

TECHNICAL MANUAL
FOR
*[SGML VERSION;
SEE RECORD OF REVISIONS]*
DESCRIPTION, OPERATION, AND
MAINTENANCE
**60 HERTZ
MAIN SWITCHBOARDS**
DDG 51 THROUGH DDG 54

DISTRIBUTION STATEMENT B: DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES ONLY; THIS PUBLICATION IS REQUIRED FOR OFFICIAL USE OR FOR ADMINISTRATIVE OR OPERATIONAL PURPOSES; 15 JUNE 2008. OTHER REQUESTS FOR THIS DOCUMENT MUST BE REFERRED TO THE NAVAL SEA SYSTEMS COMMAND (SEA-05Z).

WARNING: THIS DOCUMENT CONTAINS TECHNICAL DATA WHOSE EXPORT IS RESTRICTED BY THE ARMS EXPORT CONTROL ACT (TITLE 22, U.S.C. SEC 2751, ET SEQ.) OR THE EXPORT ADMINISTRATION ACT OF 1979, AS AMENDED, TITLE 50, U.S.C., APP 2401 ET SEQ. VIOLATIONS OF THESE EXPORT LAWS ARE SUBJECT TO SEVERE CRIMINAL PENALTIES. DISSEMINATE IN ACCORDANCE WITH PROVISIONS OF DOD DIRECTIVE 5230.25(D).

DESTRUCTION NOTICE: DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THIS DOCUMENT.

THIS MANUAL SUPERSEDES S9324-DK-MMA-010 DATED 15 JAN 1990, AND S9324-DK-MMA-020 DATED 10 FEB 1995, AND ALL CHANGES THERETO.

RECORD OF REVISIONS

REVISION NO.	DATE	TITLE AND/OR BRIEF DESCRIPTION/PREPARING ACTIVITY
REV 1	15 JUN 08	THIS REVISION COMBINES S9324-DK-MMA-010 AND S9324-DK-MMA-020 INTO A SINGLE VOLUME AND INCORPORATES THE FOLLOWING: 1. MACHALT 320-59006 (ECP-515) (SCD 03684) WHICH REPLACES THE REVERSE POWER MONITOR, OVERPOWER MONITOR, AND FAULT CURRENT DETECTOR WITH A SINGLE GENERATOR PROTECTION MODULE. 2. MACHALT 320-42001 (ECP-597) (SCD 03682) WHICH UPGRADES THE CABLES BETWEEN EACH CASUALTY POWER BREAKER AND ITS ASSOCIATED CASUALTY POWER RECEPTACLE. 3. TMDER V21487-05-4362.

NOTE

THIS TECHNICAL MANUAL (TM) HAS BEEN DEVELOPED FROM AN INTELLIGENT ELECTRONIC SOURCE KNOWN AS STANDARD GENERALIZED MARKUP LANGUAGE (SGML). THERE IS NO LOEP. ALL CHANGES, IF APPLICABLE, ARE INCLUDED. THE PAGINATION IN THIS TM WILL NOT MATCH THE PAGINATION OF THE ORIGINAL PAPER TM; HOWEVER, THE CONTENT IS EXACTLY THE SAME. ANY CHANGES RECEIVED AFTER RECEIPT OF THIS TM WILL ONLY FIT IN THIS PAGINATED VERSION.

FOREWORD

This Technical Manual covers Operating and Maintenance Instructions with Parts Lists for 60 Hertz Main Power Distribution Switchboards, used in DDG 51 through DDG 54 Guided Missile Destroyers. The structure of the manual is as follows:

- Chapter 1 – General Information and Safety Precautions
- Chapter 2 – Operation
- Chapter 3 – Functional Description
- Chapter 4 – Scheduled Maintenance
- Chapter 5 – Troubleshooting
- Chapter 6 – Corrective Maintenance
- Chapter 7 – Parts List
- Chapter 8 – Installation
- Chapter 9 – Wiring Diagrams

Ships, training activities, supply points, depots, Naval Shipyards, and Supervisors of Shipbuilding are requested to arrange for maximum practical use and evaluation of NAVSEA technical manuals. All errors, omissions, discrepancies, and suggestions for improvement to NAVSEA technical manuals shall be forwarded to:

COMMANDER,
CODE 310 TMDER, BLDG 1388
NAVSURFWARCENDIV NSDSA
4363 MISSILE WAY
PORT HUENEME CA 93043-4307

on NAVSEA/SPAWAR Technical Manual Deficiency/Evaluation Report (TMDER), NAVSEA form 4160/1. All feedback comments shall be thoroughly investigated and originators will be advised of action resulting therefrom. One copy of NAVSEA form 4160/1 is at the end of each separately bound technical manual 8-1/2 x 11 inches or larger. Copies of NAVSEA Form 4160/1 may be requisitioned from the Naval Systems Data Support Activity Code 310 at the above address. Users are encouraged to transmit deficiency submittals via the Naval Systems Data Support Activity web site located at:

<https://nsdsa2.phdnswc.navy.mil/tmder/tmder-generate.asp?lvl=1>

Individual electronic TMs do not contain NAVSEA form 4160/1 but are linked to an electronic version on the resident CD-ROM. Therefore, we encourage the user to transmit deficiency submittals via the Naval Systems Data Support Activity web site located above.

TABLE OF CONTENTS

Chapter/Paragraph	Page
1 GENERAL INFORMATION AND SAFETY PRECAUTIONS	1-1
1-1 SAFETY PRECAUTIONS	1-1
1-2 INTRODUCTION	1-1
1-2.1 EQUIPMENT, ACCESSORIES, AND DOCUMENTS SUPPLIED.	1-1
1-3 EQUIPMENT DESCRIPTION	1-2
1-3.1 SHIP'S SERVICE SWITCHBOARD 1S.	1-2
1-3.2 SHIP'S SERVICE SWITCHBOARD 2S.	1-2
1-3.3 SHIP'S SERVICE SWITCHBOARD 3S.	1-2
1-3.4 MIMIC BUS.	1-2
1-4 EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED	1-2
2 OPERATION	2-1
2-1 INTRODUCTION	2-1
2-2 OVERALL SHIP'S SERVICE SWITCHBOARD SYSTEM	2-1
2-3 CONTROLS AND INDICATORS	2-1
2-4 ISOLATION OF SWITCHBOARDS	2-29
2-4.1 BUS TIE BREAKERS.	2-29
2-4.2 DISCONNECT LINKS.	2-29
2-4.3 TO ISOLATE A SWITCHBOARD SECTION.	2-30
2-5 OTHER OPERATING CONTROLS ON SWITCHBOARDS	2-30
2-5.1 TURBINE GENERATOR CONTROLS.	2-30
2-5.1.1 Generator Space Heater.	2-30
2-5.1.2 Seawater Cooling Pump.	2-30
2-5.1.3 ISO/DROOP Governor.	2-34
2-5.1.4 DIFF/DROOP Voltage Regulator.	2-34
2-5.1.5 Voltage Regulator Mode Select.	2-34
2-5.2 BUS TIE CONTROLS.	2-34
2-5.3 GROUND DETECTION.	2-35
2-5.4 FAULT CURRENT DETECTION.	2-35
2-5.4.1 Fault Current Detection System in OPERATE Mode.	2-35
2-5.4.2 Fault Current Detection Circuit in TEST Mode (Not applicable to ships with MACHALT 320-59006 (ECP-515) installed).	2-36
2-5.4.3 Fault Current Detection Circuit in TEST Mode (Applicable to ships with MACHALT 320-59006 (ECP-515) installed).	2-36
2-5.5 LOAD SHED.	2-36
2-5.5.1 Manual Load Shed.	2-36
2-5.5.2 Automatic Load Shed.	2-37

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
2-5.6 Reverse Power Protection.	2-37
2-6 MIMIC BUS CIRCUIT BREAKERS	2-37
2-7 CASUALTY POWER	2-38
2-7.1 OPERATIONAL STATE OF CASUALTY POWER.	2-38
2-7.2 USAGE OF CASUALTY POWER.	2-38
2-8 LOCAL CONTROL OF OPERATION	2-38
2-9 GENERATOR CONTROL	2-39
2-9.1 TURBINE GENERATOR START-UP.	2-39
2-9.2 SYNCHRONIZING OFF-LINE GENERATOR WITH MAIN BUS.	2-40
2-9.3 STOPPING ONE TURBINE GENERATOR.	2-41
2-10 CONNECTING SHORE POWER TO SHIP	2-42
2-10.1 MATCHING SHIP'S POWER TO SHORE POWER.	2-42
2-10.2 OVERCURRENT RELAY MODULE (A4).	2-44
2-10.3 STOPPING ONE TURBINE GENERATOR AFTER SWITCHING TO SHORE POWER.	2-45
2-10.4 TRANSFERRING FROM SHORE POWER TO SHIP'S POWER.	2-45
3 FUNCTIONAL DESCRIPTION	3-1
3-1 INTRODUCTION	3-1
3-2 SWITCHBOARD SYSTEMS FUNCTIONAL OPERATION	3-1
3-2.1 GENERAL.	3-1
3-2.2 EMERGENCY CONFIGURATIONS.	3-1
3-2.3 SYSTEM AUTOMATIC PROTECTION.	3-1
3-3 SHIP'S SERVICE SWITCHBOARD 1S	3-2
3-3.1 SWITCHBOARD 1SG.	3-2
3-3.2 SWITCHBOARD 1SA.	3-5
3-3.3 SWITCHBOARD 1SB.	3-5
3-3.4 SWITCHBOARD 1SC.	3-5
3-4 SHIP'S SERVICE SWITCHBOARD 2S	3-5
3-4.1 SWITCHBOARD 2SG.	3-5
3-4.2 SWITCHBOARD 2SA.	3-5
3-4.3 SWITCHBOARD 2SB.	3-5
3-5 SHIP'S SERVICE SWITCHBOARD 3S	3-6
3-5.1 SWITCHBOARD 3SG.	3-6
3-5.2 SWITCHBOARD 3SA.	3-6
3-5.3 SWITCHBOARD 3SB.	3-6
3-5.4 SWITCHBOARD 3SC.	3-6

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
3-6 GENERATOR METERS AND CONTROLS	3-6
3-6.1 SWITCHBOARDS 1SG, 2SG, and 3SG METERING.	3-6
3-6.1.1 Potential Transformers.	3-6
3-6.1.2 Current Transformers.	3-7
3-6.2 GENERATOR CONTROLS.	3-7
3-6.2.1 Voltage Regulators.	3-7
3-6.2.2 Automatic Compensating.	3-7
3-6.3 VOLTAGE REGULATOR CONTROLS.	3-7
3-6.4 SYNCHRONIZING CIRCUITRY.	3-8
3-6.4.1 Synchronization Circuit Lights.	3-8
3-6.4.2 Synchronizing Monitor (A1).	3-8
3-7 CIRCUIT BREAKER CONTROL	3-10
3-7.1 MOTOR OPERATOR CIRCUIT.	3-11
3-7.1.1 Closing Circuit Breaker.	3-11
3-7.1.2 Opening Circuit Breaker.	3-11
3-7.2 SHUNT TRIP CIRCUIT.	3-11
3-7.3 OVERCURRENT PROTECTION.	3-13
3-8 GENERATOR PROTECTIVE CIRCUITRY	3-14
3-8.1 REVERSE POWER RELAY MODULE (A2).	3-14
3-8.1.1 Detailed Function.	3-14
3-8.1.2 Time Delay.	3-14
3-8.2 AC POWER SENSING RELAY MODULE (A3).	3-14
3-8.2.1 Circulation Function.	3-15
3-8.2.2 Load Shed.	3-16
3-8.3 ANALOG BUS GROUND DETECTOR.	3-17
3-8.4 FAULT CURRENT DETECTOR MODULE (A6).	3-17
3-8.4.1 FCD Function.	3-17
3-8.4.2 Fault Current Detector, Circuitry, and Components.	3-17
3-8.4.3 Power for Fault Current Detector.	3-20
3-8.4.4 Fault Current Detector Test Circuit.	3-20
3-8.5 GENERATOR PROTECTION MODULE.	3-21
3-9 GROUND FAULT DETECTION	3-22
3-10 SHORE POWER CIRCUITRY	3-23
3-10.1 CONTROL POWER.	3-23
3-10.2 2SA PHASE ROTATION.	3-23
3-10.3 PHASE ORIENTATION.	3-24
3-10.3.1 Phase Orientation Light, 2SP-DS38.	3-24
3-10.3.2 Phase Orientation Light, 2SP-DS39.	3-24
3-10.4 PROTECTIVE CIRCUITRY.	3-24
3-10.4.1 Load Shed.	3-24
3-10.4.2 Overload.	3-24
3-11 REMOTE METERING	3-24

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
4 SCHEDULED MAINTENANCE	4-1
4-1 INTRODUCTION	4-1
4-1.1 PLANNED MAINTENANCE SYSTEM.	4-1
4-1.2 EXTENT OF COVERAGE.	4-1
5 TROUBLESHOOTING	5-1
5-1 INTRODUCTION	5-1
5-2 GENERAL TROUBLE ANALYSIS	5-1
5-3 DISCONNECT LINKS	5-2
5-3.1 TO OPEN DISCONNECT LINKS, PROCEED AS FOLLOWS:	5-2
5-4 TROUBLESHOOTING FROM THE SWITCHBOARD CONTROL PANEL	5-3
5-4.1 GENERATOR CONTROL PANEL.	5-3
5-4.2 MIMIC BUS PANEL ANALYSIS.	5-3
5-4.3 BUS TIE AND TEST PANEL.	5-4
5-4.3.1 Ground Tests.	5-5
5-4.3.2 Synchronizing Monitor Test.	5-5
5-4.3.3 Fault Current Detection Circuit.	5-6
5-4.3.4 Load Shed.	5-6
5-5 AC POWER SENSING RELAY MODULE (A3a)	5-7
5-6 REVERSE POWER MONITOR (A2)	5-7
5-7 FUSES	5-7
5-8 METER CHECKS	5-8
5-9 INSTALLATION ADJUSTMENTS	5-8
5-9.1 SHORE POWER BREAKER RELAY (K3).	5-8
5-9.2 LOAD SHED RELAY (K2137).	5-8
5-10 TROUBLESHOOTING - COMPONENT LEVEL	5-8
5-10.1 SYNCHRONIZING MONITOR.	5-8
5-10.1.1 Phase Angle Card.	5-12
5-10.1.2 Voltage Card.	5-15
5-10.1.3 Frequency Card.	5-17
5-10.1.4 Output Board.	5-18
5-10.2 REVERSE POWER MONITOR (A2).	5-19
5-10.2.1 Test Objective.	5-19
5-10.2.2 Test Equipment Verification.	5-19
5-10.2.3 Physical Examination.	5-19
5-10.2.4 Test Procedures.	5-20

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
5-10.3 AC POWER SENSING RELAY (A3a)	5-23
5-10.3.1 Test Objective.	5-23
5-10.3.2 Test Equipment Verification.	5-23
5-10.3.3 Physical Examination.	5-23
5-10.3.4 Test Procedures.	5-23
5-10.4 ANALOG BUS GROUND DETECTOR.	5-26
5-10.5 FAULT CURRENT DETECTOR.	5-29
5-10.5.1 Power Supply PCB.	5-32
5-10.5.2 Current Detector PCB.	5-34
5-10.5.3 Turbine RPM (Frequency) Detector.	5-34
5-10.6 CAPACITOR-DIODE ASSEMBLY.	5-35
5-10.7 OVERCURRENT RELAY (SENSING DEVICE).	5-36
5-10.8 GENERATOR PROTECTION MODULE.	5-40
6 CORRECTIVE MAINTENANCE	6-1
6-1 INTRODUCTION	6-1
SECTION I ADJUSTMENT AND ALIGNMENT	6-1
6-2 ADJUSTMENTS	6-1
6-2.1 RELAYS.	6-1
6-2.1.1 Relay K2137.	6-1
6-2.1.2 Shore Power Breaker Relay (K3).	6-2
6-2.2 REVERSE POWER MONITOR (A2).	6-2
6-2.2.1 Trip Delay.	6-2
6-2.2.2 Trip Select.	6-2
6-2.3 AC POWER SENSING RELAY (A3).	6-4
6-2.3.1 Time Delay.	6-4
6-2.3.2 Power Level.	6-4
6-2.3.3 CT Ratio Taps.	6-4
6-2.3.4 PT Secondary.	6-4
6-2.4 GENERATOR PROTECTION MODULE.	6-6
6-2.5 ADJUSTABLE INSTANTANEOUS TRIP SETTING.	6-6
6-2.5.1 AQB-LF400 Adjustable Instantaneous Trip Setting.	6-6
6-2.5.2 AQB-A101 Adjustable Instantaneous Trip Setting.	6-6
SECTION II REPAIR	6-9
6-3 GENERAL	6-9
6-4 SPECIAL TOOLS	6-9
6-5 LARGE AIR CIRCUIT BREAKERS	6-9
6-5.1 ACB-1600HR/ACB-2000HR AIR CIRCUIT BREAKER REMOVAL (REMOVABLE ASSEMBLY).	6-10
6-5.2 ACB-1600HR/2000HR AIR CIRCUIT BREAKER REPLACEMENT.	6-11

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
6-15.2.2 Replacement.	6-35
6-15.3 POTENTIAL TRANSFORMER.	6-36
6-15.3.1 Removal.	6-36
6-15.3.2 Replacement.	6-37
6-16 THYRITE PROTECTIVE DEVICE	6-38
6-16.1 REMOVAL.	6-38
6-16.2 REPLACEMENT.	6-38
6-17 PUSHBUTTON SWITCH	6-39
6-17.1 REMOVAL.	6-39
6-17.2 REPLACEMENT.	6-39
6-18 TEST BLOCK	6-40
6-18.1 REMOVAL.	6-40
6-18.2 REPLACEMENT.	6-41
6-19 CONTACTOR	6-42
6-19.1 REMOVAL.	6-42
6-19.2 REPLACEMENT.	6-43
6-20 RESISTOR	6-44
6-20.1 REMOVAL.	6-44
6-20.2 REPLACEMENT.	6-45
6-21 DIODE	6-45
6-21.1 REMOVAL.	6-45
6-21.2 REPLACEMENT.	6-46
6-22 LAMPHOLDER AND INDICATOR LAMPS	6-46
6-22.1 LAMPHOLDER REMOVAL.	6-46
6-22.2 LAMPHOLDER REPLACEMENT.	6-47
6-22.3 LAMP REMOVAL AND REPLACEMENT.	6-47
6-23 FUSEHOLDER, BLOWN FUSE INDICATING	6-48
6-23.1 FUSEHOLDER REMOVAL.	6-48
6-23.2 FUSEHOLDER REPLACEMENT.	6-49
6-23.3 FUSE REMOVAL AND REPLACEMENT.	6-49
6-24 FUSE CLIPS AND FUSE	6-50
6-24.1 REMOVAL.	6-50
6-24.2 REPLACEMENT.	6-51
6-25 RELAYS	6-51
6-25.1 REMOVAL.	6-52
6-25.2 REPLACEMENT.	6-52

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
6-26 TERMINAL BOARDS	6-55
6-26.1 REMOVAL.	6-55
6-26.2 REPLACEMENT.	6-55
6-27 FAULT CURRENT DETECTOR	6-56
6-27.1 REMOVAL.	6-56
6-27.2 REPLACEMENT.	6-57
6-28 TURBINE RPM DETECTOR	6-58
6-28.1 REMOVAL.	6-58
6-28.2 REPLACEMENT.	6-59
6-29 AC POWER SENSING RELAY (A3)	6-61
6-29.1 A3a MODULE	6-61
6-29.1.1 Removal.	6-61
6-29.1.2 Replacement.	6-61
6-29.2 A3b MODULE	6-62
6-29.2.1 Removal.	6-62
6-29.2.2 Replacement.	6-63
6-30 SYNCHRONIZING CONTROL EQUIPMENT	6-64
6-30.1 REMOVAL.	6-64
6-30.2 REPLACEMENT.	6-65
6-31 ANALOG BUS GROUND DETECTOR	6-66
6-31.1 REMOVAL.	6-66
6-31.2 REPLACEMENT.	6-66
6-32 OVERCURRENT RELAY	6-68
6-32.1 REMOVAL.	6-68
6-32.2 REPLACEMENT.	6-68
6-33 REVERSE POWER MONITOR	6-70
6-33.1 REMOVAL.	6-70
6-33.2 REPLACEMENT.	6-70
6-34 GENERATOR PROTECTION MODULE	6-71
6-34.1 REMOVAL.	6-71
6-34.2 REPLACEMENT.	6-72
7 PARTS LIST	7-1
7-1 INTRODUCTION	7-1
7-2 PARTS LISTS	7-1
7-2.1 FIGURE/INDEX NO.	7-1
7-2.2 DESCRIPTION.	7-1

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
7-2.3 QTY.	7-1
7-2.4 CAGE.	7-1
7-2.5 PART NO.	7-1
8 INSTALLATION	8-1
8-1 INSTALLATION	8-1
8-2 INSTALLATION DRAWINGS	8-1
8-3 STORAGE REQUIREMENTS	8-1
8-4 SWITCHBOARD MOUNTING	8-1
8-5 INSTALLATION UNPACKING AND PROTECTION	8-2
8-6 INPUT REQUIREMENTS	8-3
8-7 INSTALLATION PROCEDURES	8-3
8-7.1 ASSEMBLY.	8-3
8-7.2 ELECTRICAL CONNECTIONS.	8-3
8-7.3 GROUNDING.	8-4
8-8 INSTALLATION CHECKOUT	8-4
9 WIRING DIAGRAMS	9-1

LIST OF TABLES

Table	Title	Page
1-1.	Equipment, Accessories, and Documents Supplied	1-1
1-2.	Switchboard System 1S Reference Data	1-8
1-3.	Switchboard System 2S Reference Data	1-10
1-4.	Switchboard System 3S Reference Data	1-10
1-5.	Equipment and Publications Required But Not Supplied	1-12
2-1.	Switchboard 1SG Operating Controls and Indicators	2-4
2-2.	Switchboard 1SA Operating Controls and Indicators	2-8
2-3.	Switchboard 1SB Operating Controls and Indicators	2-9
2-4.	Switchboard 1SC Operating Controls and Indicators	2-12
2-5.	Switchboard 2SG Operating Controls and Indicators	2-12
2-6.	Switchboard 2SA Operating Controls and Indicators	2-16
2-7.	Switchboard 2SB Operating Controls and Indicators	2-21
2-8.	Switchboard 3SG Operating Controls and Indicators	2-21
2-9.	Switchboard 3SA Operating Controls and Indicators	2-26
2-10.	Switchboard 3SB Operating Controls and Indicators	2-26
2-11.	Switchboard 3SC Operating Controls and Indicators	2-28
2-12.	SSGTG No. 1 Startup; Switchboard 1SG Control	2-39
2-13.	Synchronizing Off-Line Generator With Main Bus	2-40
2-14.	Stopping One Turbine Generator	2-41
2-15.	Connecting Shore Power to Ship	2-42
2-16.	Transferring From Shore Power To Ship's Power	2-45
2-17.	Circuit Breakers Affected by the Load Shed Circuits	2-46
5-1.	Generator Control Panel Analysis	5-4
5-2.	Mimic Bus Panel Analysis	5-4
5-3.	Overcurrent Relay Input and Output Voltage Range	5-37
5-4.	Component Functions, 1S Switchboard System	5-44

LIST OF TABLES - Continued

Table	Title	Page
5-5.	Component Functions, 2S Switchboard System	5-50
5-6.	Component Functions, 3S Switchboard System	5-57
5-7.	Switchboard System 1S Isolation Guide	5-63
5-8.	Switchboard System 2S Isolation Guide	5-65
5-9.	Switchboard System 3S Isolation Guide	5-66
6-1.	Publications/NAVSEA Drawings Required But Not Supplied	6-1
6-2.	Special Tools Required	6-9
7-1.	List of Major Units	7-1
7-2.	Parts List For Switchboard 1SG – DDG 51 Only	7-2
7-2A.	Parts List For Switchboard 1SG – DDG 52-54	7-9
7-3.	Parts List For Switchboard 1SA – DDG 51 Only	7-17
7-3A.	Parts List For Switchboard 1SA – DDG 52-54	7-20
7-4.	Parts List For Switchboard 1SB – DDG 51 Only	7-22
7-4A.	Parts List For Switchboard 1SB – DDG 52-54	7-24
7-5.	Parts List For Switchboard 1SC – DDG 51 Only	7-26
7-5A.	Parts List For Switchboard 1SC – DDG 52-54	7-28
7-6.	Parts List For Switchboard 2SG – DDG 51 Only	7-31
7-6A.	Parts List For Switchboard 2SG – DDG 52-54	7-39
7-7.	Parts List For Switchboard 2SA – DDG 51 Only	7-46
7-7A.	Parts List For Switchboard 2SA – DDG 52-54	7-51
7-8.	Parts List For Switchboard 2SB	7-56
7-9.	Parts List For Switchboard 3SG – DDG 51 Only	7-58
7-9A.	Parts List For Switchboard 3SG – DDG 52-54	7-66
7-10.	Parts List For Switchboard 3SA – DDG 51 Only	7-74
7-10A.	Parts List For Switchboard 3SA – DDG 52-54	7-77
7-11.	Parts List For Switchboard 3SB – DDG 51 Only	7-79

LIST OF TABLES - Continued

Table	Title	Page
7-11A.	Parts List For Switchboard 3SB – DDG 52-54	7-81
7-12.	Parts List For Switchboard 3SC – DDG 51 Only	7-84
7-12A.	Parts List For Switchboard 3SC – DDG 52-54	7-86
7-13.	List of Manufacturers	7-89
8-1.	Specification for Torquing Bus Bar Joints and Circuit Breaker Studs	8-4
8-2.	Installation, Inspection, and Pre-Energizing Procedures Checklist	8-4

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1.	Equipment Supplied	1-3
1-2.	Ship's Service Switchboard 1S	1-5
1-3.	Ship's Service Switchboard 2S	1-6
1-4.	Ship's Service Switchboard 3S	1-7
2-1.	Interconnection Diagram	2-2
2-2.	Typical Generator Control Panel - Upper	2-3
2-3.	Switchboard 1SG, Generator Control Panel - Lower	2-31
2-4.	Switchboard 2SG, Generator Control Panel - Lower	2-32
2-5.	Switchboard 3SG, Generator Control Panel - Lower	2-33
2-6.	Switchboard 1SG Control Panel	2-49
2-7.	Switchboard 1SG Front and Rear View	2-51
2-8.	Switchboard 1SA, Operating Controls and Indicators	2-53
2-9.	Switchboard 1SB, Operating Controls and Indicators	2-55
2-10.	Switchboard 1SC, Operating Controls and Indicators	2-57
2-11.	Switchboard 2SG Control Panel	2-59
2-12.	Switchboard 2SG Front and Rear View	2-61
2-13.	Switchboard 2SA Control Panel	2-63
2-14.	Switchboard 2SA, Operating Controls and Indicators	2-65
2-15.	Switchboard 2SB, Operating Controls and Indicators	2-67
2-16.	Switchboard 3SG Control Panel	2-69
2-17.	Switchboard 3SG Front and Rear View	2-71
2-18.	Switchboard 3SA, Operating Controls and Indicators	2-73
2-19.	Switchboard 3SB, Operating Controls and Indicators	2-75
2-20.	Switchboard 3SC, Operating Controls and Indicators	2-77
2-21.	Switchboard 2SA, Shore Power Control Panel	2-79
3-1.	Standard Plant Configuration	3-3

LIST OF ILLUSTRATIONS - Continued

Figure	Title	Page
3-2.	Alternate Configurations	3-4
3-3.	Motor Operator Circuit	3-12
3-4.	Circuit Breaker Closure	3-13
3-5.	AC Power Sensing Relay Power Level Setting	3-16
5-1.	Wiring Diagram for Synchronizing Monitor Assembly Module	5-11
5-2.	Test Configuration for Synchronizing Monitor	5-12
5-3.	Component PCB Test Configuration for Synchronizing Monitor	5-14
5-4.	Phase Angle PCB Schematic Layout	5-16
5-5.	Voltage PCB Schematic Layout	5-17
5-6.	Test Fixture - Reverse Power Monitor	5-22
5-7.	Test Fixture - AC Power Sensing Relay	5-25
5-8.	Bus Ground Detector Schematic	5-27
5-9.	Bus Ground Detector Test Connection	5-28
5-10.	Fault Current Detector Test Connection	5-31
5-11.	Power Supply PCB Test Connection	5-33
5-12.	Turbine RPM Detector PCB Schematic	5-35
5-13.	Capacitor Discharge Unit Schematic	5-36
5-14.	Overcurrent Relay Wiring Diagram	5-38
5-15.	Overcurrent Sensing Device Test Connection Diagram	5-39
5-16.	Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 1 of 14)	5-68
5-17.	Fault Logic Diagram; Generator Control Panel Analysis (Sheet 1 of 14)	5-82
5-18.	1S Switchboard System; Schematic (Sheet 1 of 20)	5-97
5-19.	2S Switchboard System; Schematic (Sheet 1 of 17)	5-155
5-20.	3S Switchboard System; Schematic (Sheet 1 of 20)	5-213
5-21.	Frequency PCB Schematic Layout	5-271
5-22.	Reverse Power Relay Module Schematic	5-273

LIST OF ILLUSTRATIONS - Continued

Figure	Title	Page
5-23.	Reverse Power Relay PCB Schematic Layout	5-275
5-24.	AC Power Sensing Relay Wiring Diagram	5-277
5-25.	AC Power Sensing Relay Schematic	5-279
5-26.	Fault Current Detector Schematic (Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed) . . .	5-281
5-27.	Power Supply PCB Schematic (Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed) . . .	5-283
5-28.	Current Detection PCB Schematic (Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed) . . .	5-285
5-29.	Overcurrent Sensing Device RMS to DC Board (Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed) . . .	5-287
5-30.	Overcurrent Sensing Device PCB Schematic (Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed) . . .	5-289
6-1.	Reverse Power Monitor Adjustments	6-3
6-2.	AC Power Sensing Relay Adjustments	6-5
6-3.	Instantaneous Trip Setting Adjustments	6-8
6-4.	ACB-1600HR/ACB-2000HR Air Circuit Breaker Assembly	6-12
6-5.	1600A/2000A Lifting Yoke and Circuit Breaker Wrench	6-13
6-6.	ACB-3200HR/ACB-4000HR Air Circuit Breaker Assembly	6-15
6-7.	3200A/4000A Lifting Yoke and Circuit Breaker Wrench	6-16
6-8.	AQB-LF400 Molded Case Circuit Breaker with Motor Operator	6-19
6-9.	AQB-LF250 Molded Case Circuit Breaker	6-21
6-10.	AQB-A101F Molded Case Circuit Breaker	6-23
6-11.	Rotary Switch, Style SJR	6-25
6-12.	Rotary Switch, Style 24G	6-26
6-13.	Rotary Switch, Style SJM	6-28
6-14.	Toggle Switch	6-29
6-15.	Typical Meter	6-30
6-16.	Capacitor Diode Assembly	6-32

LIST OF ILLUSTRATIONS - Continued

Figure	Title	Page
6-17.	Step-Down Transformer	6-34
6-18.	Current Transformer	6-36
6-19.	Potential Transformer	6-37
6-20.	Protective Device	6-39
6-21.	Pushbutton Switch	6-40
6-22.	Test Block	6-42
6-23.	Contactor with Mechanical Interlock	6-44
6-24.	Resistor	6-45
6-25.	Diode	6-47
6-26.	Typical Lampholder and Indicator Lamps	6-48
6-27.	Fuseholder, Blown Fuse Indicating, Type FHL12U	6-50
6-28.	Fuse Clip and Fuse	6-51
6-29.	MDR Type Relay	6-53
6-30.	Electropneumatic Relay	6-54
6-31.	Terminal Block	6-56
6-32.	Fault Current Detector	6-58
6-33.	Turbine RPM Detector	6-60
6-34.	AC Power Sensing Relay (A3a Module)	6-62
6-35.	AC Power Sensing Relay (A3b Module)	6-64
6-36.	Synchronizing Control Equipment	6-66
6-37.	Analog Bus Ground Detector	6-67
6-38.	Overcurrent Relay	6-69
6-39.	Reverse Power Monitor	6-71
6-40.	Generator Protection Module	6-73
7-1.	1SG Switchboard Assembly (Sheet 1 of 3)	7-91
7-2.	1SA Switchboard Assembly (Sheet 1 of 2)	7-97

LIST OF ILLUSTRATIONS - Continued

Figure	Title	Page
7-3.	1SB Switchboard Assembly (Sheet 1 of 2)	7-101
7-4.	1SC Switchboard Assembly (Sheet 1 of 2)	7-105
7-5.	2SG Switchboard Assembly (Sheet 1 of 3)	7-109
7-6.	2SA Switchboard Assembly (Sheet 1 of 4)	7-115
7-7.	2SB Switchboard Assembly (Sheet 1 of 2)	7-123
7-8.	3SG Switchboard Assembly (Sheet 1 of 3)	7-127
7-9.	3SA Switchboard Assembly (Sheet 1 of 3)	7-133
7-10.	3SB Switchboard Assembly (Sheet 1 of 2)	7-139
7-11.	3SC Switchboard Assembly (Sheet 1 of 2)	7-143
8-1.	Switchboard Foundation Bolting	8-5
8-2.	Lifting Data, Switchboard 1SG	8-6
8-3.	Lifting Data, Switchboard 1SA	8-7
8-4.	Lifting Data, Switchboard 1SB	8-8
8-5.	Lifting Data, Switchboard 1SC	8-9
8-6.	Lifting Data, Switchboard 2SG	8-10
8-7.	Lifting Data, Switchboard 2SA	8-11
8-8.	Lifting Data, Switchboard 2SB	8-12
8-9.	Lifting Data, Switchboard 3SG	8-13
8-10.	Lifting Data, Switchboard 3SA	8-14
8-11.	Lifting Data, Switchboard 3SB	8-15
8-12.	Lifting Data, Switchboard 3SC	8-16
8-13.	Outline and Mounting Data, Switchboard 1SG	8-17
8-14.	Outline and Mounting Data, Switchboard 1SA	8-18
8-15.	Outline and Mounting Data, Switchboard 1SB	8-19
8-16.	Outline and Mounting Data Switchboard 1SC	8-20
8-17.	Outline and Mounting Data, Switchboard 2SG	8-21

LIST OF ILLUSTRATIONS - Continued

Figure	Title	Page
8-18.	Outline and Mounting Data, Switchboard 2SA	8-22
8-19.	Outline and Mounting Data, Switchboard 2SB	8-23
8-20.	Outline and Mounting Data, Switchboard 3SG	8-24
8-21.	Outline and Mounting Data, Switchboard 3SA	8-25
8-22.	Outline and Mounting Data, Switchboard 3SB	8-26
8-23.	Outline and Mounting Data, Switchboard 3SC	8-27
9-1.	1SG Switchboard; Wiring Diagram (Sheet 1 of 20)	9-3
9-2.	1SA Switchboard; Wiring Diagram (Sheet 1 of 6)	9-99
9-3.	1SB Switchboard; Wiring Diagram (Sheet 1 of 7)	9-115
9-4.	1SC Switchboard; Wiring Diagram (Sheet 1 of 6)	9-131
9-5.	2SG Switchboard; Wiring Diagram (Sheet 1 of 19)	9-149
9-6.	2SA Switchboard; Wiring Diagram (Sheet 1 of 16)	9-239
9-7.	2SB Switchboard; Wiring Diagram (Sheet 1 of 5)	9-297
9-8.	3SG Switchboard; Wiring Diagram (Sheet 1 of 19)	9-311
9-9.	3SA Switchboard; Wiring Diagram (Sheet 1 of 7)	9-403
9-10.	3SB Switchboard; Wiring Diagram (Sheet 1 of 7)	9-425
9-11.	3SC Switchboard; Wiring Diagram (Sheet 1 of 6)	9-445

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS. Operating personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the off position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

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, with the other hand free and clear of equipment. Do not touch live equipment or personnel who are working on live equipment

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. All test equipment shall be used in accordance with instructions provided with equipment and in accordance with ship's procedures.

INTERLOCKS. Interlocks are provided for safety of personnel and equipment and should be used only for the purpose intended. They should not be battle shorted or otherwise modified except by authorized maintenance personnel. Do not depend solely upon interlocks for protection. Whenever possible, disconnect power at power distribution source. Do not open the secondary circuits of current transformers with current on.

PRECAUTIONS FOR WORKING ON ENERGIZED EQUIPMENT. NSTM Chapter 300 defines requirements for working on energized circuits or equipment, as follows: Electrical equipment is a source of great danger. The Commanding Officer is responsible for electrical safety, a responsibility that cannot be delegated. Energized electrical equipment shall not be disassembled nor undergo any corrective maintenance without approval of such action by the Commanding Officer. The only exceptions to this policy are those cases in which approved instructions issued by higher authority permit opening or inspecting equipment in the course of performing corrective maintenance, routine testing, taking measurements, or making adjustments that require equipment to be energized. Testing for voltage with a higher voltage tester is not to be considered working on live circuits or equipment unless entry into energized panels is required.

RESUSCITATION. Personnel working with or near high voltage shall be familiar with approved methods of resuscitation. Should someone be injured and stop breathing, resuscitation shall be initiated immediately. A delay could cost the victim his or her life. Resuscitation procedures shall be posted in all electrically hazardous areas.

GENERAL PRECAUTIONS. The following general precautions are to be observed at all times.

1. All maintenance operations shall comply with Navy Safety Precautions for Forces Afloat, OPNAVINST 5100 series.

SAFETY SUMMARY - Continued

2. Power shutoff and tag-out measures are essential to prevent application of power to the system/equipment any time maintenance work is in progress.
3. Do not make any unauthorized alterations to equipment or components.

The following warnings and cautions appear throughout the text of this manual and are repeated here for emphasis.

WARNING

Leave LOCAL/REMOTE Switch (S24) in LOCAL position when isolating switchboards via the bus tie breakers for maintenance. This action will not allow the EPCC or an online generator to accidentally power the main bus. (Page 2-29)

WARNING

Do not operate these devices when the Main Bus is energized. Be certain both the Generator Breaker and Bus Tie Breakers are tripped before operating. (Page 2-29)

WARNING

With ship's service switchboard 1S isolated and SSGTG No. 1 shut down, there is still power present in the cabinets if there is power on the main bus. (Page 2-30)

WARNING

Shore power connection and cables are still energized. Do not disconnect cables from shore power until all amber shore power circuit breaker lamps are extinguished. (Page 2-46)

WARNING

Current transformers must not be open circuited on their secondaries while current is flowing through its primary. High secondary voltages are generated that may create a personnel hazard and may also cause permanent damage to the CT. (Page 3-7)

WARNING

Lethal voltages and currents are present in this equipment. Remove power from the cabinet and/or isolate the cabinet with the disconnect links before replacing any pieces/parts. (Page 5-1)

WARNING

Power may not necessarily be completely removed from the entire cabinet when the bus tie breakers or disconnect links are open. Do not touch contacts or terminal boards before checking deenergized. (Page 5-2)

WARNING

Under no conditions should an attempt be made to open disconnect links with power on the main bus. Trip the affected bus tie breakers first to remove power from the switchboard cabinet. (Page 5-2)

WARNING

These switchboards contain lethal voltages. Do not touch the bus bars. (Page 5-5)

WARNING

Power should be removed whenever inserting or removing cards in the synchronizing monitor module (A1). Insertion or removal of circuit cards while energized may cause a surge or misapplication of power, resulting in component damage. (Page 5-6)

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures. (Page 5-7, page 6-6, page 6-7, page 6-10, page6-14,page6-17,page6-22,page6-24,page6-25,page6-27,page6-28,page6-29, page6-31,page6-32,page6-34,page6-36,page6-38,page6-39,page6-40,page6-42,

page6-45,page6-46,page6-46,page6-49,page6-49,page6-50,page6-52,page6-55,page6-56,page6-58,page6-61,page6-62,page6-65,page6-66,page6-68,page6-70,page 6-71)

WARNING

450 VAC power used for this test will cause a shock hazard which could be fatal. Electrical safety precautions must be taken. Secure area with warning signs and personnel barrier. (Page 5-26)

WARNING

Setpoint verification or adjustment can be made while the switchboard is energized. Extreme care must be exercised to avoid lethal voltages. (Page 5-40)

WARNING

Adjustments can be made while the switchboard is energized. Extreme care must be exercised to avoid lethal voltages. (Page 6-2, page 6-2, page 6-4, page 6-6)

WARNING

All three poles must be set to identical positions in accordance with ship-board specifications. (Page 6-6, page 6-7)

WARNING

Complete removal of power to the switchboard is required for all maintenance tasks to prevent injury to personnel. This requires removing distribution power (450 VAC, 60 Hz, 3 Phase), control power (115 VAC), and command power (28 VDC). Isolate switchboard in accordance with [tables 5-7 through 5-9](#), and tag out of service in accordance with local procedures. (Page 6-9)

WARNING

Lethal voltages are present in the cabinet. Ensure bus tie breakers and Disconnect Links have isolated the cabinet prior to LACB maintenance. (Page 6-10)

WARNING

This circuit breaker weighs 709 pounds. Use a hoist capable of lifting a minimum of 1/2 ton. (Page 6-11)

WARNING

This circuit breaker weighs 1,171 pounds. Use a hoist capable of lifting a minimum of 1 ton. (Page 6-14)

WARNING

These switchboards contain lethal voltage. Tag “Out of Service” in accordance with shipboard procedures. (Page 6-20)

WARNING

The capacitor may still contain a charge. The charge should be dissipated using a 5 kohm resistor across the two output terminals. Do not touch until a voltmeter has been used to test for total discharge. (Page 6-31)

WARNING

Personnel engaged in supervising or performing the installation must be thoroughly familiar with these instructions. Failure to install the equipment as specified can result in its premature failure and/or injury to personnel. (Page 8-1)

WARNING

To prevent equipment damage or injury, always use lifting equipment, chains, and overhead hoist with adequate lifting capacity. Refer to table 1-1 for weights and volume of this equipment. (Page 8-2)

CAUTION

When it is desired to deenergize the voltage regulators, stop the generator, place LOCOP LOCAL/REMOTE switch in LOCAL and place Voltage Regulator mode switch (S13) in the OFF position. (Page 2-34)

CAUTION

The BYPASS switch position allows an operator to place a generator directly on-line without the synchronization protective circuits. This procedure could possibly result in damage to the generator. It should be used only in an emergency or when no voltage is present on the bus. (Page 2-34)

CAUTION

Load shed trips distribution circuit breakers in both ship's service switchboards 1S and 3S from any LOAD SHED switch. (Page 2-36)

CAUTION

This power is nominally 450 VAC, 60 Hz, 3 Phase, 250 amperes, and should be connected only to specified equipment on distribution panels. (Page 2-38)

CAUTION

Sufficient load should be shed in these areas so that casualty power circuit breakers do not trip. (Page 2-38)

CAUTION

SEAWATER COOLING PUMP (CB1101, or 2101, or 3101) breakers receive power from the line side of their respective generator circuit breaker and must remain closed when the generator is running. Failure to leave these breakers closed will secure turbine generator cooling water. (Page 2-39)

CAUTION

The generator space heater must be on after shutdown to prevent condensation. When a turbine generator is started, the associated heating circuit is automatically disabled. (Page 2-41)

CAUTION

If synchronization circuits are not working properly, a generator may be synchronized manually using the BYPASS position on SYNCH MON MODE SEL. The SYNCH scope and SYNCHRONIZATION lights will still give correct indications. This action is not recommended except for urgent/emergency situations. (Page 3-8)

CAUTION

When replacing a fuse, always use the same type and size as the original. (Page 5-7)

CAUTION

During normal operation, switch 4 must be in the OFF position. Moving switch 4 to the ON position places the OPR in the test mode and enables the test mode trip point. This is done only when testing the OPR and sufficient ship's load is not available. (Page 5-42)

CAUTION

Exercise extreme care when adjusting the AC Power Sensing Relay (A3) while energized. If the trigger point is adjusted below the amount of power presently being used by the system, load shed will initiate. (Page 6-4)

CAUTION

Circuit breaker must be placed in the open position before the fuse unit is installed or removed. (Page 6-22)

CAUTION

This is a typical procedure for indicator lamp replacement. Care should be taken to correctly identify which type of lamp should be used. (Page 6-48)

CAUTION

Do not install fuses of different types or ratings. Damage to the circuit may result from an improperly protected circuit. (Page 6-49)

CHAPTER 1

GENERAL INFORMATION AND SAFETY PRECAUTIONS

1-1. SAFETY PRECAUTIONS

Refer to the [Safety Summary](#) for information pertinent to the safety of personnel and the ship.

1-2. INTRODUCTION

This manual contains the information required to install, operate, maintain and repair the 60 Hz main switchboards. The switchboards are composed of 11 main physical units located in various parts of the ship (see [figure 1-1](#)). Ship's service switchboards 1S and 3S are very similar and distribute 450 VAC, 3 Phase, 60 Hz power throughout the ship. The power input comes from the Ship's Service Gas Turbine Generators (SSGTG) or from shore power. Ship's service switchboard 2S is normally used as shore power distribution to switchboards 1S and 3S and control and distribution of power of SSGTG No. 2 when on-line. All three switchboards (1S, 2S, and 3S) have the capability of equalizing phase shift from the three main ship's generators so that ship's power is in phase throughout the ship. When both shore power and ship's power are used simultaneously, ship's power must be synchronized to shore power. Generator capacity can be upgraded to 3,000 KW when required in the future.

1-2.1 EQUIPMENT, ACCESSORIES, AND DOCUMENTS SUPPLIED. Equipment and documents supplied are given in [table 1-1](#). Columns reading left to right are headed as follows: Quantity (Qty), Nomenclature, CID/UNIT No., Dimensions (inches) Height (H) Width (W) Depth (D), Weight (pounds (lbs.)), and Volume (cubic feet (cu. ft.)). A listing of supplied maintenance tools is provided. The Commercial and Government Entity (CAGE) code of these objects is included for further identification.

Table 1-1. Equipment, Accessories, and Documents Supplied

Qty	Nomenclature	CID/UNIT No.	Dimensions (inches)			Weight (lbs.)	Volume (cu. ft.)
			H	W	D		
1	Switchboard 1SG		81	66	51	3797	158
1	Switchboard 1SA		81	72	51	5358	172
1	Switchboard 1SB		81	93	51	4077	222
1	Switchboard 1SC		81	66	51	4475	158
1	Switchboard 2SG		81	66	51	4068	158
1	Switchboard 2SA		81	90	51	5235	215
1	Switchboard 2SB		81	39	51	2182	93
1	Switchboard 3SG		81	66	51	3797	158
1	Switchboard 3SA		81	88	51	5801	210
1	Switchboard 3SB		81	83	51	3554	198
1	Switchboard 3SC		81	72	51	5078	172
1	Technical Manual	S9324-DK-MMA-010, Stock No. 0910-LP-103-9933					
1	Extension	S121-T CAGE 30086					
1	Wrench, Circuit Breaker (CB)	SA-50A CAGE 30086					
1	Lifting Yoke (1600 Amp CB)	229381-K2 CAGE 30086					
1	Lifting Yoke (3200/4000 Amp CB)	229083-K2 CAGE 30086					
1	Maintenance Handle	703530-K1 CAGE 30086					

1-3. EQUIPMENT DESCRIPTION

The switchboards provide the distribution of 450 VAC, 3 Phase, 60 Hz power. They protect and control the distribution circuits as well as monitor and protect the three SSGTGs which are rated at 2,500 KW each. The switchboards are able to align the generators in different configurations depending on ship's power requirements.

1-3.1 SHIP'S SERVICE SWITCHBOARD 1S. Ship's service switchboard 1S consists of switchboards 1SG, 1SA, 1SB, and 1SC (see [figure 1-2](#)). The 1SG switchboard contains circuit breakers for the 1SG Generator and the generator sea water cooling pump. The switchboard also contains controls and indicators for the generator, various circuit breakers, synchronizations for switchboard 2S and switchboard 3S and Local/Remote Control. Through the use of disconnect links (located in the rear of the switchboards), switchboards 1SG, 1SA, 1SB, and 1SC can each be isolated as necessary. Casualty power breakers and terminals for the Generator 1SG are located in the rear of switchboard 1S. Switchboard 1SA (refer to [table 1-2](#)) contains the 1S/2S bus tie breaker, the Load Center (LC) LC31 breaker, and several distribution breakers to vital/non-vital ship's load breakers. Switchboard 1SB (refer to [table 1-2](#)) contains vital and non-vital ship's load breakers. Switchboard 1SC (refer to [table 1-2](#)) contains the 1S/3S bus tie breaker and vital/non-vital ship's load breakers.

1-3.2 SHIP'S SERVICE SWITCHBOARD 2S. Ship's service switchboard 2S (see [figure 1-3](#)) enables SSGTG No. 2 to be connected to either or both ship's service switchboards 1S and 3S. Through ship's service switchboard 2S, the shore power is also cabled to ship's service switchboard 1S and 3S for distribution. Switchboard 2SG (refer to [table 1-3](#)) contains circuit breakers for the 2SG generator and the generator sea water cooling pump. The switchboard also contains controls and indicators for the generator, 2SB/3SC bus tie breaker, 2SA/1SA bus tie breaker, synchronizations for switchboard 1S and switchboard 3S and Local/Remote control. Two sets of disconnect links are located in switchboard 2SG so that it can be isolated the other sections of switchboard 2S. One set of disconnect links are provided in switchboard 2SA to isolate it from switchboard 1SA. Switchboard 2SB (refer to [table 1-3](#)) contains the 2SB/3SC bus tie breaker. Switchboard 2SA (refer to [table 1-3](#)) contains 12 shore power breakers with associated controls and indicators. These shore power breakers can be operated simultaneously from switchboard 2SA.

1-3.3 SHIP'S SERVICE SWITCHBOARD 3S. Ship's service switchboard 3S consists of switchboards 3SG, 3SA, 3SB, and 3SC (see [figure 1-4](#)). Ship's service switchboard 3SG (refer to [table 1-4](#)) contains circuit breaker for the 3SG generator and generator sea water cooling pump. The switchboard also contains controls and indicators for the generator, various circuit breakers, synchronizations, for switchboard 1S and switchboard 2S and Local/Remote control. Through the use of disconnect links, switchboards 3SG, 3SA, 3SB, and 3SC can each be isolated. Casualty power breakers and terminals for SSGTG No. 3 are located on the rear of switchboard 3SG. Switchboard 3SA (refer to [table 1-4](#)) contains the 3SA/1SC bus tie breaker plus circuit breakers for Load Center 21 and vital/non-vital ship loads. Switchboard 3SB (refer to [table 1-4](#)) contains vital/non-vital ship's load breakers. Switchboard 3SC (refer to [table 1-4](#)) contains 3SC/2SB bus tie breaker, the Load Center LC11 breaker and vital/non-vital ship's load breakers.

1-3.4 MIMIC BUS. A mimic bus diagram is constructed on the face of switchboards 1SG, 2SG, and 3SG which shows the status of the respective switchboard. The mimic bus is a simplified diagram or map of the Main Bus with colored lights indicating particular circuit breaker positions. This mimic bus will allow the knowledgeable operator to know at a glance the present status of the generator, switchboard bus, bus tie and main circuit breakers. Color codes of these indicators are spelled out in [Chapter 2, Operation](#).

1-4. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

Equipment and publications required but not supplied are listed in [table 1-5](#).

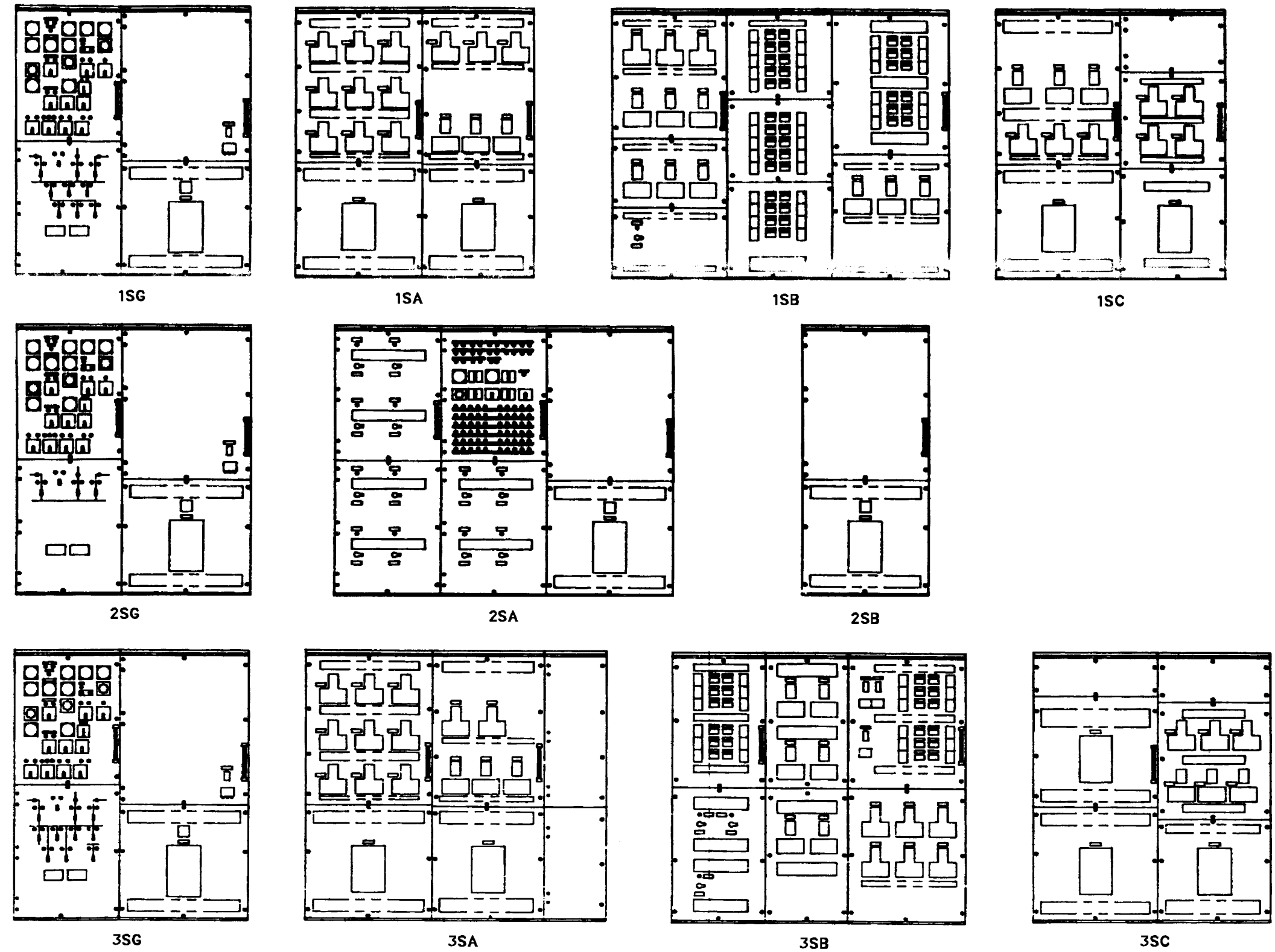


Figure 1-1. Equipment Supplied

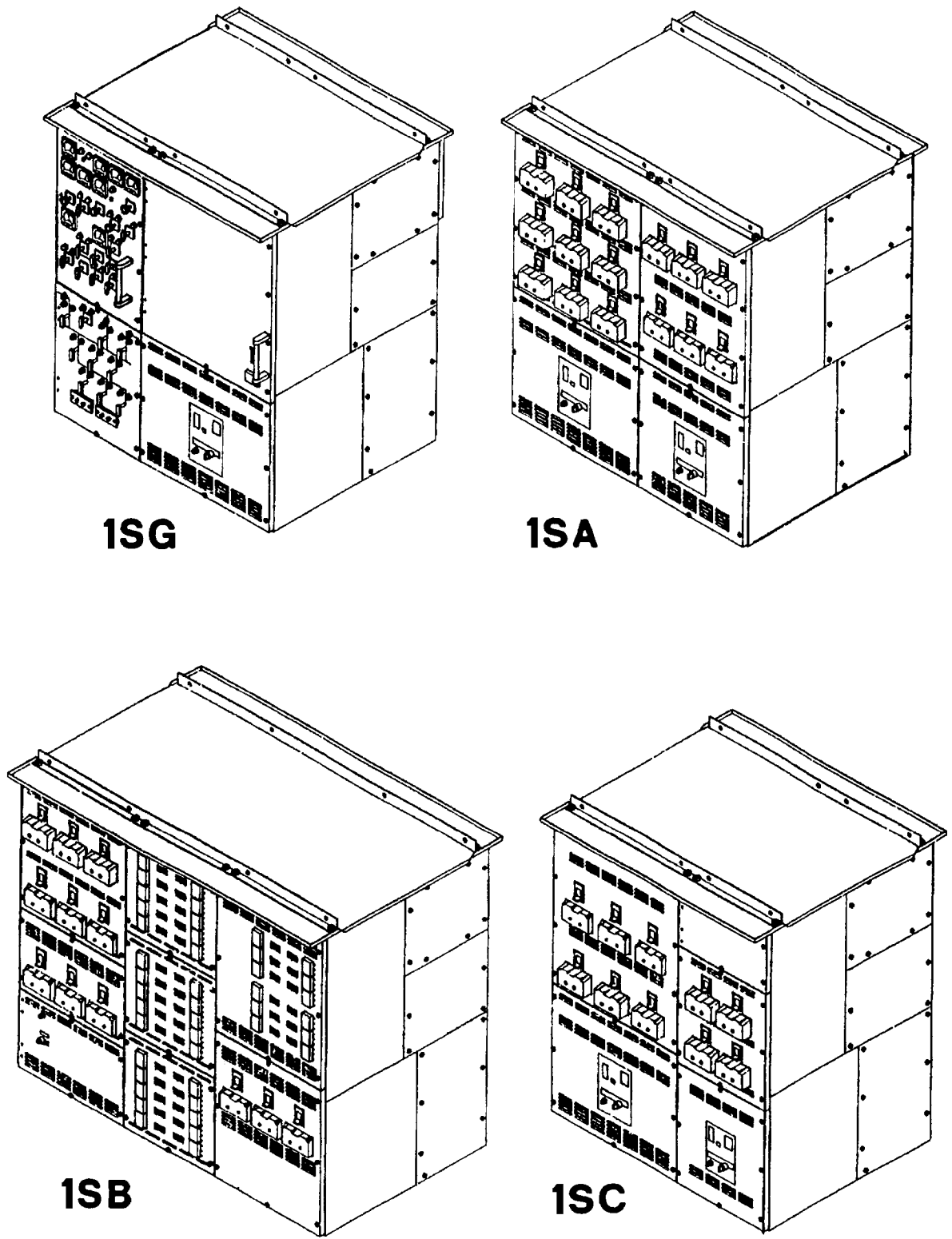


Figure 1-2. Ship's Service Switchboard 1S

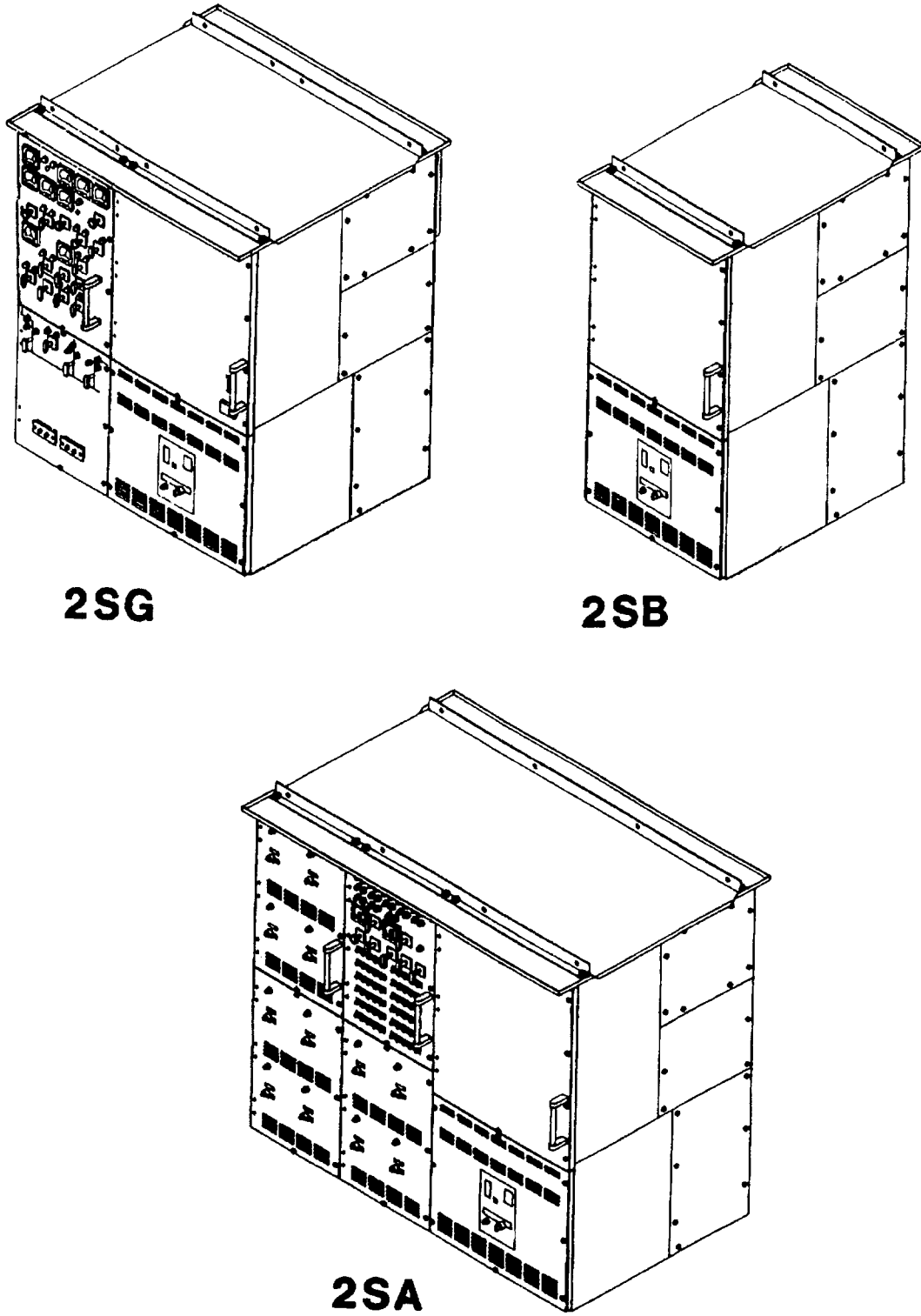


Figure 1-3. Ship's Service Switchboard 2S

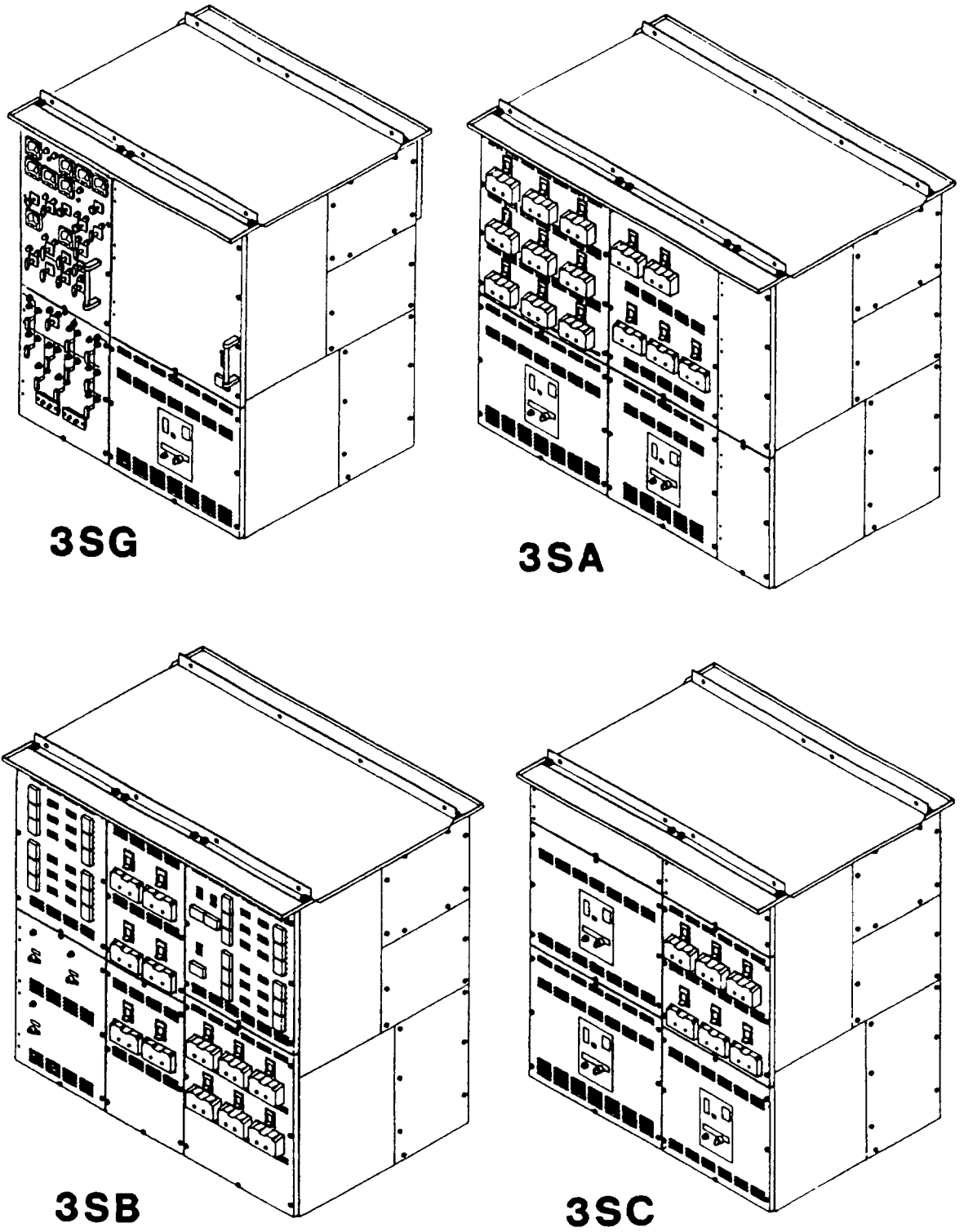


Figure 1-4. Ship's Service Switchboard 3S

Table 1-2. Switchboard System 1S Reference Data

Item	Description
Manufacturer	International Switchboard Corporation
Power Distribution:	450 VAC, 3 Phase, 60 Hz
ISG Switchboard	
Manufacturer Part No.	80047010
Functional Characteristics:	
Capabilities:	(Qty) CB Frame Size, Trip Rating
SSGTG No. 1 Breaker	(1) ACB-4000HR, 4000A
Casualty Power Breaker	(1) AQB-LF250, 250LM
Seawater Cooling Pump Breaker	(1) AQB-A101F, 15A Instantaneous trip only
Disconnect Links	(3) 4000A, Single Pole
Heat Dissipation	1791 Watts
ISA Switchboard	
Manufacturer Part No.	80047011
Functional Characteristics:	
Capabilities: DDG 51	(Qty), CB Frame Size. Trip Rating
1S/2S Bus Tie Breaker	(1) ACB-4000HR, 4000A
LC31 Load Center Breaker	(1) ACB-3200HR, 3200A
Distribution Breakers	(1) AQB-LF400, 350T (2) AQB-LF400, 300T (4) AQB-LF250, 250LM (1) AQB-LF250, 225L (1) AQB-LF250, 175LM (1) AQB-LF250, 150LM (5) AQB-LF250, 125L
Heat Dissipation	3403 Watts
ISB Switchboard	
Manufacturer Part No.	80047012
Functional Characteristics:	
Capabilities: DDG 51	(Qty) CB Frame Size, Trip Rating
Distribution Breakers	(3) AQB-LF400, 400T w/ shunt trip (2) AQB-LF400, 400TM (1) AQB-LF400, 350T w/ shunt trip (1) AQB-LF400, 350T (2) AQB-LF400, 350TM (1) AQB-LF400, 300TM w/ shunt trip (2) AQB-LF250. 175LM (1) AQB-LF250, 125LM (5) AQB-A101F. 100A w/ shunt trip (11)AQB-A101F, 100A (7) AQB-A101F, 75A (1) AQB-A101F, 50A w/ shunt trip (13)AQB-A101F, 50A (3) AQB-A101F, 25A
Capabilities: DDG 52-54	(Qty) CB Frame Size. Trip Rating
Distribution Breakers	(3) AQB-L400, 400QM w/ shunt trip (2) AQB-LL400, 400QS (2) AQB-L400, 350QM (1) AQB-L400, 350QM w/ shunt trip

Table 1-2. Switchboard System 1S Reference Data - Continued

Item	Description
	(1) AQB-LL400, 300QS w/ shunt trip (1) AQB-LL400, 350QS (2) AQB-LF250, 175LM (1) AQB-LF250, 125LM (3) AQB-A101F, 100A w/ shunt trip (11)AQB-A101F,100A (2) AQB-A101F, 75A w/ shunt trip (8) AQB-A101F, 75A (1) AQB-A101F, 50A w/ shunt trip (12)AQB-A101F, 50A (3) AQB-A101F, 25A Heat Dissipation 3853 Watts
ISC Switchboard Manufacturer Part No. Functional Characteristics: Capabilities: DDG 51 1S/3S Bus Tie Breaker Solid-state Frequency Changer (STC) 1 Breaker Distribution Breakers Capabilities: DDG 52-54 1S/3S Bus Tie Breaker Solid-state Frequency Changer (STC) 1 Breaker Distribution Breakers Disconnect Links Heat Dissipation	80047080 (Qty) CB Frame Size. Trip Rating (1) ACB-4000HR, 4000A (1) ACB-1600HR, 800A (1) AQB-LF400, 400T w/ shunt trip (1) AQB-LF400, 350TM (1) AQB-LF400, 300T w/ shunt trip (1) AQB-LF250, 175L w/ shunt trip (1) AQB-LF250, 175LM (2) AQB-LF250, 150L (1) AQB-LF250, 150LM (1) AQB-LF250, 125L (1) AQB-LF250, 125LM (Qty) CB Frame Size, Trip Rating (1) ACB-4000HR, 4000A (1) ACB-1600HR, 800A (1) AQB-L400, 400 w/ shunt trip (1) AQB-LL400, 350QS (1) AQB-L400, 300QM w/ shunt trip (1) AQB-LF250, 175L w/ shunt trip (1) AQB-LF250, 175LM (2) AQB-LF250, 150L (1) AQB-LF250, 150LM (1) AQB-LF250, 125L (1) AQB-LF250, 125LM (3) 4000A, Single Pole 2628 Watts
Environmental Characteristics: Ambient Temperature Relative Humidity	50°C 0-95 percent

Table 1-3. Switchboard System 2S Reference Data

Item	Description
Manufacturer	International Switchboard Corporation
Power Distribution:	450 VAC, 3 Phase, 60 Hz
2SG Switchboard	
Manufacturer Part No.	80047020
Functional Characteristics:	
Capabilities:	(Qty) CB Frame Size, Trip Rating
GTRB GEN 2SG Breaker	(1) AQB-4000HR, 4000A
Casualty Power Breakers	(2) AQB-LF250, 250LM
Seawater Cooling Pump Breaker	(1) AQB-A101F, 15A Instantaneous trip only
Disconnect Links	(6) 4000A, Single Pole
Heat Dissipation	1974 Watts
2SA Switchboard	
Manufacturer Part No.	80047021
Functional Characteristics:	
Capabilities: DDG 51	(Qty) CB Frame Size, Trip Rating
2S/1S Bus Tie Breaker	(1) ACB-4000A, 4000A
Shore Power Breakers	(12) AQB-LL400, 400QS
Capabilities: DDG 52-54	(Qty) CB Frame Size, Trip Rating
2SA/1SA Bus Tie Breaker	(1) ACB-4000A, 4000A
Shore Power Breakers	(12)AQB-LL400, 400QS
Disconnect Links	(3) 4000A, Single Pole
Heat Dissipation	3332 Watts
2SB Switchboard	
Manufacturer Part No.	80047022
Functional Characteristics:	
Capabilities:	(Qty) CB Frame Size, Trip Rating
2S/3S Bus Tie Breaker	(1) ACB-4000HR, 4000
Heat Dissipation	437 Watts
Environmental Characteristics:	
Ambient Temperature	50°C
Relative Humidity	0-95 percent

Table 1-4. Switchboard System 3S Reference Data

Item	Description
Manufacturer	International Switchboard Corporation
Power Distribution:	450 VAC, 3 Phase, 60 Hz
3SG Switchboard	
Manufacturer Part No.	80047030
Functional Characteristics:	
Capabilities:	(Qty) CB Frame Size, Trip Rating
SSGTG No. 3 Breaker	(1) ACB-4000HR, 4000A
Casualty Power Breakers	(2) AQB-LF250, 250LM
Seawater Cooling Pump Breaker	(1) AQB-A101F, 15A Instantaneous trip only
Disconnect Links	(3) 4000A, Single Pole
Heat Dissipation	1796 Watts
3SA Switchboard	
Manufacturer Part No.	80047031

Table 1-4. Switchboard System 3S Reference Data - Continued

Item	Description
Functional Characteristics:	
Capabilities: DDG 51	(Qty) CB Frame Size Trip Rating
1S/3S Bus Tie Breaker	(1) ACB-4000HR, 4000A
LC21 Load Center Breaker	(1) ACB-3200HR, 3200A
Distribution Breakers	(1) AQB-LF400, 400TM (1) AQB-LF400, 350T (1) AQB-LF400, 300T w/ shunt trip (3) AQB-LF250, 250LM w/ shunt trip (1) AQB-LF250, 250LM (1) AQB-LF250, 225L (1) AQB-LF250, 175L w/ shunt trip (3) AQB-LF250, 175LM (1) AQB-LF250, 150L (1) AQB-LF250, 150LM
Capabilities: DDG 52-54	(Qty) CB Frame Size, Trip Rating
1S/3S Bus Tie Breaker	(1) ACB-4000HR, 4000A
LC21 Load Center Breaker	(1) ACB-3200HR, 3200A
Distribution Breakers	(1) AQB-LL400, 400QS (1) AQB-L400, 350QM (1) AQB-L400, 300QM w/ shunt trip (3) AQB-LP250, 250LM w/ shunt trip (1) AQB-LF250, 250LM (1) AQB-LF250, 225L (1) AQB-LF250, 175L w/ shunt trip (3) AQB-LF250, 175LM (1) AQB-LF250, 150L (1) AQB-LF250, 150LM
Disconnect Links	(3) 4000A, Single Pole
Heat Dissipation	2915 Watts
3SB Switchboard	
Manufacturer Part No.	80047032
Functional Characteristics:	
Capabilities: DDG 51	(Qty) CB Frame Size, Trip rating
Distribution Breakers	(2) AQB-LF400, 400T w/ shunt trip (3) AQB-LF400, 350TM (3) AQB-LF400, 300TM w/ shunt trip (1) AQB-LF250, 225L (3) AQB-LF250, 175LM (1) AQB-LF250, 150L; (1) AQB-LF250, 125L; (4) AQB-A101F, 100A w/ shunt trip
Capabilities: DDG 52-54	(Qty) CB Frame Size, Trip rating
Distribution Breakers	(2) AQB-L400, 400QM w/ shunt trip (3) AQB-LL400, 350QS (3) AQB-LL400, 300QS w/ shunt trip (1) AQB-L400, 300QM (1) AQB-LF250, 225L w/ shunt trip

Table 1-4. Switchboard System 3S Reference Data - Continued

Item	Description
	(3) AQB-LF250, 175LM (2) AQB-LF250, 150L (4) AQB-A101F, 100A w/ shunt trip (7) AQB-A101F, 100A (3) AQB-A101F, 75A w/ shunt trip (6) AQB-A101F, 75A (5) AQB-A101F, 50A (2) AQB-A101F, 25A
Heat Dissipation	1520 Watts
3SC Switchboard	
Manufacturer Part No.	80047090
Functional Characteristics:	
Capabilities: DDG 51	(Qty) CB Frame Size, Trip Rating
3S/2S Bus Tie Breaker	(1) ACB-4000HR, 4000A
LC11 Load Center Breaker	(1) ACB-2000HR, 2000A
STC 2 Breaker	(1) ACB-1600HR, 800A
Distribution Breakers	(1) AQB-LF400, 400TM (2) AQB-LF400, 350T w/ shunt trip (1) AQB-LF400, 350T (1) AQB-LF250, 250LM (1) AQB-LF250, 175LM (1) AQB-LF250, 150LM
Capabilities: DDG 52-54	(Qty) C3 Frame Size. Trip Rating
3S/2S Bus Tie Breaker	(1) ACB-4000HR, 4000A
LC11 Load Center Breaker	(1) ACB-2000HR, 2000A
STC 2 Breaker	(1) ACB-1600HR, 800A
Distribution Breakers	(1) AQB-LL400, 400QS (2) AQB-L400, 350QM w/ shunt trip (1) AQB-L400, 350QM (1) AQB-LF250, 250LM (1) AQB-LF250, 175LM (1) AQB-LF250, 150LM
Disconnect Links	(3) 4000A, Single Pole
Heat Dissipation	2419 Watts
Environmental Characteristics:	
Ambient Temperature	50°C
Relative Humidity	0-95 percent

Table 1-5. Equipment and Publications Required But Not Supplied

Category	Recommended Equipment	Qty	Equipment Test Parameters	Application
Voltmeter, DC	Weston Model 931	1	50VDC	Verify Operation
Ammeter, DC	Weston Model 931	1	50/25/10DC	Verify Operation
Load Resistor	Ohmite: "Pwr-Rib" Stock No. 2331A	1	2.20 Ohms. Adj to 1.87 Ohms	Maintenance
Lamp	G.E. No. 1819	1 Bx		Repair

Table 1-5. Equipment and Publications Required But Not Supplied -

Continued

Category	Recommended Equipment	Qty	Equipment Test Parameters	Application
Phase Sequence Indicator Portable	Knopp Model K3	1	450 VAC, 60 Hz, 3 PH	Verify Operation
Portable AC Ammeter	Weston Model 433	1	5/2.5/1 AC Amp 25-500 Hz	Verify Operation
Auto Transformer	Powerstat Type 21	1	50-60 Hz, 1 PH	Verify Operation
Potential Transformer	Stancor RT204	1	Primary 115 V, 50-60 Hz, Multiple Tap	Verify Operation
Oscillator	General Radio 1308-A	1	115 VAC, 57-60 Hz	Test
Oscilloscope	Tektronix T-912 or Equiv.	1		Test
Digital Voltmeter	Fluke 77 or Equiv.	1		Test
Variac	Powerstat 3PN116B or Equiv.	1		Test
Ground Straps				Installation
Insulated Hand Tools				Installation/Maintenance
High Voltage Rubber Gloves				Maintenance
Rubber Mats				Maintenance
Multimeter		1	1000 VAC max and 1000 A max	Maintenance
Vacuum Cleaner		1		Maintenance
MIL-STD-2003				Installation/Reference
Technical Manuals	SPM Digital Sync 9909-160	1		Maintenance
	NAVSEA 0962-LP-042-1010	1		Maintenance
	NAVSEA 0362-LP-160-1000	1		Maintenance
	NAVSEA 0362-LP-233-3020	1		Maintenance
	NAVSEA 0362-LP-240-5000	1		Maintenance
	NAVSEA 0362-LP-240-6001	1		Maintenance
	S9324-B9-MMC-010	1		Maintenance

CHAPTER 2

OPERATION

2-1. INTRODUCTION

This chapter describes the operation of the 60 Hz main power distribution switchboards. There are three ship's service switchboards; 1S, 2S, and 3S. Each system has provisions for local control via the operator control panel located on the generator switchboards (1SG, 2SG, and 3SG) (see [figure 2-2](#)). The switchboards may also be controlled remotely at the Electric Plant Control Console (EPCC). The EPCC is not included in this technical manual. Therefore, only local operation of the switchboards will be addressed. When in the LOCAL position, the switchboards also provide remote control of their respective SSGTG. This chapter contains both figures and tables to aid the operator in location and operation of the equipment with various modes of operation being discussed. General operator maintenance tasks are defined, but actual procedures are covered in [Chapter 6](#) of this manual. The word "or" will be used when component designations differ between switchboards.

2-2. OVERALL SHIP'S SERVICE SWITCHBOARD SYSTEM

The 60 Hz power distribution system consists of three switchboards 1S, 2S, and 3S. Each switchboard has an associated Ship's Service Gas Turbine Generator; SSGTG No. 1, SSGTG No. 2, and SSGTG No. 3. The system interconnection has been designed to allow for various combinations of on-line generators and distribution switchboards. See [figure 2-1](#) for an interconnection diagram. This configuration as shown is a closed loop system or "ring bus." The placement of key bus tie circuit breakers in the switchboards allow for isolation or addition of the switchboard line-ups in the power distribution system. The EPCC normally operates the switchboard from a remote location. This manual deals with the 60 Hz main switchboards power distribution as such, and will only discuss local operation of the switchboards. This chapter provides general procedures for configuration of the 60 Hz main distribution switchboards. Shore power is discussed in [paragraph 2-10](#).

2-3. CONTROLS AND INDICATORS

[Figures 2-6](#) through [2-20](#) depict the front panel locations of the controls and indicators for the 60 Hz main distribution switchboards. [Tables 2-1](#) through [2-11](#) give the front panel designations and descriptions for each component. When reading the tables, the operator will be able to cross reference chapters and figures in the technical manual in order to locate and identify all of the components. Columns are read from left to right, and headed as follows:

- a. Fig/Item: This column contains the figure and item numbers as shown on [figures 2-6](#) through [2-20](#).
- b. Front Panel Designation: This column contains the front panel designation as it is actually shown on the switchboard. This is the nomenclature as it is actually engraved on the nameplate.
- c. Description: This column contains a brief description of what the control or indicator accomplishes when operated.

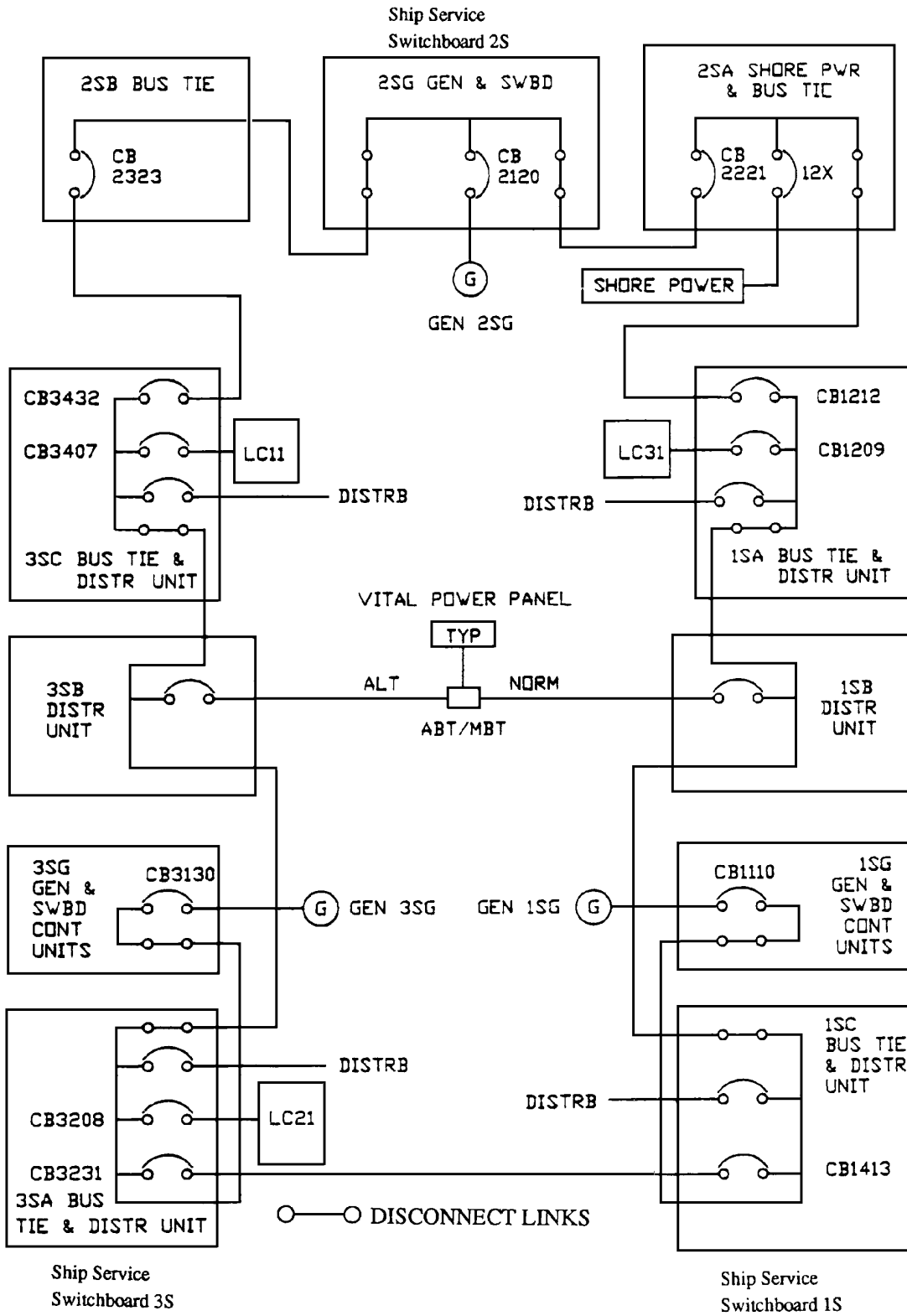
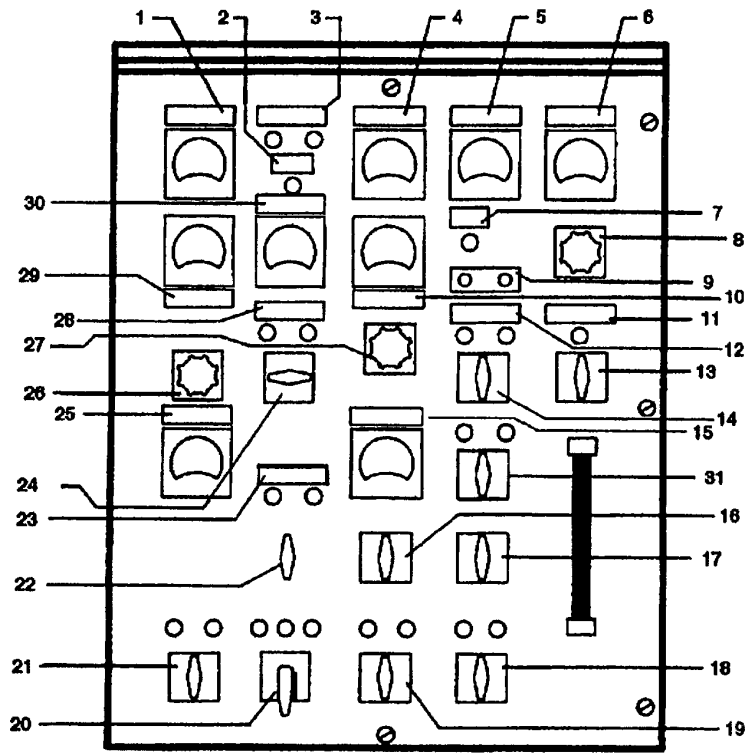


Figure 2-1. Interconnection Diagram



- | | | |
|----------------------|-----------|--------------------------------|
| 1. BUS | | 17. VOLT REG |
| BT AMPS | | SELECT |
| 2. RESET | | 18. VOLT REG |
| FC DETECTED | | MODE SEL |
| 3. BUS TIE INHIBIT | | 19. VOLT REG |
| 4. GENERATOR | | DIFF/DROOP |
| GEN AMPS | | 20. GND DET |
| 5. GENERATOR | | 21. LOAD SHED |
| GEN KW | | STAGE 1/STAGE 2 |
| 6. GENERATOR | | 22. SYNCH MON |
| GEN TEMP | | MODE |
| 7. READY TO START | | 23. SYNCH MON |
| 8. TEMP METER | | MODE SEL |
| 9. GENERATOR | GENERATOR | TEST |
| START | STOP | ON |
| 10. GENERATOR | | 24. CKT BREAKER & |
| GEN FREQ | | SYNCH SELECT |
| 11. GEN SPACE HEATER | | 25. BUS |
| 12. GOVENOR | GOVERNOR | VOLTS |
| ISO/DROOP | ISO/DROOP | 26. BUS METER |
| ISO | DROOP | SELECT |
| 13. GEN SPACE | | 27. GEN FREQ |
| HEATER | | LOWER/RAISE |
| 14. GOVERNOR | | 28. SYNCHRONIZATION |
| ISO/DROOP | | 29. BUS |
| 15. GENERATOR | | FREQ |
| GEN VOLTS | | 30. SYNCHRONIZATION |
| 16. GEN VOLTS | | SYNCH SCOPE |
| LOWER/RAISE | | 31. FAULT CURRENT DET MODE SEL |
| | | OPERATE/TEST |

Figure 2-2. Typical Generator Control Panel - Upper

NOTE

The indicator lights contained in the 60 Hz switchboards are color coded to the existing standard for Naval power plant equipment as follows:
 Circuit Breakers; Amber-Open, Blue-Closed
 Power Available/Switch Position ON; White
 Fault Detected; Red
 Circuit Ready; Green
 Ground Detection Test/Synchronization; Clear

Table 2-1. Switchboard 1SG Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-6/1 M2	BUS BT AMPS	This meter indicates the current in amps on the bus indicated.
2-6/2 PB1103	RESET FC DETECTOR	This pushbutton switch resets the Fault Current Detector (FCD) after the fault is corrected.
2-6/3 DS32	BUS TIE INHIBIT	This amber lamp lights up when the Bus Tie circuit breaker CB1413 or CB1212 is inhibited.
2-6/4 DS30	FAULT DETECTED	This red lamp lights up indicating a bus fault has been detected.
2-6/5 M1	GENERATOR GEN AMPS	This meter indicates the amount of current in amps from Generator 1SG.
2-6/6 M8	GENERATOR GEN KW	This meter indicates the electrical power being supplied by Generator 1SG.
2-6/7 M3	GENERATOR GEN TEMP	This meter indicates the temperature of the Generator 1SG stator in three locations as specified by switch (S18).
2-6/8 DS33	READY TO START	This green lamp lights up when all manually operated control devices are set up for automatic operation of Generator 1SG.
2-6/9 PB1101	GENERATOR START	This pushbutton switch starts Generator 1SG.
2-6/10 S18	TEMP METER SELECT SWITCH	This 5-position switch (OFF plus position 1-5) selects which stator temperature will be indicated on the GEN TEMP meter (M3).
2-6/11 PB1102	SSGTG STOP	This pushbutton switch stops Generator 1SG.
2-6/12 S16	GEN FREQ LOWER/RAISE	This multipole, momentary switch with oval knob, allows for generator frequency to be adjusted as required during operation. Two switch operating positions are available from the center off position. Rotating the switch to the left will LOWER the SSGTG NO. 1 frequency. Rotating the switch to the right will RAISE the generator frequency.
2-6/13 DS22	GEN SPACE HEATER	This white lamp lights up when the generator enclosure heater is on.
2-6/14 DS39	GOVERNOR DROOP	This amber lamp lights up when the Governor on the generator is in the DROOP mode.
2-6/15 S21	GEN SPACE HEATER	This switch has two operating positions. Rotating the switch to the right powers the Generator 1SG space heater. Rotating to the left turns the unit OFF.
2-6/16 S20	GOVERNOR ISO/DROOP	This multipole, momentary switch with oval knob has two operating positions. Positioning the switch to the left allows for the GOVERNOR to function in the ISO (isochronous) mode. Conversely, positioning to the right allows for the GOVERNOR to function in the DROOP mode.
2-6/17 DS38	GOVERNOR ISO	This green lamp lights up when the Governor on the generator is in the ISO (isochronous) mode.

Table 2-1. Switchboard 1SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-6/18 M4	GENERATOR GEN VOLTS	This meter indicates the voltage of Generator 1SG.
2-6/19 S15	GEN VOLTS LOWER/RAISE	This multipole, momentary switch with oval knob, allows for generator voltage to be adjusted as required during operation. Two switch operating positions are available for the center off position. Rotating the switch to the left will LOWER the SSGTG NO. 1 generator voltage. Rotating to the right will RAISE the generator voltage.
2-6/20 S31	VOLT REG SELECT	This multipole, 2-position switch with oval handle selects which voltage regulator will be used. Rotating the switch to the left selects VR1 while the right selects VR2.
2-6/21 DS36	VOLT REG DROOP	This amber lamp lights up when the Voltage Regulator is in the DROOP mode.
2-6/22 DS34	VOLT REG MODE SEL AUTO	This green lamp lights up when the Voltage Regulator is in the AUTO (automatic) mode.
2-6/23 DS35	VOLT REG MODE SEL MAN	This amber lamp lights up when the Voltage Regulator is in the MAN (manual) mode.
2-6/24 DS37	VOLT REG DIFF	This green lamp lights up when the Voltage Regulator is in the DIFF (differential) mode.
2-6/25 S13	VOLT REG MODE SEL	This 4-position, rotary switch selects the mode in which the voltage regulator circuitry will operate. OFF removes power from the unit. REMOTE transfers control to a remote operating station. AUTO allows the unit to automatically adjust the generator voltage. MANUAL allows the unit voltage to be manually adjusted.
2-6/26 S14	VOLT REG DIFF/DROOP	This multipole, momentary switch with oval knob, has two operating positions. Rotating the switch to the left allows for operation in the DIFF (differential) mode. Conversely, rotating to the right allows for operation in the DROOP mode.
2-6/27 DS23	1S GEN POWER AVAIL	This white lamp lights up when the Generator 1S is running and power is available at the Main Bus.
2-6/28 DS4	CB1110 TRIP	CB1110 - This amber lamp lights up when the circuit breaker is open. This indicates the circuit is open between the Generator 1S and the Main Bus 1S.
2-6/29 DS5	CB1110 CLOSE	CB1110 - This blue lamp lights up when the circuit breaker is closed. This indicates the circuit is closed between the Generator and the Main Bus.
2-6/30 DS25	PWR AVAIL 1S-3S BUS TIE	CB1413 - This white lamp lights up when power is available at CB1413 located in switchboard 1SC.
2-6/31 DS9	CB1413 CLOSE	CB1413 - This blue lamp lights up when the 1SC/3SC bus tie circuit breaker is closed. This indicates the power path is closed between switchboards 1SC and 3SA.
2-6/32 DS8	CB1413 TRIP	CB1413 - This amber lamp lights up when the 1SC/3SA bus tie circuit breaker is open. This indicates the power path is open between switchboards 1SC and 3SA.
2-6/33 S3	1S-3S BUS TIE BREAKER	This 2-pole, momentary switch with pistol-grip handle, operates CB1413 (1SC/3SA Bus Tie circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/34 S1	1S GEN BREAKER	This 2-pole, momentary switch with pistol-grip handle, operates CB1110 (GEN 1SG circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.

Table 2-1. Switchboard 1SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-6/35 S5	STC 1	This 2-pole, momentary switch with pistol-grip handle, operates CB1409 (STC 1 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/36 DS16	CB3038 TRIP	CB3038 in LC31 - This amber lamp lights up when the A/C CMPRSR NO. 2 ALT circuit breaker is open.
2-6/37 DS17	CB3038 CLOSE	CB3038 in LC31 - This blue lamp lights up when the A/C CMPRSR NO. 2 ALT circuit breaker is closed.
2-6/38 DS18	CB3042 TRIP	CB3042 in LC31 - This amber lamp lights up when the A/C CMPRSR NO. 3 ALT circuit breaker is open.
2-6/39 DS19	CB3042 CLOSE	CB3042 in LC31 - This blue lamp lights up when the A/C CMPRSR NO. 3 ALT circuit breaker is closed.
2-6/40 DS20	CB3043 TRIP	CB3043 in LC31 - This amber lamp lights up when the A/C CMPRSR NO. 4 ALT circuit breaker is open.
2-6/41 DS21	CB3043 CLOSE	CB3043 in LC31 - This blue lamp lights up when the A/C CMPRSR NO. 4 ALT circuit breaker is closed.
2-6/42 S9	A/C 4 ALT	This 2-pole, momentary switch with pistol-grip handle, operates CB3043 (A/C 4 circuit breaker located in LC31). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/43 S8	A/C 3 ALT	This 2-pole, momentary switch with pistol-grip handle, operates CB3042 (A/C 3 circuit breaker located in LC31). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/44, 2-6/45 J2, J1	J2 J1	TEST JACK. These test receptacles with test plugs are used to connect portable test instruments. They are used to check the metering and potential circuits during test only.
2-6/46 S7	A/C 2 ALT	This 2-pole, momentary switch with pistol-grip handle, operates CB3038 (A/C 2 circuit breaker located in LC31). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/47 S6	A/C 1 NORM	This 2-pole, momentary switch with pistol-grip handle, operates CB1352 (A/C 1 NORM circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/48 S4	LC31 FDR	This 2-pole, momentary switch with pistol-grip handle, operates CB1209 (LC31 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/49 DS10	CB1209 TRIP	CB1209 - This amber lamp lights up when the LC31 FDR circuit breaker is open.
2-6/50 DS11	CB1209 CLOSE	CB1209 - This blue lamp lights up when the LC31 FDR circuit breaker is closed.
2-6/51 DS14	CB1352 TRIP	CB1352 - This amber lamp lights up when the NORM A/C 1 circuit breaker is open.
2-6/52 DS15	CB1352 CLOSE	CB1352 - This blue lamp lights up when the NORM A/C 1 circuit breaker is closed.
2-6/53 DS12	CB1409 TRIP	CB1409 - This amber lamp lights up when the STC 1 circuit breaker is open.

