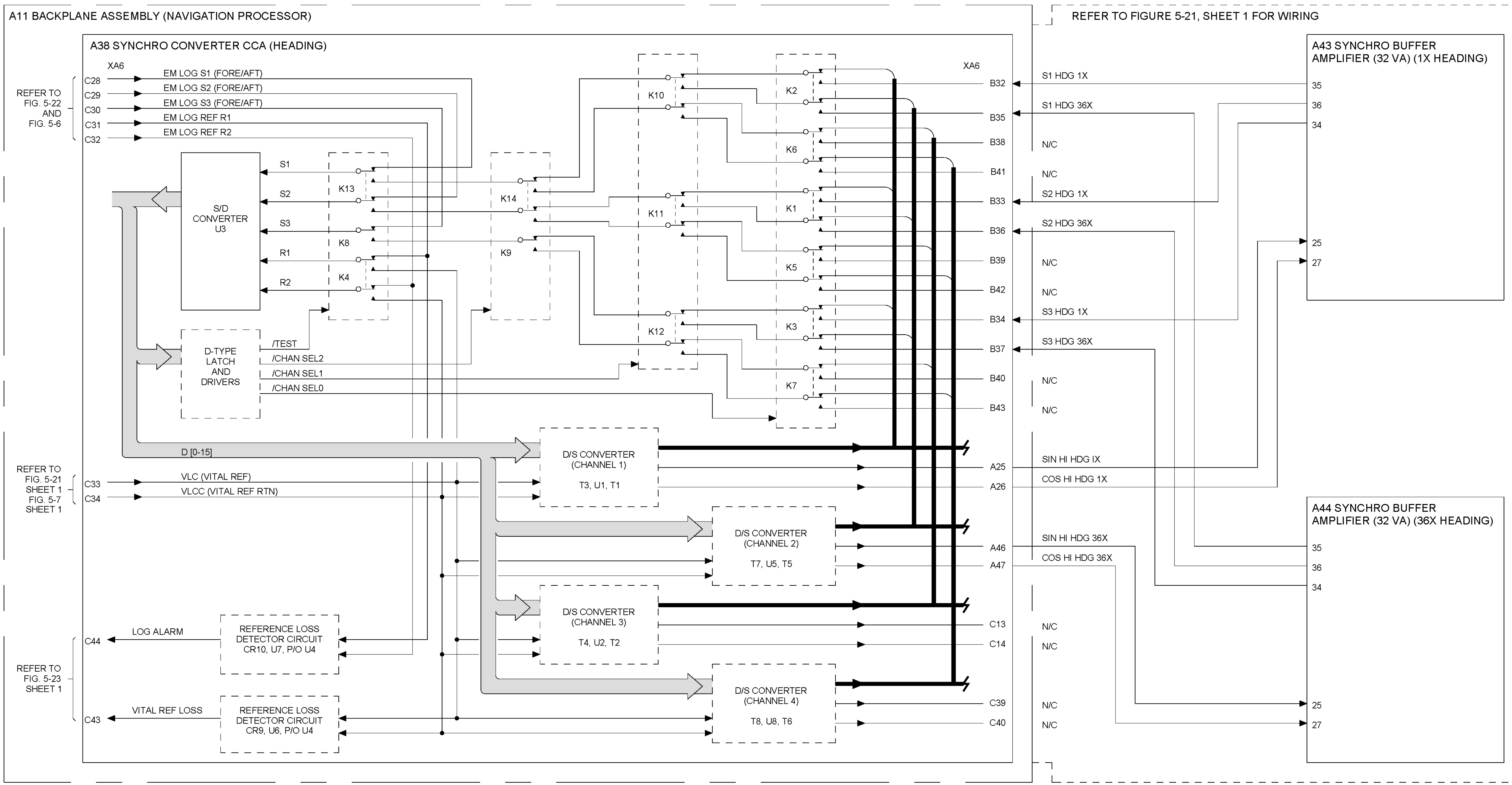


Figure 5-23 BIT Fault Monitoring Functions Diagram (Sheet 3 of 4)

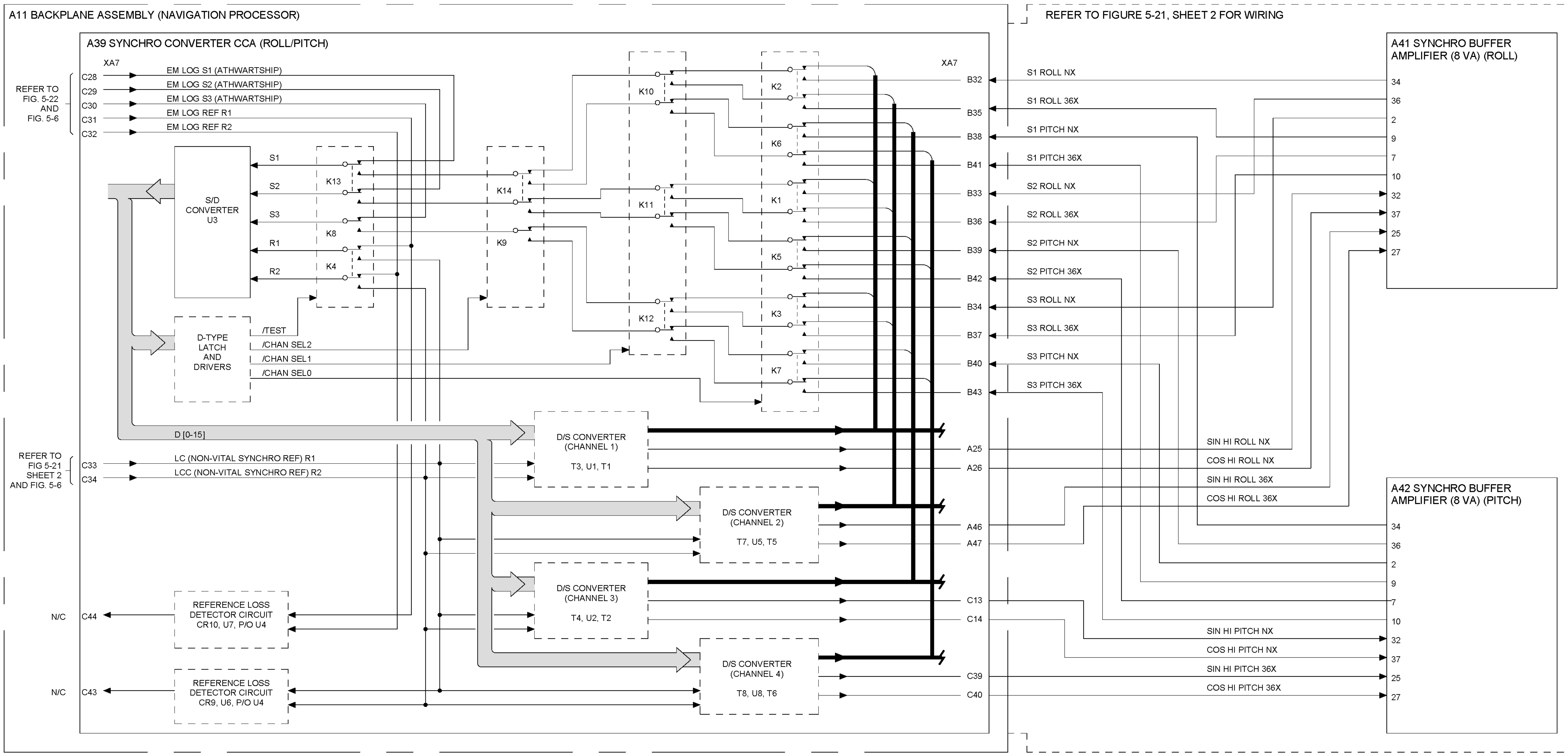


Figure 5-23 BIT Fault Monitoring Functions Diagram (Sheet 4 of 4)

CHAPTER 6
CORRECTIVE MAINTENANCE

6.1 GENERAL CORRECTIVE MAINTENANCE INFORMATION.

6.1.1 INTRODUCTION. Corrective maintenance consists of repair by replacing circuit cards and/or subassemblies with operational spares. Testing and repair of circuit cards and subassemblies require complex equipment, special procedures, and unique components that are beyond the capabilities and parts inventory for shipboard maintenance. No instructions are provided for performing maintenance to this level, and repair of circuit cards and subassemblies should not be attempted.

This chapter is divided into three sections: **Section I**, Adjustment and Alignment, contains procedures for calibrating the system after repairs have been performed that alter stored calibration data. **Section II**, Removal and Replacement, contains instructions for replacement of circuit cards and subassemblies that require specific procedures such as disassembly for access, pre-installation setup, post-installation calibration, or testing. These include replacement of subassemblies that require matching calibration Programmable Read-Only Memory (PROM) replacement to complete the maintenance action. Procedures in Section II are grouped by sequence of access within a functional area of the system. This order of presentation (rather than strict assembly reference designation order) reduces the references to procedures required to gain access to perform maintenance. **Table 6-1** lists all subassemblies and components for which special procedures are provided. **Section III**, Precautions for Shipment, contains instructions for packaging and shipment of Lowest Replaceable Units (LRUs) that require special packaging or handling precautions when being returned for repair.

When following corrective maintenance procedures, note that the text appearing in bold between **<>** symbols refers to labeled keys on the keypad. For example, **<CLEAR>**. Items in bold refer to text that appears in the display. For example: **KENV**.

6.1.2 ELECTROSTATIC DISCHARGE SENSITIVITY.

CAUTION

The AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN) contains Electrostatic Discharge Sensitive (ESDS) devices on various circuit cards and subassemblies. These cards and subassemblies require special care during handling and storage when they are removed from the system. As a precaution, wear a grounding strap when performing maintenance, and follow all standard practices applicable to testing, handling, and storage of ESDS devices whenever any subassembly is removed from the system.

a. Before removing any ESDS device, attach a grounding wrist strap cable connector to cabinet ground terminal post and put on wrist strap.

b. When handling any ESDS device, use care not to touch any components, wiring, or connector pins on the assembly.

c. Have Electrostatic Discharge (ESD)-protective bag(s) or shipping container available to hold a removed subassembly, and place the subassembly directly into the ESD-protective container after removal. If the subassembly is being replaced, use the ESD-protective container supplied with the replacement subassembly to store and return the subassembly for repair.

6.1.3 CABLE HARNESS LACING AND TIE-WRAPPING TECHNIQUES. Wiring harnesses in the Upper Processor Cabinet are laced into cables and retained in the cabinet using tie wraps. Because of flexibility and clearance considerations, harnesses in the Inertial Measuring Unit (IMU) are laced and are retained using nylon cable lacing, which is wrapped and knotted by hand.

Whenever any tie-wraps or hand-tied cable lacing must be removed for access or removal of an LRU, the technician should make careful note of the location and manner in which the cables are retained and secure all cable wires in the same manner as originally configured.

Refer to NAVSEA Specification in 0967-LP-000-0110, *Electronic Installation and Maintenance Book, Installation Standards*, paragraph 2-15.2, for instructions for retying loose harness lacing.

6.1.4 OPENING THE PROCESSOR CABINET FOR MAINTENANCE.

DANGER

The Processor Cabinet Assembly has 115 VAC power present at circuit breakers on the cabinet door and at relays mounted in the cabinet even when the SYSTEM POWER switch is turned Off.

On some occasions, it may be necessary to open the cabinet door when ship's power is applied to the unit so that powered operations, such as storing calibration data, can be performed. Whenever maintenance procedures are being performed with the RLGN cabinet open, and when the ship's power to the RLGN is not turned off, use extreme caution not to touch exposed contacts on the circuit breakers, switches, or power control relays in the unit.

Whenever maintenance is being performed involving removal or replacement of any component, the equipment should be turned off and the ship's power should be turned off at the local power panel circuit breakers and tagged out in accordance with local tagout procedures. To gain access to LRUs inside the upper cabinet of the RLGN, proceed as follows:

a. Note and record any Fault Codes indicated on the Display.

b. On the RLGN, set the SYSTEM POWER switch to OFF. Observe that the POWER indicator extinguishes.

c. On the RLGN, set the POWER, SYNCHRO REF, and VITAL REF circuit breakers to OFF.

d. If significant maintenance is to be performed on the RLGN and personal safety is a factor, secure 115 Volts, Alternating Current (VAC) 60 Hertz (Hz) and 115 VAC 400 Hz power to the RLGN at the ship's power panels and tag out these breakers following standard tag-out procedures.

e. Using a 7/32-inch T-handle Allen wrench, loosen 12 captive screws around the perimeter of the Processor Cabinet (**1A1**) door. Turn the three handles counterclockwise and swing the door open until the door hold-open latch engages to secure the door in opened position.

6.1.5 TOOLS, TEST EQUIPMENT AND SUPPORT ITEMS. All disassembly required for access to subassemblies for repair and for removal and replacement can be performed using common hand tools such as screwdrivers, open-end wrenches, Allen wrenches, and socket wrenches. **Table 6-2** lists the recommended test equipment and tools required to perform maintenance. The "In Kit" column indicates whether or not the tool listed is part of the tool kit supplied with the AN/WSN-7(V). Refer to Allowance Equipage List (AEL) 7-110000073 to find the part number for each tool. **Figure 6-1** shows the typical maintenance tools required for removal and replacement of subassemblies.

6.1.6 PERSONNEL. Unless otherwise specified, all repair and replacement operations described in the following sections require a personnel rating of IC3/ET3 or above. Where noted, extra personnel may be required to help lift heavy components.

SECTION I.
ADJUSTMENT AND ALIGNMENT

6.2 ESTABLISHING SYSTEM CONFIGURATION SETTINGS AFTER MAINTENANCE.

6.2.1 RESTORING INSTALLATION CONFIGURATION PARAMETERS.

6.2.1.1 Preliminary Information. A copy of the System Installation Configuration parameters, which were set at system installation, is stored in both battery-backed Random Access Memory (RAM) on the Navigation (Nav) Processor (CCA) (**1A1A13**) and in Electrically Erasable Programmable Read-Only Memory (EEPROM) Keyboard Entry to Non-Volatile Memory (KENV) on the Status and Command CCA (**1A1A15**). This redundant storage function allows the original set of Installation Configuration Parameters to be restored if either Circuit Card Assembly (CCA) is replaced during maintenance. Note that System Installation Configuration parameters are only stored locally and not in the remote RLGN. (Refer to **Figure 6-2**).

NOTE

If the Nav Processor CCA (**1A1A13**) is replaced, if the battery has been disconnected, or if Continuous RAM Test 282 has been performed, it is necessary to reload the system configuration parameters into the RAM on the Nav Processor CCA (**1A1A13**) from the EEPROM (KENV) on the Status and Command CCA (**1A1A15**). Similarly, if the Status and Command CCA (**1A1A15**) is replaced, it is necessary to load the system configuration parameters into the EEPROM (KENV) on CCA (**1A1A15**) from RAM on the Nav Processor CCA (**1A1A13**).

This action is performed by turning on the RLGN in TEST mode, selecting the System Config function, enabling writing of data to the EEPROM (KENV) and battery-backed RAM by activating switch S1 on the Status and Command CCA (**1A1A15**).

6.2.1.2 Restore RLGN Configuration Parameters.

Goal: Restore RLGN configuration parameters into Nav Processor CCA (**1A1A13**) after replacement, or after Battery Assembly (**1A1A5**) replacement, or after Continuous RAM Test 282 has passed. Or restore RLGN configuration parameters into Status and Command CCA (**1A1A15**) after replacement.

Time: 12 minutes

Tool: Grounding wrist strap

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Turn on the RLGN in TEST mode using the procedure in **Paragraph 5.3**.

d. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

e. Press the **<4>** key to select **System Config** function.

f. Verify that the configuration data in the Nav Processor CCA (**1A1A13**) battery-backed RAM passes checksum test, and that RAM and KENV differ by observing the message: **Battery-backed RAM was not updated**. This message is displayed only if battery-backed RAM on board the Nav Processor CCA (**1A1A13**) passes checksum test, and RAM and KENV differ.

g. Observe the display change and offer the following update choices:

(1) **1 Reset**

(2) **2 KENV : SN nnn** (Serial number in KENV field is stored on CCA (**1A1A15**) EEPROM and is displayed only when EEPROM passes checksum test.)

(3) **3 Backup** (Displayed only when the Nav Processor CCA (**1A1A13**) battery-backed RAM passes checksum test, and RAM and KENV differ.)

h. Select installation configuration data source based on maintenance performed as follows:

(1) Select **KENV** function **<2>** key to reload RAM on Nav Processor CCA (**1A1A13**) from EEPROM (KENV) on the Status and Command CCA (**1A1A15**).

(2) Select **Backup** function **<3>** key to reload the Status and Command CCA (**1A1A15**) EEPROM (KENV) from the battery-backed RAM on the Nav Processor CCA (**1A1A13**).

(3) Select **Reset <1>** key and manually reenter all of the RLGN's original, configuration parameters from the ship's log or other record source when both Nav Processor CCA (**1A1A13**) and Status and Command CCA (**1A1A15**) have been replaced.

i. Press the **<1>** key to select **Store** function.

j. Ensure that the displayed serial number matches the data plate serial number.

k. If serial numbers do not match, or if both CCAs (**1A1A13**) and (**1A1A15**) have been replaced, proceed as follows:

(1) Press the **<CLEAR>** key to return to System Configuration menu.

(2) Select **Reset** function **<1>** key to clear configuration data.

(3) Sequentially select each configuration function.

(4) Using the keypad, reset all data stored in battery-backed RAM or EEPROM (KENV) to the correct, default values.

(5) Verify for each configuration function that all entered data is displayed correctly, then press the **<ENTER>** key.

(6) Once data entry for all configuration functions is verified, proceed to storage steps by pressing the **<1>** key.

CAUTION

Configuration data changes are not saved in EEPROM (KENV) on Status and Command CCA (**1A1A15**) nor battery-backed RAM on Nav Processor CCA (**1A1A13**) until the Store function is complete. Configuration data updates can be aborted by repeated pressing of the **<CLEAR>** key.

l. Hold switch S1 on Status and Command CCA (**1A1A15**) in the write enable position (spring-loaded position), and press the **<ENTER>** key.

m. Observe that configuration data is written into both EEPROM (KENV) and battery-backed RAM.

n. Verify that configuration data is stored with the display message "store operation complete, depress CLEAR," is displayed at the bottom of the screen.

o. Release switch S1 on Status and Command CCA (**1A1A15**).

p. Press the **<CLEAR>** key.

q. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

r. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

Postrequisites:

a. Update RLGN configuration data on Installation Data Sheets, and keep at least one copy of these record sheets with the RLGN so that configuration parameters can be restored when required.

b. Restore RLGN Calibration Data using the procedure in **Paragraph 6.2.2**.

6.2.2 RESTORE RLGN CALIBRATION DATA.

Goal: Restore RLGN calibration data to the Nav Processor CCA (**1A1A13**) after replacement, or to Input/Output (I/O) Processor CCA (**1A1A21**) after replacement.

Time: 1 minute

Tools: None

Prerequisites: Restore RLGN Configuration Parameters using the procedure in **Paragraph 6.2.1.2**.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Turn on the RLGN in Test Mode using the procedure in **Paragraph 5.3**.

c. Verify that the second RLGN is operating normally without faults.

d. Select **System Config** function **<4>** key.

e. Observe that the following message is displayed:

   “The battery-backed RAM is invalid.”

   “Copy calibration from other RLGN?”

   “1 Yes”

   “2 No”

f. Press the **<1>** key to select Yes and accept calibration data transfer from battery-backed RAM on the other RLGN’s I/O Processor CCA (**1A1A21**).

g. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

h. Turn on the RLGN using the procedure in **Paragraph 2.3.1**. Calibration data is now restored into battery-backed RAM.

Postrequisites: None.

SECTION II.
REMOVAL AND REPLACEMENT

6.3 CORRECTIVE MAINTENANCE (UPPER CABINET).

6.3.1 UPPER CABINET ACCESS.

6.3.1.1 Maintenance Turn Off.

Goal: To deenergize and remove power necessary to remove or install AN/WSN-7(V) LRU assemblies that are suspected to be or have been confirmed to be faulty.

Time: 1 minute approximately

Tools: None

Prerequisites:

a. Schedule, notify, and confirm with ship's personnel that the AN/WSN-7(V) will be turned off.

b. Schedule, notify, and confirm with ship's command that installation configuration data will need to be reentered to the Nav Processor CCA (**1A1A13**) or Status and Command CCA (**1A1A15**) if replaced.

c. Schedule, notify and confirm with ship's command that a 72-hour calibration, dockside or at-sea [slaved to a second AN/WSN-7(V)] will be needed, if the Nav Processor CCA (**1A1A13**) or I/O Processor CCA (**1A1A21**) is replaced.

Procedure:

a. Identify and record all Fault Codes that may be presented on the Display (**1A1A10A1**).

b. Set the SYSTEM POWER toggle switch (S1), at the right of the AN/WSN-7(V) Data Entry Keyboard (**1A1A9**), to **OFF**.

c. Observe that the Red POWER Light Emitting Diode (LED) (**1A1DS1**) extinguishes.

d. Set the POWER, SYNCHRO REF, AND VITAL REF circuit breakers at the left of the AN/WSN-7(V) Data Entry Keyboard to **OFF**.

e. At the ship's relevant power panel(s), remove AN/WSN-7(V) power by turning off the 115 VAC, 60 Hz and 115 VAC, 400 Hz circuit breakers that control power output/input to the AN/WSN-7(V).

f. Tag out the AN/WSN-7(V) power output/input circuit breakers at the ship's panel according to ship's instructions.

Postrequisites:

a. If this procedure is performed as part of troubleshooting a suspect faulty assembly, return to the troubleshooting procedure for further instructions.

b. If this procedure is performed as part of replacing a faulty assembly, return to the removal procedure for the faulty assembly for further instructions.

c. If this procedure is performed for demonstration purposes, follow the standard procedure for turning on the RLGN or perform the Troubleshooting Turn-On procedure.

6.3.1.2 Release Upper Cabinet Door.

Goal: Gain physical access to AN/WSN-7(V) Upper Cabinet's assemblies to troubleshoot, remove or install assemblies, or store calibration data.

Time: 15 seconds

Tools: None

Prerequisites: When performing corrective maintenance, turn off the RLGN using the procedure in **Paragraph 2.3.8**.

Procedure:

DANGER

When troubleshooting, do not touch any live or exposed circuits inside the AN/WSN-7(V). 115 VAC and deadly current are present until power input to the RLGN is removed.

DANGER

When performing corrective maintenance, ensure that all ship's power to the AN/WSN-7(V) is turned off and tagged out in accordance with ship's instructions.

a. Using a 7/32-inch T-handle Allen wrench, loosen all 12 captive screws around the perimeter of the Upper (Processor) Cabinet (**1A1**) door by turning each one counterclockwise until it is completely withdrawn from the Upper Cabinet's right panel.

b. Turn all three handles along the cabinet door's right side counterclockwise until each handle is approximately parallel to the deck.

c. Open the door by pulling its handles and swinging it away from the Upper Cabinet until the door latch engages to lock the door in the open position.

Postrequisites:

a. If this procedure is performed as part of troubleshooting a suspect fault assembly, return to the troubleshooting procedure for further instructions.

b. If this procedure is performed as part of replacing a faulty assembly, return to the removal procedure for the faulty assembly for further instructions.

6.3.1.3 Secure Upper Cabinet Door.

Goal: Close and secure physical access to AN/WSN-7(V) Upper Cabinet's assemblies under all conditions.

Time: 15 seconds

Tool: 7/32-inch T-handle Allen wrench

Prerequisites: Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

Procedure:

DANGER

When troubleshooting, do not touch any live or exposed circuits inside the AN/WSN-7(V). 115 VAC and deadly current are present until power input to the RLGN is removed.

DANGER

When performing corrective maintenance, ensure that all ship's power to the AN/WSN-7(V) is turned off and tagged out in accordance with ship's instructions.

a. Disengage the door's latch by pushing upward on the bottom arm of the latch.

b. Turn all three handles along the cabinet door's right side counterclockwise until each handle is approximately parallel to the deck.

c. Using the door's handles, swing the door toward the cabinet until access to the Upper Cabinet's assemblies is closed.

d. Secure access to the Upper Cabinet's assemblies by turning each door handle clockwise to its stopping position, approximately perpendicular to the deck.

e. Verify that the door is secure by pulling sufficiently on the door handles to test that the door handle inner latches are engaged into the Upper Cabinet's right panel. The door should not open.

f. Using a 7/32-inch T-handle Allen wrench, tighten all 12 captive screws around the perimeter of the Upper Cabinet (**1A1**) door by turning each one clockwise until it reaches its fully tightened position.

Postrequisites:

a. If this procedure is performed as part of troubleshooting a suspect faulty assembly, return to the troubleshooting procedure for further instructions.

b. If this procedure is performed as part of replacing a faulty assembly, return to the replacement procedure for the faulty assembly for further instructions.

6.3.1.4 Release Cable Harness and Tie Wraps.

Goal: Gain access to, or remove an LRU.

Time: 1 minute

Tool: Small diagonal cutting pliers

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Note the location and manner in which cable harnesses are retained to ensure cable harnesses are retained in the same manner as originally configured during LRU reinstall.

d. Carefully cut and remove tie wrap(s) or nylon cable lacing.

Postrequisites: If this procedure is performed as part of replacing a suspect faulty LRU, return to the removal procedure for the suspect faulty LRU for further instructions.

6.3.1.5 Secure Cable Harness and Tie Wraps.

Goal: Secure cable harnesses using tie wraps and/or nylon cable lacing.

Time: 2 minutes

Tools: Small diagonal cutting pliers, nylon cable lacing, 1/8-inch wide x 7-inches long plastic tie wraps

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Secure cable harnesses in the same manner as originally configured, using tie wraps and/or nylon cable lacing. Refer to NAVSEA 0967-LP-000-0110, *Electronic Installation and Maintenance Book, Installation Standards* for instructions for retying nylon cable lacing.

d. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

e. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.2 CABLE REPLACEMENT.

6.3.2.1 Remove Ribbon Cable.

Goal: Preparation of CCAs for removal, or preparation for replacement of ribbon cable.

Time: 4 seconds

Tools: None

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Spread the locking hooks on the jack away from the ends of the plug until the cam action pushes the plug from the jack.

d. Reposition the ribbon cable away from the front of the CCA.

Postrequisites:

a. If this procedure is performed as part of replacing a suspect faulty assembly other than the ribbon cable, return to the removal procedure for the suspect faulty assembly for further instructions, then perform Install Ribbon Cable procedure.

b. If this procedure is being performed as part of a field change or faulty cable replacement, perform Install Ribbon Cable procedure.

6.3.2.2 Install Ribbon Cable.

Goal: Installation of ribbon cables.

Time: 9 seconds

Tools: None

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

a. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

b. Remove Ribbon Cable if a faulty cable is currently installed.

c. Position the connector over its respective jack.

d. Push the cable plug firmly into the jack until the latch hooks snap over the ends of the plug.

e. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

f. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.2.3 Remove Serial Coaxial Cable.

Goal: Preparation of CCAs for removal, or preparation for replacement of serial coaxial cable.

Time: 7 seconds

Tool: 5/16-inch open-end wrench

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Loosen the plug using the 5/16-inch open-end wrench.

d. Unscrew the plug from the jack.

e. Reposition the cable away from the front of the CCA.

Postrequisites:

a. If this procedure is performed as part of replacing a suspect faulty assembly other than the serial cable, return to the removal procedure for the suspect faulty assembly for further instructions.

b. If this procedure is being performed as part of a field change or faulty cable replacement, perform Install Serial Coaxial Cable procedure.

6.3.2.4 Install Serial Coaxial Cable.

Goal: Preparation of Processor cabinet for closing after maintenance.

Time: 12 seconds

Tool: 5/16-inch open-end wrench

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

a. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

b. Position the coaxial cable over the front of the CCA.

c. Push the plug into the jack.

d. Screw the connector into the jack by hand until snug.

e. Tighten the connector using a 5/16-inch open-end wrench. Do not over tighten.

f. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

g. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.2.5 Remove Serial Fiber Optic Cable.

Goal: Preparation of Asynchronous Transfer Mode (ATM) CCA for removal, or preparation for replacement of serial fiber optic cable.

Time: 20 seconds

Tool: 15/64-inch open-end wrench

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Loosen the plug using the 15/64-inch open-end wrench.

d. Unscrew the plug from the jack.

e. Reposition the cable away from the front of the CCA.

f. Note the number etched into the connector.

Postrequisites:

a. If this procedure is performed as part of replacing a suspect faulty assembly other than the fiber optic cable, return to the removal procedure for the suspect faulty assembly for further instructions.

b. If this procedure is being performed as part of a field change or faulty cable replacement, perform Install Serial Fiber Optic Cable procedure.

6.3.2.6 Install Serial Fiber Optic Cable.

Goal: Preparation of Processor cabinet for closing after maintenance.

Time: 36 seconds

Tool: 15/64-inch open-end wrench

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

a. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

b. Ensure that the number etched on the connector matches the number on the jack.

c. Position the cable over the front of the CCA.

d. Align the connector to the jack keyway and push the plug into the jack.

e. Screw the connector into the jack by hand until it stops turning.

CAUTION

The jacks for fiber optic connectors are extremely fragile. Be careful not to over-tighten the connector, or damage to the jack may occur.

f. Tighten the connector carefully using a 15/64-inch open-end wrench just until snug.

g. Secure the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.3.

h. Turn on the RLGN using the procedure in Paragraph 2.3.1.

Postrequisites: None.

6.3.3 CCA REPLACEMENT.

6.3.3.1 Release Wedge Locks.

Goal: Preparation of CCAs for removal.

Time: 11 seconds

Tool: 3/32-inch T-handle Allen wrench

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

c. Remove Ribbon Cable, Serial Coaxial Cable, or Serial Fiber Optic Cable if connected to the CCA where the wedge locks are being released.

d. Insert 3/32 T-handle Allen wrench into screw head and turn counterclockwise two full turns.

Postrequisites:

a. If this procedure is performed as a prerequisite to replacing a suspect faulty CCA or CCA backplane assembly, or as part of a field change, return to the Remove CCA procedure for further instructions.

b. If this procedure is being performed to ensure a CCA is securely seated in its installation location, secure the wedge lock.

6.3.3.2 Secure Wedge Locks.

Goal: Secure CCA in its position in the card rack.

Time: 12 seconds

Tool: 3/32-inch T-handle Allen wrench

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Ensure that the CCA is fully seated and the plastic cams are pointing toward the center of the card.

Procedure:

CAUTION

Wedge locks provide a thermal path from the board to the heat sink. If the wedge locks are not tightened, then a loose board may rattle and may also develop hot spots that can reduce reliability.

a. Insert 3/32-inch T-handle Allen wrench into screw head and turn clockwise until snug. Do not over tighten.

b. Install Ribbon Cable, Serial Coaxial Cable, or Serial Fiber Optic Cable, as required.

c. If a fault has been identified and this procedure is completing the replacement or correction of a known faulty assembly with a known good assembly:

(1) Secure the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.3.

(2) Turn on the RLGN using the procedure in Paragraph 2.3.1.

Postrequisites: If a suspected faulty assembly is being tested, return to the troubleshooting procedures.

6.3.3.3 Remove CCA.

Goal: Removal of CCAs from card cages.

Time: 17 seconds

Tools: ESD protective bag, grounding wrist strap

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

c. Remove Ribbon Cable, Serial Coaxial Cable, or Serial Fiber Optic Cable if connected to the CCA to be removed.

d. Release wedge locks on the CCA to be removed.

e. Obtain ESD-protective bag(s) available to hold removed CCA(s).

f. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

g. Unseat the CCA from the backplane rear connector jack by levering the CCA's plastic cam tabs at the CCA's top and bottom corners outward and away from the CCA's center.

h. Remove the CCA from its card slot by pulling with equal force on the CCA's upper and lower cam tabs.

i. Do not touch connector pins or other CCA components.

j. Place the CCA into an ESD-protective bag and store in an approved ESD and impact resistant location.

Postrequisites:

a. If this procedure is performed as a prerequisite to replacing a CCA backplane assembly, return to the appropriate Remove Backplane Assembly procedure for further instructions.

b. If this procedure is being performed for a field change or to replace a known faulty CCA:

(1) Install a known good CCA.

(2) Secure the wedge locks on the CCA.

(3) Install Ribbon Cable, Serial Coaxial Cable, or Serial Fiber Optic Cable to the replacement CCA.

6.3.3.4 Install CCA.

Goal: Installation of CCAs into card cages.

Time: 22 seconds

Tool: Grounding wrist strap

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

b. Attach grounding wrist strap to cabinet ground terminal post E1 and place wrist strap on wrist.

c. Remove the CCA to be installed from its protective bag by carefully grasping the CCA's cam tabs and pulling the CCA free of the bag.

d. Identify the CCA's correct installation location in the CCA card racks.

e. Do not touch CCA connector pins or other CCA components.

f. Insert the connector end of the CCA into its installation location's CCA tracks.

g. Apply gentle, equal force to the CCA's cam tabs until the CCA slides completely into its installation location and the CCA's cams are aligned to engage the detents in the top and bottom of the card slot.

CAUTION

Do not force the CCA to seat into its backplane assembly connector; forcing the CCA may bend or break the CCA's connector pins and cause the system to fail.

h. Grasp the cam tabs and push them inward and toward the CCA's center to fully reseat the CCA into its corresponding backplane connector jack.

i. Secure the wedge locks on the CCA.

j. Install Ribbon Cable, Serial Coaxial Cable, or Serial Fiber Optic Cable, as required.

k. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

l. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.3.5 Interchange CCAs to Track Fault.

Goal: Track fault between Dual Panel Interface Assemblies or Torquer Circuit Assemblies from installation location to test location.

Time: 1 minute

Tools: ESD protective bag, grounding wrist strap

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Remove the CCAs to be interchanged:

(1) If interchanging Dual Panel Interface Assemblies:

(a) Remove Dual Panel Interface CCA (**1A1A14**).

(b) Remove Dual Panel Interface CCA (**1A1A16**).

(2) If interchanging Torquer Circuit Assemblies:

(a) Remove Torquer CCA (**1A1A18**).

(b) Remove Torquer CCA (**1A1A19**).

d. Record the serial numbers for each card to be interchanged so that they may be tracked.

e. Place the CCAs in their new locations:

(1) If interchanging Dual Panel Interface Assemblies:

(a) Install Dual Panel Interface CCA (**1A1A14**) into the (**1A1A16**) location.

(b) Install Dual Panel Interface CCA (**1A1A16**) into the (**1A1A14**) location.

(2) If interchanging Torquer Circuit Assemblies:

(a) Install Torquer CCA (**1A1A18**) into the (**1A1A19**) location.

(b) Install Torquer CCA (**1A1A19**) into the (**1A1A18**) location.

f. Secure all wedge locks on replacement CCAs.

Postrequisites: Return to the troubleshooting procedure that required the suspect CCA to be interchanged for further directions.

6.3.3.6 Interchange CCAs to Return to Original Configuration.

Goal: Installation of CCAs into card cages.

Time: 1 minute

Tool: Grounding wrist strap

Prerequisites:

a. If the relevant troubleshooting procedure confirmed that the fault followed the interchanged, suspected faulty CCA, then acquire a known good replacement CCA to replace the faulty CCA.

b. If the troubleshooting procedure failed to confirm that the fault followed the interchanged, suspected faulty CCA, then continue with the procedures below.

c. Ensure that the RLGN is turned off.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Attach grounding wrist strap to cabinet ground terminal post E1 and place wrist strap on wrist.

b. Remove the CCAs that were interchanged:

(1) If interchanging Dual Panel Interface Assemblies:

(a) Remove Dual Panel Interface CCA (**1A1A14**).

(b) Remove Dual Panel Interface CCA (**1A1A16**).

(2) If interchanging Torquer Circuit Assemblies:

(a) Remove Torquer CCA (**1A1A18**).

(b) Remove Torquer CCA (**1A1A19**).

c. Identify the interchanged CCAs' original installation locations in their respective CCA card racks.

d. As relevant, using the original CCA or known good replacement CCA, return each interchanged CCA to its respective original installation location:

(1) Install Dual Panel Interface CCA (**1A1A14**).

(2) Install Dual Panel Interface CCA (**1A1A16**).

(3) Install Torquer CCA (**1A1A18**).

(4) Install Torquer CCA (**1A1A19**).

e. Secure the wedge locks on all installed CCAs.

f. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

Postrequisites:

a. Turn on the RLGN in Test mode.

b. Perform a System Confidence test.

6.3.3.7 Replace Nav Processor CCA (1A1A13).

Goal: Remove a failed Nav Processor CCA (**1A1A13**) and install a known good CCA of the same revision level, when time, mission or system conditions neither permit a 72-hour dockside calibration nor a slave alignment to a second RLGN.

Time: 15 minutes

Tools: ESD protective bag, grounding wrist strap

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Release the wedge locks on Nav Processor CCA (**1A1A13**).

d. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

e. Remove Nav Processor CCA (**1A1A13**).

f. Install known good Nav Processor CCA (**1A1A13**).

g. Secure the wedge locks on Nav Processor CCA (**1A1A13**).

Postrequisites:

a. Perform the Restore RLGN Installation Configuration Parameters procedure to load the data stored in the Status and the Command CCA's (**1A1A15**) KENV EEPROM, into the known good Nav Processor CCA's (**1A1A13**) battery-backed RAM.

b. Perform the Restore RLGN Calibration Data procedure as follows:

(1) Load stored calibration data to the Nav Processor CCA's (**1A1A13**) RAM from the battery-backed RAM on the same RLGN I/O Processor CCA (**1A1A21**).

(2) Or, if the RLGN's I/O Processor CCA (**1A1A21**) is faulty or has been replaced, and a second RLGN is accessible and in proper operating condition, load stored calibration data from the battery-backed RAM on the second RLGN's I/O Processor CCA (**1A1A21**).

c. Perform RLGN System Installation Datasheet maintenance procedure.

d. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

e. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.3.8 Field Change Nav Processor CCA (1A1A13).

Goal: Remove a Nav Processor CCA (**1A1A13**) and install a known good CCA having different revision than the (**1A1A13**) being removed.

Time: 15 minutes estimated

Tools: ESD protective bag, grounding wrist strap

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Release the wedge locks on Nav Processor CCA (**1A1A13**).

d. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

e. Remove Nav Processor CCA (**1A1A13**).

f. Install the known good field change Nav Processor CCA (**1A1A13**).

g. Secure the wedge locks on Nav Processor CCA (**1A1A13**).

Postrequisites:

a. Perform the Restore RLGN Installation Configuration Parameters procedure to load the data stored in the Status and the Command CCA's (**1A1A15**) KENV EEPROM, into the known good Nav Processor CCA's (**1A1A13**) battery-backed RAM.

b. Calibrate the new Nav Processor CCA (**1A1A13**):

(1) If in port and time and mission conditions permit, perform the 72-hour Dockside Alignment procedure to load new calibration data into the Nav Processor CCA's (**1A1A13**) RAM.

(2) Or, if at sea with a second, accessible RLGN that is in proper operating condition, perform the Slave Alignment procedure to align to the second RLGN.

c. Perform the RLGN System Installation Datasheet maintenance procedure.

d. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

e. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.3.9 Replace or Field Change I/O Processor CCA (1A1A21).

Goal: Remove an I/O Processor CCA (**1A1A21**) that is faulty or a required field change, and install a known good CCA having the same or a different revision than the one being removed.

Time: 15 minutes estimated

Tools: ESD protective bag, grounding wrist strap

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Release the wedge locks on I/O Processor CCA (**1A1A21**).

d. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

e. Remove I/O Processor CCA (**1A1A21**).

f. Install the known good field change I/O Processor CCA (**1A1A21**).

g. Secure the wedge locks on the I/O Processor CCA (**1A1A21**).

Postrequisites:

a. Calibrate the new I/O Processor CCA (**1A1A21**):

(1) If in port and time and mission conditions permit, perform the 72-hour Dockside Alignment procedure to load new calibration data into battery-backed RAM on the I/O Processor CCA (**1A1A21**) in each RLGN.

(2) If at sea and a second RLGN is accessible and in proper operating condition, perform the Slave Align procedure to load new calibration data into battery-backed RAM on the I/O Processor CCA (**1A1A21**) in each RLGN.

b. Perform the RLGN System Installation Datasheet maintenance procedure.

c. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

d. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.3.10 Replace Status and Command CCA (1A1A15).

Goal: Remove a faulty Status and Command CCA (**1A1A15**) and install a known good CCA.

Time: 10 minutes

Tools: ESD protective bag, grounding wrist strap

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Release the wedge locks on the Status and Command CCA (**1A1A15**).

d. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

e. Remove the faulty Status and Command CCA (**1A1A15**).

f. Install the known good Status and Command CCA (**1A1A15**).

g. Secure the wedge locks on the Status and Command CCA (**1A1A15**).

Postrequisites:

a. Perform the Restore RLGN Installation Configuration Parameters procedure to backup the data stored in the Nav Processor CCA's (**1A1A13**) battery-backed RAM to the Status and the Command CCA's (**1A1A15**) KENV, EEPROM.

b. Perform the RLGN System Installation Datasheet maintenance procedure.

c. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

d. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.3.11 Replace IMU Processor (1A1A32) PROM.

Goal: Replace by removing old and installing new, matched PROM to the IMU Processor CCA (**1A1A32**) when a new accelerometer or gyro is replaced, or the two IMU PROMs require replacement.

Time: 10 minutes

Tools: ESD protective bag, grounding wrist strap, PROM Chip Extractor

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Release the wedge locks on the IMU Processor CCA (**1A1A32**).

d. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

e. Remove the IMU Processor CCA (**1A1A32**).

f. Refer to **Figure 6-3**, and record the location of each serialized, matched set, PROM on the IMU Processor CCA (**1A1A32**) that corresponds to the gyro or accelerometer being replaced.

CAUTION

Prevent damage to the PROMs during extraction and installation by using a PROM chip extractor.

g. Using the PROM chip extractor, remove the target, matched set PROM, one at a time.

h. Using the PROM chip extractor, install the matched set PROM that accompanied the new GYRO or accelerometer by pressing it into its appropriate location on the IMU Processor CCA (**1A1A32**).

i. Reinstall the IMU Processor CCA (**1A1A32**).

j. Place the removed, matched set PROM in a plastic ESD bag, and tag out in accordance with mandated guidelines.

k. Secure the wedge locks on the IMU Processor CCA (**1A1A32**).

l. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

m. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.3.12 Transfer IMU Processor CCA (1A1A32) PROM.

Goal: Transfer all PROMs by removing all PROMs from a faulty IMU Processor (**1A1A32**) and installing to a known good IMU Processor (**1A1A32**).

Time: 10 minutes

Tools: ESD protective bag, grounding wrist strap, PROM Chip Extractor

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Release the wedge locks on the IMU Processor CCA (**1A1A32**).

d. Attach grounding wrist strap to cabinet ground terminal post E1, and place wrist strap on wrist.

e. Remove the IMU Processor CCA (**1A1A32**).

f. Remove the new IMU Processor Assembly from its ESD protective bag.

g. Record the location of each serialized, matched set PROM on the faulty IMU Processor CCA (**1A1A32**).

CAUTION

Prevent damage to the PROMs during extraction and installation by using a PROM chip extractor.

h. Using the PROM chip extractor, remove and install each PROM, one at a time, from the faulty IMU Processor CCA (**1A1A32**) to the same location on the new IMU Processor CCA (**1A1A32**).

i. Install the new IMU Processor CCA (**1A1A32**).

j. Place the faulty IMU Processor CCA (**1A1A32**) in a plastic ESD bag, and tag out in accordance with mandated guidelines.

k. Secure the wedge locks on the IMU Processor CCA (**1A1A32**).

l. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

m. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.4 BACKPLANE REPLACEMENT.

6.3.4.1 Access Backplane.

Goal: To gain access to backplane wiring.

Time: 10 minutes

Tool: 3/8-inch straight blade-tip screwdriver

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Loosen the captive screws through the holes in the Cabinet door cooling fins with a 3/8-inch straight blade-tip screwdriver. Do not unscrew these fittings beyond their normal release point because it will be difficult to reinsert them into the door.

d. When all of the screws have been loosened, swing the card rack away from the cabinet door to expose the backplane.

Postrequisites: None.

6.3.4.2 Remove Nav Processor Backplane Assembly (1A1A11) or I/O Processor Backplane Assembly (1A1A12).

Goal: Removal of Nav processor backplane or I/O processor backplane assembly.

Time: 9 minutes

Tools: ESD protective bags, 3/32-inch T-handle Allen wrench, #2 Phillips-head screwdriver

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Remove all CCAs from the card rack. (Label each CCA with reference designations as removed.) Store all CCAs in ESD protective bags during maintenance.

d. Disconnect the cabinet cable connectors from their corresponding connectors on the backplane to be replaced with a #2 Phillips-head screwdriver.

e. Refer to **Figure 6-4**.

f. Use a 3/32-inch T-handle Allen wrench to remove the 8 screws and washers that retain the backplane to the card rack frame.

g. Lift the backplane card edge as shown in **Figure 6-4**, and carefully withdraw the backplane from the card rack frame.

Postrequisites: None.

6.3.4.3 Install Nav Processor Backplane Assembly (1A1A11) or I/O Processor Backplane Assembly (1A1A12).

Goal: Installation of Nav Processor Backplane Assembly or I/O Processor Backplane Assembly.

Time: 14 minutes

Tools: 3/32-inch T-handle Allen wrench, #2 Phillips-head screwdriver

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Inspect both sides of the backplane wiring assembly for signs of damage.

b. Position backplane assembly as shown in **Figure 6-4** and insert into the card rack frame.

c. Insert the eight screws and washers that retain the backplane and screw them in partially using a 3/32-inch T-handle Allen wrench. Do not tighten the screws at this time.

d. Align the backplane assembly so that the CCA rear connectors fit easily into the backplane jacks.

e. Install two CCAs to retain the backplane alignment.

(1) If I/O Backplane Assembly (**1A1A12**) is being installed, insert the (**1A1A23**) and

(**1A1A14**) CCAs fully into their proper slots in the card rack.

(2) If Nav Processor Backplane Assembly (**1A1A11**) is being installed, insert the (**1A1A15**) and (**1A1A19**) CCAs fully into their proper slots in the card rack.

f. Tighten eight 3/32 Allen-head screws once CCAs are inserted.

g. Install all remaining CCAs in their proper positions.

h. Connect the cabinet harness connectors to their corresponding connectors on the backplane and tighten with a #2 Phillips-head screwdriver.

Postrequisites:

a. Restore data in battery-backed RAM on Nav Processor CCA (**1A1A13**) if Nav Processor Backplane Assembly (**1A1A11**) was replaced.

b. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

c. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.4.4 Remove Support Electronics Backplane Assembly (1A1A30).

Goal: Removal of Support Electronics Backplane Assembly (**1A1A30**).

Time: 6 minutes

Tools: ESD protective bags, #1 Phillips-head screwdriver, 3/8-inch blade-tip screwdriver

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Remove all CCAs from the card rack. (Label each CCA with reference designations as removed). Store all CCAs in ESD protective bags during maintenance.

d. Disconnect the cabinet cable connectors from their corresponding connectors on the backplane to be replaced.

e. Loosen eight captive screws that secure the card rack frame to the door with a 3/8-inch blade-tip screwdriver. Do not unscrew these fittings beyond their normal release point because it will be difficult to reinsert them into the door.

f. Swing the card rack on its hinge away from the door to gain access to the eight screws that secure the backplane to the card rack.

g. Using a #1 Phillips-head screwdriver, remove the 8 screws, flat washers, and lock washers that secure the backplane to the card rack frame.

h. Remove the backplane from the card rack frame as shown in **Figure 6-4**.

Postrequisites: None.

6.3.4.5 Install Support Electronics Backplane Assembly (1A1A30).

Goal: Installation of Support Electronics Backplane Assembly (**1A1A30**).

Time: 11 minutes

Tools: #1 Phillips-head screwdriver, 3/8-inch blade-tip screwdriver

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Inspect both sides of the backplane wiring assembly for signs of damage.

b. Position backplane assembly onto the card rack frame as shown in **Figure 6-4**.

c. Secure the backplane with the eight screws, flat washers, and lock washers that secure the backplane to the card rack frame, using a #1 Phillips-head screwdriver. Do not tighten the screws at this time.

d. Align the backplane assembly so that the CCA rear connectors fit easily into the backplane jacks.

e. Insert CCAs (**1A1A32**) and (**1A1A33**) fully into their proper slots in the card rack to retain the backplane alignment.

f. Tighten down the eight screws that secure the backplane assembly once CCAs are inserted, using a #1 Phillips-head screwdriver.

g. Swing the rack into the closed position and start each of the captive screws two or three turns.

h. Tighten the captive screws with a 3/8-inch blade-tip screwdriver once they have all been started.

i. Install all remaining CCAs in their proper positions.

j. Connect the cabinet harness connectors to their corresponding connectors on the backplane.

k. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

l. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5 POWER ASSEMBLIES REPLACEMENT.

6.3.5.1 Fuse Replacement.

6.3.5.1.1 Remove Battery Assembly (1A1A5) Fuse.

Goal: Removal of the fuse from the +32 VDC internal power and Battery Assembly (**1A1A5**).

Time: 4 seconds

Tools: None

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Press the fuse holder cartridge in and rotate counterclockwise to disengage the latch.

d. Pull the fuse holder cartridge free of housing. The fuse will come out with the cartridge.

e. Remove the fuse from the cartridge.

Postrequisites:

a. If testing or visual inspection reveals that the fuse is good, reinstall the fuse.

b. If testing or visual inspection reveals that the fuse is blown, replace the fuse.

6.3.5.1.2 Install Battery Assembly (1A1A5) Fuse.

Goal: Install the fuse in the +32 VDC Battery Assembly (**1A1A5**).

Time: 4 seconds

Tools: None

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

a. Position a new fuse in the cartridge.

b. Position the fuse holder cartridge over the fuse holder.

c. Push the cartridge in and rotate clockwise to engage latch.

d. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

e. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5.2 Remove Power Line Filter (1A1A1).

Goal: Removal of Power Line Filter (**1A1A1**).

Time: 2 minutes

Tool: 3/16-inch T-handle Allen wrench

Prerequisites: None.

Procedure:

WARNING

The cables that carry ship's AC power and synchro reference are attached directly to jacks J1 and J2 on the outside back of the AN/WSN-7(V) cabinet.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Disconnect 115 VAC, 60 Hz connector plug P1 from jack J1 (ship's power 115 VAC, 60 Hz, 3-phase) on the back of the AN/WSN-7(V) cabinet.

d. Disconnect 115 VAC, 400 Hz connector plug P2 from jack J2 (Synchro Ref, 115 VAC, 400 Hz, 1-phase) on the back of the AN/WSN-7(V) cabinet.

e. Disconnect harness connector plug P1 from A1J1 on the filter assembly inside the AN/WSN-7(V) cabinet.

f. Disconnect harness connector plug P2 from A1J2 on the filter assembly inside the AN/WSN-7(V) cabinet.

g. Loosen six socket cap captive screws securing the Power Line Filter (**1A1A1**), using a 3/16-inch T-handle Allen wrench.

h. Remove Power Line Filter (**1A1A1**) from Processor Cabinet Assembly. Use care not to damage the gasket.

Postrequisites: None.

6.3.5.3 Install Power Line Filter (1A1A1).

Goal: Installation of Power Line Filter (**1A1A1**).

Time: 3 minutes

Tool: 3/16-inch T-handle Allen wrench

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position the Power Line Filter on Processor Cabinet Assembly (**1A1**). Use care not to damage the gasket.

b. Ensure that the Electromagnetic Interference (EMI) gasket is in place and that guide pins on the cabinet are aligned with guide pin holes on the filter assembly.

c. Tighten six socket cap captive screws using a 3/16-inch T-handle Allen wrench.

d. Reconnect harness connector plug P2 to A1J2 on the filter assembly inside the AN/WSN-7(V) cabinet.

e. Reconnect harness connector plug P1 to A1J1 on the filter assembly inside the AN/WSN-7(V) cabinet.

f. Reconnect 115 VAC, 400 Hz connector plug P2 to jack J2 (Synchro Ref, 115 VAC, 400 Hz, 1-phase) on the back of the AN/WSN-7(V) cabinet.

g. Reconnect 115 VAC, 60 Hz connector plug P1 to jack J1 (ship's power 115 VAC, 60 Hz, 3-phase) on the back of the AN/WSN-7(V) cabinet.

h. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

i. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5.4 Remove Inverter Assembly (400 Hz) (1A1A2).

Goal: Removal of Inverter Assembly (400 Hz) (**1A1A2**).

Time: 3 minutes

Tool: 3/16-inch ball-end Allen screwdriver

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Disconnect harness connector plug P7 from A2J1 on the Inverter Assembly inside the Processor Cabinet Assembly (**1A1**).

d. Loosen six socket cap captive screws securing Inverter Assembly (400 Hz) (**1A1A2**), using a 3/16-inch ball-end Allen screwdriver.

e. Remove Inverter Assembly (400 Hz) (**1A1A2**) from Processor Cabinet Assembly (**1A1**). Use care not to damage the harness.

Postrequisites: None.

6.3.5.5 Install Inverter Assembly (400 Hz) (1A1A2).

Goal: Installation of Inverter Assembly (400 Hz) (**1A1A2**).

Time: 2 minutes

Tool: 3/16-inch ball-end Allen screwdriver

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position the inverter assembly in Processor Cabinet Assembly (**1A1**) with jack A2J1 oriented toward the top of the cabinet. Use care not to damage the harness.

b. Tighten six socket cap captive screws using a 3/16-inch ball-end Allen screwdriver.

c. Reconnect harness connector plug P7 to A2J1 on the Inverter Assembly 400 Hz (**1A1A2**).

d. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

e. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites:

None.

6.3.5.6 Remove Vital Bus CCA (1A1A3).

Goal: Removal of Vital Bus CCA (**1A1A3**).

Time: 8 minutes

Tools: 90-degree offset #2 Phillips-head screwdriver, small straight blade screwdriver, #2 Phillips-head screwdriver, ESD wrist strap, ESD-protective bag

Prerequisites: None.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Have an ESD-protective bag available to hold the removed CCA.

d. Loosen captive lock screws securing harness connector plugs P8 and P9 to CCA with a small straight blade screwdriver.

e. Remove the far left corner pan head screw, flat washer and lock washer from the CCA with a 90-degree offset #2 Phillips-head screwdriver.

f. Remove the other seven pan head screws, seven flat washers and seven lock washers from around the perimeter of the CCA with a #2 Phillips-head screwdriver.

g. Remove the center pan head screw, flat washer and lock washer from the CCA with a #2 Phillips-head screwdriver.

h. Remove Vital Bus CCA (**1A1A3**) from Processor cabinet assembly (**1A1**).

i. Place Vital Bus CCA (**1A1A3**) in an ESD-protective bag.

Postrequisites: None.

6.3.5.7 Install Vital Bus CCA (1A1A3).

Goal: Installation of Vital Bus CCA (**1A1A3**).

Time: 11 minutes

Tools: 90-degree offset #2 Phillips-head screwdriver, small straight blade screwdriver, #2 Phillips-head screwdriver, ESD wrist strap

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

CAUTION

CCAs contain parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting any CCA.

a. Position the Vital Bus CCA (**1A1A3**) in Processor Cabinet Assembly (**1A1**).

b. Insert the center pan head screw, flat washer and lock washer into the CCA.

c. Tighten with a #2 Phillips-head screwdriver.

d. Insert the eight pan head screws, eight flat washers and eight lock washers around the perimeter of the CCA.

e. Tighten the far left corner pan head screw with a 90-degree offset #2 Phillips-head screwdriver.

f. Tighten the remaining pan head screws with a #2 Phillips-head screwdriver.

g. Reconnect harness connector plugs P8 and P9 to A3J1 and A3J2 on the Vital Bus CCA

(**1A1A3**), using a small straight blade screwdriver.

h. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

i. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5.8 Power Supply (1A1A6) Replacement.

6.3.5.8.1 Remove Power Supply (1A1A6).

Goal: Removal of Power Supply (**1A1A6**).

Time: 3 minutes

Tool: 3/16-inch T-handle Allen wrench

Prerequisites: None.

Procedure:

WARNING

The Power Supply Assembly (**1A1A6**) weighs approximately 51 lbs (23 kg). To prevent injury to personnel or damage to equipment, two persons are required to remove or install it.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Disconnect harness connector plug P3 from jack A6J1 on the Power Supply (**1A1A6**).

d. Loosen four bottom socket cap captive screws using a 3/16-inch T-handle Allen wrench.

e. Loosen one socket cap captive screw on the right side using a 3/16-inch T-handle Allen wrench.

f. Support Power Supply (**1A1A6**) with one hand while loosening the top three remaining socket cap captive screws.

g. Remove Power Supply (**1A1A6**) from Processor Cabinet (**1A1**). The Power supply is heavy. Two persons are required to remove it.

Postrequisites: None.

6.3.5.8.2 Install Power Supply (1A1A6).

Goal: Installation of Power Supply (**1A1A6**).

Time: 3 minutes

Tool: 3/16-inch T-handle Allen wrench

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

WARNING

The Power Supply Assembly (**1A1A6**) weighs approximately 51 lbs (23 kg). To prevent injury to personnel or damage to equipment, two persons are required to remove or install it.

a. Position Power Supply (**1A1A6**) in Processor Cabinet Assembly (**1A1**), ensuring that the guide pin on the Power Supply is aligned with the guide hole on the mounting surface. The Power supply is heavy. Two persons may be required to install it.

b. Tighten the top three socket cap captive screws with a 3/16-inch T-handle Allen wrench.

c. Tighten one socket cap captive screw on the right side using a 3/16-inch T-handle Allen wrench.

d. Tighten the remaining four bottom socket cap captive screws with a 3/16-inch T-handle Allen wrench.

e. Connect harness connector plug P3 to A6J1 on Power Supply (**1A1A6**).

f. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

g. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5.9 Battery Charger (1A1A7) Replacement.

6.3.5.9.1 Remove Battery Charger (1A1A7).

Goal: Removal of Battery Charger (**1A1A7**).

Time: 2 minutes

Tools: 3/16-inch T-handle Allen wrench

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Set switch S1 on Battery Assembly (**1A1A5**) to **OFF**.

d. Disconnect harness connector plug P5 from jack A5J1 on Battery Assembly (**1A1A5**).

e. Disconnect harness connector plug P4 from jack A7J1 on Battery Charger (**1A1A7**).

f. Loosen four socket cap captive screws securing Battery Charger (**1A1A7**), using a 3/16-inch T-handle Allen wrench.

g. Remove Battery Charger (**1A1A7**) from Processor Cabinet Assembly (**1A1**).

Postrequisites: None.

6.3.5.9.2 Install Battery Charger (1A1A7).

Goal: Installation of Battery Charger (**1A1A7**).

Time: 2 minutes

Tool: 3/16-inch T-handle Allen wrench

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabiner door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position Battery Charger (**1A1A7**) in Processor Cabinet Assembly (**1A1**), ensuring that the guide pin on the mounting surface is aligned with the guide hole on the Battery Charger.

b. Tighten four socket cap captive screws with a 3/16-inch T-handle Allen wrench.

c. Reconnect harness connector plug P4 to jack A7J1 on Battery Charger (**1A1A7**).

d. Reconnect harness connector plug P5 to jack A5J1 on Battery Assembly (**1A1A5**).

e. Set switch S1 on Battery Assembly (**1A1A5**) to ON.

f. Restore Configuration Data AN/WSN-7(V) using the procedure in **Paragraph 6.2.1.2**.

Postrequisites:

a. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

b. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.5.10 Power Module (1A1A8) Replacement.

6.3.5.10.1 Remove Power Module (1A1A8).

Goal: Removal of Power Module (**1A1A8**).

Time: 3 minutes

Tool: 3/16-inch ball-end Allen screwdriver

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Disconnect harness connector plug P6 from jack A8J1 on Power Module (**1A1A8**).

d. Loosen six socket cap captive screws securing Power Module (**1A1A8**), using a 3/16-inch T-handle Allen wrench.

e. Remove Power Module (**1A1A8**) from Processor Cabinet Assembly (**1A1**).

Postrequisites: None.

6.3.5.10.2 Install Power Module (1A1A8).

Goal: Installation of Power Module (**1A1A8**).

Time: 2 minutes

Tool: 3/16-inch ball-end Allen screwdriver

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position Power Module (**1A1A8**) in Processor Cabinet Assembly (**1A1**), ensuring that the guide pin on the Power Module is aligned with the guide hole on the mounting surface.

b. Tighten six socket cap captive screws with a 3/16-inch ball-end Allen screwdriver.

c. Connect harness connector plug P6 to jack A8J1 on Power Module (**1A1A8**).

d. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

e. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5.11 Synchro Buffer Amplifier (8 VA) (1A1A41) Replacement.

6.3.5.11.1 Remove Synchro Buffer Amplifier (8 VA) (1A1A41).

Goal: Removal of Synchro Buffer Amplifier (8 VA) (**1A1A41**).

Time: 2 minutes

Tools: 1/8-inch straight blade screwdriver, 3/16-inch ball-end Allen screwdriver

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Loosen captive lock screws securing D-connector P15 to jack A41J1 on Synchro Buffer Amplifier (8 VA) (**1A1A41**), using a 1/8-inch straight blade screwdriver.

d. Disconnect D-connector P15 from jack A41J1 on Synchro Buffer Amplifier (8 VA) (**1A1A41**).

e. Loosen six socket cap captive screws securing Synchro Buffer Amplifier (8 VA) (**1A1A41**), using a 3/16-inch ball-end Allen screwdriver.

f. Remove Synchro Buffer Amplifier (8 VA) (**1A1A41**) from Processor Cabinet Assembly (**1A1**).

Postrequisites: None.

6.3.5.11.2 Install Synchro Buffer Amplifier (8 VA) (1A1A41).

Goal: Installation of Synchro Buffer Amplifier (8 VA) (**1A1A41**).

Time: 2.5 minutes

Tools: 3/16-inch ball-end Allen screwdriver, 1/8-inch straight blade screwdriver

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position Synchro Buffer Amplifier (8 VA) (**1A1A41**) in Processor Cabinet Assembly (**1A1**), ensuring that the guide pin on the Syncro Buffer Amp is aligned with the guide hole on the mounting surface.

b. Tighten six socket cap captive screws with a 3/16-inch ball-end Allen screwdriver.

c. Reconnect D-connector P15 to jack A41J1 on Synchro Buffer Amplifier (8 VA) (**1A1A41**).

d. Tighten captive lock screws securing D-connector P15 to jack A41J1 on Synchro Buffer Amplifier (8 VA) (**1A1A41**), using a 1/8-inch straight blade screwdriver.

e. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

f. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5.12 Synchro Buffer Amplifier (8 VA) (1A1A42) Replacement.

6.3.5.12.1 Remove Synchro Buffer Amplifier (8 VA) (1A1A42).

Goal: Removal of Synchro Buffer Amplifier (8 VA) (**1A1A42**).

Time: 2 minutes

Tools: 1/8-inch straight blade screwdriver, 3/16-inch ball-end Allen screwdriver

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Remove Power Supply (**1A1A6**).

d. Remove Synchro Buffer Amplifier (32 VA) (**1A1A43**).

e. Loosen captive lock screws securing D-connector P16 to jack A42J1 on Synchro Buffer Amplifier (8 VA) (**1A1A42**) using a 1/8-inch straight blade screwdriver.

f. Disconnect D-connector P16 from jack A42J1 on Synchro Buffer Amplifier (8 VA) (**1A1A42**).

g. Loosen six socket cap captive screws securing Synchro Buffer Amplifier (8 VA) (**1A1A42**), using a 3/16-inch ball-end Allen screwdriver.

h. Remove Synchro Buffer Amplifier (8 VA) (**1A1A42**) from Processor Cabinet Assembly (**1A1**).

Postrequisites: None.

6.3.5.12.2 Install Synchro Buffer Amplifier (8 VA) (1A1A42).

Goal: Installation of Synchro Buffer Amplifier (8 VA) (**1A1A42**).

Time: 2 minutes

Tools: 3/16-inch ball-end Allen screwdriver, 1/8-inch straight blade screwdriver

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position Synchro Buffer Amplifier (8 VA) (**1A1A42**) in Processor Cabinet Assembly (**1A1**), ensuring that the guide pin on the Synchro Buffer Amplifier is aligned with the guide hole on the mounting surface.

b. Tighten six socket cap captive screws with a 3/16-inch ball-end Allen screwdriver.

c. Connect D-connector P16 to jack A42J1 on Synchro Buffer Amplifier (8 VA) (**1A1A42**).

d. Tighten captive lock screws securing D-connector P16 to jack A42J1 on Synchro Buffer Amplifier (8 VA) (**1A1A42**), using a 1/8-inch straight blade screwdriver.

e. Install Synchro Buffer Amplifier (32 VA) (**1A1A43**).

f. Install Power Supply (**1A1A6**).

g. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

h. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

Postrequisites: None.

6.3.5.13 Synchro Buffer Amplifier (32 VA) (1A1A43) Replacement.

6.3.5.13.1 Remove Synchro Buffer Amplifier (32 VA) (1A1A43).

Goal: Removal of Synchro Buffer Amplifier (32 VA) (**1A1A43**).

Time: 2 minutes

Tools: 1/8-inch straight blade screwdriver, 3/16-inch ball-end Allen screwdriver

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Remove Power Supply (**1A1A6**).

d. Loosen captive lock screws securing D-connector P13 to jack A43J1 on Synchro Buffer Amplifier (32 VA) (**1A1A43**), using a 1/8-inch straight blade screwdriver.

e. Disconnect D-connector P13 from jack A43J1 on Synchro Buffer Amplifier (32 VA) (**1A1A43**).

f. Loosen six socket cap captive screws securing Synchro Buffer Amplifier (32 VA) (**1A1A43**), using a 3/16-inch ball-end Allen screwdriver.

g. Remove Synchro Buffer Amplifier (32 VA) (**1A1A43**) from Processor Cabinet Assembly (**1A1**).

Postrequisites: None.

6.3.5.13.2 Install Synchro Buffer Amplifier (32 VA) (1A1A43).

Goal: Installation of Synchro Buffer Amplifier (32 VA) (**1A1A43**).

Time: 3 minutes

Tools: 3/16-inch ball-end Allen screwdriver, 1/8-inch straight blade screwdriver

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position Synchro Buffer Amplifier (32 VA) (**1A1A43**) in Processor Cabinet Assembly (**1A1**), ensuring that the guide pin on the Synchro Buffer Amplifier is aligned with the guide hole on the mounting surface.

b. Tighten six socket cap captive screws with a 3/16-inch ball-end Allen screwdriver.

c. Connect D-connector P13 to jack A43J1 on Synchro Buffer Amplifier (32 VA) (**1A1A43**).

d. Tighten captive lock screws securing D-connector P13 to jack A43J1 on Synchro Buffer Amplifier (32 VA) (**1A1A43**), using a 1/8-inch straight blade screwdriver.

e. Install Power Supply (**1A1A6**).

f. Secure the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.3.

g. Turn on the RLGN using the procedure in Paragraph 2.3.1.

Postrequisites: None.

6.3.5.14 Synchro Buffer Amplifier (32 VA) (1A1A44) Replacement.

6.3.5.14.1 Remove Synchro Buffer Amplifier (32 VA) (1A1A44).

Goal: Removal of Synchro Buffer Amplifier (32 VA) (1A1A44).

Time: 2 minutes

Tools: 1/8-inch straight blade screwdriver, 3/16-inch ball-end Allen screwdriver

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

c. Loosen captive lock screws securing D-connector P14 to jack A44J1 on Synchro Buffer Amplifier (32 VA) (1A1A44), using a 1/8-inch straight blade screwdriver.

d. Disconnect D-connector P14 from jack A44J1 on Synchro Buffer Amplifier (32 VA) (1A1A44).

e. Loosen six socket cap captive screws securing Synchro Buffer Amplifier (32 VA) (1A1A44), using a 3/16-inch ball-end Allen screwdriver.

f. Remove Synchro Buffer Amplifier (32 VA) (1A1A44) from Processor Cabinet Assembly (1A1).

Postrequisites: None.

6.3.5.14.2 Install Synchro Buffer Amplifier (32 VA) (1A1A44).

Goal: Installation of Synchro Buffer Amplifier (32 VA) (1A1A44).

Time: 2 minutes

Tools: 3/16-inch ball-end Allen screwdriver, 1/8-inch straight blade screwdriver

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

Procedure:

a. Position Synchro Buffer Amplifier (32 VA) (1A1A44) in Processor Cabinet Assembly (1A1), ensuring that the guide pin on the Synchro Buffer Amplifier is aligned with the guide hole on the mounting surface.

b. Tighten six socket cap captive screws with a 3/16-inch ball-end Allen screwdriver.

c. Connect D-connector P14 to jack A44J1 on Synchro Buffer Amplifier (32 VA) (1A1A44).

d. Tighten captive lock screws securing D-connector P14 to jack A43J1 on Synchro Buffer Amplifier (32 VA) (1A1A44), using a 1/8-inch straight blade screwdriver.

e. Secure the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.3.

f. Turn on the RLGN using the procedure in Paragraph 2.3.1.

Postrequisites: None.

6.3.5.15 Battery Assembly (1A1A5) Replacement.

6.3.5.15.1 Remove Battery Assembly (1A1A5).

Goal: Removal of Battery Assembly (1A1A5).

Time: 6 minutes

Tools: ½-inch open-end wrench, ¼-inch drive ratchet, ¼-inch drive swivel adapter, 3/16-inch Allen socket, 3-inch extension

Prerequisites: None.

Procedure:

WARNING

The Battery Assembly (1A1A5) weighs 58.2 lbs (26.4 kg). To prevent injury to personnel or damage to equipment, two persons are required to remove or install it. The handle on the front of the Battery Assembly is intended to be used only for sliding the assembly into or out of the cabinet. Do not lift or carry the assembly by this handle.

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

c. Refer to Figure 6-5.

d. Set switch S1 on Battery Assembly (1A1A5) to OFF.

e. Remove rubber vent hose from vent tube on front of battery. Use care not to damage vent hose or tube.

f. Disconnect harness connector plug P5 from jack A5J1 on Battery Assembly (1A1A5). Place P5 away from the Battery Assembly to avoid damage to the wire harness.

g. Loosen clamp on each side of Battery Assembly (1A1A5) with a ½-inch open-end wrench.

h. Rotate the clamps outward to free the battery case.

i. Loosen the three screws that secure rails on each side of Battery Assembly (1A1A5) with the ¼-inch drive ratchet, ¼-inch drive swivel adapter, 3-inch extension, and 3/16-inch Allen socket.

j. Slide Battery Assembly (1A1A5) from Processor Cabinet Assembly (1A1), far enough to clear the cables and other subassemblies.

k. Lift Battery Assembly (1A1A5) from Processor Cabinet Assembly (1A1). Do not lift the battery by the handle.

Postrequisites: Refer to Paragraph 4.2 for battery maintenance, storage, and test procedures if the battery is to remain out of the system for a long period of time.

6.3.5.15.2 Install Battery Assembly (1A1A5).

Goal: Installation of Battery Assembly (1A1A5).

Time: 6 minutes

Tools: ½-inch open-end wrench, ¼-inch drive ratchet, ¼-inch drive swivel adapter, 3/16-inch Allen socket, 3-inch extension

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in Paragraph 6.3.1.2.

Procedure:

WARNING

The Battery Assembly (1A1A5) weighs 58.2 lbs (26.4 kg). To prevent injury to personnel or damage to equipment, two persons are required to remove or install it. The handle on the front of the Battery Assembly is intended to be used only for sliding the assembly into or out of the cabinet. Do not lift or carry the assembly by this handle.

a. Refer to Figure 6-5.

b. Slide Battery Assembly (1A1A5) in Processor Cabinet Assembly (1A1) with flanges on the bottom of the battery under the hold-down rails.

c. Rotate the two front clamps inward and tighten clamps with a ½-inch open-end wrench just enough to ensure that battery is firmly pushed back into position.

d. Tighten the three screws that secure the rails on each side of the Battery Assembly (1A1A5) with the ¼-inch drive ratchet, ¼-inch drive swivel adapter, 3-inch extension, and 3/16-inch Allen socket.

e. Tighten bolts that secure the front clamps on each side of Battery Assembly (1A1A5) with a ½-inch open-end wrench.

f. Connect rubber vent hose to the vent tube on the front of the battery.

g. Inspect hose to ensure it is not kinked or bent in a way that would inhibit proper venting of battery.

CAUTION

Ensure switch S1 on Battery Assembly (1A1A5) is set to OFF before connecting harness connector plug P5 to jack A5J1 on Battery Assembly.

h. Connect harness connector plug P5 to jack A5J1 on Battery Assembly (1A1A5).

i. Set switch S1 on Battery Assembly (1A1A5) to **ON**.

Postrequisites:

a. Restore RAM on Nav Processor CCA (**1A1A13**) by performing the Restore RLGN Configuration Parameters procedure.

b. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

c. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.6 DISPLAY ASSEMBLY REPLACEMENT.

6.3.6.1 Remove Display Assembly (1A1A10).

Goal: Removal of Display Assembly (**1A1A10**).

Time: 14 minutes

Tools: 5/16-inch open-end wrench, ¼-inch drive ratchet, ¼-inch drive 6-inch extension, 11/32-inch socket, small blade-tip screwdriver, small wire cutters

Prerequisites: None.

Procedure:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Refer to **Figure 6-6**.

d. Cut tie wraps that secure wire harnesses to the display assembly frame using small wire cutters. Be careful not to cut or nick wires.

e. Disconnect ribbon cable from jack J5 on Panel Interface Assembly (**1A1A10A2**) and from jack J1 on Data Entry Keyboard (**1A1A9**).

f. Disconnect door harness connectors from jacks J3 and J4 on Panel Interface Assembly (**1A1A10A2**) and from J2 on Vacuum Fluorescent Display (**1A1A10A1**) with a small blade-tip screwdriver.

WARNING

When Display Assembly (**1A1A10**) is removed, the processor cabinet door locking arm must be removed, allowing unrestricted door movement. This could become a dangerous condition in heavy seas. When the bracket is removed, the cabinet door should be tied down to restrict movement.

g. Remove the four nuts, lock washers and flat washers that secure the processor cabinet door locking arm bracket to the bottom of the Display Assembly frame, using a 5/16-inch open-end wrench.

h. Remove the 14 nuts and washers from stud bolts around the perimeter of the Display Assembly Frame with a ¼-inch drive ratchet, 6-inch extension and 11/32-inch socket.

i. Remove Display Assembly (**1A1A10**) from cabinet and place it in a safe location for servicing.

Postrequisites: None.

6.3.6.2 Remove Vacuum Fluorescent Display (1A1A10A1) from Display Assembly (1A1A10).

Goal: Removal of Vacuum Fluorescent Display (**1A1A10A1**).

Time: 18 minutes

Tools: 3/8-inch open-end wrench, ¼-inch drive ratchet, ¼-inch socket, small blade-tip screwdriver, medium size plug pliers, #2 Phillips-head screwdriver

Prerequisites: Remove Display Assembly from Upper Cabinet door.

Procedure:

CAUTION

Panel Interface Assembly (**1A1A10A2**) contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting parts sensitive to damage by ESD.

a. Place Display Assembly (**1A1A10**) on a smooth workbench surface.

b. Disconnect cable plug from Jack J1 on Panel Interface Assembly (**1A1A10A2**) with a small blade-tip screwdriver.

c. Remove the six nuts, lock washers and flat washers that secure Panel Interface Assembly (**1A1A10A2**) to the Display Assembly with a ¼-inch drive ratchet and ¼-inch socket.

d. Remove Panel Interface Assembly (**1A1A10A2**) from the stand-off mounts on Display Assembly (**1A1A10**).

e. Loosen 12 acorn mounts with medium size plug pliers approximately one turn to break adhesive seal.

f. Using a #2 Phillips-head screwdriver, back out screws (two for each mount) that secure vibration/shock mounts to Display Assembly frame, far enough to remove bumper stops from screws.

g. Remove 12 acorn bumper stops.

h. Remove the 12 screws, lock washers and flat washers that secure vibration/shock mounts to Display Assembly frame, using a #2 Phillips-head screwdriver.

i. Remove Vacuum Fluorescent Display (**1A1A10A1**) with inner mounting frame and shock/vibration mounts attached.

j. Remove four blue snubber mounts by hand from corner mounting studs on front of assembly. Exercise caution while handling or working near Vacuum Fluorescent Display (**1A1A10A1**) as it is very sharp and fragile.

k. Remove four acorn mounts from back of assembly by hand.

l. Remove two remaining sets of nuts, lock washers and flat washers that secure Vacuum Fluorescent Display (**1A1A10A1**) to inner display assembly frame with 3/8-inch open-end wrench.

m. Remove inner frame and shock mounts from Vacuum Fluorescent Display (**1A1A10A1**) by hand.

n. Remove six threaded hex spacers and six 2.5-inch long pan-head screws, which are installed through assembly mounting stand-offs.

Postrequisites: None.

6.3.6.3 Remove Panel Interface Assembly (1A1A10A2).

Goal: Removal of Panel Interface Assembly (**1A1A10A2**).

Time: 3 minutes

Tools: ¼-inch drive ratchet, ¼-inch socket, small blade-tip screwdriver, ESD protective bag

Prerequisites: None.

Procedure:

CAUTION

Panel Interface Assembly (**1A1A10A2**) contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting parts sensitive to damage by ESD.

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

c. Disconnect cable plugs from Jacks J1, J3, and J4 on Panel Interface Assembly (**1A1A10A2**) with a small blade-tip screwdriver. Disconnect ribbon cable plug J5 by spreading locking tabs outward.

d. Remove the six nuts, lock washers and flat washers that secure Panel Interface Assembly (**1A1A10A2**) to Display Assembly (**1A1A10**) with a ¼-inch drive ratchet and ¼-inch socket.

e. Remove Panel Interface Assembly (**1A1A10A2**) from the stand-off mounts on Display Assembly (**1A1A10**) and place it in an ESD protective bag.

Postrequisites: None.

6.3.6.4 Remove Display Electromagnetic Interference Window.

Goal: Removal of Display Electromagnetic Interference Window.

Time: 2 minutes

Tool: #2 Phillips-head screwdriver

Prerequisites: Remove Display Assembly (**1A1A10**) from Upper Cabinet door.

Procedure:

CAUTION

An electromagnetic interference (EMI) shielding gasket is installed between the EMI window bezel and the outside surface of the door. Use care during removal and replacement of the bezel to prevent damage to the EMI gasket. If the gasket becomes torn, it must be replaced with a new gasket.

a. Remove eight Phillips-head screws that secure Display bezel to door (from inside the door).

b. Remove bezel, EMI window and EMI shielding gasket.

Postrequisites: None.

6.3.6.5 Remove Data Entry Keyboard (1A1A9).

Goal: Removal of Data Entry Keyboard (**1A1A9**).

Time: 6.75 minutes

Tools: #2 Phillips-head screwdriver, razor blade knife, 5/16-inch socket and ratchet or 5/16-nut-driver, wire cutters

Prerequisites: Remove Display Assembly (**1A1A10**) from Upper Cabinet door.

Procedure:

CAUTION

An EMI shielding gasket is installed between the Data Entry Keyboard and the outside surface of the door. Use care during removal and replacement of the Data Entry Keyboard to prevent damage to the EMI gasket. If the gasket becomes torn, it must be replaced with a new gasket. Be sure that gasket is positioned correctly when installing the Data Entry Keyboard. Incorrect positioning of the gasket will short the printed wiring on the CCA and cause improper operation of Keyboard functions.

a. Cut the tie-wraps and clear wiring harness from lower screws of the Keyboard bezel.

b. Remove the six Phillips-head screws that secure Keyboard bezel to door (from inside the door).

c. Break the silicon rubber seal connection between the bezel and the cabinet door using a razor blade knife.

d. Remove the bezel.

e. Remove four nuts and washers that secure Data Entry Keyboard (**1A1A9**) to the door using a 5/16-inch socket or nut-driver.

f. Remove the Data Entry Keyboard (**1A1A9**) and EMI shielding gasket. Be careful not to damage the EMI gasket.

Postrequisites: None.

6.3.6.6 Install Data Entry Keyboard (1A1A9).

Goal: Installation of Data Entry Keyboard (**1A1A9**).

Time: 12 minutes

Tools: #2 Phillips-head screwdriver, Loctite Grade AV Red adhesive, Silicone rubber sealant [Room Temperature Vulcanizing (RTV)], masking tape, 5/16-inch socket and ratchet or 5/16-nut-driver, tie wraps, paper towel.

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Place the EMI shielding gasket on Data Entry Keyboard (**1A1A9**) so that gasket is positioned with narrow edge down and circular cutout in gasket is behind **<AUX FUNC>** key as shown in **Figure 6-7**. Be careful not to nick or tear the gasket. Ensure that the EMI gasket is properly positioned. Incorrect positioning can short the printed wiring on the CCA and cause improper operation of the Keyboard.

b. Position Data Entry Keyboard (**1A1A9**) on the door and secure it using four #6-32 nuts, flat washers and lock washers.

c. Insert six #6-32 x 5/8-inch Phillips-head screws through the bezel mounting holes from inside the door.

d. Secure the screws with masking tape to prevent them from falling out of the holes while the bezel is being installed.

e. Place the EMI shielding gasket on the door.

f. Center the holes in the EMI gasket on the ends of the bezel mounting screws.

g. Place a small drop of Loctite Grade AV Red adhesive on the first two threads of each bezel mounting screw.

h. Position the bezel on the door with cutouts in the bezel edge facing downward.

i. Secure the bezel with six Phillips-head screws using a #2 Phillips-head screwdriver.

j. Tighten screws by pushing the screwdriver through the tape.

k. Remove tape after all screws are tightened.

l. Secure wiring harness covering three bottom screws with tie-wraps.

m. Tighten the four nuts that secure Data Entry Keyboard (**1A1A9**), using a 5/16-inch socket and ratchet or 5/16-nut-driver.

n. Run a thin bead of silicon RTV sealing compound across the top and down each side of the bezel to seal the bezel to the front panel after the Data Entry Keyboard is installed. This seal prevents moisture from running down the front panel and behind the bezel onto the keyboard. Do not seal the bottom edge of the bezel.

o. Force the compound into the seam with finger.

p. Wipe off excess compound with a paper towel.

Postrequisites:

a. Install Display Assembly (**1A1A10**).

b. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

c. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.6.7 Install Display Electromagnetic Interference Window.

Goal: Installation of Display Electromagnetic Interference Window.

Time: 2 minutes

Tools: #2 Phillips-head screwdriver, Loctite Grade AV Red adhesive, masking tape

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

CAUTION

An electromagnetic interference (EMI) shielding gasket is installed between the EMI window bezel and the outside surface of the door. Use care during removal and replacement of the bezel to prevent damage to the EMI gasket. If the gasket becomes torn, it must be replaced with a new gasket.

a. Insert eight #6-32 x 5/8-inch Phillips-head screws through the bezel mounting holes from inside the door.

b. Secure the screws with masking tape to prevent them from falling out of the holes while the bezel is being installed.

c. Place the rubber gasket on the door.

d. Center the holes in the rubber gasket around the ends of the bezel mounting screws.

e. Place a small drop of Loctite Grade AV Red adhesive on the first two threads of each bezel mounting screw.

f. Place the EMI window and EMI gasket in the bezel so that the dull side of the window will face outward when the bezel and window are installed on the door.

g. Position the bezel and window on the door and secure the bezel using eight Phillips-head screws.

h. Tighten the screws by pushing the screwdriver through the tape.

i. Remove tape after all screws are tightened.

Postrequisites:

a. Replace Display Assembly (**1A1A10**).

b. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

c. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.6.8 Install Panel Interface Assembly (1A1A10A2).

Goal: Installation of Panel Interface Assembly (**1A1A10A2**).

Time: 3 minutes

Tools: ¼-inch drive ratchet, ¼-inch socket, small flat blade screwdriver, ESD wrist strap

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

CAUTION

Panel Interface Assembly (**1A1A10A2**) contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting parts sensitive to damage by ESD.

a. Position Panel Interface Assembly (**1A1A10A2**) on stand-off mounts on Display Assembly (**1A1A10**).

b. Install six lock washers, six flat washers and six nuts.

c. Tighten the nuts snugly with a ¼-inch drive ratchet and a ¼-inch socket (be careful not to over tighten).

d. Connect the cable plugs to jacks 1A1A10A2J1, 1A1A10A2J3, and 1A1A10A2J4 with a small flat blade screwdriver. Reconnect 1W3 ribbon cable plug to 1A1A10A2J5 by pressing connector into plug and squeezing locking tabs inward.

Postrequisites:

a. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

b. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.3.6.9 Install Vacuum Fluorescent Display (1A1A10A1) to Display Assembly (1A1A10).

Goal: Installation of Vacuum Fluorescent Display (**1A1A10A1**).

Time: 24 minutes

Tools: ¼-inch open-end wrench, #2 Phillips-head Screwdriver, 3/8-inch open-end wrench, Loctite, grade "C" blue

Prerequisites: None.

Procedure:

CAUTION

Panel Interface Assembly (**1A1A10A2**) contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting parts sensitive to damage by ESD.

a. Check that configuration jumper settings on Vacuum Fluorescent Display (**1A1A10A1**) are installed as shown in **Figure 6-8**.

b. Insert six 2.5-inch long screws through mounting stand-offs in Vacuum Fluorescent Display (**1A1A10A1**) as shown in **Figure 6-8**.

c. Place Vacuum Fluorescent Display (**1A1A10A1**) face down on a smooth clean surface.

d. Install one .38-inch long threaded hex spacer on each corner mounting screw.

e. Install one .50-inch long threaded hex spacer on each center mounting screw.

f. Tighten each spacer using a ¼-inch open-end wrench.

g. Align the inner display frame so that the detent on the frame coincides with jack 1A1A10A1J2.

h. Position the inner display frame (with shock mounts attached) on the assembly.

i. Install flat washer, lock washer and nut on two center screws to secure the inner display frame to Vacuum Fluorescent Display (**1A1A10A1**).

j. Tighten nuts using a 3/8-inch open end wrench.

k. Place a small drop of Loctite grade C Blue adhesive on threads of corner mounting screws.

l. Install a short acorn mount on each corner mounting screw to secure the frame to Vacuum Fluorescent Display (**1A1A10A1**).

m. Position Vacuum Fluorescent Display (**1A1A10A1**) (with inner mounting ring and shock mounts attached) in Display Assembly (**1A1A10**) frame so that top of display is near the circular cable routing opening in back of frame.

n. Insert the cable from Vacuum Fluorescent Display (**1A1A10A1**) through the opening and slide into the frame.

o. Install 12 sets of washers and screws that secure vibration/shock mounts to Display Assembly frame. Turn each screw only until flush with back of frame.

p. Place a small drop of Loctite grade C Blue adhesive on threads of each acorn mount.

q. Hold each acorn mount with plug pliers to prevent rotation and tighten the mounting screws so that the screws draw into screw mounting plate and acorn mount at the same time.

r. Use plug pliers to tighten the acorn mount onto the end of the mounting screw.

s. Place a small drop of Loctite grade C Blue adhesive on threads of each corner-mounting stud on front of Vacuum Fluorescent Display (**1A1A10A1**).

t. Install blue snubber mounts on studs and hand tighten.

CAUTION

Panel Interface Assembly (**1A1A10A2**) contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautions when touching, removing, storing, or inserting parts sensitive to damage by ESD.

u. Place Vacuum Fluorescent Display (**1A1A10A1**) face down on a smooth clean surface.

v. Position the Panel Interface Assembly on stand-off mounts on the Display assembly.

w. Install six lock washers, six flat washers and six nuts.

x. Tighten the nuts snugly with a ¼-inch open-end wrench (be careful not to over tighten).

y. Connect the cable plug to jack 1A1A10A2J1 with a small flat blade screwdriver.

Postrequisites: None.

6.3.6.10 Install Display Assembly (1A1A10).

Goal: Installation of Display Assembly (**1A1A10**).

Time: 20 minutes

Tools: 5/16-inch open-end wrench, ¼-inch drive ratchet, ¼-inch drive 6-inch extension, 11/32-inch socket, nylon wire ties, small blade-tip screwdriver

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

Procedure:

a. Position Display Assembly (**1A1A10**) on mounting studs on door of Processor Cabinet Assembly (**1A1**). Be sure that if the Display is new, that the protective film on the front is removed prior to installation.

b. Secure the Display Assembly with 14 nuts, 14 flat washers and 14 lock washers.

c. Tighten nuts with a ¼-inch drive ratchet, 6-inch extension and a 11/32-inch socket.

d. Secure the processor cabinet door locking arm bracket to the bottom of the Display Assembly frame with 4 nuts, 4 flat washers and 4 lock washers.

e. Tighten the bracket with a 5/16-inch open-end wrench.

f. Connect the door harness connectors to jacks J3 and J4 on Panel Interface Assembly (**1A1A10A2**) and to J2 on Vacuum Fluorescent Display (**1A1A10A1**).

g. Connect ribbon cable 1W3 to jack J5 on Panel Interface Assembly (**1A1A10A2**) and to jack J1 on Data Entry Keyboard (**1A1A9**).

h. Install ties as necessary to secure cable harness to display assembly frame.

Postrequisites:

a. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

b. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4 CORRECTIVE MAINTENANCE (LOWER CABINET).

6.4.1 LOWER CABINET ACCESS.

6.4.1.1 Remove IMU Cabinet Front Panel.

Goal: Gain physical access to AN/WSN-7(V) Lower Cabinet's IMU assemblies to troubleshoot, remove or install assemblies.

Time: 15 minutes

Tools: 3/16-inch T-handle Allen wrench

Prerequisites: When performing corrective maintenance, perform Maintenance Turn Off procedure.

Procedure:

DANGER

When troubleshooting, do not touch any live or exposed circuits inside the AN/WSN-7(V). 115 VAC and deadly current are present until power input to the RLGN is removed.

DANGER

When performing corrective maintenance, ensure that all ship's power to the AN/WSN-7(V) is turned off and tagged out in accordance with ship's instructions.

a. Using a 3/16-inch T-handle Allen wrench, remove 19 screws that secure the cover on the Cabinet.

b. Remove the cover and store it in a safe place.

Postrequisites:

a. If this procedure is performed as part of troubleshooting a suspect faulty assembly, return to the troubleshooting procedure for further instructions.

b. If this procedure is performed as part of replacing a faulty assembly, return to the removal procedure for the faulty assembly for further instructions.

c. If this procedure is performed for demonstration purposes, reinstall IMU Cabinet Front Panel.

6.4.1.2 Remove Inertial Measuring Unit (1A2A1). (Refer to Figures 6-9 and 6-10).

Goal: Removal of Inertial Measuring Unit (1A2A1).

Time: 15 minutes

Tools: small blade-tip screwdriver, 5/16-inch T-handle Allen wrench, 1-5/16-inch socket, 24-inch breaker bar and socket wrench

Prerequisites:

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Remove the IMU Cabinet Front Panel.

Procedure:

WARNING

The IMU weighs 162 lbs (73 kg). Two persons are required to remove the IMU from its cabinet and place it for servicing or shipment.

CAUTION

The lower surface of the IMU mounting plate and the upper surface of the cabinet mounting plate contain precision-machined surfaces that are used to support and align the IMU in the cabinet. When removing and replacing the IMU in the cabinet, use care not to damage these surfaces. When the IMU is removed from the cabinet, place the IMU on a smooth, 4 ft. x 4 ft. sheet of clean plywood or two layers of heavy cardboard to prevent scratching of the mounting surfaces on the bottom side of the unit.

CAUTION

It is important to maintain a correct record of configuration data, so the System Configuration Menu can be reinitialized if stored data is lost. Immediately after installing a new IMU and associated PROMs, read the new cabinet-mounting alignment values and record them on the Installation Data Record Sheet retained with the INS. These misalignments are specific for the new IMU. Use of the previous IMU's misalignment values will result in alignment errors being introduced into the system.

a. Remove two nylon screws that secure cast tabs on back of the IMU mounting plate to machined alignment surfaces at back of cabinet base using a 5/16-inch T-handle Allen wrench.

b. Remove three bolts that secure the IMU mounting plate to cabinet base, using a 1-5/16-inch socket, 24-inch breaker bar and socket wrench.

CAUTION

Gyros are susceptible to ESD damage if contact is made with pins of jacks A12J1, A12J2, A13J1, or A13J2. Cover these jacks with ESD-approved protective caps any time they are exposed.

c. Disconnect cables W1 and W4 from jacks A12J1 and A12J2.

d. Cover A12J1 and A12J2 with ESD protective caps to prevent damage.

e. Disconnect A1M1W1P1 from its mating jack on outer support with a small blade-tip screwdriver.

f. Rotate the inner gimbal ring so that it is parallel with the outer gimbal frame.

g. Slide the IMU carefully from the cabinet far enough to access the two rear cables.

h. Disconnect cables W3 and W2 from jacks A13J1 and A13J2.

i. Cover A13J1 and A13J2 with ESD protective caps to prevent damage.

CAUTION

Be sure that the inner gimbal is rotated parallel to the outer gimbal frame to prevent the inner synchro or torquer motor from hitting the top of the cabinet during removal. Do not slide the IMU directly out of the cabinet onto the floor. Slide the IMU out far enough for access, then lift the assembly and place it onto a clean smooth surface.

j. Slide the IMU out of the cabinet far enough so that it can be removed.

k. Lift the IMU from the cabinet using the outer frame and place it directly onto a piece of smooth, clean plywood or heavy cardboard surface. Do not lift the IMU by the shock mounts.

Postrequisites: None.

6.4.1.3 Remove Magnetic Shield from Sensor Block Assembly.

Goal: Removal of Magnetic Shield from Sensor Block Assembly.

Time: 8 minutes

Tools: small blade-tip screwdriver, 1/16-inch T-handle Allen wrench, 3/32-inch Allen wrench

Prerequisites: Remove Inertial Measuring Unit (1A2A1).

Procedure:

CAUTION

When removing, replacing, or storing the shield during maintenance, ensure that the shield components are not dented or bent. Dropping or striking a shield segment can result in degradation of the magnetic shielding characteristics of the metal. Damage to the shield could result in improper fit, causing balance and acoustic noise problems, as well as degradation of the magnetic shielding properties.

CAUTION

During removal or replacement of the magnetic shield, use caution when rotating the Sensor Block with partially assembled segments to prevent the edge of a segment from capturing and damaging the slip ring harnesses routed inside the inner gimbal frame.

a. Position the IMU so that you are facing the unit from the front.

b. Rotate the inner gimbal ring so that it is positioned with the inner gimbal synchro facing upward as shown in Figure 6-11, View B.

c. Rotate the sensor block so that one of the two mounting screws for shield section "C" is positioned directly below the access hole through the synchro shield and inner gimbal casting.

CAUTION

Use a standard Allen-head wrench. Use of a ball-end Allen-head wrench could cause damage to the screw.

d. Insert a 1/16-inch T-handle Allen wrench down through the access hole and loosen the first screw no more than three full turns.

e. Extract the wrench far enough to allow free rotation of the Sensor Block, and turn the Sensor Block far enough to loosen the next screw in shield segment “C”.

f. Repeat step e to loosen the third mounting screw on shield segment “C”.

g. Remove the wrench and rotate the sensor block so that the torquer is facing upward.

h. Repeat steps c through f for the screws at the torquer end of shield segment “C”.

i. Rotate the sensor block so that the seam at the junction of the “C” and “A” segments is facing upward.

j. Loosen the two captive screws securing shield segment “C” to shield segment “A” with a 3/32” Allen wrench.

k. Rotate the sensor block so that the seam at the junction of the “C” and “B” segments is facing upward.

l. Loosen the two captive screws securing shield segment “C” to shield segment “B” with a 3/32” Allen wrench.

m. Rotate the sensor block so that segment “C” is facing upward.

n. Slide the shield segment ends out from under the screws on the mounting rings and remove the segment. The inner gimbal assembly is now no longer balanced.

o. Repeat steps c through h for shield segment “B”.

p. Rotate the sensor block so that the seam at the junction of the “A” and “B” segments is facing upward.

q. Loosen the two captive screws securing shield segment “B” to shield segment “A” with a 3/32” Allen wrench.

r. Rotate the sensor block so that segment “B” is facing upward.

s. Slide the shield segment ends out from under the screws on the mounting rings and remove the shield segment.

t. Repeat steps c through h for shield segment “A”.

u. Rotate the sensor block so that segment “A” is facing upward.

v. Slide the shield segment ends out from under the screws on the mounting rings and remove the shield segment.

Postrequisites: None.

6.4.1.4 Install Magnetic Shield on Sensor Block Assembly.

Goal: Installation of Magnetic Shield on Sensor Block Assembly.

Time: 12 minutes

Tools: small blade-tip screwdriver, 5/16-inch T-handle Allen wrench, torque wrench, 1-5/16-inch socket, isopropyl alcohol or an equivalent cleaning solvent, adhesive (P/N P-1896320) or equivalent

Prerequisites: None.

Procedure:

CAUTION

When removing, replacing, or storing the shield during maintenance, ensure that the shield components are not dented or bent. Dropping or striking a shield segment can result in degradation of the magnetic shielding characteristics of the metal. Damage to the shield could result in improper fit, causing balance and acoustic noise problems, as well as degradation of the magnetic shielding properties.

CAUTION

During removal or replacement of the magnetic shield, use caution when rotating the Sensor Block with partially assembled segments to prevent the edge of a segment from capturing and damaging the slip ring harnesses routed inside the inner gimbal frame.

a. Install shield segment “A” as follows:

(1) Rotate the inner gimbal ring so that it is aligned in the same plane as the outer gimbal support, with the synchro and torquer motor positioned at the right and left, respectively. Refer to Figure 6-11, View A.

(2) Rotate the Sensor Block so that the High Voltage Power Supply and Accelerometer “B” are oriented toward the front of the IMU and facing slightly downward.

(3) Position segment “A” of the Magnetic Shield so that the identification tag on the segment is toward the right (nearest synchro on inner gimbal).

(4) Slide the segment down onto the circular mounting plates at each end so that the three screw slots on each end of the shield slide under the three mounting screws on each plate.

(5) Hold the shield segment and carefully rotate inner gimbal ring so that it is positioned with the inner gimbal synchro facing upward, as shown in Figure 6-11, View B.

(6) Rotate the Sensor Block so that the center mounting screw for segment “A” is positioned directly below the access hole through the synchro shield and inner gimbal casting.

(7) Insert a 1/16-inch T-Handle Allen wrench down through access hole and tighten the center mounting screw. Do not tighten the other two screws on this end at this time.

(8) Remove the wrench and rotate the inner gimbal so that the inner Torquer Motor is facing upward.

(9) Rotate the Sensor Block so that center mounting screw for segment “A” is positioned directly below the access hole through the Torquer Motor shield and inner gimbal casting.

(10) Tighten the center mounting screw. Do not tighten the other two screws on this end at this time.

b. Install shield segment “B” as follows:

(1) Rotate the inner gimbal ring so that it is aligned in the same plane as the outer gimbal support, with the synchro and torquer motor positioned at the right and left, respectively.

(2) Rotate the Sensor Block so that segment “A” of the shield is oriented forward and the High Voltage Power Supply is oriented facing downward and slightly toward the rear of the IMU.

(3) Position segment “B” of the Magnetic Shield so that the identification tag on the segment is toward the right (nearest synchro on inner gimbal).

(4) Slide the segment down onto the circular mounting plates at each end so that the three screw slots on each end of the shield slide under the three mounting screws on each plate.

(5) Tighten two captive screws that secure shield segment “B” to shield segment “A”, using a 3/32-inch Allen wrench.

(6) Rotate the gimbal, as required, and loosen the center end screws that secure segment “A” just far enough to allow the shield segments to be moved under the mounting screws.

(7) Rotate the Sensor Block so that the junction between segments “A” and “B” of the shield is oriented upward.

(8) Loosen the two captive screws and move the shield segments as required to obtain good alignment between the shield segments at this seam.

(9) Tighten the two captive screws.

c. Install shield segment “C” as follows:

(1) Rotate the inner gimbal ring so that it is aligned in the same plane as the outer gimbal support with the synchro and torquer motor positioned at the right and left, respectively.

(2) Rotate the Sensor Block so that the High Voltage Power Supply is oriented directly upward.

(3) Position segment “C” of the Magnetic Shield so that the identification tag on the segment is toward the right (nearest synchro on inner gimbal).

(4) Slide the segment down onto the circular mounting plates at each end so that the three screw slots on each end of the shield slide under the three mounting screws on each plate.

(5) Tighten four captive screws that secure shield segment “C” to shield segments “B” and “A”, using a 3/32-inch Allen wrench. Tighten screws just enough to secure segment “C”.

(6) Move the shield segments, as required, to obtain good alignment between the shield segments at both seams.

(7) Tighten the four captive screws.

d. Adjust and secure the shield segments as follows:

(1) Rotate the inner gimbal ring so that it is positioned with the inner gimbal synchro facing upward.

(2) Move the Magnetic Shield assembly, as necessary, so that it is centered on the circular mounting plate and does not touch the plate support hardware.

(3) Rotate the Sensor Block, as necessary, and tighten the center end mounting screw for each segment of the shield. Do not tighten the other six end screws at this time.

(4) Rotate the inner gimbal ring so that it is positioned with the inner gimbal Torquer Motor facing upward.

e. Inspect the shield assembly to confirm that it is centered on the circular mounting plate and does not touch the plate support hardware.

CAUTION

Use a standard Allen-head wrench. Use of a ball-end Allen-head wrench could cause damage to the screw.

(1) If the shield is properly centered, rotate the Sensor Block as necessary and tighten the center end mounting screw for each segment of the shield. Do not tighten the other six screws at this time.

(2) If the shield is not properly centered, repeat steps **d(1)** through **d(3)** to reposition the shield and then repeat steps **d(4)** and **e** until the shield is centered at both the synchro and torquer motor ends.

f. Rotate the inner gimbal and Sensor Block as necessary and tighten the six remaining screws at each end of the Magnetic Shield. Tighten the screws in an alternating sequence between the torquer motor and synchro ends.

Postrequisites: None.

6.4.1.5 Install Inertial Measuring Unit (1A2A1).

Goal: Installation of Inertial Measuring Unit (1A2A1).

Time: 20 minutes

Tools: small blade-tip screwdriver, 5/16-inch T-handle Allen wrench, torque wrench, 1-5/16-inch socket, isopropyl alcohol or an equivalent cleaning solvent, adhesive (P/N P-1896320) or equivalent

Prerequisites:

a. Ensure that the RLGN is turned off.

b. Remove the IMU Cabinet Front Panel using the procedure in **Paragraph 6.4.1.1**.

Procedure:

WARNING

The IMU weighs 162 lbs (73 kg). Two persons are required to install this assembly in the cabinet. Be sure that the inner gimbal is rotated parallel to the outer gimbal frame to prevent the outer synchro or torquer motor from hitting the top of the cabinet during installation. Do not slide the IMU directly into the cabinet from the floor. Lift the assembly until the bottom of the mounting plate is even with the base of the cabinet and slide it into position.

a. Rotate the inner gimbal until it is parallel with outer gimbal frame to prevent synchro or torquer motor from hitting top of cabinet during installation, as shown in **Figure 6-10**.

b. Lift the IMU into the cabinet using the outer frame and place alignment rails on bottom of IMU mounting plate into grooves in cabinet base. Do not lift the IMU by the shock mounts.

c. Slide the IMU carefully into the cabinet far enough to connect the two rear cables W3 and W2 to jacks A13J1 and A13J2.

d. Slide the locking tabs on the jacks into position to secure the cable plugs.

e. Slide the IMU carefully into the cabinet until the IMU mounting plate lowers down onto the mounting surfaces on cabinet the base, and alignment tabs on rear of plate contact the machined surfaces at back of cabinet base.

f. Connect the two front cables (W1 and W4) to jacks A12J1 and A12J2.

g. Slide the locking tabs on the jacks into position to secure the cable plugs.

h. Connect the elapsed time meter connector A1M1W1P1 to its mating jack, using a small blade-tip screwdriver.

i. Install three bolts, flat washers and lock washers that secure the IMU mounting plate to the cabinet base. Do not tighten the bolts at this time.

CAUTION

The screws used to align the mounting plate in the cabinet base are made of nylon. These screws should be tightened just sufficiently to ensure firm contact between the machined alignment surfaces (5 to 7 in-lbs). Excessive tightening of these screws may cause them to break.

j. Install two nylon screws and flat washers, which secure cast tabs on the back of the IMU mounting plate to machined alignment surfaces at back of cabinet base. Excessive tightening of these screws could cause them to break.

k. Tighten the left screw with a 5/16-inch T-handle Allen wrench first.

l. Tighten the right screw to pull the IMU mounting plate firmly into contact with the alignment surfaces.

m. Tighten the three bolts that secure the IMU mounting plate to the cabinet base, using a 1-5/16-inch socket and torque wrench.

n. Torque the bolts to 110 ft-lb alternately by torquing each bolt first to 50 ft-lb, then to 80 ft-lb, then to 110 ft-lb.

CAUTION

It is important to maintain a correct record of configuration data, so the System Configuration Menu can be reinitialized if stored data is lost. Immediately after installing a new IMU and associated PROMs, read the new cabinet-mounting alignment values and record them on the Installation Data Record Sheet retained with the INS. These misalignments are specific for the new IMU. Use of the previous IMU's misalignment values will result in alignment errors being introduced into the system.

Postrequisites:

a. Install the IMU Cabinet Front Panel using the procedure in **Paragraph 6.4.1.6**.

b. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4.1.6 Install IMU Cabinet Front Panel.

Goal: Close and secure physical access to AN/WSN-7(V) Lower Cabinet's IMU assemblies under all conditions.

Time: 15 minutes

Tools: 3/16-inch T-handle Allen wrench

Prerequisites: Ensure that the RLGN is turned off.

Procedure:

DANGER

When troubleshooting, do not touch any live or exposed circuits inside the AN/WSN-7(V). 115 VAC and deadly current are present until power input to the RLGN is removed.

DANGER

When performing corrective maintenance, ensure that all ship's power to the AN/WSN-7(V) is turned off and tagged out in accordance with ship's instructions.

a. Inspect the cover gasket for damage prior to installing. If the gasket is damaged, replace it by performing steps b through i. If gasket replacement is not required, install the cover using a 3/16-inch T-handle Allen wrench to tighten the 19 screws that secure the cover on the cabinet.

b. Remove the damaged gasket from the cover groove and clean the groove with isopropyl alcohol, or an equivalent cleaning solvent.

c. If necessary, refer to the cover on the other AN/WSN-7(V) as a guide for correct positioning of the replacement gasket.

d. Dry fit the replacement gasket (P/N 1810906-3) into the cover groove, ensuring that the gasket is positioned so that both the rubber and wire mesh sides of the gasket are visible, and the wire mesh side is facing toward the center of the cover.

e. Cut the gasket slightly longer than needed, then remove the gasket from the cover groove.

f. Knead a tube of adhesive (P/N P-1896320) or equivalent.

g. Apply a small bead of adhesive along the bottom of the cover groove and install the gasket. Trim off excess gasket.

h. Clean off any excess adhesive with isopropyl alcohol.

i. Bolt the cover into place to fully seat the gasket.

Postrequisites:

a. If this procedure is performed as part of troubleshooting a suspect fault assembly, return to the troubleshooting procedure for further instructions.

b. If this procedure is performed as part of replacing a faulty assembly, return to the removal procedure for the faulty assembly for further instructions.

c. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4.2 POWER SUPPLY REPLACEMENT.

6.4.2.1 Remove High Voltage Power Supply Assembly (1A2A1A1A4).

Goal: Removal of High Voltage Power Supply Assembly (**1A2A1A1A4**).

Time: 4 minutes

Tools: small blade-tip screwdriver, 7/64-inch T-handle Allen wrench, 9/64-inch T-handle Allen wrench, #1 Phillips-head screwdriver

Prerequisites:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Remove Inertial Measuring Unit (**1A2A1**).

c. Remove Magnetic Shield from Sensor Block Assembly.

Procedure:

CAUTION

Use care during the removal and replacement of High Voltage Power Supply Assembly (**1A2A1A1A4**). Misalignment of the IMU in the isolators can occur if care is not taken. A 72-hour alignment/calibration should be performed following the removal and replacement of the High Voltage Power Supply to compensate for IMU misalignment.

a. Rotate inner gimbal and Sensor Block Assembly (**1A2A1A1A9MP1**) so that the front of the High Voltage Power Supply faces upward and mounting hardware can be accessed easily.

b. Disconnect three "D" connectors from the front of the High Voltage Power Supply by unscrewing two captive screws on each plug with a small blade-tip screwdriver.

c. Disconnect one connector from the front of the High Voltage Power Supply by unscrewing four non-captive screws with a #1 Phillips-head screwdriver.

d. Tie cable and leads out of the way to prevent damage to wires as the Sensor Block Assembly is rotated during disassembly.

e. Loosen the two screws that secure the rear of the High Voltage Power Supply inside the sensor block using a 7/64-inch T-handle Allen wrench.

f. Loosen four captive screws that secure the front of the supply to the Sensor Block Assembly using a 9/64-inch T-handle Allen wrench.

g. Remove the High Voltage Power Supply.

Postrequisites: None.

6.4.2.2 Installation of High Voltage Power Supply Assembly (1A2A1A1A4).

Goal: Installation of High Voltage Power Supply Assembly (**1A2A1A1A4**).

Time: 6 minutes

Tools: Small blade-tip screwdriver, 7/64-inch T-handle Allen wrench, 9/64-inch T-handle Allen wrench

Prerequisites: None.