Table 2-1. Switchboard 1SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-6/54 DS13	CB1409 CLOSE	CB1409 - This blue lamp lights up when the STC 1 circuit breaker is closed.
2-6/55 S24	CONTROL XFR LOCAL/REM	This 2-position switch selects the location where the switchboard system will be operated. In LOCAL it is controlled from switchboard 1S. In REM (remote) it is controlled from the EPCC.
2-6/56 S2	1S-2S BUS TIE BREAKER	This 2-pole, momentary switch with pistol-grip handle, operates CB1212 (1SA/2SA Bus Tie circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-6/57 DS7	CB1212 CLOSE	This blue lamp lights up when the 1SA/2SA bus tie circuit breaker is closed. This indicates the power path is closed between switchboards 1SA and 2SA.
2-6/58 DS6	CB1212 TRIP	This amber lamp lights up when the 1SA/2SA bus tie circuit breaker is open. This indicates the power path is open between switchboards 1SA and 2SA.
2-6/59 DS24	PWR AVAIL 1S-2S BUS TIE	CB1212 - This white lamp lights up when power is available at CB1212 located in switchboard 1SA.
2-6/60 DS42	CONTROL XFR LOCAL	This white lamp lights up when the switchboard system controls are to be operated from the LOCAL (switchboard) location
2-6/61 DS43	CONTROL XFR REM	This white lamp lights up when the switchboard system controls are being operated from the EPCC.
2-6/62 S25	GND DET	This momentary (OFF), switch with pistol-grip handle is used to test the switchboard main bus for grounds.
2-6/63 S22	LOAD SHED STAGE 1/STAGE 2	This switch has two operating positions. Rotating the switch from the extreme left (OFF) positions to STAGE 1 initiates load shed stage 1 as listed in table 2-17 . Positioning to STAGE 2 initiates load shed stage 2 as listed in table 2-17 . STAGE 2 breakers include all those in both Stages 1 and 2.
2-6/64 DS41	LOAD SHED OCCURRED STAGE 2	This amber lamp lights up when LOAD SHED STAGE 2 has occurred.
2-6/65 DS40	LOAD SHED OCCURRED STAGE 1	This amber lamp lights up when LOAD SHED STAGE 1 has occurred.
2-6/66 DS26, DS27, DS28	GND TEST	Under normal operating conditions these three clear lamps light up equally any time the switchboard 2SG Main Bus is energized.
2-6/67 S38	SYNCH MON MODE SEL	This 4-position, rotary switch selects the mode of operation for the synchronizing monitor. Rotating the switch from the OFF to TEST position, checks to see that the synchronizing monitor (A1) is working. White indicator (DS29) illuminates. Rotating from the OPERATE to BYPASS position is utilized to energize a dead bus from an energized bus. It can be used if the synchronizing monitor is not operational. OPERATE is the normal operating position. Both TEST and BYPASS positions are spring loaded to OFF and OPERATE, respectively.
2-6/68 DS31	SYNCH MON MODE SEL ON	This white lamp lights up when the Synchronizing Monitor Mode Select switch is in the normal OPERATE position.
2-6/69 DS29	SYNCH MON MODE SEL TEST	This white lamp lights up when the Synchronizing Monitor Mode Select switch is in the TEST position.
2-6/70 M5	BUS VOLTS	This meter indicates the voltage on the bus specified by switch (S17).

Table 2-1. Switchboard 1SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-6/71 S17	BUS METER SELECT	This 4-position switch selects the Main Bus which will be monitored during paralleling operations. The positions are as follows: OFF, 1S-3S allows the voltage on the 1S/3S Bus Tie to be monitored, 1S allows the voltage on the 1S bus to be monitored, 1S-2S allows the voltage on the 1S/2S Bus Tie to be monitored.
2-6/72 S19	CIRCUIT BREAKER AND SYNCH SELECT	This 4-position switch selects the Main Bus to which the Generator 1SG will be synchronized. Off takes the switchboard and associated circuitry off-line. 1S-3S selects the comparison of bus line phase differences between the 1S bus and that of the 1S/3S bus tie. 1S-GEN selects the comparison of bus line phase differences between the 1S, bus and that of SSGTG No. 1. 1S-2S selects the comparison bus line phase differences between the 1S bus and that of the 1S/2S bus tie.
2-6/73, 74 DS1, DS2	SYNCHRONIZATION	These two clear lamps are associated with the synchroscope. When lit, they indicate the out-of-phase voltages between oncoming generator and bus. They may be dimly lit when the two voltages are in-phase.
2-6/75 M6	GENERATOR GEN FREQ	This meter indicates the frequency of Generator 1SG.
2-6/76 M7	BUS FREQ	This meter indicates the frequency of bus specified by switch (S17).
2-6/77 M11	SYNCHRONIZATION SYNCH SCOPE	This meter indicates the phase difference of the two selected switchboard systems so they can be paralleled.
2-6/78 S42	FAULT CURRENT DET MODE SEL OPERATE/TEST	This multipole rotary switch with oval shank knob allows the FCD to be in one of two modes: OPERATE or TEST. The center position selects the TEST mode of the FCD. Rotating the switch to the left selects the OPERATE mode of the FCD.
2-6/79 DS48	FAULT CURRENT DET MODE SEL OPERATE	This white lamp lights up when the FCD is in the OPERATE mode.
2-6/80 DS49	FAULT CURRENT DET MODE SEL TEST	This amber lamp lights up when the FCD is in the TEST mode.
2-7/1, 2 CB1102, CB1103	CASUALTY POWER	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for CASUALTY POWER. It is physically located on the rear panel of switchboard 1SG.
2-7/3, 4	CASUALTY POWER TERMINALS	These terminals are used to connect power from the CASUALTY POWER BREAKERS (CB1102 & CB1103). They are physically located on the external rear panel of switchboard 1SG.
2-7/5 CB1101	GEN 1SG SW COOLING CLG PUMP 1S-4P-V	This 100 amp frame, 15 amps instantaneous trip molded case breaker provides power and protection for the SSGTG No. 1 seawater cooling pump (CB1101). It is physically located in the middle right side of switchboard 1SG.
2-7/6 CB1110	SHIP'S SERVICE GEN- ERATOR 1SG 1SG-4P-1S	This 4,000 amp frame, 4,000 amp trip air circuit breaker feeds the switchboard 1SG Main Bus from the output of Gen 1S. It is physically located in the bottom right corner of switchboard 1SG.

Table 2-2. Switchboard 1SA Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-8/1 CB1210	120V LTG LC22 1S-4L-LC22 (NORM)	This 250 amp frame, 150 amp trip molded case breaker provides power and protection for the 120V LTG LC22.

Table 2-2. Switchboard 1SA Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-8/2 CB1211	450V RADAR RM NO. 1 1S-4P-(03-129-1) NORM	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for the RADAR RM NO. 1 NORMAL 450V power panel.
2-8/3 CB1213	450V RADAR RM NO. 2 1S-4P-(03-173-3) NORM	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for the RADAR RM NO. 2 NORMAL 450V power panel.
2-8/4 CB1214	450V PWR SPLY/CVRSN RM PNL 1 1S-4P-(3-159-2) NORM	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for the PWR SPLY/CVRSN RM PNL 1 NORMAL 450V power panel.
2-8/5 CB1215	PWR PNL (EP1) MK280 MOD 2 1S-4WP-J (NORM)	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for GUN 51.
2-8/6 CB1205	450V ARRAY RM NO. 1 1S -4P-(03-141-1) (NORM)	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for 450V ARRAY RM NO. 1.
2-8/7 CB1217	(BLANK)	This 400 amp frame, 350 amp trip molded case breaker is provided as a spare.
2-8/8 CB1207	450V SONAR EQPT RM 2 PNL 2 1S-4P-(2-41-1) NORM	This 400 amp frame, 300 amp trip molded case breaker provides power and protection for 450V SONAR EQPT RM 2.
2-8/9 CB1208	(BLANK)	This 400 amp frame, 300 amp trip molded case breaker is provided as a spare.
2-8/10 CB1209	LOAD CENTER 31 1S-4P-LC31	This 3,200 amp frame, 3,200 amp trip air circuit breaker feeds LC31 from the 1SA main bus.
2-8/11 CB1212	1S/2S BUS TIE 1S-4P-2S	This 4,000 amp frame, 4,000 amp trip air circuit breaker is used to connect the 1SA bus and the 2SA bus.
2-8/12 CB1206	(BLANK)	This 250 amp frame, 225 amp trip molded case breaker is provided as a spare.
2-8/13 CB1216	ENG RM NO. 1 PNL 2 - VITAL 1S-4P-(4-181-2) NORM	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for ENG RM NO. 1 VITAL PNL 2.
2-8/14 CB1204	MISC AUX ZONE 2 1S-4P-(1- 219-13) NORM	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for MISC AUX ZONE 2.
2-8/15 CB1201	FIRE PUMP NO. 4 1S-4P-D (ALTN)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 4.
2-8/16 CB1202	AUX MCHRY NO. 1 PNL 1 - VITAL 1S-4P-(4-167-2) ALTN	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for AMR NO. 1 VITAL PNL 1.
2-8/17 CB1203	CL W RECIRC & MISC AUX - ZONE 1 1S-4P-(1-64-1) NORM	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for CL W RECIRC & MISC AUX ZONE 1.

Table 2-3. Switchboard 1SB Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-9/1 CB1343	FIRE PUMP NO. 2 1S-4P-B (NORM)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 2.
2-9/2 CB1344	FIRE PUMP NO. 3 1S-4P-C (NORM)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 3.
2-9/3 CB1345	450V CBT SYS EQPT RM NO. 2 PNL 2 1S-4P-(2-152-2) NORM	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for COMBAT SYS EQPT RM 2 PNL 2
2-9/4 CB1348	AMR NO. 1 VITAL PNL 2 1S-4P-(4-131-1) NORM	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for AMR NO. 1 VITAL PNL 2.

Table 2-3. Switchboard 1SB Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-9/5 CB1351	ENG RM NO. 1 VITAL PNL 3 1S-4P-(3-219-2) NORM	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for Engine Room No. 1 Vital.
2-9/6 CB1352	AIR COND CPRSR NO. 1 1S-4P-H (NORM)	This 400 amp frame, 300 amp trip molded case breaker provides power and protection for AIR COND CPRSR NO. 1.
2-9/7	AIR COND CPRSR NO. 1 BREAKER CLOSED	This blue lamp lights up when AIR COND CPRSR NO. 1 BREAKER is closed.
2-9/8 CB1346	450V SONAR EQPT RM 2 PNL 1 1S-4P-(2-30-1) NORM	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for 450V SONAR EQPT RM 2 PNL 1.
2-9/9 CB1349	ER NO. 1 VITAL PNL 1 1S-4P- (3-211-1) NORM	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for NO. 1 VITAL PNL 1.
2-9/10 CB1347	450V PWR SPLY/CVRSN RM PNL 2 1S-4P-(3-161-2) ALTN	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for PWR SPLY/CVRSN RM PNL 2
2-9/11 CB1350	NON-VITAL AUX ZONE 2 PNL 1 1S-4P-(2-189-2)	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for NON-VITAL AUX ZONE 2 PNL 1.
2-9/12 CB1301	AFFF STA NO. 1 1S-4P-(1-65-1) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for AFFF STA NO. 1.
2-9/13 CB1302	AFFF STA NO. 2 1S-4P-(1- 329-1) ALTN	This 100 amp frame. 50 amp trip molded breaker provides power and protection for AFFF STA NO. 2.
2-9/14 CB1304	120V PILOT HSE 1S-4P-(04- 154-2) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for 120V Pilot House.
2-9/15 CB1306	GENERAL WORKSHOP 1S-4P- (2-219-2)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for GENERAL WORKSHOP.
2-9/16 CB1308	CL Z VENT ZONE 2 PNL NO. 1 1S-4P-(1-176-2)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for CL Z VENT ZONE 2 PNL NO. 1.
2-9/17 CB1310	NON-VITAL AUX ZONE 2 PNL 2 1S-4P-(2-220-2)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for NON-VITAL AUX ZONE 2 PNL 2.
2-9/18 CB1312	(BLANK)	This 100 amp frame, 50 amp trip molded case breaker is provided as a spare.
2-9/19 CB1314	450V 1C & GYRO RM 1 1S-4P- (4-100-2) NORM	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 450V IC & GYRO RM 1.
2-9/20 CB1316	B-SIZE MODULE (BACK-UP) 1S-4WP-S (NORM)	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for B-SIZE MODULE (BACKUP).
2-9/21 CB1318	120V COMM CTR PNL 2 1S-4P-(2-127-3) NORM	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for COMM CTR PNL 2.
2-9/22 CB1320	ELEX EQPT WTR COOLER HD-1077/SSQ NO. 2 1S-4P-G (ALTN)	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for ELEX EQPT WTR COOLER HD-1077/SSQ NO. 2.
2-9/23 CB1322	LOW HD PWR XFMR (FOR STBD ARRAYS) 1S-4P-P (NORM)	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for LOW HD PWR XFMR (STBD).
2-9/24 CB1324	120V CIC PNL 2 1S-4P-(1- 143-2) ALTN	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for 120V CIC PNL 2.
2-9/25 CB1326	120V CIC PNL 4 1S-4P-(1- 157-2) ALTN	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for 120V CIC PNL 4.
2-9/26 CB1357	120V LTG LC23 1S-4L-LC23 (NORM)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 120V LTG LC23.
2-9/27 CB1356	CL X PREHTR AMR NO. 1 1S-4P-M(1)	This 100 amp frame, 75 amp trip molded ease breaker provides power and protection for CL X PREHTR AMR NO. 1.

Table 2-3. Switchboard 1SB Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-9/28 CB1325	120V CIC PNL 3 1S-4P-(1-141-2) NORM	This 100 amp frame, 25 amp trip molded case breaker provides power and protection for 120V CIC PNL 3.
2-9/29 CB1323	120V CIC PNL 1 1S-4P-(1-127-2) NORM	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for 120V CIC PNL 1.
2-9/30 CB1321	LOW HD PWR XFMR (FOR PORT ARRAYS) 1S-4P-R (ALTN)	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for LOW HD PWR XFMR (PORT).
2-9/31 CB1319	ELEX EQPT WTR COOLER HD-1077/SSQ NO. 1 1S-4P-F (NORM)	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for ELEX EQPT WTR COOLER HD-1077/SSQ NO. 1
2-9/32 CB1317	450V COMM CTR 1S-4P-(2-130-1) ALTN	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for 450V COMM CTR.
2-9/33 CB1315	450V CBT SYS EQPT RM NO. 2 PNL 1 1S-4P-(2-143-2) ALTN	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for COMBAT SYS EQPT RM 2 PNL 1.
2-9/34 CB1313	120V SONAR EQPT RM 1 1S-4P-(1-41-1) NORM	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for 120V SONAR EQPT RM 1.
2-9/35 CB1311	(BLANK)	This 100 amp frame, 25 amp trip molded case breaker is provided as a spare.
2-9/36 CB1309	CL Z VENT, ZONE 2 PNL NO. 2 1S-4P-(1-218-2)	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for CL Z VENT, ZONE 2 PNL NO. 2.
2-9/37 CB1307	VITAL AUX ZONE 2 1S-4P-(1-217-1) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for VITAL AUX ZONE 2.
2-9/38 CB1305	CL W VENT A SIZE MODULE 1S-4P-(1-100-2) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for CL W VENT A SIZE MODULE.
2-9/39 CB1303	AUX MCHRY NO. 1 NON-VITAL 1S-4P-(4-169-2)	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for AMR NO. 1 NON-VITAL.
2-9/40 CB1332	VITAL AUX ZONE 1 1S-4P-(1-66-1) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for VITAL AUX ZONE 1.
2-9/41 CB1334	CL W, X, & CIR X VENT, ZONE 1 1S-4P-(01-117-1) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for CL W, X, & CIR X VENT, ZONE 1.
2-9/42 CB1336	120V LTG LC24 1S-4L-LC24 (NORM)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 120V LTG LC24.
2-9/43 CB1338	450V COMBAT SYS EQPT RM 1 1S-4P-(2-65-1) NORM	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 450V COMBAT SYS EQPT RM 1.
2-9/44 CB1340	450V RADIO XMTR RM PNL NO. 2 1S-4P-(2-168-1) NORM	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 450V RADIO XMTR RM PNL NO. 2.
2-9/45 CB1342	(BLANK)	This 100 amp frame, 100 amp trip molded case breaker is provided as a spare.
2-9/46 CB1354	ENG RM NO. 1 PNL 3 NON-VITAL 1S-4P-(3-174-2)	This 400 amp frame, 400 amp trip molded, case breaker provides power and protection for ER NO. 1 NON-VITAL.
2-9/47 CB1355	ER NO. 1 NON-VITAL PNL 1 1S-4P-(3-193-2)	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for ER NO. 1 NON-VITAL PNL 1.
2-9/48 CB1353	FUEL XFER HTR NO. 1 1S-4P-L(1)	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for FUEL XFER HTR NO. 1.
2-9/49 CB1341	(BLANK)	This 100 amp frame, 25 amp trip molded case breaker is provided as a spare.
2-9/50 CB1339	450V RADIO XMTR RM PNL NO. 1 1S-4P-(2-170-3) ALTN	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 450V RADIO XMTR RM PNL NO. 1.

Table 2-3. Switchboard 1SB Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-9/15 CB1337	120V LTG LC12 1S-4L-LC12 (NORM)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 120V LTG LC12.
2-9/52 CB1335	CL W VENT ZONE 2 1S-4P-(01-156-1) NORM	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for CL W VENT ZONE 2.
2-9/53 CB1333	CL W RECIRC ZONE 2 1S-4P-(1-210-1) NORM	This 100 amp frame, 100 amp trip case breaker provides power and protection for CL W RECIRC ZONE 2.
2-9/54 CB1331	PILOT HOUSE WINDOWS 1S-4P-(04-140-2) ALTN	This 100 amp frame, 100 amp trip molded case breaker is provides power and protection for PILOT HOUSE WINDOWS.

Table 2-4. Switchboard 1SC Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-10/1 CB1408	A SIZE MODULE 1S-4WP-K(NORM)	This 400 amp frame, 350 amp trip molded case breaker is provides power and protection for A SIZE MODULE.
2-10/2 CB1406	ER NO. 1 NON-VITAL PNL 2 1S-4P-(4-174-2)	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for ER NO. 1 NON-VITAL PNL 2.
2-10/3 CB1407	NON-VITAL AUX ZONE 1 1S-4P-(1-109-1)	This 400 amp frame, 300 amp trip molded case breaker provides power and protection for NON-VITAL AUX ZONE 1.
2-10/4 CB1404	CL X PREHTR ER NO. 1 1S-4P-N(1)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for CL X PREHTR ER NO. 1.
2-10/5 CB1411	450V ARRAY RM NO. 2 1S-4P-(03-141-2) ALTN	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for 450V ARRAY RM NO. 2.
2-10/6 CB1410	120V LTG LC13 1S-4L-LC13 (NORM)	This 250 amp frame, 150 amp trip molded case breaker provides power and protection for 120V LTG LC13.
2-10/7 CB1405	DEGAUSSING 1S-4P-(2-253-2) ALTN	This 250 amp frame, 150 amp trip molded case breaker provides power and protection for DEGAUSSING.
2-10/8 CB1409	STC 1 1S-4P-E (NORM)	This 1,600 amp frame, 800 amp trip air circuit breaker provides power and protection for STC 1.
2-10/9 CB1413	1S/3S BUS TIE 1S-4P-3S	This 4,000 amp frame, 4,000 amp trip air circuit breaker is used to connect the Main Bus between switchboards 1S and 3S.
2-10/10 CB1403	(BLANK)	This 250 amp frame, 150 amp trip molded case breaker is provided as a spare.
2-10/11 CB1402	MK16 MOD 2 WPN GP 1S-4WP-T (NORM)	This 250 amp frame, 125 amp trip molded case breaker provides power and protection for MK 16 MOD 2 WPN GP.
2-10/12 CB1401	FIRE PUMP NO. 1 1S-4P-A (NORM)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 1.

Table 2-5. Switchboard 2SG Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-11/1 M2	BUS BT AMPS	This meter indicates the amount of current in amps flowing between the Generator 2SG and the ship's load.
2-11/2 PB2103	RESET FC DETECTOR	This pushbutton switch resets the FCD when the fault is corrected.
2-11/3 DS32	B TIE INHIBIT	This amber lamp lights up when the Bus Tie circuit breaker CB2323 or CB2221 is inhibited.
2-11/4 DS30	FAULT DETECTED	This red lamp lights up indicating a bus fault has been detected.

Table 2-5. Switchboard 2SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-11/5 M1	GENERATOR GEN AMPS	This meter indicates the amount of current in amps flowing between the Generator 2SG and ship's load.
2-11/6 M8	GENERATOR GEN KW	This meter indicates the electrical power being supplied by Generator 2SG.
2-11/7 M3	GENERATOR GEN TEMP	This meter indicates the temperature of the Generator 2SG stator in three locations as specified by switch (S18).
2-11/8 DS33	READY TO START	This green lamp lights up when all manually operated control devices are set up for automatic operation of Generator 2SG.
2-11/9 PB2101	GENERATOR START	This pushbutton switch starts Generator 2SG.
2-11/10 S18	TEMP METER	This 5-position switch (OFF plus positions 1-5) selects which stator temperature will be indicated on the GEN TEMP meter (M3).
2-11/11 PB2102	GENERATOR STOP	This pushbutton switch stops Generator 2SG.
2-11/12 S16	GEN FREQ LOWER/ RAISE	This multipole, momentary switch with oval knob, allows for generator frequency to be adjusted as required during operation. Two switch operating positions are available from the center off position. Rotating the switch to the left will LOWER the SSGTG NO. 2 frequency. Rotating the switch to the right will RAISE the generator frequency.
2-11/13 DS22	GEN SPACE HEATER	This white lamp lights up when the Generator 2SG Enclosure Heater is on.
2-11/14 DS39	GOVERNOR ISO/ DROOP DROOP	This amber lamp lights up when the Governor on the generator is in the DROOP mode.
2-11/15 S21	GEN SPACE HEATER	This switch has two operating positions. Rotating the switch to the right powers the Generator 3SG space heater. Rotating to the left turns the unit OFF.
2-11/16 S20	GOVERNOR ISO/ DROOP	This multipole, momentary switch with oval knob has two operating positions. Positioning the switch to the left allows for the GOVERNOR to function in the ISO (isochronous) mode. Conversely, positioning to the right allows for the GOVERNOR to function in the DROOP mode.
2-11/17 DS38	GOVERNOR ISO/ DROOP ISO	This green lamp lights up when the Governor on the generator is in the ISO (isochronous) mode.
2-11/18 M4	GENERATOR GEN VOLTS	This meter indicates the line voltage of the Generator 2SG.
2-11/19 S15	GEN VOLTS LOWER/ RAISE	This multipole, momentary switch with oval knob, allows for generator voltage to be adjusted as required during operation. Two switch operating positions are available for the center off position. Rotating the switch to the left will LOWER the SSGTG NO. 1 generator voltage, Rotating to the right will RAISE the generator voltage.
2-11/20 S31	VOLT REG SELECT	This multipole, 2-position switch with oval handle selects which voltage regulator will be used. Rotating the switch to the left selects VR1 while the right selects VR2.
2-11/21 DS36	VOLT REG DIFF/ DROOP DROOP	This amber lamp lights up when the Voltage Regulator is in the DROOP mode.
2-11/22 DS34	VOLT REG MODE SEL AUTO	This green lamp lights up when the Voltage Regulator is in the AUTO (automatic) mode.
2-11/23 DS35	VOLT REG MODE SEL MAN	This amber lamp lights up when the Voltage Regulator is in the MAN (manual) mode.
2-11/24 DS37	VOLT REG DIFF/ DROOP DIFF	This green lamp lights up when the Voltage Regulator is in the DIFF (differential) mode.

Table 2-5. Switchboard 2SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-11/25 S13	VOLT REG MODE SEL	This 4-position, rotary switch selects the mode in which the voltage regulator circuitry will operate. OFF removes power from the unit. REMOTE transfers control to a remote operating station. AUTO allows the unit to automatically adjust the generator voltage. MANUAL allows the unit voltage to be manually adjusted.
2-11/26 S14	VOLT REG DIFF/ DROOP	This multipole, momentary switch with oval knob, has two operating positions. Rotating the switch to the left allows for operation in the DIFF (differential) mode. Conversely, rotating to the right allows for operation in the DROOP mode.
2-11/27 DS23	2S GEN POWER AVAIL	This white lamp lights up when the Generator 2S is running and power is available at the Main Bus.
2-11/28 DS25	CB2323	This white lamp lights up when power is available at the CB2323 located in switchboard 2SB.
2-11/29 DS8	CB2323 TRIP	This amber lamp lights up when the 2SB/3SC bus tie circuit breaker is open. This indicates the power path is open between switchboards 2SB and 3SC.
2-11/30 DS9	CB2323 CLOSE	This blue lamp lights up when the 2SB/3SC bus tie circuit breaker is closed. This indicates the power path is closed between switchboards 2SB and 3SC.
2-11/31 S3	CB2323	This 2-pole, momentary switch with pistol-grip handle, operates CB2323 (2SB/3SC bus tie circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-11/32 DS5	CB2120 CLOSE	This blue lamp lights up when the CB2120 is closed. This indicates the circuit is closed between Generator 2S and the Main Bus.
2-11/33 S1	CB2120	This 2-pole, momentary switch with pistol-grip handle, operates CB2120 (GEN 2SG circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-11/34 DS4	CB2120 TRIP	This amber lamp lights up when the CB2120 is open. This indicates the circuit is open between Generator 2S and the Main Bus.
2-11/35, 36 J2, J1	J2 J1	TEST JACK. These test receptacles with test plugs are used to connect portable test instruments. They are used to check the metering and potential circuits during test only.
2-11/37 S24	CONTROL XFR LOCAL/ REM	This 2-position switch selects the location where the switchboard system will be operated. In LOCAL it is controlled from switchboard 2S. In REM (remote) it is controlled from the EPCC.
2-11/38 S2	2S-1S BUS TIE BREAKER	This multi-pole, momentary switch with pistol-grip handle, operates CB2221 (2SA-1SA bus tie circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-11/39 DS6	CB2221 TRIP	This amber lamp lights up when CB2221 is open. This indicates the power path is open between 2SA/1SA bus tie circuit breaker and switchboard 2S.
2-11/40 DS24	PWR AVAIL 2S-1S-BUS TIE	This white lamp lights up when power is available at CB2221 located in switchboard 2SA.
2-11/41 DS7	CB2221 CLOSE	This blue lamp lights up when CB2221 is closed. This indicates the power path is closed between 2SA/1SA bus tie circuit breaker and switchboard 2S.
2-11/42 DS42	CONTROL XFR LOCAL	This white lamp lights up when the switchboard system controls are to be operated from the LOCAL (switchboard) location.
2-11/43 DS43	CONTROL XFR REM	This white lamp lights up when the switchboard system controls are being operated from the EPCC.

Table 2-5. Switchboard 2SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-11/44 S25	GND DET	This momentary (OFF), switch with pistol-grip handle is used to test the switchboard main bus for grounds.
2-11/45 S22	LOAD SHED STAGE 1/STAGE 2	This switch has two operating positions. Rotating the switch from the extreme left (OFF) positions to STAGE 1 initiates load shed stage 1 as listed in table 2-17 . Positioning to STAGE 2 initiates load shed stage 2 as listed in table 2-17 . STAGE 2 breakers include all those in both Stages 1 and 2.
2-11/46 DS41	LOAD SHED OCCURRED STAGE 2	This amber lamp lights up when LOAD SHED STAGE 2 has occurred.
2-11/47 DS40	LOAD SHED OCCURRED STAGE 1	This amber lamp lights up when LOAD SHED STAGE 1 has occurred.
2-11/48 DS26, DS27, DS28	GND DET	Under normal operating conditions these three clear lamps light up equally any time the switchboard 2SG Main Bus is energized.
2-11/49 S38	SYNCH MON MODE SEL	This 4-position, rotary switch selects the mode of operation for the synchronizing monitor. Rotating the switch from the OFF to TEST position, checks to see that the synchronizing monitor (A1) is working. White indicator (DS29) illuminates. Rotating from the OPERATE to BYPASS position is utilized to energize a dead bus from an energized bus. It can be used if the synchronizing monitor is not operational. OPERATE is the normal operating position. Both TEST and BYPASS positions are spring loaded to OFF and OPERATE, respectively.
2-11/50 DS31	SYNCH MON MODE SEL ON	This white lamp lights up when the Synchronizing Monitor Mode Select switch is in the normal OPERATE position.
2-11/51 DS29	SYNCH MON MODE SEL TEST	This white lamp lights up when the Synchronizing Monitor Mode Select switch is in the TEST position.
2-11/52 M5	BUS VOLTS	This meter indicates the voltage on the bus specified by switch (S17).
2-11/53 S17	BUS METER SELECT	This 4-position switch selects the Main Bus which will be monitored during paralleling operations. The positions are as follows: OFF, 2S-3S allows the voltage to be monitored on the 2S/3S bus tie, 2S allows the voltage to be monitored on the 2S bus, 2S-1S allows the voltage to be monitored on the 2S/1S bus tie.
2-11/54 S19	CKT BREAKER AND SYNCH SELECT	This 4-position switch selects the Main Bus to which the Generator 1SG will be synchronized. OFF takes the switchboard and associated circuitry off-line. 2S-3S selects the comparison of bus line phase differences between the 2S bus and that of the 2S/3S bus tie. 2S-GEN selects the comparison of bus line phase differences between the 1S bus and that of SSGTG NO. 2. 2S-1S selects the comparison bus line phase differences between the 2S bus and that of the 2S/1S bus tie.
2-11/55, 2-11/56 DS1, DS2	SYNCHRONIZATION	These two clear lamps are associated with the synchroscope. When lit, they indicate the out-of-phase voltage between oncoming generator and bus. They are dimmed when the two voltages are in phase.
2-11/57 M6	GENERATOR GEN FREQ	This meter indicates the frequency of Generator 2SG.
2-11/58 M7	BUS FREQ	This meter indicates the frequency of the bus specified by switch (S17).
2-11/59 M11	SYNCHRONIZATION SYNCH SCOPE	This meter indicates the frequency difference of the two selected switchboard systems so they can be paralleled.

Table 2-5. Switchboard 2SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-11/60 S42	FAULT CURRENT DET MODE SEL OPERATE/ TEST	This multipole rotary switch with oval shank knob allows the FCD to be in one of two modes: OPERATE or TEST. The center position selects the TEST mode of the FCD. Rotating the switch to the left selects the OPERATE mode of the FCD.
2-11/61 DS48	FAULT CURRENT DET MODE SEL OPERATE	This white lamp lights up when the FCD is in the OPERATE mode.
2-11/62 DS49	FAULT CURRENT DET MODE SEL TEST	This amber lamp lights up when the FCD is in the TEST mode.
2-12/1, 2 CB2102, CB2103	CASUALTY POWER CIRCUIT BREAKER	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for CASUALTY POWER. It is physically located on the rear panel of switchboard 2SG.
2-12/3, 4	CASUALTY POWER TERMINALS	These terminals are used to connect power from the CASUALTY POWER BREAKERS (CB2102 & CB2103). They are physically located on the external rear panel of switchboard 2SG.
2-12/5 CB2101	GEN 2SG SW COOLING PUMP 2S-4P-A	This 100 amp frame, 15 amps instantaneous trip molded case breaker provides power and protection for the SSGTG No. 2 Seawater Cooling Pump. It is physically located in the middle right side of switchboard 2SG.
2-12/6 CB2120	SHIP'S SERVICE GEN- ERATOR 2SG	This 4,000 amp frame, 4,000 amp trip air circuit breaker feeds the switchboard 2S Main Bus from the output of Gen 2S. It is physically located in the bottom right corner of switchboard 2SG.

Table 2-6. Switchboard 2SA Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-13/1 2SP-DS1	CB2201 TRIP	This amber lamp lights up when SHORE POWER CB2201 is open.
2-13/2 2SP-DS2	CB2201 CLOSE	This blue lamp lights up when SHORE POWER CB2201 is closed.
2-13/3 2SP-DS4	CB2202 TRIP	This amber lamp lights up when SHORE POWER CB2202 is open.
2-13/4 2SP-DS5	CB2202 CLOSE	This blue lamp lights up when SHORE POWER CB2202 is closed.
2-13/5 2SP-DS7	CB2203 TRIP	This amber lamp lights up when SHORE POWER CB2203 is open.
2-13/6 2SP-DS8	CB2203 CLOSE	This blue lamp lights up when SHORE POWER CB2203 is closed.
2-13/7 2SP-DS10	CB2204 TRIP	This amber lamp lights up when SHORE POWER CB2204 is open.
2-13/8 2SP-DS11	CB2204 CLOSE	This blue lamp lights up when SHORE POWER CB2204 is closed.
2-13/9 2SP-DS13	CB2205 TRIP	This amber lamp lights up when SHORE POWER CB2205 is open.
2-13/10 2SP-DS14	CB2205 CLOSE	This blue lamp lights up when SHORE POWER CB2205 is closed.
2-13/11 2SP-DS16	CB2206 TRIP	This amber lamp lights up when SHORE POWER CB2206 is open.
2-13/12 2SP-DS17	CB2206 CLOSE	This blue lamp lights up when SHORE POWER CB2206 is closed.

Table 2-6. Switchboard 2SA Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-13/13 2SP-DS19	CB2207 TRIP	This amber lamp lights up when SHORE POWER CB2207 is open.
2-13/14 2SP-DS20	CB2207 CLOSE	This blue lamp lights up when SHORE POWER CB2207 is closed.
2-13/15 2SP-DS22	CB2208 TRIP	This amber lamp lights up when SHORE POWER CB2208 is open.
2-13/16 2SP-DS23	CB2208 CLOSE	This blue lamp lights up when SHORE POWER CB2208 is closed.
2-13/17 2SP-DS25	CB2209 TRIP	This amber lamp lights up when SHORE POWER CB2209 is open.
2-13/18 2SF-DS26	CB2209 CLOSE	This blue lamp lights up when SHORE POWER CB2209 is closed.
2-13/19 2SP-DS28	CB2210 TRIP	This amber lamp lights up when SHORE POWER CB2210 is open.
2-13/20 2SP-DS29	CB2210 CLOSE	This blue lamp lights up when SHORE POWER CB2210 is closed.
2-13/21 2SP-DS31	CB2211 TRIP	This amber lamp lights up when SHORE POWER CB2211 is open.
2-13/22 2SP-DS32	CB2211 CLOSE	This blue lamp lights up when SHORE POWER CB2211 is closed.
2-13/23 2SP-DS34	CB2212 TRIP	This amber lamp lights up when SHORE POWER CB2212 is open.
2-13/24 2SP-DS35	CB2212 CLOSE	This blue lamp lights up when SHORE POWER CB2212 is closed.
2-13/25, 26 DS38, DS39	SHORE POWER PH REF	The two green lamps light up when performing phase sequence reference of shore power to bus. Both lamps illuminate when the phase sequence is correct.
2-13/27 M10	AMP SHORE POWER	This meter indicates current drawn from SHORE POWER.
2-13/28 S27A	PHASE SEQUENCE	This single pole switch uses OFF and seven positions (1, 2, 3, 4, 5, 6, and 7-12). It is used in conjunction with (S27B) to determine the correct phase rotation of incoming power on all 12 shore power circuit breakers.
2-13/29 M9	PHASE SEQ	This meter indicates the phase sequence of shore power. It determines whether the phase sequence is correct (ABC) or incorrect (CBA). It works in conjunction with switches S27 and S28.
2-13/30 S28A	PHASE ORIENTATION	This single pole switch uses OFF and seven positions (1, 2, 3, 4, 5, 6, and 7-12). It is used in conjunction with (S28B) to determine the correct phase orientation of incoming power on the shore power circuit breakers.
2-13/31 DS37	BUS TIE ENERGIZED	This white lamp lights up when switchboard 2SA/1SA main bus is energized.
2-13/32 S26	SHORE POWER AMPS	This 4-position (OFF, 1, 2, and 3), rotary switch selects which phase of power is to be monitored by the SHORE POWER AMMETER (M10).
2-13/33 S27B	PHASE SEQUENCE	This single pole switch uses OFF and six positions (7 through 12). It is used in conjunction with (S27A) for correct phase rotation in the phase sequence indicator circuit.

Table 2-6. Switchboard 2SA Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-13/34 S11	SHORE POWER CONTROL	This 3-position, momentary switch operates all 12 SHORE POWER circuit breakers simultaneously. Two operating positions are available from the center off position. Rotating the switch to the left will TRIP all 12 breakers. Conversely, rotating to the right will CLOSE all 12 breakers.
2-13/35 S28B	PHASE ORIENTATION	This single pole switch uses OFF and six positions (7 through 12). It is used in conjunction with (S28A) for correct phase orientation of incoming power on the shore power circuit breakers.
2-13/36 S4	S4 TRIP	This switch is used to trip the bus tie circuit breakers, CB1212 located in switchboard 1SA and CB2221 located in switchboard 2SA.
2-13/37, 38, 39 1F1-1F3	RCPT NO. 1 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators protect the phase sequence circuit of RCPT NO. 1 (CB2201).
2-13/40 1F4	CB2201 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2201.
2-13/41 1F5	CB2201 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2201.
2-13/42, 43, 44 2F1-2F3	RCPT NO. 2 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 2 (CB2202).
2-13/45 2F4	CB2202 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2202.
2-13/46 2F5	CB2202 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2202.
2-13/47, 48, 49 3F1-3F3	RCPT NO. 3 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 3 (CB2203).
2-13/50 3F4	CB2203 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2203.
2-13/51 3F5	CB2203 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2203.
2-13/52, 53, 54 4F1-4F3	RCPT NO. 4 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 4 (CB2204).
2-13/55 4F4	CB2204 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2204.
2-13/56 4F5	CB2204 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2204.
2-13/57, 58, 59 5F1-5F3	RCPT NO. 5 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 5 (CB2205).
2-13/60 5F4	CB2205 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2205.
2-13/61 5F5	CB2205 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2205.
2-13/62, 63, 64 6F1-6F3	RCPT NO. 6 PH SEQ CRT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 6 (CB2206).

Table 2-6. Switchboard 2SA Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-13/65 6F4	CB2206 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2206.
2-13/66 6F5	CB2206 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2206.
2-13/67, 68, 69 7F1-7F3	RCPT NO. 7 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 7 (CB2207).
2-13/70 7F4	CB2207 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2207.
2-13/71 7F5	CB2207 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2207.
2-13/72, 73, 74 8F1-8F3	RCPT NO. 8 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 8 (CB2208).
2-13/75 8F4	CB2208 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2208.
2-13/76 8F5	CB2208 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of 062208.
2-13/77, 78, 79 9F1-9F3	RCPT NO. 9 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 9 (CB2209).
2-13/80 9F4	CB2209 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2209.
2-13/81 9F5	CB2209 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2209.
2-13/82, 83, 84 10F1-10F3	RCPT NO. 10 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 10 (CB2210).
2-13/85 10F4	CB2210 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2210.
2-13/86 10F5	CB2210 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2210.
2-13/87, 88, 89 11F1-11F3	RCPT NO. 11 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 11 (CB2211).
2-13/90 11F4	CB2211 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2211.
2-13/91 11F5	CB2211 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2211.
2-13/92, 93, 94 12F1-12F3	RCPT NO. 12 PH SEQ CKT	These 6 amp fuses, mounted in blown fuse indicators, protect the phase sequence circuit of RCPT NO. 12 (CB2212).
2-13/95 12F4	CB2212 UV TRIP	This 2 amp fuse, mounted in a blown fuse indicator, protects the undervoltage trip circuitry of CB2212.
2-13/96 12F5	CB2212 CONTROL	This 10 amp fuse, mounted in a blown fuse indicator, protects the control circuitry of CB2212.
2-14/1 2SP-DS6	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 2 (CB2202) is energized.

Table 2-6. Switchboard 2SA Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-14/2 CB2202	SHORE POWER TERMINAL NO. 2 PS-4P-2S(2)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 2.
2-14/3 2SP-DS12	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 4 (CB2204) is energized.
2-14/4 CB2204	SHORE POWER TERMINAL NO. 4 PS-4P-2S(4)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 4.
2-14/5 2SP-DS18	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 6 (CB2206) is energized.
2-14/6 CB2206	SHORE POWER TERMINAL NO. 6 PS-4P-2S(6)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 6.
2-14/7 2SP-DS24	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 8 (CB2208) is energized.
2-14/8 CB2208	SHORE POWER TERMINAL NO. 8 PS-4P-2S(8)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 8.
2-14/9 CB2207	SHORE POWER TERMINAL NO. 7 PS-4P-2S(7)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 7.
2-14/10 2SP-DS21	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 7 (CB2207) is energized.
2-14/11 CB2205	SHORE POWER TERMINAL NO. 5 PS-4P-2S(5)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 5.
2-14/12 2SP-DS15	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 5 (CB2205) is energized.
2-14/13 CB2203	SHORE POWER. TERMINAL NO. 3 PS-4P-2S(3)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 3.
2-14/14 2SP-DS9	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 3 (CB2203) is energized.
2-14/15 CB2201	SHORE POWER TERMINAL NO. 1 PS-4P-2S(1)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 1.
2-14/16 2SP-DS3	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 1 (CB2201) is energized.
2-14/17 2SP-DS30	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 10 (CB2210) is energized.
2-14/18 CB2210	SHORE POWER TERMINAL NO. 10 PS-4P-2S(10)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 10.
2-14/19 2SP-DS36	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 12 (CB2212) is energized.
2-14/20 CB2212	SHORE POWER TERMINAL NO. 12 PS-4P-2S (12)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 12.
2-14/21 CB2211	SHORE POWER TERMINAL NO. 11 PS-4P-SP(11)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 11.
2-14/22 2SP-DS33	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 11 (CB2211) is energized.
2-14/23 CB2209	SHORE POWER TERMINAL NO. 9 PS-4P-SP(9)	This 400 amp frame, 400 amp trip molded case breaker provides shore power and protection for Shore Power Terminal No. 9.
2-14/24 2SP-DS27	SHORE POWER AVAILABLE	This white lamp near its associated circuit breaker lights up when SHORE POWER RECEPT NO. 9 (CB2209) is energized.
2-14/25 CB2221	2SA/1SA BUS TIE	This 4,000 amp frame, 4,000 amp trip circuit breaker connects the 2SA with the 1SA bus.

Table 2-7. Switchboard 2SB Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-15/1 CB2323	2S/3S BUS TIE 2S-4P-3S	This 4,000 amp frame, 4,000 amp trip air circuit breaker is used to connect switchboard 3SC with switchboard 2SB.

Table 2-8. Switchboard 3SG Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-16/1 M2	BUS BT AMPS	This meter indicates the current flowing in amps on the Main Bus specified by Switch (S17).
2-16/2 PB3103	RESET FC DETECTOR	This pushbutton switch resets the FCD when the fault is corrected.
2-16/3 DS32	B TIE INHIBIT	This amber lamp lights up when the bus tie circuit breaker CB3432 or CB3231 cannot be closed.
2-16/4 DS30	FAULT DETECTED	This red lamp lights up indicating a ground fault has been detected.
2-16/5 M1	GENERATOR GEN AMPS	This meter indicates the amount of current in amps from Generator 3SG.
2-16/6 M8	GENERATOR GEN KW	This meter indicates the electrical power being supplied by Generator 3SG.
2-16/7 M3	GENERATOR GEN TEMP	This meter indicates the temperature of the Generator 3SG stator in three locations as specified by switch (S18).
2-16/8 DS33	READY TO START	This green lamp lights up when all manually operated control devices are set up for automatic operation of the Generator 3SG.
2-16/9 PB3101	GENERATOR START	This pushbutton switch starts Generator 3SG.
2-16/10 S18	TEMP METER	This 5-position (OFF, 1 through 5) switch selects which stator temperature will be indicated on the GEN TEMP meter (M3).
2-16/11 PB3102	GENERATOR STOP	This pushbutton switch stops Generator 3SG.
2-16/12 S16	GEN FREQ LOWER/ RAISE	This multipole, momentary switch with oval knob, allows for generator frequency to be adjusted as required during operation. Two switch operating positions are available from the center off position. Rotating the switch to the left will LOWER the SSGTG NO. 3 frequency. Rotating the switch to the right will RAISE the generator frequency.
2-16/13 DS22	GEN SPACE HEATER	This white lamp lights up when the Generator 3SG Enclosure Heater is on.
2-16/14 DS39	GOVERNOR ISO/ DROOP DROOP	This amber lamp lights up when the Governor on the generator is in the DROOP mode.
2-16/15 S21	GEN SPACE HEATER	This switch has two operating positions. Rotating the switch to the right powers the Generator 3SG space heater. Rotating to the left turns the unit OFF.
2-16/16 S20	GOVERNOR ISO/ DROOP	This multipole, momentary switch with oval knob has two operating positions. Positioning the switch to the left allows for the GOVERNOR to function in the ISO (isochronous) mode. Conversely, positioning to the right allows for the GOVERNOR to function in the DROOP mode.

Table 2-8. Switchboard 3SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-16/17 S38	SYNCH MON MODE SEL	This 4-position, rotary switch selects the mode of operation for the synchronizing monitor. Rotating the switch from the OFF to TEST position, checks to see that the synchronizing monitor (A1) is working. White indicator (DS29) illuminates. Rotating from the OPERATE to BYPASS position is utilized to energize a dead bus from an energized bus. It can be used if the synchronizing monitor is not operational. OPERATE is the normal operating position. Both TEST and BYPASS positions are spring loaded to OFF and OPERATE, respectively.
2-16/18 M4	GENERATOR GEN VOLTS	This meter indicates the voltage of Generator 3SG.
2-16/19 S15	GEN VOLTS LOWER/ RAISE	This multipole, momentary switch with oval knob, allows for generator voltage to be adjusted as required during operation. Two switch operating positions are available for the center off position. Rotating the switch to the left will LOWER the SSGTG NO. 2 generator voltage. Rotating to the right will RAISE the generator voltage.
2-16/20 S31	VOLT REG SELECT	This multipole, 2-position switch with oval handle selects which voltage regulator will be used. Rotating the switch to the left selects VR1 while the right selects VR2.
2-16/21 DS36	VOLT REG DIFF/ DROOP DROOP	This amber lamp lights up when the Voltage Regulator is in the DROOP mode.
2-16/22 DS34	VOLT REG MODE SEL AUTO	This green lamp lights up when the Voltage Regulator is in the AUTO (automatic) mode.
2-16/23 DS35	VOLT REG MODE SEL MAN	This amber lamp lights up when the Voltage Regulator is in the MAN (manual) mode.
2-16/24 DS37	VOLT REG DIFF/ DROOP DIFF	This green lamp lights up when the Voltage Regulator is in the DIFF (differential) mode.
2-16/25 S13	VOLT REG MODE SEL	This 4-position, rotary switch selects the mode in which the voltage regulator circuitry will operate. OFF removes power from the unit. REMOTE transfers control to a remote operating station. AUTO allows the unit to automatically adjust the generator voltage. MANUAL allows the unit voltage to be manually adjusted.
2-16/26 S14	VOLT REG DIFF/ DROOP	This multipole, momentary switch with oval knob, allows for operation of switchboard system No 3 in either DIFF (differential) or DROOP modes.
2-16/27 DS4	CB3130 TRIP	This amber lamp lights up when CB3130 is open. This indicates the circuit is open between the SSGTG No. 3 and the 3SG switchboard.
2-16/28 DS23	3S GEN POWER AVAIL	This white lamp lights up when the Generator 3S is running.
2-16/29 DS5	CB3130 CLOSE	This blue lamp lights up when CB3130 is closed. This indicates the circuit is closed between the 3S Generator and the 3S Main Bus.
2-16/30 S1	CB3130	This 2-pole, momentary switch with pistol-grip handle, operates CB3231 (GEN 3SG circuit breaker).
2-16/31 DS8	CB3432 TRIP	This amber lamp lights up when 3SC/2SB bus tie circuit breaker is open. This indicates the power path is open between switchboards 3SC and 2SB.
2-16/32 DS25	CB3432	This white lamp lights up when power is available at CB3432 located in switchboard 3SC.
2-16/33 DS9	CB3432 CLOSE	This blue lamp lights up when the 3SC/2SB bus tie circuit breaker is closed. This indicates the power path is closed between switchboards 3SC and 2SB.

Table 2-8. Switchboard 3SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-16/34 S3	CB3432	This 2-pole, momentary switch with pistol-grip handle, operates CB3432 (3SC/2SB bus tie circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/35 DS13	LC11 FDR CLOSE	This blue lamp lights up when CB3407 (LC11 circuit breaker) is closed.
2-16/36 DS12	LC11 FDR TRIP	This amber lamp lights up when CB3407 (LC11 circuit breaker) is open.
2-16/37 S5	CB3407	This 2-pole, momentary switch with pistol-grip handle, operates CB3407 (LC11 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/38 DS15	A/C 1 CLOSE	This blue lamp lights up when the ALTERNATE A/C 1 circuit breaker (CB1032) is closed.
2-16/39 DS14	A/C 1 TRIP	This amber lamp lights up when the ALTERNATE A/C 1 circuit breaker (CB1032) is open.
2-16/40 S10	CB1032	This 2-pole, momentary switch with pistol-grip handle, operates CB1032 (ALTERNATE A/C 1 circuit breaker on LC11). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/41 S6	CB3408	This 2-pole, momentary switch with pistol-grip handle, operates CB3408 (STC2 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/42 S9	CB3342	This 2-pole, momentary switch with pistol-grip handle, operates CB3342 (NORMAL A/C 4 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/43, 44 J2, J1	J2 J1	TEST JACK. These test receptacles with test plugs are used to connect portable test instruments.
2-16/45 S7	CB3340	This 2-pole, momentary switch with pistol-grip handle, operates CB3340 (NORMAL A/C 2 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/46 DS16	A/C 2 TRIP	This amber lamp lights up when the NORMAL A/C CMPRSR NO. 2 circuit breaker (CB3340) is open.
2-16/47 DS17	A/C 2 CLOSE	This blue lamp lights up when the NORMAL A/C CMPRSR NO. 2 circuit breaker (CB3340) is closed.
2-16/48 DS20	A/C 4 TRIP	This amber lamp lights up when the NORMAL A/C CMPRSR NO. 4 circuit breaker (CB3342) is open.
2-16/49 DS21	A/C 4 CLOSE	This blue lamp lights up when the NORMAL A/C CMPRSR NO. 4 circuit breaker (CB3342) is closed.
2-16/50 S8	CB3341	This 2-pole, momentary switch with pistol-grip handle, operates CB3341 (NORMAL A/C 3 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/51 S4	CB3208	This 2-pole, momentary switch with pistol-grip handle, operates CB3208 (LC21 circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.

Table 2-8. Switchboard 3SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-16/52 DS10	LC21 FDR TRIP	This amber lamp lights up when CB3208 (the LC21 FDR circuit breaker) is open.
2-16/53 DS11	LC21 FDR CLOSE	This blue lamp lights up when CB3208 (LC21 FDR circuit breaker) is closed.
2-16/54 DS18	A/C 3 TRIP	This amber lamp lights up when the NORMAL A/C CMPSR NO. 3 circuit breaker (CB3341) is open.
2-16/55 DS19	A/C 3 CLOSE	This blue lamp lights up when the NORMAL A/C CMPSR NO. 3 circuit breaker (CB3341) is closed.
2-16/56 DS44	CB3408	This amber lamp lights up when the STC 2 circuit breaker is open.
2-16/57 DS45	CB3408	This blue lamp lights up when the STC 2 circuit breaker is closed.
2-16/58 S2	CB3231	This 2-pole, momentary switch with pistol-grip handle, operates CB3231 (3SA/1SC bus tie circuit breaker). Rotating the switch to the left, from center off, will TRIP the circuit breaker. Conversely, rotating to the right will CLOSE the breaker.
2-16/59 DS7	CB3231 CLOSE	This blue lamp lights up when 3SA/1SC bus tie circuit breaker is closed. This indicates the power path is closed between switchboards 3SA and 1SC.
2-16/60 DS6	CB3231 TRIP	This amber lamp lights up when 3SA/1SC bus tie circuit breaker is open. This indicates the power path is open between switchboards 3SA and 1SC.
2-16/61 DS24	CB3231	This white lamp lights up when power is available at CB3231 located in switchboard 3SA.
2-16/62 S24	CONTROL XFR LOCAL/ REM	This 2-position switch selects the location where the switchboard system will be operated. In LOCAL it is controlled from switchboard 3SG. In REM (remote) it is controlled from the EPCC.
2-16/63 DS42	CONTROL XFR LOCAL	This white lamp lights up when the switchboard system controls are to be operated from the LOCAL (switchboard) location
2-16/64 DS43	CONTROL XFR REM	This white lamp lights up when the switchboard system controls are being operated from the EPCC.
2-16/65 S25	GND DET	This momentary (OFF), switch with pistol-grip handle is used to test the switchboard main bus for grounds.
2-16/66 S22	LOAD SHED	This switch has two operating positions. Rotating the switch from the extreme left (OFF) positions to STAGE 1 initiates load shed stage 1 as listed in table 2-17 . Positioning to STAGE 2 initiates load shed stage 2 as listed in table 2-17 . STAGE 2 breakers include all those in both Stages 1 and 2.
2-16/67 DS41	LOAD SHED OCCURRED STAGE 2	This amber lamp lights up when LOAD SHED STAGE 2 has occurred.
2-16/68 DS40	LOAD SHED OCCURRED STAGE 1	This amber lamp lights up when LOAD SHED STAGE 1 has occurred.
2-16/69, 70, 71 DS26, DS27, DS28	GND DET	Under normal operating conditions these three clear lamps light up equally any time the switchboard main bus is energized.
2-16/72 DS38	GOVERNOR ISO/ DROOP ISOCH	This green lamp lights up when the Governor on the generator is in the ISOCH (isochronous) mode.
2-16/73 DS31	SYNCH MON MODE SEL ON	This white lamp lights up when the Synchronizing Monitor Mode Select switch is in the normal OPERATE position.

Table 2-8. Switchboard 3SG Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-16/74 DS29	SYNCH MON MODE SEL TEST	This white lamp lights up when the Synchronizing Monitor Mode Select switch is on the TEST position.
2-16/75 M5	BUS VOLTS	This meter indicates the voltage on the bus specified by switch (S17).
2-16/76 S17	BUS METER Select	This 4-position switch selects the Main Bus which will be monitored during the paralleling operations. The positions are as follows: OFF, 3S-2S allows the voltage to be monitored on the 3S/2S bus tie. 3S allows the voltage to be monitored on the 3S bus, 3S-1S allows the voltage to be monitored on the 3S/1S bus tie.
2-16/77 S19	CKT BREAKER & Synch Select	This 4-position switch selects the Main Bus to which the Generator 1SG will be synchronized. Off takes the switchboard and associated circuitry off-line. 3S-2S selects the comparison of bus line phase differences between the 3S bus and that of the 3S/2S bus tie. 3S-GEN selects the comparison of bus line phase differences between the 3S bus and that of SSGTG No. 3. 3S-1S selects the comparison bus line phase differences between the 3S bus and that of the 3S/1S bus tie.
2-16/78, 79 DS1, DS2	SYNCHRONIZATION	These two clear lamps are connected into circuits along with the synchroscope. When lit, they indicate the out-of-phase voltages between oncoming (generator) and bus. They are dimmed when the two voltages are in-phase.
2-16/80 M6	GENERATOR GEN FREQ	This meter indicates the frequency of Generator 3SG.
2-16/81 M7	BUS FREQ	This meter indicates the frequency of the bus specified by switch (S17).
2-16/82 M11	SYNCHRONIZATION SYNCH SCOPE	This meter indicates the phase difference of the two selected switchboard systems so they can be paralleled.
2-16/83 S42	FAULT CURRENT DET MODE SEL OPERATE/ TEST	This multipole rotary switch with oval shank knob allows the FCD to be in one of two modes: OPERATE or TEST. The center position selects the TEST mode of the FCD. Rotating the switch to the left selects the OPERATE mode of the FCD.
2-16/84 DS48	FAULT CURRENT DET MODE SEL OPERATE	This white lamp lights up when the FCD is in the OPERATE mode.
2-16/85 DS49	FAULT CURRENT DET MODE SEL TEST	This amber lamp lights up when the FCD is in the TEST mode.
2-17/1, 2 CB3102, CB3103	CASUALTY POWER BREAKER	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for CASUALTY POWER. It is physically located on the rear panel of switchboard 3S.
2-17/3, 4	CASUALTY POWER TERMINALS	These terminals are used to connect power from the CASUALTY POWER BREAKERS (CB3102 & CB3103). They are physically located on the external rear panel of switchboard 3S.
2-17/5 CB3101	GEN 3SG SW COOLING PUMP 3S-4P-V	This 100 amp frame, 15 amp instantaneous trip molded case breaker provides power and protection for the GEN 3SG SW CLG PUMP. It is physically located in the middle right side of switchboard 3S.
2-17/6 CB3130	SHIP'S SERVICE GEN- ERATOR 3SG 3SG-4P-3S	This 400 amp frame, 4,000 amp trip air circuit breaker feeds the switchboard 3S Main Bus from the output of Gen 3S. It is physically located in the bottom right corner of switchboard 3S.

Table 2-9. Switchboard 3SA Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-18/1 CB3201	FIRE PUMP NO. 3 3S-4P-C (ALTN)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 3.
2-18/2 CB3210	LAUNDRY 3S-4P-(2-417-2)	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for LAUNDRY.
2-18/3 CB3211	ER 2 NON-VITAL PNL 3 3S-4P-(3-254-2)	This 250 amp frame, 175 amp trip molded case breaker provides power for protection for ER 2 NON-VITAL PNL 3.
2-18/4 CB3214	(BLANK)	This 250 amp frame, 150 amp trip molded case breaker provided as a spare.
2-18/5 CB3215	(BLANK)	This 250 amp frame, 225 amp trip molded case breaker provides as a spare.
2-18/5 CB3215	PWR PNL 2-223-1 NON-VITAL TRASH DISPOSAL RM 3S-4P- (2-223-1)	This 250 amp frame, 225 amp trip molded case breaker provides power and protection for Trash Disposal Rm Non-Vital (Applicable to Ships with SHIPALT 51-00159K installed).
2-18/6 CB3207	B-SIZE MODULE 3S-4WP-R (NORM)	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for B-SIZE MODULE.
2-18/7 CB3212	AMR NO. 2 VITAL 3S-4P-(4- 232-2) NORM	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for AMR NO. 2 VITAL.
2-18/8 CB3213	NON-VITAL AUX ZONE 4 3S-4P-(2-418-1)	This 400 amp frame, 300 amp trip molded case breaker provides power and protection for NON-VITAL AUX ZONE 4.
2-18/9 CB3208	LOAD CENTER 21 3S-4P-LC21	This 3,200 amp frame, 3,200 amp trip large air circuit breaker provides power and protection for LC21.
2-18/10 CB3231	3S/1S BUS TIE 1S-4P-3S	This 4,000 amp frame, 4,000 amp trip circuit breaker converts the Main Bus between switchboard 1SC and 3SA.
2-18/11 CB3209	120V LTG LC33 3S-4L-LC33 (NORM)	This 250 amp frame, 150 amp trip molded case breaker provides power and protection for 120 VOLT LTG LC33.
2-18/12 CB3206	AIR COND MCHRY & POMP RM-VITAL 3S-4P-(4-308-1) NORM	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for AC MCHRY & PUMP RM-VITAL.
2-18/13 CB3205	CREW/CPO GALLEY PNL 2 3S-4P-(1-219-11)	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for CREW/CPO GALLEY PNL 2.
2-18/14 CB3202	450V RADAR RM NO. 3 3S-4P-(01-279-1) NORM	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for RADAR RM NO. 3.
2-18/15 CB3203	STEERING PNL NO. 1 3S-4P- (3-442-1) NORM	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for STEERING PNL 1.
2-18/16 CB3204	CREW/CPO GALLEY PNL 1-3S-4P-(1-219-9)	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for CREW/CPO GALLEY PNL 1.

Table 2-10. Switchboard 3SB Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-19/1 CB3302	AFFF STA NO. 2 3S-4P-(1- 329-1) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for AFFF STA NO. 2
2-19/2 CB3306	CL X PREHTR ENG RM NO. 2 3S-4P-N(1)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for CL X PREHTR ER NO. 2.
2-19/3 CB3304	CL X PREHTR ENG RM NO. 2 3S-4P-M(1)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for CL X PREHTR ER NO. 2.
2-19/4 CB3308	450V TACTAS & BATHYTHERMOGRAPH RM 3S-4P-(2-447-1) NORM	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 450V TACTAS & BATHYTHERMOGRAPH RM.

Table 2-10. Switchboard 3SB Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-19/5 CB3310	120V CCS & DC CENTRAL 3S-4P-(1-268-1) NORM	This 100 amp frame, 25 amp trip molded case breaker provides power and protection for 120V CCS & DC CENTRAL.
2-19/6 CB3312	VITAL AUX ZONE 4 3S-4P-(2-392-1) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for VITAL AUX ZONE 4.
2-19/7 3SB-DS2	AIR COND CPRSR NO. 3 BREAKER CLOSED	This blue lamp lights up when AIR COND CPRSR NO. 3 BREAKER is closed.
2-19/8 CB3341	AIR COND CPRSR NO. 3 3S-4P-G (NORM)	This 400 amp frame, 300 amp trip molded case breaker provides power and protection for AIR COND CPRSR NO. 3.
2-19/9 CB3342	AIR COND CPRSR NO. 4 3S-4P-H (NORM)	This 400 amp frame, 300 amp trip molded case breaker provides power and protection for AIR COND CPRSR NO. 4.
2-19/10 3SB-DS3	AIR COND CPRSR NO. 4 BREAKER CLOSED	This blue lamp lights up when AIR COND CPRSR NO. 4 BREAKER is closed.
2-19/11 CBS 340	AIR COND CPRSR NO. 2 3S-4P-F (NORM)	This 400 amp frame, 300 amp trip molded case breaker provides power and protection for AIR COND CPRSR NO. 2.
2-19/12 3SB-DS1	AIR COND CPRSR NO. 2 BREAKER CLOSED	This blue lamp lights up when AIR COND CPRSR NO. 2 BREAKER is closed.
2-19/13 CB3311	VITAL AUX ZONE 3 3S-4P-(1-284-1) NORM	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for VITAL AUX ZONE 3.
2-19/14 CB3309	GEN RM VITAL 3S-4P-(3-380-1) NORM	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for GEN RM VITAL.
2-19/15 CB3307	450V COMBAT SYS EQPT RM NO. 3 PNL 2 3S-4P-(1-301-1) ALTN	This 100 amp frame, 75 amp trip molded case breaker provides ALTERNATE power and protection for 450V COMBAT SYS EQPT RM NO. 3 PNL 2.
2-19/16 CB3305	450V IC & GYRO RM NO. 2 3S-4P-(3-318-2) NORM	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for 450V IC & GYRO RM NO. 2.
2-19/17 CB3303	CL X PREHTR AUX MCHRY RM NO. 2 3S-4P-L(1)	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for CL X PREHTR AMR NO. 2.
2-19/18 CB3301	AFFF STA NO. 1 3S-4P-(1-65-1) ALTN	This 100 amp frame, 50 amp trip molded case breaker provides power and protection for AFFF STA NO. 1.
2-19/19 CB3334	FUEL XFER HTR NO. 2 3S-4P- K(1)	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for FUEL XFER HTR NO. 2
2-19/20 CB3335	(BLANK)	This 400 amp frame, 300 amp trip molded case breaker is provided as a spare.
2-19/21 CB3337	ER NO. 2 VITAL PNL 2 3S-4P- (3-258-1) NORM	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for ER NO. 2 VITAL PNL 2.
2-19/22 CB3339	ER NO. 2 NON VITAL PNL 1 3S-4P-(4-295-1)	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for ER NO. 2 NON-VITAL PNL 1.
2-19/23 CB3338	ENG RM NO. 2 PNL 3 - VITAL 3S-4P-(3-256-2) NORM	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for ENG RM NO. 2 VITAL PNL 3.
2-19/24 CB3336	ER NO. 2 VITAL PNL 1 3S-4P- (3-292-1) NORM	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for ER NO. 2 VITAL PNL 1.
2-19/25 CB3315	CL Z VENT ZONE 3 PNL 1 3S-4P-(1-326-1)	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for CL Z VENT ZONE 3 PNL NO. 1.
2-19/26 CB3313	CL W VENT ZONE 3 3S-4P- (01-248-1) NORM	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for CL W VENT ZONE 3.
2-19/27 CB3314	CL W & CIR X VENT ZONE 4 3S -4P-(01-312-2) NORM	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for CL V & CL X VENT ZONE 4.
2-19/28 CB3316	CL Z VENT ZONE 4 3S-4P-(2-394-2)	This 100 amp frame, 75 amp trip molded case breaker provides power and protection for CL Z VENT ZONE 4.

Table 2-10. Switchboard 3SB Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-19/29 CB3318	CL Z VENT ZONE 3 PNL NO. 3 3S-4P-(2-359-1)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for CL Z VENT ZONE 3 PNL NO. 3.
2-19/30 CB3320	120V LTG LC41 3S-4L-LC41 (NORM)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 120V LTC LC41.
2-19/31 CB3322	(BLANK)	This 100 amp frame, 50 amp trip molded case breaker is provided as a spare.
2-19/32 CB3324	(BLANK)	This 100 amp frame, 100 amp trip molded case breaker is provided as a spare.
2-19/33 CB3326	FIRE PUMP NO. 5 3S-4P-A (NORM)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 5.
2-19/34 CB3327	CL W RECIRC & MISC AUX ZONE 3 3S-4P-(1-281-) NORM	This 250 amp frame. 150 amp trip molded case breaker provides power and protection for CL W RECIRC & MISC AUX ZONE 3.
2-19/35 CB3330	450V COMBAT SYS EQPT RM NO. 3 PNL 1 3S-4P-(1-302-2) NORM	This 250 amp frame. 175 amp trip molded case breaker provides NORMAL power and protection for 450V COMBAT SYS EQPT RM No. 3 PNL 1.
2-19/36 CB3329	NON-VITAL AUX ZONE 3 3S-4P-(2-316-2)	This 250 amp frame. 225 amp trip molded case breaker provides power and protection for NON-VITAL AUX ZONE 3.
2-19/37 CB3328	CL W RECIRC & MISC AUX Zone 4 3S-4P-2-422-1) NORM	This 250 amp frame, 125 amp, 150 amp DDG 52 and follow trip molded case breaker provides power and protection for CL W RECIRC & MISC AUX ZONE 4.
2-19/38 CB3325	FIRE PUMP NO. 4 3S-4P-D (NORM)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 4.
2-19/39 CB3347	120V LTG LC34 3S-4L-LC34 (NORM)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 120V LTG LC34.
2-19/40 CB3323	(BLANK)	This amp frame, 75 amp trip molded case breaker is provided as a spare.
2-19/41 CB3321	120V LTG LC32 3S-4L-LC32 (NORM)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 120 VOLT LTG LC32.
2-19/42 CB3319	120V LTG LC25 3S-4L-LC25	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for 120V LTG LC25.
2-19/43 CB3345	CL W VENT B SIZE MODULE	This 100 amp frame, 75 amp trip (100 amp, DDG 52 to54) trip molded case breaker provides power and protection for CL W VENT B MODULE.
2-19/44 CB3346	A SIZE MODULE (BACKUP)	This 100 amp frame, 25 amp trip molded case breaker provides power and protection for A SIZE MODULE (BACKUP).
2-19/45 CB3317	CL Z VENT ZONE 3 PNL NO. 2 3S-4P-(1-326-2)	This 100 amp frame, 100 amp trip molded case breaker provides power and protection for CL Z VENT ZONE 3 PNL NO. 2.

Table 2-11. Switchboard 3SC Operating Controls and Indicators

Fig/Item	Front Panel Designation	Description
2-20/1 CB3407	LOAD CENTER 11 3S-4P-LC11	This 2,000 amp frame, 2,000 amp trip large air breaker provides power and protection for LC11.
2-20/2 CB3432	3S/2S BUS TIE 2S-4P-3S	This 4,000 amp frame, 4,000 amp trip circuit breaker connects the Main Bus between switchboards 3SC and 2SB.
2-20/3 CB3401	FIRE PUMP NO. 6 3S-4P-B (NORM)	This 250 amp frame, 175 amp trip molded case breaker provides power and protection for FIRE PUMP NO. 6.

Table 2-11. Switchboard 3SC Operating Controls and Indicators - Continued

Fig/Item	Front Panel Designation	Description
2-20/4 CB3402	STEERING PNL 2 3S-4P-(3-442-2) ALTN	This 250 amp frame, 250 amp trip molded case breaker provides power and protection for STEERING PNL 2.
2-20/5 CB3409	ER NO. 2 NON-VITAL PNL 2 3S-4P (4-282-1)	This 400 amp frame, 350 amp trip molded case breaker provides power and protection for ER NO. 2 NON-VITAL PNL 2.
2-20/6 CB3410	(BLANK)	This 400 amp frame, 350 amp trip molded case breaker is provided as a spare.
2-20/7 CB3408	STC 2 3S-4P-E (NORM)	This 1,600 amp frame, 800 amp trip large air breaker provides power and protection for STC 2.
2-20/8 CB3403	B SIZE MODULE 3S-4WP-J (NORM)	This 400 amp frame, 400 amp trip molded case breaker provides power and protection for B SIZE MODULE.
2-20/9 CB3404	450V CIWS CONTROL RM (AFT) 3S-4WP-(02-304-1) NORM	This 250 amp frame, 150 amp trip molded case breaker provides power and protection for 450V CIWS CONTROL RM (AFT).

2-4. ISOLATION OF SWITCHBOARDS

WARNING

Leave LOCAL/REMOTE Switch (S24) in LOCAL position when isolating switchboards via the bus tie breakers for maintenance. This action will not allow the EPCC or an online generator to accidentally power the main bus.

Isolation or addition of switchboard cabinets or switchboard groups may be obtained via two procedures. One is the use of BUS TIE circuit breakers; the other, Disconnect Links. See [figure 2-1](#) for location of these items.

2-4.1 BUS TIE BREAKERS. There are six bus tie circuit breakers that enable the three switchboard systems to be joined or isolated as required. When in local operation, these bus tie breakers may be operated from the control panels of switchboards 1SG, 2SG, and 3SG respectively. When in remote operation, the EPCC controls this operation.

2-4.2 DISCONNECT LINKS.

WARNING

Do not operate these devices when the Main Bus is energized. Be certain both the Generator Breaker and Bus Tie Breakers are tripped before operating.

Disconnect links are located both strategically and physically in the backs of the various cabinets and allow main bus power to be disconnected so as to isolate switchboard sections. These disconnect links should not be used except as semi-permanent disconnections for repair or switchboard section isolation. It should be noted that circuit breakers are available for temporary isolation. The disconnect links are located in back of the cabinets and

are operated by a special wrench handle also mounted on the rear door of that particular cabinet. Refer to [Chapter 5](#) for a procedure to manually disconnect links if necessary to shut down cabinets or systems for maintenance.

2-4.3 TO ISOLATE A SWITCHBOARD SECTION.

WARNING

With ship's service switchboard 1S isolated and SSGTG No. 1 shut down, there is still power present in the cabinets if there is power on the main bus.

The procedures provided are for the 1S switchboard. Procedures for the 2S and 3S switchboards are similar and are operated as such. See [figures 2-1 through 2-3](#). [Figures 2-4 and 2-5](#) show the controls for the 2S and 3S switchboards. For the following procedure, see [figure 2-3](#).

- a. On switchboard 1S, turn CONTROL XFR switch to LOCAL.
- b. Rotate CB1212 Switch (1S-2S BUS TIE BREAKER) to the TRIP position.
- c. Rotate CB1413 Switch (1S-3S BUS TIE BREAKER) to the TRIP position. This procedure, when performed, will isolate the Main Bus power connection to other switchboard sections.
- d. When the need to isolate the switchboard section is over, return CONTROL XFR switch to REM for EPCC control.

2-5. OTHER OPERATING CONTROLS ON SWITCHBOARDS

There are other operating controls on switchboards 1S and 3S that are not normally used in standard operating situations as outlined in [tables 2-12, 2-13, 2-14, 2-15, and 2-16](#). Some are used for testing and some are used in unusual operating situations. Others are switches that control circuit breakers for power distribution.

2-5.1 TURBINE GENERATOR CONTROLS. On the control panel of switchboard 1S, 2S, and 3S, there is a GEN TEMP meter (M3) (see [figure 2-2](#)) that monitors generator temperature in three locations on the generator stator. There is a 5-position switch marked TEMP METER (S18). In TEST, the meter pointer will move, indicating the meter is operational. When the switch position A, B, or C is used, the temperature meter will indicate the temperature in degrees Fahrenheit. All three temperature readings should be similar. If any one reading is unusually high, the turbine generator should be physically inspected with possible near-future shut down for maintenance.

2-5.1.1 Generator Space Heater. The GEN SPACE HEATER 2-position switch (S21) must be in ON position to furnish heat to the generator when the generator is not running so that moisture will not form within the generator. The GEN SPACE HEATER switch may be ON when the generator is running because an automatic contact in series with the switch will deenergize the heater.

2-5.1.2 Seawater Cooling Pump. The SEAWATER COOLING PUMP circuit breaker (CB1101, CB2101, and CB3101) should also be in CLOSED position at all times (unless pump is down for maintenance, etc.). Its power comes directly from the generator side so the pump should always start when the generator is energized and running. This is the only circuit breaker located on the upper right side of switchboard 1SG, 2SG, and 3SG. See [figures 2-7, 2-12, and 2-17](#).

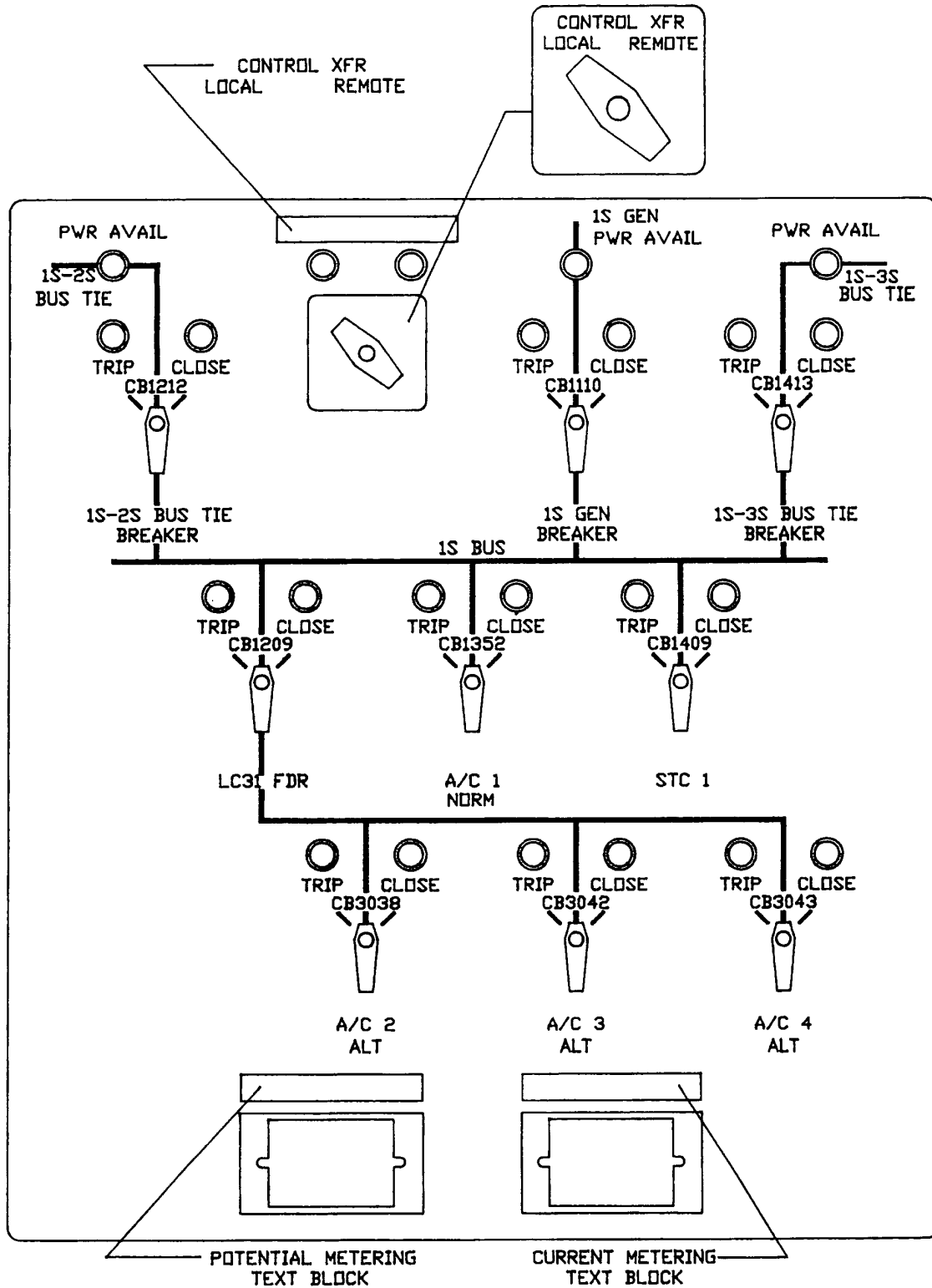


Figure 2-3. Switchboard 1SG, Generator Control Panel - Lower

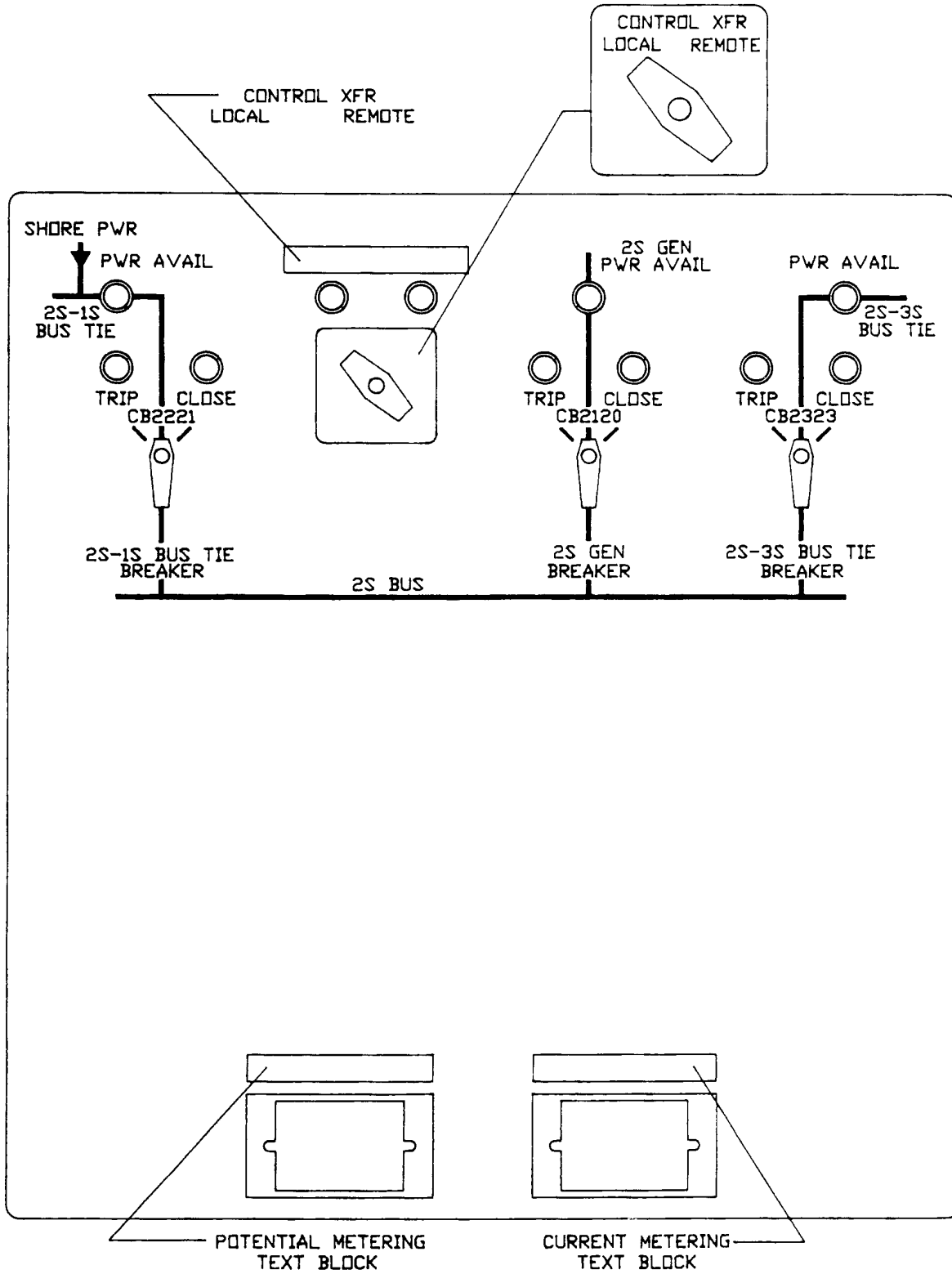


Figure 2-4. Switchboard 2SG, Generator Control Panel - Lower

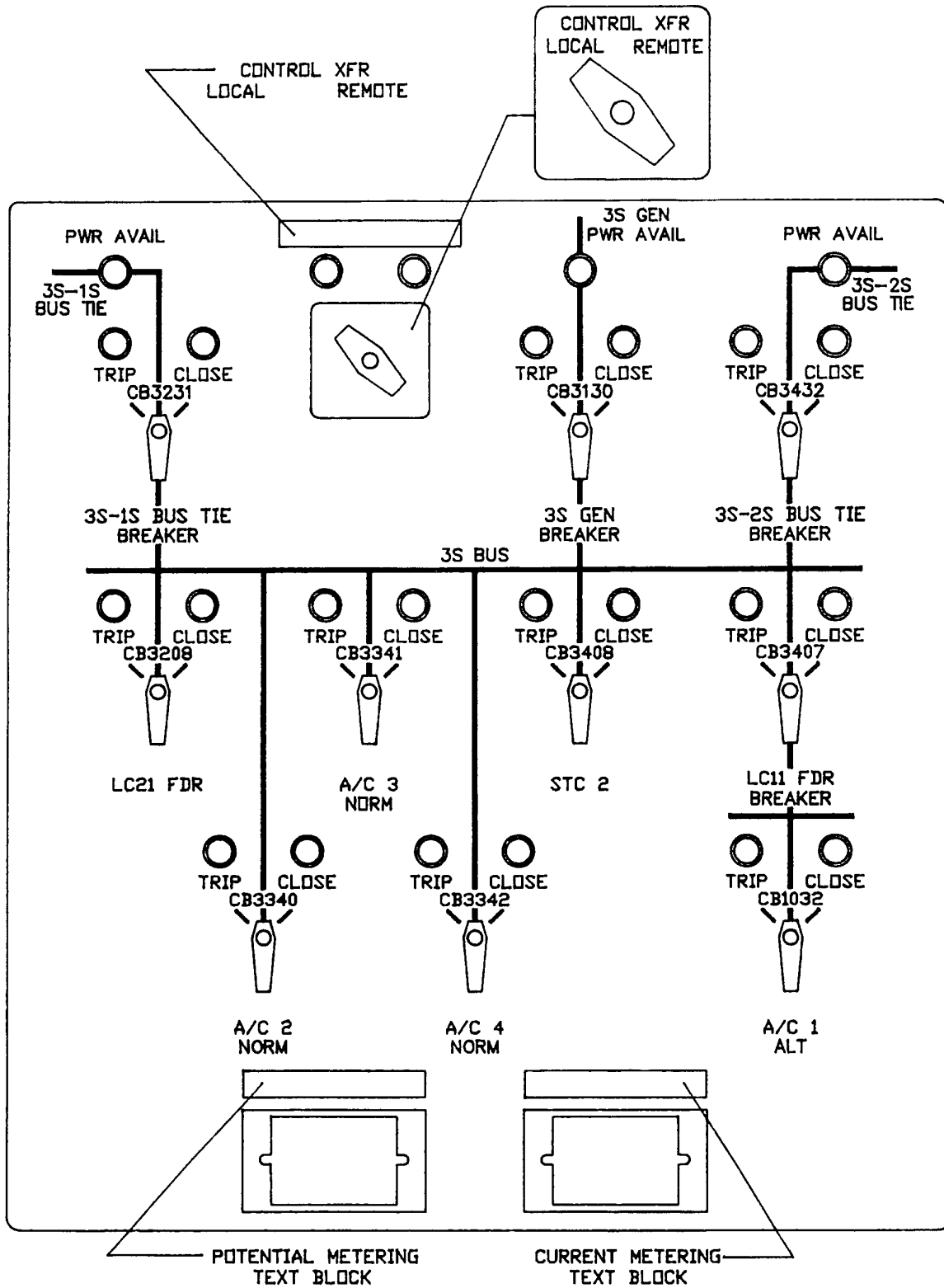


Figure 2-5. Switchboard 3SG, Generator Control Panel - Lower

2-5.1.3 ISO/DROOP Governor. The GOVERNOR ISO/DROOP control has two momentary switch positions, ISOCH and DROOP. In ISOCH position (shown with a green indicator), the generator automatically maintains frequency (and load) in tandem with other generator(s) on-line. In ISOCH or DROOP position, the GEN FREQ control can be lowered or raised so that the generator effectively transfers load with other on-line generators or shore power. When shore power control switch (S11 on switchboard 2SA) is closed, the GOVERNOR ISO/DROOP control automatically switches to DROOP position to avoid overloading ship's generators.

2-5.1.4 DIFF/DROOP Voltage Regulator. The VOLT REG DIFF/DROOP momentary switch (S14) has two positions, DIFF and DROOP. The DIFF position enables two or more paralleled generators to share a load without a decrease in voltage. This switch should normally be in DIFF (shown with a green light) position when the operator desires differential compensation. The DROOP position of the VOLT REG switch allows the associated generator to reduce its output voltage a few percent as its load is increased. Voltage Regulator Differential and Droop apply to Voltage Regulator Automatic mode with either AVR1 or AVR2 selected. Voltage Regulator DIFF is the normal mode. VR Droop is an operator selectable alternative. If Voltage Regulator DROOP position is selected, the associated amber indicator lights. When the generator is carrying a load by itself, or paralleled with another, a green light should show.

2-5.1.5 Voltage Regulator Mode Select. The VOLT REG MODE SEL (S13) is a 3-position switch with OFF, AUTO, and MAN positions. This switch normally is in the AUTO position when the generator is paralleled with another generator. Indicator (DS34) shows green. Manual is an emergency operating mode and should only be used if both Automatic Voltage Regulators have failed. Significant voltage change with generator load will occur when manual mode is selected. When manual is selected the same raise/lower switch used for Automatic Voltage Regulator control (S15) will also control the manual regulator. Significant DROOP will occur in manual mode so the operator will have to readjust as the ship load is changed. Indicator (DS35) shows amber when manual mode is selected. The automatic or manual voltage regulators cannot be remotely operator commanded deenergized when the switchboard is in remote. The EPCC operator can only select VR, DIFF, DROOP, and Manual.

CAUTION

When it is desired to deenergize the voltage regulators, stop the generator, place LOCOP LOCAL/REMOTE switch in LOCAL and place Voltage Regulator mode switch (S13) in the OFF position.

2-5.2 BUS TIE CONTROLS.

CAUTION

The BYPASS switch position allows an operator to place a generator directly on-line without the synchronization protective circuits. This procedure could possibly result in damage to the generator. It should be used only in an emergency or when no voltage is present on the bus.

The left side of the operating panel has a switch position called BYPASS on the SYNCH MON MODE SEL switch (S38) which may be used in certain alternative or emergency positions. This switch position is used to energize a dead bus tie from an energized bus tie. It can also be used if the synch monitor is not working. The switch (S33) is spring loaded from "BYPASS" to "OPERATE" and from "TEST" to "OFF" so the operator will have to hold the switch in either "BYPASS" or "TEST." The normal operating position is OPERATE. In TEST position, indicator (DS29) will light when synchronized. In OPERATE or BYPASS, white indicator (DS31) will

light. If bypassing the synchronization circuits becomes absolutely necessary, the operator may attempt to synchronize the generator manually with the on-line bus. This could create irregular voltage and current conditions detrimental to electronic equipment.

2-5.3 GROUND DETECTION. The GND DET switch (S25) and associated three indicators (DS26, DS27, DS28) may be used to detect a simple phase-to-ground fault in the TEST position. The three indicators read left to right as a problem in Phase A, Phase B, or Phase C. For example, a ground in Phase A will cause the left lamp to go out. With only one phase-to-ground fault, the switchboard system will continue to operate but maintenance personnel should investigate. This information is remoted to the EPCC via Analog Bus Ground Detector (A5).

NOTE

For ships without MACHALT 320-59006 (ECP-515) installed, fault current protection is provided by the Fault Current Detector (A6). For ships with MACHALT 320-59006 (ECP-515) installed, fault current protection is provided by a Generator Protection Module (GPM).

2-5.4 FAULT CURRENT DETECTION. The FAULT DETECTED red indicator light (DS30) goes on at the switchboard detecting a fault when a fault is detected in the main power distribution system. The fault is identified when a high load current on a generator occurs simultaneously with a drop in generator output frequency. Both conditions are necessary for the detection system to sense that a fault condition exists. This condition opens all bus tie circuit breakers with the following provision: Do not open the bus tie circuit breakers for the bus tie between switchboard 2S and the switchboard which has its generator circuit breaker open. When a fault condition occurs, the fault current detection circuit, at the switchboard detecting a fault, sends commands to latching relays which trip appropriate bus tie circuit breakers, thus isolating the fault. A signal is also sent to the other two switchboards which may trip other bus tie breakers based on plant configuration at the time a fault is detected. The latching relays activated by a fault detected also prevent bus tie breaker reclosure on the affected switchboard until local reset is activated. The BUS TIE INHIBIT indicator (DS32) glows amber on each switchboard affected by Fault Detector bus tie breaker trip logic. After the fault condition is corrected, the RESET pushbutton must be depressed at each affected switchboard resetting the latching relays thus restoring bus tie breaker closing control and turning off DS30 and DS32 indicators.

2-5.4.1 Fault Current Detection System in OPERATE Mode. When the FAULT CURRENT DET MODE SEL switch (S42) is in the OPERATE position, the fault current detector (A6 or GPM) is in OPERATE mode. In this mode, the FAULT DETECTED red indicator light (DS30) goes on at the switchboard detecting a fault when a fault is detected in the main power distribution system. The fault is identified when a high load current on a generator occurs simultaneously with a drop in generator output frequency. Both conditions are necessary for the detection system to sense that a fault condition exists. This condition opens all bus tie circuit breakers with the following provision: Do not open the bus tie circuit breakers for the bus tie between switchboard 2S and the switchboard which has its generator circuit breaker open. When a fault occurs, the fault current detector (A6 or GPM) at the switchboard detecting a fault, sends commands to latching relays which trip appropriate bus tie circuit breakers, thus isolating the fault. A signal is also sent to the other two switchboards which may trip other bus tie breakers based on plant configuration at the time a fault is detected. The latching relays activated by a detected fault also prevent bus tie breaker reclosure on the affected switchboard until local reset is activated. The BUS TIE INHIBIT indicator (DS32) glows amber on each switchboard affected by Fault Detector bus tie logic. After the fault condition is corrected, the RESET pushbutton must be depressed at each affected switchboard, resetting the latching relays and thus restoring bus tie breaker closing control and turning off DS30 and DS32 indicators.

2-5.4.2 Fault Current Detection Circuit in TEST Mode (Not applicable to ships with MACHALT 320-59006 (ECP-515) installed). When the FAULT CURRENT DET MODE SEL switch (S42) is in the TEST position the FCD is in TEST mode. In this mode, switch contacts change state to reconfigure the circuits that feed the inputs to the FCD's monitors. Two circuits are reconfigured: (1) the circuit that inputs information to the FCD's sensing for high load current, and (2) the circuit that inputs information to the FCD's sensing of generator output speed (frequency). The circuit for sensing high current is changed so that the FCD no longer senses the actual load current, but rather is prepared to sense a simulated high load current that is initiated by pressing the pushbutton on the front panel of the FCD's power Supply Module. (An oscillator in the FCD produces a voltage, to simulate the signal of high load current, whose magnitude is set to a level to be sensed by the FCD as a high load current by the proper adjustment of variable resistor R2.) The circuit for sensing generator output frequency is reconfigured by opening switch (S42) contacts which feed the actual generator output frequency to the FCD. As a result, the FCD senses a generator output speed of zero, which satisfies the fault current detected condition of the generator output frequency measuring less than 59 Hz. Thus, when the pushbutton on the front panel of the FCD's Power Supply Module is pressed, the FCD senses a simulated high load current. Since the FCD is already measuring a simulated generator output frequency less than or equal to 59 Hz, both of the necessary conditions for the detection system to sense a fault current are met. Provided that all generator bus tie breakers are closed during the test and that the generator under test is on-line, the results of the test will be the same as the results of an actual fault as described in [paragraph 2-5.4.1](#).

2-5.4.3 Fault Current Detection Circuit in TEST Mode (Applicable to ships with MACHALT 320-59006 (ECP-515) installed). When the FAULT CURRENT DET MODE SEL switch (S42) is in the TEST position, fault current protection will be initiated. Provided that all generator bus tie breakers are closed during the test and that the generator under test is on-line, the results of the test will be the same as the results of an actual fault as described in [paragraph 2-5.4.1](#).

2-5.5 LOAD SHED. There is a LOAD SHED switch (S22) on the front panels of switchboards 1SG, 2SG, and 3SG. This switch (S22) will allow manual load shed of non-vital loads. LOAD SHED STAGE 1 switch position will open circuit breakers specified in STAGE 1. STAGE 2 switch position will open circuit breakers specified in STAGE 2. Any one of these switches will shed loads from switchboards 1S and 3S. Use of the manual LOAD SHED switches should be for emergency use only. After the use of the LOAD SHED switch, affected circuit breakers in switchboards 1S and 3S must be closed manually. For circuit breakers affected by the LOAD SHED circuit, refer to [table 2-17](#). During load shed, the VLS and AN/SPY-ID anti-icing heaters will deenergize. Also during load shed, breakers are tripped in the load centers.

2-5.5.1 Manual Load Shed. To manually shed non-vital power loads in order, see [figure 2-6](#), [2-11](#), and [2-16](#), and proceed as follows:

CAUTION

Load shed trips distribution circuit breakers in both ship's service switchboards 1S and 3S from any LOAD SHED switch.

NOTE

Distribution circuit breakers tripped by LOAD SHED must be manually closed on switchboards 1S and 3S.

- a. Turn LOAD SHED switch (S22) to STAGE 1. Indicator OCCURRED light (DS40) will glow amber when all Stage 1 breakers trip.
- b. If necessary, the LOAD SHED switch may be turned to STAGE 2. Indicator OCCURRED light (DS41) glows amber when all Stage 2 breakers trip. This cuts off more load. STAGE 2 LOAD SHED should be used only for the minimum time necessary to get ship's generator capacity back on-line.
- c. The LOAD SHED switch will spring return back to central or neutral position.

NOTE

For ships without MACHALT 320-59006 (ECP-515) installed, overpower sensing is provided by the AC Power Sensing Relay Module (A3a). For ships with MACHALT 320-59006 (ECP-515) installed, overpower sensing is provided by the Generator Protection Module (GPM).

2-5.5.2 Automatic Load Shed. There are automatic protective circuits that operate to shed first stage load in 90 to 100 milliseconds and second stage load within a preset level between zero and 39 seconds. When an “overpower” condition exists or too much load is being drawn from the main bus, the overpower sensing circuit (A3a or GPM) sheds load automatically by energizing the required relays, which in turn, shed load in switchboards 1S and 3S. If the conditions still exist during a preset number of seconds, stage 2 load is shed. Current-time sensing Overcurrent Relay Module (A4) senses the overloaded condition of each of 12 shore power circuit breakers and will shed load immediately (with 700 percent overload) to minutes or hours during varying slow overload conditions. As with manual load shed, distribution breakers must be reset manually.

NOTE

For ships without MACHALT 320-59006 (ECP-515) installed, reverse power protection is provided by the Reverse Power Relay Module (A2). For ships with MACHALT 320-59006 (ECP-515) installed, reverse power protection is provided by the Generator Protection Module (GPM).

2-5.6 Reverse Power Protection. If a turbine generator is not operating properly to generate the required output, the reverse power protection circuit (A2 or GPM) will sense this condition and automatically open its generator circuit breaker (CB1110, or CB2120, or CB3130) to protect the generator and prevent “motoring.” In certain Main Bus and generator configurations, this in turn could cause an overpower condition on the Main Bus which could result in load shed. Reverse power protection is inhibited for a short period when a bus tie breaker or generator breaker is commanded to close, to allow settling out during paralleling.

2-6. MIMIC BUS CIRCUIT BREAKERS

The Mimic Bus and its associated switches and circuit breakers enable the operator to tell at a glance the status of the Main Bus, its power availability, and the main circuit breakers associated with the bus tie. For instance, the three white indicators (DS24, DS23, and DS25) at the top of the mimic bus from left to right illuminate to indicate power available on the 1S-2S bus tie, power coming from Generator 1SG, and power available on the 1S-3S bus tie. The other two white indicators (DS42, DS43) show whether the switchboard is in local or remote control. The other indicator lights indicate whether the associated circuit breakers are tripped (amber) or closed (blue). Thus a quick glance at this panel shows power available at the bus ties, generator power avail-

able and status of main circuit breakers for load centers. Since power distribution is accomplished through ship's service switchboards 1S and 3S, ship's service switchboard 2S has only the bus tie circuit breakers, the SSGTG circuit breaker, and Shore Power breakers.

2-7. CASUALTY POWER

There are two 450 VAC, 250 amperes circuit breakers available on the rear of switchboards 1SG, 2SG, and 3SG marked CASUALTY POWER. They are directly connected on the generator side to each generator breaker. They are for ship use during emergency situations.

2-7.1 OPERATIONAL STATE OF CASUALTY POWER. During NORMAL operation, the breakers remain tripped. They furnish power directly from SSGTGs 1, 2, and 3 only if those generators are running. Ship's personnel may connect this power directly into certain distribution panels when necessary to bypass normal switchboard connections.

CAUTION

This power is nominally 450 VAC, 60 Hz, 3 Phase, 250 amperes, and should be connected only to specified equipment on distribution panels.

2-7.2 USAGE OF CASUALTY POWER. In an emergency or distressed situation, casualty power can be cabled from the rear of switchboards 1SG, 2SG, and 3SG to the following non-inclusive listed areas:

CAUTION

Sufficient load should be shed in these areas so that casualty power circuit breakers do not trip.

- a. Any main bus provided sufficient load is shed.
- b. Load centers LC11, LC21, LC31.
- c. Major areas such as STC1, STC2, A/C 1, A/C 2, A/C 3, A/C 4.

2-8. LOCAL CONTROL OF OPERATION

Operating procedures in this manual apply to the local operation of the switchboard systems with the CONTROL XFR switch on switchboards 1SG, 2SG, and 3SG in the LOCAL position. With these switches in the REMOTE (remote) position, the switchboards will be operated from the EPCC, but some of those procedures may not necessarily apply. Obviously, ship's power needs must be considered as a total package. The flexibility and capability of the three switchboards allow a number of different alternatives depending on ship's power requirements under various circumstances. Under worst case conditions, each switchboard, its generator and its load may be operated independently on a local basis. Configuration for operation is not the responsibility of this manual, therefore, shipboard procedures and practices dictate the configuration to be used. This manual deals with the general local operations which allow for the configuration of the system to meet the needs of the moment. The EPCC is not discussed since it is not included in the ship's service switchboards. Remote operation, if necessary, is referenced.

2-9. GENERATOR CONTROL

Generator start-up may be activated locally on the generator's ship service control board (1SG, 2SG, or 3SG). Since the three control boards are very similar, ship's service switchboard 1S is used as an example.

2-9.1 TURBINE GENERATOR START-UP. There are provisions for starting the associated SSGTG from the 1SG switchboard control panel. Refer to [table 2-12](#) and [figure 2-6](#). See [figure 2-11](#) and [figure 2-16](#) for 2SG and 3SG switchboards. In order for this procedure to work, one generator must be on-line and the Main Bus must be energized.

Table 2-12. SSGTG No. 1 Startup; Switchboard 1S Control

Step	Action	Result
(See figures 2-2 and 2-3) Conditions of Local Operation: Switchboard 1S Main Bus energized with SSGTG No. 2 or No. 3 on line. Determine that SSGTG No. 1 is ready to start by physical inspection. All main bus disconnect links are closed (see figure 2-1 and paragraph 5-3); 1S GEN PWR AVAIL light (DS23) out; CB1110 in TRIP position.		
1.	Place CONTROL XFR (S24) in LOCAL position.	White indicator (DS42) lit.
<p>CAUTION</p> <p>SEAWATER COOLING PUMP (CB1101, or 2101, or 3101) breakers receive power from the line side of their respective generator circuit breaker and must remain closed when the generator is running. Failure to leave these breakers closed will secure turbine generator cooling water.</p>		
2.	Ensure SEAWATER COOLING PUMP (CB1101) is closed (this is the only circuit breaker on the upper right panel of switchboard 1S).	Cooling water will flow to the associated SSGTG once it is started.
3.	Ensure CASUALTY POWER BREAKERS (CB1102 and 1103) are open.	CASUALTY POWER BREAKERS are only used to furnish power under casualty conditions.
4.	Turn CKT BREAKER & SYNC SELECT switch (S19) to OFF.	
5.	Turn SYNC MON MODE SEL switch (S38) to OFF.	
6.	Turn BUS METER SELECT switch (S17) to OFF.	No meter indications on synchronizing panel (left side of control panel).
7.	Turn GOVERNOR ISO/DROOP switch (S20) to ISOCH.	Green indicator (DS38) lit.
8.	Turn VOLT REG SELECT switch (S31) to VR1.	Either VR1 or VR2 as determined by ship's operating procedures (one VR is a back-up).
9.	Turn VOLT REG MODE SEL switch (S13) to AUTO.	Green indicator (DS34) lit.
10.	Turn VOLT REG DIFF/DROOP switch (S14) to DIFF.	Green indicator (DS37) lit.
11.	Recheck the three green indicators DS34, DS37, & DS38 on Generator panel for illumination.	It is recommended that someone monitor the generator locally.
12.	Verify green Generator Ready to Start indicator (DS33) is lit.	The turbine generator is now ready to start.
13.	Depress momentary START pushbutton (PB1101).	Turbine generator starts. GEN FREQ meter (M6) reads approximately 60 Hz.
14.	The following actions are interdependent. After SSGTG No. 1 stabilizes, adjust GEN VOLTS switch (S15) to 450 volts and adjust GEN FREQ switch (S16) to 60 Hz.	GEN VOLTS meter (M4) reads 450 volts \pm 10 volts. GEN FREQ meter (M6) reads 60 Hz \pm 0.2 Hz.
15.	Check temperature of stator at three places by turning TEMPERATURE switch (S18) alternately to A, B, C.	GEN TEMP meter (M3) will read generator temperature at three stator locations. All three readings should be approximately equal.

Table 2-12. SSGTG No. 1 Startup; Switchboard 1SG Control - Continued

Step	Action	Result
16.	SSGTG No. 1 is running and ready to be synchronized with the Main Bus and placed on-line.	Refer to paragraph 2-9.2

2-9.2 SYNCHRONIZING OFF-LINE GENERATOR WITH MAIN BUS. This procedure synchronizes the output of the off-line generator with the Main Bus and allows the off-line generator to be placed on-line. In this situation, two or three generators would share the load automatically. This would allow one or more generators to be taken off-line for maintenance or repair. The following procedure is typical and uses switchboard 1SG. This procedure would be similar in synchronizing ship's generators with shore power. It is valid for any of the generators with the exception of the nomenclature of the BUS METER SELECT and CRT BREAKER & SYNCH SELECT switch positions and circuit breakers (see [figures 2-6, 2-11, 2-16](#), and [table 2-13](#)).

Table 2-13. Synchronizing Off-Line Generator With Main Bus

Step	Action	Result
(See figures 2-2 and 2-3) Conditions: Main Bus energized by ship's power. CONTROL XFR switch (S24) in LOCAL position. SSGTG No. 1 running with power available indicator (DS23) illuminated.		
1.	Check that GOVERNOR ISO/DROOP switch (S20) is in ISOCH position, VOLT REG MODE SEL switch (S13) is in AUTO position, and VOLT REG DIFF/DROOP switch (S14) is in DIFF position.	Green indicators (DS38, DS34, DS37) are lit.
2.	Turn SYNCH SELECT switch (S19) to 1S GEN.	SYNCHRONIZATION SYNCH SCOPE (M11) and clear indicator lights (DS1 and DS2) will reflect phase differences between Main Bus and SSGTG. When lights are brightest, phase differences are greatest. The rate of lamps flashing on and off is proportional to the difference in frequency of the Main Bus and the SSGTG.
3.	Turn BUS METER SELECT switch (S17) to 1S BUS.	Voltmeter (M5) will read Main Bus voltage. Frequency meter (M7) will read Main Bus frequency.
4.	Turn SYNCH MON MODE SEL switch (S38) to OPERATE.	White indicator (DS31) lit.
5.	Turn GEN VOLTS switch (S15) to LOWER or RAISE for adjusting SSGTG voltage to match Main Bus voltage.	GEN VOLTS meter (M4) should match Main Bus VOLTS meter (M5) reading.
6.	Turn GEN FREQ switch (S16) to LOWER or RAISE for adjusting SSGTG frequency to match Main Bus frequency.	GEN FREQ meter (M6) should match Main Bus FREQ meter (M7). SYNC SCOPE meter (M11) pointer rotates slowly clockwise (CW).
7.	Observe SYNCH SCOPE (M11) and synchronization indicator lights (DS1 DS2). When the pointer on the SYNCH SCOPE points to 12 o'clock and the synchronization indicators dim, generator and bus frequencies are in phase. However, when the pointer reaches 11 o'clock going slowly CW, the phases are close enough to connect the SSGTG to the bus.	If the phases are not close enough to synchronize automatically when SSGTG No. 1 is switched on-line, the circuit breaker will automatically trip or not close. Adjust GEN FREQ carefully and try again.
8.	Close CB1110 momentary switch (S1) when phase match is achieved at approximately the 11 o'clock position.	CB1110 switch (S1) shows blue (closed) indicator (DS5) lit, and amber (trip) indicator (DS4) is extinguished. After SSGTG is on-line, the Main Bus Load will be shared automatically by the generators.

Table 2-13. Synchronizing Off-Line Generator With Main Bus - Continued

Step	Action	Result
9.	Check Generator Ammeter (M1), Wattmeter (M8), and Frequency Meter (M6).	Meters will reflect load and frequency of SSGTG.
10.	Check 1S Bus Frequency Meter (M7), and Voltmeter (M5).	Should read identically with Generator Frequency Meter (M6) and Voltmeter (M4).
	Check BUS TIE Ammeter (M2) and Generator Ammeter (M1).	Generator ammeter (M1) should be proportional to bus tie ammeter. If two generators are on-line, Generator ammeter should read approximately the same as the other on-line generator.
11.	Turn BUS METER SELECT switch to OFF (S17). Turn SYNCH SELECT switch to OFF (S19).	SYNCH SCOPE (M11) is deenergized.
12.	Turn CONTROL XFR switch (S24) to REM.	White Remote Control Indicator (DS43) illuminates. White Local Control Indicator (DS42) is extinguished. Control is transferred to EPCC.

2-9.3 STOPPING ONE TURBINE GENERATOR. With any combination of generators in parallel, the total capacity of the generator may not be needed during times of reduced load. It may also be desirable to place a generator off-line for maintenance. The following procedure, in [table 2-14](#), uses Generator 1SG as a typical example (see [figures 2-6](#), [2-11](#), and [2-16](#)).

Table 2-14. Stopping One Turbine Generator

Step	Action	Result
(See figures 2-2 and 2-3) Conditions: Main Bus energized by SSGTG No. 1 and SSGTG No. 3; Local Operation.		
1.	Turn CONTROL XFR switch (S24) to LOCAL.	White Local Control Indicator (DS42) lit. White Remote Control Indicator (DS43) is extinguished.
2.	Turn BUS METER SELECT switch (S20) to 1S BUS. Turn VOLT REG MOD SEL switch (S13) to MAN. Turn VOLT REG DIFF/DROOP switch (S14) to DROOP.	Bus Ammeter (M2) shows 1SG BUS amperage. Amber indicator lamps (DS35, DS36) are lit.
3.	Turn GEN FREQ switch (S16) to LOWER to remove most of the load from the SSGTG.	Observe Frequency Meter (M7) and adjust frequency to lowest level allowed by ship's procedures before dropping out. GEN Wattmeter (M8) and GEN Ammeter (M1) show decreasing values. GEN Ammeter (M1) reaches minimum above 0.
4.	Trip CB1110 switch (S1).	Blue indicator (DS5) extinguishes. Amber indicator (DS4) lights.
5.	Read BUS TIE AMMETER (M2).	BUS TIE AMMETER (M2) should show load on 1S Bus.
6.	Depress the momentary STOP pushbutton (PB1102).	SSGTG shuts down.
CAUTION		
The generator space heater must be on after shutdown to prevent condensation. When a turbine generator is started, the associated heating circuit is automatically disabled.		
7.	Turn GEN SPACE HEATER switch (S21) to ON.	White indicator (DS22) lit.
8.	Turn BUS METER SELECT switch (S17) to OFF.	Disables BUS meters. White Remote Control Indicator (DS43) is lit. White Local Control Indicator (DS42) is extinguished.

Table 2-14. Stopping One Turbine Generator - Continued

Step	Action	Result
9.	Return CONTROL XFR switch (S24) to REM.	Remote control of switchboard is possible.

2-10. CONNECTING SHORE POWER TO SHIP

Ship's service switchboard 2S has the facilities for connecting shore power to the ship. There are 12 circuit breakers located in switchboard 2SA (see [figure 2-13](#)), each capable of handling 450 VAC, 3 Phase, 60 Hz, 400 amperes. Shore power control switch (S11) can trip or close all 12 shore power breakers simultaneously. There are provisions for checking the phase of each leg of shore power so the correct leg will be connected to ship's power. The operator of the EPCC should designate how many circuit breakers should be used, depending on how much power the ship requires at the dock. When switching to shore power, an announcement over the P.A. system should be made so that electronic and computerized systems can be shut down briefly to avoid losing memory if transients occur.

2-10.1 MATCHING SHIP'S POWER TO SHORE POWER. The basic method used in connecting to shore power involves matching ship's power to shore power. First, shore power cables should be connected to the required number of ship's shore power receptacles. Then, the phase sequence of the cable connections must be checked to determine that Phase A of shore power is connected to Phase A on all connections, Phase B to B and Phase C to C. Assuming ship's power is furnished by either Generators 1SG and/or 3SG, circuit breakers 1212 and 2221 will be tripped to isolate shore power. This can be accomplished with a switch from a panel in switchboard 2SA. Ship's power must be synchronized to shore power. The load can then be shifted to shore power and Generators 1SG and/or 3SG can be shut down. For step-by-step procedures, refer to [table 2-15](#) and [figure 2-13](#), [figure 2-11](#), [figure 2-6](#) for switchboards 2SA, 2SG, and 1SG. Assume SSGTG No. 1 is furnishing power for the Main Bus and SSGTG No. 2 and 3 are secured.

If SSGTG No. 3 is running, first isolate ship's service switchboard 3S from ship's service switchboard 1S by tripping circuit breaker CB3231. Isolation can also be accomplished by tripping the 1S-3S bus tie breaker (CB1413). The procedure would then be to synchronize SSGTG No. 1 with shore power, supply the 1S-2S bus from shore power, and then shut down SSGTG No. 1. The next step would be to synchronize SSGTG No. 3 with the 3S-1S bus using the procedure in [table 2-13](#). Then, SSGTG No. 3 would be shut down using the procedure in [table 2-14](#).

Table 2-15. Connecting Shore Power to Ship

Step	Action	Result
(See figures 2-2 through 2-5 , 2-14 and 2-21) Conditions: Main bus energized by SSGTG No. 1 in a ring bus configuration; SSGTG No. 2 and 3 are shut down. All shore power circuit breakers are tripped. Shore power receptacles energized at switchboard 2SA with amber indicators DS1, DS4, DS7, DS10, DS13, DS16, DS19, DS22, DS25, DS28, DS31, and DS34 illuminated.		
1.	On switchboard 2SG, turn CONTROL XFR switch (S24) to LOCAL.	White Local Control Indicator (DS42) lit. White Remote Control Indicator (DS43) extinguished.
2.	On switchboard 2SB, TRIP CB2323 switch (S3).	Blue 2S-3S bus tie breaker closed indicator (DS9) on switchboard 2SG, and blue 2S-3S bus tie indication on switchboard 2SG are extinguished. White Power Available on 3S-2S bus tie indicator is extinguished. CB2323 switch (S3) amber indicating light (DS8) is lit.

Table 2-15. Connecting Shore Power to Ship - Continued

Step	Action	Result
3.	On switchboard 2SA, TRIP switch (S4).	BUS TIE ENERGIZED light (DS37), goes out. Bus tie breakers CB1212 (on 1SA) and CB2221 tripped on switchboard 2SG, PWR AVAIL indicator (DS24) goes out on switchboard 1SG, PWR AVAIL indicator (DS24) on switchboard 2SG goes out. 1S-2S bus tie breaker tripped indication is illuminated, closed indication is extinguished on switchboards 1SG and 2SG. 1S-2S bus tie closed indications extinguished on switchboards 1SA and 2SA.
4.	The following steps are required to check proper phase sequence and phase orientation of each energized shore power receptacle:	
	a. Rotate switch S27A and S28A to position 1 or the number corresponding to the first energized receptacle.	This circuitry is energized for reading phase sequence and phase orientation of that receptacle.
	b. Read the three Phase Seq meter lights (M9). These lights represent phases A, B, and C.	Illumination of each light shows that the phase is energized from shore power. All three lights should illuminate.
	c. Read the inset Phase Sequence section of PHASE SEQ meter (M9). The meter will indicate CORRECT or INCORRECT phase sequence.	A CORRECT meter reading signifies that the phase sequence is correct. If INCORRECT, remove associated shore power leads and reverse to remedy.
	d. Read the SHORE POWER PH REF lamps (DS38 and DS39).	The two green SHORE POWER PH REF indicators (DS38 and DS39) illuminate if the phase orientation is correct.
5.	Repeat step 4, items a through d for each energized shore power receptacle (2 through 6).	Phase rotation and phase orientation are checked for all energized shore power receptacles (2 through 6).
6.	Rotate switch S27A and S28A to "7-12" position. Substitute S27B for S27A and S28B for S28A. Repeat step 4, items a through d for each energized shore power receptacle (7 through 12).	Phase rotation and phase orientation are checked for all energized shore power receptacles (7 through 12).
7.	When all energized shore power receptacles have been checked, position switches S27A, S27B, S28A, and S28B to OFF.	Deenergizes the phase rotation and phase orientation circuitry.
8.	Rotate switch S11 CW to CLOSE position.	Shore Power available; respective blue indicator lights (DS2, DS5, DS8, DS11, DS14, DS17, DS20, DS23, DS26, DS29, DS32, DS35) are lit. BUS TIE ENERGIZED light (DS37) lights up. SHORE POWER PH REF INCMG (DS39) LIGHTS UP. White Power Available light for 1S-2S bus tie illuminates on switchboards 1SG and 2SG.
9.	Close CB2221 switch (S2) on switchboard 2S.	1S-2S bus tie breaker closed indicator is lit on switchboards 2SG and 2SA. 1S-2S bus tie breaker indicator is extinguished on switchboard 2SG.
	NOTE Ship's power must still be synchronized with Shore Power at switchboard 1S. Circuit breakers CB1212 and CB2323 are still tripped.	
10.	At switchboard 1S, turn CONTROL XFR switch (S24) to LOCAL.	Assume local control. White Local Control Indicator (DS42) illuminated, remote control indicator (DS43) extinguished on switchboard 1SG.
	NOTE For the remaining steps, an operator should be located at switchboard 1SG. All referenced switches are located on the 1SG Generator Control Panel (see figure 2-6).	

Table 2-15. Connecting Shore Power to Ship - Continued

Step	Action	Result
11.	Turn CKT BREAKER & SYNCH SELECT switch (S19) to 1S-2S.	SYNCHRONIZATION indicators (DS1, DS2) flicker.
12.	Turn BUS METER SELECT switch (S17) to 1S-2S.	Meters indicate 1S-2S bus tie volts, frequency and amps, respectively.
13.	Turn SYNCH MON MODE SEL switch (S38) to OPERATE.	
14.	Turn GOVERNOR ISO/DROOP switch (S20) to DROOP, VOLT REG MODE SEL switch (S13) to MAN, and VOLT REG DIFF/DROOP switch (S14) to DROOP.	Amber lights lit on all three switch positions.
15.	Turn GEN FREQ switch (S16) to LOWER/RAISE matching 1S-2S bus frequency. Turn GEN VOLTS switch (S15) to LOWER/RAISE for matching 1S-2S volts.	Match GEN FREQ meter (M6) with 1S-2S frequency (M7). Match voltmeters (M5) and (M4).
16.	When pointer on SYNCH SCOPE (M11) approaches 1 o'clock slowly in a counterclockwise (CCW) direction, CLOSE switch S2 which closes CB1212.	Shore Power comes on-line and shares load with Generator 1SG.
17.	Compare the BT AMPS meter (M2) with the GEN AMPS meter (M1).	Generator 1SG is sharing the load with Shore Power.
18.	On switchboard 2S, CLOSE CB2323 switch (S3).	Ring bus is achieved. If SSGTG No. 3 was running and isolated, repeat steps 9 through 17 but with 2S-3S bus tie breaker closed. Bus tie breaker indicator (DS9) is illuminated and trip indicator (DS8) is extinguished.
19.	To shut down SSGTG No. 1, turn GEN FREQ switch (S16) to LOWER on switchboard 1S.	GEN KW meter (M8) slowly drops to first numerical increment above zero on the meter scale. Check that GEN Ammeter (M1) decreases to first increment above zero.
20.	TRIP CB1110 switch (S1).	Amber indicator light (DS4) lit.
21.	Prepare SSGTG No. 1 for the next start.	
22.	TURN GEN FREQ switch (S16) to RAISE.	GEN FREQ meter (M6) reads 60 Hz \pm 0.2 Hz.
23.	TURN GEN VOLTS switch (S15) to RAISE.	GEN VOLTS meter (M4) shows 450 volts \pm 10 volts.
24.	Depress the momentary STOP pushbutton (PB1102).	SSGTG No. 1 shuts down.
25.	Turn GEN SPACE HEATER switch (S21) to ON.	Indicator (DS22) turns on.
26.	Turn CKT BREAKER & SYNCH SELECT switch (S19) to OFF, BUS METER SELECT switch (S17) to OFF, and SYNC MON MODE SELECT switch (S38) to OFF.	None
27.	Turn CONTROL XFR switch (S24) to REM.	Remote control indicator (DS43) is lit, and local control indicator (DS42) is extinguished. EPCC can assume control.

2-10.2 OVERCURRENT RELAY MODULE (A4). If the current required by the ship exceeds the value that will require the shore power circuit breakers (CB2201 through CB2212) to trip, an overcurrent sensing relay module (A4) is provided to automatically shed loads. The set point to trip and shed loads is an automatic function of the number of shore power breakers that are closed. In operating practice, at least one more circuit breaker (capable of 400 amperes) should be connected than is expected to be needed. If "load shed" occurs, it will be necessary to go through part of the shore power connection sequence again and cable in more capacity or decrease load.

2-10.3 STOPPING ONE TURBINE GENERATOR AFTER SWITCHING TO SHORE POWER. When it is desired to shut down one or more generators for any reason, the procedure for each switchboard is identical for the control panels of switchboards 1S, 2S, and 3S (refer to [table 2-15](#)).

2-10.4 TRANSFERRING FROM SHORE POWER TO SHIP'S POWER. When shifting load from shore power to ship's power, the procedure is almost the reverse of connecting shore power to the ship. It will be necessary to determine what additional power will be needed by the ship so that the necessary number of generators can be started to handle the load. With this information, ship's personnel will proceed to start the necessary turbine generator(s) and synchronize with shore power. The basic method for performing this operation is to start the generator(s), synchronize them with the Main Bus (shore power), decrease the shore power load, trip the shore power circuit breaker, and disconnect all shore power cables. [Table 2-16](#), and [figures 2-6](#), [2-13](#), and [2-14](#) detail a method of operation using switchboards 1S and 2SA.

Table 2-16. Transferring From Shore Power To Ship's Power

Step	Action	Result
(See figures 2-2 through 2-5 , 2-14 and 2-21) Conditions: LOCAL operation; Main Bus energized by shore power; turbine generators shut down. Electric plant operators must know how much power (or amps) is being consumed by the ship. Turbine generator(s) should be started that would be running at approximately 80 percent of expected load or some load shed may occur.		
1.	Check AMP SHORE POWER meter (M10) at switchboard 2SA or check similar meter at EPCC.	Comparison of power being used vs. generator capacity required.
2.	Start turbine generator(s) as necessary. Refer to table 2-12 .	Generator power available indicator (DS23) illuminated.
3.	Ensure that all bus tie circuit breakers are closed in accordance with desired configuration.	This could include bus tie circuit breakers 1212, 1413, 2221, 3231, 3432, and 2323 if in ring bus configuration.
4.	SSGTG No. 1 controls (see figure 2-6) should be: GOVERNOR ISO/DROOP switch (S20) to DROOP; VOLT REF DIFF/DROOP switch (S14) to DROOP; VOLT REG MODE SEL (S13) switch to MAN; GEN SPACE HEATER switch (S21) to OFF.	Shore power voltage may vary and could be as high as 480 volts. High voltage audible and visual alarms could occur at EPCC. Governor droop, voltage reference droop, and voltage regulator manual indicators are illuminated, space heater indicator is extinguished.
5.	Synchronize off-line generator(s) to Main Bus (shore power). Turn CKT BREAKER & SYNCH SELECT (S19) to 1S GEN.	SYNCHRONIZATION indicators flicker.
6.	Turn BUS METER SELECT switch (S17) to 1S BUS.	Meters (M5, M7, M2) indicate 1S Main Bus volt, frequency and amperes.
7.	Turn SYNCH MON MODE SEL switch (S38) to OPERATE.	Indicator (DS31) goes on (white).
8.	Turn GEN VOLTS switch (S15) to LOWER/RAISE to match volts on Main Bus VOLTS meter (M5).	Match GEN VOLTS meter (M4) with Main Bus VOLTS meter (M5).
9.	Turn GEN FREQ LOWER/RAISE SWITCH (S16) to lower or raise frequency for matching Main Bus meter (M7).	Match GEN FREQ meter (M6) with FREQ meter (M7). SYNCH SCOPE (M11) should show pointer rotating slowly in CW direction.
10.	When the pointer reaches 11 o'clock going CW, the phases are close enough to connect SSGTG No. 1 to the Main Bus. Close generator breaker switch (S1).	Generator 1SG is synchronized with shore power. Blue generator circuit breaker closed indicator is illuminated and trip indicator is extinguished.

Table 2-16. Transferring From Shore Power To Ship's Power - Continued

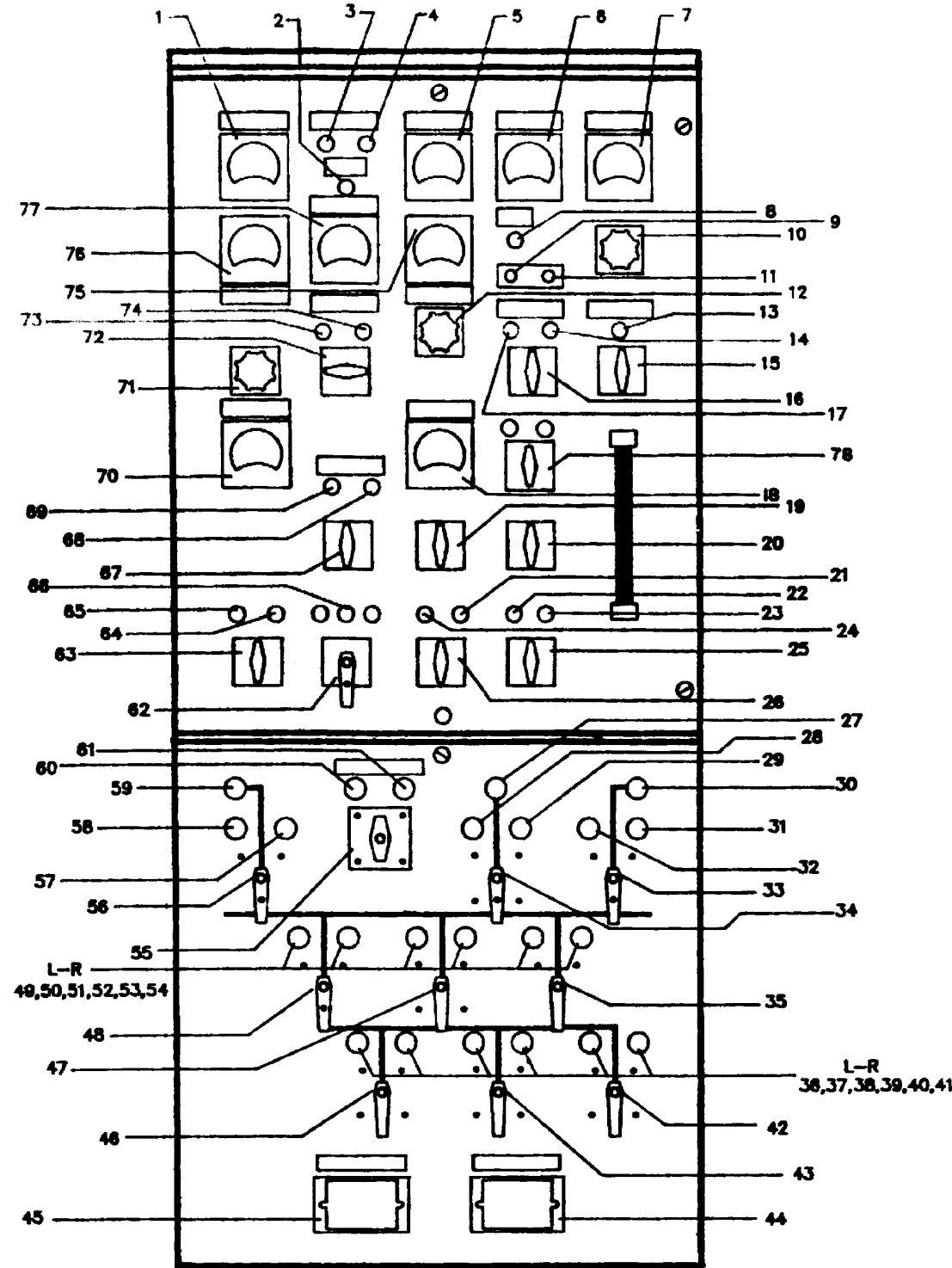
Step	Action	Result
11.	Keep frequency and voltage adjusted so that the generator assumes a portion or most of the load on the Main Bus.	If too much power is being used by the ship, load shedding may be necessary.
12.	TRIP S11 on switchboard 2SA	Trips all shore power breakers that are used. Shore Power blue indicator lights (DS2, DS5, DS8, DS11, DS14, DS17, DS20, DS23, DS26, DS29, DS32, DS35) extinguish. Shore power amber indicators (DS1, DS4, DS7, DS10, DS13, DS16, DS19, DS22, DS25, DS28, DS31, DS34) are lit.
13.	On switchboard 1SG, turn GOVERNOR ISO/DROOP switch (S20) to ISOCH; turn VOLT REG DIFF/DROOP (S14) to DIFF; turn VOLT REG MOD SEL (S13) to AUTO	Indicators (DS38, DS37, DS34) lights green.
<p>WARNING</p> <p>Shore power connection and cables are still energized. Do not disconnect cables from shore power until all amber shore power circuit breaker lamps are extinguished.</p>		
14.	Shore power breakers ashore must be TRIPPED.	All shore power amber indicating lights (DS1, DS4, DS7, DS10, DS13, DS16, DS19, DS22, DS25, DS28, DS31, DS34) extinguish.
15.	Disconnect shore power cables from ship.	
16.	Establish Main Bus configuration desired.	
17.	Turn CONTROL XFR switch (S24) to REM.	Returns control to EPCC. Remote control indicator illuminated and local control indicator extinguished.

Table 2-17. Circuit Breakers Affected by the Load Shed Circuits

Ref Desig	Service	Switchboard Location						Load Shed Stage 1	Load Shed Stage 2
		1SA	1SB	1SC	3SA	3SB	3SC		
CB1303	AMR NO. 1 NON VITAL		X					X	X
CB1306	GENERAL WORKSHOP		X					X	X
CB1308	CL Z VENT ZONE 2 PNL NO. 1		X					X	X
CB1309	CL Z VENT ZONE 2 PNL NO. 2		X					X	X
CB1310	NON VITAL AUX ZONE 2 PNL 2		X					X	X
CB1346	NON VITAL AUX ZONE 2 PNL 1		X					X	X
CB1352	A/C CMPSR NO. 1		X						X
CB1353	FUEL XFER HTR NO. 1		X					X	X
CB1354	ER NO. 1 NON VITAL		X					X	X
CB1355	ER NO. 1 NON VITAL PNL 1		X					X	X
CB1356	CL X PREHTR ARM NO. 1	X						X	X
CB1404	CL X PREHTR ER NO. 1			X				X	X
CB1406	ER NO. 1 NON VITAL PNL 2			X				X	X
CB1407	NON VITAL AUX ZONE 1			X				X	X
CB3204	CREW/CPO GALLEY PNL 1				X			X	X
CB3205	CREW/CPO GALLEY PNL 2				X			X	X
CB3210	LAUNDRY				X			X	X
CB3211	ER 2 NON VITAL PNL 3				X			X	X

Table 2-17. Circuit Breakers Affected by the Load Shed Circuits - Continued

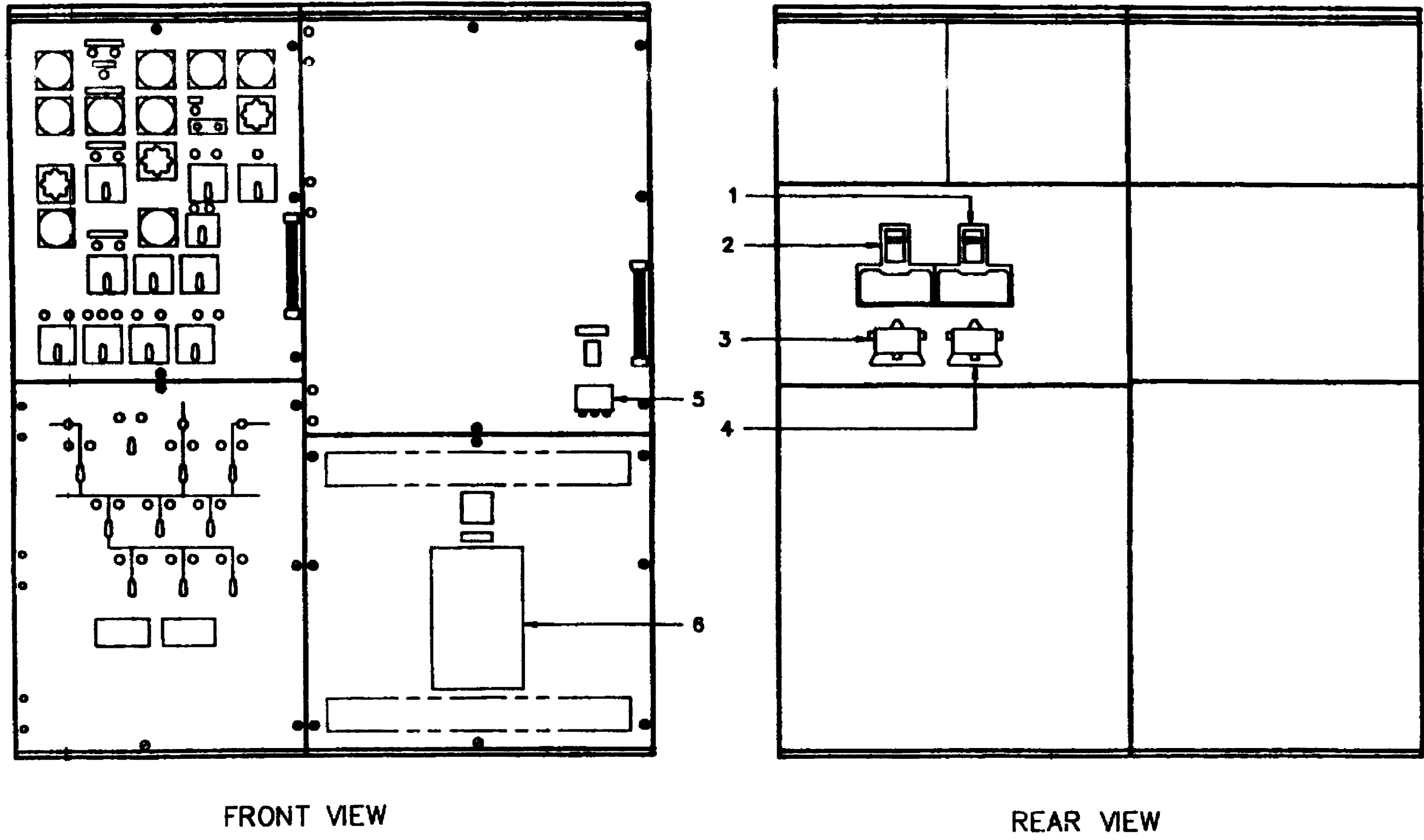
Ref Desig	Service	Switchboard Location						Load Shed Stage 1	Load Shed Stage 2
		1SA	1SB	1SC	3SA	3SB	3SC		
CB3213	NON VITAL AUX ZONE 4				X			X	X
CB3303	CL X PREHTR AMR NO. 2					X		X	X
CB3304	CL X PREHTR ER NO. 2					X		X	X
CB3306	CL X PREHTR ER NO. 2					X		X	X
CB3315	CL Z VENT ZONE 3 PNL NO. 1					X		X	X
CB3316	CL Z VENT ZONE 4					X		X	X
CB3317	CL Z VENT ZONE 3 PNL NO. 2					X		X	X
CB3318	CL Z VENT ZONE 3 PNL NO. 3					X		X	X
CB3329	NON VITAL AUX ZONE 3					X		X	X
CB3334	FUEL XFER HTR NO. 2					X		X	X
CB3339	ER NO. 2 NON VITAL PNL 1					X		X	X
CB3340	A/C CMPSR NO. 2					X			X
CB3341	A/C CMPSR NO. 2					X			X
CB3342	A/C CMPSR NO. 4					X			X
CB3409	ER NO. 2 NON VITAL PNL 2						X	X	X
	SPY-ID ANTI-ICING HEATERS								X
	VLS ANTI-ICING HEATERS								X
	LOAD CENTERS								X



- 1. BUS • BT AMPS
- 2. RESET • FC DETECTOR
- 3. B TIE INHIBIT
- 4. FAULT DETECTED
- 5. GENERATOR • GEN AMPS
- 6. GENERATOR • GEN KW
- 7. GENERATOR • GEN TEMP
- 8. READY TO START
- 9. GENERATOR • START
- 10. TEMP METER • SELECT SWITCH
- 11. SSGTG • STOP
- 12. GEN FREQ • LOWER/RAISE
- 13. GEN SPACE HEATER
- 14. GOVERNOR DROOP
- 15. GEN SPACE • HEATER
- 16. GOVERNOR • ISO/DROOP
- 17. GOVERNOR ISO
- 18. GENERATOR • GEN VOLTS
- 19. GEN VOLTS • LOWER/RAISE
- 20. VOLT REG • SELECT
- 21. VOLT REG DROOP
- 22. VOLT REG • MODE SEL AUTO
- 23. VOLT REG • MODE SEL MAN
- 24. VOLT REG DIFF
- 25. VOLT REG • MODE SEL
- 26. VOLT REG • DIFF/DROOP
- 27. 1S GEN POWER • AVAIL
- 28. CB1110 TRIP
- 29. CB1110 CLOSE
- 30. PWR AVAIL • 1S-3S • BUS TIE
- 31. CB1413 CLOSE
- 32. CB1413 TRIP
- 33. 1S-3S BUS TIE • BREAKER
- 34. 1S GEN • BREAKER
- 35. STC 1
- 36. CB3038 • TRIP
- 37. CB3038 • CLOSE
- 38. CB3042 • TRIP
- 39. CB3042 • CLOSE
- 40. CB3043 • TRIP
- 41. CB3043 • CLOSE
- 42. A/C 4 • ALT
- 43. A/C 3 • ALT
- 44. J2
- 45. J1
- 46. A/C 2 • ALT
- 47. A/C 1 NORM
- 48. LC31 FDR
- 49. CB1209 • TRIP
- 50. CB1209 • CLOSE
- 51. CB1352 • TRIP
- 52. CB1352 • CLOSE
- 53. CB1409 • TRIP
- 54. CB1409 • CLOSE
- 55. CONTROL XFR • LOCAL/REM
- 56. 1S-2S BUS • TIE BREAKER
- 57. CB1212 CLOSE
- 58. CB1212 TRIP
- 59. PWR AVAIL • 1S-2S • BUS TIE
- 60. CONTROL XFR LOCAL
- 61. CONTROL XFR REM
- 62. GND DET
- 63. LOAD SHED • STAGE 1/STAGE 2
- 64. LOAD SHED • OCCURRED STAGE 2
- 65. LOAD SHED • OCCURRED STAGE 1
- 66. GND TEST
- 67. SYNCH MON • MODE SEL
- 68. SYNCH MON • MODE SEL ON
- 69. SYNCH MON • MODE SEL TEST
- 70. BUS • VOLTS
- 71. BUS METER SELECT
- 72. CIRCUIT BREAKER AND • SYNCH SELECT
- 73. SYNCHRONIZATION
- 74. SYNCHRONIZATION
- 75. GENERATOR • GEN FREQ
- 76. BUS • FREQ
- 77. SYNCHRONIZATION • SYNCH SCOPE
- 78. FAULT CURRENT DET MODE SEL

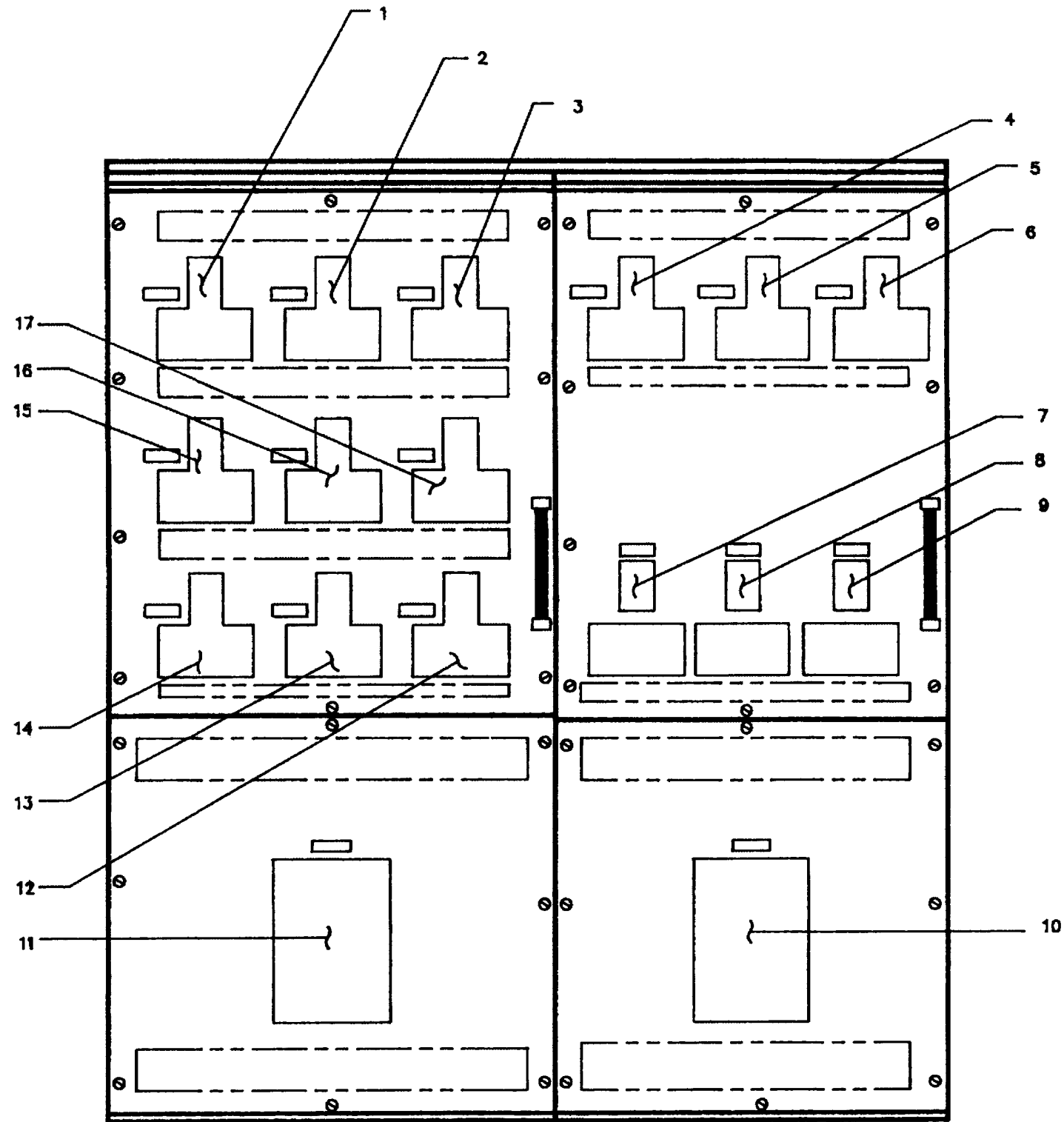
• DENOTES LINE CHANGE

Figure 2-6. Switchboard 1SG Control Panel



- 1. CASUALTY POWER
 - 2. CASUALTY POWER
 - 3. CASUALTY POWER TERMINALS
 - 4. CASUALTY POWER TERMINALS
 - 5. GEN 1SG SW COOLING PUMP *
1S-4P-V
 - 6. SHIP SERVICE *
GENERATOR 1SG *
1SG-4P-1S
- * DENOTES LINE CHANGE

Figure 2-7. Switchboard 1SG Front and Rear View



- 1. 120V LTG LC22 * 1S-4L-LC22 (NORM)
 - 2. 450V RADAR RM NO 1 * 1S-4P-(03-129-1)NORM
 - 3. 450V RADAR RM NO 2 * 1S-4P-(03-173-3)NORM
 - 4. 450V PWR SPLY/CURSN * RM PNL 1 * 1S-4P-(3-159-2)NORM
 - 5. PWR PNL (EP1) * MK280 MOD 2 * 1S-4WP-J(NORM)
 - 6. 450V ARRAY RM * NO 1 * 1S-4P-(03-141-1)(NORM)
 - 7. (BLANK)
 - 8. 450V SONAR EQPT RM 2 * PNL 2 * 1S-4P-(2-41-1)NORM
 - 9. (BLANK)
 - 10. LOAD CENTER * 31 * 1S-4P-LC31
 - 11. 1S/2S BUS TIE * 1S-4P-2S
 - 12. (BLANK)
 - 13. ENG RM NO 1 * PNL 2 VITAL * 1S-4P-(4-181-2)NORM
 - 14. MISC AUX ZONE 2 * 1S-4P-(1-219-13)NORM
 - 15. FIRE PUMP NO 4 * 1S-49 P-D(ALTN)
 - 16. AUX MCHRY RM NO 1 * PNL 1 VITAL * 1S-4P-(4-167-2)ALTN
 - 17. CL W RECIRC & MISC * AUX ZONE 1 * 1S-4P-(1-64-1)NORM
- * DENOTES LINE CHANGE

Figure 2-8. Switchboard ISA, Operating Controls and Indicators

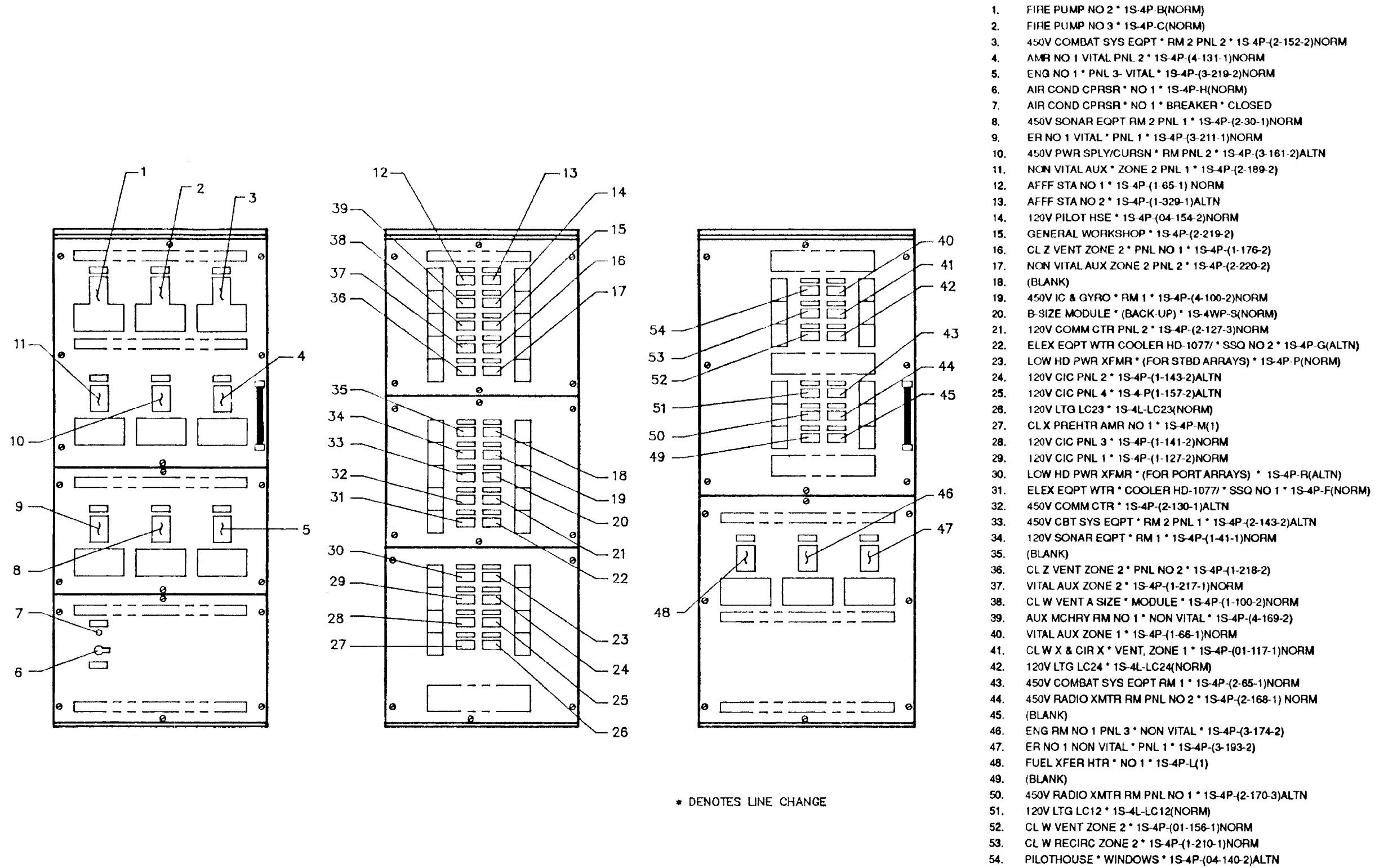
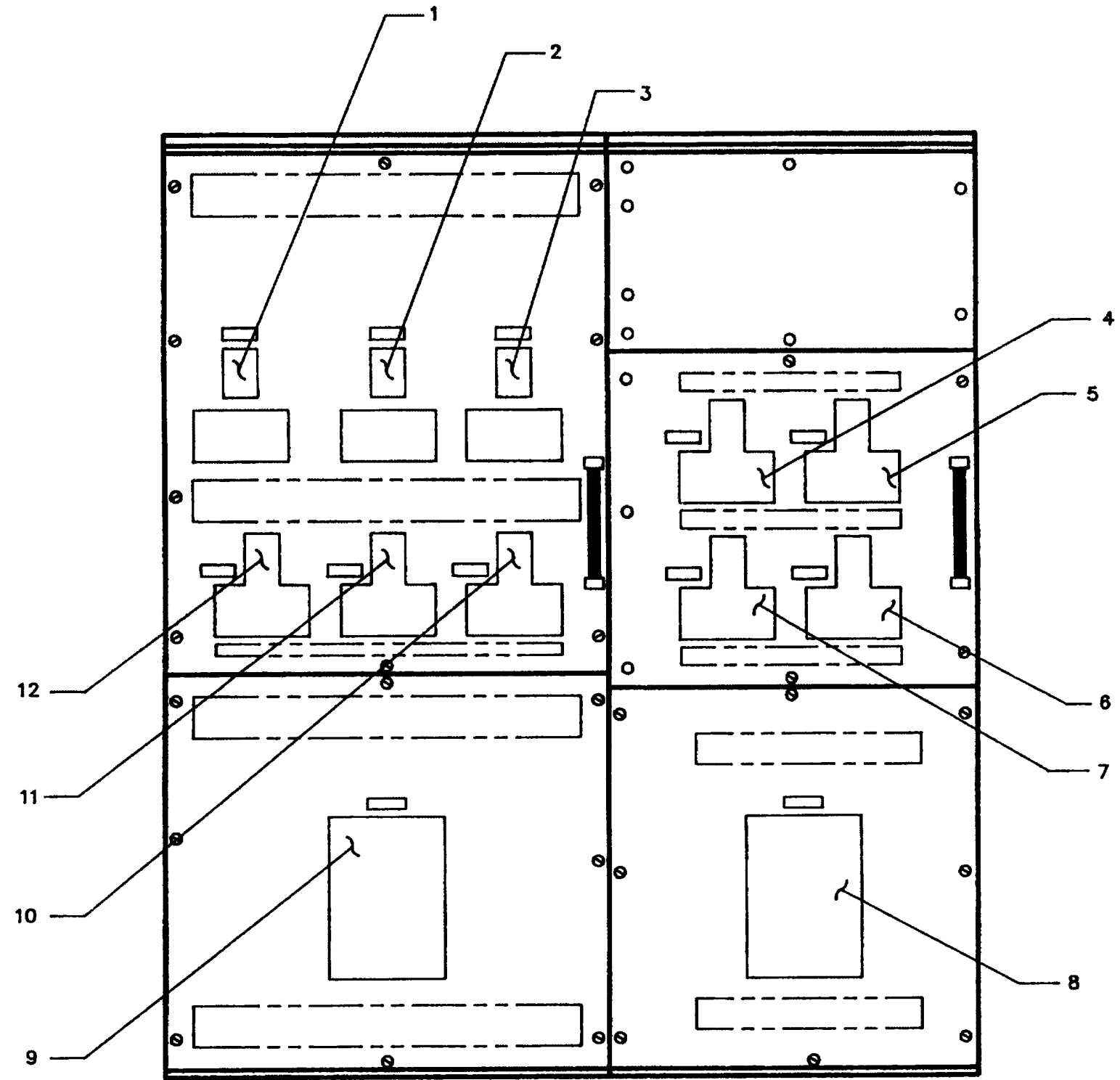


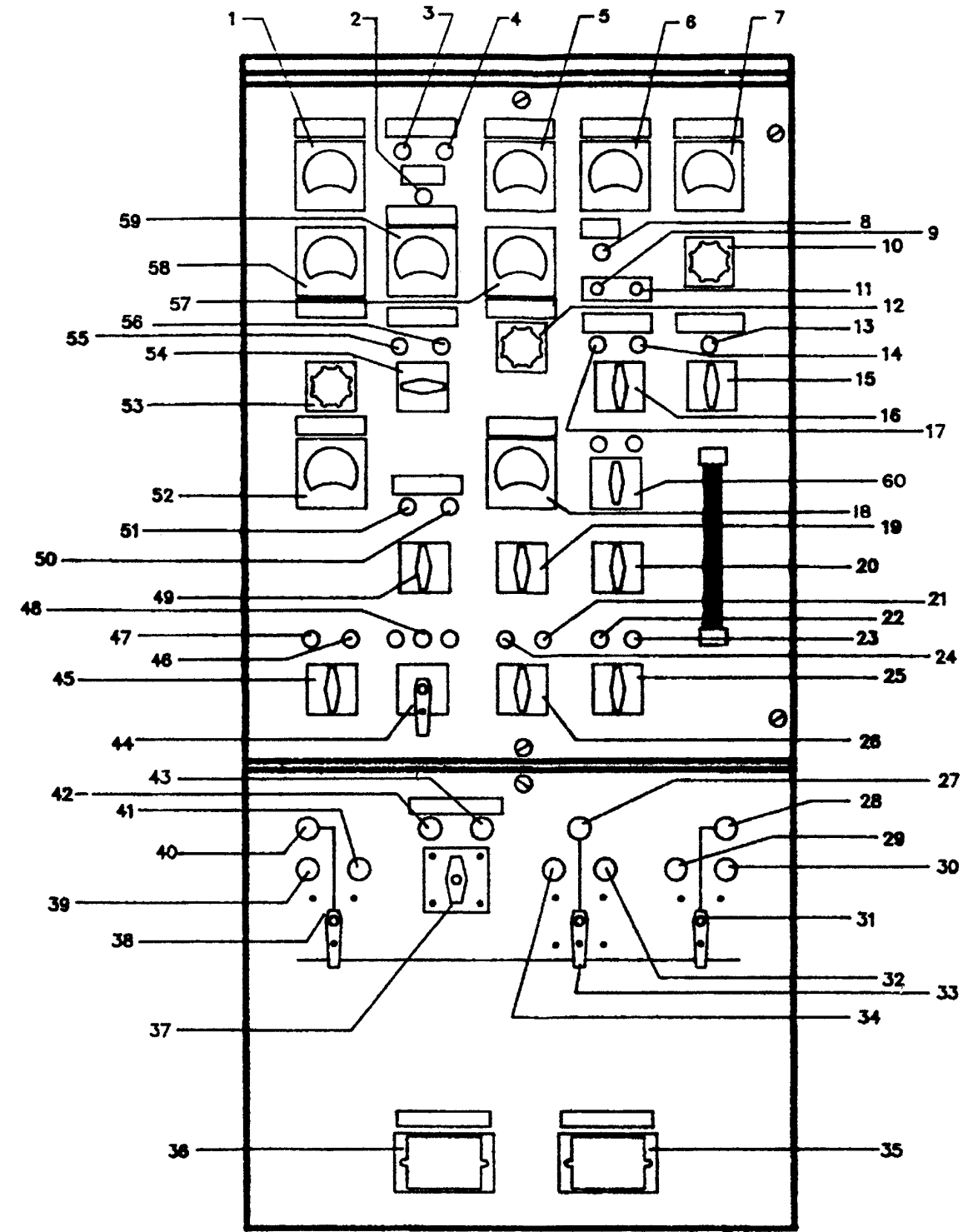
Figure 2-9. Switchboard 1SB, Operating Controls and Indicators



- 1. A SIZE MODULE * 1S-4WP-K(NORM)
- 2. ER NO 1 NON VITAL * PNL 2 * 1S-4P-(4-174-2)
- 3. NON VITAL AUX * ZONE 1 * 1S-4P-(1-100-1)
- 4. CL X PREHTR * ER NO 1 * 1S-4P-N(1)
- 5. 450V ARRAY RM * NO 2 * 1S-4P-(03-141-2)(ALTN)
- 6. 120V LTG LC13 * 1S-4L-LC13(NORM)
- 7. DEGAUSSING * 1S-4P-(2-253-2)ALTN
- 8. STC 1 * 1S-4P-E(NORM)
- 9. 1S-3S BUS TIE * 1S-4P-3S
- 10. (BLANK)
- 11. MK16 MOD * 2 WPN GP * 1S-4WP-T(NORM)
- 12. FIRE PUMP NO 1 * 1S-4P-A(NORM)

*DENOTES LINE CHANGE

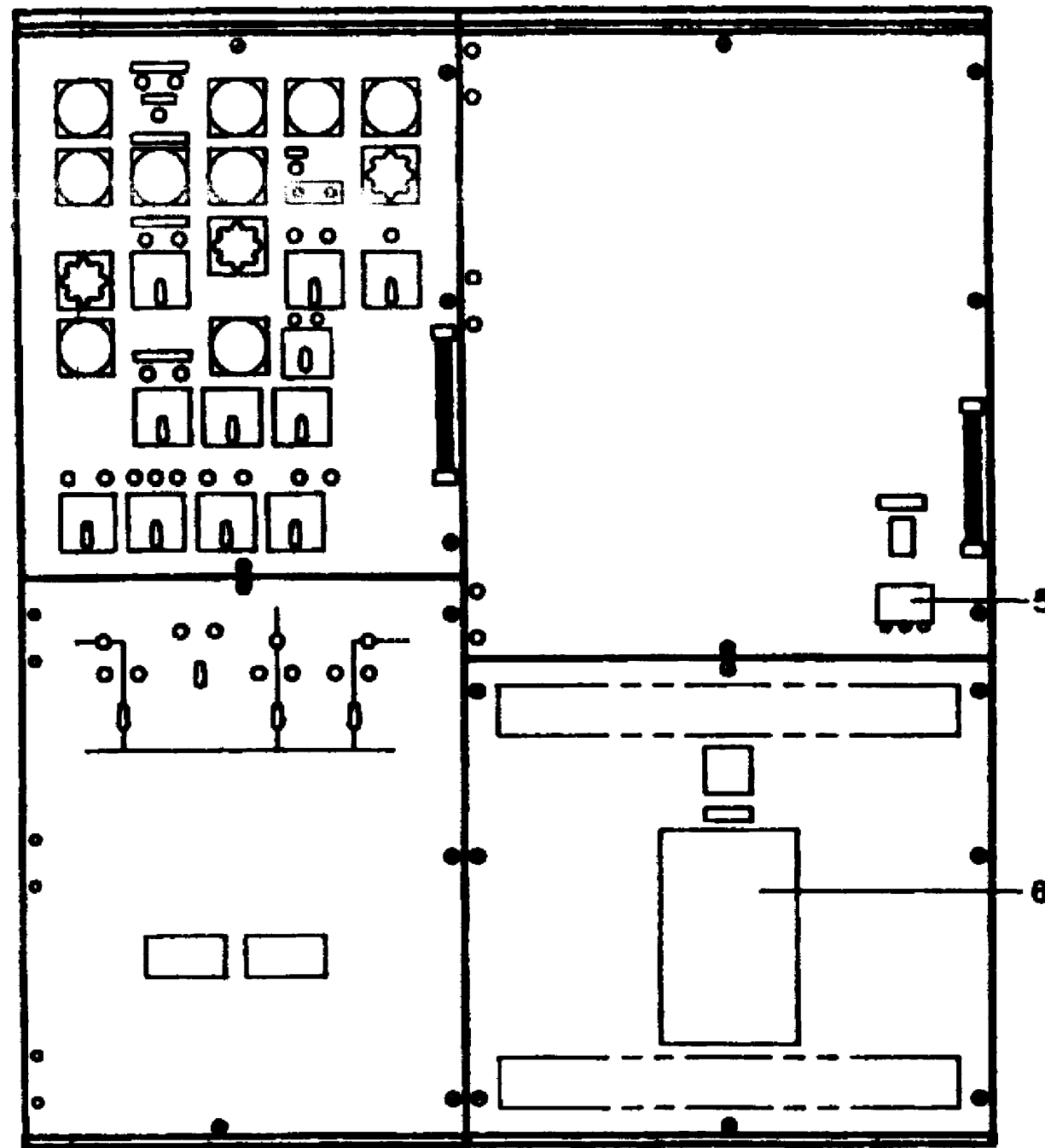
Figure 2-10. Switchboard 1SC, Operating Controls and Indicators



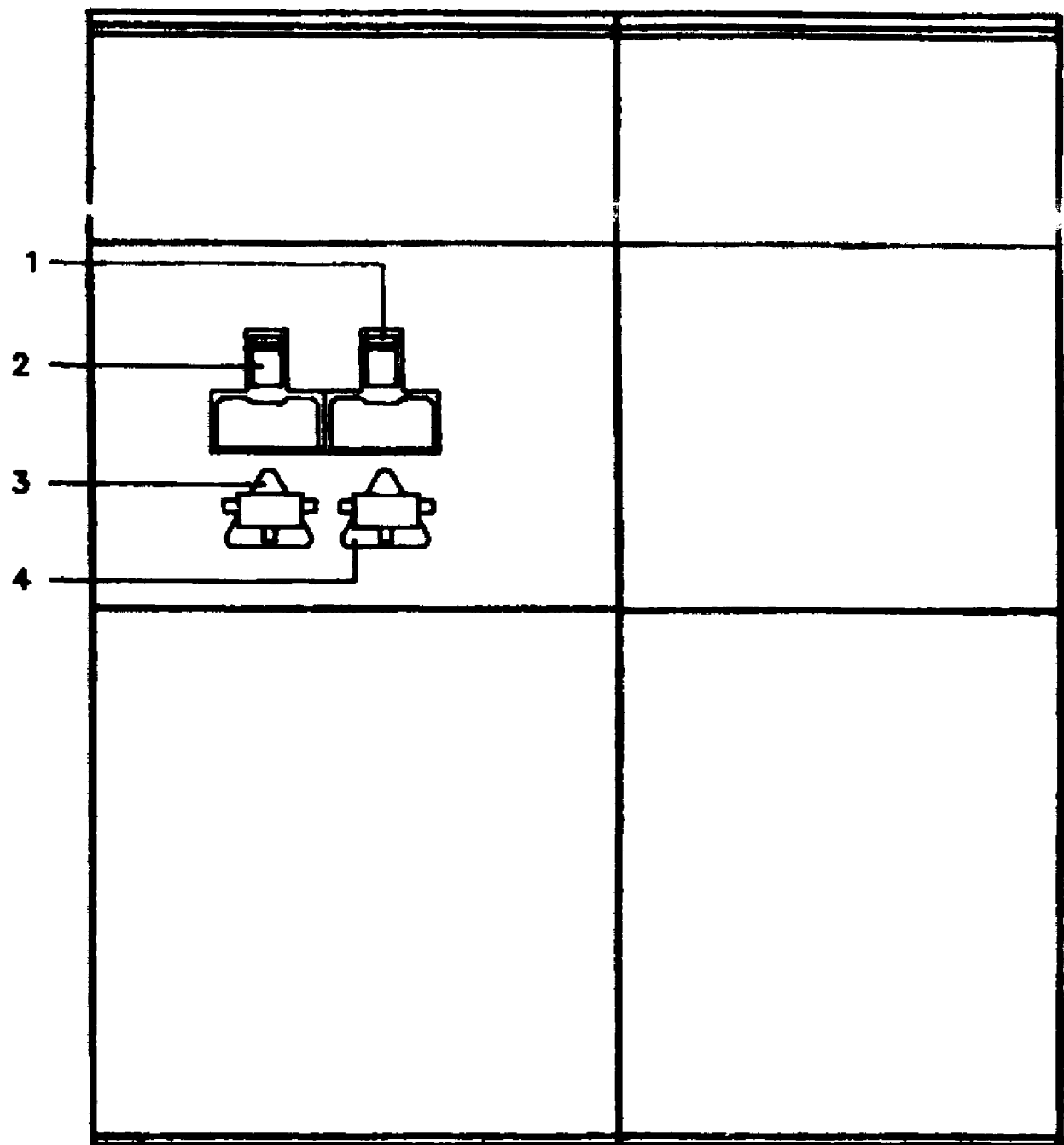
- | | |
|---------------------------------|-----------------------------------|
| 1. BUS • BT AMPS | 31. CB2323 |
| 2. RESET • FC DETECTOR | 32. CB2120 CLOSE |
| 3. B TIE INHIBIT | 33. CB2120 |
| 4. FAULT DETECTED | 34. CB2120 TRIP |
| 5. GENERATOR • GEN AMPS | 35. J2 |
| 6. GENERATOR • GEN KW | 36. J1 |
| 7. GENERATOR • GEN TEMP | 37. CONTROL XFR • LOCAL/REM |
| 8. READY TO START | 38. 2S-1S BUS TIE • BREAKER |
| 9. GENERATOR • START | 39. CB2221 TRIP |
| 10. TEMP METER | 40. PWR AVAIL • 2S-1S BUS TIE |
| 11. GENERATOR • STOP | 41. CB2221 CLOSE |
| 12. GEN FREQ • LOWER/RAISE | 42. CONTROL XFR LOCAL |
| 13. GEN SPACE HEATER | 43. CONTROL XFR REM |
| 14. GOVERNOR • ISO/DROOP DROOP | 44. GND DET |
| 15. GEN SPACE • HEATER | 45. LOAD SHED • STAGE 1/STAGE 2 |
| 16. GOVERNOR • ISO/DROOP | 46. LOAD SHED • OCCURRED STAGE 2 |
| 17. GOVERNOR • ISO/DROOP ISO | 47. LOAD SHED • OCCURRED STAGE 1 |
| 18. GENERATOR • GEN VOLTS | 48. GND DET |
| 19. GEN VOLTS • LOWER/RAISE | 49. SYNCH MON • MODE SEL |
| 20. VOLT REG • SELECT | 50. SYNCH MON • MODE SEL ON |
| 21. VOLT REG • DIFF/DROOP DROOP | 51. SYNCH MON • MODE SEL TEST |
| 22. VOLT REG • MODE SEL AUTO | 52. BUS • VOLTS |
| 23. VOLT REG • MODE SEL MAN | 53. BUS METER • SELECT |
| 24. VOLT REG • DIFF/DROOP DIFF | 54. CKT BREAKER & • SYNCH SELECT |
| 25. VOLT REG • MODE SEL | 55. SYNCHRONIZATION |
| 26. VOLT REG • DIFF/DROOP | 56. SYNCHRONIZATION |
| 27. 2S GEN POWER • AVAIL | 57. GENERATOR • GEN FREQ |
| 28. CB2323 | 58. BUS • FREQ |
| 29. CB2323 TRIP | 59. SYNCHRONIZATION • SYNCH SCOPE |
| 30. CB2323 CLOSE | 60. FAULT CURRENT DET MODE SEL |

• DENOTES LINE CHANGE

Figure 2-11. Switchboard 2SG Control Panel



FRONT VIEW

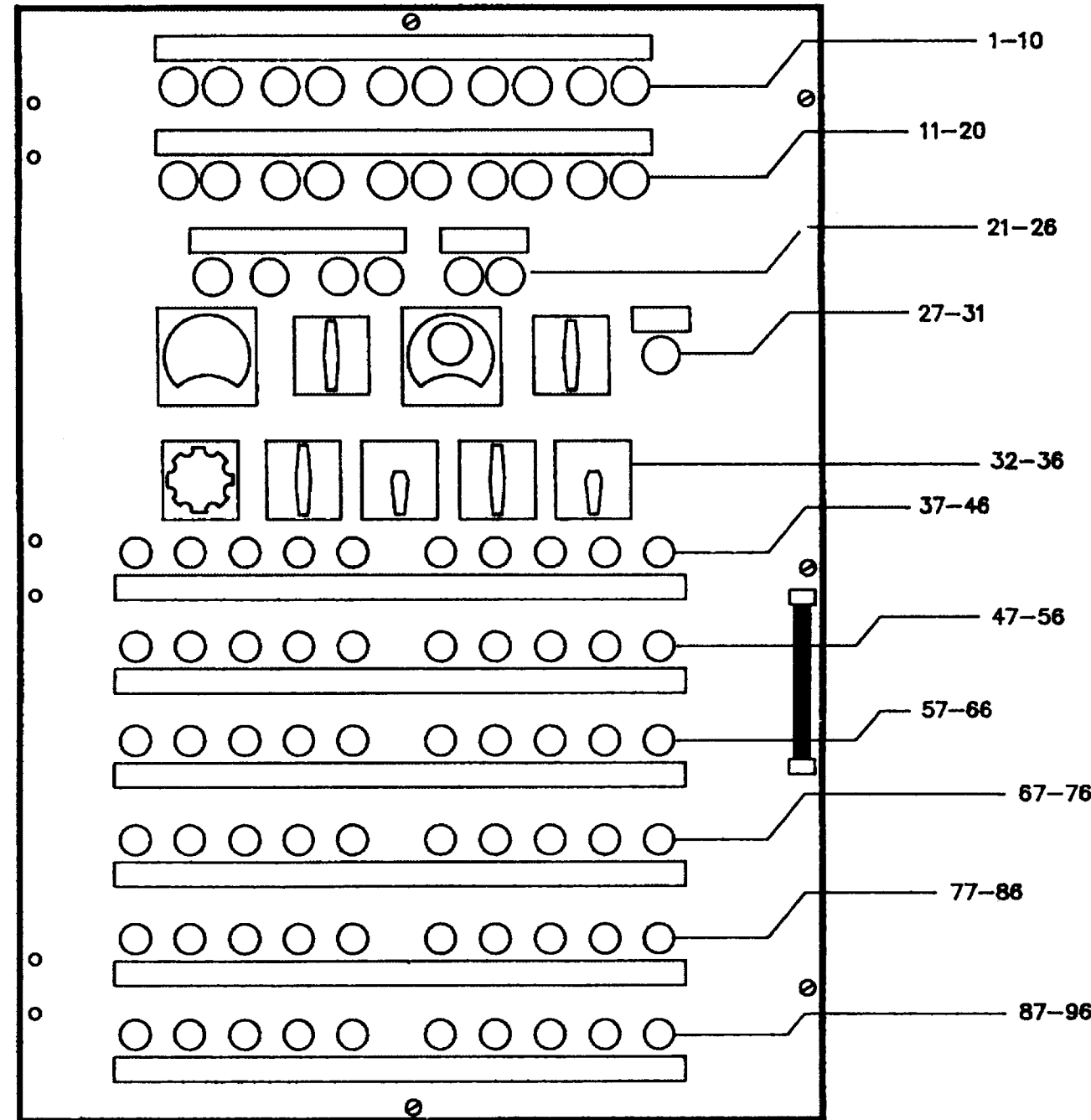


REAR VIEW

- 1. CASUALTY POWER *
CIRCUIT BREAKER
 - 2. CASUALTY POWER *
CIRCUIT BREAKER
 - 3. CASUALTY POWER *
TERMINAL
 - 4. CASUALTY POWER *
TERMINAL
 - 5. GEN 2SG SW *
COOLING PUMP *
2S-4P-A
 - 6. SHIP SERVICE *
GENERATOR 2SG *
2SG-4P-2S 1E *
- *DENOTES LINE CHANGE

Figure 2-12. Switchboard 2SG Front and Rear View

NOTE: ALL ITEMS READ LEFT TO RIGHT



- | | |
|----------------------------|-----------------------------|
| 1. CB2201 TRIP | 51. CB2203 * CONTROL |
| 2. CB2201 CLOSE | 52. RCPT NO 4 PH * SEQ CKT |
| 3. CB2202 TRIP | 53. RCPT NO 4 PH * SEQ CKT |
| 4. CB2202 CLOSE | 54. RCPT NO 4 PH * SEQ CKT |
| 5. CB2203 TRIP | 55. CB2204 * UV TRIP |
| 6. CB2203 CLOSE | 56. CB2204 * CONTROL |
| 7. CB2204 TRIP | 57. RCPT NO 5 PH * SEQ CKT |
| 8. CB2204 CLOSE | 58. RCPT NO 5 PH * SEQ CKT |
| 9. CB2205 TRIP | 59. RCPT NO 5 PH * SEQ CKT |
| 10. CB2205 CLOSE | 60. CB2205 * UV TRIP |
| 11. CB2206 TRIP | 61. CB2205 * CONTROL |
| 12. CB2206 CLOSE | 62. RCPT NO 6 PH * SEQ CKT |
| 13. CB2207 TRIP | 63. RCPT NO 6 PH * SEQ CKT |
| 14. CB2207 CLOSE | 64. RCPT NO 6 PH * SEQ CKT |
| 15. CB2208 TRIP | 65. CB2206 * UV TRIP |
| 16. CB2208 CLOSE | 66. CB2206 * CONTROL |
| 17. CB2209 TRIP | 67. RCPT NO 7 PH * SEQ CKT |
| 18. CB2209 CLOSE | 68. RCPT NO 7 PH * SEQ CKT |
| 19. CB2210 TRIP | 69. RCPT NO 7 PH * SEQ CKT |
| 20. CB2210 CLOSE | 70. CB2207 * UV TRIP |
| 21. CB2211 TRIP | 71. CB2207 * CONTROL |
| 22. CB2211 CLOSE | 72. RCPT NO 8 PH * SEQ CKT |
| 23. CB2212 TRIP | 73. RCPT NO 8 PH * SEQ CKT |
| 24. CB2212 CLOSE | 74. RCPT NO 8 PH * SEQ CKT |
| 25. SHORE POWER PH * REF | 75. CB2208 * UV TRIP |
| 26. SHORE POWER PH * REF | 76. CB2208 * CONTROL |
| 27. AMP SHORE POWER | 77. RCPT NO 9 PH * SEQ CKT |
| 28. PHASE SEQUENCE | 78. RCPT NO 9 PH * SEQ CKT |
| 29. PHASE SEQ | 79. RCPT NO 9 PH * SEQ CKT |
| 30. PHASE ORIENTATION | 80. CB2209 * UV TRIP |
| 31. BUS TIE ENERGIZED | 81. CB2209 * CONTROL |
| 32. SHORE POWER AMPS | 82. RCPT NO 10 PH * SEQ CKT |
| 33. PHASE SEQUENCE | 83. RCPT NO 10 PH * SEQ CKT |
| 34. SHORE POWER * CONTROL | 84. RCPT NO 10 PH * SEQ CKT |
| 35. PHASE ORIENTATION | 85. CB2210 * UV TRIP |
| 36. S4 TRIP | 86. CB2210 * CONTROL |
| 37. RCPT NO 1 PH * SEQ CKT | 87. RCPT NO 11 PH * SEQ CKT |
| 38. RCPT NO 1 PH * SEQ CKT | 88. RCPT NO 11 PH * SEQ CKT |
| 39. RCPT NO 1 PH * SEQ CKT | 89. RCPT NO 11 PH * SEQ CKT |
| 40. CB2201 * UV TRIP | 90. CB2211 * UV TRIP |
| 41. CB2201 * CONTROL | 91. CB2211 * CONTROL |
| 42. RCPT NO 2 PH * SEQ CKT | 92. RCPT NO 12 PH * SEQ CKT |
| 43. RCPT NO 2 PH * SEQ CKT | 93. RCPT NO 12 PH * SEQ CKT |
| 44. RCPT NO 2 PH * SEQ CKT | 94. RCPT NO 12 PH * SEQ CKT |
| 45. CB2202 * UV TRIP | 95. CB2212 * UV TRIP |
| 46. CB2202 * CONTROL | 96. CB2212 * CONTROL |
| 47. RCPT NO 3 PH * SEQ CKT | |
| 48. RCPT NO 3 PH * SEQ CKT | |
| 49. RCPT NO 3 PH * SEQ CKT | |
| 50. CB2203 * UV TRIP | |
- * DENOTES LINE CHANGE

Figure 2-13. Switchboard 2SA Control Panel

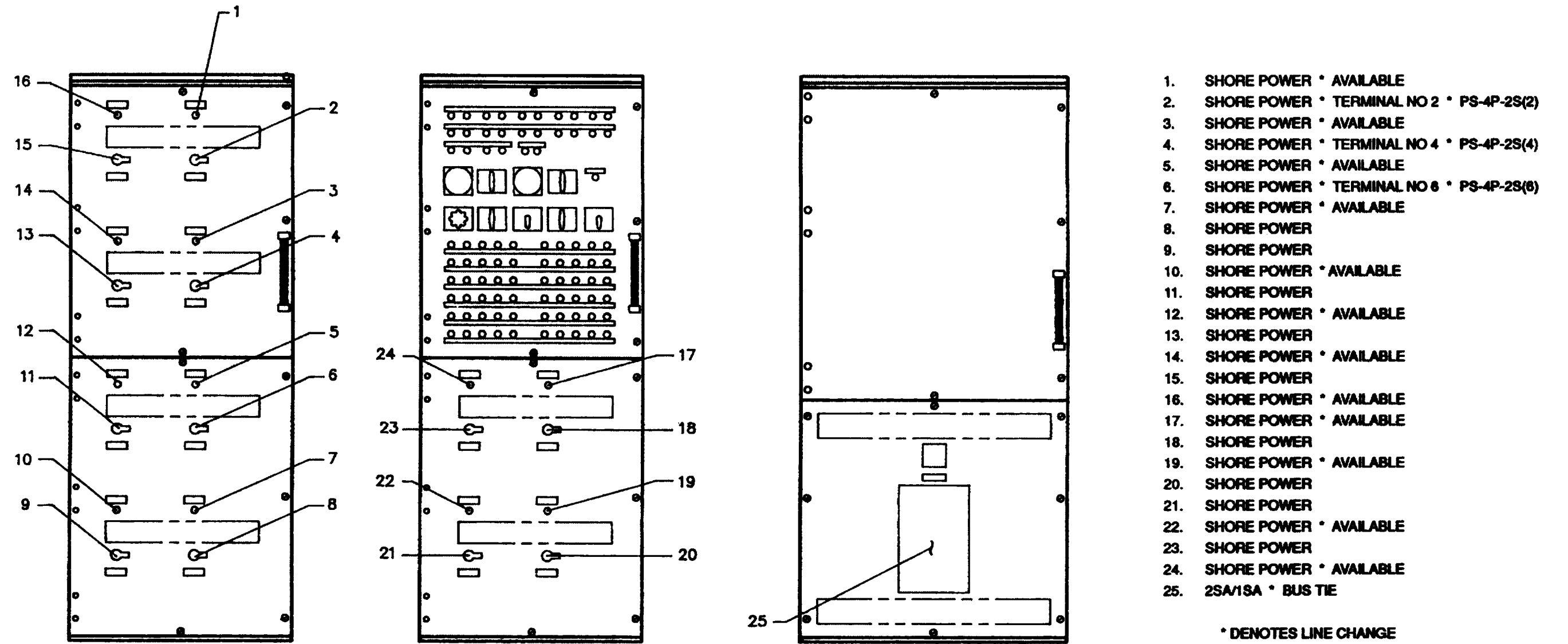


Figure 2-14. Switchboard 2SA, Operating Controls and Indicators

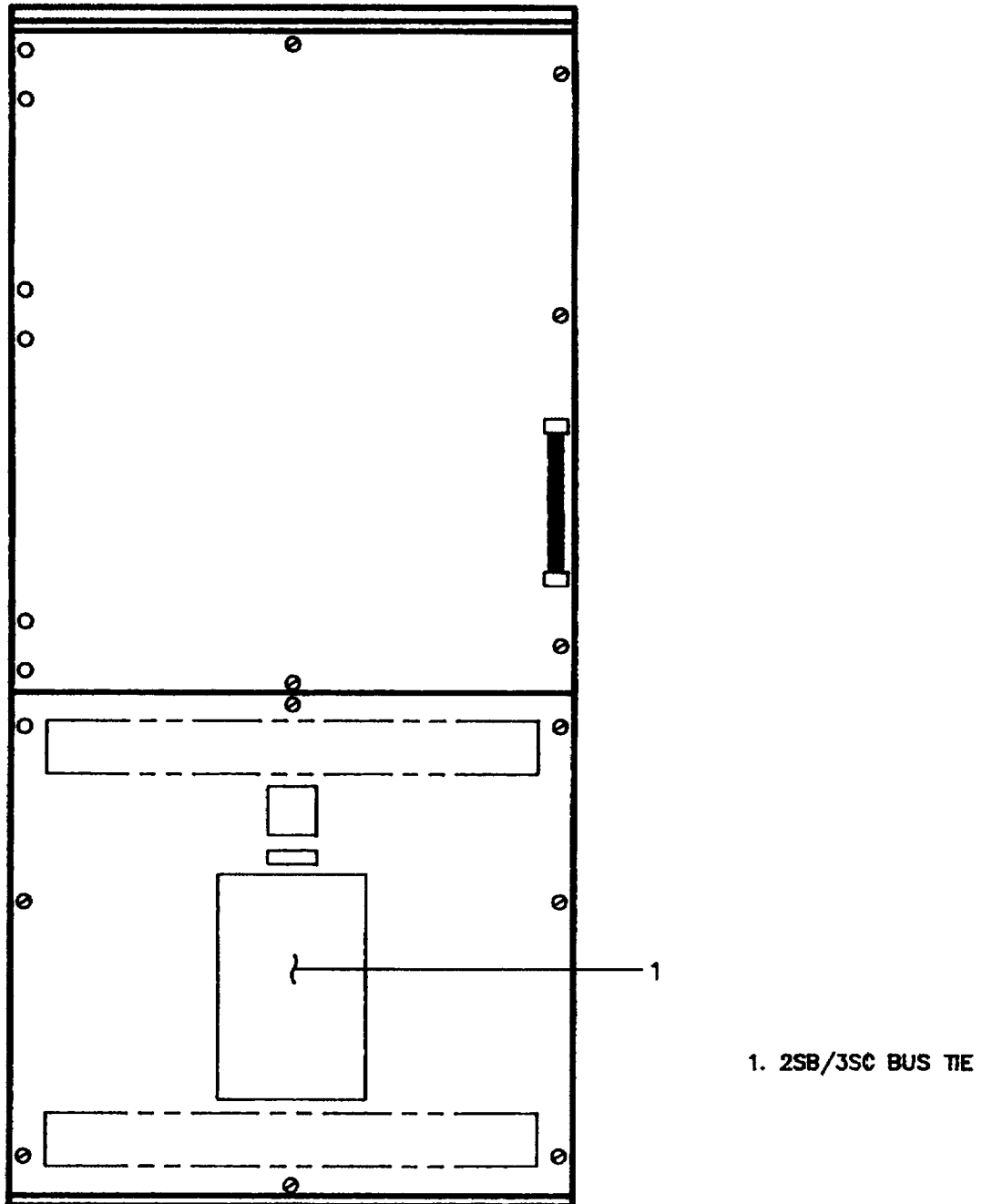
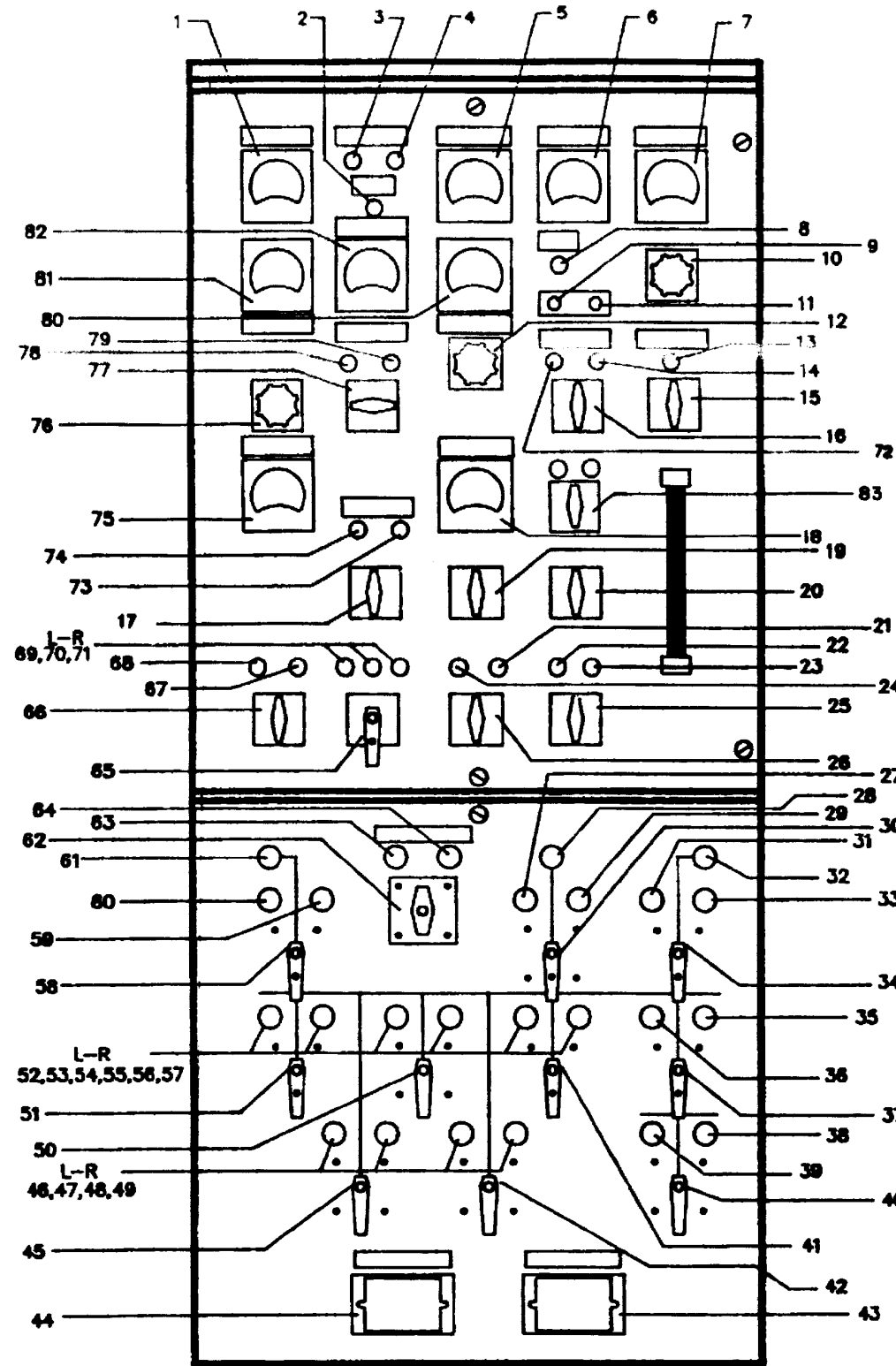
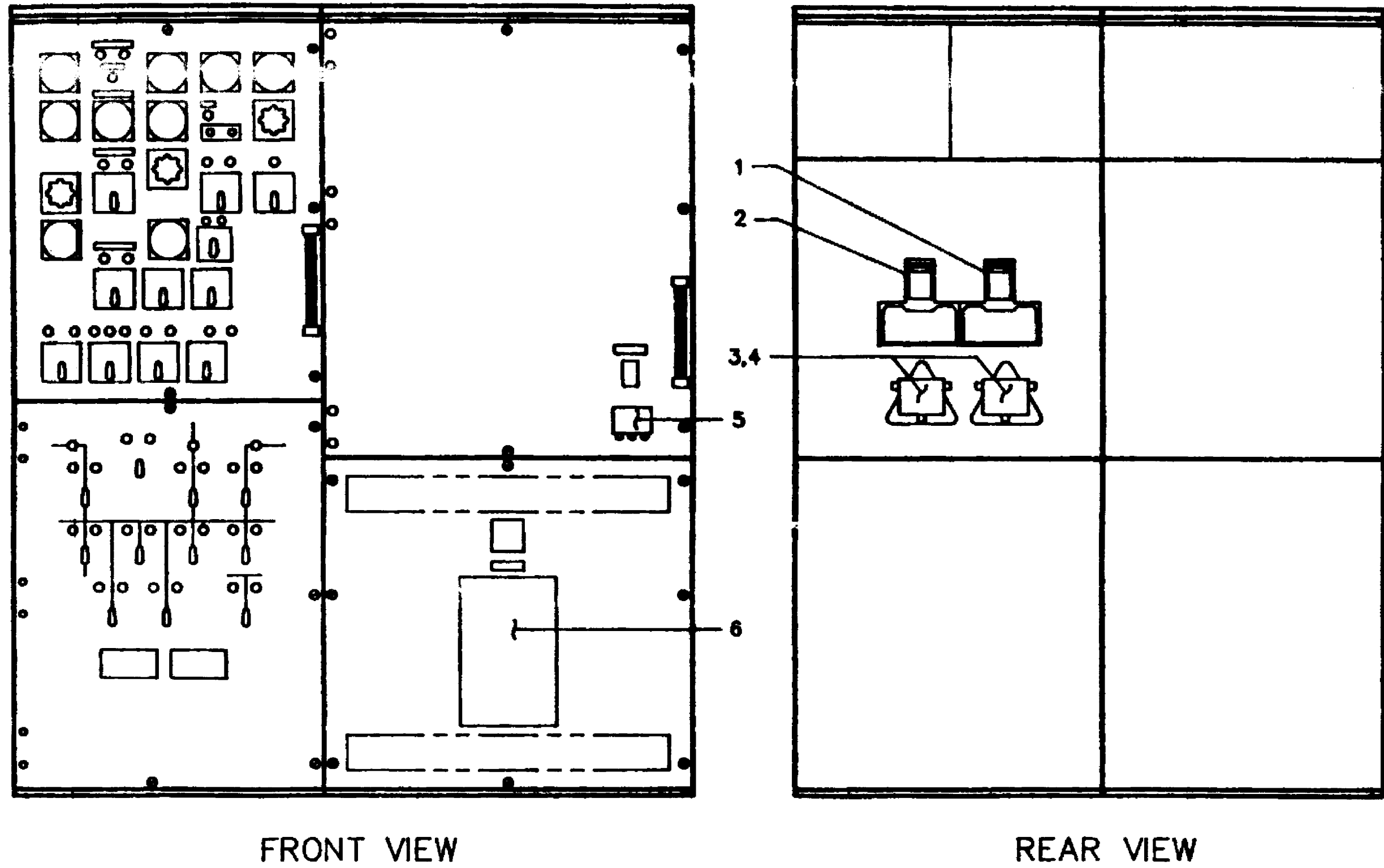


Figure 2-15. Switchboard 2SB, Operating Controls and Indicators



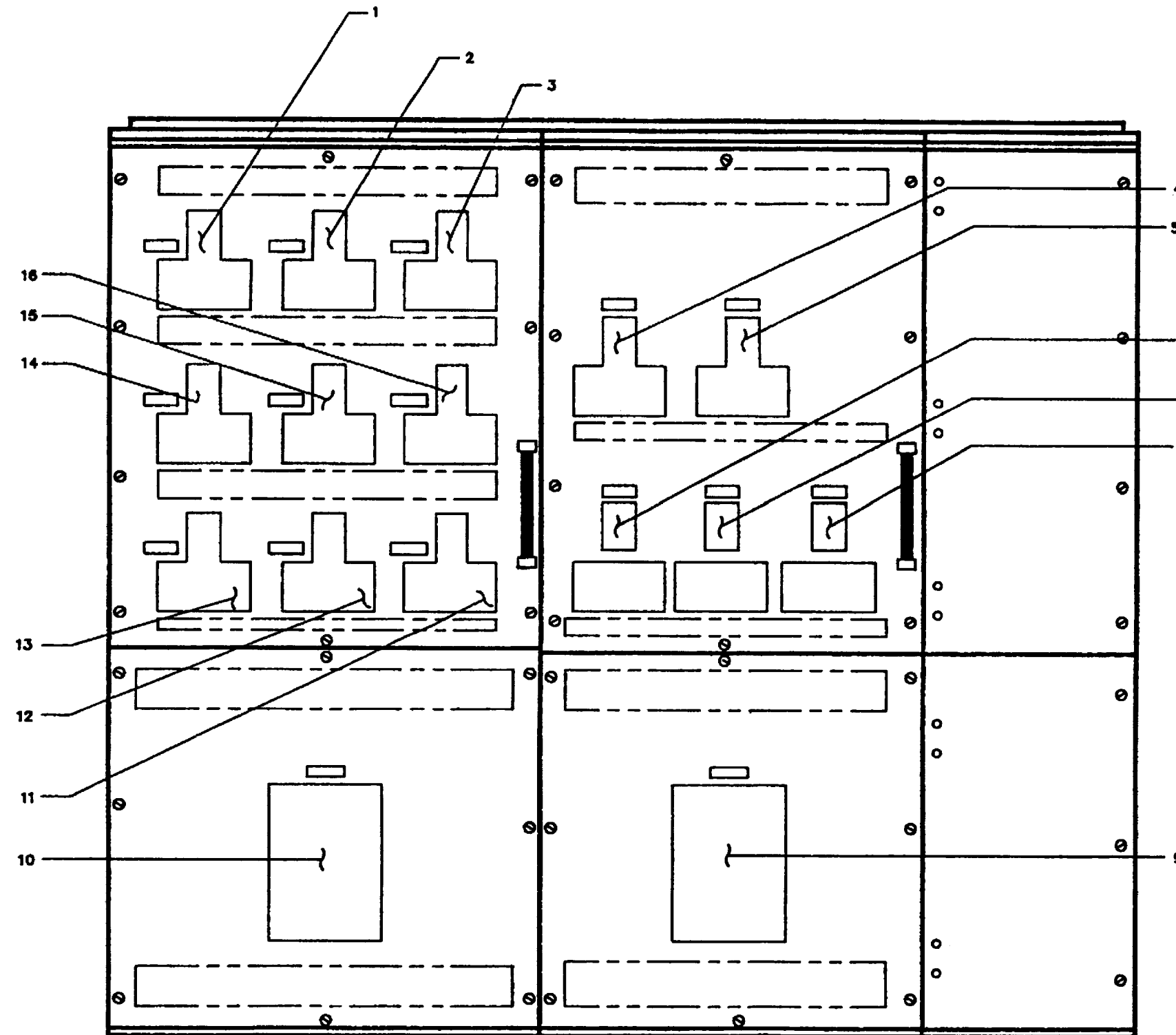
- 1. BUS • BT AMPS
 - 2. RESET • FC DETECTOR
 - 3. B TIE INHIBIT
 - 4. FAULT DETECTED
 - 5. GENERATOR • GEN AMPS
 - 6. GENERATOR • GEN KW
 - 7. GENERATOR • GEN TEMP
 - 8. READY TO START
 - 9. GENERATOR • START
 - 10. TEMP METER
 - 11. GENERATOR • STOP
 - 12. GEN FREQ • LOWER/RAISE
 - 13. GEN SPACE HEATER
 - 14. GOVERNOR • ISO/DROOP DROOP
 - 15. GEN SPACE • HEATER
 - 16. GOVERNOR • ISO/DROOP
 - 17. SYNCH MON • MODE SEL
 - 18. GENERATOR • GEN VOLTS
 - 19. GEN VOLTS • LOWER/RAISE
 - 20. VOLT REG • SELECT
 - 21. VOLT REG • DIFF/DROOP DROOP
 - 22. VOLT REG • MODE SEL AUTO
 - 23. VOLT REG • MODE SEL MAN
 - 24. VOLT REG • DIFF/DROOP DIFF
 - 25. VOLT REG • MODE SEL
 - 26. VOLT REG • DIFF/DROOP
 - 27. CB3130 TRIP
 - 28. 3S GEN POWER • AVAIL
 - 29. CB3130 CLOSE
 - 30. CB3130
 - 31. CB3432 TRIP
 - 32. CB3432
 - 33. CB3432 CLOSE
 - 34. CB3432
 - 35. LC11 FDR CLOSE
 - 36. LC11 FDR TRIP
 - 37. CB3407
 - 38. AC 1 CLOSE
 - 39. AC 1 TRIP
 - 40. CB1032
 - 41. CB3408
 - 42. CB3342
 - 43. J2
 - 44. J1
 - 45. CB3340
 - 46. A/C 2 TRIP
 - 47. A/C 2 CLOSE
 - 48. A/C 4 TRIP
 - 49. A/C 4 CLOSE
 - 50. CB3341
 - 51. CB3208
 - 52. LC21 FDR TRIP
 - 53. LC21 FDR CLOSE
 - 54. A/C 3 TRIP
 - 55. A/C 3 CLOSE
 - 56. CB3408
 - 57. CB3408
 - 58. CB3231
 - 59. CB3231 CLOSE
 - 60. CB3231 TRIP
 - 61. CB3231
 - 62. CONTROL XFR • LOCAL/REM
 - 63. CONTROL XFR LOCAL
 - 64. CONTROL XFR REM
 - 65. GND DET
 - 66. LOAD SHED
 - 67. LOAD SHED • OCCURRED STAGE 2
 - 68. LOAD SHED • OCCURRED STAGE 1
 - 69. GND DET
 - 70. GND DET
 - 71. GND DET
 - 72. GOVERNOR • ISO/DROOP ISOCH
 - 73. SYNCH MON • MODE SEL ON
 - 74. SYNCH MON • MODE SEL TEST
 - 75. BUS • VOLTS
 - 76. BUS METER • SELECT
 - 77. CKT BREAKER & • SYNCH SELECT
 - 78. SYNCHRONIZATION
 - 79. SYNCHRONIZATION
 - 80. GENERATOR • GEN FREQ
 - 81. BUS • FREQ
 - 82. SYNCHRONIZATION • SYNCH SCOPE
 - 83. FAULT CURRENT DET MODE SEL
- * DENOTES LINE CHANGE