Procedure:

CAUTION

Use care during the removal and replacement of High Voltage Power Supply Assembly (**1A2A1A1A4**). Misalignment of the IMU in the isolators can occur if care is not taken. A 72-hour alignment/calibration should be performed following the removal and replacement of the High Voltage Power Supply to compensate for IMU misalignment.

a. Rotate the inner gimbal and sensor block so that the High Voltage Power Supply cavity faces upward.

b. Insert the High Voltage Power Supply into Sensor Block Assembly (**1A2A1A1A9MP1**), using care not to damage wires from Slip Ring Assembly (**1A2A1A1A11**), which enter the Sensor Block Assembly near the back of the cavity.

c. Engage two screws that secure the rear of the High Voltage Power Supply inside the sensor block, using a 7/64-inch T-handle Allen wrench. Do not tighten the screws at this time.

d. Tighten four captive screws that secure the front of the High Voltage Power Supply to the Sensor Block Assembly, using a 9/64-inch T-handle Allen wrench.

e. Tighten two screws that secure the rear of the High Power Supply to the Sensor Block Assembly, using a 7/64-inch T-handle Allen wrench.

f. Connect plugs (**1A2A1A1A9A4P1**) through (**1A2A1A1A9A4P4**) to jacks 1A2A1A1A9A4J1 through 1A2A1A1A9A4J4 on front of High Voltage Power Supply.

Postrequisites:

a. Install the Magnetic Shield on the Sensor Block Assembly.

b. Install the IMU.

c. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4.3 GYROCOMPASS REPLACEMENT.

6.4.3.1 Gyro "A" (1A2A1A1A1) Replacement.

6.4.3.1.1 Remove Gyro "A" (1A2A1A1A1) (419 Hz dither frequency).

Goal: Removal of Gyro "A" (**1A2A1A1A1**).

Time: 5 minutes

Tools: Small blade-tip screwdriver, 90-degree offset blade-tip screwdriver, 5/32-inch ball-end Allen screwdriver, 3/16-inch T-handle Allen wrench

Prerequisites:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Remove the IMU.

c. Remove the Magnetic Shield from the Sensor Block Assembly.

d. Remove the High Voltage Power Supply Assembly.

Procedure:

CAUTION

Ring Laser Gyros are ESDS devices. Handle in accordance with ESD procedures. Gyros are shock sensitive. Use great care when handling and storing gyros.

CAUTION

The surfaces on Sensor Block Assembly (**1A2A1A9**) for mounting the RLGs and accelerometers, as well as the mounting surfaces of the gyros and accelerometers, are precision-machined surfaces. Be careful not to damage these surfaces when performing repairs. Place gyros and accelerometers in a protective ESD bag and store these subassemblies in a safe place to prevent them from being damaged while they are removed from the system.

CAUTION

The attachment screws on each Ring Laser Gyro (RLG) should be evenly tightened to approximately the specified torque. Since the torque recommendations primarily ensure that screws are sufficiently tightened without being stressed or broken by over tightening, and since some mounting screws are inaccessible using some torque measuring devices, it is acceptable to tighten these screws based on the feel of effort required to tighten the screw.

CAUTION

Accidentally touching the bare pins of receptacle J1 on the RLG may result in the failure of its internal electronics. Therefore, after disconnecting P1 from the RLG, it is good practice to cover J1 with the electrostatic protective cover removed from the new device being installed. Reuse the same packaging materials that came with the new RLG to return the defective RLG for repair. Handle in accordance with ESD procedures.

a. Disconnect the brown and blue high voltage leads from J2 and J3 on the gyro.

b. Refer to Figure 6-12. Remove the screw from one end of balance weight located on Sensor Block Assembly (1A2A1A1A9MP1) near gyro mounting screw (D) with a 90-degree offset blade-tip screwdriver if required to gain access to gyro mounting screw.

c. Loosen the screw at the other end of the weight just sufficiently to allow the free end of the weight to be moved far enough to gain access to loosen screw (D). Retain the mounting hardware.

d. Loosen mounting screw (D) using a 5/32-inch ball-end Allen screwdriver.

e. Refer to Figure 6-13. Loosen three captive mounting screws (A, B, and C) on the top side of the gyro with a 5/32-inch ball-end Allen screw driver. Do not remove the screws at this time.

f. Remove screw (E), which secures center gyro mounting surface to block using a 3/16-inch T-handle Allen wrench, as shown in Figure 6-13. This screw is accessed from inside the mounting cavity for the High Voltage Power Supply.

CAUTION

Loosen each gyro receptacle connector retaining screw alternately to prevent the screws from stripping and the connector from breaking.

g. Use a small, flat-blade screwdriver to loosen the connector-retaining screws, alternately, until fully disengaged from the gyro receptacle.

h. Disconnect receptacle connector (1A2A1A1A9A1P1) from receptacle J1 on the gyro.

i. Cover J1 with an ESD protective cover.

j. Tie cable and leads out of the way to prevent damage to wires as the Sensor Block Assembly is rotated during disassembly.

k. Hold the gyro while loosening the three captive screws (A, B, and C) the remainder of the way, and remove the gyro from the Sensor Block Assembly.

Postrequisites: If Gyro “A” is to be replaced:

a. Remove the IMU Processor (1A1A32).

b. Remove the Gyro “A” serialized matched set calibration PROM from location U-15 on IMU Processor (1A1A32).

6.4.3.1.2 Install Gyro “A” (1A2A1A1A1) (419 Hz dither frequency).

Goal: Installation of Gyro “A” (1A2A1A1A1).

Time: 8 minutes

Tools: Small blade-tip screwdriver, 90-degree offset flat blade screwdriver, 5/32-inch ball-end Allen screw driver, 3/16-inch ball-end Allen screwdriver, 5/32-inch Allen socket, torque wrench (0-75 in-lb), lint-free cloth

Prerequisites: None.

Procedure.

a. Inspect mounting surfaces on the gyro and on Sensor Block Assembly (1A2A1A1A9MP1) for dirt or scratches.

b. Wipe all surfaces with a clean lint-free cloth before installing the gyro.

c. Hold the gyro against the Sensor Block Assembly mounting surfaces.

d. Using a 5/32-inch L-type Allen wrench, tighten three captive screws (A, B, and C) just sufficiently to retain the gyro in position. See Figure 6-13.

CAUTION

To prevent the connector from breaking, do not attempt to torque the gyro receptacle connector retaining screws after they are fully seated against the gyro connector.

CAUTION

Tighten each gyro receptacle connector-retaining screw alternately to prevent the screws from stripping and the connector from breaking.

e. Connect receptacle connector (1A2A1A1A9A1P1) to receptacle J1 on the gyro.

f. Use a small, flat-blade screwdriver to alternately tighten connector-retaining screws, one turn at a time, until fully seated against the gyro receptacle connector and fully engaged in the gyro receptacle connector.

g. Tighten screw (E), which secures the center gyro mounting surface to Sensor Block Assembly, using a 3/16-inch ball-end Allen screwdriver. This screw is accessed from inside the mounting cavity for the High Voltage Power Supply.

h. Tighten mounting screw (D) using a 5/32-inch ball-end Allen screwdriver.

i. Tighten the three captive mounting screws (A, B, and C) on the top side of the gyro to 27 ±2 in-lb, using a 5/32-inch Allen socket and torque wrench.

j. Connect the brown and blue high voltage leads to J2 and J3 on the gyro and hand tighten.

k. Install the previously removed screw that secures the balance weight located on the Sensor Block Assembly near screw (D) if required.

l. Tighten both weight retaining screws with a 90-degree offset screwdriver.

Postrequisites:

a. Install High Voltage Power Supply Assembly (1A2A1A1A4).

b. Install the Magnetic Shield on the Sensor Block Assembly.

c. Install the IMU.

d. If Gyro “A” was replaced, install the Gyro “A” serialized matched set calibration Programmable Read-Only Memory (PROM) in location U-15 on IMU Processor (1A1A32).

e. Turn on the RLGN using the procedure in Paragraph 2.3.1.

6.4.3.2 Gyro “B” (1A2A1A1A2) Replacement.

6.4.3.2.1 Remove Gyro “B” (1A2A1A1A2) (369 Hz dither frequency).

Goal: Removal of Gyro “B” (1A2A1A1A2).

Time: 5 minutes

Tools: Small blade-tip screwdriver, 5/32-inch ball-end Allen screwdriver, 3/16-inch T-handle Allen wrench

Prerequisites:

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Remove the IMU.

c. Remove the Magnetic Shield from the Sensor Block Assembly.

d. Remove the High Voltage Power Supply Assembly.

Procedure:

CAUTION

Ring Laser Gyros are ESDS devices. Handle in accordance with ESD procedures. Gyros are shock sensitive. Use great care when handling and storing gyros.

CAUTION

The surfaces on Sensor Block Assembly (1A2A1A1A9) for mounting the RLGs and accelerometers, as well as the mounting surfaces of the gyros and accelerometers, are precision-machined surfaces. Be careful not to damage these surfaces when performing repairs. Place gyros and accelerometers in a protective ESD bag and store these subassemblies in a safe place to prevent them from being damaged while they are removed from the system.

CAUTION

The attachment screws on each Ring Laser Gyro (RLG) should be evenly tightened to approximately the specified torque. Since the torque recommendations primarily ensure that screws are sufficiently tightened without being stressed or broken by over tightening, and since some mounting screws are inaccessible using some torque measuring devices, it is acceptable to tighten these screws based on the feel of effort required to tighten the screw.

CAUTION

Accidentally touching the bare pins of receptacle J1 on the RLG may result in the failure of its internal electronics. Therefore, after disconnecting P1 from the RLG, it is good practice to cover J1 with the electrostatic protective cover removed from the new device being installed. Reuse the same packaging materials that came with the new RLG to return the defective RLG for repair. Handle in accordance with ESD procedures.

a. Loosen captive screw (D), which attaches mounting surface of gyro at small end to Sensor Block Assembly (**1A2A1A1A9MP1**), using a 5/32-inch, ball-end, Allen screwdriver. The screw is accessed in the area behind receptacle A10J1, between Gyro “C” (**1A2A1A1A3**) and torquer mounting casting on the Sensor Block Asembly (**1A2A1A1A9MP1**).

b. Loosen the three captive mounting screws (A, B, and C) on the top side of the gyro. Do not remove the screws at this time.

c. Completely loosen screw (E), which secures center gyro mounting surface to Sensor Block Assembly, using a 3/16-inch T-handle Allen wrench. This screw is accessed from inside the mounting cavity for High Voltage Power Supply (**1A2A1A1A4A1**).

CAUTION

Loosen each gyro receptacle connector retaining screw alternately to prevent the screws from stripping and the connector from breaking.

d. Use a small, flat-blade screwdriver to loosen connector-retaining screws, alternately, until the screws are fully disengaged from the gyro receptacle.

e. Disconnect receptacle connector (**1A2A1A1A9A2P1**) from receptacle J1 on the gyro.

f. Cover J1 with an ESD protective cover.

g. Tie cable and leads out of the way to prevent damage to wires as the Sensor Block Assembly is rotated during disassembly.

h. Refer to **Figure 6-13**. Hold the gyro, loosen three captive screws (A, B, and C) the remainder of the way, and remove the gyro from the Sensor Block Assembly far enough to access the green and white high voltage leads.

i. Disconnect the green and white high voltage leads from J2 and J3 on the gyro, and remove the gyro.

Postrequisites: If Gyro “B” is to be replaced:

a. Remove IMU Processor (**1A1A32**).

b. Remove the Gyro “B” serialized matched set calibration PROM from location U-02 on IMU Processor (**1A1A32**).

6.4.3.2.2 Install Gyro “B” (1A2A1A1A2) (369 Hz dither frequency).

Goal: Installation of Gyro “B” (**1A2A1A1A2**).

Time: 5 minutes

Tools: Small blade-tip screwdriver, 5/32-inch ball-end Allen screwdriver, 3/16-inch ball-end Allen screwdriver, 5/32-inch Allen socket, torque wrench (0-75 in-lb), lint-free cloth

Prerequisites: Ensure that Gyro “C” is installed.

Procedure:

a. Inspect the mounting surfaces on the gyro and on Sensor Block Assembly (**1A2A1A1A4A1**) for dirt or scratches.

b. Wipe all surfaces with a clean lint-free cloth before installing the gyro.

c. Connect the white and green high voltage leads to J2 and J3 on the gyro.

d. Refer to **Figure 6-13**. Hold the gyro against the mounting surface and tighten three captive screws (A, B, and C), just sufficiently to retain gyro in position, using a 5/32-inch ball-end Allen screwdriver.

CAUTION

To prevent the connector from breaking, do not attempt to torque the gyro receptacle connector retaining screws after they are fully seated against the gyro connector.

CAUTION

Tighten each gyro receptacle connector-retaining screw alternately to prevent the screws from stripping and the connector from breaking.

e. Connect cable receptacle connector (**1A2A1A1A9A2P1**) to receptacle J1 on the gyro.

f. Use a small, flat-blade screwdriver to alternately tighten the connector-retaining screws, one turn at a time, until fully they are fully seated against the gyro connector and fully engaged in the gyro receptacle.

g. Refer to **Figure 6-13**. Tighten screw (E), which secures the center gyro mounting surface to Sensor Block Assembly, using a 3/16-inch T-handle Allen wrench (at least 9 inches long). This screw is accessed from inside the mounting cavity for High Voltage Power Supply Assembly (**1A2A1A1A4**).

h. Refer to **Figure 6-13**. Tighten mounting screw (D) using a 5/32-inch ball-end Allen wrench.

i. Tighten the three captive mounting screws (A, B, and C) on the top side of the Gyro to 27 ±2 in-lb, using a 5/32-inch Allen socket and torque wrench.

Postrequisites:

a. Install the High Voltage Power Supply Assembly.

b. Install the Magnetic Shield on the Sensor Block Assembly.

c. Install the IMU.

d. If Gyro “B” was replaced, install the Gyro “B” serialized matched set calibration PROM in location U-02 on IMU Processor (**1A1A32**).

6.4.3.3 Gyro “C” (1A2A1A1A3) Replacement.

6.4.3.3.1 Remove Gyro “C” (1A2A1A1A3) (319 Hz dither frequency).

Goal: Removal of Gyro “C” (**1A2A1A1A3**).

Time: 10 minutes

Tools: Small blade-tip screwdriver, 5/32-inch L-type Allen screwdriver, 5/32-inch T-handle Allen screwdriver, 3/16-inch L-type Allen wrench

Prerequisites:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Remove the IMU.

c. Remove the Magnetic Shield from Sensor Block Assembly.

d. Remove the High Voltage Power Supply Assembly.

e. Remove Gyro “B”.

Procedure:

CAUTION

Ring Laser Gyros are ESDS devices. Handle in accordance with ESD procedures. Gyros are shock sensitive. Use great care when handling and storing gyros.

CAUTION

The surfaces on Sensor Block Assembly (**1A2A1A1A9**) for mounting the RLGs and accelerometers, as well as the mounting surfaces of the gyros and accelerometers, are precision-machined surfaces. Be careful not to damage these surfaces when performing repairs. Place gyros and accelerometers in a protective ESD bag and store these subassemblies in a safe place to prevent them from being damaged while they are removed from the system.

CAUTION

The attachment screws on each Ring Laser Gyro (RLG) should be evenly tightened to approximately the specified torque. Since the torque recommendations primarily ensure that screws are sufficiently tightened without being stressed or broken by over tightening, and since some mounting screws are inaccessible using some torque measuring devices, it is acceptable to tighten these screws based on the feel of effort required to tighten the screw.

CAUTION

Accidentally touching the bare pins of receptacle J1 on the RLG may result in the failure of its internal electronics. Therefore, after disconnecting P1 from the RLG, it is good practice to cover J1 with the electrostatic protective cover removed from the new device being installed. Reuse the same packaging materials that came with the new RLG to return the defective RLG for repair. Handle in accordance with ESD procedures.

a. Disconnect the black and red high voltage leads from J2 and J3 on the gyro.

b. Completely loosen captive mounting screw (C), located at the large end of the gyro, using a 5/32-inch ball-end Allen screwdriver.

c. Rotate Sensor Block Assembly (1A2A1A1A9MP1) so that the torquer motor end is facing upward and the block is rotated so that left captive screw (A), located in the cavity under the accelerometer's mounting casting, is aligned with the access hole in the casting beside the torquer motor shield (refer to Figure 6-11).

d. Completely loosen captive mounting screw (A) using a 5/32-inch T-handle Allen wrench.

e. Refer to Figure 6-12. Rotate the Sensor Block Assembly so that the mounting surface for Gyro "B" (1A2A1A1A2) is accessible. The right gyro captive screw (B) is accessible through an opening in this surface.

f. Reach through the access opening and completely loosen captive screw (B), using a 5/32-inch L-type Allen wrench.

CAUTION

Loosen each gyro receptacle connector retaining screw alternately to prevent the screws from stripping and the connector from breaking.

g. Use a small, flat-blade screwdriver to loosen the connector-retaining screws, alternately, until fully disengaged from the gyro plug receptacle.

h. Disconnect receptacle connector (1A2A1A1A9A3P1) from receptacle J1 on the gyro by alternately loosening connector retainer screws one turn at a time.

i. Cover J1 with an electrostatic discharge (ESD) protective cover.

j. Tie cable and leads out of the way to prevent damage to wires as the Sensor Block Assembly is rotated during disassembly.

k. Hold the gyro while completely loosening captive screw (D), which secures the gyro's small end, using a 5/32-inch L-type Allen wrench.

l. Completely loosen captive screw (E), which secures the center gyro mounting surface to the Sensor Block Assembly, using a 3/16-inch L-type Allen wrench. These two screws are accessed from inside the mounting cavity for High Voltage Power Supply (1A2A1A1A4).

m. Slide the gyro out from under the Torquer Motor and remove from the Sensor Block Assembly.

Postrequisites: If Gyro "C" is to be replaced:

a. Remove IMU Processor (1A1A32).

b. Remove the Gyro "C" matched set calibration PROM from location U-04 on IMU Processor (1A1A32).

6.4.3.3.2 Install Gyro "C" (1A2A1A1A3) (319 Hz dither frequency).

Goal: Installation of Gyro "C" (1A2A1A1A3).

Time: 9 minutes

Tools: Small blade-tip screwdriver, 5/32-inch L-type Allen wrench, 5/32-inch T-handle Allen wrench, 3/16-inch ball-end Allen wrench, 3/16-inch L-type Allen wrench, 5/32-inch Allen socket, torque wrench (0-75 in-lb), lint-free cloth

Prerequisites: None.

Procedure:

a. Inspect the mounting surfaces on the gyro and on Sensor Block Assembly (1A2A1A1A9) for dirt or scratches.

b. Wipe all surfaces with a clean lint-free cloth before installing gyro.

c. Refer to Figure 6-13. Hold the gyro against the mounting surface and tighten screw (C) just sufficiently to retain the gyro in position, using a 5/32-inch L-type Allen wrench.

CAUTION

To prevent the connector from breaking, do not attempt to torque the gyro receptacle connector retaining screws after they are fully seated against the gyro connector.

CAUTION

Tighten each gyro receptacle connector-retaining screw alternately to prevent the screws from stripping and the connector from breaking.

d. Connect cable receptacle connector (1A2A1A1A9A3P1) to receptacle J1 on the gyro.

e. Use a small, flat-blade screwdriver to alternately tighten connector-retaining screws, one turn at a time, until fully seated against the gyro connector and fully engaged in the gyro receptacle.

f. Rotate the inner gimbal and the Sensor Block Assembly, as necessary, and, through the access hole in the block, tighten captive screw (A) just sufficiently to retain the gyro in position, using a 5/32-inch T-handle Allen wrench.

g. Loosely secure captive mounting screw (B) using a 5/32-inch L-type Allen wrench. Screw (B) is accessible through the opening in Gyro "B" (1A2A1A1A2) mounting surface.

h. Install and tighten screw (D), which secures the small end of the gyro mounting surface to block, using a 5/32-inch L-type Allen wrench. This screw is accessed from inside the mounting cavity for High Voltage Power Supply Assembly (1A2A1A1A4).

i. Install and tighten mounting screw (E), which secures the center gyro mounting surface to block, using a 3/16-inch L-type Allen wrench. This screw is accessed from inside the mounting cavity for the High Voltage Power Supply.

j. Tighten three captive mounting screws (A, B, and C) on the top side of the gyro to 27 ±2 in-lb using a 5/32-inch Allen socket and torque screwdriver. Because of access limitation through the Sensor Block Assembly, it is not possible to torque screw (A) unless a special long-reach Allen socket adapter is available. If a long-reach adapter is not available, tighten screw (A) and screw (B) to approximately 27 in-lb, based on the feel of effort required to tighten screw (C).

k. Connect the black and red high voltage leads to J2 and J3 on the gyro and hand tighten.

Postrequisites:

a. Install Gyro "B" (1A2A1A1A2) (369 Hz dither frequency).

b. Install High Voltage Power Supply Assembly (1A2A1A1A4).

c. Install the Magnetic Shield on the Sensor Block Assembly.

d. Install Inertial Measuring Unit (1A2A1).

e. If Gyro "C" was replaced, install the Gyro "C" serialized matched set calibration PROM in location U-04 on IMU Processor (1A1A32).

f. Turn on the RLGN using the procedure in Paragraph 2.3.1.

6.4.4 ACCELEROMETER REPLACEMENT.

6.4.4.1 Remove Accelerometer.

Goal: Removal of accelerometer "A", "C" or "B" (1A2A1A1A5), (1A2A1A1A6), (1A2A1A1A7).

Time: 5.25 minutes

Tools: Small blade-tip screwdriver, 3/32-inch L-type Allen wrench

Prerequisites:

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Remove Inertial Measuring Unit (1A2A1).

c. Remove the Magnetic Shield from the Sensor Block Assembly.

Procedure:

CAUTION

If more than one accelerometer is removed during maintenance and will be reinstalled, record the serial number of the accelerometer and match it with its mounting location. Be sure to replace each accelerometer in its original mounting location and orientation on Sensor Block Assembly (**1A2A1A1A9**) during reassembly. Accelerometer connectors are not keyed. Attach a temporary label to each accelerometer cable harness plug to identify its correct jack. Use care to connect plug on each accelerometer cable to the corresponding marked jack mounted on Sensor Block Assembly.

CAUTION

Use care when cutting cable ties so that wires are not damaged.

a. Disconnect the accelerometer plug from the corresponding jack on the Sensor Block Assembly.

b. Remove ties as necessary to free the accelerometer cable from its harness.

c. Attach temporary marking tags to the plugs to identify their mating jacks.

d. Refer to **Figure 6-14**. Loosen three captive mounting screws using a 3/32-inch Allen wrench.

e. Remove the accelerometer, noting the accelerometer ground lead location.

f. Because of wiring harness density, to gain access for removal of Accelerometer “C” (**1A2A1A1A6**), it may be necessary to first remove Accelerometer “A” (**1A2A1A1A5**).

Postrequisites: If accelerometer is to be replaced:

a. Open the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.2**.

b. Remove IMU Processor (**1A1A32**).

c. Remove the accelerometer serialized matched set calibration PROM from the corresponding location on IMU Processor (**1A1A32**). Refer to **Figure 6-3** for location of the calibration PROMs.

6.4.4.2 Install Accelerometer.

Goal: Installation of Accelerometer "A", "C" or "B" (**1A2A1A1A5**), (**1A2A1A1A6**), (**1A2A1A1A7**).

Time: 13 minutes

Tools: Small blade-tip screwdriver, 3/32-inch Allen socket, torque screwdriver, lint-free cloth, lacing material

Prerequisites: None.

Procedure:

CAUTION

If more than one accelerometer is removed during maintenance and will be reinstalled, record the serial number of the accelerometer and match it with its mounting location. Be sure to replace each accelerometer in its original mounting location and orientation on Sensor Block Assembly (**1A2A1A1A9**) during reassembly. Accelerometer connectors are not keyed. Attach a temporary label to each accelerometer cable harness plug to identify its correct jack. Use care to connect plug on each accelerometer cable to the corresponding marked jack mounted on Sensor Block Assembly.

a. Clean the accelerometer mounting surfaces on the Sensor Block with a clean, lint-free cloth.

b. Install Accelerometers with pins oriented as shown in **Figure 6-14**. If more than one accelerometer has been removed, the correct installation sequence is (1) Accelerometer “C” (**1A2A1A1A6**), (2) Accelerometer “A” (**1A2A1A1A5**), (3) Accelerometer “B” (**1A2A1A1A7**).

c. Ensure the correct serial number accelerometer is installed into each cavity.

d. Tighten three captive mounting screws on each accelerometer to 5 ± 1 in-lbs torque using a 1/4-inch drive torque screwdriver and 3/32-inch Allen socket.

e. Note the temporary marking tabs on each accelerometer cable and connect plug on each accelerometer cable to the corresponding marked jack mounted on Sensor Block Assembly.

f. Remove temporary tags.

g. Tie all accelerometer cables back into the harness with lacing material to prevent wires from contacting the magnetic shield when it is installed on the Sensor Block Assembly.

Postrequisites:

a. Install the Magnetic Shield on the Sensor Block Assembly.

b. Install Inertial Measuring Unit (**1A2A1**).

c. If the accelerometer was replaced, install the accelerometer serialized matched set calibration PROM on IMU Processor (**1A1A32**). Refer to **Figure 6-3** for the location of the calibration PROMs.

d. Install IMU Processor (**1A1A32**).

e. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

f. Install the IMU Cabinet Front Panel using the procedure in **Paragraph 6.4.1.6**.

g. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4.5 ACCELEROMETER STIMULUS ASSEMBLY REPLACEMENT.

6.4.5.1 Remove Accelerometer Stimulus Assembly (1A2A1A1A9A1).

Goal: Removal of Accelerometer Stimulus Assembly (**1A2A1A1A9A1**).

Time: 3 minutes

Tools: Small blade-tip screwdriver, 5/64-inch L-type Allen wrench

Prerequisites:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Remove IMU (**1A2A1**).

c. Remove the Magnetic Shield from the Sensor Block Assembly.

Procedure:

a. Disconnect the harness plug from jack J1 on the Accelerometer Stimulus Assembly.

b. Cut the lacing that secures the wire harness to Accelerometer Stimulus Assembly (**1A2A1A1A9A1**) stand-offs.

c. Loosen four captive mounting screws using a 5/64-inch Allen wrench.

d. Remove Accelerometer Stimulus Assembly (**1A2A1A1A9A1**).

Postrequisites: None.

6.4.5.2 Install Accelerometer Stimulus Assembly (1A2A1A1A9A1).

Goal: Installation of Accelerometer Stimulus Assembly (**1A2A1A1A9A1**)

Time: 4 minutes

Tools: Small blade-tip screwdriver, 5/64-inch L-type Allen wrench, lacing material

Prerequisites: None.

Procedure:

a. Position Accelerometer Stimulus Assembly (**1A2A1A1A9A1**) as shown in **Figure 6-12**.

b. Install Accelerometer Stimulus Assembly (**1A2A1A1A9A1**) on stand-offs.

c. Tighten four captive mounting screws using a 5/64-inch Allen wrench.

d. Connect the harness plug to J1 using a small blade-tip screwdriver.

e. Secure the harness to Accelerometer Stimulus Assembly (**1A2A1A1A9A1**) stand-offs with lacing material.

Postrequisites:

a. Install the Magnetic Shield on the Sensor Block Assembly.

b. Install IMU (**1A2A1**).

c. Secure the RLGN Upper Cabinet door using the procedure in **Paragraph 6.3.1.3**.

d. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4.6 SLIP RING REPLACEMENT.

6.4.6.1 Slip Ring Assembly (1A2A1A1A10) Replacement.

6.4.6.1.1 Remove Slip Ring Assembly (1A2A1A1A10).

Goal: Removal of Slip Ring Assembly (**1A2A1A1A10**).

Time: 12 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver

Prerequisites:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Remove Inertial Measuring Unit (1A2A1).

c. Remove the Magnetic Shield from the Sensor Block Assembly.

d. Remove High Voltage Power Supply Assembly (1A2A1A1A4).

e. Remove Gyro "B" (1A2A1A1A2) (369 Hz dither frequency).

f. Remove Gyro "C" (1A2A1A1A3) (319 Hz dither frequency).

Procedure:

a. Perform the following steps using a #1 Phillips-head screwdriver or a small blade-tip screwdriver as necessary.

b. Remove four screws that secure the wire guide shield to Torquer Motor (1A2A1A1B2).

c. Remove the shield.

d. Disconnect slip ring plugs A10P1 and A10P2 from jacks A10J1 and A10J2 on the Sensor Block Assembly.

e. Cut ties, as necessary, to free the two slip ring cables from the Sensor Block Assembly.

f. Rotate the Inner Gimbal so that the Inner Torquer Motor faces upward.

g. Cut ties, as necessary, to free the slip ring harness from the Inner Gimbal Assembly.

h. Disconnect the slip ring harness wires from terminal board TB21 near plug A13P1 and jack A10J1, removing lacing as required.

i. Disconnect slip ring jack A10J1 from plug A13P1 and jack A10J2 from plug A12P2 on the inner gimbal assembly.

j. Remove the harness clamp.

k. Remove the four screws and flat washers that secure cap shield to the Torquer Motor and remove the shield.

l. Hold the Sensor Block and remove four screws that secure the slip ring retainer to the rotor of the Torquer Motor.

m. Feed slip ring harness through Sensor Block casting and lift slip ring up out of Torquer Motor. Use care when sliding plugs through the Torquer Motor to prevent the plugs from snagging and damaging any wiring.

Postrequisites: None.

6.4.6.1.2 Install Slip Ring Assembly (1A2A1A1A10).

Goal: Installation of Slip Ring Assembly (1A2A1A1A10)

Time: 24 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver, lacing material

Prerequisites: None.

Procedure:

a. Rotate the Inner Gimbal so that the Inner Torquer Motor faces upward.

b. Feed the ends of slip ring cables (P1 and P2) down through the center of the Torquer Motor and up through the Sensor Block Assembly one connector at a time. Use care when sliding plugs through the Torquer Motor to prevent the plugs from snagging and damaging any wiring.

c. Check that the cables are positioned so that plugs A10P1 and A10P2 will mate with jacks A10J1 and A10J2 on the Sensor Block Assembly without having to twist or overlap the cables.

d. Hold the Sensor Block and install four flat-head screws that secure the slip ring retainer (and slip ring) to the rotor of the Torquer Motor.

e. Connect slip ring plugs A10P1 and A10P2 to jacks A10J1 and A10J2 on the Sensor Block Assembly.

f. Insert slip ring cables (J1 and J2) through cap shield.

g. Install cap shield on Torquer Motor using four screws and flat washers. Ensure that cap shield is positioned so that access hole in cap is aligned with access hole in inner gimbal casting.

h. Connect slip ring jack A10J1 to plug A13P1 and jack A10J2 to plug A12P2 on the Inner Gimbal Assembly as shown in Figure 6-15.

i. Install the harness clamp.

j. Connect lug-terminated slip ring harness wires to terminal board TB21 per sleeve markings.

k. Install the wire guide shield on the cap shield using four screws and flat washers. Use care not to pinch wires between the wire guide shield and the cap shield. Ensure that wires lie flat in guides.

l. Secure the slip ring cables using lacing material as necessary.

m. Replace the slip ring cable harness inside the Gyro "C" cavity.

Postrequisites:

a. Install Gyro "C" (1A2A1A1A3) (319 Hz dither frequency).

b. Install Gyro "B" (1A2A1A1A2) (369 Hz dither frequency).

c. Install High Voltage Power Supply Assembly (1A2A1A1A4).

d. Install the Magnetic Shield on the Sensor Block Assembly.

e. Install IMU (1A2A1).

f. Install the IMU Cabinet Front Panel using the procedure in Paragraph 6.4.1.6.

g. Turn on the RLGN using the procedure in Paragraph 2.3.1.

6.4.6.2 Slip Ring Assembly (1A2A1A1A11) Replacement.

6.4.6.2.1 Remove Slip Ring Assembly (1A2A1A1A11).

Goal: Removal of Slip Ring Assembly (1A2A1A1A11).

Time: 13 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver

Prerequisites:

a. Turn off the RLGN using the procedure in Paragraph 2.3.8.

b. Remove IMU (1A2A1).

c. Remove the Magnetic Shield from the Sensor Block Assembly.

d. Remove High Voltage Power Supply Assembly (1A2A1A1A4).

Procedure:

a. Perform the following steps using a #1 Phillips-head screwdriver or a small blade-tip screwdriver as necessary.

b. Remove four screws that secure the wire guide shield to Inner Gimbal Synchro Transmitter (1A2A1A1B4).

c. Remove the wire guide shield.

d. Disconnect slip ring plugs A11P1 and A11P2 from jacks A11J1 and A11J2 on the Sensor Block Assembly.

e. Cut ties, as necessary, to free the two slip ring cables from each other and from the Inner Gimbal Assembly.

f. Disconnect the white slip ring harness wires from terminal board TB23 near plug A12P1 and jack A11J1.

g. Cut lacing, as required, to separate the slip ring harness from the synchro wiring.

h. Disconnect slip ring jack A11J1 from plug A12P1 and jack A11J2 from plug A13P2 on the Inner Gimbal Assembly.

i. Rotate the Inner Gimbal so that the inner synchro faces upward.

j. Remove the cable clamp from A11J2.

k. Remove four screws and flat washers that secure the cap shield to the synchro and remove the shield.

l. Remove three screws that secure the slip ring retainer to the synchro rotor.

m. Feed the slip ring harness through the Sensor Block casting and lift the slip ring up out of the synchro. Use care when sliding the plugs through the synchro to prevent the plugs from snagging and damaging any wiring.

Postrequisites: None.

6.4.6.2.2 Install Slip Ring Assembly (1A2A1A1A11).

Goal: Installation of Slip Ring Assembly (1A2A1A1A11).

Time: 31 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver, lacing material

Prerequisites: None.

Procedure:

a. Rotate the Inner Gimbal so that the Inner Synchro faces upward.

b. Feed the ends of slip ring cables (P1 and P2) down through the center of the synchro and up through the power supply mounting cavity in the Sensor Block Assembly one connector at a time. Use care when sliding the plugs through the synchro to prevent the plugs from snagging and damaging any wiring.

c. Check that the cables are positioned so that plugs A11P1 and A11P2 will mate with jacks A11J1 and A11J2 on the Sensor Block Assembly without having to twist or overlap the cables.

d. Hold the Sensor Block and install three screws that secure the slip ring retainer (and slip ring) to the synchro rotor.

e. Connect slip ring plugs A11P1 and A11P2 to jacks A11J1 and A11J2 on the Sensor Block Assembly.

f. Insert slip ring cables (J1 and J2) through the cap shield.

g. Install the cap shield on the synchro using four screws and flat washers. Ensure that the cap shield is positioned so that the access hole in the cap is aligned with the access hole in the inner gimbal casting.

h. Connect slip ring jack A11J1 to plug A12P1 and jack A11J2 to plug A13P2 on the Inner Gimbal Assembly as shown in **Figure 6-15**.

i. Connect the lug-terminated slip ring harness wires to terminal board TB23 per sleeve markings.

j. Reconnect harness clamp at A11J2.

k. Install the wire guide shield on the cap shield using four screws and flat washers. Use care not to pinch any wires between the wire guide shield and the cap shield. Ensure that wires lie flat in the guides.

l. Secure the slip ring cables using lacing material as necessary.

m. Replace the slip ring cable harness inside the High Voltage Power Supply cavity.

Postrequisites:

a. Install High Voltage Power Supply Assembly (**1A2A1A1A4**).

b. Install the Magnetic Shield on the Sensor Block Assembly.

c. Install Inertial Measuring Unit (**1A2A1**).

d. Install the IMU Cabinet Front Panel using the procedure in **Paragraph 6.4.1.6**.

e. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4.6.3 Slip Ring Assembly (1A2A1A1A12) Replacement.

6.4.6.3.1 Remove Slip Ring Assembly (1A2A1A1A12).

Goal: Removal of Slip Ring Assembly (**1A2A1A1A12**)

Time: 19 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver, 5/32-inch open-end wrench, 1/8-inch open-end wrench, 3/16-inch nut driver, ¼-inch socket wrench

Prerequisites:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Remove Inertial Measuring Unit (**1A2A1**).

c. Remove the Magnetic Shield from the Sensor Block Assembly.

Procedure:

a. Perform the following steps using a #1 Phillips-head screwdriver or a small blade-tip screwdriver as necessary.

b. Remove four screws that secure the wire guide shield to Inner Torquer Motor (**1A2A1A1B2**).

c. Remove the wire guide shield.

d. Disconnect slip ring plugs A12P1 and A12P2 from jacks A11J1 and A10J2 on the Inner Gimbal Assembly.

e. Cut ties, as necessary, to free the two slip ring cables from the Inner Gimbal Assembly.

f. Remove mounting screws that secure slip ring plugs A12P1 and A12P2 mounting brackets to the Inner Gimbal Assembly.

g. Remove the mounting brackets from the plugs using a 5/32-inch open-end wrench and a 1/8-inch open-end wrench.

h. Remove the clear plastic protective cover from TB31 using a 3/16-inch nut driver.

i. Disconnect the slip ring harness wires from terminal board TB21 near jack A12J1.

j. Remove nuts and washers using a 3/16-inch nut driver and disconnect slip ring jack A12J1 and jack A12J2 from the brackets on the IMU frame.

k. Remove ¼-inch stand-off studs that secure slip ring harness to front of IMU frame using a ¼-inch socket wrench.

l. Remove the cable clamps from the harness.

m. Remove tie wraps and cut lacing, as necessary, to separate the cable harnesses.

n. Remove four screws that secure the cap shield to the Torquer Motor and remove shield.

o. Hold the Sensor Block and remove four screws that secure the slip ring retainer to the Torquer Motor rotor.

p. Feed the slip ring harness through the Inner Gimbal Assembly casting and lift slip ring up out of Torquer Motor. Use care when sliding plugs through the Torquer Motor to prevent the plugs from snagging and damaging wiring.

Postrequisites: None.

6.4.6.3.2 Install Slip Ring Assembly (1A2A1A1A12).

Goal: Installation of Slip Ring Assembly (**1A2A1A1A12**).

Time: 41 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver, 5/32-inch nut driver, 1/8-inch open-end wrench, 3/16-inch nut driver, lacing material, tie wraps

Prerequisites: None.

Procedure:

a. Feed the ends of slip ring cables (P1 and P2) down through the center of the Torquer Motor and up through the Sensor Block Assembly one connector at a time. Use care when sliding the plugs through the Torquer Motor to prevent the plugs from snagging and damaging any wiring.

b. Check that the cables are positioned so that plugs A12P1 and A12P2 will mate with jacks A11J1 and A10J2 on the Sensor Block Assembly without having to twist or overlap the cables.

c. Hold the inner gimbal and install four flat-head screws that secure the slip ring retainer (and slip ring) to the Torquer Motor rotor.

d. Install the mounting brackets on the plugs and secure the plugs to the Inner Gimbal Assembly using a 5/32-inch nut driver and 1/8-inch open-end wrench.

e. Connect slip ring plugs A12P1 and A12P2 to jacks A11J1 and A10J2 on the Sensor Block Assembly.

f. Insert slip ring cables (J1 and J2) through cap shield.

g. Install the cap shield on the Torquer Motor using four screws and flat washers. Ensure that the cap shield is positioned so that the access hole is at the bottom.

h. Install locking studs, washers, and nuts and connect slip ring jacks A12J1 and A12J2 to brackets on the IMU frame as shown in **Figure 6-15**, using a 3/16-inch nut driver. Keep the smaller end of the jack toward the inner gimbal.

i. Connect the lug-terminated slip ring harness wires to terminal board TB31 per sleeve markings.

j. Install lock washers and nuts and replace the clear plastic protective cover over TB31 using a 3/16-inch nut driver.

k. Install the wire guide shield on the cap shield using four screws and flat washers. Use care not to pinch any wires between the wire guide shield and the cap shield. Ensure that wires lie flat in the guides.

l. Install cable clamps on the harness and secure the harness using the ¼-inch studs removed during disassembly.

m. Secure the slip ring cables using lacing material and tie wraps, as necessary.

Postrequisites:

a. Install the Magnetic Shield on the Sensor Block Assembly.

b. Install Inertial Measuring Unit (**1A2A1**).

c. Install the IMU Cabinet Front Panel using the procedure in **Paragraph 6.4.1.6**.

d. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

6.4.6.4 Slip Ring Assembly (1A2A1A1A13) Replacement.

6.4.6.4.1 Remove Slip Ring Assembly (1A2A1A1A13).

Goal: Removal of Slip Ring Assembly (**1A2A1A1A13**).

Time: 28 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver, 5/32-inch nut driver, 1/8-inch open-end wrench, 3/16-inch nut driver, ¼-inch socket wrench

Prerequisites:

a. Turn off the RLGN using the procedure in **Paragraph 2.3.8**.

b. Remove Inertial Measuring Unit (**1A2A1**).

c. Remove the Magnetic Shield from the Sensor Block Assembly.

Procedure:

a. Perform the following steps using a #1 Phillips-head screwdriver or a small blade-tip screwdriver as necessary.

b. Remove four screws that secure the wire guide shield to Outer Synchro Transmitter (**1A2A1A1B3**).

c. Remove the wire guide shield.

d. Disconnect slip ring plugs A13P1 and A13P2 from jacks A10J1 and A11J2 on the Inner Gimbal Assembly.

e. Cut ties, as necessary, to free the two slip ring cables from the Inner Gimbal Assembly.

f. Remove mounting screws and washers that secure slip ring plugs A13P1 and A13P2 mounting brackets to the Inner Gimbal Assembly.

g. Remove mounting brackets from plugs using a 5/32-inch nut driver and a 1/8-inch open-end wrench.

h. Remove the clear plastic protective cover from TB32 using a 3/16-inch nut driver.

i. Disconnect the white slip ring harness wires from terminal board TB32 near jack A13J1.

j. Disconnect slip ring jack A13J1 and jack A13J2 from the brackets on the IMU frame using a 3/16-inch nut driver.

k. Remove ¼-inch stand-off studs and flat washers that secure slip ring harness to front of IMU frame using a ¼-inch socket wrench.

l. Remove the cable clamps from the harness.

m. Remove the tie wraps and cut lacing, as necessary, to separate the cable harnesses at TB32.

n. Remove four screws that secure the cap shield to the synchro and remove the cap shield.

o. Hold the inner gimbal and remove three screws that secure the slip ring retainer to the synchro rotor.

p. Feed the slip ring harness through Inner Gimbal Assembly casting and lift the slip ring up out of synchro. Use care when sliding the plugs through the synchro to prevent the plugs from snagging and damaging any wiring.

Postrequisites: None.

6.4.6.4.2 Install Slip Ring Assembly (1A2A1A1A13).

Goal: Installation of Slip Ring Assembly (**1A2A1A1A13**).

Time: 1 hour and 2 minutes

Tools: Small blade-tip screwdriver, #1 Phillips-head screwdriver, 1/8-inch hex-head socket, 1/8-inch open-end wrench, 3/16-inch nut driver, lacing material

Prerequisites: None.

Procedure:

a. Feed the ends of slip ring cables (P1 and P2) down through the center of the synchro and up through the Inner Gimbal Assembly one connector at a time. Use care when sliding the plugs through the synchro to prevent the plugs from snagging and damaging any wiring.

b. Check that the cables are positioned so that plugs A13P1 and A13P2 will mate with jacks A10J1 and A11J2 without having to twist or overlap the cables.

c. Hold the inner gimbal and install three flat-head screws that secure the slip ring retainer (and slip ring) to the synchro rotor.

d. Install the mounting brackets (removed during disassembly) on plugs and secure the plugs to the Inner Gimbal Assembly using a 1/8-inch hex-head socket and 1/8-inch open-end wrench.

e. Connect slip ring plugs A13P1 and A13P2 to jacks A10J1 and A11J2 on the Inner Gimbal Assembly.

f. Insert slip ring cables (J1 and J2) through the cap shield.

g. Install the cap shield on the synchro rotor using four screws and flat washers. Ensure that the cap shield is positioned so that the access hole in the cap shield is at the bottom.

h. Install locking studs, washers, and nuts and connect slip ring jacks A13J1 and A13J2 to the brackets on the IMU frame as shown in **Figure 6-15**, using a 3/16-inch nut driver. Keep the smaller end of the jack toward the inner gimbal.

i. Connect the lug-terminated slip ring harness wires to terminal board TB32 per sleeve markings.

j. Install lock washers and nuts and replace the clear plastic protective cover over TB32 using a 3/16-inch nut driver.

k. Install the wire guide shield on the cap shield using four screws and flat washers. Use care not to pinch any wires between the wire guide shield and the cap shield. Ensure that the wires lie flat in the guides.

l. Install cable clamps on the harness and secure the harness using ¼-inch studs (removed during disassembly).

m. Secure the slip ring cables to the inner gimbal using lacing material as necessary.

Postrequisites:

a. Install the Magnetic Shield on the Sensor Block.

b. Install IMU (**1A2A1**).

c. Install the IMU Cabinet Front Panel using the procedure in **Paragraph 6.4.1.6**.

d. Turn on the RLGN using the procedure in **Paragraph 2.3.1**.

SECTION III.
PRECAUTIONS FOR SHIPMENT

6.5 GENERAL PROCEDURES FOR SHIPPING LRUS.

The complete RLGN and the IMU Assembly use protective covers and require specially manufactured shipping crates for shipping. Follow Navy standard procedures and practices applicable to packaging and shipping of electronic subassemblies when returning all other LRUs to the factory or overhaul facility for repair.

In general, sealed electronic subassemblies should be bagged or wrapped in a barrier material and then packaged in a heavy cardboard box or container with sufficient bubble wrap or foam padding to prevent movement of the item. Where applicable, a desiccant and humidity indicator card should also be included in the inner container. The inner container box should be bagged or wrapped in a barrier material and placed inside a close fitting exterior shipping box.

CCAs or other electronic subassemblies that have exposed electronic components should be placed inside a static protection bag or wrapped in a static protection material and then further wrapped in a sheet of foam cushioning. The wrapped and cushioned CCAs should then be placed in a sealed barrier bag and shipped in a rigid folding carton. Because of its weight and shock concerns, the Battery Assembly requires special packaging. Information for packaging of the LRUs is provided in the Special Packaging Instructions (SPIs) contained in this section.

6.5.1 PACKING AND SHIPMENT OF RING LASER GYRO NAVIGATOR. The complete RLGN is bolted to a shipping base and crated for reshipment. This unit is shipped from the factory with the IMU removed and flat shipping covers installed on the lower Measurement Cabinet Assembly. For reshipment, the IMU should be removed and (if the complete RLGN is being shipped) should be shipped separately from the RLGN electronic cabinet assembly. Refer to **Table 6-4**.

6.5.2 PACKING AND SHIPMENT OF INERTIAL MEASURING UNIT. The IMU is shipped from the factory with a top cover and two end covers, which protect the magnetic shields and roll axis synchro/torquer motors. These covers should be retained or removed from the replacement IMU and installed on the IMU being returned for service. Refer to **Table 6-5** or **6-6** for packaging of this unit.

6.5.3 PACKING AND SHIPMENT OF BATTERY ASSEMBLY. Because of its weight, the Battery Assembly requires heavy foam padding to prevent damage during shipment. Refer to **Table 6-7** for packaging of the Battery Assembly.

6.5.4 PACKING AND SHIPMENT OF RING LASER GYRO ASSEMBLIES. Spare Ring Laser Gyros are shipped from the factory in specially padded containers. These containers should be retained for reshipment of Gyros. Special care should be taken during handling to avoid damage to the precision mounting pads on the bottom of the Gyros. To prevent damage to these surfaces, always place the Gyro in a padded container whenever it is removed from the IMU. In addition, ensure the Calibration PROM (removed from the IMU Processor CCA) is shipped along with the Gyro being returned for repair. Refer to **Table 6-8** for packaging of the Ring Laser Gyros.

6.5.5 PACKING AND SHIPMENT OF CIRCUIT CARD ASSEMBLIES. Except for slight differences in exterior dimensions, all CCAs are identical with respect to packaging for shipment. Care should be taken with all CCAs to prevent damage from static discharge when the CCA is removed from the unit. Refer to **Tables 6-9** and **6-10** for packaging of the rack-mounted assemblies. Refer to **Table 6-11** for packaging of the Vital Bus Assembly.

6.5.6 PACKING AND SHIPMENT OF CHASSIS-MOUNTED ELECTRONIC SUBASSEMBLIES. The chassis-mounted electronic subassemblies consist of the following:

- 400 Hz Inverter Assembly 1982618 (**1A1A2**) (See **Table 6-12**.)
- Power Supply 1979342 (**1A1A6**) (See **Table 6-13**.)
- Battery Charger Assembly 1810853 (**1A1A7**) (See **Table 6-14**.)
- Power Module 1205050-3 (**1A1A8**) (See **Table 6-15**.)
- Display Assembly 1979344 (**1A1A10**) (See **Table 6-16**.)
- Synchro Buffer Amplifiers 1976545-3 and 1976547-4 (**1A1A41** through **1A1A44**) (See **Table 6-17**.)
- High Voltage Power Supply 1979045 (**1A2A1A1A4**) (See **Table 6-18**.)

Except for slight differences in exterior dimensions, all chassis-mounted sub-assemblies are identical with respect to packaging for shipment. Refer to applicable Special Packaging Instruction (SPI) for packaging of these subassemblies.

LRUs not listed above are considered to be non-repairable and, if determined to be defective, should be disposed of according to standard Navy procedures.

Table 6-1. Summary of Corrective Maintenance Procedures

TITLE	REMOVE AND REPLACE PER PARA.	SET UP OR ALIGN PER PARA.	APPLICABLE REFERENCE FIGURE
Rack-Mounted Circuit Cards (General)	6.3.3		
Access to Backplane Wiring	6.3.4.1		
1A1A11 and **1A1A12** Backplane Assemblies	6.3.4.2		6-4
1A1A1 Filter, Power Line	6.3.5.2		
1A1A2 Inverter Assembly (400 Hz)	6.3.5.4		
1A1A3 Vital Bus CCA	6.3.5.6		
1A1A6 Power Supply	6.3.5.8		

Table 6-1. Summary of Corrective Maintenance Procedures - Continued

TITLE	REMOVE AND REPLACE PER PARA.	SET UP OR ALIGN PER PARA.	APPLICABLE REFERENCE FIGURE
1A1A7 Battery Charger Assembly	6.3.5.9		
1A1A8 Power Module	6.3.5.10		
1A1A41 Synchro Buffer Amplifier (8 VA)	6.3.5.11		
1A1A42 Synchro Buffer Amplifier (8 VA)	6.3.5.12		
1A1A43 Synchro Buffer Amplifier (32 VA)	6.3.5.13		
1A1A44 Synchro Buffer Amplifier (32 VA)	6.3.5.14		
1A1A13 Nav Processor CCA	6.3.3.7	6.2	
1A1A15 Status and Command CCA	6.3.3.10	6.2	

Table 6-1. Summary of Corrective Maintenance Procedures - Continued

TITLE	REMOVE AND REPLACE PER PARA.	SET UP OR ALIGN PER PARA.	APPLICABLE REFERENCE FIGURE
1A1A30 Support Electronics Backplane Assembly	6.3.4.4		
1A1A32 IMU Processor CCA	6.3.3.11		6-3
1A1A5 Battery Assembly	6.3.5.15	Chapter 4	6-5
1A1A10 Display Assembly	6.3.6.1		6-6, 6-8, 7-6
1A1A9 Data Entry Keyboard	6.3.6.5		6-7
1A2A1A1 IMU Assembly	6.4.1	6.3.3.11	6-9, 6-10, 6-3
1A2A1A1A9 Magnetic Shield on Sensor Block	6.4.1.3		6-11
1A2A1A1A4 High Voltage Power Supply	6.4.2		
1A2A1A1A1 Ring Laser Gyro "A"	6.4.3.1	6.3.3.11	6-12, 6-13
1A2A1A1A2 Ring Laser Gyro "B"	6.4.3.2	6.3.3.11	6-12, 6-13
1A2A1A1A3 Ring Laser Gyro "C"	6.4.3.3	6.3.3.11	6-12, 6-13
1A2A1A1A5, 1A2A1A1A6, 1A2A1A1A7 Accelerometers	6.4.4	6.3.3.11	6-14
1A2A1A1A9A1 Accelerometer Stimulus Assembly	6.4.5		6-12
1A2A1A1A10 Slip Ring (Inner Torque Motor end)	6.4.6.1		6-15
1A2A1A1A11 Slip Ring (Inner Synchro end)	6.4.6.2		6-15
1A2A1A1A12 Slip Ring (Outer Torque Motor end)	6.4.6.3		6-15
1A2A1A1A13 Slip Ring (Outer Synchro end)	6.4.6.4		6-15

Table 6-2. Tools, Test Equipment and Support Items

TOOL/ EQUIPMENT	TYPE/NOMENCLATURE	USE AND APPLICATION	IN KIT
Adapter, Swivel	1/4-inch drive	Used with 3-inch extension and 3/16 Allen head socket for access to loosen rear screws which secure battery hold-down rails.	X
Adapter, Swivel	3/8-inch drive	General removal and replacement of mounting hardware.	X
Adhesive	P/N P-1896320, or equivalent	Installing IMU.	
Alcohol, Isopropyl	1 oz.	Installing IMU.	
Bags, ESDS, Packaging	12-in. x 12-in. (count 21)	Store removed CCAs during maintenance.	X
Bar, Breaker	1/2-inch drive, 24-inch long	Remove mounting bolts which secure IMU Assembly to Measurements Cabinet base.	X
Cable Lacing, Nylon		Harness lacing and retention.	X
Compound, Silicone Rubber Sealing	Dow Corning 839 clear RTV, or equivalent	Seal edge of Keypad Assembly bezel to front panel.	
Converter, Drive	3/8-inch drive to 1/2-inch drive converter	Adapt 1/2-drive sockets to 3/8-drive ratchet and extensions.	X
Data Sheets, Installation	Figure 8-12	Recording AN/WSN-7(V) system configuration parameters.	
Driver, Nut	3/16-inch	Removal of slip rings.	X
Driver, Socket	3/16-inch Xcelite, ball point hex	Removal and installation of Inverter Assembly.	
Extensions, Ratchet	3/8-inch drive, 6-inch and 10 inch long	General removal and replacement of mounting hardware.	X
Extensions, Ratchet	1/4-inch drive, 3-inch and 6 inch long	General removal and replacement of mounting hardware.	X
Extraction Tool, Chip	EEPROM size	Removal of PROMs on IMU Processor (1A1A32).	X
Grounding Strap, Wrist	Size M/L	When handling ESDS assemblies.	X
Knife, Utility	with Razor Blades	Removal of Membrane Keypad.	
Loctite® Grade AV, Red, Item No. 8731	MIL-S-22473, 97-302-78	Securing mounting screws.	
Loctite® Grade C, Blue		Securing bumper stops in Display Assembly.	
Multimeter, Digital	89536-77/AN	Continuity testing and analog signal and voltage checks.	X
Pliers, Channel Locking	Miniature	General removal of mounting hardware.	X
Pliers, Diagonal Cutting	Small	Cutting cable lacing and tie-wraps.	X

Table 6-2. Tools, Test Equipment and Support Items - Continued

TOOL/ EQUIPMENT	TYPE/NOMENCLATURE	USE AND APPLICATION	IN KIT
Pliers, Plug	Medium	Repair of Display Assembly.	
Ratchet	1/4-inch drive	General removal and replacement of mounting hardware.	X
Ratchet	3/8-inch drive	General removal and replacement of mounting hardware.	X
Screwdriver Set, Phillips	Set including sizes 0 through 3	General removal of mounting hardware.	X
Screwdriver Set, Straight Blade Tip	Set including sizes 4 through 10	General removal of mounting hardware.	
Screwdriver, Allen	5/32-inch Ball end screwdriver	Removal of screw securing bottom narrow end of Gyros to Sensor Block.	
Screwdriver, Offset	Size #1 Phillips-head	Removal of LRUs located on the IMU.	
Screwdriver, Offset	#2 Phillips head	Removal and replacement of Vital Bus Assembly.	
Screwdriver, Offset	Small straight blade with 90 degree offset	Removal of screw for balance weight. Required for access to remove Gyro A (**1A2A1A1A1**).	X
Screwdriver, Phillips	Size #1 (18-inch long)	Removal of Backplane mounting screws and general removal of mounting hardware.	X
Screwdriver, Stub	Blade Tip	Removal of mounting hardware.	X
Screwdriver, Torque	1/4-inch drive, 3-15 inch-lb. torque range	Used with 3/32 Allen end sockets to tighten fasteners which secure Accelerometers.	X
Socket Set, Hex Head	3/8-inch drive; set including sizes 3/16 through 3/4-inch	General removal of mounting hardware.	X
Socket, Allen head	1/16-inch (1/4-inch drive)	Removal of sensor block assembly mounting hardware.	X
Socket, Allen head	3/16-inch (3/8-inch drive)	Loosening battery hold-down rail screws.	X
Socket, Allen head	5/32-inch (1/4-inch drive) 1 inch long	Used with Torque Screwdriver to tighten captive fasteners which secure Gyros.	X
Socket, Allen head	5/32-inch (1/4-inch drive) 4-inch long	Used with Torque Screwdriver to tighten captive fasteners which secure Gyros.	X
Socket, Allen head	1/4-inch drive, 3/32-inch	Removal and installation of Accelerometers.	

Table 6-2. Tools, Test Equipment and Support Items - Continued

TOOL/ EQUIPMENT	TYPE/NOMENCLATURE	USE AND APPLICATION	IN KIT
Socket, Allen Head	3/8-inch drive 5/16 Allen head	Installing nylon screws which secure IMU to alignment surfaces in Measurement Cabinet base.	X
Socket, Hex head	11/32-inch (1/4-inch drive)	Repair of Display Assembly.	X
Socket, Hex head	1/4-inch (1/4-inch drive)	Removal of stand-off mounts on Display Assembly (**1A1A10**).	X
Socket, Hex Head	1/2-inch drive, 1-5/16 inch	Removal of mounting bolts securing IMU Assembly to Measurements Cabinet base.	X
Tape, Masking	Roll, 1-inch wide	Replacement of Display EMI Window	
Tie-Wraps, Plastic	1/8-inch wide x 7-inches long	Replacing and securing of cable wiring harness.	X
Towels, Paper	Roll, 12-inch wide	Installation of Membrane Keypad	
Tweezers	7-inches long	General purpose.	X
Wipes, Lint-free	3 (required)	General purpose.	
Wrench Set, Open-End	Set including sizes 1/8, 3/8, 1/4, 5/16 and 1/2-inch	General removal of mounting hardware.	X
Wrench, Allen	5/64-inch L-type wrench	Removal of screws securing Accelerometer Stimulus CCA to Sensor Block.	X
Wrench, Allen	3/32-inch L-type wrench	Removal and replacement of various components.	X
Wrench, Allen	5/32-inch L-type wrench	Loosening captive fasteners which secure Gyros to Sensor Block.	X
Wrench, Allen	3/16-inch L-type wrench	Removal of screw securing bottom center of Gyros to Sensor Block.	X
Wrench, Allen	1/16-inch T-handle	Loosening fasteners securing ends of magnetic shield sections to mounting plate on Sensor Block.	X
Wrench, Allen	3/32-inch T-handle	Loosening captive fasteners securing rack mounted circuit cards and Accelerometers.	X
Wrench, Allen	7/64-inch T-handle (12-inch long)	Loosening captive fasteners securing rear brackets of High Voltage Power Supply to Sensor Block.	X
Wrench, Allen	9/64-inch T-handle	Loosening captive fasteners securing High Voltage Power Supply to Sensor Block.	X
Wrench, Allen	5/32-inch T-handle	Loosening three outside captive fasteners securing Gyros to Sensor Block.	X

Table 6-2. Tools, Test Equipment and Support Items - Continued

TOOL/ EQUIPMENT	TYPE/NOMENCLATURE	USE AND APPLICATION	IN KIT
Wrench, Allen	3/16-inch T-handle	Removal of screws securing cover on Measurement Cabinet Assembly (Unit 2).	X
Wrench, Allen	7/32-inch T-handle	Loosening captive fasteners securing Processor Cabinet Assembly (Unit 1) door.	X
Wrench, Allen	5/16-inch T-handle (12-inch long)	Removal of nylon screws securing IMU to alignment surfaces in Measurement Cabinet base.	X
Wrench, Torque	1/4-inch drive, 0-50 inch-lb. torque range	Used with 5/32 and 3/16 Allen end sockets to tighten fasteners securing Gyros.	X
Wrench, Torque	1/2-inch drive, 0-120 ft-lb. torque range	Installation of IMU bolts to Baseplate.	X
Loctite® is a registered trademark of Loctite Corp.			

Table 6-3. Slip Ring Assembly Mounting Information

SLIP RING ASSEMBLY	PART NUMBER	MOUNTING LOCATION
1A2A1A1A10	1810553-1	Torquer Motor (**1A2A1A1B2**) (inner)
1A2A1A1A11	1810553-2	Synchro (inner) 1A2A1B4
1A2A1A1A12	1810553-3	Torquer Motor (**1A2A1A1B1**) (outer)
1A2A1A1A13	1810553-4	Synchro (outer) 1A2A1B3

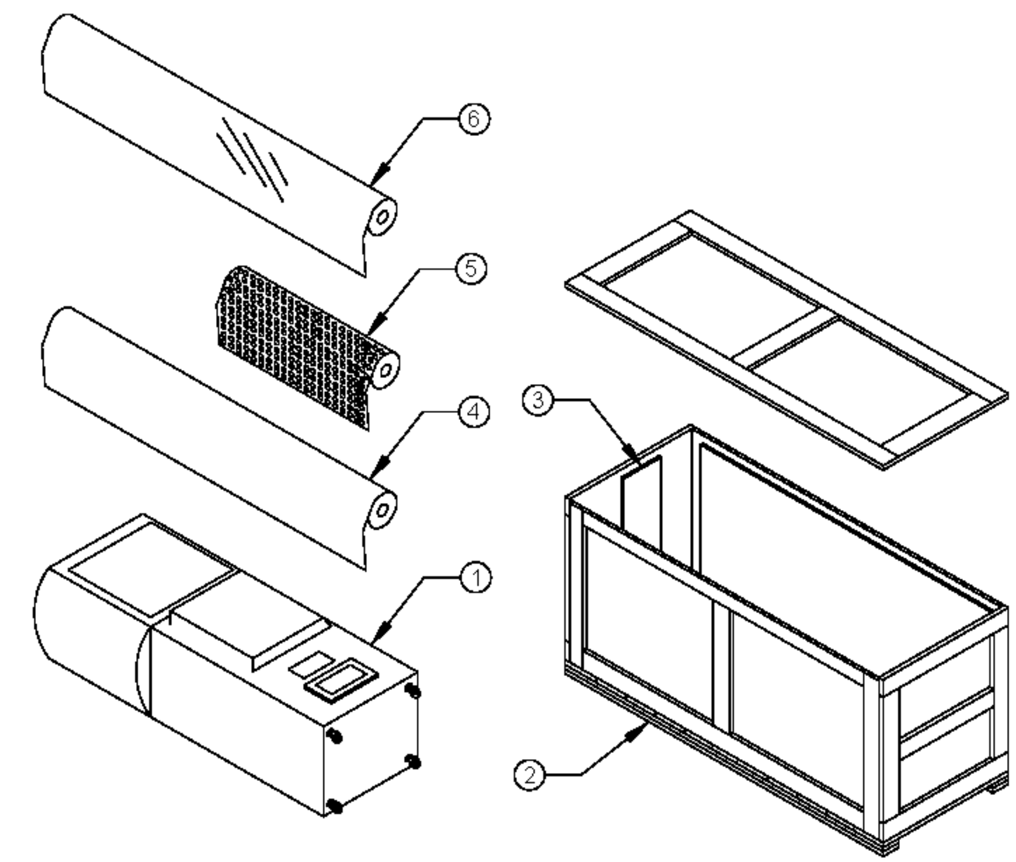
Table 6-4. Packaging Instructions for Ring Laser Gyro Navigator

<table>
<tr><td colspan="3">SPECIAL PACKAGING INSTRUCTION</td><td>CODE IDENT
03956</td><td colspan="2">SPI NO. (TPO)
SPI 1981101</td></tr>
<tr><td colspan="2">PART NUMBER
1981101-6, 1981101-2, or 1981101-3</td><td>NSN</td><td>REV</td><td colspan="2" rowspan="2">LL
CHK
ENGR
AUTH</td></tr>
<tr><td colspan="3">ITEM NOMENCLATURE
CN-1695/1696/1697/WSN-7(V) RING LASER GYRO NAVIGATOR (RLGN)</td><td>ORIGINAL DATE</td></tr>
<tr><td colspan="3" rowspan="6">PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IIb
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A</td><td colspan="3">PACKING AS SPECIFIED BELOW AND BILL OF MATERIALS
LEVEL SPEC A | STYLE TYPE PPP-B-601 | CL A | VAR OS | GR B</td></tr>
<tr><td colspan="3">GROSS CU FT 56.25
GROSS WT (LBS) 700</td></tr>
<tr><td colspan="3">DESIGN FRAGILITY = 50 g</td></tr>
<tr><td></td><td>HEIGHT (IN)</td><td>WIDTH (IN)</td><td>DEPTH (IN)</td></tr>
<tr><td>CNTR I.D.
CNTR O.D.
ITEM DIM
ITEM WT (LBS)</td><td>77
80
70
640</td><td>31.25
36.0
23.5</td><td>29.75
32.0
20.0</td></tr>
</table>

NOTES:
1. ALL WEIGHT IN POUNDS.
2. ALL DIMENSIONS IN INCHES.

ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION
6	A/R	ESD WRAP	SEE ABOVE SPEC.	MIL-B-131H, TY 1, CL I
5	A/R	CLEAR BUBBLE WRAP	1” THICK, SEE ABOVE SPEC.	LPC/AS; P/N LPCLD-48
4	A/R	BROWN WRAPPING PAPER	SEE ABOVE SPEC.	MIL-B-121F, TY III, CL I
3	A/R	FOAM, BLUE, PACKING	2”H X 24”W X 106”W	
2	1	CONTAINER, WOODEN, EXTERNAL	38”W X 33”H X 85”L	SEE ABOVE SPEC.
1	1	RLGN	SEE ABOVE SPEC.	SEE ABOVE SPEC.

Table 6-4. Packaging Instructions for Ring Laser Gyro Navigator - Continued



CN-1695/WSN-7(V), or
CN-1696/WSN-7(V), or
CN-1697/WSN-7(V)
RING LASER GYRO NAVIGATOR (RLGN)

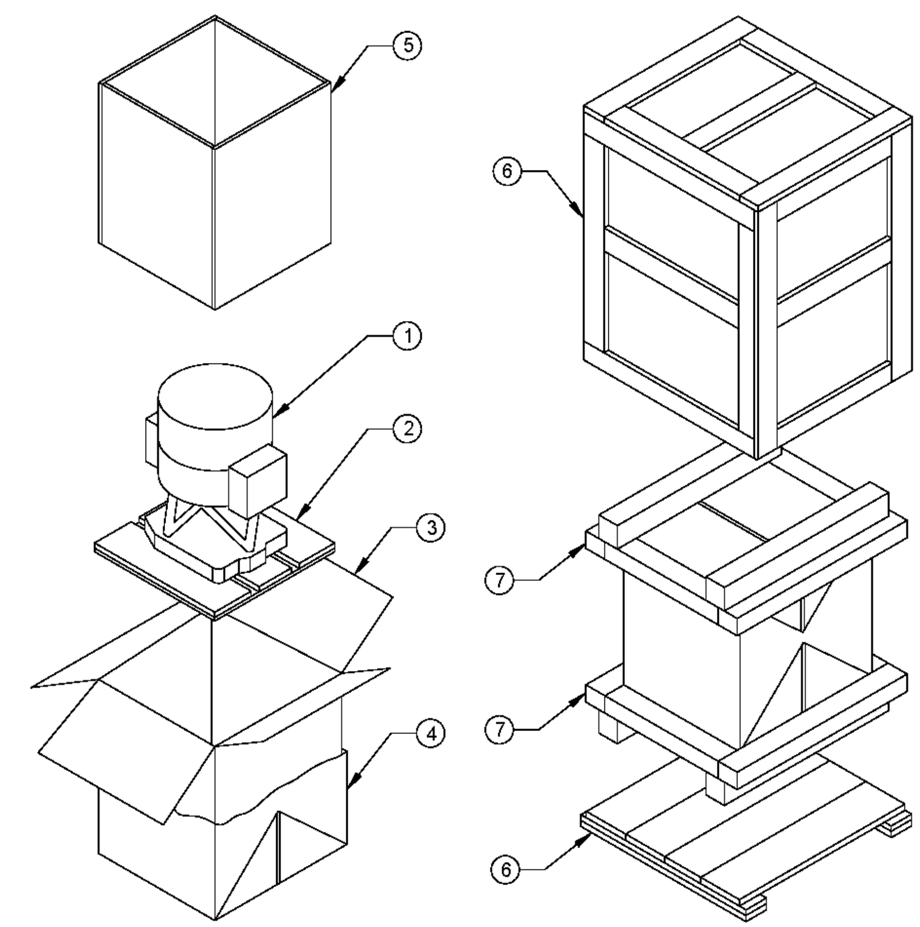
Table 6-5. Packaging Instructions for Inertial Measuring Unit

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1812593
PART NUMBER 1812593 or 4300859	NSN	REV	LL CHK ENGR AUTH	
ITEM NOMENCLATURE MX-11681/WSN-7 or MX-11681A/WSN-7A(V) INERTIAL MEASURING UNIT (IMU)		ORIGINAL DATE		
PRESERVATION IAW MIL-P-116 LEVEL A – METHOD IIb LEVEL B LEVEL C QUP: IAW MIL-P-116 CLEANING: IAW MIL-P-116 C-1 PROCESS DRYING: IAW MIL-P-116 D-4 PROCESS PRESERVATIVE: N/A MARKING: IAW MIL-STD-129 SPECIAL MARKING: N/A		PACKING AS SPECIFIED BELOW AND BILL OF MATERIALS LEVEL SPEC A	STYLE TYPE PPP-B-601	CL A / VAR OS / GR B
		GROSS CU FT GROSS WT (LBS)		32.20 350
		DESIGN FRAGILITY = 20 g		
			HEIGHT (IN)	WIDTH (IN) / DEPTH (IN)
		CNTR I.D. CNTR O.D. ITEM DIM ITEM WT (LBS)	34.50 36.75 20.75 165.00	34.50 / 35.50 36.75 / 41.13 19.75 / 18.00

ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION
11	A/R	STEEL STRAPPING	.75 X .023 THK	QQ-S-781
10	A/R	TAPE, SEALING	N/A	PPP-T-60 TY IV CL I
9	1	HUMIDITY INDICATOR CARD	N/A	MS20003
8	12	DESICCANT	12 – 16 UNIT BAGS	MIL-D-3464
7	1	CUSHIONING TOP AND BOTTOM	2 LB DENSITY	PPP-C-1752 TY I CL II
6	1	EXTERIOR CONTAINER	SEE ABOVE SPEC.	SEE ABOVE SPEC.
5	1	LINER	97.75 X 23.50	PPP-B-320 VAR TW
4	1	BARRIER	58 X 120 FLAT	MIL-B-131 TY I CL I
3	1	INTERIOR CONTAINER	25 X 25 X 25 ID	PPP-B-640 CL II ST E
2	1.3	MOUNTING BASE, 1/2 X 3 BOLTS	24.88 X 24.88 X .75	NN-P-530
1	1	IMU WITH WRAP – PLASTIC BAG	SEE ABOVE SPEC.	SEE ABOVE SPEC.

Table 6-5. Packaging Instructions for Inertial Measuring Unit - Continued

NOTES:
1. CONTAINER CLOSURE, SEALING AND REINFORCEMENT SHALL BE IAW APPLICABLE SPECIFICATION, EXCEPT TOP FLAPS OF FIBERBOARD SHALL BE CLOSED WITH TAPE IN LIEU OF GLUE.
2. ALL WEIGHT IN POUNDS.
3. ALL DIMENSIONS IN INCHES.



INERTIAL MEASURING UNIT (IMU)

Table 6-6. Alternate Packaging Instructions for Inertial Measuring Unit

SPECIAL PACKAGING INSTRUCTION			CODE IDENT: 03956	SPI NO. (TPO): SPI 1812593
PART NUMBER: 1812593 or 4300859	NSN:	REV:	LL CHK ENGR AUTH	
ITEM NOMENCLATURE: MX-11681/WSN-7 or MX-11681A/WSN-7A(V) INERTIAL MEASURING UNIT (IMU)	ORIGINAL DATE:			

PRESERVATION IAW MIL-P-116 LEVEL A – METHOD IIb LEVEL B LEVEL C QUP: IAW MIL-P-116 CLEANING: IAW MIL-P-116 C-1 PROCESS DRYING: IAW MIL-P-116 D-4 PROCESS PRESERVATIVE: N/A MARKING: IAW MIL-STD-129 SPECIAL MARKING: N/A	PACKING AS SPECIFIED BELOW AND BILL OF MATERIALS

LEVEL:	SPEC:	STYLE:	TYPE:	CL:	VAR:	GR:
A	PPP-B-601	A	OS			B

GROSS CU FT:	24.2
GROSS WT (LBS):	350.00
DESIGN FRAGILITY = 20 g	

	LENGTH (IN)	WIDTH (IN)	HEIGHT (IN)
CNTNR O.D.	31.75	29.75	29.00
CNTNR O.D.	36.50	32.27	35.37
ITEM DIM	20.75	19.75	18.00
ITEM WT (LBS)	165.00		

NOTES:
1. CONTAINER CLOSURE SHALL BE IAW APPLICABLE SPECIFICATION.
2. ALL WEIGHT IN POUNDS.
3. ALL DIMENSIONS IN INCHES.

ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE (inches)	MATERIAL SPECIFICATION
7	1	HUMIDITY INDICATOR CARD	N/A	MS20003
6	6	DESICCANT	12 - 16 UNIT BAGS	MIL-D-3464
5	1	CONTAINER COVER	SEE ABOVE SPEC.	SEE ABOVE SPEC.
4	8	CONTAINER - TOP	SEE ABOVE SPEC.	SEE ABOVE SPEC.
3	1	CONTAINER - BOTTOM	SEE ABOVE SPEC.	SEE ABOVE SPEC.
2	1,3	MOUNTING BASE,	5/16 X 19 X 20.5 X 1.75	NN-P-530
1	1	IMU WITH WRAP - PLASTIC BAG	SEE ABOVE SPEC.	SEE ABOVE SPEC.

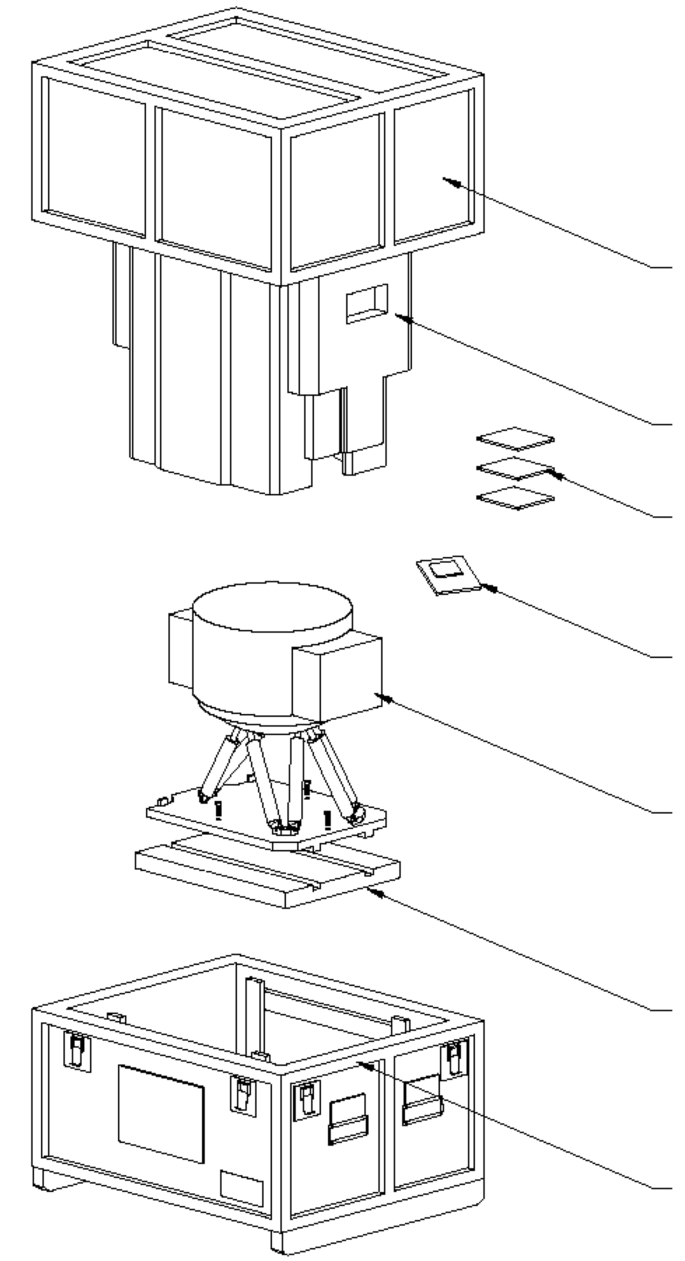


Table 6-7. Packaging Instructions for Battery Assembly 1981554

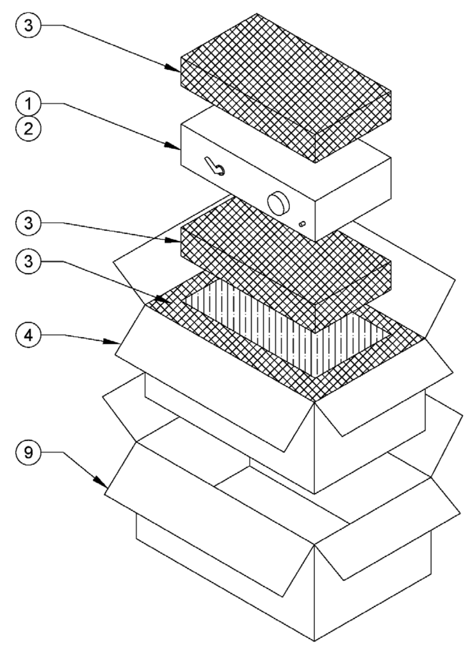
SPECIAL PACKAGING INSTRUCTION	CODE IDENT 03956	SPI NO. (TPO) SPI 1981554

PART NUMBER 1981554	NSN	REV	LL CHK ENGR AUTH
ITEM NOMENCLATURE BATTERY ASSEMBLY		ORIGINAL DATE	

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD III
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A

NOTE

Item weighs 26.4 Kg (58 lbs)



ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION
9	1	EXTERIOR SHIPPING CONTAINER	23 X 15 X 11 ID	PPP-B-636 TY CF CL WR
8	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
7	N/A			
6	N/A			
5	N/A			
4	1	INTERIOR CONTAINER	22 X 14 X 10 ID	PPP-B-636 TY CF ST OPF
3	A/R	CUSHIONING	1.5 FT^3	SEMI-RIGID FOAM BOARD
2	1	WRAP – PLASTIC BAG	24 X 30	L-P-378
1	1	BATTERY ASSEMBLY	17.25 X 10.0 X 4.0	N/A

Table 6-8. Packaging Instructions for Ring Laser Gyros 1812594-n

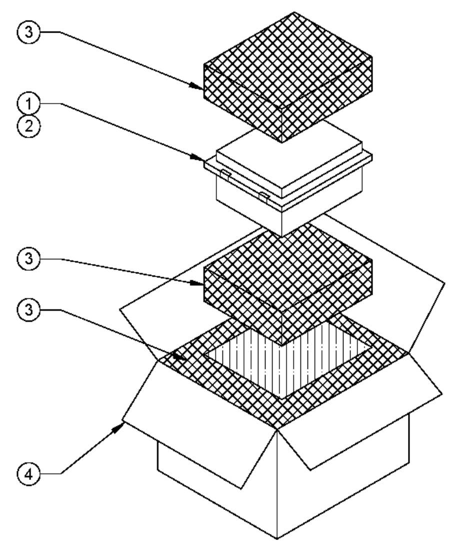
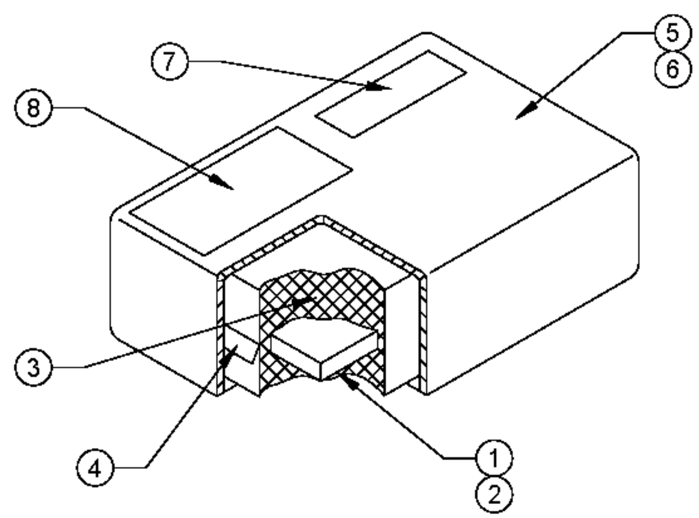
<table>
<tr><td colspan="4">SPECIAL PACKAGING INSTRUCTION</td><td>CODE IDENT
03956</td><td>SPI NO. (TPO)
SPI 1812594</td></tr>
<tr><td colspan="2">PART NUMBER
1812594-var</td><td>NSN</td><td>REV</td><td colspan="2" rowspan="2">LL
CHK
ENGR
AUTH</td></tr>
<tr><td colspan="3">ITEM NOMENCLATURE
RING LASER GYRO MATCHED SET</td><td>ORIGINAL DATE</td></tr>
<tr><td colspan="6">PRESERVATION IAW MIL-P-116
LEVEL A – METHOD III
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A

</td></tr>
<tr><td>8</td><td>A/R</td><td colspan="2">TAPE, SEALING</td><td>N/A</td><td>PPP-T-45 TY II CL I</td></tr>
<tr><td>7</td><td>N/A</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>6</td><td>N/A</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>5</td><td>N/A</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>4</td><td>1</td><td colspan="2">FIBERBOARD FOLDING CARTON</td><td>15.5 X 13.5 X 11 ID</td><td>PPP-B-636 TY CF ST OPF</td></tr>
<tr><td>3</td><td>A/R</td><td colspan="2">CUSHIONING</td><td>1.5 FT^3</td><td>SEMI-RIGID FOAM BOARD</td></tr>
<tr><td>2</td><td>1</td><td colspan="2">REUSEABLE SHIPPING CONTAINER</td><td>11.5 X 11.5 X 4.0</td><td>N/A</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">RING LASER GYRO AND CALIBRATION PROM</td><td></td><td>N/A</td></tr>
<tr><td>ITEM</td><td>QTY</td><td colspan="2">NOMENCLATURE OR DESCRIPTION</td><td>SIZE</td><td>MATERIAL SPECIFICATION</td></tr>
</table>

Table 6-9. Packaging Instructions for Nav, I/O, and ATM Processor Assemblies

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1812590
PART NUMBER 1812590/ 1812591/ 1900040	NSN	REV VARIOUS	LL CHK ENGR AUTH	
ITEM NOMENCLATURE NAVIGATION, I/O, AND ATM PROCESSOR CCAs (ALL)		ORIGINAL DATE		

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IA8
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A



8	2	IDENTIFICATION LABEL	4 X 2	MIL-61002 TY II GR I
7	2	PRECAUTIONARY LABEL	2.5 X 1.0	ANTI-STATIC
6	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
5	1	FIBERBOARD FOLDING CARTON	10 X 10 X 3	PPP-B-636 TY CF ST OPF
4	1	SEALED BARRIER BAG	10 X 12 ID	MIL-B-117 TY I CL F ST I
3	1	CUSHIONING	19 X 7.75 X .25 THK	PPP-C-795 BUBBLE WRAP
2	1	WRAP	17.0 X 8.0	MIL-B-81705
1	1	NAVIGATION, I/O, AND ATM PROCESSOR CIRCUIT CARD ASSEMBLIES (ALL)	7.25 X 7.5 X 1	N/A
ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION

Table 6-10. Packaging Instructions for Support Electronic Assemblies

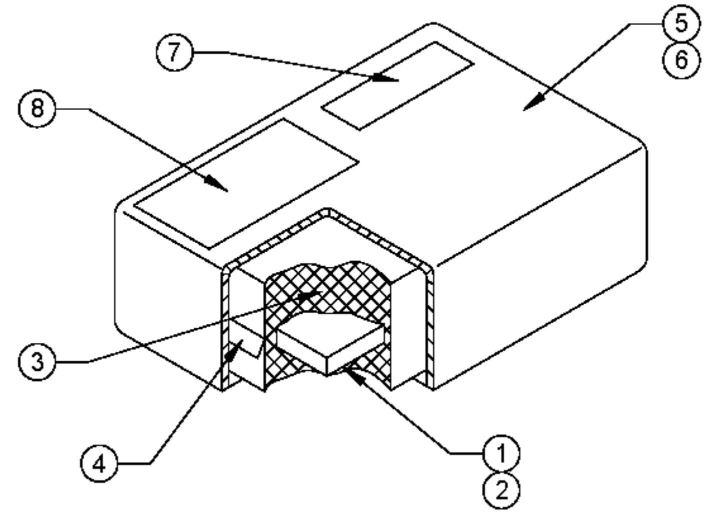
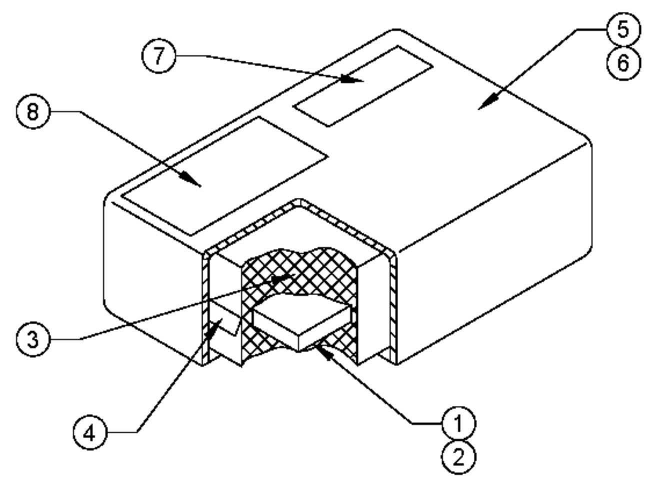
<table>
<tr><td colspan="3">SPECIAL PACKAGING INSTRUCTION</td><td>CODE IDENT
03956</td><td>SPI NO. (TPO)
SPI SP_CCA2</td></tr>
<tr><td>PART NUMBER
various</td><td>NSN</td><td>REV</td><td colspan="2" rowspan="2">LL
CHK
ENGR
AUTH</td></tr>
<tr><td colspan="2">ITEM NOMENCLATURE
SUPPORT ELECTRONIC CCAs (ALL)</td><td>ORIGINAL DATE</td></tr>
<tr><td colspan="5">PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IA8
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A

</td></tr>
<tr><td>8</td><td>2</td><td>IDENTIFICATION LABEL</td><td>4 X 2</td><td>MIL-61002 TY II GR I</td></tr>
<tr><td>7</td><td>2</td><td>PRECAUTIONARY LABEL</td><td>2.5 X 1.0</td><td>ANTI-STATIC</td></tr>
<tr><td>6</td><td>A/R</td><td>TAPE, SEALING</td><td>N/A</td><td>PPP-T-45 TY II CL I</td></tr>
<tr><td>5</td><td>1</td><td>FIBERBOARD FOLDING CARTON</td><td>10 X 10 X 3</td><td>PPP-B-636 TY CF ST OPF</td></tr>
<tr><td>4</td><td>1</td><td>SEALED BARRIER BAG</td><td>10 X 12 ID</td><td>MIL-B-117 TY I CL F ST I</td></tr>
<tr><td>3</td><td>1</td><td>CUSHIONING</td><td>19 X 7.75 X .25 THK</td><td>PPP-C-795 BUBBLE WRAP</td></tr>
<tr><td>2</td><td>1</td><td>WRAP</td><td>17.0 X 8.0</td><td>MIL-B-81705</td></tr>
<tr><td>1</td><td>1</td><td>SUPPORT ELECTRONICS CIRCUIT CARD ASSEMBLIES (ALL)</td><td>6.15 X 6.12 X .75</td><td>N/A</td></tr>
<tr><td>ITEM</td><td>QTY</td><td>NOMENCLATURE OR DESCRIPTION</td><td>SIZE</td><td>MATERIAL SPECIFICATION</td></tr>
</table>

Table 6-11. Packaging Instructions for Vital Bus Assembly 1978322

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1978322
PART NUMBER 1978322	NSN	REV	LL CHK ENGR AUTH	
ITEM NOMENCLATURE VITAL BUS CCA		ORIGINAL DATE		

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IA8
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A

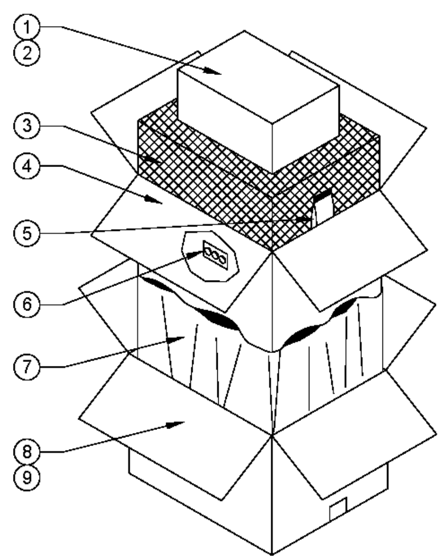


8	2	IDENTIFICATION LABEL	4 X 2	MIL-61002 TY II GR I
7	2	PRECAUTIONARY LABEL	2.5 X 1.0	ANTI-STATIC
6	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
5	1	FIBERBOARD FOLDING CARTON	10 X 10 X 3	PPP-B-636 TY CF ST OPF
4	1	SEALED BARRIER BAG	10 X 12 ID	MIL-B-117 TY I CL F ST I
3	1	CUSHIONING	19 X 7.75 X .25 THK	PPP-C-795 BUBBLE WRAP
2	1	WRAP	17.0 X 8.0	MIL-B-81705
1	1	VITAL BUS CIRCUIT CARD ASSEMBLY	9.5 X 7 X 1.25	N/A
ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION

Table 6-12. Packaging Instructions for 400 Hz Inverter Assembly 1982618

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1982618
PART NUMBER 1982618	NSN	REV A	LL CHK ENGR AUTH	
ITEM NOMENCLATURE 400 HZ INVERTER ASSEMBLY		ORIGINAL DATE		

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IIb
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A



ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION
9	1	EXTERIOR SHIPPING CONTAINER	11 X 11 X 11 ID	PPP-B-636 TY CF CL WR
8	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
7	1	BARRIER	22 X 23 ID	MIL-B-131 TY I CL I
6	1	HUMIDITY INDICATOR CARD	N/A	MS20003
5	3	DESICCANT	3 – 4 UNIT BAGS	MIL-D-3464
4	1	INTERIOR CONTAINER	10 X 10 X 10 ID	PPP-B-636 TY CF ST OPF
3	A/R	CUSHIONING	3.5 FT^2	PPP-C-795 BUBBLE WRAP
2	1	WRAP – PLASTIC BAG	16 X 24	L-P-378
1	1	400 HZ INVERTER ASSEMBLY	7.5 X 6.0 X 5.0	N/A

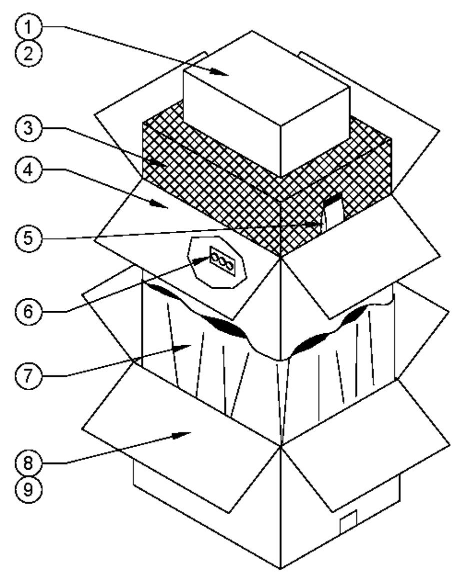
Table 6-13. Packaging Instructions for Power Supply 1979342

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1979342
PART NUMBER 1979342	NSN	REV	LL CHK ENGR AUTH	
ITEM NOMENCLATURE POWER SUPPLY		ORIGINAL DATE		

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IIb
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A

NOTE

Item weighs 23 Kg (51 lbs)

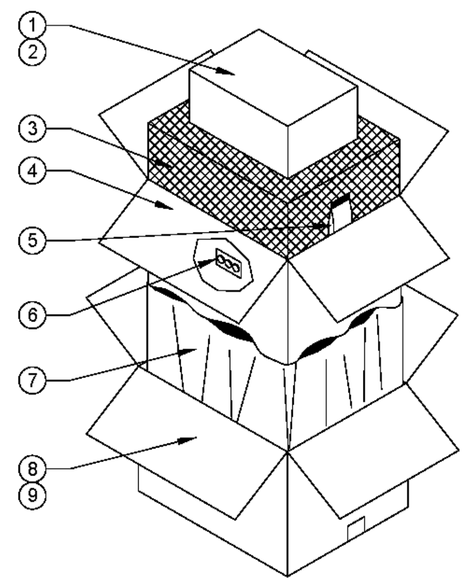


ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION
9	1	EXTERIOR SHIPPING CONTAINER	11 X 11 X 11 ID	PPP-B-636 TY CF CL WR
8	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
7	1	BARRIER	22 X 23 ID	MIL-B-131 TY I CL I
6	1	HUMIDITY INDICATOR CARD	N/A	MS20003
5	3	DESICCANT	3 – 4 UNIT BAGS	MIL-D-3464
4	1	INTERIOR CONTAINER	10 X 10 X 10 ID	PPP-B-636 TY CF ST OPF
3	A/R	CUSHIONING	3.5 FT^2	PPP-C-795 BUBBLE WRAP
2	1	WRAP – PLASTIC BAG	16 X 24	L-P-378
1	1	POWER SUPPLY	7.5 X 6.0 X 5.0	N/A

Table 6-14. Packaging Instructions for Battery Charger 1810853

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1810853
PART NUMBER 1810853	NSN	REV	LL CHK ENGR AUTH	
ITEM NOMENCLATURE BATTERY CHARGER ASSEMBLY		ORIGINAL DATE		

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IIb
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A



ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION
9	1	EXTERIOR SHIPPING CONTAINER	11 X 11 X 11 ID	PPP-B-636 TY CF CL WR
8	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
7	1	BARRIER	22 X 23 ID	MIL-B-131 TY I CL I
6	1	HUMIDITY INDICATOR CARD	N/A	MS20003
5	3	DESICCANT	3 – 4 UNIT BAGS	MIL-D-3464
4	1	INTERIOR CONTAINER	10 X 10 X 10 ID	PPP-B-636 TY CF ST OPF
3	A/R	CUSHIONING	3.5 FT^2	PPP-C-795 BUBBLE WRAP
2	1	WRAP – PLASTIC BAG	12 X 16	L-P-378
1	1	BATTERY CHARGER ASSEMBLY	8.3 X 6.3 X 4.3	N/A

Table 6-15. Packaging Instructions for Power Module 1205050-3

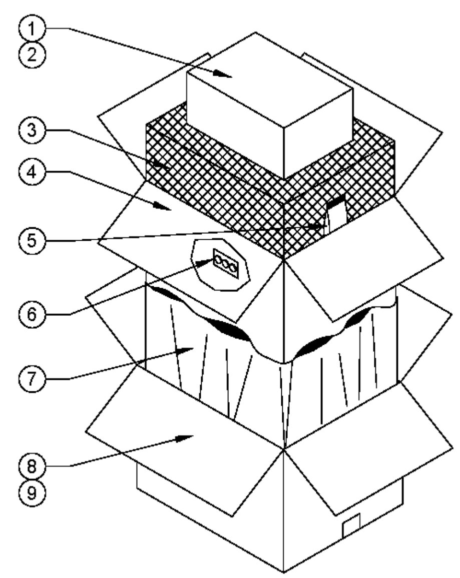
<table>
<tr><td colspan="3">SPECIAL PACKAGING INSTRUCTION</td><td>CODE IDENT
03956</td><td>SPI NO. (TPO)
SPI 1205050-3</td></tr>
<tr><td>PART NUMBER
1205050-3</td><td>NSN</td><td>REV</td><td colspan="2" rowspan="2">LL
CHK
ENGR
AUTH</td></tr>
<tr><td colspan="2">ITEM NOMENCLATURE
POWER MODULE</td><td>ORIGINAL DATE</td></tr>
<tr><td colspan="5">PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IIb
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A
</td></tr>
<tr><td>9</td><td>1</td><td>EXTERIOR SHIPPING CONTAINER</td><td>17 X 11 X 11 ID</td><td>PPP-B-636 TY CF CL WR</td></tr>
<tr><td>8</td><td>A/R</td><td>TAPE, SEALING</td><td>N/A</td><td>PPP-T-45 TY II CL I</td></tr>
<tr><td>7</td><td>1</td><td>BARRIER</td><td>22 X 23 ID</td><td>MIL-B-131 TY I CL I</td></tr>
<tr><td>6</td><td>1</td><td>HUMIDITY INDICATOR CARD</td><td>N/A</td><td>MS20003</td></tr>
<tr><td>5</td><td>3</td><td>DESICCANT</td><td>3 – 4 UNIT BAGS</td><td>MIL-D-3464</td></tr>
<tr><td>4</td><td>1</td><td>INTERIOR CONTAINER</td><td>16 X 10 X 10 ID</td><td>PPP-B-636 TY CF ST OPF</td></tr>
<tr><td>3</td><td>A/R</td><td>CUSHIONING</td><td>3.5 FT^2</td><td>PPP-C-795 BUBBLE WRAP</td></tr>
<tr><td>2</td><td>1</td><td>WRAP – PLASTIC BAG</td><td>56 X 54</td><td>L-P-378</td></tr>
<tr><td>1</td><td>1</td><td>POWER MODULE</td><td>12 X 6.5 X 6</td><td>N/A</td></tr>
<tr><td>ITEM</td><td>QTY</td><td>NOMENCLATURE OR DESCRIPTION</td><td>SIZE</td><td>MATERIAL SPECIFICATION</td></tr>
</table>

Table 6-16. Packaging Instructions for Display Assembly 1979344

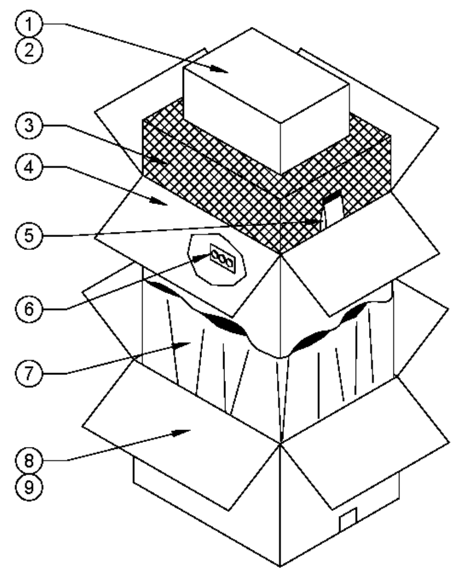
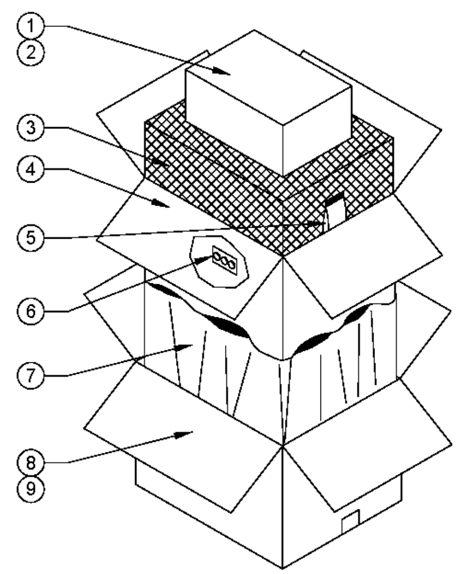
SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1979344
PART NUMBER 1979344	NSN	REV	LL CHK ENGR AUTH	
ITEM NOMENCLATURE DISPLAY ASSEMBLY		ORIGINAL DATE		
PRESERVATION IAW MIL-P-116 LEVEL A – METHOD IIb LEVEL B LEVEL C QUP: IAW MIL-P-116 CLEANING: IAW MIL-P-116 C-1 PROCESS DRYING: IAW MIL-P-116 D-4 PROCESS PRESERVATIVE: N/A MARKING: IAW MIL-STD-129 SPECIAL MARKING: N/A				
9	1	EXTERIOR SHIPPING CONTAINER	19 X 17 X 9 ID	PPP-B-636 TY CF CL WR
8	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
7	1	BARRIER	40 X 40 ID	MIL-B-131 TY I CL I
6	1	HUMIDITY INDICATOR CARD	N/A	MS20003
5	3	DESICCANT	3 – 4 UNIT BAGS	MIL-D-3464
4	1	INTERIOR CONTAINER	18 X 16 X 8 ID	PPP-B-636 TY CF ST OPF
3	A/R	CUSHIONING	6 FT^2	PPP-C-795 BUBBLE WRAP
2	1	WRAP – PLASTIC BAG	24 X 24	L-P-378
1	1	DISPLAY ASSEMBLY	16.7 X 10.5 X 4.5	N/A
ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION

Table 6-17. Packaging Instructions for Synchro Buffer Amplifiers 1976545 and 1976547

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1976545
PART NUMBER 1976545 and 1976547	NSN	REV	LL CHK ENGR AUTH	
ITEM NOMENCLATURE SYNCHRO BUFFER AMPLIFIER (8 VA AND 32 VA)		ORIGINAL DATE		

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IIb
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A



9	1	EXTERIOR SHIPPING CONTAINER	11 X 11 X 11 ID	PPP-B-636 TY CF CL WR
8	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
7	1	BARRIER	22 X 23 ID	MIL-B-131 TY I CL I
6	1	HUMIDITY INDICATOR CARD	N/A	MS20003
5	3	DESICCANT	3 – 4 UNIT BAGS	MIL-D-3464
4	1	INTERIOR CONTAINER	10 X 10 X 10 ID	PPP-B-636 TY CF ST OPF
3	A/R	CUSHIONING	3.5 FT^2	PPP-C-795 BUBBLE WRAP
2	1	WRAP – PLASTIC BAG	12 X 16	L-P-378

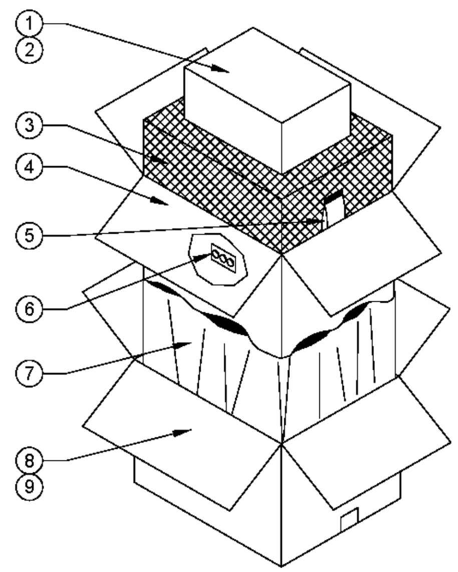
Table 6-17. Packaging Instructions for Synchro Buffer Amplifiers 1976545 and 1976547 - Continued

1	1	SYNCHRO BUFFER 32 VA AND 8 VA	8.3 X 6.9 X 4.0	N/A
ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION

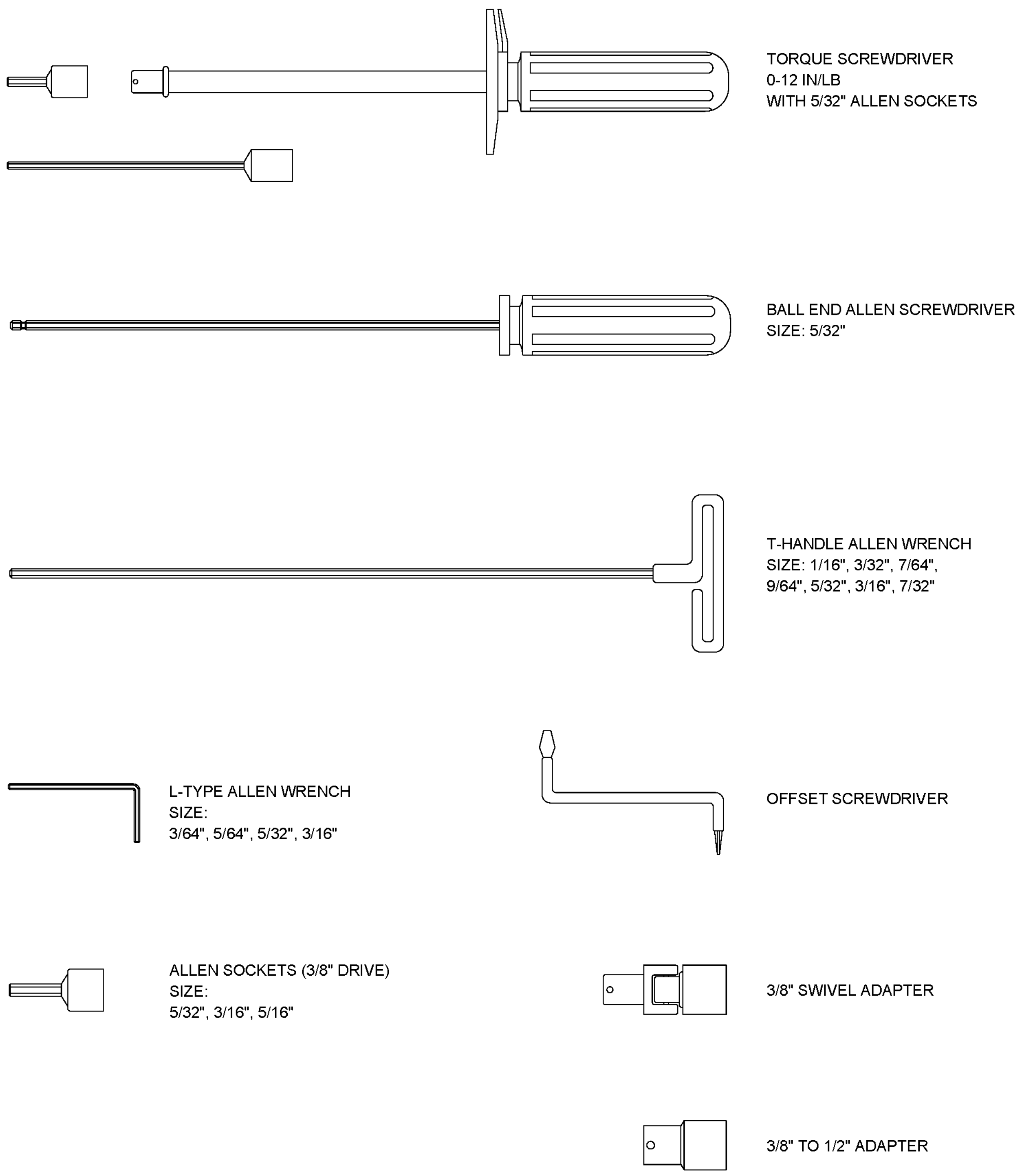
Table 6-18. Packaging Instructions for High Voltage Power Supply 1979045

SPECIAL PACKAGING INSTRUCTION			CODE IDENT 03956	SPI NO. (TPO) SPI 1979045
PART NUMBER 1979045	NSN	REV	LL CHK ENGR AUTH	
ITEM NOMENCLATURE HIGH VOLTAGE POWER SUPPLY		ORIGINAL DATE		

PRESERVATION IAW MIL-P-116
LEVEL A – METHOD IIb
LEVEL B
LEVEL C
QUP: IAW MIL-P-116
CLEANING: IAW MIL-P-116 C-1 PROCESS
DRYING: IAW MIL-P-116 D-4 PROCESS
PRESERVATIVE: N/A
MARKING: IAW MIL-STD-129
SPECIAL MARKING: N/A



9	1	EXTERIOR SHIPPING CONTAINER	11 X 9 X 7 ID	PPP-B-636 TY CF CL WR
8	A/R	TAPE, SEALING	N/A	PPP-T-45 TY II CL I
7	1	BARRIER	22 X 23 ID	MIL-B-131 TY I CL I
6	1	HUMIDITY INDICATOR CARD	N/A	MS20003
5	3	DESICCANT	3 – 4 UNIT BAGS	MIL-D-3464
4	1	INTERIOR CONTAINER	10 X 8 X 6 ID	PPP-B-636 TY CF ST OPF
3	A/R	CUSHIONING	3.5 FT^2	PPP-C-795 BUBBLE WRAP
2	1	WRAP – PLASTIC BAG	12 X 16	L-P-378
1	1	HIGH VOLTAGE POWER SUPPLY	6.5 X 5.0 X 2.5	N/A
ITEM	QTY	NOMENCLATURE OR DESCRIPTION	SIZE	MATERIAL SPECIFICATION



(All size dimensions are in inches)

Figure 6-1. Typical Maintenance Tools

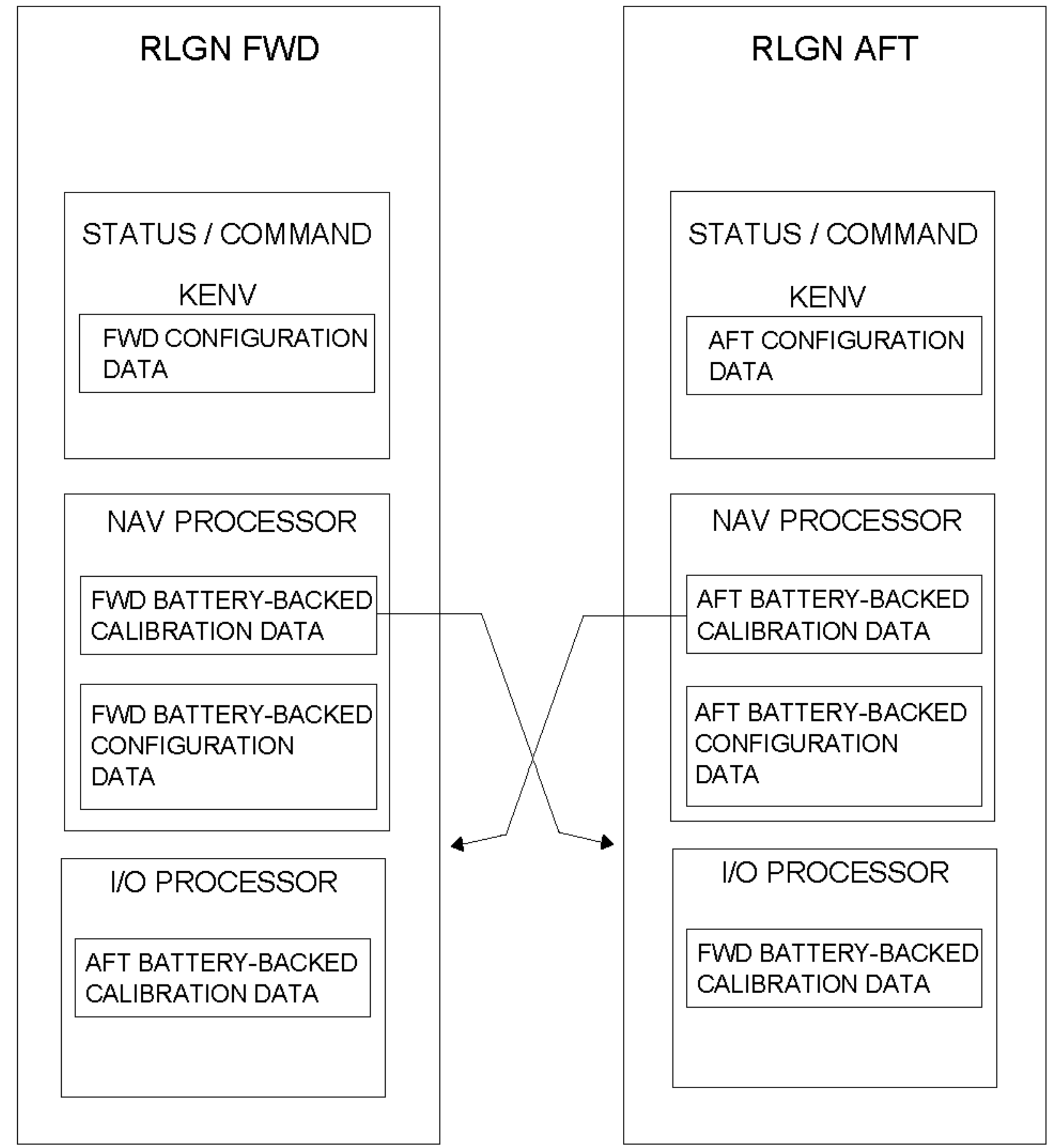
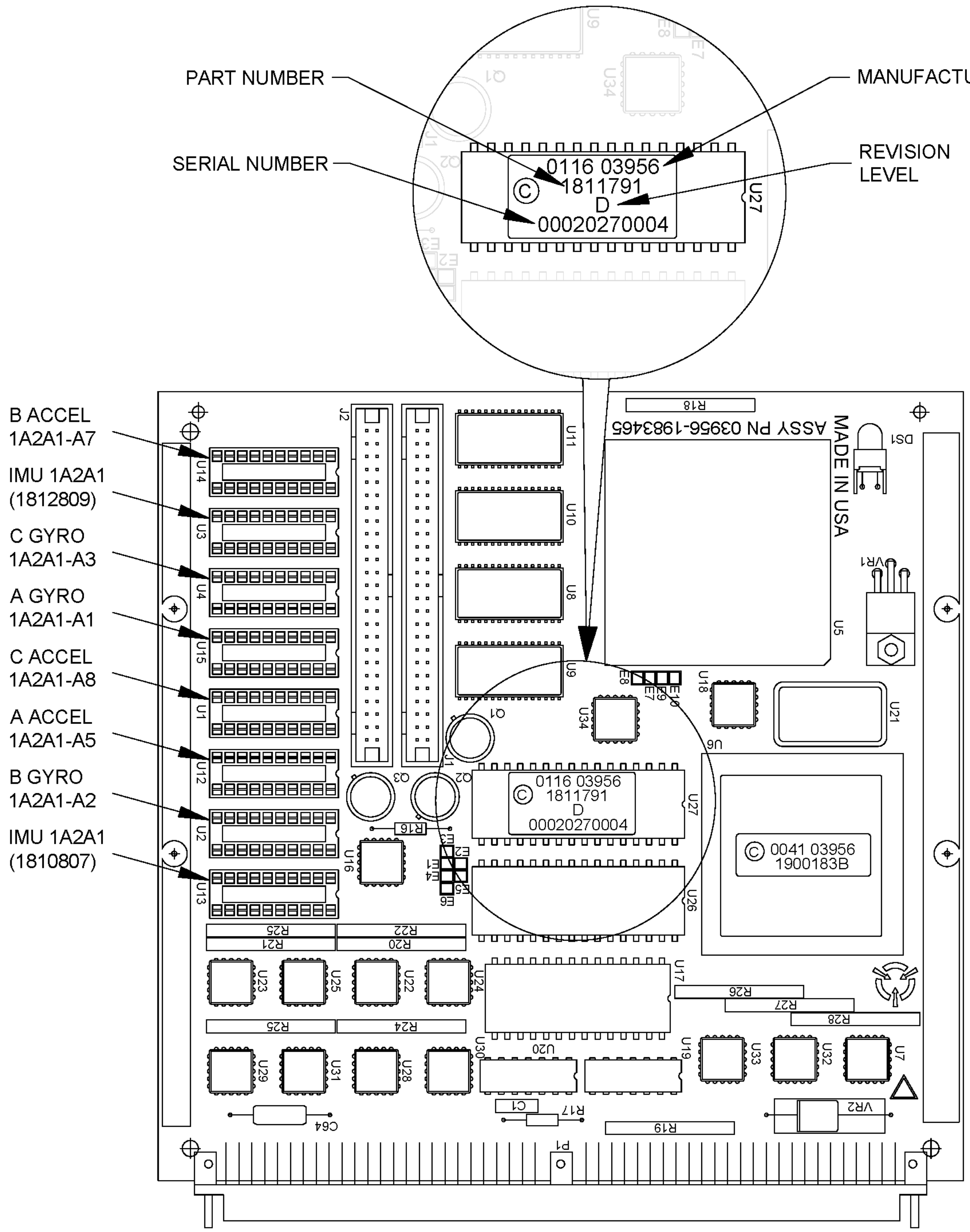
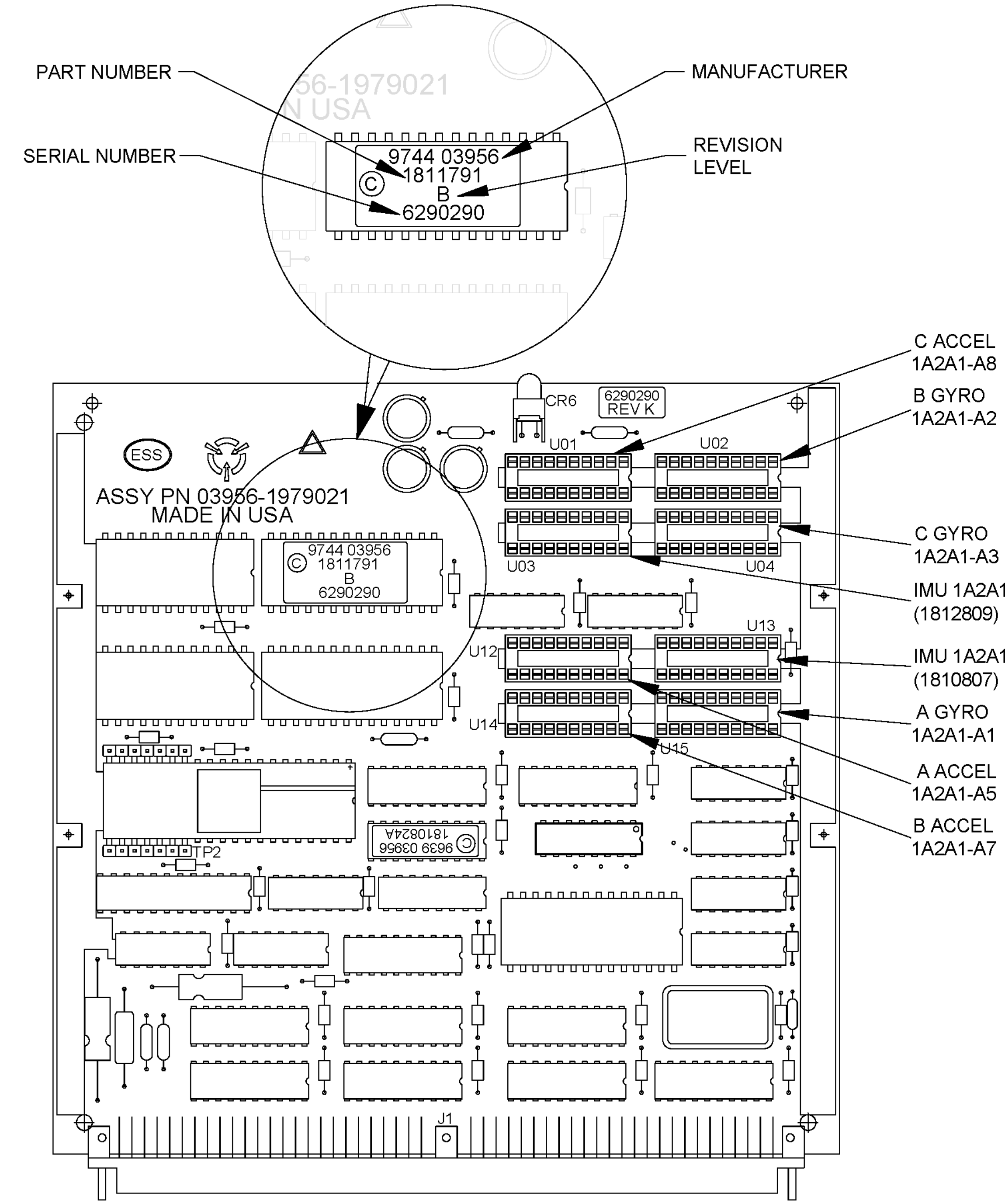


Figure 6-2. Battery-Backed Configuration Data



CALIBRATION PROMS (U14, U03, U04, U15, U01, U12, U02, U13)



CALIBRATION PROMS (U01, U02, U03, U04, U12, U13, U14, U15)

NOTE:
TWO CALIBRATION PROMS ARE USED FOR THE INERTIAL MEASURING UNIT (1A2A1). SOCKET XU13 IS THE ACTIVE SOCKET AND XU03 IS THE LOCATION FOR THE INACTIVE PROM. FOR SURFACE APPLICATIONS INSTALL PROM PART NUMBER 1910807 IN SOCKET XU13.

IF THE IMU IS REPLACED, BE SURE THAT THE CORRECT PROM PART NUMBER IS INSTALLED IN EACH LOCATION SHOWN.

Figure 6-3. Identification of Calibration PROMs on IMU Processor CCA

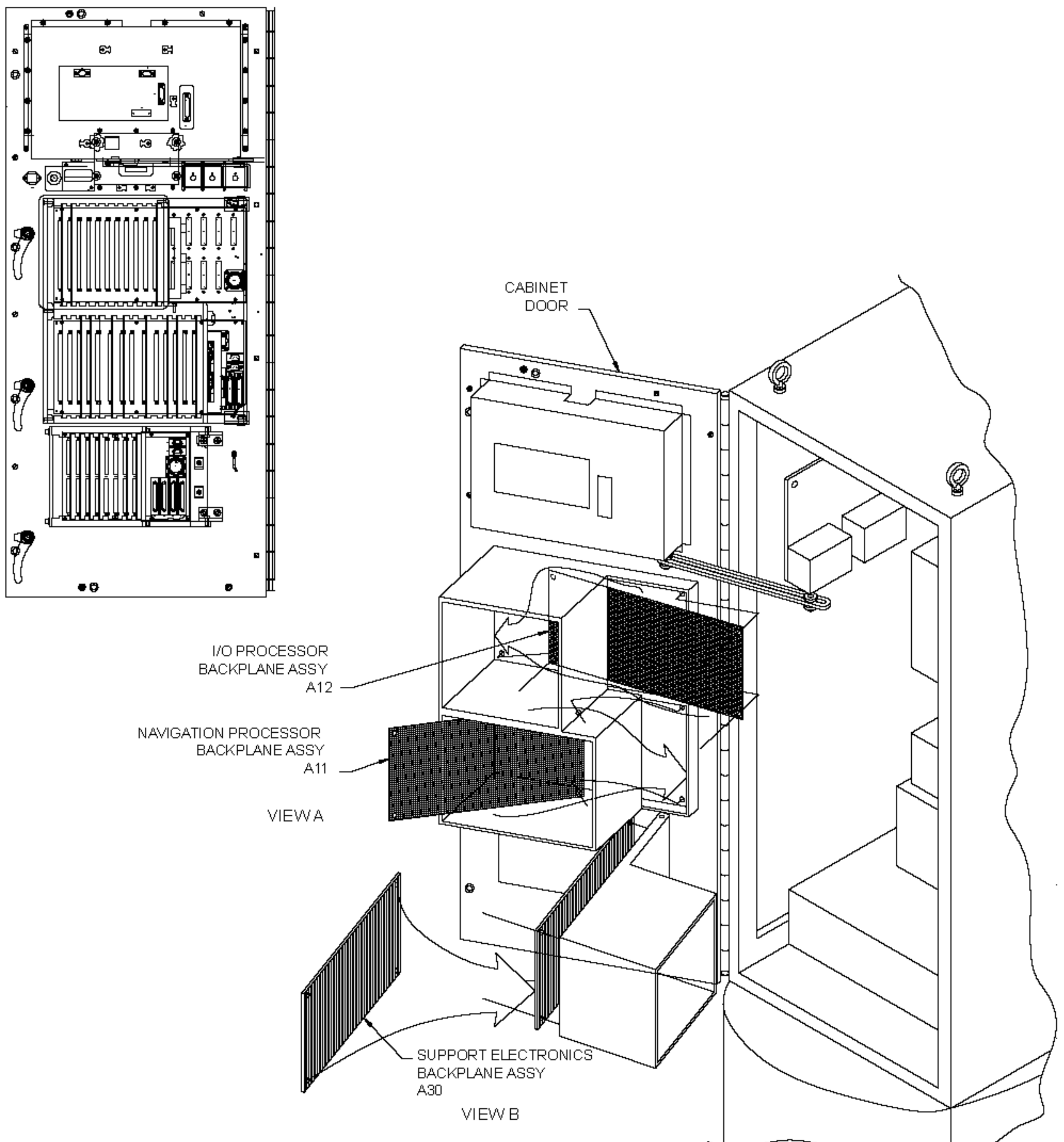


Figure 6-4. Removal of Backplane Wiring Assemblies

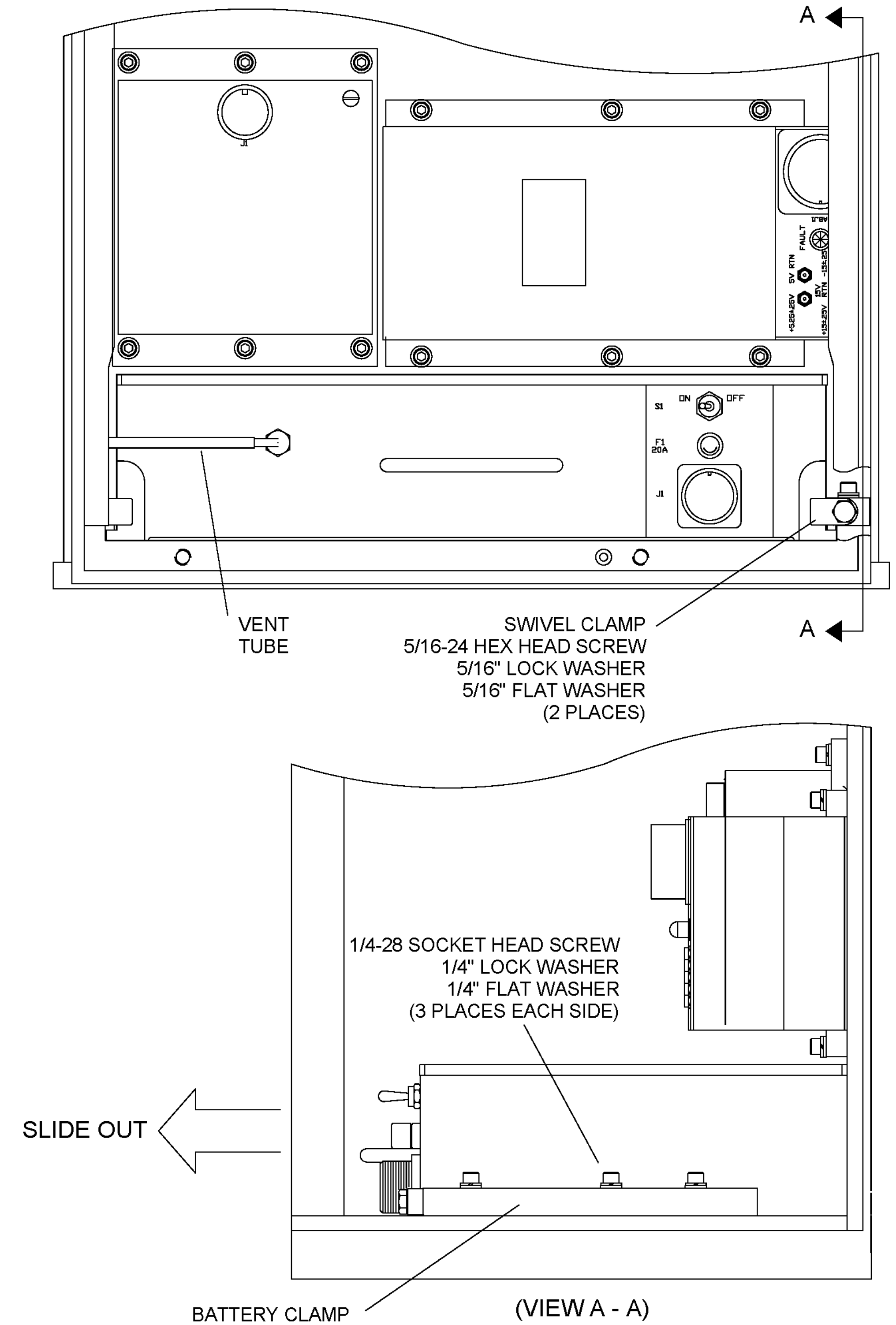


Figure 6-5. Replacement of Battery Assembly (1A1A5)

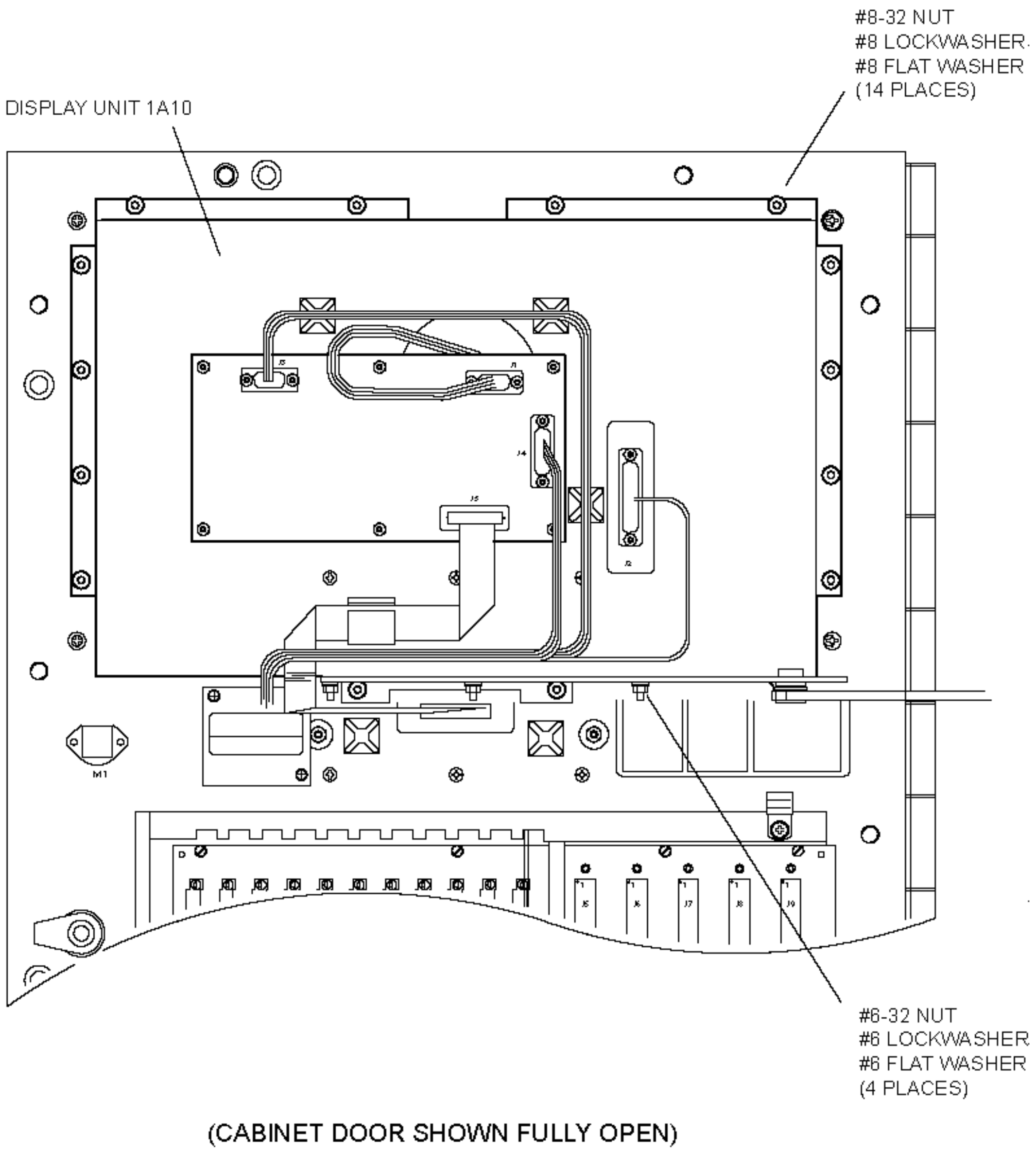


Figure 6-6. Replacement of Display Assembly (1A1A10)

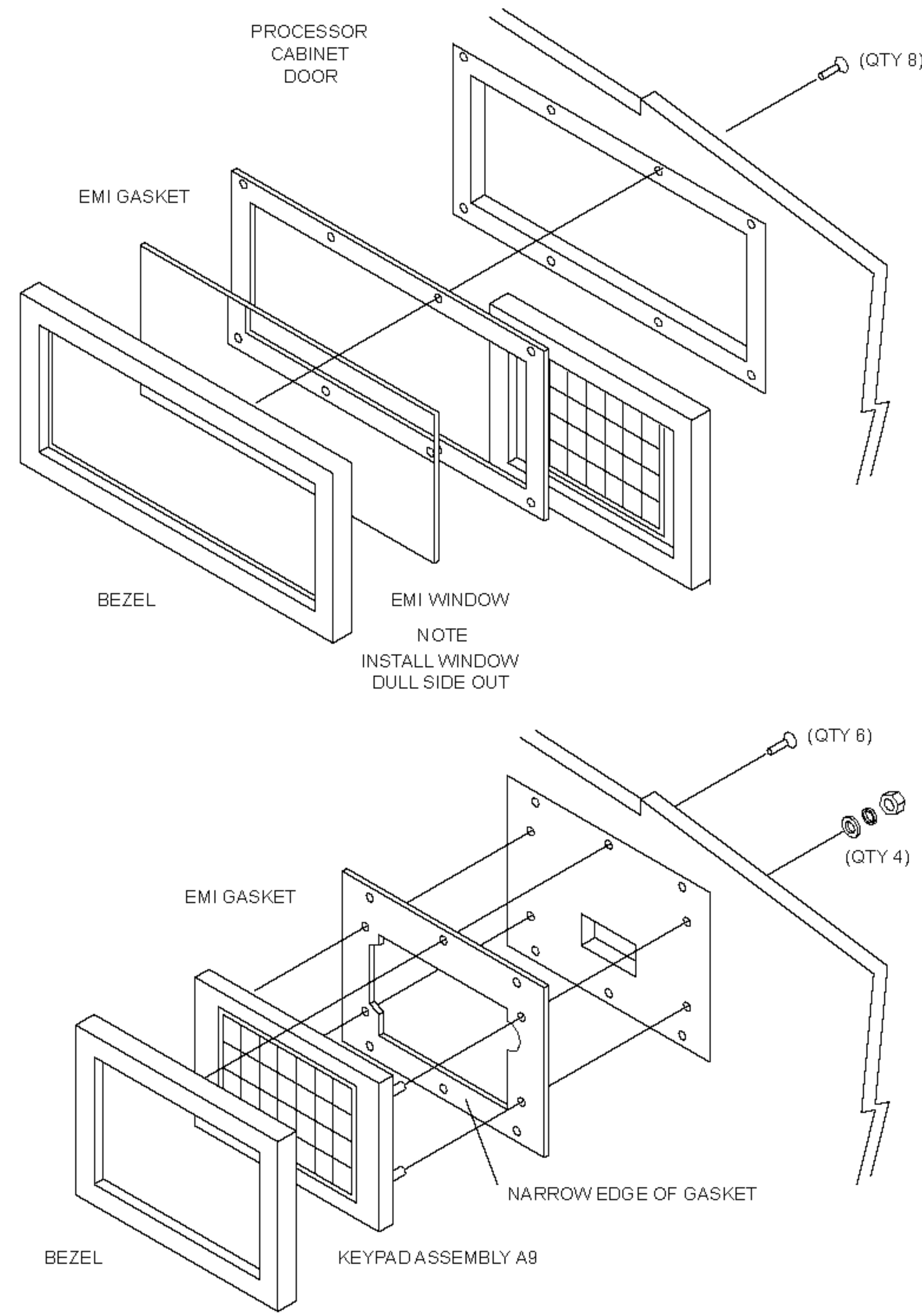


Figure 6-7. Replacement of Data Entry Keyboard (1A1A9)

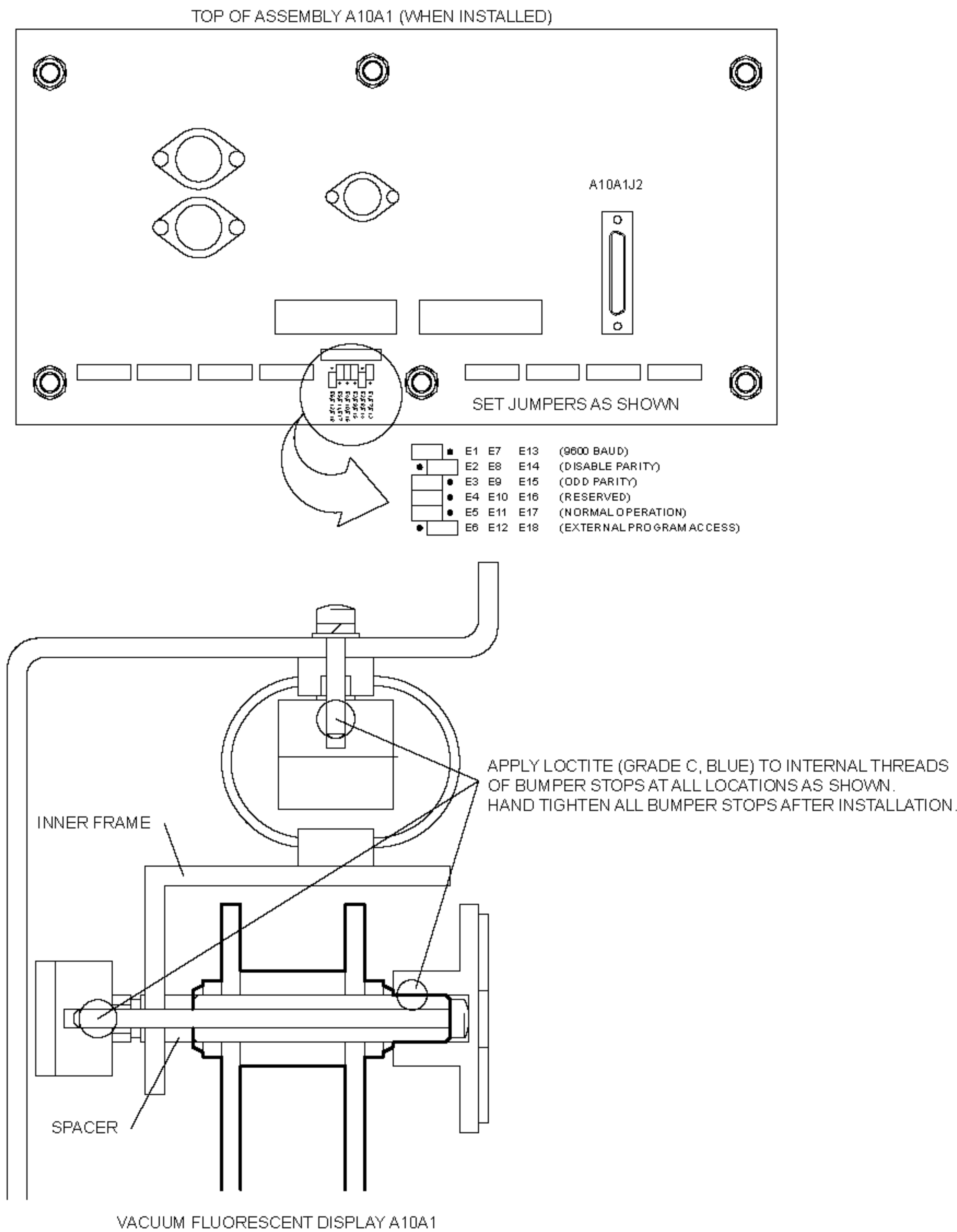


Figure 6-8. Replacement of Vacuum Fluorescent Display (1A1A10A1)

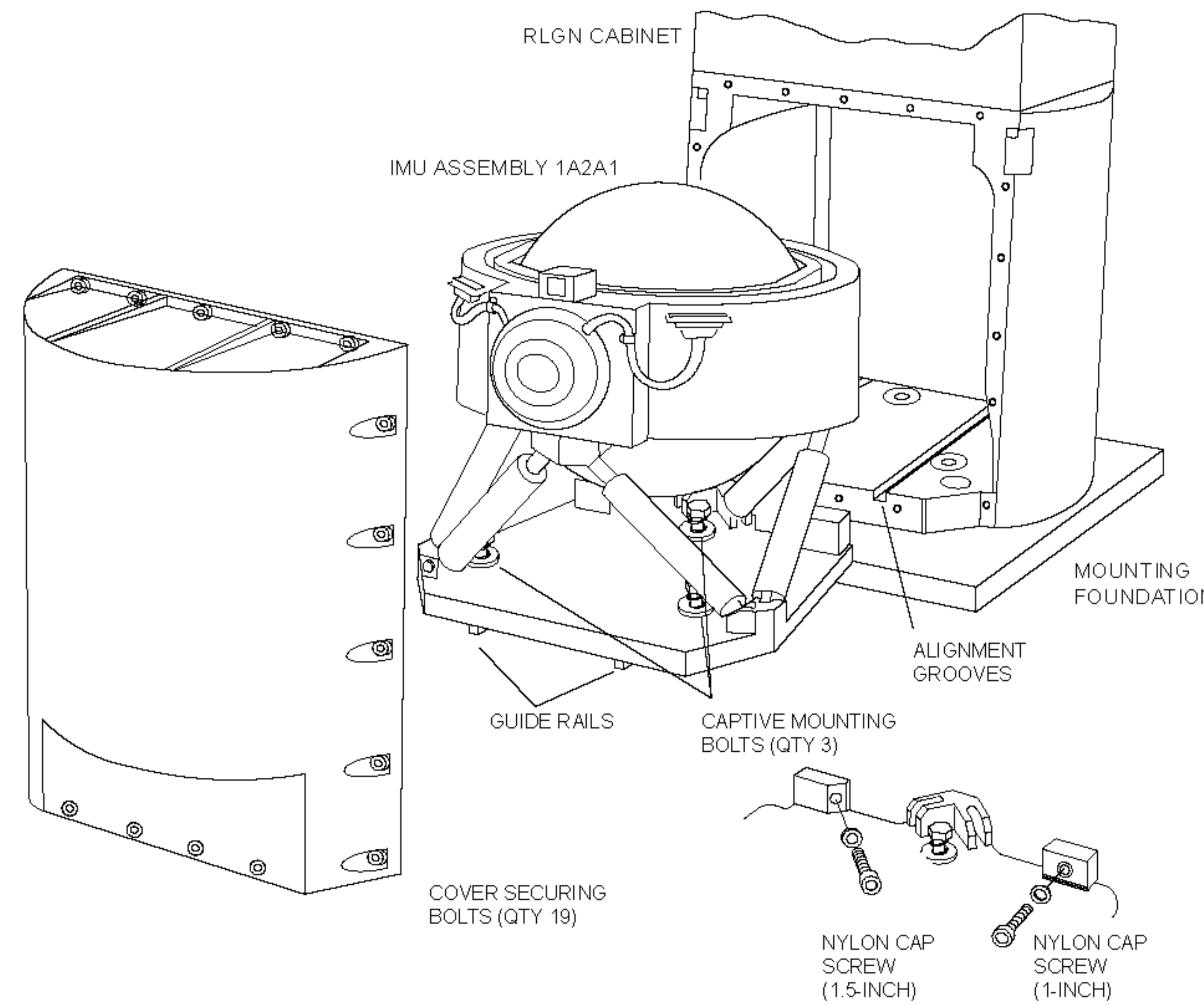


Figure 6-9. Inertial Measuring Unit in Measurement Cabinet Assembly

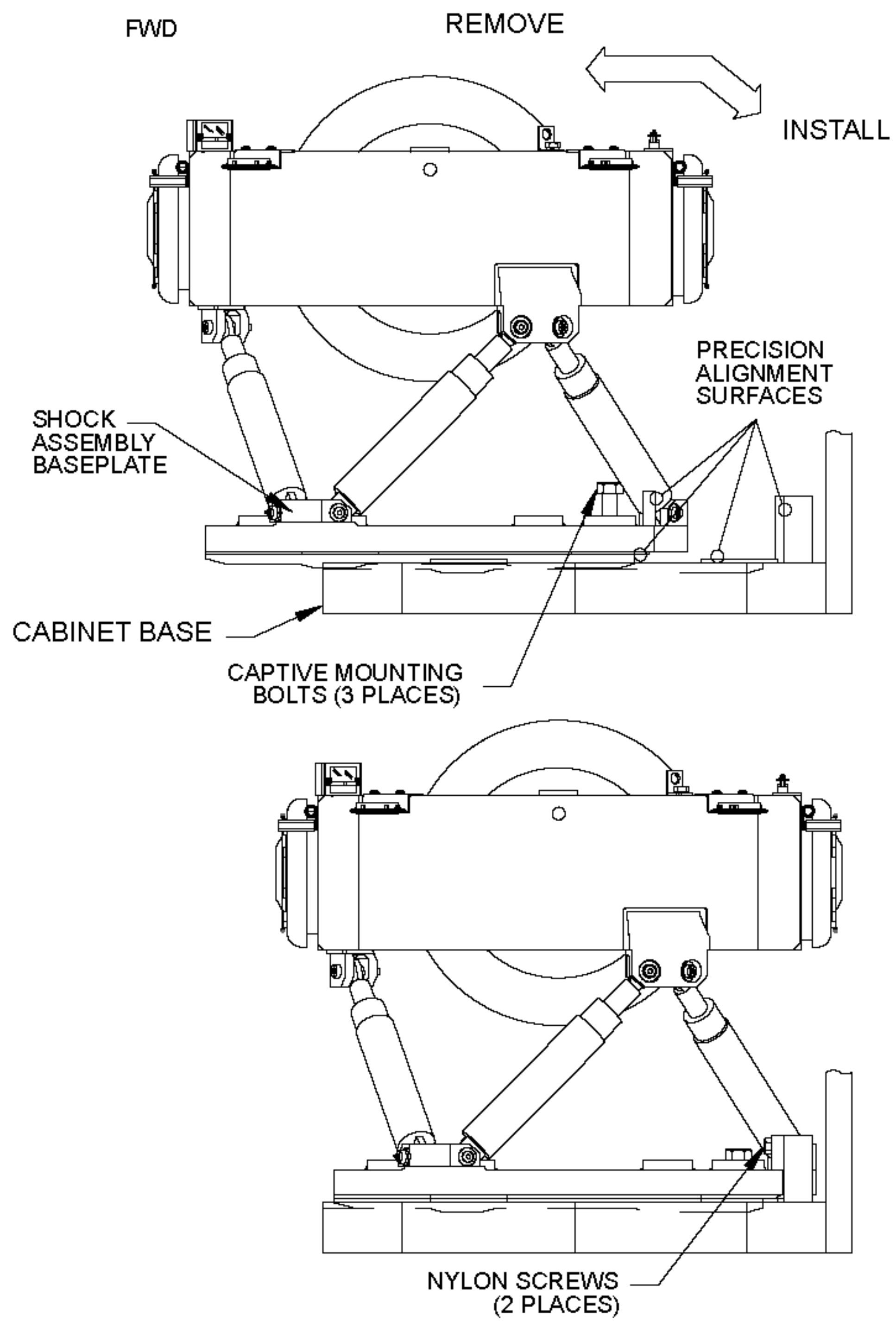


Figure 6-10. Removal of Inertial Measuring Unit from Measurement Cabinet Assembly

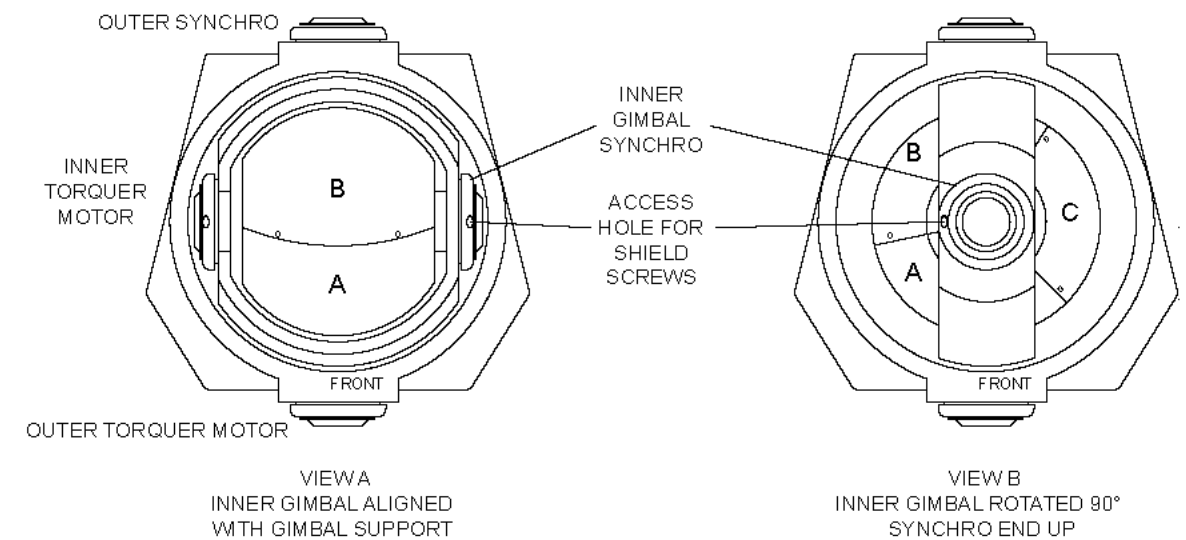


Figure 6-11. Mounting of Magnetic Shield on Sensor Block Assembly (1A2A1A1A9)

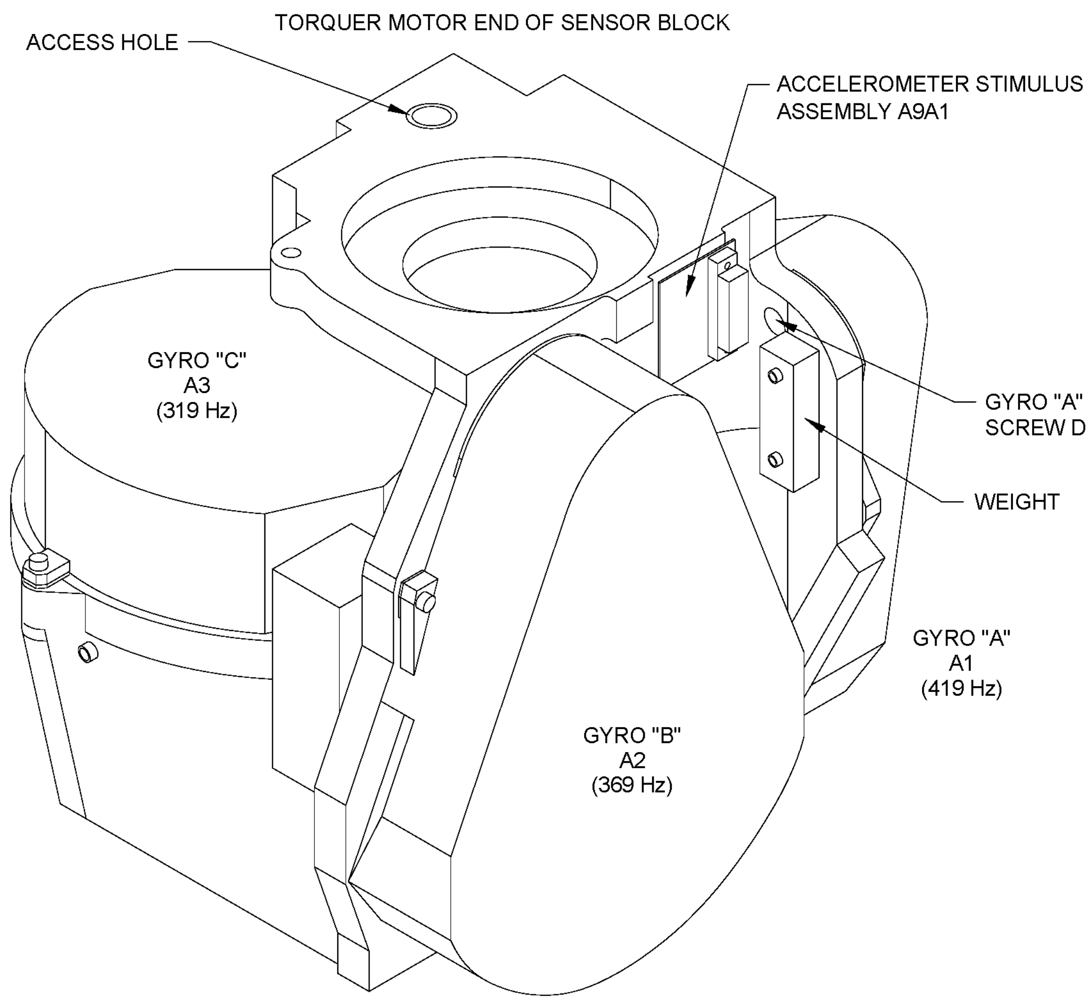


Figure 6-12. Gyro and Circuit Board Mounting Locations and Orientation

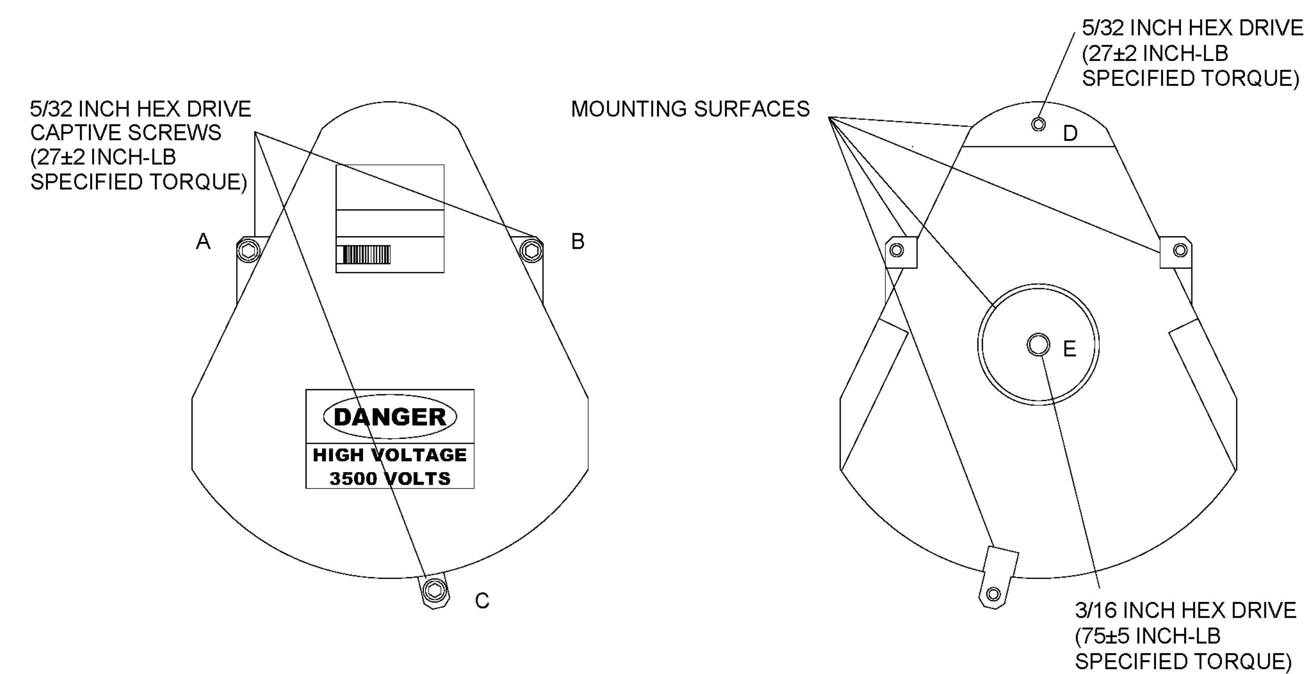


Figure 6-13. Location of Ring Laser Gyro Attachment Points

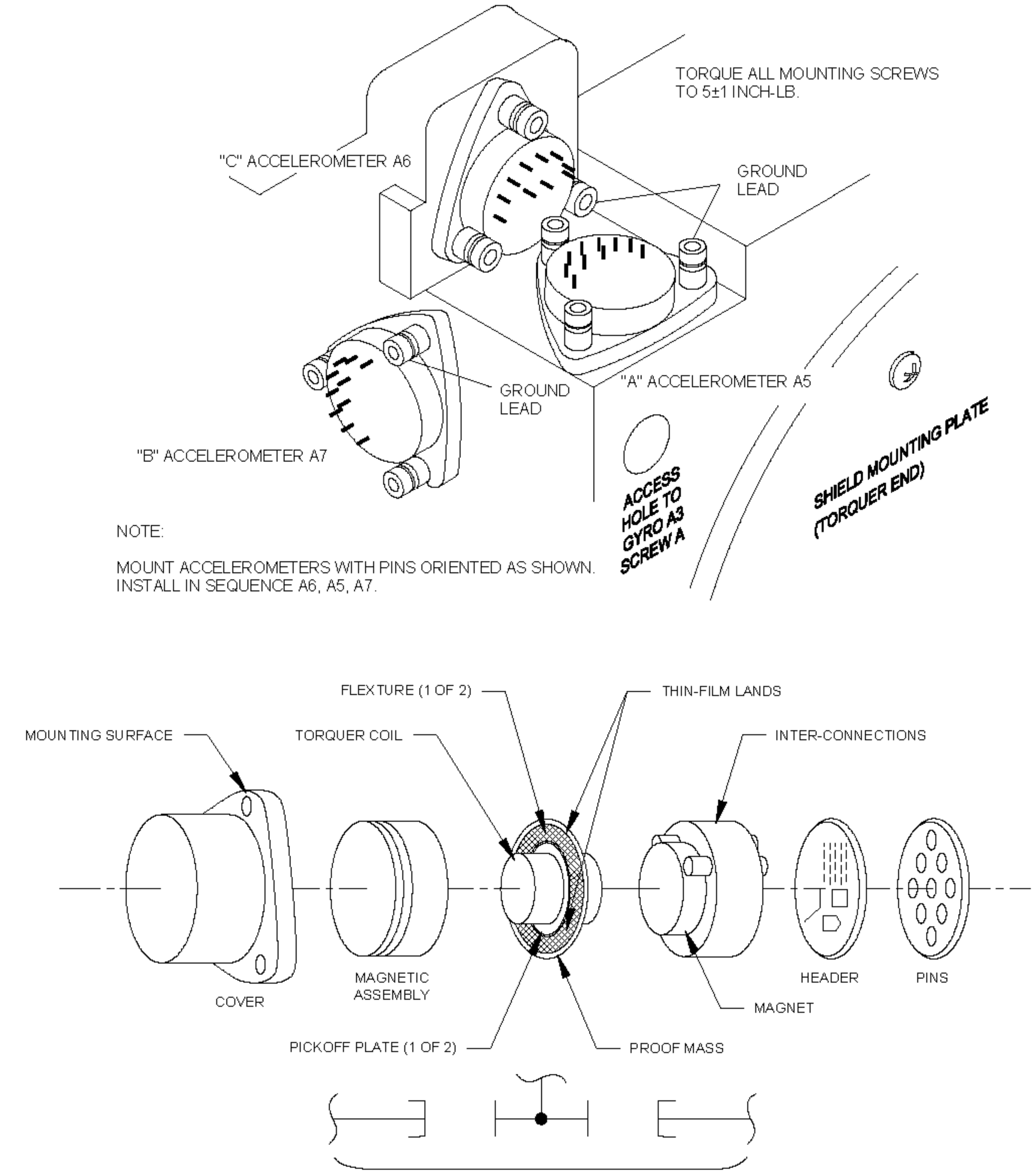


Figure 6-14. Accelerometers Mounting Locations and Orientation

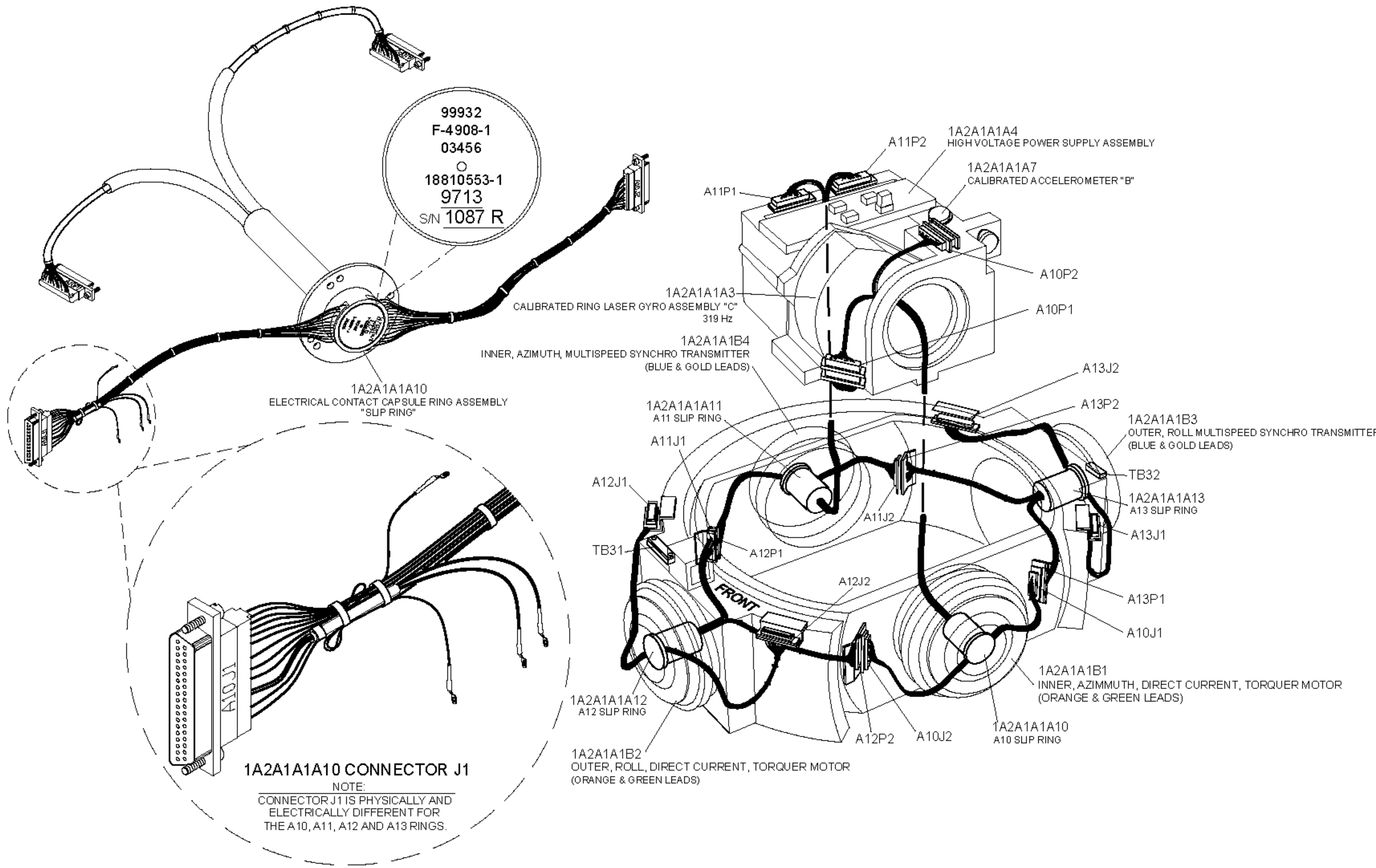


Figure 6-15. Location of Slip Rings in Inertial Measuring Unit

CHAPTER 7
PARTS LISTING

7.1 INTRODUCTION.

Chapter 7, Parts Listing, references the following AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN) parts tables:

- **Table 7-1**, List of Major Assemblies
- **Table 7-2**, Parts List by Reference Designator Order
- **Table 7-3**, Parts List by Diagram Location Order
- **Table 7-4**, Cross Reference by Part Number Order
- **Table 7-5**, Manufacturers List

This chapter identifies the major units and repairable assemblies of the AN/WSN-7(V) RLGN and locates them on diagrams at the end of the chapter. It also identifies and locates the Lowest Replaceable Units (LRUs) of the AN/WSN-7(V) RLGN, describes the parts associated with a field change, and provides information required for ordering replacement parts. In addition, this chapter enables maintenance personnel to identify parts by comparing them to their location on a diagram.

7.2 PARTS TABLES DESCRIPTIONS.

Table 7-1, List of Major Assemblies, lists the AN/WSN-7(V) RLGN units and assemblies that contain maintenance-significant subassemblies.

Table 7-1, Table 7-2, Table 7-3, and Table 7-4 are generated from one database. Each table provides the following nine data items for each AN/WSN-7(V) unit and assembly identified in this manual's identification diagrams:

1. Figure
2. Location Number
3. Reference Designator
4. Nomenclature/Description
5. Commercial and Government Entity (CAGE) Code
6. Part Number
7. System Quantity (except Table 7-1)
8. Variant (except Table 7-1)

Table 7-2 is sorted according to reference designator, Table 7-3 is sorted according to diagram location, and Table 7-4 is sorted according to part number.

In all tables, dimensions are in inches unless otherwise noted. Lowest Replaceable Units (LRUs) are noted with an asterisk (*).

7.3 MANUFACTURERS.

Table 7-5, Manufacturers List, provides information about the manufacturers for all parts described in the parts tables. The manufacturers are listed in ascending, numerical order according to their CAGE Code. The CAGE Code is defined by the United States Federal Supply Code for Manufacturers and listed in Cataloging Handbook H4 2.

Manufacturer CAGE Code data was verified for this manual using the following Web site: https://www.bpn.gov/bincs/begin_search.asp.

Table 7-1. List of Major Assemblies

REF DES	QTY	NOMENCLATURE/DESCRIPTION	PAGE LISTING	PN	VARIANT
1A1	1	WSN-7 Processor Cabinet Assembly		1981539-6	V1
1A1	1	WSN-7 Processor Cabinet Assembly		1981539-2	V2
1A1	1	WSN-7 Processor Cabinet Assembly		1981539-3	V3
1A1A1	1	Filter, Power Line *		1981532	V1 V2 V3
1A1A10	1	Display Assembly *		1979344	V1 V2 V3
1A1A11	1	Nav Card Rack Wirewrap Backplane Assembly		1981660	V1 V2 V3
1A1A12	1	I/O Processor Backplane Assembly		1981534-var	V1 V2 V3
1A1A13	1	Nav Processor CCA *		1812590	V1 V2 V3
1A1A14	1	Dual Panel Interface CCA *		1977455	V1 V2 V3
1A1A15	1	Status and Command CCA *		1980513	V1 V2 V3
1A1A16	1	Dual Panel Interface CCA *		1977455	V1 V2 V3
1A1A17	1	IMU Interface CCA *		1977538-0	V1 V2 V3
1A1A18	1	Torquer CCA, Outer, Roll *		1977569	V1 V2 V3
1A1A19	1	Torquer CCA, Inner, Azimuth *		1977569	V1 V2 V3
1A1A2	1	Inverter Assembly, 400-Hz *		1982618	V1 V2 V3
1A1A20	1	Bus Interface CCA *		1980488-2	V1 V2 V3
1A1A21	1	I/O Processor CCA *		1812591	V1 V2 V3
1A1A23	1	Dual Port Memory CCA *		1980486–2	V1 V2 V3
1A1A3	1	Vital Bus CCA *		1978322	V1 V2 V3
1A1A30	1	Support Electronics Backplane		1981572	V1 V2 V3
1A1A31	1	I/O Control (BITE) & Filter CCA *		1981570	V1 V2 V3
1A1A32	1	IMU Processor CCA *		1811791	V1 V2 V3
1A1A33	1	Repositioning Interface CCA *		1979023	V1 V2 V3
1A1A34	1	A/D Multiplexer CCA *		1979047	V1 V2 V3
1A1A35	1	Accelerometer and Sensor Electronics CCA *		1979046	V1 V2 V3
1A1A36	1	Gyro Support Electronics CCA *		1979348	V1 V2 V3
1A1A37	1	Support Electronics Power Supply *		1979057	V1 V2 V3
1A1A38	1	Synchro Converter CCA, 1X/36X Heading Output, 1X/10X Total Velocity Output, and Synchro Speed Input *		1979087-3	V1 V2 V3

Table 7-1. List of Major Assemblies - Continued

REF DES	QTY	NOMENCLATURE/DESCRIPTION	PAGE LISTING	PN	VARIANT
1A1A39	1	Synchro Converter CCA, 2X/36X Roll and 2X/36X Pitch Output *		1979087-3	V1 V2 V3
1A1A4	1	ATM Processor CCA *		1900040	V1 V2 V3
1A1A40	1	Synchro Converter CCA, 1X/10X Vn and 1X/10X Ve Velocity output *		1979087-3	V1 V2 V3
1A1A41	1	Synchro Buffer Amplifier, 8 VA *		1976545-3	V1 V2 V3
1A1A42	1	Synchro Buffer Amplifier, 8 VA *		1976545-3	V1 V2 V3
1A1A43	1	Synchro Buffer Amplifier, 32 VA *		1976547-4	V1 V2 V3
1A1A44	1	Synchro Buffer Amplifier, 32 VA *		1976547-4	V1 V2 V3
1A1A5	1	Battery Assembly *		1981554	V1 V2 V3
1A1A51	1	NTDS Type E Low Serial Interface Assembly *		1981559	V1 V2 V3
1A1A52	1	NTDS Type A Low Parallel Interface Assembly *		1981087	V2 V3
1A1A52	1	NTDS Type E Low Serial Interface Assembly *		1981559	V1
1A1A53	1	NTDS Type E Low Serial Interface Assembly *		1981559	V1 V2
1A1A53	1	NTDS Type A Low Parallel Interface Assembly *		1981087	V3
1A1A54	1	NTDS Type E Low Serial Interface Assembly *		1981559	V1
1A1A54	1	NTDS Type D High Level Serial Interface Assembly *		1981561	V2
1A1A54	1	NTDS Type A Low Parallel Interface Assembly *		1981087	V3
1A1A55	1	NTDS Type D High Serial Interface Assembly *		1981561	V1
1A1A55	1	NTDS Type A Low Parallel Interface Assembly		1981087	V2 V3
1A1A56	1	NTDS Type A Low Parallel Interface Assembly		1981087	V1 V2 V3
1A1A57	1	NTDS Type A Low Parallel Interface Assembly		1981087	V1 V2 V3
1A1A58	1	NTDS Type A Low Parallel Interface Assembly		1981087	V1 V2 V3
1A1A6	1	Power Supply *		1979342	V1 V2 V3
1A1A7	1	Battery Charger *		1810853	V1 V2 V3
1A1A8	1	Power Module *		1205050-3	V1 V2 V3

Table 7-1. List of Major Assemblies - Continued

REF DES	QTY	NOMENCLATURE/DESCRIPTION	PAGE LISTING	PN	VARIANT
1A1A9	1	Keyboard, Data Entry *		1859873	V1 V2 V3
1A2	1	Measurement Cabinet Electrical Assembly		1981548	V1 V2 V3
1A2A1	1	IMU MX-11681/WSN-7 or MX-11681A/WSN-7A(V) (Matched Set, with all EPROMS)		1812593 or 4300859	V1 V2 V3
* Lowest Replaceable Unit (LRU)					

Table 7-2. Parts List by Reference Designator Order

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1	1	03956	1981539-6	WSN-7 Processor Cabinet Assembly	7-1	V1
1A1	1	03956	1981539-3	WSN-7 Processor Cabinet Assembly	7-1	V3
1A1	1	03956	1981539-2	WSN-7 Processor Cabinet Assembly	7-1	V2
1A1A1	1	03956	1981532	Filter, Power Line *	7-2 (4)	V1 V2 V3
1A1A10	1	03956	1979344	Display Assembly *	7-3 (1)	V1 V2 V3
1A1A10A1	1	03956	1859230	Vacuum Fluorescent, Display *	7-6 (3)	V1 V2 V3
1A1A10A1P1	REF			Connector, Electrical Plug	7-3 (109)	V1 V2 V3
1A1A10A2	1	03956	1977647	Panel Interface Assembly *	7-3 (104)	V1 V2 V3
1A1A10A2	1	03956	1977647	Panel Interface Assembly	7-6 (17)	V1 V2 V3
1A1A10MP1	2	03956	1810785-1	Mounts, Shock, Vibration	7-6 (16)	V1 V2 V3
1A1A10MP2	4	03956	1810785-2	Mounts, Shock, Vibration	7-6 (15)	V1 V2 V3
1A1A10MP3	4	03956	1820230-1	Acorn Mount	7-6 (7)	V1 V2 V3
1A1A10MP4	12	03956	1820230-2	Acorn Mount	7-6 (14)	V1 V2 V3
1A1A10MP5	4	03956	1820232	Snubber, Mount	7-6 (4)	V1 V2 V3
1A1A11	1	03956	1981660	Nav Card Rack Wirewrap Backplane Assembly	7-3 (28)	V1 V2 V3
1A1A11MP3	REF	03956	1800604-6	Sliding Post, Lock	7-3 (173)	V1 V2 V3
1A1A12	1	03956	1981534-var	I/O Processor Backplane Assembly	7-3 (22)	V1 V2 V3
1A1A13	1	03956	1812590	Nav Processor CCA *	7-3 (76)	V1 V2 V3
1A1A13DS1	1	NA	NA	Nav Processor Fault	5-2	V1 V2 V3
1A1A14	1	03956	1977455	Dual Panel Interface CCA *	7-3 (87)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1A15	1	03956	1980513	Status and Command CCA *	7-3 (75)	V1 V2 V3
1A1A15DS1	1	NA	NA	20 MS (800-Hz) Processors Timing Interrupt Monitor	5-2	V1 V2 V3
1A1A15DS2	1	NA	NA	Status and Command Board (Heart Beat Fault)	5-2	V1 V2 V3
1A1A15DS3	1	NA	NA	Navigation Processor Data Bus Fault	5-2	V1 V2 V3
1A1A16	1	03956	1977455	Dual Panel Interface CCA *	7-3 (74)	V1 V2 V3
1A1A17	1	03956	1977538-0	IMU Interface CCA *	7-3 (73)	V1 V2 V3
1A1A18	1	03956	1977569	Torquer CCA, Outer, Roll *	7-3 (68)	V1 V2 V3
1A1A18DS1	1	NA	NA	Outer Gimbal Torquer Active (+25 V Enabled)	5-2	V1 V2 V3
1A1A18DS2	1	NA	NA	Outer Gimbal Torquer Active (-25 V Enabled)	5-2	V1 V2 V3
1A1A19	1	03956	1977569	Torquer CCA, Inner, Azimuth *	7-3 (70)	V1 V2 V3
1A1A19DS1	1	NA	NA	Inner Gimbal Torquer Drive Active (+25 V Enabled)	5-2	V1 V2 V3
1A1A19DS2	1	NA	NA	Inner Gimbal Torquer Drive Active (-25 V Enabled)	5-2	V1 V2 V3
1A1A2	1	03956	1982618	Inverter Assembly, 400-Hz *	7-3 (158)	V1 V2 V3
1A1A20	1	03956	1980488-2	Bus Interface CCA *	7-3 (65)	V1 V2 V3
1A1A21	1	03956	1812591	I/O Processor CCA *	7-3 (88)	V1 V2 V3
1A1A21DS1	1	NA	NA	I/O Processor Fault	5-2	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1A23	1	03956	1980486-2	Dual Port Memory CCA *	7-3 (78)	V1 V2 V3
1A1A2A1	REF	03956	1812595	P/O 1A1A2 Inverter Assembly, 400 HZ	7-3 (161)	V1 V2 V3
1A1A3	1	03956	1978322	Vital Bus CCA *	7-3 (117)	V1 V2 V3
1A1A30	1	03956	1981572	Support Electronics Backplane	7-3 (63)	V1 V2 V3
1A1A31	1	03956	1981570	I/O Control (BITE) & Filter CCA *	7-3 (58)	V1 V2 V3
1A1A31DS2	1	NA	NA	I/O Control Board Fault		V1 V2 V3
1A1A32	1	03956	1811791	IMU Processor CCA *	7-3 (57)	V1 V2 V3
1A1A32DS1	1	NA	NA	IMU Processor Fault		V1 V2 V3
1A1A33	1	03956	1979023	Repositioning Interface CCA *	7-3 (59)	V1 V2 V3
1A1A34	1	03956	1979047	A/D Multiplexer CCA *	7-3 (54)	V1 V2 V3
1A1A35	1	03956	1979046	Accelerometer and Sensor Electronics CCA *	7-3 (53)	V1 V2 V3
1A1A36	1	03956	1979348	Gyro Support Electronics CCA *	7-3 (52)	V1 V2 V3
1A1A37	1	03956	1979057	Support Electronics Power Supply *	7-3 (64)	V1 V2 V3
1A1A37DS1	1	NA	NA	Power OK	5-2	V1 V2 V3
1A1A37DS2	1	NA	NA	Power Supply +5 VDC Output Available	5-2	V1 V2 V3
1A1A37DS3	1	NA	NA	Power Supply +28 VDC Output Available	5-2	V1 V2 V3
1A1A37DS4	1	NA	NA	Power Supply -15 VDC Output Available	5-2	V1 V2 V3
1A1A37DS5	1	NA	NA	Power Supply +15 VDC Output Available	5-2	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1A38	1	03956	1979087-3	Synchro Converter CCA, 1X/36X Heading Output, 1X/10X Total Velocity Output, and Synchro Speed Input *	7-3 (72)	V1 V2 V3
1A1A39	1	03956	1979087-3	Synchro Converter CCA, 2X/36X Roll and 2X/36X Pitch Output *	7-3 (71)	V1 V2 V3
1A1A4	1	03956	1900040	ATM Processor CCA *	7-3 (67)	V1 V2 V3
1A1A40	1	03956	1979087-3	Synchro Converter CCA, 1X/10X Vn and 1X/10X Ve Velocity output *	7-3 (69)	V1 V2 V3
1A1A41	1	03956	1976545-3	Synchro Buffer Amplifier, 8 VA *	7-1 (47)	V1 V2 V3
1A1A41	1	03956	1976545-3	Synchro Buffer Amplifier, 8 VA *	7-3 (169)	V1 V2 V3
1A1A42	1	03956	1976545-3	Synchro Buffer Amplifier, 8 VA *	7-3 (135)	V1 V2 V3
1A1A43	1	03956	1976547-4	Synchro Buffer Amplifier, 32 VA *	7-3 (115)	V1 V2 V3
1A1A43	1	03956	1976547-4	Synchro Buffer Amplifier, 32 VA *	7-3 (132)	V1 V2 V3
1A1A44	1	03956	1976547-4	Synchro Buffer Amplifier, 32 VA	7-3 (162)	V1 V2 V3
1A1A4DS1	1	NA	NA	ATM Processor Fault		V1 V2 V3
1A1A5	1	03956	1981554	Battery Assembly *	7-1 (42)	V1 V2 V3
1A1A5	1	03956	1981554	Battery Assembly *	7-3 (156)	V1 V2 V3
1A1A51	1	03956	1981559	NTDS Type E Low Serial Interface Assembly *	7-3 (86)	V1 V2 V3
1A1A52	1	03956	1981559	NTDS Type E Low Serial Interface Assembly *	7-3 (85)	V1

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1A52	1	03956	1981087	NTDS Type A Low Parallel Interface Assembly *	7-3 (85)	V2 V3
1A1A53	1	03956	1981559	NTDS Type E Low Serial Interface Assembly *	7-3 (84)	V1 V2
1A1A53	1	03956	1981087	NTDS Type A Low Parallel Interface Assembly *	7-3 (84)	V3
1A1A54	1	03956	1981087	NTDS Type A Low Parallel Interface Assembly *	7-3 (83)	V3
1A1A54	1	03956	1981559	NTDS Type E Low Serial Interface Assembly *	7-3 (83)	V1
1A1A54	1	03956	1981561	NTDS Type D High Level Serial Interface Assembly *	7-3 (83)	V2
1A1A55	1	03956	1981087	NTDS Type A Low Parallel Interface Assembly	7-3 (82)	V2 V3
1A1A55	1	03956	1981561	NTDS Type D High Serial Interface Assembly *	7-3 (82)	V1
1A1A56	1	03956	1981087	NTDS Type A Low Parallel Interface Assembly	7-3 (81)	V1 V2 V3
1A1A57	1	03956	1981087	NTDS Type A Low Parallel Interface Assembly	7-3 (80)	V1 V2 V3
1A1A58	1	03956	1981087	NTDS Type A Low Parallel Interface Assembly	7-3 (79)	V1 V2 V3
1A1A5MP3	1	03956	1857571-2	Vent Tube Assembly	7-3 (9)	V1 V2 V3
1A1A6	1	03956	1979342	Power Supply *	7-3 (134)	V1 V2 V3
1A1A6	1	03956	1979342	Power Supply *	7-1 (48)	V1 V2 V3
1A1A7	1	03956	1810853	Battery Charger *	7-3 (149)	V1 V2 V3
1A1A8	1	03956	1205050-3	Power Module *	7-1 (59)	V1 V2 V3
1A1A8	1	03956	1205050-3	Power Module *	7-3 (154)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1A9	1	03956	1859873	Keyboard, Data Entry *	7-1 (19)	V1 V2 V3
1A1CB1	1	81349	M39019/05-327S	Circuit Breaker 7.5 Amp	7-1 (17)	V1 V2 V3
1A1CB2	1	81349	M39019/03-240S	Circuit Breaker 7.5 Amp	7-1 (16)	V1 V2 V3
1A1CB3	1	81349	M39019/03-216S	Circuit Breaker 1.0 Amp	7-1 (15)	V1 V2 V3
1A1DS1	1	81349	FF200CW600-28V-P/ FF200-0CW-028B	Light Emiting Diode (Red) *	7-1 (3)	V1 V2 V3
1A1DS2	1	81349	FF200CW600-28V-P/ FF200-0CW-028B	Light Emitting Diode (Green)	7-1 (9)	V1 V2 V3
1A1F1	1	81349	F02A250V2A	Fuse MIL-F-15160, 2 Amp (SPARE)	7-3 (163)	V1 V2 V3
1A1F1	1	81349	F02A250V2A	Fuse MIL-F-15160, 2 Amp	7-3 (165)	V1 V2 V3
1A1J13	REF	96906	MS27656T23A35S	Connector, Receptacle, Electrical	7-5 (13)	V1 V2 V3
1A1J14	1	03956	1812592	Connector, Electrical Coaxial	7-5 (11)	V1
1A1J14MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (12)	V1 V2 V3
1A1J15	1	03956	1812592	Connector, Coaxial, Electrical	7-5 (49)	V1 V3
1A1J15MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (48)	V1 V3
1A1J16	1	03956	1812592	Connector, Electrical Coaxial	7-5 (7)	V1 V2
1A1J16MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (8)	V1 V2
1A1J17	1	03956	1812592	Connector, Electrical Coaxial	7-5 (9)	V1 V2
1A1J17MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (10)	V1 V2
1A1J18	1	03956	1812592	Connector, Electrical Coaxial	7-5 (5)	V1
1A1J18MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (6)	V1

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1J19	1	03956	1812592	Connector, Electrical Coaxial	7-5 (3)	V1
1A1J19MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (4)	V1
1A1J8	1	03956	1812592	Connector, Electrical Coaxial	7-5 (24)	V1 V2 V3
1A1J8MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (25)	V1 V2 V3
1A1J9	1	03956	1812592	Connector, Electrical Coaxial	7-5 (22)	V1 V2 V3
1A1J9MP1	1	03956	1812599	Cover, Cap Triaxial	7-5 (23)	V1 V2 V3
1A1K1	1	81349	M83536/10-024M	Relay	7-3 (139)	V1 V2 V3
1A1K2	1	81349	M83536/10-024M	Relay	7-3 (140)	V1 V2 V3
1A1K3	1	81349	M83536/10-024M	Relay	7-3 (141)	V1 V2 V3
1A1K4	1	81349	M83536/16-022M	Relay	7-3 (143)	V1 V2 V3
1A1K6	1	81349	M83536/10-024M	Relay	7-3 (142)	V1 V2 V3
1A1K7	1	81349	M83536/10-024M	Relay	7-3 (144)	V1 V2 V3
1A1M1	1	03956	1975362-6	Meter, Time Totalizing	7-3 (95)	V1 V2 V3
1A1M1	1	03956	1975362-6	Meter, Time Totalizing	7-1 (7)	V1 V2 V3
1A1MP1	1	03956	1981518	Cabinet, Assembly, Electrical Equipment	7-1 (1)	V1 V2 V3
1A1MP10	2	03956	1818661	Swivel Clamp	7-1 (43)	V1 V2 V3
1A1MP12	2	03956	1805624-1	Clamp, Cable, Adhesive Backed	7-3 (101)	V1 V2 V3
1A1MP14	1	03956	1859268-2	Bracket, Angle	7-3 (18)	V1 V2 V3
1A1MP15	1	03956	1859290–1	Clamp, Battery	7-2 (5)	V1 V2 V3
1A1MP15	1	03956	1859290-1	Clamp, Battery	7-1 (39)	V1 V2 V3
1A1MP16	1	03956	1859268-1	Bracket, Angle	7-3 (41)	V1 V2 V3
1A1MP17	1	03956	1859284–2	Bracket, Angle	7-3 (42)	V1 V2 V3
1A1MP18	1	03956	1859290-2	Clamp, Battery	7-1 (40)	V1 V2 V3
1A1MP19	1	03956	1859284-1	Bracket, Angle	7-3 (49)	V1 V2 V3
1A1MP2	1	03956	1891448	Heat Shield Assembly	7-1 (41)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1MP20	54	03956	1857613-1	Screw, Captive .250-28 X 1.00 L	7-3 (112)	V1 V2 V3
1A1MP21	1	03956	1859297	Cover, Protective	7-3 (93)	V1 V2 V3
1A1MP22	2	03956	1860143	Bracket, Cable Tie Base	7-3 (14)	V1 V2 V3
1A1MP25	1	03956	1981667	Bezel, Window	7-1 (21)	V1 V2 V3
1A1MP26	1	03956	1859289	Gasket	7-1 (20)	V1 V2 V3
1A1MP27	1	03956	1981668	Bezel	7-1 (37)	V1 V2 V3
1A1MP28	1	03956	1859310	Gasket	7-1 (18)	V1 V2 V3
1A1MP29	2	03956	1859267	Pin, Straight, Headed	7-3 (17)	V1 V2 V3
1A1MP3	1	03956	1981510	Upper Card Rack Assembly	7-1 (66)	V1 V2 V3
1A1MP3	1	03956	1981510	Upper Card Rack Assembly	7-3 (89)	V1 V2 V3
1A1MP30	2	03956	1859283	Pin, Straight, Headed	7-3 (50)	V1 V2 V3
1A1MP31	1	03956	1981556	Gasket	7-5 (1)	V1 V2 V3
1A1MP31	1	03956	1981556	Gasket	7-5 (62)	V1 V2 V3
1A1MP32	1	03956	1816382-23	Stud, Threaded .250–20 X 1.25" L	7-3 (119)	V1 V2 V3
1A1MP35	9	03956	1800662-21	Spacer, Hex .164-32 X .62" L	7-1 (70)	V1 V2 V3
1A1MP36	2	03956	1800662-81	Spacer, Hex Threaded .112-40 X 1.50" L	7-1 (68)	V1 V2 V3
1A1MP37	1	03956	1818842	Plug	7-1 (23)	V1 V2 V3
1A1MP38	1	03956	1801594-29	Screw, Shoulder .250-20	7-1 (25)	V1 V2 V3
1A1MP39	2	96906	MS15795-812	Washer, Flat .312	7-1 (26)	V1 V2 V3
1A1MP4	1	03956	1979347	Card Rack Assembly	7-3 (66)	V1 V2 V3
1A1MP4	1	03956	1979347	Card Rack Assembly	7-1 (64)	V1 V2 V3
1A1MP40	4	03956	1810805-5	Washer, Spring Tension	7-1 (29)	V1 V2 V3
1A1MP41	1	03956	1860145	Link Assembly	7-4 (6)	V1 V2 V3
1A1MP41	1	03956	1860145	Link Assembly	7-1 (28)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1MP42	1	03956	1860240	Rail, Door Stay	7-4 (1)	V1 V2 V3
1A1MP42	1	03956	1860240	Rail, Door Stay	7-1 (34)	V1 V2 V3
1A1MP43	1	03956	1800544-17	Washer, Flat, Nonmetallic .312	7-1 (24)	V1 V2 V3
1A1MP44	30	03956	1812694-2	Clamp, Cable	7-3 (19)	V1 V2 V3
1A1MP44	30	03956	1812694-2	Clamp, Cable	7-3 (19)	V1 V2 V3
1A1MP44	30	03956	1812694-2	Clamp, Cable	7-1 (55)	V1 V2 V3
1A1MP45	28	03956	1811774	Plate, Mounting, Clamp Loop	7-2 (1)	V1 V2 V3
1A1MP45	28	03956	1811774	Plate, Mounting, Clamp Loop	7-3 (2)	V1 V2 V3
1A1MP45	28	03956	1811774	Plate, Mounting, Clamp Loop	7-4 (2)	V1 V2 V3
1A1MP46	1	03956	1857683-7	Clamp, Cable, Flat	7-3 (25)	V1 V2 V3
1A1MP47	25	96906	MS3367-1-9	Strap, Tiedown	7-1 (58)	V1 V2 V3
1A1MP47	25	96906	MS3367-1-9	Strap, Tiedown	7-3 (16)	V1 V2 V3
1A1MP48	14	96906	MS3367-5-9	Strap, Tiedown	7-2 (3)	V1 V2 V3
1A1MP48	14	96906	MS3367-5-9	Strap, Tiedown	7-3 (10)	V1 V2 V3
1A1MP49	13	96906	MS3367-4-9	Strap, Tiedown	7-3 (4)	V1 V2 V3
1A1MP49	13	96906	MS3367-4-9	Strap, Tiedown	7-4 (4)	V1 V2 V3
1A1MP53	4	81349	M83528/004K025	Shielding Gasket, EMI RFI	7-5 (14)	V1
1A1MP54	4	96906	MS27502A23CL	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	7-5 (15)	V1
1A1MP54	7	96906	MS27502A23CL	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	7-5 (15)	V3
1A1MP54	5	96906	MS27502A23CL	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	7-5 (15)	V2
1A1MP55	2	96906	MS25043-10DA	Cover, Electrical Connector (P/O 1A1W30J20, 1A1W31J21)	7-5 (50)	V1 V2 V3
1A1MP6	1	03956	1983108	Plate, Mounting Connector	7-5 (56)	V3
1A1MP6	1	03956	4800307	Plate, Mounting Connector	7-5 (61)	V2

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1MP6	1	03956	1983105-A	Plate, Mounting Connector	7-5 (2)	V1
1A1MP7	1	03956	1859987-1	Gasket	7-3 (96)	V1 V2 V3
1A1MP7	1	03956	1859987-1	Gasket	7-1 (8)	V1 V2 V3
1A1S1	1	96906	MS24660-23D	Switch, Toggle	7-1 (2)	V1 V2 V3
1A1TB1	REF	81349	M81714/67-30	Terminal Junction System, Rack Assembly	7-3 (126)	V1 V2 V3
1A1TB1	REF	81349	M81714/67-30	Terminal Junction System, Rack Assembly	7-3 (150)	V1 V2 V3
1A1TB1-1	REF	81349	M81714/61-0Z	Terminal Junction Block	7-3 (124)	V1 V2 V3
1A1TB1-10	REF	81349	M81714/60-16-01	Terminal Junction Block	7-3 (128)	V1 V2 V3
1A1TB1-11	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1TB1-12	REF	81349	M81714/60-16-01	Terminal Junction Block	7-3 (128)	V1 V2 V3
1A1TB1-13	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1TB1-14	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1TB1-15	REF	81349	M81714/60-16-01	Terminal Junction Block	7-3 (128)	V1 V2 V3
1A1TB1-16	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1TB1-17	REF	81349	M81714/61-0Z	Terminal Junction Block	7-3 (124)	V1 V2 V3
1A1TB1-18	REF	81349	M81714/60-20-01	Terminal Junction Block	7-3 (129)	V1 V2 V3
1A1TB1-19	REF	81349	M81714/61-0Z	Terminal Junction Block	7-3 (124)	V1 V2 V3
1A1TB1-2	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1TB1-20	REF	81349	M81714/60-20-01	Terminal Junction Block	7-3 (129)	V1 V2 V3
1A1TB1-21	REF	81349	M81714/60-20-01	Terminal Junction Block	7-3 (129)	V1 V2 V3
1A1TB1-22	REF	81349	M81714/60-20-02	Terminal Junction Block	7-3 (125)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1TB1-23	REF	81349	M81714/60-20-02	Terminal Junction Block	7-3 (125)	V1 V2 V3
1A1TB1-3	REF	81349	M81714/60-20-01	Terminal Junction Block	7-3 (129)	V1 V2 V3
1A1TB1-4	REF	81349	M81714/61-0Z	Terminal Junction Block	7-3 (124)	V1 V2 V3
1A1TB1-5	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1TB1-6	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1TB1-7	REF	81349	M81714/60-20-01	Terminal Junction Block	7-3 (129)	V1 V2 V3
1A1TB1-8	REF	81349	M81714/60-16-01	Terminal Junction Block	7-3 (128)	V1 V2 V3
1A1TB1-9	REF	81349	M81714/61-0Y	Terminal Junction Block	7-3 (127)	V1 V2 V3
1A1W1	REF	03956	T969420	Main Harness Assembly	7-1	V1 V2 V3
1A1W10-1A1W17	1	03956	T968912	Cable Assembly	7-5 (63)	V1 V2 V3
1A1W1E1	REF	81349	M39029/92-534	Contact, Electrical Connector		V1 V2 V3
1A1W1J23	REF			Connector, Coaxial, Electrical (DSVL) (P/O 1A1W1)	7-5 (55)	V1 V2 V3
1A1W1J3	REF	96906	MS3402D40-56E	Connector, Receptacle, Electrical	7-5 (28)	V1 V2 V3
1A1W1J4	REF	96906	MS3402D20-27D	Connector, Receptacle, Electrical	7-5 (31)	V1 V2 V3
1A1W1J5	REF	96906	MS3402D24-28D	Connector, Electrical Receptacle	7-5 (38)	V1 V2 V3
1A1W1J6	REF	96906	MS3402D22-14S	Connector, Electrical	7-5 (41)	V1 V2 V3
1A1W1J7	REF	96906	MS3402D28-21D	Connector, Receptacle, Electrical	7-5 (43)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1W1MP8	REF	81349	M85049/52-1-20W	Strain Relief, Connector, Electrical; 1A1W1P11, 1A1W1P19, 1A1W1P21	7-3 (23)	V1 V2 V3
1A1W1MP9	REF	81349	M24308/25-9	Screw, Lock, Male	7-3 (7)	V1 V2 V3
1A1W1MP9	REF	81349	M24308/25-9	Screw, Lock, Male	7-1 (51)	V1 V2 V3
1A1W1MPA	REF	03956	1818839	Disc	7-3 (121)	V1 V2 V3
1A1W1MPD	1	81349	M83528/004K032	Shielding Gasket, EMI-RFI	7-5 (29)	V1 V2 V3
1A1W1MPE	REF	96906	MS25043-40DA	Cover, Electrical Connector (P/O 1A1W1J3)	7-5 (27)	V1 V2 V3
1A1W1MPF	1	96906	MS25251-16	Plug, End Seal Electrical Connector	7-5 (26)	V1 V2 V3
1A1W1MPG	1	81349	M83528/004K021	Shielding Gasket, EMI-RFI	7-5 (32)	V1 V2 V3
1A1W1MPH	REF	96906	MS25043-20DA	Cover, Electrical Connector	7-5 (30)	V1 V2 V3
1A1W1MPJ	1	81349	M83528/004K027	Shielding Gasket, EMI-RFI	7-5 (37)	V1 V2 V3
1A1W1MPK	REF	96906	MS25043-24DA	Cover, Electrical Connector (P/O 1A1W1J5)	7-5 (36)	V1 V2 V3
1A1W1MPL	1	81349	M83528/004K024	Shielding Gasket, EMI-RFI	7-5 (40)	V1 V2 V3
1A1W1MPM	1	96906	MS25043-22DA	Cover, Electrical Connector	7-5 (39)	V1 V2 V3
1A1W1MPN	1	81349	M83528/004K029	Shielding Gasket, EMI-RFI	7-5 (44)	V1 V2 V3
1A1W1MPP	1	96906	MS25043-28DA	Cover, Electrical Connector (P/O 1A1W1J7)	7-5 (42)	V1 V2 V3
1A1W1P1	REF	96906	MS3456W16S-1P	Connector, Plug, Electrical	7-3 (170)	V1 V2 V3
1A1W1P10	REF	81349	M24308/4-4F	Connector, Electrical, Receptacle	7-3 (37)	V1 V2 V3
1A1W1P10MP7	REF	81349	M85049/48-2-4F	Strain Relief, Connector, Electrical	7-3 (36)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1W1P10MP7	REF	81349	M85049/48-2-4F	Strain Relief, Connector, Electrical	7-1 (50)	V1 V2 V3
1A1W1P11	REF	96906	MS3456W20-16S	Connector, Plug, Electrical	7-3 (27)	V1 V2 V3
1A1W1P12	REF	81349	M24308/4-4F	Connector, Electrical, Receptacle	7-3 (39)	V1 V2 V3
1A1W1P13	REF	81349	M24308/2-4F	Connector, Receptacle, Electrical	7-3 (116)	V1 V2 V3
1A1W1P13	REF	81349	M24308/2-4F	Connector, Electrical, Receptacle	7-1 (49)	V1 V2 V3
1A1W1P14	REF	81349	M24308/2-4F	Connector, Plug, Electrical	7-3 (167)	V1 V2 V3
1A1W1P15	REF	81349	M24308/2-4F	Connector, Plug, Electrical	7-3 (168)	V1 V2 V3
1A1W1P16	REF	81349	M24308/2-4F	Connector, Plug, Electrical	7-3 (136)	V1 V2 V3
1A1W1P17	REF	81349	M24308/4-4F	Connector, Electrical, Receptacle	7-3 (38)	V1 V2 V3
1A1W1P18	REF	81349	M24308/2-2F	Connector, Electrical, Receptacle	7-1 (75)	V1 V2 V3
1A1W1P18	REF	81349	M24308/2-2F	Connector, Receptacle, Electrical	7-3 (110)	V1 V2 V3
1A1W1P19	REF	96906	MS3456W20-29S	Connector, Plug, Electrical		V1 V2 V3
1A1W1P1MP1	REF	81349	M85049/52-1-16W	Strain Relief, Connector, Electrical	7-3 (171)	V1 V2 V3
1A1W1P2	REF	96906	MS3456W14S-2P	Connector, Electrical Plug	7-3 (130)	V1 V2 V3
1A1W1P20	REF	81349	M24308/4-3F	Connector, Electrical, Rectangular	7-3 (51)	V1 V2 V3
1A1W1P21	REF	96906	MS3456W20-16S	Connector, Plug, Electrical	7-3 (24)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1W1P2MP2	REF	81349	M85049/52-1-14W	Connector, Electrical Backshell	7-3 (131)	V1 V2 V3
1A1W1P3	REF	96906	MS3456W28-11SW	Connector, Plug, Electrical	7-3 (137)	V1 V2 V3
1A1W1P3MP3	REF	81349	M85049/52-1-28W	Strain Relief, Connector, Electrical	7-3 (138)	V1 V2 V3
1A1W1P4	REF	96906	MS3456W28-11SX	Connector, Plug, Electrical	7-3 (147)	V1 V2 V3
1A1W1P4MP3	REF	81349	M85049/52-1-28W	Strain Relief, Connector, Electrical	7-3 (148)	V1 V2 V3
1A1W1P5	REF	96906	MS3456W20-18P	Connector, Plug, Electrical	7-3 (155)	V1 V2 V3
1A1W1P6	REF	96906	MS3456W28-11S	Connector, Plug, Electrical	7-3 (152)	V1 V2 V3
1A1W1P6MP3	REF	81349	M85049/52-1-28W	Strain Relief, Connector, Electrical	7-3 (153)	V1 V2 V3
1A1W1P7	REF	96906	MS3476L16-8S	Connector, Plug, Electrical	7-3 (160)	V1 V2 V3
1A1W1P7MP4	REF	81349	M85049/52-1-16N	Strain Relief, Connector, Electrical	7-3 (159)	V1 V2 V3
1A1W1P8	REF	81349	M24308/2-2F	Connector, Electrical, Receptacle	7-1 (74)	V1 V2 V3
1A1W1P8MP5	REF	81349	M85049/48-2-2F	Strain Relief, Connector, Electrical	7-3 (111)	V1 V2 V3
1A1W1P8MP5	REF	81349	M85049/48-2-2F	Strain Relief, Connector, Electrical	7-1 (71)	V1 V2 V3
1A1W1P9	REF	81349	M24308/2-3F	Connector, Electrical, Rectangular	7-1 (72)	V1 V2 V3
1A1W1P9	REF	81349	M24308/2-3F	Connector, Electrical, Rectangular	7-3 (35)	V1 V2 V3
1A1W1P9MP6	REF	81349	M85049/48-2-3F	Strain Relief, Connector, Electrical	7-3 (8)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1W2	REF	03956	T968840	Cable Assembly, Door Cable and Harness Assembly	7-5	V1 V2 V3
1A1W20-1A1W26	1	03956	T968913	Cable Assembly	7-5 (64)	V1 V2
1A1W20J10	REF	96906	MS27656T23A35S	Connector, Receptacle, Electrical	7-5 (21)	V1 V2 V3
1A1W20MP1	REF	96906	MS27488-22	Plug, End Seal, Electrical Connector (P/O 1A1J10-1A1J14, 1A1J17, 1A1J18)	7-5 (16)	V1 V2 V3
1A1W21J11	REF	96906	MS27656T23A35S	Connector, Receptacle, Electrical	7-5 (20)	V1 V2 V3
1A1W23J12	REF	96906	MS27656T23A35S	Connector, Receptacle, Electrical	7-5 (58)	V1 V2 V3
1A1W24J14	REF	96906	MS27656T23A35S	Connector, Receptacle, Electrical	7-5 (57)	V2 V3
1A1W25J17	REF	96906	MS27656T23A35S	Connector, Receptacle, Electrical	7-5 (59)	V3
1A1W26J18	REF	96906	MS27656T23A35S	Connector, Receptacle, Electrical	7-5 (60)	V3
1A1W2P1	REF	81349	M83503/7-11	Connector, Electrical		V1 V2 V3
1A1W2P2	REF	81349	M83503/7-11	Connector, Electrical		V1 V2 V3
1A1W2W1	REF	03956	P1898175	Fl Ribbon Cable w/Ground Plane (P/O 1A1W2)		V1 V2 V3
1A1W3	REF	03956	T967883	Cable Assembly, Ribbon (58-B02-14-009)	7-3 (102)	V1 V2 V3
1A1W30J20	REF	03956	1810919	Connector, Coaxial, Electrical	7-5 (51)	V1 V2
1A1W31	1	03956	T968914	Cable Assembly	7-5 (65)	V1 V2
1A1W31J21	REF	03956	1810919	Connector, Coaxial, Electrical	7-5 (52)	V1 V2

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1W3P1	REF	81349	M83503/7-02	Connector, Electrical	7-3 (100)	V1 V2 V3
1A1W3P2	REF	81349	M83503/7-02	Connector, Electrical	7-3 (103)	V1 V2 V3
1A1W4MP1	REF	81349	M85049/48-2-1-F	Strain Relief, Connector, Electrical (P/O 1A1W4P1) (P/O 1A1W4P2)	7-3 (31)	V1 V2 V3
1A1W4MP2	REF	03956	1809463-1	Key, Polarizing, Electrical Connector (P/O 1A1W4P2)	7-3 (48)	V1 V2 V3
1A1W4MP3	REF	03956	1800604-1	Slide Lock (P/O 1A1W4MP1) (P/O 1A1W4MP2)	7-3 (47)	V1 V2 V3
1A1W4MP3	REF	03956	1800604-1	Slide Lock (P/O 1A1W4P1) (P/O 1A1W4P2)	7-3 (30)	V1 V2 V3
1A1W4P1	REF	81349	M24308/4-1F	Connector, Electrical, Rectangular	7-3 (29)	V1 V2 V3
1A1W4P2	REF	81349	M24308/4-1F	Connector, Electrical, Rectangular	7-3 (46)	V1 V2 V3
1A1W5MP1	REF	81349	M85049/48-2-1-F	Strain Relief, Connector, Electrical (P/O 1A1W5P1) (P/O 1A1W5P2)	7-3 (33)	V1 V2 V3
1A1W5MP3	REF	03956	1800604-1	Slide Lock (P/O 1A1W5MP1) (P/O 1A1W5MP2)	7-3 (34)	V1 V2 V3
1A1W5P1	REF	81349	M24308/4-1F	Connector, Electrical, Rectangular	7-3 (32)	V1 V2 V3
1A1W5P2	REF	81349	M24308/4-1F	Connector, Electrical, Rectangular	7-3 (45)	V1 V2 V3
1A1W6MP1	REF	81349	M85049/48-2-3F	Strain Relief, Connector, Electrical	7-3 (56)	V1 V2 V3
1A1W6P1	REF	81349	M24308/4-3F	Connector, Electrical, Rectangular	7-3 (55)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A1W6P2	REF	81349	M24308/4-3F	Connector, Electrical, Rectangular	7-3 (6)	V1 V2 V3
1A1W6P3	REF	81349	M24308/2-1F	Connector, Receptacle, Electrical	7-3 (108)	V1 V2 V3
1A1W7	1	03956	1900013-1	Cable Assembly, Fiber Optic ATM/synchronous Optical Network (SONET) Interface		V1 V2 V3
1A1W7	1	03956	140013-1	Cable Assembly (ATM)	7-5 (66)	V1 V2 V3
1A1W7J22MP56	1	81349	M28876/15-BDW	Connector, Dust Cover	7-5 (17)	V1 V2 V3
1A1W7W1	1	81349	M85045/16-01	Cable, Fiber Optic Assembly	7-5 (19)	V1 V2 V3
1A1W7W1	REF	53711	5165359-6	Sleeve, Wire Adapter		V1 V2 V3
1A1XDS1	1	96906	MS25041-6	Light, Indicator (Red Socket) *	7-1 (4)	V1 V2 V3
1A1XDS1MP1	2	03956	1857086-2	Transparent Flexible Seal	7-1 (5)	V1 V2 V3
1A1XDS1MP2	1	03956	1857086-11	Nut Adapter	7-1 (6)	V1 V2 V3
1A1XDS2	1	96906	MS25041-3	Light, Indicator (Green Socket)	7-1 (10)	V1 V2 V3
1A1XF1	REF	03956	4300416	Fuse Holder (P/O 1A1W1)	7-3 (164)	V1 V2 V3
1A1XK1	REF	81349	M12883/41-16	Socket (P/O 1A1W1)	7-3 (139)	V1 V2 V3
1A1XK2	REF	81349	M12883/41-16	Socket (P/O 1A1W1)	7-3 (140)	V1 V2 V3
1A1XK3	REF	81349	M12883/41-16	Socket (P/O 1A1W1)	7-3 (141)	V1 V2 V3
1A1XK4	REF	81349	M12883/40-19	Socket (P/O 1A1W1)	7-3 (143)	V1 V2 V3
1A1XK6	REF	81349	M12883/41-16	Socket (P/O 1A1W1)	7-3 (142)	V1 V2 V3
1A1XK7	REF	81349	M12883/41-16	Socket (P/O 1A1W1)	7-3 (144)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2	1	03956	1981548	Measurement Cabinet Electrical Assembly	7-7	V1 V2 V3
1A2	1	03956	1981548	Measurement Cabinet Electrical Assembly	7-8	V1 V2 V3
1A2A1	1	03956	1812593 or 4300859	IMU MX-11681/WSN-7 or MX-11681A/WSN-7A(V) (Matched Set, with all EPROMS)	7-7 (1)	V1 V2 V3
1A2A1A1	1	03956	1981549 or 4800592	Inertial Measuring Unit Assembly	7-8 (1)	V1 V2 V3
1A2A1A1A1	1	03956	1812594-3	Calibrated Ring Laser Gyro Assembly (Matched Set) (419-Hz "A" Gyro)	7-8 (59)	V1 V2 V3
1A2A1A1A1	1	03956	1812594-3	Calibrated Ring Laser Gyro Assembly (Matched Set) (419-Hz "A" Gyro)	7-11 (11)	V1 V2 V3
1A2A1A1A10	1	03956	1810553-1	Ring, Electrical Contact Capsule Assembly	7-9 (16)	V1 V2 V3
1A2A1A1A10J1	REF	03956	1810535-20	Connector, Electrical	7-9 (12)	V1 V2 V3
1A2A1A1A10J2	REF	03956	1810535-22	Connector, Electrical	7-9 (21)	V1 V2 V3
1A2A1A1A10P1	REF	03956	1810535-22	Connector, Electrical	7-9 (49)	V1 V2 V3
1A2A1A1A10P2	REF	03956	1810535-20	Connector, Electrical	7-9 (50)	V1 V2 V3
1A2A1A1A11	1	03956	1810553-2	Ring, Electrical Contact Capsule Assembly	7-9 (44)	V1 V2 V3
1A2A1A1A11J1	REF	03956	1810535-20	Connector, Electrical	7-9 (39)	V1 V2 V3
1A2A1A1A11J2	REF	03956	1810535-22	Connector, Electrical	7-9 (46)	V1 V2 V3
1A2A1A1A11P1	REF	03956	1810535-22	Connector, Electrical	7-9	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2A1A1A11P2	REF	03956	1810535-20	Connector, Electrical	7-9 (12)	V1 V2 V3
1A2A1A1A12	1	03956	1810553-3	Ring, Electrical Contact Capsule Assembly	7-9 (29)	V1 V2 V3
1A2A1A1A12J1	REF	81349	M24308/4-262	Connector, Electrical, Rectangular	7-8 (55)	V1 V2 V3
1A2A1A1A12J2	REF	81349	M24308/4-262	Connector, Electrical, Rectangular	7-8 (41)	V1 V2 V3
1A2A1A1A12P1	REF	03956	1810535-23	Connector, Electrical	7-9 (38)	V1 V2 V3
1A2A1A1A12P2	REF	03956	1810535-21	Connector, Electrical	7-9 (22)	V1 V2 V3
1A2A1A1A13	1	03956	1810553-4	Ring, Electrical Contact Capsule Assembly	7-9 (1)	V1 V2 V3
1A2A1A1A13J1	REF	81349	M24308/4-262	Connector, Electrical, Rectangular	7-8 (29)	V1 V2 V3
1A2A1A1A13J2	REF	81349	M24308/4-262	Connector, Electrical, Rectangular	7-8 (66)	V1 V2 V3
1A2A1A1A13P1	REF	03956	1810535-23	Connector, Electrical	7-9 (11)	V1 V2 V3
1A2A1A1A13P2	REF	03956	1810535-21	Connector, Electrical	7-9 (47)	V1 V2 V3
1A2A1A1A2	1	03956	1812594-2	Calibrated Ring Laser Gyro Assembly (Matched Set) (369-Hz "B" Gyro)	7-11 (13)	V1 V2 V3
1A2A1A1A2	1	03956	1812594-2	Calibrated Ring Laser Gyro Assembly (Matched Set) (369-Hz "B" Gyro)	7-8 (65)	V1 V2 V3
1A2A1A1A3	1	03956	1812594-1	Calibrated Ring Laser Gyro Assembly (Matched Set) (319-Hz "C" Gyro)	7-8 (58)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2A1A1A4	1	03956	1979045	High Voltage Power Supply Assembly	7-8 (56)	V1 V2 V3
1A2A1A1A4	1	03956	1979045	High Voltage Power Supply Assembly *	7-12	V1 V2 V3
1A2A1A1A4	1	03956	1979045	High Voltage Power Supply Assembly	7-11 (14)	V1 V2 V3
1A2A1A1A4A1	1	03956	1980509	High Voltage Power Supply	7-12 (15)	V1 V2 V3
1A2A1A1A4E1	1	03956	1813465	Insulator Plate Transistor	7-12	V1 V2 V3
1A2A1A1A4E2	1	03956	1808166-1	Washer, Shoulder, Nonmetallic	7-12 (8)	V1 V2 V3
1A2A1A1A4MP1	4	03956	1859208-3	Screw, Captive	7-12 (1)	V1 V2 V3
1A2A1A1A4MP3	3	03956	1859208-8	Screw, Captive	7-12 (5)	V1 V2 V3
1A2A1A1A4MP5	1	03956	1980522	Enclosure	7-12 (16)	V1 V2 V3
1A2A1A1A4MP6	1	03956	1859758	Cover, Housing	7-12 (13)	V1 V2 V3
1A2A1A1A4MP7	5	03956	1800383-59	Stand-Off	7-12 (22)	V1 V2 V3
1A2A1A1A4MP8	4	03956	1859257	Jack Socket, Female Screwlock	7-12 (18)	V1 V2 V3
1A2A1A1A5	1	03956	1810720	Calibrated Accelerometer (Matched Set) (Accelerometer A)	7-11 (6)	V1 V2 V3
1A2A1A1A5	1	03956	1810720	Calibrated Accelerometer (Matched Set) (Accelerometer A)	7-8 (42)	V1 V2 V3
1A2A1A1A6	1	03956	1810720	Calibrated Accelerometer (Matched Set) (Accelerometer C)	7-8 (43)	V1 V2 V3
1A2A1A1A6	1	03956	1810720	Calibrated Accelerometer (Matched Set) (Accelerometer C)	7-11 (7)	V1 V2 V3
1A2A1A1A7	1	03956	1810720	Calibrated Accelerometer (Matched Set) (Accelerometer B)	7-8 (44)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2A1A1A7	1	03956	1810720	Calibrated Accelerometer (Matched Set) (Accelerometer B)	7-11 (5)	V1 V2 V3
1A2A1A1A9	1	03956	1979018-2	Sensor Block Assembly	7-8 (32)	V1 V2 V3
1A2A1A1A9	1	03956	1979018-2	Sensor Block Assembly	7-11 (Image)	V1 V2 V3
1A2A1A1A9A1	1	03956	1980596	Accelerometer Stimulus	7-11 (22)	V1 V2 V3
1A2A1A1A9C1	1	81349	M39006/22-0327	Capacitor, Fixed ±20% 30 VDC	7-11 (33)	V1 V2 V3
1A2A1A1A9C2	1	81349	M39006/22-0327	Capacitor, Fixed ±20% 30 VDC	7-11 (34)	V1 V2 V3
1A2A1A1A9C3	1	81349	M39014/05-2855	Capacitor, Fixed ±10% 50 VDC	7-11 (36)	V1 V2 V3
1A2A1A1A9C4	1	81349	M39014/05-2855	Capacitor, Fixed ±10% 50 VDC	7-11 (37)	V1 V2 V3
1A2A1A1A9MP1	1	03956	1981137	Sensor Block Assembly	7-11 (1)	V1 V2 V3
1A2A1A1A9MP3	4	03956	1859234	Bracket, Connector	7-11 (39)	V1 V2 V3
1A2A1A1A9MP4	3	03956	1859235	Bracket, Connector	7-11 (21)	V1 V2 V3
1A2A1A1A9MP5	1	03956	1859388	Weight, Balance	7-11 (19)	V1 V2 V3
1A2A1A1A9MP6	1	03956	1859389	Weight, Balance	7-11 (28)	V1 V2 V3
1A2A1A1A9TB1	1	03956	1859939	Terminal Board Assembly	7-11 (35)	V1 V2 V3
1A2A1A1A9TB2	1	56232	0372-2	Terminal Board	7-11 (40)	V1 V2 V3
1A2A1A1A9W1	1	03956	T968693	Harness Assembly	7-11	V1 V2 V3
1A2A1A1A9W1 A10J1	REF	03956	1810535-6	Connector, Electrical	7-11 (44)	V1 V2 V3
1A2A1A1A9W1 A10J2	REF	03956	1810535-8	Connector, Electrical	7-11 (43)	V1 V2 V3
1A2A1A1A9W1 A11J1	REF	03956	1810535-6	Connector, Electrical	7-11 (42)	V1 V2 V3
1A2A1A1A9W1 A11J2	REF	03956	1810535-8	Connector, Electrical	7-11 (38)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2A1A1A9W1 A1P1	1	03956	1803362-34	Connector, Receptacle, Electrical	7-11 (15)	V1 V2 V3
1A2A1A1A9W1 A2P1	1	03956	1803362-34	Connector, Receptacle, Electrical	7-11 (26)	V1 V2 V3
1A2A1A1A9W1 A3P1	1	03956	1803362-34	Connector, Receptacle, Electrical	7-11 (3)	V1 V2 V3
1A2A1A1A9W1 A4P1	REF	03956	1810535-9	Connector, Electrical	7-11 (48)	V1 V2 V3
1A2A1A1A9W1 A4P2	REF	03956	1810535-13	Connector, Electrical	7-11 (47)	V1 V2 V3
1A2A1A1A9W1 A4P3	REF	03956	1810734	Connector, HV Power	7-11 (45)	V1 V2 V3
1A2A1A1A9W1 A4P4	REF	03956	1810535-11	Connector, Electrical	7-11 (46)	V1 V2 V3
1A2A1A1A9W1 A5J1	REF	03956	1810535-10	Connector, Electrical	7-11 (10)	V1 V2 V3
1A2A1A1A9W1 A6J1	REF	03956	1810535-10	Connector, Electrical	7-11 (9)	V1 V2 V3
1A2A1A1A9W1 A7J1	REF	03956	1810535-10	Connector, Electrical	7-11 (8)	V1 V2 V3
1A2A1A1A9W1 A9P1	REF	03956	1810535-11	Connector, Electrical	7-11 (23)	V1 V2 V3
1A2A1A1B1	1	03956	1979358	Motor, Direct Current, Torquer (Outer, Roll, Orange and Green Leads)	7-9 (24)	V1 V2 V3
1A2A1A1B1MP1	REF	03956	1859274	Support, Slip Ring		V1 V2 V3
1A2A1A1B2	1	03956	1979358	Motor, Direct Current, Torquer (Inner, Azimuth, Orange and Green Leads)	7-9 (13)	V1 V2 V3
1A2A1A1B2	1	03956	1979358	Motor, Direct Current, Torquer (Inner, Azimuth, Orange and Green Leads)	7-11 (12)	V1 V2 V3
1A2A1A1B2MP1	REF	03956	1859274	Support, Slip Ring	7-9 (15)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2A1A1B3	2	03956	1243107-2	Synchro Transmitter, Multispeed (Outer, Roll, Yellow and Blue Leads)	7-9 (4)	V1 V2 V3
1A2A1A1B4	2	03956	1243107-2	Synchro Transmitter, Multispeed (Inner, Azimuth, Yellow and Blue Leads)	7-9 (45)	V1 V2 V3
1A2A1A1B4MP1	REF	03956	1859274	Support, Slip Ring	7-9 (43)	V1 V2 V3
1A2A1A1M1	1	03956	1975362-6	Meter, Time Totalizing	7-8 (54)	V1 V2 V3
1A2A1A1MP1	1	03956	1979356	Frame Assembly, Inner	7-8 (31)	V1 V2 V3
1A2A1A1MP10	1	03956	1980551-1	Noise Attenuator Assembly Matched Set	7-9 (23)	V1 V2 V3
1A2A1A1MP11	1	03956	1980551-2	Noise Attenuator Assembly Matched Set	7-9 (41)	V1 V2 V3
1A2A1A1MP12	1	03956	1981516	Baseplate, Shock Assembly	7-8 (12)	V1 V2 V3
1A2A1A1MP14	2	03956	1979471-2	Shield, Cap	7-9 (40)	V1 V2 V3
1A2A1A1MP15	6	03956	1859264	Bolt, Shoulder	7-8 (18)	V1 V2 V3
1A2A1A1MP16	6	03956	1859265	Bolt, Shoulder	7-8 (13)	V1 V2 V3
1A2A1A1MP17	3	03956	1201037	Mirror, Optical Instrument	7-8 (23)	V1 V2 V3
1A2A1A1MP19	8	03956	1855408-3	Balance Weight	7-9 (55)	V1 V2 V3
1A2A1A1MP2	1	03956	1979354	Frame Assembly, Outer	7-8 (33)	V1 V2 V3
1A2A1A1MP20	3	03956	1855408-2	Balance Weight	7-9 (54)	V1 V2 V3
1A2A1A1MP21	3	03956	1855433	Bracket	7-8 (22)	V1 V2 V3
1A2A1A1MP22	3	03956	1855344	Spring	7-8 (24)	V1 V2 V3
1A2A1A1MP23	6	96906	MS21919WDG5	Clamp, Loop	7-8 (7)	V1 V2 V3
1A2A1A1MP24	16	03956	1812185-2	Clamp, Loop	7-9 (6)	V1 V2 V3
1A2A1A1MP25	1	03956	1819968-1	Weight, Balance	7-9 (61)	V1 V2 V3
1A2A1A1MP26	1	03956	1819968-2	Weight, Balance	7-9 (62)	V1 V2 V3
1A2A1A1MP27	2	03956	1857794-4	Clamp, Loop	7-9 (51)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2A1A1MP28	1	03956	1859976	Bracket, Connector	7-8 (57)	V1 V2 V3
1A2A1A1MP29	1	03956	1980543	Magnetic Shield Assembly	7-8 (3)	V1 V2 V3
1A2A1A1MP3	4	03956	1819953-2	Spacer	7-8 (36)	V1 V2 V3
1A2A1A1MP30	1	03956	1981680	Hoist Block	7-9 (67)	V1 V2 V3
1A2A1A1MP30	1	03956	1981680	Hoist Block	7-8 (10)	V1 V2 V3
1A2A1A1MP31	1	03956	1859987-1	Gasket	7-8 (53)	V1 V2 V3
1A2A1A1MP32	2	03956	1855408-4	Weight, Balance	7-8 (67)	V1 V2 V3
1A2A1A1MP33	6	03956	1981550	Shock Absorber, Direct Action	7-8 (11)	V1 V2 V3
1A2A1A1MP34	2	03956	1979471-1	Shield, Cap	7-8 (19)	V1 V2 V3
1A2A1A1MP34	2	03956	1979471-1	Shield, Cap	7-9 (20)	V1 V2 V3
1A2A1A1MP35	2	03956	1819915	Cover, Protective	7-8 (50)	V1 V2 V3
1A2A1A1MP36	6	03956	1800383-25	Stand-Off	7-8 (8)	V1 V2 V3
1A2A1A1MP37	4	03956	1819987-4	Pad, Snubber	7-8 (73)	V1 V2 V3
1A2A1A1MP38	8	03956	1811212	Grommet, Ribbed Thermoplastic	7-8 (40)	V1 V2 V3
1A2A1A1MP39	4	03956	1820164	Cushion, Sleeve	7-8 (37)	V1 V2 V3
1A2A1A1MP4	4	03956	1819953-1	Spacer	7-8 (65)	V1 V2 V3
1A2A1A1MP40	4	03956	1820163	Cushion, Sleeve	7-8 (63)	V1 V2 V3
1A2A1A1MP42	3	03956	1859208-4	Screw, Captive	7-8 (68)	V1 V2 V3
1A2A1A1MP43	8	03956	1800604-6	Sliding Post, Lock	7-8 (30)	V1 V2 V3
1A2A1A1MP5	3	03956	1859266	Bracket, Connector, Electrical	7-8 (9)	V1 V2 V3
1A2A1A1MP6	4	03956	1859317	Bracket, Angle	7-9 (7)	V1 V2 V3
1A2A1A1MP7	4	03956	1859281	Guide, Wire	7-8 (34)	V1 V2 V3
1A2A1A1MP7	4	03956	1859281	Guide, Wire	7-9 (31)	V1 V2 V3
1A2A1A1MP8	3	03956	1819961	Bracket, Angle	7-8 (46)	V1 V2 V3
1A2A1A1MP9	2	03956	1859254	Retainer Ring, Ext Thd	7-9 (18)	V1 V2 V3
1A2A1A1TB21	1	56232	0372-5	Terminal Board	7-9 (63)	V1 V2 V3
1A2A1A1TB23	1	56232	0372-6	Terminal Board	7-9 (59)	V1 V2 V3
1A2A1A1TB31	1	56232	0372-6	Terminal Board	7-8 (51)	V1 V2 V3
1A2A1A1TB32	1	56232	0372-6	Terminal Board	7-8 (72)	V1 V2 V3