Figure 2-16. Switchboard 3SG Control Panel



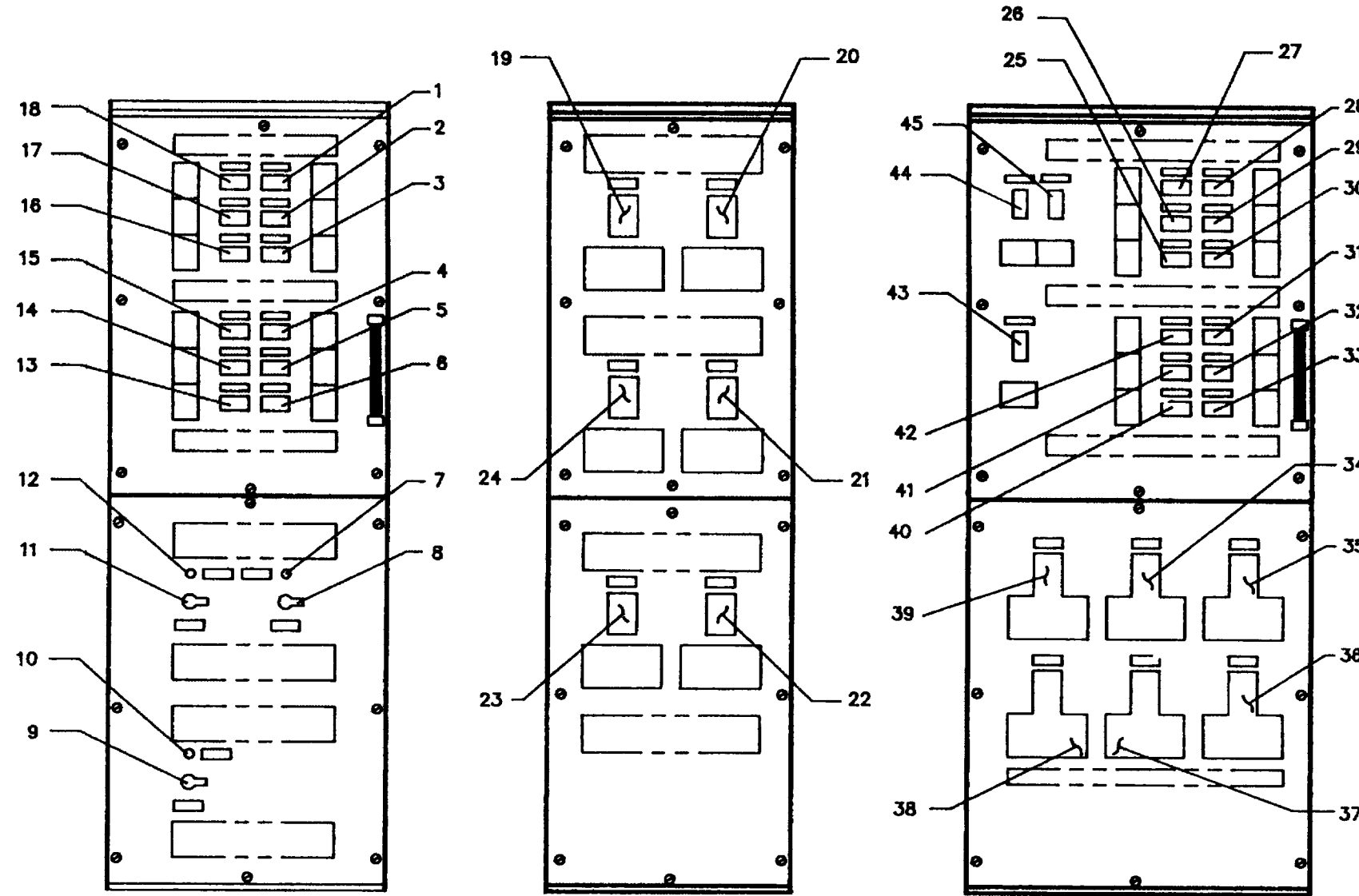
- 1. CASUALTY POWER BREAKER
 - 2. CASUALTY POWER BREAKER
 - 3. CASUALTY POWER *
 - 3. TERMINALS
 - 4. CASUALTY POWER *
 - 4. TERMINALS
 - 5. GEN 3SG SW *
 - 5. COOLING PUMP *
 - 5. 3S-4P-V
 - 6. SHIP SERVICE GENERATOR 3SG *
 - 6. 3SG-4P-3S
- * DENOTES LINE CHANGE

Figure 2-17. Switchboard 3SG Front and Rear View



- 1. FIRE PUMP NO. 3 * 3S-4P-C(ALTN)
 - 2. LAUNDRY 3S-4P-(2-417-2)
 - 3. ER 2 NON VITAL * PNL 3 * 3S-4P-(3-254-2)
 - 4. (BLANK)
 - 5. PWR PNL 2-223-1 * NON-VITAL * TRASH DISPOSAL RM * 3S-4P-(2-223-1)
(W/SHIPALT 51-00159K INSTALLED)
 - 6. B-SIZE MODULE* 3S-4WP-R(NORM)
 - 7. AMR NO. 2 VITAL * 3S-4P-(4-232-2)NORM
 - 8. NON VITAL AUX * ZONE 4 * 3S-4P-(2-418-1)
 - 9. LOAD CENTER * 21 * 3S-4P-LC21
 - 10. 3S/1S * BUB TIE * 1S-4P-3S
 - 11. 120V LTG LC33 * 3S-4L-LC33(NORM)
 - 12. AIR COND MCHRY & * PUMP RM-VITAL * 3S-4P-(4-308-1)NORM
 - 13. CREW/CPO * GALLEY PNL 2 * 3S-4P-(1-219-11)
 - 14. 450V * RADAR RM NO. 3 * 3S-4P-(01-279-1)NORM
 - 15. STEERING PNL 1 * 3S-4P-(3-442-1)NORM
 - 16. CREW/CPO * GALLEY PNL 1 * 3S-4P-(1-219-9)
- * DENOTES LINE CHANGE

Figure 2-18. Switchboard 3SA, Operating Controls and Indicators



1. AFFF STA NO 2 * 3S-4P-(1-329-1)NORM
2. CL X PREHEATER * ENG RM NO 2 * 3S-4P-M(1)
3. CL X PREHEATER * ENG RM NO 2 * 3S-4P-N(1)
4. 450V TACTAS BATHY THERMOGRAPH RM * 3S-4P-(2-447-1)NORM
5. 120V CCS & DC * CENTRAL * 3S-4P-(1-268-1)NORM
6. VITAL AUX ZONE 4 * 3S-4P-(2-392-1)NORM
7. AIR COND CPRSR NO 3 * BREAKER * CLOSED
8. AIR COND CPRSR NO 3 * 3S-4P-G(NORM)
9. AIR COND CPRSR NO 4 * 3S-4P-H(NORM)
10. AIR COND CPRSR NO 4 * BREAKER * CLOSED
11. AIR COND CPRSR NO 2 * 3S-4P-F(NORM)
12. AIR COND CPRSR NO 2 * BREAKER * CLOSED
13. VITAL AUX ZONE 3 * 3S-4P-(1-284-1)NORM
14. GEN RM VITAL * 3S-4P-(3-380-1)NORM
15. 450V COMBAT SYS EQPT RM NO 3 P 2 * 3S-4P-(1-301-1)ALTN
16. 450V IC & GYRO RM NO 2 * 3S-4P-(3-318-2)NORM
17. CL X PREHEATER * AUX MCHRY RM NO 2 * 3S-4P-L(1)
18. AFFF STA NO 1 * 3S-4P-(1-65-1)ALTN
19. FUEL XFER PURIFIER HTR NO 2 * 3S-4P-K(1)
20. (BLANK)
21. ER NO 2 VITAL * PNL 2 * 3S-4P-(3-258-1)NORM
22. ER NO 2 NON * VITAL PNL 1 * 3S-4P-(4-295-1)
23. ENG RM NO 2 VITAL * PNL 3 * 3S-4P-(3-256-2)NORM
24. ER NO 2 VITAL * PNL 1 * 3S-4P-(3-292-1)NORM
25. CL Z VENT ZONE 3 * PNL NO 1 * 3S-4P-(1-326-1)
26. CL W VENT ZONE 3 * 3S-4P-(01-248-1)NORM
27. CL W & X VENT * ZONE 4 * 3S-4P-(01-312-2)NORM
28. CL Z VENT ZONE 4 * 3S-4P-(2-394-2)
29. CL Z VENT ZONE 3 * PNL NO 3 * 3S-4P-(2-359-1)
30. 120V LTG LC41 * 3S-4L-LC41(NORM)
31. (BLANK)
32. (BLANK)
33. FIRE PUMP NO 5 * 3S-4P-A(NORM)
34. CL W RECIRC & MISC AUX ZONE 3 * 3S-4P-(1-281-1)NORM
35. 450V COMBAT SYS EQPT RM NO 3 P 1 * 3S-4P-(1-302-2)NORM
36. NON VITAL AUX * ZONE 3 * 3S-4P-(2-316-2)
37. CL W RECIRC & MISC AUX ZONE 4 * 3S-4P-(2-422-1)NORM
38. FIRE PUMP NO 4 * 3S-4P-D(NORM)
39. 120V LTG LC34 * 3S-4L-LC34(NORM)
40. (BLANK)
41. 120V LTG LC32 * 3S-4L-LC32(NORM)
42. 120V LTG LC25 * 3S-4L-LC25
43. CL W VENT B SIZE * MODULE * 3S-4P-(1-335-2)NORM
44. A SIZE MODUEL * (BACKUP) * 3S-4WP-P(NORM)
45. CL Z VENT ZONE 3 * PNL NO 2 * 3S-4P-(1-326-2)

* DENOTES LINE CHANGE

Figure 2-19. Switchboard 3SB, Operating Controls and Indicators

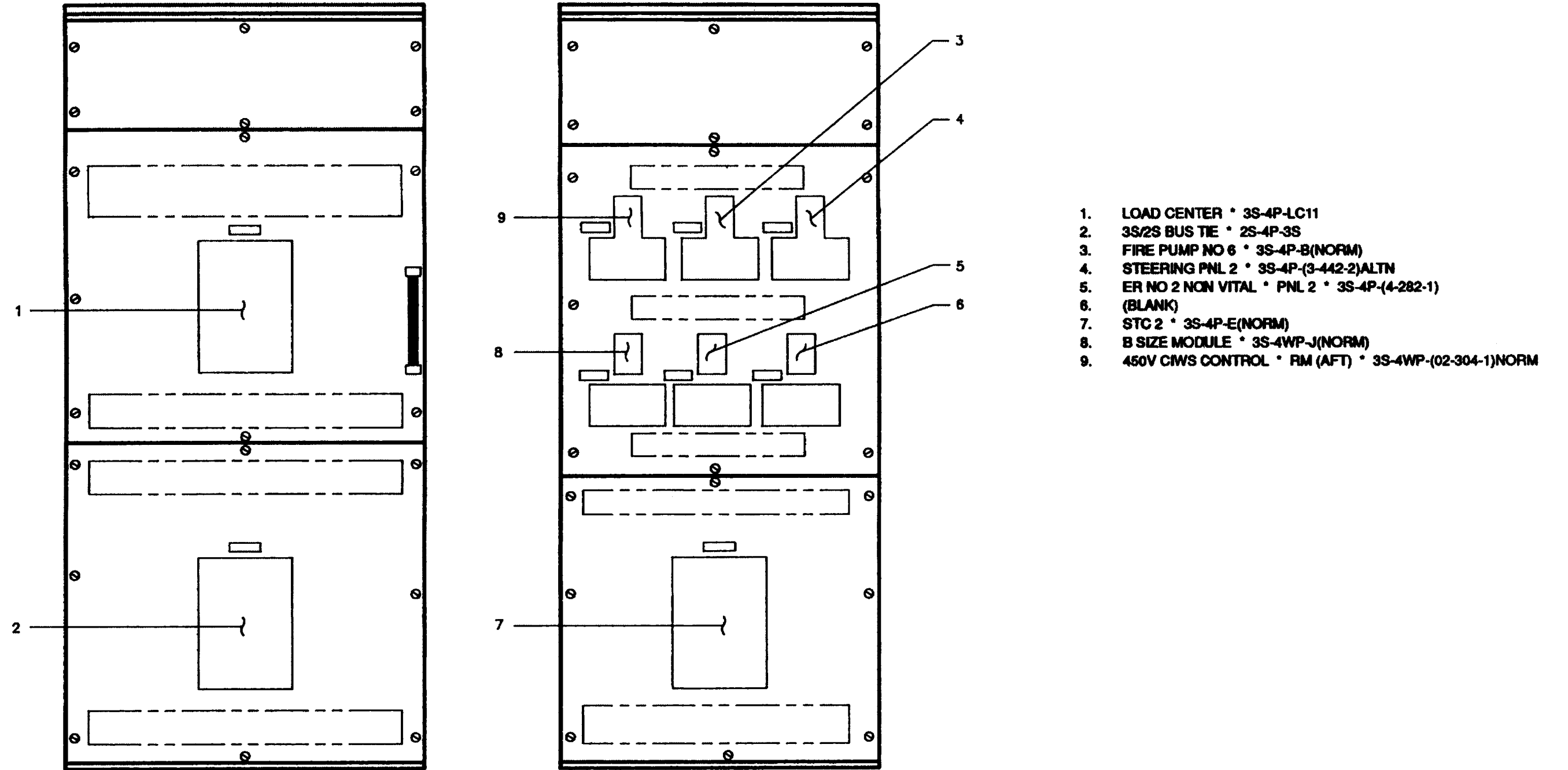
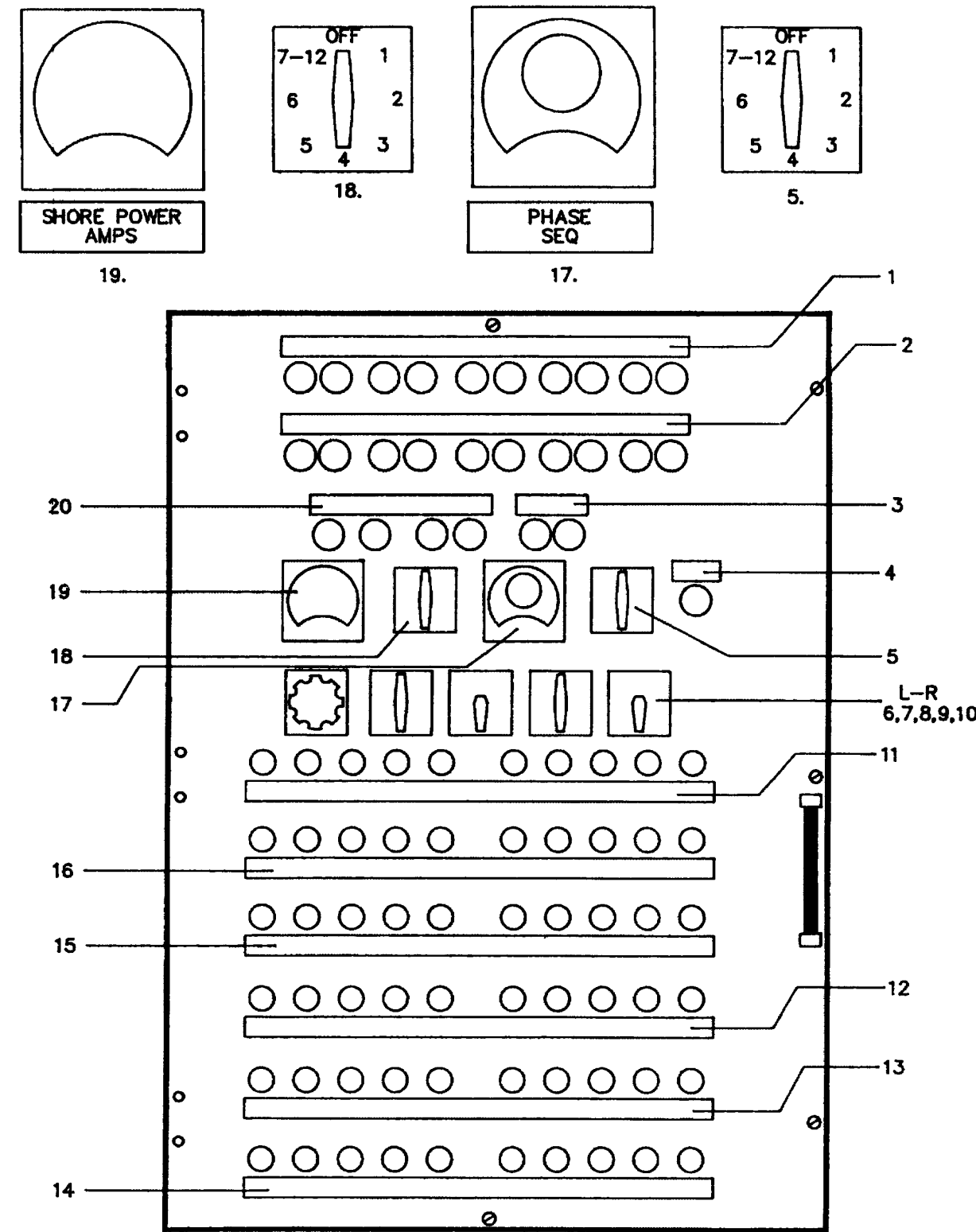


Figure 2-20. Switchboard 3SC, Operating Controls and Indicators



- | | | | | | |
|-----|----------------------|----------------------|----------------------|----------------------|----------------------|
| 1. | CB2201
TRIP CLOSE | CB2202
TRIP CLOSE | CB2203
TRIP CLOSE | CB2204
TRIP CLOSE | CB2205
TRIP CLOSE |
| 2. | 2206
TRIP CLOSE | CB2207
TRIP CLOSE | CB2208
TRIP CLOSE | CB2209
TRIP CLOSE | CB2210
TRIP CLOSE |
| 20. | CB2211
TRIP CLOSE | CB2212
TRIP CLOSE | | | |

3. SHORE POWER PH REF
REF INCMG

4. BUS TIE
ENERGIZED

- | | | | | | | | | | | |
|-----|----------------------|------------------|---------------|----------------------|-----------------------|----------------------|------------------|---------------|----------------------|-----------------------|
| 11. | 6A RCPT NO 1
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2201
UV TRIP | 10A CB2201
CONTROL | 6A RCPT NO 2
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2202
UV TRIP | 10A CB2202
CONTROL |
| 16. | 6A RCPT NO 3
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2203
UV TRIP | 10A CB2203
CONTROL | 6A RCPT NO 4
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2204
UV TRIP | 10A CB2204
CONTROL |
| 15. | 6A RCPT NO 5
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2205
UV TRIP | 10A CB2205
CONTROL | 6A RCPT NO 6
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2206
UV TRIP | 10A CB2206
CONTROL |
| 12. | 6A RCPT NO 7
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2207
UV TRIP | 10A CB2207
CONTROL | 6A RCPT NO 8
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2208
UV TRIP | 10A CB2208
CONTROL |
| 13. | 6A RCPT NO 9
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2209
UV TRIP | 10A CB2209
CONTROL | 6A RCPT NO 10
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2210
UV TRIP | 10A CB2210
CONTROL |
| 14. | 6A RCPT NO 11
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2211
UV TRIP | 10A CB2211
CONTROL | 6A RCPT NO 12
PHA | 6A PH SEQ
PHB | 6A CKT
PHC | 2A CB2212
UV TRIP | 10A CB2212
CONTROL |

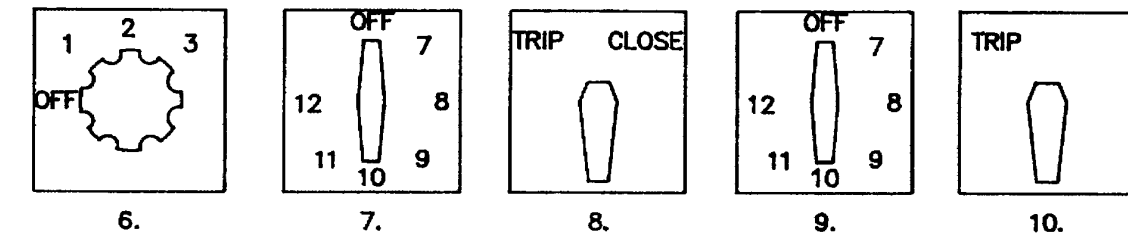


Figure 2-21. Switchboard 2SA, Shore Power Control Panel

CHAPTER 3

FUNCTIONAL DESCRIPTION

3-1. INTRODUCTION

This chapter includes the description of how the equipment operates functionally. [Figure 1-1](#) illustrates the physical appearance of the various cabinets. Basically this equipment can control and distribute 450 VAC, 60 Hz, 3 Phase power wherever needed throughout the ship. Ship's service switchboards 1S, 2S, and 3S perform essentially the same tasks, but with differences due to the distribution of the power to various destinations. Ship's service switchboard 2S has no distribution function. However, it contains the local controls for SSGTG No. 2 and has provisions for connecting shore power to the ship's main distribution system (switchboard 2SA). Ship's service switchboards 1S and 3S can stand alone and function separately with their own generator and distribution system (see [figures 3-1](#) and [3-2](#)). Ship's service switchboard 2S has provisions to add additional generating capacity and connections for shore power. Although the various cabinets of ship's service switchboards 1S and 3S may look differently (see [figure 1-1](#)), they function almost identically. Physical differences are primarily due to the distribution capabilities of each switchboard and the Load Centers supported.

3-2. SWITCHBOARD SYSTEMS FUNCTIONAL OPERATION

3-2.1 GENERAL. One shipset of equipment designed to furnish 450 VAC, 60 Hz, 3 Phase power contains three switchboard systems, associated turbine generators, an EPCC, distribution centers (Load Centers), and associated cabling. This manual is primarily concerned with the switchboards and their capabilities. To illustrate some of the possible configurations available with use of the bus tie breakers, see [figure 3-1](#). With power being distributed from ship's service switchboards 1S and 3S, any standard configuration must have the Main Bus energized in these systems, no matter which generator(s) feed the system. Thus the advantage in having ship's service switchboard 2S bus energized is the ability to have power available at switchboard 2S to control the SSGTG No. 2 in case its power is required. The three generator systems and associated six bus tie breakers allow at least 16 different standard and non-standard configurations available by controls from the switchboard systems or the EPCC. For main bus cabling and bus tie breakers, see [figure 2-1](#) Interconnection Diagram.

3-2.2 EMERGENCY CONFIGURATIONS. [Figure 3-2](#) shows some possible emergency or alternative configurations available when required. Whenever only one generator is feeding the Main Bus, some load shed of non-vital power may be required. These configurations can normally be arranged by the bus tie breakers from the EPCC or from switchboard 1SG, 2SG, and 3SG controls.

3-2.3 SYSTEM AUTOMATIC PROTECTION. There are some protective circuits which operate automatically under certain conditions to activate generator breakers, bus tie circuit breakers, and/or shed load throughout the system. These function primarily to protect the generator(s) but also isolate ship's service switchboards. The FCD Module (A6) operates to isolate switchboards when a fault is detected. It will automatically trip bus tie breakers when conditions dictate. A fault is defined by the FCD when a high load current occurs simultaneously with a drop in generator output frequency. The associated bus tie breakers which are tripped are inhibited from being closed manually until the fault is corrected and the Fault Detector Reset switch is manually pushed on each affected switchboard 1SG, 2SG, and 3SG. The AC Power Sensing Relay Modules (A3a and A3b) activate to shed loads when an overpower condition occurs on a generator. A Reverse Power Relay Module (A2) trips the generator circuit breaker to prevent "motoring" of the generator. For ships with MACHALT 320-59006 (ECP-515) installed, the FCD Module (A6), AC Power Sensing Relay Module (A3a), and Reverse Power Relay Module (A2) are replaced by a single Generator Protection Module. The synchronizing monitor circuits will prevent a genera-

tor from being placed on-line unless it is synchronized with any other generator or shore power already on the Main Bus. The synchronizing system on each generator switchboard may be bypassed under emergency conditions. The Synchronizing Monitor is also bypassed automatically when the switchboard Main Bus is dead. The switchboard bus, therefore, can be reenergized rapidly by closing an energized generator or bus tie breaker onto the dead Main Bus. A ground detection system output on switchboards 1SG, 2SG, and 3SG will detect a ground on phases A, B, or C with lights on the control panel. A ground indication (one or more lights dim) on a phase should be investigated but does not necessarily shut down the system. Detailed functional descriptions of these protective circuits are contained in [paragraph 3-7](#).

3-3. SHIP'S SERVICE SWITCHBOARD 1S

Ship's service switchboard 1S consists of four cabinets containing all necessary controls and circuit breakers to distribute 450 VAC, 3 Phase, 60 Hz power to a portion of the ship.

3-3.1 SWITCHBOARD 1SG. Switchboard 1SG in LOCAL control can start, synchronize and monitor SSGTG No. 1. In addition, it contains protective circuits, panel controls, SSGTG No. 1 circuit breaker, test controls, and indicators. It has two 450 VAC, 60 Hz, 250 ampere casualty power breakers on the rear panel. On the right front panel, it has the circuit breaker that controls the power to the seawater cooling pump for SSGTG No. 1. Switchboard 1SG has switch controls and indicators for the following circuit breakers located in switchboards 1SA, 2SB and 1SC Load Center 31: 1S-2S bus tie, 1S-3S bus tie, STC 1, A/C Compressor 1 (NORM), Load Center 31 and A/C Compressors 2, 3 and 4 (ALTN). On the lower front panel are jacks (J1 and J2) that enable test equipment to be connected for checking some panel metering and controls. It has provisions to connect major metering and control functions to a remote EPCC. Components A1 through A8, with the exception of A4, are physically located in switchboard 1SG. These components are:

- A1 - Synchronizing Monitor
- A2 - Reverse Power Relay Module*
- A3 - AC Power Sensing Relay Module (Overpower)(A3a* and A3b)
- A5 - Analog Bus Ground Detector Module
- A6 - Fault Current Detector Module*
- A7 - Capacitor Discharge Unit
- A8 - Remote Turbine RPM Detector Module*

* For ships with MACHALT 320-59006 (ECP-515) installed, these components are replaced by a single Generator Protection Module.

The circuit breakers are designated the 1100 series: for instance, Generator Breaker (1110), Casualty Power (1102, 1103) and Seawater Cooling (1101). Switchboard 1S is also supplied 28 VDC from an external source (No Break Power Supply) for use with FCD circuits. Additional externally sourced and controlled 28 VDC relays provide the means for remote control. In the rear of switchboard 1SG are located Disconnect Links (one per phase), which manually separates the Main Bus of switchboard 1SG from switchboard 1SC. This is normally connected but may be disconnected when it is necessary to isolate switchboard 1SG or 1SC for servicing. A manual type disconnect wrench (located on rear) is furnished for this task. Most of the control and monitoring relays of ship's service switchboard 1S are physically located in switchboard 1SG.

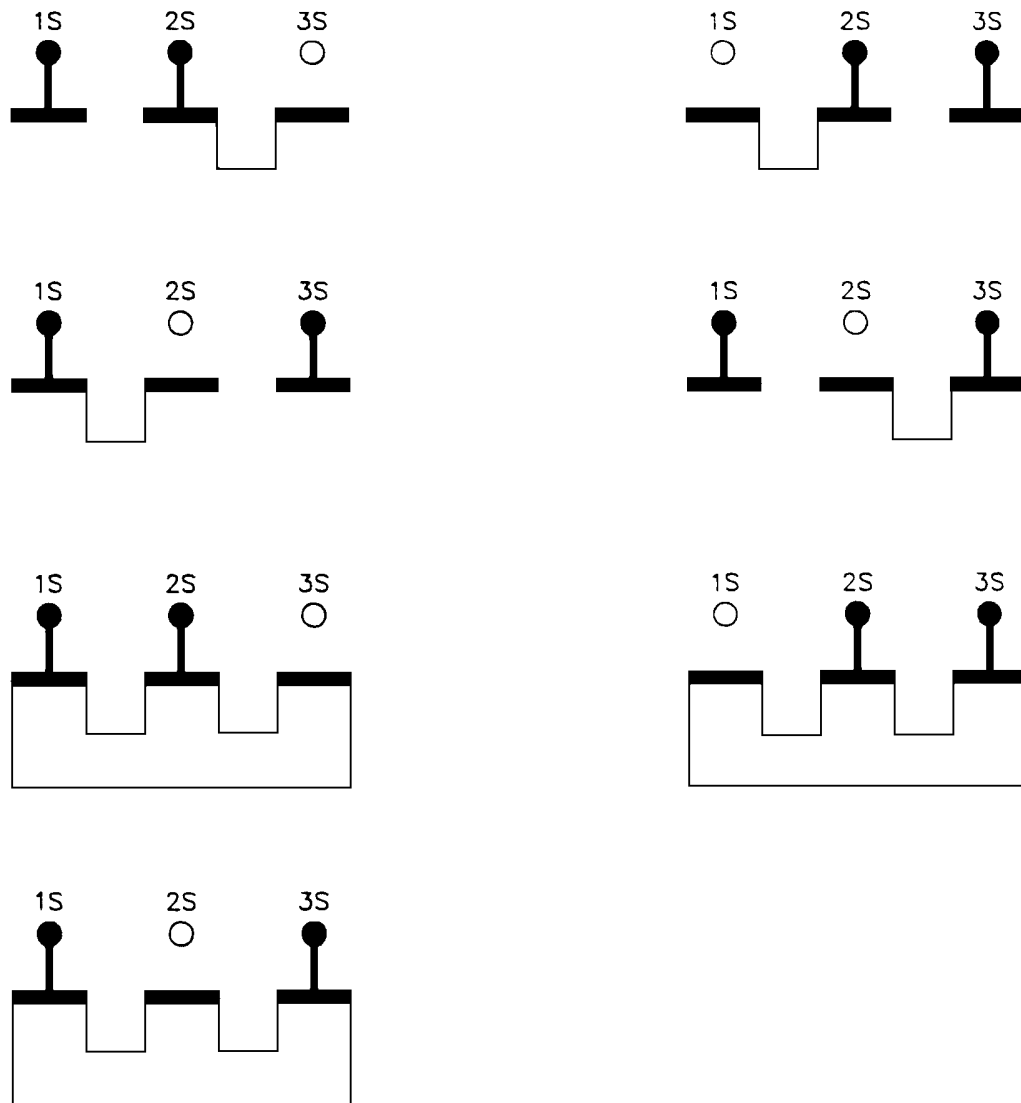
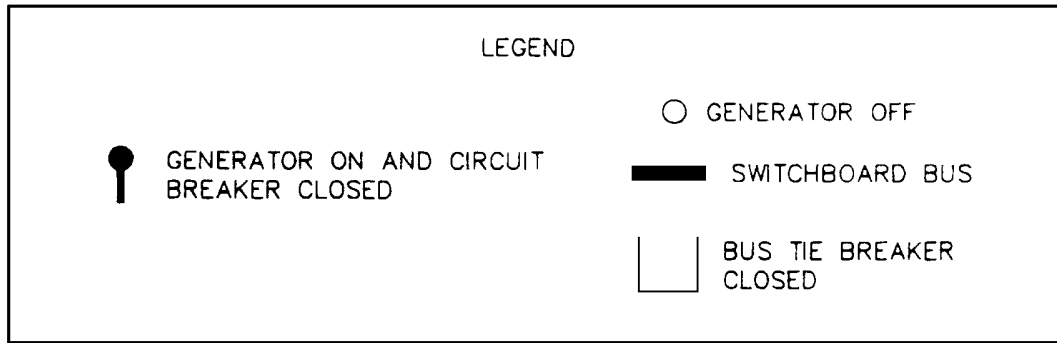


Figure 3-1. Standard Plant Configuration

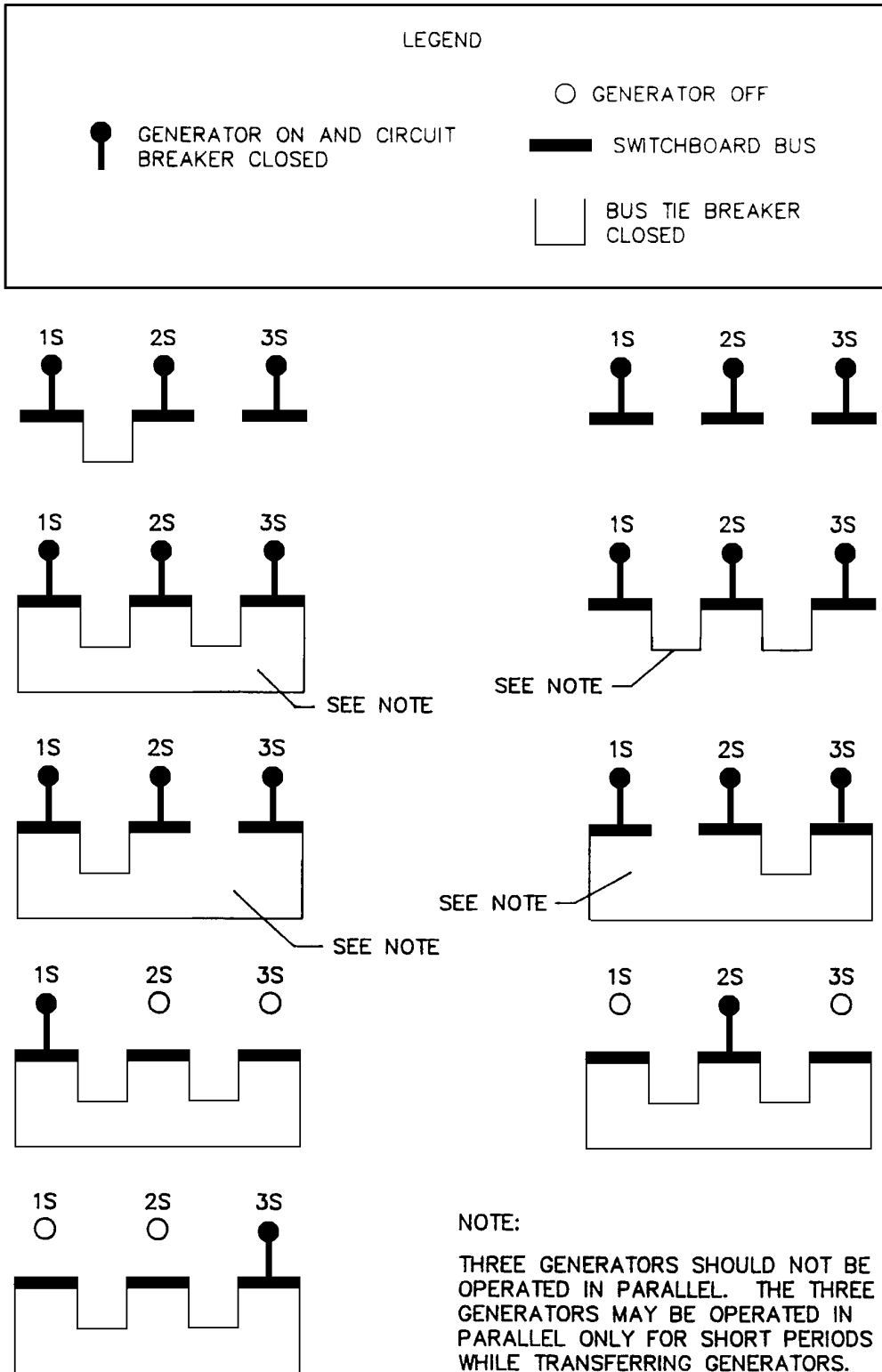


Figure 3-2. Alternate Configurations

3-3.2 SWITCHBOARD 1SA. Switchboard 1SA is a distribution switchboard and contains 17 circuit breakers (CB1201 through CB1217). Disconnect links are provided to manually separate the main bus of switchboards 1SA and 1SB. A bus tie breaker (CB1212 for 1SA/2SA) which is used to isolate the Main Bus in 1SA. The other large circuit breaker (CB1209) supports a Load Center (LC31). Other circuit breakers go to various major users of 450 VAC, 60 Hz, 3 Phase power. Three spare circuit breakers are furnished for future use.

3-3.3 SWITCHBOARD 1SB. Switchboard 1SB is strictly a distribution switchboard with 53 circuit breakers (CB1301 through CB1357) feeding various locations with 450 VAC, 60 Hz, 3 Phase power. It contains four spare circuit breakers for future use.

3-3.4 SWITCHBOARD 1SC. Switchboard 1SC is also primarily a distribution switchboard, containing 12 large circuit breakers. It contains disconnect links which isolate switchboard 1SC from switchboard 1SB. Circuit breaker (CB1413) is the 1S/3S bus tie breaker which connects ship's service switchboards 1SC and 3SA. The other large breaker (CB1409) furnishes power to solid-state Frequency Changer 1. These circuit breakers carry the 1400-series reference designation. One spare circuit breaker is available.

3-4. SHIP'S SERVICE SWITCHBOARD 2S

Ship's service switchboard 2S and its associated generator function together as a source of power when the crew desires to energize ship's service switchboards 1S and/or 3S with power from SSGTG No. 2. Ship's service switchboard 2S, in switchboard 2SA, also functions as the control for connection to shore power when required.

3-4.1 SWITCHBOARD 2SG. Switchboard 2SG has the same controls and indicators as switchboard 1SG for controlling and monitoring SSGTG 2 but does not provide distribution. It contains the SSGTG No. 2 circuit breaker (CB2120) and also the same synchronizing, monitoring and test circuits as switchboard 1SG. It contains control switches for bus tie breakers (CB2323 and CB2221) which are located on switchboards 2SB and 2SA, respectively. It also contains two Casualty Power breakers on the rear and the Seawater Cooling breaker on the right front. There are two sets of disconnect links for isolation of switchboards 2SG from 2SA and 2SB. A disconnect link wrench is mounted on the rear panel. Circuit breakers in this system carry the reference designation in the 2100 series (CB2120, CB2101, etc.). Switchboard 2SG contains solid-state component modules A1 through A8 except for A4 which is located in switchboard 2SA. For ships with MACHALT 320-59006 (ECP-515) installed, modules A2, A3a, A6, and A8 are replaced by a single Generator Protection Module.

3-4.2 SWITCHBOARD 2SA. Switchboard 2SA provides the capability to tie shore power into the ship's distribution system. It utilizes 12 circuit breakers for this purpose, each capable of carrying 400 amperes at 450 VAC, 60 Hz 3 Phase. Normally, only the anticipated quantity of circuit breakers required to handle all power requirements of the ship in port are connected. Switchboard 2SA has a trip switch (S4) which can isolate Main Bus 1SA-2SA by tripping circuit breaker (CB1212) in switchboard 1SA and (CB2221) in switchboard 2SA. The control panel also has switches and a meter, and lights to check for correct phase sequence and orientation. Fuses are provided on each leg of incoming connections. A switch (S11) enables all connected circuit breakers (CB2201 through CB2212) to be opened or closed simultaneously when transferring power to the 2SA bus. Circuit breakers in switchboard 2SA carry a 2200 series reference designation. In addition, switchboard 2SA contains Over-current (Shore Power) Detector Modules (A4). These modules will load when overcurrent conditions exist.

3-4.3 SWITCHBOARD 2SB. Switchboard 2SB contains bus tie breaker (CB2323) and associated circuits and is controlled from switchboard 2S. Switchboard 2SB has no distribution function and does contain a Main Bus.

3-5. SHIP'S SERVICE SWITCHBOARD 3S

Ship's service switchboard 3S performs the same functions as ship's service switchboard 1S, however, it is located aft on the ship. It operates independently with the load systems it supports or in parallel with the configurations indicated in [paragraph 3-2](#). The cabinets have a different physical appearance due to the differing distribution requirements.

3-5.1 SWITCHBOARD 3SG. The switchboard 3SG Generator control panel is identical in component layout to switchboard 1SG except for the differing nomenclature. Switchboard 3SG has all the capabilities of switchboard 1SG (refer to [paragraph 3-3.1](#)). Similarly to switchboard 1SG, switchboard 3SG contains solid-state component modules A1 through A8 except for A4 which is located in switchboard 3SA. For ships with MACHALT 320-59006 (ECP-515) installed, modules A2, A3a, A6, and A8 are replaced by a single Generator Protection Module. Circuit breaker reference designations start with series 3100. This cabinet contains most of the relays for ship's service switchboard 3S. Disconnect links are provided to manually separate switchboard 3SG from switchboard 3SA. A manual type disconnect wrench (located on rear) is furnished for this task.

3-5.2 SWITCHBOARD 3SA. Switchboard 3SA contains bus tie breaker (CB3231) which connects the Main Bus to the 3S/1S bus tie and to switchboard 1SC. The primary purpose of this switchboard is to distribute 450 VAC, 60 Hz, 3 Phase, vital and non-vital power to various locations as well as to Load Center (LC21), distribution to LC21 requires a large breaker (CB3208). It contains 15 circuit breakers (CB3201 through CB3215) plus the bus tie breaker (CB3231). Disconnect links are provided to manually separate switchboard 3SA from switchboard 3SB. Two spare circuit breakers are furnished for future use.

3-5.3 SWITCHBOARD 3SB. Switchboard 3SB is used as a distribution center connecting 450 VAC, 60 Hz, 3 Phase power from its main bus. Forty-two circuit breakers (CB3301 through CB3330 and CB3334 through CB3347) are utilized feeding a large variety of equipment with power from the Main Bus. Four spare circuit breakers are provided for future use.

3-5.4 SWITCHBOARD 3SC. Switchboard 3SC contains nine circuit breakers and is primarily used for distribution of 450 VAC, 60 Hz, 3 Phase electrical power from its main bus. It contains three large air breakers and disconnect links. The disconnect links provide a manual means to isolate switchboard 3SC from switchboard 3SB. One bus tie circuit breaker (CB3432) connects the Main Bus from switchboard 3SC to the 2SB main bus. The other two large circuit breakers (CB3407, CB3408) support Load Center (LC11) and solid-state Frequency Changer 2. One spare circuit breaker is provided for future use.

3-6. GENERATOR METERS AND CONTROLS

3-6.1 SWITCHBOARDS 1SG, 2SG, and 3SG METERING. Voltage to power the metering circuits of these switchboards is supplied by both step-down and current transformers.

3-6.1.1 Potential Transformers. Voltage to the meters on the Generator Control Panel of switchboards 1SG, 2SG and 3SG is supplied by step-down transformers from the Main Bus on the generator side (see [figure 5-1](#)). Using switchboard 1SG as a typical example, operating voltages for the meters come from the secondaries of power transformers (PT1 and PT2). The primary of each transformer is protected in each leg by fuses (F101 through F104) and furnishes nominal 120 VAC, 60 Hz, 1 Phase power for Wattmeter (M8), Voltmeter (M11), and Frequency Meter (M6) as well as AC Power Sensing and Reverse Power Relay Modules. There is a Test Jack (J1) in the secondary circuits, which may be used for a means of connecting external metering circuits. AC voltage to metering circuits may be measured here using a primary standard voltmeter to check meters.

3-6.1.2 Current Transformers.

WARNING

Current transformers must not be open circuited on their secondaries while current is flowing through its primary. High secondary voltages are generated that may create a personnel hazard and may also cause permanent damage to the CT.

CT1 and CT2 reduce current from the generator Main Bus at a ratio of 6,000:5 to be used for Wattmeter (M8), Ammeter (M1), Fault Current Detection, Reverse Power, and Overpower Protective circuits. The secondary of each transformer is protected by a thyrite protective device containing a thermostatic switch which allows current to flow with negligible secondary burden. A toggle switch (S32) is also placed across the secondary windings and should be turned on when replacing a meter. A test jack (J2) provides a means for connecting a primary standard ammeter or wattmeter to check the accuracy of the panel meters. Identical transformers, switches, fuses, and thyrite protective devices are furnished for remote metering to the EPCC (with different reference designations) (see [figure 5-18](#)).

3-6.2 GENERATOR CONTROLS. The main gas turbine generator starting controls are remoted to the switchboard 1S, 2S, and 3S control panels and the EPCC from the LOCOP (Generator Local Operating Panel). The operation of these controls is explained in [Chapter 2; OPERATION](#). These switches actuate various relays which close contacts and cause the indicated actions. [Tables 5-4, 5-5, and 5-6](#) specify which relays perform certain functions.

3-6.2.1 Voltage Regulators. Each generator has three voltage regulators (not contained in the switchboard) consisting of two automatic regulators and one manual regulator. The switchboard contains the means to select the regulator mode, voltage set point, and the regulator to be in control while the switchboard is in LOCAL control. When the switchboard is set up for remote control the EPCC operator can select between automatic or manual regulators, can select differential or droop control for automatic regulator operation, can raise or lower the automatic regulator in control or the manual regulator if it is in control. The primary automatic voltage regulator desired can only be selected at the switchboard (by means of S31). The other automatic voltage regulator is automatically established as the backup regulator. The EPCC operator is not provided with the ability to deenergize the voltage regulators.

3-6.2.2 Automatic Compensating. The automatic compensating methods are selectable when operating with an automatic voltage regulator. These are differential and droop. Differential is normally selected. This method of compensation provides the highest degree of regulation. Droop mode associated with automatic regulators may also be selected, however, voltage may drop slightly as generator load is increased. This mode works better than differential mode when operating in parallel with shore power.

3-6.3 VOLTAGE REGULATOR CONTROLS. When the voltage regulator is operating in the AUTO mode (DS34 illuminated) the selected automatic voltage regulator (S31) becomes the primary. The automatic regulator (VR1 or VR2) not selected is the standby regulator and is selected by LOCOP upon detecting primary voltage regulator failure. Both primary and standby automatic voltage regulators (VR1 or VR2) attempt to maintain the set voltage on the Main Bus. The voltage regulator is not contained within the switchboard systems, but is controlled by switches (S14 and S15) and relays K1110, K1111 and K1114. The Generator Volts switch (S15) is still adjustable when the VOLT REG MODE SEL switch is in the AUTO position. AUTO is the normal position for

this switch. With switch (S13) in the MAN position, the voltage may change with generator loads changes and the operator will need to periodically reset the generator output voltage by means of switch S15. The DIFF position of the VOLT REG DIFF/DROOP switch (S14) is normal when the generator is on-line with the GOVERNOR ISOCH/DROOP switch set in the ISOCH position. The DROOP position of the VOLT REG DIFF/DROOP switch (S14) corresponds to the DROOP position of the GOVERNOR ISO/DROOP switch or when shore power is being put on-line. When a ship's service generator is operating in parallel with shore power, the voltage regulator and governor should always be in DROOP mode of operation.

3-6.4 SYNCHRONIZING CIRCUITRY. The purpose of the synchronizing control circuitry is to electrically prevent the closing of the generator circuit breaker or bus tie breakers until the energized systems are properly synchronized. The synchronizing circuits in switchboard 1SG, 2SG, and 3SG are practically identical. On the left side of the control panel, there are three Main Bus meters: BT AMPS (M2), FREQ (M7), and VOLTS (M5). Also, the synchronizing monitor (SYNCH SCOPE-M11) is on this side. In addition, there are two clear-lensed synchronization lamps (DS1 and DS2), which reflect the phase difference between two sources on opposite sides of an open generator or bus tie breaker. These synchronization lamps are not connected to the main synchronizing circuitry but are alternate indicators in the event the main synchronizing circuitry is not working. When synchronizing generator power with Main Bus power, these lights will go out when the voltage is in phase. The BUS METER SELECT switch (S17) allows the operator to select the bus that will show on his meters. The CRT BREAKER & SYNCH SELECT switch (S19) allows the selection of the bus with which synchronization is desired. The meters on the synchronizing panel should be compared with the generator meters and the operator should match the voltage and frequency prior to synchronization. The SYNCH MON MODE SEL switch (S38) should be in the OPERATE position for normal operation. In the BYPASS position the safety interlocks (provided by the synchronizing monitor to prevent breaker closure when out of phase are defeated. BYPASS should only be used by an experienced operator when conditions are not present to satisfy the synch monitor or in the event that the synch monitor is out of commission. Care should be taken to assure bus ties are dead or voltages on opposite sides of a breaker are synchronized prior to operating breakers.

3-6.4.1 Synchronization Circuit Lights. The clear-lensed synchronization circuit light indicators (DS1 and DS2) enable the operator to see a phase difference by the brightness of the lights (see [figure 5-18](#)). A reference voltage (phase C) is obtained from the Main Bus by the position of CKT BREAKER & SYNCH SELECT switch (S19). It is impressed across a transformer and compared with phase C of the voltage coming from the generator on the opposite side of the selected breaker. When the indicator lights are brightest, the phase difference is greatest; and the generator circuit breaker (CB1110, CB2120, or CB3130) must not be closed. When the indicator lights are dim or out, phase difference is nil or negligible, and the selected breaker can be closed.

3-6.4.2 Synchronizing Monitor (A1).

CAUTION

If synchronization circuits are not working properly, a generator may be synchronized manually using the BYPASS position on SYNCH MON MODE SEL. The SYNCH scope and SYNCHRONIZATION lights will still give correct indications. This action is not recommended except for urgent/emergency situations.

Synchronizing Monitor Module (A1) is a separate, 4-card module that compares generator voltage and Main Bus voltage prior to synchronizing the generator with the Main Bus. From potential transformers (PT5 and PT6) on the Main Bus, it compares Main Bus reference voltage, frequency and phase angle to generator voltage, fre-

quency and phase angle. If these items match, and a command to close the selected breaker is received while these match, then the synch monitor will close a permissive contact that will pass the breaker close command on to the closing relay of the selected breaker. Power for Synchronizing Monitor Module A1 is obtained from the oncoming and reference AC sources applied as inputs. For the synchronizing circuits to work, CKT BREAKER & SYNCH SELECT Switch (S19) must be positioned to the breaker which operator intends to close and SYNCH MON MODE SEL (S38) must be in OPERATE position. If the Generator Switch (S1) is closed outside the “window” of acceptable values of voltage, frequency and phase angle, the synchronizer ignores the CLOSE command. The switch (S1) must be allowed to return to neutral so the synchronizer can reset and allow another try. The synchronizing scope (M11) gives a visual indication of the synchronization so that the operator can rapidly synchronize a generator with the Main Bus. A TEST position of the SYNCH MON MODE SEL switch furnishes the operator with reassurance that the synchronizing circuits are operating properly. Turning the switch to the test position must also be accomplished while the synch monitor is within the “window.” Indicator DS31 will light when SYNCH MON MOD SEL switch is in OPERATE. Both indicators (DS29 and DS31) will light when frequencies are synchronized and SYNCH MON MODE SEL switch is in TEST or operate position. The test light on indicates that the synchronizing monitor is satisfied and its output contacts change state. The contact closure is prevented from operating breakers because S38 must be in the “operate” position and S1, S2, or S3 must be closed. Neither is true during test. The cards in Module A1 are factory adjusted and should be replaced when the unit itself malfunctions (refer to [paragraph 5-4.3.2](#)).

3-6.4.2.1 Synch Monitor Modules. The synchronizing monitor contains four plug-in modules, as follows: (1) Frequency Module, which prevents the circuit breaker from closing unless the difference in frequency between the oncoming generator and the bus is less than 0.2 Hz; (2) Voltage Module, which prevents the circuit breaker from closing unless the difference in voltage between the oncoming generator and the bus is within 5 percent of rated voltage; (3) Phase Angle Module, which prevents the circuit breaker from closing unless the difference in phase angle between the oncoming generator and the bus is between minus 30 and zero electrical degrees and (4) Output Board Module, which responds to the output signals of the three previously listed modules, and acts to allow or prohibit a circuit breaker closing signal.

3-6.4.2.2 General Theory of Operation. See [figure 5-1](#). The input voltages which the synchronizing monitor compares for phase angle, voltage magnitude, and frequency, are applied to it via terminals 3 through 8 of terminal board TB1. The primary windings of potential transformers T1, T2, and T3 each receive an input of 120 VAC, 60 Hz, but not all from the same voltage source. Transformers T1 and T3 receive their input voltage from one side of the generator, bus tie, or shore power circuit breaker. However, transformer T2 receives its input voltage from the opposite side of the same circuit breaker. This operation shows how the AC inputs to the synchronizing monitor are electrically connected (through switchboard circuitry) directly across the circuit breaker to be closed. Actual closure of the monitored circuit breaker removes voltage from transformers T1, T2, and T3.

3-6.4.2.3 Output Module. See [figure 5-3](#). The functional operation of the phase angle, voltage, and frequency modules in the synchronizing monitor can best be understood after becoming familiar with the operation of the output module, described as follows:

3-6.4.2.4 Relay K1. One of the most important detail parts in the synchronizing monitor is relay K1 in the output module. It is important because the 28 VDC circuit breaker closure signal will not have a completed current path unless the normally open K1 contacts are closed. When closed, these contacts jumper together terminals 6 and 7 on terminal board TB1, therefore, for circuit breaker closure, it is mandatory that relay K1 be energized. The power to energize relay K1 (and the other detail parts in the output module) comes from the output of the full wave rectifier bridge comprised of diode rectifier CR2. This rectifier bridge receives its AC input voltage from the secondary windings of internal transformer T3. The end of the K1 coil connects to the negative output

terminal of the rectifier bridge through transistor Q2, which must be in the on (conducting) state for relay K1 to be energized. Moreover, Q2 will not be in the on state unless transistor Q1 in the output module, and the other three modules (phase angle pin N, voltage pin P, and frequency pin H) either prevent (low signal) or permit (high signal) circuit breaker closure.

3-6.4.2.5 Frequency 0.2 Hz Module. See [figure 5-21](#). The frequency module is made up of diodes (CR1 and CR2), op amps (Z1, Z2, and Z3), frequency-to-voltage converter (Z3, Z4), resistors, and potentiometers (R14 and R23). The purpose of the frequency module is to prevent the monitored circuit breaker from closing unless the difference in frequency between the oncoming generator and the bus is less than 0.2 Hz.

3-6.4.2.6 Frequency Theory of Operation. The frequencies from generators are inputted via terminals P & R which are buffered to Z4 and Z5, frequency to voltage converters. The output voltages are taken from pins 8 of Z4 and Z5 which are buffered and amplified equally by Z3 and Z1 operating amplifiers. The voltage inputs to Z2 pins 13 and 12 are equal and give a null output at pin 14. The threshold values at pins 3 and 9 of Z2 are set at +0.195V and -0.195V respectively by comparators Z3 (pin 12) and Z1 (pin 12). If the output at pin 14 of Z2 should exceed ± 0.195 V in either direction this will turn transistor Q1 on, driving the output H low. This output voltage at H is sent to the output module.

3-6.4.2.7 Voltage 5 Percent Module. The purpose of the phase angle module is to prevent the monitored circuit breaker from closing unless the difference in voltage between the oncoming generator and the bus is within 5 percent. Generator A is tied to terminals N and R, while Generator B is tied to terminals F and H. The rectified voltage values are inputted across the inputs 2 and 3 of Z1. The output at pin 1 is approximately 0 volts. Should the output at pin 1 vary more than ± 0.370 volts, transistor Q1 will turn on and output P will go low.

NOTE

The threshold range of ± 0.370 volts is set by pots R6 and R4 on the voltage board.

3-6.4.2.8 Phase Angle Module. (See [figure 5-4](#)). The purpose of the phase angle module is to prevent the monitored circuit breaker from closing unless the difference in phase angle between the oncoming generator and the bus is between minus 30 and 0 electrical degrees.

3-6.4.2.9 Theory of Operation. The inputs from Generator A are taken across terminals R and A; and Generator B is taken across terminals S and B. The phase angle printed circuit board has two identical separate circuits. Should either malfunction, the other can be utilized by engaging switch P from position 2 to position 1 or vice versa. When the frequency inputs at terminals R and S are synchronized, the output of the D type flip flop will give a steady pulse train. This turns Q1 on and lights the LED at terminal N. As long as the frequencies terminals R and S receive a phase angle of 30° of each other, the above condition remains true. Exceeding this angle shuts off Q1 and in turn LED at terminal N. The same principle applies for inputs B and A when that circuit is selected.

3-7. CIRCUIT BREAKER CONTROL

An operator at the main switchboard controls the generator and bus tie circuit breaker for power distribution to loads. The overall Electric Plant is arranged to provide for independent and split plant operation of the SSGTGs to ensure power availability to electrical systems and equipment. Each switchboard contains numerous types of circuit breakers: AQB-A101F, AQB-LF250, AQB-LF400, ACB-1600HR, and ACB-4000HR. These

breakers receive their electrical power from the switchboard main bus which is in turn, energized by the SSGTG. The primary purpose of the circuit breakers is to distribute electrical current to a load when the breaker is closed. The closure is initiated either manually (at the switchboard) or electrically (at the switchboard or EPCC). An operator physically performs the manual operation while a 28 VDC relay and/or 115 VAC motor performs the electrical operation.

3-7.1 MOTOR OPERATOR CIRCUIT. The A/C CMPSR (located in the Load Centers) breakers are normally operated by a motor operator which is mounted on the circuit breaker itself. The motor is electrically controlled by relays energized by signals from the appropriate 60 Hz main switchboard. These signals may be initiated locally at the 60 Hz main switchboard or remotely (closing only) from the EPCC. When this 115 VAC relay is energized (see [figure 3-3](#)), it closes a set of contacts which apply 115 VAC to the motor operator of the circuit breaker. The motor operator then turns and closes the related breaker.

3-7.1.1 Closing Circuit Breaker. As shown in [figure 3-4](#), 115 VAC power is available at S1. Upon the momentary rotation of S1 to the CLOSE (C) position, A and B contacts (N.O.) close and energize the closing relay (CR). Contact 1S (N.O.) is closed via the circuit breaker mechanical interlock. This interlock prevents closure when the removable element of the circuit breaker has been removed. This allows CR to energize the closing coil (CC) of the circuit breaker. The circuit breaker closes thus closing the auxiliary contact “a” and illuminating DS1.

3-7.1.2 Opening Circuit Breaker. To open the circuit breaker, momentarily place S1 in the TRIP (T) position thus closing the H & G contacts and energizing the Trip Coil (TC). The Trip Coil then allows for the mechanical release of the circuit breaker contacts. The auxiliary contact “a” opens, extinguishing DS1.

3-7.2 SHUNT TRIP CIRCUIT. Several breakers in the 60 Hz main switchboards contain shunt trip circuits. These shunt trips are a part of the load shedding circuit for the ship’s service distribution system. Refer to the control schematic sections of [figures 5-18](#) through [5-20](#) for a detailed overall view. When indicated, a signal closes the associated in-line relay contact of the shunt trip circuit. If the circuit breaker is already shut, the “a” and “b” contacts of the circuit breaker are closed and opened respectively. This completes the circuit to the shunt trip coil and allows for tripping of the circuit breaker.

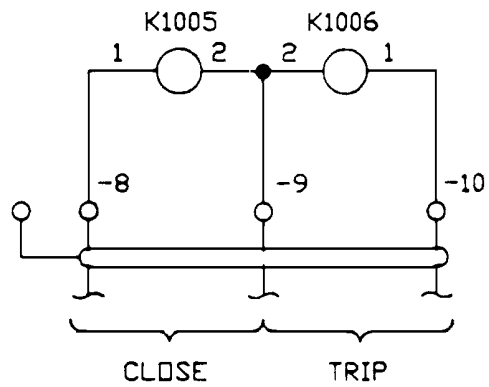
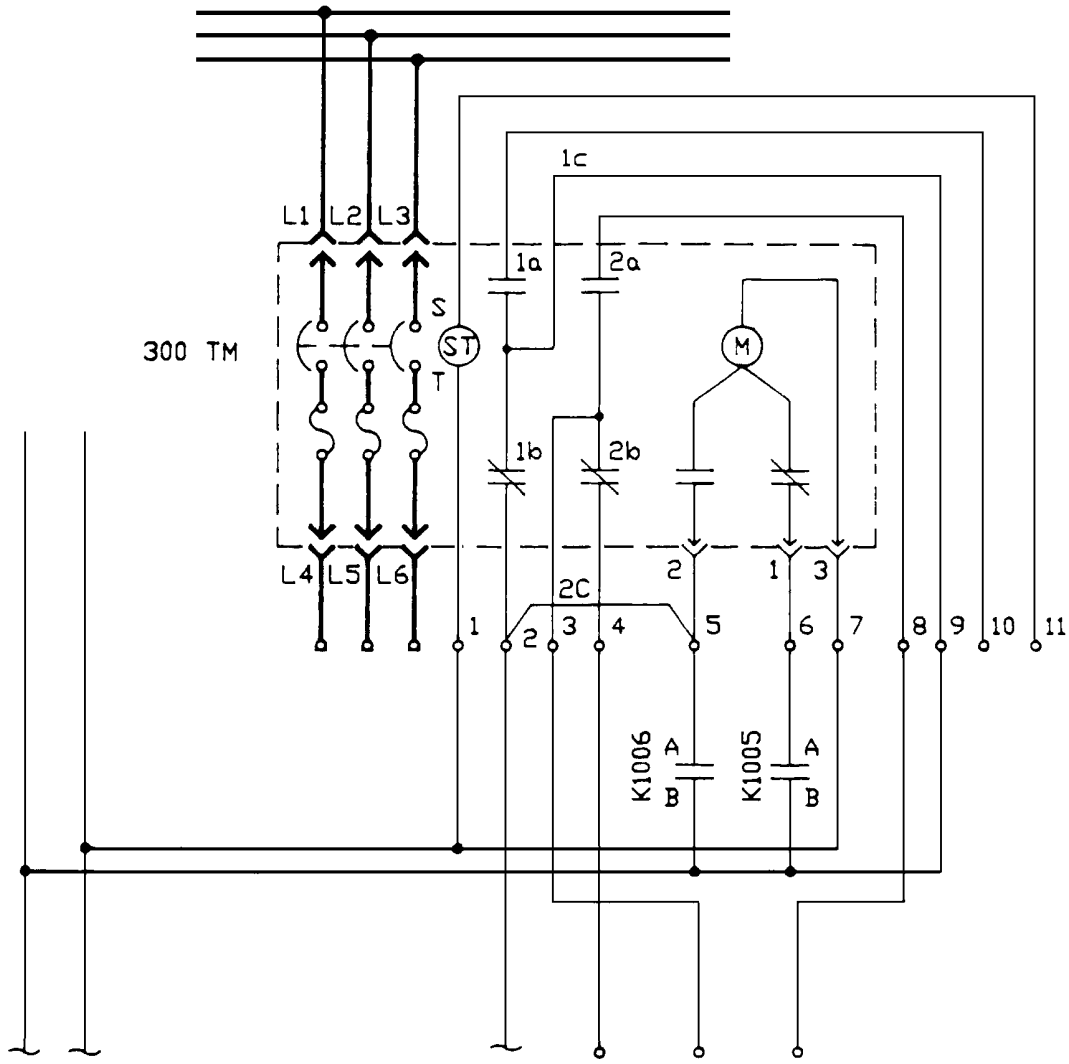


Figure 3-3. Motor Operator Circuit

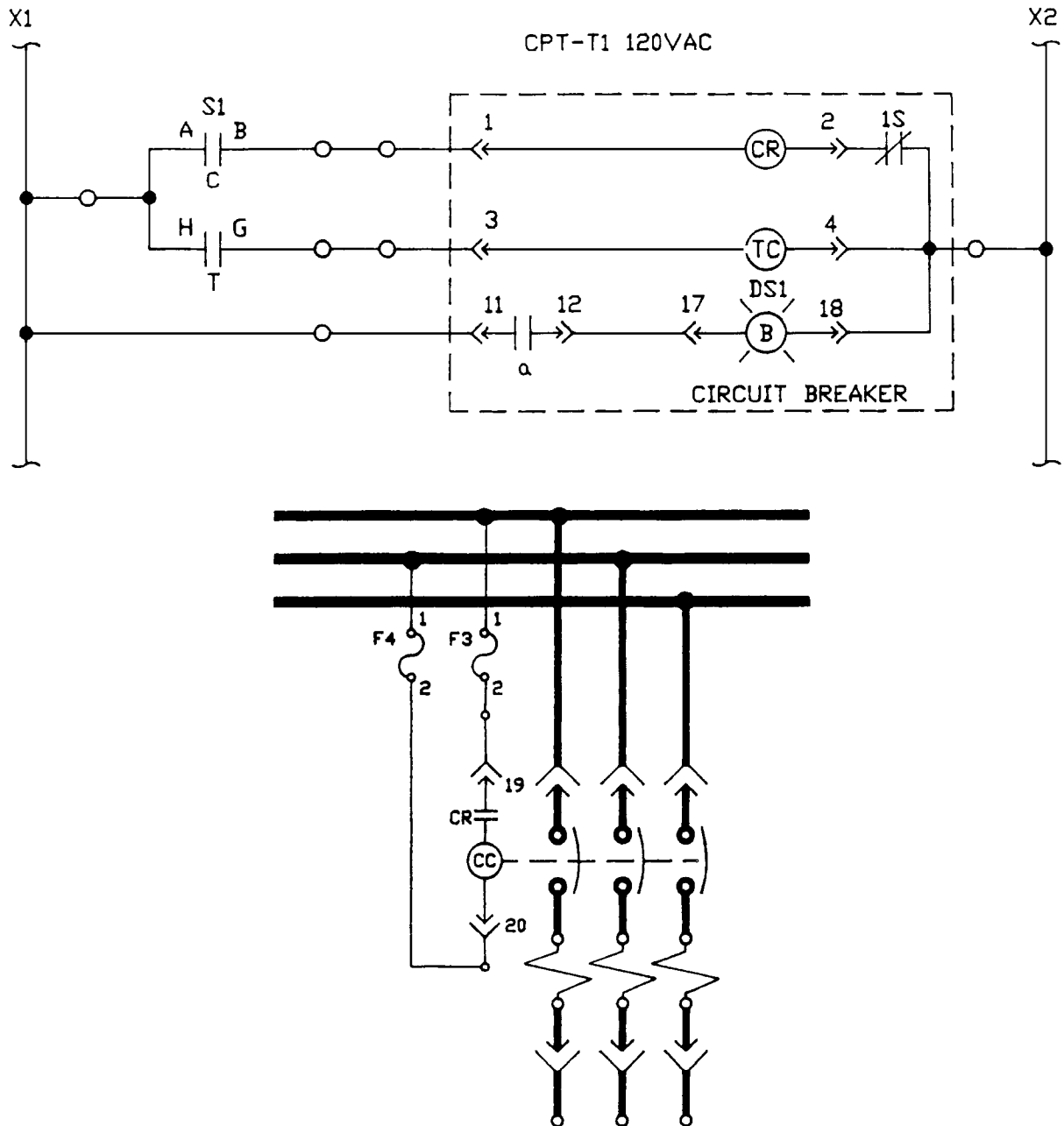


Figure 3-4. Circuit Breaker Closure

3-7.3 OVERCURRENT PROTECTION. The purpose of a circuit breaker is to prevent an overcurrent condition from damaging the equipment. Through the use of a trip element, the circuit breaker opens when current exceeds the rated output value of that element. The trip elements vary within each type of breaker due to power demands and current protection requirements of the loads. Instantaneous trip elements are also installed in the circuit breakers. These elements are provided to protect equipment during short circuit conditions. The instantaneous current ratings on all fused circuit breakers are 100,000 amps asymmetrical.

3-8. GENERATOR PROTECTIVE CIRCUITRY

NOTE

For ships with MACHALT 320-59006 (ECP-515) installed, the Reverse Power Relay Module (A2) is replaced with a Generator Protection Module (refer to [paragraph 3-8.5](#)).

3-8.1 REVERSE POWER RELAY MODULE (A2). The purpose of the Reverse Power Relay Module (A2) is to prevent the generator from “motoring” the turbine-generator after loss of driving power. The Reverse Power Relay Module senses a power reversal and initiates trip of the generator circuit breaker, within 90 to 100 milliseconds, to prevent damage to the turbine. One module is located in each of switchboards 1SG, 2SG, and 3SG. However, an adjustable time delay (between 1 and 5 seconds) inhibits the module while closing breakers during the synchronizing of generators. This time delay is initiated by a 115 VDC half-wave momentary command from the breaker control switch whenever any generator or bus tie circuit breaker is closed.

3-8.1.1 Detailed Function. The Reverse Power Relay Module uses voltages from phases AB and BC of the Main Bus from Transformers (PT1 and PT2) (see [figure 5-18](#)). It receives current from the A and C lines of the Main Bus stepped down by Transformers (CT1 and CT2). Line currents are converted to voltage signals and are then processed by a multiplier with the voltages from Transformers (PT1 and PT2) to be representative of the power (wattage) on the Main Bus. This resultant voltage output signal is inverted so that the monitor becomes only sensitive to reverse power. When this monitored signal exceeds the set point threshold, it generates an output signal to a solid-state optically coupled relay. This relay then completes the 115 VAC trip circuit of the generator circuit breaker. If the reverse power condition should drop below the set point value in less than 90 milliseconds, no output is applied to the optically coupled relay. An adjustable time delay circuit of 1 to 5 seconds is provided when synchronizing to prevent nuisance tripping from momentary system instability.

3-8.1.2 Time Delay. This time delay circuit is active only when the generator or bus tie circuit breakers are being closed. Control power from the 115 VAC generator and bus tie breaker closing circuit is half-wave rectified through a diode whenever the switches are closed for synchronization and a breaker control switch is positioned momentarily to close the breaker. When this rectified control signal is impressed across terminals C1 and C2 of the Reverse Power Relay Module, the output signal is inhibited for a predetermined time interval between 1 and 5 seconds. At the end of the preset interval, the module reverts to its normal mode of operation.

NOTE

For ships with MACHALT 320-59006 (ECP-515) installed, the AC Power Sensing Relay Module (A3a) is replaced with a Generator Protection Module (refer to [paragraph 3-8.5](#)).

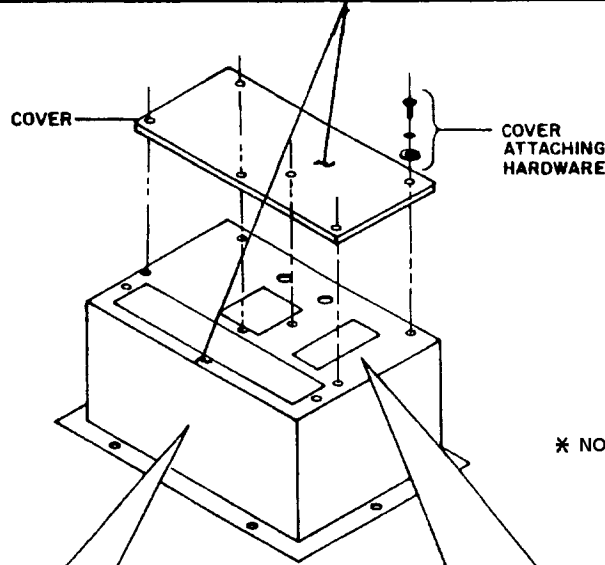
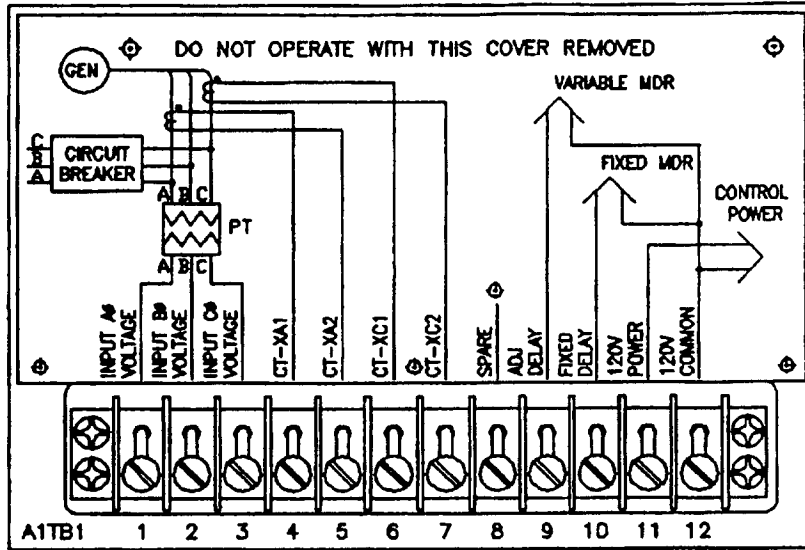
3-8.2 AC POWER SENSING RELAY MODULE (A3). The purpose of the AC Power Sensing Relay Module (A3) is to protect the generator from overload, and thus prevent loss of vital electrical loads. The AC Power Sensing Relay Module senses power output of the generator and initiates Load Shed 1 or 2 to automatically when triggered. The AC Power Sensing Relay Module (A3) consists of two physically separate units; A3a and A3b. The A3a unit provides all the inputs and controls. The A3b unit is essentially an output contact multiplier.

NOTE

Load shed can be initiated in four ways: (1) automatically by the AC Power Sensing Relay Module, (2) manually from the generator switchboards, (3) manually from the EPCC, and (4) by Overcurrent Relays (A4) when energized by shore power.

One AC Power Sensing Relay Module (A3) is contained in each of the generator switchboards. Each module contains two separate contact closures for the purpose of load shedding; four normally open and four normally closed contacts for fixed delay actuation (Load Shed Stage 1); and four normally open and four normally closed contacts for adjustable time delay actuation (Load Shed Stage 2). The AC Power Sensing Relay works when the load required by the Main Bus exceeds established capacity. The AC Power Sensing Relay Module is adjustable so that it will trigger Load Shed 1 contacts anywhere from 30 to 129 percent of the capacity of the generator, depending on the setting. The adjustment is marked to indicate the approximate percentage of power level at each setting (see [figure 3-5](#)). First stage load shed will occur approximately 90 to 100 milliseconds after the capacity point is reached. If the load on the Main Bus is still excessive, Load Shed Stage 2 contacts will close, initiating Stage 2 Load Shed following an additional, adjustable, 0-39 second delay. However, when shore power is feeding the Main Bus, the Overcurrent Relay Modules (A4) can initiate Load Shed 1. In this case the trigger point of Load Shed 2 is adjustable from zero to 39 seconds (Relay K2137) in increments of one second. It will not operate if the power level drops below the setpoint prior to the preset time interval expiration. Both load shed relay contacts will reset when measured power on the Main Bus is reduced to approximately 90 percent of the preset power level. [Table 2-17](#) lists the circuit breakers tripped by LOAD SHED 1 and 2. These circuit breakers must be reset manually.

3-8.2.1 Circulation Function. The A3a module is a small, three card unit with adjustments available from the outside of the unit. It receives nominal 115 VAC from transformers PT1 and PT2 (see [figure 5-18](#)), and stepped down current from transformers CT1 and CT2. Power is measured by converting line currents to voltage signals and multiplying these signals to obtain a voltage signal proportional to power on the Main Bus.



* NOTE: SET TIME DELAY, POWER LEVEL, CT RATIO TAPS AND PT SECONDARY PER SHIPS OPERATING PROCEDURES

RATIO TAP INSTALLATION TABLE

CT RATIO	1	2	3	4
1.00	▲	▲	▲	▲
1.04		▲	▲	▲
1.25			▲	▲
1.56				▲
1.66				

▲ = JUMPER INSTALLED CT PRIMARY

CT RATIO = _____
GENERATOR F.L. AMPS

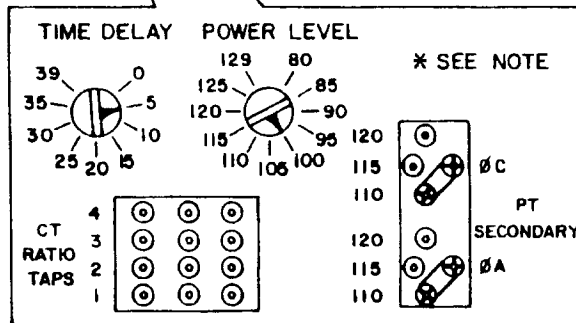


Figure 3-5. AC Power Sensing Relay Power Level Setting

3-8.2.2 Load Shed. Stage 1 Load Shed Relay then initiates action through multiple relays to shed stage 1 load throughout ship's service switchboards 1S and 3S. If there is still an excessive power demand on the Main Bus, Load Shed 2 will occur almost immediately. All relays will reset automatically when power requirements on the Main Bus are reduced to approximately 90 percent of preset power. Adjustments to the Power Sensing Relay are

normally preset by a depot level installation crew. Load Shed “occurred” signals are received from Load Center 31 at the 1S switchboard (DS16, DS18, and DS20) and from Load Center 11 at the 3S switchboard (DS14).

3-8.3 ANALOG BUS GROUND DETECTOR. The Analog Bus Ground Detector is a device which consists of a transformer and a single printed circuit board mounted in an enclosure. All three phases of power (A, B, and C) are connected to the transformer mounted internal to the unit. The stepped down voltage is rectified to an equivalent VDC output. This voltage is sent to the EPCC for remote metering.

NOTE

MACHALT 320-59006 (ECP-515) installs a Generator Protection Module to perform the functions of the Fault Current Detector Module (A6). The Fault Current Detector Module (A6), Turbine (Turb) RPM Detector Module (A8), Current Transformers (IT1 and IT2), and Resistors (R1 and R2) are removed. All other components and functions associated with fault current protection, described below, remain the same. For information specific to the Generator Protection Module, refer to [paragraph 3-8.5](#).

3-8.4 FAULT CURRENT DETECTOR MODULE (A6). The FCD will detect a bus fault and provide a signal that will open appropriate bus tie circuit breakers within milliseconds to isolate the bus fault. A bus fault is defined as a generator current greater than 250 percent of its rating with a reduced speed above the under speed trip rating. In addition, there are two specific requirements for the FCD: (1) It must not open the bus tie circuit breakers between ship’s service switchboard 2S and the switchboard system which has its generator breaker open, and; (2) It must prevent bus tie circuit breaker reclosure on the affected switchboard system until the affected switchboard system can reset its FCD. One FCD Module (A6) is located in each of the generator switchboards. Any FCD will trip applicable bus tie breakers to separate the systems and prevent complete electric plant collapse. The FCD receives its power from the ship’s 28 VDC No Break Power Supply. Generator speed is fed to the FCD via the Remote Turbine RPM Detector Module (A8). When triggered, the FCD output causes the Capacitor Discharge Unit (A7) to discharge into the trip coils of the specified bus tie breakers.

3-8.4.1 FCD Function. Main Bus current is continuously monitored in lines A and C by current transformers CT1 and CT2 (see [figure 5-18](#)). Secondary current from CT1 and CT2 flows through resistors R1 and R2 and develops a proportional voltage in isolation transformers IT1 and IT2. These voltages are impressed on the integrator-comparator circuitry in the Current Detector card located in the FCD Control Module. If these voltages exceed a preset threshold value (approximately 250 percent x 4,000 amperes - 10,000 amperes), then a signal is sent to the FCD logic circuit as an input to the AND gate circuitry. At the same time, generator frequency (speed) is converted to a 0-10 VDC analog signal at the Local Control Panel (LOCOP) and sent to the Remote Turbine RPM Detector Module (A8). When generator speed is 59 Hz or greater, an output signal is sent to the FCD logic circuit which will inhibit the signal sent from the current detector. If generator speed drops below 59 Hz, an output signal is sent from the FCD logic circuit to the FCD Logic AND gate circuitry. If the FCD Logic AND gate circuitry receives signals from both the current and frequency detectors, an output signal will be applied to two relay drivers. One relay driver operates latching relays (K1401 and K1201) in switchboard 1SG, or latching relays (K2201 and K2301) in switchboard 2SG, or latching relays (K3201 and K3401) in switchboard 3SG. Relays K1401 and K1201 (or the equivalents in switchboards 2SG and 3SG) allow the Capacitor Discharge Unit (A7) to trip the bus tie circuit breakers and isolate the switchboard systems.

3-8.4.2 Fault Current Detector, Circuitry, and Components. See [figure 5-26](#). This figure shows the A6 rack wiring and the interconnect between three connectors used to join the Power Supply (Unit A1), the Current Detector (Unit A2), and the Turb RPM Detector (Unit A3). The three terminal blocks which connect to the rest of the system are on the external surface of the A6 rack. Also shown on this drawing is the wiring for the 78H18 (Q1) voltage regulator, which takes an input of 20 to 35 VDC and reduces it to 18 VDC for units A1 and A2. C1 filters the input to Q1, while C2 filters its output.

3-8.4.2.1 Power Supply Card. The Power Supply Card ([figure 5-27](#)) serves three main functions:

- a. The first function of the card is to supply +5V power for the onboard logic and for operating the Turb RPM Detector Card in the main rack. Plus (+) 18 VDC power is applied to the Power Supply Card on pin 2, with power ground on pin 1. Capacitor C1 filters this input, which supplies both analog sections and the +5V regulator. The +5V regulator's input is locally filtered by capacitor C2. This input power is applied to pin 1 of LM109K (U8), which provides a +5V regulated output from pin 2. This output is connected to capacitor C3 to suppress oscillation of U8.
- b. The second function of the Power Supply Card is simulation of a current input signal for the system test modes of operation. The initial circuitry contains an oscillator followed by a buffer amplifier with DC blocking. Oscillator U2 generates a triangular wave form which is coupled from U2 to U3, then filtered to become approximately sinusoidal. This signal is within 5 percent of a 60 Hz frequency and is used as a test signal for the Current Detector Card. Resistor R2 provides attenuation so that this test signal can be set to equivalent current levels of from 0 to 18,000 amps. Pushbutton switch S1 couples this signal into pins 4 and 5 on the card, and to test points TP1 and TP2. Pins 4 and 5 provide output connections which allow the test signal to be sent to the Current Detector Card through the FAULT CURRENT DETECTOR MODE SEL switch. U2, an LM111 comparator, is set up through R16 and R12 as a Schmidt trigger. The output from pin 7 is fed back to negative input pin 3 through R1. R1 charges capacitor C4 (tied between pin 3 and ground).
- (1) Resistor R1. This configuration causes R1 to alternately charge and discharge C4, forming a triangular voltage wave form at pin 3 of U2. R13 provides pull-up power for the open collector, pin 7 of U2. Timing is set by the combination of the amount of hysteresis set by R12 and R16, and the RC constant between R13 plus R1 and C4. This signal is then AC-coupled through R4 and C9 to the buffer filter U3, blocking any DC offset in the test signal going to the Current Detector Card.
 - (2) Filter Operation. The filter operates as follows: R4-C9 couples the triangular signal into the inverting input, pin 2 of U3. R38 establishes bias for this input, with R18 biasing the non-inverting input (pin 3). Feedback network R17-C5 forces the output of U3 pin 6 to filter the triangular input to a high sinusoidal output. Output from pin 6 of U3 is then passed through R2 to allow variable attenuation, then through pushbutton switch S1 to pins 4 and 5; out to the terminal blocks; and to the system's Test-Operate switch.
 - (3) Temperature Stability. U1 forms a center voltage for generating the test current signal. This works by taking +18V, powering LM107 (U1), and dividing it by two through matched 10K ohm resistors (R10/R11). R36 provides a 4.99 ohm follower bias path to U1. This provides good temperature stability and approximately 9V dynamic ground for the analog circuitry previously described.
- c. The third function is to provide logic and drive for the FCD. Basically, the current detector's output together with Turb RPM Detector output are AND in combination, providing a signal to drive both the trip and inhibit relays. This combination gives front panel indication that a fault has been detected. Inputs are provided for external application of auxiliary signals, which can be added later to cause a trip. Pins 12 and 11 going to U7 are inputs from the Turb RPM board. A log logic level on these lines provides a high output on pin 11 of U7.
- (1) AND Gate. This high output is AND with the output of pin 8 on U7, which becomes high when either pin 9 or pin 10 (or both) of U7 and pull-up resistors R39/R40 are pulled low, by signals from pins 14/13 of the Current Detector Card, indicating that either Phase A or Phase C overcurrent condition exists. These two high conditions are applied to pins 9 and 10 of U6, with pins 13 and 12 tied high through R7/R8. An AND condition is created from the combination of low turb RPM and either Phase A or Phase C overcurrent condition.
 - (2) Buffer Amplifier. The resulting logic high output on pin 8 of U6 is then applied to pins 1 and 2 of U7, serving as a buffer amplifier which pulls down and illuminates fault indicator lamp D1 (on the front panel) through current limiting resistor R9. This signal also appears at Test Point 4 for troubleshooting applications. The signal is then paralleled between two gates of U5 (pins 4 and 1 of 5432 OR gate).
 - (3) OR Gate. The OR gate has a second set of paralleled inputs, pins 5 and 2. These inputs, tied to Test Point 4, return from an auxiliary input through AND gate U6 pin 6. The AND gate has two external connections which come out on pins 8 and 9 of the card edge connector. These connections, jumpered low at the terminal block terminations, allow two extra inputs which can provide additional signal for tripping the relays.
 - (4) Trip Signal. This trip signal is not indicated on the front panel indicator light of the box. Output pins 6 and 3 of U5 go through identical drive circuits which are used to drive latching relays, and are capable of driving two relays in parallel. Operation from pin 6 of U5 includes equivalent components which are obvious from the schematic and perform identically. A logic high output, indicating a fault current condition on U5, releases output pin 6 causing pull-up resistor R28 to source into R29-R30 divider, driving the

base of Q6. This base drive turns on Q6 and causes it to conduct through current-limiting resistor R31 in the collector circuit, down through the base drive, which is then clamped at about 0.6V through the base of Q1.

- (5) Q1 Collector. Enough current is provided in this drive to saturate Q1. The Q1 collector is then tied to the +24V through latching relay coils. When U5 goes into a logic low condition, Q6 is turned off by 0.4V low voltage at the pin 6 side of R29, with the ground voltage exhibited at the far side of R30. The base of Q6 is now turned off so no current flows to Q1, allowing it to cut off and interrupting current to the relay coils. An additional circuit (R37 tied from +18V to pin 10) is used as a current source for the Turb RPM card.

3-8.4.2.2 Current Detector Card. See [figure 5-28](#). The Current Detector Card (A2) takes signals from either the test circuitry or the burden resistors on current transformer circuits (through the series isolation transformer) for Phase A and Phase C of generator current-metering circuits. The card consists of two identical detection circuits. Phase A circuit has input on pins 54 and 4 with output on pin 13. Phase C circuit has input on pins 10/11 and output on pin 14. Operation of these two identical channels permits easy troubleshooting when one seems to be functioning and the other is not.

- a. Power Supply Circuit. In addition to these duplicate circuits, the power supply circuit (with its C5 capacitor) takes +18V from the rack supply and filters it. A center voltage circuit similar to that on the Power Supply Card (A1) consists of the following: R29 and R30 (matched 10K ohm resistors); R31 (a 4.99K ohm feedback follower resistor); and a high op-amp which buffers the center voltage output for use in all analog circuits.
- b. Circuit Operations. Since circuit operations for the two current detectors are identical, only the Phase A circuit will be explained. AC input between pins 5 and 4 represent current level voltage, with one volt equalling 4,000 amps. This signal is immediately applied to test points 1 and 2 to allow for external measurement of the signal during troubleshooting and for isolating problems between the board and wiring going to it. The signal passes through R36/R27, R3/R4, and C1 low pass filter, with diode clamping by D11, D12, D13, and D14. This keeps the signal within the ground +18V range of power on the card, and permits low pass filtering of the input signal.
- c. Filtered Signal. The filtered signal passes through U8-R5-R6 combination, providing a gain of 2.2. Output from pin 6 of U8 then goes through diode bridge D1/2/3/4 to ground. Resistor R32 allows symmetrical loading of the diodes as current passes in either direction, giving them a better thermal characteristic. Full-wave rectified voltage of the AC signal input from pin 6 of U8 is induced across R32, then buffered through unit gain buffer U6-R7-R8-R9-R10 and presented at Test Point 5.
- d. Integrator Circuit. From here it travels through variable offset integrator circuit U4 (LM107), with C2 and R11 providing integrating constant for the circuit. R12 variable pot adjusts the hold time of the integrator. Threshold offset for positive integration is set by R1 front panel connection (20K ohm pot). The amount of negative saturation allowed by the circuit is determined by ratio of R11 to R12, which sets response time for the integrator.
- e. Resistor R13. R13 then couples the integrator output to U2, which is a comparator to ground with a 0.1 percent hysteresis, through coupling resistor R14 and back to pin 3. Pin 1 provides the output of this circuit. The output is next split off among R15 and Q1 (MCT4R optical isolator) which serves as level shifter for inputs on the Power Supply Logic Card; P34D5 (Phase A current-too-high indicator light); and Test Point 7. The same procedures can be followed through Phase C circuitry, through R9, U7, U5, and U3.

3-8.4.2.3 Turbine (Turb) RPM Detector Module (A8). The purpose of this card is to take the current loop signal that has been sent through the Engine Control Panel contacts, debounce the signal, and translate it to a 5V signal for the logic section of the Power Supply Card. C1 serves as a filter capacitor for 5V used on all logic cards. The current loop signal passes from pin 11 to pin 5 through the light-emitting diode on Q1 (MCT4R) when current is applied. It saturates the phototransistor collector, pin 2, causing a logic low to be presented at pin 2 on U1. When current between pins 11 and 5 is interrupted, the transistor turns off R1, pulling pin 2 to a logic high. Pin 2's logic is high for underfrequency condition, and low when the frequency is correct.

- a. Flip Flops. The two flip flops in U1 are coupled as a digital glitch filter. Pins 3 and 11 are clocked at approximately 2 KHz by the arrangement on U2, LM122H. This clock takes the low or high signal appearing at pin

2 on U1 and passes it through to pin 5 on a rising clock pulse. If this is a logic high signal, it can then be passed through at the next clock pulse, turning up a low signal on Q pin 8 of U1. The low signal is then transmitted to the Power Supply Card. It also turns on the D2 diode, which is front panel indication of underfrequency condition. Current limiting is provided by R6.

- b. Logic Signals. Logic low signals appearing at pin 5 U1 activate pin 13 U1, forcing 0 pin 8 into a high condition. U2 forms a free-running oscillator with pin 1 (an output logic direction designator) tied to pin 3 (a logic high 3.16V reference). Pin 3 at 3.16V also provides pull-up to pin 2 through R2. Pin 2 is a trigger input of the one shot to C3 and pin 4, through R3/R4, providing a ramp voltage on the capacitor.
- c. DC Coupling. D1 initiates DC coupling between the output and ramp input on pin 4, guaranteeing oscillator start up. C2 couples the output transitions to the trigger, causing the device to be self-triggering (free running). R5 provides output (pin 9) pull-up to 5V.

3-8.4.3 Power for Fault Current Detector. Power for the FCD is obtained from the ship's 28 VDC No Break Power Supply. Capacitor Discharge Unit (A7) charges up when it receives a signal and furnishes the power to trip the large bus tie circuit breakers. When a FCD actuated latching relay connected to the trip command of a bus tie breaker is latched (closed), its closed contacts connect the Capacitor Discharge Units to the tie breakers' shunt trip circuit while opening (inhibiting) the normal and closing trip control circuits. One latching relay and capacitor discharge unit is provided for each bus tie breaker. These relays, when latched, isolate the tie breakers from all outside control.

3-8.4.3.1 Fault Detected Lamp. The output of the second relay driver from the FCD logic circuits is applied to latching relay K1103 (or K2103, or K3103) and fault detector auxiliary relay K1103 (or K2103, or K3103) applies 28 VDC power to the Fault Detected red lamp (DS30) on each switchboard. Fault detector auxiliary relay K1129 (or K2129, or K3129) when energized completes relay and diode logic circuits that determine whether the other switchboards tie breakers trip or remain closed as determined by ship specification. On switchboards 1SG, 2SG, and 3SG control panels, the BUS TIE INHIBIT amber lamp (DS32) lights whenever either or both of the latching relays (K1401 and K1201, or K2201 and K3201, or K3201 and K3401) are energized. The RESET pushbutton (PB1103, PB2103, or PB3103) returns the local FCD switchboard system to normal.

3-8.4.3.2 Fault Current Detector Power. The FCD systems use power from the ship's 28 VDC No Break Power Supply. Circuit protection is located at the power supply itself, and no means of removing this power is provided at the switchboards.

3-8.4.4 Fault Current Detector Test Circuit. The FCD Test Circuit has two modes of operation: OPERATE mode and TEST mode. When the FAULT CURRENT DET MODE SEL switch (S42) is in the OPERATE position, the FCD monitors the main power distribution system or fault conditions. When the FAULT CURRENT DET MODE SEL switch (S42) is in the TEST position, pressing the pushbutton on the front panel of the Power Supply Module of the FCD will simulate fault current conditions for the FCD to sense.

3-8.4.4.1 Fault Current Detector Test Circuit in OPERATE Mode. When the FAULT CURRENT DET MODE SEL switch (S42) is in the OPERATE mode, the FCD is fully operational.

3-8.4.4.2 Fault Current Detector Test Circuit in TEST Mode. When the FAULT CURRENT DET MODE SEL switch (S42) is in the TEST position, the FCD is in TEST mode. In this mode, switch contacts change state to reconfigure the circuits that feed the inputs to the FCD. Two circuits are reconfigured: (1) the circuit for sensing high current, and (2) the circuit for sensing generator output frequency. The circuit for sensing high current is changed so that the FCD no longer senses the actual load current, but rather is prepared to sense a simulated high load current that is initiated by pressing the pushbutton on the front panel of the FCD Power Supply Module (refer to [paragraph 3-8.4.2](#)). The circuit for sensing generator output frequency is reconfigured by opening switch (S42) contacts which feed the actual generator output frequency to the FCD. As a result, the FCD senses a generator output speed of zero. Thus, when the pushbutton on the front panel of the FCD Power Supply Module is pressed, the FCD senses a simulated high load current and a simulated generator output frequency less than 59 Hz. Both of the necessary conditions for the FCD to sense a fault current are met. Provided that all generator bus

tie breakers are closed during the test and the generator under test is on-line, the results of the test will be the same as the results of an actual fault (refer to [paragraph 2-5.4.1](#)).

3-8.5 GENERATOR PROTECTION MODULE. (Refer to [paragraph 5-10.8](#) for adjustment procedures) The Generator Protection Module (GPM) is described as two major components: the hardware and software.

The hardware is divided into:

- (1) Analog Input
- (2) Digital Input
- (3) Microcontroller
- (4) Memory
- (5) Output
- (6) Display
- (7) Power Supply

The software is divided into:

- (1) Measurement
- (2) Compare
- (3) Timing
- (4) Control
- (5) User Interface

a. Hardware.

- (1) Analog Input. The GPM has four analog inputs: two voltage inputs from 4:1 potential transformers and two current inputs from current transformers (CT) with 5-amp secondaries.
 - (a) Voltage Input. Voltage A to B phase (VAB), applied to terminals TB1-1 and TB1-2 (TB1-2 and TB1-3 for VBC), is sent into the electromagnetic interference (EMI) enclosure. The signal is passed through a step-down transformer, offset +2.5 VDC, applied to a series of filters, and sent to the analog to digital (a/d) converter.
 - (b) Current Input. Phase A current (IA), applied to terminals TB1-4 and TB1-5 (TB1-6 and TB1-7 for IC), is sent into the EMI enclosure. The signal is passed through a 1,000:15 CT, offset +2.5 VDC, applied to a 2-ohm resistor, calibrated, amplified, and sent to the a/d converter.
- (2) Digital Input. There are two digital inputs; Fuel Valve and Reverse Power Inhibit.
 - (a) Fuel Valve. This signal is a 24-VDC input and includes a current limiting resistor, an opto-isolator and an anti-reverse polarity diode. This function is not installed on all ships.
 - (b) Reverse Power Inhibit. After this 115-VAC signal is applied, the GPM will not initiate a reverse power trip during the time period set by the breaker delay setpoint.
- (3) Microcontroller. Functions are as follows:
 - (a) Computes generator voltage by performing an a/d conversion on the incoming voltage signals, and computing the rms value of the digitized signals over one power cycle. Average voltage is calculated by adding the rms values of VAB and VBC, and dividing by 2.
 - (b) Computes generator current by performing an a/d conversion on the incoming current signals and calculating the rms value of the digitized signals over one power cycle. Average current is calculated by adding the rms values of IA and IC, and dividing by 2.
 - (c) Computes generator power by performing an a/d conversion on the incoming voltage and current signals, and multiplying the digitized voltage by the digitized current. This product is averaged over one power cycle for IA and IC.
 - (d) Calculates input frequency by measuring the time between consecutive low to high transitions of the phase lock loop, and dividing that number into 1.
 - (e) Compares the inputs with preset setpoints and takes appropriate control action.
 - (f) Displays the values of voltage, current, frequency, and power on the RS-232 remote display.

- (g) Receives setpoint programming and stores the values in non-volatile memory.
- (4) Memory. The GPM has three types of memory: permanent (prom), temporary (ram), and non-volatile (flash). Permanent memory, located inside the microprocessor, contains the software to run the unit, and is changed only by replacing the microprocessor. Temporary memory, soldered to the processor board, stores measurements and other variables. Non-volatile memory, located on the EMI board, stores the semi-permanent setpoints.
 - (5) Output. The GPM has seven outputs; six are relays and one is a status signal. Of the six relays, four are capable of switching ac or dc, and two will only switch dc. The four ac/dc relays are assigned to Generator Circuit Breaker, 1st Stage Load Shed, 2nd Stage Load Shed, and Underfrequency. The Generator Circuit Breaker relay will trip on overvoltage, reverse power, or loss of fuel valve input (not used). The 1st and 2nd Stage Load Shed relays trip on overpower. The Underfrequency relay trips on an underfrequency condition. The two dc relays each trip on fault current and control 28 VDC to remote MDR relays via terminal TB2-7 or TB2-9. If a fault current condition occurs, TB2-8 or TB2-10 is sent to common, completing the circuit path. Under normal conditions, all relay outputs appear as normally open contacts, with the exception of the underfrequency relay contacts which appear as normally closed.
 - (6) RS-232 Powered Remote Display. This unit is a 20-character by 4-line liquid crystal display. Information is displayed on one line in the following format “449 2464 60.0 78” where 449 is bus voltage, 2464 is line current, 60.0 is bus frequency, and 78 is percent generated power.
 - (7) Power Supply. The unit is powered from the 112.5 VAC nominal input. VAB is applied to terminals TB1-1 and TB1-2 where it is fed into the EMI enclosure. The signal is run through a step-down transformer, rectified, and filtered to produce approximately 20 VDC. The signal is then fed to a dc-to-dc converter. The nominal 20 volts is converted to 12 VDC, which is used to power most analog circuits, and applied across a shunt regulator and two diodes producing +10 VDC, +5 VDC, ground, and -1.4 VDC.

b. Software.

- (1) Measurement. The microcontroller performs an a/d conversion on the incoming voltage and current signals. The microcontroller then performs an rms conversion on the signal and calculates average voltage and current. The microcontroller also receives a square wave signal, measuring the time between two consecutive low to high transitions of the square wave, and converts this time to a frequency.
- (2) Compare. The measured values are compared to preset setpoints.
- (3) Timing. The microcontroller uses a hardware timer to determine time delay and frequency.
- (4) Control. The microcontroller takes action after a generator output parameter is exceeded for the preset time delay.
- (5) User Interface. The user interface has two modes of operation: normal display and setpoint programming.
 - (a) In the normal mode, the remote display will show:

ATIS GPM Ver X.XX SHIP CLASS XXXX VAC AAC Freq %P XXX XXXX XX.X XX

The values of X are determined by the microcontroller. The Xs in the first and second line are self-explanatory. The Xs in the fourth line are the values of bus voltage, current, frequency, and percent power as measured by the GPM.

3-9. GROUND FAULT DETECTION

There are three indicators (DS26, DS27, DS28) on the control panel of switchboards 1SG, 2SG, and 3SG that indicate ground faults respectively on phases A, B, and C. These clear-lensed indicators are normally lit when the GND DET switch (S25) is in the OFF position. By placing GND DET switch (S25) in TEST position, one or more lights will dim if there is a ground fault on that phase. Each phase of the Main Bus has light connecting across the secondary of each transformer (see [figure 5-18](#)). GND DET switch (S25) in TEST position grounds one leg of the primary. If a ground fault is present on one phase, no or minimum voltage is induced across the secondary of that phase and the light dims or goes out. The other phases (with no ground faults) glow brighter.