Table 7-2. Parts List by Reference Designator Order - Continued

REF DES	QTY	CAGE	PART NO	NOMEN /DESCR	FIGURE (ITEM NO)	VARIANT
1A2A1A1W1	1	03956	T968832	Lead Assembly	7-8 (52)	V1 V2 V3
1A2A1A1W2	1	03956	1810734	Cable Assembly, HV Power	7-9 (35)	V1 V2 V3
1A2MP1	1	03956	1981535	IMU Housing Assembly	7-7 (5)	V1 V2 V3
1A2MP1	1	03956	1981535	IMU Housing Assembly	7-8 (2)	V1 V2 V3
E1	1	03956	T969060	Ground Strap	7-3 (120)	V1 V2 V3
E2-E3	1	03956	T967901	Ground Strap	7-3 (122)	V1 V2 V3
E4-E3	1	03956	T967889	Ground Strap		V1 V2 V3
E5-E3	1	03956	T967888	Ground Strap		V1 V2 V3
* Lowest Replaceable Unit (LRU)						

Table 7-3. Parts List by Diagram Location Order

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
5-2	1A1A13DS1	NA	NA	Nav Processor Fault	1	V1 V2 V3
5-2	1A1A15DS1	NA	NA	20 MS (800-Hz) Processors Timing Interrupt Monitor	1	V1 V2 V3
5-2	1A1A15DS2	NA	NA	Status and Command Board (Heart Beat Fault)	1	V1 V2 V3
5-2	1A1A15DS3	NA	NA	Navigation Processor Data Bus Fault	1	V1 V2 V3
5-2	1A1A18DS1	NA	NA	Outer Gimbal Torquer Active (±25 V Enabled)	1	V1 V2 V3
5-2	1A1A18DS2	NA	NA	Outer Gimbal Torquer Active (-25 V Enabled)	1	V1 V2 V3
5-2	1A1A19DS1	NA	NA	Inner Gimbal Torquer Drive (+25 V Enabled)	1	V1 V2 V3
5-2	1A1A19DS2	NA	NA	Inner Gimbal Torquer Drive (-25 V Enabled)	1	V1 V2 V3
5-2	1A1A21DS1	NA	NA	I/O Processor Fault	1	V1 V2 V3
5-2	1A1A37DS1	NA	NA	Power OK	1	V1 V2 V3
5-2	1A1A37DS2	NA	NA	Power Supply +5 VDC Output Available	1	V1 V2 V3
5-2	1A1A37DS3	NA	NA	Power Supply +28 VDC Output Available	1	V1 V2 V3
5-2	1A1A37DS4	NA	NA	Power Supply -15 VDC Output Available	1	V1 V2 V3
5-2	1A1A37DS5	NA	NA	Power Supply +15 VDC Output Available	1	V1 V2 V3
5-5	1A1W2	T968840	03956	Cable Assembly, Door Cable and Harness Assembly	REF	V1 V2 V3
7-1	1A1	1981539-3	03956	WSN-7 Processor Cabinet Assembly	1	V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-1	1A1	1981539-2	03956	WSN-7 Processor Cabinet Assembly	1	V2
7-1	1A1W1	T969420	03956	Main Harness Assembly	REF	V1 V2 V3
7-1	1A1	1981539-6	03956	WSN-7 Processor Cabinet Assembly	1	V1
7-1 (1)	1A1MP1	1981518	03956	Cabinet, Assembly, Electrical Equipment	1	V1 V2 V3
7-1 (2)	1A1S1	MS24660-23D	96906	Switch, Toggle	1	V1 V2 V3
7-1 (3)	1A1DS1	FF200CW600-28V-P/ FF200-0CW-028B	81349	Light Emiting Diode (Red) *	1	V1 V2 V3
7-1 (4)	1A1XDS1	MS25041-6	96906	Light, Indicator (Red Socket) *	1	V1 V2 V3
7-1 (5)	1A1XDS1MP1	1857086-2	03956	Transparent Flexible Seal	2	V1 V2 V3
7-1 (6)	1A1XDS1MP2	1857086-11	03956	Nut Adapter	1	V1 V2 V3
7-1 (7)	1A1M1	1975362-6	03956	Meter, Time Totalizing	1	V1 V2 V3
7-1 (8)	1A1MP7	1859987-1	03956	Gasket	1	V1 V2 V3
7-1 (9)	1A1DS2	FF200CW600-28V-P/ FF200-0CW-028B	81349	Light Emitting Diode (Green)	1	V1 V2 V3
7-1 (10)	1A1XDS2	MS25041-3	96906	Light, Indicator (Green Socket)	1	V1 V2 V3
7-1 (11)	None.	1812647-1	03956	Plate Identification	1	V1 V2 V3
7-1 (12)	None.	1812647-8	03956	Plate Identification	1	V1 V2 V3
7-1 (13)	None.	MS51957-3	96906	Screw, Pan Head .086-56 X .25" L	8	V1 V2 V3
7-1 (14)	None.	M695178-4	03956	Sealing and Retaining Compound MIL-S-22473, Grade AV, (97-302-78)	AR	V1 V2 V3
7-1 (15)	1A1CB3	M39019/03-216S	81349	Circuit Breaker 1.0 Amp	1	V1 V2 V3
7-1 (16)	1A1CB2	M39019/03-240S	81349	Circuit Breaker 7.5 Amp	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-1 (17)	1A1CB1	M39019/05-327S	81349	Circuit Breaker 7.5 Amp	1	V1 V2 V3
7-1 (18)	1A1MP28	1859310	03956	Gasket	1	V1 V2 V3
7-1 (19)	1A1A9	1859873	03956	Keyboard, Data Entry *	1	V1 V2 V3
7-1 (20)	1A1MP26	1859289	03956	Gasket	1	V1 V2 V3
7-1 (21)	1A1MP25	1981667	03956	Bezel, Window	1	V1 V2 V3
7-1 (22)	None.	1979505	03956	EMI Window	1	V1 V2 V3
7-1 (23)	1A1MP37	1818842	03956	Plug	1	V1 V2 V3
7-1 (24)	1A1MP43	1800544-17	03956	Washer, Flat, Nonmetallic .312	1	V1 V2 V3
7-1 (25)	1A1MP38	1801594-29	03956	Screw, Shoulder .250-20	1	V1 V2 V3
7-1 (26)	1A1MP39	MS15795-812	96906	Washer, Flat .312	2	V1 V2 V3
7-1 (27)	None.	MS15795-810	96906	Washer, Flat .250"	1	V1 V2 V3
7-1 (28)	1A1MP41	1860145	03956	Link Assembly	1	V1 V2 V3
7-1 (29)	1A1MP40	1810805-5	03956	Washer, Spring Tension	4	V1 V2 V3
7-1 (30)	None.	MS35649-264	96906	Nut, Hex .138-32	8	V1 V2 V3
7-1 (31)	None.	MS35338-136	96906	Washer, Lock .138"	15	V1 V2 V3
7-1 (32)	None.	MS15795-805	96906	Washer, Flat .138"	71	V1 V2 V3
7-1 (33)	1A1A10	1979344	03956	Display Assembly *	1	V1 V2 V3
7-1 (34)	1A1MP42	1860240	03956	Rail, Door Stay	1	V1 V2 V3
7-1 (35)	None.	MS51959-29	96906	Screw, Flat Head .138-32 X .44" L	3	V1 V2 V3
7-1 (36)	None.	MS51959-31	96906	Screw, Flat Head .138-32 X .62" L	14	V1 V2 V3
7-1 (37)	1A1MP27	1981668	03956	Bezel	1	V1 V2 V3
7-1 (38)	None.	MS35308-333	96906	Screw, Cap, Hex Head .312-24 X .88" L	2	V1 V2 V3
7-1 (39)	1A1MP15	1859290-1	03956	Clamp, Battery	1	V1 V2 V3
7-1 (40)	1A1MP18	1859290-2	03956	Clamp, Battery	1	V1 V2 V3
7-1 (41)	1A1MP2	1891448	03956	Heat Shield Assembly	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-1 (42)	1A1A5	1981554	03956	Battery Assembly *	1	V1 V2 V3
7-1 (43)	1A1MP10	1818661	03956	Swivel Clamp	2	V1 V2 V3
7-1 (44)	None.	MS51957-45	96906	Screw, Pan Head .164-32 X .50" L	25	V1 V2 V3
7-1 (45)	None.	MS15795-807	96906	Washer, Flat .164"	28	V1 V2 V3
7-1 (46)	None.	MS35338-137	96906	Washer, Lock .164"	28	V1 V2 V3
7-1 (47)	1A1A41	1976545–3	03956	Synchro Buffer Amplifier, 8 VA	1	V1 V2 V3
7-1 (48)	1A1A6	1979342	03956	Power Supply	1	V1 V2 V3
7-1 (49)	1A1W1P13	M24308/2-4F	81349	Connector, Electrical, Receptacle	REF	V1 V2 V3
7-1 (50)	1A1W1P10MP7	M85049/48-2-4F	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-1 (51)	1A1W1MP9	M24308/25-9	81349	Screw, Lock, Male	REF	V1 V2 V3
7-1 (52)	None.	1980412	03956	Bracket, Mtg, Relay (P/O 1A1W1)	REF	V1 V2 V3
7-1 (53)	None.	MS21266-3N	96906	Grommet, Plastic Edging (P/O 1A1W1)	REF	V1 V2 V3
7-1 (54)	None.	MMM-A-134TY1	81348	Adhesive; ADH #28, 56232-M695727, 97-028-78 (P/O 1A1W1)	REF	V1 V2 V3
7-1 (55)	1A1MP44	1812694-2	03956	Clamp, Cable	30	V1 V2 V3
7-1 (56)	None.	MS15795-808	96906	Washer, Flat .190"	31	V1 V2 V3
7-1 (57)	None.	MS51957-42	96906	Screw, Pan Head .164-32 X .31" L	53	V1 V2 V3
7-1 (58)	1A1MP47	MS3367-1-9	96906	Strap, Tiedown	25	V1 V2 V3
7-1 (59)	1A1A8	1205050-3	03956	Power Module	1	V1 V2 V3
7-1 (60)	None.	MS16996-25	96906	Screw, Socket Head .250-28 X 1.25" L	6	V1 V2 V3
7-1 (61)	None.	AN960C416	88044	Washer, Flat .250"	78	V1 V2 V3
7-1 (62)	None.	MS35338-139	96906	Washer, Lock .250"	80	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-1 (63)	None.	1807256-10	03956	Label, Tape Pressure Sensitive Adhesive	2	V1 V2 V3
7-1 (64)	1A1MP4	1979347	03956	Card Rack Assembly	1	V1 V2 V3
7-1 (65)		1981659-var	03956	Label, Placard Nav CCA Rack (P/O 1A1)	1	V1 V2 V3
7-1 (66)	1A1MP3	1981510	03956	Upper Card Rack Assembly	1	V1 V2 V3
7-1 (67)	None.	MS3376-3-9	96906	Strap, Tiedown	5	V1 V2 V3
7-1 (68)	1A1MP36	1800662-81	03956	Spacer, Hex Threaded .112-40 X 1.50" L	2	V1 V2 V3
7-1 (69)	None.	MS35649-284	96906	Nut, Hex .164-32	1	V1 V2 V3
7-1 (70)	1A1MP35	1800662-21	03956	Spacer, Hex .164-32 X .62" L	9	V1 V2 V3
7-1 (71)	1A1W1P8MP5	M85049/48-2-2F	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-1 (72)	1A1W1P9	M24308/2-3F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-1 (73)	1A1A3	1978322	03956	Vital Bus CCA	1	V1 V2 V3
7-1 (74)	1A1W1P8	M24308/2-2F	81349	Connector, Electrical, Receptacle	REF	V1 V2 V3
7-1 (75)	1A1W1P18	M24308/2-2F	81349	Connector, Electrical, Receptacle	REF	V1 V2 V3
7-10	None.	Not Listed.		IMU: Subassembly Identification (1A2A1A1)		V1 V2 V3
7-10 (1)	None.	MS35307-330	96906	Screw, Cap, Hex Head 5/16-18 X .56" L	3	V1 V2 V3
7-10 (2)	None.	MS35338-140	96906	Washer, Lock .312"	3	V1 V2 V3
7-10 (3)	None.	1981989	03956	Cover, Transport Torquer/Synchro	2	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-10 (4)	None.	1981549-501	03956	Spacer	6	V1 V2 V3
7-10 (5)	None.	1981555	03956	IMU Cover, Shipping	1	V1 V2 V3
7-10 (6)	None.	MS51957-37	96906	Screw, Pan Head .138-32 X .75" L	6	V1 V2 V3
7-10 (7)	None.	1981549-501	03956	Spacer	6	V1 V2 V3
7-10 (8)	None.	AA55610-136		Washer, Lock .138"	20	V1 V2 V3
7-10 (9)	None.	MS15795-805	96906	Washer, Flat .138"	22	V1 V2 V3
7-11	None.	1812336	03956	Wire List, Sensor Block	REF	V1 V2 V3
7-11	None.	MIL-S-22473	81349	Sealing and Retaining Compound, Grade AA	AR	V1 V2 V3
7-11	None.	M690587	56232	Electrical Wiring	X	V1 V2 V3
7-11	1A2A1A1A9W1	T968693	03956	Harness Assembly	1	V1 V2 V3
7-11 (1)	1A2A1A1A9MP1	1981137	03956	Sensor Block Assembly	1	V1 V2 V3
7-11 (3)	1A2A1A1A9W1 A3P1	1803362-34	03956	Connector, Receptacle, Electrical	1	V1 V2 V3
7-11 (4)	None.	Not Listed.		E1 — E15		V1 V2 V3
7-11 (5)	1A2A1A1A7	1810720	03956	Calibrated Accelerometer (Matched Set) (Accelerometer B)	1	V1 V2 V3
7-11 (6)	1A2A1A1A5	1810720	03956	Calibrated Accelerometer (Matched Set) (Accelerometer A)	1	V1 V2 V3
7-11 (7)	1A2A1A1A6	1810720	03956	Calibrated Accelerometer (Matched Set) (Accelerometer C)	1	V1 V2 V3
7-11 (8)	1A2A1A1A9W1 A7J1	1810535-10	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (9)	1A2A1A1A9W1 A6J1	1810535-10	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (10)	1A2A1A1A9W1 A5J1	1810535-10	03956	Connector, Electrical	REF	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-11 (11)	1A2A1A1A1	1812594-3	03956	Calibrated Ring Laser Gyro Assembly (Matched Set) (419-Hz "A" Gyro)	1	V1 V2 V3
7-11 (12)	1A2A1A1B2	1979358	03956	Motor, Direct Current, Torquer (Inner, Azimuth, Orange and Green Leads)	1	V1 V2 V3
7-11 (13)	1A2A1A1A2	1812594-2	03956	Calibrated Ring Laser Gyro Assembly (Matched Set) (369-Hz "B" Gyro)	1	V1 V2 V3
7-11 (14)	1A2A1A1A4	1979045 (Rev J)	03956	High Voltage Power Supply Assembly	1	V1 V2 V3
7-11 (15)	1A2A1A1A9W1 A1P1	1803362-34	03956	Connector, Receptacle, Electrical	1	V1 V2 V3
7-11 (16)	None.	MS35338-135	96906	Washer, Lock .112"	10	V1 V2 V3
7-11 (17)	None.	MS15795-803	96906	Washer, Flat .112"	10	V1 V2 V3
7-11 (18)	None.	MS51957-20	96906	Screw, Pan Head #4-40 X .88" L	2	V1 V2 V3
7-11 (19)	1A2A1A1A9MP5	1859388	03956	Weight, Balance	1	V1 V2 V3
7-11 (20)	None.	MS51959-3	96906	Screw, Flat Head #2-56 X .25" L	14	V1 V2 V3
7-11 (21)	1A2A1A1A9MP4	1859235	03956	Bracket, Connector	3	V1 V2 V3
7-11 (22)	1A2A1A1A9A1	1980596	03956	Accelerometer Stimulus	1	V1 V2 V3
7-11 (23)	1A2A1A1A9W1 A9P1	1810535-11	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (24)	None.	MS25281-F4	96906	Clamp, Loop	4	V1 V2 V3
7-11 (25)	None.	MS51957-15	96906	Screw, Pan Head .122-40 X .38" L	4	V1 V2 V3
7-11 (26)	1A2A1A1A9W1 A2P1	1803362-34	03956	Connector, Receptacle, Electrical	1	V1 V2 V3
7-11 (27)	None.	MS51957-22	96906	Screw, Pan Head #4-40 X 1.25" L	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-11 (28)	1A2A1A1A9MP6	1859389	03956	Weight, Balance	1	V1 V2 V3
7-11 (29)	None.	MS51957-18	96906	Screw, Pan Head .122-40 X .62" L	1	V1 V2 V3
7-11 (30)	None.	0933-101	56232	Spacer, Sleeve	4	V1 V2 V3
7-11 (31)	None.	MS51957-5	96906	Screw, Pan Head #2-56 X .38" L	6	V1 V2 V3
7-11 (32)	None.	MS15795-802	96906	Washer, Flat .086"	4	V1 V2 V3
7-11 (33)	1A2A1A1A9C1	M39006/22-0327	81349	Capacitor, Fixed ±20% 30 VDC	1	V1 V2 V3
7-11 (34)	1A2A1A1A9C2	M39006/22-0327	81349	Capacitor, Fixed ±20% 30 VDC	1	V1 V2 V3
7-11 (35)	1A2A1A1A9TB1	1859939	03956	Terminal Board Assembly	1	V1 V2 V3
7-11 (36)	1A2A1A1A9C3	M39014/05-2855	81349	Capacitor, Fixed ±10% 50 VDC	1	V1 V2 V3
7-11 (37)	1A2A1A1A9C4	M39014/05-2855	81349	Capacitor, Fixed ±10% 50 VDC	1	V1 V2 V3
7-11 (38)	1A2A1A1A9W1 A11J2	1810535-8	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (39)	1A2A1A1A9MP3	1859234	03956	Bracket, Connector	4	V1 V2 V3
7-11 (40)	1A2A1A1A9TB2	0372-2	56232	Terminal Board	1	V1 V2 V3
7-11 (41)	None.	NAS620C2	80205	Washer, Flat #2	2	V1 V2 V3
7-11 (42)	1A2A1A1A9W1 A11J1	1810535-6	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (43)	1A2A1A1A9W1 A10J2	1810535-8	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (44)	1A2A1A1A9W1 A10J1	1810535-6	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (45)	1A2A1A1A9W1 A4P3	1810734	03956	Connector, HV Power	REF	V1 V2 V3
7-11 (46)	1A2A1A1A9W1 A4P4	1810535-11	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (47)	1A2A1A1A9W1 A4P2	1810535-13	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (48)	1A2A1A1A9W1 A4P1	1810535-9	03956	Connector, Electrical	REF	V1 V2 V3
7-11 (49)	None.	1859256	03956	Bracket, Angle	REF	V1 V2 V3
7-11 (Image)	1A2A1A1A9	1979018-2	03956	Sensor Block Assembly	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-12	1A2A1A1A4E1	1813465	03956	Insulator Plate Transistor	1	V1 V2 V3
7-12	None.	TS1897587	03956	Test Spec for High Voltage Power Supply Assembly	X	V1 V2 V3
7-12	1A2A1A1A4	1979045	03956	High Voltage Power Supply Assembly *	1	V1 V2 V3
7-12 (1)	1A2A1A1A4MP1	1859208-3	03956	Screw, Captive	4	V1 V2 V3
7-12 (2)	None.	MS15795-807	96906	Washer, Flat .164"	4	V1 V2 V3
7-12 (3)	None.	MS24693-C1	96906	Screw, Flat Head #4-40 X .19" L	9	V1 V2 V3
7-12 (4)	None.	NAS620C6	80205	Washer, Flat #6	3	V1 V2 V3
7-12 (5)	1A2A1A1A4MP3	1859208-8	03956	Screw, Captive	3	V1 V2 V3
7-12 (6)	None.	NAS662C2R4	80205	Screw, Flat Head #2-56 X .25" L	4	V1 V2 V3
7-12 (7)	None.	MS35335-57	96906	Washer, Lock #4	4	V1 V2 V3
7-12 (8)	1A2A1A1A4E2	1808166-1	03956	Washer, Shoulder, Nonmetallic	1	V1 V2 V3
7-12 (9)	None.	MS35649-244	96906	Nut, Hex .112-40	1	V1 V2 V3
7-12 (10)	None.	MS24693-C4	03956	Screw, Flat Head #4-40 X .38" L	1	V1 V2 V3
7-12 (11)	None.	MS15795-803	96906	Washer, Flat .112"	20	V1 V2 V3
7-12 (12)	None.	MS35338-135	96906	Washer, Lock .112"	5	V1 V2 V3
7-12 (13)	1A2A1A1A4MP6	1859758	03956	Cover, Housing	1	V1 V2 V3
7-12 (14)	None.	1819897	03956	Label, Caution	1	V1 V2 V3
7-12 (15)	1A2A1A1A4A1	1980509	03956	High Voltage Power Supply	1	V1 V2 V3
7-12 (16)	1A2A1A1A4MP5	1980522	03956	Enclosure	1	V1 V2 V3
7-12 (17)	None.	MS51957-13	96906	Screw, Pan Head .112-40 X .25" L	5	V1 V2 V3
7-12 (18)	1A2A1A1A4MP8	1859257	03956	Jack Socket, Female Screwlock	4	V1 V2 V3
7-12 (19)	None.	NAS620C3L	80205	Washer, Flat #3	4	V1 V2 V3
7-12 (20)	None.	MS35338-134	96906	Washer, Lock .086"	4	V1 V2 V3
7-12 (21)	None.	MS35649-224	96906	Nut, Hex .086-56	4	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-12 (22)	1A2A1A1A4MP7	1800383-59	03956	Stand-Off	5	V1 V2 V3
7-12 (23)	None.	MIL-S-22473	81349	Sealing and Retaining Compound MIL-S-22473, Grade C (97-303-78)	AR	V1 V2 V3
7-2 (1)	1A1MP45	1811774	03956	Plate, Mounting, Clamp Loop	28	V1 V2 V3
7-2 (2)	None.	MS51959-42	96906	Screw, Flat Head #8-32 X .31" L	52	V1 V2 V3
7-2 (3)	1A1MP48	MS3367-5-9	96906	Strap, Tiedown	14	V1 V2 V3
7-2 (4)	None.	M695178-4	03956	Sealing and Retaining Compound, MIL-S-22473, GR, AV, (97–302–78)	AR	V1 V2 V3
7-2 (4)	1A1A1	1981532	03956	Filter, Power Line *	1	V1 V2 V3
7-2 (5)	1A1MP15	1859290-1	03956	Clamp, Battery	1	V1 V2 V3
7-2 (6)	None.	ZZR765/9-131D5	81348	Rubber, Silicone Tubing .186 ID X .020 Wall Red (76 009-25)	2 FT	V1 V2 V3
7-2 (7)	None.	MS35691-23	96906	Nut, Hex .375-24	1	V1 V2 V3
7-2 (8)	None.	NAS1523-6Y	80205	Packing With Retainer	1	V1 V2 V3
7-2 (9)	1A1A5MP3	1857571-2	03956	Vent Tube Assembly	1	V1 V2 V3
7-2 (10)	None.	Not Listed.	03956	Handle, Door, Latching	3	V1 V2 V3
7-3 (1)	1A1A10	1979344	03956	Display Assembly *	1	V1 V2 V3
7-3 (2)	1A1MP45	1811774	03956	Plate, Mounting, Clamp Loop	28	V1 V2 V3
7-3 (3)	None.	MS51959-26	96906	Screw, Flat Head .138-32 X .25" L	6	V1 V2 V3
7-3 (4)	1A1MP49	MS3367-4-9	96906	Strap, Tiedown	13	V1 V2 V3
7-3 (5)	None.	M695178-4	03956	Sealing and Retaining Compound MIL-S-22473, GR, AV, (97–302–78)	AR	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (6)	1A1W6P2	M24308/4-3F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (7)	1A1W1MP9	M24308/25-9	81349	Screw, Lock, Male	REF	V1 V2 V3
7-3 (8)	1A1W1P9MP6	M85049/48-2-3F	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (9)	None.	MS51959-42	96906	Screw, Flat Head #8–32 X .31" L	52	V1 V2 V3
7-3 (10)	1A1MP48	MS3367-5-9	96906	Strap, Tiedown	14	V1 V2 V3
7-3 (11)	None.	MS15795-807	96906	Washer, Flat .138"	REF	V1 V2 V3
7-3 (12)	None.	MS35338-136	96906	Washer, Lock .138"	REF	V1 V2 V3
7-3 (13)	None.	MS35649-264	96906	Nut, Hex .138–32	REF	V1 V2 V3
7-3 (14)	1A1MP22	1860143	03956	Bracket, Cable Tie Base	2	V1 V2 V3
7-3 (15)	None.	MS24671-17	96906	Screw, Cap, Flat Head .164-32 X 1.00" L	8	V1 V2 V3
7-3 (16)	1A1MP47	MS3367-1-9	96906	Strap, Tiedown	25	V1 V2 V3
7-3 (17)	1A1MP29	1859267	03956	Pin, Straight, Headed	2	V1 V2 V3
7-3 (18)	1A1MP14	1859268-2	03956	Bracket, Angle	1	V1 V2 V3
7-3 (19)	1A1MP44	1812694-2	03956	Clamp, Cable	30	V1 V2 V3
7-3 (19)	1A1MP44	1812694-2	03956	Clamp, Cable	30	V1 V2 V3
7-3 (20)	None.	MS15795-808	96906	Washer, Flat .190"	31	V1 V2 V3
7-3 (21)	None.	MS51957-42	96906	Screw, Pan Head .164–32 X .31" L	53	V1 V2 V3
7-3 (22)	1A1A12	1981534-var	03956	I/O Processor Backplane Assembly	1	V1 V2 V3
7-3 (23)	1A1W1MP8	M85049/52-1-20W	81349	Strain Relief, Connector, Electrical; 1A1W1P11, 1A1W1P19, 1A1W1P21	REF	V1 V2 V3
7-3 (24)	1A1W1P21	MS3456W20-16S	96906	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (25)	1A1MP46	1857683-7	03956	Clamp, Cable, Flat	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (26)	None.	MS51959	96906	Screw, Flat Head .138–32 X .44" L	3	V1 V2 V3
7-3 (27)	1A1W1P11	MS3456W20-16S	96906	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (28)	1A1A11	1981660	03956	Nav Card Rack Wirewrap Backplane Assembly	1	V1 V2 V3
7-3 (29)	1A1W4P1	M24308/4-1F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (30)	1A1W4MP3	1800604-1	03956	Slide Lock (P/O 1A1W4P1) (P/O 1A1W4P2)	REF	V1 V2 V3
7-3 (31)	1A1W4MP1	M85049/48-2-1-F	81349	Strain Relief, Connector, Electrical (P/O 1A1W4P1) (P/O 1A1W4P2)	REF	V1 V2 V3
7-3 (32)	1A1W5P1	M24308/4-1F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (33)	1A1W5MP1	M85049/48-2-1-F	81349	Strain Relief, Connector, Electrical (P/O 1A1W5P1) (P/O 1A1W5P2)	REF	V1 V2 V3
7-3 (34)	1A1W5MP3	1800604-1	03956	Slide Lock (P/O 1A1W5MP1) (P/O 1A1W5MP2)	REF	V1 V2 V3
7-3 (35)	1A1W1P9	M24308/2-3F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (36)	1A1W1P10MP7	M85049/48-2-4F	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (37)	1A1W1P10	M24308/4-4F	81349	Connector, Electrical, Receptacle	REF	V1 V2 V3
7-3 (38)	1A1W1P17	M24308/4-4F	81349	Connector, Electrical, Receptacle	REF	V1 V2 V3
7-3 (39)	1A1W1P12	M24308/4-4F	81349	Connector, Electrical, Receptacle	REF	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (40)	None.	MS51960-83	96906	Screw, Flat Head .250-28 X .62" L	8	V1 V2 V3
7-3 (41)	1A1MP16	1859268-1	03956	Bracket, Angle	1	V1 V2 V3
7-3 (42)	1A1MP17	1859284-2	03956	Bracket, Angle	1	V1 V2 V3
7-3 (43)	None.	MS35335-60	96906	Washer, Lock .190"	1	V1 V2 V3
7-3 (44)	None.	MS35650-304	96906	Nut, Hex .190-32	2	V1 V2 V3
7-3 (45)	1A1W5P2	M24308/4-1F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (46)	1A1W4P2	M24308/4-1F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (47)	1A1W4MP3	1800604-1	03956	Slide Lock (P/O 1A1W4MP1) (P/O 1A1W4MP2)	REF	V1 V2 V3
7-3 (48)	1A1W4MP2	1809463-1	03956	Key, Polarizing, Electrical Connector (P/O 1A1W4P2)	REF	V1 V2 V3
7-3 (49)	1A1MP19	1859284-1	03956	Bracket, Angle	1	V1 V2 V3
7-3 (50)	1A1MP30	1859283	03956	Pin, Straight, Headed	2	V1 V2 V3
7-3 (51)	1A1W1P20	M24308/4-3F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (52)	1A1A36	1979348	03956	Gyro Support Electronics CCA *	1	V1 V2 V3
7-3 (53)	1A1A35	1979046	03956	Accelerometer and Sensor Electronics CCA *	1	V1 V2 V3
7-3 (54)	1A1A34	1979047	03956	A/D Multiplexer CCA *	1	V1 V2 V3
7-3 (55)	1A1W6P1	M24308/4-3F	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-3 (56)	1A1W6MP1	M85049/48-2-3F	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (57)	1A1A32	1811791	03956	IMU Processor CCA *	1	V1 V2 V3
7-3 (58)	1A1A31	1981570	03956	I/O Control (BITE) & Filter CCA *	1	V1 V2 V3
7-3 (59)	1A1A33	1979023	03956	Repositioning Interface CCA *	1	V1 V2 V3
7-3 (60)	None.	MS15795-803	96906	Washer, Flat .112"	58	V1 V2 V3
7-3 (61)	None.	MS35338-135	96906	Washer, Lock .112"	26	V1 V2 V3
7-3 (62)	None.	MS51957-16	96906	Screw, Pan Head .112-40 X .44" L	24	V1 V2 V3
7-3 (63)	1A1A30	1981572	03956	Support Electronics Backplane	1	V1 V2 V3
7-3 (64)	1A1A37	1979057	03956	Support Electronics Power Supply *	1	V1 V2 V3
7-3 (65)	1A1A20	1980488-2	03956	Bus Interface CCA *	1	V1 V2 V3
7-3 (66)	1A1MP4	1979347	03956	Card Rack Assembly	1	V1 V2 V3
7-3 (67)	1A1A4	1900040	03956	ATM Processor CCA *	1	V1 V2 V3
7-3 (68)	1A1A18	1977569	03956	Torquer CCA, Outer, Roll *	1	V1 V2 V3
7-3 (69)	1A1A40	1979087-3	03956	Synchro Converter CCA, 1X/10X Vn and 1X/10X Ve Velocity output *	1	V1 V2 V3
7-3 (70)	1A1A19	1977569	03956	Torquer CCA, Inner, Azimuth *	1	V1 V2 V3
7-3 (71)	1A1A39	1979087-3	03956	Synchro Converter CCA, 2X/36X Roll and 2X/36X Pitch Output *	1	V1 V2 V3
7-3 (72)	1A1A38	1979087-3	03956	Synchro Converter CCA, 1X/36X Heading Output, 1X/10X Total Velocity Output, and Synchro Speed Input *	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (73)	1A1A17	1977538-0	03956	IMU Interface CCA *	1	V1 V2 V3
7-3 (74)	1A1A16	1977455	03956	Dual Panel Interface CCA *	1	V1 V2 V3
7-3 (75)	1A1A15	1980513	03956	Status and Command CCA *	1	V1 V2 V3
7-3 (76)	1A1A13	1812590	03956	Nav Processor CCA *	1	V1 V2 V3
7-3 (77)	None.	MS51957-16	96906	Screw, Pan Head	24	V1 V2 V3
7-3 (78)	1A1A23	1980486-2	03956	Dual Port Memory CCA	1	V1 V2 V3
7-3 (79)	1A1A58	1981087	03956	NTDS Type A Low Parallel Interface Assembly	1	V1 V2 V3
7-3 (80)	1A1A57	1981087	03956	NTDS Type A Low Parallel Interface Assembly	1	V1 V2 V3
7-3 (81)	1A1A56	1981087	03956	NTDS Type A Low Parallel Interface Assembly	1	V1 V2 V3
7-3 (82)	1A1A55	1981561	03956	NTDS Type D High Serial Interface Assembly *	1	V1
7-3 (82)	1A1A55	1981087	03956	NTDS Type A Low Parallel Interface Assembly	1	V2 V3
7-3 (83)	1A1A54	1981087	03956	NTDS Type A Low Parallel Interface Assembly *	1	V3
7-3 (83)	1A1A54	1981561	03956	NTDS Type D High Level Serial Interface Assembly *	1	V2
7-3 (83)	1A1A54	1981559	03956	NTDS Type E Low Serial Interface Assembly *	1	V1
7-3 (84)	1A1A53	1981087	03956	NTDS Type A Low Parallel Interface Assembly *	1	V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (84)	1A1A53	1981559	03956	NTDS Type E Low Serial Interface Assembly *	1	V1 V2
7-3 (85)	1A1A52	1981559	03956	NTDS Type E Low Serial Interface Assembly *	1	V1
7-3 (85)	1A1A52	1981087	03956	NTDS Type A Low Parallel Interface Assembly *	1	V2 V3
7-3 (86)	1A1A51	1981559	03956	NTDS Type E Low Serial Interface Assembly *	1	V1 V2 V3
7-3 (87)	1A1A14	1977455	03956	Dual Panel Interface CCA *	1	V1 V2 V3
7-3 (88)	1A1A21	1812591	03956	I/O Processor CCA *	1	V1 V2 V3
7-3 (89)	1A1MP3	1981510	03956	Upper Card Rack Assembly	1	V1 V2 V3
7-3 (90)	None.	MS519598-31	96906	Screw, Pan Head .138-32 X .62" L	14	V1 V2 V3
7-3 (91)	None.	MS51957-15	96906	Screw, Pan Head .112–40 X .38" L	2	V1 V2 V3
7-3 (92)	None.	1800662-81	03956	Spacer, Hex Threaded .112–40 X 1.50" L	2	V1 V2 V3
7-3 (93)	1A1MP21	1859297	03956	Cover, Protective	1	V1 V2 V3
7-3 (94)	None.	1819907-1	03956	Label, Caution	1	V1 V2 V3
7-3 (95)	1A1M1	1975362-6	03956	Meter, Time Totalizing	1	V1 V2 V3
7-3 (96)	1A1MP7	1859987-1	03956	Gasket	1	V1 V2 V3
7-3 (97)	None.	MS15795-802	96906	Washer, Flat .086"	2	V1 V2 V3
7-3 (98)	None.	MS35338-134	96906	Washer, Lock .086"	2	V1 V2 V3
7-3 (99)	None.	MS51957-4	96906	Screw, Pan Head .086–56 X .31" L	2	V1 V2 V3
7-3 (100)	1A1W3P1	M83503/7-02	81349	Connector, Electrical	REF	V1 V2 V3
7-3 (101)	1A1MP12	1805624-1	03956	Clamp, Cable, Adhesive Backed	2	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (102)	1A1W3	T967883	03956	Cable Assembly, Ribbon (58-B02-14-009)	REF	V1 V2 V3
7-3 (103)	1A1W3P2	M83503/7-02	81349	Connector, Electrical	REF	V1 V2 V3
7-3 (104)	1A1A10A2	1977647	03956	Panel Interface Assembly *	1	V1 V2 V3
7-3 (105)	None.	MS35649-284	96906	Nut, Hex .164-32	15	V1 V2 V3
7-3 (106)	None.	MS35338-137	96906	Washer, Lock .164"	28	V1 V2 V3
7-3 (107)	None.	MS15795-807	96906	Washer, Flat .164"	28	V1 V2 V3
7-3 (108)	1A1W6P3	M24308/2-1F	81349	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-3 (109)	1A1A10A1P1			Connector, Electrical Plug	REF	V1 V2 V3
7-3 (110)	1A1W1P18	M24308/2-2F	81349	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-3 (111)	1A1W1P8MP5	M85049/48-2-2F	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (112)	1A1MP20	1857613-1	03956	Screw, Captive .250-28 X 1.00 L	54	V1 V2 V3
7-3 (113)	None.	AN960C416	88044	Washer, Flat .250"	78	V1 V2 V3
7-3 (114)	None.	MS35338-139	96906	Washer, Lock .250"	80	V1 V2 V3
7-3 (115)	1A1A43	1976547-4	03956	Synchro Buffer Amplifier, 32 VA *	1	V1 V2 V3
7-3 (116)	1A1W1P13	M24308/2-4F	81349	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-3 (117)	1A1A3	1978322	03956	Vital Bus CCA *	1	V1 V2 V3
7-3 (118)	None.	MS35691-3	96906	Nut, Hex .250-20	3	V1 V2 V3
7-3 (119)	1A1MP32	1816382-23	03956	Stud, Threaded .250-20 X 1.25" L	1	V1 V2 V3
7-3 (120)	E1	T969060	03956	Ground Strap	1	V1 V2 V3
7-3 (121)	1A1W1MPA	1818839	03956	Disc	REF	V1 V2 V3
7-3 (122)	E2-E3	T967901	03956	Ground Strap	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (123)	None.	MS35338-138	96906	Washer, Lock .190"	8	V1 V2 V3
7-3 (124)	1A1TB1-19	M81714/61-0Z	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (124)	1A1TB1-17	M81714/61-0Z	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (124)	1A1TB1-4	M81714/61-0Z	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (124)	1A1TB1-1	M81714/61-0Z	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (125)	1A1TB1-23	M81714/60-20-02	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (125)	1A1TB1-22	M81714/60-20-02	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (126)	1A1TB1	M81714/67-30	81349	Terminal Junction System, Rack Assembly	REF	V1 V2 V3
7-3 (127)	1A1TB1-2	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (127)	1A1TB1-9	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (127)	1A1TB1-5	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (127)	1A1TB1-11	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (127)	1A1TB1-13	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (127)	1A1TB1-6	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (127)	1A1TB1-16	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (127)	1A1TB1-14	M81714/61-0Y	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (128)	1A1TB1-15	M81714/60-16-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (128)	1A1TB1-10	M81714/60-16-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (128)	1A1TB1-8	M81714/60-16-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (128)	1A1TB1-12	M81714/60-16-01	81349	Terminal Junction Block	REF	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (129)	1A1TB1-21	M81714/60-20-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (129)	1A1TB1-18	M81714/60-20-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (129)	1A1TB1-7	M81714/60-20-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (129)	1A1TB1-3	M81714/60-20-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (129)	1A1TB1-20	M81714/60-20-01	81349	Terminal Junction Block	REF	V1 V2 V3
7-3 (130)	1A1W1P2	MS3456W14S-2P	96906	Connector, Electrical Plug	REF	V1 V2 V3
7-3 (131)	1A1W1P2MP2	M85049/52-1-14W	81349	Connector, Electrical Backshell	REF	V1 V2 V3
7-3 (132)	1A1A43	1976547-4	03956	Synchro Buffer Amplifier, 32 VA *	1	V1 V2 V3
7-3 (133)	None.	MS3376-3-9	96906	Strap, Tiedown	5	V1 V2 V3
7-3 (134)	1A1A6	1979342	03956	Power Supply *	1	V1 V2 V3
7-3 (135)	1A1A42	1976545-3	03956	Synchro Buffer Amplifier, 8 VA *	1	V1 V2 V3
7-3 (136)	1A1W1P16	M24308/2-4F	81349	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (137)	1A1W1P3	MS3456W28-11SW	96906	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (138)	1A1W1P3MP3	M85049/52-1-28W	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (139)	1A1XK1	M12883/41-16	81349	Socket (P/O 1A1W1)	REF	V1 V2 V3
7-3 (139)	1A1K1	M83536/10-024M	81349	Relay	1	V1 V2 V3
7-3 (140)	1A1K2	M83536/10-024M	81349	Relay	1	V1 V2 V3
7-3 (140)	1A1XK2	M12883/41-16	81349	Socket (P/O 1A1W1)	REF	V1 V2 V3
7-3 (141)	1A1K3	M83536/10-024M	81349	Relay	1	V1 V2 V3
7-3 (141)	1A1XK3	M12883/41-16	81349	Socket (P/O 1A1W1)	REF	V1 V2 V3
7-3 (142)	1A1K6	M83536/10-024M	81349	Relay	1	V1 V2 V3
7-3 (142)	1A1XK6	M12883/41-16	81349	Socket (P/O 1A1W1)	REF	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (143)	1A1XK4	M12883/40-19	81349	Socket (P/O 1A1W1)	REF	V1 V2 V3
7-3 (143)	1A1K4	M83536/16-022M	81349	Relay	1	V1 V2 V3
7-3 (144)	1A1K7	M83536/10-024M	81349	Relay	1	V1 V2 V3
7-3 (144)	1A1XK7	M12883/41-16	81349	Socket (P/O 1A1W1)	REF	V1 V2 V3
7-3 (145)	None.	MS51958-63	96906	Screw, Pan Head .190-32 X .50" L	6	V1 V2 V3
7-3 (146)	None.	1980412	03956	Bracket, Mtg. Relay	REF	V1 V2 V3
7-3 (147)	1A1W1P4	MS3456W28-11SX	96906	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (148)	1A1W1P4MP3	M85049/52-1-28W	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (149)	1A1A7	1810853	03956	Battery Charger *	1	V1 V2 V3
7-3 (150)	1A1TB1	M81714/67-30	81349	Terminal Junction System, Rack Assembly	REF	V1 V2 V3
7-3 (151)	None.	MS51957-30	96906	Screw, Pan Head .138-32 X .50" L	3	V1 V2 V3
7-3 (152)	1A1W1P6	MS3456W28-11S	96906	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (153)	1A1W1P6MP3	M85049/52-1-28W	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (154)	1A1A8	1205050-3	03956	Power Module *	1	V1 V2 V3
7-3 (155)	1A1W1P5	MS3456W20-18P	96906	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (156)	1A1A5	1981554	03956	Battery Assembly	1	V1 V2 V3
7-3 (157)	None.	ZZR765/9-131ID5	81348	Rubber Silicone Tubing .186 ID X .020" Wall Red (76–009–25)	2 FT	V1 V2 V3
7-3 (158)	1A1A2	1982618	03956	Inverter Assembly, 400-Hz *	1	V1 V2 V3
7-3 (159)	1A1W1P7MP4	M85049/52-1-16N	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (160)	1A1W1P7	MS3476L16-8S	96906	Connector, Plug, Electrical	REF	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-3 (161)	1A1A2A1	1812595	03956	P/O 1A1A2 Inverter Assembly, 400 HZ	REF	V1 V2 V3
7-3 (162)	1A1A44	1976547-4	03956	Synchro Buffer Amplifier, 32 VA	1	V1 V2 V3
7-3 (163)	1A1F1	F02A250V2A	81349	Fuse MIL-F-15160, 2 Amp (SPARE)	1	V1 V2 V3
7-3 (164)	1A1XF1	4300416	03956	Fuse Holder (P/O 1A1W1)	REF	V1 V2 V3
7-3 (165)	1A1F1	F02A250V2A	81349	Fuse MIL-F-15160, 2 Amp	1	V1 V2 V3
7-3 (166)	None.	1859992	03956	Bracket, Fuse (P/O 1A1W1)	REF	V1 V2 V3
7-3 (167)	1A1W1P14	M24308/2-4F	81349	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (168)	1A1W1P15	M24308/2-4F	81349	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (169)	1A1A41	1976545-3	03956	Synchro Buffer Amplifier, 8 VA	1	V1 V2 V3
7-3 (170)	1A1W1P1	MS3456W16S-1P	96906	Connector, Plug, Electrical	REF	V1 V2 V3
7-3 (171)	1A1W1P1MP1	M85049/52-1-16W	81349	Strain Relief, Connector, Electrical	REF	V1 V2 V3
7-3 (172)	None.	MS35335-61	96906	Washer, Lock .250"	1	V1 V2 V3
7-3 (173)	1A1A11MP3	1800604-6	03956	Sliding Post, Lock	REF	V1 V2 V3
7-3 (20)	None.	MS15795-808	96906	Washer, Flat .190"	31	V1 V2 V3
7-3 (21)	None.	MS51957-42	96906	Screw, Pan Head .164–32 X .31" L	53	V1 V2 V3
7-4 (1)	1A1MP42	1860240	03956	Rail, Door Stay	1	V1 V2 V3
7-4 (2)	1A1MP45	1811774	03956	Plate, Mounting, Clamp Loop	28	V1 V2 V3
7-4 (3)	None.	MS51959-42	96906	Screw, Flat Head #8–32 X .31" L	52	V1 V2 V3
7-4 (4)	1A1MP49	MS3367-4-9	96906	Strap, Tiedown	13	V1 V2 V3
7-4 (5)	None.	M695178-4	03956	Sealing and Retaining Compound MIL-S-22473, GR, AV, (97–302–78)	AR	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-4 (6)	1A1MP41	1860145	03956	Link Assembly	1	V1 V2 V3
7-5 (1)	1A1MP31	1981556	03956	Gasket	1	V1 V2 V3
7-5 (2)	1A1MP6	1983105-A	03956	Plate, Mounting Connector	1	V1
7-5 (3)	1A1J19	1812592	03956	Connector, Electrical Coaxial	1	V1
7-5 (4)	1A1J19MP1	1812599	03956	Cover, Cap Triaxial	1	V1
7-5 (5)	1A1J18	1812592	03956	Connector, Electrical Coaxial	1	V1
7-5 (6)	1A1J18MP1	1812599	03956	Cover, Cap Triaxial	1	V1
7-5 (7)	1A1J16	1812592	03956	Connector, Electrical Coaxial	1	V1 V2
7-5 (8)	1A1J16MP1	1812599	03956	Cover, Cap Triaxial	1	V1 V2
7-5 (9)	1A1J17	1812592	03956	Connector, Electrical Coaxial	1	V1 V2
7-5 (10)	1A1J17MP1	1812599	03956	Cover, Cap Triaxial	1	V1 V2
7-5 (11)	1A1J14	1812592	03956	Connector, Electrical Coaxial	1	V1
7-5 (12)	1A1J14MP1	1812599	03956	Cover, Cap Triaxial	1	V1 V2 V3
7-5 (13)	1A1J13	MS27656T23A35S	96906	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-5 (14)	1A1MP53	M83528/004K025	81349	Shielding Gasket, EMI RFI	4	V1
7-5 (15)	1A1MP54	MS27502A23CL	96906	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	4	V1
7-5 (15)	1A1MP54	MS27502A23CL	96906	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	5	V2
7-5 (15)	1A1MP54	MS27502A23CL	96906	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	7	V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-5 (16)	1A1W20MP1	MS27488-22	96906	Plug, End Seal, Electrical Connector (P/O 1A1J10-1A1J14, 1A1J17, 1A1J18)	REF	V1 V2 V3
7-5 (17)	1A1W7J22MP56	M28876/15-BDW	81349	Connector, Dust Cover	1	V1 V2 V3
7-5 (18)	None.	1813939	03956	Plug, Dummy, Assembly (ATM)	1	V1 V2 V3
7-5 (19)	1A1W7W1	M85045/16-01	81349	Cable, Fiber Optic Assembly	1	V1 V2 V3
7-5 (20)	1A1W21J11	MS27656T23A35S	96906	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-5 (21)	1A1W20J10	MS27656T23A35S	96906	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-5 (22)	1A1J9	1812592	03956	Connector, Electrical Coaxial	1	V1 V2 V3
7-5 (23)	1A1J9MP1	1812599	03956	Cover, Cap Triaxial	1	V1 V2 V3
7-5 (24)	1A1J8	1812592	03956	Connector, Electrical Coaxial	1	V1 V2 V3
7-5 (25)	1A1J8MP1	1812599	03956	Cover, Cap Triaxial	1	V1 V2 V3
7-5 (26)	1A1W1MPF	MS25251-16	96906	Plug, End Seal Electrical Connector	1	V1 V2 V3
7-5 (27)	1A1W1MPE	MS25043-40DA	96906	Cover, Electrical Connector (P/O 1A1W1J3)	REF	V1 V2 V3
7-5 (28)	1A1W1J3	MS3402D40-56E	96906	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-5 (29)	1A1W1MPD	M83528/004K032	81349	Shielding Gasket, EMI-RFI	1	V1 V2 V3
7-5 (30)	1A1W1MPH	MS25043-20DA	96906	Cover, Electrical Connector	REF	V1 V2 V3
7-5 (31)	1A1W1J4	MS3402D20-27D	96906	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-5 (32)	1A1W1MPG	M83528/004K021	81349	Shielding Gasket, EMI-RFI	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-5 (33)	None.	MS21044C04	96906	Nut, Hex, Self-Locking .112-40	16	V1 V2 V3
7-5 (34)	None.	MS51957-18	96906	Screw, Pan Head .112-40 X .62" L	8	V1 V2 V3
7-5 (35)	None.	MS15795-803	96906	Washer, Lock .112"	58	V1 V2 V3
7-5 (36)	1A1W1MPK	MS25043-24DA	96906	Cover, Electrical Connector (P/O 1A1W1J5)	REF	V1 V2 V3
7-5 (37)	1A1W1MPJ	M83528/004K027	81349	Shielding Gasket, EMI-RFI	1	V1 V2 V3
7-5 (38)	1A1W1J5	MS3402D24-28D	96906	Connector, Electrical Receptacle	REF	V1 V2 V3
7-5 (39)	1A1W1MPM	MS25043-22DA	96906	Cover, Electrical Connector	1	V1 V2 V3
7-5 (40)	1A1W1MPL	M83528/004K024	81349	Shielding Gasket, EMI-RFI	1	V1 V2 V3
7-5 (41)	1A1W1J6	MS3402D22-14S	96906	Connector, Electrical	REF	V1 V2 V3
7-5 (42)	1A1W1MPP	MS25043-28DA	96906	Cover, Electrical Connector (P/O 1A1W1J7)	1	V1 V2 V3
7-5 (43)	1A1W1J7	MS3402D28-21D	96906	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-5 (44)	1A1W1MPN	M83528/004K029	81349	Shielding Gasket, EMI-RFI	1	V1 V2 V3
7-5 (45)	None.	MS15795-805	96906	Washer, Flat .138"	2	V1 V2 V3
7-5 (46)	None.	MS51957-32	96906	Screw, Pan Head .138-32 X .75" L	32	V1 V2 V3
7-5 (47)	None.	MS21044C06	96906	Nut, Hex, Self-Locking .138-32	32	V1 V2 V3
7-5 (48)	1A1J15MP1	1812599	03956	Cover, Cap Triaxial	1	V1 V3
7-5 (49)	1A1J15	1812592	03956	Connector, Coaxial, Electrical	1	V1 V3
7-5 (50)	1A1MP55	MS25043-10DA	96906	Cover, Electrical Connector (P/O 1A1W30J20, 1A1W31J21)	2	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-5 (51)	1A1W30J20	1810919	03956	Connector, Coaxial, Electrical	REF	V1 V2
7-5 (52)	1A1W31J21	1810919	03956	Connector, Coaxial, Electrical	REF	V1 V2
7-5 (53)	None.	MS35649-264	96906	Nut, Hex .138-32	2	V1 V2 V3
7-5 (54)	None.	MS35338-136	96906	Washer, Lock .138"	2	V1 V2 V3
7-5 (55)	1A1W1J23			Connector, Coaxial, Electrical (DSVL) (P/O 1A1W1)	REF	V1 V2 V3
7-5 (56)	1A1MP6	1983108	03956	Plate, Mounting Connector	1	V3
7-5 (57)	1A1W24J14	MS27656T23A35S	96906	Connector, Receptacle, Electrical	REF	V2 V3
7-5 (58)	1A1W23J12	MS27656T23A35S	96906	Connector, Receptacle, Electrical	REF	V1 V2 V3
7-5 (59)	1A1W25J17	MS27656T23A35S	96906	Connector, Receptacle, Electrical	REF	V3
7-5 (60)	1A1W26J18	MS27656T23A35S	96906	Connector, Receptacle, Electrical	REF	V3
7-5 (61)	1A1MP6	4800307	03956	Plate, Mounting Connector	1	V2
7-5 (62)	1A1MP31	1981556	03956	Gasket	1	V1 V2 V3
7-5 (63)	1A1W10-1A1W17	T968912	03956	Cable Assembly	1	V1 V2 V3
7-5 (64)	1A1W20-1A1W26	T968913	03956	Cable Assembly	1	V1 V2
7-5 (65)	1A1W31	T968914	03956	Cable Assembly	1	V1 V2
7-5 (66)	1A1W7	140013-1	03956	Cable Assembly (ATM)	1	V1 V2 V3
7-6 (1)	None.	MS51960-64	96906	Screw, Flat Head #10-32 X .44" L	12	V1 V2 V3
7-6 (2)	None.	MIL-S-22473	81349	Sealing And Retaining Compound, Grade C	AR	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-6 (3)	1A1A10A1	1859230	03956	Vacuum Fluorescent, Display *	1	V1 V2 V3
7-6 (4)	1A1A10MP5	1820232	03956	Snubber, Mount	4	V1 V2 V3
7-6 (5)	None.	1800662-78	03956	Spacer, Hex Threaded #10-32 X .38" L	4	V1 V2 V3
7-6 (6)	None.	MS35276-273	96906	Screw, Fillister Head #10-32 X 2.50" L	6	V1 V2 V3
7-6 (7)	1A1A10MP3	1820230-1	03956	Acorn Mount	4	V1 V2 V3
7-6 (8)	None.	1800662-74	03956	Spacer, Hex Threaded #10-32 X .50" L	2	V1 V2 V3
7-6 (9)	None.	MS35650-304	96906	Nut, Hex .190-32	2	V1 V2 V3
7-6 (10)	None.	MS35338-138	96906	Washer, Lock .190"	14	V1 V2 V3
7-6 (11)	None.	MS15795-808	96906	Washer, Flat .190"	14	V1 V2 V3
7-6 (12)	None.	1979485	03956	Frame, Electrical Equipment	1	V1 V2 V3
7-6 (13)	None.	1979484	03956	Frame Assembly, Display	1	V1 V2 V3
7-6 (14)	1A1A10MP4	1820230-2	03956	Acorn Mount	12	V1 V2 V3
7-6 (15)	1A1A10MP2	1810785-2	03956	Mounts, Shock, Vibration	4	V1 V2 V3
7-6 (16)	1A1A10MP1	1810785-1	03956	Mounts, Shock, Vibration	2	V1 V2 V3
7-6 (17)	1A1A10A2	1977647	03956	Panel Interface Assembly	1	V1 V2 V3
7-6 (18)	None.	MS15795-803	96906	Washer, Flat .112"	6	V1 V2 V3
7-6 (19)	None.	MS35333-70	96906	Washer, Lock .112"	6	V1 V2 V3
7-6 (20)	None.	MS35649-244	96906	Nut, Hex .112-40	6	V1 V2 V3
7-6 (21)	None.	1800662-2	03956	Spacer, Hex Threaded #4-40 X .38" L	6	V1 V2 V3
7-6 (22)	None.	MS51958-65	96906	Screw, Pan Head #10-32 X .75" L	12	V1 V2 V3
7-7	1A2	1981548	03956	Measurement Cabinet Electrical Assembly	1	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-7 (1)	1A2A1	1812593 or 4300859	03956	IMU MX-11681/WSN-7 or MX-11681A/WSN-7A(V) (Matched Set, with all EPROMS)	1	V1 V2 V3
7-7 (2)	None.	1859982	03956	Screw, Hex Head Captive .875–14 UNF X 3.00" L	3	V1 V2 V3
7-7 (3)	None.	MS15795-824	96906	Washer, Flat .875"	3	V1 V2 V3
7-7 (4)	None.	MS35338-147	96906	Washer, Lock .875"	3	V1 V2 V3
7-7 (5)	1A2MP1	1981535	03956	IMU Housing Assembly	1	V1 V2 V3
7-7 (6)	None.	MS15795-814	96906	Washer, Flat .375"	2	V1 V2 V3
7-7 (7)	None.	1810768-1	03956	Screw, Cap, SCH (Plastic) .375-24 X 1.00" L	1	V1 V2 V3
7-7 (8)	None.	1810768-2	03956	Screw, Cap, SCH (Plastic) .375-24 X 1.50" L	1	V1 V2 V3
7-7 (9)	None.	P1897762	03956	Adhesive	AR	V1 V2 V3
7-7 (10)	None.	MS35338-137	96906	Washer, Lock .164"	5	V1 V2 V3
7-7 (11)	None.	MS15795-807	96906	Washer, Flat .164"	5	V1 V2 V3
7-7 (12)	None.	MS51957-45	96906	Screw, Pan Head .164-32 X .50" L	5	V1 V2 V3
7-7 (13)	None.	MS21919WDG10	96906	Clamp, Loop	2	V1 V2 V3
7-7 (14)	None.	MS21919WDG13	96906	Clamp, Loop	2	V1 V2 V3
7-7 (15)	None.	MS21919WDG7	96906	Clamp, Loop	1	V1 V2 V3
7-8	None.	EB1897822	03956	Directions for Construction & Installation of Snubber Pads	X	V1 V2 V3
7-8	None.	M1897819	03956	Applicable Specification for Two-Component Adhesive System	X	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-8	None.	M695178-9	03956	Sealing And Retaining Compound MIL-S-22473, Grade AA, (97-309-78)	AR	V1 V2 V3
7-8	None.	T967913	03956	Marker Set, Sleeve	1	V1 V2 V3
7-8	None.	MMM-A-134TY1	81348	Adhesive (ADH #28, 56232-M695727, 97-028-78)	AR	V1 V2 V3
7-8	None.	1859318	03956	Synchro-Torque Motor Interconnecting Diagram	REF	V1 V2 V3
7-8	1A2	1981548	03956	Measurement Cabinet Electrical Assembly	1	V1 V2 V3
7-8	None.	632523-45	03956	Terminal Lug #2	24	V1 V2 V3
7-8	None.	Not Listed.		Inertial Measuring Unit		V1 V2 V3
7-8 (1)	1A2A1A1	1981549 or 4800592	03956	Inertial Measuring Unit Assembly	1	V1 V2 V3
7-8 (2)	1A2MP1	1981535	03956	IMU Housing Assembly	1	V1 V2 V3
7-8 (3)	1A2A1A1MP29	1980543	03956	Magnetic Shield Assembly	1	V1 V2 V3
7-8 (4)	None.	MS15795-805	96906	Washer, Lock .138"	22	V1 V2 V3
7-8 (5)	None.	AA55610-136		Washer, Lock .138"	20	V1 V2 V3
7-8 (6)	None.	MS51957-27	96906	Screw, Pan Head .138-32 X .31" L	8	V1 V2 V3
7-8 (7)	1A2A1A1MP23	MS21919WDG5	96906	Clamp, Loop	6	V1 V2 V3
7-8 (8)	1A2A1A1MP36	1800383-25	03956	Stand-Off	6	V1 V2 V3
7-8 (9)	1A2A1A1MP5	1859266	03956	Bracket, Connector, Electrical	3	V1 V2 V3
7-8 (10)	1A2A1A1MP30	1981680	03956	Hoist Block	1	V1 V2 V3
7-8 (11)	1A2A1A1MP33	1981550	03956	Shock Absorber, Direct Action	6	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-8 (12)	1A2A1A1MP12	1981516	03956	Baseplate, Shock Assembly	1	V1 V2 V3
7-8 (13)	1A2A1A1MP16	1859265	03956	Bolt, Shoulder	6	V1 V2 V3
7-8 (14)	None.	MS15795-810	96906	Washer, Flat .250"	12	V1 V2 V3
7-8 (15)	None.	AA55610-139		Washer, Lock .250"	12	V1 V2 V3
7-8 (16)	None.	MS35649-2254	96906	Nut, Hex .250-20	12	V1 V2 V3
7-8 (17)	None.	MS15795-812	96906	Washer, Flat .312"	12	V1 V2 V3
7-8 (18)	1A2A1A1MP15	1859264	03956	Bolt, Shoulder	6	V1 V2 V3
7-8 (19)	1A2A1A1MP34	1979471-1	03956	Shield, Cap	2	V1 V2 V3
7-8 (20)	None.	MS16995-4	96906	Screw, Socket Head #2-56 X .50" L	6	V1 V2 V3
7-8 (21)	None.	MS15795-802	96906	Washer, Flat .086"	62	V1 V2 V3
7-8 (22)	1A2A1A1MP21	1855433	03956	Bracket	3	V1 V2 V3
7-8 (23)	1A2A1A1MP17	1201037	03956	Mirror, Optical Instrument	3	V1 V2 V3
7-8 (24)	1A2A1A1MP22	1855344	03956	Spring	3	V1 V2 V3
7-8 (25)	None.	NAS1454C02-0102	80205	Rod, Continuous Thread #2-56 X 1.12" L	4	V1 V2 V3
7-8 (26)	None.	AA55610-134		Washer, Lock .086"	22	V1 V2 V3
7-8 (27)	None.	MS35649-224	96906	Nut, Hex .086-56	6	V1 V2 V3
7-8 (28)	None.	1800662-80	03956	Spacer, Hex Threaded #2-56 X .25" L	4	V1 V2 V3
7-8 (29)	1A2A1A1A13J1	M24308/4-262	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-8 (30)	1A2A1A1MP43	1800604-6	03956	Sliding Post, Lock	8	V1 V2 V3
7-8 (31)	1A2A1A1MP1	1979356	03956	Frame Assembly, Inner	1	V1 V2 V3
7-8 (32)	1A2A1A1A9	1979018-2	03956	Sensor Block Assembly	1	V1 V2 V3
7-8 (33)	1A2A1A1MP2	1979354	03956	Frame Assembly, Outer	1	V1 V2 V3
7-8 (34)	1A2A1A1MP7	1859281	03956	Guide, Wire	4	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-8 (35)	None.	MS21266-1N	96906	Grommet, Plastic Edging	5 FT	V1 V2 V3
7-8 (36)	1A2A1A1MP3	1819953-2	03956	Spacer	4	V1 V2 V3
7-8 (37)	1A2A1A1MP39	1820164	03956	Cushion, Sleeve	4	V1 V2 V3
7-8 (38)	None.	MS51957-20	96906	Screw, Pan Head #4-40 X .88" L	5	V1 V2 V3
7-8 (39)	None.	AN960C4	88044	Washer, Flat #4	8	V1 V2 V3
7-8 (40)	1A2A1A1MP38	1811212	03956	Grommet, Ribbed Thermoplastic	8	V1 V2 V3
7-8 (41)	1A2A1A1A12J2	M24308/4-262	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-8 (42)	1A2A1A1A5	1810720	03956	Calibrated Accelerometer (Matched Set) (Accelerometer A)	1	V1 V2 V3
7-8 (43)	1A2A1A1A6	1810720	03956	Calibrated Accelerometer (Matched Set) (Accelerometer C)	1	V1 V2 V3
7-8 (44)	1A2A1A1A7	1810720	03956	Calibrated Accelerometer (Matched Set) (Accelerometer B)	1	V1 V2 V3
7-8 (45)	None.	MS35307-330	96906	Screw, Cap, Hex Head 5/16-18 X .56" L	3	V1 V2 V3
7-8 (46)	1A2A1A1MP8	1819961	03956	Bracket, Angle	3	V1 V2 V3
7-8 (47)	None.	MS35338-140	96906	Washer, Lock .312"	3	V1 V2 V3
7-8 (48)	None.	1859280	03956	Spacer, Wire	4	V1 V2 V3
7-8 (49)	None.	1819916-1	03956	Label, Caution	2	V1 V2 V3
7-8 (50)	1A2A1A1MP35	1819915	03956	Cover, Protective	2	V1 V2 V3
7-8 (51)	1A2A1A1TB31	0372-6	56232	Terminal Board	1	V1 V2 V3
7-8 (52)	1A2A1A1W1	T968832	03956	Lead Assembly	1	V1 V2 V3
7-8 (53)	1A2A1A1MP31	1859987-1	03956	Gasket	1	V1 V2 V3
7-8 (54)	1A2A1A1M1	1975362-6	03956	Meter, Time Totalizing	1	V1 V2 V3
7-8 (55)	1A2A1A1A12J1	M24308/4-262	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-8 (56)	1A2A1A1A4	1979045	03956	High Voltage Power Supply Assembly	1	V1 V2 V3
7-8 (57)	1A2A1A1MP28	1859976	03956	Bracket, Connector	1	V1 V2 V3
7-8 (58)	1A2A1A1A3	1812594-1	03956	Calibrated Ring Laser Gyro Assembly (Matched Set) (319-Hz "C" Gyro)	1	V1 V2 V3
7-8 (59)	1A2A1A1A1	1812594-3	03956	Calibrated Ring Laser Gyro Assembly (Matched Set) (419-Hz "A" Gyro)	1	V1 V2 V3
7-8 (60)	None.	1819933	03956	Screw, Button Head	3	V1 V2 V3
7-8 (61)	None.	1819914-2	03956	Washer, Special	3	V1 V2 V3
7-8 (62)	None.	MS51957-22	96906	Screw, Pan Head .112-40 X 1.25" L	4	V1 V2 V3
7-8 (63)	1A2A1A1MP40	1820163	03956	Cushion, Sleeve	4	V1 V2 V3
7-8 (65)	1A2A1A1MP4	1819953-1	03956	Spacer	4	V1 V2 V3
7-8 (65)	1A2A1A1A2	1812594-2	03956	Calibrated Ring Laser Gyro Assembly (Matched Set) (369-Hz "B" Gyro)	1	V1 V2 V3
7-8 (66)	1A2A1A1A13J2	M24308/4-262	81349	Connector, Electrical, Rectangular	REF	V1 V2 V3
7-8 (67)	1A2A1A1MP32	1855408-4	03956	Weight, Balance	2	V1 V2 V3
7-8 (68)	1A2A1A1MP42	1859208-4	03956	Screw, Captive	3	V1 V2 V3
7-8 (69)	None.	1819914-1	03956	Washer, Special	3	V1 V2 V3
7-8 (70)	None.	MIL-STD-130	96906	Identification Marking (03956-M691418)	X	V1 V2 V3
7-8 (71)	None.	M695791-1	03956	Ink, Marking MIL-I-43553(MI), FED-STD-595, #17038	AR	V1 V2 V3
7-8 (72)	1A2A1A1TB32	0372-6	56232	Terminal Board	1	V1 V2 V3
7-8 (73)	1A2A1A1MP37	1819987-4	03956	Pad, Snubber	4	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-8 (74)	None.	1979050-501	03956	Shim Stock .001" Thick Sh Cres QQ-S-766, Shim Stock, Type 301	4	V1 V2 V3
7-8 (75)	None.	P1897762	03956	Adhesive	AR	V1 V2 V3
7-9	1A2A1A1A11P1	1810535-22	03956	Connector, Electrical	REF	V1 V2 V3
7-9	None.	EB1897646	03956	Engineering Bull to Balance Inner Frame Assembly	X	V1 V2 V3
7-9	None.	EB1897677	03956	Installation of Synchros to IMU Assembly	X	V1 V2 V3
7-9	None.	Not Listed.		Measurement Cabinet Electrical Assembly		V1 V2 V3
7-9	None.	EB1897822	03956	Directions for Construction & Installation of Snubber Pads	X	V1 V2 V3
7-9 (1)	1A2A1A1A13	1810553-4	03956	Ring, Electrical Contact Capsule Assembly	1	V1 V2 V3
7-9 (2)	None	NAS620C10L	80205	Washer, Flat #10	36	V1 V2 V3
7-9 (3)	None.	MS16996-13	96906	Screw, Socket Head #10-32 X .88" L	8	V1 V2 V3
7-9 (4)	1A2A1A1B3	1243107-2	03956	Synchro Transmitter, Multispeed (Outer, Roll, Yellow and Blue Leads)	2	V1 V2 V3
7-9 (5)	None.	MS16996-12	96906	Screw, Socket Head #10-32 X .75" L	24	V1 V2 V3
7-9 (6)	1A2A1A1MP24	1812185-2	03956	Clamp, Loop	16	V1 V2 V3
7-9 (7)	1A2A1A1MP6	1859317	03956	Bracket, Angle	4	V1 V2 V3
7-9 (8)	None.	AA55610-135		Washer, Lock .112"	9	V1 V2 V3
7-9 (9)	None.	MS15795-803	96906	Washer, Flat .112"	9	V1 V2 V3
7-9 (10)	None.	MS51957-17	96906	Screw, Pan Head .112-40 X .50" L	8	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-9 (11)	1A2A1A13P1	1810535-23	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (12)	1A2A1A10J1	1810535-20	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (13)	1A2A1A1B2	1979358	03956	Motor, Direct Current, Torquer (Inner, Azimuth, Orange and Green Leads)	1	V1 V2 V3
7-9 (14)	None.	1859255	03956	Ring, Ext Thd	2	V1 V2 V3
7-9 (15)	1A2A1A1B2MP1	1859274	03956	Support, Slip Ring	REF	V1 V2 V3
7-9 (16)	1A2A1A1A10	1810553-1	03956	Ring, Electrical Contact Capsule Assembly	1	V1 V2 V3
7-9 (17)	None.	MS51959-4	96906	Screw, Flat Head #2-56 X .31" L	14	V1 V2 V3
7-9 (18)	1A2A1A1MP9	1859254	03956	Retainer Ring, Ext Thd	2	V1 V2 V3
7-9 (19)	None.	MS16996-11	96906	Screw, Socket Head #10-32 X .62" L	4	V1 V2 V3
7-9 (20)	1A2A1A1MP34	1979471-1	03956	Shield, Cap	2	V1 V2 V3
7-9 (21)	1A2A1A1A10J2	1810535-22	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (22)	1A2A1A1A12P2	1810535-21	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (23)	1A2A1A1MP10	1980551-1	03956	Noise Attenuator Assembly Matched Set	1	V1 V2 V3
7-9 (24)	1A2A1A1B1	1979358	03956	Motor, Direct Current, Torquer (Outer, Roll, Orange and Green Leads)	1	V1 V2 V3
7-9 (25)	None.	1856327	03956	Screw, Cap, Socket	8	V1 V2 V3
7-9 (26)	None.	MS51957-2	96906	Screw, Pan Head #2-56 X .19" L	16	V1 V2 V3
7-9 (27)	None.	MS15795-802	96906	Washer, Flat .086"	62	V1 V2 V3
7-9 (28)	None.	MS51957-3	96906	Screw, Pan Head #2-56 X .25" L	12	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-9 (29)	1A2A1A1A12	1810553-3	03956	Ring, Electrical Contact Capsule Assembly	1	V1 V2 V3
7-9 (30)	None.	MS21266–IN	96906	Grommet, Plastic Edging	5 FT	V1 V2 V3
7-9 (31)	1A2A1A1MP7	1859281	03956	Guide, Wire	4	V1 V2 V3
7-9 (32)	None.	1859280	03956	Spacer, Wire	4	V1 V2 V3
7-9 (33)	None.	MS51959-2	96906	Screw, Flat Head #2-56 X .19" L	16	V1 V2 V3
7-9 (34)	None.	MS16996-14	96906	Screw, Socket Head #10-32 X 1.00" L	12	V1 V2 V3
7-9 (35)	1A2A1A1W2	1810734	03956	Cable Assembly, HV Power	1	V1 V2 V3
7-9 (36)	None.	1812647-6	03956	Plate, Identification	1	V1 V2 V3
7-9 (37)	None.	M695178-9	03956	Sealing And Retaining Compound MIL-S-22473, Grade AA, (97-309-78)	AR	V1 V2 V3
7-9 (38)	1A2A1A1A12P1	1810535-23	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (39)	1A2A1A1A11J1	1810535-20	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (40)	1A2A1A1MP14	1979471-2	03956	Shield, Cap	2	V1 V2 V3
7-9 (41)	1A2A1A1MP11	1980551-2	03956	Noise Attenuator Assembly Matched Set	1	V1 V2 V3
7-9 (42)	None.	MS51957-7	96906	Screw, Pan Head #2-56 X .50" L	8	V1 V2 V3
7-9 (43)	1A2A1A1B4MP1	1859274	03956	Support, Slip Ring	REF	V1 V2 V3
7-9 (44)	1A2A1A1A11	1810553-2	03956	Ring, Electrical Contact Capsule Assembly	1	V1 V2 V3
7-9 (45)	1A2A1A1B4	1243107-2	03956	Synchro Transmitter, Multispeed (Inner, Azimuth, Yellow and Blue Leads)	2	V1 V2 V3
7-9 (46)	1A2A1A1A11J2	1810535-22	03956	Connector, Electrical	REF	V1 V2 V3

Table 7-3. Parts List by Diagram Location Order - Continued

FIGURE (ITEM NO)	REF DES	PART NO	CAGE	NOMEN /DESCR	QTY	VARIANT
7-9 (47)	1A2A1A1A13P2	1810535-21	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (48)	None.	MS15795-808	96906	Washer, Flat .190"	12	V1 V2 V3
7-9 (49)	1A2A1A1A10P1	1810535-22	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (50)	1A2A1A1A10P2	1810535-20	03956	Connector, Electrical	REF	V1 V2 V3
7-9 (51)	1A2A1A1MP27	1857794-4	03956	Clamp, Loop	2	V1 V2 V3
7-9 (52)	None.	MS15795-805	96906	Washer, Lock .138"	22	V1 V2 V3
7-9 (53)	None.	0407-73	03956	Screw, Machine Fillister Head #2-56 X 1.00" L	8	V1 V2 V3
7-9 (54)	1A2A1A1MP20	1855408-2	03956	Balance Weight	3	V1 V2 V3
7-9 (55)	1A2A1A1MP19	1855408-3	03956	Balance Weight	8	V1 V2 V3
7-9 (56)	None.	MS51957-8	96906	Screw, Pan Head #2-56 X .62" L	12	V1 V2 V3
7-9 (57)	None.	AA55610-134		Washer, Lock .086"	22	V1 V2 V3
7-9 (58)	None.	MS51957-5	96906	Screw, Pan Head #2-56 X .38" L	4	V1 V2 V3
7-9 (59)	1A2A1A1TB23	0372-6	56232	Terminal Board	1	V1 V2 V3
7-9 (60)	None.	MS51597-20	96906	Screw, Pan Head	5	V1 V2 V3
7-9 (61)	1A2A1A1MP25	1819968-1	03956	Weight, Balance	1	V1 V2 V3
7-9 (62)	1A2A1A1MP26	1819968-2	03956	Weight, Balance	1	V1 V2 V3
7-9 (63)	1A2A1A1TB21	0372-5	56232	Terminal Board	1	V1 V2 V3
7-9 (64)	None.	AA55610-136		Washer, Lock .138"	20	V1 V2 V3
7-9 (65)	None.	1800383-25	03956	Stand-Off	6	V1 V2 V3
7-9 (66)	None.	MS21919WDG5	96906	Clamp, Loop	6	V1 V2 V3
7-9 (67)	1A2A1A1MP30	1981680	03956	Hoist Block	1	V1 V2 V3
7-9 (68)	None.	MS51960-74	96906	Screw, Flat Head #10-32 X 2.25" L	4	V1 V2 V3

* Lowest Replaceable Unit (LRU)

Table 7-4. Parts List by Part Number Order

PART NO	REF DES	FIGURE (ITEM NO)	NOMEN /DESCR	CAGE	QTY	VARIANT
0372-2	1A2A1A1A9TB2	7-11 (040)	Terminal Board	56232	1	V1 V2 V3
0372-5	1A2A1A1TB21	7-9 (063)	Terminal Board	56232	1	V1 V2 V3
0372-6	1A2A1A1TB23	7-9 (059)	Terminal Board	56232	1	V1 V2 V3
0372-6	1A2A1A1TB31	7-8 (051)	Terminal Board	56232	1	V1 V2 V3
0372-6	1A2A1A1TB32	7-8 (072)	Terminal Board	56232	1	V1 V2 V3
0407-73	None.	7-9 (053)	Screw, Machine Fillister Head #2-56 X 1.00" L	03956	8	V1 V2 V3
0933-101	None.	7-11 (030)	Spacer, Sleeve	56232	4	V1 V2 V3
1201037	1A2A1A1MP17	7-8 (023)	Mirror, Optical Instrument	03956	3	V1 V2 V3
1205050-3	1A1A8	7-3 (154)	Power Module *	03956	1	V1 V2 V3
1205050-3	1A1A8	7-1 (059)	Power Module *	03956	1	V1 V2 V3
1243107-2	1A2A1A1B3	7-9 (004)	Synchro Transmitter, Multispeed (Outer, Roll, Yellow and Blue Leads)	03956	2	V1 V2 V3
1243107-2	1A2A1A1B4	7-9 (045)	Synchro Transmitter, Multispeed (Inner, Azimuth, Yellow and Blue Leads)	03956	2	V1 V2 V3
140013-1	1A1W7	7-5 (066)	Cable Assembly (ATM)	03956	1	V1 V2 V3
1800383-25	1A2A1A1MP36	7-8 (008)	Stand-Off	03956	6	V1 V2 V3
1800383-25	None.	7-9 (065)	Stand-Off	03956	6	V1 V2 V3
1800383-59	1A2A1A1A4MP7	7-12 (022)	Stand-Off	03956	5	V1 V2 V3
1800544-17	1A1MP43	7-1 (024)	Washer, Flat, Nonmetallic .312	03956	1	V1 V2 V3
1800604-1	1A1W5MP3	7-3 (034)	Slide Lock (P/O 1A1W5MP1) (P/O 1A1W5MP2)	03956	REF	V1 V2 V3
1800604-1	1A1W4MP3	7-3 (030)	Slide Lock (P/O 1A1W4P1) (P/O 1A1W4P2)	03956	REF	V1 V2 V3
1800604-1	1A1W4MP3	7-3 (047)	Slide Lock (P/O 1A1W4MP1) (P/O 1A1W4MP2)	03956	REF	V1 V2 V3
1800604-6	1A2A1A1MP43	7-8 (030)	Sliding Post, Lock	03956	8	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

PART NO	REF DES	FIGURE (ITEM NO)	NOMEN /DESCR	CAGE	QTY	VARIANT
1800604-6	1A1A11MP3	7-3 (173)	Sliding Post, Lock	03956	REF	V1 V2 V3
1800662-2	None.	7-6 (021)	Spacer, Hex Threaded #4-40 X .38" L	03956	6	V1 V2 V3
1800662-21	1A1MP35	7-1 (070)	Spacer, Hex .164-32 X .62" L	03956	9	V1 V2 V3
1800662-74	None.	7-6 (008)	Spacer, Hex Threaded #10-32 X .50" L	03956	2	V1 V2 V3
1800662-78	None.	7-6 (005)	Spacer, Hex Threaded #10-32 X .38" L	03956	4	V1 V2 V3
1800662-80	None.	7-8 (028)	Spacer, Hex Threaded #2-56 X .25" L	03956	4	V1 V2 V3
1800662-81	1A1MP36	7-1 (068)	Spacer, Hex Threaded .112-40 X 1.50" L	03956	2	V1 V2 V3
1800662-81	None.	7-3 (092)	Spacer, Hex Threaded .112–40 X 1.50" L	03956	2	V1 V2 V3
1801594-29	1A1MP38	7-1 (025)	Screw, Shoulder .250-20	03956	1	V1 V2 V3
1803362-34	1A2A1A1A9W1 A2P1	7-11 (026)	Connector, Receptacle, Electrical	03956	1	V1 V2 V3
1803362-34	1A2A1A1A9W1 A3P1	7-11 (003)	Connector, Receptacle, Electrical	03956	1	V1 V2 V3
1803362-34	1A2A1A1A9W1 A1P1	7-11 (015)	Connector, Receptacle, Electrical	03956	1	V1 V2 V3
1805624-1	1A1MP12	7-3 (101)	Clamp, Cable, Adhesive Backed	03956	2	V1 V2 V3
1807256-10	None.	7-1 (063)	Label, Tape Pressure Sensitive Adhesive	03956	2	V1 V2 V3
1808166-1	1A2A1A1A4E2	7-12 (008)	Washer, Shoulder, Nonmetallic	03956	1	V1 V2 V3
1809463-1	1A1W4MP2	7-3 (048)	Key, Polarizing, Electrical Connector (P/O 1A1W4P2)	03956	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1810535-10	1A2A1A1A9W1 A7J1	7-11 (008)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-10	1A2A1A1A9W1 A5J1	7-11 (010)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-10	1A2A1A1A9W1 A6J1	7-11 (009)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-11	1A2A1A1A9W1 A9P1	7-11 (023)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-11	1A2A1A1A9W1 A4P4	7-11 (046)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-13	1A2A1A1A9W1 A4P2	7-11 (047)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-20	1A2A1A1A11J1	7-9 (039)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-20	1A2A1A1A10J1	7-9 (012)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-20	1A2A1A1A10P2	7-9 (050)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-20	1A2A1A1A11P2	7-9 (012)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-21	1A2A1A1A13P2	7-9 (047)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-21	1A2A1A1A12P2	7-9 (022)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-22	1A2A1A1A11J2	7-9 (046)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-22	1A2A1A1A10J2	7-9 (021)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-22	1A2A1A1A10P1	7-9 (049)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-23	1A2A1A1A12P1	7-9 (038)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-23	1A2A1A1A13P1	7-9 (011)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-6	1A2A1A1A9W1 A10J1	7-11 (044)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-6	1A2A1A1A9W1 A11J1	7-11 (042)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-8	1A2A1A1A9W1 A10J2	7-11 (043)	Connector, Electrical	03956	REF	V1 V2 V3
1810535-8	1A2A1A1A9W1 A11J2	7-11 (038)	Connector, Electrical	03956	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1810535-9	1A2A1A1A9W1 A4P1	7-11 (048)	Connector, Electrical	03956	REF	V1 V2 V3
1810553-1	1A2A1A1A10	7-9 (016)	Ring, Electrical Contact Capsule Assembly	03956	1	V1 V2 V3
1810553-2	1A2A1A1A11	7-9 (044)	Ring, Electrical Contact Capsule Assembly	03956	1	V1 V2 V3
1810553-3	1A2A1A1A12	7-9 (029)	Ring, Electrical Contact Capsule Assembly	03956	1	V1 V2 V3
1810553-4	1A2A1A1A13	7-9 (001)	Ring, Electrical Contact Capsule Assembly	03956	1	V1 V2 V3
1810720	1A2A1A1A5	7-11 (006)	Calibrated Accelerometer (Matched Set) (Accelerometer A)	03956	1	V1 V2 V3
1810720	1A2A1A1A5	7-8 (042)	Calibrated Accelerometer (Matched Set) (Accelerometer A)	03956	1	V1 V2 V3
1810720	1A2A1A1A7	7-8 (044)	Calibrated Accelerometer (Matched Set) (Accelerometer B)	03956	1	V1 V2 V3
1810720	1A2A1A1A7	7-11 (005)	Calibrated Accelerometer (Matched Set) (Accelerometer B)	03956	1	V1 V2 V3
1810720	1A2A1A1A6	7-11 (007)	Calibrated Accelerometer (Matched Set) (Accelerometer C)	03956	1	V1 V2 V3
1810720	1A2A1A1A6	7-8 (043)	Calibrated Accelerometer (Matched Set) (Accelerometer C)	03956	1	V1 V2 V3
1810734	1A2A1A1A9W1 A4P3	7-11 (045)	Connector, HV Power	03956	REF	V1 V2 V3
1810734	1A2A1A1W2	7-9 (035)	Cable Assembly, HV Power	03956	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1810768-1	None.	7-7 (007)	Screw, Cap, SCH (Plastic) .375–24 X 1.00" L	03956	1	V1 V2 V3
1810768-2	None.	7-7 (008)	Screw, Cap, SCH (Plastic) .375–24 X 1.50" L	03956	1	V1 V2 V3
1810785-1	1A1A10MP1	7-6 (016)	Mounts, Shock, Vibration	03956	2	V1 V2 V3
1810785-2	1A1A10MP2	7-6 (015)	Mounts, Shock, Vibration	03956	4	V1 V2 V3
1810805-5	1A1MP40	7-1 (029)	Washer, Spring Tension	03956	4	V1 V2 V3
1810853	1A1A7	7-3 (149)	Battery Charger*	03956	1	V1 V2 V3
1810919	1A1W30J20	7-5 (051)	Connector, Coaxial, Electrical	03956	REF	V1 V2
1810919	1A1W31J21	7-5 (052)	Connector, Coaxial, Electrical	03956	REF	V1 V2
1811212	1A2A1A1MP38	7-8 (040)	Grommet, Ribbed Thermoplastic	03956	8	V1 V2 V3
1811774	1A1MP45	7-4 (002)	Plate, Mounting, Clamp Loop	03956	28	V1 V2 V3
1811774	1A1MP45	7-2 (001)	Plate, Mounting, Clamp Loop	03956	28	V1 V2 V3
1811774	1A1MP45	7-3 (002)	Plate, Mounting, Clamp Loop	03956	28	V1 V2 V3
1811791	1A1A32	7-3 (057)	IMU Processor CCA *	03956	1	V1 V2 V3
1812185-2	1A2A1A1MP24	7-9 (006)	Clamp, Loop	03956	16	V1 V2 V3
1812336	None.	7-11	Wire List, Sensor Block	03956	REF	V1 V2 V3
1812590	1A1A13	7-3 (076)	Nav Processor CCA *	03956	1	V1 V2 V3
1812591	1A1A21	7-3 (088)	I/O Processor CCA *	03956	1	V1 V2 V3
1812592	1A1J8	7-5 (024)	Connector, Electrical Coaxial	03956	1	V1 V2 V3
1812592	1A1J16	7-5 (007)	Connector, Electrical Coaxial	03956	1	V1 V2
1812592	1A1J18	7-5 (005)	Connector, Electrical Coaxial	03956	1	V1
1812592	1A1J19	7-5 (003)	Connector, Electrical Coaxial	03956	1	V1

Table 7-4. Parts List by Part Number Order - Continued

1812592	1A1J14	7-5 (011)	Connector, Electrical Coaxial	03956	1	V1
1812592	1A1J15	7-5 (049)	Connector, Coaxial, Electrical	03956	1	V1 V3
1812592	1A1J9	7-5 (022)	Connector, Electrical Coaxial	03956	1	V1 V2 V3
1812592	1A1J17	7-5 (009)	Connector, Electrical Coaxial	03956	1	V1 V2
1812593 or 4300859	1A2A1	7-7 (001)	IMU MX-11681/WSN-7 or MX-11681A/WSN-7A(V) (Matched Set, with all EPROMS)	03956	1	V1 V2 V3
1812594-1	1A2A1A1A3	7-8 (058)	Calibrated Ring Laser Gyro Assembly (Matched Set) (319-Hz "C" Gyro)	03956	1	V1 V2 V3
1812594-2	1A2A1A1A2	7-11 (013)	Calibrated Ring Laser Gyro Assembly (Matched Set) (369-Hz "B" Gyro)	03956	1	V1 V2 V3
1812594-2	1A2A1A1A2	7-8 (065)	Calibrated Ring Laser Gyro Assembly (Matched Set) (369-Hz "B" Gyro)	03956	1	V1 V2 V3
1812594-3	1A2A1A1A1	7-8 (059)	Calibrated Ring Laser Gyro Assembly (Matched Set) (419-Hz "A" Gyro)	03956	1	V1 V2 V3
1812594-3	1A2A1A1A1	7-11 (011)	Calibrated Ring Laser Gyro Assembly (Matched Set) (419-Hz "A" Gyro)	03956	1	V1 V2 V3
1812595	1A1A2A1	7-3 (161)	P/O 1A1A2 Inverter Assembly, 400 HZ	03956	REF	V1 V2 V3
1812599	1A1J18MP1	7-5 (006)	Cover, Cap Triaxial	03956	1	V1
1812599	1A1J17MP1	7-5 (010)	Cover, Cap Triaxial	03956	1	V1 V2

Table 7-4. Parts List by Part Number Order - Continued

1812599	1A1J9MP1	7-5 (023)	Cover, Cap Triaxial	03956	1	V1 V2 V3
1812599	1A1J14MP1	7-5 (012)	Cover, Cap Triaxial	03956	1	
1812599	1A1J15MP1	7-5 (048)	Cover, Cap Triaxial	03956	1	V1 V3
1812599	1A1J16MP1	7-5 (008)	Cover, Cap Triaxial	03956	1	V1 V2
1812599	1A1J8MP1	7-5 (025)	Cover, Cap Triaxial	03956	1	V1 V2 V3
1812599	1A1J19MP1	7-5 (004)	Cover, Cap Triaxial	03956	1	V1
1812647-1	None.	7-1 (011)	Plate Identification	03956	1	V1 V2 V3
1812647-6	None.	7-9 (036)	Plate, Identification	03956	1	V1 V2 V3
1812647-8	None.	7-1 (012)	Plate Identification	03956	1	V1 V2 V3
1812694-2	1A1MP44	7-3 (019)	Clamp, Cable	03956	30	V1 V2 V3
1812694-2	1A1MP44	7-1 (055)	Clamp, Cable	03956	30	V1 V2 V3
1813465	1A2A1A1A4E1	7-12	Insulator Plate Transistor	03956	1	V1 V2 V3
1813925-1	None.		Plate, Modification	03956	1	V1 V2 V3
1813939	None.	7-5 (018)	Plug, Dummy, Assembly (ATM)	03956	1	V1 V2 V3
1816382-23	1A1MP32	7-3 (119)	Stud, Threaded .250–20 X 1.25" L	03956	1	V1 V2 V3
1818661	1A1MP10	7-1 (043)	Swivel Clamp	03956	2	V1 V2 V3
1818839	1A1W1MPA	7-3 (121)	Disc	03956	REF	V1 V2 V3
1818842	1A1MP37	7-1 (023)	Plug	03956	1	V1 V2 V3
1819897	None.	7-12 (014)	Label, Caution	03956	1	V1 V2 V3
1819907-1	None.	7-3 (094)	Label, Caution	03956	1	V1 V2 V3
1819914-1	None.	7-8 (069)	Washer, Special	03956	3	V1 V2 V3
1819914-2	None.	7-8 (061)	Washer, Special	03956	3	V1 V2 V3
1819915	1A2A1A1MP35	7-8 (050)	Cover, Protective	03956	2	V1 V2 V3
1819916-1	None.	7-8 (049)	Label, Caution	03956	2	V1 V2 V3
1819933	None.	7-8 (060)	Screw, Button Head	03956	3	V1 V2 V3
1819948	None.		Bushing, Sleeve	03956	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1819953-1	1A2A1A1MP4	7-8 (065)	Spacer	03956	4	V1 V2 V3
1819953-2	1A2A1A1MP3	7-8 (036)	Spacer	03956	4	V1 V2 V3
1819961	1A2A1A1MP8	7-8 (046)	Bracket, Angle	03956	3	V1 V2 V3
1819968-1	1A2A1A1MP25	7-9 (061)	Weight, Balance	03956	1	V1 V2 V3
1819968-2	1A2A1A1MP26	7-9 (062)	Weight, Balance	03956	1	V1 V2 V3
1819987-4	1A2A1A1MP37	7-8 (073)	Pad, Snubber	03956	4	V1 V2 V3
1820163	1A2A1A1MP40	7-8 (063)	Cushion, Sleeve	03956	4	V1 V2 V3
1820164	1A2A1A1MP39	7-8 (037)	Cushion, Sleeve	03956	4	V1 V2 V3
1820230-1	1A1A10MP3	7-6 (007)	Acorn Mount	03956	4	V1 V2 V3
1820230-2	1A1A10MP4	7-6 (014)	Acorn Mount	03956	12	V1 V2 V3
1820232	1A1A10MP5	7-6 (004)	Snubber, Mount	03956	4	V1 V2 V3
1855344	1A2A1A1MP22	7-8 (024)	Spring	03956	3	V1 V2 V3
1855408-2	1A2A1A1MP20	7-9 (054)	Balance Weight	03956	3	V1 V2 V3
1855408-3	1A2A1A1MP19	7-9 (055)	Balance Weight	03956	8	V1 V2 V3
1855408-4	1A2A1A1MP32	7-8 (067)	Weight, Balance	03956	2	V1 V2 V3
1855433	1A2A1A1MP21	7-8 (022)	Bracket	03956	3	V1 V2 V3
1856327	None.	7-9 (025)	Screw, Cap, Socket	03956	8	V1 V2 V3
1857086-11	1A1XDS1MP2	7-1 (006)	Nut Adapter	03956	1	V1 V2 V3
1857086-2	1A1XDS1MP1	7-1 (005)	Transparent Flexible Seal	03956	2	V1 V2 V3
1857571-2	1A1A5MP3	7-2 (009)	Vent Tube Assembly	03956	1	V1 V2 V3
1857613-1	1A1MP20	7-3 (112)	Screw, Captive .250-28 X 1.00 L	03956	54	V1 V2 V3
1857683-7	1A1MP46	7-3 (025)	Clamp, Cable, Flat	03956	1	V1 V2 V3
1857794-4	1A2A1A1MP27	7-9 (051)	Clamp, Loop	03956	2	V1 V2 V3
1859208-3	1A2A1A1A4MP1	7-12 (001)	Screw, Captive	03956	4	V1 V2 V3
1859208-4	1A2A1A1MP42	7-8 (068)	Screw, Captive	03956	3	V1 V2 V3
1859208-8	1A2A1A1A4MP3	7-12 (005)	Screw, Captive	03956	3	V1 V2 V3
1859230	1A1A10A1	7-6 (003)	Vacuum Fluorescent, Display *	03956	1	V1 V2 V3
1859234	1A2A1A1A9MP3	7-11 (039)	Bracket, Connector	03956	4	V1 V2 V3
1859235	1A2A1A1A9MP4	7-11 (021)	Bracket, Connector	03956	3	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1859254	1A2A1A1MP9	7-9 (018)	Retainer Ring, Ext Thd	03956	2	V1 V2 V3
1859255	None.	7-9 (014)	Ring, Ext Thd	03956	2	V1 V2 V3
1859256	None.	7-11 (049)	Bracket, Angle	03956	REF	V1 V2 V3
1859257	1A2A1A1A4MP8	7-12 (018)	Jack Socket, Female Screwlock	03956	4	V1 V2 V3
1859264	1A2A1A1MP15	7-8 (018)	Bolt, Shoulder	03956	6	V1 V2 V3
1859265	1A2A1A1MP16	7-8 (013)	Bolt, Shoulder	03956	6	V1 V2 V3
1859266	1A2A1A1MP5	7-8 (009)	Bracket, Connector, Electrical	03956	3	V1 V2 V3
1859267	1A1MP29	7-3 (017)	Pin, Straight, Headed	03956	2	V1 V2 V3
1859268-1	1A1MP16	7-3 (041)	Bracket, Angle	03956	1	V1 V2 V3
1859268-2	1A1MP14	7-3 (018)	Bracket, Angle	03956	1	V1 V2 V3
1859274	1A2A1A1B1MP1		Support, Slip Ring	03956	REF	V1 V2 V3
1859274	1A2A1A1B2MP1	7-9 (015)	Support, Slip Ring	03956	REF	V1 V2 V3
1859274	1A2A1A1B4MP1	7-9 (043)	Support, Slip Ring	03956	REF	V1 V2 V3
1859280	None.	7-8 (048)	Spacer, Wire	03956	4	V1 V2 V3
1859280	None.	7-9 (032)	Spacer, Wire	03956	4	V1 V2 V3
1859281	1A2A1A1MP7	7-8 (034)	Guide, Wire	03956	4	V1 V2 V3
1859281	1A2A1A1MP7	7-9 (031)	Guide, Wire	03956	4	V1 V2 V3
1859283	1A1MP30	7-3 (050)	Pin, Straight, Headed	03956	2	V1 V2 V3
1859284-1	1A1MP19	7-3 (049)	Bracket, Angle	03956	1	V1 V2 V3
1859284-2	1A1MP17	7-3 (042)	Bracket, Angle	03956	1	V1 V2 V3
1859289	1A1MP26	7-1 (020)	Gasket	03956	1	V1 V2 V3
1859290-1	1A1MP15	7-1 (039)	Clamp, Battery	03956	1	V1 V2 V3
1859290-1	1A1MP15	7-2 (005)	Clamp, Battery	03956	1	V1 V2 V3
1859290-2	1A1MP18	7-1 (040)	Clamp, Battery	03956	1	V1 V2 V3
1859297	1A1MP21	7-3 (093)	Cover, Protective	03956	1	V1 V2 V3
1859310	1A1MP28	7-1 (018)	Gasket	03956	1	V1 V2 V3
1859317	1A2A1A1MP6	7-9 (007)	Bracket, Angle	03956	4	V1 V2 V3
1859318	None.	7-8	Synchro-Torque Motor Interconnecting Diagram	03956	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1859388	1A2A1A1A9MP5	7-11 (019)	Weight, Balance	03956	1	V1 V2 V3
1859389	1A2A1A1A9MP6	7-11 (028)	Weight, Balance	03956	1	V1 V2 V3
1859758	1A2A1A1A4MP6	7-12 (013)	Cover, Housing	03956	1	V1 V2 V3
1859873	1A1A9	7-1 (019)	Keyboard, Data Entry *	03956	1	V1 V2 V3
1859939	1A2A1A1A9TB1	7-11 (035)	Terminal Board Assembly	03956	1	V1 V2 V3
1859976	1A2A1A1MP28	7-8 (057)	Bracket, Connector	03956	1	V1 V2 V3
1859982	None.	7-7 (002)	Screw, Hex Head Captive .875–14 UNF X 3.00" L	03956	3	V1 V2 V3
1859987-1	1A2A1A1MP31	7-8 (053)	Gasket	03956	1	V1 V2 V3
1859987-1	1A1MP7	7-1 (008)	Gasket	03956	1	V1 V2 V3
1859987-1	1A1MP7	7-3 (096)	Gasket	03956	1	V1 V2 V3
1859992	None.	7-3(166)	Bracket, Fuse (P/O 1A1W1)	03956	REF	V1 V2 V3
1860143	1A1MP22	7-3 (014)	Bracket, Cable Tie Base	03956	2	V1 V2 V3
1860145	1A1MP41	7-1 (028)	Link Assembly	03956	1	V1 V2 V3
1860145	1A1MP41	7-4 (006)	Link Assembly	03956	1	V1 V2 V3
1860240	1A1MP42	7-4 (001)	Rail, Door Stay	03956	1	V1 V2 V3
1860240	1A1MP42	7-1 (034)	Rail, Door Stay	03956	1	V1 V2 V3
1891448	1A1MP2	7-1 (041)	Heat Shield Assembly	03956	1	V1 V2 V3
1900013-1	1A1W7		Cable Assembly, Fiber Optic ATM/synchronous Optical Network (SONET) Interface	03956	1	V1 V2 V3
1900040	1A1A4	7-3 (067)	ATM Processor CCA *	03956	1	V1 V2 V3
1975362-6	1A2A1A1M1	7-8 (054)	Meter, Time Totalizing	03956	1	V1 V2 V3
1975362-6	1A1M1	7-1 (007)	Meter, Time Totalizing	03956	1	V1 V2 V3
1975362-6	1A1M1	7-3 (095)	Meter, Time Totalizing	03956	1	V1 V2 V3
1976545-3	1A1A42	7-3 (135)	Synchro Buffer Amplifier, 8 VA *	03956	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1976545-3	1A1A41	7-3 (169)	Synchro Buffer Amplifier, 8 VA *	03956	1	V1 V2 V3
1976545-3	1A1A41	7-1 (047)	Synchro Buffer Amplifier, 8 VA *	03956	1	V1 V2 V3
1976547-4	1A1A43	7-3 (132)	Synchro Buffer Amplifier, 32 VA *	03956	1	V1 V2 V3
1976547-4	1A1A43	7-3 (115)	Synchro Buffer Amplifier, 32 VA *	03956	1	V1 V2 V3
1976547-4	1A1A44	7-3 (162)	Synchro Buffer Amplifier, 32 VA *	03956	1	V1 V2 V3
1977455	1A1A16	7-3 (074)	Dual Panel Interface CCA	03956	1	V1 V2 V3
1977455	1A1A14	7-3 (087)	Dual Panel Interface CCA *	03956	1	V1 V2 V3
1977538-0	1A1A17	7-3 (073)	IMU Interface CCA*	03956	1	V1 V2 V3
1977569	1A1A19	7-3 (070)	Torquer CCA, Inner, Azimuth *	03956	1	V1 V2 V3
1977569	1A1A18	7-3 (068)	Torquer CCA, Outer, Roll*	03956	1	V1 V2 V3
1977647	1A1A10A2	7-3 (104)	Panel Interface Assembly *	03956	1	V1 V2 V3
1977647	1A1A10A2	7-6 (017)	Panel Interface Assembly	03956	1	V1 V2 V3
1978322	1A1A3	7-3 (117)	Vital Bus CCA *	03956	1	V1 V2 V3
1978322	1A1A3	7-1 (073)	Vital Bus CCA	03956	1	V1 V2 V3
1979018-2	1A2A1A1A9	7-11 (Image)	Sensor Block Assembly	03956	1	V1 V2 V3
1979018-2	1A2A1A1A9	7-8 (032)	Sensor Block Assembly	03956	1	V1 V2 V3
1979023	1A1A33	7-3 (059)	Repositioning Interface CCA	03956	1	V1 V2 V3
1979045 (Rev J)	1A2A1A1A4	7-11 (014)	High Voltage Power Supply Assembly*	03956	1	V1 V2 V3
1979045 (Rev J)	1A2A1A1A4	7-12	High Voltage Power Supply Assembly *	03956	1	V1 V2 V3
1979045 (Rev J)	1A2A1A1A4	7-8 (056)	High Voltage Power Supply Assembly *	03956	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1979046	1A1A35	7-3 (053)	Accelerometer and Sensor Electronics CCA	03956	1	V1 V2 V3
1979047	1A1A34	7-3 (054)	A/D Multiplexer CCA *	03956	1	V1 V2 V3
1979050-501	None.	7-8 (074)	Shim Stock .001" Thick Sh Cres QQ-S-766, Shim Stock, Type 301	03956	4	V1 V2 V3
1979057	1A1A37	7-3 (064)	Support Electronics Power Supply *	03956	1	V1 V2 V3
1979087-3	1A1A38	7-3 (072)	Synchro Converter CCA, 1X/36X Heading Output, 1X/10X Total Velocity Output, and Synchro Speed Input *	03956	1	V1 V2 V3
1979087-3	1A1A39	7-3 (071)	Synchro Converter CCA, 2X/36X Roll and 2X/36X Pitch Output *	03956	1	V1 V2 V3
1979087-3	1A1A40	7-3 (069)	Synchro Converter CCA, 1X/10X Vn and 1X/10X Ve Velocity output *	03956	1	V1 V2 V3
1979342	1A1A6	7-3 (134)	Power Supply *	03956	1	V1 V2 V3
1979342	1A1A6	7-1 (048)	Power Supply *	03956	1	V1 V2 V3
1979344	1A1A10	7-3 (001)	Display Assembly *	03956	1	V1 V2 V3
1979344	1A1A10	7-1 (033)	Display Assembly *	03956	1	V1 V2 V3
1979347	1A1MP4	7-1 (064)	Card Rack Assembly	03956	1	V1 V2 V3
1979347	1A1MP4	7-3 (066)	Card Rack Assembly	03956	1	V1 V2 V3
1979348	1A1A36	7-3 (052)	Gyro Support Electronics CCA *	03956	1	V1 V2 V3
1979354	1A2A1A1MP2	7-8 (033)	Frame Assembly, Outer	03956	1	V1 V2 V3
1979356	1A2A1A1MP1	7-8 (031)	Frame Assembly, Inner	03956	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1979358	1A2A1A1B1	7-9 (024)	Motor, Direct Current, Torquer (Outer, Roll, Orange and Green Leads)	03956	1	V1 V2 V3
1979358	1A2A1A1B2	7-9 (013)	Motor, Direct Current, Torquer (Inner, Azimuth, Orange and Green Leads)	03956	1	V1 V2 V3
1979358	1A2A1A1B2	7-11 (012)	Motor, Direct Current, Torquer (Inner, Azimuth, Orange and Green Leads)	03956	1	V1 V2 V3
1979471-1	1A2A1A1MP34	7-9 (020)	Shield, Cap	03956	2	V1 V2 V3
1979471-1	1A2A1A1MP34	7-8 (019)	Shield, Cap	03956	2	V1 V2 V3
1979471-2	1A2A1A1MP14	7-9 (040)	Shield, Cap	03956	2	V1 V2 V3
1979484	None.	7-6 (013)	Frame Assembly, Display	03956	1	V1 V2 V3
1979485	None.	7-6 (012)	Frame, Electrical Equipment	03956	1	V1 V2 V3
1979505	None.	7-1 (022)	EMI Window	03956	1	V1 V2 V3
1980412	None.	7-1 (052)	Bracket, Mtg, Relay (P/O 1A1W1)	03956	REF	V1 V2 V3
1980412	None.	7-3 (146)	Bracket, Mtg. Relay	03956	REF	V1 V2 V3
1980486-2	1A1A23	7-3 (078)	Dual Port Memory CCA *	03956	1	V1 V2 V3
1980488-2	1A1A20	7-3 (065)	Bus Interface CCA *	03956	1	V1 V2 V3
1980509	1A2A1A1A4A1	7-12 (015)	High Voltage Power Supply	03956	1	V1 V2 V3
1980513	1A1A15	7-3 (075)	Status and Command CCA *	03956	1	V1 V2 V3
1980522	1A2A1A1A4MP5	7-12 (016)	Enclosure	03956	1	V1 V2 V3
1980543	1A2A1A1MP29	7-8 (003)	Magnetic Shield Assembly	03956	1	V1 V2 V3
1980551-1	1A2A1A1MP10	7-9 (023)	Noise Attenuator Assembly Matched Set	03956	1	V1 V2 V3
1980551-2	1A2A1A1MP11	7-9 (041)	Noise Attenuator Assembly Matched Set	03956	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1980596	1A2A1A1A9A1	7-11 (022)	Accelerometer Stimulus	03956	1	V1 V2 V3
1981087	1A1A55	7-3 (082)	NTDS Type A Low Parallel Interface Assembly *	03956	1	V2 V3
1981087	1A1A53	7-3 (084)	NTDS Type A Low Parallel Interface Assembly *	03956	1	V3
1981087	1A1A52	7-3 (085)	NTDS Type A Low Parallel Interface Assembly *	03956	1	V2 V3
1981087	1A1A56	7-3 (081)	NTDS Type A Low Parallel Interface Assembly *	03956	1	V1 V2 V3
1981087	1A1A57	7-3 (080)	NTDS Type A Low Parallel Interface Assembly *	03956	1	V1 V2 V3
1981087	1A1A58	7-3 (079)	NTDS Type A Low Parallel Interface Assembly *	03956	1	V1 V2 V3
1981087	1A1A54	7-3 (083)	NTDS Type A Low Parallel Interface Assembly *	03956	1	V3
1981137	1A2A1A1A9MP1	7-11 (001)	Sensor Block Assembly	03956	1	V1 V2 V3
1981510	1A1MP3	7-1 (066)	Upper Card Rack Assembly	03956	1	V1 V2 V3
1981510	1A1MP3	7-3 (089)	Upper Card Rack Assembly	03956	1	V1 V2 V3
1981516	1A2A1A1MP12	7-8 (012)	Baseplate, Shock Assembly	03956	1	V1 V2 V3
1981518	1A1MP1	7-1 (001)	Cabinet, Assembly, Electrical Equipment	03956	1	V1 V2 V3
1981532	1A1A1	7-2 (004)	Filter, Power Line *	03956	1	V1 V2 V3
1981534-var	1A1A12	7-3 (022)	I/O Processor Backplane Assembly	03956	1	V1 V2 V3
1981535	1A2MP1	7-8 (002)	IMU Housing Assembly	03956	1	V1 V2 V3
1981535	1A2MP1	7-7 (005)	IMU Housing Assembly	03956	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