3-10. SHORE POWER CIRCUITRY

In switchboard 2SA, provisions are available to connect shore power to ship's power. There are 12 circuit breakers (CB2201-CB2212) that enable 450 VAC, 60 Hz, 3 Phase power to be connected to the Main Bus. Each receptacle is capable of handling 400 amps with a total rated maximum of 4,800 amps. Each circuit breaker can handle a certain amount of overload. There is a Shore Power Overcurrent Relay Module (A4) on each circuit breaker that will initiate load shed when overload causes the circuit breakers to heat up. These circuit breakers operate quickly with 600-700 percent overload. However, uneven spikes and surges typical of shore power will not trip these circuit breakers immediately. Provisions to check proper phase relationships between ship's power and shore power are available at the switchboard 2SA Control Panel. However, synchronization must be accomplished by first adjusting ship's power to shore power. Refer to [table 2-15](#). There are 60 fuses (5 each per 12 circuit breakers) on the control panel of switchboards 2SA. Refer to [table 2-16](#) for a description. There is one fuse, mounted in a blown fuse indicator, per phase that protects its associated incoming power. Another fuse, also mounted in a blown fuse indicator, protects the undervoltage trip circuitry of its associated circuit breaker. The breaker UV trip relay will trip the breaker if associated shore power receptacle is opened with its circuit breaker energized. The fifth fuse protects the associated circuit breaker control circuitry. Switch S11 can control all 12 circuit breakers simultaneously and transfer shore power to an extension of the 1S-2S bus tie (between Bus-Tie breakers 2S-1S and 1S-2S) within switchboard 2SA. An interlock is provided by relays K3 and K3A to prevent switch S11 from closing shore power breakers onto an energized 1S-2S bus tie. Prior to this action all phases must be connected to the receptacles correctly. Switches (S27A, S27B, S28A, and S28B) along with Phase Sequence Meter (M9) and both phase orientation lights (DS38 and DS39) allow this to be accomplished (refer to [paragraph 2-5.4](#)). Current from shore power on each phase may be monitored on AMP Shore Power Meter (M10) located on the Control Panel of switchboard 2SA.

3-10.1 CONTROL POWER. Control power comes from 2SP Bus through fuses F7 and F8 to Time Delay relay K3. K3 relay has a 1-5 second time delay in closing. When relay has closed then relay K3A is energized. K3A (NC) contacts (one for each Shore Power breaker) change state and prohibit the closing of the 12 shore power breakers if the 2SP Bus is already energized. In order to close the shore power breakers, power must be removed from the 2SP Bus. The bus tie circuit breakers CB1212 (1SA) and CB2221 (2SA) must be open. With K3A contacts E & F closed, the closing control circuit of the (12) 400A shore power breakers is operational. With shore power available, transformer T5 is energized. 450 VAC is transformed to 115 VAC for control power. 115 VAC travels to DS3 indicating shore power is available.

3-10.2 2SA PHASE ROTATION. Phase rotation must be identical between ship's power and shore power. This rotation is checked using the phase sequence meter and associated circuitry. Two green lights (DS38 and DS39) are also used as a shore power reference. Each of the three incoming phases from the 12 shore power receptacles are connected through fuses to switches S27A and S27B. When a particular position is selected (1 through 6, or 7 through 12) the incoming shore power receptacle is referenced for proper phase rotation (ABC) through the phase sequence meter (M9). This meter performs the two functions of 1) visually indicating the presence or absence of power on all three phases and 2) visually indicating whether phase rotation of shore power is ABC or CBA.

NOTE

Switch S27A works in conjunction with S27B. S27A contacts 11, 18, 21, 28, 31, 38, 41, and 48 are closed when switch is placed in the 7-12 position.

The indicator needle of M9 shows whether phase rotation is CORRECT or INCORRECT. The three lights on the meter indicate the presence of power on all three phases of shore power.

3-10.3 PHASE ORIENTATION. The phase orientation indicators (2SP-DS38 and 2SP-DS39) illuminate when A and B phases are in the proper phase orientation. To illuminate 2SP-DS38, the following circuitry is utilized:

3-10.3.1 Phase Orientation Light, 2SP-DS38. A-Phase shore power is routed through switch S28A contacts to 2SP-DS38/2. B-Phase power is routed from shore power through switch contacts S27A to 2SP-DS38/1. When S27A and S28A are selected to one of the switch positions, the light illuminates if the phases are oriented correctly. The same theory applies to S28B and S27B. Refer to [table 2-15](#) for operating procedures.

3-10.3.2 Phase Orientation Light, 2SP-DS39. Light 2SP-DS39 illuminates a similar type of circuit. A-Phase shore power is routed through switch S27A (S27B) to 2SP-DS39/1. B-Phase is routed from shore power through switch S28A (S28B) to 2SP-DS39/2. When switches S27A (S27B) and S28A (S28B) are selected to one of the switch positions, the light illuminates if the phases are oriented correctly.

3-10.4 PROTECTIVE CIRCUITRY. One Overcurrent Sensing Relay Module (A4) is provided to sense the current through each of the shore power circuit breakers. The Overcurrent Sensing Module (A4) is self-contained with two circuit cards supplying the control. The circuit cards sample phase AB through a transformer (T5 for Shore Power Receptacle 1) to measure the overload current through each of the shore power circuit breakers in use.

3-10.4.1 Load Shed. If the current overload is in excess of 600-700 percent, it causes the power transistor to trip Relay K2136 and initiate Stage 1 Load Shed. At this time, an adjustable Relay (K2137) is actuated that will initiate LOAD SHED 2 within a preset time between 1 and 39 seconds after LOAD SHED 1. If the current demand drops below 100 percent prior to the preset time delay of K2137, LOAD SHED 2 is not initiated.

3-10.4.2 Overload. Another situation could occur with overload current rising above 100 percent part of the time and under 100 percent part of the time. In this case, above 100 percent would start a timer that would start counting up, possibly for 1 to 2 hours before initiating load shed. During part of this time, a load under 100 percent would cause this same clock to count down, thus subtracting from the count that would cause the load shed. However if the LOAD SHED 1 count is reached and actuates, then the load shed 2 count of Relay (K2137), adjustable from 1 to 39 seconds, is started. These protective circuits reset automatically after the load shed problems are corrected.

3-11. REMOTE METERING

There are provisions in each cabinet (but primarily in switchboards 1SG, 2SG, and 3SG) for furnishing information to meters on the EPCC. Thus the EPCC has access to the same information that is shown on the control panels of switchboards 1SG, 2SG, and 3SG. The EPCC can control electrically operated relays, control and synchronize generators, and switch bus tie breakers to operate a variety of Main Bus configurations.

CHAPTER 4

SCHEDULED MAINTENANCE

4-1. INTRODUCTION

4-1.1 PLANNED MAINTENANCE SYSTEM. Required preventive maintenance procedures to be performed on a scheduled basis are provided in Planned Maintenance System (PMS) documentation. OPNAVINST 4790.4 describes this system which also covers departmental and work center record keeping, as well as the Maintenance Index Page (MIP) and Maintenance Requirement Cards (MRCs). MRCs cover scheduled inspection, testing, and repair procedures for the equipment covered by this manual.

4-1.2 EXTENT OF COVERAGE. The extensive and comprehensive scheduled maintenance provided by MRCs eliminates the need for any coverage within this chapter. Specific corrective maintenance is covered in [Chapter 6](#).

CHAPTER 5

TROUBLESHOOTING

5-1. INTRODUCTION

Chapter 5 covers methods of locating possible malfunctions within the switchboard systems. All abbreviations and symbols used in this manual are in accordance with MIL-STD-12 unless otherwise noted. Although these switchboards contain circuits designed to protect their gas turbine generators, they do not diagnose any primary causes of turbine generator malfunctions. There is an automatic means of removing loads or isolating trouble in the turbine generators, but the only means of shutting down the turbine generators from the switchboard is manually in LOCAL control. There is no means of troubleshooting problems at the EPCC other than the comparison of meter readings, or checking outputs from the switchboards. The switchboards are a very reliable means of distributing 450 VAC, 60 Hz power for the ship.

See figures 3-1 and 3-2 for 16 common system configurations. These different configurations in combination with the meters, built-in test circuits, and basic protective circuits enable the technicians to locate and isolate faulty areas. There are in-line fuses, in addition to the circuit breakers and indicators, which point toward sources of trouble. Most operations are accomplished by relays and switches which perform defined functions. A mimic bus on each generator control panel enables the operator to isolate problems using circuit breakers. By following this mimic bus, the operating state of key circuit breakers can be determined. A circuit breaker dropping off line can easily be identified by the amber (open) trip light illuminating. The protective circuits automatically protect this equipment from operating or actual component malfunctions. There should not be any failures which could shut down the ship's electrical power system with a qualified operator at the EPCC.

5-2. GENERAL TROUBLE ANALYSIS

There are two basic areas of trouble that can be expected in this equipment: (1) operator failures that are caused by action or lack of action under certain conditions, and (2) actual equipment malfunctions. This equipment is designed to be relatively fail-safe from operator actions. Under some possible operator-type failures such as main bus overload or reverse power situations, it is simply a matter of adding generator capacity and closing tripped circuit breakers in accordance with ship's operating procedures. Where malfunctions occur in particular areas, it may be only a temporary overload that tripped a circuit breaker or blew a fuse. This can be located easily and corrective measures taken. Circuit breaker, relay, and protective module malfunctions occur rarely but do require corrective actions on the part of qualified maintenance personnel. It should be mentioned that protective fuses are numerous throughout the switchboards and should limit any possible damage caused by relay or circuit breaker malfunctions as well as pointing specifically to the circuitry involved. Comprehensive schematics (see figures 5-18 through 5-20) are available in this chapter as well as tabular material that lists the functions of specific components (switches, circuit breakers, and relays).

WARNING

Lethal voltages and currents are present in this equipment. Remove power from the cabinet and/or isolate the cabinet with the disconnect links before replacing any pieces/parts.

Prior to performing any troubleshooting or maintenance inside the 60 Hz main switchboards, they must be electrically isolated. Tables 5-7 through 5-9 identify the fuses, circuit breakers, switches, etc., that must be tagged

out to isolate the 1S, 2S, and 3S switchboards. See [figure 2-1](#) interconnection diagram for location of main bus tie and generator breakers. These bus tie breakers can be used to isolate switchboard systems when necessary. Bus tie circuit breakers are located in switchboards 1SA (see [figure 2-8](#)), 1SC (see [figure 2-10](#)), 2SA (see [figure 2-14](#)), 2SB (see [figure 2-15](#)), 3SA (see [figure 2-18](#)), and 3SC (see [figure 2-20](#)). These bus tie breakers can be used to isolate switchboard systems when necessary. Refer to [paragraph 5-3.1](#) for the proper procedure to isolate the disconnect links which are used during maintenance periods to manually disconnect ship's cabling and the main bus of a particular cabinet.

5-3. DISCONNECT LINKS

Ship's service switchboards are linked together through ship cabling in a ring bus configuration. Through the use of bus tie circuit breakers, this configuration can be altered to meet ship's requirements (see [figure 2-1](#)). The bus tie circuit breakers only isolate one switchboard system (1S, 2S, or 3S) from another. Disconnect links protect maintenance personnel from injury by isolating the main bus of the switchboard and incoming cabling (see [figure 2-1](#)). These disconnect links are located in switchboards 1SG, 1SA, 1SC, 2SG (2 places), 2SA, 3SG, 3SA, and 3SC.

NOTE

Disconnect links are not required when a switchboard can be isolated through the use of bus tie circuit breakers, and are therefore not located in each switchboard.

WARNING

Power may not necessarily be completely removed from the entire cabinet when the bus tie breakers or disconnect links are open. Do not touch contacts or terminal boards before checking deenergized.

5-3.1 TO OPEN DISCONNECT LINKS, PROCEED AS FOLLOWS:

- a. Remove power from disconnect links and cabinets by tripping applicable bus tie breakers. Tag "Out of Service." On switchboards 1SG, 2SG, or 3SG, place CONTROL XFR switch (S24) in LOCAL so that bus tie breakers cannot be closed from EPCC.

WARNING

Under no conditions should an attempt be made to open disconnect links with power on the main bus. Trip the affected bus tie breakers first to remove power from the switchboard cabinet.

- b. Remove T-handle disconnect link wrench (Part No. 703540-K02) from back door of cabinet by removing four screws on clamp fastening T-handle to the door.
- c. Disconnect link location is identified by warning labels mounted on the rear covers. Remove covers as required and retain hardware. Disconnect links are installed as a set (one per phase).

NOTE

Switchboard 2S contains two sets of disconnect links (six disconnect links total).

- d. On the bus bar, look for the nameplates identifying DISCONNECT LINK. Between this nameplate and a WARNING nameplate is a 1-inch square drive nut. Using the disconnect link wrench, rotate the drive nut CW to a hard stop. Observe position indicator on disconnect link. Verify OPEN status. Repeat steps for all remaining drive nuts.
- e. Switchboard disconnect links are now open.
- f. Repair or replace component as required.
- g. After all repairs are completed, ensure there are no tools or loose parts in switchboard.
- h. Close disconnect links by rotating the drive nut CCW to a hard stop. Observe position indicator on disconnect link. Verify CLOSED status. Repeat steps for all remaining drive nuts.
- i. Install covers and hardware.
- j. Replace the T-handle on the door and tighten the four screws on the clamp.
- k. Remove “Out of Service” tags from bus tie breakers.
- l. Close applicable bus tie breakers to return unit to service. Place CONTROL XFR switch (S24) in REM.

5-4. TROUBLESHOOTING FROM THE SWITCHBOARD CONTROL PANEL

Much of the troubleshooting process can be accomplished from the controls, meters, and mimic bus arrangements on switchboards 1SG, 2SG, and 3SG. Start with the isolation of malfunction areas from the control panels. When following [tables 5-1](#) and [5-2](#), it is required that maintenance personnel be reasonably familiar with the operational configurations of the switchboard systems and understand the normal operation of the switchboard generator control panel. Refer to [tables 2-12](#) through [2-14](#). [Tables 5-1](#) and [5-2](#) give logical places to start. For individual component functions, refer to [tables 5-4](#), [5-5](#), and [5-6](#).

5-4.1 GENERATOR CONTROL PANEL. The generator control panel will be operational at the switchboard if the LOCOP controls on the turbine generator are in remote and the CONTROL XFR switch (S24) is in LOCAL. Indicator DS42 will illuminate. This publication makes no attempt to determine exact generator malfunctions. However, this procedure isolates the malfunction to the generator, the switchboard controls, or interconnecting cabling. Communication should be established between personnel at the switchboard control panel (switchboard 1SG, 2SG or 3SG) and personnel at the generator (LOCOP) controls for part of the procedure. Start SSGTG No. 1 in accordance with [table 2-12](#), [Table 5-1](#), and [figures 5-16](#) and [5-17](#) suggest possible trouble and remedies. Reference designators for relays and circuit breakers are given for switchboard system 1S; if trouble is in switchboard systems 2S or 3S, use equivalent reference designators. Refer to schematic diagrams as necessary ([figures 5-18](#) through [5-20](#)).

5-4.2 MIMIC BUS PANEL ANALYSIS. The mimic bus areas of switchboards 1SG, 2SG, and 3SG are used primarily by operators to arrange desired configurations of the switchboard systems. The information furnished by the indicators can also be valuable to maintenance personnel. The circuit breakers shown on the mimic bus are all electrically operated and are normally operated from the EPCC. They can be operated manually from switchboard 1SG, 2SG, or 3SG in LOCAL control. They also are tripped automatically during LOAD SHED by protective circuits and some are inhibited from closing until certain conditions are met. Refer to [table 5-2](#). Refer to schematic diagrams as necessary ([figures 5-18](#) through [5-20](#)).

Table 5-1. Generator Control Panel Analysis

Trouble	Probable Cause	Remedy
Generator does not start	Controls at LOCOP; Switch S24 in REM; faulty relays.	Check control positioning. Check relays K1123, K1128, and Switch S24.
No meter indications	No feed from Generator; Fuses F101, F102, F103, F104. Check position of S32; no power on Main Bus.	Remote LOCOP control; check fuses; if bad, check circuit and/or replace; turn S32 off. Check for approximately 5 amps at each leg of CT1 and CT2.
Generator Control Panel meter on switchboard 1S does not match readings at LOCOP	Faulty meter.	Substitute meter at J1 and J2. If meters are faulty, adjust or replace.
TEMP METER readings unusually high	Seawater Cooling Circuit Breaker (CB1101) off; Generator problem.	Turn CB1101 on; prepare to shut down generator for maintenance.
Generator drifts in frequency	Switch position; GOVERNOR ISO/DROOP circuits; GEN FREQ circuits.	Switches S14 and S20 should be in ISOCH & DIFF. Check relays K1108, K1109. Check relays K1119, K1120. Check relays K1133, K1134. Check generator.
Generator drifts in voltage	Switch position; voltage regulator relays; Voltage Regulator.	Switch S14 in DIFF; VOLT REG MODE SEL in AUTO. Check relays K1131, K1132, K1130. Check Voltage Regulator.
GEN FREQ switch (S16) does not raise or lower generator frequency. GEN VOLTS switch (S15) does not lower or raise voltage.	LOCOP not in REMOTE position; Switch (S16); Relays K1108, K1109. LOCOP not in REMOTE position. Switch (S15); Relays K1110, K1111.	Check LOCOP switch positions. Check and/or replace relays K1108, K1109, Switch (S16). Check LOCOP switch positions. Check and/or replace relays K1110, K1111, or Switch (S15).

Table 5-2. Mimic Bus Panel Analysis

Trouble	Probable Cause	Remedy
Generator Circuit Breaker CB1110 will not close	Generator not synchronized with Main Bus; Synchronizing Circuits off or not working; Reverse power situation; Faulty circuit breaker	Synchronize generator to Main Bus; Check synchronizing operation and/or replace Relay K1101, K1106, K1127, K1105. Switch S1; Correct problem in generator; Replace circuit breaker.
Bus Tie Breaker CB1212 will not close.	FCD inhibits closing; faulty relays, faulty circuit breaker.	Correct fault; reset PB1103; Check and/or replace relays K1102, K1107, K1103, L1204, K1205; Switch S2; Replace circuit breaker.
Bus Tie Breaker CB1413 will not close.	FCD inhibits closing; faulty relays, faulty circuit breaker.	Correct fault; reset PB1103; Check and/or replace relays K1102, K1103, K1107, L1404, K1405; Switch S3; Replace circuit breaker.
Circuit Breakers CB1209, CB1352,	Circuit breakers; faulty relay, fuses in CB1352; switches.	Check and/or replace K1112, K1352. Replace circuit breakers. Check and/or replace fuse elements in CB1352 (correct fault conditions first). Check/replace switches S4, S5, or S6.
Circuit Breakers CB3038 (A/C2), CB3042 (A/C3), CB3043 (A/C4) will not close.	Switches S7, S8, or S9 wiring, or circuit breakers (located in LC31). Short circuit downstream.	Check/replace switches. Check/replace circuit breakers. Check circuits downstream.

5-4.3 BUS TIE AND TEST PANEL. The bus tie and test panel area contains meters and switches associated with the bus tie and synchronization circuits, ground test functions, load shed, and fault current detection. The

TEST positions on this panel assure that the synchronization circuits work and that no phase is grounded; therefore, these tests should be accomplished before troubleshooting in this area (refer to [paragraphs 2-5.3 through 2-5.5](#)).

5-4.3.1 Ground Tests. Test for grounds on any phase of the Main Bus as follows:

- a. Turn GND DET switch (S25) to TEST position. The lamps (DS26, DS27, DS28) read left to right as Phase A, Phase B, and Phase C. If any phase is grounded, that lamp will dim or go out while the other two will glow brightly. The main bus can operate with one leg grounded. If two are grounded, the system will shut down.
- b. If any phase is grounded, further efforts must be made to find the ground and correct it.
- c. One method is to isolate the system with bus tie breakers so that the ground may be identified to a particular switchboard system.
- d. If possible, momentarily open one distribution breaker at a time. In conjunction with the GND DET test switch, this action will locate the ground either in the switchboard systems or in one of the distribution areas.

WARNING

These switchboards contain lethal voltages. Do not touch the bus bars.

- e. If in the switchboard system, carefully look at the grounded phase bus bar throughout the switchboard system for physical arcing or damage. Check for blown fuses to particular circuits.
- f. If the fault is not readily visible, isolate each cabinet separately by using disconnect links and bus tie breakers. Shut down the power, and make a resistance check to ground of the specific bus bar in each cabinet. If there has been any arcing to ground, carbon traces should be noticed.

5-4.3.2 Synchronizing Monitor Test. There is a TEST position on the SYNCH MON MODE SEL switch (S38) that will indicate with a light (DS29) that the Synchronizing Monitor Module (A1) is operating properly. The Synchronizing monitor compares incoming and reference signals for compatibility in voltage, frequency, and phase angle. In order to conduct this test, power must be available on the main bus as a reference and generator power must be available. The SYNCH MON MODE SEL switch in TEST position is a spring-return-to-off switch that mimics a generator breaker switch but inhibits the closing of the generator circuit breaker (see [figures 5-18 through 5-20](#)). To ensure the Synchronizing Monitor Module (A1) is working properly, proceed as follows:

- a. Start the SSGTG in accordance with [table 2-12](#).
- b. Adjust generator controls as if preparing to put it on-line with the main bus. Place BUS METER switch (S17) on 1S BUS, and CKT BREAKER AND SYNCH SELECT switch (S19) in GEN 1SG.
- c. Match GEN VOLTS meter (M4) to 1S BUS meter (M5) by adjusting GEN VOLTS switch (S15).
- d. Match GEN FREQ meter (M5) to 1S BUS FREQ meter (M7).
- e. When the pointer on the SYNCH SCOPE (M11) slowly approaches the 11 o'clock position, turn SYNCH MON MODE SEL switch (S38) to TEST position. If indicator (DS29) lights, the synchronizing circuits are working. In TEST position, this switch also prevents the generator breaker switch from being closed.
- f. When the generator has already been synchronized to the main bus, turning the SYNCH MON MODE SEL

switch to TEST will cause indicator (DS29) to light. With the generator synchronized to the main bus, both DS29 and DS31 will be lighted. In OPERATE position, only DS31 will be lighted.

WARNING

Power should be removed whenever inserting or removing cards in the synchronizing monitor module (A1). Insertion or removal of circuit cards while energized may cause a surge or misapplication of power, resulting in component damage.

g. If this test does not give desired results, the synchronizing monitor cards should be tested and replaced if necessary (refer to [paragraph 5-10.1](#)).

5-4.3.3 Fault Current Detection Circuit. The fault current detection circuits isolate switchboard systems when a fault current is detected anywhere in the connected switchboard systems. The fault current detection circuit uses a 28 VDC (external to the switchboards) no-break power supply to send a trip signal to the bus tie breakers to separate the systems and prevent total system power failure. A bus tie inhibit signal is also sent, preventing closure of the bus tie breakers until the fault is corrected and RESET pushbuttons (PB1103, or PB2103, or PB3103) are pressed.

For ships without MACHALT 320-59006 (ECP-515) installed, the FCD may be removed from the switchboard and tested on a bench for proper operation. Alternatively, with the FCD in the switchboard, the cover can be removed (after being completely deenergized) and cards replaced. It is not advisable to simulate a fault with SSGTGs on line to check out the FCD system. Refer to [paragraph 5-10.5](#) for card adjustment.

For ships with MACHALT 320-59006 (ECP-515) installed, there are no bench test procedures available.

5-4.3.4 Load Shed. The load shed circuits can be checked by using LOAD SHED switch (S22) on the control panel. This switch is in parallel with the load sensing circuitry and remote (EPCC Load Shed) contacts so that all areas can be checked from this switch. LOAD SHED switch (S22) should trip all circuit breakers listed in [table 2-17](#) both in LOAD SHED STAGE 1 or 2.

NOTE

Before performing this check, personnel should be warned so that electronic and computer equipment can be properly shut down.

Any circuit breaker that should have tripped, but did not, should have its associated circuitry checked. Relays K1121, K2136, and K3121 initiate LOAD SHED STAGE 1. Relays K1122, K2137, and K3122 initiate LOAD SHED STAGE 2 and Shore Power LOAD SHED 2.

NOTE

For ships with MACHALT 320-59006 (ECP-515) installed, the AC Power Sensing Relay Module (A3a) is replaced with a Generator Protection Module (refer to [paragraph 3-8.5](#)).

5-5. AC POWER SENSING RELAY MODULE (A3a)

The AC Power Sensing Relay Module (A3a) operates to shed load when the load on the main bus exceeds established capacity (refer to [paragraph 2-5.5.2](#)). It can be pre-set from 80 to 129 percent of the capacity of the generator. LOAD SHED STAGE 1 will occur approximately 90 to 100 milliseconds after the capacity point is reached. If LOAD SHED STAGE 1 does not remove enough load, LOAD SHED STAGE 2 will occur within the time established by ship's operating procedures to prevent losing all loads. This time delay is adjustable from 0 to 39 seconds on module A3 (refer to [paragraph 6-2.3](#)). The set point of LOAD SHED STAGE 2 for shore power can also be adjusted from 0 to 39 seconds (Relay K2137) in increments of one second (refer to [paragraph 6-2.3](#)). If trouble is encountered with the A3a module, additional bench testing should be performed in accordance with [paragraph 5-10.3](#).

NOTE

For ships with MACHALT 320-59006 (ECP-515) installed, the Reverse Power Module (A2) is replaced with a Generator Protection Module (refer to [paragraph 3-8.5](#)).

5-6. REVERSE POWER MONITOR (A2)

The Reverse Power Module (A2) works similarly to the AC Power Sensing Relay Module (A3a) (refer to [paragraph 3-8.1](#)) and prevents damage to the generator by opening the generator circuit breaker when it senses a power reversal. Adjustments to this module are described in [paragraph 6-2.2](#).

5-7. FUSES

The switchboards contain fuses to protect circuitry throughout the cabinets. The location of fuse panels is shown in the figures of [Chapter 7](#). The circuits downstream must be checked when a fuse blows repeatedly.

CAUTION

When replacing a fuse, always use the same type and size as the original.

To replace fuses in molded circuit breakers type AQB-LF250, AQB-LF400, proceed as follows:

- a. Turn off power to circuit breaker. It will be necessary to isolate the cabinet with bus tie breakers and possibly the disconnect links.

WARNING

These switchboards contain lethal voltages. Tag "Out of Service" in accordance with shipboard procedures.

- b. With 1/2-inch socket and ratchet, remove two bolts fastening fuse unit to the circuit breaker.
- c. With fuse unit physically removed from the circuit breaker, remove 1/4-20 screw holding fuses.
- d. Replace fuses with size designated for this circuit breaker.
- e. While power is off, remove circuit breaker for inspection.

- f. Remove four screws and pull out circuit breaker.
- g. Inspect contacts of the circuit breaker. If any corrosion exists, wipe it off with light sandpaper or emery cloth. Lubricate lightly with Elvolute (Gulf Oil) or equivalent.
- h. Replace the circuit breaker. Tighten bolts snugly.
- i. Replace fuse unit on circuit breaker. Tighten bolts snugly.
- j. Close disconnect links if applicable. Close cabinet.
- k. Return cabinet to service.

5-8. METER CHECKS

On the lower front door of switchboard 1S, 2S, and 3S are two test jacks, J1 and J2. Test jack J1 receives nominal 120 VAC, 60 Hz from the main bus of the switchboard through transformer PT1 and PT2 (see [figure 5-18](#)). The main bus voltage may be checked here using a hand-held voltmeter. Compare the voltages (stepped down from 450 VAC) with meter (M4) on the generator switchboard panel on switchboard 1SG. You will also note that frequency meter (M6), wattmeter (M8), reverse power sensing circuits, and overpower sensing circuits all receive their power through transformers PT1 and PT2. Wattmeter (M8), ammeter (M1), reverse power sensing circuits, the overpower sensing circuits, and the fault current detection circuits also sample current stepped down through current transformers CT1 and CT2. Test jack J2 enables a check of stepped down current on the main bus. Both jacks will open the circuit to meters on switchboards 1S, 2S, and 3S and the remote circuit to the EPCC. Switch S32 (when closed) is placed across the secondary of transformers CT1 and CT2 so that no current is present on circuits serviced by transformers CT1 and CT2. However, voltage is still available from transformers PT1 and PT2 unless the circuit is opened at test jack J2.

5-9. INSTALLATION ADJUSTMENTS

5-9.1 SHORE POWER BREAKER RELAY (K3). There are 12 shore power circuit breakers that are closed with one switch (S11) on the shore power control panel of switchboard 2SA. Since these circuit breakers have some mechanical and electrical variances in their closing times, an adjustable relay (K3) prevents the interruption of the closing signal until all circuit breakers connected have a chance to close to the main bus. Refer to [paragraph 6-2.1.2](#).

5-9.2 LOAD SHED RELAY (K2137). In switchboard 2S, time delay adjustable relay K2137 may be adjusted from 1 to 39 seconds. This relay determines the time Load Shed 2 will occur after Load Shed 1 unless current demand on the main bus falls below the trigger point (refer to [paragraph 6-2.1.1](#)).

5-10. TROUBLESHOOTING - COMPONENT LEVEL

The following procedural steps for troubleshooting and testing are performed with the unit removed from the switchboard (except where noted). Refer to [Chapter 6](#) for removal and installation of components.

5-10.1 SYNCHRONIZING MONITOR. See [figure 6-35](#). The following procedure is a function test of the synchronizing monitor with all printed circuit cards installed. See [figure 5-1](#) for component wiring diagram. If any of the printed circuit cards fail the tests in this section, individual cards may be tested further using the procedures of [paragraphs 5-10.1.1](#) through [5-10.1.4](#). Refer to [paragraphs 6-30.1](#) and [6-30.2](#) for removal/replacement steps.

Equipment requirements for this test include:

- Dual oscilloscope
- Two Voltmeters
- Two LEDs (red) Dialight #521-9200 or Equivalent
- Two Resistors 1 Kohm
- Capacitor 1 μ F 200V
- Two Frequency Counters
- Pushbutton switch, 120 VAC, 1 Amp (S1)
- DPDT switch, 120 VAC, 1 Amp (S2)
- 4DPDT switch 120 VAC, 1 Amp (S3)
- Two Function Generators
- Two Power Amplifiers
- Two Generators (Gen A and Gen B, see other requirements below)

Power requirements: 120 VAC and test connection set up as shown in [figure 5-2](#).

Other requirements: Two generators must be operating and on line with same voltages (120 VAC), frequencies, and phase angles (0 degree phase shift).

Remove the Synchronizing Monitor from the switchboard and position on test bench.

NOTE

While conducting test with multimeter, the voltage shown is nominal voltage, not an absolute. Line fluctuation and manufacturing tolerances shall be considered. A plus or minus 5 percent deviation shall be considered normal.

- a. Connect synchronizing monitor as shown in [figure 5-2](#). Power supply, switch, and LEDs must be connected prior to starting generator unit.
- b. Adjust Function Generator A and Function Generator B as follows:
 - (1) Same voltage: Use two voltmeters to check 120 VAC (TB1-5 and TB1-6) of Generator A; and 120 VAC (TB1-7 and TB1-8) of Generator B.
 - (2) Same frequency: Use two frequency counters to check both Generators A and B at 60 Hz.
 - (3) Same Phase Angle: Use dual oscilloscope channel 1 connected to TB1-7 and channel 2 connected to TB1-5. Switch S3 to the UP position. Check for 0 degrees phase angle between TB1-5 and TB1-7.
- c. Enable test switch S2 to Power On and verify:
 - (1) +15 VDC \pm 0.5 at TB2-1.
 - (2) -15 VDC \pm 0.5 at TB2-2.
 - (3) Power LED on Output Board is on.
 - (4) Test LED on Output Board is on.
- d. Push switch S1 then release.
 - (1) Power LED on Output Board remains on.
 - (2) Test LED on Output Board remains on.
 - (3) LED 1 and LED 2 ([figure 5-2](#)) are on.
- e. Frequency test:

- (1) Slowly increase frequency of Generator A until test LED on Output Board turns off, then LED 1 and LED 2 (figure 5-2) turn off with about 0.5 second delay. Verify Frequency Counter of Generator A reads 60.2 ± 0.05 Hz.
- (2) Adjust frequency of Generator A to back to 60 Hz. Verify test LED turns on the Output Board.
- (3) Push switch S1 and then release to illuminate LED 1 and LED 2.
- (5) Slowly decrease frequency of Generator A until test LED on Output Board turns off. Verify LED 1 and LED 2 (figure 5-2) turn off with about 0.5 second delay when frequency of Generator A is 58.2 Hz, or $0.2 \text{ Hz} \pm 0.05$ lower than frequency of Generator B.
- (6) Repeat steps e (2) and (3) to illuminate test LED, LED 1 and LED 2.

f. Voltage Test:

- (1) Increase RMS voltage of Generator A until test LED on the Output Board turns off, then LED 1 and LED 2 turn off at about 0.5 second delay. Verify that voltage of Generator A is 126 ± 1.0 VAC.
- (2) Set RMS voltage of generator A back to 120 ± 1.0 VAC. Test LED turns on.
- (3) Push switch S1 and release. LED 1 and LED 2 will illuminate.
- (4) Decrease RMS voltage of Generator A until the LED of the Output Board turns off, then LED 1 and LED 2 turn off after a 0.5 second delay. Verify the voltage of Generator A is 114 ± 1 VAC.
- (5) Repeat step f (2) and (3) to turn on test LED, LED 1 and LED 2.

g. Phase Angle Test:

- (1) Locate switch S3 to the down position, adjust P1 (figure 5-2) until test LED on the Output Board turns off, then LED 1 and LED 2 turns off after 0.5 second delay. Observe dual oscilloscope and verify the sine wave of channel 1 leads the sine wave of channel 2 by approximately 30 degrees.

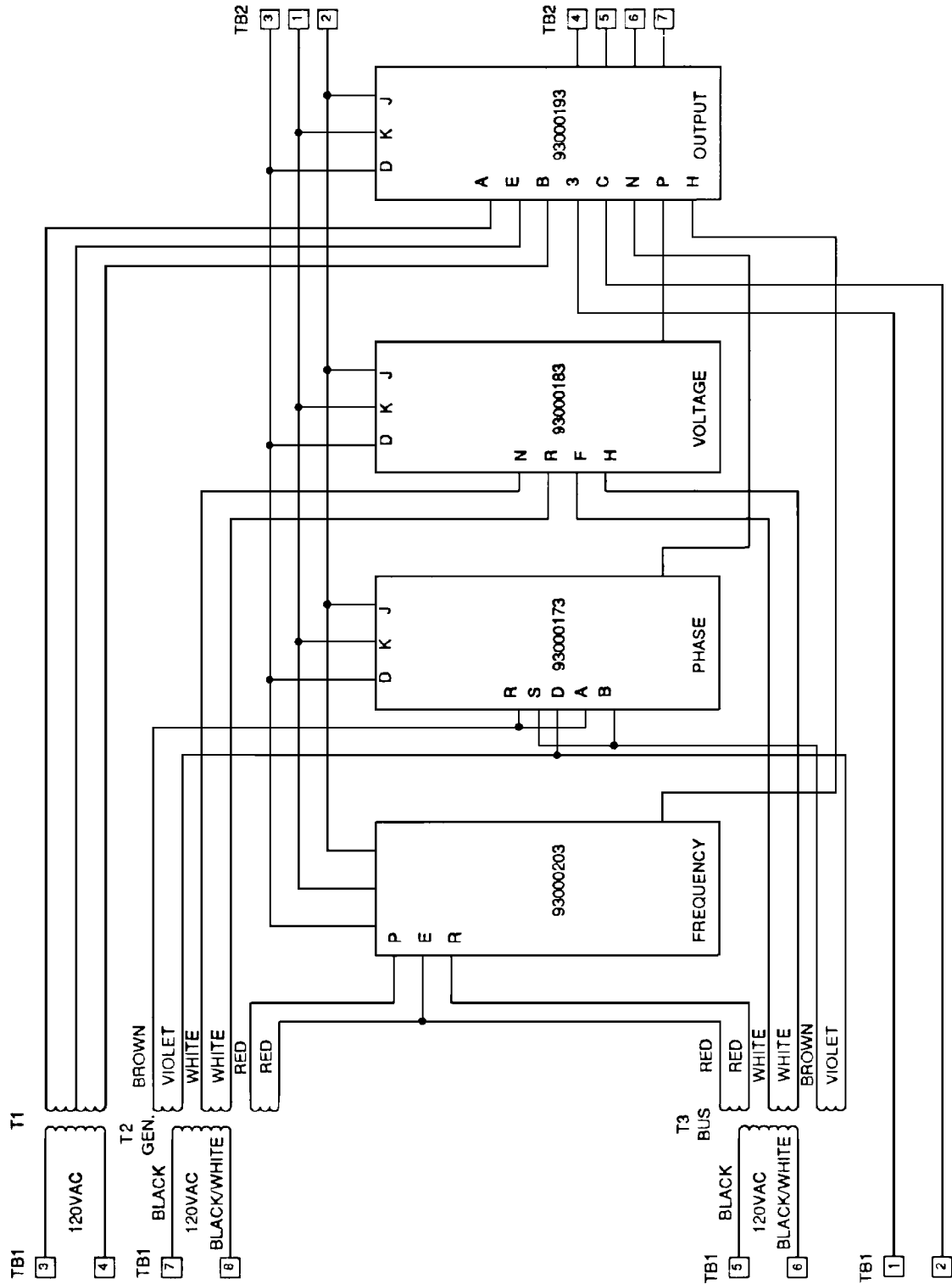


Figure 5-1. Wiring Diagram for Synchronizing Monitor Assembly Module

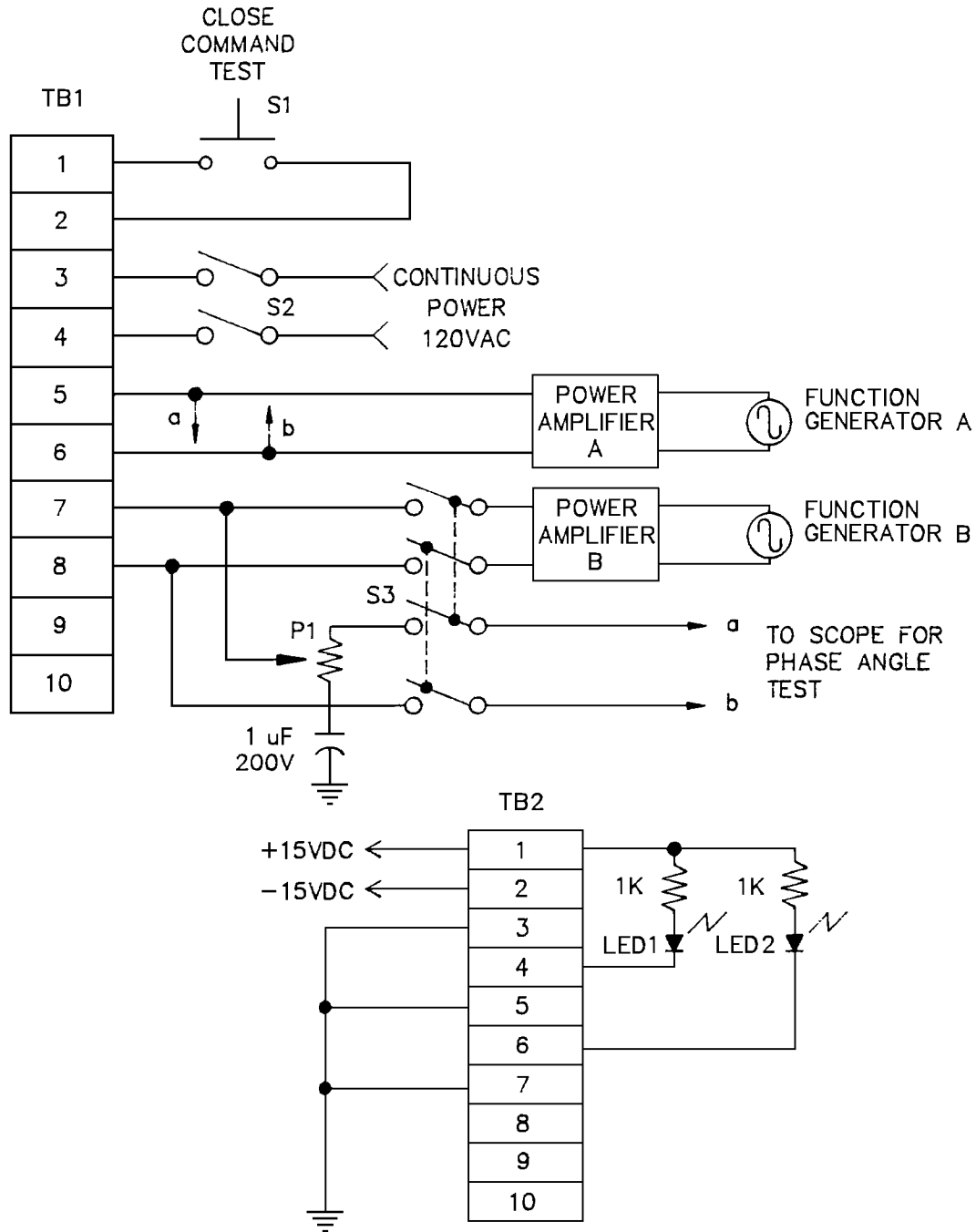


Figure 5-2. Test Configuration for Synchronizing Monitor

5-10.1.1 Phase Angle Card. The following test procedure is for function test of Synchronizing Monitor Phase Angle Card.

NOTE

The individual cards of the synchronizing monitor all use the Test Fixture as shown in [figure 5-3](#).

Equipment requirements for all card tests include an oscilloscope and voltmeter.

ISC test fixture consisting of the following components:

P-8667 Transformer
 PD60
 Two Capacitors 300 μ f
 Two Capacitors 10 μ f
 LM 7815
 LM 7915

Power requirements: 120 VAC connected to a power supply as shown in [figure 5-3](#).

- a. Visually inspect the PCB for poor solder joints, solder splashes, incorrect components, and incorrect diode and capacitor directions. See [figure 5-4](#) for schematic.
- b. Connect PCB as shown in [figure 5-3](#).
- c. Energize power supply and check for $+15 \pm 0.5$ VDC at connector pin K and -15 VDC at pin J. Verify ground at pin D and variable resistors R1 and R22 are turned fully CW.
- d. Jumper between P and 1 (Z2 pin 13 connected to variable resistor R18). Switch S1 to up position ([figure 5-3](#)) to apply signal from point A to pin R of connector and point B to pin S of connector. Adjust generator for 10V peak to peak. Sine wave 60 Hz.
- e. Adjust variable resistor P1 so that sine wave at point A leads sine wave point B by 30 degrees.
- f. Turn variable resistor R1 CCW until LED at pin N turns on. Verify pin 9 on Z1 is set at about 5.3 ± 0.5 VDC.
- g. Set bus phase reference (lag).

NOTE

Setting bus phase reference gives same result if switch S1 switch is set to UP
 (enable for R and S) position.

- (1) Place switch S1 to DOWN position (A, B enable) to apply signal from power supply point A to pin B and point B (ground) to pin A.
- (2) Turn variable resistor R22 CCW until LED at pin N of connector illuminates. Verify pin 6 on Z3 is set at about 5.3 ± 0.5 VDC. Voltage on pin 6 must be set as close as possible to voltage on generator phase.
- (3) Turn P1 and verify LED at pin N of connector turns off when both sine waves at pins A and B are greater than 30 degrees out of phase.

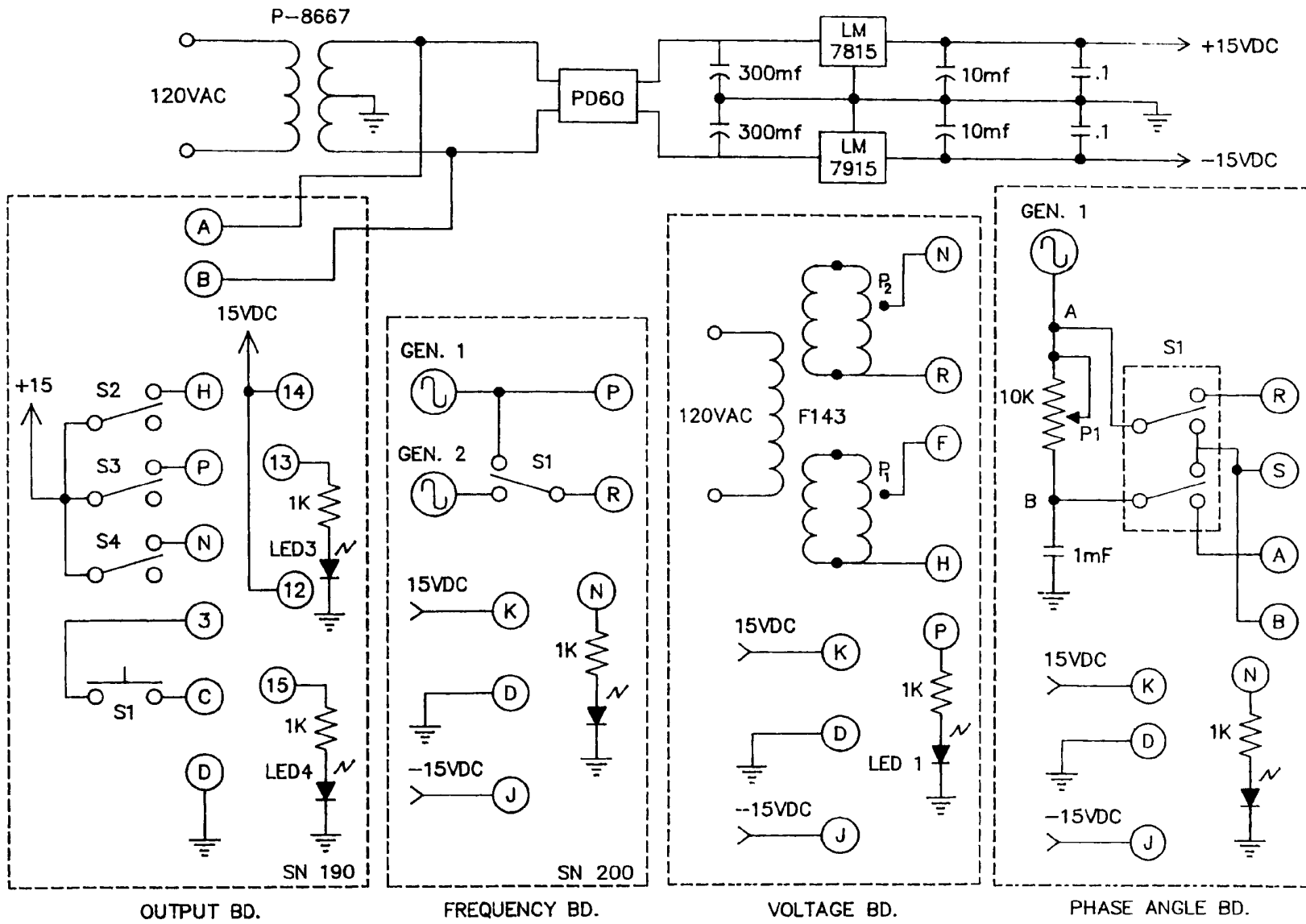


Figure 5-3. Component PCB Test Configuration for Synchronizing Monitor

5-10.1.2 Voltage Card. The following test procedure is for function test of Synchronizing Monitor Voltage Card.

Equipment requirements for this test include:

oscilloscope
voltmeter
two LEDs
pushbutton switch

Power requirements: 120 VAC connected to a power supply as shown in [figure 5-3](#).

- a. Visually inspect PCB for poor solder joints, solder splashes, incorrect components, and incorrect diode and capacitor directions. See [figure 5-5](#) for schematic.
- b. Connect Output board as shown in [figure 5-3](#).
- c. Energize power supply and check for $+15 \pm 0.5$ VDC at connector pin K and -15 VDC at pin J. Verify ground at pin D1.
- d. Adjust variable resistor P1 (variable AC input adjustment) until voltage between pins F and H reads 5.3 ± 0.05 VAC.
- e. Adjust variable resistor P2 (variable AC input adjustment) until voltage between pins N and R reads 5.3 VAC. Verify 0 ± 0.05 VDC is at pin 1 of Z1. LED at pin P is illuminated.
- f. Adjust R6 (on voltage PCB) until voltage at pin 6 of Z1 reads 0.37 ± 0.05 VDC.
- g. Adjust R6 (on voltage PCB) until voltage at pin 9 of Z1 reads 0.37 ± 0.05 VDC.
- h. Increase variable resistor P2 (variable AC input adjustment) between pins N and R until voltage at pin 8 of Z1 changes from -14.0 VDC to +14.0 VDC. Also verify LED at pin P turns off. Verify pin 1 at Z1 reads -0.375 ± 0.02 VDC.
- i. Decrease variable resistor P2 (variable AC input adjustment) between pins N and R until voltage at pin 7 of Z1 changes from -14.0 VDC to +14.0 VDC. Verify pin 1 at Z1 reads $+0.375 \pm 0.02$ VDC. LED at pin P turns off.

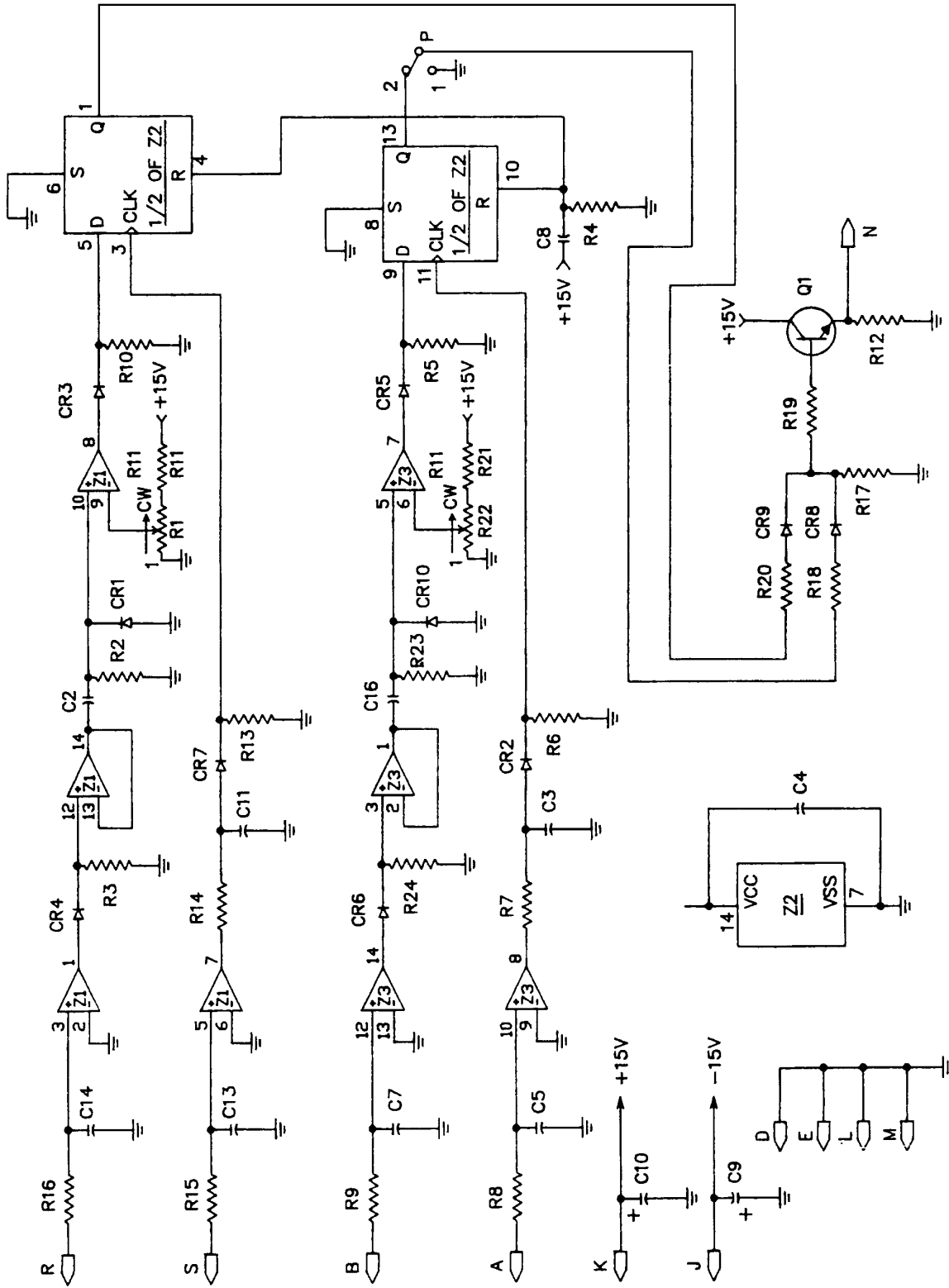


Figure 5-4. Phase Angle PCB Schematic Layout

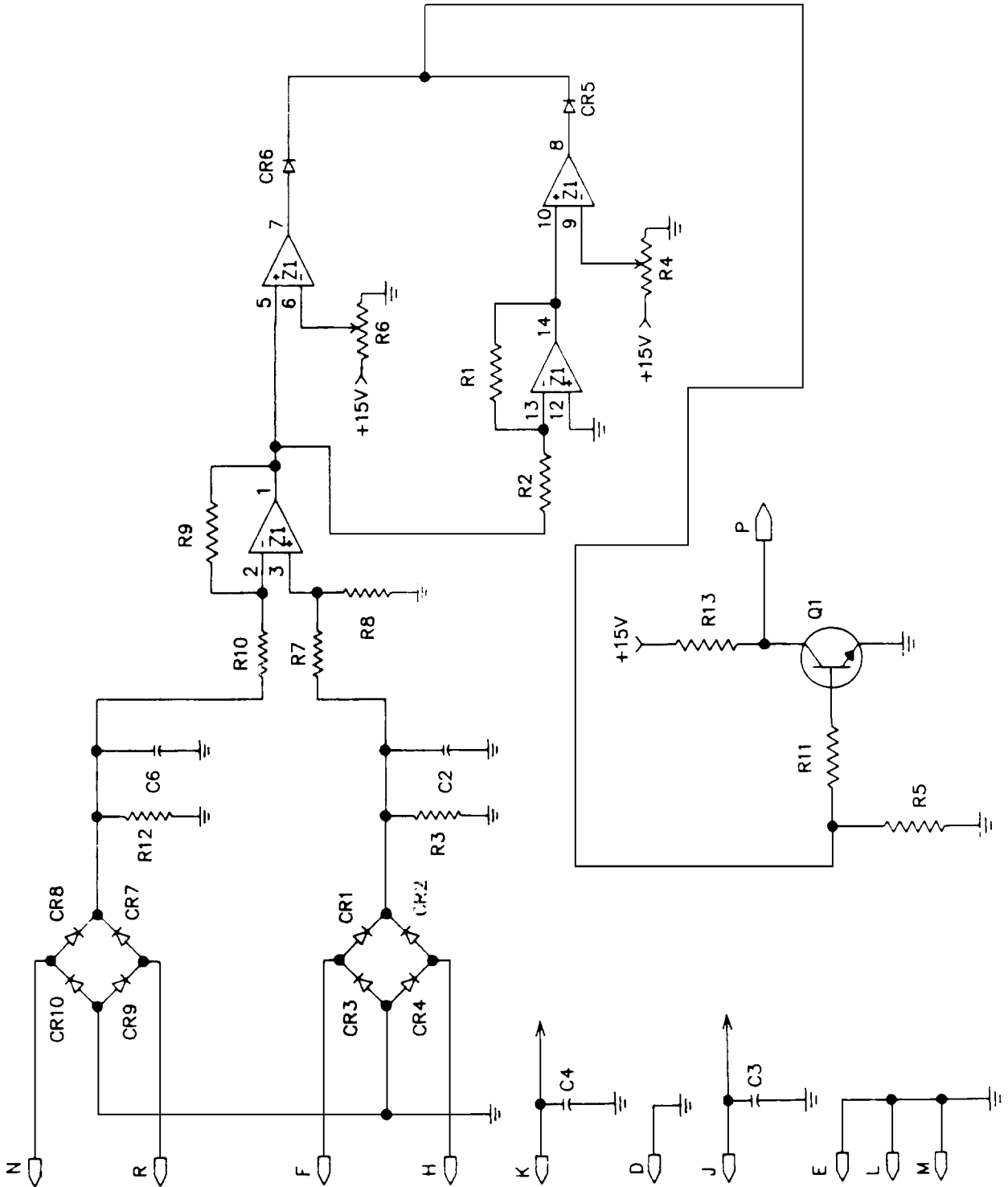


Figure 5-5. Voltage PCB Schematic Layout

5-10.1.3 Frequency Card. The following test procedure is for function test of Synchronizing Monitor Frequency Card.

Equipment requirements for this test include:

oscilloscope
voltmeter
two frequency generators (not ship's service generators)
ISC test fixture (LEDs, 1 Kohm resistor, and pushbutton switch)

Power requirements: 120 VAC connected to a power supply as shown in [figure 5-3](#).

- a. Visually inspect PCB for poor solder joints, solder splashes, incorrect components, and incorrect diode and capacitor directions. See [figure 5-21](#) for schematic.
- b. Connect PCB as shown in [figure 5-3](#).
- c. Energize power supply and check for $+15 \pm 0.5$ VDC at connector pin K and -15 VDC at pin J. Verify ground at pin D.
- d. Enable signal from generator 1 to pins P and R by setting switch S1 to UP position.
- e. Set low frequency range.
 - (1) Set frequency generator for 55 Hz.
 - (2) Adjust variable resistor R23 for 0.00 ± 0.05 VDC at pin 8 on Z3.
 - (3) Adjust variable resistor R14 for 0.00 ± 0.05 VDC at pin 8 on Z1.
- f. Set high frequency range.
 - (1) Set frequency generator for 65 Hz.
 - (2) Adjust variable resistor R10 for 10 ± 0.05 VDC at pin 8 on Z3.
 - (3) Adjust variable resistor R1 for 10 ± 0.05 VDC at pin 8 on Z1

NOTE

It may be necessary to repeat [steps e](#) and [f](#) until no further adjustment is needed.

- g. Verify -200 ± 10 mV at pin 14 of Z3 and $+200$ mV at pin 14 of Z1.
- h. Enable pin R to receive signal from frequency generator 2 by placing switch S1 in the "DOWN" position.
- i. Set both frequency generators to 60 ± 0.05 Hz and verify 0.00 ± 0.005 VDC at pin 14 of 22.
- j. Verify LED at pin H turns off any time frequency of generator 1 is above or below frequency of generator 2 by 0.2 ± 0.05 VDC. Check by slowly increasing and decreasing frequency of generator 1.

5-10.1.4 Output Board. The following test procedure is for function test of Synchronizing Monitor Output Board.

Equipment requirements for this test include:

oscilloscope
voltmeter
two LEDs
pushbutton switch

Power requirements: 120 VAC and a power supply as shown in [figure 5-3](#).

- a. Visually inspect PCB for poor solder joints, solder splashes, incorrect components, and incorrect diode and capacitor directions, S2, S3 and S4 open. See [figure 5-3](#) for schematic.

- b. Connect card as shown in [figure 5-3](#).
- c. Energize power supply and check for $+15 \pm 0.5$ VDC at connector pin K and -15 VDC at pin J. Verify ground at pin D and LED 1 on with LED 2 off.
- d. Close switch S2, S3, and S4 to enable $+15 \pm 0.5$ VDC to pins H, P, and N. Verify LED 2 is illuminated.
- e. Push switch S1 and release. Verify relay K1 energizes to illuminate LED 3 and LED 4.
- f. Open S2 to turn off LED 2. Verify LED 3 and LED 4 turn off after 0.5 second delay.
- g. Close S2 and repeat [step \(e\)](#) above to turn off LED 3 and LED 4.
- h. Open S3 to turn off LED 2. Verify LED 3 and LED 4 turn off after 0.5 second delay.
- i. Close S3 and repeat [step \(e\)](#) above to turn off LED 3 and LED 4.
- j. Open S4 to turn off LED 2. Verify LED 3 and LED 4 turn off after 0.5 second delay.

NOTE

[Paragraph 5-10.2](#) is not applicable to ships with MACHALT 320-59006 (ECP-515) installed.

5-10.2 REVERSE POWER MONITOR (A2). The following bench test is required to verify the proper operation of the Reverse Power Monitor. If the Reverse Power Monitor fails any portion of this test, it should be replaced using the procedures found in [paragraph 6-33](#).

Equipment requirements for this test include:

1. Test Fixture 1 (TF1) as shown on [figure 5-6](#).
2. Test Fixture 2 (TF2) as shown on [figure 5-6](#), consisting of the following components:
 - a. VARIAC 0-140 VAC Single phase 60 Hz
 - b. Transformer 60 Hz 115/26 VAC CT single phase
 - c. Resistor RJS22R Ohmite
 - d. Ammeter, 0-10 Amp range
 - e. (Qty 2) Power supply, 115 VAC, 60 Hz, single phase 10 amp
 - f. Power supply, 115 VAC, 60 Hz, three phase 10 amp
 - g. (Qty 2) Relay MDR 131-1
 - h. (Qty 2) Indicating Lamp LH98-3
 - i. Terminal Board 10TB12

5-10.2.1 Test Objective. The test objective is to verify that this solid-state device meets proper physical and functional requirements prior to use.

5-10.2.2 Test Equipment Verification. Perform the following verification before the start of testing.

- a. Verify that all test equipment and instrumentation listed in this procedure is present.
- b. Configure Test Fixtures 1 and 2 as shown in [figure 5-6](#).

5-10.2.3 Physical Examination. Examine the unit to ensure that the part being tested is the correct part as described in the parts list in [Chapter 7](#).

5-10.2.4 Test Procedures. Perform the following functional test to ensure the proper operation of the Reverse Power Monitor.

- a. Connect Reverse Power Monitor A2 unit to be tested as shown on [figure 5-6](#).
 - (1) Verify connection of A2TB1-1 to Test Fixture 1 (TF1) TB2-5.
 - (2) Verify connection of A2TB1-2 to TF1 TB2-2.
 - (3) Verify connection of A2TB1-3 to TF1 TB2-4.
 - (4) Verify connection of A2TB1-9 to Test Fixture 2 (TF2) TB1-8.
 - (5) Verify connection of A2TB1-10 to TF2 TB1-5.
 - (6) Verify connection of TF2 TB1-5 to TF1 TB1-8.
 - (7) Verify connection of TF2 TB-1 to TF1 TB1-9:
 - (8) Verify connection of Variac supply of 115 VAC to Variac T1-1.
 - (9) Verify connection of Variac return of 115 VAC to Variac T1-2
 - (10) Verify connection of T1/3 to R1.
 - (11) Verify connection of T1/6 to R1 centertap.
 - (12) Verify connection of R1 centertap through AM1 to A2TB1-4.
 - (13) Verify connection of T1/6 to A2TB1-5.
 - (14) Verify connection of 115 VAC supply to A2TB2-C1.
 - (15) Verify connection of 115 VAC return to A2TB1-C2.
- b. Connect 450 VAC, 3 Ph, 60 Hz Power Source to Test Fixture as shown on [figure 5-6](#):
 - (1) Verify connection of PH A to TF1 TB1-1.
 - (2) Verify connection of PH B to TF1 TB1-2.
 - (3) Verify connection of PH C to TF1 TB1-3.
- c. Connect 3 Ph Variable load to TF:
 - (1) Verify connection of PH A to TF TB1-5.
 - (2) Verify connection of PH B to TF TB1-6.
 - (3) Verify connection of PH C to TF TB1-7.
- d. Configure Load Bank resistive elements as shown on [figure 5-6](#).
- e. Verify Reverse Power Monitor A2 is set at the following settings:
 - (1) Time Delay Setting at 5 seconds.
 - (2) Power Level Setting at 100 ma.
- f. Apply 115 VAC from Power Source. Adjust Variac to R1 until AM1 reads 3.33 amps.
- g. Observe relay for 3 minutes. Verify K1 (DS1 light) is not energized.
- h. Adjust Variac and R1 until AM1 reads 0 amps.
- i. Secure power at power source. Change connection to RPM A2 as follows:
 - (1) Change connections of R1 center tap through AM1 to A2TB1-5.
 - (2) Change connection of T1/6 to A2TB1-4.
- j. Apply 450 VAC power and 115 VAC power to Variac. Adjust Variac and R1 until AM1 reads 0.167 amps. Slowly lower trip point setting until DS1 illuminates.

- k. Adjust Variac and R1 until AM reads 0 amps.
- l. Secure power at power source. Change connections to RPR A2 as follows:
 - (1) Change connection of R1 center tap through AM1 to A2TB1-6.
 - (2) Change connection of T1/6 to A2TB1-7.
 - (3) Change connection of TF1 TB2-5 to A2TB1-3.
 - (4) Change connection of TF1 TB2-4 to A2TB1-1.
- m. Apply 450 VAC power from power source. Voltage at RPM terminals A2TB1-1 to A2TB1-2, and A2TB1-1 to A2TB1-2 shall be 115 ± 5 VAC.
- n. Apply 115 VAC from Power Source. Adjust Variac to R1 until AM1 reads 3.33 amps.
- o. Observe relay for 3 minutes. Verify K1 (DS1 light) is not energized.
- p. Adjust Variac and R1 until AM1 reads 0 amps.
- q. Secure power at power source. Change connections to RPR A2 as follows:
 - (1) Change connections of R1 center tap through AM1 to A2TB1-7.
 - (2) Change connection of T1/6 to A2TB1-6.
- r. Apply 450 VAC power and 115 VAC power to Variac. Adjust Variac and R1 until AM1 reads 0.167 amps. Slowly lower trip point setting until DS1 illuminates.
- s. Without changing settings, secure 115 VAC power to Variac.
- t. Verify S1 is open. Apply 115 VAC to S1. Simultaneously energize 115 VAC to Variac and close S1. Start timer. Proper operation should verify that DS1 illuminates after 5 second Time Delay.
- u. End item functional test complete. If the Reverse Power Monitor failed any portion of this test, it should be replaced using the procedures found in [paragraph 6-33](#).

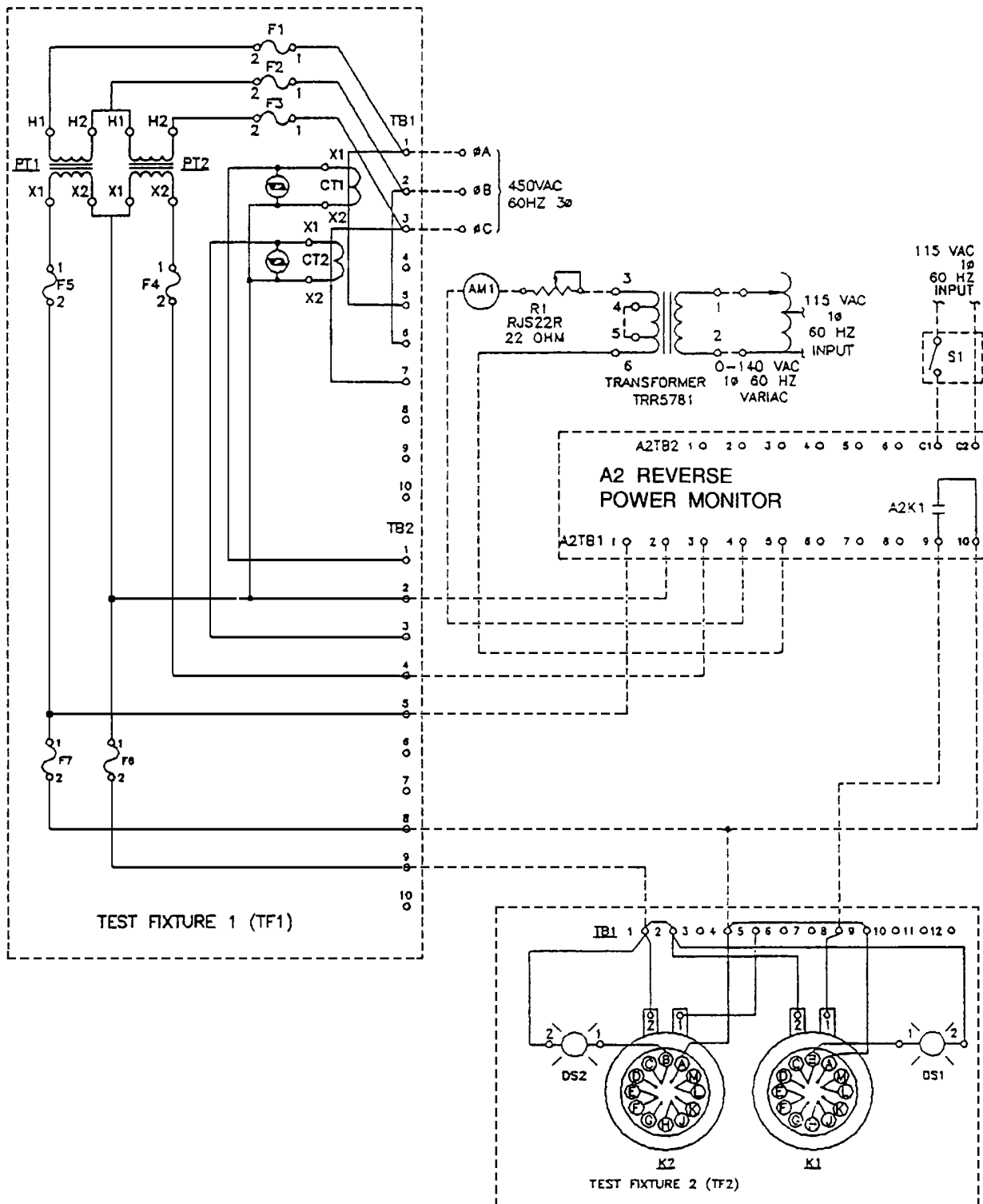


Figure 5-6. Test Fixture - Reverse Power Monitor

NOTE

Paragraph 5-10.3 is not applicable to ships with MACHALT 320-59006 (ECP-515) installed.

5-10.3 AC POWER SENSING RELAY (A3a). The following bench test is required to verify the proper operation of the AC Power Sensing Relay. If the relay fails any portion of this test, it should be replaced using the procedures found in [paragraph 6-29](#).

Equipment requirements for this test include:

1. Test Fixture 1 (TF1) as shown on [figure 5-6](#).
2. Test Fixture 4 (TF4) as shown on [figure 5-7](#), consisting of the following components:
 - a. VARIAC 0-140 VAC Single phase 60 Hz
 - b. Transformer 60 Hz 115/26 VAC CT single phase
 - c. Resistor RJS22R Ohmite
 - d. Ammeter, 0-10 Amp range
 - e. (Qty 2) Power supply, 115 VAC, 60 Hz, single phase 10 amp
 - f. Power supply, 115 VAC, 60 Hz, three phase 10 amp
 - g. (Qty 2) Relay MDR 131-1
 - h. (Qty 2) Indicating Lamp LH98-3
 - i. Terminal Board 10TB12

5-10.3.1 Test Objective. The test objective is to verify that this solid-state device meets proper physical and functional requirements prior to use.

5-10.3.2 Test Equipment Verification. Perform the following verification before the start of testing.

- a. Verify that all test equipment and instrumentation listed in this procedure is present.
- b. Configure Test Fixtures as shown in [figure 5-7](#).

5-10.3.3 Physical Examination. Examine the unit to ensure that the part being tested is the correct part as described in the parts list in [Chapter 7](#).

5-10.3.4 Test Procedures. Perform the following steps to ensure the proper operation of the Power Sensing Relay.

- a. Connect Power Sensing Relay A3a unit to be tested to test fixtures (TF) as shown in [figure 5-7](#);
 - (1) Confirm connection on A3TB1-1 to TF1 TB2-5.
 - (2) Confirm connection on A3TB1-2 to TF1 TB2-2.
 - (3) Confirm connection on A3TB1-3 to TF1 TB2-4.
 - (4) Confirm connection on A3TB1-4 through AM1 to R1.
 - (5) Confirm connection on R1 Centertap to T1-3.
 - (6) Confirm connection on T1-6 to A3TB1-5.
 - (7) Confirm connection on A3TB-9 to TF4 TB1-5.
 - (8) Confirm connection on A3TB1-10 to TF4 TB1-8.

- (9) Confirm connection on A3TB1-11 to TF1 TB2-8.
 - (10) Confirm connection on A3TB1-12 to TF4 TB1-1.
 - (11) Confirm connection on TF1 TB1-1 to TF1 TB2-9.
- b. Connect 450 VAC, 3PH, 60 Hz power source to test fixture (TF) as shown in [figure 5-2](#).
 - (1) Connect PH A to TF1 TB1-1.
 - (2) Connect PH B to TF1 TB1-2.
 - (3) Connect PH C to TF1 TB1-3.
 - c. Verify Power Sensing Relay A3a is set at the following positions:
 - (1) CT ratio Taps - no straps installed.
 - (2) PT Secondary Taps - PH A and PH C are set at 110 VAC.
 - (3) Time Delay setting at 20 seconds.
 - (4) Power level setting at 100 percent.
 - d. Apply power to TF1. Voltage at PSR terminals A3TB1-1 to A3TB1-2, and A3TB1-3 to A3TB1-2, shall be 115 ± 5 VAC.
 - e. Energize and adjust Variac and R1 until AM 1 reads 3.33 amps.
 - f. Observe Relay for 3 minutes. Verify that neither (DS1 light) nor K2 (DS2 light) is energized.
 - g. Adjust Variac and R1 until AM1 reads 4.16 amps. Slowly lower Power Sensing Relay power level setting until K1 activates. When DS1 illuminates, start timer.
 - h. Observe relay K2 activates (DS2 illuminates) 20 seconds after relay K1 activates (DS1 illuminates).
 - i. Lower Variac setting until AM1 reads zero (0) amps. Secure all power. Change connections to Power Sensing Relay as follows:
 - (1) Change R1 through AM1 to A3TB1-6.
 - (2) Change Tl-6 to A3TB1-7.
 - (3) Change TF1 TB2-5 to A3TB1-3.
 - (4) Change TF1 TB2-4 to A3TB1-1.
 - j. Apply 450 VAC power to TF1. Voltage at Power Sensing Relay terminals A3TB1-1 to A3TB1-2, and A3TB1-3 to A3TB1-2 shall be 115 ± 5 VAC.
 - k. Energize and adjust Variac and R1 until AM1 reads 3.33 amps.
 - l. Observe Relay for 3 minutes. Verify neither K1 (DS1 light) nor K2 (DS2 light) is energized.
 - m. Adjust Variac and R1 until AM1 reads 4.16 amps. Slowly lower Power Sensing Relay power level setting until K1 activates. When DS1 illuminates, start timer.
 - n. Observe relay K2 activates (DS2 illuminates) 20 seconds after relay K1 activates (DS1 illuminates).
 - o. Secure power and disconnect test equipment.
 - p. Functional test complete. If the relay failed any portion of this test, it should be replaced using the procedures found in [paragraph 6-29](#).

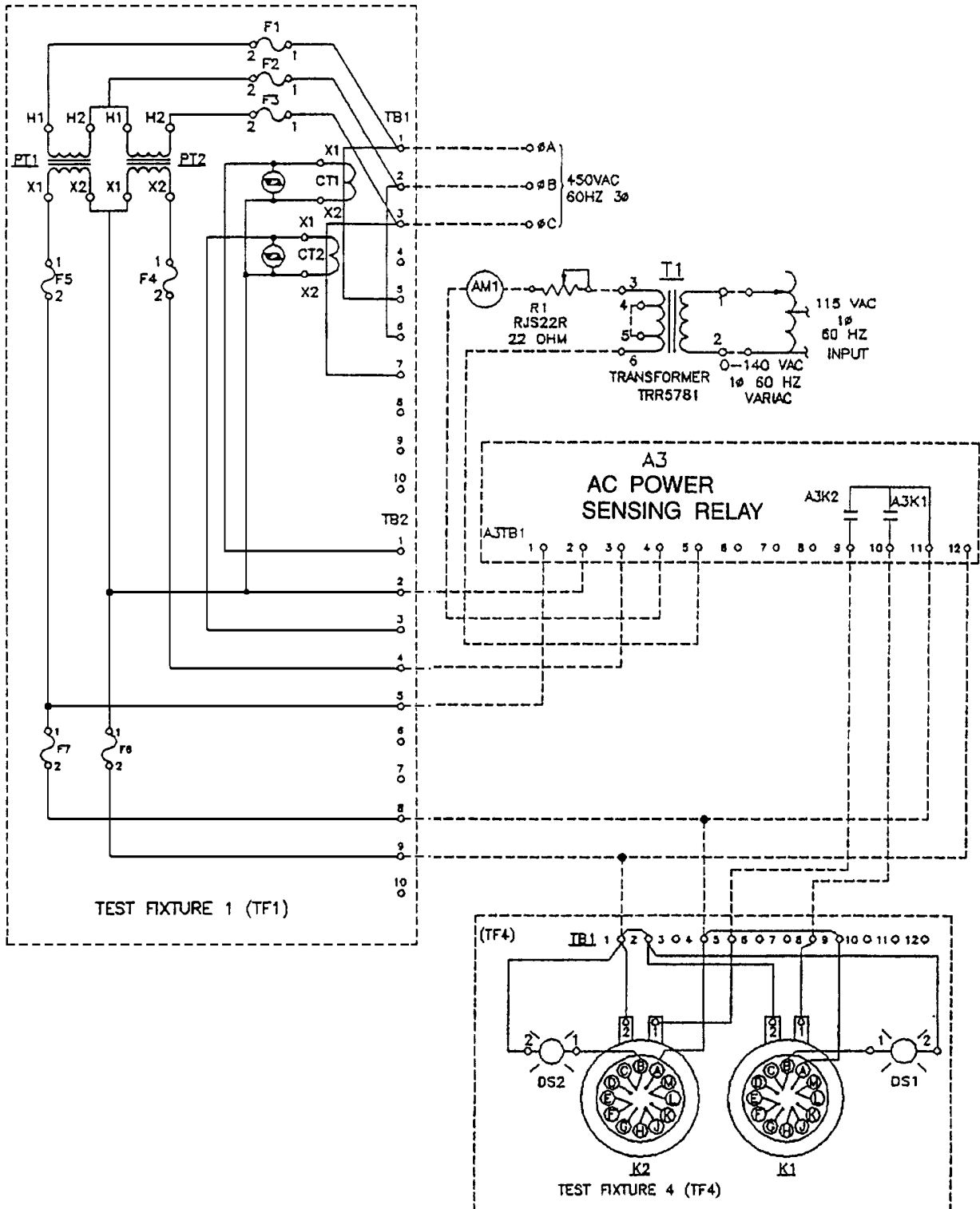


Figure 5-7. Test Fixture - AC Power Sensing Relay

5-10.4 ANALOG BUS GROUND DETECTOR. See [figure 6-37](#). This function test simulates shipboard operation. Refer to [paragraph 6-31.1](#) for removal steps.

Equipment requirements for this test include:

multimeter
3PST switch (1 amp)
selector switch (3-position, 1 common)
pushbutton (1 amp, 450 VAC), and 1:1 transformer

Power requirements: three phase, 450 VAC.

WARNING

450 VAC power used for this test will cause a shock hazard which could be fatal. Electrical safety precautions must be taken. Secure area with warning signs and personnel barrier.

- a. Visually inspect unit for poor solder joints, solder splashes, incorrect components, and incorrect capacitor directions. See [figure 5-8](#) for schematic.
- b. Connect ground detector to test components according to [figure 5-9](#).
- c. Apply power to system and verify 450 VAC between inputs:
 - (1) TB1-5 to TB1-7
 - (2) TB1-7 to TB1-9
 - (3) TB1-5 to TB1-9
- d. Place switch S3 in OPEN position and check for 2.5 ± 1.0 VDC at output TB1-2 and TB1-3.
- e. Place switch S2 in POSITION 1 and close switch S3. Verify voltage between TB1-2 and TB1-3 is 7.5 ± 1.0 VDC.
- f. Place switch S3 in OPEN position and check for 2.5 ± 1.0 VDC at output TB1-2 and TB1-3.
- g. Place switch S2 in POSITION 2 and close switch S3. Verify voltage between TB1-2 and TB1-3 is 7.5 ± 1.0 VDC.
- h. Place switch S3 in OPEN position and check for 2.5 ± 1.0 VDC at output TB1-2 and TB1-3.
- i. Place switch S2 in "POSITION 3" and close switch S3. Verify voltage between TB1-2 and TB1-3 is 7.5 ± 1.0 VDC.
- j. Open switch S3 and turn power off. Restore equipment.

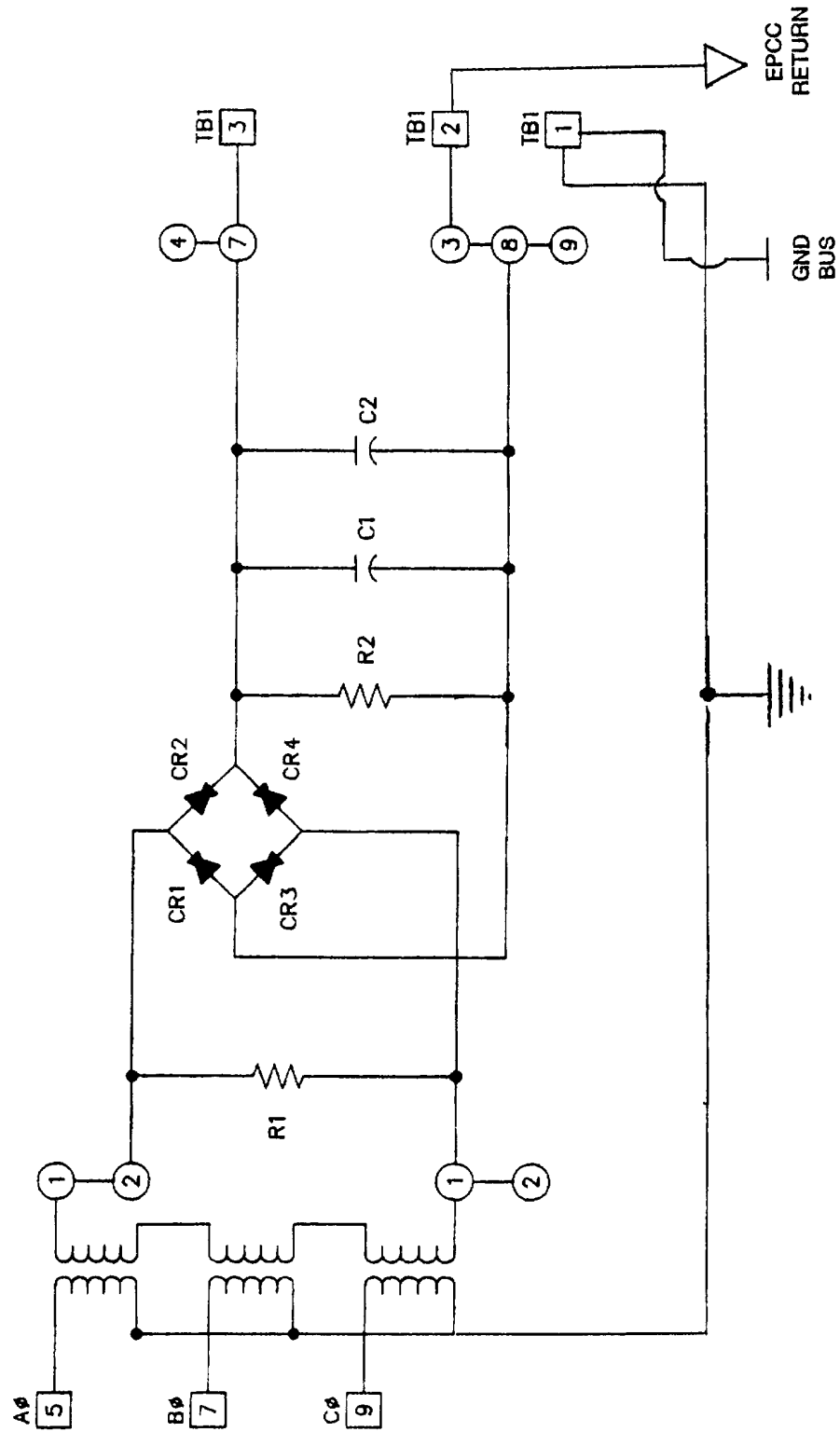


Figure 5-8. Bus Ground Detector Schematic

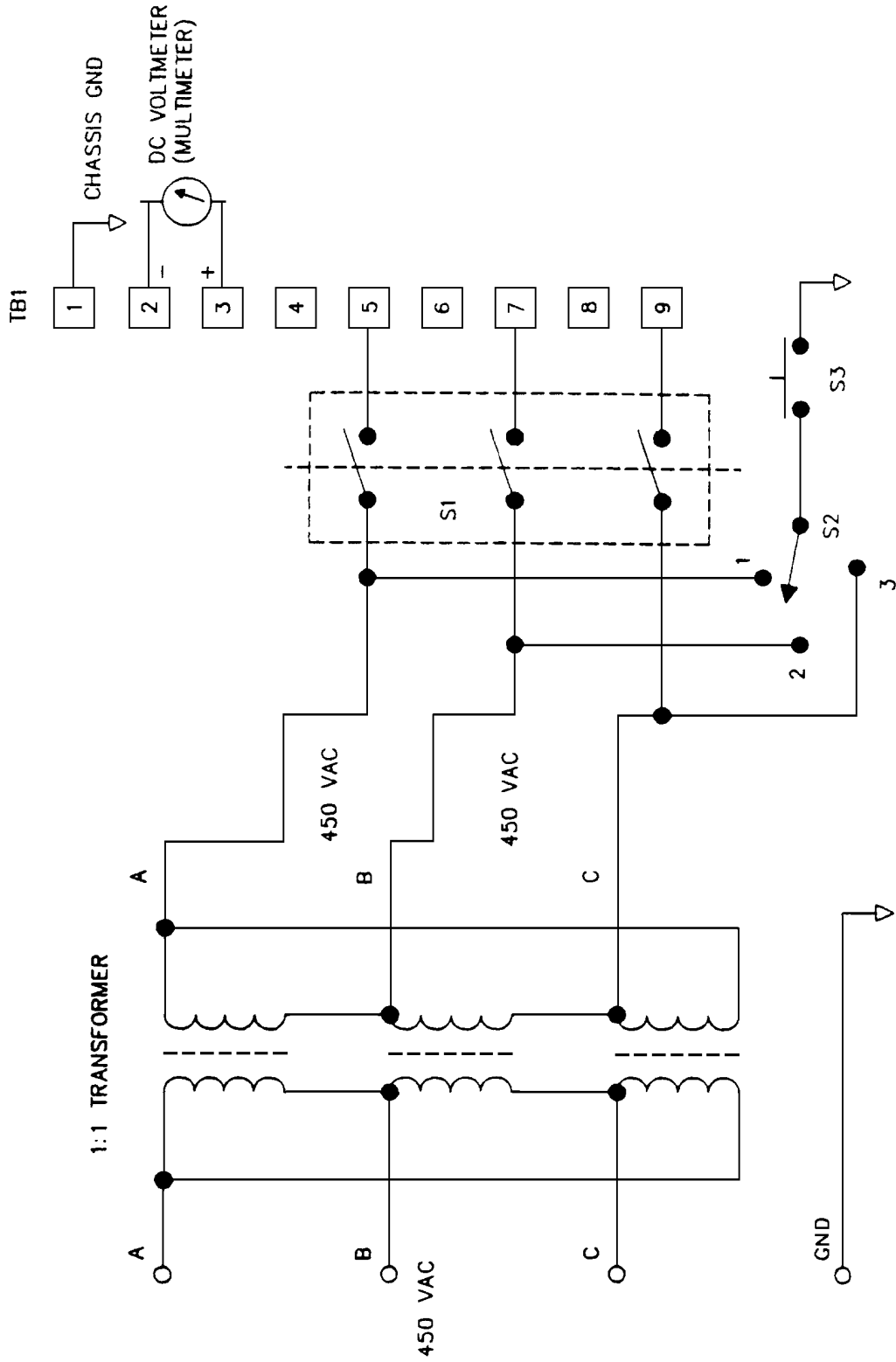


Figure 5-9. Bus Ground Detector Test Connection

NOTE

Paragraph 5-10.5 is not applicable to ships with MACHALT 320-59006 (ECP-515) installed.

5-10.5 FAULT CURRENT DETECTOR. See figure 6-32. The following test procedure is for function test of the FCD with all components installed. See figure 5-26 for system schematic. Individual components of system are tested using steps found in paragraphs 5-10.5.1 through 5-10.5.3 of this manual. Refer to 6-27.1 for detector removal.

Equipment requirements for test include:

- three multimeters
- two 10K ohm (1 watt) resistors
- two LEDs (red)
- two function generators
- three SPST (120 VAC, 1 amp) switches

Power requirements: 24 VDC as shown in figure 5-10. Modules (PCB) require 24 VDC through power supply card or 18 VDC applied to card.

- a. Visually inspect all the PCB for poor solder joints, solder splashes, incorrect components, and incorrect diode and capacitor directions. Refer to paragraph 6-27.1 for component removal. Component (PCBs) from left to right are:
 - (1) Power Supply Module
 - (2) Current Supply Module
 - (3) Remote RPM Detector
- b. Connect FCD to test components as shown in figure 5-10 and place switches SW1 and SW2 in "CLOSED" position and switch SW3 in "OPEN" position.
- c. Set Function Generator 1 and 2 to 0 VAC.
- d. Energize all test equipment and verify:
 - (1) LED 1 and LED 2 are illuminated
 - (2) Fault LED on Power Supply Module is off
 - (3) Phase A and C LEDs on Current Detector Module are off
 - (4) "LOW" LED on Remote RPM Detector Module is on and voltage reading between TB1-5 and TB1-6 read 0.00 ± 0.1 VAC
- e. Increase voltage on Function Generator 1 to 3.0 VAC and verify:
 - (1) Phase A LED on Current Detector 1 Module illuminates
 - (2) Phase C LED on Current Detector Module remains off
 - (3) Fault LED on Power Supply Module illuminates
 - (4) LED 1 and LED 2 illuminate
 - (5) "LOW" LED on Remote RPM Module is illuminated
- f. Decrease voltage on Function Generator 1 until LED 1 and LED 2 extinguish and verify:
 - (1) Fault LED on Power Supply Module illuminates
 - (2) Phase A LED on Current Detector 1 Module goes off
 - (3) Phase C LED on Current Detector Module remains off

- (4) “LOW” LED on Remote RPM Module is illuminated
- (5) Voltage reading of Function Generator 1 is 2.40 ± 0.1 VAC
- g. Increase voltage on Function Generator 2 to 3.0 VAC and verify:
 - (1) Phase A LED on Current Detector 1 Module remains off
 - (2) Phase C LED on Current Detector Module illuminates
 - (3) Fault LED on Power Supply Module illuminates
 - (4) LED 1 and LED 2 illuminate
 - (5) “LOW” LED on Remote RPM Module is illuminated
- h. Decrease voltage on Function Generator 1 until LED 1 and LED 2 go off and verify:
 - (1) Fault LED on Power Supply Module is off
 - (2) Phase A LED on Current Detector 1 Module is off
 - (3) Phase C LED on Current Detector Module is off
 - (4) “LOW” LED on Remote RPM Module is illuminated
 - (5) Voltage reading of Function Generator 2 is 2.40 ± 0.1 VAC
- i. Close switch SW3 and verify “LOW” LED on Remote RPM Module goes off and all other LEDs remain illuminated.
- j. Increase voltage of Function Generator 1 to 3.0 ± 0.1 VAC and then return voltage to 2.4 ± 0.1 VAC. Verify all LEDs remain unchanged during voltage increase and decrease to Function Generator 1.
- k. Place switch SW1 in “OPEN” position and verify LED 1 and LED 2 illuminate.
- l. Place switch SW1 in “CLOSED” position and verify LED 1 and LED 2 go off.
- m. Place switch SW2 in “OPEN” position and verify LED 1 and LED 2 go off.
- n. Press pushbutton on front panel of Power Supply Module and verify voltage between TB1-5 and TB1-6 reads 3.6 ± 0.1 VAC.

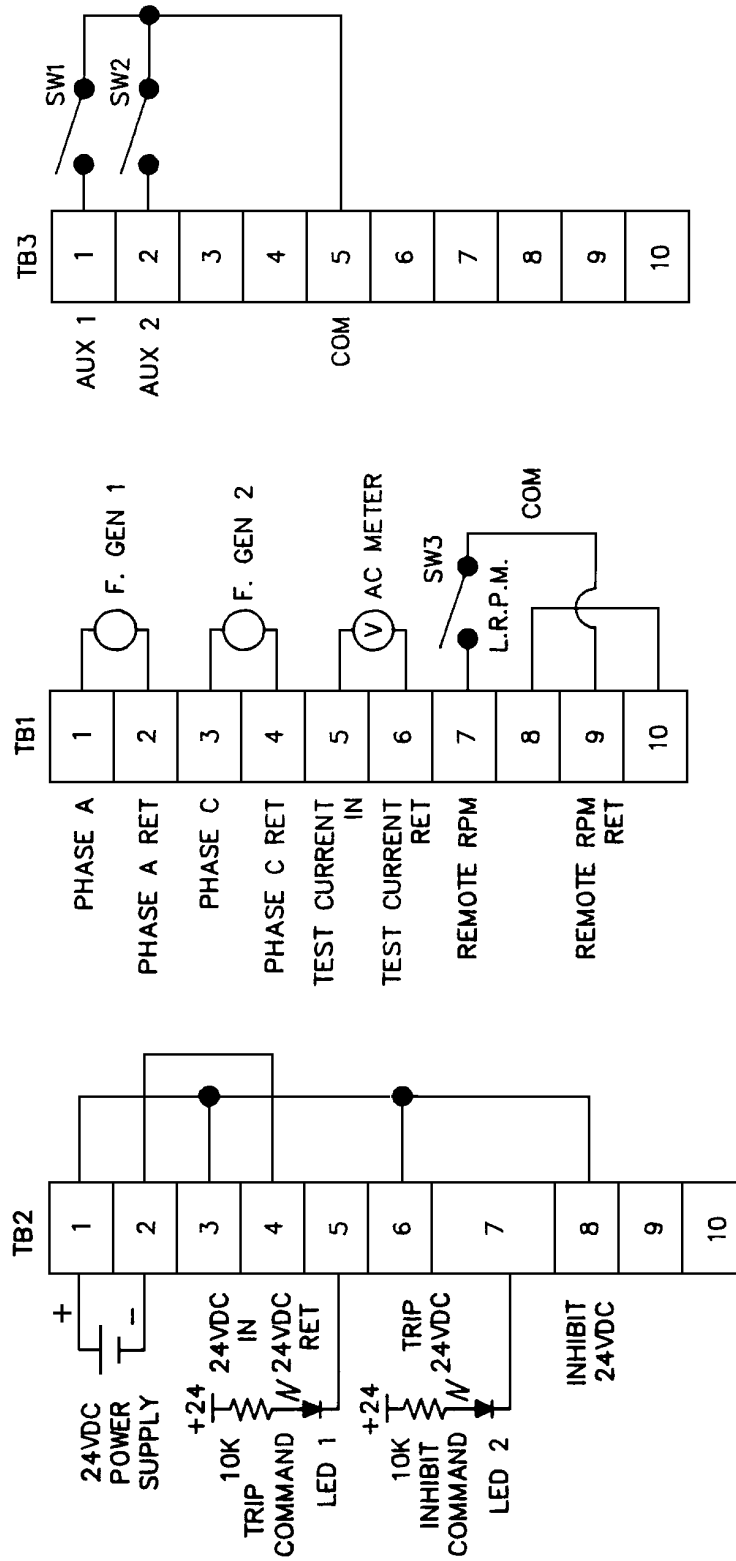


Figure 5-10. Fault Current Detector Test Connection

5-10.5.1 Power Supply PCB.

- a. Visually inspect unit for poor solder joints, solder splashes, incorrect components, and incorrect capacitor directions. See [figure 5-27](#) for schematic.
- b. Connect Power Supply PCB to test components as shown in [figure 5-11](#) and perform the following steps:
 - (1) Apply 18 ± 0.5 VDC to board with positive on pin 2 and common on pin 1.
 - (2) Check for $+5.0 \pm 0.05$ VDC from pin 15 of board to common on pin 6.
 - (3) Verify U1-6 reads $+9.0 \pm 0.25$ VDC.
- c. Fault Detection.
 - (1) Place switches SW1, SW2, and SW3 in “OFF” position.
 - (2) Verify LED 1 and LED 2 are illuminated with fault LED on module off.
 - (3) Place switch SW1 in “POSITION 1”, then to “POSITION 2” and verify fault LED remains off.
 - (4) Place switch SW1 in “OFF” position.
 - (5) Place switch SW2 in “POSITION 1”, then to “POSITION 2” and verify fault LED remains off.
 - (6) Place switch SW2 in “POSITION 2” with switch SW1 in “POSITION 1” and verify fault LED illuminates.
 - (7) Place switch SW2 in “POSITION 1” and verify fault LED remains illuminated.
 - (8) Place switch SW1 in “POSITION 2” and verify fault LED remains illuminated.
- d. Shutdown
 - (1) Place switch SW3 in “POSITION 1”, then “POSITION 2” and verify LED 1 and LED 2 remain illuminated.
 - (2) Place switch SW3 in “POSITION 2” with switch SW1 in “OFF” and verify LED 1 and LED 2 turn off.
 - (3) Place switch SW3 in “POSITION 3” and verify LED 1 and LED 2 remain off.
- e. Current Test Signal
 - (1) Connect DVM (set for AC volts) across connector pins 4 and 5.
 - (2) Press pushbutton switch and turn R2 fully CW. DVM should read 5.3 ± 0.2 VAC.
 - (3) Turn P2 fully CCW and verify voltage reads 0.0 ± 0.005 VAC.
 - (4) Turn R2 so that voltage reads 3.6 ± 0.05 VAC.