1981539-2	1A1	7-1	WSN-7 Processor Cabinet Assembly	03956	1	V2
1981539-3	1A1	7-1	WSN-7 Processor Cabinet Assembly	03956	1	V3
1981539-6	1A1	7-1	WSN-7 Processor Cabinet Assembly	03956	1	V1
1981548	1A2	7-7	Measurement Cabinet Electrical Assembly	03956	1	V1 V2 V3
1981548	1A2	7-8	Measurement Cabinet Electrical Assembly	03956	1	V1 V2 V3
1981549 or 4800592	1A2A1A1	7-8 (001)	Inertial Measuring Unit Assembly	03956	1	V1 V2 V3
1981549-501	None.	7-10 (004)	Spacer	03956	6	V1 V2 V3
1981549-501	None.	7-10 (007)	Spacer	03956	6	V1 V2 V3
1981550	1A2A1A1MP33	7-8 (011)	Shock Absorber, Direct Action	03956	6	V1 V2 V3
1981554	1A1A5	7-1 (042)	Battery Assembly	03956	1	V1 V2 V3
1981554	1A1A5	7-3 (156)	Battery Assembly	03956	1	V1 V2 V3
1981555	None.	7-10 (005)	IMU Cover, Shipping	03956	1	V1 V2 V3
1981556	1A1MP31	7-5 (001)	Gasket	03956	1	V1 V2 V3
1981556	1A1MP31	7-5 (062)	Gasket	03956	1	V1 V2 V3
1981559	1A1A54	7-3 (083)	NTDS Type E Low Serial Interface Assembly *	03956	1	V1
1981559	1A1A53	7-3 (084)	NTDS Type E Low Serial Interface Assembly *	03956	1	V1 V2
1981559	1A1A52	7-3 (085)	NTDS Type E Low Serial Interface Assembly *	03956	1	V1
1981559	1A1A51	7-3 (086)	NTDS Type E Low Serial Interface Assembly *	03956	1	V1 V2 V3
1981561	1A1A55	7-3 (082)	NTDS Type D High Serial Interface Assembly *	03956	1	V1

Table 7-4. Parts List by Part Number Order - Continued

1981561	1A1A54	7-3 (083)	NTDS Type D High Level Serial Interface Assembly *	03956	1	V2
1981570	1A1A31	7-3 (058)	I/O Control (BITE) & Filter CCA *	03956	1	V1 V2 V3
1981572	1A1A30	7-3 (063)	Support Electronics Backplane	03956	1	V1 V2 V3
1981659-var		7-1 (065)	Label, Placard Nav CCA Rack (P/O 1A1)	03956	1	V1 V2 V3
1981660	1A1A11	7-3 (028)	Nav Card Rack Wirewrap Backplane Assembly	03956	1	V1 V2 V3
1981667	1A1MP25	7-1 (021)	Bezel, Window	03956	1	V1 V2 V3
1981668	1A1MP27	7-1 (037)	Bezel	03956	1	V1 V2 V3
1981680	1A2A1A1MP30	7-9 (067)	Hoist Block	03956	1	V1 V2 V3
1981680	1A2A1A1MP30	7-8 (010)	Hoist Block	03956	1	V1 V2 V3
1981989	None.	7-10 (003)	Cover, Transport Torquer/Synchro	03956	2	V1 V2 V3
1982618	1A1A2	7-3 (158)	Inverter Assembly, 400-Hz	03956	1	V1 V2 V3
1983105-A	1A1MP6	7-5 (002)	Plate, Mounting Connector	03956	1	V1
1983108	1A1MP6	7-5 (056)	Plate, Mounting Connector	03956	1	V3
4300416	1A1XF1	7-3 (164)	Fuse Holder (P/O 1A1W1)	03956	REF	V1 V2 V3
4800307	1A1MP6	7-5 (061)	Plate, Mounting Connector	03956	1	V2
5165359-4	None.		Sleeve, Wire Adapter	53711	REF	V1 V2 V3
5165359-6	1A1W7W1		Sleeve, Wire Adapter	53711	REF	V1 V2 V3
632523-45	None.	7-8	Terminal Lug #2	03956	24	V1 V2 V3
AA55610-134	None.	7-9 (057)	Washer, Lock .086"		22	V1 V2 V3
AA55610-134	None.	7-8 (026)	Washer, Lock .086"		22	V1 V2 V3
AA55610-135	None.	7-9 (008)	Washer, Lock .112"		9	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

AA55610-136	None.	7-9 (064)	Washer, Lock .138"		20	V1 V2 V3
AA55610-136	None.	7-8 (005)	Washer, Lock .138"		20	V1 V2 V3
AA55610-136	None.	7-10 (008)	Washer, Lock .138"		20	V1 V2 V3
AA55610-139	None.	7-8 (015)	Washer, Lock .250"		12	V1 V2 V3
AN960C4	None.	7-8 (039)	Washer, Flat #4	88044	8	V1 V2 V3
AN960C4	None.	7-8 (039)	Washer, Flat #4	88044	8	V1 V2 V3
AN960C416	None.	7-1 (061)	Washer, Flat .250"	88044	78	V1 V2 V3
AN960C416	None.	7-3 (113)	Washer, Flat .250"	88044	78	V1 V2 V3
EB1897646	None.	7-9	Engineering Bull to Balance Inner Frame Assembly	03956	X	V1 V2 V3
EB1897677	None.	7-9	Installation of Synchros to IMU Assembly	03956	X	V1 V2 V3
EB1897822	None.	7-9	Directions for Construction & Installation of Snubber Pads	03956	X	V1 V2 V3
EB1897822	None.	7-8	Directions for Construction & Installation of Snubber Pads	03956	X	V1 V2 V3
F02A250V2A	1A1F1	7-3 (163)	Fuse MIL-F-15160, 2 Amp (SPARE)	81349	1	V1 V2 V3
F02A250V2A	1A1F1	7-3 (165)	Fuse MIL-F-15160, 2 Amp	81349	1	V1 V2 V3
FF200CW600-28V-P/ FF200-0CW-028B	1A1DS1	7-1 (003)	Light Emiting Diode (Red) *	81349	1	V1 V2 V3
FF200CW600-28V-P/ FF200-0CW-028B	1A1DS2	7-1 (009)	Light Emitting Diode (Green)	81349	1	V1 V2 V3
M12883/40-19	1A1XK4	7-3 (143)	Socket (P/O 1A1W1)	81349	REF	V1 V2 V3
M12883/41-16	1A1XK2	7-3 (140)	Socket (P/O 1A1W1)	81349	REF	V1 V2 V3
M12883/41-16	1A1XK3	7-3 (141)	Socket (P/O 1A1W1)	81349	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

M12883/41-16	1A1XK7	7-3 (144)	Socket (P/O 1A1W1)	81349	REF	V1 V2 V3
M12883/41-16	1A1XK1	7-3 (139)	Socket (P/O 1A1W1)	81349	REF	V1 V2 V3
M12883/41-16	1A1XK6	7-3 (142)	Socket (P/O 1A1W1)	81349	REF	V1 V2 V3
M1897819	None.	7-8	Applicable Specification for Two-Component Adhesive System	03956	X	V1 V2 V3
M23053/5-102-C	None.		Insulation, Sleeving	03956	1 FT	V1 V2 V3
M24308/2-1F	1A1W6P3	7-3 (108)	Connector, Receptacle, Electrical	81349	REF	V1 V2 V3
M24308/2-2F	1A1W1P18	7-3 (110)	Connector, Receptacle, Electrical	81349	REF	V1 V2 V3
M24308/2-2F	1A1W1P8	7-1 (074)	Connector, Electrical, Receptacle	81349	REF	V1 V2 V3
M24308/2-2F	1A1W1P18	7-1 (075)	Connector, Electrical, Receptacle	81349	REF	V1 V2 V3
M24308/2-3F	1A1W1P9	7-1 (072)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/2-3F	1A1W1P9	7-3 (035)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/2-4F	1A1W1P16	7-3 (136)	Connector, Plug, Electrical	81349	REF	V1 V2 V3
M24308/2-4F	1A1W1P14	7-3 (167)	Connector, Plug, Electrical	81349	REF	V1 V2 V3
M24308/2-4F	1A1W1P13	7-1 (049)	Connector, Electrical, Receptacle	81349	REF	V1 V2 V3
M24308/2-4F	1A1W1P15	7-3 (168)	Connector, Plug, Electrical	81349	REF	V1 V2 V3
M24308/2-4F	1A1W1P13	7-3 (116)	Connector, Receptacle, Electrical	81349	REF	V1 V2 V3
M24308/25-9	1A1W1MP9	7-3 (007)	Screw, Lock, Male	81349	REF	V1 V2 V3
M24308/25-9	1A1W1MP9	7-1 (051)	Screw, Lock, Male	81349	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

M24308/4-1F	1A1W5P2	7-3 (045)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-1F	1A1W5P1	7-3 (032)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-1F	1A1W4P2	7-3 (046)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-1F	1A1W4P1	7-3 (029)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-262	1A2A1A1A12J1	7-8 (055)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-262	1A2A1A1A12J2	7-8 (041)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-262	1A2A1A1A13J2	7-8 (066)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-262	1A2A1A1A13J1	7-8 (029)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-3F	1A1W6P2	7-3 (006)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-3F	1A1W6P1	7-3 (055)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-3F	1A1W1P20	7-3 (051)	Connector, Electrical, Rectangular	81349	REF	V1 V2 V3
M24308/4-4F	1A1W1P17	7-3 (038)	Connector, Electrical, Receptacle	81349	REF	V1 V2 V3
M24308/4-4F	1A1W1P10	7-3 (037)	Connector, Electrical, Receptacle	81349	REF	V1 V2 V3
M24308/4-4F	1A1W1P12	7-3 (039)	Connector, Electrical, Receptacle	81349	REF	V1 V2 V3
M27488-20	None.		Plug, End Seal		3	V1 V2 V3
M28876/11B1S1	None.		Connector, Receptacle, Fiber Optic	81349	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

M28876/15-BDW	1A1W7J22MP56	7-5 (017)	Connector, Dust Cover	81349	1	V1 V2 V3
M39006/22-0327	1A2A1A1A9C1	7-11 (033)	Capacitor, Fixed ±20% 30 VDC	81349	1	V1 V2 V3
M39006/22-0327	1A2A1A1A9C2	7-11 (034)	Capacitor, Fixed ±20% 30 VDC	81349	1	V1 V2 V3
M39014/05-2855	1A2A1A1A9C3	7-11 (036)	Capacitor, Fixed ±10% 50 VDC	81349	1	V1 V2 V3
M39014/05-2855	1A2A1A1A9C4	7-11 (037)	Capacitor, Fixed ±10% 50 VDC	81349	1	V1 V2 V3
M39019/03-216S	1A1CB3	7-1 (015)	Circuit Breaker 1.0 Amp	81349	1	V1 V2 V3
M39019/03-240S	1A1CB2	7-1 (016)	Circuit Breaker 7.5 Amp	81349	1	V1 V2 V3
M39019/05-327S	1A1CB1	7-1 (017)	Circuit Breaker 7.5 Amp	81349	1	V1 V2 V3
M39029/30-218	None.		Contact, Electrical Connector	81349	REF	V1 V2 V3
M39029/30-219	None.		Contact, Electrical Connector	81349	REF	V1 V2 V3
M39029/92-534	1A1W1E1		Contact, Electrical Connector	81349	REF	V1 V2 V3
M690587	None.	7-11	Electrical Wiring	56232	X	V1 V2 V3
M695178-1	None.		Sealing and Retaining Compound MIL-S-22473, Grade C (97-303-78)	03956	REF	V1 V2 V3
M695178-4	None.	7-1 (014)	Sealing and Retaining Compound MIL-S-22473, Grade AV, (97-302-78)	03956	AR	V1 V2 V3
M695178-4	None.	7-3 (005)	Sealing and Retaining Compound MIL-S-22473, GR, AV, (97–302–78)	03956	AR	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

M695178-4	None.	7-2 (004)	Sealing and Retaining Compound, MIL-S-22473, GR, AV, (97–302–78)	03956	AR	V1 V2 V3
M695178-4	None.	7-4 (005)	Sealing and Retaining Compound MIL-S-22473, GR, AV, (97–302–78)	03956	AR	V1 V2 V3
M695178-9	None.	7-8	Sealing And Retaining Compound MIL-S-22473, Grade AA, (97-309-78)	03956	AR	V1 V2 V3
M695178-9	None.	7-9 (037)	Sealing And Retaining Compound MIL-S-22473, Grade AA, (97-309-78)	03956	AR	V1 V2 V3
M695791-1	None.	7-8 (071)	Ink, Marking MIL-I-43553(MI), FED-STD-595, #17038	03956	AR	V1 V2 V3
M81714/60-16-01	1A1TB1-12	7-3 (128)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-16-01	1A1TB1-10	7-3 (128)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-16-01	1A1TB1-8	7-3 (128)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-16-01	1A1TB1-15	7-3 (128)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-20-01	1A1TB1-3	7-3 (129)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-20-01	1A1TB1-7	7-3 (129)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-20-01	1A1TB1-18	7-3 (129)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-20-01	1A1TB1-20	7-3 (129)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-20-01	1A1TB1-21	7-3 (129)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/60-20-02	1A1TB1-22	7-3 (125)	Terminal Junction Block	81349	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

M81714/60-20-02	1A1TB1-23	7-3 (125)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-5	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-14	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-13	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-11	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-6	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-16	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-2	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Y	1A1TB1-9	7-3 (127)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Z	1A1TB1-19	7-3 (124)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Z	1A1TB1-1	7-3 (124)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Z	1A1TB1-4	7-3 (124)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/61-0Z	1A1TB1-17	7-3 (124)	Terminal Junction Block	81349	REF	V1 V2 V3
M81714/67-30	1A1TB1	7-3 (126)	Terminal Junction System, Rack Assembly	81349	REF	V1 V2 V3
M81714/67-30	1A1TB1	7-3 (150)	Terminal Junction System, Rack Assembly	81349	REF	V1 V2 V3
M83503/7-02	1A1W3P1	7-3 (100)	Connector, Electrical	81349	REF	V1 V2 V3
M83503/7-02	1A1W3P2	7-3 (103)	Connector, Electrical	81349	REF	V1 V2 V3
M83503/7-11	1A1W2P1		Connector, Electrical	81349	REF	V1 V2 V3
M83503/7-11	1A1W2P2		Connector, Electrical	81349	REF	V1 V2 V3
M83528/004K021	1A1W1MPG	7-5 (032)	Shielding Gasket, EMI-RFI	81349	1	V1 V2 V3
M83528/004K024	1A1W1MPL	7-5 (040)	Shielding Gasket, EMI-RFI	81349	1	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

M83528/004K025	1A1MP53	7-5 (014)	Shielding Gasket, EMI RFI	81349	4	V1
M83528/004K027	1A1W1MPJ	7-5 (037)	Shielding Gasket, EMI-RFI	81349	1	V1 V2 V3
M83528/004K029	1A1W1MPN	7-5 (044)	Shielding Gasket, EMI-RFI	81349	1	V1 V2 V3
M83528/004K032	1A1W1MPD	7-5 (029)	Shielding Gasket, EMI-RFI	81349	1	V1 V2 V3
M83536/10-024M	1A1K7	7-3 (144)	Relay	81349	1	V1 V2 V3
M83536/10-024M	1A1K1	7-3 (039)	Relay	81349	1	V1 V2 V3
M83536/10-024M	1A1K3	7-3 (141)	Relay	81349	1	V1 V2 V3
M83536/10-024M	1A1K2	7-3 (140)	Relay	81349	1	V1 V2 V3
M83536/10-024M	1A1K6	7-3 (142)	Relay	81349	1	V1 V2 V3
M83536/16-022M	1A1K4	7-3 (143)	Relay	81349	1	V1 V2 V3
M85045/16-01	1A1W7W1	7-5 (019)	Cable, Fiber Optic Assembly	81349	1	V1 V2 V3
M85049/48-2-1-F	1A1W5MP1	7-3 (033)	Strain Relief, Connector, Electrical (P/O 1A1W5P1) (P/O 1A1W5P2)	81349	REF	V1 V2 V3
M85049/48-2-1-F	1A1W4MP1	7-3 (031)	Strain Relief, Connector, Electrical (P/O 1A1W4P1) (P/O 1A1W4P2)	81349	REF	V1 V2 V3
M85049/48-2-2F	1A1W1P8MP5	7-1 (071)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/48-2-2F	1A1W1P8MP5	7-3 (111)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/48-2-3F	1A1W1P9MP6	7-3 (008)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/48-2-3F	1A1W6MP1	7-3 (056)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/48-2-4F	1A1W1P10MP7	7-3 (036)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/48–2-4F	1A1W1P10MP7	7-1 (050)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

M85049/52-1-14W	1A1W1P2MP2	7-3 (131)	Connector, Electrical Backshell	81349	REF	V1 V2 V3
M85049/52-1-16N	1A1W1P7MP4	7-3 (159)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/52-1-16W	1A1W1P1MP1	7-3 (171)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/52-1-20W	1A1W1MP8	7-3 (023)	Strain Relief, Connector, Electrical; 1A1W1P11, 1A1W1P19, 1A1W1P21	81349	REF	V1 V2 V3
M85049/52-1-28W	1A1W1P6MP3	7-3 (153)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/52-1-28W	1A1W1P4MP3	7-3 (148)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
M85049/52-1-28W	1A1W1P3MP3	7-3 (138)	Strain Relief, Connector, Electrical	81349	REF	V1 V2 V3
MIL-S-22473	None.	7-12 (023)	Sealing and Retaining Compound MIL-S-22473, Grade C (97-303-78)	81349	AR	V1 V2 V3
MIL-S-22473	None.	7-11	Sealing and Retaining Compound, Grade AA	81349	AR	V1 V2 V3
MIL-S-22473	None.	7-6 (002)	Sealing And Retaining Compound, Grade C	81349	AR	V1 V2 V3
MIL-STD-130	None.	7-8 (070)	Identification Marking (03956-M691418)	96906	X	V1 V2 V3
MMM-A-134TY1	None.	7-1 (054)	Adhesive; ADH #28, 56232-M695727, 97-028-78 (P/O 1A1W1)	81348	REF	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MMM-A-134TY1	None.	7-8	Adhesive (ADH #28, 56232-M695727, 97-028-78)	81348	AR	V1 V2 V3
MS15795-802	None.	7-9 (027)	Washer, Flat .086"	96906	62	V1 V2 V3
MS15795-802	None.	7-11 (032)	Washer, Flat .086"	96906	4	V1 V2 V3
MS15795-802	None.	7-8 (021)	Washer, Flat .086"	96906	62	V1 V2 V3
/-. 8221qw3b9o..3xcgtt						
MS15795-802	None.	7-3 (097)	Washer, Flat .086"	96906	2	V1 V2 V3
MS15795-803	None.	7-9 (009)	Washer, Flat .112"	96906	9	V1 V2 V3
MS15795-803	None.	7-11 (017)	Washer, Flat .112"	96906	10	V1 V2 V3
MS15795-803	None.	7-12 (011)	Washer, Flat .112"	96906	20	V1 V2 V3
MS15795-803	None.	7-6 (018)	Washer, Flat .112"	96906	6	V1 V2 V3
MS15795-803	None.	7-5 (035)	Washer, Lock .112"	96906	58	V1 V2 V3
MS15795-803	None.	7-3 (060)	Washer, Flat .112"	96906	58	V1 V2 V3
MS15795-805	None.	7-10 (009)	Washer, Flat .138"	96906	22	V1 V2 V3
MS15795-805	None.	7-1 (032)	Washer, Flat .138"	96906	71	V1 V2 V3
MS15795-805	None.	7-8 (004)	Washer, Lock .138"	96906	22	V1 V2 V3
MS15795-805	None.	7-5 (045)	Washer, Flat .138"	96906	2	V1 V2 V3
MS15795-805	None.	7-9 (052)	Washer, Lock .138"	96906	22	V1 V2 V3
MS15795-807	None.	7-12 (002)	Washer, Flat .164"	96906	4	V1 V2 V3
MS15795-807	None.	7-1 (045)	Washer, Flat .164"	96906	28	V1 V2 V3
MS15795-807	None.	7-3 (011)	Washer, Flat .138"	96906	REF	V1 V2 V3
MS15795-807	None.	7-3 (107)	Washer, Flat .164"	96906	28	V1 V2 V3
MS15795-807	None.	7-7 (011)	Washer, Flat .164"	96906	5	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS15795-808	None.	7-6 (011)	Washer, Flat .190"	96906	14	V1 V2 V3
MS15795-808	None.	7-1 (056)	Washer, Flat .190"	96906	31	V1 V2 V3
MS15795-808	None.	7-9 (048)	Washer, Flat .190"	96906	12	V1 V2 V3
MS15795-808	None.	7-3 (020)	Washer, Flat .190"	96906	31	V1 V2 V3
MS15795-810	None.	7-1 (027)	Washer, Flat .250"	96906	1	V1 V2 V3
MS15795-810	None.	7-8 (014)	Washer, Flat .250"	96906	12	V1 V2 V3
MS15795-812	1A1MP39	7-1 (026)	Washer, Flat .312	96906	2	V1 V2 V3
MS15795-812	None.	7-8 (017)	Washer, Flat .312"	96906	12	V1 V2 V3
MS15795-814	None.	7-7 (006)	Washer, Flat .375"	96906	2	V1 V2 V3
MS15795-824	None.	7-7 (003)	Washer, Flat .875"	96906	3	V1 V2 V3
MS16995-4	None.	7-8 (020)	Screw, Socket Head #2-56 X .50" L	96906	6	V1 V2 V3
MS16996-11	None.	7-9 (019)	Screw, Socket Head #10-32 X .62" L	96906	4	V1 V2 V3
MS16996-12	None.	7-9 (005)	Screw, Socket Head #10-32 X .75" L	96906	24	V1 V2 V3
MS16996-13	None.	7-9 (003)	Screw, Socket Head #10-32 X .88" L	96906	8	V1 V2 V3
MS16996-14	None.	7-9 (034)	Screw, Socket Head #10-32 X 1.00" L	96906	12	V1 V2 V3
MS16996-25	None.	7-1 (060)	Screw, Socket Head .250-28 X 1.25" L	96906	6	V1 V2 V3
MS21044C04	None.	7-5 (033)	Nut, Hex, Self-Locking .112-40	96906	16	V1 V2 V3
MS21044C06	None.	7-5 (047)	Nut, Hex, Self-Locking .138-32	96906	32	V1 V2 V3
MS21266-1N	None.	7-8 (035)	Grommet, Plastic Edging	96906	5 FT	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS21266-3N	None.	7-1 (053)	Grommet, Plastic Edging (P/O 1A1W1)	96906	REF	V1 V2 V3
MS21266-IN	None.	7-9 (030)	Grommet, Plastic Edging	96906	5 FT	V1 V2 V3
MS21919WDG10	None.	7-7 (013)	Clamp, Loop	96906	2	V1 V2 V3
MS21919WDG13	None.	7-7 (014)	Clamp, Loop	96906	2	V1 V2 V3
MS21919WDG5	1A2A1A1MP23	7-8 (007)	Clamp, Loop	96906	6	V1 V2 V3
MS21919WDG5	None.	7-9 (066)	Clamp, Loop	96906	6	V1 V2 V3
MS21919WDG7	None.	7-7 (015)	Clamp, Loop	96906	1	V1 V2 V3
MS24660-23D	1A1S1	7-1 (002)	Switch, Toggle	96906	1	V1 V2 V3
MS24671-17	None.	7-3 (015)	Screw, Cap, Flat Head .164-32 X 1.00" L	96906	8	V1 V2 V3
MS24693-C1	None.	7-12 (003)	Screw, Flat Head #4-40 X .19" L	96906	9	V1 V2 V3
MS24693-C4	None.	7-12 (010)	Screw, Flat Head #4-40 X .38" L	03956	1	V1 V2 V3
MS25041-3	1A1XDS2	7-1 (010)	Light, Indicator (Green Socket)	96906	1	V1 V2 V3
MS25041-6	1A1XDS1	7-1 (004)	Light, Indicator (Red Socket) *	96906	1	V1 V2 V3
MS25043-10DA	1A1MP55	7-5 (050)	Cover, Electrical Connector (P/O 1A1W30J20, 1A1W31J21)	96906	2	V1 V2 V3
MS25043-20DA	1A1W1MPH	7-5 (030)	Cover, Electrical Connector	96906	REF	V1 V2 V3
MS25043-22DA	1A1W1MPM	7-5 (039)	Cover, Electrical Connector	96906	1	V1 V2 V3
MS25043-24DA	1A1W1MPK	7-5 (036)	Cover, Electrical Connector (P/O 1A1W1J5)	96906	REF	V1 V2 V3
MS25043-28DA	1A1W1MPP	7-5 (042)	Cover, Electrical Connector (P/O 1A1W1J7)	96906	1	V1 V2 V3
MS25043-40DA	1A1W1MPE	7-5 (027)	Cover, Electrical Connector (P/O 1A1W1J3)	96906	REF	V1 V2 V3
MS25251-16	1A1W1MPF	7-5 (026)	Plug, End Seal Electrical Connector	96906	1	V1 V2 V3
MS25281-F4	None.	7-11 (024)	Clamp, Loop	96906	4	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS27488-22	1A1W20MP1	7-5 (016)	Plug, End Seal, Electrical Connector (P/O 1A1J10-1A1J14, 1A1J17, 1A1J18)	96906	REF	V1 V2 V3
MS27502A23CL	1A1MP54	7-5 (015)	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	96906	7	V3
MS27502A23CL	1A1MP54	7-5 (015)	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	96906	4	V1
MS27502A23CL	1A1MP54	7-5 (015)	Cover, Electrical Connector (P/O 1A1J10-1A1J13)	96906	5	V2
MS27656T23A35S	1A1W20J10	7-5 (021)	Connector, Receptacle, Electrical	96906	REF	V1 V2 V3
MS27656T23A35S	1A1W26J18	7-5 (060)	Connector, Receptacle, Electrical	96906	REF	V3
MS27656T23A35S	1A1W23J12	7-5 (058)	Connector, Receptacle, Electrical	96906	REF	V1 V2 V3
MS27656T23A35S	1A1W24J14	7-5 (057)	Connector, Receptacle, Electrical	96906	REF	V2 V3
MS27656T23A35S	1A1J13	7-5 (013)	Connector, Receptacle, Electrical	96906	REF	V1 V2 V3
MS27656T23A35S	1A1W21J11	7-5 (020)	Connector, Receptacle, Electrical	96906	REF	V1 V2 V3
MS27656T23A35S	1A1W25J17	7-5 (059)	Connector, Receptacle, Electrical	96906	REF	V3
MS3367-1-9	1A1MP47	7-1 (058)	Strap, Tiedown	96906	25	V1 V2 V3
MS3367-1-9	1A1MP47	7-3 (016)	Strap, Tiedown	96906	25	V1 V2 V3
MS3367-4-9	1A1MP49	7-4 (004)	Strap, Tiedown	96906	13	V1 V2 V3
MS3367-4-9	1A1MP49	7-3 (004)	Strap, Tiedown	96906	13	V1 V2 V3
MS3367-5-9	1A1MP48	7-3 (010)	Strap, Tiedown	96906	14	V1 V2 V3
MS3367-5-9	1A1MP48	7-2 (003)	Strap, Tiedown	96906	14	V1 V2 V3
MS3376-3-9	None.	7-3 (133)	Strap, Tiedown	96906	5	V1 V2 V3
MS3376-3-9	None.	7-1 (067)	Strap, Tiedown	96906	5	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS3402D20-27D	1A1W1J4	7-5 (031)	Connector, Receptacle, Electrical	96906	REF	V1 V2 V3
MS3402D22-14S	1A1W1J6	7-5 (041)	Connector, Electrical	96906	REF	V1 V2 V3
MS3402D24-28D	1A1W1J5	7-5 (038)	Connector, Electrical Receptacle	96906	REF	V1 V2 V3
MS3402D28-21D	1A1W1J7	7-5 (043)	Connector, Receptacle, Electrical	96906	REF	V1 V2 V3
MS3402D40-56E	1A1W1J3	7-5 (028)	Connector, Receptacle, Electrical	96906	REF	V1 V2 V3
MS3456W14S-2P	1A1W1P2	7-3 (130)	Connector, Electrical Plug	96906	REF	V1 V2 V3
MS3456W16S-1P	1A1W1P1	7-3 (170)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3456W20-16S	1A1W1P21	7-3 (024)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3456W20-16S	1A1W1P11	7-3 (027)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3456W20-18P	1A1W1P5	7-3 (155)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3456W20-29S	1A1W1P19		Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3456W28-11S	1A1W1P6	7-3 (152)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3456W28-11SW	1A1W1P3	7-3 (137)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3456W28-11SX	1A1W1P4	7-3 (147)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS3476L16-8S	1A1W1P7	7-3 (160)	Connector, Plug, Electrical	96906	REF	V1 V2 V3
MS35276-273	None.	7-6 (006)	Screw, Fillister Head #10-32 X 2.50" L	96906	6	V1 V2 V3
MS35307-330	None.	7-10 (001)	Screw, Cap, Hex Head 5/16-18 X .56" L	96906	3	V1 V2 V3
MS35307-330	None.	7-8 (045)	Screw, Cap, Hex Head 5/16-18 X .56" L	96906	3	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS35308-333	None.	7-1 (038)	Screw, Cap, Hex Head .312-24 X .88" L	96906	2	V1 V2 V3
MS35333-70	None.	7-6 (019)	Washer, Lock .112"	96906	6	V1 V2 V3
MS35335-57	None.	7-12 (007)	Washer, Lock #4	96906	4	V1 V2 V3
MS35335-60	None.	7-3 (043)	Washer, Lock .190"	96906	1	V1 V2 V3
MS35335-61	None.	7-3 (172)	Washer, Lock .250"	96906	1	V1 V2 V3
MS35338-134	None.	7-12 (020)	Washer, Lock .086"	96906	4	V1 V2 V3
MS35338-134	None.	7-3 (098)	Washer, Lock .086"	96906	2	V1 V2 V3
MS35338-135	None.	7-12 (012)	Washer, Lock .112"	96906	5	V1 V2 V3
MS35338-135	None.	7-3 (061)	Washer, Lock .112"	96906	26	V1 V2 V3
MS35338-135	None.	7-11 (016)	Washer, Lock .112"	96906	10	V1 V2 V3
MS35338-136	None.	7-1 (031)	Washer, Lock .138"	96906	15	V1 V2 V3
MS35338-136	None.	7-5 (054)	Washer, Lock .138"	96906	2	V1 V2 V3
MS35338-136	None.	7-3 (012)	Washer, Lock .138"	96906	REF	V1 V2 V3
MS35338-137	None.	7-1 (046)	Washer, Lock .164"	96906	28	V1 V2 V3
MS35338-137	None.	7-7 (010)	Washer, Lock .164"	96906	5	V1 V2 V3
MS35338-137	None.	7-3 (106)	Washer, Lock .164"	96906	28	V1 V2 V3
MS35338-138	None.	7-3 (123)	Washer, Lock .190"	96906	8	V1 V2 V3
MS35338-138	None.	7-6 (010)	Washer, Lock .190"	96906	14	V1 V2 V3
MS35338-139	None.	7-1 (062)	Washer, Lock .250"	96906	80	V1 V2 V3
MS35338-139	None.	7-3 (114)	Washer, Lock .250"	96906	80	V1 V2 V3
MS35338-140	None.	7-10 (002)	Washer, Lock .312"	96906	3	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS35338-140	None.	7-8 (047)	Washer, Lock .312"	96906	3	V1 V2 V3
MS35338-147	None.	7-7 (004)	Washer, Lock .875"	96906	3	V1 V2 V3
MS35649-224	None.	7-12 (021)	Nut, Hex .086-56	96906	4	V1 V2 V3
MS35649-224	None.	7-8 (027)	Nut, Hex .086-56	96906	6	V1 V2 V3
MS35649-2254	None.	7-8 (016)	Nut, Hex .250-20	96906	12	V1 V2 V3
MS35649-244	None.	7-12 (009)	Nut, Hex .112-40	96906	1	V1 V2 V3
MS35649-244	None.	7-6 (020)	Nut, Hex .112-40	96906	6	V1 V2 V3
MS35649-264	None.	7-1 (030)	Nut, Hex .138-32	96906	8	V1 V2 V3
MS35649-264	None.	7-5 (053)	Nut, Hex .138–32	96906	2	V1 V2 V3
MS35649-264	None.	7-3 (013)	Nut, Hex .138–32	96906	REF	V1 V2 V3
MS35649-284	None.	7-1 (069)	Nut, Hex .164-32	96906	1	V1 V2 V3
MS35649-284	None.	7-3 (105)	Nut, Hex .164–32	96906	15	V1 V2 V3
MS35650-304	None.	7-3 (044)	Nut, Hex .190-32	96906	2	V1 V2 V3
MS35650-304	None.	7-6 (009)	Nut, Hex .190-32	96906	2	V1 V2 V3
MS35691-23	None.	7-2 (007)	Nut, Hex .375-24	96906	1	V1 V2 V3
MS35691-3	None.	7-3 (118)	Nut, Hex .250–20	96906	3	V1 V2 V3
MS51597-20	None.	7-9 (060)	Screw, Pan Head	96906	5	V1 V2 V3
MS51957-13	None.	7-12 (017)	Screw, Pan Head .112-40 X .25" L	96906	5	V1 V2 V3
MS51957-15	None.	7-11 (025)	Screw, Pan Head .122-40 X .38" L	96906	4	V1 V2 V3
MS51957-15	None.	7-3 (091)	Screw, Pan Head .112–40 X .38" L	96906	2	V1 V2 V3
MS51957-16	None.	7-3 (062)	Screw, Pan Head .112-40 X .44" L	96906	24	V1 V2 V3
MS51957-16	None.	7-3 (077)	Screw, Pan Head	96906	24	V1 V2 V3
MS51957-17	None.	7-9 (010)	Screw, Pan Head .112-40 X .50" L	96906	8	V1 V2 V3
MS51957-18	None.	7-11 (029)	Screw, Pan Head .122-40 X .62" L	96906	1	V1 V2 V3
MS51957-18	None.	7-5 (034)	Screw, Pan Head .112-40 X .62" L	96906	8	V1 V2 V3
MS51957-2	None.	7-9 (026)	Screw, Pan Head #2-56 X .19" L	96906	16	V1 V2 V3
MS51957-20	None.	7-11 (018)	Screw, Pan Head #4-40 X .88" L	96906	2	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS51957-20	None.	7-8 (038)	Screw, Pan Head #4-40 X .88" L	96906	5	V1 V2 V3
MS51957-22	None.	7-8 (062)	Screw, Pan Head .112-40 X 1.25" L	96906	4	V1 V2 V3
MS51957-22	None.	7-11 (027)	Screw, Pan Head #4-40 X 1.25" L	96906	1	V1 V2 V3
MS51957-27	None.	7-8 (006)	Screw, Pan Head .138–32 X .31" L	96906	8	V1 V2 V3
MS51957-3	None.	7-9 (028)	Screw, Pan Head #2-56 X .25" L	96906	12	V1 V2 V3
MS51957-3	None.	7-1 (013)	Screw, Pan Head .086-56 X .25" L	96906	8	V1 V2 V3
MS51957-30	None.	7-3 (151)	Screw, Pan Head .138-32 X .50" L	96906	3	V1 V2 V3
MS51957-32	None.	7-5 (046)	Screw, Pan Head .138-32 X .75" L	96906	32	V1 V2 V3
MS51957-37	None.	7-10 (006)	Screw, Pan Head .138-32 X .75" L	96906	6	V1 V2 V3
MS51957-4	None.	7-3 (099)	Screw, Pan Head .086–56 X .31" L	96906	2	V1 V2 V3
MS51957-42	None.	7-1 (057)	Screw, Pan Head .164-32 X .31" L	96906	53	V1 V2 V3
MS51957-42	None.	7-3 (021)	Screw, Pan Head .164–32 X .31" L	96906	53	V1 V2 V3
MS51957-42	None.	7-3 (21)	Screw, Pan Head .164–32 X .31" L	96906	53	V1 V2 V3
MS51957-45	None.	7-1 (044)	Screw, Pan Head .164-32 X .50" L	96906	25	V1 V2 V3
MS51957-45	None.	7-7 (012)	Screw, Pan Head .164–32 X .50" L	96906	5	V1 V2 V3
MS51957-46	None.		Screw, Pan Head .164-32 X .62" L	96906	9	V1 V2 V3
MS51957-5	None.	7-11 (031)	Screw, Pan Head #2-56 X .38" L	96906	6	V1 V2 V3
MS51957-5	None.	7-9 (058)	Screw, Pan Head #2-56 X .38" L	96906	4	V1 V2 V3
MS51957-7	None.	7-9 (042)	Screw, Pan Head #2-56 X .50" L	96906	8	V1 V2 V3
MS51957-8	None.	7-9 (056)	Screw, Pan Head #2-56 X .62" L	96906	12	V1 V2 V3
MS51958-63	None.	7-3 (145)	Screw, Pan Head .190-32 X .50" L	96906	6	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

MS51958-65	None.	7-6 (022)	Screw, Pan Head #10-32 X .75" L	96906	12	V1 V2 V3
MS51959	None.	7-3 (026)	Screw, Flat Head .138–32 X .44" L	96906	3	V1 V2 V3
MS51959-2	None.	7-9 (033)	Screw, Flat Head #2-56 X .19" L	96906	16	V1 V2 V3
MS51959-26	None.	7-3 (003)	Screw, Flat Head .138-32 X .25" L	96906	6	V1 V2 V3
MS51959-29	None.	7-1 (035)	Screw, Flat Head .138-32 X .44" L	96906	3	V1 V2 V3
MS51959-3	None.	7-11 (020)	Screw, Flat Head #2-56 X .25" L	96906	14	V1 V2 V3
MS51959-31	None.	7-1 (036)	Screw, Flat Head .138-32 X .62" L	96906	14	V1 V2 V3
MS51959-4	None.	7-9 (017)	Screw, Flat Head #2-56 X .31" L	96906	14	V1 V2 V3
MS51959-42	None.	7-2 (002)	Screw, Flat Head #8-32 X .31" L	96906	52	V1 V2 V3
MS51959-42	None.	7-3 (009)	Screw, Flat Head #8–32 X .31" L	96906	52	V1 V2 V3
MS51959-42	None.	7-4 (003)	Screw, Flat Head #8–32 X .31" L	96906	52	V1 V2 V3
MS519598-31	None.	7-3 (090)	Screw, Pan Head .138-32 X .62" L	96906	14	V1 V2 V3
MS51960-64	None.	7-6 (001)	Screw, Flat Head #10-32 X .44" L	96906	12	V1 V2 V3
MS51960-74	None.	7-9 (068)	Screw, Flat Head #10-32 X 2.25" L	96906	4	V1 V2 V3
MS51960-83	None.	7-3 (040)	Screw, Flat Head .250-28 X .62" L	96906	8	V1 V2 V3
NAS1454C02-0102	None.	7-8 (025)	Rod, Continuous Thread #2-56 X 1.12" L	80205	4	V1 V2 V3
NAS1523-6Y	None.	7-2 (008)	Packing With Retainer	80205	1	V1 V2 V3
NAS620C10L	None.	7-9 (002)	Washer, Flat #10	80205	36	V1 V2 V3
NAS620C10L	None	7-9 (002)	Washer, Flat #10	80205	36	V1 V2 V3
NAS620C2	None.	7-11 (041)	Washer, Flat #2	80205	2	V1 V2 V3
NAS620C3L	None.	7-12 (019)	Washer, Flat #3	80205	4	V1 V2 V3
NAS620C6	None.	7-12 (004)	Washer, Flat #6	80205	3	V1 V2 V3
NAS662C2R4	None.	7-12 (006)	Screw, Flat Head #2-56 X .25" L	80205	4	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

Not Listed.	None.	7-9	Measurement Cabinet Electrical Assembly			V1 V2 V3
Not Listed.	None.	7-2 (010)	Handle, Door, Latching	03956	3	V1 V2 V3
Not Listed.	None.	7-8	Inertial Measuring Unit			V1 V2 V3
Not Listed.	None.	7-10	IMU: Subassembly Identification (1A2A1A1)			V1 V2 V3
Not Listed.	None.	7-11 (004)	E1 — E15			V1 V2 V3
P1897762	None.	7-8 (075)	Adhesive	03956	AR	V1 V2 V3
P1897762	None.	7-7 (009)	Adhesive	03956	AR	V1 V2 V3
P1898175	1A1W2W1		Fl Ribbon Cable w/Ground Plane (P/O 1A1W2)	03956	REF	V1 V2 V3
T967883	1A1W3	7-3 (102)	Cable Assembly, Ribbon (58-B02-14-009)	03956	REF	V1 V2 V3
T967888	E5-E3		Ground Strap	03956	1	V1 V2 V3
T967889	E4-E3		Ground Strap	03956	1	V1 V2 V3
T967901	E2-E3	7-3 (122)	Ground Strap	03956	1	V1 V2 V3
T967913	None.	7-8	Marker Set, Sleeve	03956	1	V1 V2 V3
T968693	1A2A1A1A9W1	7-11	Harness Assembly	03956	1	V1 V2 V3
T968832	1A2A1A1W1	7-8 (052)	Lead Assembly	03956	1	V1 V2 V3
T968840	1A1W2	5-5	Cable Assembly, Door Cable and Harness Assembly	03956	REF	V1 V2 V3
T968912	1A1W10-1A1W17	7-5 (063)	Cable Assembly	03956	1	V1 V2 V3
T968913	1A1W20-1A1W26	7-5 (064)	Cable Assembly	03956	1	V1 V2
T968914	1A1W31	7-5 (065)	Cable Assembly	03956	1	V1 V2
T969060	E1	7-3 (120)	Ground Strap	03956	1	V1 V2 V3
T969420	1A1W1	7-1	Main Harness Assembly	03956	REF	V1 V2 V3
TS1897587	None.	7-12	Test Spec for High Voltage Power Supply Assembly	03956	X	V1 V2 V3

Table 7-4. Parts List by Part Number Order - Continued

ZZR765/9-131D5	None.	7-2 (006)	Rubber, Silicone Tubing .186 ID X .020 Wall Red (76 009-25)	81348	2 FT	V1 V2 V3
ZZR765/9-131ID5	None.	7-3 (157)	Rubber Silicone Tubing .186 ID X .020" Wall Red (76–009–25)	81348	2 FT	V1 V2 V3
	1A1W1J23	7-5 (055)	Connector, Coaxial, Electrical (DSVL) (P/O 1A1W1)		REF	V1 V2 V3
* Lowest Replaceable Unit (LRU)						

Table 7-5. Manufacturers List

CAGE CODE	NAME	ADDRESS
03956	Northrop Grumman Systems Corporation, DBA Sperry Marine	1070 Seminole Trail Charlottesville, VA 22901-2827
53711	Naval Sea Systems Command	1333 Isaac Hull Ave., SE Washington, DC 20376
56232	Lockheed Martin Corporation DBA Maritime Systems and Sensors	55 Charles Lindberg Blvd. Mitchell Field, NY 11553-3682
80205	National Aerospace Standards Committee, Aerospace Industries of America	1250 I St., NW Washington, DC 20005
81348	Federal Specification Promulgated by General Services Administration	Washington, DC
81349	Military Standards Promulgated by Military Departments under Authority of Defense Standardization Manual 4120-3-M	
88044	Aeronautical Standards Group Department of Navy and Air Force	
8Z410	Ledtronics, Inc.	23105 Keshiwa Court Torrance, CA 90505-4026
96906	Military Standards Promulgated by Military Departments under Authority of Defense Standardization Manual 4120-3-M	

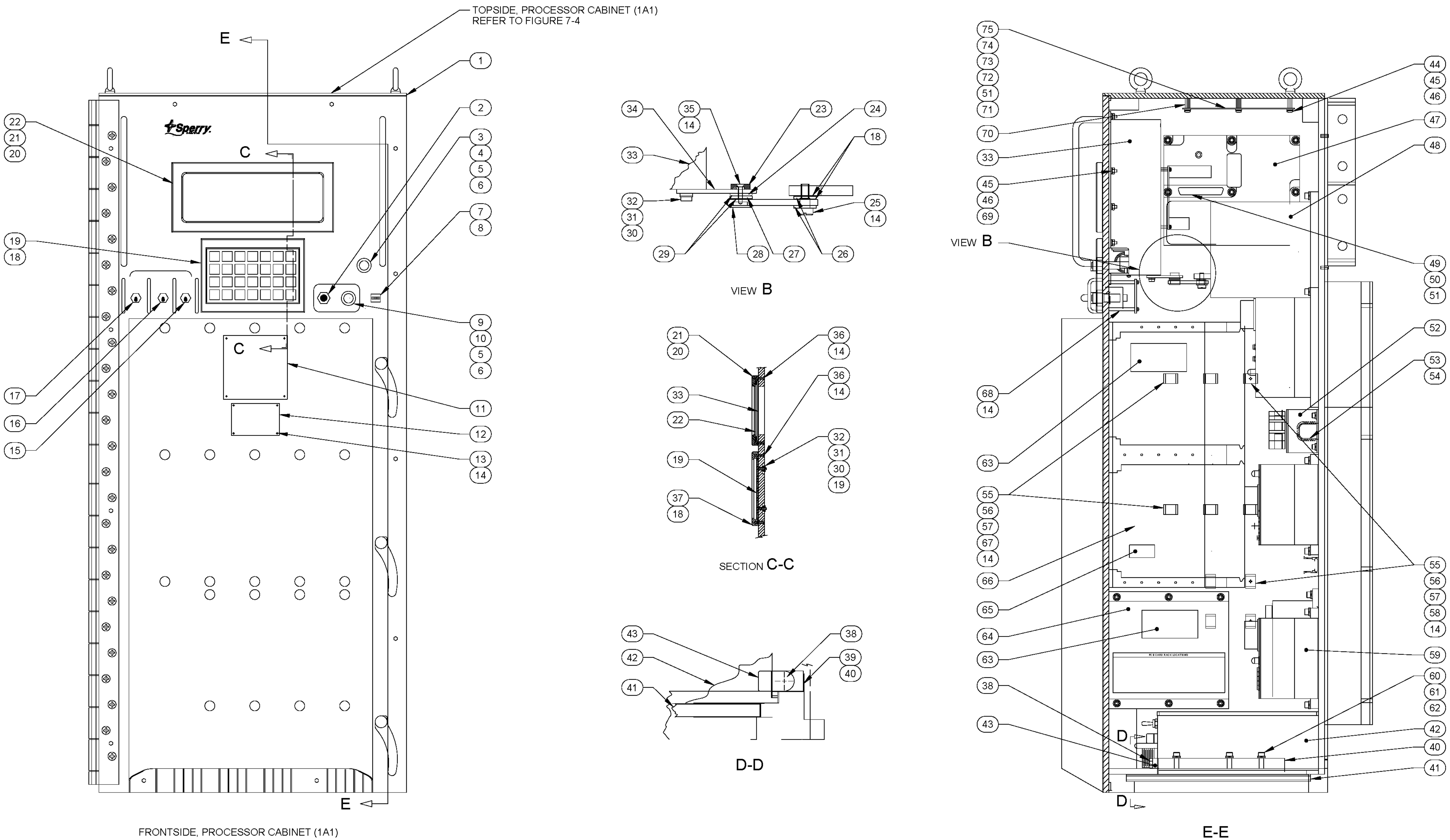


Figure 7-1. Processor Cabinet Assembly (1A1) (Unit 1)

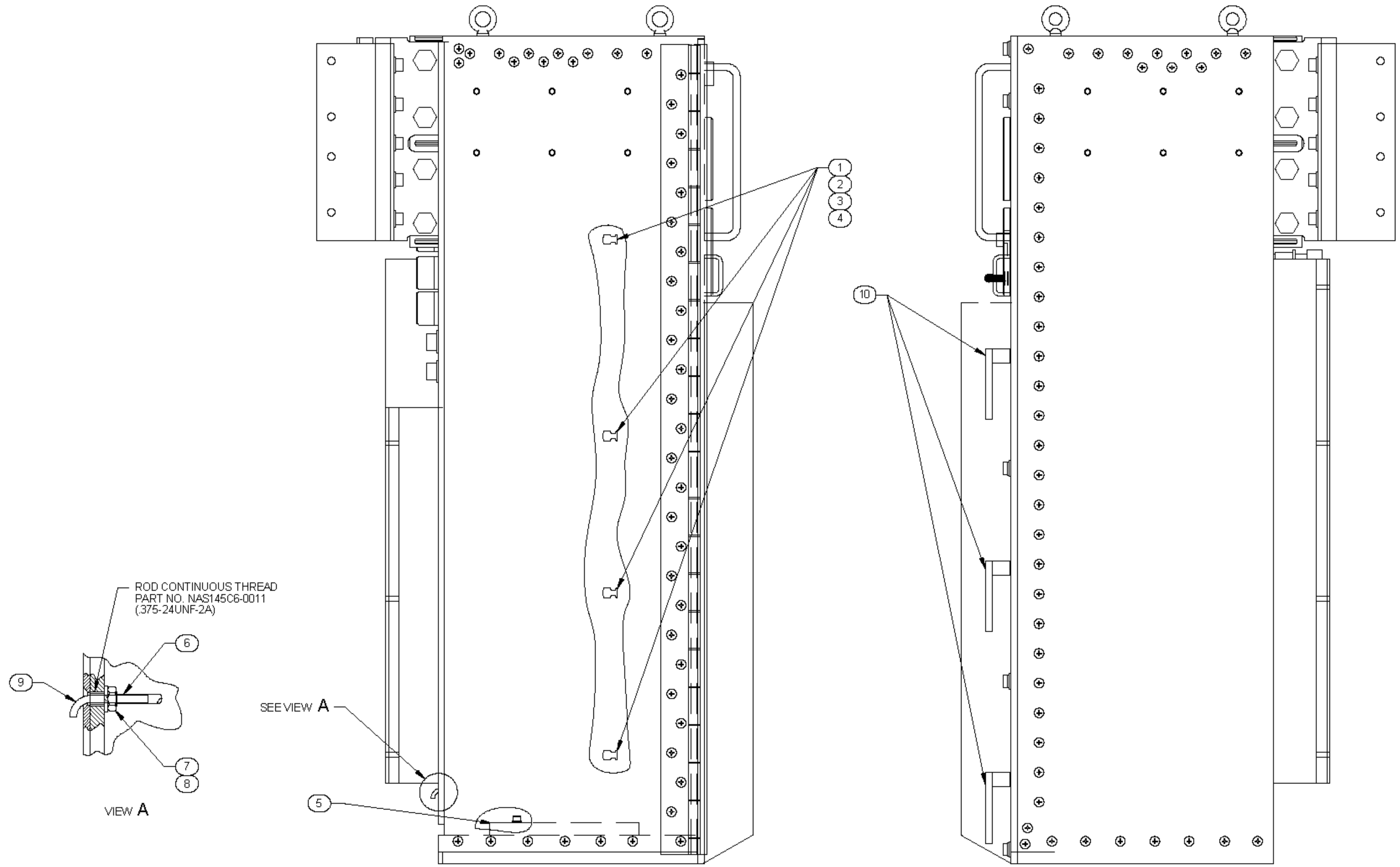


Figure 7-2. Processor Cabinet Assembly (1A1) (Unit 1) Side Views

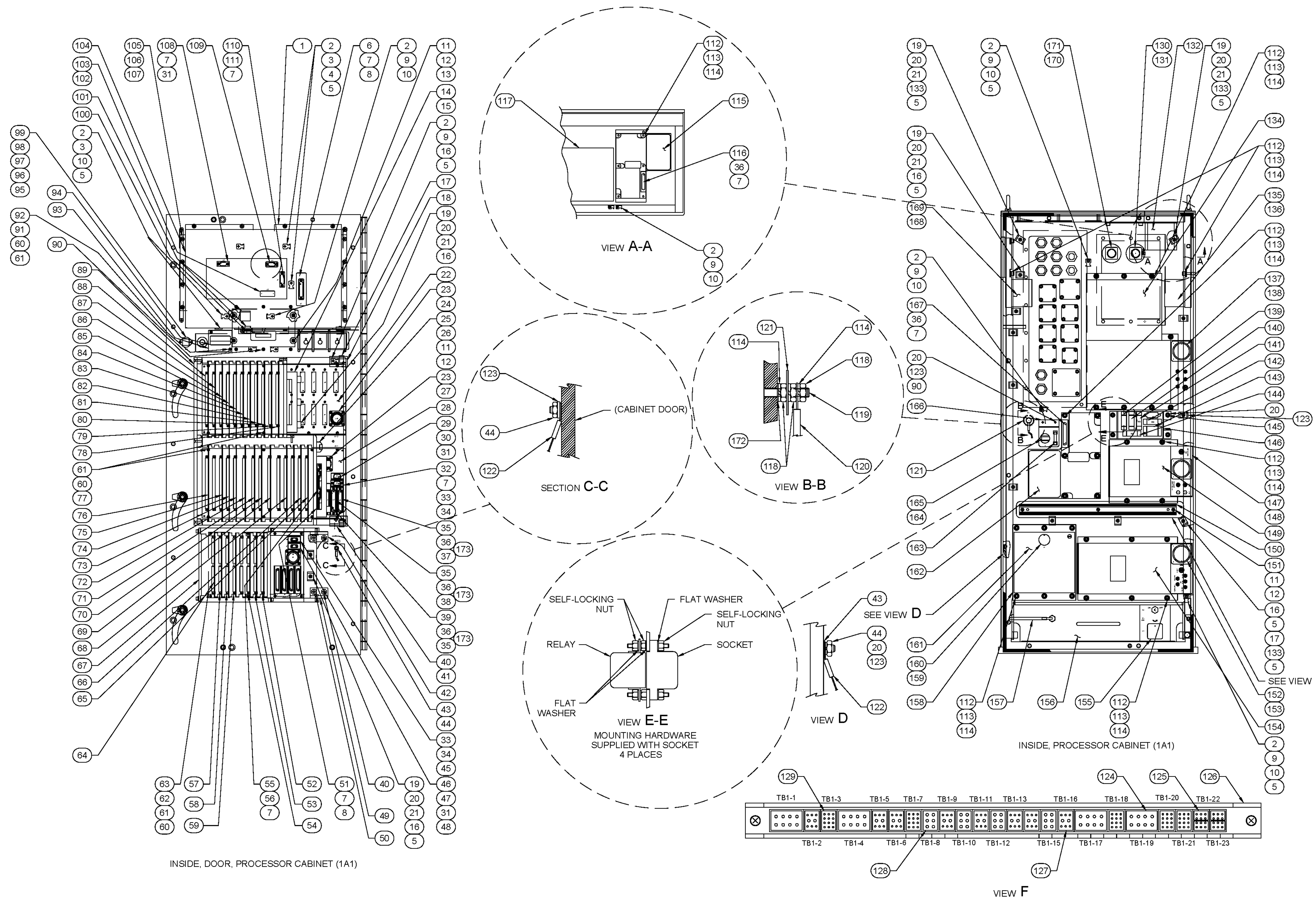


Figure 7-3. Processor Cabinet Assembly (1A1) (Unit 1) Internal Components

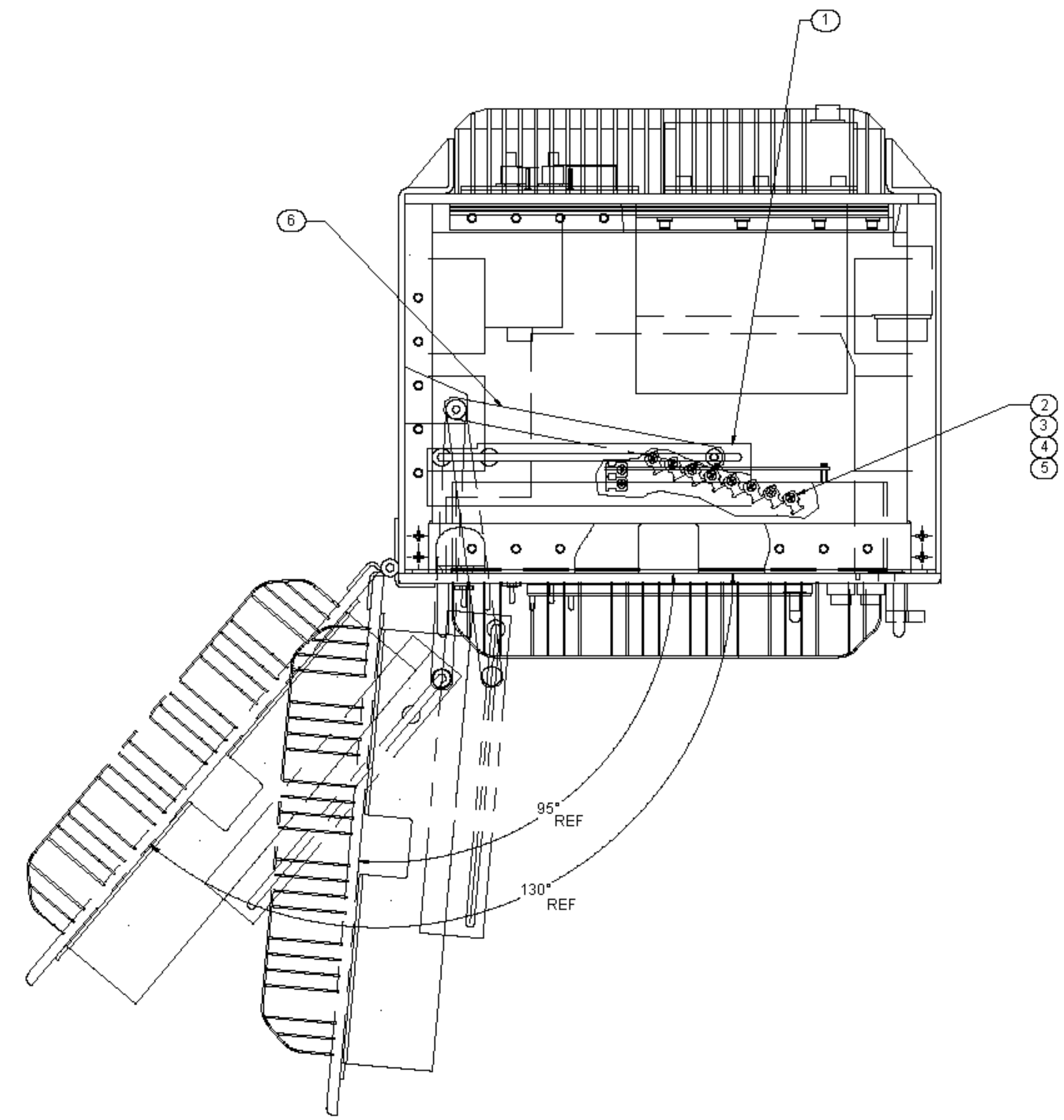
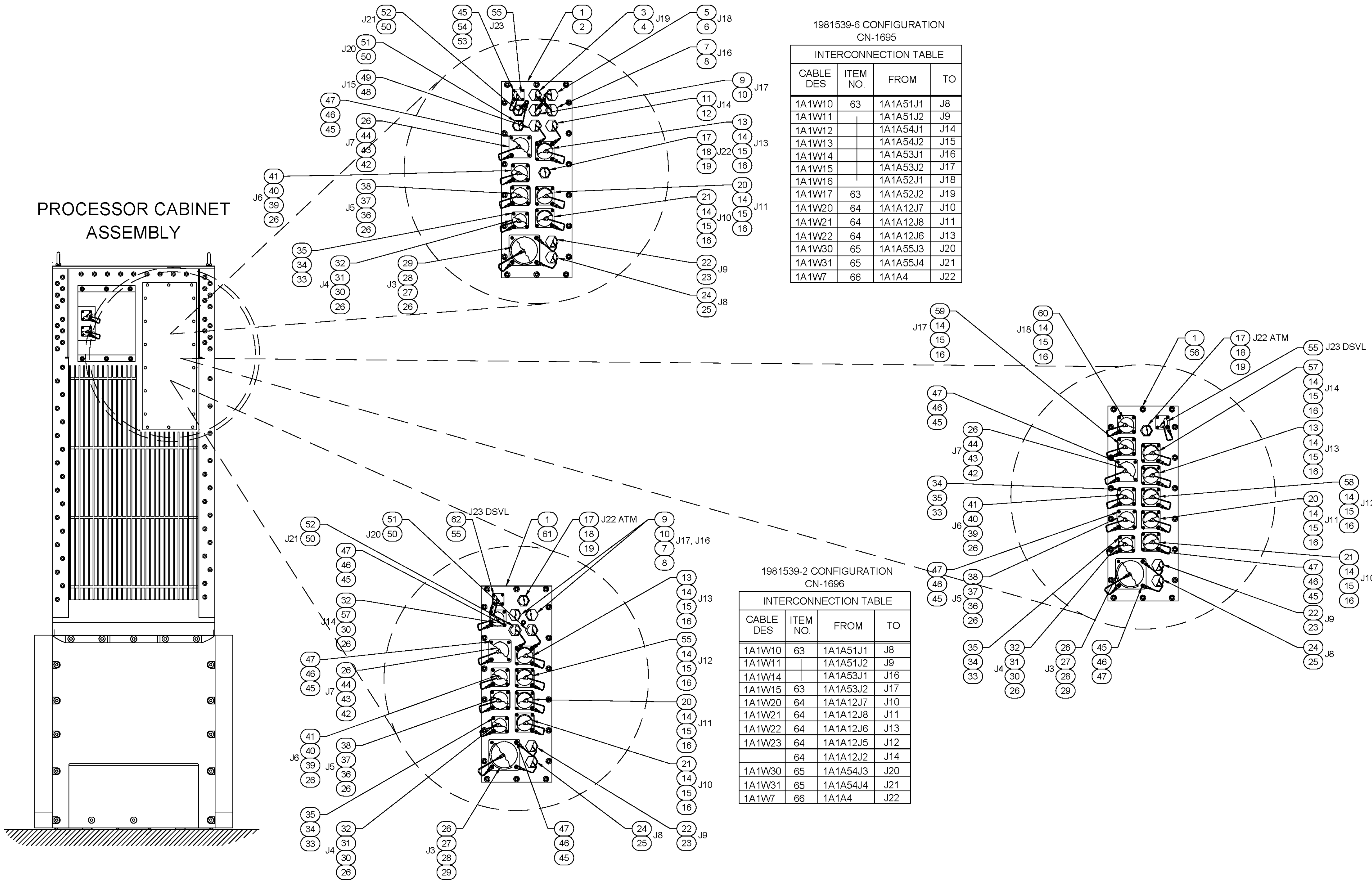


Figure 7-4. Processor Cabinet Assembly (1A1) (Unit 1) Topside



1981539-6 CONFIGURATION
CN-1695

INTERCONNECTION TABLE			
CABLE DES	ITEM NO.	FROM	TO
1A1W10	63	1A1A51J1	J8
1A1W11		1A1A51J2	J9
1A1W12		1A1A54J1	J14
1A1W13		1A1A54J2	J15
1A1W14		1A1A53J1	J16
1A1W15		1A1A53J2	J17
1A1W16		1A1A52J1	J18
1A1W17	63	1A1A52J2	J19
1A1W20	64	1A1A12J7	J10
1A1W21	64	1A1A12J8	J11
1A1W22	64	1A1A12J6	J13
1A1W30	65	1A1A55J3	J20
1A1W31	65	1A1A55J4	J21
1A1W7	66	1A1A4	J22

1981539-2 CONFIGURATION
CN-1696

INTERCONNECTION TABLE			
CABLE DES	ITEM NO.	FROM	TO
1A1W10	63	1A1A51J1	J8
1A1W11		1A1A51J2	J9
1A1W14		1A1A53J1	J16
1A1W15	63	1A1A53J2	J17
1A1W20	64	1A1A12J7	J10
1A1W21	64	1A1A12J8	J11
1A1W22	64	1A1A12J6	J13
1A1W23	64	1A1A12J5	J12
	64	1A1A12J2	J14
1A1W30	65	1A1A54J3	J20
1A1W31	65	1A1A54J4	J21
1A1W7	66	1A1A4	J22

1981539-3 CONFIGURATION
CN-1697

INTERCONNECTION TABLE			
CABLE DES	ITEM NO.	FROM	TO
1A1W10	63	1A1A51J1	J8
1A1W11	63	1A1A51J2	J9
1A1W13	63	NONE	J15
1A1W14	63	NONE	J16
1A1W20	64	1A1A12J7	J10
1A1W21	64	1A1A12J8	J11
1A1W22	64	1A1A12J6	J13
1A1W23	64	1A1A12J5	J12
1A1W24	64	1A1A12J2	J14
1A1W25	64	1A1A12J3	J17
1A1W26	64	1A1A12J4	J18
1A1W7	66	1A1A4	J22

Figure 7-5. Installation: Mounting Arrangement

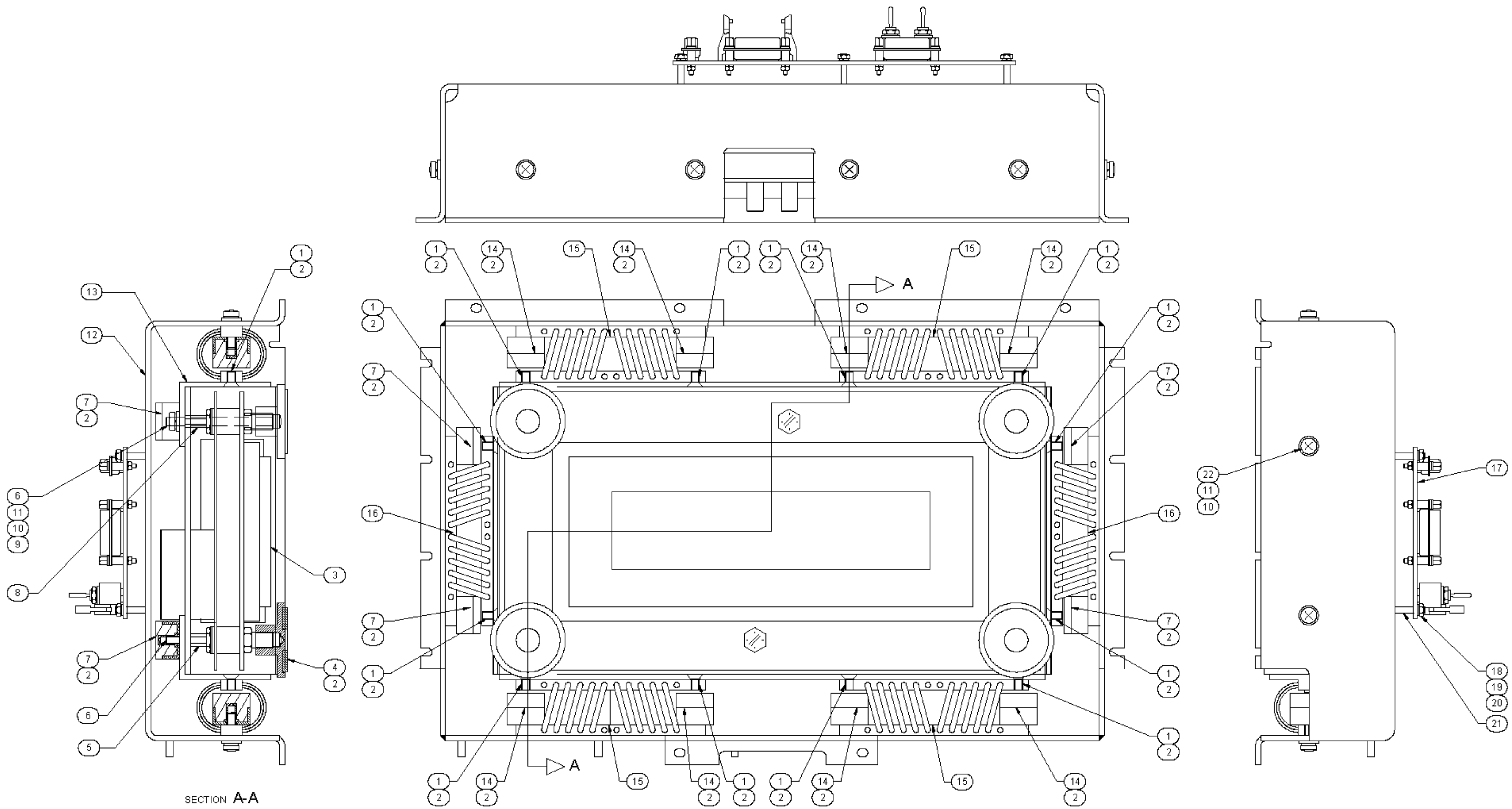


Figure 7-6. Front Panel: Display Assembly (1A1A10)

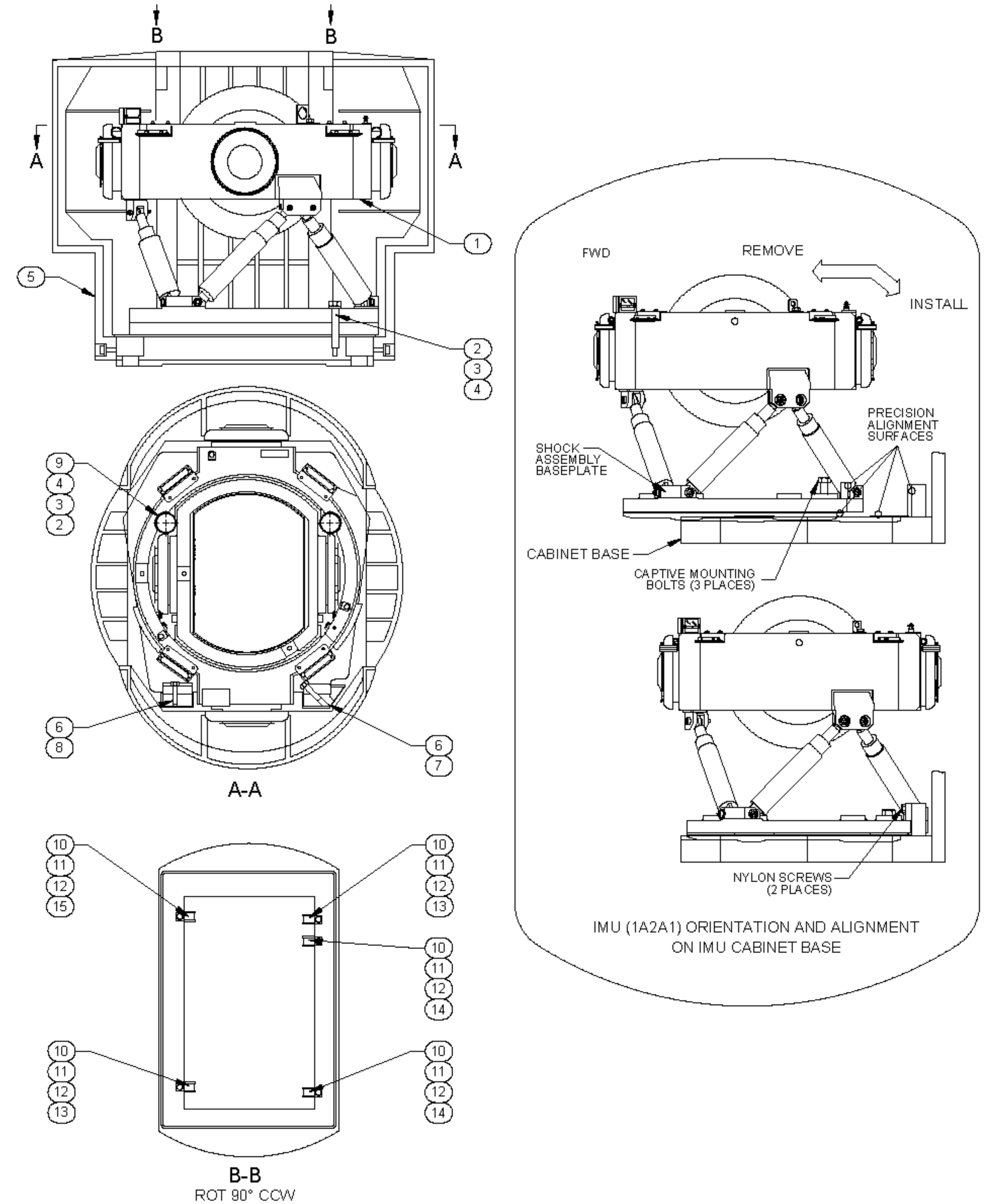
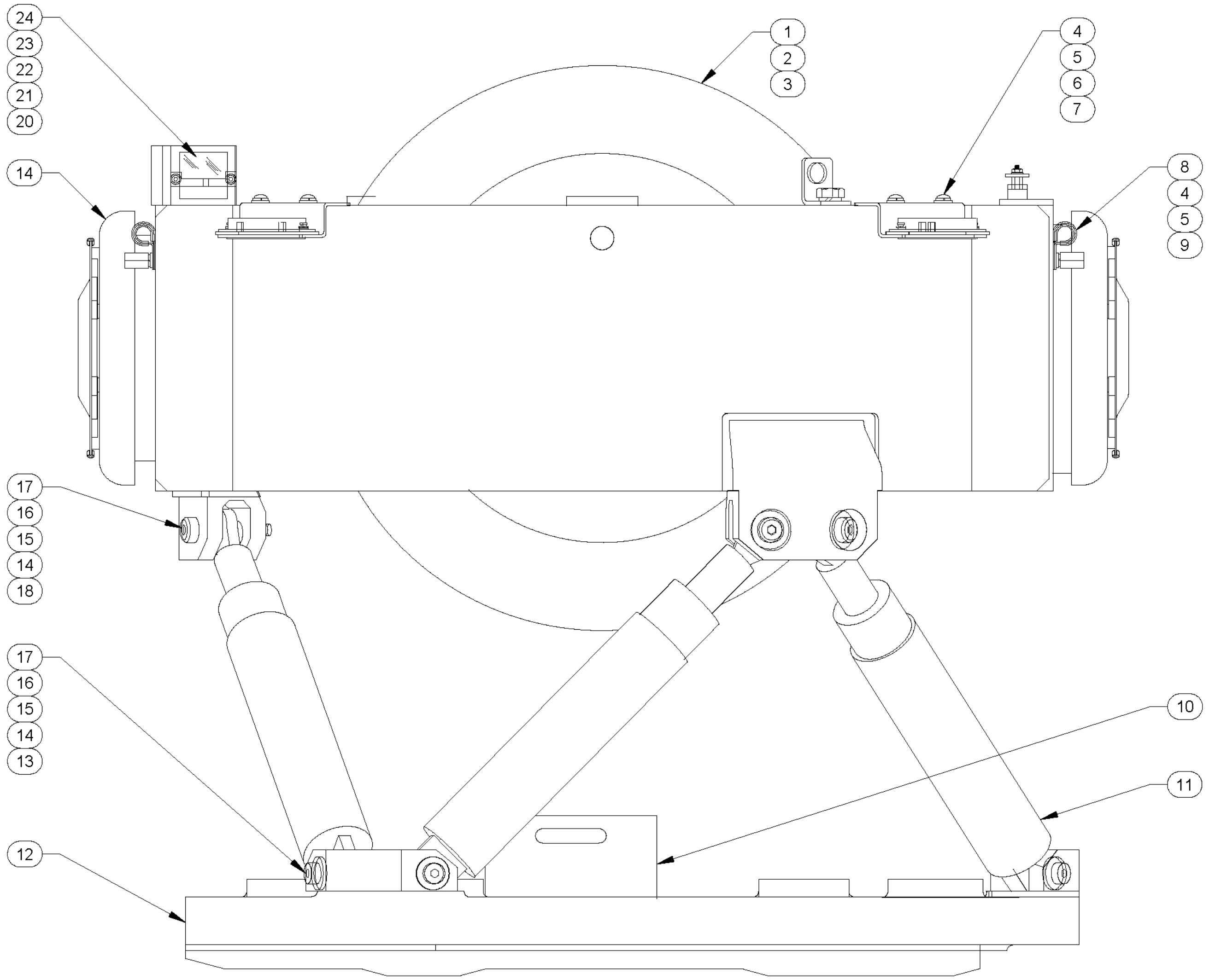
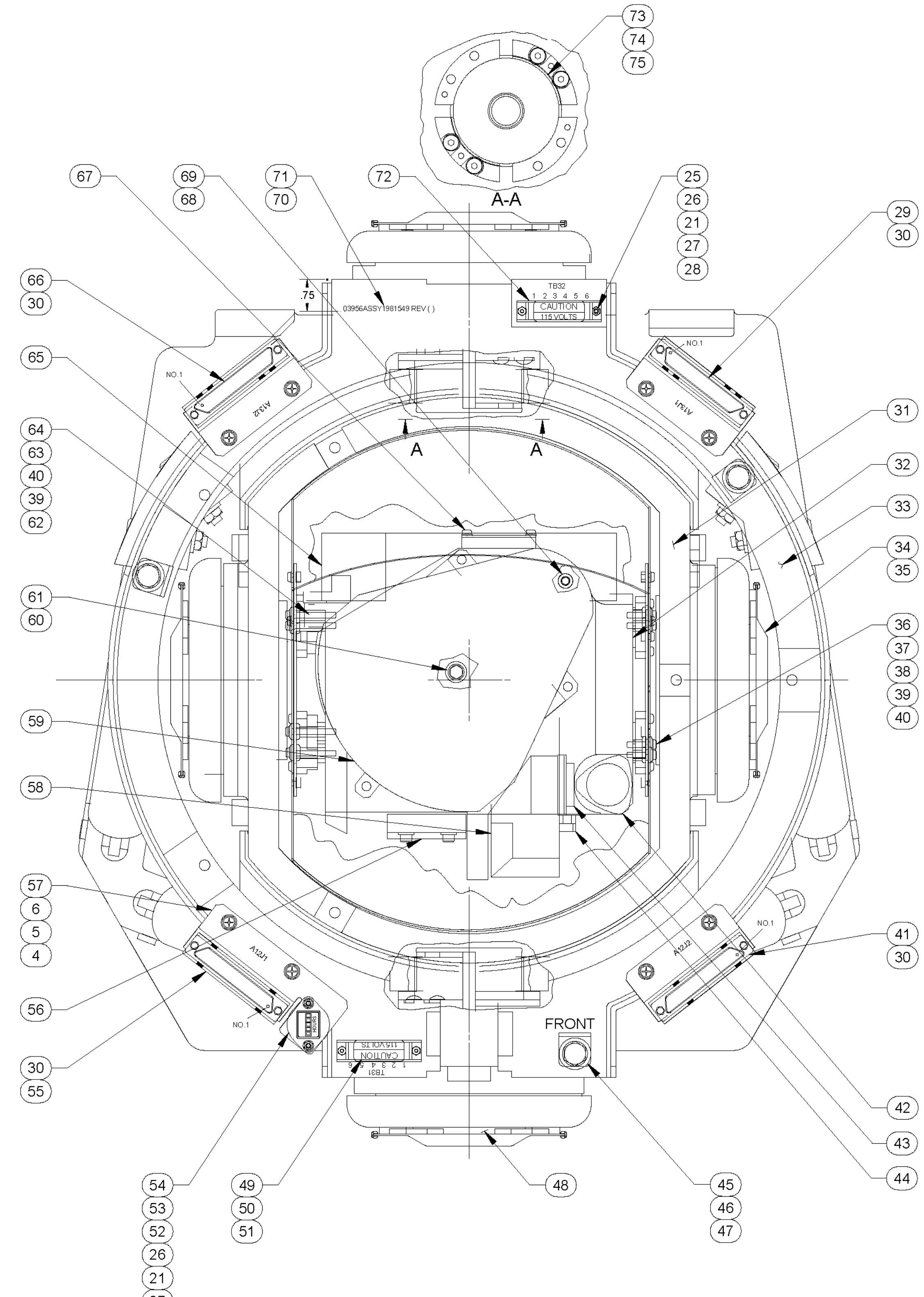


Figure 7-7. IMU: Measurement Cabinet Assembly (1A2) (Unit 2)



NOTE:

1. BEFORE INSTALLATION OF ITEM 1 (MAG SHIELD ASSY), THE TRUSS HEAD SCREWS WHICH ATTACH THE MAG SHIELD SEGMENTS TO THE END PLATES MUST BE MADE CAPTIVE. WITH THE SEGMENTS OFF, AND THE SCREWS FULLY THREADED ON, APPLY A DROP OF ITEM 75 (ADHESIVE) TO END OF EACH SCREW. THE DROP OF ADHESIVE SHOULD COVER 1-2 THREADS OF THE SCREW END.



TOPSIDE, INSIDE IMU (1A2)

Figure 7-8. IMU: Subassembly Identification (1A2A1A1)

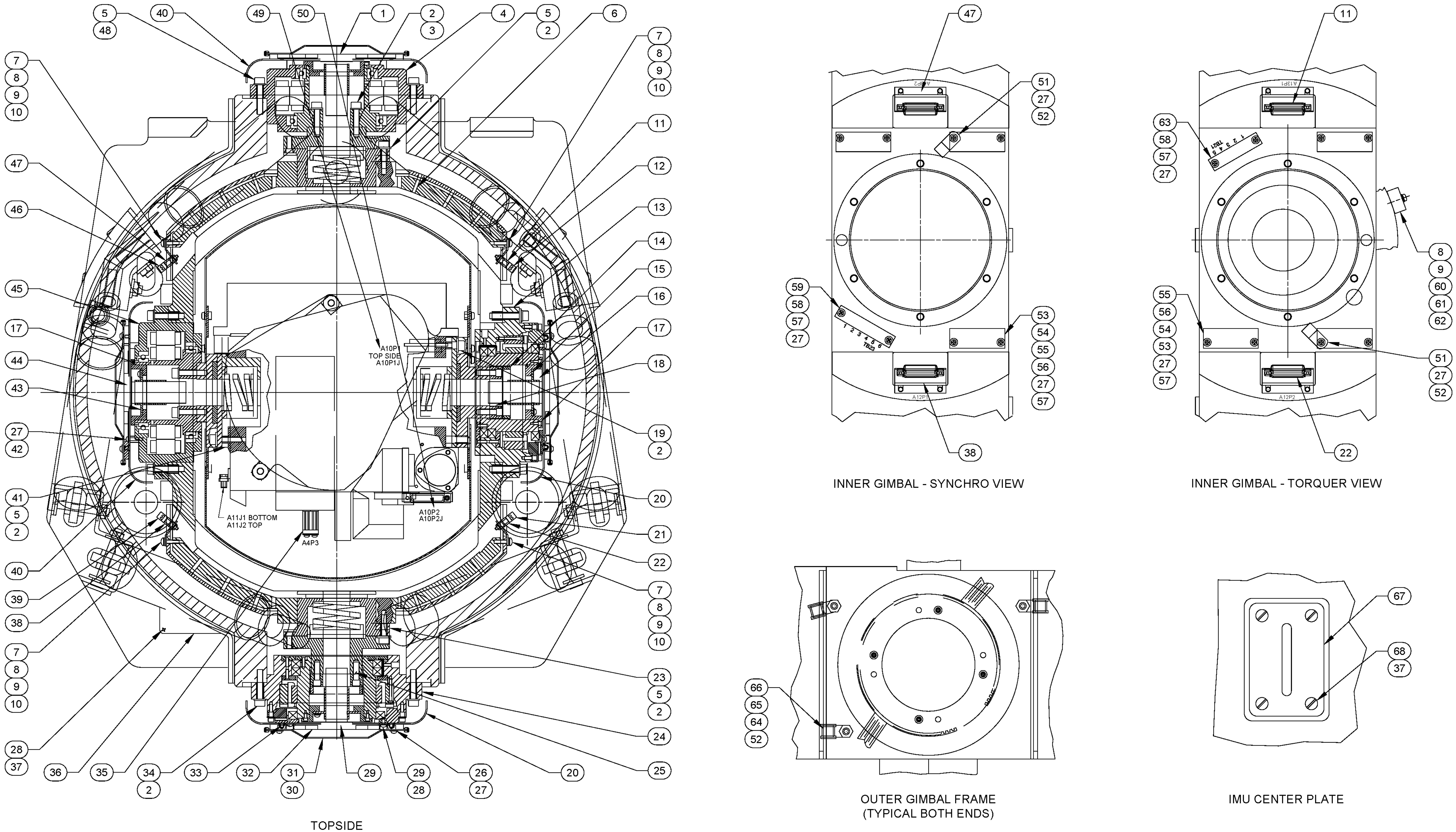


Figure 7-9. IMU: Subassembly Identification (1A2A1A1)

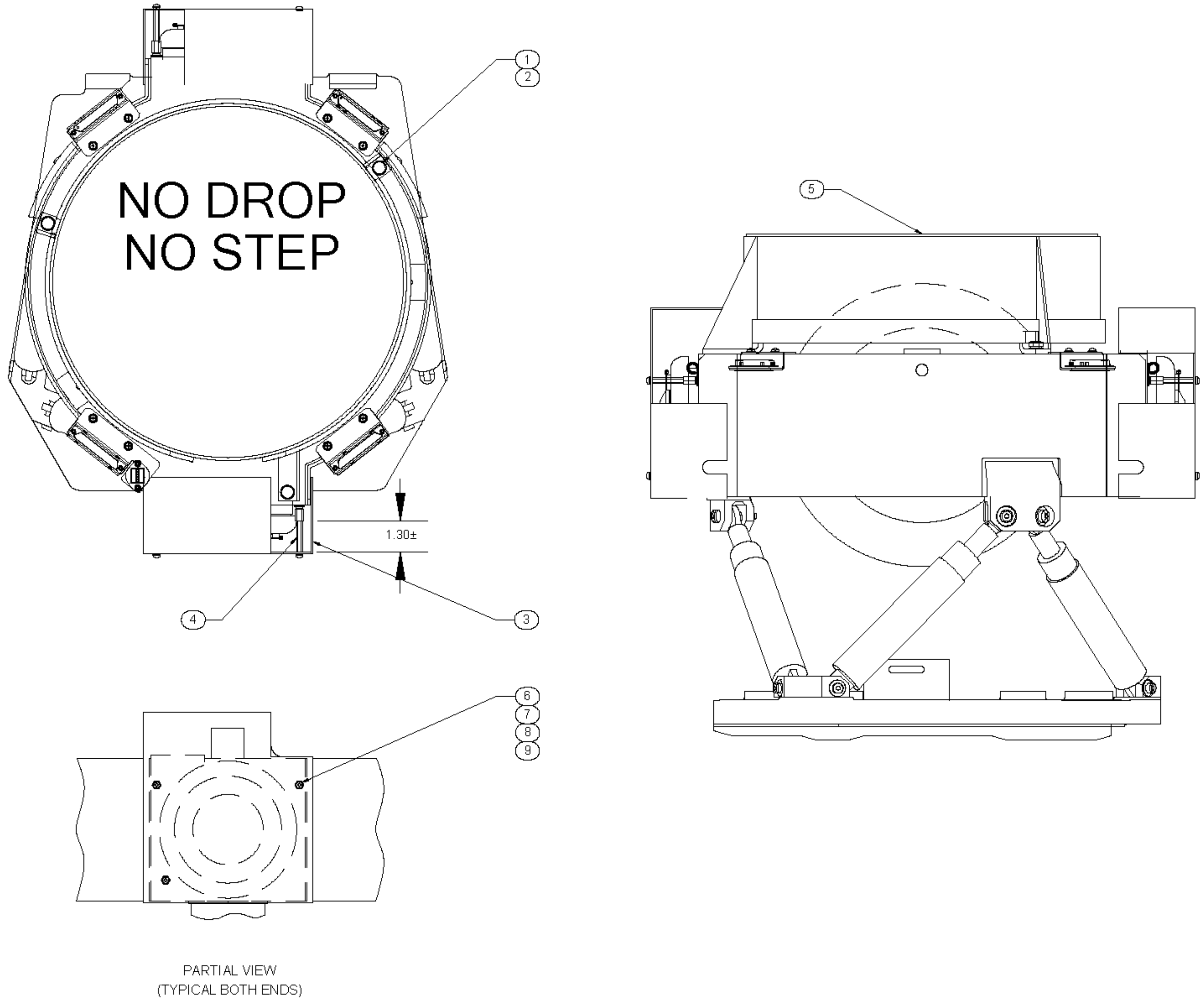


Figure 7-10. IMU: Subassembly Identification (1A2A1A1)

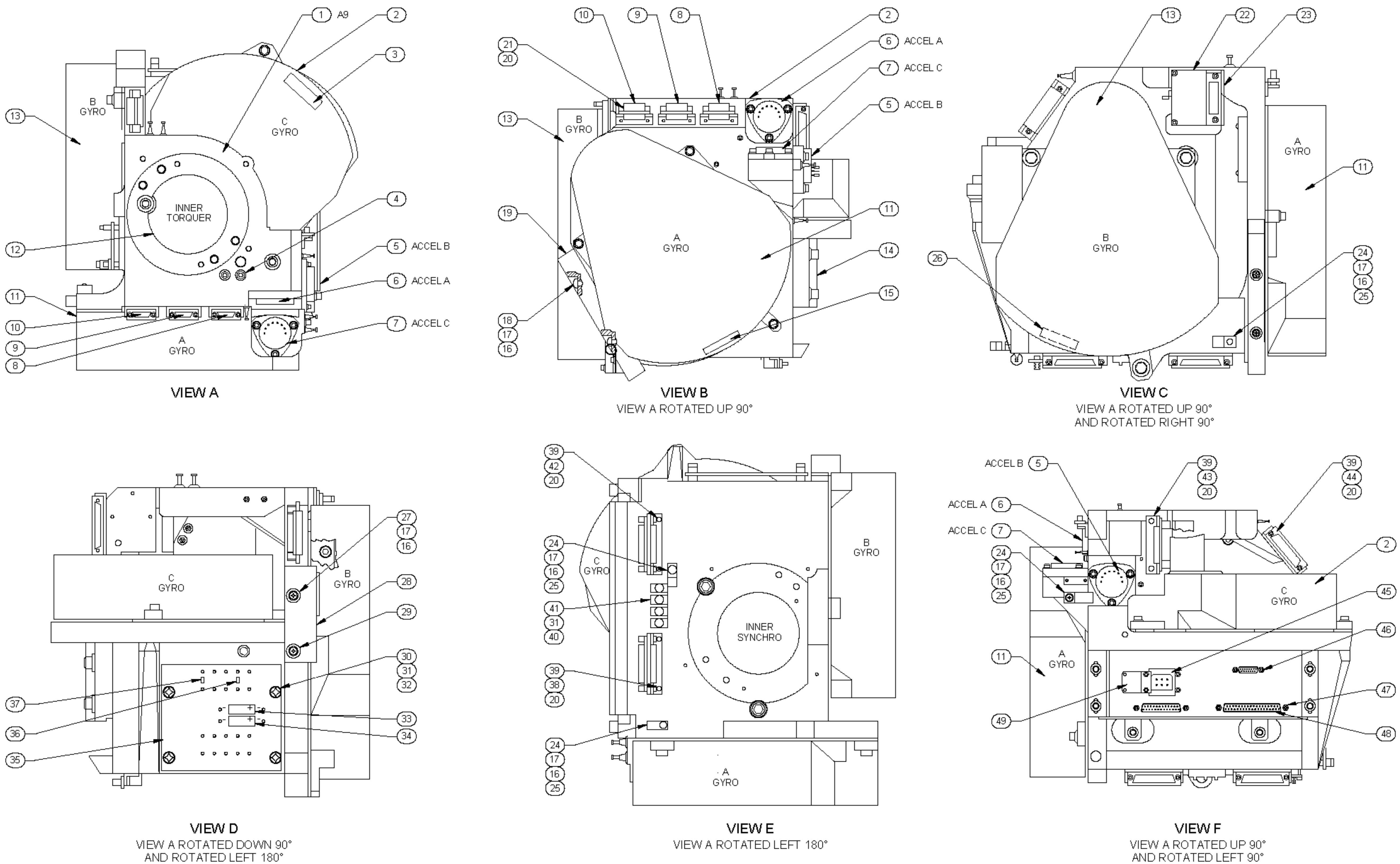


Figure 7-11. IMU: Sensor Block Assembly (1A2A1A1A9)

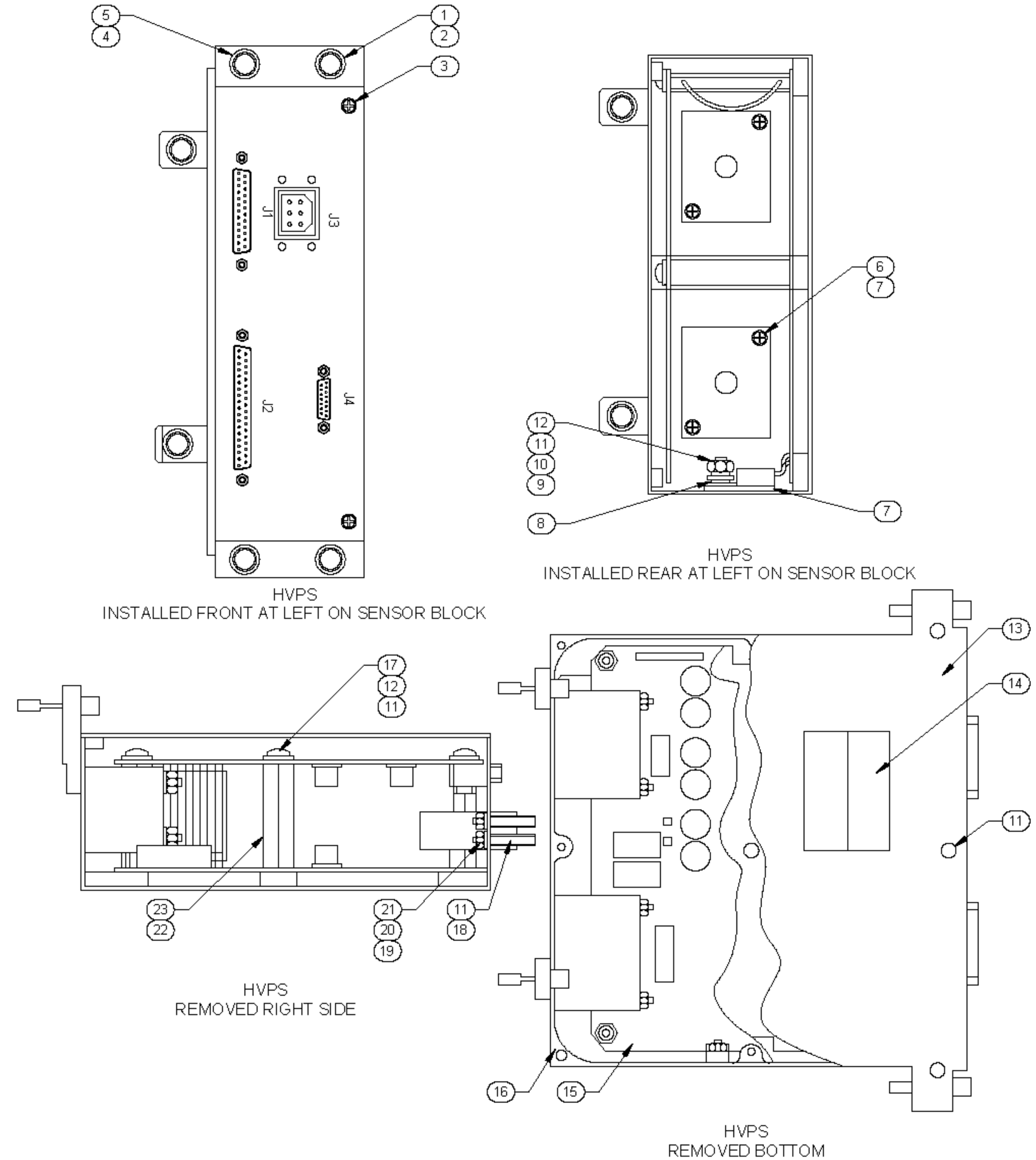


Figure 7-12. High Voltage Power Supply Assembly (1A2A1A1A4)

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CHAPTER 8
INSTALLATION

8.1 INTRODUCTION.

This chapter contains procedures and drawings developed to aid in the installation and alignment of the AN/WSN-7(V) Inertial Navigation System (INS). Some procedures and drawings in this chapter provide general information that is applicable to all INS installations. **Figure 8-1** provides a sample Configuration Data Sheet used in recording the settings assigned to each RLGN during installation. **Figures 8-2** through **8-14** provide data essential to installation and testing of the AN/WSN-7(V), including alignment information and cable connections. All dimensions on the figures are in inches and millimeters (in parentheses), unless otherwise noted. This information is supplemented by specific information found on Outline and Installation Drawings supplied with the equipment.

NOTE

Because installation configuration details may change between the time of printing of this technical manual and the time of actual installation of the equipment, the installation drawings printed in this manual should be used only for reference during pre-installation planning. The latest revision of the Navy Installation Control Drawings (ICDs) should be used as the reference for actual installation.

Because of the precision with which the INS provides azimuth, roll, and pitch attitude outputs, the equipment is designed to use only optical methods to align the Inertial Measuring Unit (IMU) in each AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN) to the ship's azimuth, roll, and pitch references.

Three reference mirrors, which are mounted on the front of the IMU outer frame, are optically aligned at the factory with respect to the precision-machined alignment/mounting surfaces on the IMU base plate. Mirror offset values determined by this alignment are stored in a Programmable Read-Only Memory (PROM) chip, which is part of a serialized matched set with the IMU, and which is installed in the Programmable Array Logic (PAL) chip U13 location on RLGN IMU Processor Software Circuit Card Assembly (CCA) (**1A1A32**). This PROM also contains other IMU reference data, which are determined by a computer-controlled dynamic calibration routine.

After the AN/WSN-7(V) RLGN Cabinet Assembly is mounted to the foundation on the ship's deck, the IMU is installed in the cabinet without further mechanical alignment of the cabinet base. When the IMU is installed in the Measurement Cabinet Assembly, contact between the precision-machined alignment/mounting surfaces ensures that exact alignment of the IMU to the Measurement Cabinet Assembly is maintained and that alignment of the IMU is not affected if the IMU is removed and reinstalled in the cabinet.

Alignment of the INS consists of optically determining the mounting errors of the IMU(s) with respect to the ship's references using the mirrors on the IMU outer frame. Once these errors have been determined and recorded, the error angle values are then manually entered into battery-backed memory storage [battery-backed Random Access Memory (RAM) and Electrically Erasable Programmable Read-Only Memory (EEPROM) Keyboard Entry to Non-Volatile Memory (KENV)] using an installation configuration menu that is activated after the INS is installed and power is applied.

During operation, the software uses these offset correction values in its calculations to compensate for mounting misalignment. This method of alignment eliminates the need for tedious mechanical adjustment of the cabinet to the ship's references.

Since optical alignment of the IMU establishes the azimuth, pitch, and roll axis mounting offset of the cabinet, the IMU can be replaced with a different IMU without requiring that optical alignment to the ship's references be repeated. If a different IMU is installed, however, the calibration PROMs installed in the IMU Processor CCA (**1A1A32**) must also be replaced with the matching PROMs for the new IMU.

8.2 WELDING RESTRICTIONS.

Prior to welding in the area/compartment of the AN/WSN-7(V) INS, perform the following procedures.

NOTE

Step a. can be eliminated by removal of all system CCAs from the RLGN. Otherwise, as a minimum, accomplish Step a. (1) below.

a. Remove or disconnect the following digital interface cables:

(1) RLGN to Control Display Unit (CDU)

(2) RLGN to Interfacing systems

NOTE

If welding is conducted in compartments that contain equipment interfacing with the AN/WSN-7(V) INS, disconnection of those digital interfacing cables also is recommended.

b. Ensure that welding cables are at least 3 feet from the AN/WSN-7(V) INS intra-system cables or digital interfacing system cables, and are not parallel to them, if draped on the deck or strung in the overhead.

c. Ensure that welding cables are at least 3 feet from the RLGN.

8.3 EQUIPMENT REQUIRED FOR INSTALLATION AND OPTICAL ALIGNMENT.

The following paragraphs provide suggestions for optical equipment and tools that should be procured prior to installation and alignment of the INS equipment. Optical equipment required will be determined primarily by the space of the installation site, type of ship's heading, pitch, and roll references (plates with scribe marks or bulkhead-mounted calibrated mirrors), and the requirements for translating ship's references to the IMU installation location.

8.3.1 EQUIPMENT SUGGESTED FOR OPTICAL ALIGNMENT. The following types of equipment are suggested for optical alignment:

Two precision Theodolites equipped with autocollimator eyepiece. A set of adapter lenses to shorten the focal length of the telescope, for working in areas of limited space. The theodolites should also be equipped with an optical plummet for centering the theodolite over benchmarks on the ship's deck.

NOTE

The Wild T3A Precision Theodolite is equipped with a built-in auto-collimation eyepiece.

The suggested accompanying instruments are the Wild T2, T3 or T3A Precision Theodolite, manufactured by Wild Leitz (formerly Wild Heerbrugg Lts.); CH-9435 Heerbrugg, Switzerland.

Tripods or adjustable stands for theodolites to hold the instrument's telescope rigidly at the installed height of the optical alignment fixture mirrors.

One Optical Alignment Fixture, CAGE 03956, P/N 1983837. (Used for optical alignment and calibration of the AN/WSN-7(V) cabinet.)

8.3.2 TOOLS, DRAWINGS AND SUPPORT ITEMS REQUIRED FOR INSTALLATION. **Table 8-1** lists the tools required for mechanical installation of the INS equipment. The tools in this table are provided as part of the AN/WSN-7 tool kit unless provided by the installating activity. Some of the listed tools are required in addition to those listed in **Table 6-2** and are needed only for installation or removal of the IMU.

The following Navy-controlled drawings are required for AN/WSN-7(V) INS installation reference and for fabrication of shipboard cables that connect to the AN/WSN-7(V) RLGN:

1. (53711)-7100680, Inertial Navigation System AN/WSN-7(V) Drawing List
2. (53711)-7100681, Inertial Navigation System AN/WSN-7(V) Block Diagram
3. (53711)-7100682, Inertial Navigation System AN/WSN-7(V) Summary List of Installation Materials
4. (53711)-7100683, Inertial Navigation System AN/WSN-7(V) Input/Output Sheets
5. (53711)-7100684, Inertial Navigation System AN/WSN-7(V) Cable Running Sheets
6. (53711)-7100685, Ring Laser Gyro Navigator CN-1695/WSN-7(V), CN-1696/WSN-7(V) and

CN-1697/WSN-7(V) Outline and Installation Drawing

7. (53711)-7100687, Control Display Unit IP-1747/WSN Outline and Installation Drawing

8. (53711)-7100688, Inertial Navigation System AN/WSN-7(V) Tool Kit

8.3.3 INSTALLATION MATERIALS SUPPLIED WITH EQUIPMENT.

NOTE

The AN/WSN-7(V) installations are dual configurations. A ship installation requires two sets of material (03956-1812650 and 03956-1812807) -- one for each RLGN.

Each system includes two installation kits, part numbers 03956-1812807 and 03956-1812650. Each kit provides all installation hardware, terminating connectors, and backshells necessary to connect ship's system cables to one RLGN. In addition to the installation materials, kit 1812650 includes one set of Built-in Test (BIT) wraparound cables. These cables (part numbers 1981552-n) are required to perform certain off-line tests of the display and data interface functions. Refer to the Installation Guidance Drawing and kit parts listing sheets supplied with the equipment for detailed identification of connectors. Tables 8-2 and 8-3 list the materials included in these kits.

8.4 SHIPBOARD PRE-INSTALLATION REQUIREMENTS.

In addition to providing the optical equipment, it is the responsibility of the ship designer, shipbuilder, or the installing activity to provide the following structures and ship's reference benchmark, which are needed for correct installation and alignment of the IMU(s):

a. Ship's azimuth, pitch, and roll reference lines of sight should be located by at least two permanent benchmarks in the area where the INS is to be installed. The benchmarks may either be scribe lines on convenient bulkheads on which the theodolite telescope may be sighted, or may be calibrated mirrors that are mounted on the bulkhead against which the autocollimator may be aligned. If mirrors are installed, the centerline of the mirrors should be located 18.4 inches (467.9 mm) above the surface of the INS foundation plate.

b. A scribe line parallel to the ship's fore-aft reference line must be laid down on the deck at the future position of the INS foundation plate(s), to be used as the centerline reference for establishing the cabinet mounting hole locations.

c. A rigid foundation plate must be installed on the deck for mounting the RLGN Cabinet Assembly. The foundation plate and underlying structure must be capable of supporting the 840 lb. (381 kg) unit within the resonance and loading specifications outlined on Installation Guidance Drawing, Figure 8-14, sheet 1.

The foundation plate should be a minimum of two inches thick, and the upper surface of the plate should be level to the ship's roll and pitch axes within 1.5 degrees. The base must be oriented, drilled, and tapped as per Figure 8-5 and as shown on Installation Guidance Drawing Figure 8-14, sheet 1. The centerlines for determining the locations of the eight mounting holes in the base must be aligned to the ship's fore-aft (azimuth) reference line to within 1.5 degrees. Cabinet foundation surface flatness shall not exceed .020 inch total deviation.

Observe all clearance as shown in Figure 8-14, sheet 1 and provide space for setting up the theodolites and maintaining line of sight to ship's reference marks or mirrors for optical alignment after the RLGN cabinet has been installed.

d. If support brackets are to be used to attach the RLGN Cabinet Assembly to the ship's bulkhead (brackets are required for single-cabinet installation configurations), the bulkhead must be drilled and tapped to mount the support brackets, and a support bracket assembly must be fabricated to attach the bracket assembly supplied with the RLGN (refer to Table 8-3).

e. All external cabling and wiring, both input and output, must be provided. See Figure 8-14, sheets 4-6 for recommended cable types. Sperry Marine Systems, Inc., supplies the cable connectors necessary for installing these cables at the INS end.

Information for mechanical installation, determining offset parameters, and entering configuration data into the battery-backed memory is applicable to each RLGN in a multiple-system configuration.

8.5 INSTALLATION OF INS ASSEMBLIES.

After the mounting foundation has been installed and drilled, and the ship's system cables have been installed and terminated at the INS interface end, installation of the INS consists of performing the following procedures:

1. Uncrate and install the RLGN Processor Cabinet Assembly/ Measurement Cabinet Assembly on the mounting base. (Paragraph 8.5.1, 8.5.2)

2. Uncrate and install the IMU into the Measurement Cabinet Assembly. (Paragraph 8.5.1, 8.5.3)

3. Install eight serialized (matched set) calibration PROMs in sockets on IMU Processor CCA (1A1A32). (Paragraph 8.5.4)

4. Verify powered operation of the INS and associated equipment. (Paragraph 8.5.5)

5. Determine INS and other ship's systems configuration data such as lever arm lengths for the IMU and the position and velocity sensors, type and baud rate of external devices communicating with the INS, scaling of synchro output from INS, and operator set preferences for displayed data. (Paragraph 8.6)

6. Optically measure angular misalignment between the RLGN cabinet azimuth, pitch and roll axis, and the ship's azimuth, pitch, and roll reference lines. (Paragraph 8.6.1)

7. Enter and store installation configuration data in the non-volatile memory. (Paragraph 8.7)

8.5.1 UNCRATING AND PREPARATION OF EQUIPMENT FOR INSTALLATION.

CAUTION

To prevent damage to the alignment surfaces on the bottom of the IMU mounting plate when the IMU is removed from the packing crate, keep the IMU mounted to the plywood shipping base prior to installation in the Measurement Cabinet Assembly.