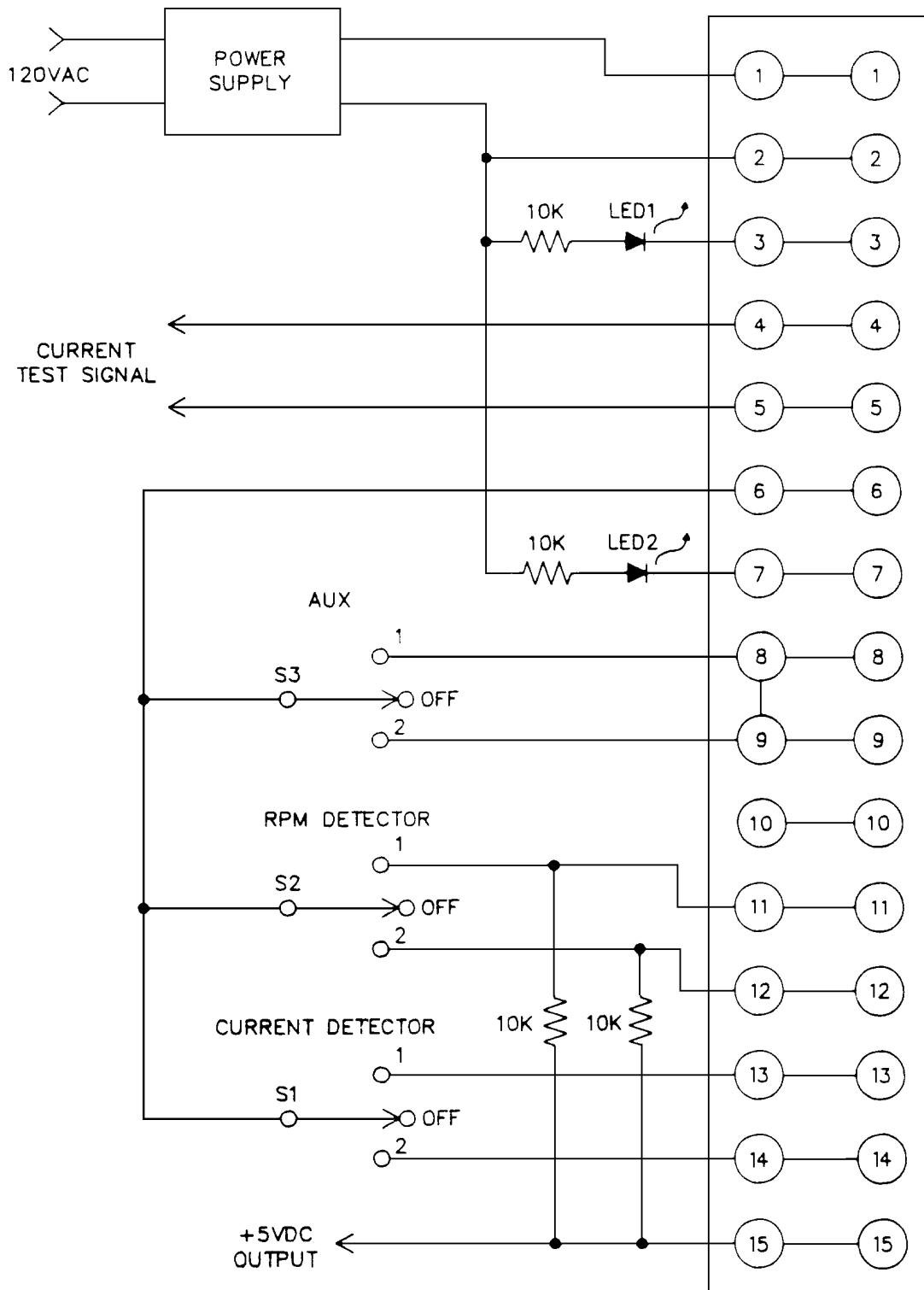


Figure 5-11. Power Supply PCB Test Connection

5-10.5.2 Current Detector PCB.

- a. Visually inspect unit for poor solder joints, solder splashes, incorrect components, and incorrect capacitor directions. See [figure 5-28](#) for schematic.
- b. Connect board to test components as shown in [figure 5-21](#).
- c. Energize power supply and verify 18 ± 0.5 VDC to board with positive on pin 2.
- d. Verify U1-6 reads $+9.0 \pm 0.05$ VDC.
- e. Verify variac is adjusted to 0.00 VAC input to board with TP5 and TP8 reading $+9.0 \pm 0.1$ VDC.
- f. Increase variac voltage so that TP1 and TP2 read 3.0 ± 0.05 VAC with TP5 and TP8 reading $+4.5 \pm 0.1$ VDC.
- g. Adjust R1 and R2 for $+6.0 \pm 0.1$ VDC on wiper.
- h. Adjust R12 and R25 for $+12.0 \pm 0.1$ VDC on TP6 and TP9. Verify LED A, LED C (on module), LED 1, and LED 2 illuminate.
- i. Decrease variac until all LEDs go out and verify voltage between TP1 and TP2 read 2.4 ± 0.1 VAC.

5-10.5.3 Turbine RPM (Frequency) Detector.

- a. Visually inspect unit for poor solder joints, solder splashes, incorrect components, and incorrect capacitor directions. See [figure 5-12](#) for schematic.
- b. Connect board as shown in [figure 5-10](#) or apply power as shown in [figure 5-12](#).
- c. Energize power supply and verify 18 ± 0.5 VDC to board with positive on pin 11.
- d. Verify pin 15 reads $+5.0 \pm 0.05$ VDC.
- e. Connect scope to observe clock pulses on U1-3. Verify period between each pulse is 1 msec.

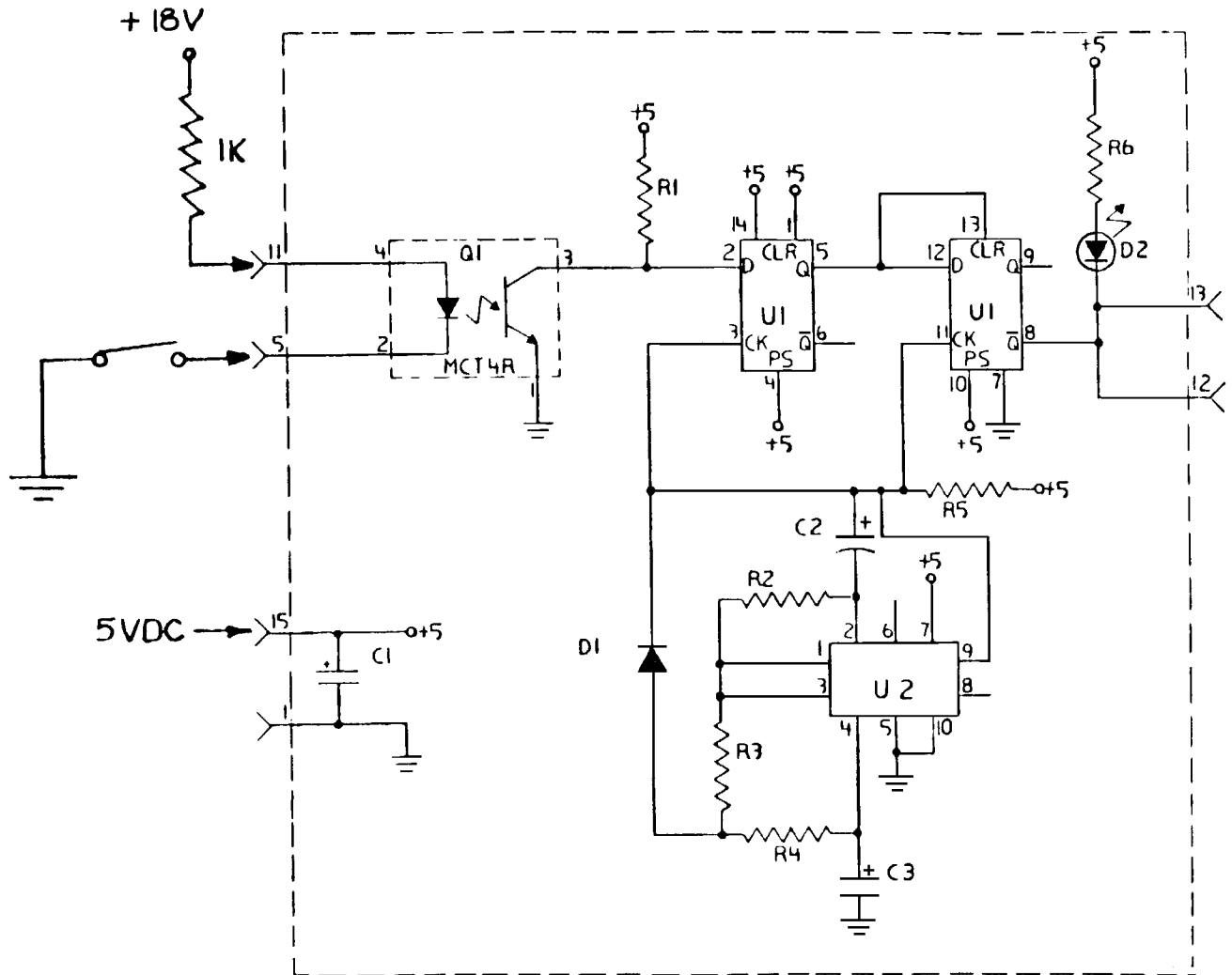


Figure 5-12. Turbine RPM Detector PCB Schematic

5-10.6 CAPACITOR-DIODE ASSEMBLY. See [figure 6-16](#). The following procedure is for function test of the Capacitor Discharge Unit. See [figure 5-13](#) for schematic and refer to [paragraph 6-14.1](#) for unit removal. Equipment requirements for test include a multimeter. Power requirements: 115 VAC.

- Visually inspect the unit for, incorrect components, incorrect diode and capacitor directions and faulty crimped connections. Refer to [paragraph 6-14.1](#) for component removal.
- Connect 115 VAC to terminals 2 and 4 of terminal block.
- Apply voltage for approximately 1 minute to fully charge capacitor. Remove power.
- Connect multimeter to terminals 1 and 3 of terminal block. Verify voltage to read 170 VDC.

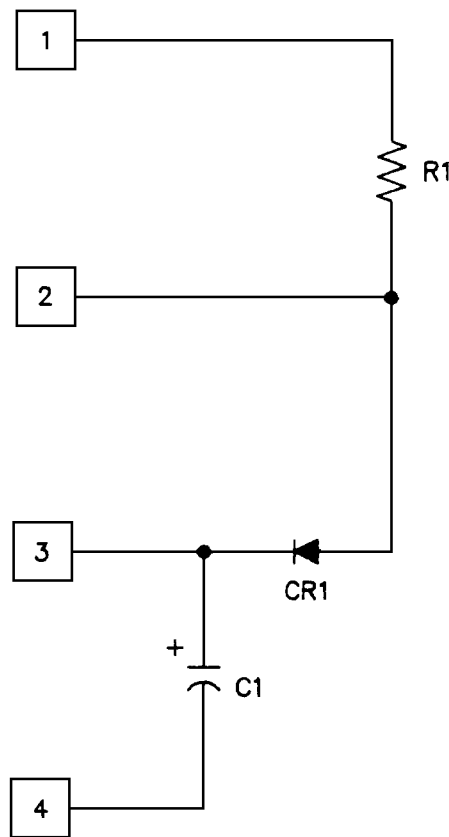


Figure 5-13. Capacitor Discharge Unit Schematic

5-10.7 OVERCURRENT RELAY (SENSING DEVICE). See [figure 6-38](#). The following procedure is for function test of the Overcurrent Relay Device. See [figure 5-14](#) for system wiring diagram. Refer to [paragraph 6-32.1](#) for removal.

Equipment requirements for test include:

- digital voltmeter
- Sine wave generator
- stop watch
- three phase Overcurrent Sensing Device test fixture (see [figure 5-15](#)).

Power requirements: 120 VAC as shown in [figure 5-15](#).

- a. Visually inspect unit for poor solder joints, solder splashes, incorrect components, and incorrect capacitor directions. See [figure 5-29](#) for RMS to DC schematic and [figure 5-30](#) for Device Control PCB schematic.
- b. Connect board and test components as shown in [figure 5-28](#).
- c. Energize 120 VAC power supply to TB1 and TB2. Verify $+30 \pm 0.5$ VDC to board at C13 and $+15 \pm 0.5$ VDC to board at C14.
- d. Voltage Amplifier.

- (1) Apply 0.65 ± 0.01 VAC RMS between TB1-5 and TB1-6. Verify 0.65 ± 0.01 VDC at Z3-8 of the “RMS to DC Board.”
- (2) Adjust R12 until voltage at cathode of CR1 is 0.072 ± 0.005 VDC.
- (3) Set “FIELD ADJUST” (R29) to 15 percent and verify voltage at W5 is 0.0828 ± 0.008 VDC.
- (4) Increase input voltage as shown in [table 5-3](#) and cathode voltage of CR1.
- (5) Decrease input voltage to 2.00 ± 0.05 VAC and set “FIELD ADJUST” (R29) to 0 percent. Verify voltage at W5 is 7.51 ± 0.5 VDC.
- (6) Set “FIELD ADJUST” (R29) to 15 percent and verify voltage at W5 is 8.63 ± 0.5 VDC.
- (7) Set “FIELD ADJUST” (R29) to 0 percent.

Table 5-3. Overcurrent Relay Input and Output Voltage Range

AC Voltage (In)	AC Voltage (Out)
0.5	0.055 ± 0.005
0.65	0.072 ± 0.005
1.25	0.532 ± 0.2
1.5	3.53 ± 0.2
2.00	7.51 ± 0.5
2.25	9.51 ± 0.5
2.50	12.55 ± 0.75
2.75	19.44 ± 0.75
3.00	26.08 ± 0.75

e. Time Delay.

- (1) Set input voltage between TB1-5 and TB1-6 to read 3.0 VAC ± 0.05 .
- (2) Deenergize (power off) Overcurrent Relay.
- (3) Reenergize (power on) Overcurrent Relay and start timing contact relay between TB1-3 and TB1-4. Verify relay closes after 13 seconds ± 3 .
- (4) Decrease input voltage between TB1-5 and TB1-6 to read 0.5 VAC ± 0.05 . Verify that contact relay opens immediately.
- (5) Set input voltage between TB1-5 and TB1-6 to read 2.5 VAC ± 0.05 .
- (6) Deenergize (power off) Overcurrent Relay.
- (7) Reenergize (power on) Overcurrent Relay and start timing contact relay between TB1-3 and TB1-4. Verify relay closes after 25 seconds ± 3 .
- (8) Set input voltage between TB1-5 and TB1-6 to read 4.00 VAC ± 0.05 .
- (9) Deenergize (power off) Overcurrent Relay.
- (10) Reenergize (power on) Overcurrent Relay and start timing contact relay between TB1-3 and TB1-4. Verify relay closes after 3 seconds ± 0.5 .

f. Deenergize (test) power and remove test equipment. Restore to operating condition.

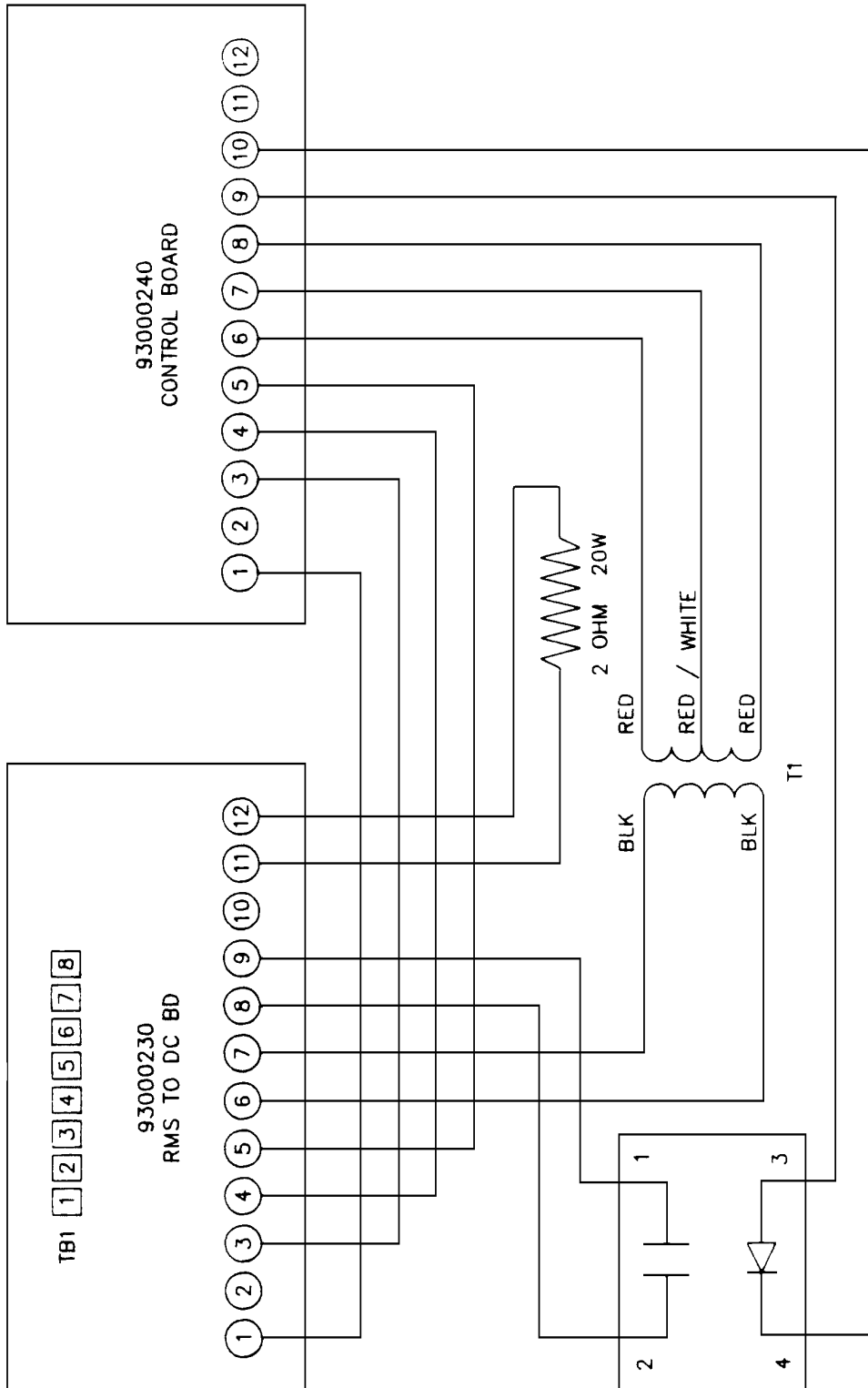


Figure 5-14. Overcurrent Relay Wiring Diagram

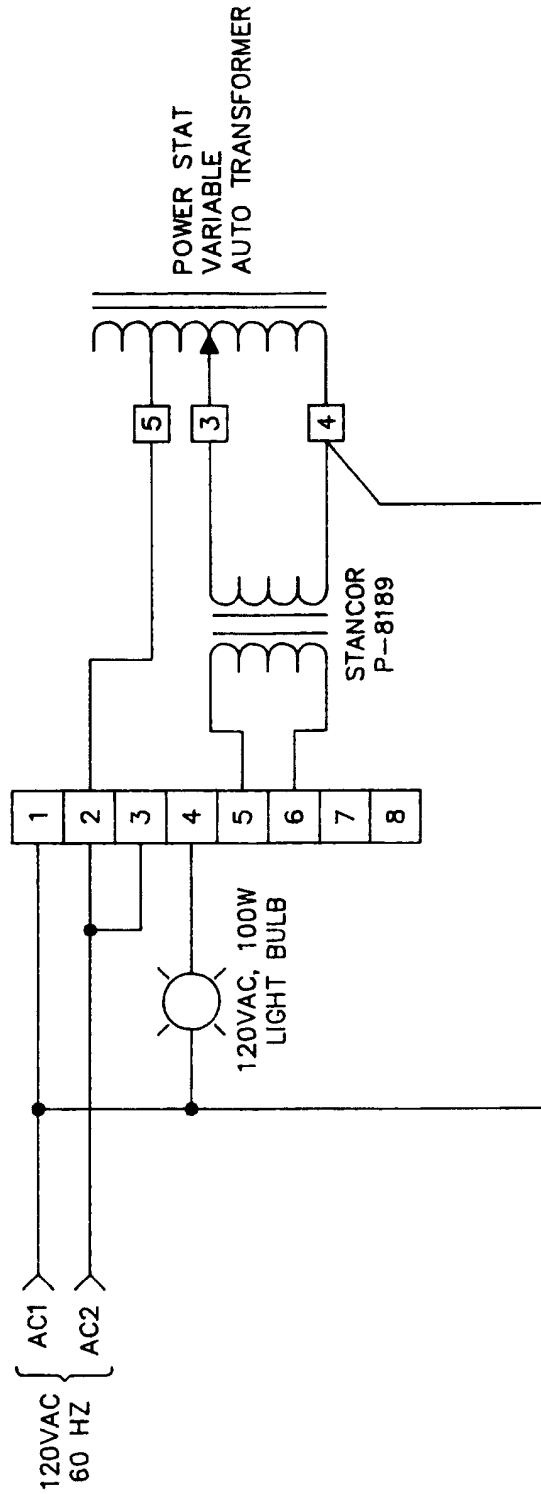


Figure 5-15. Overcurrent Sensing Device Test Connection Diagram

NOTE

Paragraph 5-10.8 is applicable only to ships with MACHALT 320-59006 (ECP-515) installed.

5-10.8 GENERATOR PROTECTION MODULE. The following procedure for setpoint verification or adjustment of the GPM can be performed with the unit installed or removed from the switchboard. If setpoint verification or adjustment is performed while the unit is removed from the switchboard, an external source of 120 VAC will be required. Refer to paragraph 6-34.1 for removal.

Equipment requirements for test include:

digital voltmeter

laptop computer with a modem program similar to MS Windows Hyper Terminal (communication parameters should be set to 9,600 baud, 8 data bits, non-parity, and one stop bit)

serial cable, double male end

WARNING

Setpoint verification or adjustment can be made while the switchboard is energized. Extreme care must be exercised to avoid lethal voltages.

- a. Remove the cover plate from the GPM (see figure 6-40).
- b. Using the serial cable, connect the laptop computer to the GPM via the RS-232 port.
- c. In the normal mode, the laptop display will show:

```
ATIS GPM Ver X.XX
SHIP CLASS XXXX
VAC AAC Freq %P
XXX XXXX XX.X XX
```

The values of X are determined by the microcontroller. The Xs in the first and second line are self-explanatory. The Xs in the fourth line are the values of bus voltage, current, frequency, and percent power as measured by the GPM.

- e. Place switch 1 in the ON position to enter the setpoint programming mode; the laptop display will show:

```
Console commands:
r – Input report
p – Parameter report
s – Setup Parameters
k – Stop resetting watchdog
x – Do a software restart
? – This help screen
```

- (1) Typing an “r” displays an input report which contains:


```

Generator Power Monitor (2310)
Version X.XX
freq1: 59.99 Hz
voltage1: 452 (raw: 273)
current1: 2475 (raw: 112)
voltage2: 447 (raw: 270)
current2: 2453 (raw: 111)
Power: 78 (raw: 53519)
Last trip: Fault Current

      Power: 78 Voltage: 450
      Current: 2475 Freq: 59.98

```

The first line states the software version. The ‘freq1: 59.99 Hz’ is the last measured frequency. ‘voltage1: 452’ is the last rms bus voltage VAB. ‘current1: 2475’ is the last rms line current IA. ‘voltage2: 447’ is the last rms bus voltage VBC. ‘current2: 2453’ is the last rms line current IC. ‘Power: 78’ is the last average power in percent of generator full load. ‘Last trip: Fault Current Power: 78 Voltage: 450 Current: 2475 Freq: 59.98’ is the last trip and the values of power, voltage, current, and frequency when the trip occurred.

(2) Typing a “p” displays a parameter or setpoint report. The report contains:

```

Generator Power Monitor (2310)
Version X.XX
Ship Class: XX XXX Class
OPR – Delay1: 2.0s Delay2: 5s

      Level: 110% Reset: 85% Test Level: 40%
RPR – Delay: 50 ms Level: 5.0%
      Reset: 85% Breaker Delay: 5s
FCR – Current Level: 6000a
      Freq Level: 59.0Hz Reset: 4000a
UFR – Level: 57.0Hz Reset: 57.0Hz
OVR – Level: 140%

```

The first two lines are self-explanatory. The line ‘OPR – Delay1: 2.0s Delay2: 5s Level: 110% Reset: 85% Test Level: 40%’ lists the settings for the overpower function, and is explained as: Delay1 is the time from reaching ‘level’ to tripping load shed 1. Delay2 is the time from reaching ‘level’ to tripping load shed 2. Level is the percent generator power at which load shed will initiate. Reset is the percent of ‘level’ that will reset the unit. Test Level is the level at which Delay1 will start if the function is in the test mode. The line ‘RPR – Delay: 50ms Level: 5.0% Reset: 85% Breaker Delay: 5s’ lists the settings for the reverse power function, and is explained as: Delay is the time delay from ‘level’ being reached until tripping the generator breaker. Level is the percent of generator power at which the GPM will initiate tripping. Reset is the percent of ‘level’ that will reset the GPM. Breaker Delay is the time the GPM will be inhibited from tripping after receiving the inhibit signal from the auxiliary contact on the generator breaker. The line ‘FCR – Current Level: 6000a Freq Level: 59.0Hz Reset: 4000a’ lists the settings for the fault current function and is explained as: Current level is the current required to trip the fault current outputs. Freq level is the frequency the generator must be below to trip the fault current outputs. Reset is the current the generator must be below to reset the fault current outputs. The line ‘UFR – Level: 57.0Hz Reset: 57.0Hz’ lists the settings for the underfrequency function, and is explained as: Level is the frequency the generator must be below to trip the underfrequency output. Reset is the frequency the generator must be above to reset the output. The line ‘OVR – Level: 140%’ lists the percentage above 450 volts at which the unit will trip on overvoltage.

(3) Typing an “s” displays the setpoint setting screen. The screen contains:

Select Function: 1 – Ship Class 2 – Over Power 3 – Reverse Power 4 – Fault Current 5 – Underfrequency 6 – Over Voltage 7 – Enable Fuel Valve 8 – Write to Flash and Exit
--

- (a) Typing a “1” displays the ship classes available. Typing the appropriate number will scale the input and display of the GPM.
- (b) Typing a “2” displays the Overpower (OPR) setpoint screen. The selections are:

Select OPR Parameter: 1 – trip 2 – delay 1 3 – delay 2 4 – reset 5 – test trip

NOTE

In the following paragraphs, the ‘u’, for up, will raise, and the ‘d’, for down, will lower the setpoint. Pressing the “Esc” key returns to the setpoint setting screen.

Typing a “1” allows setting the trip point. The displayed setpoint is a percentage of generator rated power.

Typing a “2” allows setting the time delay until Load Shed 1 output is tripped. The displayed setpoint is in seconds.

Typing a “3” allows setting the time delay between Load Shed 1 and Load Shed 2. The displayed setpoint is in seconds.

Typing a “4” allows setting the reset point. The displayed setpoint is a percentage of the trip setpoint.

CAUTION

During normal operation, switch 4 must be in the OFF position. Moving switch 4 to the ON position places the OPR in the test mode and enables the test mode trip point. This is done only when testing the OPR and sufficient ship’s load is not available.

Typing a “5” allows setting the test mode trip point. The displayed setpoint is a percentage of generator rated power and can be adjusted between 40 and 100 percent.

- (c) Typing a “3” displays the Reverse Power screen. The selections are:

Select RPR Parameter: 1 – trip 2 – delay 3 – breaker delay 2 4 – reset
--

Typing a “1” allows setting the trip point. The displayed setpoint is a percentage of generator rated power.

Typing a “2” allows setting the time delay from the setpoint being reached until the generator breaker is tripped. The displayed setpoint is in milliseconds.

Typing a “3” allows setting the time delay from the Reverse Power Inhibit signal being applied until the GPM will allow a reverse power trip. The displayed setpoint is in seconds.

Typing a “4” allows setting the reset point. The displayed setpoint is a percentage of the trip point.

(d) Typing a “4” displays the Fault Current screen. The selections are:

Select FCR Parameter: 1 – current trip 2 – freq trip 3 – reset

Typing a “1” allows setting the fault current trip point. The displayed setpoint is bus current in amps. Switch 2 should be in the OFF position unless the FCR is being tested.

Typing a “2” allows setting the frequency setpoint. The displayed setpoint is bus frequency in hertz.

Typing a “3” allows setting the fault current reset point. The displayed setpoint is bus current in amps.

(e) Typing a “5” displays the Underfrequency screen. The selections are:

Select UFR Parameter: 1 – trip 2 – reset
--

Typing a “1” allows setting the underfrequency trip point. The displayed setpoint is in hertz.

Typing a “2” allows setting the underfrequency reset point. The displayed setpoint is in hertz.

(f) Typing a “6” displays the Overvoltage screen. The selection is:

Select OVR Parameter: 1 – trip

Typing a “1” allows setting the overvoltage setpoint. The displayed setpoint is a percentage of 450 VAC.

(g) Typing a “7” displays the Fuel Valve screen. The selections are:

Select FVS Parameter: 1 – enable 2 – disable
--

Typing a “1” enables the fuel valve input. Typing a “2” disables the fuel valve input.

(h) After entering or modifying all desired setpoints, the user can store the settings into long-term memory. While the setpoint setting screen is still displayed, move switch 3 to the OFF position and press “8”. This stores the settings into long-term memory. Ensure switch 3 is returned to the ON position. If it is not desired to store the settings into long-term memory, press the ‘Esc’ key, and the settings will return to their previous values when the power is cycled off and on.

e. After completing maintenance or testing, return switches 1 through 4 to their normal positions as follows:

Switch 1 – 0 (Off)

Switch 2 – 0 (Off)

Switch 3 – 1 (On)

Switch 4 – 0 (Off)

Table 5-4. Component Functions, 1S Switchboard System

Component	Function
See figure 5-18	
A1	Synchronizing Monitor
A2	Reverse Power Relay (Removed by MACHALT 320-59006 (ECP-515))
A3a, A3b	AC Power Sensing Relay (A3a removed by MACHALT 320-59006 (ECP-515))
A5	Analog Bus Gnd Detector
A6	Fault Current Detector (Removed by MACHALT 320-59006 (ECP-515))
A7	Capacitor Discharge Unit
A8	Turbine RPM Detector (Removed by MACHALT 320-59006 (ECP-515))
GPM	Generator Protection Module (Installed by MACHALT 320-59006 (ECP-515))
Switchboard 1SG	
CB1101	Gen 1SG SW Clg Pump
CB1102	Casualty Power Breaker
CB1103	Casualty Power Breaker
CB1110	Ship's Service Generator 1SG
Switchboard 1SA	
CB1201	Fire Pump No 4
CB1202	AMR No 1 Vital Pnl 1
CB1203	CL W Recirc & Misc Aux Zone 1
CB1204	Misc Aux Zone 2
CB1205	450V Array Rm No 1
CB1206	Spare
CB1207	450V Sonar Eqpt Rm 2 Pnl 1
CB1Z08	Spare
CB1209	Load Center 31
CB1210	120V Ltg LC22
CB1211	Radar Rm No 1
CB1212	1S/2S Bus Tie
CB1213	Radar Rm No 2
CB1214	Pwr Sply/Cvrsn Rm Pnl 1
CB1215	Pwr Pnl (EP1) MK280 Mod 2
CB1216	ER No 1 Vital - Pnl 2
CB1217	Spare
Switchboard 1SB	
CB1301	AFFF Sta No 1
CB1302	AFFF Sta No 2
CB1303	AMR No 1 Non-Vital
CB1304	120V Pilot Hse
CB1305	CL W Vent-A Size Module
CB1306	General Workshop
CB1307	Vital Aux-Zone 2
CB1308	CL Z Vent, Zone 2, Pnl No 1
CB1309	CL Z Vent, Zone 2, Pnl No 2
CB1310	Non Vital Aux Zone 2, Pnl 2
CB1311	Spare
CB1312	Spare
CB1313	120V Sonar Eqpt Rm 1
CB1314	450V IC & Gyro Rm 1
CB1315	Combat Sys Eqpt Rm 2 Pnl 1

Table 5-4. Component Functions, 1S Switchboard System - Continued

Component	Function
CB1316	B-Size Module (Back-Up)
CB1317	450V Comm Ctr
CB1318	Comm Ctr Pnl
CB1319	Elex Eqpt Wtr Hd-1077/SSQ No 1
CB1320	Elex Eqpt Wtr Hd-1077/SSQ No 2
CB1321	Low Hd Pwr Xfmr (Port)
CB1322	Low Hd Pwr Xfmr (Stbd)
CB1323	120V CIC Pnl 1
CB1324	120V CIC Pnl 2
CB1325	120V CIC Pnl 3
CB1326	120V CIC Pnl 4
CB1331	Pilot House Windows
CB1332	Vital Aux - Zone 1
CB1333	CL W Recirc Zone 2
CB1334	CL W, X & Cir X Vent, Zone 1
CB1335	CL W Vent Zone 2
CB1336	120V Ltg Lc24
CB1337	120V Ltg Lc12
CB1338	450V Combat Sys Eqpt Rm 1
CB1339	450V Radio Xmtr Rm - Pnl No 1
CB1340	450V Radio Xmtr Rm - Pnl No 2
CB1341	Spare
CB1342	Spare
CB1343	Fire Pump No 2
CB1344	Fire Pump No 3
CB1345	Combat Sys Eqpt Rm 2 Pnl 2
CB1346	Non-Vital Aux Zone 2 Pnl 1
CB1347	Pwr Sply/Cvrsn Rm Pnl 2
CB1348	AMR No 1 Vital Pnl 2
CB1349	ER No 1 Vital - Pnl 1
CB1350	450V Sonar Eqpt Rm 2 Pnl 1
CB1351	ER No 1 Vital Pnl3
CB1352	A/C Cmprsr No 1
CB1353	Fuel Xfer Htr No 1
CS1354	ER No 1 Non-Vital
CB1355	ER No 1 Non-Vital - Pnl 1
CB1356	CL X Prehtr AMR No 1
CB1357	120V Ltg LC23
Switchboard 1SC	
CB1401	Fire Pump No 1
CB1402	MK16 Mod 2 Wpn Gp
CB1403	Spare
CB1404	CL X Prehtr ER No 1
CB1405	Degaussing
CB1406	ER No 1 Non-Vital - Pnl 2
CB1407	Non-Vital Aux Zone 1
CB1408	A-Size Module

Table 5-4. Component Functions, 1S Switchboard System - Continued

Component	Function
CB1409	STC 1
CB1410	120V Ltg LC13 (Norm)
CB1411	450V Array Rm No 2
CB1413	1S/3S Bus Tie
CR1	Diode
CR2	Diode
CT1-CT2	Transformer, Current 1SG Switchboard Metering Relays
CT3-CT4 RELAYS	Transformer, Current Remote EPCC Metering
CT5	Transformer, Current 1SA Bus Tie Local Metering Relays
CT6	Transformer, Current 1SA Bus Tie Remote Metering Relays
CT7	Transformer, Current 1SC Bus Tie Local Metering Relays
CT8	Transformer, Current 1SC Bus Tie Remote Metering Relays
Switchboard 1SG	
DS1-DS2	Lamp, Synchronizing
DS4	Lamp, Indicating CB1110 Open
DSS	Lamp, Indicating CB1110 Closed
DS6	Lamp, Indicating CB1212 Open
DS7	Lamp, Indicating CB1212 Closed
DS8	Lamp, Indicating CB1413 Open
DS9	Lamp, Indicating CB1413 Closed
DS10	Lamp, Indicating CB1209 STC1 Open
DS11	Lamp, Indicating Gb1209 STC1 Closed
DS12	Lamp, Indicating CB1409 LC31 Feeder Open
DS13	Lamp, Indicating CB1409 LC31 Feeder Closed
DS14	Lamp, Indicating (Normal) CB1352 A/C Cmprsr No 1 Open
DS15	Lamp, Indicating (Normal) CB1352 A/C Cmprsr No 1 Closed
DS16	Lamp, Indicating (Alternate) CB3038 A/C Cmprsr No 2 Open
DS17	Lamp, Indicating (Alternate) CB3038 A/C Cmprsr No 2 Closed
DS18	Lamp, Indicating (Alternate) CB3042 A/C Cmprsr No 3 Open
DS19	Lamp, Indicating (Alternate) CB3042 A/C Cmprsr No 3 Closed
DS20	Lamp, Indicating (Alternate) CB3043 A/C Cmprsr No 4 Open
DS21	Lamp, Indicating (Alternate) CB3043 A/C Cmprsr No 4 Closed
DS22	Lamp, Indicating Generator Enclosure Heater On
DS23	Lamp, Indicating Generator Power Available
DS24	Lamp, Indicating 1SA Tie Power Available
DS26-DS28	Lamp, Indicating Ground Fault Detection
DS29	Lamp, Sync Monitor Test
DS30	Lamp, Indicating Fault Detected
DS31	Lamp, Synch Monitor On
DS32	Lamp, Indicating Bus Tie Closure Inhibited
DS33	Lamp, Indicating Generator Ready To Start
DS34	Lamp, Indicating Voltage Regulator Mode Auto
DS35	Lamp, Indicating Voltage Regulator Mode Manual
DS36	Lamp, Indicating Voltage Regulator Mode Droop
DS37	Lamp, Indicating Voltage Regulator Mode Differential
DS38	Lamp, Indicating Governor Mode Isochronous
DS39	Lamp, Indicating Governor Mode Droop

Table 5-4. Component Functions, 1S Switchboard System - Continued

Component	Function
DS40	Lamp, Indicating Load Shed Stage 1 Occurred
DS41	Lamp, Indicating Load Shed Stage 2 Occurred
DS42	Lamp, Indicating Control Transfer Sw Local
DS43	Lamp, Indicating Control Transfer Sw Remote
DS48	Lamp, Indicating FCD Operate
DS49	Lamp, Indicating Fault Current Detector Test Mode
1SB-DS1	Lamp, Indicating A/C Cmprsr No 1 Closed
Switchboard 1SG	
1F1	Fuse, Reverse Power Inhibit
F101-F102	Fuse, PT1 Pri (Synch & Metering) Generator Ckts
F103-F104	Fuse, PT2 Pri (Synch & Metering) Generator Ckts
F105-F106	Fuse, Gen Control T1 Pri
F107-F108	Fuse, PT3 Pri Remote Gen EPCC Meters
F109-110	Fuse, PT4 Pri Remote Meters EPCC
F111-F112	Fuse, Generator Breaker Closing Coil
F113-F115	Fuse, Ground Detection Lights Transformer Primary
F116-F117	Fuse, T3, T5, Altn Source & Dead Bus Relay
F118-F120	Fuse, Analog Bus Ground Detector
F107-F108	Fuse, PT3 Pri Remote Gen EPCC Meters
F109-110	Fuse, PT4 Pri Remote Meters EPCC
F111-F112	Fuse, Generator Breaker Closing Coil
F113-F115	Fuse, Ground Detection Lights Transformer Primary
F116-F117	Fuse, T3, T5, Altn Source & Dead Bus Relay
F118-F120	Fuse, Analog Bus Ground Detector
F121-F122	Fuse, Bus Tie CB Closing & Coil Power (Altn)
F123-F124	Fuse, Load Shed Transformer Primary
F125-F126	Fuse, PT5 Pri (Synch & Metering) Main Bus Ckts
F127-F128	Fuse, PT6 Pri (Syn Lp) Main Bus Ckts
F129	Fuse, Gen Stator Temp
F130-F131	Fuse, Remote Gen EPCC Meters
F132	Fuse, AC Brkr Status
F133	Fuse, 1S Bus EPCC Metering
F134	Fuse, 1S-2S CB Flt Ckt
F135	Fuse, 1S-3S CB Flt Ckt
F136	Fuse, SSGTG Stop
F137	Fuse, AC Plants Bkr Cont
F138	Fuse, Shed 2 at LC31
F139	Fuse, Shed 2 at 3S
F140	Fuse, Shed 1 at 1SC
F141	Fuse, Shed 1 at 1SC
F142	Fuse, Shed 1 at 1SB
F143	Fuse, Stg 1 Status Relays 1SB
F144	Fuse, Shed 2 At 1SB
F145	Fuse, Stg 2 Status Relays 1SB
F147	Fuse, Stg 1 Occurred
F148	Fuse, Stg 2 Occurred
F149, 167,	Fuse, A/C Breaker Close & Trip Circuits

Table 5-4. Component Functions, 1S Switchboard System - Continued

Component	Function
F150	Fuse, LOCOP Gen CB Cont
Switchboard 1SA	
F151-F152	Fuse, 1S-2S CB Closing Power Norm Source
F153-F154	Fuse, 1S-2S Synch Ckt & Metering PT7 Primary
F155	Fuse, 1S-2S (Syn Lp) PT8 Pri
F156	Fuse, 1S-2S (Syn Lp) PT8 Pri
F157-F158	Fuse, 1S-2S CB Cont & Ind Norm Source T3 Pri
F159-F160	Fuse, LC31 CB Closing Coil Power
F163	Fuse, 1S-2S EPCC Metering
F164-F165	Fuse, Synch And Metering 1S-2S Bus Tie Ckts
F166	Fuse, 1S-2S CB Cont & Ind
Switchboard 1SB	
F181-F182	Fuse, 1S-3S CB Closing Power Norm Source
F183-F184	Fuse, 1S-3S Synch Ckt & Metering PT9 Primary
F185-F186	Fuse, 1S-3S (Syn Lp) PT 10 Primary
F187-F188	Fuse, 1S-3S CB Cont Norm Source T5 Pri
F189-F190	Fuse, Stc1 CB Closing Coil Power
F193	Fuse, 1S-3S EPCC Metering
F194-F195	Fuse, Synch And Metering 1S-3S Bus Tie Ckts
F196	Fuse, 1S-3S CB Cont & Ind
K1101	Relay, 1S Main Bus Potential & Tie Breaker Control Power Transfer (DBR)
K1102	Contactora, Tie Breaker Closing Coil Power Transfer
K1103	Relay, Bus Tie Closure Inhibited (FCD)
K1104	Relay, Remote Sync To 1S Bus
K1105	Relay, CB1110 Remote Close
K1106	Relay, CB1110 Remote Trip
K1107	Relay, Bus Tie Control Power Transfer
K1108	Relay, Gov Freq Raise Command
K1109	Relay, Gov Freq Lower Command
K1110	Relay, Volt Reg Voltage Raise Command
K1111	Relay, Volt Reg Voltage Lower Command
K1112	Relay, A/C Plant No 1 Normal Power Restore Command
K1113	Relay, Sync Monitor Bypass Command
K1114	Relay, Voltage Reg Manual Mode
K1115	Relay, 1S Load Shed Stage 1 (1RS1) Command
K1116	Relay, 1S Load Shed Stage 2 (1RS1) Command
K1117	Relay, 1S Load Shed Stage 1 Occurred (2LS1)
K1118	Relay, 1S Load Shed Stage 2 Occurred (2LS1)
K1119	Relay, 1S Gov (ISOCH/DROOP) Paralleling Mode Command
K1120	Relay, 1S Volt Reg (DIFF/DROOP) Paralleling Mode
K1121	Relay, 1S Stage 1 Load Shed Initiate
K1122	Relay, 1S Stage 2 Load Shed Initiate
K1123	Relay, Gen Ready To Start
K1124	Relay, 2S Stage 2 Load Shed Initiate (KB12)
K1125	Relay, Sync Monitor Reset
K1126	Relay, 3S Stage 2 Load Shed Initiate (KB13)
K1127	Relay, LOCOP CB1110 Remote Trip

Table 5-4. Component Functions, 1S Switchboard System - Continued

Component	Function
K1128	Relay, 1S Gen Run/Voltage Available
K1129	Relay, 1S Swbd Fault Detector Aux
K1130	Relay, VR Manual Mode Command
K1131	Relay, VR Diff Command
K1132	Relay, VR Droop Command
K1133	Relay, Gov Isoch Command
K1134	Relay, Gov Droop Command
K1135	Relay, Shore Power Droop Control
K1136	Relay, 2SA Tie Breaker Open
K1201	Relay, CB1212 FCD 1SA Trip
K1202	Relay, CB1212 Remote Trip
K1204	Relay, CB1212 Remote Sync To 1S Bus
K1205	Relay, CB1212 Remote Close
K1303	Relay, CB1303 Auxiliary
K1306	Relay, CB1306 Auxiliary
K1308	Relay, CB1308 Auxiliary
K1309	Relay, CB1309 Auxiliary
K1310	Relay, CB1310 Auxiliary
K1352	Relay, CB1352 Auxiliary
K1401	Relay, CB1413 FCD 1SC Trip
K1402	Relay, CB1413 Remote Trip
K1404	Relay, CB1413 Remote Sync To 1S Bus
K1405	Relay, CB1413 Remote Close
M1	Ammeter, Generator
M2	Ammeter, Bus Tie
M3	Temp Meter
M4	Voltmeter, Generator
M5	Voltmeter, Bus Meter Select
M6	Frequency Meter, Generator
M7	Frequency Meter, Bus
M8	Wattmeter
M11	Synchroscope
PB1101	Switch, 1S Turbine Start
PB1102	Switch, 1S Turbine Stop
PB1103	Switch, FCD
PD1-PD2	Protective Device, Thyrite Generator Metering
PD3-PD4	Protective Device, Thyrite Generator Remote Metering
PD5-PD6	Protective Device, Thyrite 1SA Tie Metering
PD7-PD8	Protective Device, Thyrite 1SC Tie Metering
PT1-PT2	Potential Transformer, 1S Generator Metering & Sync
PT3-PT4	Potential Transformer, 1S Generator Remote Metering & Sync
PT5-PT6	Potential Transformer, 1S Bus Metering & Sync
PT7-PT8	Potential Transformer, 1SA Tie Breaker Sync Circuit
PT9-PT10	Potential Transformer, 1SCTie Breaker Sync Circuit
S1	Switch, CB1110 Control
S2	Switch, CB1212 Control
S3	Switch, CB1413 Control

Table 5-4. Component Functions, 1S Switchboard System - Continued

Component	Function
S4	Switch, CB1209 Control
S5	Switch, CB1409 Control
S6	Switch, CB1352 Control
S7	Switch CB3038 Control
S8	Switch CB3042 Control
S9	Switch, CB3043 Control
S13	Switch, Voltage Regulator Mode Select
S14	Switch, Voltage Regulator Paralleling Mode
S15	Switch, Voltage Control
S16	Switch, Frequency Control
S17	Switch, Amp/Volt/Freq Meters
S18	Switch, Generator Temperature Meter
S19	Switch, Synchronizing Control
S20	Switch, Governor Control
S21	Switch, Generator Space Heater
S22	Switch, Load Shed
S24	Switch, Control Transfer
S25	Switch, Ground Fault Test
S31	Switch, Voltage Regulator Select
S32	Switch, Generator Current Transformer Shorting (CT1 & CT2)
S33	Switch, Generator Current Transformer Shorting (CT3 & CT4)
S34	Switch, 1SA Bus Tie Transformer Shorting (CT5)
S35	Switch, 1SA Bus Tie Transformer Shorting (CT6)
S36	Switch, 1SC Bus Tie Transformer Shorting (CT7)
S37	Switch, 1SC Bus Tie Transformer Shorting (CT8)
S38	Switch, Sync Mode
S42	Switch, Fault Current Detector Test-Operate
T1	Transformer, CB1110 Control
T2	Transformer, 1S Main Bus
T3	Transformer, CB1212 & CB1209 Control
T5	Transformer, CB1413 & CB1409 Control
IT1, IT2	Transformer, Isolation Fault Current Detection (Removed by MACHALT 320-59006 (ECP-515))
T2A, B, C	Transformer

Table 5-5. Component Functions, 2S Switchboard System

Component	Function
See figure 5-19	
A1	Synchronizing Monitor
A2	Reverse Power Relay (Removed by MACHALT 320-59006 (ECP-515))
A3a, A3b	AC Power Sensing Relay (A3a removed by MACHALT 320-59006 (ECP-515))
A4	Overcurrent (Shore Power) Detector Module
A5	Analog Bus Gnd Detector Module
A6	Fault Current Detector Module (Removed by MACHALT 320-59006 (ECP-515))
A7	Capacitor Discharge Unit
A8	Turbine RPM Detector (Removed by MACHALT 320-59006 (ECP-515))

Table 5-5. Component Functions, 2S Switchboard System - Continued

Component	Function
GPM	Generator Protection Module (Installed by MACHALT 320-59006 (ECP-515))
Switchboard 2SG	
CB2101	Gen 2SG SW Cooling Pump Breaker
CB2102	Casualty Power Breaker
CS2103	Casualty Power Breaker
CB2120	2S Generator Circuit Breaker
CB2221	2SA/1SA Bus Tie Breaker
CB2323	2S/3S Bus Tie Breaker
Switchboard 2SA	
CB2201	Shore Power Receptacle No 1
CB2202	Shore Power Receptacle No 2
CB2203	Shore Power Receptacle No 3
CB2204	Shore Power Receptacle No 4
CB2205	Shore Power Receptacle No 5
CB2206	Shore Power Receptacle No 6
CB2207	Shore Power Receptacle No 7
CB2208	Shore Power Receptacle No 8
CB2209	Shore Power Receptacle No 9
CB2210	Shore Power Receptacle No 10
CB2211	Shore Power Receptacle No 11
CB2212	Shore Power Receptacle No 12
CT1-CT2	Transformer, Current 2SG Switchboard Metering Relays
CT3-CT4	Transformer, Current Remote EPCC Metering Relays
CT5	Transformer, Current 2SA Bus Tie Relays Local Metering
CT6	Transformer, Current 2SA Bus Tie Relays Remote Metering
CT7	Transformer, Current 2SB Bus Tie Local Metering Relays
CT8	Transformer, Current 2SB Bus Tie Remote Metering
CT9-CT12	Transformer, Current Shore Power Metering Relays
Switchboard 2SG	
DS1-DS2	Lamp, Synchronizing
DS4	Lamp, Indicating CB2120 Open
DS5	Lamp, Indicating CB2120 Closed
DS6	Lamp, Indicating CB2221 Open
DS7	Lamp, Indicating CB2221 Closed
DS8	Lamp, Indicating CB2323 Open
DS9	Lamp, Indicating CB2323 Closed
DS22	Lamp, Indicating Generator Enclosure Heater On
DS23	Lamp, Indicating Generator Power Available
DS24	Lamp, Indicating 2SA Tie Power Available
DS25	Lamp, Indicating 2SB Tie Power Available
DS26-DS28	Lamp, Indicating Ground Fault Detection
DS29	Lamp, Sync Monitor Test
DS30	Lamp, Indicating Fault Detected
DS31	Lamp, Synch Monitor On
DS32	Lamp, Indicating Bus Tie Closure Inhibited
DS33	Lamp, Indicating Generator Ready To Start
DS34	Lamp, Indicating Voltage Regulator Mode Auto

Table 5-5. Component Functions, 2S Switchboard System - Continued

Component	Function
DS35	Lamp, Indicating Voltage Regulator Mode Manual
DS36	Lamp, Indicating Voltage Regulator Mode Droop
DS37	Lamp, Indicating Voltage Regulator Mode Differential
DS38	Lamp, Indicating Governor Mode Isochronous
DS39	Lamp, Indicating Governor Mode Droop
DS40	Lamp, Indicating Load Shed Stage 1 Occurred
DS41	Lamp, Indicating Load Shed Stage 2 Occurred
DS42	Lamp, Indicating Control Transfer Sw Local
DS43	Lamp, Indicating Control Transfer Sw Remote
DS48	Lamp, Indicating Fault Current Detector Operate
DS49	Lamp, Indicating Fault Current Detector Test Mode
2SP-DS1	Lamp, Indicating CB2201 Open
2SP-DS2	Lamp, Indicating CB2201 Closed
2SP-DS3	Lamp, Indicating Shore Power Receipt No 1 Energized
2SP-DS4	Lamp, Indicating CB2202 Open
2SP-DS5	Lamp, Indicating CB2202 Closed
2SP-DS6	Lamp, Indicating Shore Power Receipt No 2 Energized
2SP-DS7	Lamp, Indicating CB2203 Open
2SP-DS8	Lamp, Indicating CB2203 Closed
2SP-DS9	Lamp, Indicating Shore Power Recept No 3 Energized
2SP-DS10	Lamp, Indicating CB2204 Open
2SP-DS11	Lamp, Indicating CB2204 Closed
2SP-DS12	Lamp, Indicating Shore Power Recept No 4 Energized
2SP-DS13	Lamp, Indicating CB2205 Open
2SP-DS14	Lamp, Indicating CB2205 Closed
2SP-DS15	Lamp, Indicating Shore Power Receipt No 5 Energized
2SP-DS16	Lamp, Indicating CB2206 Open
2SP-DS17	Lamp, Indicating CB2206 Closed
2SP-DS18	Lamp, Indicating Shore Power Recept No 6 Energized
2SP-DS19	Lamp, Indicating CB2207 Open
2SP-DS20	Lamp, Indicating CB2207 Closed
2SP-DS21	Lamp, Indicating Shore Power Receipt No 7 Energized
2SP-DS22	Lamp, Indicating CB2208 Open
2SP-DS23	Lamp, Indicating CB2208 Closed
2SP-DS24	Lamp, Indicating Shore Power Receipt No 8 Energized
2SP-DS2S	Lamp, Indicating CB2209 Open
2SP-DS26	Lamp, Indicating CB2209 Closed
2SP-DS27	Lamp, Indicating Shore Power Recept No 9 Energized
2SP-DS28	Lamp, Indicating CB2210 Open
2SP-DS29	Lamp, Indicating CB2210 Closed
2SP-DS30	Lamp, Indicating Shore Power Recept No 10 Energized
2SP-DS31	Lamp, Indicating CB2211 Open
2SP-DS32	Lamp, Indicating CB2211 Closed
2SP-DS33	Lamp, Indicating Shore Power Recept No 11 Energized
2SP-DS34	Lamp, Indicating CB2212 Open
2SP-DS35	Lamp, Indicating CB2212 Closed
2SP-DS36	Lamp, Indicating Shore Power Recept No 12 Energized

Table 5-5. Component Functions, 2S Switchboard System - Continued

Component	Function
2SP-DS37	Lamp, Indicating But Tie Energized
2SP-DS38-39	Lamp, Indicating Shore Power 2SP-DS39 Phase Ref Correct
Switchboard 2SG	
2F1	Fuse, Reverse Power Inhibit
F201-F202	Fuse, PT1 Pri (Synch & Metering)
F203-F204	Fuse, PT2 Pri (Synch & Metering)
F205	Fuse, Gen Control T1 Pri
F206	Fuse, Gen Control T1 Pri
F207-F208	Fuse, PT3 Pri (Synch & Meters) Gen Ckts at EPCC
F209-F210	Fuse, PT4 Pri (Power Meter) Gen Ckts at EPCC
F211-F212	Fuse, Gen Breaker Closing Coil Power
F213-F215	Fuse, Ground Detection Lights Transformer Primary
F216-F217	Fuse, T3, T4, Altn Source & Dead Bus Relay
F218-F220	Analog Bus Ground Detector
F221-F222	Fuse, Tie Breaker Closing Power Altn Source
F223-F224	Fuse, Load Shed Transformer Primary
F225-F226	Fuse, PT5 Pri (Synch & Metering) Main Bus Ckts
F227-F228	Fuse, PT6 Pri (Syn Lp) Main Bus Ckts
F229	Fuse, Stator Temp Meter
F230-F231	Fuse, Remote EPCC Gen Synch & Meter Ckts
F233	Fuse, 2S Bus EPCC Metering
F234	Fuse, 2S-1S Bkr FCD Trip
F235	Fuse, 2S-3S Bkr FCD Trip
F236	Fuse, Gen Stop To LOCOP
F238	Fuse, Load Shed 2 at 1S
F239	Fuse, Load Shed 2 at 3S
F240	Fuse, Load Shed 1 Occurred
F241	Fuse, Load Shed 2 Occurred
F242	Fuse, Shore Pwr Load Shed
F250	Fuse, LOCOP Gen CB Cont
Switchboard 2SA	
F7-F8	Fuse, 1S-2S But Tie Energized & Closing Interlock
F237	Fuse, 1S-2S CB Cont
F251-F252	Fuse, 2S-1S CB Closing Power Norm Source
F253-F254	Fuse, PT7 Pri (Synch & Metering) 2S-1S Bus Tie Ckts
F255-F256	Fuse, PT8 Pri (Syn Lp) 2S- 1S Bus Tie Ckts
F257-F258	Fuse, 2S-1S CB Cont & Ind Norm Source T3 Pri
F259	Fuse, Cmd Rmt Droop
F260	Fuse, Swbd 2 Load Shed
F263	Fuse, 2S-1S EPCC Metering
F264-F265	Fuse, Synch & Metering 2S-1S Bus Tie Ckts
F266	Fuse, 2S-1S CB Cont
F267	Fuse, 2S-1S CB Status
Switchboard 2SB	
F281-F282	Fuse, 2S-3S CB Closing Power Norm Source
F283-F284	Fuse, PT9 Pri (Synch & Metering) 2S-3S Bus Tie Ckts
F285-F286	Fuse, PT10 Pri (Syn Lp) 2S-3S Bus Tie Ckts

Table 5-5. Component Functions, 2S Switchboard System - Continued

Component	Function
F287-F288	Fuse, 2S-3S CB Cont & Ind Norm Source T4 Pri
F293	Fuse, 2S-3S EPCC Metering
F294-F295	Fuse, Synch & Metering 2S-3S Bus Tie Ckts
F296	Fuse, 3S-3S CB Cont
F297	Fuse, 2S-3S CB Status
12F5	Fuse, CB2212 Motor Operator Coil Circuit
1F1-1F3	Fuse, Shore Power Recept No 1 Voltage Sensing
1F4	Fuse, CB2201 Under Voltage Coil Circuit
1F5	Fuse, CB2201 Motor Operator Circuit
2F1-2F3	Fuse, Shore Power Recept No 2 Voltage Sensing
2F4	Fuse, CB2202 Under Voltage Coil Circuit
2F5	Fuse, CB2202 Motor Operator Circuit
3F1-3F3	Fuse, Shore Power Recept No 3 Voltage Sensing
3F4	Fuse, CB2203 Under Voltage Coil Circuit
3F5	Fuse, CB2203 Motor Operator Circuit
4F1-4F3	Fuse, Shore Power Recept No 4 Voltage Sensing
4F4	Fuse, CB2204 Under Voltage Coil Circuit
4F5	Fuse, CB2204 Motor Operator Circuit
5F1-5F3	Fuse, Shore Power Recept No 5 Voltage Sensing
5F4	Fuse, CB2205 Under Voltage Coil Circuit
5F5	Fuse, CB2205 Motor Operator Circuit
6F1-6F3	Fuse, Shore Power Recept No 6 Voltage Sensing
6F4	Fuse, CB2206 Under Voltage Coil Circuit
6F5	Fuse, CB2206 Motor Operator Circuit
7F1-7F3	Fuse, Shore Power Recept No 7 Voltage Sensing
7F4	Fuse, CB2207 Under Voltage Coil Circuit
7F5	Fuse, CB2207 Motor Operator Circuit
8F1-8F3	Fuse, Shore Power Recept No 8 Voltage Sensing
8F4	Fuse, CB2208 Under Voltage Coil Circuit
8F5	Fuse, CB2208 Motor Operator Circuit
9F1-9F3	Fuse, Shore Power Recept No 9 Voltage Sensing
9F4	Fuse, CB2209 Under Voltage Coil Circuit
9F5	Fuse, CB2209 Motor Operator Circuit
10F1-10F3	Fuse, Shore Power Recept No 10 Voltage Sensing
10F4	Fuse, CB2210 Under Voltage Coil Circuit
10F5	Fuse, CB2210 Motor Operator Circuit
11F1-11F3	Fuse, Shore Power Recept No 11 Voltage Sensing
11F4	Fuse, CB2211 Under Voltage Coil Circuit
11F5	Fuse, CB2211 Motor Operator Circuit
12F1-12F3	Fuse, Shore Power Recept No 12 Voltage Sensing
12F4	Fuse, CB2212 Under Voltage Coil Circuit
K1	Relay, Remote Trip Shore Power Breakers
K3	Relay, Tie Bus Voltage Sensing
K3A	Relay, Auxiliary Tie Bus Voltage Sensing
K4	Relay, Shore Power Available
K2101	Relay, 2S Main Bus Potential & Tie Breaker Control Power Transfer (DBR)
K2102	Contact, Tie Breaker Closing Coil Power Transfer

Table 5-5. Component Functions, 2S Switchboard System - Continued

Component	Function
K2103	Relay, Bus Tie Closure Inhibited (FCD)
K2104	Relay, Remote Sync To 2S Bus
K2105	Relay, CB2120 Remote Close
K2106	Relay, CB2120 Remote Trip
K2107	Relay, Bus Tie Control Power Transfer
K2108	Relay, Gov Freq Raise Command
K2109	Relay, Gov Freq Lower Command
K2110	Relay, VR Voltage Raise Command
K2111	Relay, VR Voltage Lower Command
K2113	Relay, Sync Monitor Bypass Command
K2114	Relay, VR Manual Mode
K2119	Relay, 2S Gov (Isoch/Droop) Paralleling Mode Command
K2120	Relay, 2S VR (Diff/Droop) Paralleling Mode
K2123	Relay, SSGTG Ready To Start
K2125	Relay, Sync Monitor Reset
K2127	Relay, LOCOP CB1110 Remote Trip
K2128	Relay, SSGTG Running/Voltage Available
K2129	Relay, 2S Swbd Fault Detector Aux
K2130	Relay, VR Manual Mode Command
K2131	Relay, VR Diff Command
K2132	Relay, VR Droop Command
K2133	Relay, Gov Isoch Command
K2134	Relay, Gov Droop Command
K2135	Relay, Shore Power Droop Control
K2136	Relay, Shore Power Load Shed Stage 1
K2137	Relay, Shore Power Load Shed Stage 2
K2201	Relay, CB2121 FCD 2SA Trip
K2202	Relay, CB2121 Remote Trip
K2204	Relay, CB2121 Remote Sync To 2S Bus
K2205	Relay, CB2121 Remote Close
K2301	Relay, CB2323 FCD 2SCTrip
K2302	Relay, CB2323 Remote Trip
K2304	Relay, CB2323 Remote Sync to 2S Bus
K2305	Relay, CB2323 Remote Close
M1	Ammeter, Generator
M2	Ammeter, Bus Tie
M3	Temp Meter
M4	Voltmeter, Generator
M5	Voltmeter, Bus Meter Select
M6	Frequency Meter, Generator
M7	Frequency Meter, Bus Wattmeter
M9	Phase Sequence Meter
M10	Ammeter, Shore Power
M11	Synchroscope
PB2101	Switch, 2S Turbine Start
PB2102	Switch, 2S Turbine Stop
PB2103	Switch, FCD Inhibit Reset

Table 5-5. Component Functions, 2S Switchboard System - Continued

Component	Function
PD1-PD2	Protective Device, Thyrite Generator Metering
PD3-PD4	Protective Device, Thyrite Generator Remote Metering
PD5-PD6	Protective Device, Thyrite 2SA Tie Metering
PD7-PD8	Protective Device, Thyrite 2SC Tie Metering
PD9	Protective Device, Thyrite 2SA Remote Shore Power Metering
S1	Switch, CB2120 Control
S2	Switch, CB2221 Control
S3	Switch, CB2323 Control
S4	Switch, CB2221 & CB1212 Control (Trip Only - SP)
S11	Switch, Shore Power Control
S13	Switch, Volt Reg Mode Sel
S14	Switch, Voltage Regulator Paralleling Mode
S15	Switch, Gen Volts Control
S16	Switch, Gen Frequency Control
S17	Switch, Volt/Volt/Freq Meter
S18	Switch, Gen Temperature Meter
S19	Switch, Synchronizing Control
S20	Switch, Governor Control
S21	Switch, Gen Space Heater
S22	Switch, Load Shed
S24	Switch, Control Transfer
S25	Switch, Ground Fault Test
S26	Switch, Shore Power Amps
S27A	Switch, Phase Sequence Orientation
S27B	Switch, Phase Sequence Orientation
S28A	Switch, Phase Reference
S28B	Switch, Phase Reference
S31	Switch, Volt Reg Select
S32	Switch, Gen Current Transformer Shorting (CT1 & CT2)
S33	Switch, Gen Current Transformer Shorting (CT3 & CT4)
S34	Switch, 2SA Bus Tie Transformer Shorting (CT5)
S35	Switch, 2SA Bus Tie Transformer Shorting (CT6)
S36	Switch, 2SC Bus Tie Transformer Shorting (CT7)
S37	Switch, 2SC Bus Tie Transformer Shorting (CT8)
S38	Switch, Sync Mode
S39	Switch, Shore Power Current Transformer Shorting (CT9)
S40	Transformer, Shorting (CT10-CT12)
S42	Switch, Fault Current Detector Test Operate
T1	Transformer, CB2120 Control
T2	Transformer, Load Bank Control
T3	Transformer, CB2221 Control
T4	Transformer, CB2323 Control
T5	Transformer, CB2201 Control
T6	Transformer, CB2202 Control
T7	Transformer, CB2203 Control
T8	Transformer, CB2204 Control
T9	Transformer, CB2205 Control

Table 5-5. Component Functions, 2S Switchboard System - Continued

Component	Function
T10	Transformer, CB2206 Control
T11	Transformer, CB2207 Control
T12	Transformer, CB2208 Control
T13	Transformer, CB2209 Control
T14	Transformer, CB2210 Control
T15	Transformer, CB2211 Control
T16	Transformer, CB2212 Control
IT1, IT2	Transformer, Isolation Fault Current Detection (Removed by MACHALT 320-59006 (ECP-515))

Table 5-6. Component Functions, 3S Switchboard System

Component	Function
See figure 5-20	
A1	Synchronizing Monitor
A2	Reverse Power Relay (Removed by MACHALT 320-59006 (ECP-515))
A3a, A3b	AC Power Sensing Relay (A3a removed by MACHALT 320-59006 (ECP-515))
A5	Analog Bus Gnd Detector
A6	Fault Current Detector (Removed by MACHALT 320-59006 (ECP-515))
A7	Capacitor Discharge Unit
A8	Turbine RPM Detector (Removed by MACHALT 320-59006 (ECP-515))
GPM	Generator Protection Module (Installed by MACHALT 320-59006 (ECP-515))
Switchboard 3SG	
CB3101	Gen 3SG SW Cooling Pump Breaker
CB3102	Casualty Power Breaker
CB3103	Casualty Power Breaker
CB3130	3S Generator Circuit Breaker
Switchboard 3SA	
CB3201	Fire Pump No. 3
CB3202	Radar Rm No. 3 Pnl 1
CB3203	Steering Pnl 1
CB3204	Crew/CPO Galley Pnl 1
CB3205	Crew/CPO Galley Pnl 2
CB3206	AC Machy & Pump Rm-Vital
CB3207	B-Size Module
CB3208	Load Center 21
CB3209	120V Ltg LC33
CB3210	Laundry
CB3211	ER 2 Non-Vital Pnl 3
CB3212	AMR No. 2 Vital
CB3213	Non-Vital Aux Zone 4
CB3214	Spare
CB3215	Spare
CB3231	Trash Disposal Rm Non-Vital (w/ ShipAlt 51-00159K Installed)
CB3231	3S/1S Bus Tie
Switchboard 3SB	
CB3301	AFFF Sta No. 1

Table 5-6. Component Functions, 3S Switchboard System - Continued

Component	Function
CB3302	AFFF Sta No. 2
CB3303	CL X Prehtr AMR No. 2
CB3304	CL X Prehtr ER No. 2
CB3305	450V IC & Gyro Rm No. 2
CB3306	CL X Prehtr ER No. 2
CB3307	450V Combat Sys Eqpt Rm No. 3 P2
CB3308	450V TACTAS Bathythermograph Rm
CB3309	Gen Rm Vital
CB3310	120V CCS & DC Central
CB3311	Vital Aux - Zone 3
CB3312	Vital Aux - Zone 4
CB3313	CL W Vent - Zone 3
CB3314	CL W & Cir X Vent - Zone 4
CB3315	CL Z Vent - Zone 3 Pnl No. 1
CB3316	CL Z Vent - Zone 4
CB3317	CL Z Vent - Zone 3 Pnl No. 2
CB3318	CL Z Vent - Zone 3 Pnl No. 3
CB3319	120V Ltg LC25
CB3320	120V Ltg LC41
CB3321	120V Ltg LC32
CB3322	Spare
CB3323	Spare
CB3324	Spare
CB3325	Fire Pump No. 4
CB3326	Fire Pump No. 5
CB3327	CL W Recirc & Misc Aux - Zone 3
CB3328	CL W Recirc & Misc Aux - Zone 4
CB3329	Non Vital Aux Zone 3
CB3330	450V Combat Sys Eqpt Rm No. 3 Pnl 1
CB3334	Fuel Xfr Htr No. 2
CB3335	Spare
CB3336	ER No. 2 Vital - Pnl 1
CB3337	ER No. 2 Vital - Pnl 2
CB3338	ER No. 2 Vital - Pnl 3
CB3339	ER No. 2 Non-Vital Pnl 1
CB3340	A/C Cmprsr No. 2
CB3341	A/C Cmprsr No. 3
CB3342	A/C Cmprsr No. 4
CB3345	CL W Vent - B-Size Module
CB3346	A-Size Module (Backup)
CB3347	120V Ltg LC34
Switchboard 3SC	
CB3401	Fire Pump No. 6
CB3402	Steering Pnl 2
CB3403	B-Size Module
CB3404	450V CIWS Control Rm (Aft)
CB3407	Load Center 11

Table 5-6. Component Functions, 3S Switchboard System - Continued

Component	Function
CB3408	STC 2
CB3409	ER No. 2 Non-Vital Pnl 2
CB3410	Spare
CB3432	3S/2S Bus Tie
CT1-CT2	Transformer, Current 3SG Switchboard Metering Relays
CT3-CT4	Transformer, Current Remote EPCC Metering Relays
GT5	Transformer, Current 3SA Bus Tie Local Metering Relays
CT6	Transformer, Current 3SA Bus Tie Remote Metering Relays
CT7	Transformer, Current 3SC Bus Tie Local Metering Relays
CT8	Transformer, Current 3SC Bus Tie Remote Metering Relays
Switchboard 3SG	
DS1-DS2	Lamp, Synchronizing
DS4	Lamp, Indicating CB3130 Open
DS5	Lamp, Indicating CB3130 Closed
DS6	Lamp, Indicating CB3231 Open
DS7	Lamp, Indicating CB3231 Closed
DS8	Lamp, Indicating CB3432 Open
DS9	Lamp, Indicating CB3132 Closed
DS10	Lamp, Indicating CB3208 LC21 Open
DS11	Lamp, Indicating CB3208 LC21 Closed
DS12	Lamp, Indicating CB3407 LC11 Feeder Open
DS13	Lamp, Indicating CB3407 LC11 Feeder Closed
DS14	Lamp, Indicating (Alternate) CB1032 A/C Cmprsr No 1 Open
DS15	Lamp, Indicating (Alternate) CB1032 A/C Cmprsr No 1 Closed
DS16	Lamp, Indicating (Normal) CB 3340 A/C Cmprsr No 2 Open
DS17	Lamp, Indicating (Normal) CB3340 A/C Cmprsr No 2 Closed
DS18	Lamp, Indicating (Normal) CB3341 A/C Cmprsr No 3 Open
DS19	Lamp, Indicating (Normal) CB3341 A/C Cmprsr No 3 Closed
DS20	Lamp, Indicating (Normal) CB3342 A/C Cmprsr No 4 Open
DS21	Lamp, Indicating (Normal) CB3342 A/C Cmprsr No 4 Closed
DS22	Lamp, Indicating Generator Enclosure Heater On
DS23	Lamp, Indicating Generator Power Available
DS24	Lamp, Indicating 3SA Tie Power Available
DS25	Lamp, Indicating 3SC Tie Power Available
DS26-DS28	Lamp, Indicating Ground Fault Detection
DS29	Lamp, Sync Monitor Test
DS30	Lamp, Indicating Fault Detected
DS31	Lamp, Synch Monitor On
DS32	Lamp, Indicating Bus Tie Closure Inhibited
DS33	Lamp, Indicating Generator Ready To Start
DS34	Lamp, Indicating Voltage Regulator Mode Auto
DS35	Lamp, Indicating Voltage Regulator Mode Manual
DS36	Lamp, Indicating Voltage Regulator Mode Droop
DS37	Lamp, Indicating Voltage Regulator Mode Differential
DS38	Lamp, Indicating Governor Mode Isochronous
DS39	Lamp, Indicating Governor Mode Droop
DS40	Lamp, Indicating Load Shed Stage 1 Occurred

Table 5-6. Component Functions, 3S Switchboard System - Continued

Component	Function
DS41	Lamp, Indicating Load Shed Stage 2 Occurred
DS42	Lamp, Indicating Control Transfer Sw Local
DS43	Lamp, Indicating Control Transfer Sw Remote
DS44	Lamp, Indicating CB3408 STC Open
DS45	Lamp, Indicating CB3408 STC2 Closed
DS48	Lamp, Indicating Fault Current Detector Operate Mode
DS49	Lamp, Indicating Fault Current Detector Test Mode
3SB-DS1	Lamp, Indicating (Normal) CB3340 A/C Cmprsr No 2 Closed
3SB-DS2	Lamp, Indicating (Normal) CB3341 A/C Cmprsr No 3 Closed
3SB-DS3	Lamp, Indicating (Normal) CB3342 A/C Cmprsr No 4 Closed
Switchboard 3SG	
3F1	Fuse, Reverse Power Relay Inhibit
F301-F304	Fuse, 3S Gen PT1 & PT2 Primary Circuit
F305-F306	Fuse, 3S Gen T1 Primary Circuit
F307-F310	Fuse, 3S Gen PT3 & PT4 Primary Circuit
F311-F312	Fuse, CB3130 Closing Circuit
F313-F315	Fuse, 3S Swbd Ground Fault Detection Circuit
F316-F317	Fuse, 3S Tie CB Control Power Circuit
F318-F320	Fuse, 3S Bus Gnd Voltage Circuit Breaker
F321-F322	Fuse, 3S Tie CB Closing Power Circuit
F323-F324	Fuse, 3S Main Bus T2 Primary Circuit
F325-F328	Fuse, 3S Main Bus PT5 & PT6 Primary Circuit
F329	Fuse, 3S Temp Meter Circuit
F330-F331	Fuse, 3S Gen PT3 & PT4 Secondary Circuit
F332	Fuse, LC11 Circuit Breaker Status Indicators
F333	Fuse, Remote Metering Circuit EPCC
F334	Fuse, 3SA Tie-Breaker A7 Charge Circuit
F335	Fuse, 3SC Tie-Breaker A7 Charge Circuit
F336	Fuse, LOCOP Remote Stop
F337	Fuse, A/C Cmprsr Control
F339	Fuse, Load Shed 2 at LC11
F340	Fuse, Load Shed 2 at 1S
F341	Fuse, Load Shed 2 at LC21
F342	Fuse, Load Shed 1 at 3SA
F343	Fuse, Load Shed 1 at 3SB
F344	Fuse, Load Shed 3SB Status
F345	Fuse, Load Shed 1 at 3SC
F346	Fuse, Load Shed 1 at 3SA
F347	Fuse, Load Shed 2 3SB Status
F348	Fuse, Stg 1 Occurred
F349	Fuse, Stg 2 Occurred
F350	Fuse, LOCOP Gen CB Cont
3SA Switchboard	
F351-F352	Fuse, 3S-1S CB Closing Power Norm Source
F353-F354	Fuse, 3S-1S Synch Ckt & Metering PT7 Primary
F355-F356	Fuse, 3S-1S Synch Lights PT8 Primary
F357-F358	Fuse, 3S-1S CB Cont & Ind Norm Source T3 Pri

Table 5-6. Component Functions, 3S Switchboard System - Continued

Component	Function
F359-F360	Fuse, Load Ctr 21 Breaker Closing Coil Power
F363	Fuse, 3S-1S EPCC Metering
F364-F365	Fuse, Synch & Metering 3S-1S Bus Tie Ckts
F366	Fuse, 3S-1S Bkr Cont & Ind
3SC Switchboard	
F381-F382	Fuse, 3S-2S CB Closing Power Norm Source
F383-F384 CKTS	Fuse, PT9 Pri (Synch & Metering) 3S-2S Bus Tie
F385-F386	Fuse, PT10 Pri (Syn Lp) 3S-2S Bus Tie Ckts
F387-F388	Fuse, 3S-2S CB Cont & Ind Norm Source T5 Pri
F389-F390	Fuse, LC11 Breaker Closing Coil Power
F391-F392	Fuse, STC #2 Breaker Closing Coil Power
F393	Fuse, 3S-2S EPCC Metering
F394-F395	Fuse, Synch and Metering 3S-2S Bus Tie Ckts
F396	Fuse, 3S-2S Bkr Cont & Ind
K3101	Relay, 3S Main Bus Potential & Tie Breaker Control Power Transfer (DBR)
K3102	Contact, Tie Breaker Closing Coil Power Transfer
K3101	Relay, Bus Tie Closure Inhibited (FCD)
K3104	Relay, Remote Sync To 3S Bus
K3105	Relay, CB3130 Remote Close
K3106	Relay, CB3130 Remote Trip
K3107	Relay, Bus Tie Control Power Transfer
K3108	Relay, Gov Freq Raise Command
K3109	Relay, Gov Freq Lower Command
K3110	Relay, Volt Reg Voltage Raise Command
K3111	Relay, Volt Reg Voltage Lower Command
K3112	Relay, A/C Plant No 2, 3, & 4 Normal Power Restore Command
K3113	Relay, Sync Monitor Bypass Command
K3114	Relay, Voltage Reg Manual Mode
K3115	Relay, 3S Load Shed Stage 1 Command
K3116	Relay, 3S Load Shed Stage 2 Command
K3117	Relay, 3S Load Shed Stage 1 Occurred
K3118	Relay, 3S Load Shed Stage 2 Occurred
K3119	Relay, 3S Gov (ISOCH/DROOP) Paralleling Mode Command
K3120	Relay, 3S Volt Reg (DIFF/DROOP) Paralleling Mode
K3121	Relay, 3S Stage 1 Load Shed Initiate
K3122	Relay, 3S Stage 2 Load Shed Initiate
K3123	Relay, Gen Ready To Start
K3124	Relay, 1S Stage 2 Load Shed Initiate
K3125	Relay, Sync Monitor Reset
K3126	Relay, 3S Stage 2 Load Shed Initiate
K3127	Relay, LOCOP CB3130 Remote Trip
K3128	Relay, 3S Gen Run/Voltage Available
K3129	Relay, 3S Swbd Fault Detector Aux
K3130	Relay, VR Manual Mode Command
K3131	Relay, VR Diff Command
K3132	Relay, VR Droop Command
K3133	Relay, Gov Isoch Command

Table 5-6. Component Functions, 3S Switchboard System - Continued

Component	Function
K3134	Relay, Gov Droop Command
K3135	Relay, Shore Power Droop Control
K3201	Relay, CB3231 FCD 3SA Trip
K3202	Relay, CB3231 Remote Trip
K3204	Relay, CB3231 Remote Sync to 3S Bus
K3205	Relay, CB3231 Remote Close
K3303	Relay, CB3303 Auxiliary
K3304	Relay, CB3304 Auxiliary
K3306	Relay, CB3306 Auxiliary
K3315	Relay, CB3315 Auxiliary
K3316	Relay, CB3316 Auxiliary
K3317	Relay, CB3317 Auxiliary
K3318	Relay, CB3318 Auxiliary
K3340	Relay, CB3340 Auxiliary
K3341	Relay, CB3341 Auxiliary
K3342	Relay, CB3342 Auxiliary
K3401	Relay, CB3413 FCD 3 SC Trip
K3402	Relay, CB3432 Remote Trip
K3404	Relay, CB3432 Remote Sync to 3S Bus
K3405	Relay, CB3432 Remote Close
M1	Ammeter, Generator
M2	Ammeter, Bus Tie
M3	Temp Meter
M4	Voltmeter, Generator
M5	Voltmeter, Bus Meter Select
M6	Frequency Meter, Generator
M7	Frequency Meter, Bus Wattmeter
M8	Wattmeter
M11	Synchroscope
PB3101	Switch, 3S Turbine Start
PB3102	Switch, 3S Turbine Stop
PB3103	Switch, FCD
PD1-PD2	Protective Device, Thyrite Generator Metering
PD3-PD4	Protective Device, Thyrite Generator Remote Metering
PD5-PD6	Protective Device, Thyrite 3SA Tie Metering
PD7-PD8	Protective Device, Thyrite 3SC Tie Metering
PT1-PT2	Potential Transformer, 3S Generator Metering & Synch
PT3-PT4	Potential Transformer, 3S Generator Remote Metering & Sync
PT5-PT6	Potential Transformer, 3S Bus Metering & Sync
PT7-PT8	Potential Transformer, 3SA Tie Breaker Sync Circuit
PT9-PT10	Potential Transformer, 3SC Tie Breaker Sync Circuit
S1	Switch, CB3110 Control
S2	Switch, CB3231 Control
S3	Switch, CB3432 Control
S4	Switch, CB3208 Control
S5	Switch, CB3407 Control
S6	Switch, CB3408 Control

Table 5-6. Component Functions, 3S Switchboard System - Continued

Component	Function
S7	Switch, CB3340 Control
S8	Switch, CB33041 Control
S9	Switch, CB3042 Control
S10	Switch, CB1032 Control
S13	Switch, Voltage Regulator Mode Select
S14	Switch, Voltage Regulator Paralleling Mode
S15	Switch, Voltage Control
S16	Switch, Frequency Control
S17	Switch, Volt/Freq Meter
S18	Switch, Generator Temperature Meter
S19	Switch, Synchronizing Control
S20	Switch, Governor Control
S21	Switch, Generator Space Heater
S22	Switch, Load Shed
S24	Switch, Control Transfer
S25	Switch, Ground Fault Test
S31	Switch, Voltage Regulator Select
S32	Switch, Generator Current Transformer Shorting (CT1 & CT2)
S33	Switch, Generator Current Transformer Shorting (CT3 & CT4)
S34	Switch, 3SA Bus Tie Transformer Shorting (CT5)
S35	Switch, 3SA Bus Tie Transformer Shorting (CT6)
S36	Switch, 3SC Bus Tie Transformer Shorting (CT7)
S37	Switch, 3SC Bus Tie Transformer Shorting (CT8)
S38	Switch, Synch Mode
S42	Switch Fault Current Detector-Test Operate
T1	Transformer, CB3130 Control
T2, T2A, T2B	Transformer, 3S Main Bus
T3	Transformer, CB3231 & CB3208 Control
T5	Transformer, CB3432, CB3407, CB3408 Control
IT1, IT2	Transformer, Isolation Fault Current Detection (Removed by MACHALT 320-59006 (ECP-515))

Table 5-7. Switchboard System 1S Isolation Guide

Item	Location	Tagged Position	Ckt. Effected
Fuse 2F1	2S Swbd	Fuse Removed	2S Swbd Reverse Power Inhibit
Fuse F237	2S Swbd	Fuse Removed	2S-1S Status
Fuse F238	2S Swbd	Fuse Removed	Load Shed (L/S) STG 2 Cmd 1S Swbd
Fuse F240	2S Swbd	Fuse Removed	L/S STG 1 Occurred Ind on 2S Swbd
Fuse F241	2S Swbd	Fuse Removed	L/S STG 2 Occurred Ind on 2S Swbd
Fuse F259	2S Swbd	Fuse Removed	Shore Pwr Gov Droop Cont
Fuse 3F1	3S Swbd	Fuse Removed	3S Swbd Reverse Power Inhibit
Fuse F323	3S Swbd	Fuse Removed	L/S STG 1 Cmd & Occurred Ind to 1S Swbd; CB Ind on 3S Swbd; AC Compr Trip/Close Cmds
Fuse F324	3S Swbd	Fuse Removed	L/S STG 1 Cmd & Occurred Ind to 1S Swbd; CB Ind on 3S Swbd; AC Compr Trip/Close Cmds
Fuse F1	LC11	Fuse Removed	L/S Cmd to LC11

Table 5-7. Switchboard System 1S Isolation Guide - Continued

Item	Location	Tagged Position	Ckt. Effected
Fuse F2	LC11	Fuse Removed	L/S Cmd to LC11
Fuse F1	LC21	Fuse Removed	L/S Cmd to LC21
Fuse F2	LC21	Fuse Removed	L/S Cmd to LC21
CB Gen 1	1S Swbd	Open/Racked Out	
CB 1S/2S	1SA Swbd	Open/Racked Out	
CB 1S/3S	1SC Swbd	Open/Racked Out	
CB 2S/1S	2SA Swbd	Open/Racked Out	**Isolates Shore Power from Elec Plant
CB 3S/1S	3SA Swbd	Open/Racked Out	
P/B 1101, GTG No. 1, Start	1S Swbd	Do Not Operate	
SW 13 VR Mode, Cont	1S Swbd	Off	
SW 24 Cont XFR	1S Swbd	Local	
P/B Start	SSGTG #1 LOCOP	Do Not Operate	
SW Cont Pnl, Local/Remote	SSGTG #1 LOCOP	Local	
CB GTG #1, SP HTR	(3-173-1)-1L-E	Off	
CB NBPS Output, to GTG 1 LOCOP	#1 NBPS	Off	
CB NBPS Output, to 1S Swbd	#1 NBPS	Off	
P/B GTG #1 On	EPCC	Do Not Operate	
The following items remove EPCC 28 VDC from switchboard without hindering remote electric plant operation. EPCC 28 VDC cannot be completely removed from the switchboard without hindering remote electric plant operation.			
P/B 1S/2S BT Close	EPCC	Do Not Operate	
P/B 1S/2S BT Open	EPCC	Do Not Operate	
P/B 1S/3S BT Close	EPCC	Do Not Operate	
P/B 1S/3S BT Open	EPCC	Do Not Operate	
P/B 2S/1S BT Close	EPCC	Do Not Operate	
P/B 2S/1S BT Open	EPCC	Do Not Operate	
P/B 3S/1S BT Close	EPCC	Do Not Operate	
P/B 3S/1S BT Open	EPCC	Do Not Operate	
P/B Gen CB 1 Close	EPCC	Do Not Operate	
P/B Gen CB 1 Open	EPCC	Do Not Operate	
P/B Synch Mon Bypass	EPCC	Do Not Operate	
P/B Loadshed STG 1	EPCC	Do Not Operate	
P/B Loadshed STG 2	EPCC	Do Not Operate	
P/B AC Plants Pwr Restore	EPCC	Do Not Operate	
SW Volt Raise/Lower	EPCC	Do Not Operate	
SW Freq Raise/Lower	EPCC	Do Not Operate	
Fuse A14, XF19 Volt Diff/Droop	EPCC	Fuse Removed	
Fuse A14, XF20 XF21 Volt Man/Raise/Lower	EPCC	Fuse Removed	
Fuse A14, XF27 Freq Isoch/Droop	EPCC	Fuse Removed	
Discharge A7 module capacitor in accordance with paragraph 6-14 .			
Fault current detection circuitry can become energized with 28 VDC from 2S and 3S switchboards if a fault occurs.			

Table 5-7. Switchboard System 1S Isolation Guide - Continued

Item	Location	Tagged Position	Ckt. Effected
** CB 2S/1S is to be opened/racked out only when on ship's power. To isolate 1S switchboard when on shore power, shift to ship's power, isolate 2SA switchboard, open 2SA switchboard disconnect link, return to original configuration.			

Table 5-8. Switchboard System 2S Isolation Guide

Item	Location	Tagged Position	Ckt. Effected
Fuse 1F1	1S Swbd	Fuse Removed	1S Swbd Reverse Power Inhibit
Fuse F123	1S Swbd	Fuse Removed	L/S Cmd & Ind; CB Ind on 1S Swbd; AC Compr Trip/Close Cmds
Fuse F124	1S Swbd	Fuse Removed	L/S Cmd & Ind; CB Ind on 1S Swbd; AC Compr Trip/Close Cmds
Fuse 3F1	3S Swbd	Fuse Removed	3S Swbd Reverse Power Inhibit
Fuse F323	3S Swbd	Fuse Removed	L/S Cmd & Ind; CB Ind on 3S Swbd; AC Compr Trip/Close Cmds
Fuse F324	3S Swbd	Fuse Removed	L/S Cmd & Ind; CB Ind on 3S Swbd; AC Compr Trip/close Cmds
Fuse F1	LC11	Fuse Removed	L/S Cmd to LC11
Fuse F2	LC11	Fuse Removed	L/S Cmd to LC11
Fuse F1	LC21	Fuse Removed	L/S Cmd to LC21
Fuse F2	LC21	Fuse Removed	L/S Cmd to LC21
CB Gen 2	2S Swbd	Open/Racked Out	
CB 2S/1S	2SA Swbd	Open/Racked Out	
CB 2S/3S	2SB Swbd	Open/Racked Out	
CB 33/28	3SC Swbd	Open/Racked Out	
CB 1S/2S	1SA Swbd	Open/Racked Out	
P/B 2101 GTG #2 Start	2S Swbd	Do Not Operate	
SW 13 VR Mode Cont	2S Swbd	Off	
SW 24 Cont XFR	2S Swbd	Local	
SW 11 Shore Pwr CB Cont	2S Swbd	Do Not Operate	
CB's Shore Pwr (12)	2S Swbd	Open	
P/B Start	SSGTG #2 LOCOP	Do Not Operate	
SW Cont Pnl, Local/Remote	SSGTG #2, LOCOP	Local	
CB GTG #2 SP Htr	(2-299-1)-1L-D	Off	
CB NBPS Output to GTG 2 LOCOP	#2 NBPS	Off	
CB NBPS Output to 2S Swbd	#2 NBPS	Off	
P/B GTG #2 On	EPCC	Do Not Operate	
The following items remove EPCC 28 VDC from switchboard without hindering remote electric plant operation. EPCC 28 VDC cannot be completely removed from the switchboard without hindering remote electric plant operation.			
P/B 2S/1S BT Close	EPCC	Do Not Operate	
P/B 2S/1S BT Open	EPCC	Do Not Operate	
P/B 2S/3S BT Close	EPCC	Do Not Operate	
P/B 2S/3S BT Open	EPCC	Do Not Operate	
P/B 1S/2S BT Close	EPCC	Do Not Operate	
P/B 1S/2S BT Open	EPCC	Do Not Operate	
P/B 3S/2S BT Close	EPCC	Do Not Operate	

Table 5-8. Switchboard System 2S Isolation Guide - Continued

Item	Location	Tagged Position	Ckt. Effected
P/B 3S/2S BT Open	EPCC	Do Not Operate	
P/B Gen CB 2 Close	EPCC	Do Not Operate	
P/B Gen CB 2 Open	EPCC	Do Not Operate	
P/B Sync Mon Bypass	EPCC	Do Not Operate	
SW Volt Raise/Lower	EPCC	Do Not Operate	
SW Freq Raise/Lower	EPCC	Do Not Operate	
Fuse A15, XF20 Volt Diff/ Droop	EPCC	Fuse Removed	
Fuse A15, XF33 XF22 Volt Man/Raise/Lower	EPCC	Fuse Removed	
Fuse A15, XF27 Freq Isoch/ Droop	EPCC	Fuse Removed	
P/S Shore Pwr Open All CB's	EPCC	Do Not Operate	
Discharge A7 module capacitor in accordance with paragraph 6-14 .			
Fault current detection circuitry can become energized with 28 VDC from 1S and 3S switchboards if a fault occurs.			

Table 5-9. Switchboard System 3S Isolation Guide

Item	Location	Tagged Position	Ckt. Effected
Fuse 1F1	1S Swbd	Fuse Removed	1S Swbd Reverse Power Inhibit
Fuse F123	1S Swbd	Fuse Removed	L/S Cmd & Ind; CB Ind on 1S Swbd; AC Compr Trip/Close Cmts
Fuse F124	1S Swbd	Fuse Removed	L/S Cmd & Ind; CB Ind on 1S Swbd; AC Compr Trip/Close Cmts
Fuse F239	2S Swbd	Fuse Removed	L/S STG 2 Comd to 3S
Fuse F240	2S Swbd	Fuse Removed	L/S STG 1 Occurred Ind Swbd
Fuse F241	2S Swbd	Fuse Removed	L/S STG 2 Occurred Ind
Fuse F259	2S Swbd	Fuse Removed	Shore Pwr Gov Droop Cont
Fuse 2F1	2S Swbd	Fuse Removed	2S Swbd Reverse Power Inhibit
Fuse F1	LC11	Fuse Removed	L/S Cmd to LC11
Fuse F2	LC11	Fuse Removed	L/S Cmd to LC11
Fuse F1	LC21	Fuse Removed	L/S Cmd to LC21
Fuse F2	LC21	Fuse Removed	L/S Cmd to LC21
CB Gen 3	3S Swbd	Open/Racked Out	
CB 1S/3S	1SC Swbd	Open/Racked Out	
CB 3S/1S	3SA Swbd	Open/Racked Out	
CB 2S/3S	2 SB Swbd	Open/Racked Out	
CB 3S/2S	3SC Swbd	Open/Racked Out	
P/B 3101 GTG #3 Start	3S Swbd	Do Not Operate	
SW 13 VR Mode Cont	3S Swbd	Off	
SW 24 Cont XFR	3S Swbd	Local	
P/B Start	SSGTG #3 LOCOP	Do Not Operate	
SW Cont Pnl Local/ Remote	SSGTG #3 LOCOP	Local	
CB GTG #3 SP Htr	(2-409-1)1L-G	Off	

Table 5-9. Switchboard System 3S Isolation Guide - Continued

Item	Location	Tagged Position	Ckt. Effected
P/B GTG #3 On	EPCC	Do Not Operate	
CB NBPS Output To GTG 3 LOCOP	#3 NBPS	Off	
CB NBPS Output	#3 NBPS	Off	
The following items remove EPCC 28 VDC from switchboard without hindering remote electric plant operation. EPCC 28 VDC cannot be completely removed from the switchboard without hindering remote electric plant operation.			
PP/B 3S/1S BT Close	EPCC	Do Not Operate	
P/B 3S/1S BT Open	EPCC	Do Not Operate	
P/B 1S/3S BT Close	EPCC	Do Not Operate	
P/B 1S/3S BT Open	EPCC	Do Not Operate	
P/B 3S/2S BT Close	EPCC	Do Not Operate	
P/B 3S/2S BT Open	EPCC	Do Not Operate	
P/B 23/23 BT Close	EPCC	Do Not Operate	
P/B 2S/3S BT Open	EPCC	Do Not Operate	
P/B Gen CB 3 Close	EPCC	Do Not Operate	
P/B Gen CB 3 Open	EPCC	Do Not Operate	
P/B Sync Mon Bypass	EPCC	Do Not Operate	
P/B AC Plants Pwr Restore	EPCC	Do Not Operate	
SW Volt Raise/Lower	EPCC	Do Not Operate	
SW Freq Raise/Lower	EPCC	Do Not Operate	
Fuse A16, XF19 Volt Diff/Droop	EPCC	Fuse Removed	
Fuse A16, XF03 XF21, Volt Man/Raise/Lower	EPCC	Fuse Removed	
Fuse A16, XF26 Freq Isoch/Droop	EPCC	Fuse Removed	
Discharge A7 module capacitor in accordance with paragraph 6-14 .			
Fault current detection circuitry can become energized with 28 VDC from 1S and 2S switchboards if a fault occurs.			