The RLGN shipset is shipped from the factory partially disassembled and packaged in seven containers:

Containers 1 and 2:

RLGN Processor Cabinet Assembly (Unit 1) and Measurement Cabinet Assembly (Unit 2) with IMU covers removed. Protective flat shipping covers are installed on the Measurement Cabinet Assembly in place of the IMU covers.

Containers 3 and 4:

a. The IMU (1A2A1) and IMU mounting hardware. The IMU is shipped attached to a plywood base and has protective shipping covers installed over the synchro and torquer motor on the Outer Gimbal Frame, and over the Sensor Block Assembly. The cover over the Sensor Block Assembly is installed using bolts and lifting angle brackets, which may be used to lift the IMU Assembly.

b. The mounting hardware used to install the IMU in the Measurement Cabinet Assembly is packaged in two shipping envelopes, which are included in this container.

c. The serialized calibration PROMs (eight chips) associated with the IMU platform, the Ring Laser Gyros, and the accelerometers are packaged in a static protection tube and shipping envelope, which are included in this container.

Containers 5 and 6:

a. IMU Covers (quantity 2).

b. Attaching hardware consisting of 38 sets of socket head screws, flat washers, and lock washers used to attach the covers to the Measurement Cabinet Assembly.

Container 7:

a. Installation Material and BIT Cables kit 03956-1812650-var (refer to Table 8-2).

b. Common Installation Material kit 03956-1812807 (refer to Table 8-3).

8.5.2 CABINET INSTALLATION PROCEDURE.

CAUTION

The RLGN cabinet without the IMU installed, weighs approximately 675 lbs. (306 kg). Use proper rated hoisting equipment when installing the cabinet. To prevent damage to the surface of the mounting foundation or mounting surfaces on the bottom of the cabinet, do not attempt to slide the cabinet on the mounting foundation without lifting the cabinet. Be sure that the cabinet is positioned on the mounting foundation in correct orientation prior to removal of hoisting rig.

To install the RLGN cabinet:

NOTE

If limited access clearance after cabinet is mounted will make installation of the rear IMU Cover difficult, the rear cover can be installed on the Measurement Cabinet Assembly prior to installation of the cabinet on the mounting foundation. It is not necessary to remove the rear cover either to install the IMU in the Measurement Cabinet Assembly or to perform optical calibration of cabinet mounting misalignment.

a. Remove flat transport covers from front and rear of Measurement Cabinet Assembly.

b. Apply anti-seize compound N-1000 and C-5A “FELPRO” to eight hex-head bolts.

c. Place cabinet on foundation aligned with mounting holes and secure cabinet using eight hex-head machine bolts (item 17), flat washers (item 18), and lock washers (item 19) supplied in Common Installation Materials kit 03956-1812807.

d. Torque mounting bolts to 580 ±20 ft-lbs. Tighten mounting bolts in a cross pattern, alternately tightening bolts on opposite sides of the cabinet.

e. Connect grounding strap (customer supplied) between base of cabinet and suitable frame grounding point on foundation. Attach strap to base of RLGN cabinet using 1/4-28 hex-head cap screw (item 20). Refer to **Figure 8-14, sheet 1**.

f. Connect two support brackets (item 24) to back of Processor Cabinet Assembly using four 3/8-16 hex-head cap screws (item 23).

g. Connect AN/WSN-7(V) brackets to ship’s bulkhead using customer supplied foundation brackets as shown in **Figure 8-14, sheet 2**.

h. Connect system cables to connectors on back of RLGN Processor Cabinet Assembly.

8.5.3 INSTALLATION OF INERTIAL MEASURING UNIT (1A2A1) IN MEASUREMENT CABINET ASSEMBLY. (Refer to **Figures 6-9** and **6-10**).

WARNING

The IMU weighs 162 lbs (73 kg). Two persons are required to install this assembly in the cabinet. Be sure that the inner gimbal is rotated parallel to the outer gimbal frame to prevent the outer synchro or torquer motor from hitting the top of the cabinet during installation. Do not slide the IMU directly into the cabinet from the floor. Lift the assembly until the bottom of the mounting plate is even with the base of the cabinet and slide it into position.

CAUTION

The lower surface of the IMU mounting plate and the upper surface of the cabinet mounting plate contain precision-machined surfaces, which are used to support and align the IMU in the cabinet. When installing the IMU in the cabinet, use care not to damage these surfaces.

CAUTION

Always: Review, record, and save misalignment values immediately after installing a new IMU with associated PROMs; record misalignment values to the INS Installation Data Record Sheets where the IMU is installed; use the IMU specific values recorded on the Installation Data Record Sheet to reinitialize the System Configuration menu after loss of stored data.

CAUTION

No welding or welding cables are permitted within three feet of the IMU.

To install the IMU (**1A2A1**) into the Measurement Cabinet Assembly:

a. Remove torquer and synchro transport covers from ends of IMU outer frame assembly. Remove IMU transport cover.

b. Apply a thin film of Lube #3 03956-P1896766 to all machined alignment surfaces on the IMU baseplate and on the baseplate of measurement enclosure. Wipe all surfaces almost dry using a lint-free wiper.

c. Using the outer frame, lift the IMU into the cabinet and place alignment rails on bottom of IMU mounting plate into grooves in cabinet base.

d. Rotate inner gimbal so that it is parallel with outer frame and carefully slide IMU into cabinet far enough to connect the two rear cables (W3 and W2) to jacks A13J1 and A13J2. Slide locking tab on jacks into position to secure cable plugs.

e. Carefully slide IMU into cabinet until IMU mounting plate lowers down onto mounting surfaces on cabinet base and alignment tabs on rear of plate contact machined alignment surfaces at back of cabinet base.

f. Connect the two front cables (W1 and W4) to jacks A12J1 and A12J2. Slide locking tab on jacks into position to secure cable plugs. Attach plug W1P3 to elapsed time meter plug.

g. Install three bolts, flat washers, and lock washers that secure IMU mounting plate to cabinet base. Do not tighten the three bolts at this time.

CAUTION

The screws used to align the mounting plate in the cabinet base are made of nylon. These screws should be tightened just sufficiently to ensure firm contact between the machined alignment surfaces (5 to 7 in-lbs). Excessive tightening of these screws may cause them to break.

h. Install two nylon screws and flat washers which secure the cast tabs on back of IMU mounting plate to machined alignment surfaces at back of cabinet base. Using a 5/16-inch T-handle Allen wrench, tighten the left (angled) screw first and then tighten the right screw to pull the IMU mounting plate firmly in contact with the alignment surfaces.

i. Using a 1-5/16-inch socket and torque wrench, tighten three bolts that secure IMU mounting plate to cabinet base. Torque bolts to 110 ft-lbs.

8.5.4 INSTALLATION OF CALIBRATION PROMS ASSOCIATED WITH THE IMU. The eight calibration PROM chips packaged with the IMU (**1A2A1**) must be installed in the proper locations in IMU Processor CCA (**1A1A32**). To install the PROMs, proceed as follows:

a. Open door on cabinet and remove IMU Processor CCA (**1A1A32**) from the Support Electronics card rack. Refer to **Figure 5-2** for location of IMU Processor CCA (**1A1A32**). Refer to **Paragraph 6.3.3** for CCA removal and replacement procedure.

b. Install each calibration PROM in the correct location on IMU Processor CCA (**1A1A32**). Refer to **Paragraph 6.3.3.12** and **Figure 6-3**. Be sure the part number for the IMU calibration PROM installed in location PAL chip U13 on CCA (**1A1A32**) corresponds to the type of equipment installation (surface or submarine).

c. Install IMU Processor CCA (**1A1A32**) back in Support Electronics card rack.

8.5.5 VERIFICATION OF POWERED OPERATION. After the hardware installation has been completed and the calibration PROMs have been installed, powered operation of the INS should be verified:

a. Refer to **Chapter 4, Scheduled Maintenance** to verify battery voltage, and charge battery if necessary.

b. Turn on RLGN in Test mode as outlined in **Paragraph 5.3**, and run the System Confidence self-test.

NOTE

Some tests may generate fault numbers because I/O devices and synchro output configuration have not been properly set. It may be necessary to select the System Configuration function and set Input/Output and Synchro Output configuration parameters to eliminate these false error conditions.

c. If System Confidence self-test passes, the installation Calibration and Configuration data can be entered. Refer to **Paragraph 8.6**.

d. After all Calibration and Configuration data have been entered and verified, turn off the RLGN and then turn power back on with Test mode selected. Repeat System Confidence self-test to verify proper operation.

8.6 DETERMINING CALIBRATION AND CONFIGURATION DATA.

After the INS has been installed, system calibration and configuration data must be determined. This data must then be entered into each RLGN's system memory via the Display after powered operation of the INS has been verified.

Correct determination and recording of the ship's INS system configuration data and RLGN cabinet alignment correction data is essential for correct navigational performance. **Figure 8-1** is a sample Installation Data Check Sheet. It is recommended that this sheet be copied and used to record the calibration and configuration data. After the recorded data has been entered into memory, a copy of the recorded data sheet for each RLGN should be filed with the ship's log or other safe location. This is so that the configuration data can be re-entered in the event that the data is lost due to failure or incorrect performance of maintenance on the RLGN.

The following paragraphs provide information for determining configuration and alignment correction data, which must be entered to complete the installation process.

8.6.1 OPTICAL MEASUREMENT OF CABINET AZIMUTH, PITCH, AND ROLL ALIGNMENT CORRECTION. (Refer to **Figures 8-6** and **8-7**.) After the RLGN Measurement Cabinet Assembly has been installed on the mounting base and the IMU Assembly has been installed in the cabinet, optical measurements must be made to determine the amount of misalignment between the reference axis of each IMU and ship's azimuth, pitch, and roll references. This data is recorded for entry into each RLGN as calibration offset values, which are used as corrections by the software.

The primary concerns when measuring misalignment angles are:

1. Measurement accuracy: The INS can provide azimuth, roll, and pitch outputs to high levels of accuracy only if the alignment between the IMU reference axes and the ship's reference axes are properly measured.
2. Proper determination of the polarity of all reference calibration numbers: The polarity of the calibration numbers entered from bulkhead-mounted reference mirrors or calibration benchmarks must be properly determined and entered into the offset calculations. Incorrect entry of the polarity of a calibration number will generate an error in the alignment reference that is twice as large as the reference calibration number.
3. Proper determination and entry of the polarity for the Mounting Misalignment data entered into the RLGN: As with reference calibration numbers, incorrect entry of the polarity (+ or -) Mounting Misalignment data will double the misalignment error-applied navigation data calculations.

Figure 8-2 illustrates the standard convention used to determine the polarity of the rotation offset for the calibration reference mirrors on the IMU Outer Gimbal Frame. This convention is normally applied to bulkhead-mounted mirrors used to reference the ship's azimuth, pitch, and roll axes. It is good practice, however, to verify the alignment of previously installed ship's reference mirrors back to the ship's master reference before using them as reference for determining alignment of the IMU. Measurement of cabinet-mounting misalignment from the calibration mirrors on the IMU and the configuration data entered to correct for misalignment are referenced to the azimuth, pitch, and roll axes of the IMU, and not to the ship's rotational axes. Cabinet pitch axis misalignment is always measured using calibration mirror M1 on the IMU. Cabinet roll axis misalignment can be measured using either calibration mirror M2 or M3. Cabinet azimuth axis misalignment can be measured using any of the three calibration mirrors. This relation is shown in **Figure 8-6**.

When measuring and recording mounting misalignment values, it is important to remember:

1. In a bow- or stern-mounting orientation, the RLGN cabinet pitch axis and roll axis are aligned to the ship's pitch axis and roll axis references.
2. In a port or starboard mounting orientation, the RLGN cabinet pitch axis is aligned to the ship's roll axis reference and the RLGN cabinet roll axis is aligned to the ship's pitch axis reference.
3. When data is recorded and entered during installation configuration, the misalignment numbers are for cabinet pitch (forward/backward tilt of the cabinet) and cabinet roll (side-to-side tilt of the cabinet), regardless of the ship's rotational axis reference used for making the measurement.
4. The rotation convention for the calibration mirrors (and for the angular offset of the optical calibration device) is the same, regardless of the mirror used for measuring mounting misalignment as is shown in **Figures 8-2** and **8-6**, view A. The software automatically makes any necessary mathematical conversions of polarity based on the cabinet mounting orientation and the calibration mirrors selected during entry of the cabinet mounting misalignment configuration data.

As previously stated, the actual procedure used for measuring cabinet-mounting misalignment will be determined by the following:

- Type of optical equipment available.
- Location and type of references (scribe marks or bulkhead-mounted mirrors).
- Mounting orientation of the IMU.
- Clearance for setting up the measurement equipment.
- Obstructions to lines of sight to references.

Figure 8-7 shows a typical setup for measuring mounting misalignment of the IMU. In the example, the cabinet is mounted in a bow orientation (cabinet door and front of IMU frame positioned toward stern of the ship). The following procedure provides an example method for measuring cabinet azimuth and pitch-mounting misalignment using two autocollimators and a bulkhead-mounted mirror, which is calibrated to the ship's azimuth and pitch references.

EXAMPLE PROCEDURE:

Establish lines of sight (LOS 1 and LOS 2) shown in **Figure 8-7**, view A as follows:

a. Position one autocollimator (B) so that a collimated image can be obtained from the ship's reference mirror (A). When a collimated image is obtained, lock the autocollimator (B) in position and set the autocollimator azimuth and elevation dials to indicate zero.

b. Determine the mirror azimuth and pitch calibration numbers. Unlock autocollimator (B) and rotate the autocollimator in azimuth and elevation until the numbers are set on the azimuth and elevation dials. Line of sight (LOS 1) is now aligned parallel to the ship's azimuth (fore/aft) and pitch reference.

c. Lock autocollimator (B) in position and set the autocollimator azimuth and elevation dials to indicate zero.

d. Position the second autocollimator (C) so that a collimated image can be obtained from IMU reference mirror M1 (D). When a collimated image is obtained, lock autocollimator (C) in position and set the autocollimator azimuth and elevation dials to indicate zero.

Establish the transfer line of sight (LOS 3) shown in **Figure 8-7**, view B as follows:

e. Rotate both autocollimators toward each other and adjust the azimuth and elevation of each until a collimated image of the other instrument can be obtained in each autocollimator.

f. Lock both autocollimators in position and record the dial readings from each instrument.

Example:

- Autocollimator (B):
- Azimuth = 037°24′17″
- Elevation = –03°13′21″
- Autocollimator (C):
- Azimuth = 036°18′21″
- Elevation = +02°35′42″

g. For azimuth misalignment, subtract the absolute values of the readings for autocollimator (C) from auto-collimator (B). The absolute values of the results (001°05′56″ for azimuth and 00°37′39″ for elevation) are the azimuth and pitch mounting misalignment of the IMU.

h. To determine the polarity of the mounting misalignment angles, the following rules apply:

(1) If LOS 2 is to the observer's left of LOS 1 (as illustrated in the example shown in **Figure 8-7**), then for each axis: If the absolute value of the angle from autocollimator (C) is smaller than the absolute value of the angle from autocollimator (B), the misalignment data is recorded as a positive value.

(2) If LOS 2 is to the observer's right of LOS 1 (mirror image of the setup illustrated in **Figure 8-7**), then for each axis: If the absolute value of the angle from autocollimator (C) is larger than the absolute value of the angle from autocollimator (B), the misalignment data is recorded as a positive value.

Check the results as shown in **Figure 8-7**, view C as follows:

i. Lock autocollimator (C) in position and set the autocollimator azimuth and elevation dials to indicate the same readings as autocollimator (B).

j. Unlock autocollimator (B) and rotate the autocollimator in azimuth and elevation until the azimuth and elevation dials indicate zero. Line of sight (LOS 2) is now aligned parallel to (LOS 1).

k. Adjust the autocollimator to obtain a collimated image from calibration mirror M1. Verify that the azimuth and elevation dials now indicate the same values as obtained in step g.

NOTE

Mounting misalignment angles are entered into the Calibration and Configuration function as decimal values with three places of accuracy (nearest 1/1000 degree). If angles are measured in degrees, minutes, and seconds, the angles must be converted for data entry.

l. Record the mirror used to make each mounting misalignment measurement and record the cabinet misalignment angle measured from each mirror.

m. Convert the misalignment angles to decimal format for calibration data entry. Since one arc minute is equal to 1/60 degree and one arc second is equal to 1/3600 degree, in the above example for azimuth and cabinet pitch misalignment determined in step g:

$+1°05'56'' = 1° + [5' \times (1/60)] + [56'' \times (1/3600)] = 1.0988\ldots$

$= +1.099$ degrees

$+0°37'39'' = 0° + [37' \times (1/60)] + [39'' \times (1/3600)]$

$= +0.628$ degrees

8.6.2 DETERMINING CONVENTION FOR AZIMUTH, PITCH, AND ROLL OUTPUT DATA. (Refer to Figure 8-8.) Two standard conventions are used for establishing the convention applied to rotation vectors for ship's heading, pitch, and roll. These are U.S. Navy Convention and Standard NATO Agreement (STANAG) 4222 convention. Figure 8-8 illustrates the vector relationship for each convention.

The INS can be configured to use either convention for determining the sign applied to all heading, pitch, and roll data output by the system. This selection is made by selecting the **Sign Convention <2>** key on the **Ship Configuration** menu and is determined by the standard applicable to the particular ship's configuration. Incorrect selection for the Sign Convention will cause all pitch and roll data reference angles to be reversed.

8.6.3 DETERMINING LEVER ARMS FOR INS MOUNTING LOCATION AND POSITION AND VELOCITY OUTPUT LOCATIONS. (Refer to Figure 8-9.) Offset of the IMU mounting location from the ship's pitch and roll axis introduces accelerations that result from ship's motions. The magnitude and direction of the accelerations is determined by the distance and direction of the mounting location from each axis. These distances are called lever arms.

In a similar manner, the location on the ship designated as the reference point for ship's position or velocity may be different from the actual mounting location of the IMU. By determining and entering the position of this point with respect to the IMU mounting location, the navigation system will calculate position and velocity data as if it were actually mounted at the position and velocity reference point. Since the designated position reference point and the velocity reference point may be different, the lever arms for each of these data output points can be set independently.

Lever arms are measured from the IMU to the axis of rotation or output data reference point. The convention for determining lever arms' axis, polarity, and length is shown in Figure 8-9. These distances must be determined in feet and entered in the **Lever Arms** menu of the System Configuration function.

8.6.4 DETERMINING LEVER ARMS FOR POSITION AND VELOCITY SENSORS. (Refer to Figure 8-10.) In a similar manner to the offset of the IMU mounting location from the ship's pitch and roll axis, offset of the position and velocity sensor mounting locations from the ship's pitch and roll axis causes cyclic variations in position and speed data which result from ship's motions. The magnitude and direction of the variations are determined by the distance and direction of the sensor mounting location from each axis.

Lever arms for sensors are measured from each sensor to the axis of rotation, or to a ship's reference point. The convention for determining sensor lever arms' axis, polarity, and length is identical to that used for IMU mounting location lever arms. These distances must be determined in feet and entered in the **Position Reference Devices** and **Velocity Reference Devices** menus of the System Configuration function.

Note that the Global Positioning System (GPS) can be configured as both a position reference device and as a velocity reference device. In this case, two sets of lever arms must be determined for the GPS antenna mounting location. One set of lever arms (Position Reference) is determined from the GPS antenna to the center of each navigation system IMU.

The second set of lever arms (Velocity Reference) is determined based on the GPS installation configuration. The navigation system has the capability of communicating lever arm and attitude data to the GPS. In some installation configurations, the GPS can use this data to translate its position and velocity output data so that the GPS antenna appears to be located at the mounting position for the navigation system IMU. When this installation configuration is selected, the velocity reference lever arms for the GPS velocity reference (VGPS) are measured from each IMU to the ship's center of rotation as shown in Figure 8-11, view A. These values are the same as those determined for the IMU mounting locations lever arms.

If the GPS does not receive lever arm and IMU attitude data from each navigation system, then all GPS data is referenced to the actual GPS antenna mounting location. Then the lever arms for the GPS velocity reference (VGPS) are measured from the GPS antenna mounting location to the ship's center of rotation as shown in Figure 8-11, view B.

8.7 ENTERING INSTALLATION AND CONFIGURATION DATA.

The operator enters configuration data using a System Configuration menu, which is accessed by turning on the navigation system in the Test mode. After the data has been entered and stored, copies of the data remain stored in EEPROM (KENV) memory on Status and Command CCA (1A1A15) and in RAM on Navigation (Nav) Processor CCA (1A1A13). Figure 8-12 provides a complete menu tree for the System Configuration function. To turn on the navigation system and select the System Configuration function, proceed as follows:

a. Press the **<TEST>** key and set the **SYSTEM POWER** switch to ON. (Hold the **<TEST>** key depressed until cursor disappears from screen—approximately seven seconds.)

b. Press the **<4>** key to select the **Configuration Selection** menu. This menu provides up to three configuration choices based on memory passing software-initiated checksum tests:

- **1 Reset**
- **2 KENV : SN nnn**
- **3 Backup**

c. (a) If all stored values are to be re-entered, press the **<1>** key to select the Reset function. This function clears any previously stored configuration data and activates the System Configuration data entry menu.

OR

(b) If configuration has been previously performed and data stored, press the **<2>** key to select the **KENV** function. This selection retains previously stored configuration data and activates the System Configuration data entry menu.

d. Sequentially select each configuration function and manually enter correct configuration data and settings using the keypad.

e. Verify that all displayed data is correct, and then press the **<ENTER>** key.

f. Complete data entry for each configuration function, and then select the **<1>** key function to store data.

8.7.1 STORE FUNCTION.

NOTE

Up to the point before the **<ENTER>** key is pressed, neither EEPROM nor RAM has been altered, and the configuration update procedure can be terminated by repeated pressing of the **<CLEAR>** key.

To store the configuration data, return to **System Configuration** menu and press the **<1>** key to select the **Store** function. Hold switch S1 on Status and Command CCA (1A1A15) in the write enable (down) position (spring-loaded position) and press the **<ENTER>** key. Selected configuration data will be written into both EEPROM and RAM. Observe that the verification message “store operation complete, hit CLEAR” is displayed at the bottom of the screen.

8.7.2 INPUT/OUTPUT FUNCTION SELECTIONS. The **Input/Output** (I/O) function allows selection of active INS-INS, Doppler Sonar Velocity Log (DSVL), and Asynchronous Transfer Mode (ATM) interfaces and external I/O ports; and setting of the message protocol established for the device connected to the selected I/O port. Toggled or listed choices are selected by pressing the associated number key until the correct choice is displayed. Select:

a. I/O Installed = yes

b. I/O BUS Configuration; (16 pages, one page configures each I/O port).

Enable/disable physically installed Naval Tactical Data System (NTDS) I/O port.

Assign the Interface Design Specification for data/message type to be communicated via the enabled port.

Set and enable or disable specific message parameters unique to the requirements of receiving device to be accessed via the port. Depending on Interface Design Specification (IDS) Code set, these include (for NTDS Ports):

- Retries − ENBL/DSBL
- Forced EF − ENBL/DSBL
- Parity − ODD/EVEN
- Parity − ENBL/DSBL
- Day − ENBL/DSBL
- Secondary − ENBL/DSBL
- Nav Msg − ENBL/DSBL
- Attd Msg − ENBL/DSBL
- Msg Rate − 8 Hz/16 Hz
- Precision − HIGH/NORM

Or, for ATM Ports, these include:

- Ext Fix − ENBL/DSBL
- GPS Fix − ENBL/DSBL
- FCN 3 − ENBL/DSBL
- Vref Input − ENBL/DSBL
- Attd Data − ENBL/DSBL
- FCN 6 − ENBL/DSBL
- Depth − ENBL/DSBL
- BFTT In − ENBL/DSBL
- Grav Grad − ENBL/DSBL
- SLCM In − ENBL/DSBL

NOTE

For parallel I/O boards, configure port 1 Enabled and set the applicable IDS code. Configure port 2 Disabled and set the IDS code to 00. Refer to **Table 8-4** for listing of factory-selected Port/IDS numbers. Refer to **Table 8-5** for a listing of IDS codes vs Interface Design Specification and applicable NTDS I/O Board types.

c. Two RLGNs Configured

- Second RLGN Installed = yes
- This RLGN Primary = (yes or no)
- RLGN Designation = (1 or 2)

(Configure Primary status and Designation number for each RLGN in a dual system. The system designated “Primary” should be designated as number 1. This is an arbitrary selection and affects only certain status bits inserted in the NTDS output messages.

d. Remote Control (installed) = yes

8.7.3 REFERENCE DEVICES FUNCTION SELECTIONS. The **Reference Devices** function is entered for the configured Position and Velocity Reference Devices. Data entered for the configured Velocity Reference Device consists of speed bias offset values and the synchro scaling and gradient associated with each device. Synchro scaling divides the synchro gradient, which is typically 100 knots per revolution, between forward and reverse motion, read as clockwise or counterclockwise rotation of the synchro signal. For example, a 90/10 ratio allows for up to 90 knots of forward speed, and 10 knots in reverse. If the reverse motion happens to exceed 10 knots, the synchro input will read the forward motion that would normally be indicated by that position of the synchro. For example, -11 knots would “roll over” to 90 knots at the next synchro update. Lever arm length and sign for Position and Velocity Sensors are determined as described in **Paragraph 8.6.4**, and **Figures 8-10** and **8-11**. All data, except for speed bias calibration values for Velocity Sensors, are entered during the initial system configuration. Bias calibration values are determined and entered during sea trials (refer to **Paragraph 8.8**.)

a. Position Reference Devices – Allows selection of up to three position sensors (one per page) and entry of lever arm lengths and signs for selected position sensors.

b. Velocity Reference Devices – Allows selection of velocity sensors and entry of speed bias offset values and synchro scaling and gradient values, as applicable.

c. Depth Reference Devices – Not used in surface configurations.

d. Attitude Reference Devices – Not used in surface configurations.

8.7.4 OPERATOR CONFIGURATION FUNCTION SELECTIONS. The **Operator Configuration** function provides menus for setting parameters associated with display of data and modes of operation that will be available from the Display Panel. Select by pressing the associated number key until the correct choice is displayed.

a. Normal/Transverse (Norm/Txvs) – Selects modes available to the operator with which the system can be switched between the coordinates reference system used for calculation of position and heading. Refer to **Table 2-2**, **MODE** menu, **Norm/Txvs** function. Selectable modes are:

Auto/Manual – When this mode is chosen, the control selections available on the Mode Menu, Norm/Txvs function will be AUTO, Manual Normal (MNORM), and Manual Transverse (MTXVS).

Manual Only – When this mode is chosen, the control selections available on the Mode Menu, Norm/Txvs function will be limited to MNORM and MTXVS.

b. Reset Mode – Selects operator protocol to be used for entering position fixes from the navigation aid. Refer to **Table 2-2**, **MODE** menu, **Reset** function. Selectable modes are:

Auto, Auto/Review – When this mode is chosen, the control selections available on the Mode Menu, Reset function will be Auto, Auto/Review, and Review.

Auto/Review, Review – When this mode is chosen, the control selections available on the Mode Menu, Reset function will be limited to Auto/Review and Review.

Review – When this mode is chosen, the control selections available on the Mode Menu, Reset function will be limited to Review only.

c. Serial Number – Allows entry of RLGN serial number.

d. Velocity Damping – Allows selection of the velocity error damping method to be used when the system is operating in the Navigate mode. Two methods are available, these are Kalman and Third Order damping. Regardless of the method selected, Kalman is used by the system during Calibrate/Align. If Third Order is selected, the system switches to this method when it enters Navigate mode and switches back to Kalman whenever it switches back to the Calibrate/Align condition.

e. Control Panel Blank Time – Allows entry of the time interval required between keypad activities before the Display Panel is automatically blanked. 0 = No blanking.

f. Remote Panel Blank Time – Allows entry of the time interval required between keypad activities before the Display Panel on the Remote Control Display Unit is automatically blanked. 0 = No blanking.

g. Attitude Comparison Threshold – Allows selection of the default alarm comparison threshold for difference in attitude (heading, roll, or pitch) between the two inertial navigators.

h. Attitude Comparison Filter Constant – Allows selection of the default filter time constant for attitude comparison (1.28 seconds is the non-filtered value). The filter time constant is applied to the attitude comparison samples (once every 1.28 seconds) to filter ship’s motions from the calculation of the attitude differences compared to the threshold value.

NOTE

The selected Attitude Comparison Threshold and Filter Time Constant values should be determined based on the type of installation and anticipated ship dynamics. If the two inertial navigators are installed close to each other on a common rigid mounting structure, lower values can be selected without causing false alarm indications during operation. If the two inertial navigators are installed near opposite ends of a large vessel or on a small vessel that may experience severe roll/pitch dynamics, larger Attitude Comparison Threshold and longer Filter Time Constant settings may be required. The settings are used as the default values selected each time the system is turned on. These values can be changed through Operator menu functions at any time during operation of the system.

8.7.5 SHIP CONFIGURATION FUNCTION SELECTIONS. The **Ship Configuration** function provides menus for selecting parameters associated with ship type, data output convention, and ship’s design. Select by pressing the associated number key until the correct choice is displayed.

a. Ship Type - Selectable types are:

Surface – Selection of the Ship Type as Surface limits the selections on Page 3 of the SENSOR menu and Page 1 of the DISPLAY function menu by blanking depth-related display and depth sensor control functions. Refer to **Table 2-2 SENSOR** and **DISPLAY** menus.

b. Sign Convention (Refer to **Figure 8-8**) – Selects convention used for output of all heading, pitch, and roll data from the INS. Selectable types are:

U.S. Navy (Select for AN/WSN-7(V) systems)

STANAG 4222

c. Sideslip coefficient – Allows entry of ship's sideslip coefficient. This value is related to ship type and ship length. The value entered is compared against maximum reasonable limits and data entry is restricted to within this range. If the sideslip coefficient is not known at the time of installation, set the value to zero (default).

8.7.6 ALIGNMENT FUNCTION SELECTIONS. The **Alignment** function provides menus for selecting the IMU mounting orientation, entering angular offset values, and entering the lever arms associated with the IMU mounting location and data output points. Lever arms length and sign are determined as described in **Paragraph 8.6.3**. Select by pressing the associated number key until the correct choice is displayed.

a. Orientation (refer to **Figure 8-5**) − Selects mounting orientation of IMU. Selectable orientations are:

- Bow
- Starboard
- Stern
- Port

b. (Key number 2 not used)

c. Mounting Misalignment – Allows entry of angular offset values associated with the IMU. These optically determined values are the rotational offset of the IMU references from the ship's azimuth, pitch, and roll axes reference lines. Mounting misalignment values are determined as described in **Paragraph 8.6.1**.

Page 1, Azimuth misalignment – Allows selection of mirror used to measure azimuth misalignment (M1, M2 or M3) and entry of azimuth mounting misalignment angle measured from the indicated mirror.

Page 2, (cabinet) Pitch misalignment – Allows entry of cabinet pitch mounting misalignment angle. This angle can only be measured using mirror M1.

Page 3, (cabinet) Roll misalignment – Allows selection of mirror used to measure cabinet roll mounting misalignment (M2 or M3) and entry of cabinet roll mounting misalignment angle measured from the indicated mirror.

d. Lever Arms – Allows entry of lever arm lengths associated with IMU mounting location and location of the position and velocity output point(s). Methods for determining lever arms length and sign for the IMU and for the data output point(s) are described in **Paragraph 8.6.3** and **Figure 8-9**.

8.7.7 SYNCHRO OUTPUT FUNCTION SELECTIONS. The **Synchro Output** function provides menus for selecting ship's attitude and synchro velocity output, and scaling for ship's synchro heading, roll, and pitch outputs. Select by pressing the associated number key until the correct choice is displayed. Select the following settings:

a. Synchro attitude output = yes

b. SBA fitted = yes

c. Roll output = 2X/36X

d. Pitch output = 2X/36X

e. Synchro velocity output = yes

8.8 DETERMINING VELOCITY REFERENCE BIAS CALIBRATION VALUES.

Some types of Velocity Reference Devices can be calibrated so that speed output from the device to the INS is corrected at the device. Other types of Velocity Reference Devices output only raw (uncalibrated) speed data. If the Velocity Reference Device can be calibrated, the calibration values for speed should be set at the Velocity Reference Device, and the bias calibration values should be set to zero at the INS.

If the Velocity Reference Device is a type that cannot be calibrated, the speed bias (difference between the indicated and actual speed) can be determined and entered in the **System Configuration** menu. These bias values are then used internally by the INS to correct the raw speed data input when the Velocity Reference Device is selected.

The INS allows bias calibration values to be entered for fore/aft (x axis), stbd/port (y axis), and vertical (z axis) components of indicated speed for up to 11 different ship's speeds. The bias calibration required is dependent on the Velocity Reference Device. In general:

Water Speed:

- Axis (X), Electromagnetic (EM) Log or Single-Axis Doppler Log
- Axis (X, Y). Two-Axis Doppler Log

Ground Speed:

- Axis (X), Single-Axis Doppler Log (Bottom Lock)
- Axis (X, Y), Two-Axis Doppler Log (Bottom Lock) or Correlation Log
- Axis (X, Y, Z), GPS

A common method used to determine the speed bias calibration values is to make several trial runs on a constant heading in still water between reference points that allow the ship's actual speed to be calculated by elapsed time measurement. During each trial run, the forward (X axis) and stbd/port (Y axis) speed, and vertical (Z axis) speed for GPS are recorded for each Velocity Reference Device. These data points are used to generate speed error curves for the device. The bias calibration values are then determined for a set of selected speeds (4-knot intervals are suggested) from the curves.

Figure 8-13 provides a sample worksheet, which can be used for recording speed calibration run data and determining bias calibration data values. Make a copy of this figure for each Velocity Reference Device to be configured, enter the speed data, plot speed curves, and record the bias data for each applicable axis. (For additional information concerning log calibration, refer to **Paragraph 2.4.3**.) In the example graph shown in **Figure 8-3** for a single-axis log, four-speed calibration runs were made at measured speeds of 9.8, 21, 29, and 35.5 knots. The indicated speed from the Velocity Reference for each of these runs (heavy dots on the graph) was 11.1, 21.7, 27.2, and 31.6 knots. From the curve drawn through the data points, bias calibration values can be determined for any ship's speed. Bias calibration values were determined from the curve at 0 knots and at 4-knot intervals from 4 to 36 knots.

The bias calibration value for each speed is:

BIAS = (Indicated Speed) − (Actual Ship's Speed)

In the example graph (**Figure 8-3**), the bias calibration data from 0 to 23 knots are positive values; bias calibration data from 23 to 36 knots are negative values.

To enter the bias calibration data without resetting other previously entered configuration data to the default settings, proceed as follows:

NOTE

This procedure is used to correct or modify any configuration settings.

a. Turn on the RLGN in Test mode by holding the **<TEST>** key depressed when SYSTEM POWER switch is set to ON.

b. Press the **<4>** key to select **System Config** function; observe that **Configuration Selection** menu is displayed. This menu provides up to three configuration choices based on memory passing software-initiated checksum tests:

- **1 Reset**
- **2 KENV :SN nnn**
- **3 Backup :SN nnn**

c. Select **KENV** function **<2>** key to edit the configuration data.

NOTE

Do not press **Reset**. The function sets all data displayed on the **System Configuration** menus to the default values.

d. Press the **<3>** key to select the **Reference Devices** function, then press the **<2>** key to select the **Velocity Reference Devices** data entry menu.

e. Sequentially select each data entry page and manually enter bias calibration data values using the keypad.

f. Verify that each displayed data entry is correct, and then press the **<ENTER>** key.

g. Complete data entry for each bias calibration value for all configured Velocity Reference Devices and then proceed to step h to store data.

NOTE

Up to the point in step h before the **<ENTER>** key is pressed, neither EEPROM nor RAM has been altered, and the configuration update procedure can be terminated by repeatedly pressing the **<CLEAR>** key.

h. To store the indicated configuration data, return to **System configuration** menu and press the **<1>** key to select the Store function. Hold switch S1 on Status and Command CCA (**1A1A15**) in the write enable position (spring-loaded position) and press the **<ENTER>** key. Selected configuration data will be written into both EEPROM and RAM. Observe that the verification message “store operation complete, hit **CLEAR**” is displayed at the bottom of the screen.

8.9 DSVL INTERFACE MODIFICATION KIT INSTALLATION.

Table 8-6 identifies the DSVL Interface Modification Kit installation applicability by system type and Processor Cabinet part number. Because of variability between the Connector Mounting Plates, the correct kit part number must be used to modify the system. Install the modification kit per RLGN Field Change Bulletin 001 P/N 03956-EB1898369 (kit item 4). Installation associated with the DSVL interface also consists of fabrication of the system interface cable for the DSVL to INS serial data communication.

After installation of the correct revision-programmed Navigation Processor and I/O Processor boards, additional procedures consist of restoring system installation configuration data, and of selecting the DSVL as an installed input source on the Installation Menu for Velocity Reference Devices and setting the lever arms to the DSVL speed reference output location.

Since the Navigation Processor CCA (**1A1A13**) is replaced when the DSVL interface is installed, it is necessary to first re-establish all other installation configuration data into battery-backed RAM. For currently installed systems, this data can be transferred from EEPROM (KENV) on Status and Command CCA (**1A1A15**) for each system. Refer to Chapter 6, Section I for procedures to re-establish the system configuration settings from KENV into the battery-backed RAM on the Navigation Assembly Processor.

8.9.1 DSVL INTERFACE CABLE CONNECTIONS **Figure 8-14**, sheets 4 and 5, provide Installation Guidance including cable information additions associated with the DSVL interface (part of RLGN Field Change 1). **Figure 8-4** shows the inter-connection by jack and pin number for the data interface cable between the RLGN and the DSVL. Refer to this figure for wiring of the interconnection cable. Connectors for Electronics Control Unit (ECU) jacks J23 are included in item 3 of the DSVL Interface Field Change Kit (03956-PL1813788-var). Cable connectors for DSVL plugs P15 and P16 are included in the DSVL Installation Kit (03956-1806107).

8.9.2 DSVL INSTALLATION CONFIGURATION. After a currently installed Inertial Navigation System has been modified, and the current installation configuration data has been re-established for each RLGN (refer to Chapter 6, Section I), the DSVL input to each navigation system must be configured (refer to **Paragraph 8-6**). Configuration of the DSVL interface consists of selecting the DSVL as a velocity damping input and entering lever arm values for the offset between the DSVL data output location and the ship’s center of rotation.

Normally, the velocity sensors’ lever arms entered in each RLGN are determined from the velocity sensor location to the ship’s center of rotation (refer to **Figure 8-10**). The DSVL can, however, be independently configured (within the DSVL) to reference data output to a specific location other than the transducer. For this reason, the DSVL lever arm values set in the RLGN installation configuration must be determined from the velocity reference output location that is configured in the DSVL.

The recommended method of lever arm configuration is to select the ship’s center of rotation as the velocity reference output location and enter the lever arm values for this reference in the DSVL installation configuration. This, in effect, places the DSVL velocity sensor location at the ship’s center of rotation. With the velocity sensor located at the ship’s center of rotation, the velocity sensor lever arm values are then set to zero in both RLGN systems.

If other velocity configuration considerations require that the DSVL velocity reference output location be set to a location other than the ship’s center of rotation, then the lever arm values for each RLGN must be determined from this velocity reference location to the ship’s center of rotation and the offset values entered accordingly.

Table 8-1. Tools and Support Items Required for Installation

TOOL/EQUIPMENT	PART NO./NSN	USE AND APPLICATION
Socket, 7/16-inch	P/O 5120-01-429-6503	Battery removal
Socket, 3/4-inch	P/O 5120-01-429-6503	Stabilizer installation
Socket, 1-5/16-inch	5120-01-335-0830	IMU Platform installation
Socket, 1-7/16-inch	Installing activity provides	IMU Cabinet installation
Allen wrench, 3/16-inch L-type wrench	P/O 5120-00-935-4641	IMU Covers installation
Allen wrench, 7/32-inch L-type wrench	P/O 5120-00-935-4641	Door removal
Allen wrench, 5/16-inch L-type wrench	P/O 5120-00-935-4641	IMU Platform installation
Open-end wrench, 3/4-inch	Installing activity provides	Stabilizer installation

Table 8-2. Installation Materials and Bit Cables Kit 03956-1812650-var

ITEM	CAGE	PART NO.	DESCRIPTION	P/N 1981101 (QTY)		
				-6	-2	-3
1	81349	M39012/01-0005	Coaxial Connector Plug	2	2	–
2	03956	1812597-2	Triaxial Connector Plug	8	6	2
3	96906	MS27467T23A35P	Electrical Connector Plug	3	4	7
4	81349	M85049/17-22W06	Electrical Connector Backshell	3	4	7
5	96906	MS27488-22	Electrical Connector Plug End Seal	60	80	140
6	03956	1981552-1	BIT Test Cable (NTDS Type A)	1	1	1
7	03956	1981552-7	BIT Test Cable Adapter (NTDS Type E)	1	1	1
8	03956	1981552-8	BIT Test Cable	1	1	1
9	03956	1981552-10	BIT Test Cable (ISN)	1	1	1
10	03956	1981552-11	BIT Test Cable (Display)	1	1	1
11	03956	1981552-14	BIT Test Cable	1	1	1
12	03956	1981552-6	BIT Test Cable	1	1	–
13	03956	1860241	BIT Test Cable (DSVL)[1]	1	1	1
14	03956	1900239	BIT Test Cable (ATM)[1]	1	1	1

1 Part of RLGN Field Change 1.

Table 8-3. Common Installation Materials Kit 03956-1812807

ITEM	CAGE	PART NO.	DESCRIPTION	QTY
1	96906	MS3406D14S-2S	Electrical Connector Plug	1
2	96906	MS3406D14S-2SX	Electrical Connector Plug	1
3	96906	MS3406D40-56P	Electrical Connector Plug	1
4	96906	MS3406D20-27S	Electrical Connector Plug	1
5	96906	MS3406D24-28S	Electrical Connector Plug	1
6	96906	MS3406D22-14P	Electrical Connector Plug	1
7	96906	MS3406D28-21S	Electrical Connector Plug	1
8	81349	M85049/10-116W	Electrical Connector Backshell	1
9	81349	M85049/10-17W	Electrical Connector Backshell	1
10	81349	M85049/10-79W	Electrical Connector Backshell	1
11	81349	M85049/10-33W	Electrical Connector Backshell	1
12	81349	M85049/10-51W	Electrical Connector Backshell	1
13	81349	M85049/10-41W	Electrical Connector Backshell	1
16	81349	M85049/10-59W	Electrical Connector Backshell	1
17	03956	1813396	Hex Head Machine Bolt	8
18	96906	MS15795-826	Flat Washer 1.0"	8
19	96906	MS35338-148	Lock Washer 1.0"	8
20	96906	MS35308-306	Hex Head Cap Screw .250"-28 x .75" L	2
21	96906	MS15795-810	Flat Washer .25"	2
22	96906	MS35338-139	Lock Washer .25"	2
23	96906	MS51045-73	Hex Head Set Screw .375"-16 x .31" L	2
24	03956	1981573	Bracket Assembly Support	2
25	96906	MS27488-16	Electrical Connector Plug End Seal	29

Table 8-4. Factory (As Shipped) NTDS Configurations

Slot	Assy	Board Type	Port	IDS Code	Jack (1A1)	Board Type	Port	IDS Code	Jack (1A1)	Board Type	Port	IDS Code	Jack (1A1)
		Part Number 1981101-6				Part Number 1981101-2				Part Number 1981101-3			
XA3	A51	Type E (Serial)	A1		J8	Type E (Serial)	A1		J8	Type E (Serial)	A1		J8
			A2		J9		A2		J9		A2		J9
XA4	A52	Type E (Serial)	B1		J18	Type A (Parallel)	B1	00	J14	Type A (Parallel)	B1		J14
			B2		J19		B2	00	--		B2	00	--
XA5	A53	Type E (Serial)	C1		J16	Type E (Serial)	C1		J16	Type A (Parallel)	C1		J17
			C2		J17		C2		J17		C2	00	--
XA6	A54	Type E (Serial)	D1		J14	Type D (Serial)	D1		J20	Type A (Parallel)	D1		J18
			D2		J15		D2		J21		D2	00	--
XA7	A55	Type D (Serial)	E1		J20	Type A (Parallel)	E1		J12	Type A (Parallel)	E1		J12
			E2		J21		E2	00	--		E2	00	--
XA8	A56	Type A (Parallel)	F1		J13	Type A (Parallel)	F1		J13	Type A (Parallel)	F1		J13
			F2	00	--		F2	00	--		F2	00	--
XA9	A57	Type A (Parallel)	G1		J10	Type A (Parallel)	G1		J10	Type A (Parallel)	G1		J10
			G2	00			G2	00	--		G2	00	--
XA10	A58	Type A (Parallel)	H1		J11	Type A (Parallel)	H1		J11	Type A (Parallel)	H1		J11
			H2	00	--		H2	00	--		H2	00	--

Table 8-5. Identification of NTDS Port Interface Design Specification

IDS CODE	NTDS TYPE	DIRECTION	SPECIFICATION
00	-	-	Not fitted
01	A	Input/Output	NAVSEA SE174-AB-IDS-010/GPS
02[1]	B	Input/Output	NAVSEA SE174-AB-IDS-010/GPS
03	A	Input/Output	S9427-AN-IDS-050/WSN-7 [T9427-AB-IDS-010/CVNS]
04	A	Input/Output	S9427-AN-IDS-070/WSN-7 [T9427-AA-IDS-010/WSN-5]
05[1]	B	Input/Output	S9427-AP-IDS-010/RLGN [T9427-BA-IDS-020/ESGN]
06[1]	B	Output	S9427-AP-IDS-020/RLGN [T9427-BA-IDS-030/ESGN]
07	D	Input/Output	S9427-AN-IDS-030/WSN-7 [T9427-AA-IDS-050/WSN-5]
08	A	Output	S9427-AN-IDS-040/WSN-7 [T9427-AA-IDS-060/WSN-5]
09	E	Output	S9427-AN-IDS-020/WSN-7 [T9427-AA-IDS-070/WSN-5]
10	E	Input/Output	S9427-AN-IDS-020/WSN-7 [T9427-AA-IDS-070/WSN-5]
11	A	Output	S9427-AN-IDS-060/WSN-7 [T9427-AA-IDS-080/WSN-5]
12	-	-	(Reserved)
13	E	Input/Output	S9427-AN-IDS-010/WSN-7 (Super Channel)
14[1]	B	Input/Output	S9427-AP-IDS-030/RLGN [0967-LP-027-7270/ESGN]
15[1]	B	Input/Output	S9427-AP-IDS-040/RLGN [0967-LP-027-7280/ESGN]
16	ATM	Input/Output	S9427-AN-IDS-080/WSN-7[2]
17-31	-	-	(Reserved)

1 IDS Code applies only to submarine installations.

2 Part of RLGN Field Change 1.

Table 8-6. DSVL Interface Modification Kit Application

KIT PART NUMBER	MODIFIES SYSTEM PART NUMBER	SYSTEM NOMENCLATURE	INSTALLATION APPLICATION	PROCESSOR CABINET ASSY PART NUMBER
1813788-1	1981101-6	CN-1695/WSN-7(V)	AEGIS Class Vessels	1981539-6
1813788-2	1981101-3	CN-1697/WSN-7(V)	Carrier Version (CVN, CV)	1981539-3

Rev: 08/23/06

FORWARD AN/WSN-7 CONFIGURATION DATA SHEET

SHIP/HULL NUMBER: USS SHIP NAME DDG 99　　INSTALLATION DATE: mm/dd/yy

CONFIGURATION REVISION DATE: mm/dd/yy *

AN/WSN-7 SERIAL NUMBER: ______　　IMU SERIAL NUMBER: ______

PROCESSOR REVISIONS:　NAV: ______　IMU: ______　I/O: ______

NOTE: NOTIFY ISEA OF ALL CHANGES. SPAWARSYSCEN AN/WSN-7 SUPPORT CENTER (888) 942-2232, MON-FRI 0800-1500 EST.

1 CALIBRATION PROMS RECORD: Verify installation and list serial number of PROMS installed in IMU Processor Memory CCA (1A1A32). (See Figure 6-4.)

ASSEMBLY:	LOCATION:	SET SERIAL NO:	ASSEMBLY:	LOCATION:	SET SERIAL NO:
IMU Platform	XU13		A Accel (A5)	XU12	
A Gyro (A1)	XU15	4625-	B Accel (A7)	XU14	
B Gyro (A2)	XU02	4425-	C Accel (A6)	XU01	
C Gyro (A3)	XU04	4525-	*HOLDER SOCKET	XU03	

2 INPUT/OUTPUT: Enable INS-INS port and configure NTDS ports to match NTDS Interface CCAs' installation configuration. Select system configuration protocol and RCDU installed status.

1. Installed (INS-INS I/O port): YES (X) NO ( )
2. I/O Bus Configuration: (17 pages. Each page sets one port.)

Board Location:	A51	
NTDS TYPE:	E	E
I/O Jack(s)	8	9
Port	A1	A2
Enable (E)	( )	( )
Disable (D)	(X)	(X)
IDS [1]	13	00
Ext. Fix (E/D)		
GPS Fix (E/D)		
Rmt Cntrl (E/D)		
Vref Input (E/D)		
Attd Data (E/D)		
Waypoint (E/D)		
Depth (E/D)		
FCN 8 (E/D)		
FCN 9 (E/D)		
FCN 10 (E/D)		
System Interface	SUPER	CHANNEL

Board Location:	A52		A53		A54		A55		A56	
NTDS Type:										
I/O Jack(s)										
Port	B1	B2	C1	C2	D1	D2	E1	E2	F1	F2
Enable (E)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
Disable (D)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)
IDS										
Retries (E/D)										
Parity (O/E)										
Forced EF										
Parity (E/D)										
Day (E/D)										
Secondary (E/D)										
Nav Msg (E/D)										
Attd Msg (E/D)										
Msg Rate 8/16)										
Precision (HI/Norm)										

[1] Port A1/A2, data entries are set as default with IDS code 13. No action required for setup.

Page 1

* When system configuration is changed, ensure that the revision date is updated. Also, provide a brief description in the "NOTES" section of Page 5 stating the reason for the configuration revision.

Figure 8-1. Sample Installation Data Sheet (Sheet 1 of 5)

Rev: 08/23/06

FORWARD AN/WSN-7 CONFIGURATION DATA SHEET

SYSTEM SERIAL NUMBER:

2 cont

Board Location:	A57		A58	
NTDS Type:	A	-		
I/O Jack(s)				
Port	G1	G2	H1	H2
Enable (E)	( )	( )	( )	( )
Disable (D)	(X)	(X)	(X)	(X)
IDS	01	00		
Retries (E/D)	D			
Parity (O/E)				
Forced EF	D			
Parity (E/D)	D			
Day (E/D)	D			
Secondary (E/D)	D			
Nav Msg (E/D)	D			
Attd Msg (E/D)	D			
Msg Rate 8/16)	8			
Precision (HI/Norm)	HI			
System Interface	GPS			

Board Location:	A4
NTDS Type:	ATM
I/O Jack(s)	22
Port	I
Enable (E)	( )
Disable (D)	(X)
IDS	00
Ext. Fix (E/D)	
GPS Fix (E/D)	
FCN 3 (E/D)	
VREF In (E/D)	
Attd Data (E/D)	
FCN 6 (E/D)	
Depth (E/D)	
BFFT In (E/D)	
Grav. Grad (E/D)	
SLCM In (E/D)	
System Interface	SPARE

3. Two RLGNs Configured:
   - Second RLGN Installed: YES (X) NO ( )
   - This RLGN Master: YES ( ) NO ( )
   - RLGN Designation: 1 (X) 2 ( )

4. Remote Control Installed: YES (X) NO ( )

5. ATM addresses:
   (Page 1 of 2)
   - Subnet Mask: ____ . ____ . ____ . ____
   - IP Address: ____ . ____ . ____ . ____
   - ARP Address: ______________________

   (Page 2 of 2)
   - NTP Address: ____ . ____ . ____ . ____

Page 2

Figure 8-1. Sample Installation Data Sheet (Sheet 2 of 5)

Rev: 08/23/06

FORWARD AN/WSN-7 CONFIGURATION DATA SHEET

SYSTEM SERIAL NUMBER:

3 REFERENCE DEVICES

1. Position reference devices: (Configure up to three devices – one for each Menu page.)

1. Type:

Type	Page 1	Page 2	Page 3
None	( )	( )	( )
GPS	( )	( )	( )
SLAVE	( )	( )	( )
EC	( )	( )	( )

2. Lever Arms:

X Arm			
Y Arm			
Z Arm			

2. Velocity Reference Devices: (Configure up to seven devices - one for each Menu page)

1. Type:

Type	Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7
None	( )	( )	( )	( )	( )	( )	( )
VGPS	( )	( )	( )	( )	( )	( )	( )
DSVL	( )	( )	( )	( )	( )	( )	( )
Rod 1	( )	( )	( )	( )	( )	( )	( )
Rod 2	( )	( )	( )	( )	( )	( )	( )
DUMMY	( )	( )	( )	( )	( )	( )	( )
VNVE	( )	( )	( )	( )	( )	( )	( )
SLAVE	( )	( )	( )	( )	( )	( )	( )

2. Lever Arms

X Arm							
Y Arm							
Z Arm							

3. Bias Calibration (For ROD1 or ROD2 only):

Bias table selected: KENV (X) NVRAM ( ) Zero ( )

Bias Tables (Calculate and record values for up to eleven speed readings for each device.):

5. Synchro Data:

Synchro input fitted: YES (X) NO ( )

Fore/Aft Ratio:

50/50	( )	( )	( )	( )	( )	( )	( )
90/10	(X)	( )	( )	( )	( )	( )	( )

Gradient (kts/rev):

100 kts/rev

3. Depth Reference Devices (Configure one device.):

Type:

None (X)

DEPTH ( )

Lever Arm: ______

4. Attitude References Devices:

Attitude Reference Fitted: YES ( ) NO (X)

Page 3

Figure 8-1. Sample Installation Data Sheet (Sheet 3 of 5)

Rev: 08/23/06

FORWARD AN/WSN-7 CONFIGURATION DATA SHEET

SYSTEM SERIAL NUMBER:

4 OPERATOR CONFIGURATION

(Page 1 of 2)

1. Normal/Transverse: (Switching Mode)
   Auto/Manual ( ) Manual Only (X)
2. Reset Mode:
   Auto Review/Review ( ) Auto Review ( ) Auto, Auto/Review, Review (X)
3. Serial No.: ______
4. Velocity Damping Kalman (X) 3rd Order ( )

(Page 2 of 2)

1. Control Panel Blank Time 10 mins. (10 default)
2. Remote Panel Blank Time 10 mins. (10 default)
3. Attitude Comparison Threshold .25 degrees
4. Attitude Comparison Filter Constant 001 seconds

5 SHIP'S CONFIGURATION:

1. Ship Type: Surface (X) Submarine ( )
2. Ship Convention: US Navy (X) STANAG 4222 ( )
3. Sideslip Coefficient: ______

6 ALIGNMENT: (INS cabinet mounting orientation, optical misalignment, and distance between IMU and ship's reference points.)

1. Orientation: Bow (X) Stern ( ) Stbd ( ) Port ( )

3. Mounting Misalignment:

1. Azimuth Misalignment Measurement:
   Mirror: M1 ( ) M2 ( ) M3 ( ) Misalignment Angle: ____°
2. Pitch Misalignment Measurement:
   Mirror: M1 (No Option) Misalignment Angle: ____°
3. Roll Misalignment Measurement:
   Mirror: M2 ( ) M3 ( ) Misalignment Angle: ____°

NOTE: Misalignment Angle values determined at system installation apply only to the IMU for which the values were optically measured. If the IMU is replaced, the system calculates new Misalignment Angles for the replacement IMU based on the data stored in the calibration PROM for the Replacement IMU. To maintain a record of the data required to totally reconfigure the INS, if the original installed IMU is replaced, the new system calculated Misalignment Angle values must be read and recorded on this data sheet. Refer to Chapter 6 of this Technical Manual.

Page 4

Figure 8-1. Sample Installation Data Sheet (Sheet 4 of 5)

Rev: 08/23/06

FORWARD AN/WSN-7 CONFIGURATION DATA SHEET

SYSTEM SERIAL NUMBER:

6 cont

4. Lever Arms:
   1. Distance to Center of Rotation (ft): X Axis ______ Y Axis ______ Z Axis ______
   2. Distance to Velocity Reference Point (ft): X Axis ______ Y Axis ______ Z Axis ______
   3. Distance to Position Reference Point (ft): X Axis ______ Y Axis ______ Z Axis ______
   4. Distance to Flight Deck (ft): Z Axis ______

7 SYNCHRO OUTPUT:

(Page 1 of 2)

1. Synchro Attitude Output:	YES	(X)	NO	( )
2. SBA Fitted:	YES	(X)	NO	( )
3. Roll Output:	1X/36X	( )	2X/36X	(X)
4. Pitch Output:	1X/36X	( )	2X/36X	(X)
(Page 2 of 2)				
5. Synchro Velocity Output	YES	(X)	NO	( )

NOTES:

NOTIFY ISEA OF ALL CHANGES. SPAWARSYSCEN AN/WSN-7 SUPPORT CENTER (888) 942-2232, MON-FRI 0800-1500 EST

Port "I" IDS to be configured '00', if ATM is not installed.

INSERT APPROPRIATE SHIP CLASS NAVSSI LEVER ARM TABLE

Page 5

Figure 8-1. Sample Installation Data Sheet (Sheet 5 of 5)

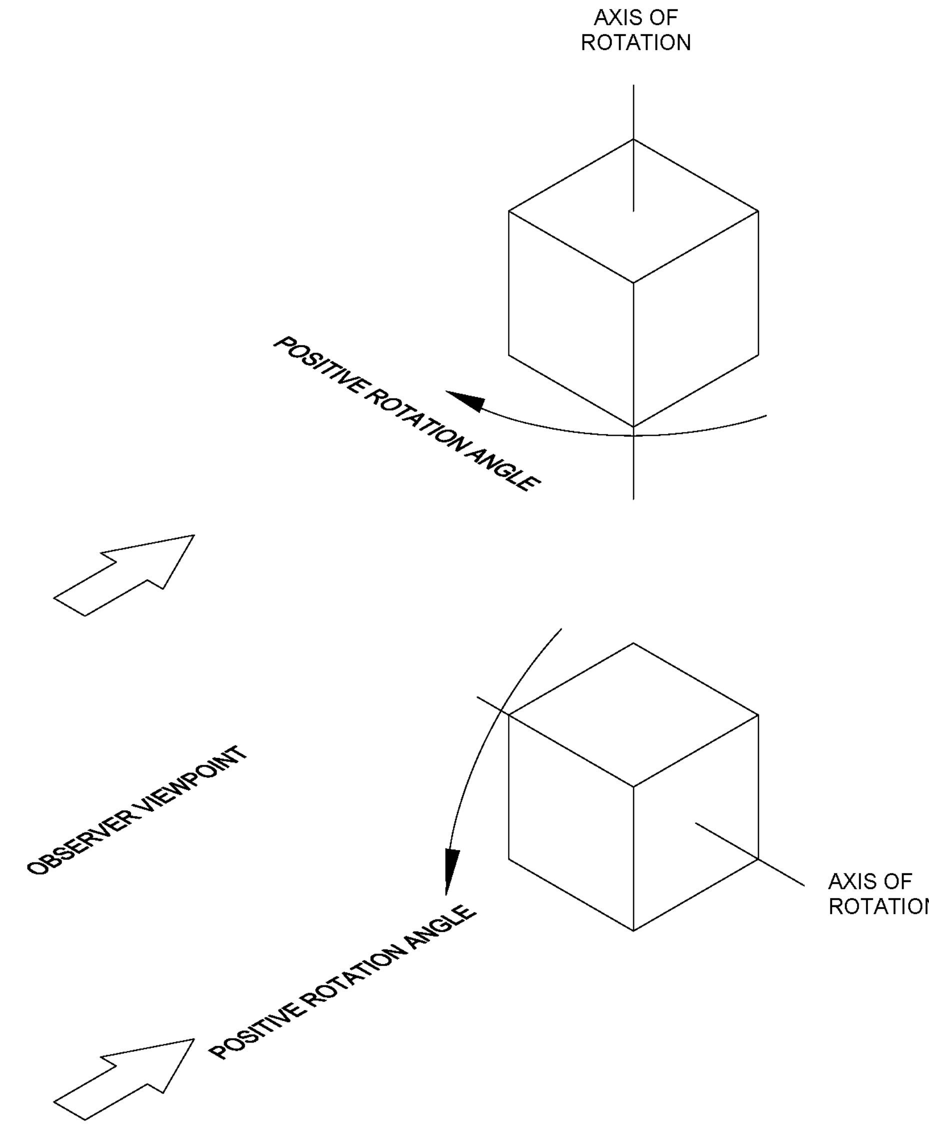


Figure 8-2. Polarity Definitions for Frame Mirrors

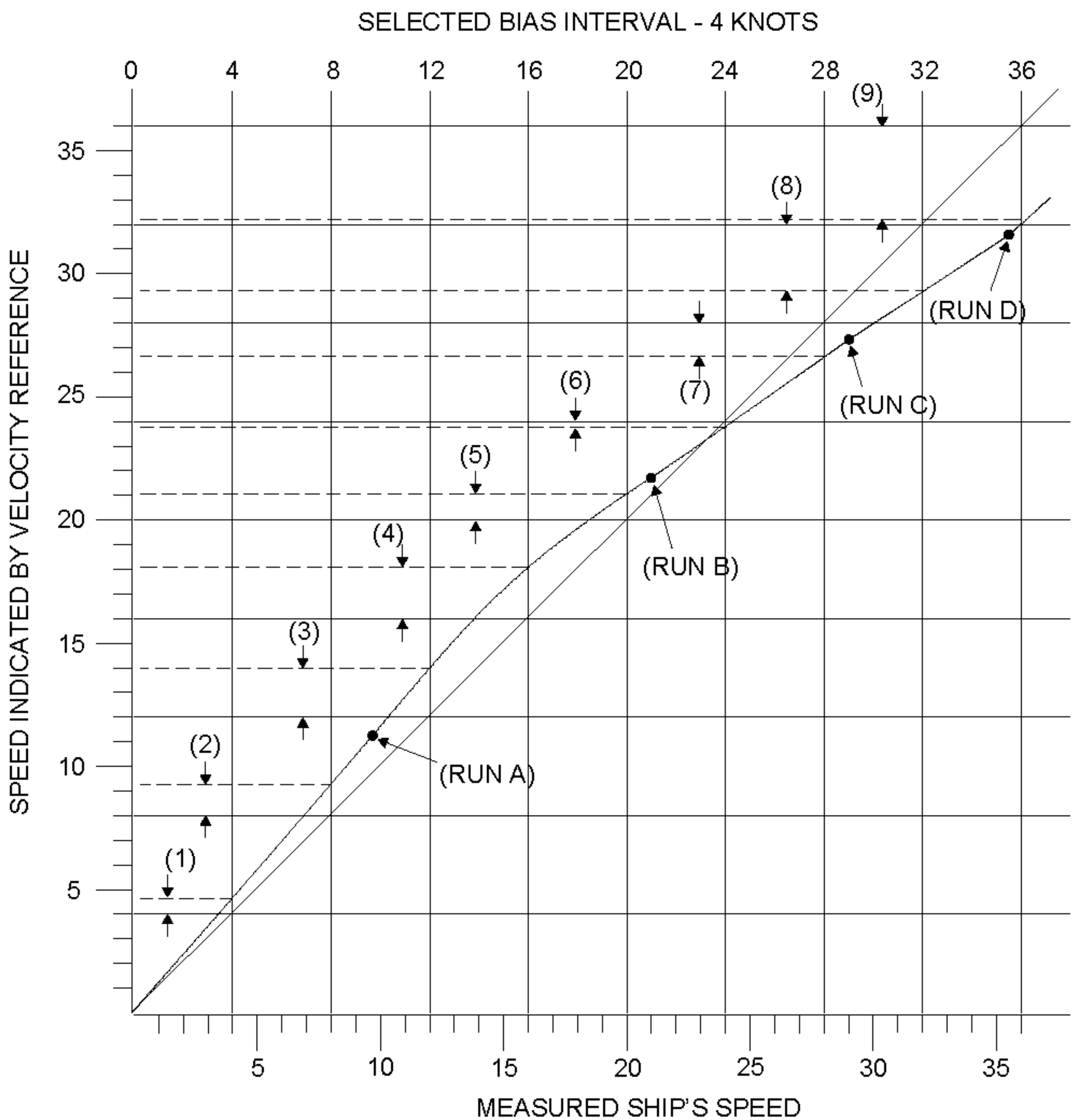


Figure 8-3. Bias Calibration Graph Example

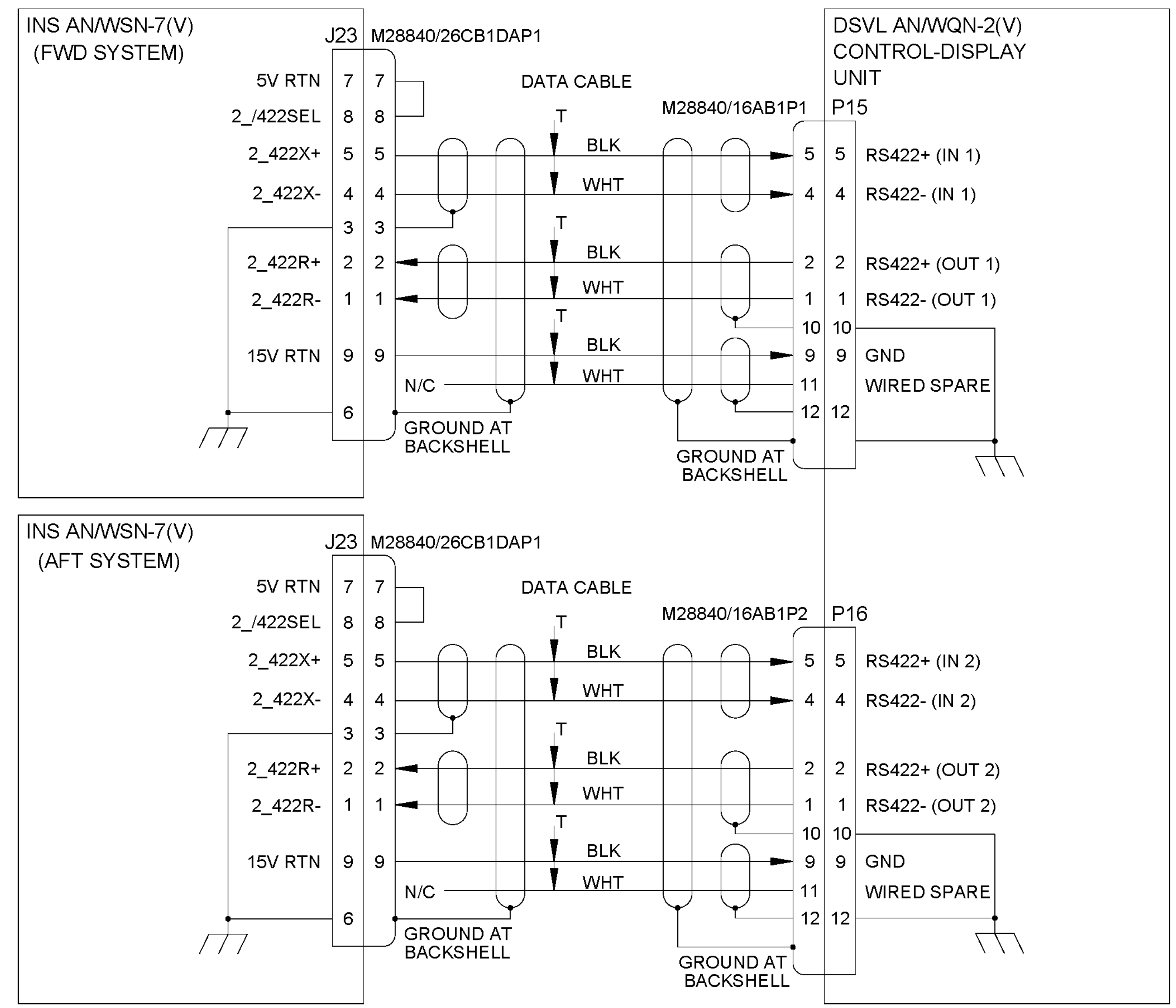
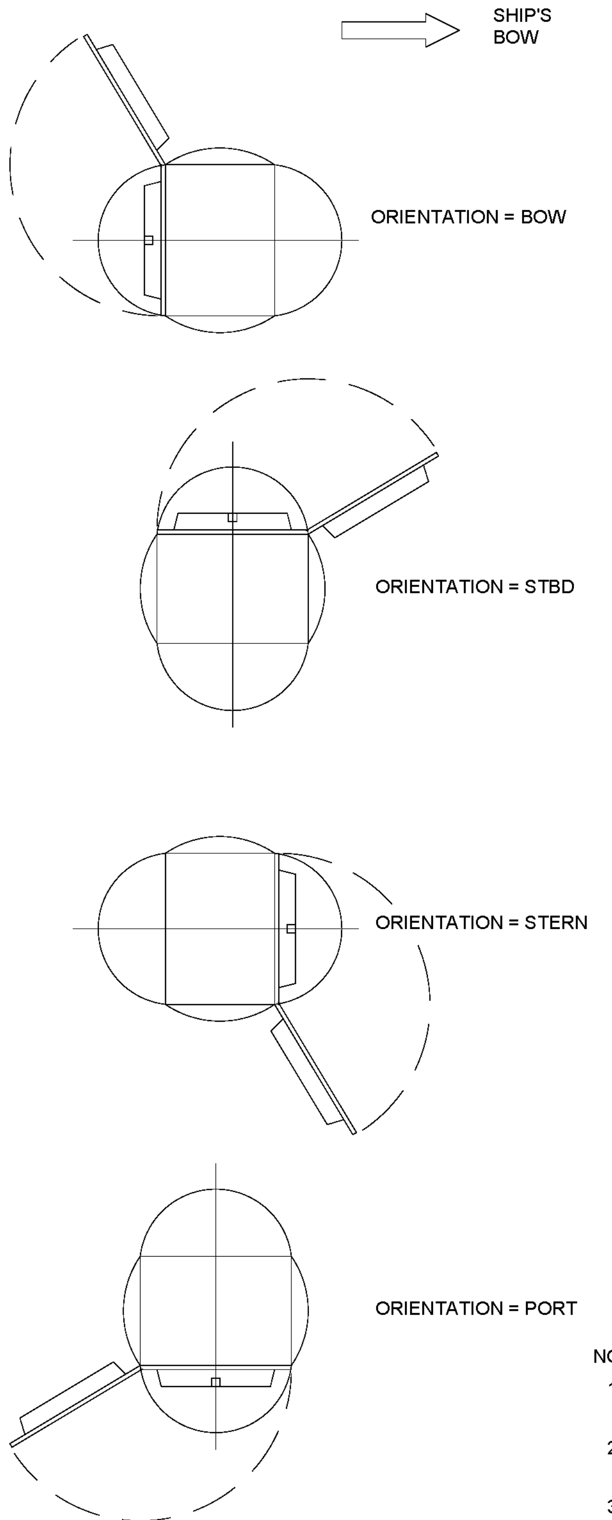
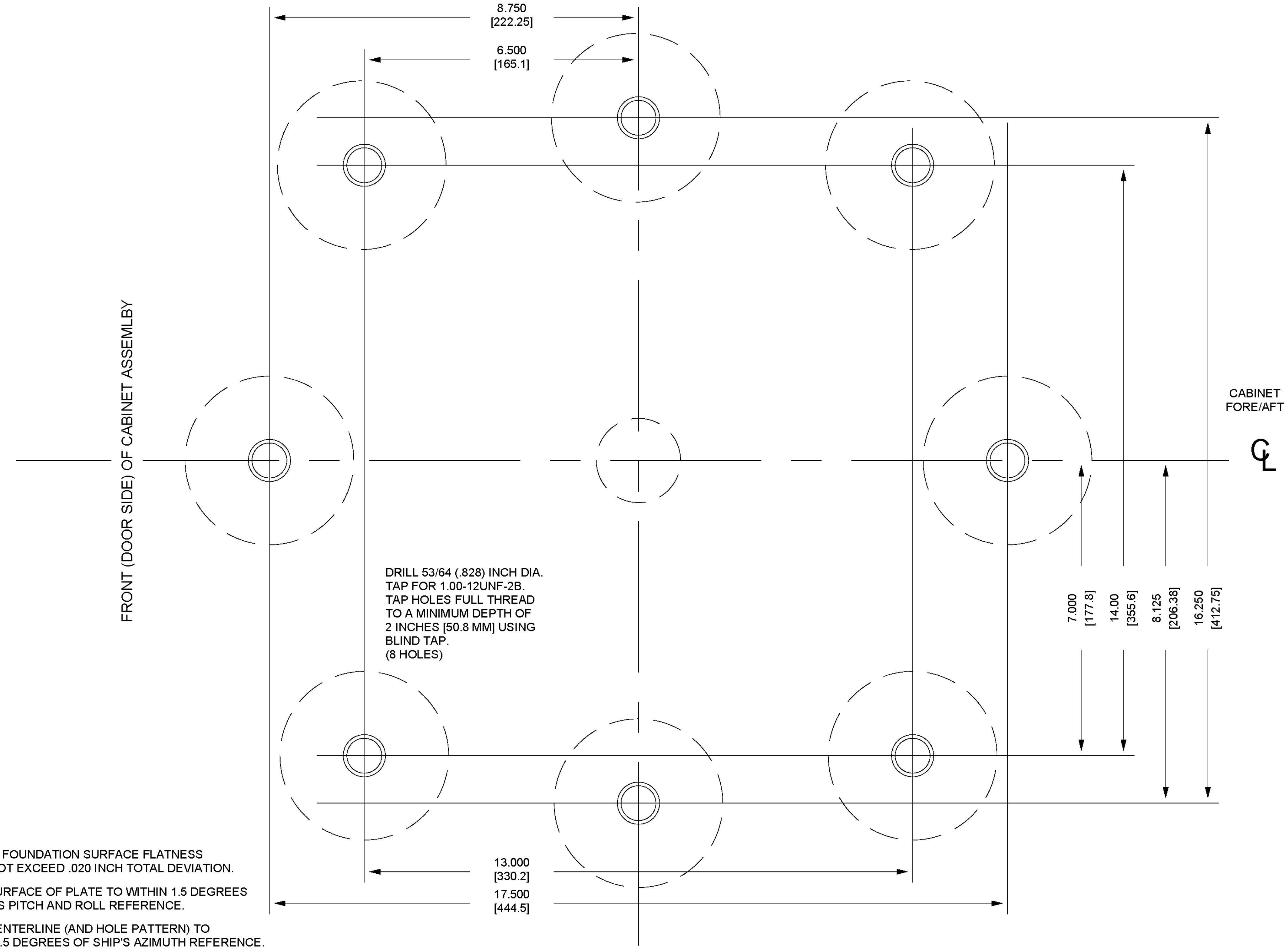


Figure 8-4. RLGN to DSVL Interface Cable Connections





NOTES:

1. CABINET FOUNDATION SURFACE FLATNESS SHALL NOT EXCEED .020 INCH TOTAL DEVIATION.
2. ALIGN SURFACE OF PLATE TO WITHIN 1.5 DEGREES OF SHIP'S PITCH AND ROLL REFERENCE.
3. ALIGN CENTERLINE (AND HOLE PATTERN) TO WITHIN 1.5 DEGREES OF SHIP'S AZIMUTH REFERENCE.

Figure 8-5. Mounting Base Orientation and Mounting Holes Location Diagram

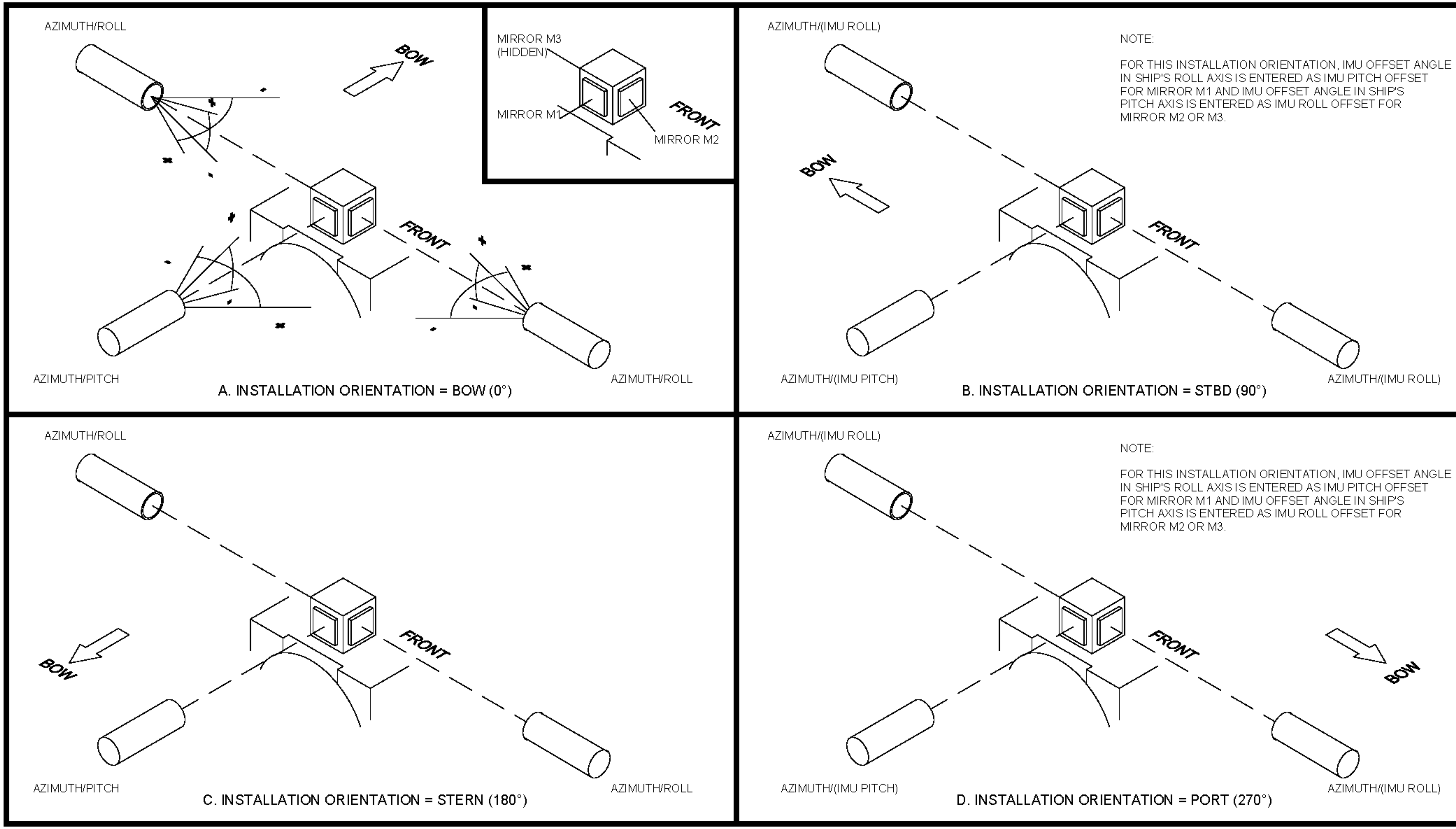


Figure 8-6. Identifying IMU Mirrors to be used for Optical Alignment of the Cabinet

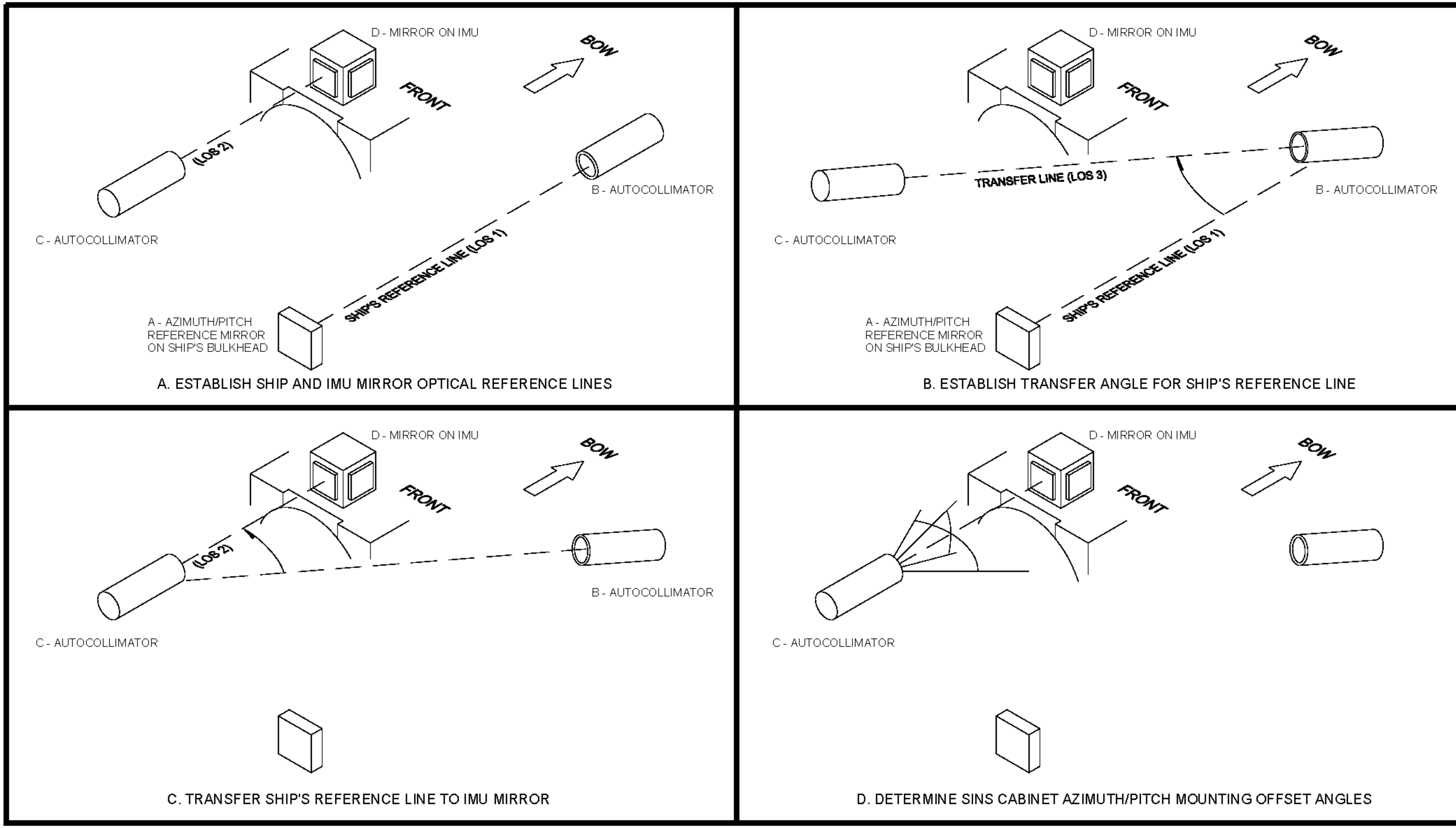


Figure 8-7. Optical Measurement of Cabinet Mounting Misalignment

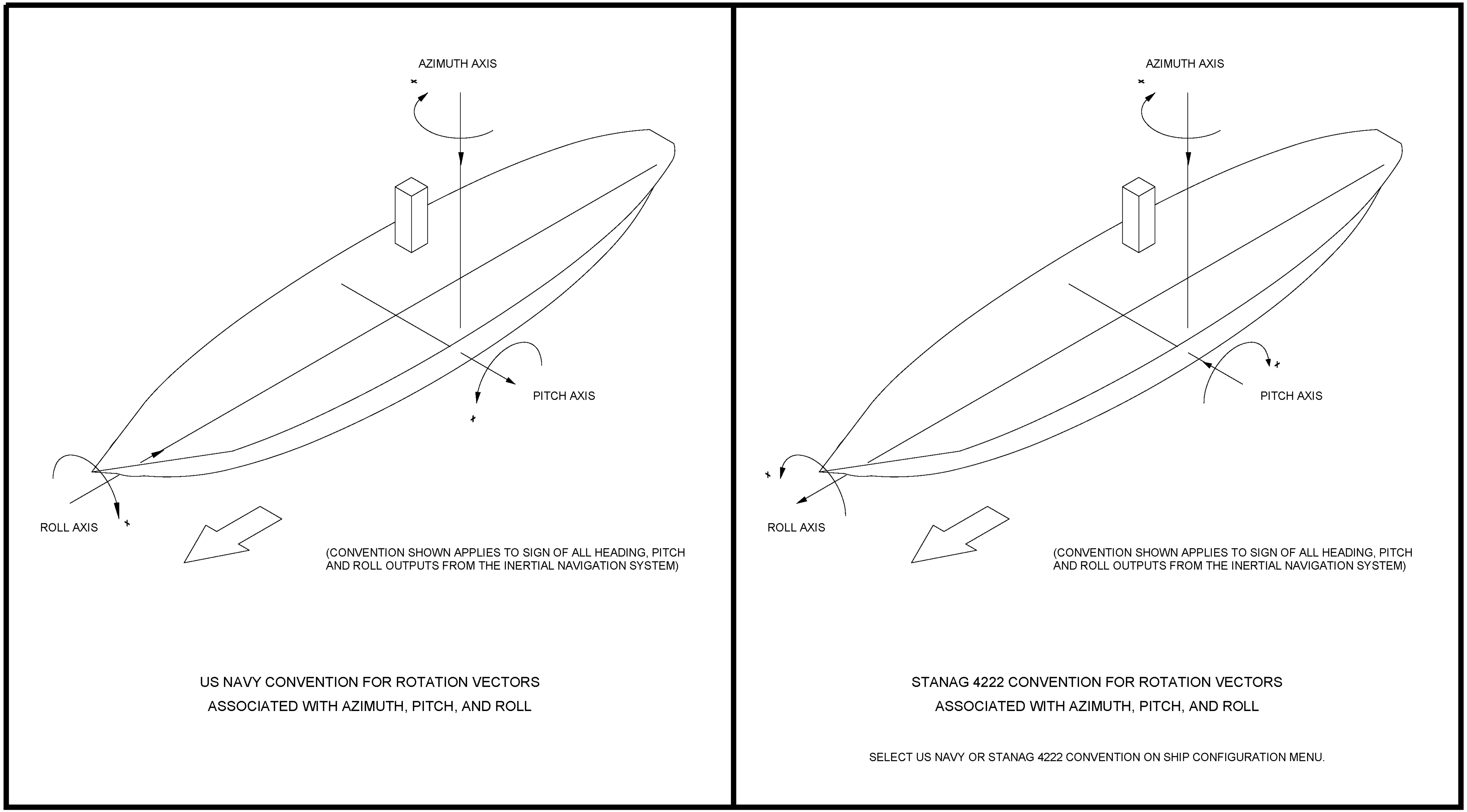


Figure 8-8. Determining Ship's Azimuth, Pitch, Roll Convention

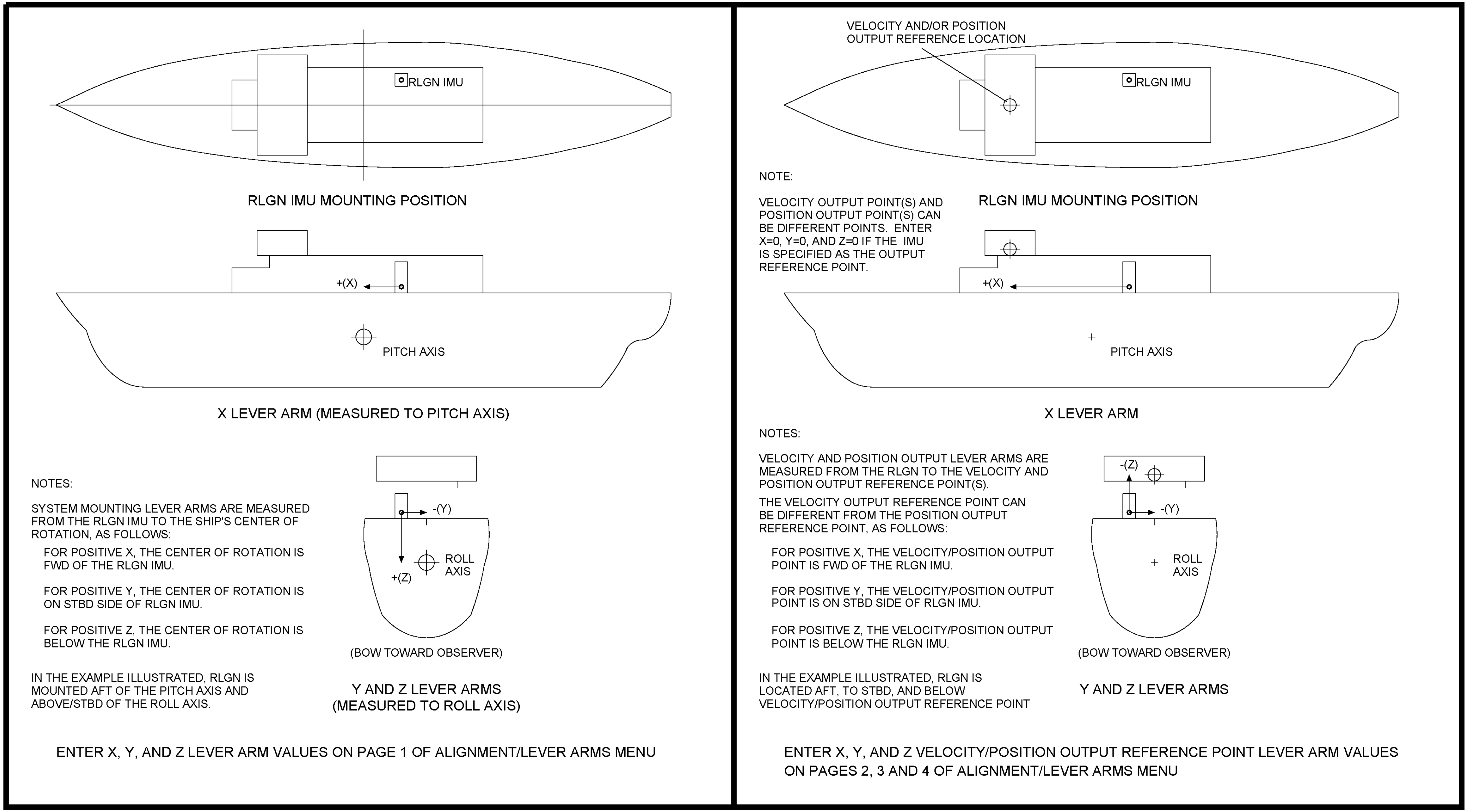


Figure 8-9. Determining INS Lever Arms

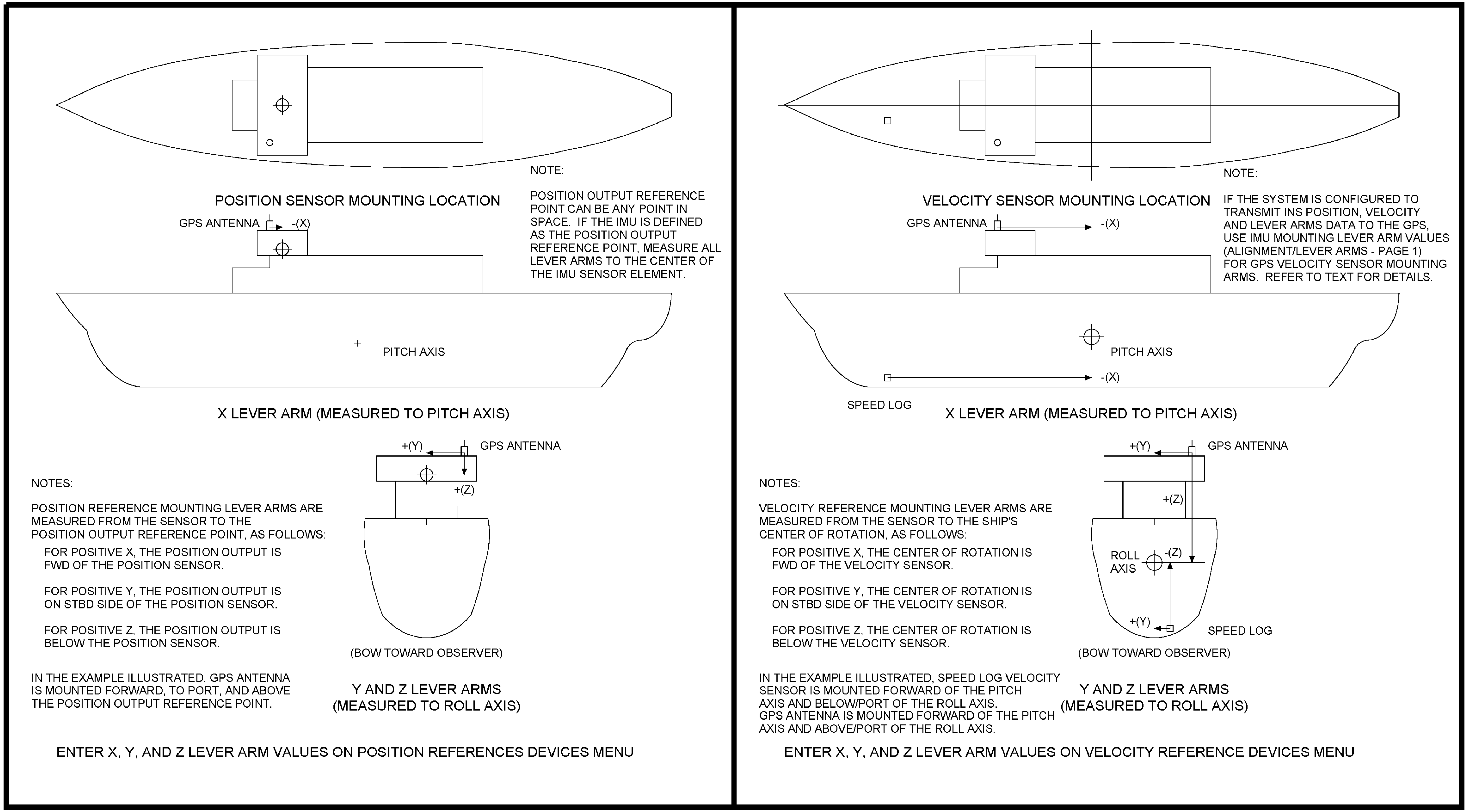
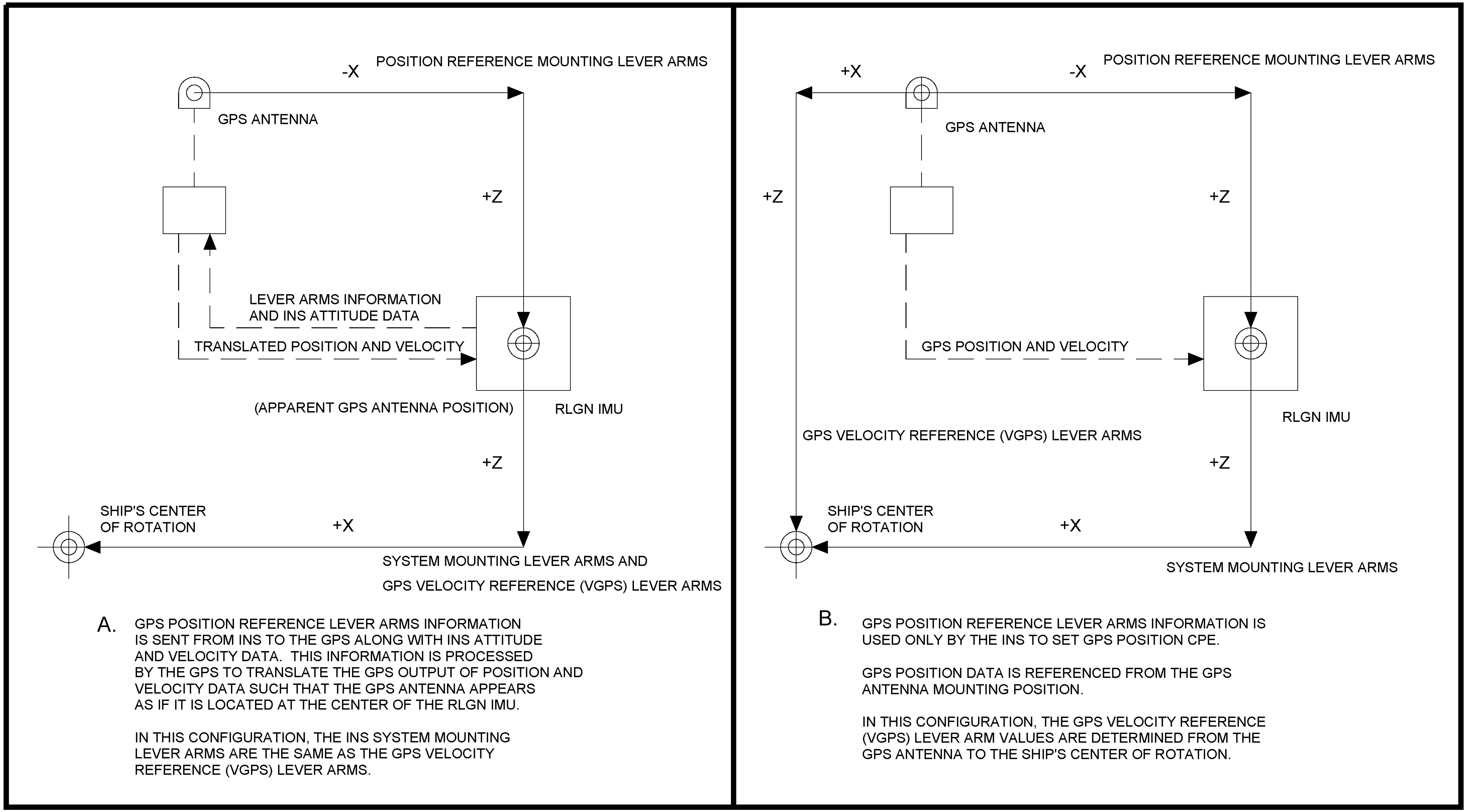


Figure 8-10. Determining Position and Velocity Sensors Lever Arms



NOTE: Y LEVER ARMS OMITTED FOR CLARITY

Figure 8-11. Determining GPS Velocity Sensors (VGPS) Lever Arms

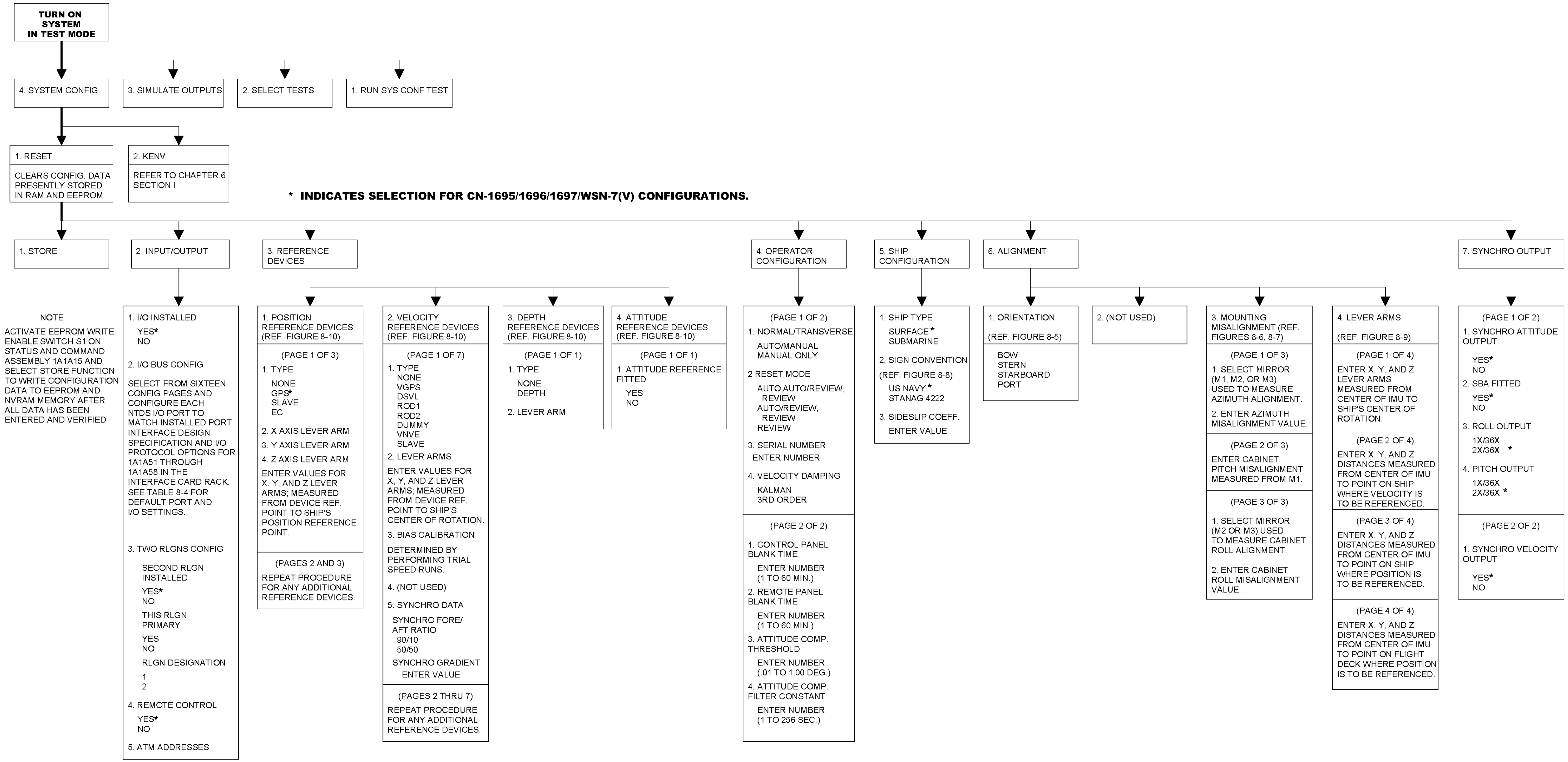


Figure 8-12. Identifying Installation Configuration Menus and Configuration Data Entry Required

SPEED CALIBRATION RUNS DATA:

FOR EACH SPEED CALIBRATION RUN, MEASURE AND RECORD SHIP'S ACTUAL SPEED AND RECORD SPEED INDICATED BY THE VELOCITY REFERENCE. USE DATA POINTS TO CONSTRUCT A SPEED CURVE FOR EACH APPLICABLE SPEED AXIS.

SPEED RUN	MEASURED SHIP'S SPEED	INDICATED SPEED X AXIS	INDICATED SPEED Y AXIS	INDICATED SPEED Z AXIS
A				
B				
C				
D				
E				
F				

VELOCITY REFERENCE(S) BIAS DATA:

USE CURVES TO DETERMINE BIAS VALUES (SPEED ERRORS) FOR EACH AXIS AT THE INDICATED SHIP'S SPEEDS. RECORD BIAS VALUES AND ENTER THE DATA ON THE SYSTEM CONFIGURATION MENU FOR THE CONFIGURED VELOCITY REFERENCE.

BIAS = (INDICATED SPEED) - (ACTUAL SHIP'S SPEED)

PAGE	SHIP'S SPEED (KTS)	SPEED BIAS CALIBRATION VALUES		
		X AXIS	Y AXIS	Z AXIS
1	0			
2	4			
3	8			
4	12			
5	16			
6	20			
7	24			
8	28			
9	32			
10	36			
11	40			

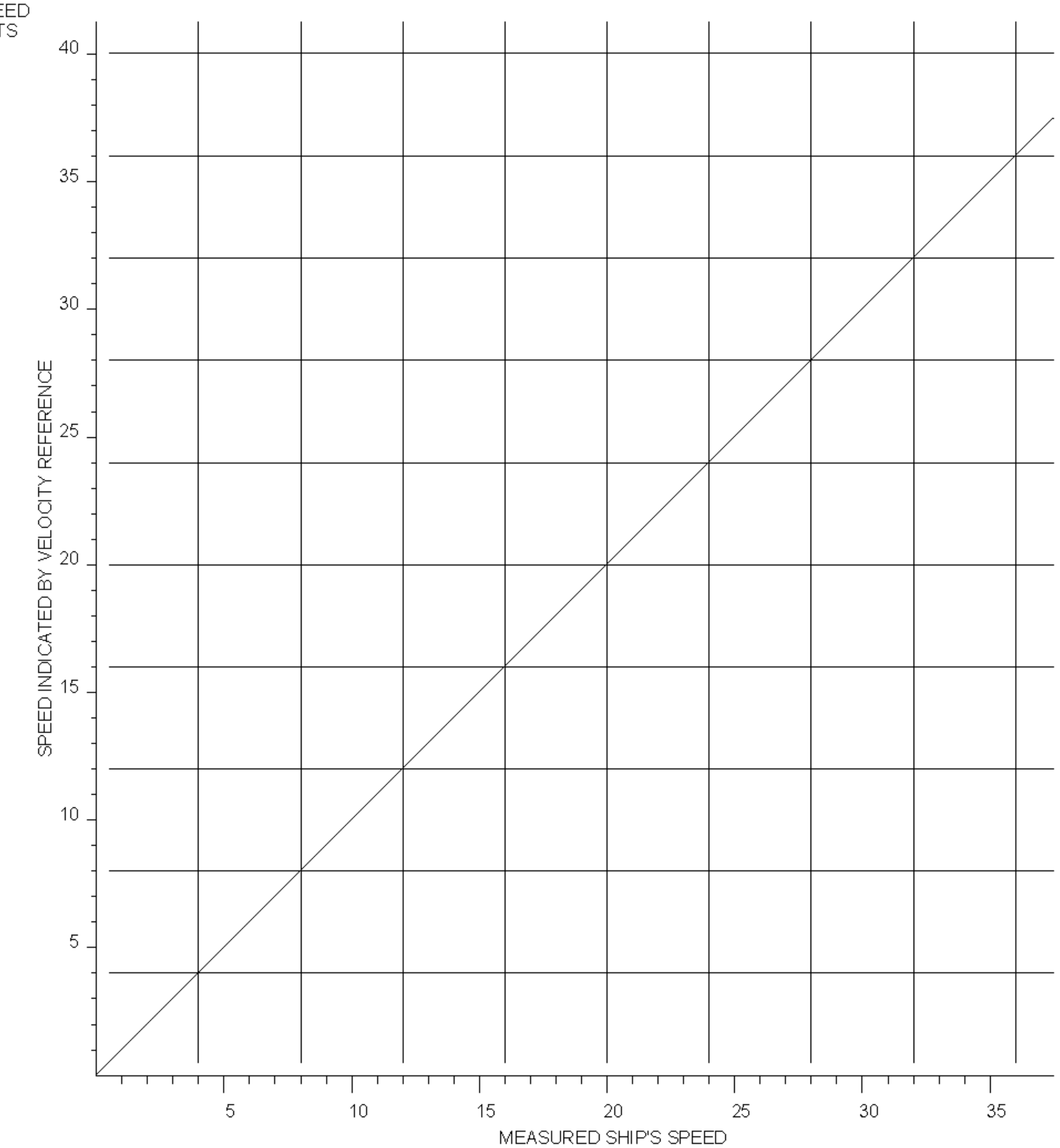
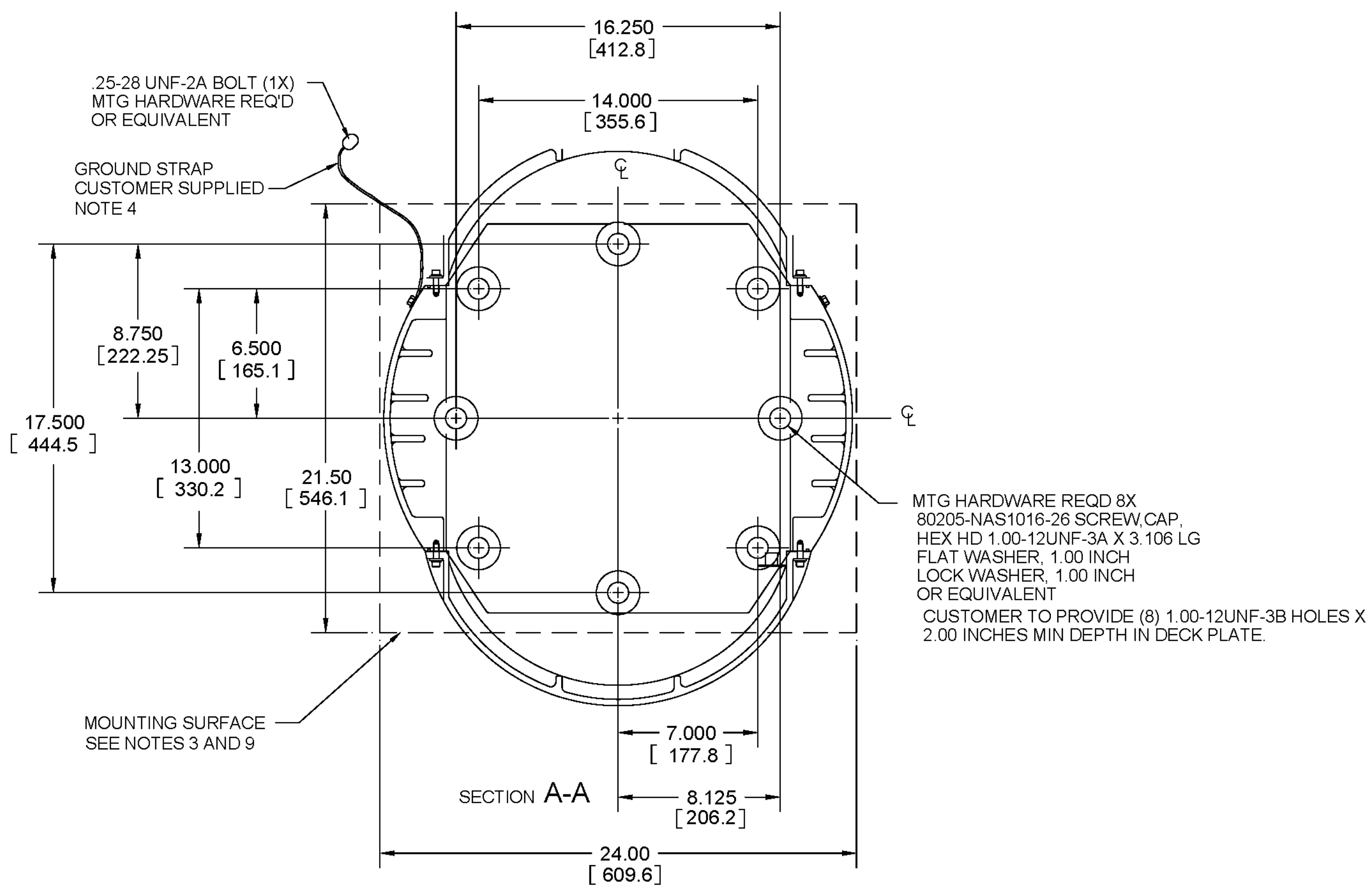


Figure 8-13. Sample Speed Bias Calibration Worksheet

GENERAL NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-D-1000, LEVEL 3.
2. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ANSI Y14.5M-1982.
3. MOUNTING SURFACE IS TO BE PARALLEL TO SHIP'S HORIZONTAL REFERENCE AXIS TO WITHIN 1.5°.
4. SURFACE VESSEL INSTALLATION CONSISTS OF ONE TYPE 3 BOND STRAP PER MIL-STD-1310 FIG.19, OPTIONAL POSITION.
5. ATTACH CABLE FROM SHIPS DIGITAL GROUND BUS.
6. UNIT WEIGHT: 840 LBS (381 KG).
7. ◐ DENOTES CENTER OF GRAVITY.
8. THE DECK SHALL BE ADEQUATE TO SUPPORT A RIGID ITEM WITH THE MASS, CG, FOOTPRINT SHOWN WITH NO RESONANCES BELOW 80 HZ. THE UPPER BRACE SHALL HAVE A MINIMUM STIFFNESS OF 150,000 LB/IN AND SHALL SUPPORT A MINIMUM LOAD OF 3000 LBS PERPENDICULAR TO THE FLOOR.
9. CABINET FOUNDATION SURFACE FLATNESS SHALL NOT EXCEED .020 INCH TOTAL DEVIATION.



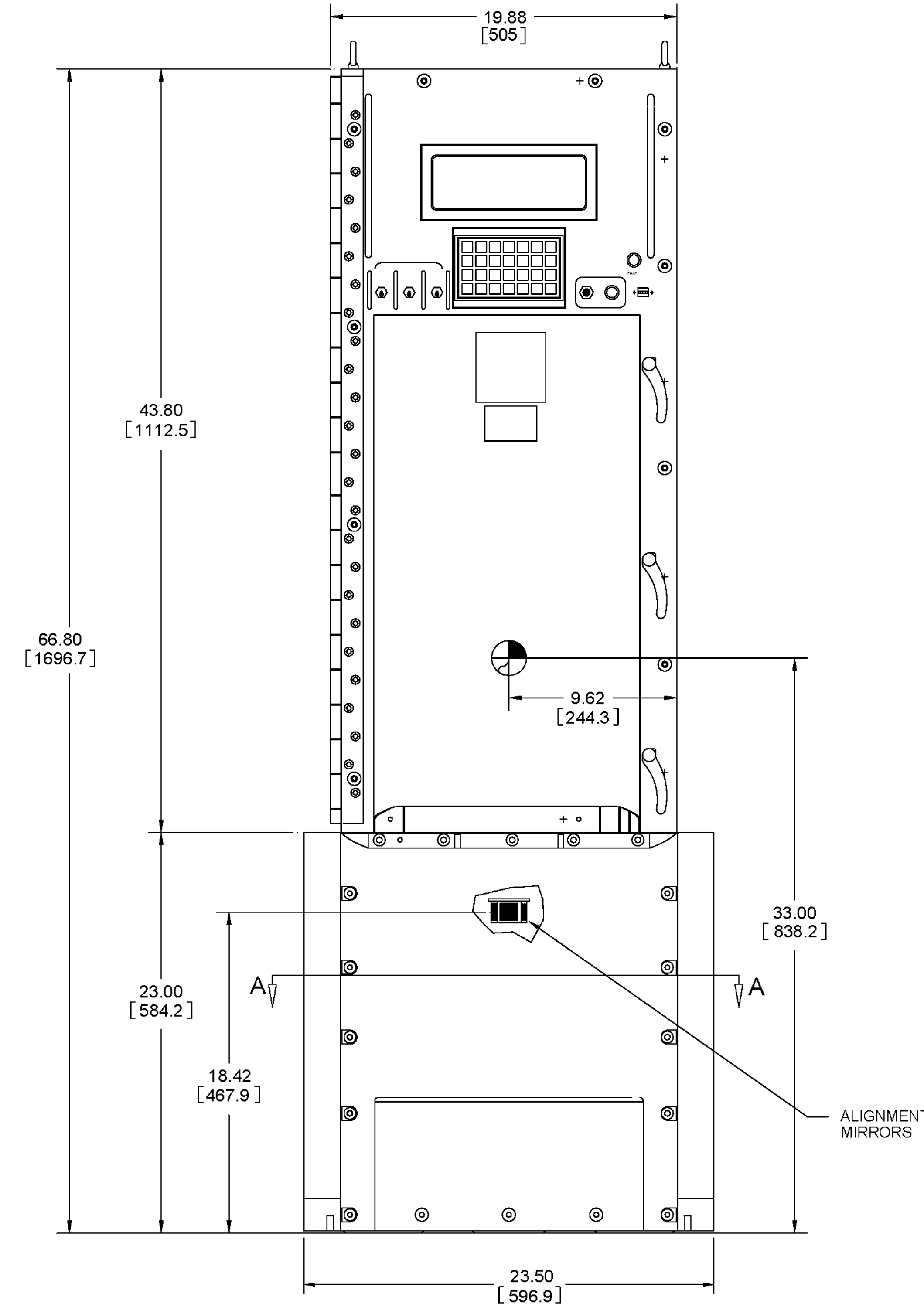


Figure 8-14. Installation Guidance Mounting Arrangement (Sheet 1 of 6)

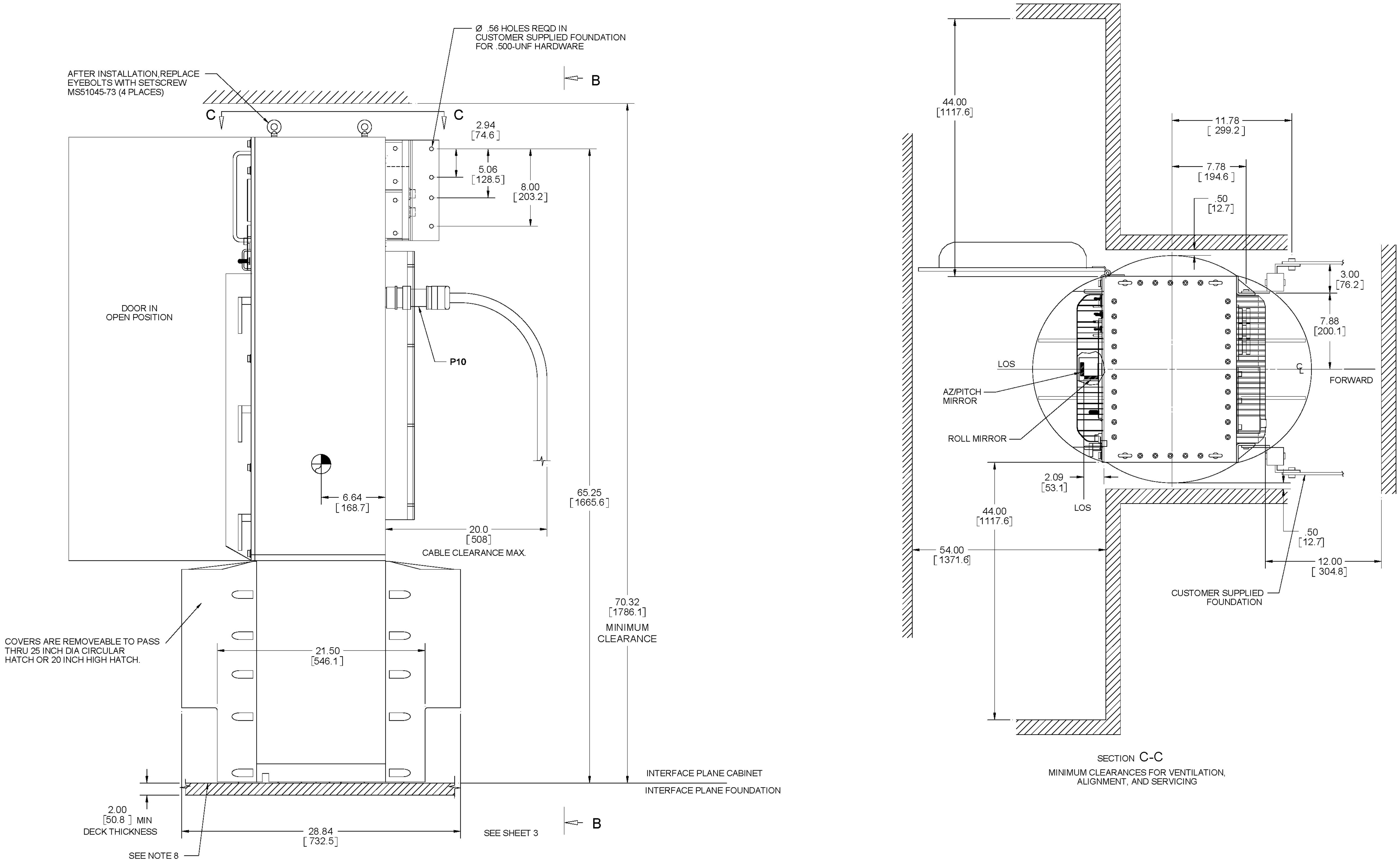


Figure 8-14. Installation Guidance Mounting Arrangement (Sheet 2 of 6)

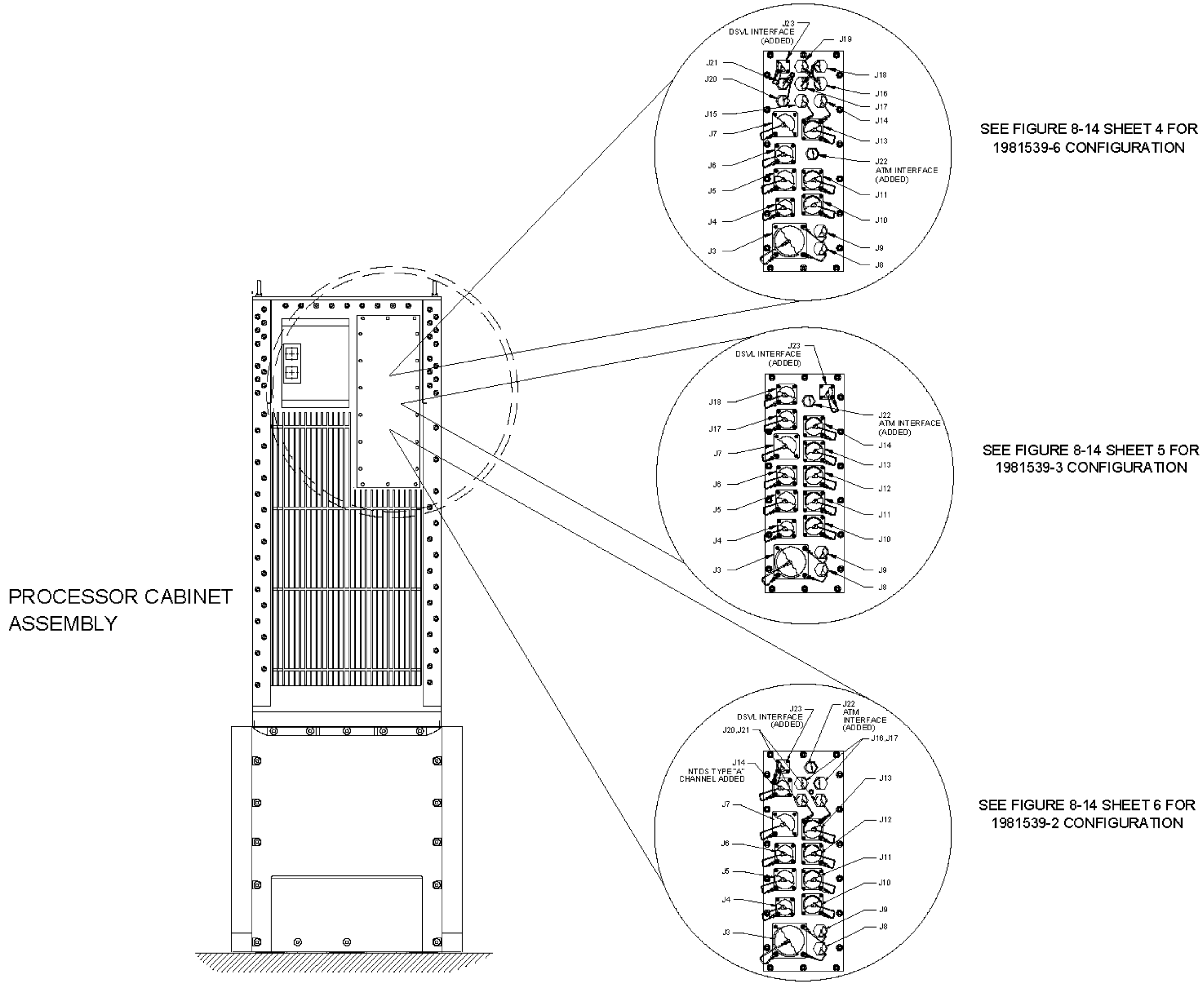
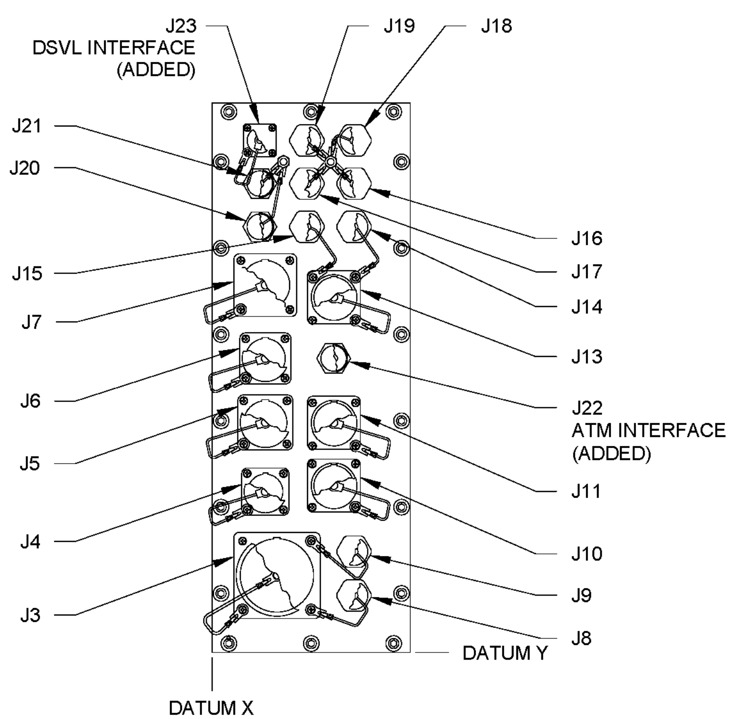


Figure 8-14. Installation Guidance Mounting Arrangement (Sheet 3 of 6)

CN-1695

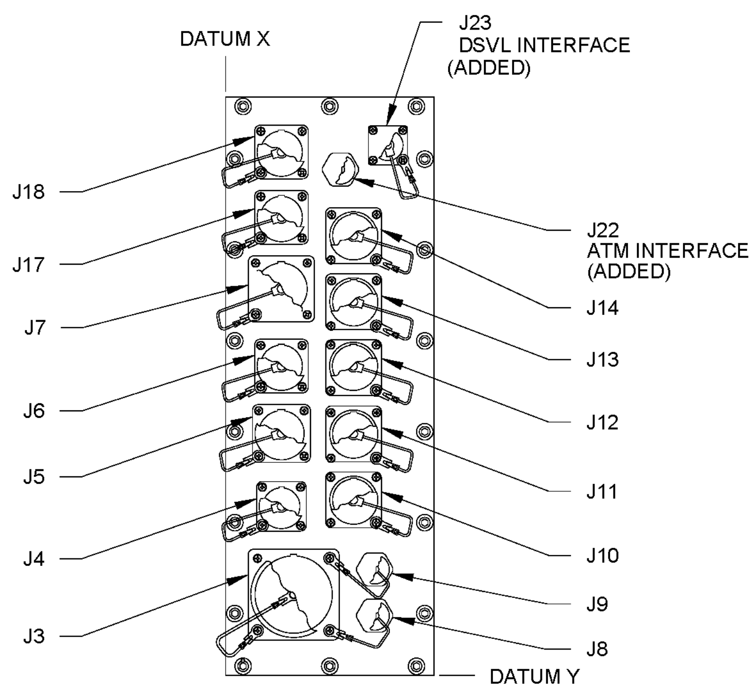


1981539-6 CONFIGURATION
SEE SHEET 3

REF DESIG	FUNCTION	CABINET SOCKET	RECOMMENDED CABLE TYPE	CABLE PLUG	BACKSHELL	CABLE LENGTH	CONNECTOR CENTERLINE DATUM 'X'	CONNECTOR CENTERLINE DATUM 'Y'
J1	SHIP'S POWER 115VAC, 60HZ, 3-PHASE	MS3402D14S-2P	TXOW-3	MS3406D14S-2S	M85049/10-116W	64 FT	-	11.69 IN.
J2	SYNCHRO REF,115VAC, 1 PH,400HZ	MS3402D14S-2PX	2XS0W-3	MS3406D14S-2SX	M85049/10-17W	600 FT	-	13.56 IN.
J3	ANALOG SYNCHRO OUTPUT	MS3402D40-56E	3XS0W-19	MS3406D40-56P	M85049/10-79W	110 FT	2.06 IN.	2.45 IN.
J4	EM LOG & REF., 400HZ OR 60HZ	MS3402D20-27D	3XSOW-7	MS3406D20-27S	M85049/10-33W	70 FT	1.69 IN.	5.12 IN.
J5	RCDU/FIM	MS3402D24-28D	2XSOW-12	MS3406D24-28S	M85049/10-51W	600 FT	1.69 IN.	7.33 IN.
J6	RLGN - RLGN	MS3402D22-14S	2XSAOW-7	MS3406D22-14P	M85049/10-41W	1000 FT	1.69 IN.	9.37 IN.
J7	ALARMS	MS3402D28-21D	3XSOW-14	MS3406D28-21S	M85049/10-59W	70 FT	1.69 IN.	11.7 IN.
J8	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	4.76 IN.	1.81 IN.
J9	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	4.76 IN.	3.21 IN.
J10	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	5.31 IN.
J11	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	7.31 IN.
J13	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	11.31 IN.
J14	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	4.52 IN.	13.56 IN.
J15	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	3.02 IN.	13.56 IN.
J16	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	4.52 IN.	14.93 IN.
J17	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	3.02 IN.	14.93 IN.
J18	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	4.52 IN.	16.31 IN.
J19	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A		900 FT	3.02 IN.	16.31 IN.
J20	NTDS SERIAL TYPE D	03956-1810919	M17/191-00001	81349 M39012/01-0005		1000 FT	1.52 IN.	13.56 IN.
J21	NTDS SERIAL TYPE D	03956-1810919	M17/191-00001	81349 M39012/01-0005		1000 FT	1.52 IN.	14.93 IN.
J22	ATM	M28876/11B1S1	M85045/16-01	M28876/8B12P1	(PART OF CABLE PLUG)	-	3.87 IN.	9.31 IN.
J23	DSVL	M28840/10AB1S1	LS2SUS-3	M28840/26CB1DAP1	(PART OF CABLE PLUG)	600 FT	1.52 IN.	16.31 IN.

Figure 8-14. Installation Guidance Mounting Arrangement (Sheet 4 of 6)

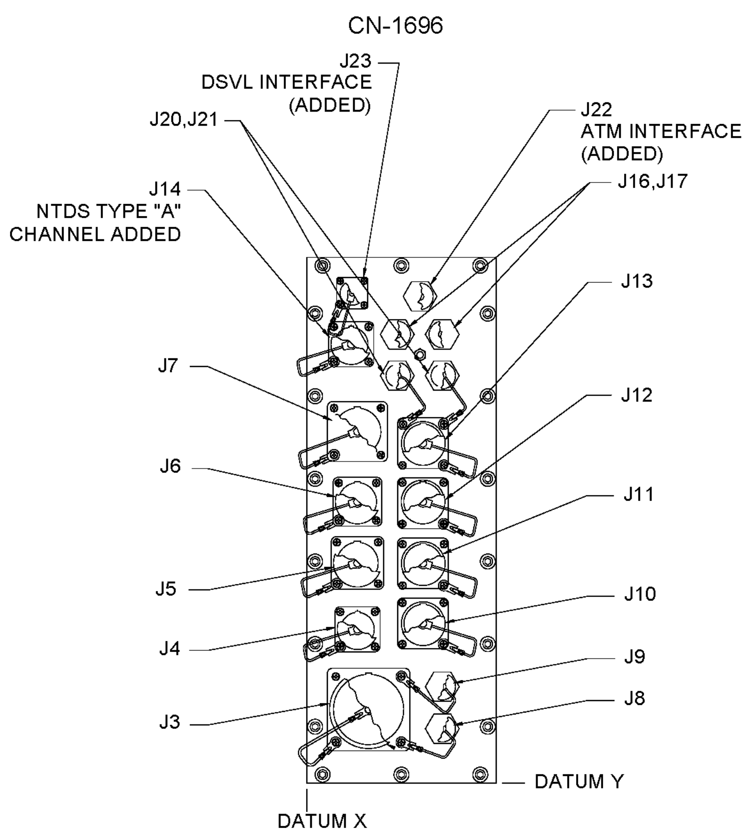
CN-1697



1981539-3 CONFIGURATION
SEE SHEET 3

REF DESIG	FUNCTION	CABINET SOCKET	RECOMMENDED CABLE TYPE	CABLE PLUG	BACKSHELL	CABLE LENGTH	CONNECTOR CENTERLINE DATUM 'X'	CONNECTOR CENTERLINE DATUM 'Y'
J1	SHIP'S POWER 115VAC, 60HZ, 3-PHASE	MS3402D14S-2P	TXOW-3	MS3406D14S-2S	M85049/10-116W	64 FT	-	11.69 IN.
J2	SYNCHRO REF,115VAC, 1 PH,400HZ	MS3402D14S-2PX	2XS0W-3	MS3406D14S-2SX	M85049/10-17W	600 FT	-	13.56 IN.
J3	ANALOG SYNCHRO OUTPUT	MS3402D40-56E	3XS0W-19	MS3406D40-56P	M85049/10-79W	110 FT	2.06 IN.	2.45 IN.
J4	EM LOG & REF., 400HZ OR 60HZ	MS3402D20-27D	3XSOW-7	MS3406D20-27S	M85049/10-33W	70 FT	1.69 IN.	5.12 IN.
J5	RCDU/FIM	MS3402D24-28D	2XSOW-12	MS3406D24-28S	M85049/10-51W	600 FT	1.69 IN.	7.33 IN.
J6	RLGN - RLGN	MS3402D22-14S	2XSAOW-7	MS3406D22-14P	M85049/10-41W	1000 FT	1.69 IN.	9.37 IN.
J7	ALARMS	MS3402D28-21D	3XSOW-14	MS3406D28-21S	M85049/10-59W	70 FT	1.69 IN.	11.7 IN.
J8	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A	-	900 FT	4.76 IN.	1.81 IN.
J9	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A	-	900 FT	4.76 IN.	3.21 IN.
J10	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	5.31 IN.
J11	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	7.31 IN.
J12	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	9.31 IN.
J13	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	11.31 IN.
J14	NTDS SERIAL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	13.31 IN.
J15	-	-	-	-	-	-	-	-
J16	-	-	-	-	-	-	-	-
J17	NTDS SERIAL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	1.69 IN.	13.88 IN.
J18	NTDS SERIAL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	1.69 IN.	15.93 IN.
J19	-	-	-	-	-	-	-	-
J20	-	-	-	-	-	-	-	-
J21	-	-	-	-	-	-	-	-
J22	ATM	M28876/11B1S1	M85045/16-01	M28876/8B12P1	(PART OF CABLE PLUG)	-	3.51 IN.	15.24 IN.
J23	DSVL	M28840/10AB1S1	LS2SUS-3	M28840/26CB1DAP1	(PART OF CABLE PLUG)	600 FT	4.91 IN.	16.10 IN.

Figure 8-14. Installation Guidance Mounting Arrangement (Sheet 5 of 6)



1981539-2 CONFIGURATION
SEE SHEET 3

REF DESIG	FUNCTION	CABINET SOCKET	RECOMMENDED CABLE TYPE	CABLE PLUG	BACKSHELL	CABLE LENGTH	CONNECTOR CENTERLINE DATUM 'X'	CONNECTOR CENTERLINE DATUM 'Y'
J1	SHIP'S POWER 115VAC, 60HZ, 3-PHASE	MS3402D14S-2P	TXOW-3	MS3406D14S-2S	M85049/10-116W	64 FT	-	11.69 IN.
J2	SYNCHRO REF,115VAC, 1 PH,400HZ	MS3402D14S-2PX	2XS0W-3	MS3406D14S-2SX	M85049/10-17W	600 FT	-	13.56 IN.
J3	ANALOG SYNCHRO OUTPUT	MS3402D40-56E	3XS0W-19	MS3406D40-56P	M85049/10-79W	110 FT	2.06 IN.	2.45 IN.
J4	EM LOG & REF., 400HZ OR 60HZ	MS3402D20-27D	3XSOW-7	MS3406D20-27S	M85049/10-33W	70 FT	1.69 IN.	5.12 IN.
J5	RCDU/FIM	MS3402D24-28D	2XSOW-12	MS3406D24-28S	M85049/10-51W	600 FT	1.69 IN.	7.33 IN.
J6	RLGN - RLGN	MS3402D22-14S	2XSAOW-7	MS3406D22-14P	M85049/10-41W	1000 FT	1.69 IN.	9.37 IN.
J7	ALARMS	MS3402D28-21D	3XSOW-14	MS3406D28-21S	M85049/10-59W	70 FT	1.69 IN.	11.7 IN.
J8	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A	-	900 FT	4.76 IN.	1.81 IN.
J9	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A	-	900 FT	4.76 IN.	3.21 IN.
J10	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	5.31 IN.
J11	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	7.31 IN.
J12	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	9.31 IN.
J13	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	3.87 IN.	11.31 IN.
J14	NTDS PARALLEL TYPE A	MS27656T23A35S	2XOW-42	MS27467T23A35P	M85049/17-22WO6	600 FT	1.52 IN.	14.24 IN.
J15	-	-	-	-	-	-	-	-
J16	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A	-	900 FT	4.78 IN.	14.55 IN.
J17	NTDS SERIAL TYPE E	03956-1812592 14949-ADBJ20-E1-BJ89	M17/135-00004	03956-1812597-2 14949-PL80-14A	-	900 FT	3.28 IN.	14.55 IN.
J18	-	-	-	-	-	-	-	-
J19	-	-	-	-	-	-	-	-
J20	NTDS SERIAL TYPE D	03956-1810919	M17/191-00001	81349 M39012/01-0005	-	1000 FT	4.78 IN.	13.18 IN.
J21	NTDS SERIAL TYPE D	03956-1810919	M17/191-00001	81349 M39012/01-0005	-	1000 FT	3.28 IN.	13.18 IN.
J22	ATM	M28876/11B1S1	M85045/16-01	M28876/8B12P1	(PART OF CABLE PLUG)	-	4.03 IN.	16.06 IN.
J23	DSVL	M28840/10AB1S1	LS2SUS-3	M28840/26CB1DAP1	(PART OF CABLE PLUG)	600 FT	1.52 IN.	16.31 IN.

Figure 8-14. Installation Guidance Mounting Arrangement (Sheet 6 of 6)

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APPENDIX A BIT TEST CABLES

A.1 INTRODUCTION.

This appendix provides schematic and parts information to the Built-In Test (BIT) Cables supplied in the Inertial Navigation System (INS) Installation Kit and Doppler Sonar Velocity Log (DSVL) Installation Kit. These cables are used during testing to establish wraparound signal paths in order to test various signal and interface data input and output functions. BIT Cable information is provided to aid in performing continuity testing of system cables and to allow repair or fabrication of new BIT Cables.

The parts listing and schematic/assembly drawings provided in this appendix include the complete set of 14 cables manufactured in accordance with Sperry Marine part number 03956-1981552-n (and the DSVL cable manufactured in accordance with Sperry Marine part number 03956-1860241). These cables cover requirements for BIT testing of the system and the various interface types for all versions of the AN/WSN 7(V) and AN/WSN 7A(V). Only the BIT Cables listed in Table A-1 are applicable for testing of the AN/WSN-7(V) and DSVL data interface.

A.2 CABLE PARTS LISTING.

Table A-2 provides parts listing for fabrication or repair of all applicable BIT Cables. Figures A-1 through A-7 provide schematic/wiring and parts location information for the cables listed in Table A-1.

Table A-1. Applicable Built-In Test Cables

PART NUMBER	APPLICATION	FIGURE
1981552-1	NTDS Type A Interface, long loop testing	A-1
1981552-6	NTDS Type D Interface, long loop testing	A-2
1981552-7	NTDS Type E Interface, long loop testing	A-2
1981552-8	RCDU Data Interface port, long loop testing	A-3
1981552-10	IMU signal interface testing	A-4
1981552-11	Display Unit signal interface testing	A-5
1981552-14	INS-INS Data Interface port, long loop testing	A-6
1860241	DSVL Serial Data Interface, long loop testing[1]	A-7
1900239	ATM Interface, long loop testing[1]	A-8

1 Part of RLGN Field Change 1.

Table A-2. Built-In Test Wraparound Cables Parts List

FIG/ITEM	QTY	REF DESIG	CAGE	PART NUMBER	NOMENCLATURE OR DESCRIPTION
A-1				**1981552-1**	**NTDS Type A BIT Cable**
1	X		96906	MS33558	Numerals and Letters
2	AR		81349	MIL-I-43553 (MI)	Ink, Marking
3	1 Ft		81343	AMS 3587	Tubing, Electrical 2.00" ID, Black
4	1	P1	96906	MS27467T23A35P	Connector, Plug Electrical
8	40 Ft		81349	M81044/12-26-0	Wire, Electrical No. 26 American Wire Gauge (AWG), Black
9	40 Ft		81349	M81044/12-26-0	Wire, Electrical No. 26 AWG, White
13	AR		03956	P1895534-29	Stycast, Black
14	AR		03956	P1895534-28	Curing Agent
16	20		96906	MS27488-22	Plug, End Seal, Electrical Connector
A-2				**1981552-6**	**NTDS Type D BIT Cable**
1	X		96906	MS33558	Numerals and Letters
2	AR		81349	MIL-I-43553 (MI)	Ink, Marking
3	1 Ft		81343	AMS 3587	Tubing, Electrical .375" ID, Black
4	2	P1, P2	81343	UG-603A	Connector, Coax Electrical
13	2 Ft		81343	M17/29-RG59	Cable, Coaxial
A-2				**1981552-7**	**NTDS Type E BIT Cable**
1	X		96906	MS33558	Numerals and Letters
2	AR		81349	MIL-I-43553 (MI)	Ink, Marking
3	1 Ft		81343	AMS 3587	Tubing, Electrical .500" ID, Black
4	2	P1, P2	03956	1812597-1	Connector, Triaxial, Electrical
12	2 Ft		81349	M17/134-00001	Cable, Triaxial
A-3				**1981552-8**	**RCDU Interface BIT Cable**
1	X		96906	MS33558	Numerals and Letters

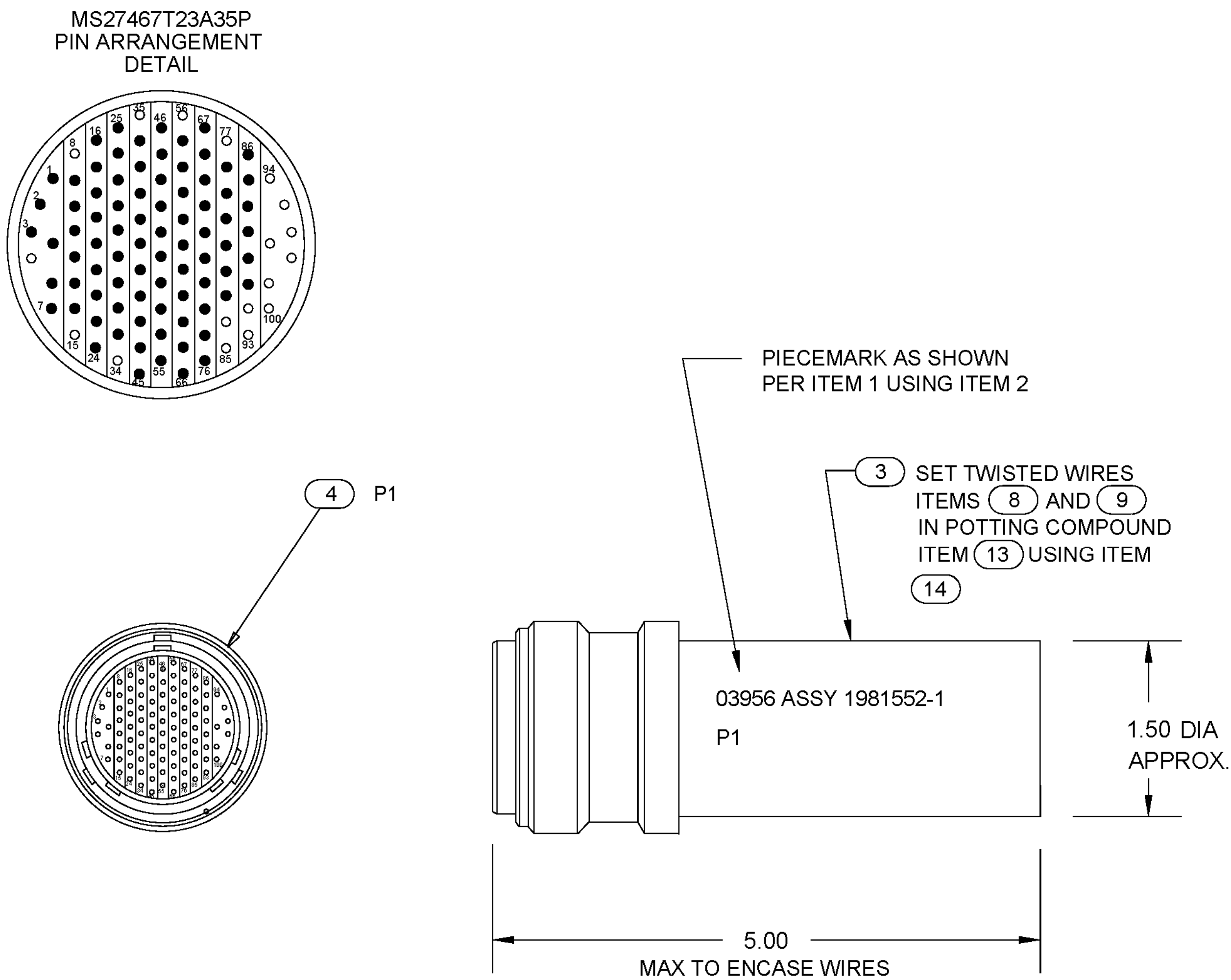
Table A-2. Built-In Test Wraparound Cables Parts List - Continued

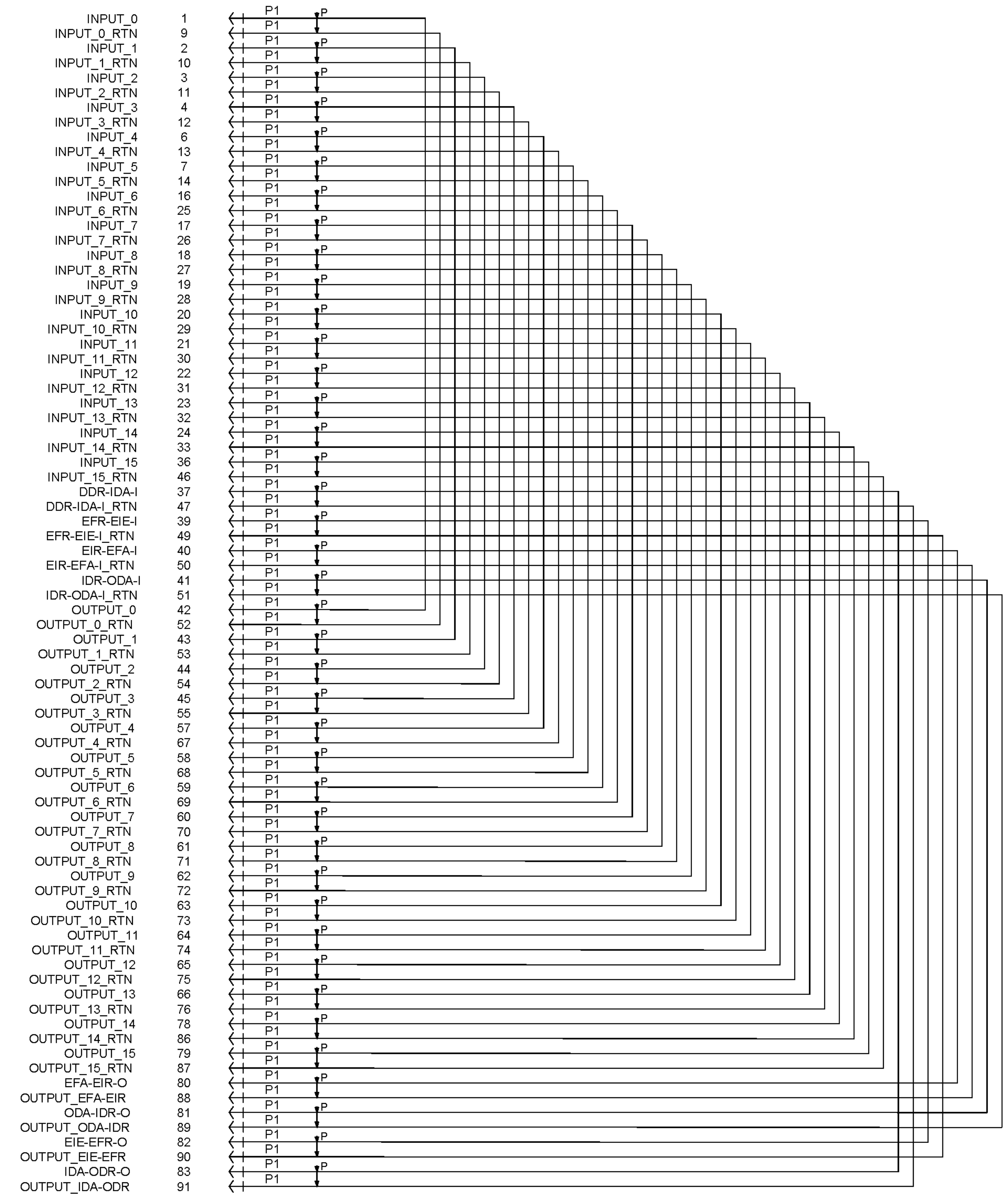
FIG/ITEM	QTY	REF DESIG	CAGE	PART NUMBER	NOMENCLATURE OR DESCRIPTION
2	AR		81349	MIL-I-43553 (MI)	Ink, Marking
3	1 Ft		81343	AMS 3587	Tubing, Electrical 2.00" ID, Black
4	1	P1	96906	MS3406D24-28S	Connector, Plug Electrical
8	2 Ft		81349	M16878/4BFB9	Wire, Electrical No. 22 AWG, Black
9	2 Ft		81349	M16878/4BFB0	Wire, Electrical No. 22 AWG, White
13	AR		03956	P1895534-29	Stycast, Black
14	AR		03956	P1895534-28	Curing Agent
16	18		96906	MS27488-16	Plug, End Seal
A-4				**1981552-10**	**IMU Interface BIT Cable**
1	X		96906	MS33558	Numerals and Letters
2	AR		81349	MIL-I-43553 (MI)	Ink, Marking
3	1 Ft		81343	AMS 3587	Tubing, Electrical 2.00" ID, Black
4	1	P1	81349	M24308/4-1F	Connector, Electrical, Rectangular
5	2		81349	M85049/48-2-1F	Strain Relief, Connector, Elec
6	1	P2	81349	M24308/2-1F	Connector, Rcpt, Electrical
7	2		96906	MS3420-4A	Bushing
8	3 Ft		81349	M16878/4BGE9	Wire, Electrical No. 20 AWG, White
9	3 Ft		81349	M16878/4BGE0	Wire, Electrical No. 20 AWG, Black
11	1		03956	1809463-2	Key, Polarizing, Elec Connector
12	1		03956	1809463-1	Key, Polarizing, Elec Connector
13	1		03956	1800604-1	Slide Lock
15	1 Ft		03956	P1897278-8	Insul Sleeving, Elec, Braided Nylon
17	2		03956	1800604-6	Sliding Post Lock
A-5				**1981552-11**	**Display BIT Cable**
1	X		96906	MS33558	Numerals and Letters
2	AR		81349	MIL-I-43553 (MI)	Ink, Marking
3	1 Ft		81343	AMS 3587	Tubing, Electrical .500" ID, Black
4	1	P1	81349	M24308/2-1F	Connector, Rcpt, Electrical
5	1		81349	M85049/48-2-1F	Strain Relief, Electrical Straight
6	1	P2	81349	M24308/4-3F	Connector, Electrical, Rectangular
7	2		96906	MS3420-3A	Bushing
8	1 Ft		81349	M16878/4BFB9	Wire, Electrical No. 22 AWG, Black
9	1 Ft		81349	M16878/4BFB0	Wire, Electrical No. 22 AWG, White
10	1		81349	M85049/48-2-3F	Strain Relief, Electrical Straight
11	2		96906	MS3420-4	Bushing
13	1		81349	M24308/25-9F	Screw, Lock, Male
15	1 Ft		03956	P1897278-9	Insul Sleeving, Elec, Braided Nylon
A-6				**1981552-14**	**INS-INS BIT Cable**
1	X		96906	MS33558	Numerals and Letters
2	AR		81349	MIL-I-43553 (MI)	Ink, Marking
3	1 Ft		81343	AMS 3587	Tubing, Electrical 2.00" ID, Black
4	1	P1	96906	MS3406D22-14P	Connector, Rcpt, Electrical
8	1 Ft		81349	M16878/4BFB9	Wire, Electrical No. 22 AWG, Black
9	1 Ft		81349	M16878/4BFB0	Wire, Electrical No. 22 AWG, White
13	AR		03956	P1895534-29	Stycast, Black
14	AR		03956	P1895534-28	Curing Agent
16	15		96906	MS27488-1	Plug, End Seal
A-7			**03956**	**1860241**	**DSVL BIT Cable**[1]
1	1		81349	M28840/16AB1P1	Connector, Plug, Electrical
2	1 Ft		81349	M16878/4BFB9	Wire, Electrical No. 22 AWG, White
3	AR		03956	P1895534-29	Stycast, Black
4	AR		03956	P1895534-28	Curing Agent
5	6		96906	MS27488-20	Plug, End Seal
6	AR		81349	MIL-I-43553 (MI)	Ink, Marking
7	X		96906	MS33558	Numerals and Letters
8	1 Ft		81343	AMS 3587	Tubing, Electrical 1.50" ID, Black
A-8				**1900239**	**ATM BIT Cable**[1]

1 Part of RLGN Field Change 1.

Table A-2. Built-In Test Wraparound Cables Parts List - Continued

FIG/ITEM	QTY	REF DESIG	CAGE	PART NUMBER	NOMENCLATURE OR DESCRIPTION
1	1		81349	M28876/6B1P1	Connector, Plug
2	1 Ft		81349	M85045/16-01	Cable, Fiber Optic, One Fiber
3	2		81349	M29504/14-4131C	Termini, Fiber Optic
4	2		81349	M29504/03-4038	Termini, Fiber Optic, Dummy
5	1		08RC6	0900-3000	Backshell Housing
6	1		81349	M28876/10BCW	Dust Cover
7	AR		81349	MIL-I-43553 (MI)	Ink, Marking
8	X		96906	MS33558	Numerals and Letters





NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-D-1000, LEVEL 3.
2. TWIST WHITE AND BLACK DESIGNATED WIRE PAIRS TOGETHER USING 3 TWISTS PER INCH.
3. ALL MARKING TO BE ON ITEM 3, PER ITEM 1, USING ITEM 2. (UNLESS OTHERWISE SPECIFIED)
4. CUT LENGTH ITEM 3 TO FIT MARKINGS REQUIRED.
5. FILL UNWIRED CONNECTOR CAVITIES WITH ITEM 16 AND CONTACTS SUPPLIED WITH CONNECTOR PLUG).

Figure A-1. NTDS Type A Interface BIT Test Cable 1981552-1

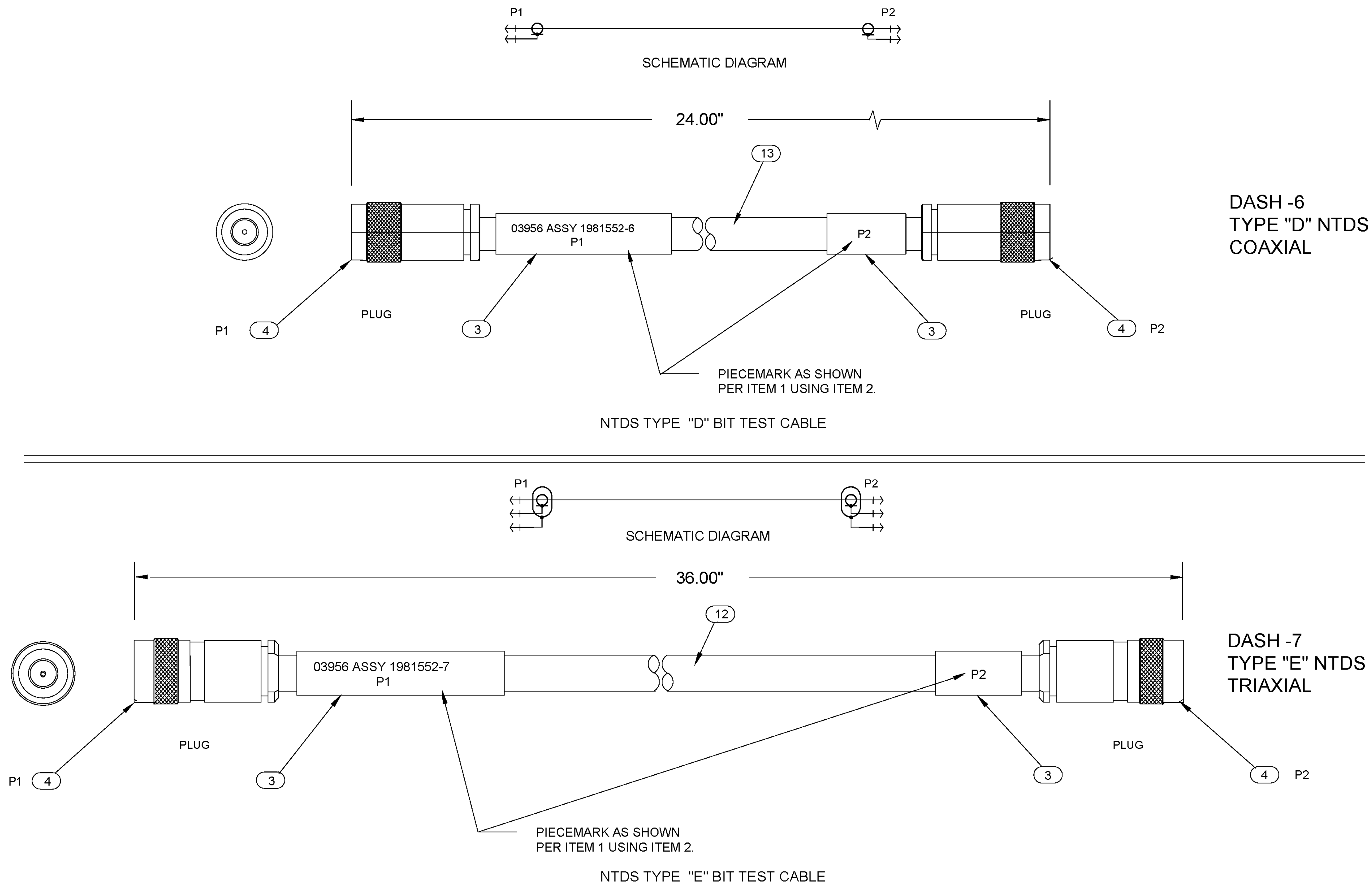


Figure A-2. NTDS Type D and E Interface BIT Test Cable 1981552-6 and -7

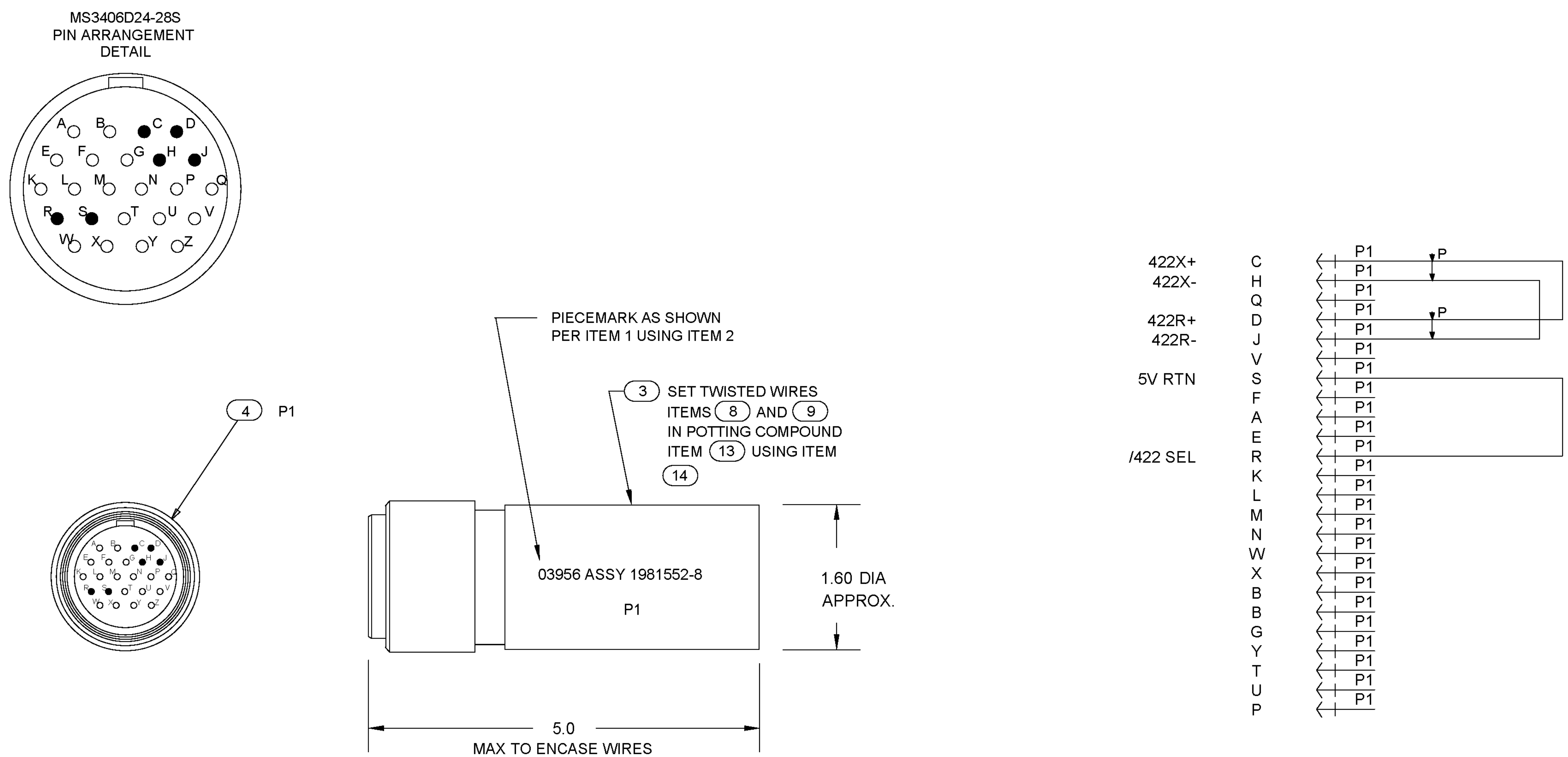


Figure A-3. RCDU Data Interface BIT Test Cable 1981552-8

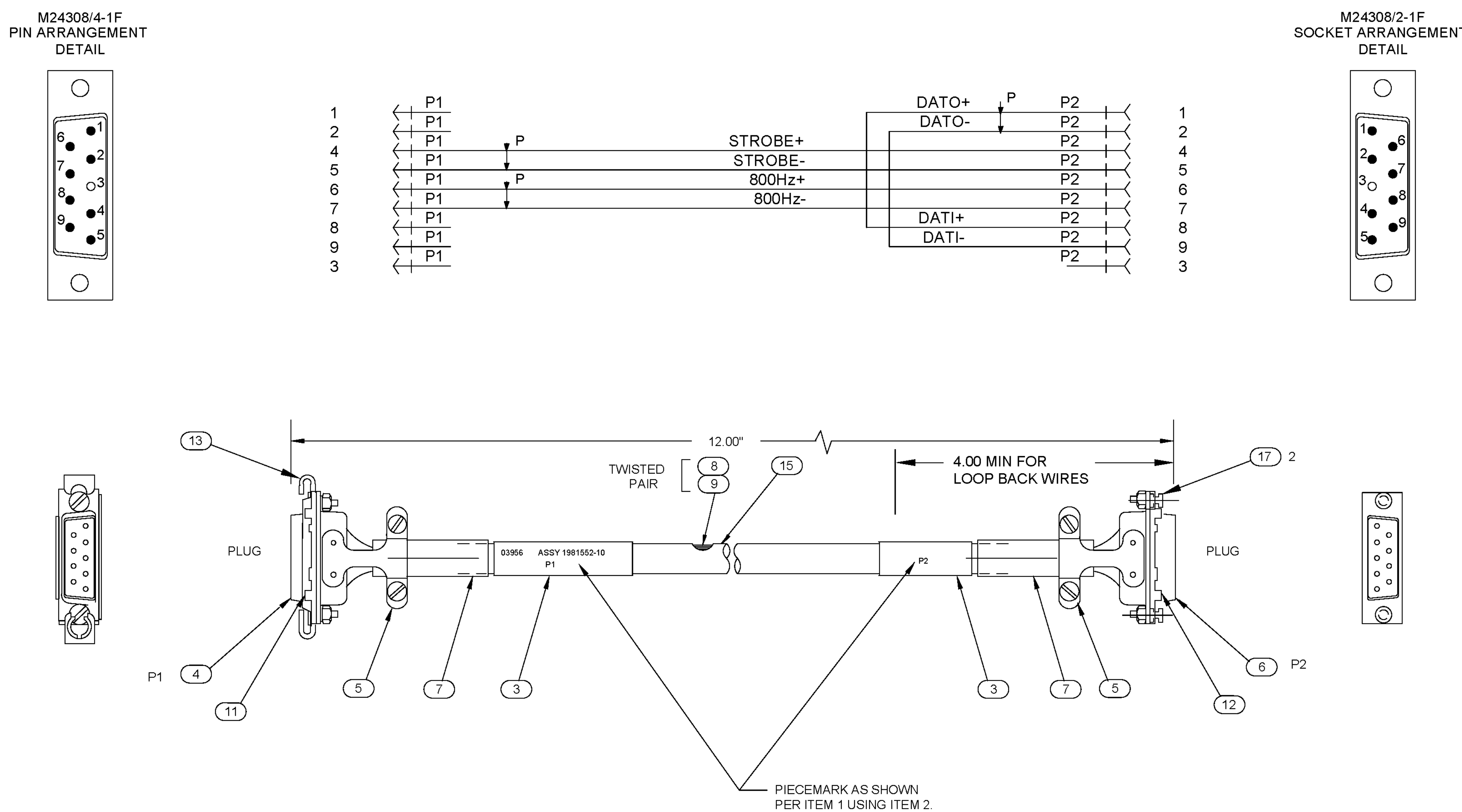


Figure A-4. IMU Interface BIT Test Cable 1981552-10

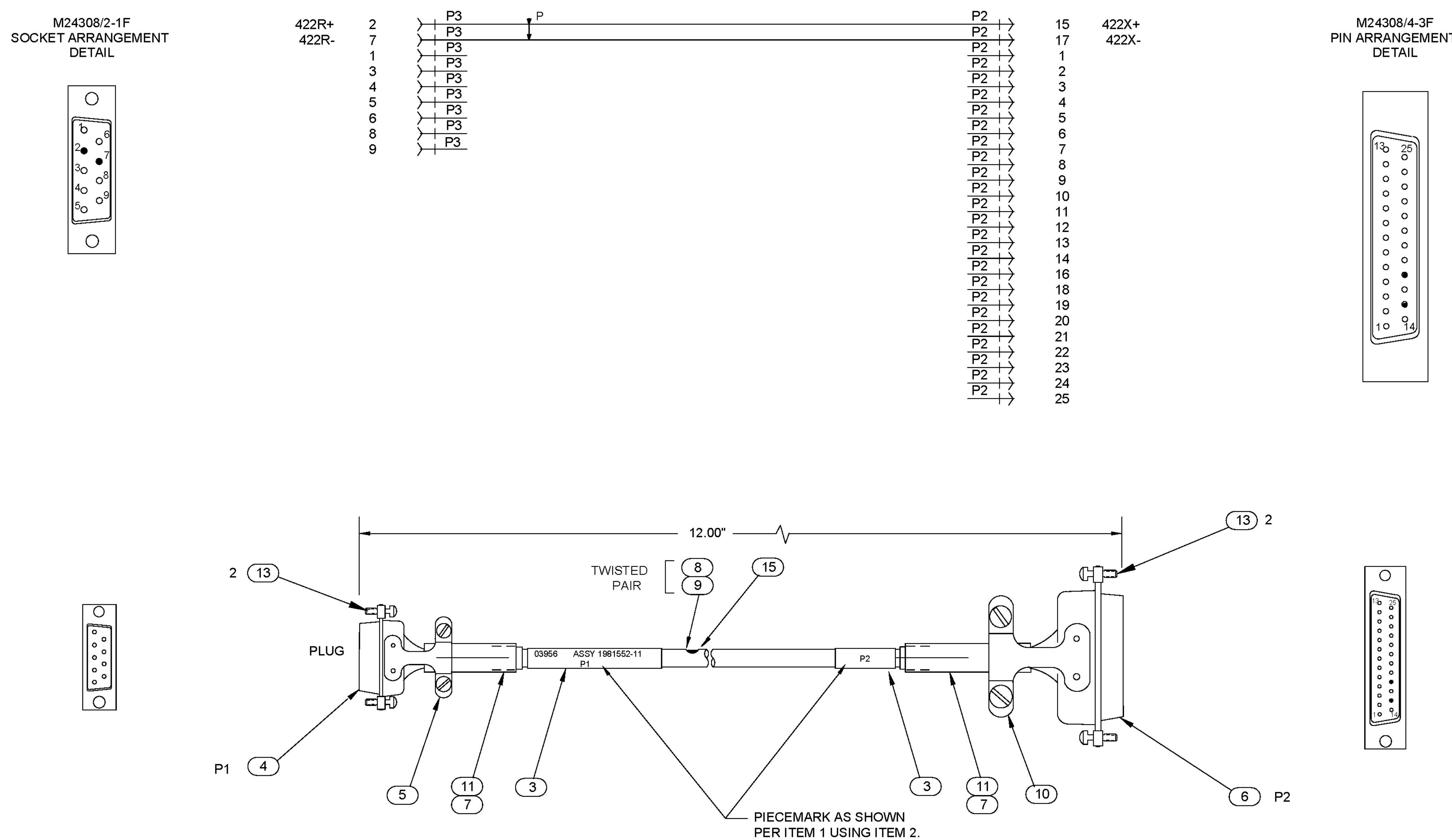


Figure A-5. Display Unit BIT Test Cable 1981552-11

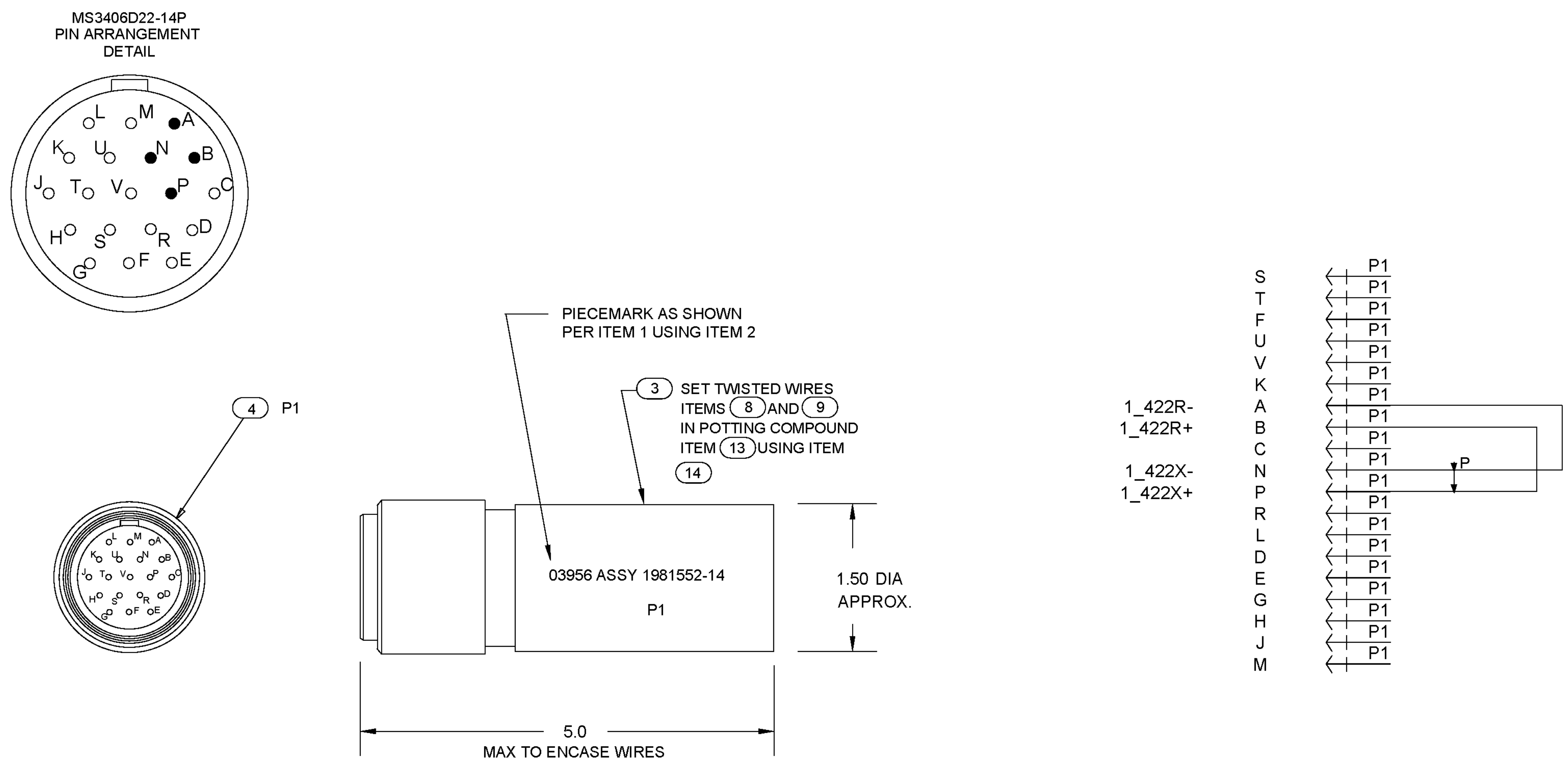
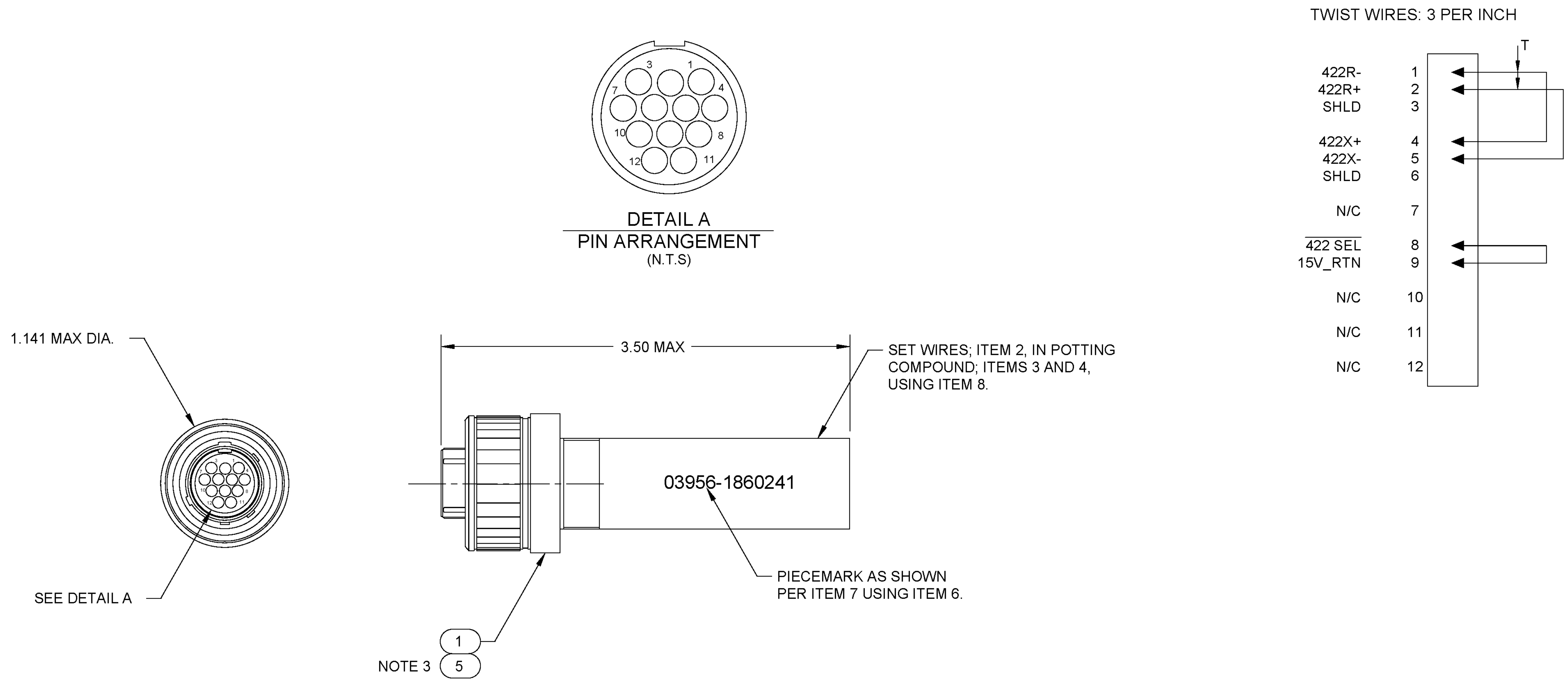


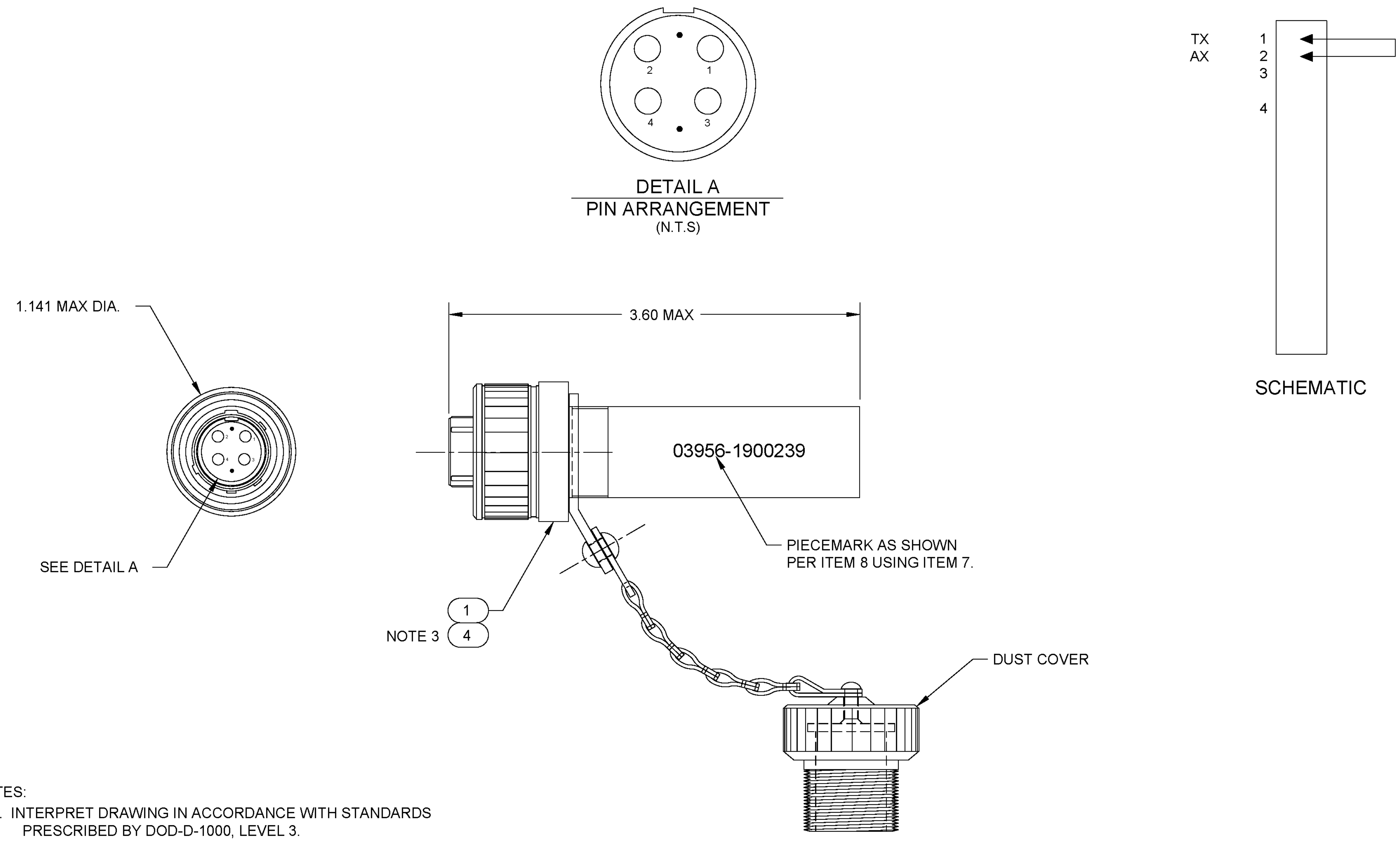
Figure A-6. INS-INS Data Interface BIT Test Cable 1981552-14



NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-D-1000, LEVEL 3.
2. DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ANSI Y14.5M-1982.
3. FILL ALL UNWIRED CAVITIES WITH PINS AND ITEM 5 BEFORE POTTING.

Figure A-7. DSVL Interface BIT Test Cable 1860241



NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-D-1000, LEVEL 3.
2. DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ANSI Y14.5M-1982.
3. FILL ALL UNWIRED CAVITIES WITH PINS AND ITEM 4 BEFORE POTTING.

Figure A-8. ATM Interface BIT Test Cable 1900239

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APPENDIX B LIST OF FAULT CODES

B.1 INTRODUCTION.

Unacknowledged faults are displayed in the upper-right corner of the display. Active faults (fault conditions which have been acknowledged but which are still present) are displayed upon request by the operator selecting the **AUX FUNC** Menu **Faults** display function.

Table B-1 lists all fault codes that can be displayed by the Inertial Navigation System (INS) during on-line operation and provides description and diagnostic information for the fault codes. Many of the codes are associated with software-determined limits and may represent transient conditions resulting from acceptance of incorrect or unreasonable position fix values. Other codes associated with overrun and time-out errors may also be transient as a result of transmission line noise or external equipment being turned off or switched off line.

B.2 FAULT CODES NOT RESULTING IN FAILURES.

Whenever a fault code which does not result in a system fail indication is detected during otherwise normal operation of the equipment, the fault should be acknowledged and the system monitored to determine if the same fault (or other faults) recurs. If a fault does not recur, in all likelihood the condition which generated the fault was transient and will not affect operation.

B.3 FAULT CODES FOR DEBUGGING SOFTWARE.

Certain fault codes are associated with the operation of the software and are intended for aids in debugging software changes or additions. These faults (primarily in the group 224 through 271) should not be encountered during operation unless the system control program has become corrupted. Faults of this type are highly unlikely; however, it is possible that they may be introduced through static discharge caused by improper handling or storage of the memory circuit card assemblies when they are removed from the card rack.

B.4 FAULT RELAYS.

Fault relays K1, K2, and K3 are normally held in the set condition (coil energized). Each of these relays is reset by the Status and Command CCA (1A1A15) in response to a fault of the category indicated in Table B-1. Whether or not fault relays (or lamps) are set is a function of whether a fault is active or has been acknowledged.

- Not Ready/System Fail relay K1 is initially reset when the system is in Standby and sets when the system enters Align. The relay resets when any System Failure category fault is detected and sets only when the fault condition clears.
- Malfunction relay K2 is reset when any Critical Fault category fault is detected and sets only when the fault condition clears.
- Advisory relay K3 resets when any fault or operator advisory condition is detected and sets either when the fault condition clears or when the fault is acknowledged by the operator pressing the **<ALARM ACK>** key.

B.5 ON-LINE FAULT CATEGORIES.

Table B-1 lists all possible on-line fault codes which can be announced by the AN/WSN-7(V) Built-In-Test (BIT). The Fault Category column in Table B-1 provides additional information on each fault.

B.5.1 CATEGORY 0 (OPERATOR ADVISORY). Category 0 faults are operator advisory in nature. Fault codes in this category identify prompts that are intended primarily to inform the operator that an observation must be made or that manual acceptance of data is required. A (C) next to the “0” indicates that the fault code represents a failure only if the fault remains continuously.

B.5.2 CATEGORIES 1 THROUGH 3 (FAULT ADVISORY K3; SYSTEM FAIL K1; MALFUNCTION K2). Fault code categories 1 through 3 indicate that the associated relay is de-energized and resets when the fault is detected.

B.5.3 CATEGORY 4 (SYSTEM MALFUNCTION). A “4” in the Fault Category column indicates that the SYSTEM FAULT indicator is illuminated when the fault is detected.

B.5.4 CATEGORY 5 (SHUTDOWN STATUS). A category 5 fault indicates that the Ring Laser Gyro Navigator (RLGN) automatically shuts down when the fault is detected.

A (C) next to the “5” indicates that the RLGN has detected a critical fault but is operating in the Casualty mode using default parameters to bypass the fault condition. The message "CASUALTY" will appear in the upper-left corner of the display whenever a Casualty fault is detected. The RLGN will continue to operate; however, navigation capability will be compromised in a manner and to an extent determined by the type of fault condition detected.

B.5.5 CATEGORY 6 (RESET FAULT BIT). A category 6 fault indicates that the fault code is automatically cleared without being acknowledged (fault bit reset) when the fault condition is no longer detected by Built-In Test Equipment (BITE).

B.5.6 CATEGORY 7 (DELAY NVRAM UPDATE). A category 7 fault indicates that the battery-backed Random Access Memory (RAM) is not updated to store data if the fault condition is announced. This inhibit prevents corruption of data previously stored in RAM.

B.5.7 CATEGORY 8 (I/O OR ATM PROCESSOR SHUTDOWN). A category 8 fault indicates that the Input/Output (I/O) or Asynchronous Transfer Mode (ATM) Processor function is shut down as a result of detection of the associated fault code. Refer to Paragraph 2.3.7.8 for procedure to restart the I/O Processor.

B.5.8 CATEGORY 9 (IGNORE FAULT). A category 9 fault indicates that the fault condition is transient, external to the INS, or is non-critical to operation and performance of the INS’s mission. Certain codes in this category may indicate INS-related faults that require troubleshooting and correction when operation can be interrupted.

B.6 SOFTWARE ERROR WORDS.

Faults are grouped by the software error word (FERRnn) in which the fault bit corresponding to each fault code is stored. The first fault code number in each group corresponds to bit location 0 in the 16-bit error word. The last fault code number in each group corresponds to bit location 15. Refer to Chapter 3 and Figure 3-31 for further information on setting of fault bits.

Table B-1. Fault Code Descriptions and Fault Isolation

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
	Fault Code Category 0. **Operator Advisory = Code may occur during normal operation.** 1. **Fault Advisory = Review action required.** 2. **System Fail = Not ready - Relay K1 Opens.** 3. **Malfunction = Relay K2 Opens - Critical Fault.** 4. **System Malfunction = Indicator illuminates.** 5. **Shutdown Status = System Casualty mode/automatic shutdown.** 6. **Reset Fault Bit.** 7. **Delay Non-Volatile Random Access Memory (NVRAM) Update.** 8. **I/O or ATM Processor Shutdown.** 9. **Ignore Fault.**		
N/A	No response from system at power-up or garbled display.	1. Perform "display self-test" using the switches on the Panel Interface Assembly (**1A1A10A2**). The switch functions are: a. S1 - Clear display. b. S2 - Display self-test pattern. If self-test fails, suspect Vacuum Fluorescent Display (**1A1A10A1**). 2. Check that the red LED (DS1) on the Nav Processor CCA (**1A1A13**) and the red LED (DS3) on the Status and Command CCA (**1A1A15**) both light on system power-up and go off after approximately 2 seconds. If this does not happen: a. Replace Nav Processor CCA (**1A1A13**). If fault continues, replace I/O Processor CCA (**1A1A21**). b. Suspect the Status and Command CCA (**1A1A15**).	

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
N/A	Display does not operate or cursor does not blink.	1. Check System Power Indicator. 2. Check that ribbon cable 1W3 is properly connected at (**1A1A9**). Check 1A1A10A2J3 and 1A1A10A2J5 connections. (See **Figure 3-20**.) Check 1A1A11J6 connections. (See **Figure 5-20**.) 3. Shift to other system and check display functionality. If the display does not function: a. Suspect the Panel Interface Assembly (**1A1A10A2**). b. Suspect the Data Entry Keyboard (**1A1A9**) 4. Check that the red LED (DS1) on the Nav Processor CCA (**1A1A13**) and the red LED (DS3) on the Status and Command CCA (**1A1A15**) both light on system power-up and go off after approximately 2 seconds. If this does not happen: a. Suspect the Nav Processor CCA (**1A1A13**). b. Suspect the Status and Command CCA (**1A1A15**). 5. Suspect the Dual Panel Interface CCA (**1A1A16**).	

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
N/A	Display is operating but does not respond to specific keyboard presses.	1. Run BIT Test 202. 2. Perform “display self-test” using the switches on the Panel Interface Assembly (1A1A10A2). The switch functions are: a. S1 – Clear display. b. S2 – Display self-test pattern. 3. Shift to other system and check keyboard functionality. If the keyboard does not function: a. Suspect the Panel Interface Assembly (1A1A10A2). b. Suspect the Data Entry Keyboard (1A1A9). 4. Check that ribbon cable 1W3 is properly connected at (1A1A9). Check 1A1A10A2J3 and 1A1A10A2J5 connections. (See Figure 3-20.) Check 1A1A11J6 connections. (See Figure 5-20.) 5. Check that the red LED (DS1) on the Nav Processor CCA (1A1A13) and the red LED (DS3) on the Status and Command CCA (1A1A15) both light on system power-up and go off after approximately 2 seconds. If this does not happen: a. Suspect the Nav Processor CCA (1A1A13). b. Suspect the Status and Command CCA (1A1A15). 6. Suspect the Dual Panel Interface CCA (1A1A16).	
N/A	Display is operating but does not respond to specific keypad presses.	1. Run BIT Test 202. 2. Suspect the Dual Panel Interface CCA (1A1A16). 3. Suspect the Data Entry Keyboard (1A1A9).	

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
N/A	Unable to use the Control Display Unit (CDU).	1. Check cable from connector 1A1J5 to CDU. 2. Check AUX Menu Page 3 select menu item “Aux Panel” (#3) and verify Panel vice Monitor is selected. 3. Run BIT Tests 210 and 211. 4. Suspect the Dual Panel Interface CCA (1A1A16).	
Faults 000 to 239 are set by the Nav Processor. FERR00 – System Initialization and Executive Functions (Faults 000 to 031).			
000	Spare.		9
001	Spare.		9
002	Spare.		9
003	Spare.		9
004	Spare.		9
005	Spare.		9
006	Spare.		9
007	Spare.		9
008	Spare.		9
009	Spare.		9
010	Spare.		9
011	Spare.		9
012	Spare.		9
013	Spare.		9
014	Spare.		9
015	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
016	Loss of synchronization: Indicates a lack of synchronization between the 50 Hz timing signal and the 800 Hz interrupt request signal (IRQ5) generated on the I/O Control (BITE) and Filter CCA (**1A1A31**). Both of these signals are derived from the 3.84 MHz clock supplied from the Accelerometer and Sensor Electronics CCA (**1A1A35**). If the signals are not synchronized, the software executes one “retry.” If the retry is successful, Fault **016** can be acknowledged and cleared. If the retry is unsuccessful, Fault **028** is flagged up indicating loss of the 50 Hz strobe and Shutdown mode is executed.	1. Check the cable between connector J6 on the Support Electronics card rack and connector J10 on the Nav Processor card rack. 2. Check that the green LED (DS1) on Status and Command CCA (**1A1A15**) flashes approximately once per second, indicating the presence of the 800 Hz signal. If this does not happen, suspect the Status and Command CCA (**1A1A15**). 3. If Faults **184** or **185** are also flagged up, the 50 Hz timing signal is missing. Suspect the: a. Accelerometer and Sensor Electronics CCA (**1A1A35**). b. I/O Control (BITE) and Filter CCA (**1A1A31**). 4. If Faults **184** or **185** are not flagged up, suspect the: a. IMU Interface CCA (**1A1A17**). b. Nav Processor CCA (**1A1A13**). 5. Check that the red LED (DS1) on the IMU Processor (**1A1A32**) lights momentarily on power-up. Suspect the IMU Processor (**1A1A32**) if the red LED (DS1) is lit.	0, 1, 4, 6
017	Overrun error (processor overload condition): Indicates that the software real-time executive has been interrupted during execution of a task.	1. Suspect the Nav Processor CCA (**1A1A13**). 2. Check that the 800 Hz interrupt request signal is at the correct frequency. Suspect the: a. IMU Interface CCA (**1A1A17**). b. I/O Control (BITE) and Filter CCA (**1A1A31**).	1, 2, 3, 4, 5, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
018	PROM checksum error: Indicates corruption of the system program stored in PROM ICs on Nav Processor CCA (**1A1A13**).	Suspect the Nav Processor CCA (**1A1A13**).	1, 2, 3, 4, 5, 7
019	Invalid COMRAM test pattern (See Fault **252** for I/O Processor test). The Navigation Processor periodically performs a test pattern write/read test on the common RAM (dual port memory) on Dual Port Memory CCA (**1A1A23**). Fault is announced if test fails twice in a row.	Suspect the Dual Port Memory CCA (**1A1A23**).	1, 4
020	486 CPU timer fail: The NAV Processor Floating Point Unit (FPU) self-test is executed as part of the system initialization checks on system power-up.	Check that the red LED (DS1) on the Nav Processor CCA (**1A1A13**) and the red LED (DS3) on the Status and Command CCA (**1A1A15**) both light on system power-up and go off after approximately 2 seconds. If this does not happen, suspect the Nav Processor CCA (**1A1A13**).	1, 2, 3, 4, 5, 7
021	RAM fail: The NAV Processor RAM self-test is executed as part of the system initialization checks on system power-up. This fault code indicates a failure of the RAM on Nav Processor CCA (**1A1A13**).	1. Check that the red LED (DS1) on the Nav Processor CCA (**1A1A13**) and the red LED (DS3) on the Status and Command CCA (**1A1A15**) both light on system power-up and go off after approximately 2 seconds. If this does not happen, suspect the Nav Processor CCA (**1A1A13**). 2. Run BIT Test 282.	1, 2, 3, 4, 5, 7
022	Loss of operational data in battery-backed RAM: Checksum on data is indicating failure of the battery-backed RAM on the Nav Processor CCA (**1A1A13**). Battery-backed RAM data will be lost if the system main supply is removed and the Battery Assembly (**1A1A5**) is switched off, removed, or discharged. Battery-backed RAM data will also be lost if the Nav Processor CCA (**1A1A13**) has been disconnected from the Nav Processor card rack Backplane.	1. Check that the switch on the Battery Assembly (**1A1A5**) is set to ON. 2. Reconnect main supply and a fully charged Battery Assembly (**1A1A5**). Select Kalman Reinit and align system for 72 hours. 3. If the fault persists, suspect the Nav Processor CCA (**1A1A13**).	0, 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
023	EEPROM and battery-backed RAM system configurations disagree: Checksums on system configuration data held in the Nav Processor CCA (1A1A13) and the copy held in the Status and Command Assembly (1A1A15) do not match.	1. See the comments under Fault 022 about the loss of battery-backed RAM data. 2. Follow the procedures of Paragraph 6.2.1.1.	0, 1, 2, 3, 4, 5, 7
024	Loss of system configuration in EEPROM: Checksum on data is incorrect, indicating a failure of the nonvolatile memory used to store system installation and calibration data on the Status and Command CCA (1A1A15).	1. Suspect the Status and Command CCA (1A1A15). 2. Run BIT Test 204.	0, 1, 2, 3, 4, 5, 7
025	I/O Processor Timed out on initialization.	Suspect the I/O Processor CCA (1A1A21).	1, 4, 6
026	Loss of system configuration in battery-backed RAM: Checksum error on system configuration data held in battery-backed RAM on Navigation Processor CCA (1A1A13).	1. See the comments under Fault 022 about the loss of battery-backed RAM data. 2. Follow the procedures of Paragraph 6.2.1.1. 3. If the fault persists, suspect the Nav Processor CCA (1A1A13).	0, 1, 2, 3, 4, 5, 7
027	Loss of 800 Hz interrupt: The Interrupt Control Unit (IC U16) on the Nav Processor CCA (1A1A13) indicates failure to receive 800 Hz interrupt request signal (1RQ5) from the Support Electronics. This fault is related to Fault 016.	1. Suspect the Nav Processor CCA (1A1A13). 2. Suspect the IMU Interface CCA (1A1A17). 3. If Fault 251 is also flagged up, suspect the I/O Control (BITE) and Filter CCA (1A1A31).	1, 2, 3, 4, 5, 7
028	Loss of lower unit 50 Hz strobe. (Related to Fault 016.)	Refer to Fault 016.	1, 2, 3, 4, 5, 7
029	Unable to obtain master semaphore: Indicates RS-422 handshaking failure between the Nav Processor CCA (1A1A13) and the I/O Processor CCA (1A1A21).	1. Suspect the I/O Processor CCA (1A1A21). 2. Suspect the Dual Port Memory CCA (1A1A23). 3. Suspect the Bus Interface CCA (1A1A20). 4. Suspect the Nav Processor CCA (1A1A13).	0, 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
030	Invalid IOSYS.ECOUNT (two occurrences): Indicates RS-422 handshaking failure between the Nav Processor CCA (1A1A13) and the I/O Processor CCA (1A1A21).	Refer to Fault 029.	0, 1, 4, 6
031	Dual Port Memory (Common RAM) failure: The Dual Port Memory test is executed on power-up as part of the system initialization checks.	Suspect the Dual Port Memory CCA (1A1A23).	0, 1, 4, 6
FERR01 − Hardware Status Word (Faults 032 to 047).			
032	EEPROM Write switch S1 set to write position (down) while operating in normal (online) mode.	1. Check that switch S1 on Status and Command CCA (1A1A15) is not stuck in write (down) position. 2. Suspect the Status and Command CCA (1A1A15).	9
033	Loss of internal synchro reference: Indicates the loss of the 115 V, 400 Hz internal synchro reference. The Vital Bus CCA (1A1A3) monitors the internal 115 V, 400 Hz supply generated by the Inverter Assembly (400 Hz) (1A1A2) and sets the INT REF LOSS status bit HI on failure. This signal is then read on the Status and Command CCA (1A1A15) as System Status Word Bit 1 (SYNC ALARM).	1. Check that the red BAT CHG FLT lamp on the Battery Charger (1A1A7) is not lit. 2. Check that the green lamp on the Power Supply (1A1A6) is lit. Measure the +25 VDC supply at the test points on the Power Supply (1A1A6). 3. Check that the red BAT FLT lamp on the Battery Charger (1A1A7) is not lit. 4. Run BIT Test 108. 5. Run BIT Test 117. 6. Suspect the Inverter Assembly (400 Hz) (1A1A2). 7. Suspect the Vital Bus CCA (1A1A3). 8. Suspect the Status and Command CCA (1A1A15).	1, 2, 3, 4, 5(C), 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
034	3-phase power loss: Indicates a failure of at least one of the phases of the 3-phase main supply. A transient failure can be determined if the fault code does not appear in the active fault list after the fault has been acknowledged via the front panel. A hard fault will be indicated if the fault code appears in the active fault list after the fault has been acknowledged. Under a hard fault condition, the system will automatically switch to the internal battery support. The system will continue to operate normally for a period of approximately 30 minutes on a fully charged Battery Assembly (**1A1A5**). If the 3-phase power is not re-applied before the battery voltage has dropped to 19.5V ±0.5 V, the Shutdown mode will be executed. Failure of the 3-phase supply is detected by the Vital Bus CCA (**1A1A3**) and is signaled to the Status and Command CCA (**1A1A15**) by the 3-PHS LOSS signal. This signal is then read as System Status Word Bit 2 (PRIM ALARM).	1. Check that the POWER circuit breaker (**1A1CB1**) has tripped. If so, reset (**1A1CB1**). 2. Check the active fault list for hard fault. 3. Run BIT Test 106. 4. Run BIT Test 107. 5. Suspect the Vital Bus CCA (**1A1A3**). 6. Suspect the Status and Command CCA (**1A1A15**).	0, 1, 3, 4, 7
035	Power supply failure: Indicates failure of ±25 VDC, ±15 VDC or +5 VDC supplies. Failure is detected by the Power Module (**1A1A8**) and is signaled to the Status and Command CCA (**1A1A15**) by the /PSFAIL signal. This signal is then read as System Status Word Bit 3 (PSFAIL).	1. Check that the red FAULT lamp on Power Module (**1A1A8**) is not lit. 2. Suspect the Power Supply (**1A1A6**). 3. Suspect the Battery Charger (**1A1A7**). 4. Suspect the Status and Command CCA (**1A1A15**).	0(C), 1, 3, 4, 7
036	Loss of log synchro reference: Indicates loss of 115 V, 60- or 400 Hz speed log reference supply. Loss of speed log reference is detected on Synchro Converter CCA (**1A1A38**). The BIT signal (LOG ALARM) set by the synchro converter is signaled to the Status and Command CCA (**1A1A15**). This signal is then read as System Status Word Bit 4 (LOG ALARM).	1. Check that the ship's speed log is functional. 2. Suspect the Relay (1K4). 3. Suspect the Status and Command CCA (**1A1A15**).	0, 1, 3, 4, 9
037	Battery or Battery Charger/Inverter fault: Indicates the presence of a fault condition detected by the Battery Charger Assembly (**1A1A7**). The fault could be due to either a faulty Battery Assembly (**1A1A5**), Battery Charger Assembly (**1A1A7**), or Power Supply (**1A1A6**). The fault is signaled by the Battery Charger to the Status and Command CCA (**1A1A15**) as /BATT FAULT. The signal is then read as System Status Word Bit 5 (BATT FAULT). This fault may require 30 to 60 seconds to reappear after turning power off and back on.	1. Before turning off system power, check for the presence of a red fault lamp illuminated on the Battery Charger (**1A1A7**). This fault may require 30 to 60 seconds to reappear after power is turned back on. a. If BAT CHG FLT lamp is ON, suspect the Battery Charger (**1A1A7**). b. If BAT FLT lamp is ON, suspect the Battery Assembly (**1A1A5**). 2. Check that the switch on the Battery Assembly (**1A1A5**) is set ON. 3. Check the Battery Assembly (**1A1A5**) fuse F1 (20 A). 4. Run BIT Test 106. 5. Suspect the Power Supply (**1A1A6**). 6. Suspect the Status and Command CCA (**1A1A15**).	0, 1, 3, 4
038	Heading 1X Synchro Buffer Amplifier failure: Indicates failure of Synchro Buffer Amplifier (SBA) (**1A1A43**). The HDG 1X SBA FAIL signal, derived on the module, is sent to the Status and Command CCA (**1A1A15**) which transmits the signal as System Status Word Bit 6.	1. Run BIT Test 534. 2. Suspect the Synchro Buffer Amplifier (**1A1A43**). 3. Suspect the Synchro Converter CCA (**1A1A38**). 4. Suspect the Status and Command CCA (**1A1A15**).	0, 1, 3, 4, 9
039	Heading 36X Synchro Buffer Amplifier failure: Indicates failure of Synchro Buffer Amplifier (**1A1A44**). The HDG 36X SBA FAIL signal, derived on the module, is sent to the Status and Command CCA (**1A1A15**) which transmits the signal as System Status Word Bit 7.	1. Run BIT Test 536. 2. Suspect the Synchro Buffer Amplifier (**1A1A44**). 3. Suspect the Synchro Converter CCA (**1A1A38**). 4. Suspect the Status and Command CCA (**1A1A15**).	0, 1, 3, 4, 9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
040	Roll Synchro Buffer Amplifier failure: Indicates failure of Synchro Buffer Amplifier (**1A1A41**). The ROLL SBA FAIL signal, derived on the module, is sent to the Status and Command CCA (**1A1A15**) which transmits the signal as System Status Word Bit 8.	1. Run BIT Tests 542 and 544. 2. Suspect the Synchro Buffer Amplifier (**1A1A41**). 3. Suspect the Synchro Converter CCA (**1A1A39**). 4. Suspect the Status and Command CCA (**1A1A15**).	0, 1, 3, 4, 9
041	Pitch Synchro Buffer Amplifier failure: Indicates failure of Synchro Buffer Amplifier (**1A1A42**). The PITCH SBA FAIL signal, derived on the module, is set to the Status and Command CCA (**1A1A15**) which transmits the signal as System Status Word Bit 9.	1. Run BIT Tests 538 and 540. 2. Suspect the Synchro Buffer Amplifier (**1A1A42**). 3. Suspect the Synchro Converter CCA (**1A1A39**). 4. Suspect the Status and Command CCA (**1A1A15**).	0, 1, 3, 4, 9
042	Heartbeat failure: Indicates a major loss of system functions. All processing by the Nav Processor has stopped. If strobe signals are not received by Status and Command CCA (**1A1A15**) over a period of 2 seconds, a timer on the CCA generates the heartbeat fail signal and LED DS2 will be held permanently on instead of flashing every 1.2 seconds. The heartbeat fail signal is also transmitted as System Status Word Bit 10. The heartbeat fail signal can only be reset by powering down the system.	1. Run BIT Test 245. 2. Suspect the Nav Processor CCA (**1A1A13**). 3. Check that the green LED (DS1) on the Status and Command CCA (**1A1A15**) flashes every 1.2 seconds. 4. Suspect the Status and Command CCA (**1A1A15**).	1, 2, 3, 4, 5, 7
043	Inner axis (azimuth) torquer disabled: The torquer motor will be disabled as a protective measure if other faults which could affect the safety of the system are detected. This fault code indicates that the IMU inner axis indexing rotation is inhibited. This can be under manual, hardware or software control. Manual control is achieved via the front panel. The Nav Processor CCA (**1A1A13**) outputs a command which is latched in the Status and Command CCA (**1A1A15**). The BAZEN output signal is sent to the Inner Azimuth Torquer CCA (**1A1A19**) input TQR ENABLE which, if LO, will disable the motor drive. Hardware control is achieved via overvoltage and overcurrent protection circuitry on Inner Azimuth Torquer CCA (**1A1A19**). Software control is achieved by Nav Processor CCA (**1A1A13**) sending out the appropriate command to Status and Command CCA (**1A1A15**), as when under manual control. Inner Torquer CCA (**1A1A19**) sends output TQR DISABLE to the Status and Command CCA (**1A1A15**) input AZ DISABLED. The signal is read as System Status Word Bit 11 (AZ DISABLED). Both torquers are disabled as a safety feature when other system faults have been detected. These other faults should be rectified in the Test mode. NOTE: Torquers are disabled in the Test mode. Loss of Indexing rotations alone will not affect the system capability to navigate. Only long-term navigational performance will be degraded.	1. Check that the green LEDs (DS1 and DS2) on Inner Torquer CCA (**1A1A19**) are not illuminated (torquer disabled). If the fault is transient, try to enable the Inner Torquer CCA (**1A1A19**) via the front panel. 2. If Fault **068** is also displayed, the Inner Torquer CCA (**1A1A19**) has been disabled by hardware control. 3. If Fault **068** is not displayed, the Inner Torquer CCA (**1A1A19**) has been disabled by software control. 4. Suspect the: a. Inner Torquer CCA (**1A1A19**). Interchange Inner Torquer CCA (**1A1A19**) and Outer Torquer CCA (**1A1A18**) to confirm failure by fault transfer. b. Status and Command CCA (**1A1A15**). c. Nav Processor CCA (**1A1A13**). 5. Run tests 220 and 221. 6. Check for mechanical interferences or resistance.	0, 1, 3, 4, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
044	Outer axis (roll) torquer disabled: The torquer motor will be disabled as a protective measure if other faults which could affect the safety of the system are detected. This fault code indicates that the IMU outer axis indexing rotation is inhibited. This can be under manual, hardware or software control. Manual control is achieved via the front panel. The Nav Processor CCA (**1A1A13**) outputs a command which is latched in the Status and Command CCA (**1A1A15**). The BROLLEN output signal is sent to the Outer Roll Torquer CCA (**1A1A18**) input TQR ENABLE which, if LO, will disable the motor drive. Hardware control is achieved via overvoltage and overcurrent protection circuitry on Outer Roll Torquer CCA (**1A1A18**). Software control is achieved by Nav Processor CCA (**1A1A13**) sending out the appropriate command to Status and Command CCA (**1A1A15**), as per manual control. Outer Torquer CCA (**1A1A18**) sends output TQR DISABLE to Status and Command CCA (**1A1A15**) input ROLL DISABLED. The signal is read as System Status Word Bit 12 (ROLL DISABLED). Both torquers are disabled as a safety feature when other system faults have been detected. These other faults should be rectified in the Test mode. NOTE: Torquers are disabled in the Test mode. Loss of indexing rotations alone will not affect the system capability to navigate. Only long-term navigational performance will be degraded.	1. Check that the green LEDs (DS1 and DS2) on Outer Torquer CCA (**1A1A18**) are not illuminated (torquer disabled). If the fault is transient, try to enable the Outer Torquer CCA (**1A1A18**) via the front panel. 2. If Fault **069** is also displayed, the Outer Torquer CCA (**1A1A18**) has been disabled by hardware control. 3. If Fault **069** is not displayed, the Outer Torquer CCA (**1A1A18**) has been disabled by the software control. 4. Suspect the: a. Outer Torquer CCA (**1A1A18**). Interchange Outer Torquer CCA (**1A1A18**) and Inner Torquer CCA (**1A1A19**) to confirm failure by fault transfer. b. Status and Command CCA (**1A1A15**). c. Nav Processor CCA (**1A1A13**). 5. Run BIT tests 220 and 221. 6. Check for mechanical interference or resistance.	0, 1, 3, 4, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
045	Loss of vital heading synchro reference: Indicates failure of the 115 V, 400 Hz synchro reference supply, derived from the Inverter Assembly (400 Hz) (**1A1A2**) via the Vital Bus CCA (**1A1A3**) when the external 115 V, 400 Hz supply is lost. Failure is detected by Synchro Converter CCA (**1A1A38**) and is signaled by the INT REF LOSS signal to the Status and Command CCA (**1A1A15**). The signal is read as System Status Word Bit 13 (SSW13).	1. Check VITAL REF circuit breaker (**1A1CB3**) is ON. 2. Confirm 115 V, 400 Hz ship's supply is not available. 3. Suspect the relay (**1A1K4**) if Fault **036** is also present. 4. Suspect the Inverter Assembly (400 Hz) (**1A1A2**). 5. Suspect the Vital Bus CCA (**1A1A3**). 6. Suspect the Synchro Converter CCA (**1A1A38**). 7. Suspect the Status and Command CCA (**1A1A15**). 8. Suspect the Nav Processor CCA (**1A1A13**).	0, 1, 3, 4, 9
046	Loss of non-vital heading synchro reference: Indicates failure of the external 115 V, 400 Hz, supply. Failure is detected by Vital Bus CCA (**1A1A3**) and is signaled by the NON-VITAL REF LOSS signal to the Status and Command CCA (**1A1A15**). The signal is read as System Status Word Bit 14 (SSW14).	1. Confirm loss of external 115 V, 400 Hz supply. 2. Check SYNCHRO circuit breaker (1CB2) is ON. 3. Suspect the relay (**1A1K4**) if Fault **036** is also present. 4. Suspect the Vital Bus CCA (**1A1A3**). 5. Suspect the Status and Command CCA (**1A1A15**). 6. Suspect the Nav Processor CCA (**1A1A13**).	0, 1, 3, 4, 9
047	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR02 – Navigation and Velocity Reference Functions (Faults **048** to **063**).			
048	Normal latitude >86° (in normal mode): Indicates that the system is displaying normal latitude coordinates instead of transverse latitude coordinates while operating near the true north or south pole. The system automatically displays transverse latitude when operating at latitudes >86° unless normal mode has been manually selected.	1. Select transverse mode. 2. Suspect the Nav Processor CCA (**1A1A13**).	0, 1, 4
049	Heading error exceeds limit when operating in Navigate at latitude >84°.	Operator Advisory, no fault has occurred. Perform heading realignment as outlined in **Paragraph 2.3.3**.	0, 1, 4
050	Transverse latitude >86° (in transverse mode): Indicates that the system is displaying transverse latitude coordinates, instead of normal latitude coordinates, while operating near the transverse north or south poles. The system automatically displays normal latitude coordinates when operating at normal latitude <86° unless transverse mode has been manually selected.	1. Select normal mode. 2. Suspect the Nav Processor CCA (**1A1A13**).	0, 1, 4
051	Velocity Reference must be selected. Position data waiting. Indicates that the system has been given a dockside fix, but requires a velocity reference to be selected at, or leaving, dockside.	Select a valid velocity reference.	0, 1, 4
052	Spare.		9
053	Spare.		9
054	Spare.		9
055	Spare.		9
056	Loss of (speed) log: Indicates loss of ship's analog speed log input.	1. Check that the ship's speed log is functional. 2. Suspect the Synchro Converter CCA (**1A1A38**).	1, 4

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
057	Excessive (speed) log rate: Indicates abnormal ship's analog speed log input.	1. Check that the ship's speed log is functional. 2. Suspect the Synchro Converter CCA (**1A1A38**).	1, 4, 7
058	C-axis accelerometer bias > half gravity (0.5g): Indicates that the C-axis accelerometer bias, measured during dockside align, is outside the programmed limit of 0.5g. The C accelerometer detects acceleration in the vertical plane. During dockside alignment, the C accelerometer bias is calculated by measuring the output in both vertical orientations, and subtracting g from the measured average. Failure is symptomatic of errors on the vertical velocity loop or in the IMU indexing functions which utilize many subassemblies. Suggested recovery action is therefore limited to specific subassemblies.	1. Check that the torquers are operating normally (i.e., neither Fault **043** nor **044** is displayed). 2. Check that the correct calibration PROM for the particular accelerometer is fitted in position U01 on IMU Processor (**1A1A32**). 3. Run BIT Test 329 (Accelerometer test sequence). 4. Suspect the Accelerometer and Sensor Electronics CCA (**1A1A35**). 5. Suspect the Accelerometer Matched Set C (**1A2A1A1A6**) in the IMU. 6. Run BIT test 371.	1, 4
059	Vertical velocity >200 knots: Indicates the system has not reached alignment during dockside align or failure of system navigation functions in Navigate mode.	1. Wait until the system has had sufficient time to settle - maximum 4 hours. or 2. Check that invalid fix data has not been manually forced. 3. Inspect other faults which may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests.	1, 2, 4
060	East velocity >200 knots: Indicates the system has not reached alignment during dockside align or failure of system navigation functions in Navigate mode.	1. Wait until system has had sufficient time to settle - maximum 4 hours. or 2. Check that invalid fix data has not been manually forced. 3. Inspect other faults which may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests.	1, 2, 4