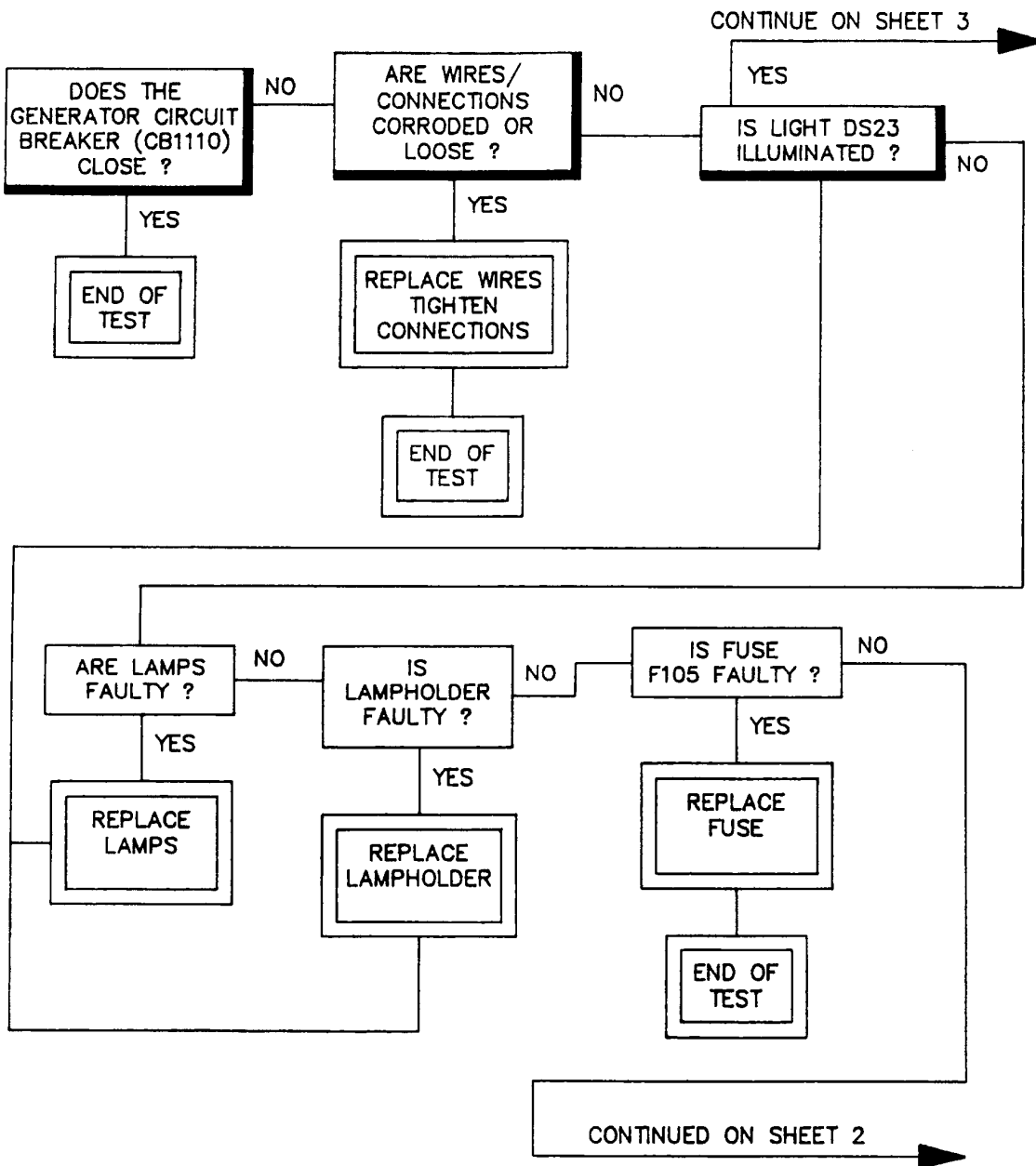


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 1 of 14)

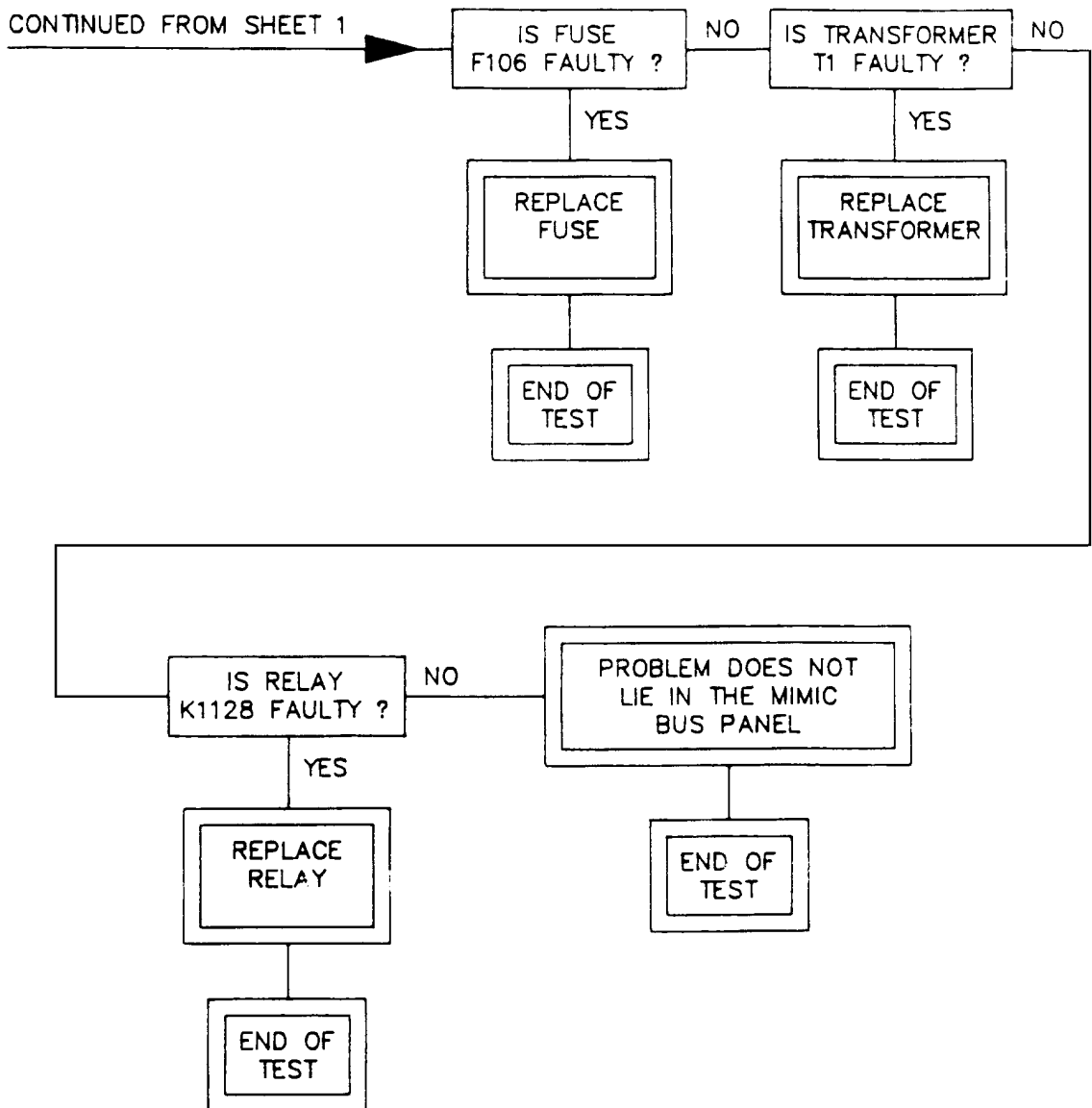


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 2 of 14)

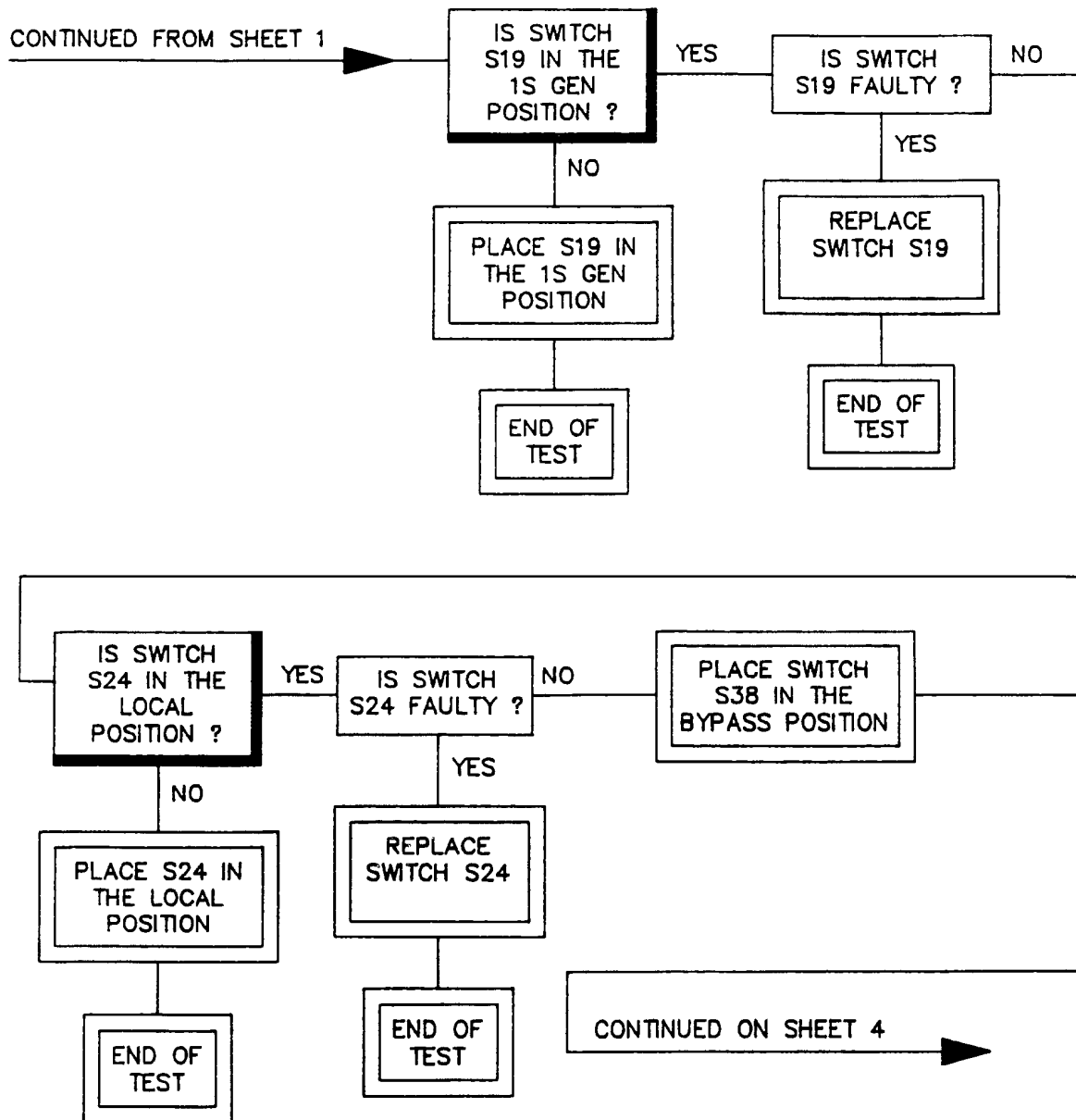


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 3 of 14)

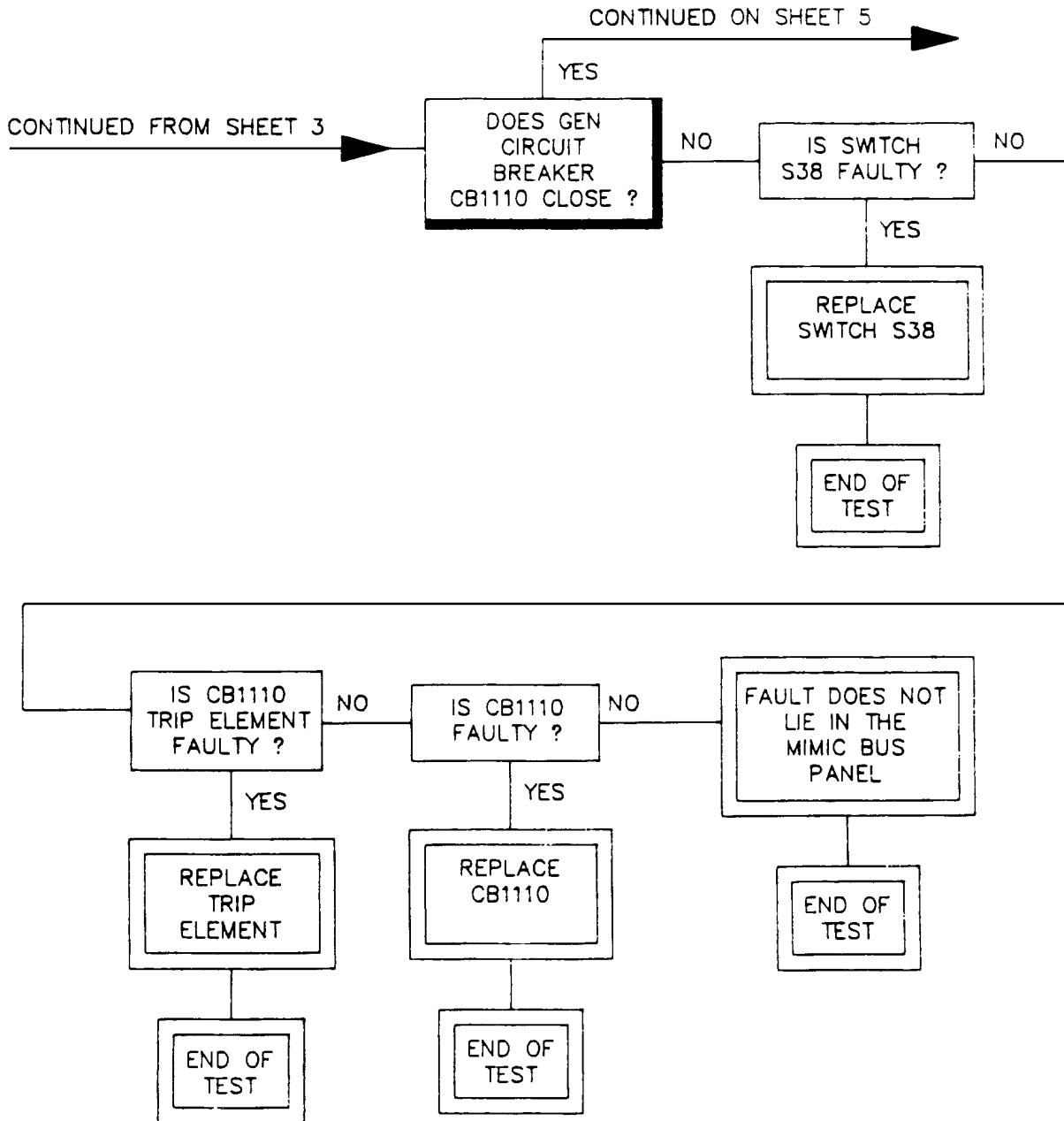


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 4 of 14)

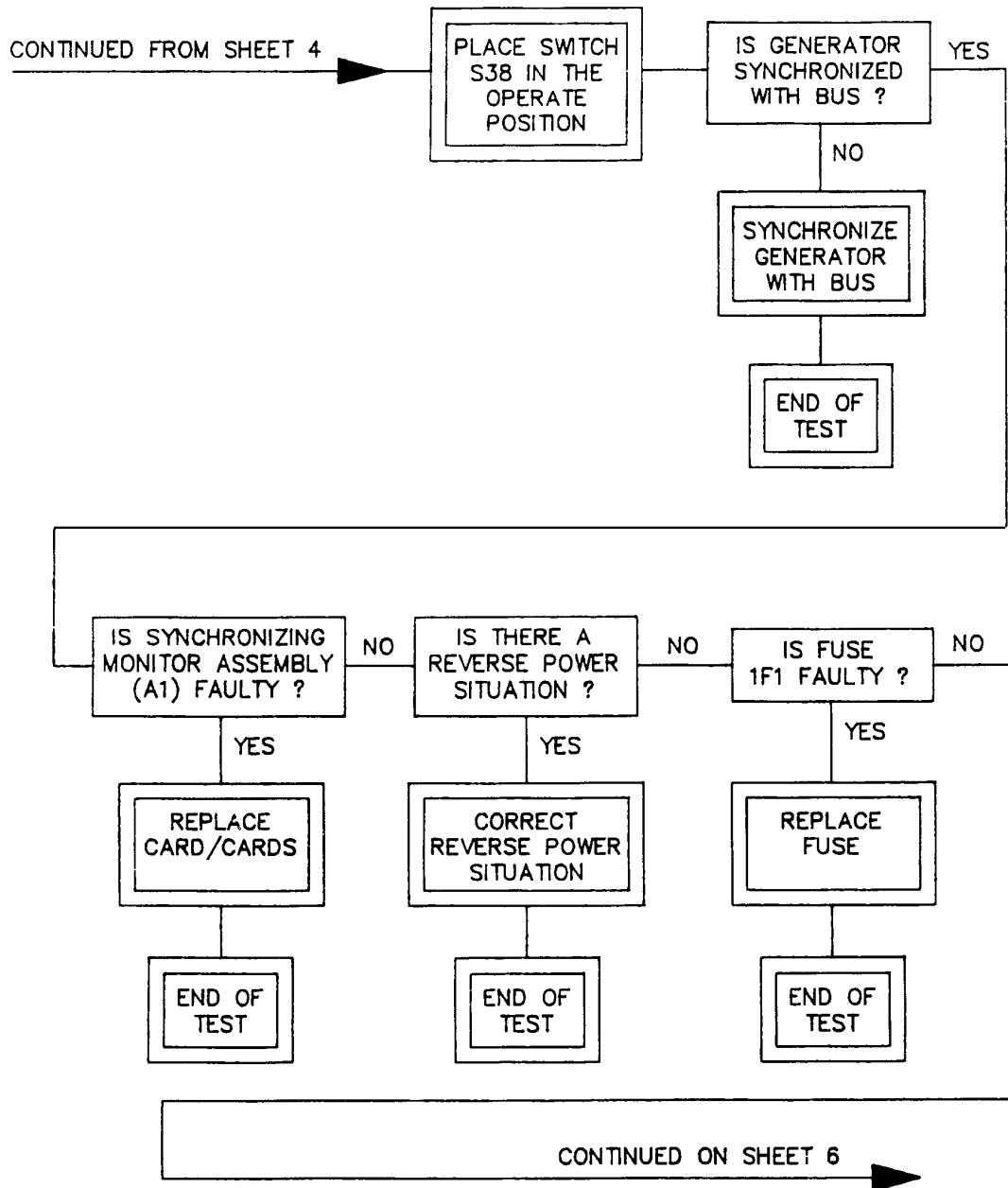


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 5 of 14)

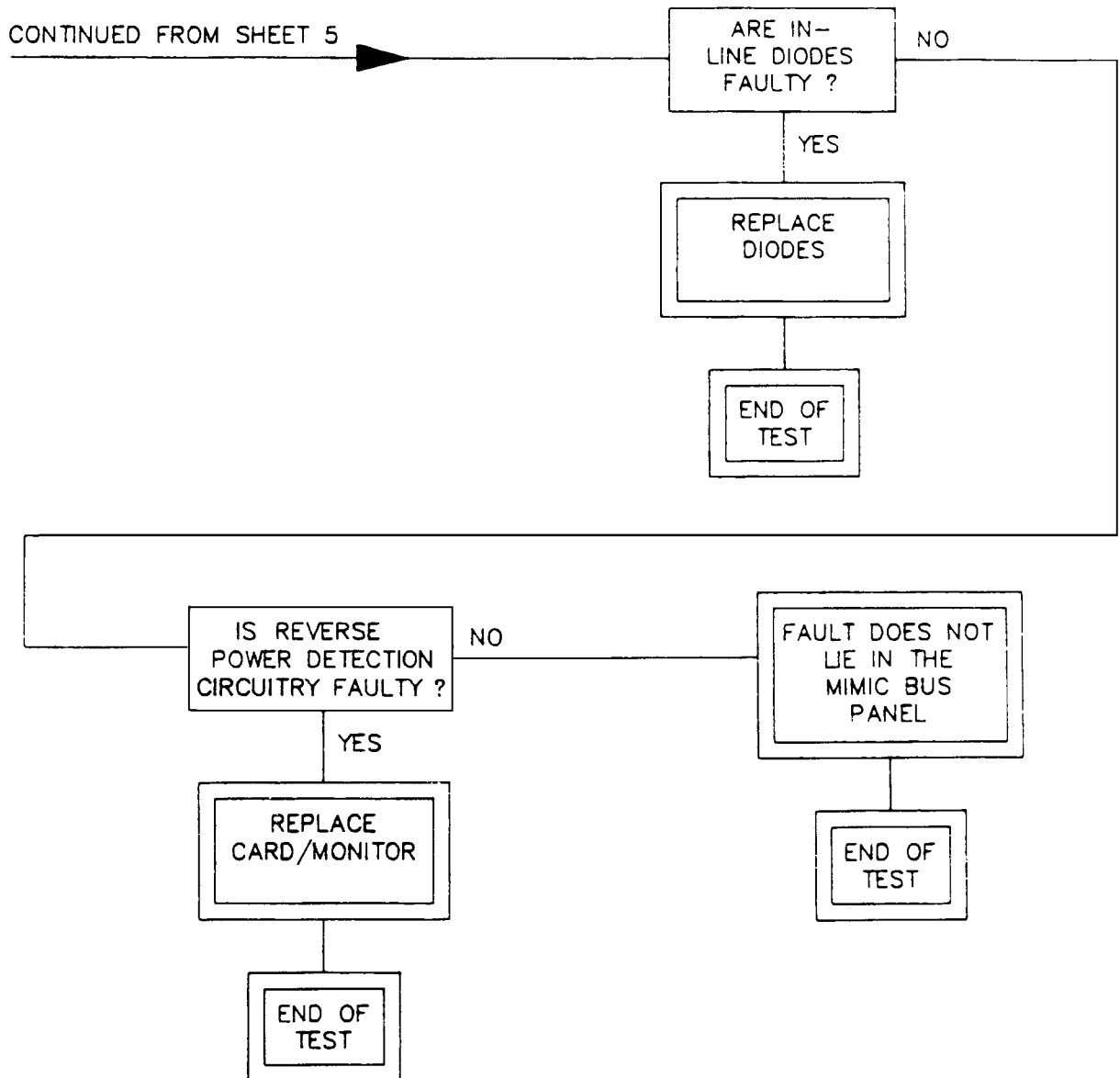


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 6 of 14)

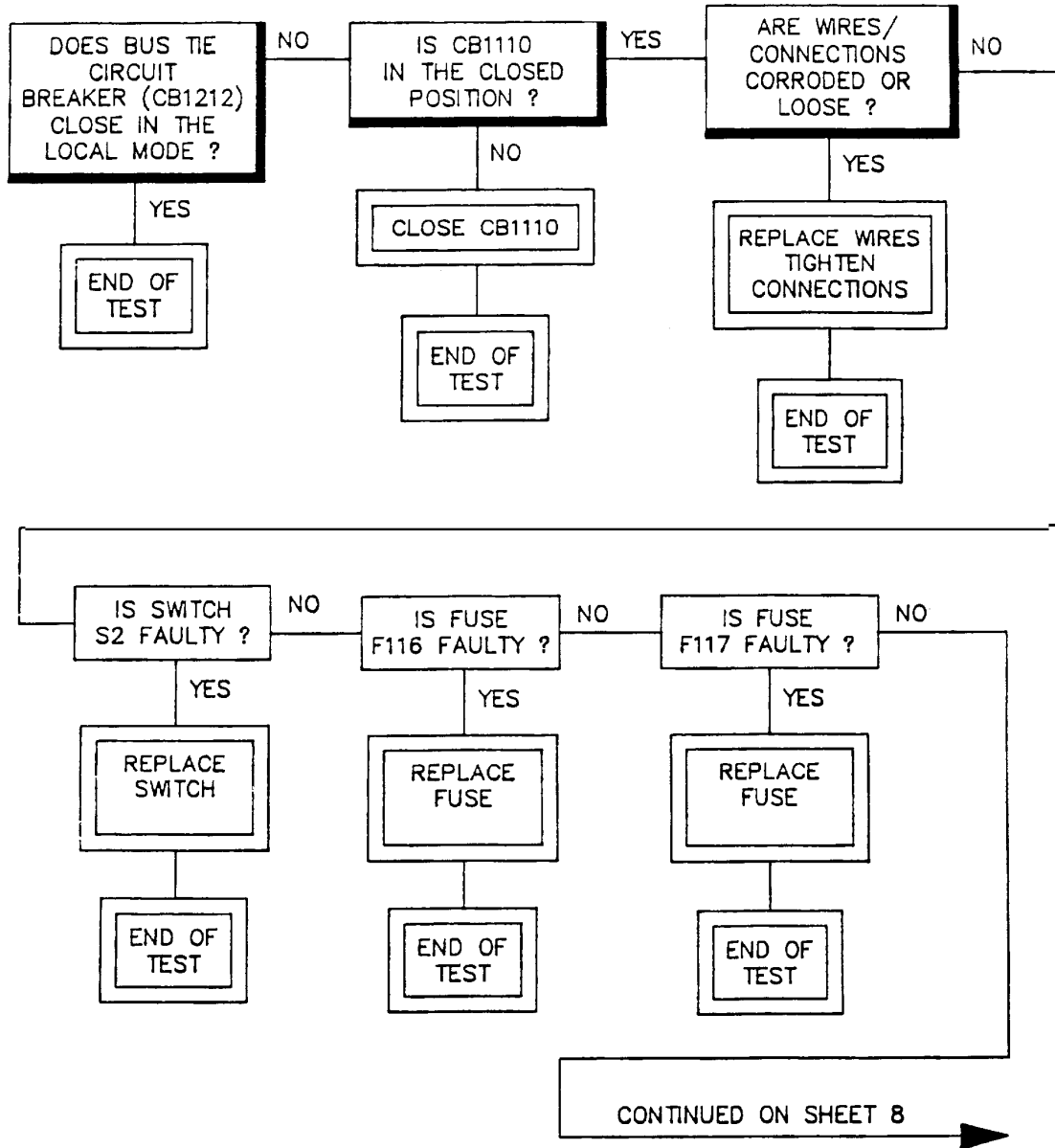


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 7 of 14)

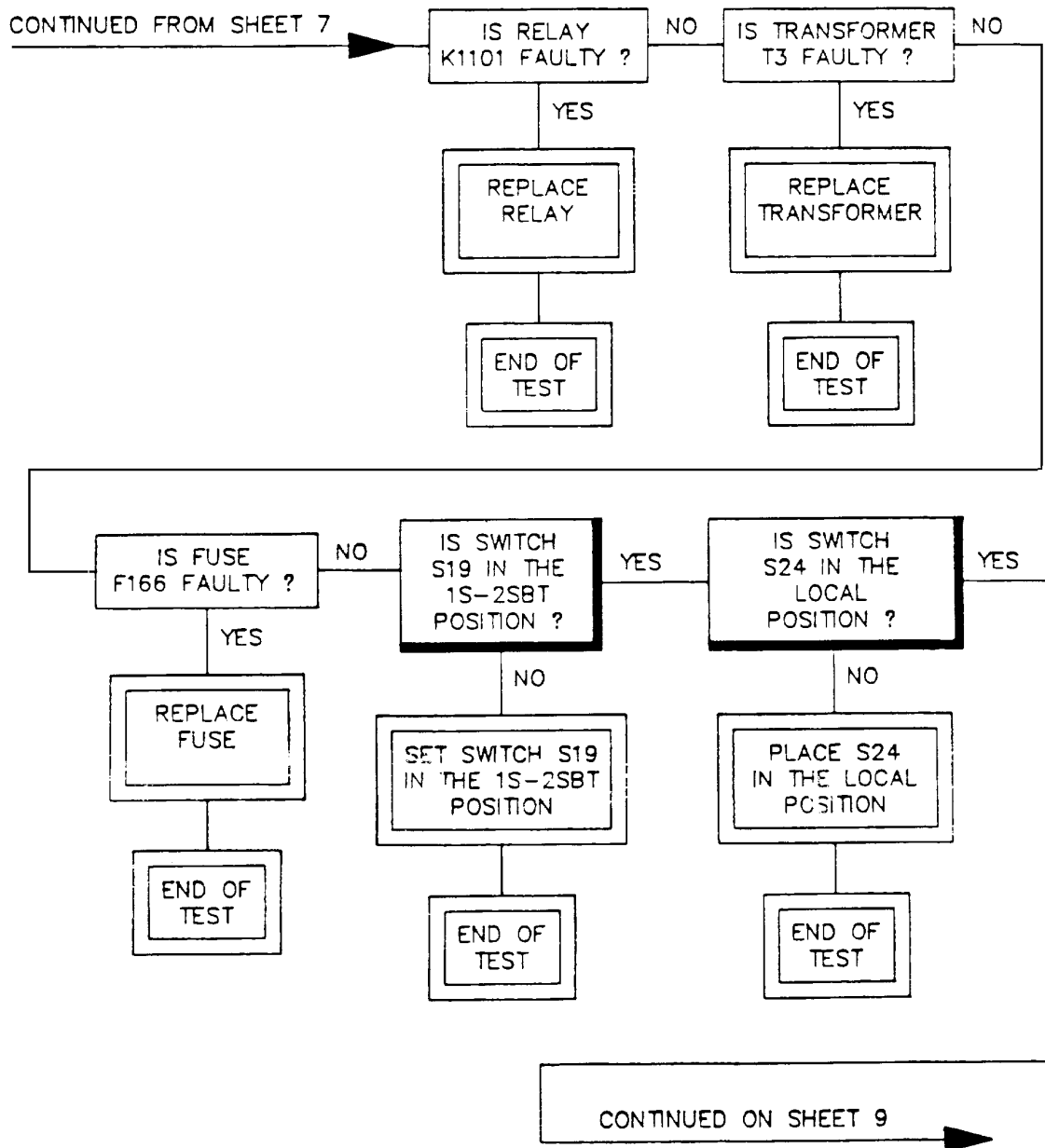


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 8 of 14)

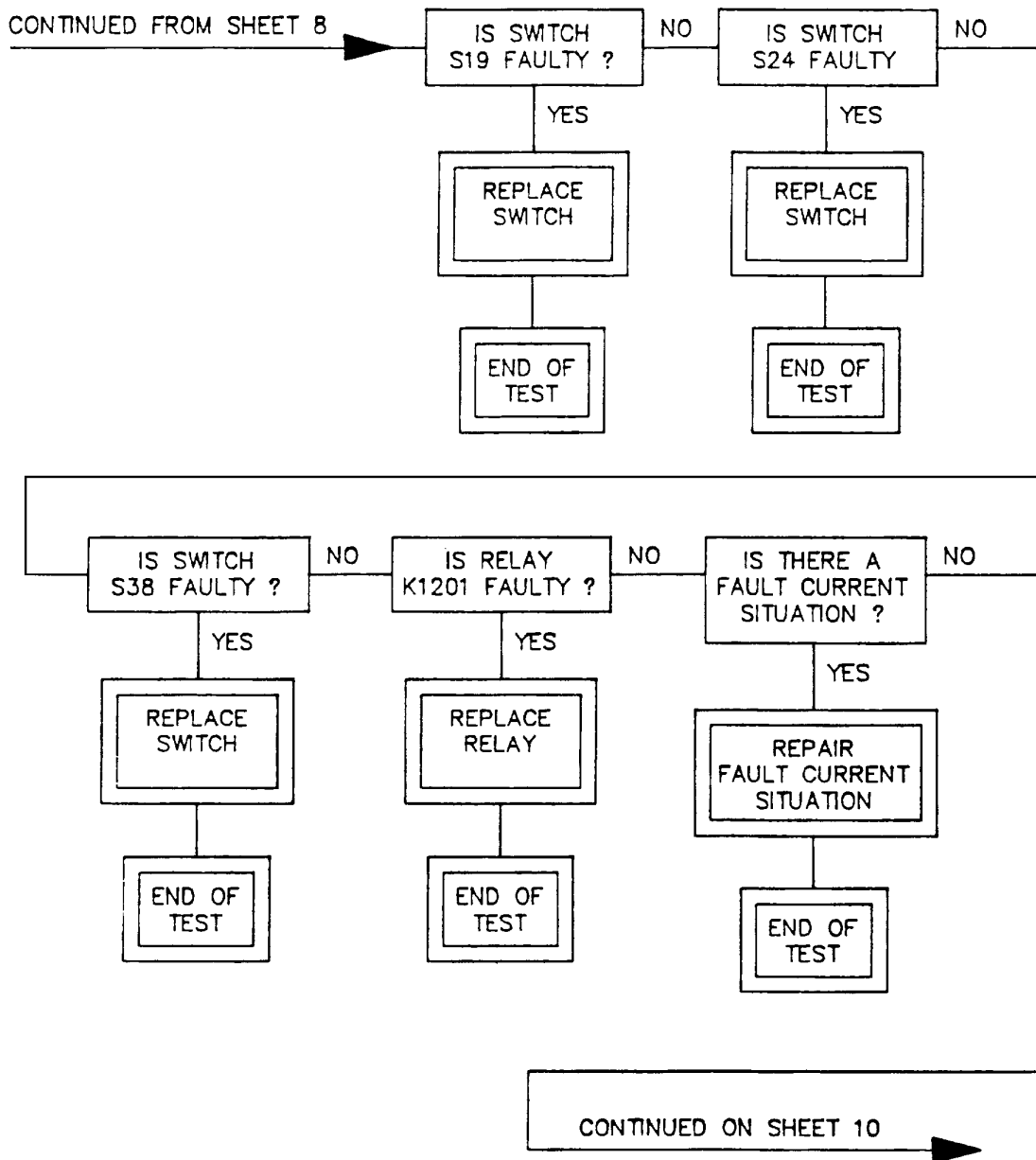


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 9 of 14)

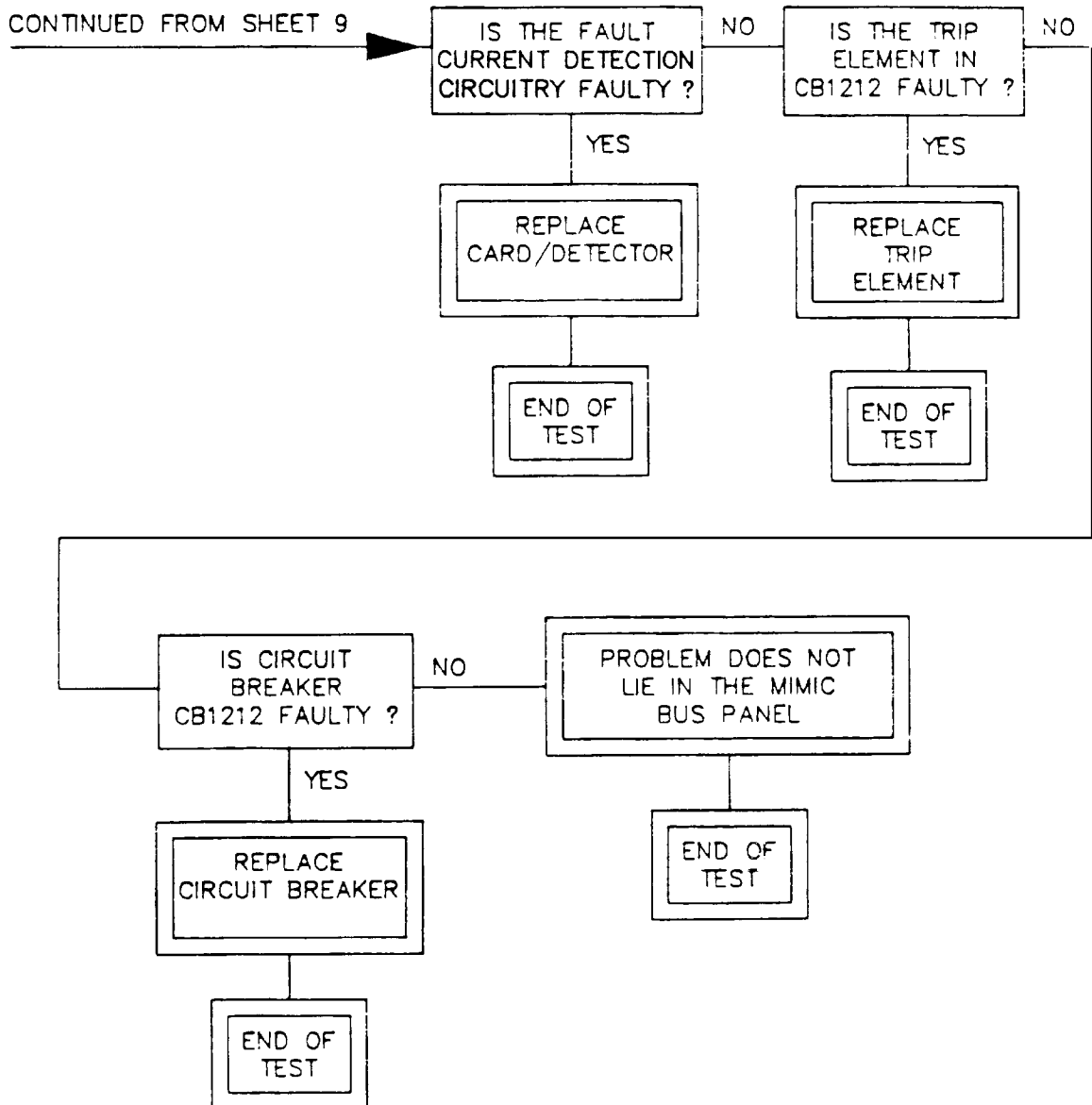


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 10 of 14)

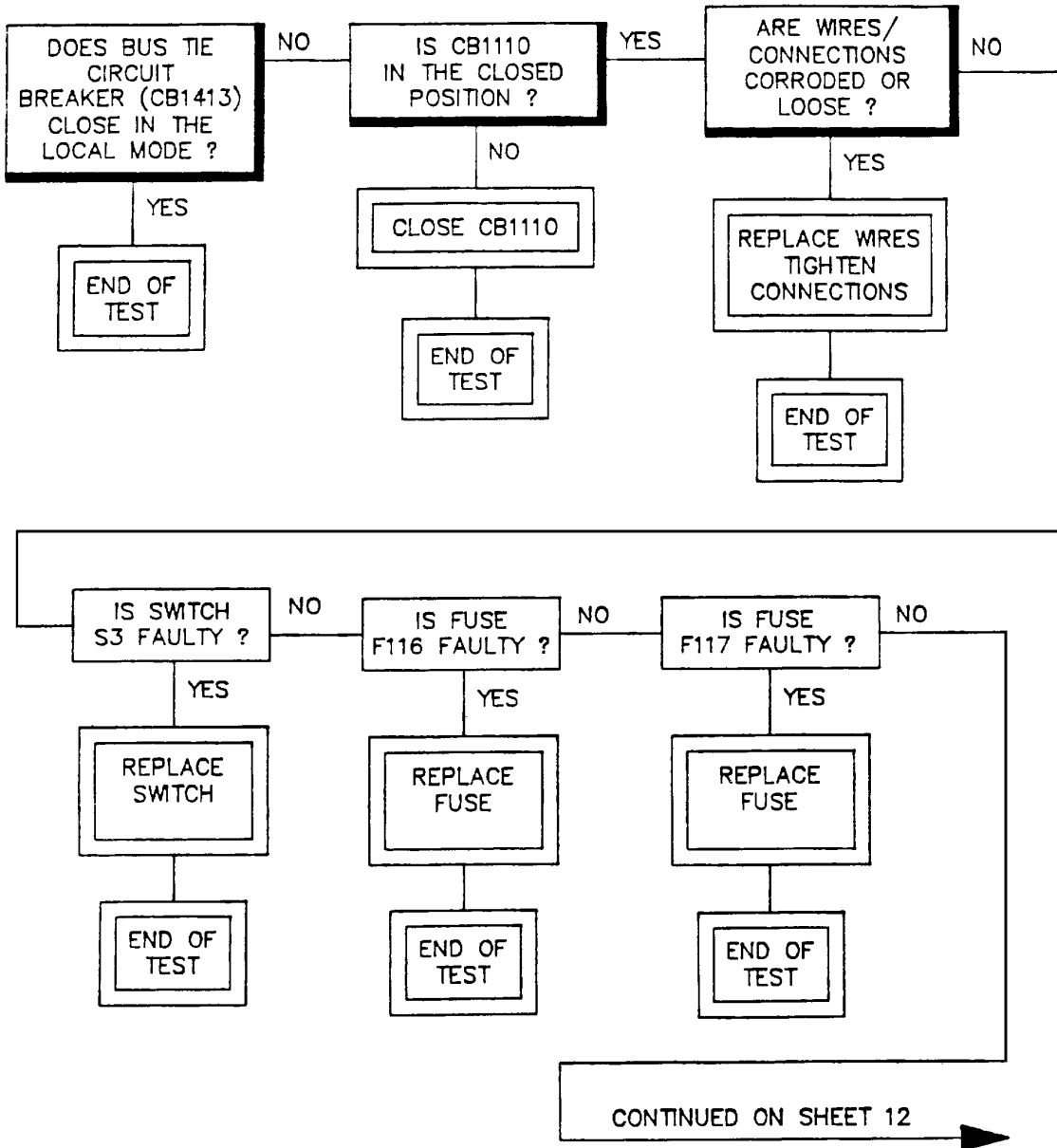


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 11 of 14)

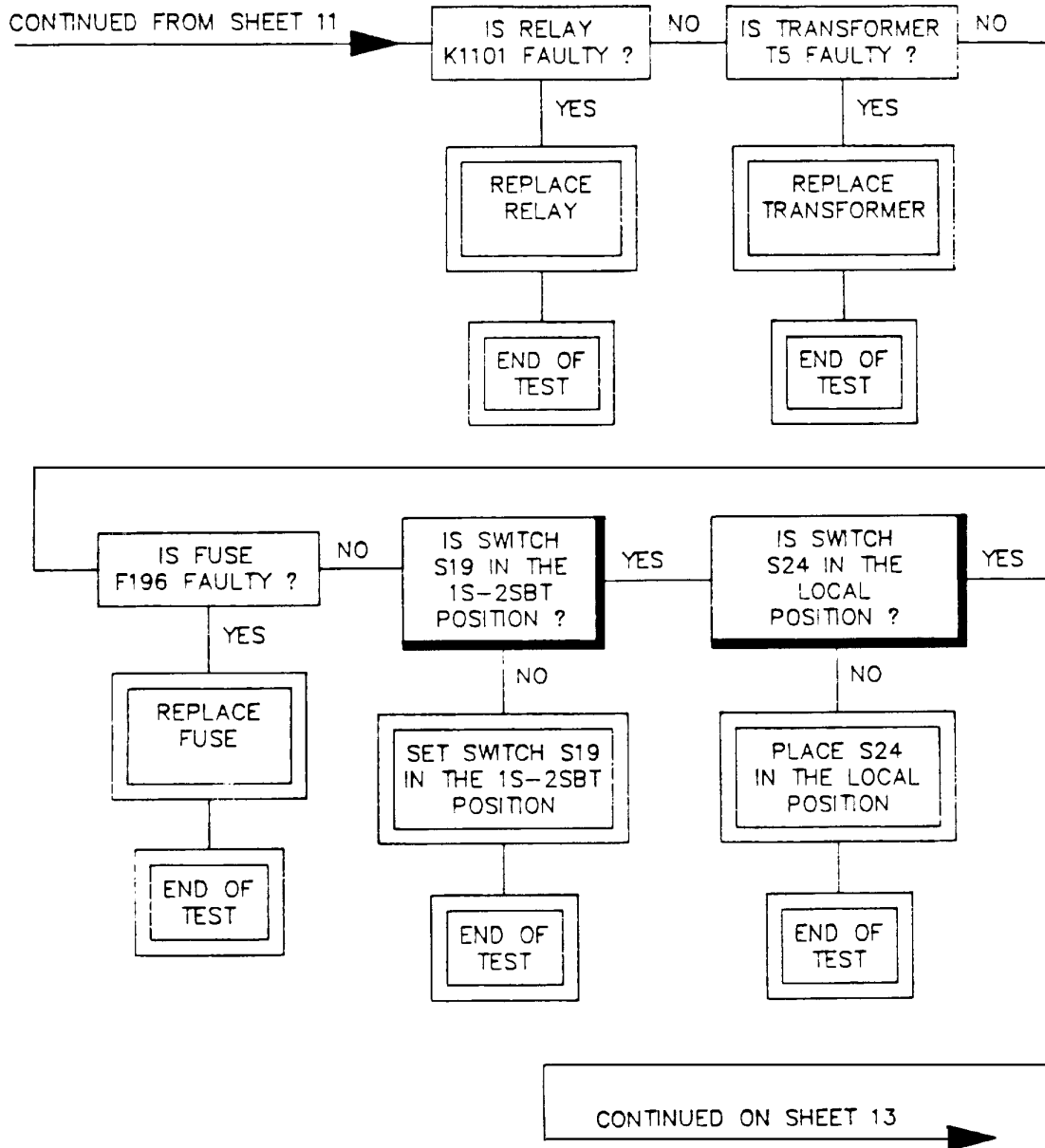


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 12 of 14)

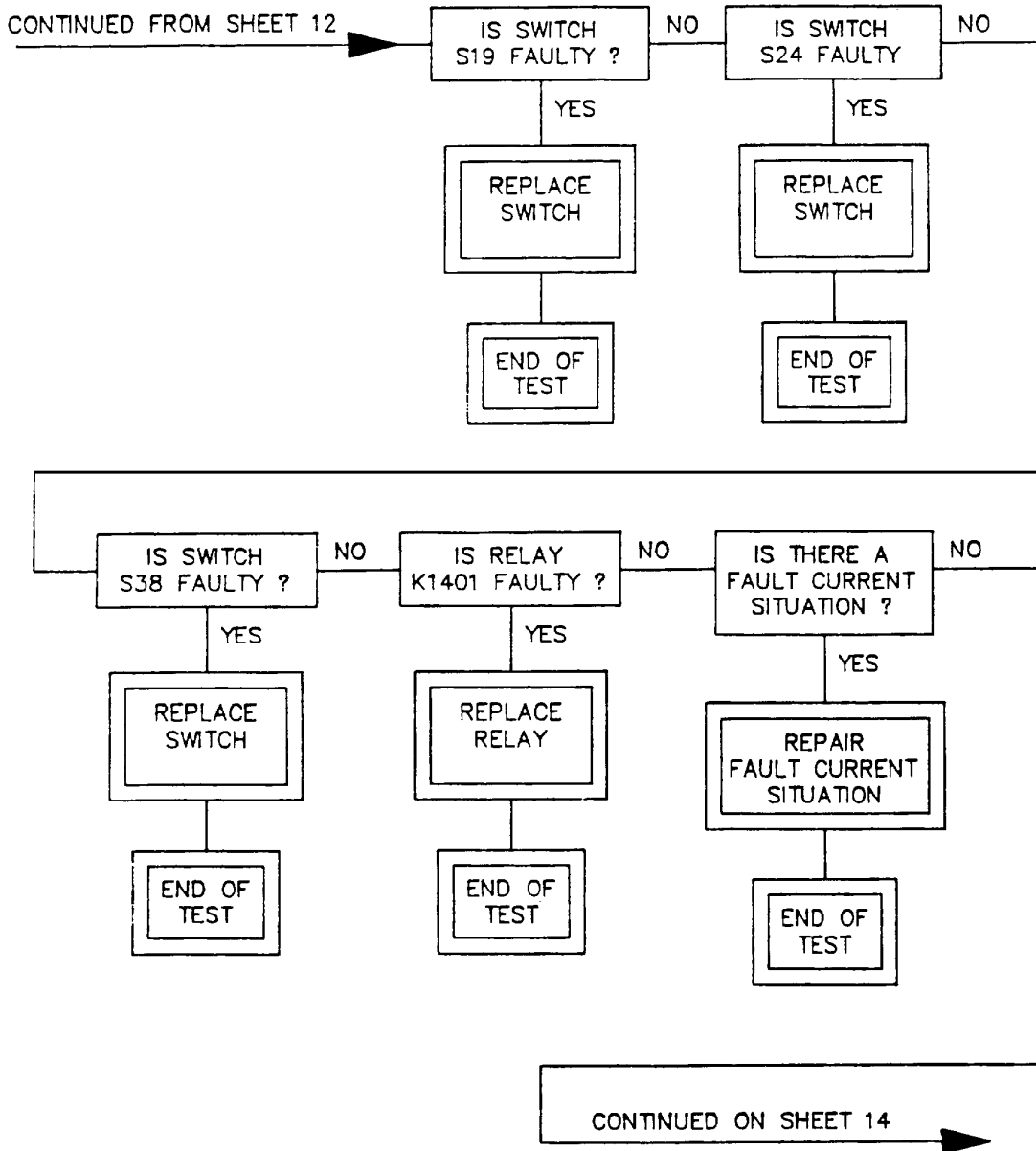


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 13 of 14)

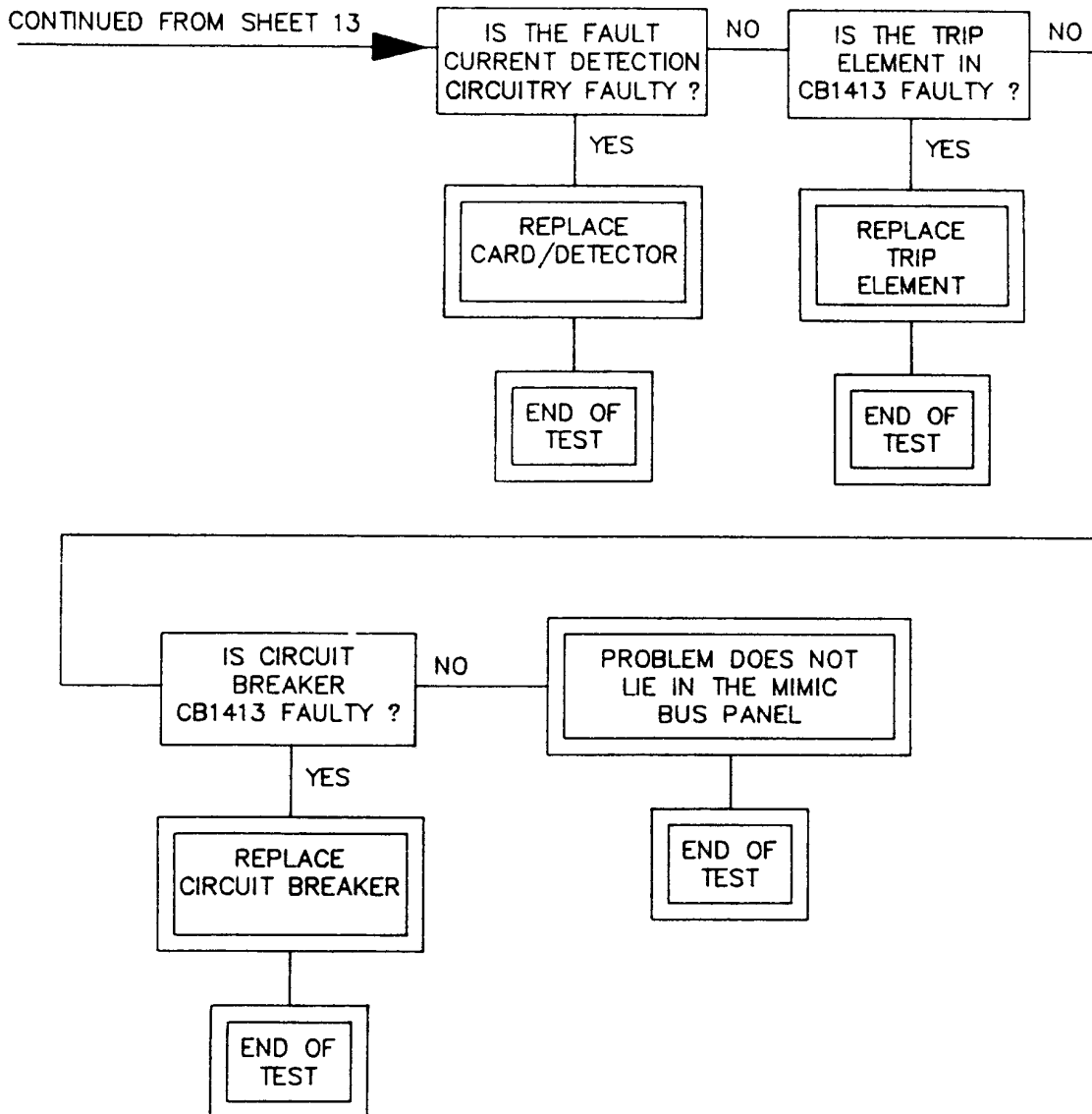


Figure 5-16. Fault Logic Diagram; Mimic Bus Panel Analysis (Sheet 14 of 14)

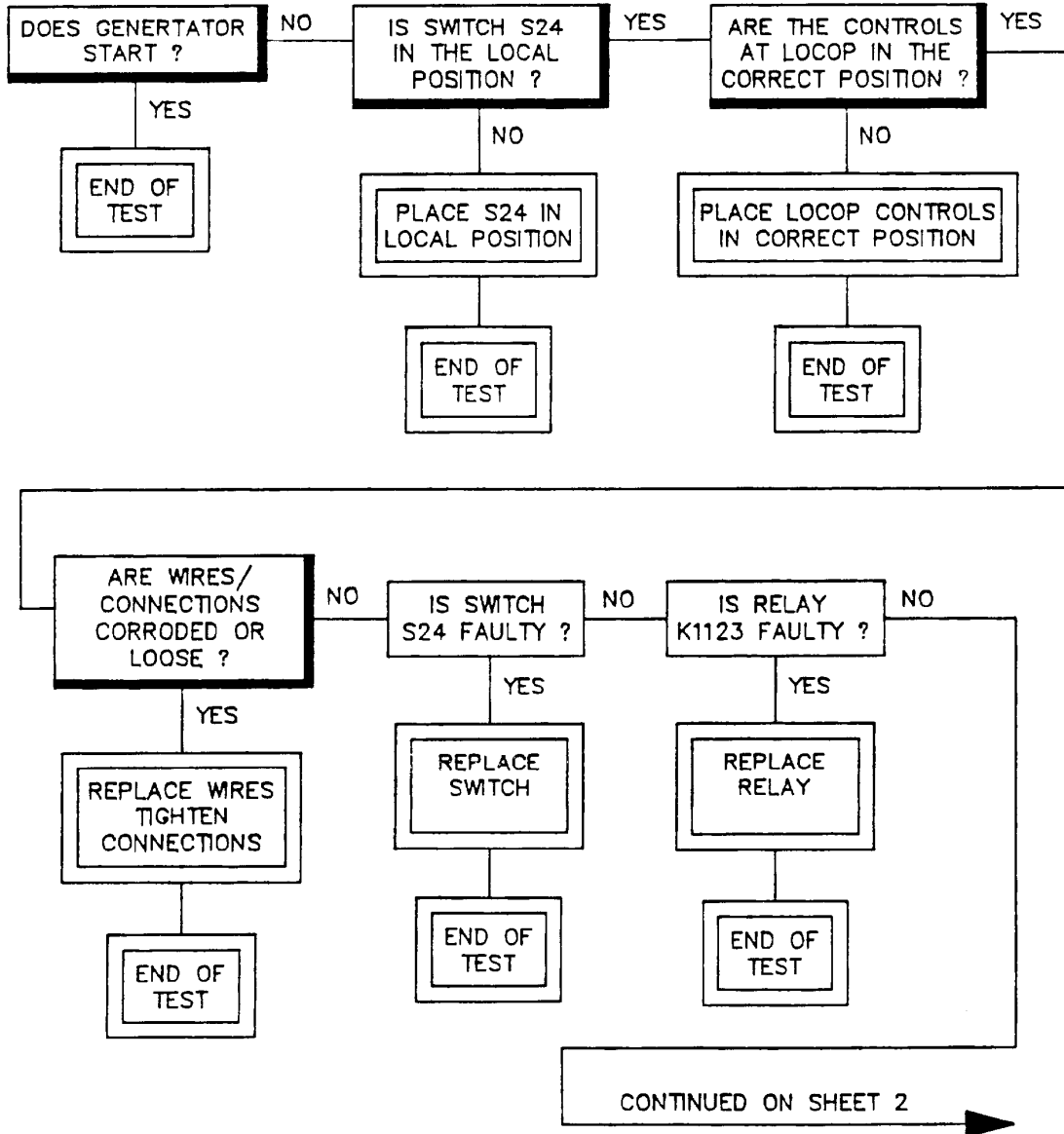


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 1 of 14)

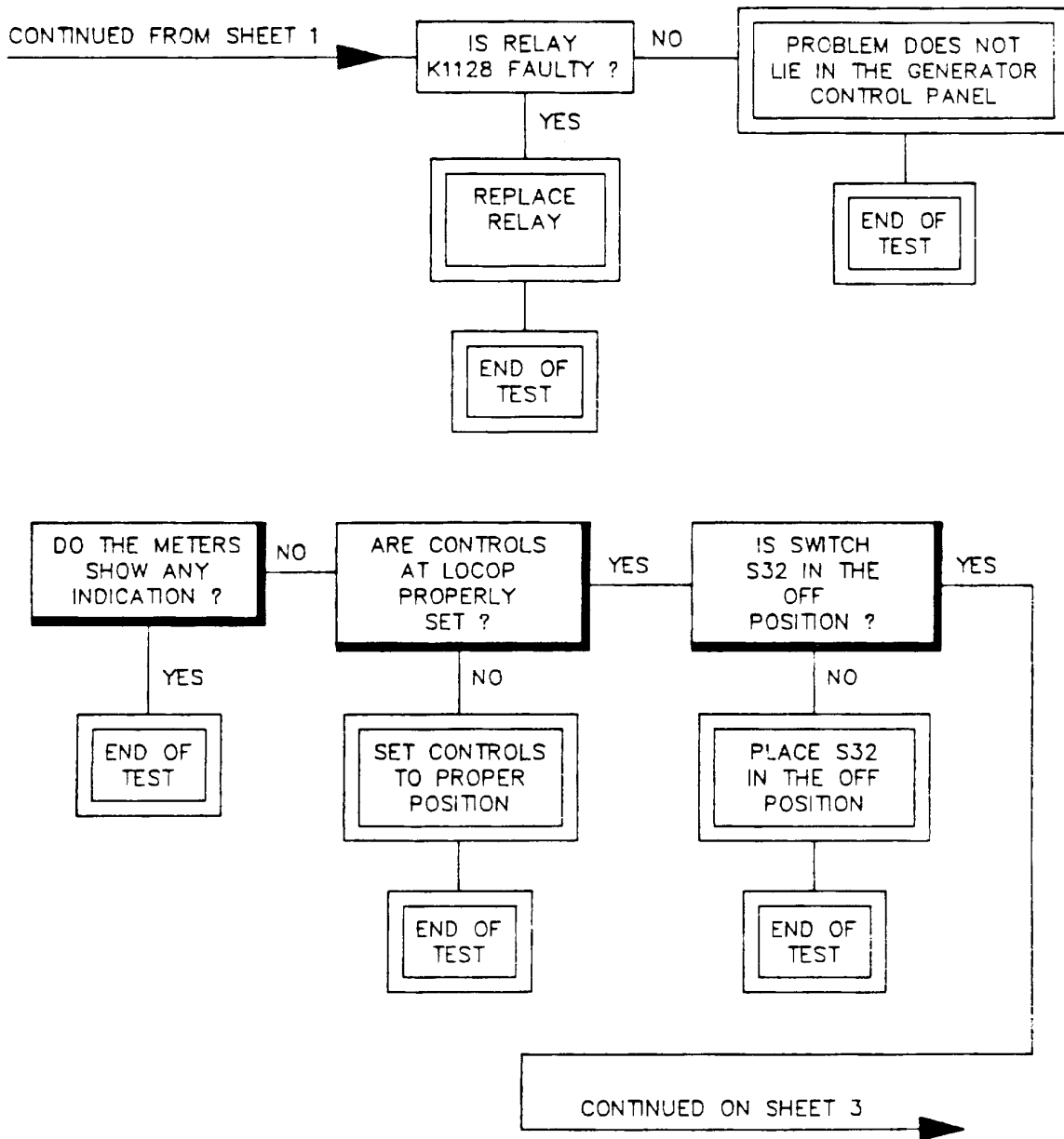


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 2 of 14)

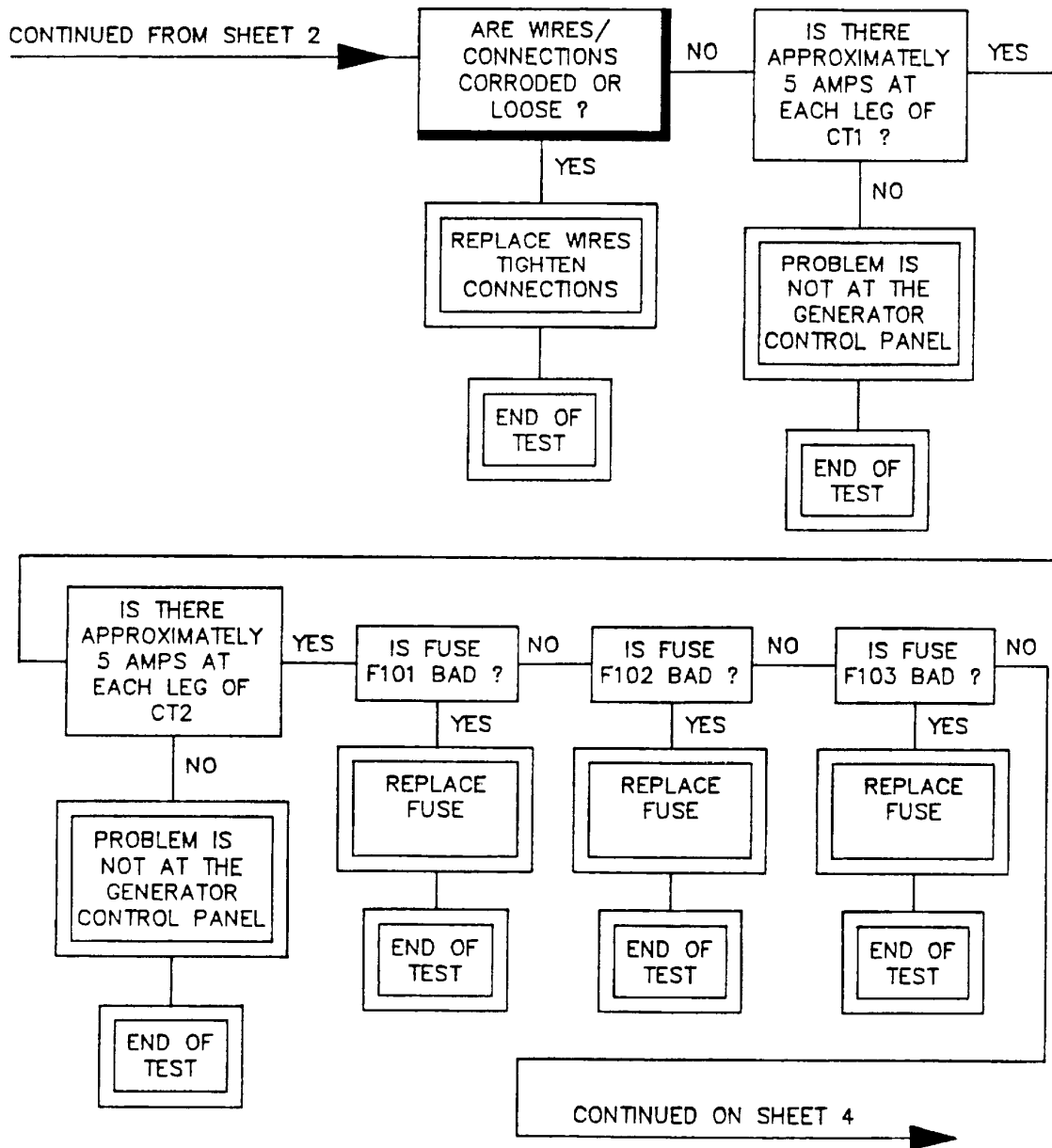


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 3 of 14)

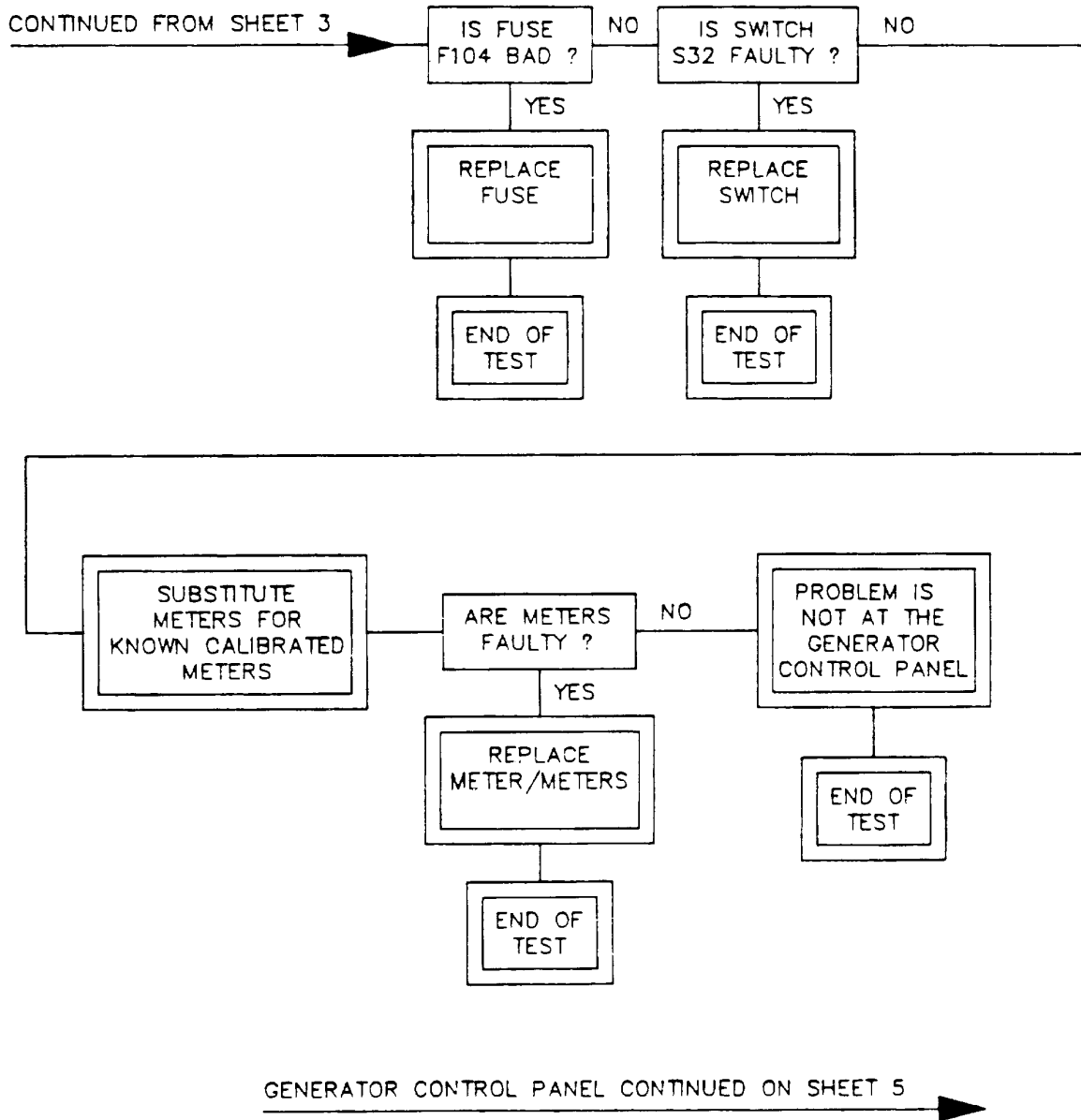
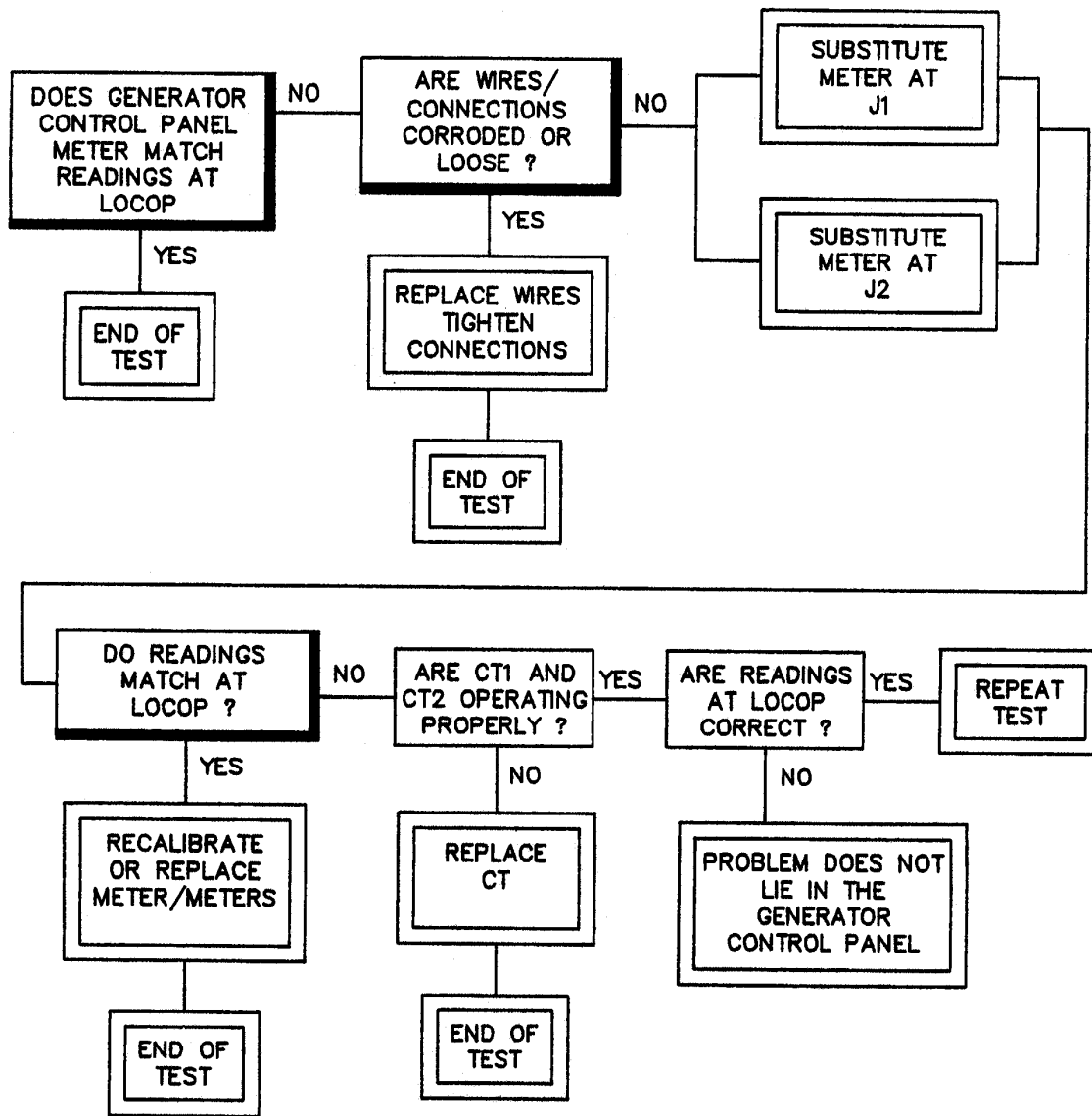


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 4 of 14)



GENERATOR CONTROL PANEL CONTINUED ON SHEET 6



Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 5 of 14)

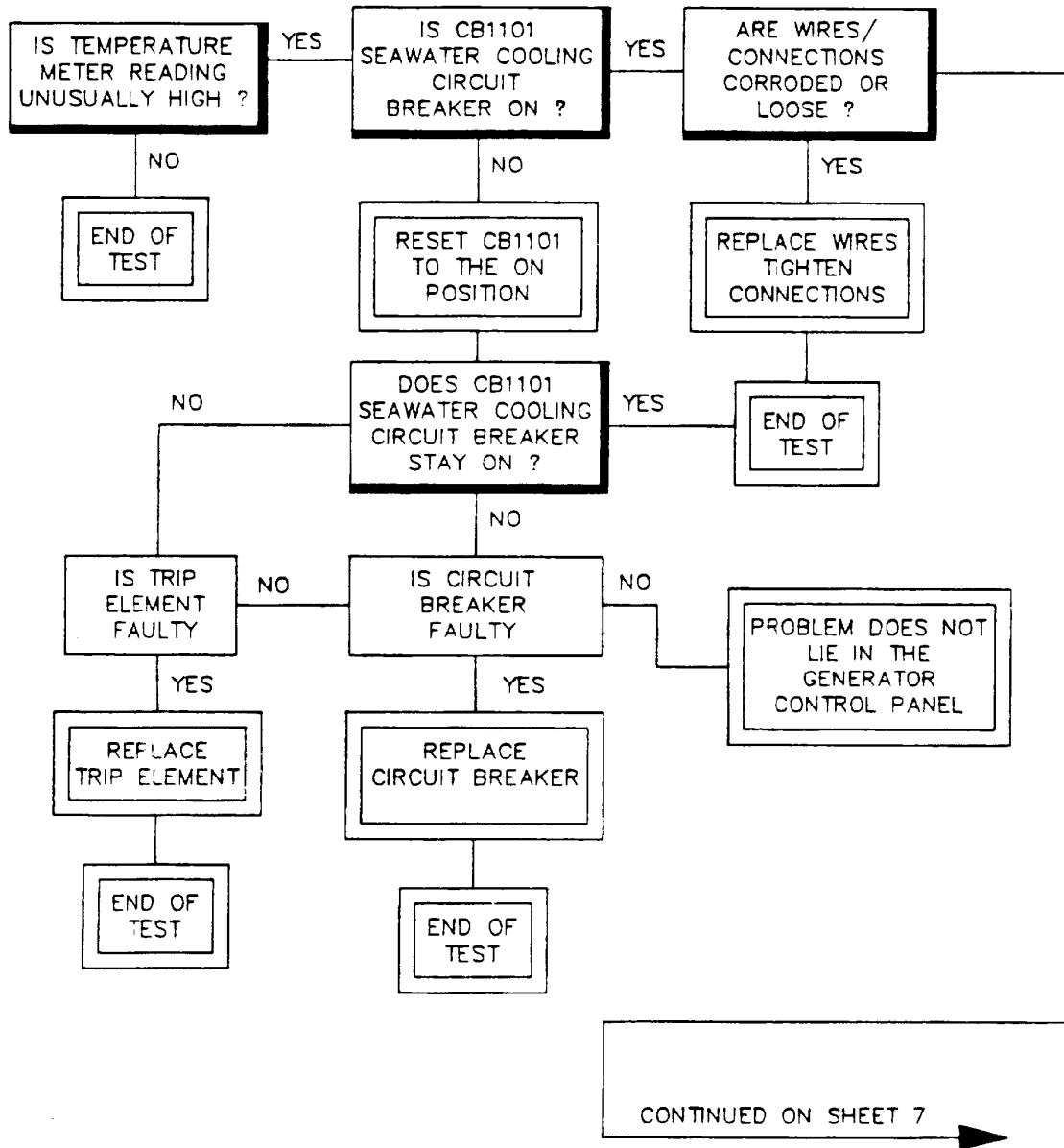


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 6 of 14)

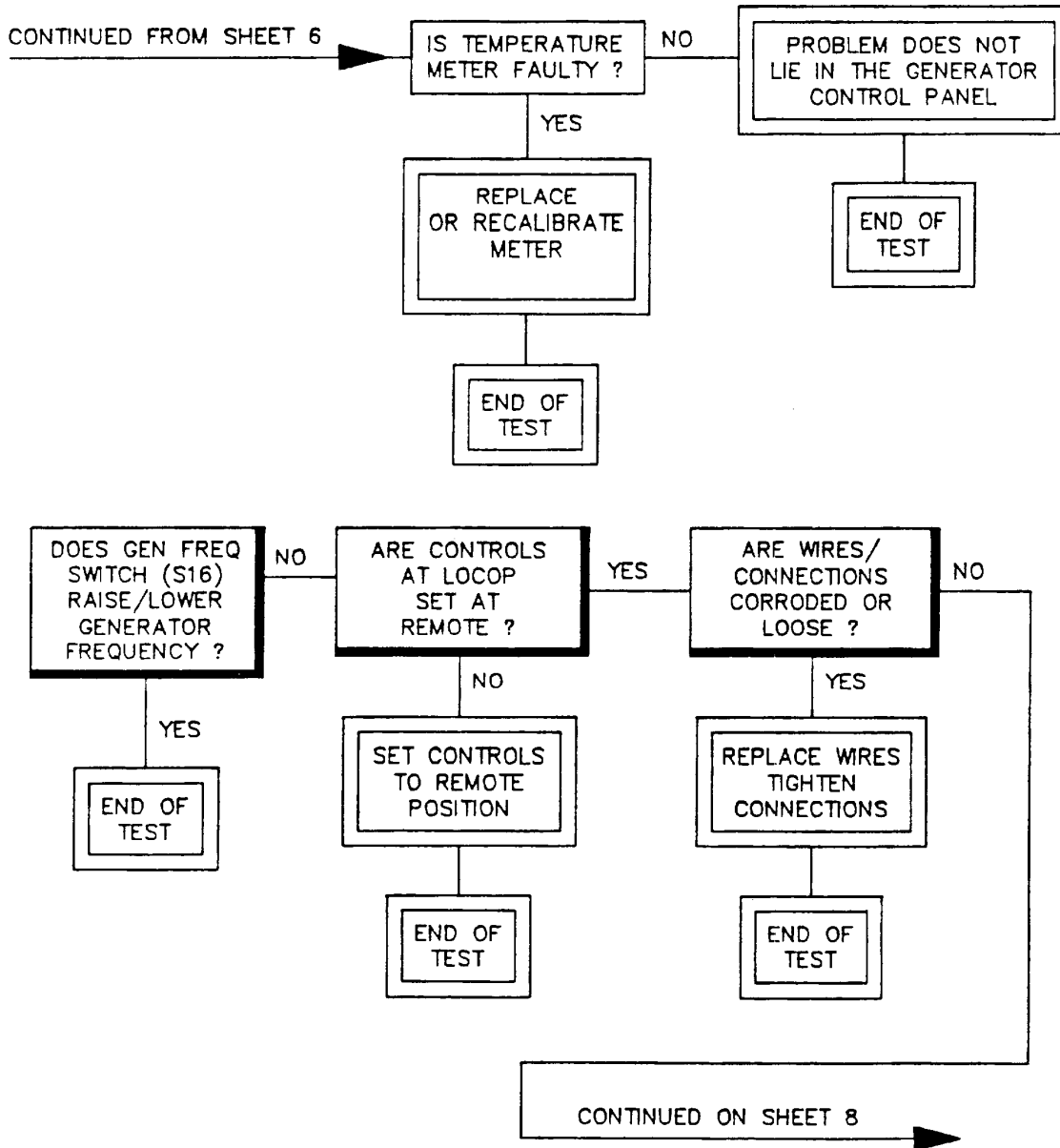


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 7 of 14)

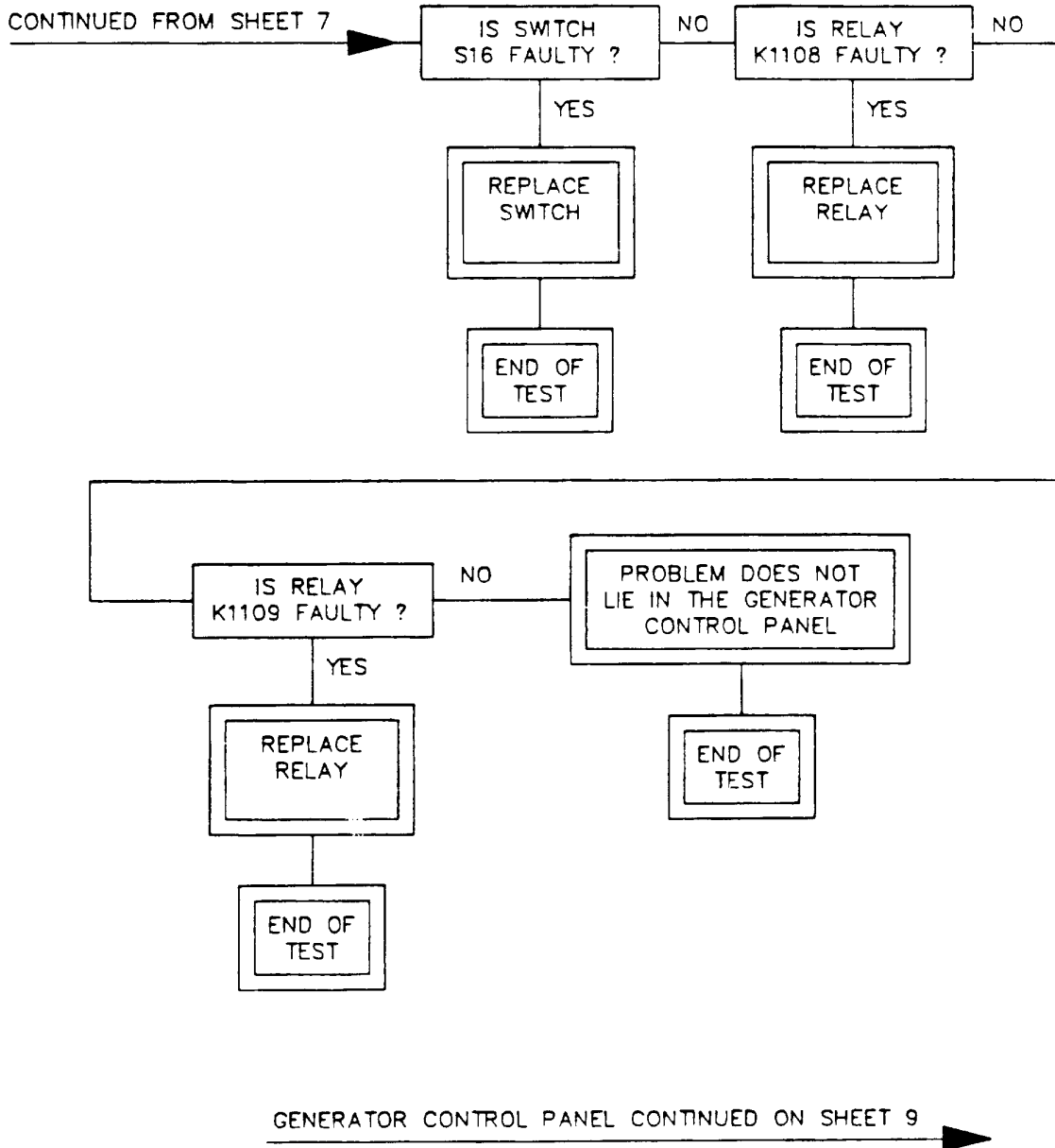
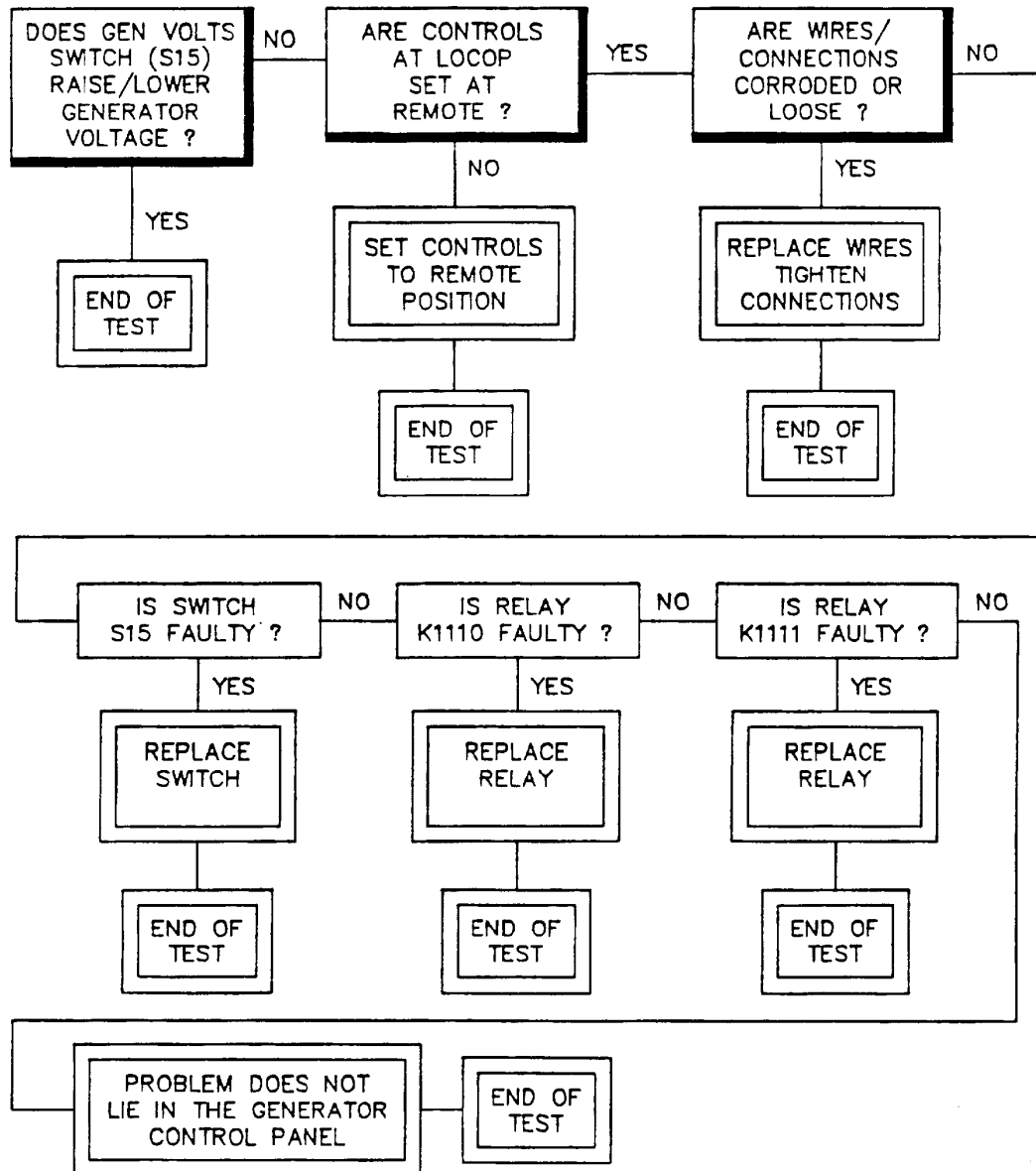


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 8 of 14)



GENERATOR CONTROL PANEL CONTINUED ON SHEET 10

Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 9 of 14)

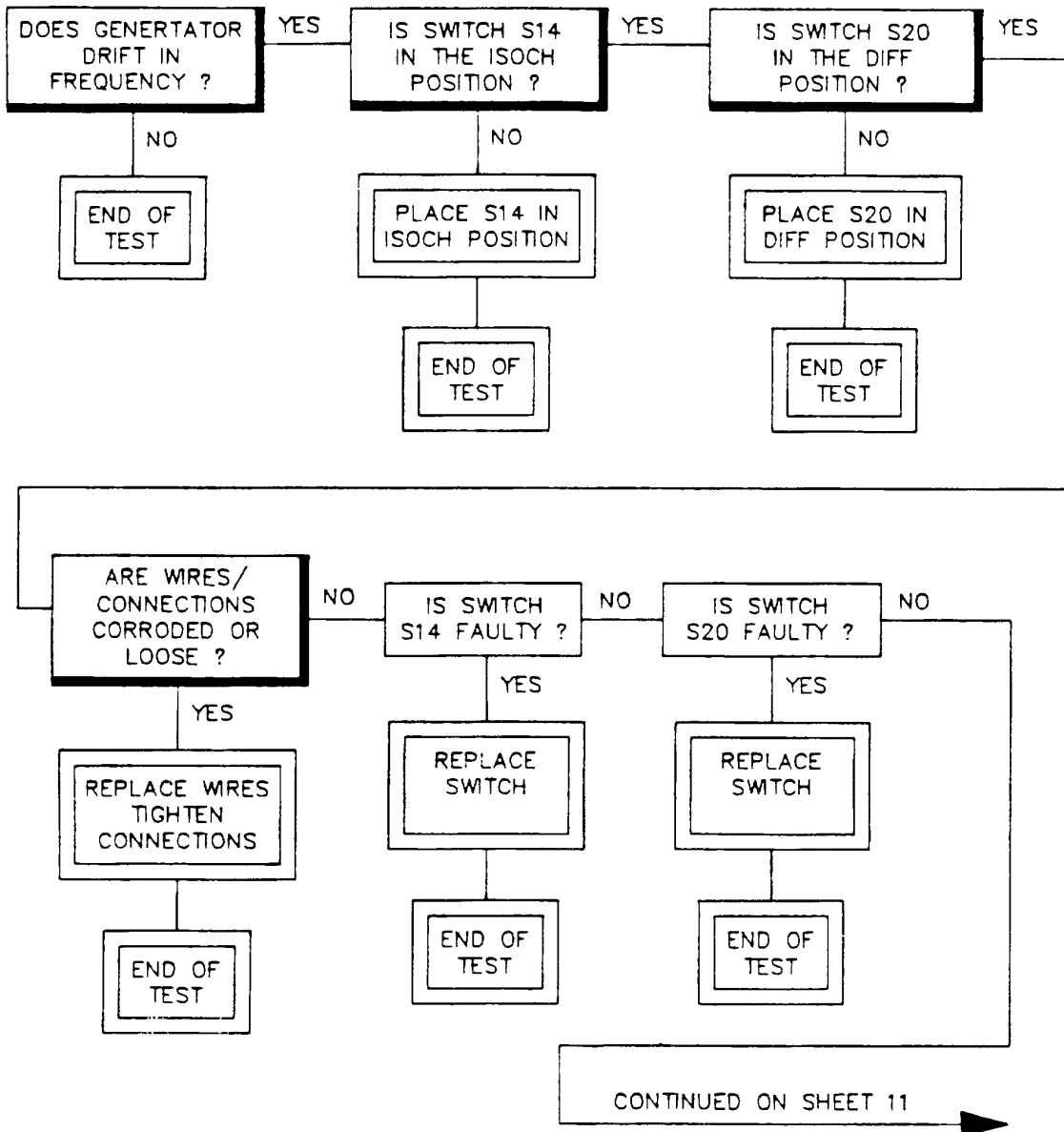


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 10 of 14)

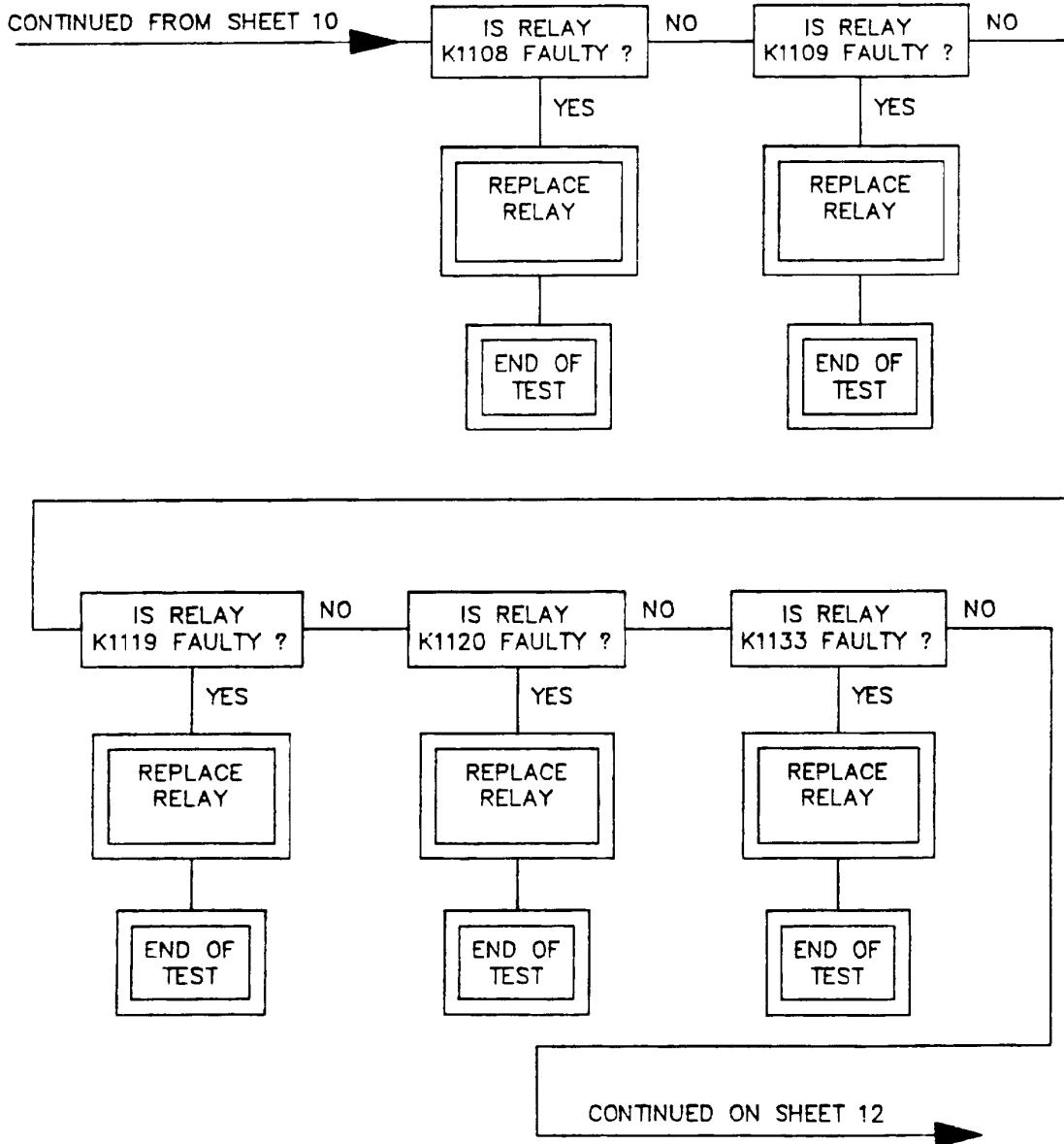


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 11 of 14)

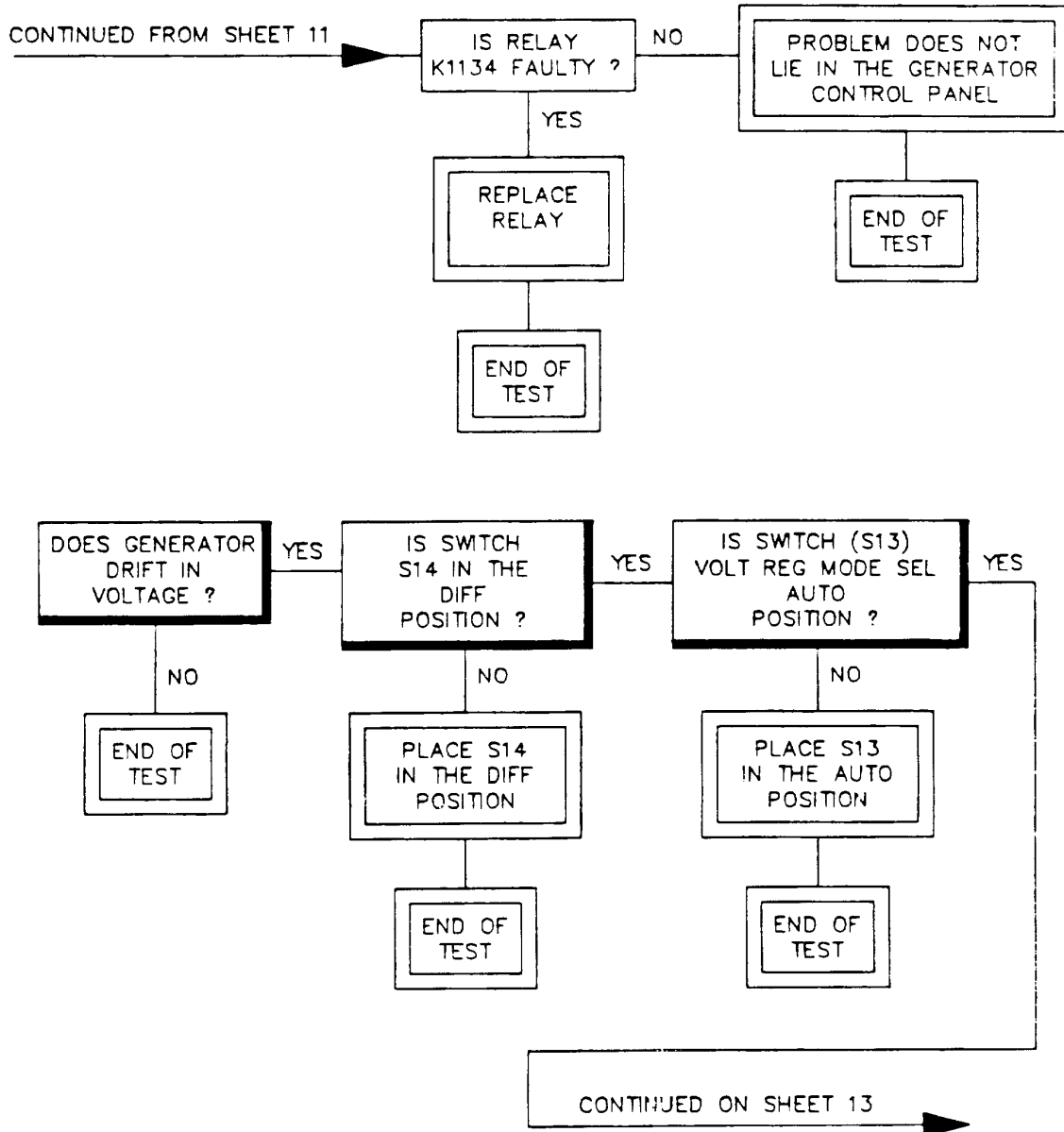


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 12 of 14)

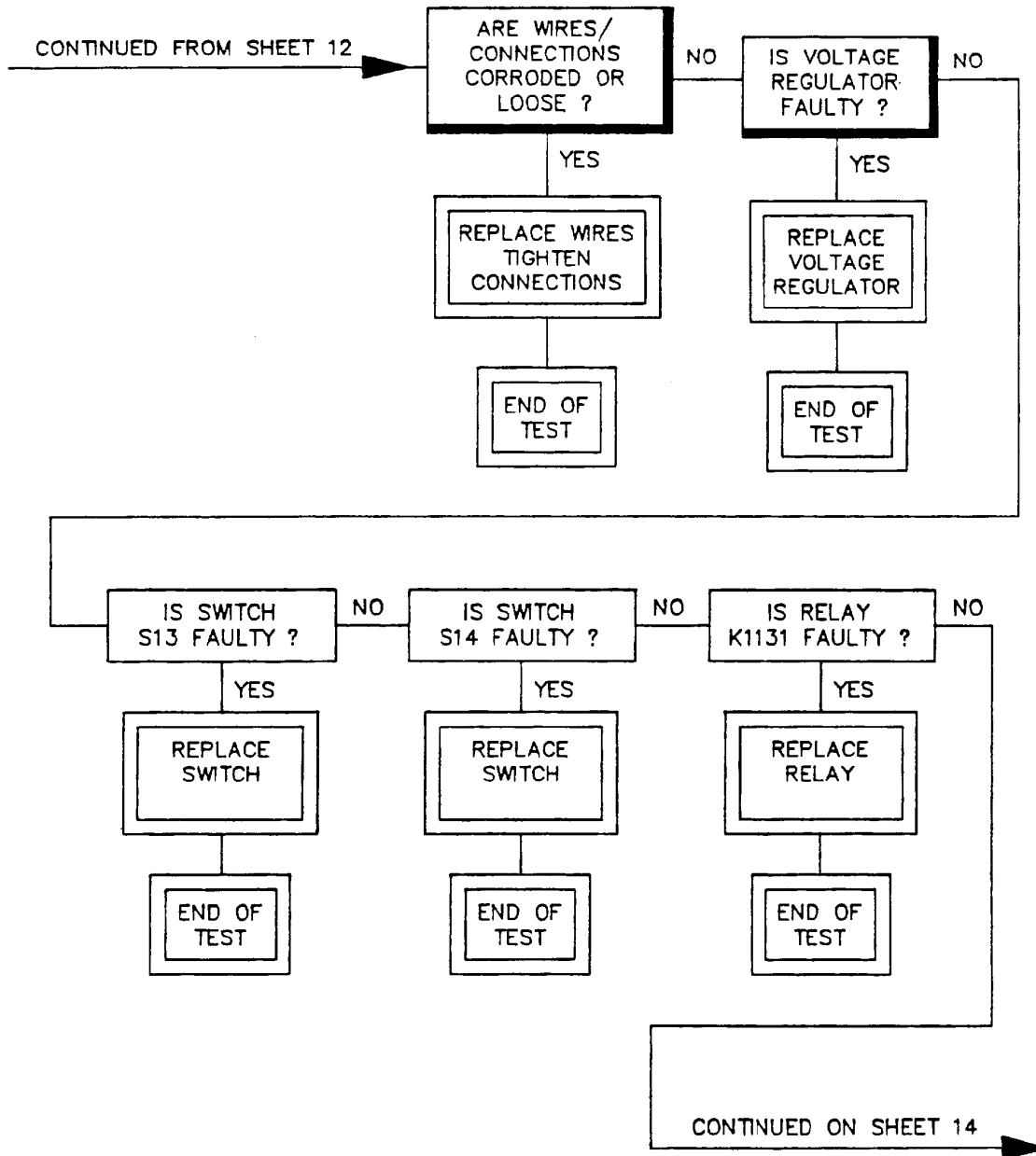


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 13 of 14)

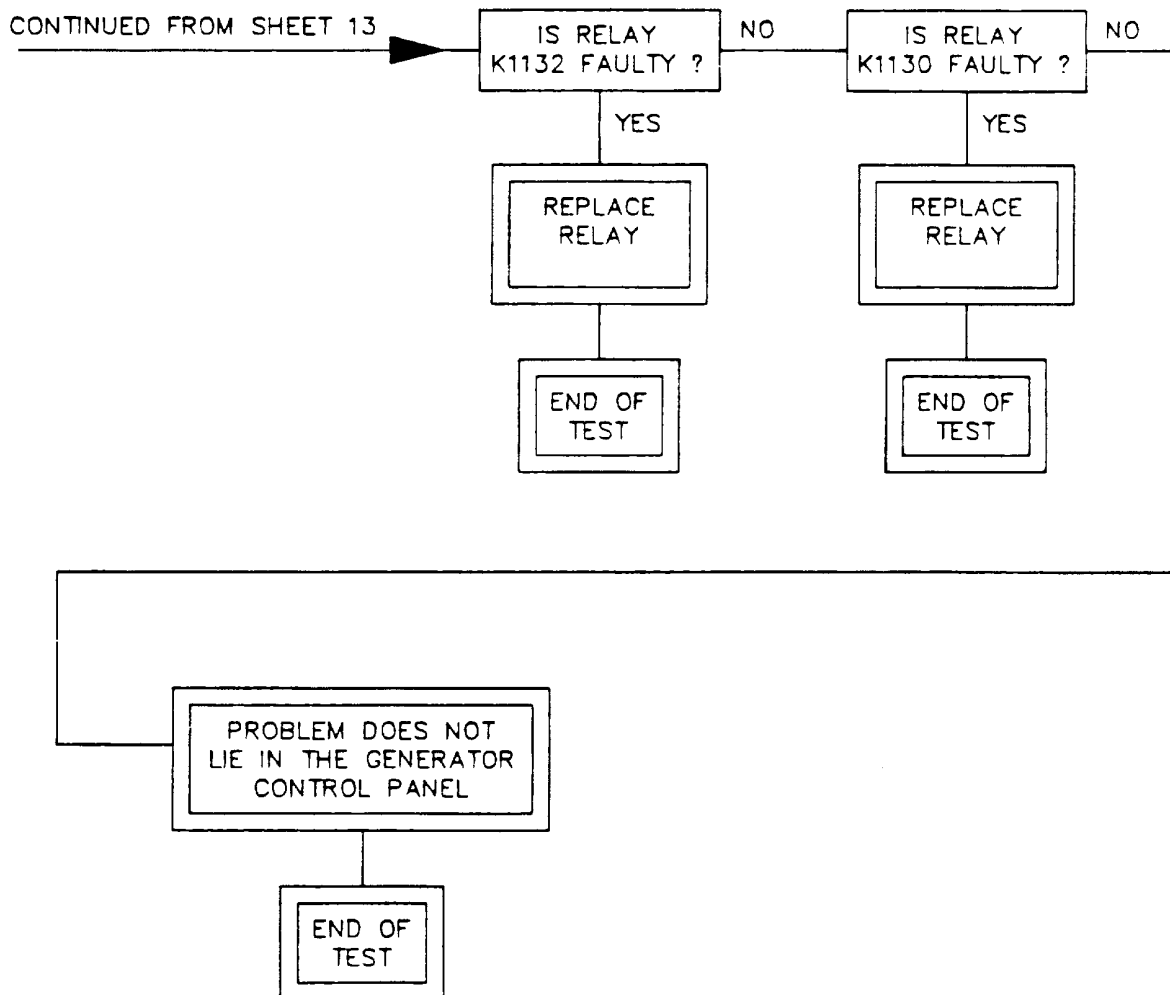
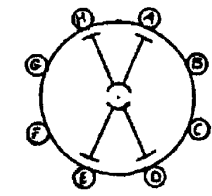
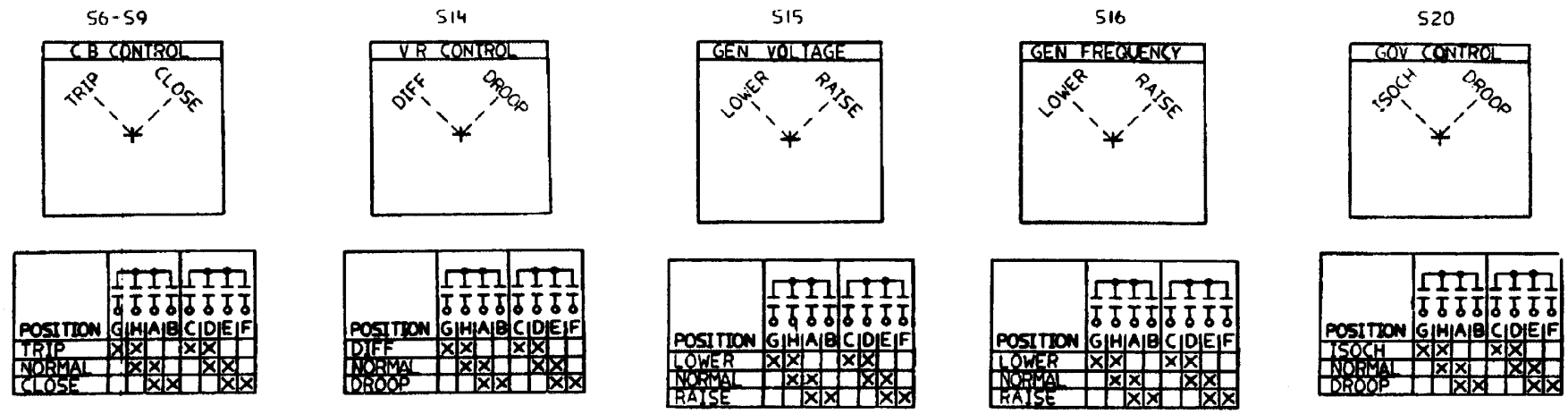
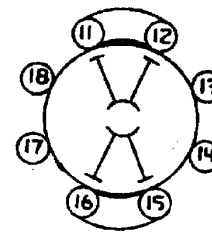
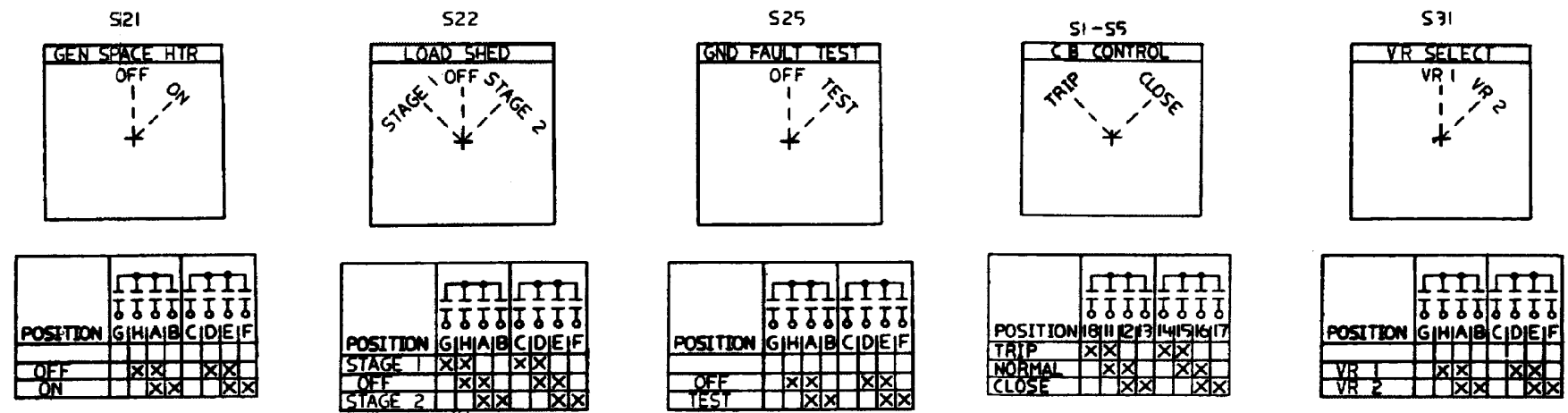


Figure 5-17. Fault Logic Diagram; Generator Control Panel Analysis (Sheet 14 of 14)



TYPICAL
S14-S16, S20-S21, S25, S31.
1 SECTION
S6-S9
2 SECTIONS
S22
3 SECTIONS

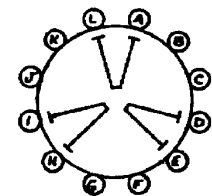
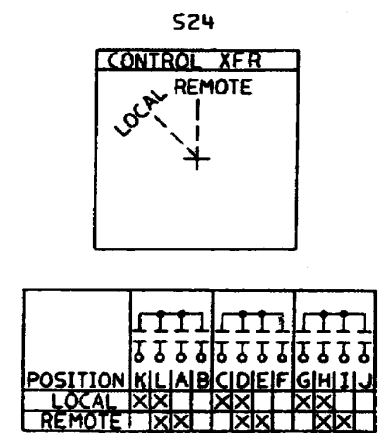
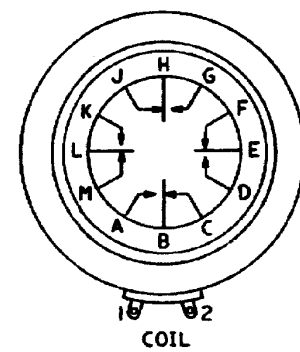
NOTE: SWITCHES S6-9, S14-16, 20, 22 & 25 ARE SPRING RETURN TO NORMAL/OFF POSITION.