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
061	North velocity >200 knots: Indicates the system has not reached alignment during dockside align or failure of system navigation functions in Navigate mode.	1. Wait until system has had sufficient time to settle - maximum 4 hours. or 2. Check that invalid fix data has not been manually forced. 3. Inspect other faults which may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests.	1, 2, 4
062	System latitude ≥90 degrees: Indicates a failure of processor computation.	Suspect the Nav Processor CCA (1A1A13).	1, 2, 4, 6
063	Integrated velocity exceeds limit.	1. Wait until system has had sufficient time to settle - maximum 4 hours. or 2. Check that invalid fix data has not been manually forced. 3. Inspect other faults which may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests.	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR03 – Strapdown Functions (Faults 064 to 079).			
064 065	Azimuth non-follow-up (>2 seconds of 10 volts applied): Roll non-follow-up (>2 seconds of 10 volts applied): The non-follow-up faults are a gimbal protection feature and indicate that the associated IMU gimbal does not appear to have rotated at 20°/sec to the demanded indexing position. Azimuth and roll non-follow-up faults are generated by the software platform control function, not by monitoring S/D error voltages on the Repositioning Interface CCA (1A1A33). Whenever the control loop saturates, a counter counts up until the non-follow-up threshold is reached, the fault is declared and the torquer board is disabled. If the control loop comes out of saturation before the non-follow-up threshold is reached, the counter counts back down at a much slower rate, meaning the effect of loop saturation errors is cumulative unless the errors occur far enough apart in time (such as 2 minutes). Starting from zero, the counter will reach the non-follow-up threshold in 2 seconds when the control loop is saturated. Almost any assembly involved in sensor interface, strapdown calculations or gimbal control can lead to non-follow-up.	1. Run BIT Tests 220 and 330. 2. Inspect other faults which may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests. 3. Refer to Figures 3-18 and 5-13. Check torquer motor resistance values. 4. Check for mechanical interference or resistance.	1, 3, 4, 6, 7
066	Azimuth fail: This only occurs during indexing motions. The system checks for direction of rotation to avoid summation errors. A 2-second impulse is applied, then a check is made on the direction of rotation of the Sensor Block Assembly (1A2A1A1A9).	Refer to Fault 064. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	1, 3, 4, 6, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
067	Roll fail: This only occurs during indexing motions. The system checks for direction of rotation to avoid summation errors. A 2-second impulse is applied, then a check is made on the direction of rotation of the Sensor Block Assembly (**1A2A1A1A9**).	Refer to Fault **065**. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	1, 3, 4, 6, 7
068	Azimuth torquer fail (hardware disabled): Discriminates between hardware and software disablement of Inner Azimuth Torquer CCA (**1A1A19**).	1. Refer to Faults **043** and **064**. 2. Run the System Confidence Test. 3. Inspect other faults that may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests.	1, 3, 4, 6, 7
069	Roll torquer fail (hardware disabled): Discriminates between hardware and software disablement of Outer Roll Torquer CCA (**1A1A18**).	1. Refer to Faults **044** and **065**. 2. Run the System Confidence Test. 3. Inspect other faults that may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests.	1, 3, 4, 6, 7
070 **071**	Azimuth rate limit exceeded: Roll rate limit exceeded: Indicates angular rate of associated gimbal >50° per second for 3 seconds. It is monitored by the platform control software that controls the gimbal torquing. These rate thresholds work in a similar fashion to the non-follow-up thresholds (Fault Codes **064** and **065**).	1. Run the System Confidence Test. 2. Inspect other faults which may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Tests (220, 221, and 379). NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	1, 2, 4, 6, 7
072 **073** **074**	Gyro A rate limit exceeded: Gyro B rate limit exceeded: Gyro C rate limit exceeded: This gyro rate limit is based on gyro counts and is set at 90°/sec.	1. Run the System Confidence Test. 2. Inspect other faults which may be displayed in order to isolate the problem to a particular area and run the appropriate BIT Test (330). NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	1, 2, 3, 4, 6, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
075	Angle increment limit: Indicates that a particular gyro channel has exceeded the limit for angle increments which are input to the strapdown algorithm.	1. Check if Faults **072**, **073**, or **074** are also displayed. This will identify which gyro channel (A, B or C) is involved. 2. Run BIT Test 530. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	1, 2, 3, 4, 6, 7
076	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
077 078 079	Gyro A PLC failure: Gyro B PLC failure: Gyro C PLC failure: Indicates that the gyro laser path length is not being maintained at the optimum length, i.e., an integral number of laser wavelengths. The gyro's power signal is checked for tolerance by the Gyro Support Electronics CCA (1A1A36). If low power is detected, a Path Length Control request signal is generated and latched on the Repositioning Interface CCA (1A1A33) for monitoring by the IMU Processor. The Gyro Support Electronics CCA (1A1A36) outputs control signals to the High Voltage Power Supply (HVPS) mirror control circuitry. The IMU Processor can enable/disable Path Length Control via Accelerometer and Sensor Electronics CCA (1A1A35). The gyro's power output signal is demodulated with respect to a carrier modulating the path length and then feeds an integrator on the Gyro Support Electronics CCA (1A1A36). The resulting Path Length Control integrator signal is monitored to be within the allowable operating voltage range. If the PLC integrator output exceeds the range, a path length reset request is generated. During warm-up of a system that has been off for a long time, a transient path length fault may occasionally be generated. If the Path Length Control fault is not persistent and does not cause other faults, it is not a problem and may be simply acknowledged.	1. Run BIT Tests 323, 372 and 373. 2. Suspect the Gyro Support Electronics CCA (1A1A36). 3. Suspect the Repositioning Interface CCA (1A1A33). 4. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 5. Suspect the A/D Multiplexer CCA (1A1A34). 6. Suspect the HVPS Assy (1A2A1A4). 7. Suspect the RLG Matched Set A (1A2A1A1), B (1A2A1A2) or C (1A2A1A3) as applicable. 8. If a single PLC fault is occurring (077, 078, or 079), suspect the Slip Ring Assembly (1A2A1A13) or (1A2A1A10). 9. If all three PLC faults are occurring (077, 078, and 079), suspect the Slip Ring Assembly (1A2A1A12) or (1A2A1A11).	0(C), 1, 2, 3, 4, 6, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR04 – Strapdown Functions (Faults 080 to 095).			
080 081 082	Accelerometer A rate limit: Accelerometer B rate limit: Accelerometer C rate limit: The accelerometer limits are set at 6g.	1. Run BIT Test 371. 2. Run BIT Test 329. 3. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 4. Suspect the Accelerometer Matched Sets A (1A2A1A5), C (1A2A1A6) or B (1A2A1A7) as applicable. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	1, 2, 3, 4, 6, 7
083	Spare.		9
084	Spare.		9
085	Spare.		9
086	Spare.		9
087	Spare.		9
088	Spare.		9
089	Spare.		9
090	Spare.		9
091	Spare.		9
092	Spare.		9
093	Spare.		9
094	Spare.		9
095	Spare.		9
FERR05 – IMU Interface Functions (Faults 096 to 111).			
096	Spare.		9
097	Spare.		9
098	Spare.		9
099	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
100	IMU PROM ID error.	1. Check that the correct IMU PROMs are inserted in IMU Processor (**1A1A32**). Refer to **Figure 6-3**. 2. Suspect the IMU Processor (**1A1A32**).	1, 2, 3, 4, 5(C), 7
101	Two consecutive input errors: Indicates a failure in the transmission for data from the Support Electronics to the Nav Processor. Messages are transmitted from the Support Electronics every 20 ms. The Nav Processor executes a checksum on the received data. If the checksum is in error, a request is sent to the Support Electronics to resend the data. The fault code is flagged up if the checksum executed on the resent data is also incorrect.	1. Check the cable interconnect between connector J6 on the Support Electronics card rack and connector J10 on the Nav Processor card rack. 2. Suspect the I/O Control (BITE) and Filter CCA (**1A1A31**) [confirmed if red LED DS1 is lit]. 3. Suspect the IMU Interface CCA (**1A1A17**). 4. Suspect the IMU Processor (**1A1A32**) [confirmed if red LED DS1 is lit]. 5. Suspect the Nav Processor CCA (**1A1A13**). 6. Refer to **Figure 3-21**. Run BIT Tests 212 and 213.	1, 2, 3, 4, 5(C), 7
102	Gyro dither frequency error: Indicates a failure to read the nominal gyro dither frequency data from the gyro calibration PROMs located on the IMU Processor CCA (**1A1A32**).	1. Check that the gyro calibration PROMs are correctly fitted on the IMU Processor CCA (**1A1A32**) in position U15, U02, and U04 for gyros A, B, and C, respectively. 2. Suspect the IMU Processor (**1A1A32**) [confirmed if red LED (DS1) is illuminated]. 3. Suspect the IMU Interface CCA (**1A1A17**).	1, 2, 3, 4, 5(C), 7
103	Two consecutive lower unit calibration PROM checksum errors: Indicates a failure to read calibration PROM data. A checksum is executed by the Nav Processor CCA (**1A1A13**) on PROM data. If the checksum is in error, the data is re-read, and if the checksum is again incorrect, the fault code is flagged up.	1. Run BIT Test 318. 2. Suspect the calibration PROMs fitted on the IMU Processor (**1A1A32**) as follows: Position U15 - Gyro A Position U02 - Gyro B Position U04 - Gyro C Position U12 - Accelerometer A Position U14 - Accelerometer B Position U01 - Accelerometer C Position U13 - Platform (IMU **1A2A1**) Position U03 - Platform (alternate orientation) See **Figure 6-3** for PROM locations.	1, 3, 4
104	Output buffer not empty: Indicates that all of the Nav Processor data loaded into the output First-in First-out (FIFO) on the IMU Interface CCA (**1A1A17**) has not been transmitted to the Support Electronics during the 20 ms transmission period.	1. Refer to Faults **027** and **028**. If the 800 Hz timing is not working properly, 50 Hz synchronization and message timing may also fail. 2. Suspect the IMU Processor (**1A1A32**) [confirmed if red LED (DS1) is lit]. 3. Suspect the IMU Interface CCA (**1A1A17**). 4. Suspect the I/O Control (BITE) and Filter CCA (**1A1A31**).	0, 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
105	Input buffer not empty: Indicates that all of the Support Electronics data received by the input FIFO on the IMU Interface CCA (1A1A17) has not been read by the Nav Processor during the 20 ms transmission time.	1. Refer to Faults 027 and 028. If the 800 Hz timing is not working properly, 50 Hz synchronization and message timing may also fail. 2. Suspect the IMU Interface CCA (1A1A17). 3. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 4. Suspect the IMU Processor CCA (1A1A32) [confirmed if red LED (DS1) is lit]. 5. Suspect the I/O Control (BITE) and Filter CCA (1A1A31).	0, 1, 4, 6
106	Temperature is out of sequence: Indicates that the part of the IMU interface message that rotates through different sensor temperatures on each subsequent transmission is not in the expected sequence. This is probably indicative of a missed message and would happen in conjunction with other Nav - IMU interface faults.	Run BIT Test 370.	0, 1, 4, 6
107	Input buffer empty; no data available: Indicates that the Support Electronics data has not been loaded into the input FIFO on the IMU Interface CCA (1A1A17) during the 1.25 ms transmission period.	1. Suspect the I/O Control (BITE) and Filter CCA (1A1A31) [confirmed if red LED (DS1) is illuminated]. 2. Suspect the IMU Interface CCA (1A1A17). 3. Suspect the IMU Processor (1A1A32) [confirmed if red LED (DS1) is illuminated].	0, 1, 4, 6
108	Short input message: Indicates that fewer than 32 16-bit data words from the Support Electronics have been loaded into the input FIFO on the IMU Interface CCA (1A1A17) during the read cycle.	1. Suspect the I/O Control (BITE) and Filter CCA (1A1A31) [confirmed if red LED (DS1) is illuminated]. 2. Suspect the IMU Interface CCA (1A1A17). 3. Suspect the IMU Processor (1A1A32) [confirmed if red LED (DS1) is illuminated].	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
109	Synchro angles disagree >5°: Indicates invalid attitude data. A comparison is made between the 1X and 36X outputs of both the inner and outer IMU gimbal ring synchros. If the electrical angle is greater than 5° then the fault is flagged up.	1. Suspect the Repositioning Interface CCA (1A1A33). 2. Suspect the IMU Assy. a. If the fault is intermittent, suspect the Slip Rings. b. If the fault does not occur with the indexer off, this indicates the Slip Rings. 3. Refer to Figures 3-18 and 5-13. Check continuity. If Synchro is open, the IMU must be replaced.	1, 2, 3, 4, 5(C), 7
110	Command words mismatch: Indicates that Command Word 1 and/or Command Word 2 transmitted from the Nav Processor has not been correctly latched in the Support Electronics.	1. Suspect the IMU Interface CCA (1A1A17). 2. Suspect the I/O Control (BITE) and Filter CCA (1A1A31).	0, 1, 4, 6
111	Input message checksum error: Indicates an error in the checksum performed on the 32 16-bit words transmitted from the Support Electronics.	1. Suspect the IMU Interface CCA (1A1A17). 2. Suspect the I/O Control (BITE) and Filter CCA (1A1A31).	0, 1, 4, 6
FERR06 – IMU Functions (Faults 112 to 127).			
112	+31 VDC Temperature Circuit Activation (TCA) limit check.		0(C), 9
113	+10 VDC TCA limit check.		0(C), 9
114	Checksum failure - Platform (IMU) PROM: Indicates an error in reading IMU calibration PROM data. This fault should normally only occur on system power-up.	1. Run BIT Test 318. 2. Check that IMU calibration PROM is fitted correctly to IMU Processor (1A1A32) in the U13 position. 3. Suspect the IMU Processor (1A1A32).	1, 2, 3, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
115	3500 VDC limit check: Indicates that the +3500 VDC anode supply to the gyros has been applied for a period greater than 210 seconds after system power-up. Normally the +3500 VDC supply is removed when gyro lasing is initiated and only the -930 VDC cathode potential is required to maintain gyro lasing. Fault Code 115 is masked for a period of 20 seconds after power-up. If gyro lasing has not occurred after this period, Fault 115 is displayed. A voltage proportional to the output is monitored via the A/D Multiplexer CCA (1A1A34).	**CAUTION** If Fault **115** is indicated, the system should not be left on for more than 30 minutes as this may result in the HVPS overheating. 1. Check for Faults 163, 164, and 165: If Fault 163 is displayed, suspect Gyro A. If Fault 164 is displayed, suspect Gyro B. If Fault 165 is displayed, suspect Gyro C. If all three faults are displayed, suspect the HVPS. 2. If the fault is intermittent, suspect the A/D Multiplexer CCA (1A1A34). NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0(C), 1, 4, 6
116	Spare.		9
117	Spare.		9
118	Spare.		9
119	Spare.		9
120	Spare.		9
121	Spare.		9
122	Unmaskable interrupt: Indicates that the microprocessor (IC U16) on IMU Processor CCA (1A1A32) has been invalidly interrogated. Because the non-maskable interrupt input to the microprocessor is not used, this is an invalid Fault Code.	Suspect the IMU Processor CCA (1A1A32) if the fault persists.	0, 1, 4, 6
123	Time exceeded on upper unit input: Indicates that the time between command words sent from the Nav Processor exceeded 20 ms.	1. IMU Interface CCA (1A1A17). 2. I/O Control (BITE) and Filter CCA (1A1A31).	0, 1, 3, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
124	Segmented mode (not on Z8002): Indicates that the prohibited segmented mode addressing is being executed by the IMU processor.	Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
125	System call instruction: Indicates failure of the IMU Processor.	Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
126	Execution of privileged instructions: Indicates failure of the IMU Processor.	Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
127	Unimplemented instructions: Indicates failure of the IMU Processor.	Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
FERR07 – IMU Functions (Faults 128 to 143).			
128 129 130	Checksum failure - Gyro A PROM: Checksum failure - Gyro B PROM: Checksum failure - Gyro C PROM: Indicates corrupted gyro calibration data.	1. Run BIT Test 318. 2. Check that the gyro calibration PROMs are correctly fitted in IMU Processor (1A1A32) in positions U15, U02, and U04 for Gyros A, B, and C, respectively. See Figure 6-3. 3. Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
131 132 133	Checksum failure - Accelerometer A PROM: Checksum failure - Accelerometer B PROM: Checksum failure - Accelerometer C PROM: Indicates corrupted accelerometer calibration data.	1. Run BIT Test 318. 2. Check that accelerometer calibration PROMs are correctly fitted in IMU Processor (1A1A32) in positions U12, U14, and U01 for accelerometers A, B, and C, respectively. See Figure 6-3. 3. Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
134	+15 VDC power supply limit check: Indicates that the +15 VDC supply generated on the Support Electronics Power Supply CCA (**1A1A37**) is <13.5 VDC or >16.5 VDC. A voltage proportional to the output is monitored via the A/D Multiplexer CCA (**1A1A34**).	1. Run BIT Test 315. 2. Suspect the Support Electronics Power Supply CCA (**1A1A37**). a. If LED DS5 is illuminated, replace the Support Electronics Power Supply CCA (**1A1A37**) at earliest convenience. b. If LED DS5 is not lit, replace the Support Electronics Power Supply CCA (**1A1A37**) immediately. 3. Suspect the A/D Multiplexer CCA (**1A1A34**).	0(C), 1, 4, 6
135	-15 VDC power supply limit check: Indicates that the -15 VDC supply generated on the Support Electronics Power Supply CCA (**1A1A37**) is >-16.5 VDC or <-13.5 VDC. A voltage proportional to the output is monitored via the A/D Multiplexer CCA (**1A1A34**).	1. Run BIT Test 315. 2. Suspect the Support Electronics Power Supply CCA (**1A1A37**). a. If LED DS4 is illuminated, replace the Support Electronics Power Supply CCA (**1A1A37**) at earliest convenience. b. If LED DS4 is not illuminated, replace the Support Electronics Power Supply CCA (**1A1A37**) immediately. 3. Suspect the A/D Multiplexer CCA (**1A1A34**). NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0(C), 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
136	+5 VDC power supply limit check: Indicates that the +5 VDC supply generated on the Support Electronics Power Supply CCA (**1A1A37**) is <4.5 VDC or >5.5 VDC. A voltage proportional to the output is monitored via the A/D Multiplexer CCA (**1A1A34**).	1. Run BIT Test 315. 2. Suspect the Support Electronics Power Supply CCA (**1A1A37**). a. If LED DS2 is illuminated, replace the Support Electronics Power Supply CCA (**1A1A37**) at earliest convenience. b. If LED DS2 is not illuminated, replace the Support Electronics Power Supply CCA (**1A1A37**) immediately. 3. Suspect the A/D Multiplexer CCA (**1A1A34**).	0(C), 1, 4, 6
137	-930 VDC power supply limit check: Indicates that the -930 VDC supply, generated in the HVPS is >-1017 VDC or <-832 VDC. A voltage proportional to the output is monitored via the A/D Multiplexer CCA (**1A1A34**). A critical fault in this area will result in a system shutdown.	1. Run BIT Test 316. 2. Suspect the HVPS Assy (**1A2A1A1A4**) in the IMU. 3. Suspect the A/D Multiplexer CCA (**1A1A34**). NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0(C), 1, 4, 6
138	+280 VDC power supply limit check: Indicates that the +280 VDC supply generated in the HVPS is <247 VDC or >301 VDC. A voltage proportional to the output is monitored via the A/D Multiplexer CCA (**1A1A34**).	1. Run BIT Test 316. 2. Suspect the HVPS Assy (**1A2A1A1A4**) in the IMU. 3. Suspect the A/D Multiplexer CCA (**1A1A34**). NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0(C), 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
139	+23.5 VDC power supply limit check: Indicates that the nominal +25 VDC supply generated on the Power Supply (1A1A6) is <23.5 VDC or >29.4 VDC. A voltage proportional to the output is derived via the Support Electronics Power Supply CCA (1A1A37) input circuitry and is fed to the A/D Multiplexer CCA (1A1A34) for monitoring. NOTE: This failure indicates low battery output when the INS is operating on battery backup.	1. Run BIT Test 315. 2. Suspect the Power Supply (1A1A6). 3. Suspect the Support Electronics Power Supply CCA (1A1A37). 4. Suspect the A/D Multiplexer CCA (1A1A34). 5. Faulty or undercharged Battery Assembly (1A1A5).	0(C), 1, 4, 6
140	+28 VDC power supply limit check: Indicates that the +28 VDC power supply generated on the Support Electronics Power Supply CCA (1A1A37) is <25 VDC or >30 VDC. A voltage proportional to the output is monitored via the A/D Multiplexer CCA (1A1A34).	1. Run BIT Test 315. 2. Check Support Electronics Power Supply CCA (1A1A37). a. If LED DS3 is not illuminated, replace the Support Electronics Power Supply CCA (1A1A37). b. If LED DS3 is illuminated, suspect the A/D Multiplexer CCA (1A1A34). NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0(C), 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
141 142 143	Accelerometer A temperature failure: Accelerometer B temperature failure: Accelerometer C temperature failure: A voltage proportional to temperature is output from the temperature sensing circuitry within each accelerometer assembly and is monitored via the A/D Multiplexer CCA (1A1A34).	1. Run BIT Test 370. 2. Suspect the A/D Multiplexer CCA (1A1A34). 3. Suspect the Support Electronics Power Supply CCA (1A1A37). 4. Suspect the Accelerometer Matched Set A (1A2A1A1A5), C (1A2A1A1A6) or B (1A2A1A1A7) as applicable. 5. Suspect the Accelerometer Stimulus CCA (1A2A1A1A9A1). If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0, 1, 4, 6, 7
FERR08 – IMU Functions (Faults 144 to 159).			
144 145 146	Gyro A pulse accumulation failure: Gyro B pulse accumulation failure: Gyro C pulse accumulation failure: Indicates failure of Pulse Accumulator Module (PAM) self-test, initiated by the IMU Processor at system power-up. During self-test, inputs to the PAM from the gyros are replaced by inputs from the self-test circuitry and validity checks are performed on the contents of the appropriate pulse accumulators on the PAM (U39) on the Accelerometer and Sensor Electronics CCA (1A1A35).	1. Run BIT Tests 330 and 331. 2. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 3. Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
147 148 149	Accelerometer A pulse accumulation failure: Accelerometer B pulse accumulation failure: Accelerometer C pulse accumulation failure: Indicates failure of Pulse Accumulator Module (PAM) self-test, initiated by the IMU Processor at system power-up. During self-test, inputs to the PAM from the accelerometers are replaced by inputs from the self-test circuitry and validity checks are performed on the contents of the appropriate pulse accumulators on the PAM (U39) on the Accelerometer and Sensor Electronics CCA (1A1A35).	1. Run BIT Test 329. 2. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 3. Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
150 151 152	Coning 1 pulse accumulation failure: Coning 2 pulse accumulation failure: Coning 3 pulse accumulation failure: Indicates failure of PAM self-test, initiated by the IMU Processor at system power-up. Validity checks are performed on the contents of the 32-bit coning compensation register in the PAM (U39) on the Accelerometer and Sensor Electronics CCA (1A1A35).	1. Run BIT Tests 330 and 331. 2. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 3. Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
153	Accelerometer A, B, and C summation, gravity: This fault is declared when the average vector sum of the accelerometer data is out of tolerance compared to the expected gravity biased measurement. This test is initiated at system power-up.	Run BIT Tests 329 and 371.	0, 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
154	Gyro A, B, and C summation, Earth rate: This fault is declared when the average vector sum of the gyro data is out of tolerance compared to the expected Earth rate biased measurement. This test is initiated at system power-up.	Run BIT Tests 330 and 331.	0, 1, 4, 6
155	Spare.		9
156	Spare.		9
157	Spare.		9
158	Spare.		9
159	Spare.		9
FERR09 – IMU Functions (Faults 160 to 175).			
160 161 162	Gyro A temperature failure: Gyro B temperature failure: Gyro C temperature failure: Indicates that the gyro temperature is <-4°C or >75°C. The gyro temperature sensor output voltage is monitored via the A/D Multiplexer CCA (1A1A34).	1. Run BIT Test 370. 2. Suspect the A/D Multiplexer CCA (1A1A34). 3. Suspect the RLG Matched Set A (1A2A1A1A1), B (1A2A1A1A2), or C (1A2A1A1A3) as applicable in the IMU. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0, 1, 4, 6, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
163 164 165	Gyro A laser intensity failure. Gyro B laser intensity failure. Gyro C laser intensity failure. Indicates that the gyro Laser Intensity Monitor (LIM) voltage is out of tolerance. The gyro LIM voltage limit is 1.1 to 7.5V. LIM voltage is monitored via the A/D Multiplexer CCA (1A1A34).	1. Suspect the IMU Processor CCA (1A1A32). Verify IMU Processor (1A1A32) revision level (Refer to Table 2-2, DISPLAY function, Page 4, Part Nos. function, Page 4), and verify gyro LIM voltages (Refer to Table 2-2, DISPLAY function, Page 5, LIM Volts function). If Revision B or earlier is installed, Fault Codes 163, 164, or 165 may be displayed if gyro LIM voltage is < 2.3 volts, although 1.1 volts is an acceptable minimum limit. If gyro LIM voltage is above the minimum limit of 1.1 volts, the gyros are within specification, and the faults can be cleared by replacing the Revision B IMU Processor (1A1A32) with a Revision C or greater. If Revision C or greater is installed, verify gyro LIM voltages. 2. Run BIT Test 372. 3. Suspect the HVPS Assembly (1A2A1A1A4). 4. Suspect the A/D Multiplexer CCA (1A1A34). 5. Suspect the Gyro Support Electronics CCA (1A1A36). 6. Suspect the RLG Matched Set A (1A2A1A1A1), B (1A2A1A1A2) or C (1A2A1A1A3) as applicable in the IMU. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0(C), 1, 2, 4, 6
166 167 168	Gyro A dither amplitude failure: Gyro B dither amplitude failure: Gyro C dither amplitude failure: Indicates that the gyro dither output voltage is out of tolerance. The gyro dither pick-off signal is fed to the Gyro Support Electronics CCA (1A1A36) which generates a gyro dither monitor voltage. This voltage is monitored via the A/D Multiplexer CCA (1A1A34). The gyro dither pick-off signal is also modified by random noise before being fed to the Repositioning Interface CCA (1A1A33) where it is amplified before being returned to the gyro dither drive input.	1. Run BIT Tests 322 and 372. 2. Suspect the Gyro Support Electronics CCA (1A1A36). 3. Suspect the Repositioning Interface CCA (1A1A33). 4. Suspect the A/D Multiplexer CCA (1A1A34). 5. Suspect the RLG Matched Set A (1A2A1A1A1), B (1A2A1A1A2) or C (1A2A1A1A3) as applicable in the IMU. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0(C), 1, 4, 6
169	A/D converter test failure: Indicates a failure of the A/D Multiplexer CCA (1A1A34).	1. Run BIT Test 314. 2. Suspect the A/D Multiplexer CCA (1A1A34).	0, 1, 2, 4, 6
170 171 172	Gyro A sum = 0: Gyro B sum = 0: Gyro C sum = 0: Indicates that no output has been detected from the gyro.	1. Run BIT Test 330 and 331. 2. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 3. Suspect the RLG Matched Set A (1A2A1A1A1), B (1A2A1A1A2) or C (1A2A1A1A3) as applicable in the IMU. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0, 1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
173 174 175	Accelerometer A sum = 0: Accelerometer B sum = 0: Accelerometer C sum = 0: Indicates that no output has been detected from the accelerometer.	1. Run BIT Test 329. 2. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35). 3. Suspect the Accelerometer Matched Set A (1A2A1A1A5), B (1A2A1A1A7) or C (1A2A1A1A6) as applicable in the IMU. NOTE: If the fault(s) recur(s) after all diagnostic efforts have been performed, the problem may be Slip-Ring-related.	0, 1, 4, 6
FERR10 – IMU Functions (Faults 176 to 191).			
176	Spare.		9
177	Spare.		9
178	Spare.		9
179	Spare.		9
180	Spare.		9
181	Command message checksum error: Indicates that the IMU Processor is receiving corrupted command words from the Nav Processor.	1. Run System Confidence Test. 2. Suspect the IMU Interface CCA (1A1A17). 3. Suspect the I/O Control (BITE) and Filter CCA (1A1A31). 4. Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6
182	Incomplete or no command received. (Related to Fault 181.)	Refer to Fault 181.	0, 1, 4, 6
183	No 50 Hz strobe received: Indicates that the 50 Hz strobe from the I/O Control (BITE) and Filter CCA (1A1A31) is missing. This signal is derived from the 3.84 MHz clock produced by the Accelerometer and Sensor Electronics CCA (1A1A35).	1. Run the System Confidence Test. 2. Suspect the I/O Control (BITE) and Filter CCA (1A1A31). 3. Suspect the IMU Processor CCA (1A1A32). 4. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35).	0(C), 1, 2, 3, 4, 6, 7

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
184	Loss of synchronization: Indicates loss of synchronization between the 50 Hz strobe and the 800 Hz interrupt timing signal on the Support Electronics.	Refer to Fault 016.	0(C), 1, 2, 3, 4, 6, 7
185	No Z8002 50 Hz strobe present: Indicates missing system interrupt signal to the microprocessor (IC U16) non-vectored interrupt input on the IMU Processor CCA (1A1A32).	1. Suspect the IMU Processor CCA (1A1A32). 2. Suspect the Accelerometer and Sensor Electronics CCA (1A1A35).	0(C), 1, 2, 3, 4, 6, 7
186	Parity error on command word: Indicates Nav Processor command word corrupted when received by I/O Control (BITE) and Filter CCA (1A1A31).	1. Run BIT Tests 212 and 213. 2. Suspect the I/O Control (BITE) and Filter CCA (1A1A31). 3. Suspect the IMU Interface CCA (1A1A17). 4. Suspect the IMU Processor CCA (1A1A32).	0, 1, 4, 6, 7
187	Illegal mode: This fault is declared when the IMU Processor detects an illegal mode in the command message from the Nav Processor.	1. Suspect the Nav Processor CCA (1A1A13). 2. Suspect the IMU Interface CCA (1A1A17). 3. Suspect the I/O Control (BITE) and Filter CCA (1A1A31). 4. Suspect the IMU Processor (1A1A32).	0, 1, 4, 6, 7
188	Failure to reenter background processing: This fault is declared when the IMU Processor detects that the IMU processing has not returned to the background processing function in the allowed time frame.	Suspect the IMU Processor (1A1A32).	0(C), 1, 2, 3, 4, 5(C), 7
189	Spare.		9
190	Spare.		9
191	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR11 − System Initialization and Executive Functions (Faults 192 to 207).			
192 193 194 195 196 197	Misc Trap: Divide-by-zero trap: Breakpoint trap: Undefined instruction trap: General protection trap: Floating point trap: Indicates Nav Processor or Navigation Control Program malfunction.	Suspect the NAV Processor CCA (1A1A13).	1, 2, 3, 4, 5, 7
198	Spare.		9
199	Spare.		9
200	Spare.		9
201	Spare.		9
202	Spare.		9
203	4-Channel Synchro Converter CCA Failure "Board C."	1. Run tests 546 through 549. 2. Suspect the Synchro Converter CCA (1A1A40). Interchange Synchro Converter CCA (1A1A40) and the Synchro Converter CCA (1A1A39) to confirm failure by fault transfer.	1, 3, 4
204	4-Channel Synchro Converter CCA Failure "Board A."	1. Run tests 533 through 536, 591, 592. 2. Suspect the Synchro Converter CCA (1A1A38). Interchange Synchro Converter CCA (1A1A38) and the Synchro Converter CCA (1A1A39) to confirm failure by fault transfer.	1, 3, 4
205	4-Channel Synchro Converter CCA Failure "Board B."	1. Run tests 537 through 544. 2. Suspect the Synchro Converter CCA (1A1A39). Interchange Synchro Converter CCA (1A1A39) and the Synchro Converter CCA (1A1A40) to confirm failure by fault transfer.	1, 3, 4

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
206	Common Memory Timeout	If fault codes associated with 50 Hz strobe timing (183, 184, or 185) are not also announced, suspect the Nav Processor CCA (1A1A13). Run offline system test.	1, 3, 4, 5
207	Common Memory Update fault (excessive time required for 20ms queue processing)	If fault codes associated with 50 Hz strobe timing (183, 184, or 185) are not also announced, suspect the Nav Processor CCA (1A1A13). Run offline system test.	1, 3, 4
FERR12 – Kalman Function (Navigation Processor) (Faults 208 to 223).			
208	Heading fix data unreasonable: Indicates input fix data would result in a large heading transition.	Not Applicable for AN/WSN-7(V) system with no source of Heading fix input data.	0, 1, 4
209	Position fix data unreasonable: Indicates input fix data would result in a large position transition.	Check that input fix data is valid. Do not force unreasonable fix data until it has been checked for validity. If a fix is put up for review, the system will hold that fix for manual review for approximately 10 minutes and then will automatically reject it if no action has been taken. During that time no additional fixes will be processed.	0, 1, 4
210	Velocity fore/aft fix data unreasonable: Indicates speed log velocity data is suspect.	Check that input velocity fix data is valid. Do not force unreasonable fix data until it has been checked for validity. If a fix is put up for review, the system will hold that fix for manual review for approximately 10 minutes and then will automatically reject it if no action has been taken. During that time no additional fixes will be processed.	0, 1, 4
211	Velocity port/starboard fix data unreasonable: Indicates speed log velocity data is suspect.	Refer to Fault 210.	0, 1, 4
212	Velocity reset unreasonable: Indicates that a forced fix would result in a large velocity correction.	Refer to Faults 209 and 210.	0, 1, 4
213	Tilt and Heading reset unreasonable: Indicates that a forced fix would result in a large tilt and heading correction.	Refer to Faults 209 and 210.	0, 1, 4

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
214	Position reset unreasonable: Indicates that a forced fix would result in a large position correction.	Refer to Faults 209 and 210.	0, 1, 4
215	Gyro bias reset unreasonable: This fault is not normally flagged up on installed systems.	Refer to Faults 209 and 210.	0, 1, 4
216	Accelerometer bias reset unreasonable: This fault is not normally flagged up on installed systems.	Refer to Faults 209 and 210.	0, 1, 4
217	Gyro and accelerometer alignment and scale factor reset unreasonable: This fault is not normally flagged up on installed systems.	Refer to Faults 209 and 210.	0, 1, 4
218	Position fix time error: Indicates that fix time is in advance of current system time (GMT) or is more than 60 minutes earlier than current system time (GMT).	1. Ensure that recent fix data is applied to the system. 2. Verify time of fix data and time synchronization. 3. Fix data not correctly time synchronized.	0, 1, 4
219	Kalman Filter covariance matrix reinitialization error: The covariance matrix elements consist of the system's estimates of uncertainty in velocity, position and attitude parameters. If any element exceeds the specification limit, the system will revert from Navigate mode to Align mode and Kalman reinitialization will automatically be executed.	1. Run System Confidence Test to further isolate fault. 2. Suspect the Nav Processor CCA (1A1A13). 3. Suspect an intermittent hardware fault or degraded gyro.	0, 1, 4
220	Position fix variance input error: Indicates that position fix accuracy is not specified correctly on transmission of position fix data from GPS.	1. Reject position fix data from the GPS. 2. Check the validity of the GPS input data.	0, 1, 4
221	Position fix waiting for review: Alerts the operator to review fix data and either accept or reject fix.	Review (accept or reject) fix data. See Paragraph 2.3.4.7.	0, 1, 4

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
222	Selected velocity data not available: Indicates that data from the selected velocity reference has become unavailable. This fault will be flagged up if velocity data transmitted on the data bus is missing or invalid for a period of 5 minutes.	1. Check if input from selected velocity reference is present. 2. Selected velocity reference not valid.	0, 1, 3, 4
223	System undamped (excessive time): Indicates that the system has been in an undamped mode continuously for more than 84 minutes.	1. Check validity of selected velocity reference input. 2. Check system inertial velocities for validity against another velocity reference, such as speed log, GPS, or the other INS. 3. See Paragraph 2.3.5.	0, 1, 4
FERR13 – Front Panel, Remote Panel, and Database Manager Functions (Navigation Processor) (Faults 224 to 239).			
224	Spare.		9
225	Spare.		9
226	Front panel output FIFO half full: Indicates a fault in transmission of data to the front panel display.	1. Run BIT Test 209. 2. Suspect the Dual Panel Interface CCA (1A1A16).	1, 4, 6, 7
227	Remote panel output FIFO half full: Indicates a failure to communicate with the RCDU or Factory Interface Monitor (FIM) facility.	1. Run BIT Tests 210 and 211. 2. Suspect the Dual Panel Interface CCA (1A1A16). Interchange with Dual Panel Interface CCA (1A1A14) to confirm failure by fault transfer.	1, 4, 6, 7, 9
228	Front panel Universal Asynchronous Receiver/Transmitter (UART) error (framing error or overrun): Indicates a fault in transmission of data to the front panel display or input of data via the front panel keypad.	1. Run BIT Test 209. 2. Suspect the Dual Panel Interface CCA (1A1A16). 3. Suspect the Nav Processor CCA (1A1A13).	1, 4, 6, 7
229	Remote panel UART error (framing error or overrun): Indicates a failure to communicate with the RCDU or FIM facility.	1. Run BIT Tests 210 and 211. 2. Suspect the Dual Panel Interface CCA (1A1A16).	1, 4, 6, 7
230	Spare.		9
231	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
232	Incorrect response to command by the I/O Processor: Indicates that the I/O Processor is not executing Nav Processor commands correctly.	1. Run the System Confidence Test. 2. Suspect the I/O Processor (1A1A21). 3. Suspect the Dual Port Memory CCA (1A1A23). 4. Suspect the Bus Interface CCA (1A1A20).	1, 4, 6
233	Timeout of I/O Processor on software semaphore (semaphore not in NAV state): Indicates that the Nav Processor cannot get access to Dual Port Memory because the I/O Processor has retained control of the memory for a period greater than 15 microseconds.	Refer to Fault 232.	1, 4, 6
234	"Error" response from I/O Processor: Indicates that the I/O Processor received an illegal command from the Nav Processor.	Refer to Fault 232.	1, 4, 6
235	Too many consecutive "Commands in Progress" from I/O Processor: The Nav Processor has detected that the I/O Processor is executing a command for a period greater than 80 ms.	Refer to Fault 232.	1, 4, 6
236	Spare.		9
237	Spare.		9
238	Spare.		9
239	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR14 – I/O Processor Initialization and Executive Functions (I/O Processor) (Faults 240 to 255).			
240	Loss of synchronization: Indicates lack of synchronization between the 50 Hz lower unit strobe (LUS) and the 800 Hz interrupt request signal (IRQ5). Both signals are derived from the I/O Control (BITE) and Filter CCA (1A1A31) and transmitted via the IMU Interface CCA (1A1A17) and Bus Interface CCA (1A1A20) to the I/O Processor card rack via the ribbon cable interconnect. The signals are subsequently transmitted via the Dual Port Memory CCA (1A1A23) to the I/O Processor CCA (1A1A21). The synchronization check is performed once only.	1. Check the cable interconnect between Bus Interface CCA (1A1A20) and Dual Port Memory CCA (1A1A23). 2. Suspect the I/O Processor CCA (1A1A21). 3. Suspect the Dual Port Memory CCA (1A1A23). 4. Suspect the Bus Interface CCA (1A1A20). 5. Suspect the IMU Interface CCA (1A1A17). 6. Suspect the I/O Control (BITE) and Filter CCA (1A1A31).	1, 4, 6, 8
241	Overrun error: Indicates that the software real-time executive has been interrupted during execution of a task.	Suspect the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
242	Read Only Memory (ROM) checksum error: Indicates data errors in the I/O software program held in ROM on the I/O Processor CCA (1A1A21).	Suspect the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
243	High Priority queue full: The I/O Processor CPU self-test is initiated on system power-up. A small routine of basic CPU instructions is executed and the results are checked for validity.	1. Check that the red LED (DS1) on I/O Processor CCA (1A1A21) illuminates momentarily on power-up. 2. Suspect the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
244	486 CPU Timer fail:	1. Check that the red LED (DS1) on I/O Processor CCA (1A1A21) illuminates momentarily on power-up. 2. Suspect the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
245	RAM fail: The I/O Processor RAM self-test is executed as part of the system initialization check on system power-up. Indicates failure of scratchpad memory RAM (ICs AU5-U12) on I/O Processor CCA (1A1A21).	Refer to Fault 243.	1, 3, 4, 6, 8
246	Loss of 50 Hz strobe: Indicates that the 50 Hz timing signal from the Support Electronics is missing. This fault code is flagged up if the I/O Processor fails to detect the signal after two attempts.	Refer to Fault 240.	1, 4, 6, 8
247	Low Priority queue full.	Refer to Fault 243.	1, 3, 4, 6, 8
248	System packet not in I/O state: The I/O Processor has failed in an attempt to gain access to Dual Port Memory during system initialization checks at power-up. Indicates that the Nav Processor has retained access to Dual Port Memory for an excessive time.	1. Suspect the I/O Processor CCA (1A1A21). 2. Suspect the Dual Port Memory CCA (1A1A23).	1, 4, 6, 8
249	Spare.		9
250	Invalid system packet format (test patterns, error count, or command wrong): Indicates incorrect test data read from the SYS packet located in Dual Port Memory.	Suspect the Dual Port Memory CCA (1A1A23).	1, 4, 6, 8
251	Loss of 800 Hz interrupts: Indicates failure of the interrupt control unit (IC U16) on the I/O Processor to receive the 800 Hz interrupt request signal (IRQ5) from the Support Electronics.	1. Suspect the I/O Processor CCA (1A1A21). 2. Suspect the Dual Port Memory CCA (1A1A23).	1, 3, 4, 6, 8

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
252	Invalid COMRAM test pattern: (See Fault 019 for Navigation Processor test) The I/O Processor periodically performs a test pattern write/read test on the common RAM (dual port memory) on Dual Port Memory CCA (1A1A23). Fault is announced if test fails twice in a row.	Suspect the Dual Port Memory CCA (1A1A23).	1, 4, 6
253	Unable to obtain master semaphore: Indicates that the I/O Processor is unable to access the master semaphore flag giving access to the Dual Port Memory.	Suspect the I/O Processor CCA (1A1A21).	1, 4, 6, 8
254	Inconsistent system packets error count (two occurrences): Indicates a failure to initialize the I/O Processor after two attempts. Error counter in the Dual Port Memory = 2.	1. Suspect the I/O Processor CCA (1A1A21). 2. Suspect the Dual Port Memory CCA (1A1A23).	1, 4, 6, 8
255	Dual Port (Common RAM) Memory fail: Indicates failure of Dual Port Memory initialization confidence test.	1. Suspect the Dual Port Memory CCA (1A1A23). 2. Suspect the I/O Processor CCA (1A1A21).	1, 4, 6, 8
FERR15 - I/O Processor Initialization and Executive Functions (Faults 256 to 271).			
256	Miscellaneous trap.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
257	General protection trap.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
258	50 Hz, 10 ms queue overflow on initialization.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
259	Floating point trap.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
260	50 Hz, 6.25 ms queue overflow on initialization.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
261	50 Hz, 3.75 ms queue overflow on initialization.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
262	Divide by zero trap.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
263	32 Hz queue overflow on initialization.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
264	Breakpoint trap.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
265	Spare.		9
266	Undefined instruction trap.	Suspect: the I/O Processor CCA (1A1A21).	1, 3, 4, 6, 8
267	Spare.		9
268	Spare.		9
269	Interface Port 1 failure on initialization: Wrap Test on Port 1 fails during system startup.	1. Run BIT Tests 484 and 486. 2. Suspect the Dual Panel Interface CCA (1A1A14). 3. Interchange Dual Panel Interface CCA (1A1A16) with Dual Panel Interface CCA (1A1A14) to confirm failure by fault transfer.	1, 4, 6
270	Interface Port 2 failure on initialization: Wrap Test on Port 2 fails during system startup.	1. Run BIT Tests 484 and 486. 2. Suspect the Dual Panel Interface CCA (1A1A14). 3. Interchange Dual Panel Interface CCA (1A1A16) with Dual Panel Interface CCA (1A1A14) to confirm failure by fault transfer.	1, 4, 6
271	I/O assertion error. Logical check on I/O processor program execution.	Suspect: the I/O Processor CCA (1A1A21).	9
FERR16 – I/O Port 1 (INS-INS Interface) Message and Data Transfer Errors (Faults 272 to 287).			
The I/O Processor responds to errors detected in any of the five message packets transmitted between the two Ring Laser Gyro Navigators (RLGNs) in a dual-INS configuration. Transient Faults associated with a single message type may indicate noise on the data interface cable between the two units. Occurrence of several faults that recur after being cleared may indicate a failure in the data interface cable or in the I/O board in one of the two RLGNs.			
272 273 274 275 276	Invalid RLGN Message: Incorrect Test Pattern in RLGN Message: Timeout of RLGN Message (>2.5 seconds): Invalid GPS Message: Incorrect Test Pattern in GPS Message:	1. Run BIT Tests 484 and 486 in both RLGNs. 2. Suspect the Dual Panel Interface CCA (1A1A14) if short loop BIT 484 fails. 3. Suspect the Dual Panel Interface CCA (1A1A14) and wiring from I/O backplane to output jack 1A1J6 if long loop BIT 486 fails. 4. Suspect the Data interface cable between units if both BIT 484 and 486 pass.	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
277 278 279 280 281 282 283 284 285 286	Timeout of GPS Message (>2.5 seconds): Invalid RLGN #1 Calibration Message: Incorrect Test Pattern in RLGN #1 Calibration Message: Timeout of RLGN #1 Calibration Message (>2.5 seconds): Invalid RLGN #2 Calibration Message: Incorrect Test Pattern in RLGN #2 Calibration Message: Timeout of RLGN #2 Calibration Message (>2.5 seconds): Invalid Waypoint Message: Incorrect Test Pattern in Waypoint Message: Output FIFO half full: Indicates a fault in transmission of data to the other RLGN.	1. Run BIT Tests 484 and 486 in both RLGNs. 2. Suspect the Dual Panel Interface CCA (1A1A14) if short loop BIT 484 fails. 3. Suspect the Dual Panel Interface CCA (1A1A14) and wiring from I/O backplane to output jack 1A1J6 if long loop BIT 486 fails. 4. Suspect the Data interface cable between units if both BIT 484 and 486 pass.	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
287	Port 1 UART error (framing error or overrun condition): Indicates a fault in transmission of data to the other RLGN or input of data from the other RLGN.	1. Run BIT Tests 484 and 486 in both RLGNs. 2. Suspect the Dual Panel Interface CCA (1A1A14) if short loop BIT 484 fails. 3. Suspect the Dual Panel Interface CCA (1A1A14) and wiring from I/O backplane to output jack 1A1J6 if long loop BIT 486 fails. 4. Suspect the Data interface cable between units if both BIT 484 and 486 pass.	1, 4, 6
FERR17 - I/O Port 2 (DSVL RS-422 Interface) (Faults 288 to 303).			
Announced by the I/O Processor in response to detection of message or transfer errors detected in the input data or the operation of the DSVL interface port on Dual Panel Interface CCA (1A1A14).			
288 289 290 291 292	DSVL velocity not corrected. Timeout of DSVL input message. DSVL message test pattern failure. DSVL message overrun. DSVL message transmission error.	1. Run BIT Tests 485 and 487 in both RLGNs. 2. Suspect the Dual Panel Interface CCA (1A1A14) if short loop BIT 485 fails. 3. Suspect the Dual Panel Interface CCA (1A1A14) and wiring from I/O backplane to output jack (1A1J23) if long loop BIT 487 fails. 4. Suspect the DSVL and delivery systems.	1, 4, 6
293	Spare.		9
294	Spare.		9
295	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
296	Spare.		9
297	Spare.		9
298	Spare.		9
299	Spare.		9
300	Spare.		9
301	Spare.		9
302 303	Output FIFO half full. UART error (framing error or overrun condition).	1. Run BIT Tests 485 and 487. 2. Suspect the Dual Panel Interface CCA (1A1A14). 3. Interchange Dual Panel Interface CCA (1A1A16) with Dual Panel Interface CCA (1A1A14) to confirm failure by fault transfer.	1, 4, 6
FERR18 – NTDS CCA I/O Ports A through D (Faults 304 to 319).			
A short loop wraparound test is performed on each NTDS interface port at system startup and is also performed as an automatic diagnostic if a transmission error is detected in two consecutive messages being transmitted or received by the port. (Refer to Fault Codes 448 through 703.)			
304 305	Short Wraparound test failed (Port A1). Short Wraparound test failed (Port A2).	1. Run Interface Tests 424 and 462. 2. Replace the NTDS board associated with ports A1 and A2 [CCA location (1A1A51)].	1, 4, 6
306	Incorrect Interface type (Port A).	1. The Interface Design Specification (IDS) code set for NTDS Port A is not correct for the NTDS board type installed in the Port A location [CCA location (1A1A51)]. 2. Check for correctly installed board type and correctly selected IDS code. 3. Refer to Paragraph 2.4.2 and Paragraph 8.7.2; AUX FUNC function, Page 1, I/O Config in Table 2-2 , and Figure 3-22, sheet 2.	1, 4, 6
307	Spare.		9
308 309	Short Wraparound test failed (Port B1). Short Wraparound test failed (Port B2).	1. Run Interface Tests 425 and 463. 2. Replace NTDS board associated with ports B1 and B2 (CCA location [1A1A52)].	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
310	Incorrect Interface type (Port B).	1. The Interface Design Specification (IDS) code set for NTDS Port B is not correct for the NTDS board type installed in the Port B location [CCA location (1A1A52)]. 2. Check for correctly installed board type and correctly selected IDS code. 3. Refer to Paragraph 2.4.2 and Paragraph 8.7.2; AUX FUNC function, Page 1, I/O Config in Table 2-2, and Figure 3-22, sheet 2.	1, 4, 6
311	Spare.		9
312 313	Short Wraparound test failed (Port C1). Short Wraparound test failed (Port C2).	1. Run Interface Tests 426 and 464. 2. Replace NTDS board associated with ports C1 and C2 (CCA location [1A1A53)].	1, 4, 6
314	Incorrect Interface type (Port C).	1. The Interface Design Specification (IDS) code set for NTDS Port C is not correct for the NTDS board type installed in the Port C location (CCA location [1A1A53)]. 2. Check for correctly installed board type and correctly selected IDS code. 3. Refer to Paragraph 2.4.2 and Paragraph 8.7.2; AUX FUNC function, Page 1, I/O Config in Table 2-2, and Figure 3-22, sheet 2).	1, 4, 6
315	Spare.		9
316 317	Short Wraparound test failed (Port D1). Short Wraparound test failed (Port D2).	1. Run Interface Tests 427 and 465. 2. Replace NTDS board associated with ports D1 and D2 (CCA location [1A1A54)].	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
318	Incorrect Interface type (Port D).	1. The Interface Design Specification (IDS) code set for NTDS Port D is not correct for the NTDS board type installed in the Port D location [CCA location (1A1A54)]. 2. Check for correctly installed board type and correctly selected IDS code. 3. Refer to Paragraph 2.4.2 and Paragraph 8.7.2; AUX FUNC function, Page 1, I/O Config in Table 2-2, and Figure 3-22, sheet 2.	1, 4, 6
319	Spare.		9
FERR19 – NTDS CCA I/O Ports E through H (Faults 320 to 335).			
320 321	Short Wraparound test failed (Port E1). Short Wraparound test failed (Port E2).	1. Run Interface Tests 458 and 466. 2. Replace NTDS board associated with ports E1 and E2 (CCA location [1A1A55)].	1, 4, 6
322	Incorrect Interface type (Port E).	1. The Interface Design Specification (IDS) code set for NTDS Port E is not correct for the NTDS board type installed in the Port E location [CCA location (1A1A55)]. 2. Check for correctly installed board type and correctly selected IDS code. 3. Refer to Paragraph 2.4.2 and Paragraph 8.7.2; AUX FUNC function, Page 1, I/O Config in Table 2-2, and Figure 3-22, sheet 2.	1, 4, 6
323	Spare.		9
324 325	Short Wraparound test failed (Port F1). Short Wraparound test failed (Port F2).	1. Run Interface Tests 459 and 467. 2. Replace NTDS board associated with ports F1 and F2 (CCA location [1A1A56)].	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
326	Incorrect Interface type (Port F).	1. The Interface Design Specification (IDS) code set for NTDS Port F is not correct for the NTDS board type installed in the Port F location [CCA location (1A1A56)]. 2. Check for correctly installed board type and correctly selected code. 3. Refer to Paragraph 2.4.2 and Paragraph 8.7.2; AUX FUNC function, Page 1, I/O Config in Table 2-2, and Figure 3-22, sheet 2.	1, 4, 6
327	Spare.		9
328 329	Short Wraparound test failed (Port G1). Short Wraparound test failed (Port G2)	1. Run Interface Tests 460 and 468. 2. Replace NTDS board associated with ports G1 and G2 (CCA location [1A1A57)].	1, 4, 6
330	Incorrect Interface type (Port G).	1. The Interface Design Specification (IDS) code set for NTDS Port G is not correct for the NTDS board type installed in the Port G location [CCA location (1A1A57)]. 2. Check for correctly installed board type and correctly selected IDS code. 3. Refer to Paragraph 2.4.2 and Paragraph 8.7.2; AUX FUNC function, Page 1, I/O Config in Table 2-2, and Figure 3-22, sheet 2.	1, 4, 6
331	Spare.		9
332 333	Short Wraparound test failed (Port H1). Short Wraparound test failed (Port H2).	1. Run Interface Tests 461 and 469. 2. Replace NTDS board associated with ports H1 and H2 (CCA location [1A1A58)].	1, 4, 6
334	Incorrect Interface type (Port H).	1. The Interface Design Specification (IDS) code set for NTDS Port H is not correct for the NTDS board type installed in the Port H location [CCA location (1A1A58)]. 2. Check for correctly installed board type and correctly selected IDS code. 3. Refer toParagraph 2.4.2 and Paragraph 8.7.2 I; AUX FUNC function, Page 1, I/O Config in Table 2-2, and Figure 3-22, sheet 2.	1, 4, 6
335	Spare.		9
FERR20 – I/O Processor Run Time Errors (Faults 336 to 351).			
336	1 Pulse Per Second (PPS) Interrupt Timeout (>2.5 seconds).	1. Check that the GPS is functional. 2. Run the BIT Test for the NTDS port used for reception of the GPS message.	1, 4, 6
337	Two GMT Corrections within 2.5 seconds: Indicates that the system time maintained by the Nav Processor cannot be synchronized with time derived from GPS.	Check that the GPS is functional.	1, 4, 6
338	Invalid system packet command: Indicates that the command sent from the Nav Processor to the I/O Processor via the Dual Port Memory is not recognized and cannot be executed.	1. Suspect the Dual Port Memory CCA (1A1A23). 2. Suspect the I/O Processor CCA (1A1A21).	1, 4, 6, 8
339	1 PPS Interrupt reoccurred too quickly (<500 ms): Indicates that the precision 1 PPS synchronizing signal has reoccurred in less than 500 ms.	Refer to Fault 336.	1, 4, 6
340	ICU counter out of range: Indicates that the timer on the I/O Processor CCA (1A1A21) interrupt control unit is out of range.	Refer to Faults 240 and 251.	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
341	BIT timeout (>2 seconds): Indicates that the I/O Processor has received a BIT request from the NAV Processor that the I/O Processor doesn't complete within 2 seconds.	1. Suspect the I/O Processor CCA (1A1A21). 2. Suspect the Dual Port Memory CCA (1A1A23). 3. Suspect the Bus Interface CCA (1A1A20).	1, 3, 4, 6
342 343 344 345 346	Fix Packet not in I/O state. Vector Reference Packet not in I/O state. Calibration Packet not in I/O state. Depth Packet not in I/O state. Gyro Packet not in I/O state.	1. For Faults 342 through 351, the I/O Processor checks for the state of the software semaphore that permits access to the appropriate packet in Dual Port Memory. 2. The semaphore is checked at a rate in accordance with the message rate associated with the particular packet. 3. If the Nav Processor or I/O Processor fails to execute properly or if synchronization between the two is lost, these faults may occur (probably in conjunction with additional dianostic faults). 4. Suspect the Dual Port Memory CCA (1A1A23). 5. Suspect the Bus Interface CCA (1A1A20). 6. Suspect the I/O Processor CCA (1A1A21). 7. Suspect the Nav Processor CCA (1A1A13).	1, 3, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
347 348 349 350 351	Navigation Packet not in I/O state. Attitude Packet not in I/O state. GPS Packet not in I/O state. Time Output Packet not in I/O state. Time Input Packet not in I/O state.	1. For Faults 342 through 351, the I/O Processor checks for the state of the software semaphore that permits access to the appropriate packet in Dual Port Memory. 2. The semaphore is checked at a rate in accordance with the message rate associated with the particular packet. 3. If the Nav Processor or I/O Processor fails to execute properly or if synchronization between the two is lost, these faults may occur (probably in conjunction with additional diagnostic faults). 4. Suspect the Dual Port Memory CCA (1A1A23). 5. Suspect the Bus Interface CCA (1A1A20). 6. Suspect the I/O Processor CCA (1A1A21). 7. Suspect the Nav Processor CCA (1A1A13).	1, 3, 4, 6, 8
FERR21 – RS422 Port 1 (INS-INS Interface) Waypoint Message Errors (Faults 352 to 367).			
352 353	Timeout of Waypoint Message (Acknowledge >2.5 seconds). Waypoint Database Checksum error.	1. Fault Codes 352's and 353's conditions are checked only when the operator selects transfer from the other RLGN in a dual configuration. 2. If a fault occurs, clear the fault, and repeat the transfer operation. 3. If the fault repeated, but no other faults associated with the INS-INS data transfer have occurred, then the waypoint data in the other RLGN is probably corrupted; suspect the corrupted waypoint database in the other RLGN.	1, 4, 6
354	Spare.		9
355	Spare.		9
356	Spare.		9
357	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
358	Spare.		9
359	Spare.		9
360	Spare.		9
361	Spare.		9
362	Spare.		9
363	Spare.		9
364	Spare.		9
365	Spare.		9
366	Spare.		9
367	Spare.		9
FERR22 – GPS Data and I/O Initialization Errors (Faults 368 to 383).			
Faults 368 to 383 are associated with GPS data transfer between the I/O and Navigation Processors. NOTE: Received via an NTDS interface, the I/O Processor formats and transmits GPS data to common memory on Dual Port Memory CCA (1A1A23) for delivery to Nav Processor (1A1A13).			
368	GPS Position Invalid.	Operator Advisory - No Corrective Action Required.	0, 9
369	GPS Velocity Invalid.	Operator Advisory - No Corrective Action Required.	0, 9
370 371 372	Invalid TP1 received by GPS. Invalid TP2 received by GPS. Invalid Checksum received by GPS.	1. If the fault is transient, and if no other processor or I/O faults have occurred, clear the fault. 2. If the fault recurs, suspect the Dual Port Memory CCA (1A1A23).	1, 4
373	GPS has no lever arm corrections.	1. Check installation configuration for Position Sensors. 2. Refer to Paragraph 8.6 and Paragraph 8.6.4.	1, 4
374	GPS Timeout of periodic External Computer (EC) transmission.	1. If the fault is transient, and if no other processor or I/O faults have occurred, clear the fault. 2. If the fault recurs, suspect the Dual Port Memory CCA (1A1A23).	1, 4
375	GPS Set and Drift invalid.	Operator Advisory - No Corrective Action Required.	0, 9
376	Less than three satellites used for GPS fix.	Operator Advisory - No Corrective Action Required.	0, 9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
377	Invalid EF Code word received.	Operator Advisory - No Corrective Action Required.	0, 9
378	GPS Universal Time Coordinated (UTC) invalid.	1. If the fault is transient, and if no other processor or I/O faults have occurred, clear the fault. 2. If the fault recurs, suspect the Dual Port Memory CCA (1A1A23).	1, 4
379 380 381 382 383	Incorrect Response to RUN command by I/O Processor. I/O Processor failure on initialization. Invalid I/O Processor response on initialization. Invalid IOSYS packet format. Failure of 20ms time mark strobe.	1. Suspect the I/O Processor CCA (1A1A21). 2. Suspect the Dual Port Memory CCA (1A1A23). 3. Suspect the Bus Interface CCA (1A1A20).	1, 4, 6
FERR23 – Attitude Comparison and Monitored Performance Errors (Faults 384 to 399).			
384 385 386	RLGN #1 and #2 disagree in Heading. RLGN #1 and #2 disagree in Roll. RLGN #1 and #2 disagree in Pitch.	1. Check default setting for Attitude Comparison Threshold and Attitude Comparison Filter Constant. 2. Refer to Paragraph 8.6 and Paragraph 2.4.10.2. 3. Ensure limts are within prescribed tolerances. 4. If divergence continues, perform a 72-hour calibration at the soonest possibility.	1, 4, 6
387	Spare.		9
388	Spare.		9
389	Spare.		9
390	Spare.		9
391	Spare.		9
392	Spare.		9
393	Spare.		9
394	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
395 396 397 398	Position variance greater than specified value. RMS east-west velocity greater than specified value. RMS north-south velocity greater than specified value. RMS position greater than specified value.	1. Fault codes 395 to 399 are associated with online, system performance monitoring. 2. Refer to Paragraph 2.4.6. 3. Faults 395 through 398 may indicate that the RLGN is operating beyond RLGN design parameters. 4. If no other faults have been detected, ensure that the RLGN is properly settled. 5. Verify that correct position fixes are being entered.	1, 4
399	No Position Reference available.	Fault codes 395 to 399 are associated with online, system performance monitoring. Fault 399 indicates that the position reference source has become invalid during system performance monitoring. Check the position reference source for proper operation.	1, 4
FERR24 – Nav-Processor-Declared ATM Faults (Faults 400 to 415).			
400	ATM Processor timeout on initialization.	Suspect the ATM Processor CCA (1A1A4).	1, 4, 6
401	Dual Port Memory fail:Indicates failure of the Dual Port Memory initialization confidence test.	Suspect the ATM Processor CCA (1A1A4).	1, 4, 6
402 403 404 405	Incorrect response to RUN command by the ATM Processor. ATM Processor failure on initialization. Timeout of the ATM Processor. Invalid ATMSYS packet format.	1. Run the System Confidence Test. 2. Suspect the ATM Processor CCA (1A1A4).	1, 4, 6
406	Incorrect response to command by the ATM Processor: Indicates that the ATM Processor is not executing Nav Processor commands correctly.		1, 4, 6
407	Unable to obtain master semaphore: Indicates that the ATM Processor is unable to access the master semaphore flag giving access to the Dual Port Memory.	Suspect the ATM Processor CCA (1A1A4).	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
408	Invalid ATMSYS. ECOUNT (two occurrences): Indicates handshaking failure between the Nav Processor CCA (1A1A13) and the ATM Processor CCA (1A1A4).	1. Suspect the ATM Processor CCA (1A1A4). 2. Suspect the Nav Processor CCA (1A1A13).	1, 4, 6
409	Invalid ATM COMRAM test pattern (two occurrences): The Nav Processor periodically performs a test pattern write/read test on the common RAM (dual port memory) on ATM Processor CCA (1A1A4). Fault is announced if test fails twice in a row.	Suspect the ATM Processor CCA (1A1A4), Dual Port Memory.	1, 4, 6
410	Timeout of ATM Processor on software semaphore (semaphore not in Nav state): Indicates that the Nav Processor cannot get access to Dual Port Memory as the ATM Processor has retained control of the memory for a period greater than 15 microseconds.	Refer to Fault 406.	1, 4, 6
411	Error response from ATM Processor: Indicates that the ATM Processor received an illegal command from the Nav Processor.	Refer to Fault 406.	1, 4, 6
412	Too many consecutive Commands in Progress from ATM Processor: The Nav Processor had detected that the ATM Processor is executing a command for a period greater than 80 ms.	Refer to Fault 406.	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
413	BFTT – Communication interrupted/failed.	1. The ATM Processor has shut down. 2. This fault is usually accompanied by other faults that can provide insight into the cause of the failure. 3. When the ATM Processor shuts down and BFTT simulation is active, simulated output will be terminated in the same manner as for operator-initiated quick abort. Refer to Fault414. 4. Simulated values will be set (not slewed) to Nav values. Reset the ATM Processor. 5. If fault recurs, and the BFTT and LAN are functioning properly, suspect the ATM Processor CCA (1A1A4).	1, 4, 6, 8
414	BFTT – Operator aborted.	1. BFTT simulation has been manually aborted by the AN/WSN-7 operator. 2. Simulation variables will not be set (not slewed) to Nav quantities.	1, 4, 6
415	Cannot enable BFTT Nav in simulate mode.	1. The AN/WSN-7 is already in a simulated output mode, providing static simulated data to the users. 2. The AN/WSN-7 cannot support both static and BFTT-generated simulated outputs. 3. Static simulated output mode must be terminated before BFTT simulated can start. 4. Terminate simulated outputs as follows: AUX FUNC key; page 3; Sim Output < 1 key >;Enabled < 1 key > = OFF	1, 4, 6
416	Spare.		9
FERR25 – FERR26 (Reserved For Nav Processor)			
417	Spare.		9
418	Spare.		9
419	Spare.		9
420	Spare.		9
421	Spare.		9
422	Spare.		9
423	Spare.		9
424	Spare.		9
425	Spare.		9
426	Spare.		9
427	Spare.		9
428	Spare.		9
429	Spare.		9
430	Spare.		9
431	Spare.		9
432	Spare.		9
433	Spare.		9
434	Spare.		9
435	Spare.		9
436	Spare.		9
437	Spare.		9
438	Spare.		9
439	Spare.		9
440	Spare.		9
441	Spare.		9
442	Spare.		9
443	Spare.		9
444	Spare.		9
445	Spare.		9
446	Spare.		9
447	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR27 – NTDS Message Error (Port A1) (Faults 448 - 463) (I/O Processor).			
These fault codes relate to RLGN NTDS interface message transfer with external equipment. Their detection depends upon NTDS interface board configuration and each enabled I/O port's message Interface Design Specification and configuration. Short loop wraparound tests are automatically run on suspected faulty NTDS ports when the on-line BITE detects any message fault twice in a row (refer to Faults 304 through 335). If the short loop wraparound test fails, BITE sets an additional applicable fault code indicating that the fault is internal to the NTDS interface board.			
448	Invalid Message (Message 01).	1. Run offline, Short Loop Wraparound Test, BIT 424. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 462. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
449	Incorrect Test Pattern (Message 01).		
450	Timeout (Message 01).		
451	Transmission Error (Message 01).		
452	Invalid Message (Message 02).		
453	Incorrect Test Pattern (Message 02).		
454	Timeout (Message 02).		
455	Transmission Error (Message 02).		
456	Invalid Message (Message 03).		
457	Incorrect Test Pattern (Message 03).		
458	Timeout (Message 03).		
459	Transmission Error (Message 03).		
460	Invalid Message (Message 04).		
461	Incorrect Test Pattern (Message 04).		
462	Timeout (Message 04).		
463	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR28 – NTDS Message Error (Port A2) (I/O Processor) (Faults 464 to 479).			
464	Invalid Message (Message 01).	1. Run off-line, Short Loop Wraparound Test, BIT 424. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 462. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Tet passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
465	Incorrect Test Pattern (Message 01).		
466	Timeout (Message 01).		
467	Transmission Error (Message 01).		
468	Invalid Message (Message 02).		
469	Incorrect Test Pattern (Message 02).		
470	Timeout (Message 02).		
471	Transmission Error (Message 02).		
472	Invalid Message (Message 03).		
473	Incorrect Test Pattern (Message 03).		
474	Timeout (Message 03).		
475	Transmission Error (Message 03).		
476	Invalid Message (Message 04).		
477	Incorrect Test Pattern (Message 04)		
478	Timeout (Message 04).		
479	Transmission Error (Message 04)		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR29 – NTDS Message Error (Port B1) (I/O Processor) (Faults 480 to 495).			
480	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 425.	1, 4, 6
481	Incorrect Test Pattern (Message 01).		
482	Timeout (Message 01).	2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA.	
483	Transmission Error (Message 01).		
484	Invalid Message (Message 02).	3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 463.	
485	Incorrect Test Pattern (Message 02).		
486	Timeout (Message 02).		
487	Transmission Error (Message 02).	4. If the Long Loop Wraparound Test fails, suspect:	
488	Invalid Message (Message 03).		
489	Incorrect Test Pattern (Message 03).	a. I/O Processor Card Rack Backplane.	
490	Timeout (Message 03).	b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet.	
491	Transmission Error (Message 03).		
492	Invalid Message (Message 04).		
493	Incorrect Test Pattern (Message 04).	5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	
494	Timeout (Message 04).		
495	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR30 – NTDS Message Error (Port B2) (I/O Processor) (Faults 496 to 511).			
496	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 425.	1, 4, 6
497	Incorrect Test Pattern (Message 01).		
498	Timeout (Message 01).	2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA.	
499	Transmission Error (Message 01).		
500	Invalid Message (Message 02).	3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 463.	
501	Incorrect Test Pattern (Message 02).		
502	Timeout (Message 02).		
503	Transmission Error (Message 02).	4. If the Long Loop Wraparound Test fails, suspect:	
504	Invalid Message (Message 03).		
505	Incorrect Test Pattern (Message 03).	a. I/O Processor Card Rack Backplane.	
506	Timeout (Message 03).	b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet.	
507	Transmission Error (Message 03).		
508	Invalid Message (Message 04).		
509	Incorrect Test Pattern (Message 04).	5. If the Long Loop Wraparound Test passes, suspect the cabling equipment external to the RLGN.	
510	Timeout (Message 04).		
511	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR31 – NTDS Message Error (Port C1) I/O Processor (Faults 512 to 527).			
512	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 426. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 464. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
513	Incorrect Test Pattern (Message 01).		
514	Timeout (Message 01).		
515	Transmission Error (Message 01).		
516	Invalid Message (Message 02).		
517	Incorrect Test Pattern (Message 02).		
518	Timeout (Message 02).		
519	Transmission Error (Message 02).		
520	Invalid Message (Message 03).		
521	Incorrect Test Pattern (Message 03).		
522	Timeout (Message 03).		
523	Transmission Error (Message 03).		
524	Invalid Message (Message 04).		
525	Incorrect Test Pattern (Message 04).		
526	Timeout (Message 04).		
527	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR32 – NTDS Message Error (Port C2) (I/O Processor) (Faults 528 to 543).			
528	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 426. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 464. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
529	Incorrect Test Pattern (Message 01).		
530	Timeout (Message 01).		
531	Transmission Error (Message 01).		
532	Invalid Message (Message 02).		
533	Incorrect Test Pattern (Message 02).		
534	Timeout (Message 02).		
535	Transmission Error (Message 02).		
536	Invalid Message (Message 03).		
537	Incorrect Test Pattern (Message 03).		
538	Timeout (Message 03).		
539	Transmission Error (Message 03).		
540	Invalid Message (Message 04).		
541	Incorrect Test Pattern (Message 04).		
542	Timeout (Message 04).		
543	Transmission Error (Message 04)		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR33 – NTDS Message Error (Port D1) (I/O Processor) (Faults 544 - 559)			
544	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 427. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 465. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
545	Incorrect Test Pattern (Message 01).		
546	Timeout (Message 01).		
547	Transmission Error (Message 01).		
548	Invalid Message (Message 02).		
549	Incorrect Test Pattern (Message 02).		
550	Timeout (Message 02).		
551	Transmission Error (Message 02).		
552	Invalid Message (Message 03).		
553	Incorrect Test Pattern (Message 03).		
554	Timeout (Message 03).		
555	Transmission Error (Message 03).		
556	Invalid Message (Message 04).		
557	Incorrect Test Pattern (Message 04).		
558	Timeout (Message 04).		
559	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR34 – NTDS Message Error (Port D2) (I/O Processor) (Faults 560 - 575)			
560	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 427. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 465. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
561	Incorrect Test Pattern (Message 01).		
562	Incorrect Test Pattern (Message 01).		
563	Transmission Error (Message 01).		
564	Invalid Message (Message 02).		
565	Incorrect Test Pattern (Message 02).		
566	Timeout (Message 02).		
567	Transmission Error (Message 02).		
568	Invalid Message (Message 03).		
569	Incorrect Test Pattern (Message 03).		
570	Timeout (Message 03).		
571	Transmission Error (Message 03).		
572	Invalid Message (Message 04).		
573	Incorrect Test Pattern (Message 04).		
574	Timeout (Message 04).		
575	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR35 – NTDS Message Error (Port E1) (I/O Processor) (Faults 576 - 591)			
576	Invalid Message (Message 01).	1. Run offline, Short Loop Wraparound Test, BIT 458.	1, 4, 6
577	Incorrect Test Pattern (Message 01).	2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA.	
578	Timeout (Message 01).	3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 466.	
579	Transmission Error (Message 01).	4. If the Long Loop Wraparound Test fails, suspect:	
580	Invalid Message (Message 02).	a. I/O Processor Card Rack Backplane.	
581	Incorrect Test Pattern (Message 02).	b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet.	
582	Timeout (Message 02).	5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	
583	Transmission Error (Message 02).		
584	Invalid Message (Message 03).		
585	Incorrect Test Pattern (Message 03).		
586	Timeout (Message 03).		
587	Transmission Error (Message 03).		
588	Invalid Message (Message 04).		
589	Incorrect Test Pattern (Message 04).		
590	Timeout (Message 04).		
591	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR36 - NTDS Message Error (Port E2) (I/O Processor) (Faults 592 - 607)			
592	Invalid Message (Message 01).	1. Run offline, Short Loop Wraparound Test, BIT 458.	1, 4, 6
593	Incorrect Test Pattern (Message 01).	2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA.	
594	Timeout (Message 01).	3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 466.	
595	Transmission Error (Message 01).	4. If the Long Loop Wraparound Test fails, suspect:	
596	Invalid Message (Message 02).	a. I/O Processor Card Rack Backplane.	
597	Incorrect Test Pattern (Message 02).	b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet.	
598	Timeout (Message 02).	5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	
599	Transmission Error (Message 02).		
600	Invalid Message (Message 03).		
601	Incorrect Test Pattern (Message 03).		
602	Timeout (Message 03).		
603	Transmission Error (Message 03).		
604	Invalid Message (Message 04).		
605	Incorrect Test Pattern (Message 04).		
606	Timeout (Message 04).		
607	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR37 – NTDS Message Error (Port F1) (I/O Processor) (Faults 608 - 623)			
608	Invalid Message (Message 01).	1. Run offline, Short Loop Wraparound Test, BIT 459. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 467. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
609	Incorrect Test Pattern (Message 01).		
610	Timeout (Message 01).		
611	Transmission Error (Message 01).		
612	Invalid Message (Message 02).		
613	Incorrect Test Pattern (Message 02).		
614	Timeout (Message 02).		
615	Transmission Error (Message 02).		
616	Invalid Message (Message 03).		
617	Incorrect Test Pattern (Message 03).		
618	Timeout (Message 03).		
619	Transmission Error (Message 03).		
620	Invalid Message (Message 04).		
621	Incorrect Test Pattern (Message 04).		
622	Timeout (Message 04).		
623	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR38 – NTDS Message Error (Port F2) (I/O Processor) (Faults 624 - 639)			
624	Invalid Message (Message 01).	1. Run offline, Short Loop Wraparound Test, BIT 459. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 467. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
625	Incorrect Test Pattern (Message 01).		
626	Timeout (Message 01).		
627	Transmission Error (Message 01).		
628	Invalid Message (Message 02).		
629	Incorrect Test Pattern (Message 02).		
630	Timeout (Message 02).		
631	Transmission Error (Message 02).		
632	Invalid Message (Message 03).		
633	Incorrect Test Pattern (Message 03).		
634	Timeout (Message 03).		
635	Transmission Error (Message 03).		
636	Invalid Message (Message 04).		
637	Incorrect Test Pattern (Message 04).		
638	Timeout (Message 04).		
639	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR39 – NTDS Message Error (Port G1) (I/O Processor) (Faults 640 - 655)			
640	Invalid Message (Message 01).	1. Run offline, Short Loop Wraparound Test, BIT 460. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 468. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
641	Incorrect Test Pattern (Message 01).		
642	Timeout (Message 01).		
643	Transmission Error (Message 01).		
644	Invalid Message (Message 02).		
645	Incorrect Test Pattern (Message 02).		
646	Timeout (Message 02).		
647	Transmission Error (Message 02).		
648	Invalid Message (Message 03).		
649	Incorrect Test Pattern (Message 03).		
650	Timeout (Message 03).		
651	Transmission Error (Message 03).		
652	Invalid Message (Message 04).		
653	Incorrect Test Pattern (Message 04).		
654	Timeout (Message 04).		
655	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATEGORY
FERR40 – NTDS Message Error (Port G2) (I/O Processor) (Faults 656 - 671)			
656	Invalid Message (Message 01).	1. Run offline, Short Loop Wraparound Test, BIT 460. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wraparound Test Cable and run Long Loop Wraparound Test, BIT 468. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
657	Incorrect Test Pattern (Message 01).		
658	Timeout (Message 01).		
659	Transmission Error (Message 01).		
660	Invalid Message (Message 02).		
661	Incorrect Test Pattern (Message 02).		
662	Timeout (Message 02).		
663	Transmission Error (Message 02).		
664	Invalid Message (Message 03).		
665	Incorrect Test Pattern (Message 03).		
666	Timeout (Message 03).		
667	Transmission Error (Message 03).		
668	Invalid Message (Message 04).		
669	Incorrect Test Pattern (Message 04).		
670	Timeout (Message 04).		
671	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR41 – NTDS Message Error (Port H1) (I/O Processor) (Faults 672 - 687)			
672	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 461. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 469. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
673	Incorrect Test Pattern (Message 01).		
674	Timeout (Message 01).		
675	Transmission Error (Message 01).		
676	Invalid Message (Message 02).		
677	Incorrect Test Pattern (Message 02).		
678	Timeout (Message 02).		
679	Transmission Error (Message 02).		
680	Invalid Message (Message 03).		
681	Incorrect Test Pattern (Message 03).		
682	Timeout (Message 03).		
683	Transmission Error (Message 03).		
684	Invalid Message (Message 04).		
685	Incorrect Test Pattern (Message 04).		
686	Timeout (Message 04).		
687	Transmission Error (Message 04).		

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
FERR42 – NTDS Message Error (Port H2) (I/O Processor) (Faults 688 - 703)			
688	Invalid Message (Message 01).	1. Run offline, Short Loop Wrap-around Test, BIT 461. 2. If the Short Loop Wraparound Test fails, suspect the port's related NTDS interface CCA. 3. If the Short Loop Wraparound Test passes, use the appropriate Wrap-around Test Cable and run Long Loop Wraparound Test, BIT 469. 4. If the Long Loop Wraparound Test fails, suspect: a. I/O Processor Card Rack Backplane. b. Cable between the I/O Processor Card Rack Backplane, or card edge, and the RLGN I/O jack on the cabinet. 5. If the Long Loop Wraparound Test passes, suspect the cabling or equipment external to the RLGN.	1, 4, 6
689	Incorrect Test Pattern (Message 01).		
690	Timeout (Message 01).		
691	Transmission Error (Message 01).		
692	Invalid Message (Message 02).		
693	Incorrect Test Pattern (Message 02).		
694	Timeout (Message 02).		
695	Transmission Error (Message 02).		
696	Invalid Message (Message 03).		
697	Incorrect Test Pattern (Message 03).		
698	Timeout (Message 03).		
699	Transmission Error (Message 03).		
700	Invalid Message (Message 04).		
701	Incorrect Test Pattern (Message 04).		
702	Timeout (Message 04).		
703	Transmission Error (Message 04).		
FERR43 – ATM Processor Initialization and Executive Functions (Faults 704 - 719)			
704	Loss of synchronization: Indicates lack of synchronization between the 50 Hz Lower Unit Strobe (LUS) and the 800 Hz interrupt request signal (IRQ5). Both signals are derived from the I/O Control (BITE) and Filter Assy (1A1A31), and transmitted via the Status and Command CCA (1A1A15) to the ATM Processor CCA (1A1A4). The fault is declared after one occurrence. NOTE: Checked at run-time.	1. Check status of red LEDs on the Nav, ATM, and I/O Processor CCAs. 2. If all CCA red LEDs are static, suspect the I/O Control (BITE) and Filter Assy (1A1A31). 3. If the ATM and I/O Processors CCA red LEDs are static, suspect the Status and Command CCA (1A1A15). 4. If only the ATM Processor CCA's red LED is static, suspect the ATM Processor CCA (1A1A4).	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
705	Overrun error: Indicates that the software real-time executive has been interrupted during execution of a task. May result from excessive LAN activity. NOTE: Checked at run-time.	1. Reset the ATM Processor. 2. If fault recurs, suspect the ATM Processor CCA (**1A1A4**).	1, 3, 4, 6, 8
706	ROM checksum error: Indicates data errors in the ATM software program held in ROM on the ATM Processor CCA (**1A1A4**). NOTE: Checked at Initialization.	Suspect the ATM Processor CCA (**1A1A4**).	1, 3, 4, 6, 8
707	Spare.		9
708	486 CPU Timer fail. NOTE: Checked at initialization.	1. Check that the red LED (DS1) on ATM Processor CCA (**1A1A4**) illuminates momentarily on power-up. 2. If the ATM CCA's LED (DS1) does not light at power up, or does not extinguish after lighting, suspect the ATM Processor CCA (**1A1A4**).	1, 3, 4, 6, 8
709	RAM fail: The ATM Processor RAM self-test is executed as part of the system initialization check on system power-up. Indicates failure of scratchpad memory RAM (AU5-U12) on ATM Processor CCA (**1A1A4**). NOTE: Checked at initialization.	1. Check that the red LED (DS1) on ATM Processor CCA (**1A1A4**) illuminates momentarily on power-up. 2. If the ATM CCA's LED (DS1) does not light at power up, or does not extinguish after lighting, suspect the ATM Processor CCA (**1A1A4**).	1, 3, 4, 6, 8
710	Loss of 50 Hz strobe: Indicates that the 50 Hz timing signal from the Support Electronics is missing. This fault code is flagged up if the ATM Processor fails to detect the signal after two attempts. Refer to Fault **704**. NOTE: Checked at initialization. NOTE: Checked at run-time.	1. Check status of red LEDs on the Nav, ATM, and I/O Processor CCAs. 2. If all CCA red LEDs are static, suspect the I/O Control (BITE) and Filter Assy (**1A1A31**). 3. If the ATM and I/O Processors CCA red LEDs are static, suspect the Status and Command CCA (**1A1A15**). 4. If only the ATM Processor CCA's red LED is static, suspect the ATM Processor CCA (**1A1A4**).	1, 4, 6, 8

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
711	PMC Short Loop power-up failure. NOTE: Checked at initialization.	Suspect the ATM Processor CCA (**1A1A4**).	1, 4, 6
712	System packet not in ATM state: The ATM Processor has failed in an attempt to gain access to the Dual Port Memory during system initialization checks at power-up. Indicates that the Nav Processor has retained access to the Dual Port Memory for an excessive time. NOTE: Checked at initialization. NOTE: Checked at run-time.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. ATM Processor CCA (**1A1A4**). b. Nav Processor CCA (**1A1A13**).	1, 4, 6, 8
713	Spare.		9
714	Invalid system packet format (test patterns, error count, or command wrong): Indicates incorrect test data read from the SYS packet located in the Dual Port Memory. NOTE: Checked at initialization.	1. Resete the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (**1A1A13**). b. ATM Processor CCA (**1A1A4**), Dual Port Memory.	1, 4, 6, 8
715	Loss of 800 Hz interrupts: Indicates failure of the interrupt control unit (IC U16) on the ATM Processor to receive the 800 Hz interrupt request signal (IRQ5) from the Support Electronics. Refer to Fault **704**. NOTE: Checked at run-time.	1. Check status of red LEDs on the Nav, ATM, and I/O Processor CCAs. 2. If all CCA red LEDs are static, suspect the I/O Control (BITE) and Filter Assy (**1A1A31**). 3. If the ATM and I/O Processors CCA red LEDs are static, suspect the Status and Command CCA (**1A1A15**). 4. If only the ATM Processor CCA's red LED is static, suspect the ATM Processor CCA (**1A1A4**).	1, 3, 4, 6, 8

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
716	Invalid COMRAM test pattern: The ATM Processor periodically performs a test pattern write/read test on the common RAM (dual port memory) on Dual Port Memory CCA (1A1A23). Fault is announced if test fails twice in a row. Refer to Fault 019 for Nav Processor test. Refer to Fault 714. NOTE: Checked at run-time.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4), Dual Port Memory.	1, 4, 8
717	Unable to obtain master semaphore: Indicates that the ATM Processor is unable to access the master semaphore flag giving access to the Dual Port Memory. Refer to Fault 714. NOTE: Checked at initialization. NOTE: Checked at run-time.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4), Dual Port Memory.	1, 4, 6, 8
718	Inconsistent system packets error count (two occurrences): Indicates a failure to initialize the ATM Processor after two attempts. Error counter in Dual Port Memory = 2. Refer to Fault 714. NOTE: Checked at run-time.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4), Dual Port Memory.	1, 4, 6, 8
719	Dual Port Memory fail: Indicates failure of Dual Port Memory initialization confidence test. NOTE: Checked at initialization.	Suspect the ATM Processor CCA (1A1A4).	1, 4, 6, 8
FERR44 – ATM Processor Initialization and Executive Functions (Faults 720 - 735)			
720	Misc. trap: Includes any interrupt vector not already defined (debug, exception, NMI interrupt, INTO-detected overflow, BOUND range exceeded, device not available, double fault, coprocessor segment overrun, invalid TSS, segment not present, stack fault, page fault, align check, all intel reserved interrupt vectors, any unexpected maskable interrupt).	Reserved Faults – Not currently implemented.	1, 3, 4, 6, 8
721	General Protection trap (Exception 13).	Reserved Faults – Not currently implemented.	1, 3, 4, 6, 8
722	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
723	Floating point trap (Exception 16).	Reserved Faults – Not currently implemented.	1, 3, 4, 6, 8
724	Spare.		9
725	Spare.		9
726	Divide-by-zero trap (Exception 0).	Reserved Faults – Not currently implemented.	1, 3, 4, 6, 8
727	Spare.		9
728	Breakpoint trap (Exception 3).	Reserved Faults – Not currently implemented.	1, 3, 4, 6, 8
729	Spare.		9
730	Undefined instruction trap (Exception 6): Indicates ATM Processor executive error.	Reserved Faults – Not currently implemented.	1, 3, 4, 6, 8
731	ATM assertion error. Logical check on ATM processor program execution.	Suspect the ATM Processor CCA (1A1A4).	1, 3, 4, 6, 8
732	Spare.		9
733	ATM Port failure on initialization.	1. ATM Port I configured for incompatible IDS. 2. Perform offline configuration to reconfigure port.	1, 4, 6
734	Reserved for ATM port output overrun error.	Reserved Faults – Not currently implemented.	1, 4, 6
735	Reserved for UART error (framing error or overrun condition).	Reserved Faults – Not currently implemented.	1, 4, 6
FERR45 – ATM Processor and Run Time Errors. (Faults 736 - 751)			
For Faults 739 and 741 through 751, and 776, the ATM processor checks for the state of the software semaphore that permits access to the appropriate packet in Dual Port Memory. The semaphore is checked at a rate in accordance with the message rate associated with the particular packet. If the Nav Processor or ATM Processor fails to execute properly, or if synchronization between the two is lost, these faults may occur (probably in conjunction with additional diagnostic faults.			
736	Spare.		9
737	Spare.		9
738	Invalid system packet command: Indicates that the command sent from the Nav Processor to the ATM Processor is not recognized and cannot be executed. Refer to Fault 714. NOTE: I/O or ATM processor shutdown after two consecutive occurrences.	1. Reset the ATM Processor. 2. If fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4), Dual Port Memory.	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
739	Vertical Correction packet not in ATM state.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4), Dual Port Memory.	1, 3, 6
740	General BIT failure or timeout.	Unable to perform BIT test. Consider this fault the same as failure of BIT test.	1, 4, 6
741 742 743 744 745 746	SINS 2 Packet not in ATM state. Fix Packet not in ATM state. Velocity Reference Packet not in ATM state. Calibration Packet not in ATM state. Depth Packet not in ATM state. Gyro Packet not in ATM state.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4), Dual Port Memory.	1, 3, 4, 6
747 748 749 750 751	Navigation Packet not in ATM state. NOTE: I/O or ATM processor shutdown after two consecutive occurrences. Attitude Packet not in ATM state. NOTE: I/O or ATM processor shutdown after two consecutive occurrences. GPS Packet not in ATM state. Time Output Packet not in ATM state. NOTE: I/O or ATM processor shutdown after two consecutive occurrences. Time Input Packet not in ATM state.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4), Dual Port Memory.	1, 3, 4, 6, 8
FERR46 - Peripheral Component Interface (PCI) Exception Faults (Faults 752 - 767)			
752	PCI configuration error at power-up, Port I: Indicates that the ATM Processor detected that PCI interface to the ATM PMC Mezzanine card was not configured properly at startup.	1. Reset the ATM Processor. 2. If the fault recurs, suspect the ATM Processor CCA (1A1A4).	9
753	Reserved for Network Interface Card (NIC) detected long loop failure.	Reserved Faults – Not currently implemented.	9
754	Reserved for NIC detected short loop failure.	Reserved Faults – Not currently implemented.	9
755	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
756	Spare.		9
757	Spare.		9
758	Spare.		9
759	Spare.		9
760	Spare.		9
761	Spare.		9
762	Spare.		9
763	Spare.		9
764	Spare.		9
765	Spare.		9
766	Spare.		9
767	Spare.		9
FERR47 - ATM Processor Run Time Exceptions (Faults 768 - 783)			
768	ATM Interface error: ATM Port I configured for incompatible IDS.	Perform offline configuration to reconfigure port.	1, 4, 6
769	Spare.		9
770	ATM System Packet test pattern incorrect (two occurrences): The ATM Processor continuously performs a test pattern test of common RAM (Dual Port Memory) on the ATM Processor Assembly. A fault is declared if this test fails twice.	Suspect the Dual Port Memory on ATM Processor CCA (1A1A4).	1, 4, 6
771	Spare.		9
772	Spare.		9
773	Spare.		9
774	Spare.		9
775	Spare.		9
776	BFTT packet not in ATM state.	1. Reset the ATM Processor. 2. If the fault recurs, suspect: a. Nav Processor CCA (1A1A13). b. ATM Processor CCA (1A1A4).	1, 4, 6
777	BFTT – in dockside and VMAN not selected.	VMAN must be selected to operate in BFTT Dockside mode.	1, 4, 6

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
778	BFTT – input message 2.5 sec timeout. Either communication with BFTT user lost, or BFTT simulation incorrectly terminated.	Verify that the BFTT and LAN are operating properly. If BFTT and LAN are operating properly, treat fault the same as Faults **784** through **796**.	1, 4, 6
779	BFTT – input message 10 sec timeout.	Either communication with BFTT user lost, or BFTT simulation incorrectly terminated. Simulated variables will be slewed back to Nav values and simulation terminated.	1, 4, 6
780	Spare.		9
781	Spare.		9
782	Spare.		9
783	Spare.		9
FERR48 - ATM Port 1 Message Timeout Faults - Fault **784** through **799** are associated with ATM message transfer between the INS and external equipment. These faults are dependent upon ATM interface configuration.			
784 **785**	External Fix message timeout, Port I. GPS Fix message timeout, Port I.	1. Verify that the LAN and the ATM message source equipment is working correctly. 2. If the LAN and ATM message source equipment are working correctly, and the fault persists, run a short loop wraparound BIT test 488 by restarting the ATM. Suspect the ATM Processor CCA (**1A1A4**). 3. If the short loop wraparound and all BIT tests pass successfully without ATM startup faults, perform offline, long loop wraparound BIT test 489, and suspect the ATM Processor CCA (**1A1A4**), PMC card optic module. 4. If the offline, long loop wraparound BIT test passes, suspect: a. Cabling to the equipment external to the navigation system. b. Normal operation of equipment external to the navigation system.	1, 4, 6
786	Reserved for Remote Control message timeout, Port I.	Reserved Faults – Not currently implemented.	9
787 **788**	Velocity Reference message timeout, Port I. Attitude Input message timeout, Port I.	1. Verify that the LAN and the ATM message source equipment is working correctly. 2. If the LAN and ATM message source equipment are working correctly, and the fault persists, run a short loop wraparound BIT test 488 by restarting the ATM. Suspect the ATM Processor CCA (**1A1A4**). 3. If the short loop wraparound and all BIT tests pass successfully without ATM startup faults, perform offline, long loop wraparound BIT test 489, and suspect the ATM Processor CCA (**1A1A4**), PMC optic module. 4. If the offline, long loop wraparound BIT tests passes, suspect: a. Cabling to the equipment external to the navigation system. b. Normal operation of equipment external to the navigation system.	1, 4, 6
789	Reserved for Waypoint Input message timeout, Port I.	Reserved Faults – Not currently implemented.	9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
790	Depth message timeout, Port I.	1. Verify that the LAN and the ATM message source equipment is working correctly. 2. If the LAN and ATM message source equipment are working correctly, and the fault persists, run a short loop wraparound BIT test 488 by restarting the ATM. Suspect the ATM Processor CCA (**1A1A4**). 3. If the short loop wraparound and all BIT tests pass successfully without ATM startup faults, perform offline, long loop wraparound BIT test 489, and suspect the ATM Processor CCA (**1A1A4**), PMC optic module. 4. If the offline, long loop wraparound BIT test passes, suspect: a. Cabling to the equipment external to the navigation system. b. Normal operation of equipment external to the navigation system.	1, 4, 6
791	BFTT Input message timeout, Port I.	1. Verify that the LAN and the ATM message source equipment is working correctly. 2. If the LAN and ATM message source equipment are working correctly, and the fault persists, run a short loop wraparound BIT test by restarting the ATM. Suspect the ATM Processor CCA (**1A1A4**). 3. If the short loop wraparound and all BIT tests pass successfully without ATM startup faults, proceed to offline, long loop wraparound BIT test, and suspect the ATM Processor CCA (**1A1A4**), PMC card optic module. 4. If the offline, long loop wraparound BIT test passes, suspect: a. Cabling to the equipment external to the navigation system. b. Normal operation of equipment external to the navigation system.	1, 4, 6
792	Gravity Gradient message timeout, Port I.	1. Verify that the LAN and the ATM message source equipment is working correctly. 2. If the LAN and ATM message source equipment are working correctly, and the fault persists, run a short loop wraparound BIT test 488 by restarting the ATM. Suspect the ATM Processor CCA (**1A1A4**). 3. If the short loop wraparound and all BIT tests pass successfully without ATM startup faults, perform offline, long loop wraparound BIT test 489, and suspect the ATM Processor CCA (**1A1A4**), PMC card optic module. 4. If the offline, long loop wraparound BIT test passes, suspect: a. Cabling to the equipment external to the navigation system. b. Normal operation of eqipment external to the navigation system.	1, 4, 6
793 794 795 796	Output Buffer Allocation error: May result from excessive LAN activity. Socket error: Could not modify I/O control options for ATM socket. May result from excessive LAN activity. Transmit error: An ATM output message was not transmitted completely. May result from excessive LAN activity. Receive error: Reading of ATM input message failed. May result from excessive LAN activity.	1. Reset the ATM Processor. 2. If the fault recurs, suspect the ATM Processor CCA (**1A1A4**).	1, 4, 6
797	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
798	Spare.		9
799	Spare.		9
FERR49 – Reserved Faults (Faults **800 - 815**)			
800	Spare.		9
801	Spare.		9
802	Spare.		9
803	Spare.		9
804	Spare.		9
805	Spare.		9

Table B-1. Fault Code Descriptions and Fault Isolation - Continued

FAULT	DESCRIPTION	DIAGNOSTIC INFORMATION	FAULT CATE-GORY
806	Spare.		9
807	Spare.		9
808	Spare.		9
809	Spare.		9
810	Spare.		9
811	Spare.		9
812	Spare.		9
813	Spare.		9
814	Spare.		9
815	Spare.		9

GLOSSARY

All the acronyms and abbreviations that are used in the text, tables, and figures of this manual are included in this glossary. Acronyms are shown in upper case; abbreviations, in title case. These include non-obvious abbreviations, which are displayed in menus or marked on controls or subassemblies in the system.

LIST OF ACRONYMS AND ABBREVIATIONS

3M	(Navy) Maintenance and Material Management System
A/D	Analog-to-Digital
AC	Alternating Current
Accel	Accelerometer
ACK	Acknowledge
ADH	Adhesive
Aft	After
ALIGN-C	Coarse Align
ALIGN-F	Fine Align
ANORM	Auto Normal
APL	Allowance Parts List
AR	As Required
ATM	Asynchronous Transfer Mode
ATXVS	Auto Transverse
Auto	Automatic
AUTOD	Auto Damped
AUTOU	Auto Undamped
Aux	Auxiliary
AUX FUNC	Auxiliary Function
AWG	American Wire Gauge
AZ	Azimuth
BAT	Battery
BFTT	Battle Force Tactical Trainer
BIT	Built-in Test
BITE	Built-in Test Equipment
BLUS	Buffered Lower Unit Strobe
BMI	Base Motion Isolation
C	Centigrade (Celsius)
CAGE	Commercial and Government Entity
CB	Circuit Breaker
CCA	Circuit Card Assembly
CDU	Control Display Unit
CEP	Circular Error Probability
CHG	Charger
Chg	Change
CID	Component Identification Designator
Cm	Centimeter(s)
COMRAM	Common RAM (Dual Port Memory)
Cos	Cosine
CPU	Central Processing Unit
CSCI	Computer Software Configuration Item
CSOSS	Combat Systems Operational Sequencing System
CSTOM	Combat Systems Technical Operation Manual
CTS	Clear To Send
DAM33	C accelerometer scale factor
D/S	Digital-to-Synchro (Converter or Conversion)
DC	Direct Current
DCM	Direction Cosine Matrix
DCS	Display Control Subsystem
DDIG	Digital Depth Sensor
DD°MM.mm'	Degrees and Minutes Format of Position
DE	Reset East Distance
DGM11	Gyro A scale factor
DGM12	Gyro A misalignment into B
DGM13	Gyro A misalignment into C
DGM21	Gyro B misalignment into A
DGM22	Gyro B scale factor
DGM23	Gyro B misalignment into C
DGM31	Gyro C misalignment into A
DGM32	Gyro C misalignment into B
DGM33	Gyro C scale factor
DN	(Reset) North Distance
Dock	Dockside
DR	Dead Reckoning
DSBL	Disable
DSR	Data Set Ready
DSVL	Doppler Sonar Velocity Log
dTHBK	Residual IMU Vertical Bias
dTHBN	Residual IMU North Bias
DTR	Data Terminal Ready
DV_e	Difference Between East/West Inertial and Selected Reference Velocity
DVb3	C Accelerometer Bias
DV_n	Difference Between North/South Inertial and Selected Reference Velocity
E	East
EC	External Computer
ECU	Electronic Control Unit
EEPROM	Electrically Erasable Programmable Read-Only Memory
EF	External Function
EM	Electromagnetic
EMI	Electromagnetic Interference
EM Log	Electromagnetic Log
EP	Embedded Processor, or Enhanced Position, or Estimated Position
ESD	Electrostatic Discharge
ESDS	Electrostatic Discharge Sensitive
F	Fahrenheit
FERRnn	Software Error Word
FIFO	First-in First-out
FIG	Figure
FIM	Factory Interface Monitor
FLT	Fault
FM	Figure of Merit
FPU	Floating Point Unit
FSE	Fix Sigma East
FSN	Fix Sigma North
Ft	Feet
Fwd	Forward
g	Force of Gravity
GMT	Greenwich Mean Time
GPS	Global Positioning System
HDG	Heading
HH:MM:SS	Hours:Minutes:Seconds
Hr	Hour
HVPS	High Voltage Power Supply
Hz	Hertz (Cycles Per Second)
I/O	Input/Output
IC	Interrupt Control
ID	Identification or Inside Diameter
IDS	Interface Design Specification
IMU	Inertial Measuring Unit
In	Inch(es)
INS	Inertial Navigation System
ISEA	In-Service Engineering Agent
K	Vertical/Down Vector or Position Fix Weighting Factor (Gain)
kdVB0	A accelerometer bias
kdVB1	B accelerometer bias
KENV	Keyboard Entry to Non-Volatile Memory
KF	Kalman Filter
Kg	Kilograms
KTS	Knots
LAN	Local Area Network
Lat	Latitude
Lbs	Weight in Pounds
LED	Light Emitting Diode
LIM	Laser Intensity Monitor
Log	(Speed) Log
Lon	Longitude
LOS	Line of Sight
LRU	Lowest (or Line) Replaceable Unit
LUS	Lower Unit Strobe
MAC	Media Access Control
Man	Manual
MAND	Manual Damped
MANU	Manual Undamped
Max	Maximum
MIP	Maintenance Index Page
Mk	Mark
MNORM	Manual Normal
Mon	Monitor
MRC	Maintenance Requirement Card
Ms	Milliseconds
MTXVS	Manual Transverse
N	North
N/A	Not Applicable
Nav	Navigation
NAVAID	Navigation Aid
NAVSTAR	Navigation Satellite Timing and Ranging
NDU	Navigation Data Unit
NIC	Network Interface Card
Nm	Nautical Mile
No.	Number
Norm	Normal
Nos.	Numbers
NSDSA	Naval Systems Data Support Activity
NTDS	Naval Tactical Data System
NTP	Network Time Protocol
NVRAM	Non-Volatile Random Access Memory
OBRP	On-Board Repair Part
P/N	Part Number
P/O	Part of
PAL	Programmable Array Logic
PAM	Pulse Accumulator Module
Para	Paragraph
PCI	Peripheral Component Interface
PDF®	Portable Document Format
PDIG	Digital Position Sensor Source
PDU	Power Distribution Unit
PLAD	Plain Language Address
PLC	Path Length Control
PMC	PCI Mezzanine Card
PMS	Planned Maintenance System
Pos	Position
PPM	Pulses Per Minute
PPS	Pulses Per Second
PROM	Programmable Read-Only Memory
Psi	Pounds Per Square Inch
PWR	Power
RAM	Random Access Memory
RCDU	Remote Control Display Unit
RDI	Random Drift Improvement

Ref	Reference
Reinit	Reinitialize or Reinitialization
Rev	Revision or Revolution
RLG	Ring Laser Gyro
RLGN	Ring Laser Gyro Navigator
RMC	Regional Maintenance Center
RMS	Root Mean Square
ROM	Read Only Memory
RPE	Radial Position Error
RPM	Revolutions per minute
RST	Reset
RTN	Return
RTS	Request to Send
RTV	Room Temperature Vulcanizing
S	South
S/D	Synchro-to-Digital
S&H	Sample and Hold
SBA	Synchro Buffer Amplifier or Sensor Block Assembly
SCAT	Subcategory
SCR	Silicon Controlled Rectifier
SCS	Ship Control System
SE	Sigma East
Sec	Secondary or Section
Sec	Secant or Second(s)
SF	Scale Factor
Sin	Sine
SINS	Ship's Inertial Navigation System
SLCM	Sea/Submarine Launched Cruise Missile
SN	Sigma North
SONET	Synchronous Optical Network
SPAWAR	Space and Naval Warfare Systems Center
SPI	Special Packaging Instruction
SRA	Spin Reference Axis
STANAG	Standard NATO Agreement
Stbd	Starboard
Sys	System
TACAN	Tactical Airborne Navigation
Tan	Tangent
TCA	Temperature Circuit Activation
TDMIS	Technical Data Management Information System
THD	Transverse Heading
TJS	Terminal Junction System
TLN	Transverse Longitude
TLT	Transverse Latitude
TMDER	Technical Manual Deficiency/Evaluation Report
TQR	Torquer
TRMS	Time Root Mean Square
TST	Test
Txvs	Transverse
UART	Universal Asynchronous Receiver/Transmitter
UTC	Universal Time Coordinated
V	Volts
VA	Volt Amps
VAC	Volts, Alternating Current
Var	Variance
VDC	Volts, Direct Current
VDIG	Digital Velocity Sensor
$\mathbf{V_e}$	Velocity East
Vel	Velocity
Vfa	Velocity Fore/Aft
VGPS	Three-Axis Speed Input From a GPS Device
Vk	Velocity Up/Down
VMAN	Manually Entered Speed
$\mathbf{V_n}$	Velocity North
Vps	Velocity Port/Starboard
$\mathbf{V_t}$	Total Horizontal Velocity
Vv	Vertical Velocity (from Speed Log)
W	West

INDEX

A/D Multiplexer CCA
- Description 3.4.6.3
- Packing and Shipment 6.5.5
- Removal and Replacement 6.3.3
- Tests Table 5-1

Accelerometer and Sensor Electronics CCA
- Description 3.4.6.3
- Packing and Shipment 6.5.5
- Removal and Replacement 6.3.3
- Tests Table 5-1

Accelerometer Assemblies
- Description 3.4.6.3
- Removal and Replacement 6.4.4
- Tests Table 5-1

Accelerometer Stimulus CCA
- Removal and Replacement 6.4.5

Align Modes
- 20-Hour Align 2.3.2.4.1
- Align Mode States 2.3.2.1
- At-Sea 2.3.2.4.3
- Coarse vs. Fine 2.3.2.4.5
- Dockside 2.3.2.4.1
- Navigate/At-Sea Align 2.3.2.4.3
- Operating in Align Modes 2.3.2.3
- Preferred Method 2.3.2.4.4
- Selection 2.3.2.5
- Self-Align/Calibrate 3.2.9.3
- Slave Align 2.3.2.4.2

AN/WSN-7(V) RLGN
- Configurations, Interfaces, and Companion Equipment 1.3
- Control Display Unit Information 1.5.2
- Design, Physical Characteristics, and Specifications Table 1-1
- Digital Data Interface Table 1-2
- Documentation Required but Not Supplied Table 1-6
- Documentation Supplied Table 1-7
- Equipment and Accessories Supplied Table 1-8
- External Interfaces 1.3.2
- Field Changes Table 1-10
- General Description 1.2
- General Equipment Function 1.2.1
- General Information and Safety Precautions 1.1
- Introduction and Description 2.1
- Normal Operation 1.2.2
- Power 1.2.4
- Procedures 2.3
- Troubleshooting and Maintenance Concept 1.6
- Units and Assemblies 1.4

ATM Processor CCA
- Description 1.4.2
- Packing and Shipment 6.5.5, Table 6-9
- Removal and Replacement 6.3.3
- Tests Table 5-1

B

Battery Assembly
- Description 2.3.7.3
- Maintenance and Storage 2.3.7.3
- Packing and Shipment 6.5.3, Table 6-7
- Removal and Replacement 6.3.5.15
- Tests Table 5-1

Battery Charger
- Description 3.4.9.4
- Packing and Shipment 6.5.6, Table 6-14
- Removal and Replacement 6.3.5.9
- Tests Table 5-1

BIT Test Cables
- Description and Listing A.1, A.2

Bus Interface CCA
- Packing and Shipment 6.5.5

D

Dual Panel Interface CCA
- Description 1.4.1
- Packing and Shipment 6.5.5
- Tests Table 5-1

Dual Port Memory CCA
- Description 3.3.3.2
- Packing and Shipment 6.5.5

F

Fault Codes
- Acknowledging and Identifying Fault Conditions 2.3.7.1
- Alternating Current Power Fault 2.3.7.3
- Casualty Mode Faults 2.3.7.10
- Fault Codes List and Description Table B-1
- GPS Faults 2.3.7.6
- Indexer Faults 2.3.7.4
- List of Fault Codes Appendix B, Table B-1
- Operating with System Faults 2.3.7.2
- Operator Advisory Faults 2.4.10.2
- Performance Monitoring Faults 2.4.9
- Position Fix and Velocity Reference Faults 2.3.7.7
- Previously Stored (Shutdown) Faults 5.4.3, 5.4.4
- Speed Data Source Faults 2.3.7.5

Functional Descriptions, System
- BIT and Status 3.4.9
- Display Control Table 2-1
- External Data Interface 3.4.4
- Platform Indexing 3.4.2
- Position Sensing and Processing 3.4.6
- Power Distribution and Emergency Power Switching 3.4.1
- Synchro Attitude and Velocity Data Interface 3.4.7
- System Timing and Navigation Processing 3.4.3

G

GPS
- Automatic Fix Entry 2.3.4.8
- Description 3.2.17
- Faults 2.3.7
- GPS - INS Filter 3.2.17.1
- INS Interface 3.2.17
- Lever Arm Data 3.2.17.4
- Manual Fix Entry 2.3.4.9, 2.3.4.10
- Selecting as a Fix Source 2.3.5

Gyro Support Electronics CCA

Description 3.3.3.3
Packing and Shipment 6.5.5, Table 6-10

H

High Voltage Power Supply
Description 3.4.6.1
Packing and Shipment 6.5.6, Table 6-18
Removal and Replacement 6.4.2
Tests Table 5-1

I

I/O Control (BITE) and Filter CCA
Description 3.3.3.3
Packing and Shipment 6.5.5
Tests Table 5-1
I/O Processor
Description 3.3.3.2
I/O Processor CCA
Description 3.3.3.2
Packing and Shipment 6.5.5, Table 6-9
Tests
IMU
Description 1.4, 3.3.3.4
Installation 8.5.3
Packing and Shipment 6.5.2, Table 6-5
Removal and Replacement 6.4.1.2, 6.4.1.5
Tests Table 5-1
IMU Interface CCA
Description 3.3.3.1
Packing and Shipment 6.5.5, Table 6-5
Tests Table 5-1
IMU Processor CCA
Description 3.3.3.1
Packing and Shipment 6.5.5
Removal and Replacement 6.4.1.2, 6.4.1.5
Tests Table 5-1
Inertial Theory
Basic Inertial Navigation Principles 3.2
Basic RLG Operation 3.2
Concepts of Statistical Estimation and Kalman Filter Overview 3.2.6
Description 3.2.6.1
Polar Navigation Basics 3.2.12
Strapdown Processing 3.2.4
Inverter Assembly
Description 2.3.7.3
Packing and Shipment 6.5.6, Table 6-12
Removal and Replacement 6.3.5.4, 6.3.5.5
Tests Table 5-1

K

Kalman Filter
Description 3.2.6.1
Fix Reset Processing 3.2.17.2
Reinitialization 3.2.10
Returning
Statistical Estimation and Overview 3.2.16

M

Membrane Keypad
Description 2.2.1
Removal and Replacement
Tests Table 5-1

N

Nav Processor
Description 3.3.3.1
Nav Processor CCA
Alignment 2.3.2.4
Description 3.3.3.1
Packing and Shipment 6.5.5, Table 6-9
Removal and Replacement 6.3.3.7
Tests Table 5-1
NTDS CCAs
Description 1.3.2
Packing and Shipment 6.5.5
Removal and Replacement 6.3.3
Tests Table 5-1

O

Operations
Accepting and Entering Position Fixes 2.3.4
DR Data Output 2.4.11
Key Functions 2.2.2
Keypad Controls and Menu Display 2.2.1
Menu Selections 2.2.3
Operating Modes 2.3.2
Operating Under Interfering Conditions 2.3.7
Performance Monitor Turn Off 2.4.8
Performance Monitor Turn On 2.4.7
Performance Monitoring Fault Codes 2.4.9
Selecting Data for Display 2.3.6
Selecting the Velocity Damping Mode, Source, and Filter 2.3.5
System Turn Off 2.3.8
System Turn On 2.3.1
Transverse Coordinates Reference and Display 2.3.3

P

Panel Interface Assembly
Removal and Replacement 6.3.6.3, 6.3.6.8
Tests Table 5-1
Power
DC Supplies, Controls, and Related Subassemblies 3.3.3
Description 1.2.4
Distribution and Switching 3.4.1
Faults 2.3.7.3
Requirements 1.2.4
Power Line Filter
Removal and Replacement 6.3.5.2, 6.3.5.3
Power Module
Packing and Shipment 6.5.6, Table 6-15
Removal and Replacement 6.3.5.10
Tests Table 5-1
Power Supply (1A1A6)
Description 2.3.7.3
Distribution and Switching 3.4.1
Removal and Replacement 6.3.5.8
Tests Table 5-1

R

Repositioning Interface CCA
Description 3.4.2.1
Packing and Shipment 6.5.5
RLG Assemblies
Basic Operation 3.4
Description 3.4
Packing and Shipment 6.5.4, Table 6-8
Removal and Replacement 6.3.3

S

S/D Converter CCA
Description 3.4.11
Packing and Shipment 6.5.5
Tests Table 5-1
Slip Rings

Description 3.3.3.4
Removal and Replacement 6.4.6
Troubleshooting 5.9

Status and Command CCA
Alignment 2.3.2.2
Description 3.4.2.1
Packing and Shipment 6.5.5
Removal and Replacement 6.3.3
Tests Table 5-1

Support Electronics Power Supply (1A1A37)
Description 3.4.6.1
Tests Table 5-1

Support Electronics
Description 3.3.3.3

T

Torquer CCAs
Description 3.4.2.1
Packing and Shipment 6.5.5
Tests Table 5-1

Torquer Motors (DC)
Description 3.4.2.1
Tests Table 5-1

V

Vacuum Fluorescent Display
Description 1.2.2
Removal and Replacement 6.3.6.2, 6.3.6.9
Tests Table 5-1

Vital Bus CCA
Description 3.4.1
Packing and Shipment 6.5.5, Table 6-11
Removal and Replacement 6.3.3
Tests Table 5-1

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Ref: NAVSEAINST 4160.3A NAVSEA S0005-AA-PRO-010/TMMP

NAVSEA/SPAWAR TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)

INSTRUCTION: Continue on 8 1/2" x 11" paper if additional space is needed.
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7. RECOMMENDED CHANGES TO PUBLICATION

7a. Page #	7b. Para #	7c. RECOMMENDED CHANGES AND REASONS

8. ORIGINATOR'S NAME and WORK CENTER	9. DATE	10. ORIGINATOR'S E-MAIL ADDRESS	11. TMMA of Manual (NSDSA will complete)

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