TYPICAL
S1-S5
2 SECTIONS
(SPRING RETURN TO NORMAL)

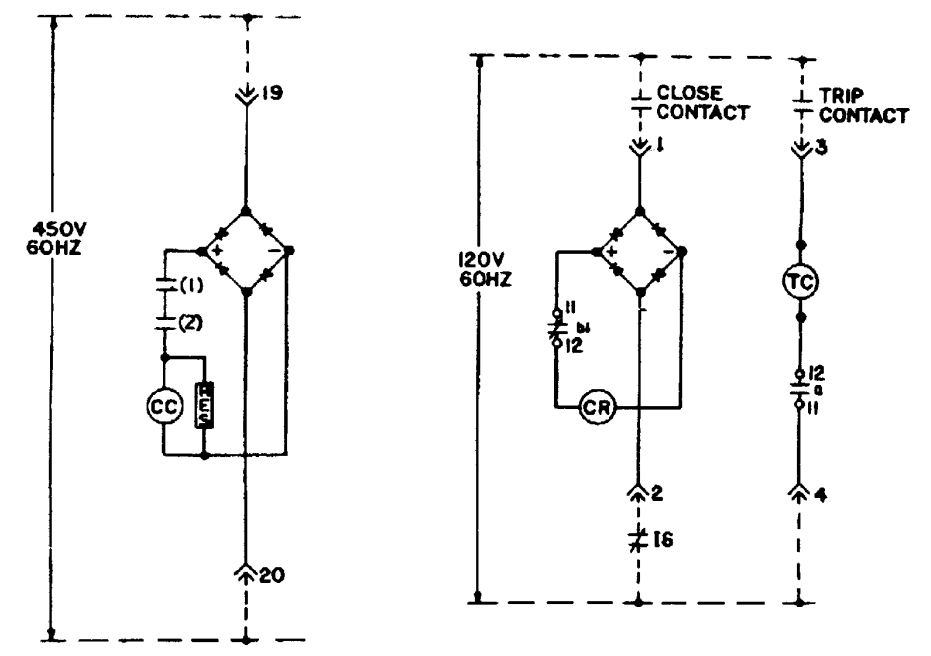
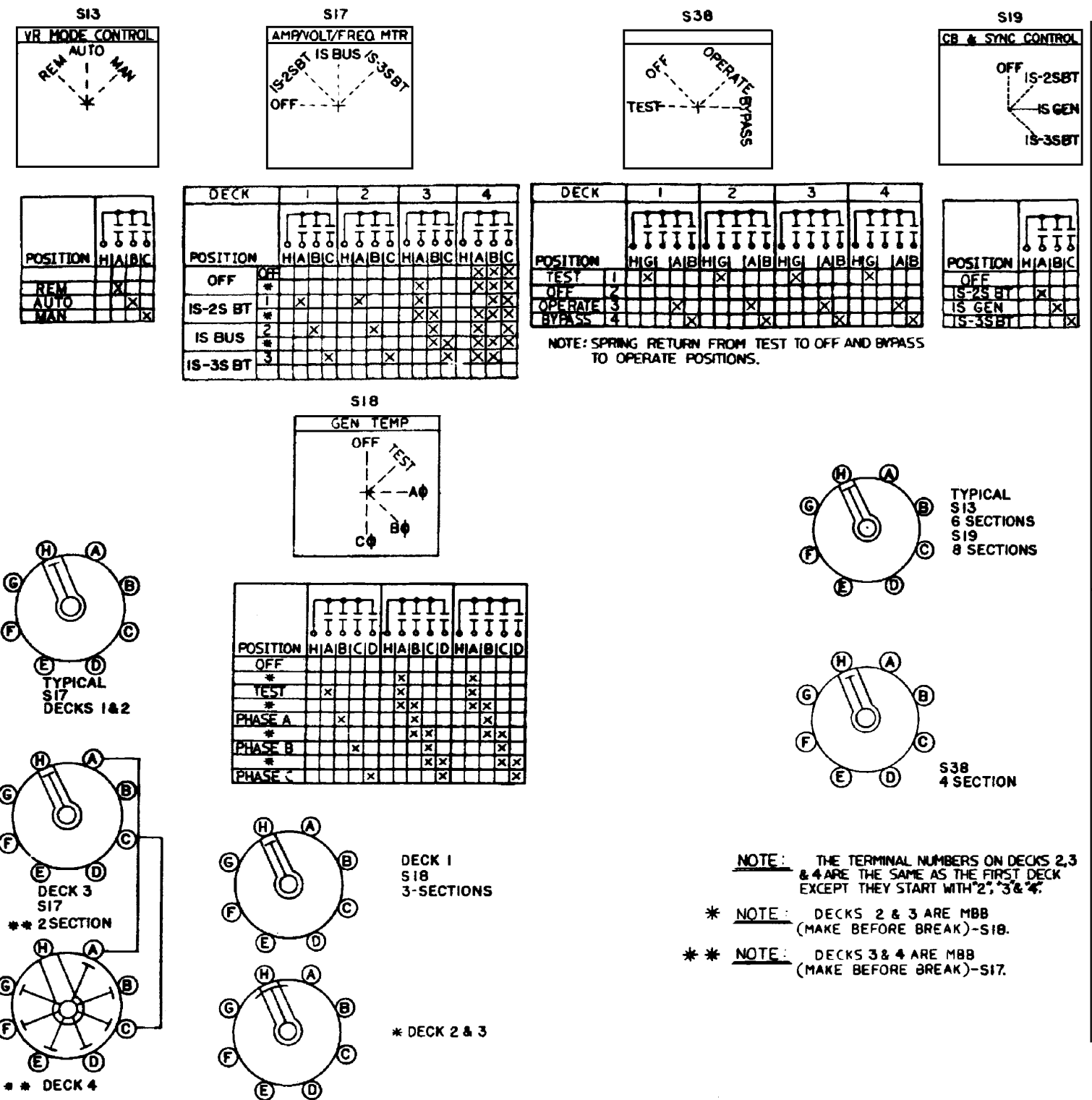
TYPICAL OF ALL ROTARY RELAYS SECTION ONE & COIL SHOWN DE-ENERGIZED

LATCHING RELAYS HAVE THE SAME CONTACT ARRANGEMENT WITH COIL N° 1 (LC) ENERGIZED CONTACTS A-B, D-E, G-H & K-L CLOSE

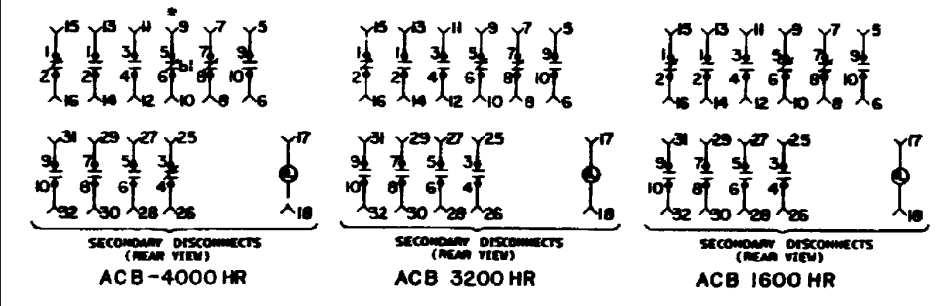


TYPICAL
S24
9 SECTIONS

Figure 5-18. 1S Switchboard System; Schematic (Sheet 1 of 20)



BREAKER ELEMENTARY DIAGRAM
(ITE TYPICAL 1600, 3200 & 4000A)

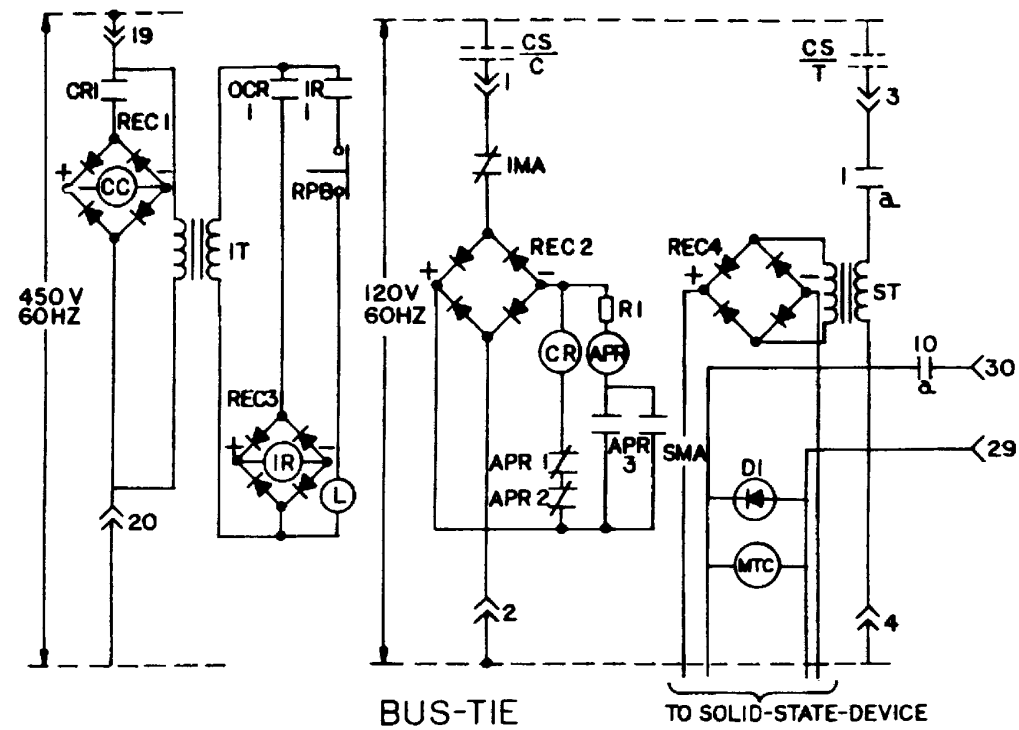
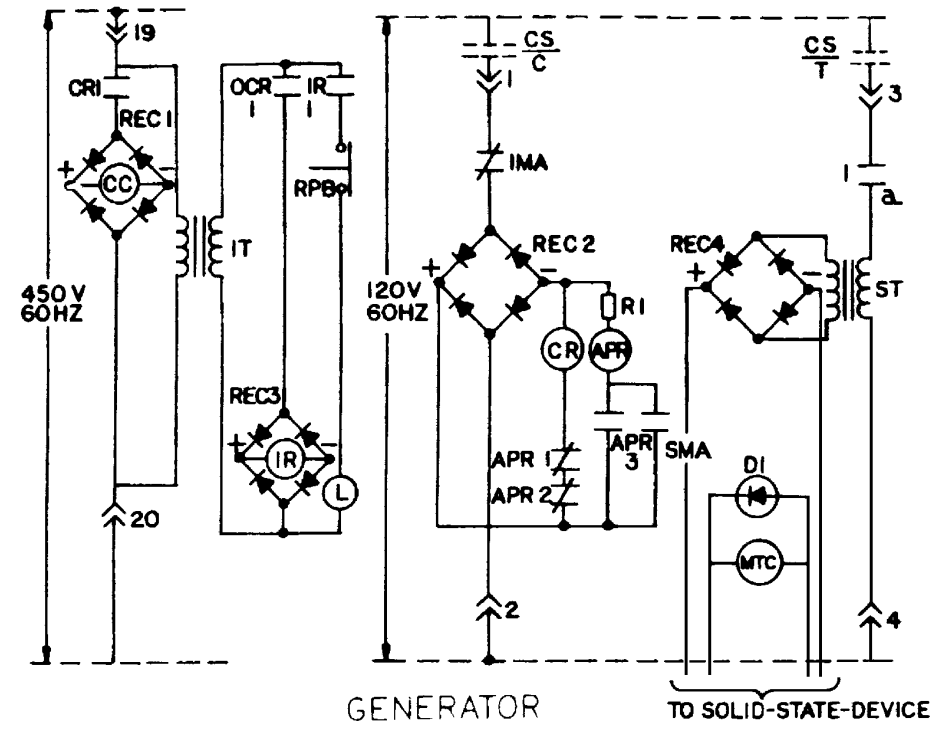
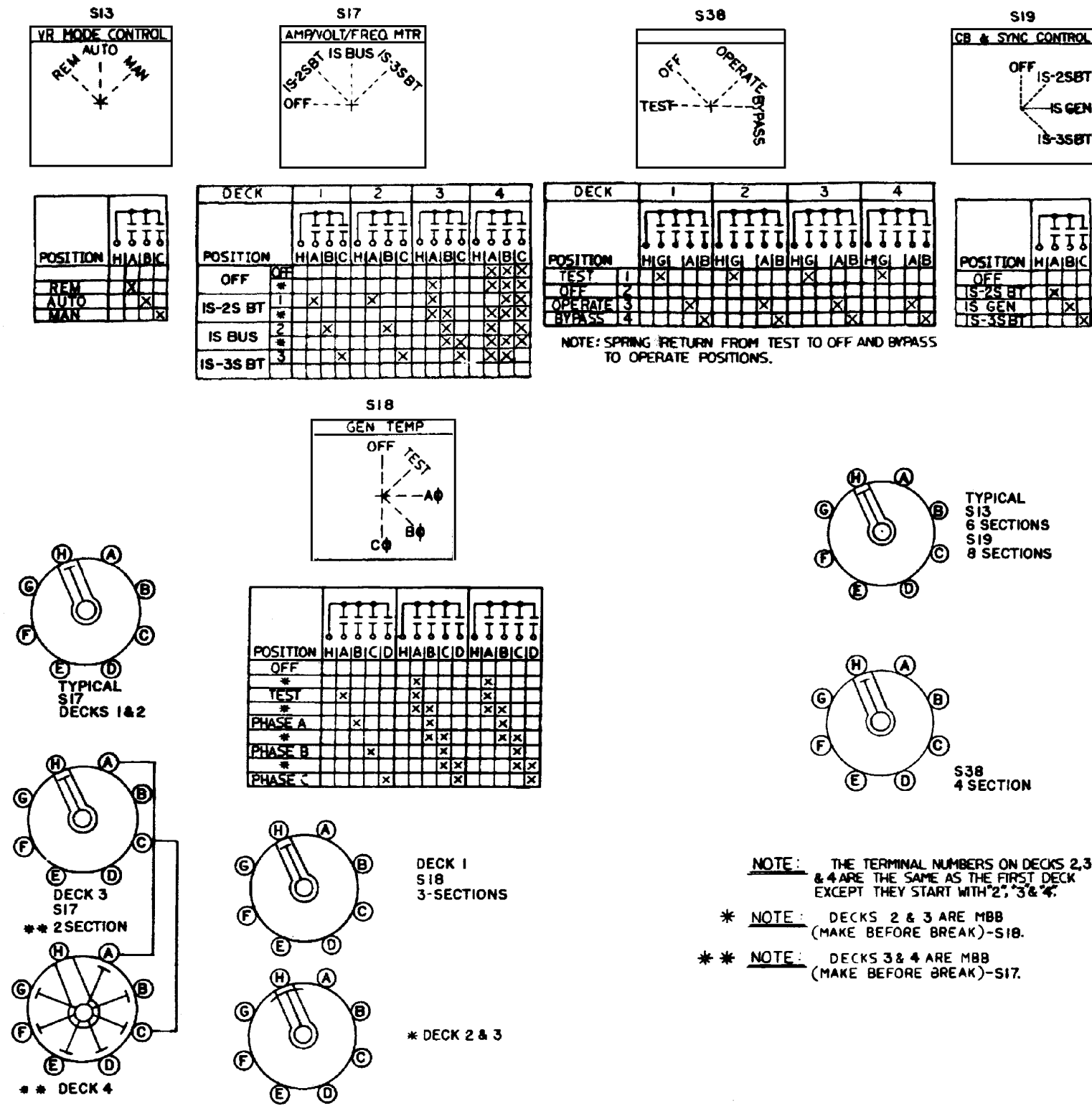


TYPICAL AUXILIARY CONTACT ARRANGEMENT

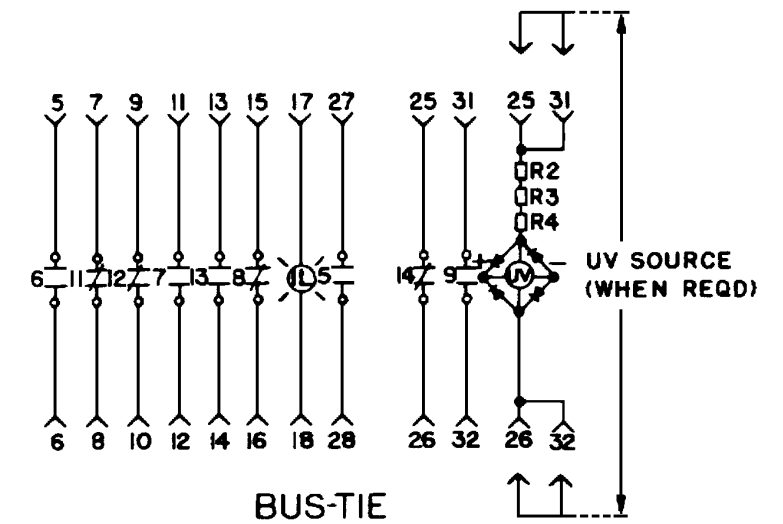
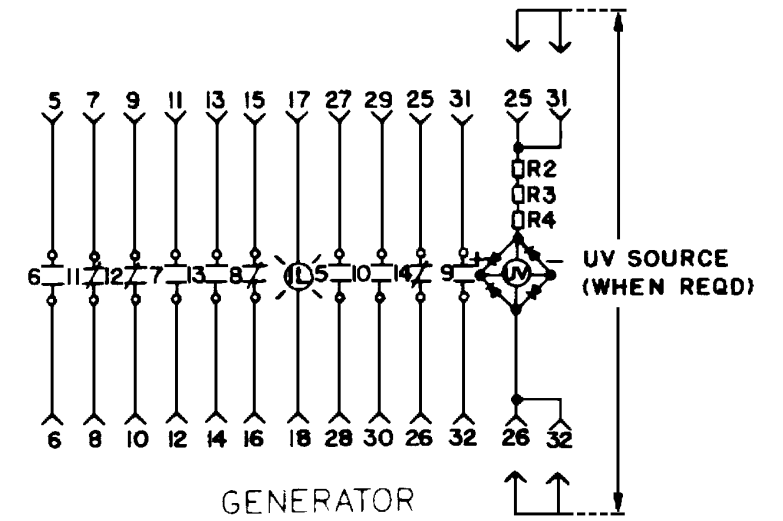
* LONG "b"

NOTE:
DDG 51 ONLY

Figure 5-18. 1S Switchboard System; Schematic (Sheet 2 of 20)



BREAKER ELEMENTARY DIAGRAM
(TYPICAL WHIPP & BOURNE CIRCUIT BREAKER)



TYPICAL AUXILIARY CONTACT ARRANGEMENT
(FOR WHIPP & BOURNE CIRCUIT BREAKER)

NOTE:
DDG 52-54 ONLY

Figure 5-18. 1S Switchboard System; Schematic (Sheet 2 of 20)

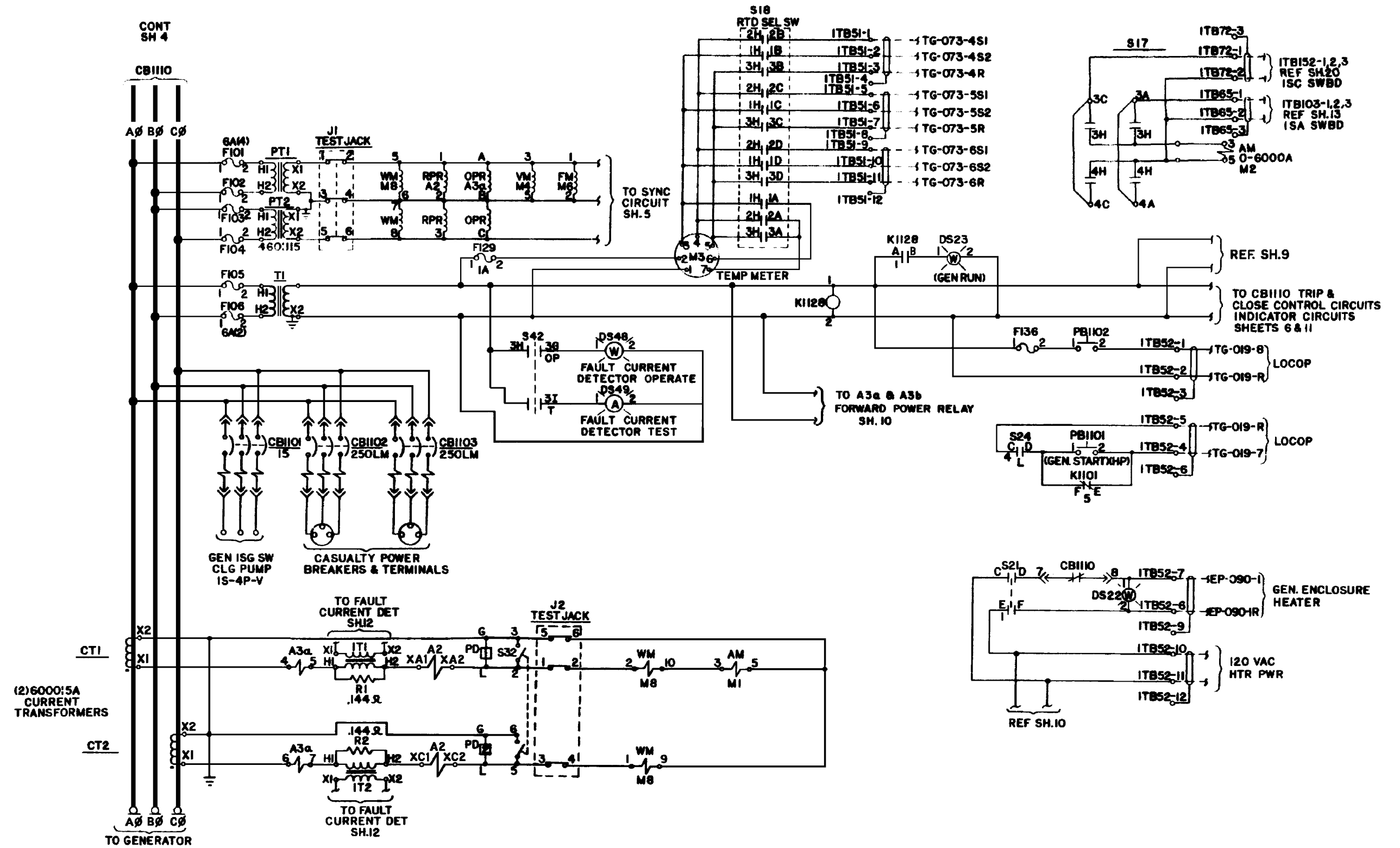


Figure 5-18. 1S Switchboard System; Schematic (Sheet 3 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

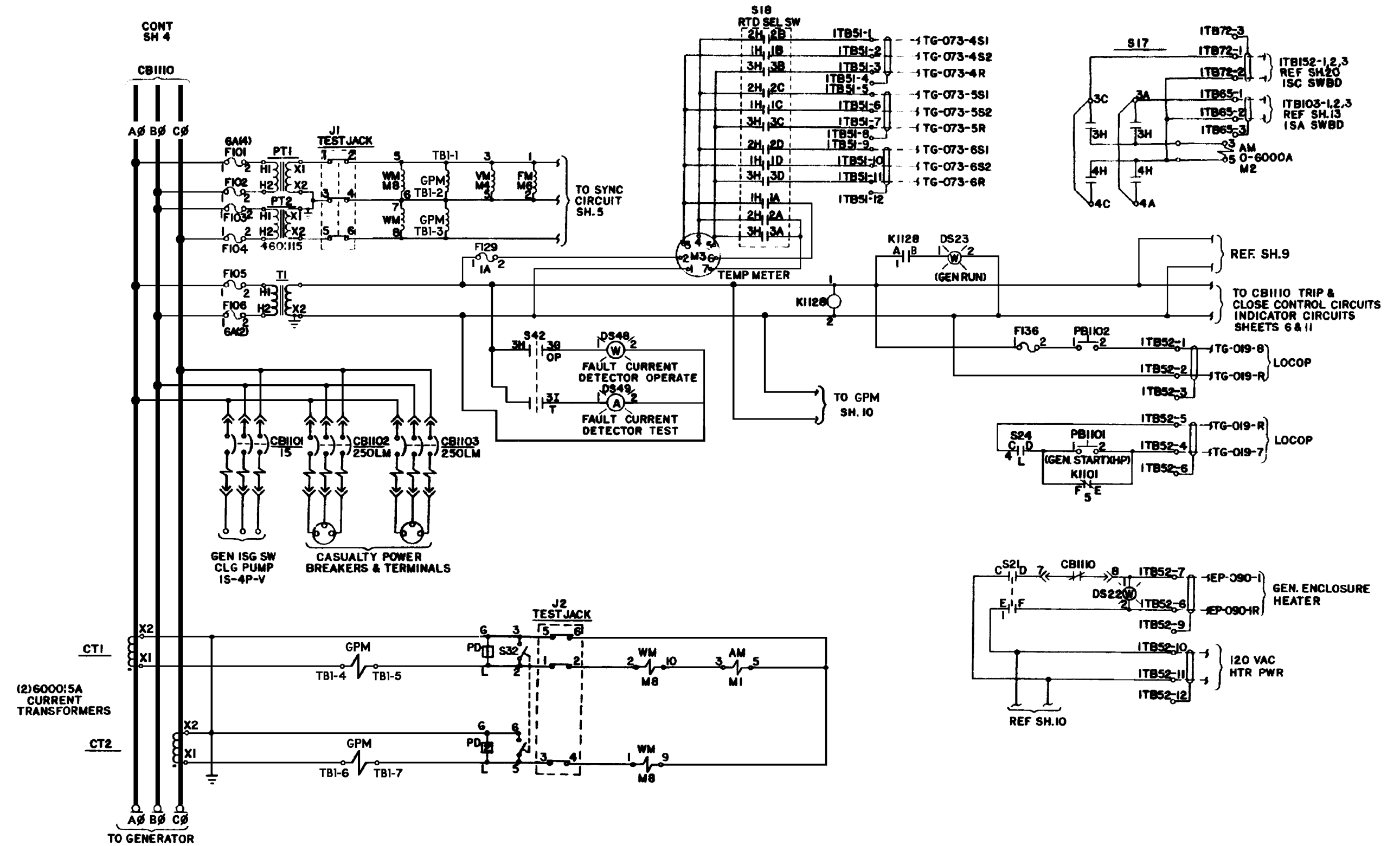


Figure 5-18. 1S Switchboard System; Schematic (Sheet 3 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

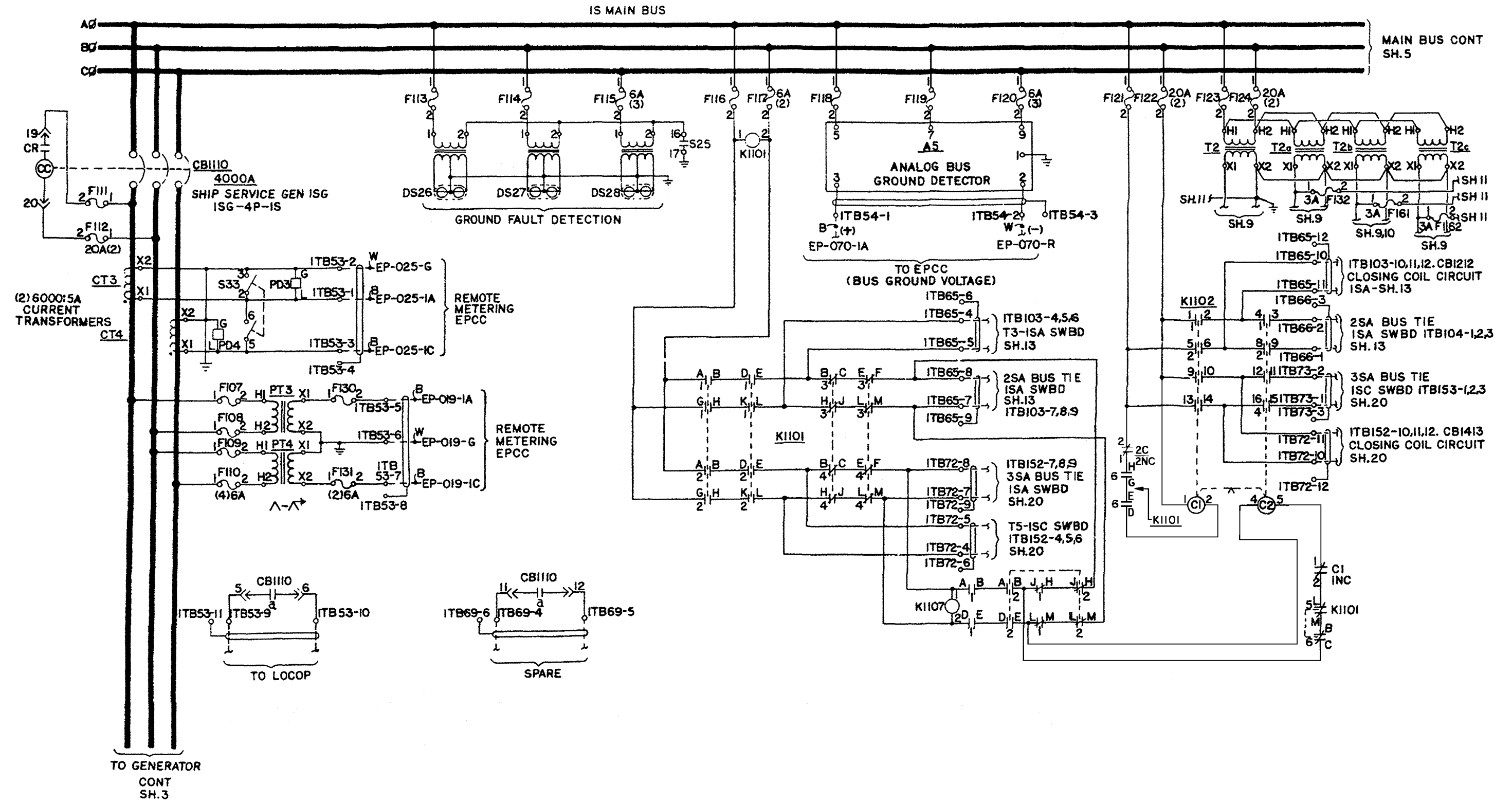


Figure 5-18. 1S Switchboard System; Schematic (Sheet 4 of 20)

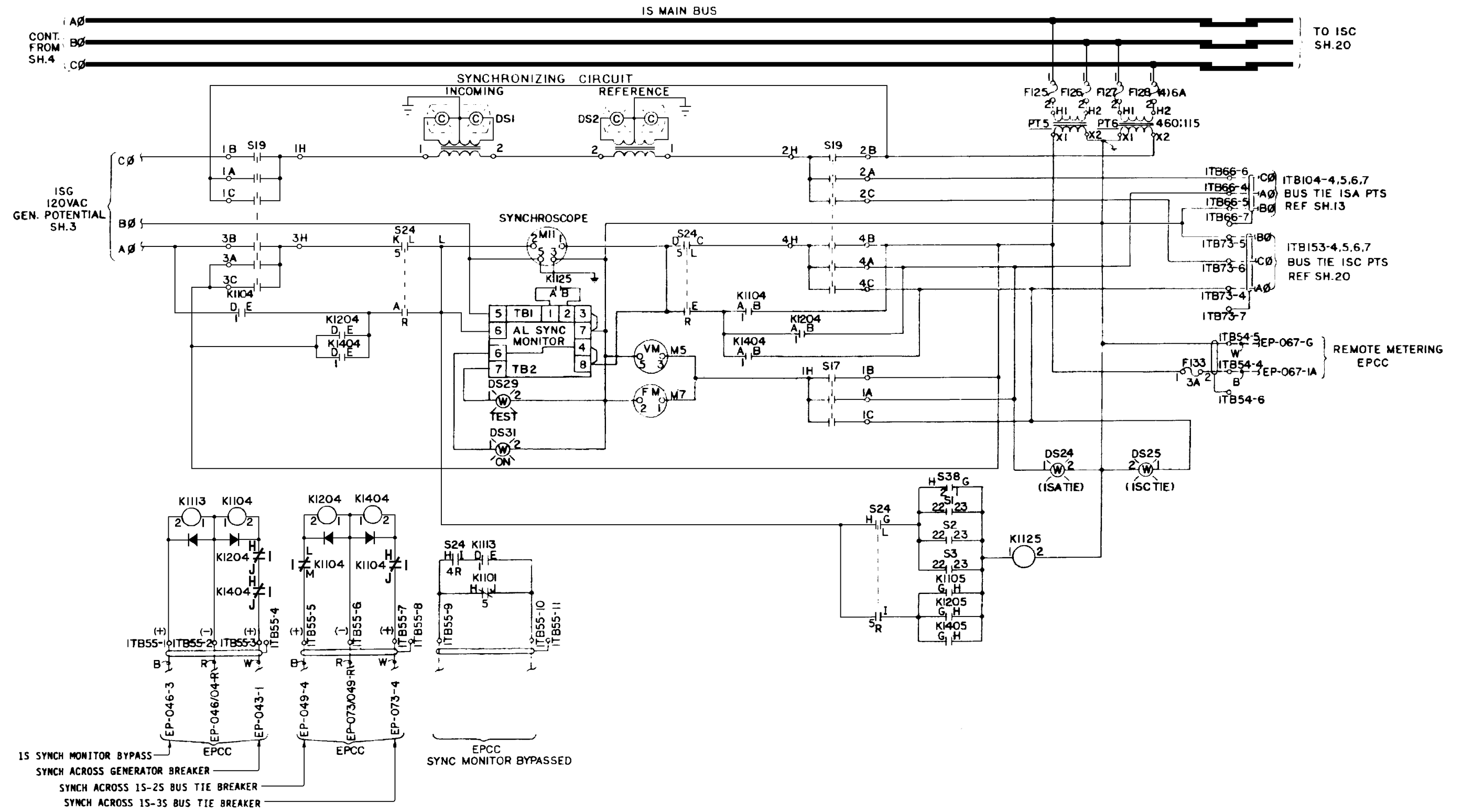


Figure 5-18. 1S Switchboard System; Schematic (Sheet 5 of 20)

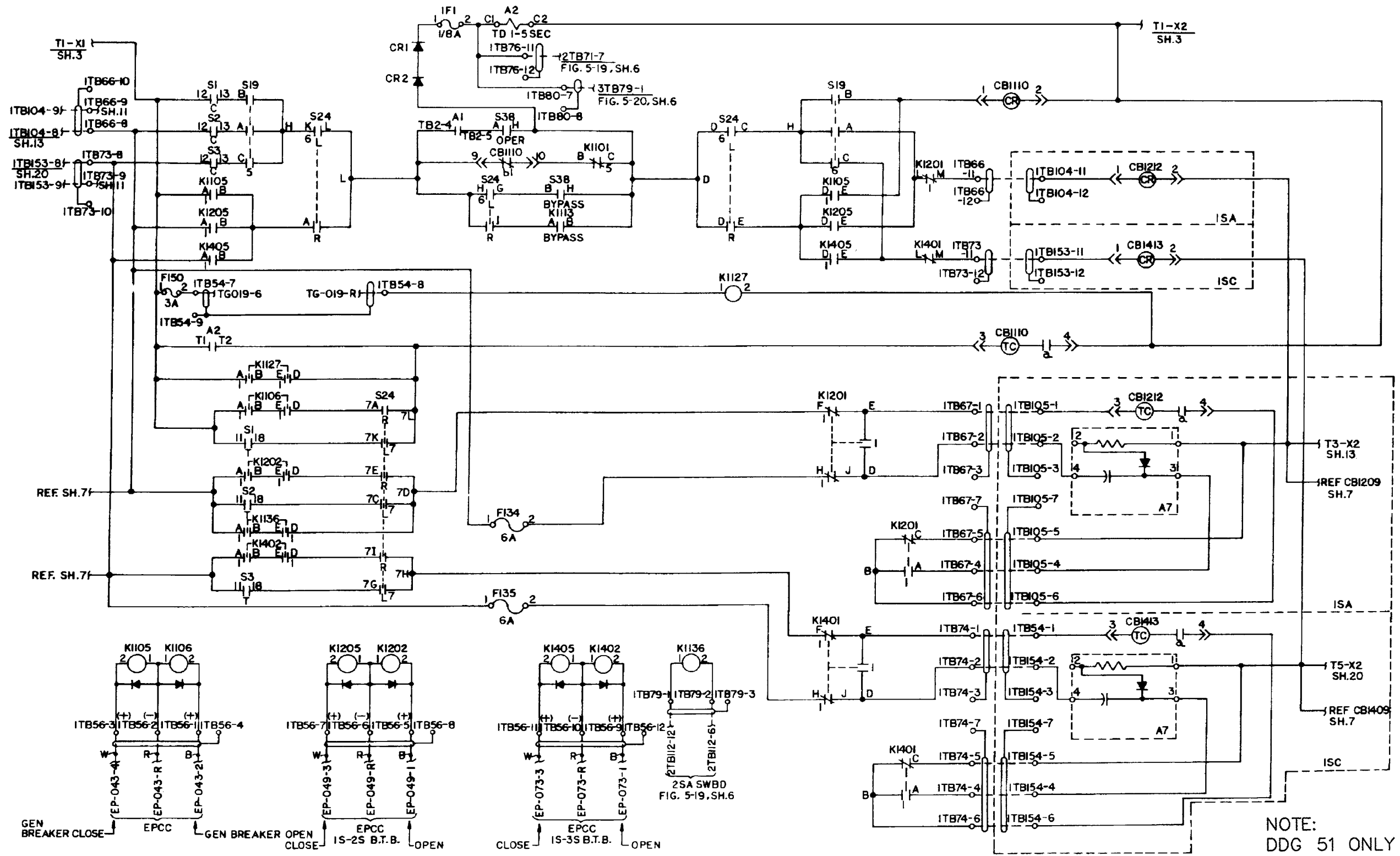


Figure 5-18. 1S Switchboard System; Schematic (Sheet 6 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

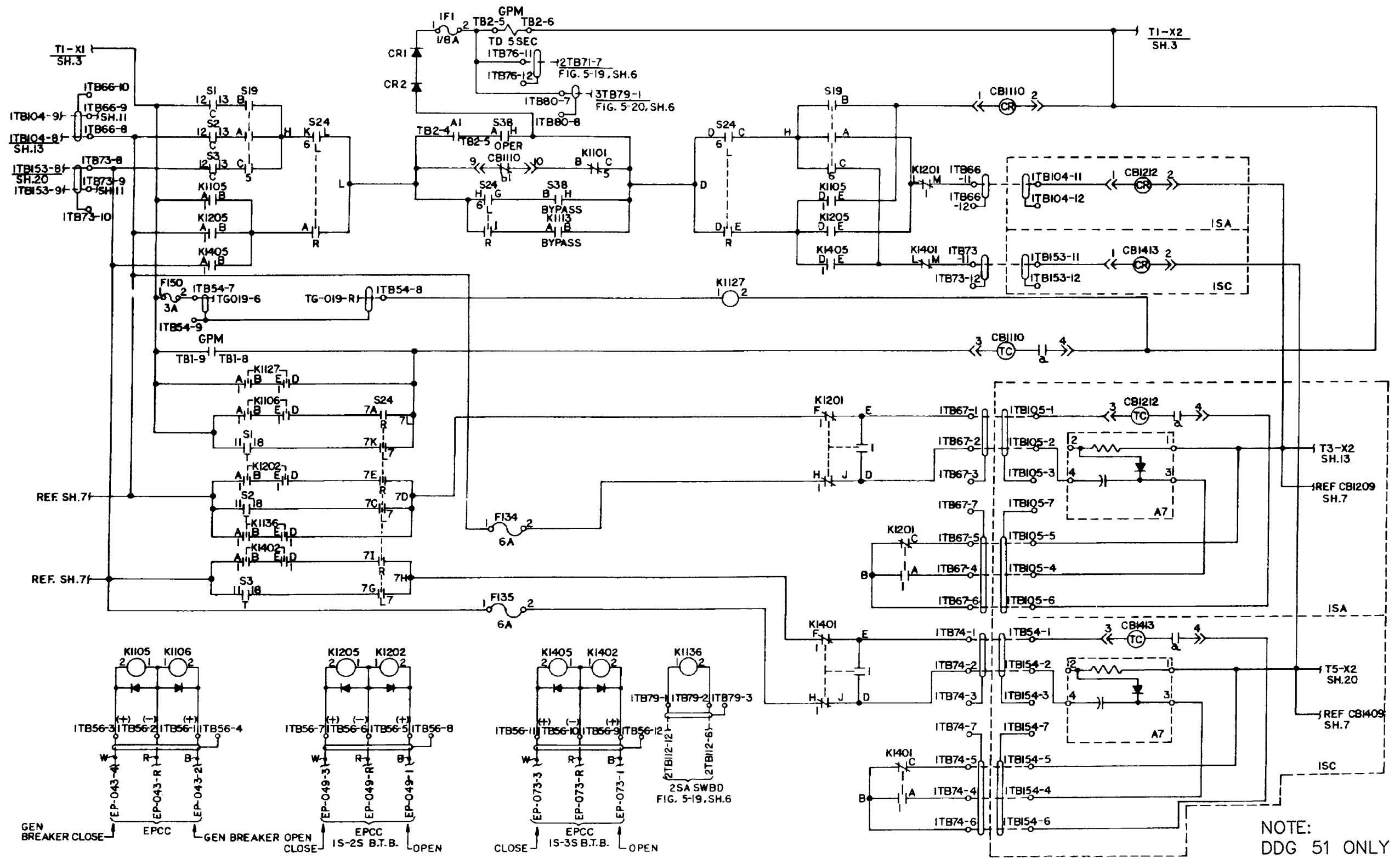


Figure 5-18. 1S Switchboard System; Schematic (Sheet 6 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

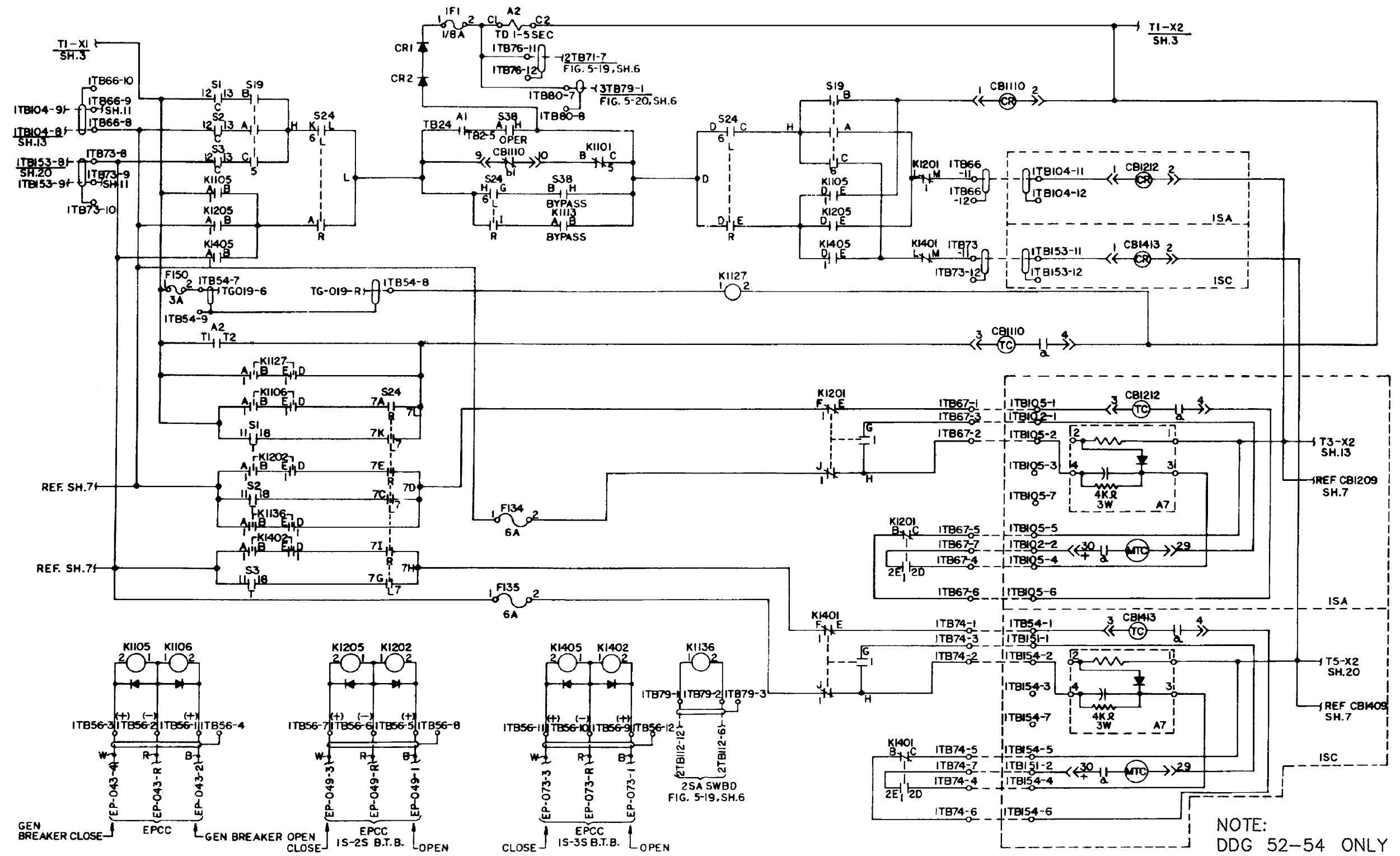


Figure 5-18. 1S Switchboard System; Schematic (Sheet 6 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

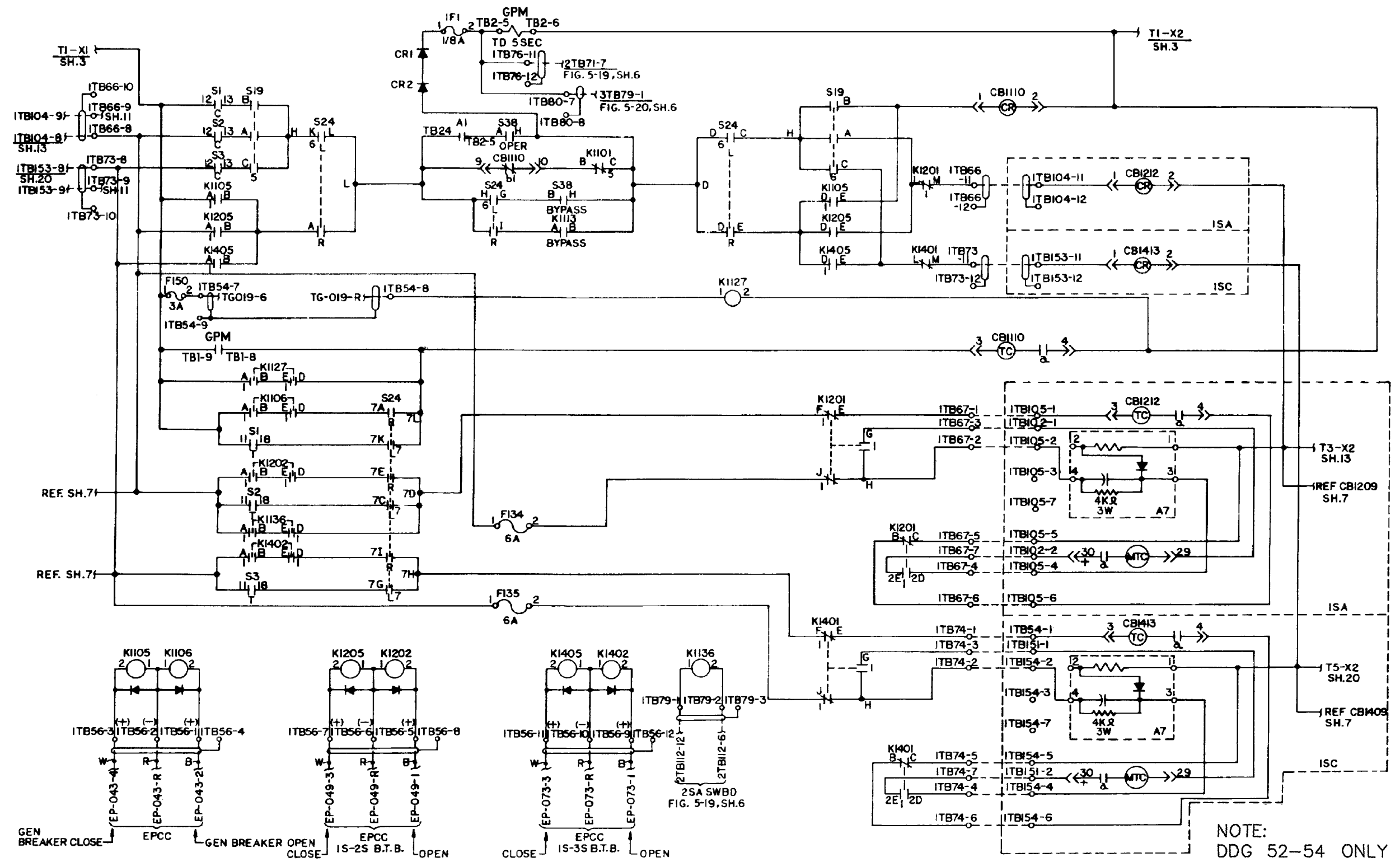


Figure 5-18. 1S Switchboard System; Schematic (Sheet 6 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

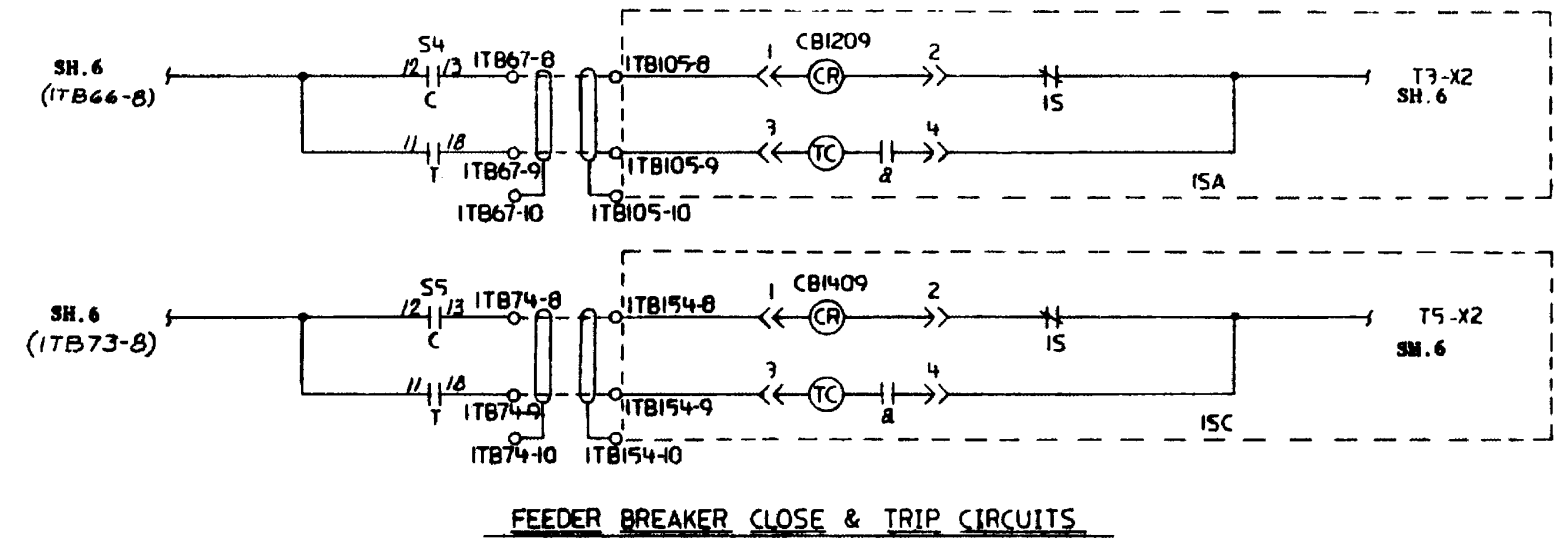


Figure 5-18. 1S Switchboard System; Schematic (Sheet 7 of 20)

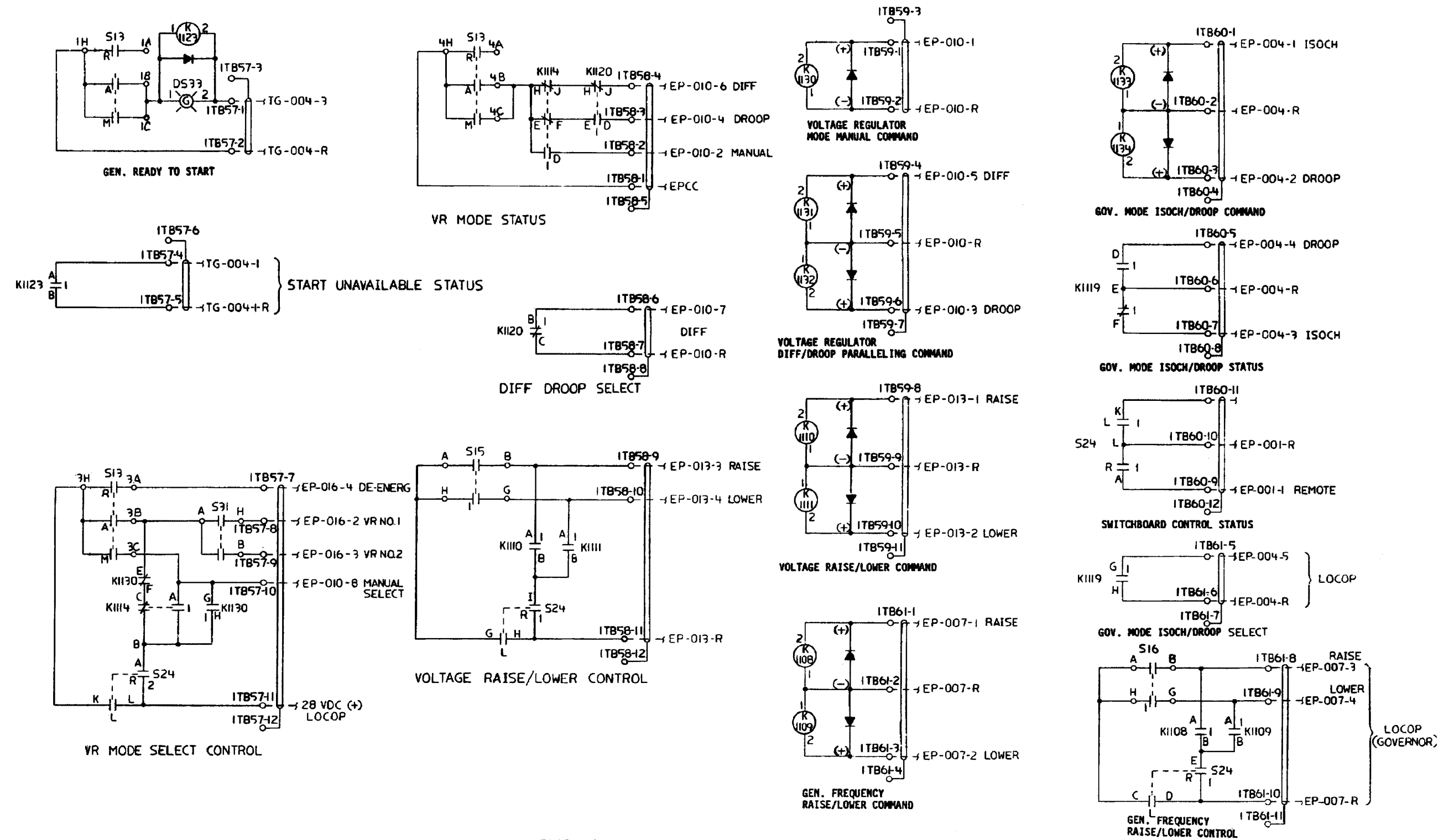


Figure 5-18. 1S Switchboard System; Schematic (Sheet 8 of 20)

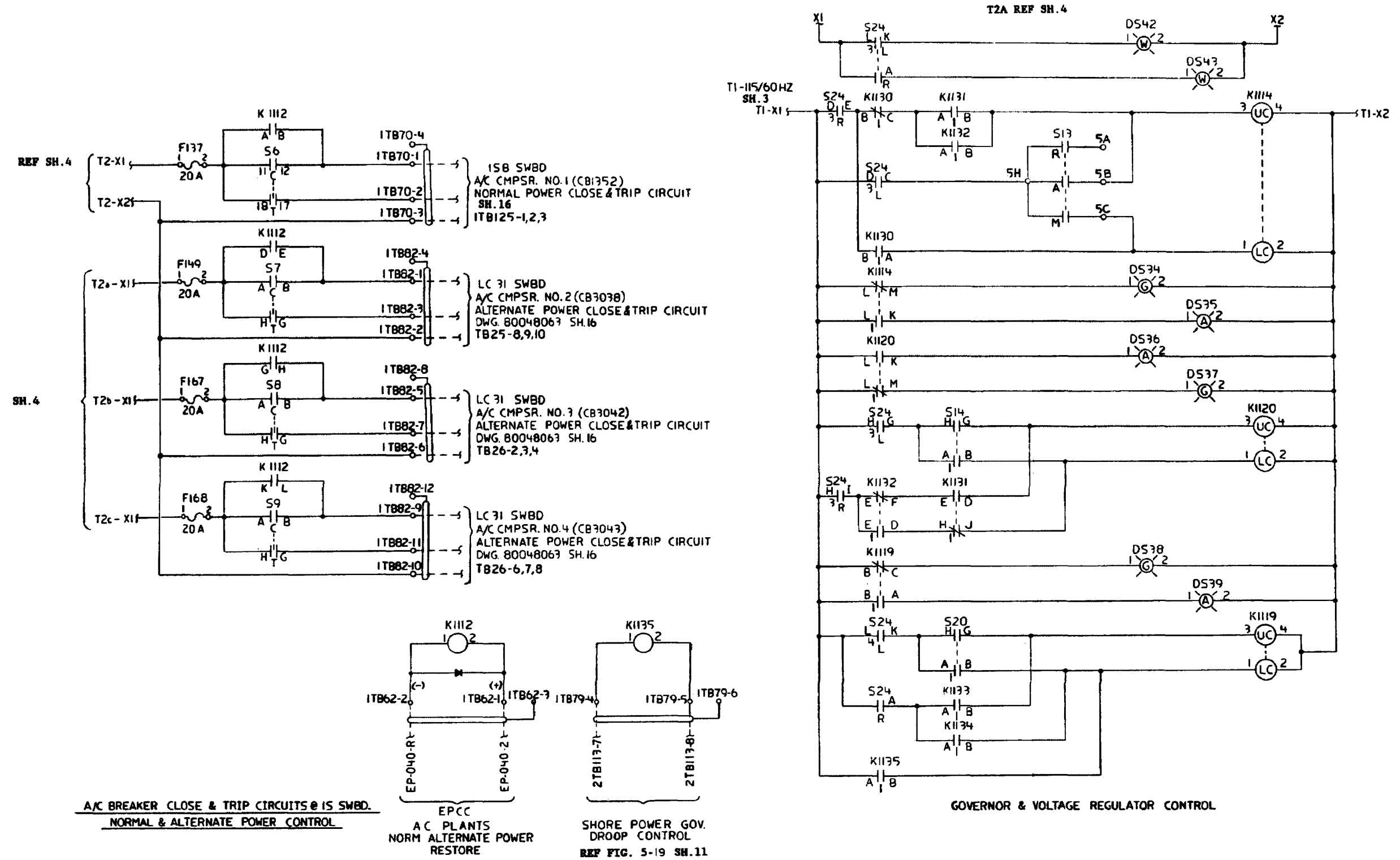


Figure 5-18. 1S Switchboard System; Schematic (Sheet 9 of 20)

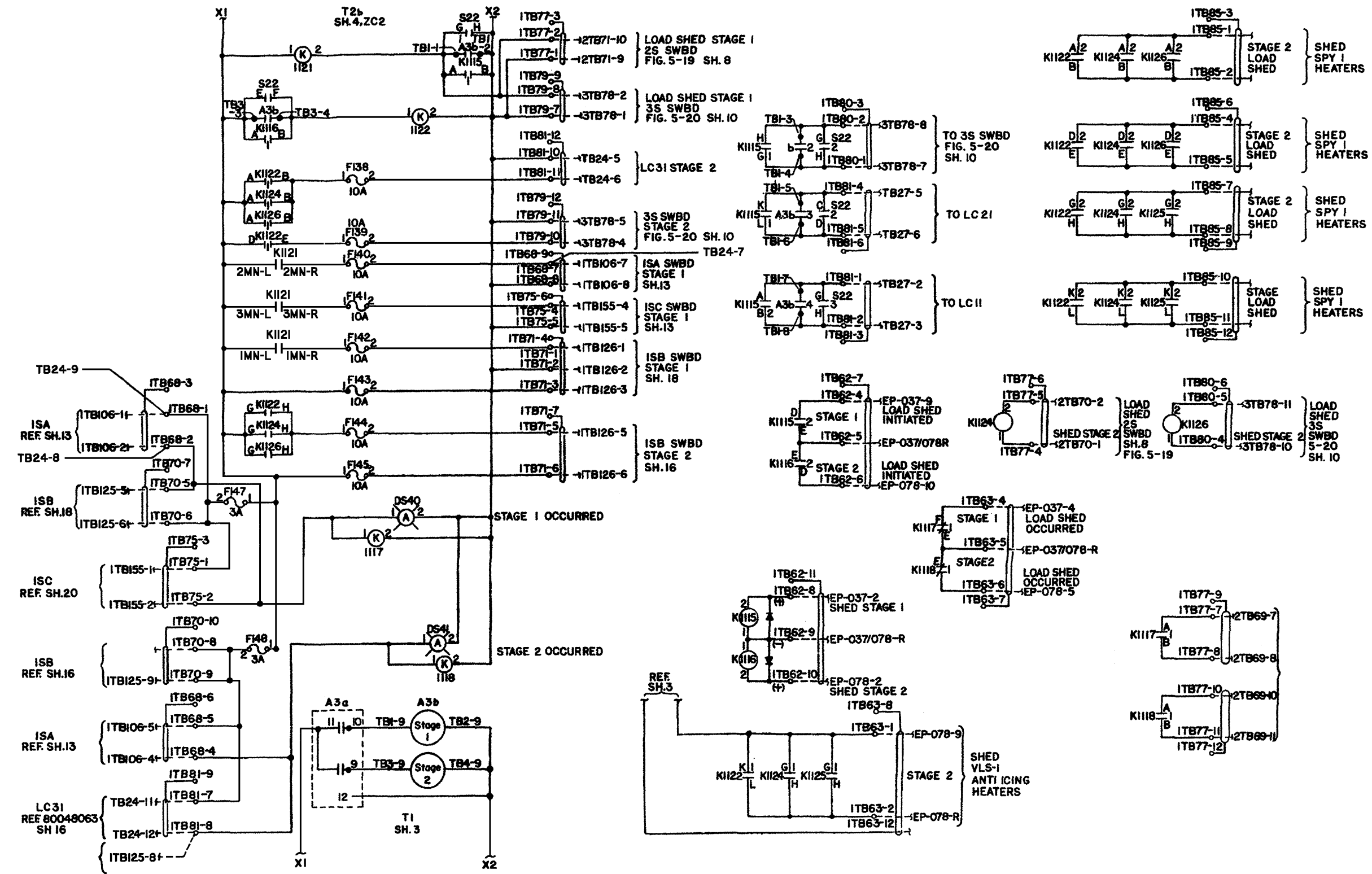


Figure 5-18. 1S Switchboard System; Schematic (Sheet 10 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

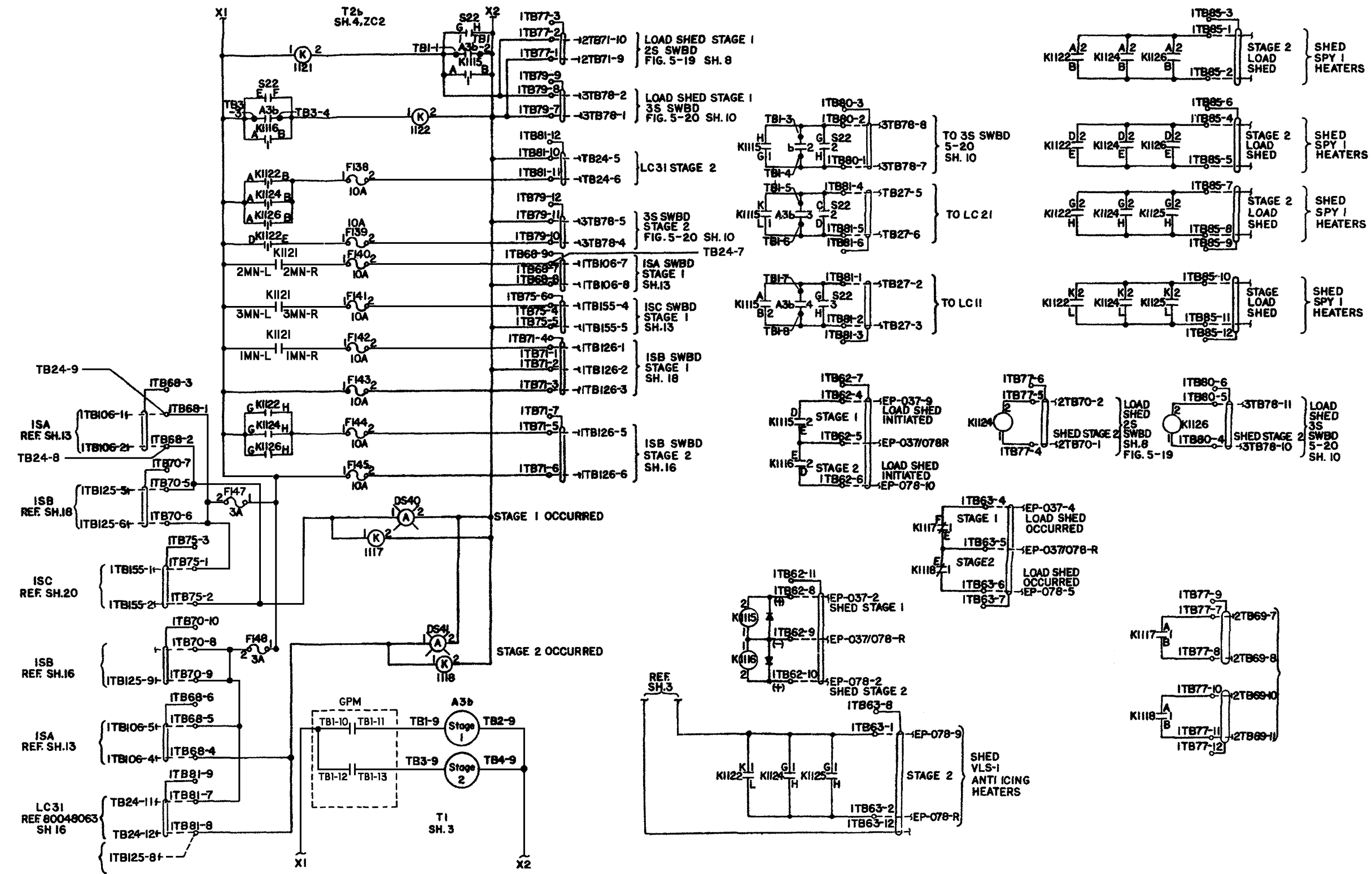


Figure 5-18. 1S Switchboard System; Schematic (Sheet 10 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

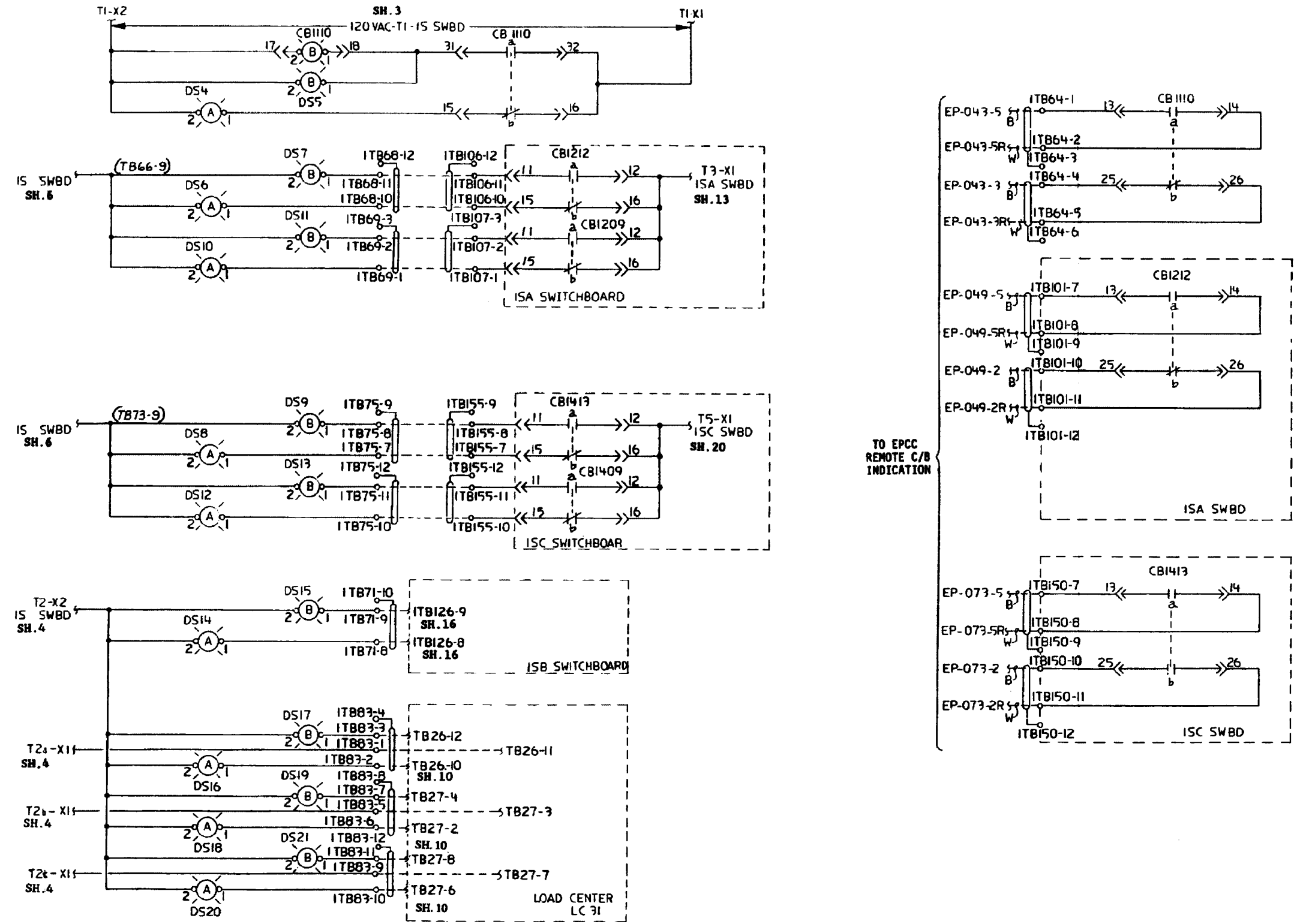


Figure 5-18. 1S Switchboard System; Schematic (Sheet 11 of 20)

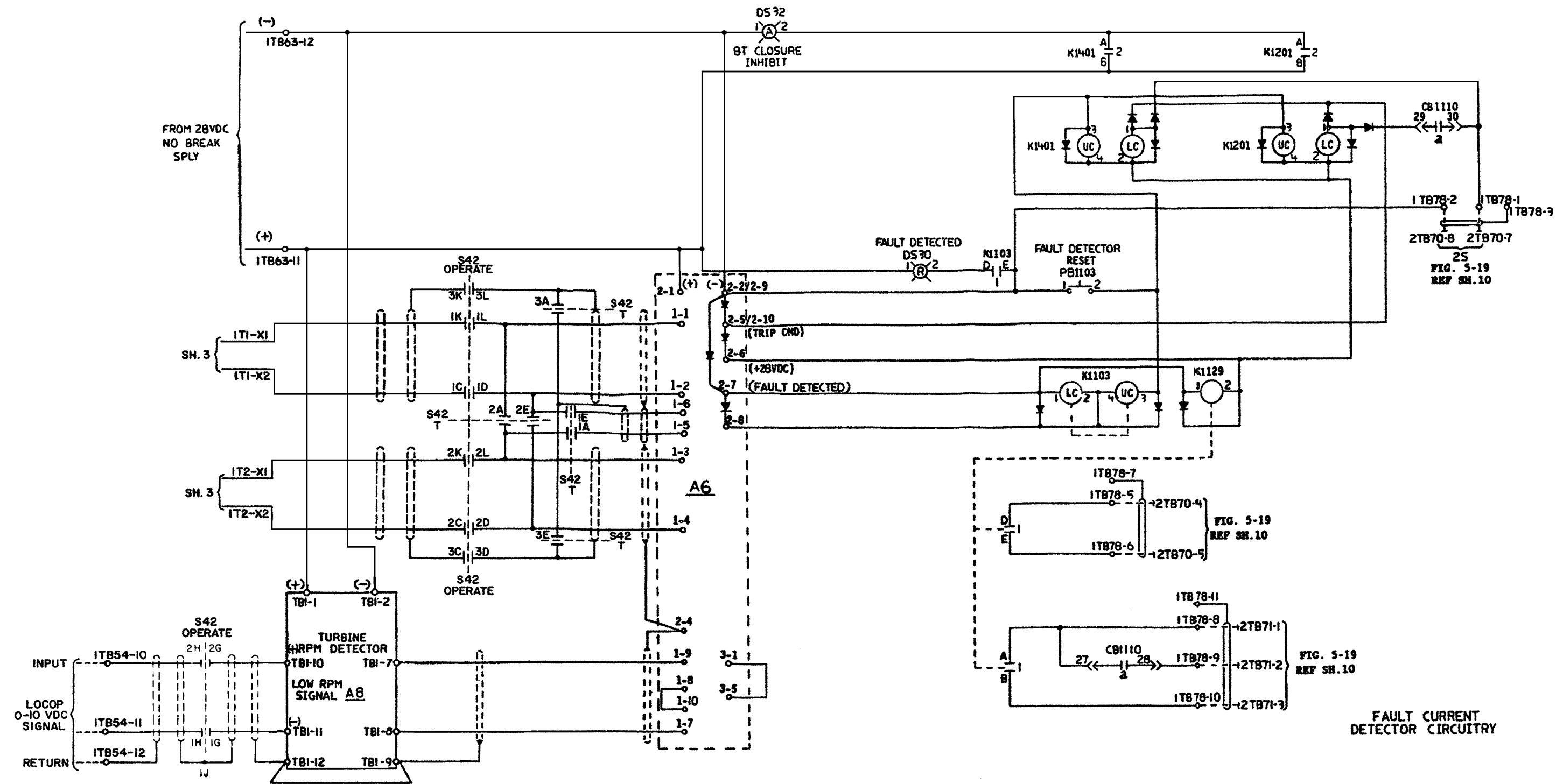


Figure 5-18. 1S Switchboard System; Schematic (Sheet 12 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

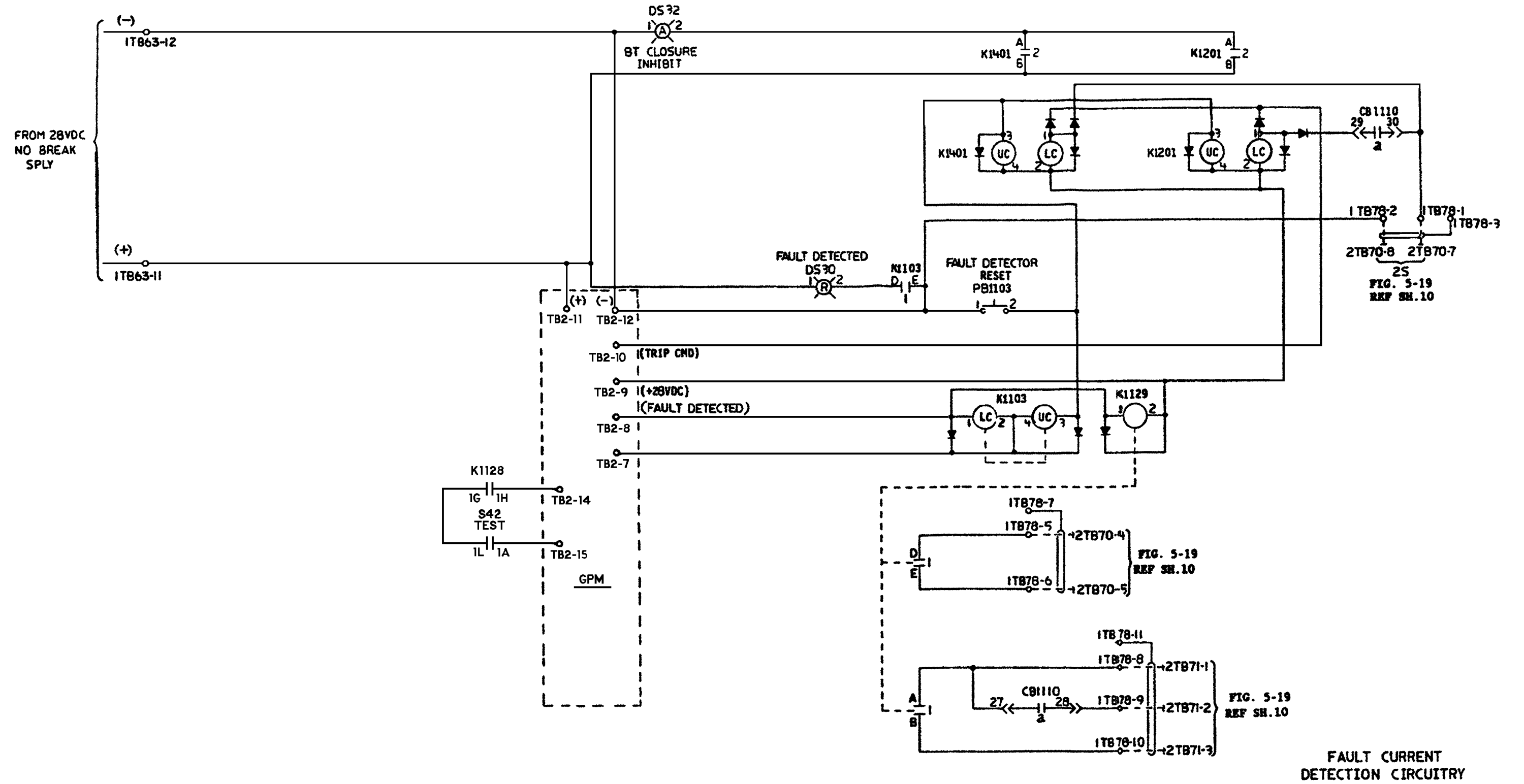


Figure 5-18. 1S Switchboard System; Schematic (Sheet 12 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

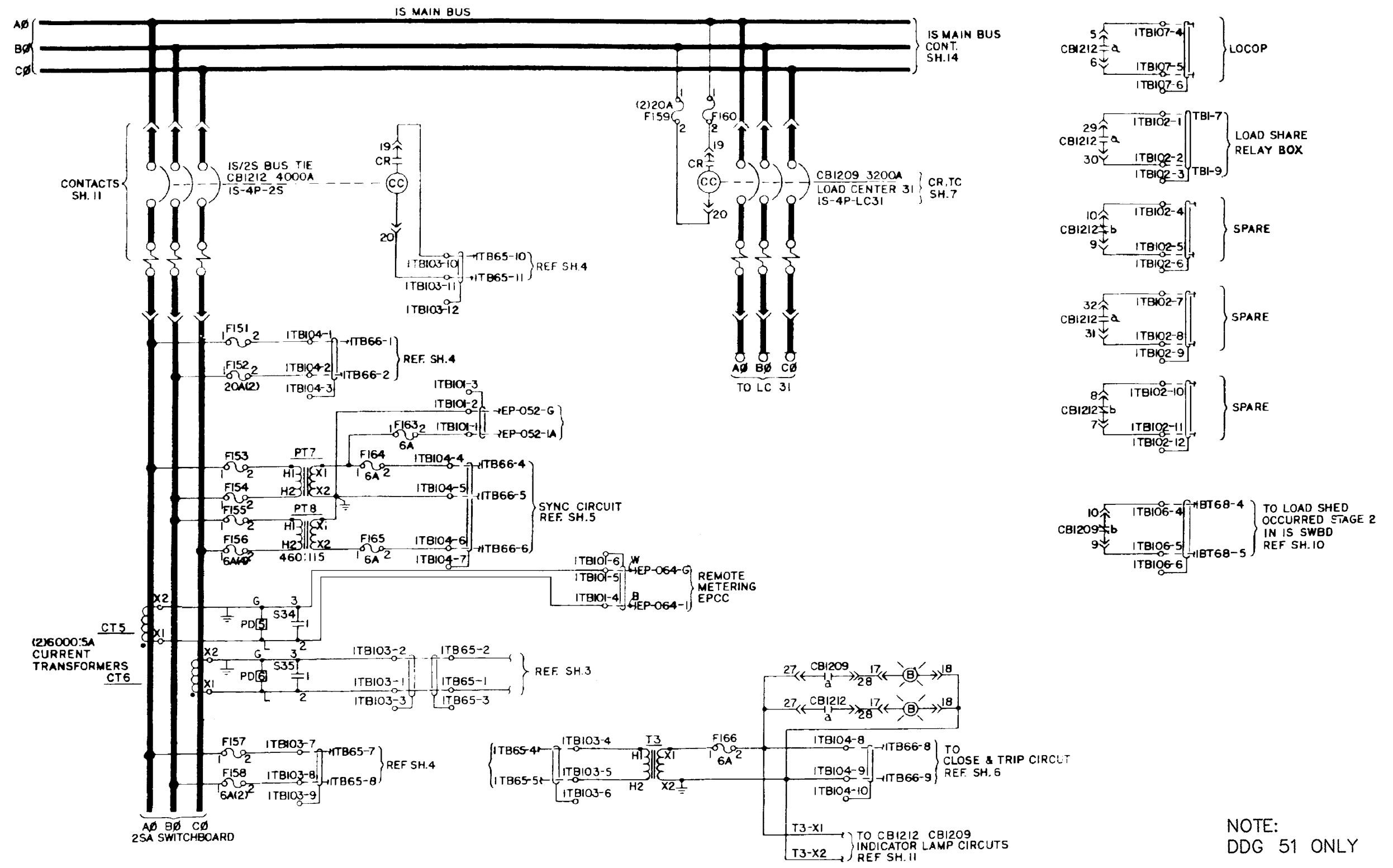


Figure 5-18. 1S Switchboard System; Schematic (Sheet 13 of 20)

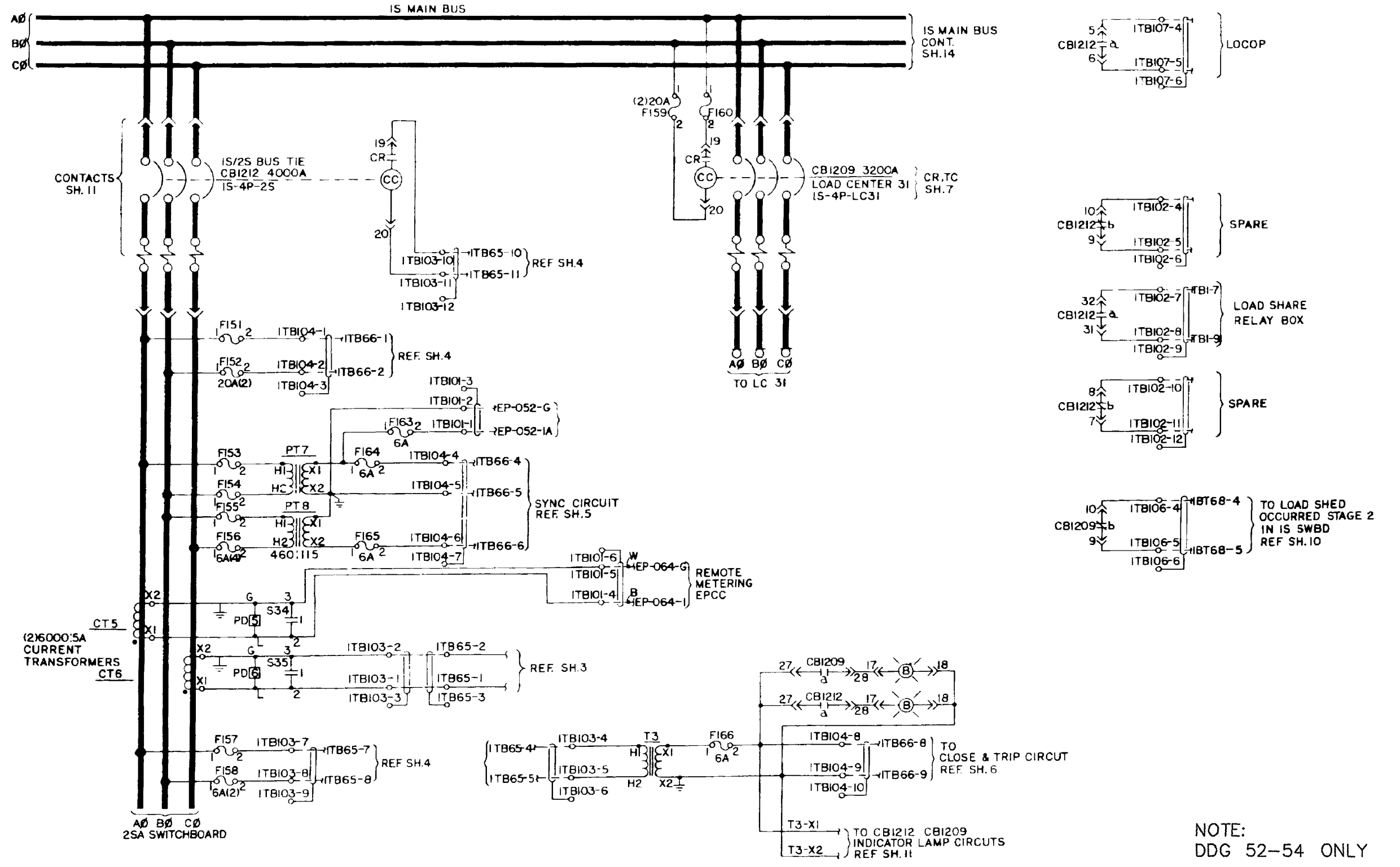


Figure 5-18. 1S Switchboard System; Schematic (Sheet 13 of 20)

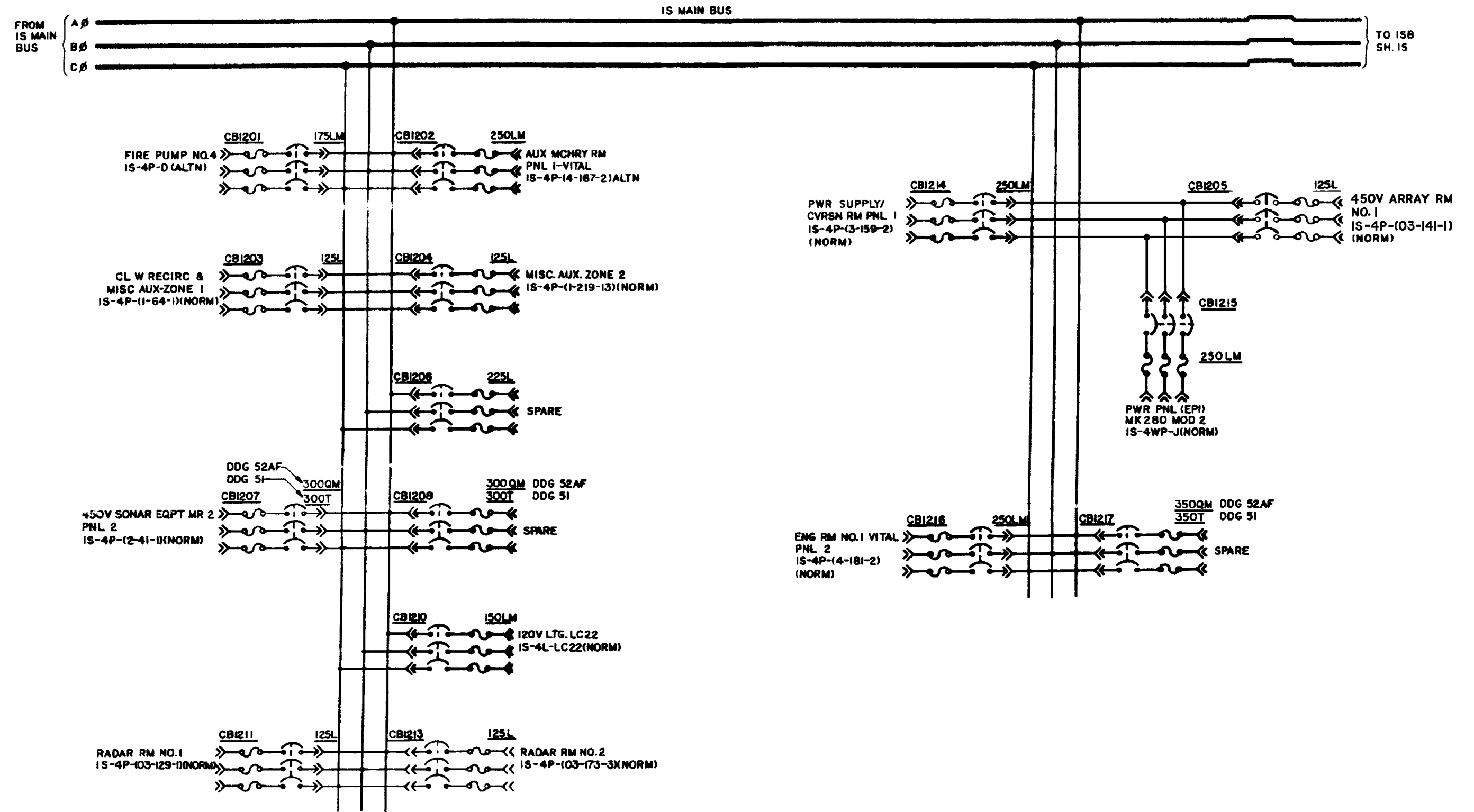


Figure 5-18. 1S Switchboard System; Schematic (Sheet 14 of 20)

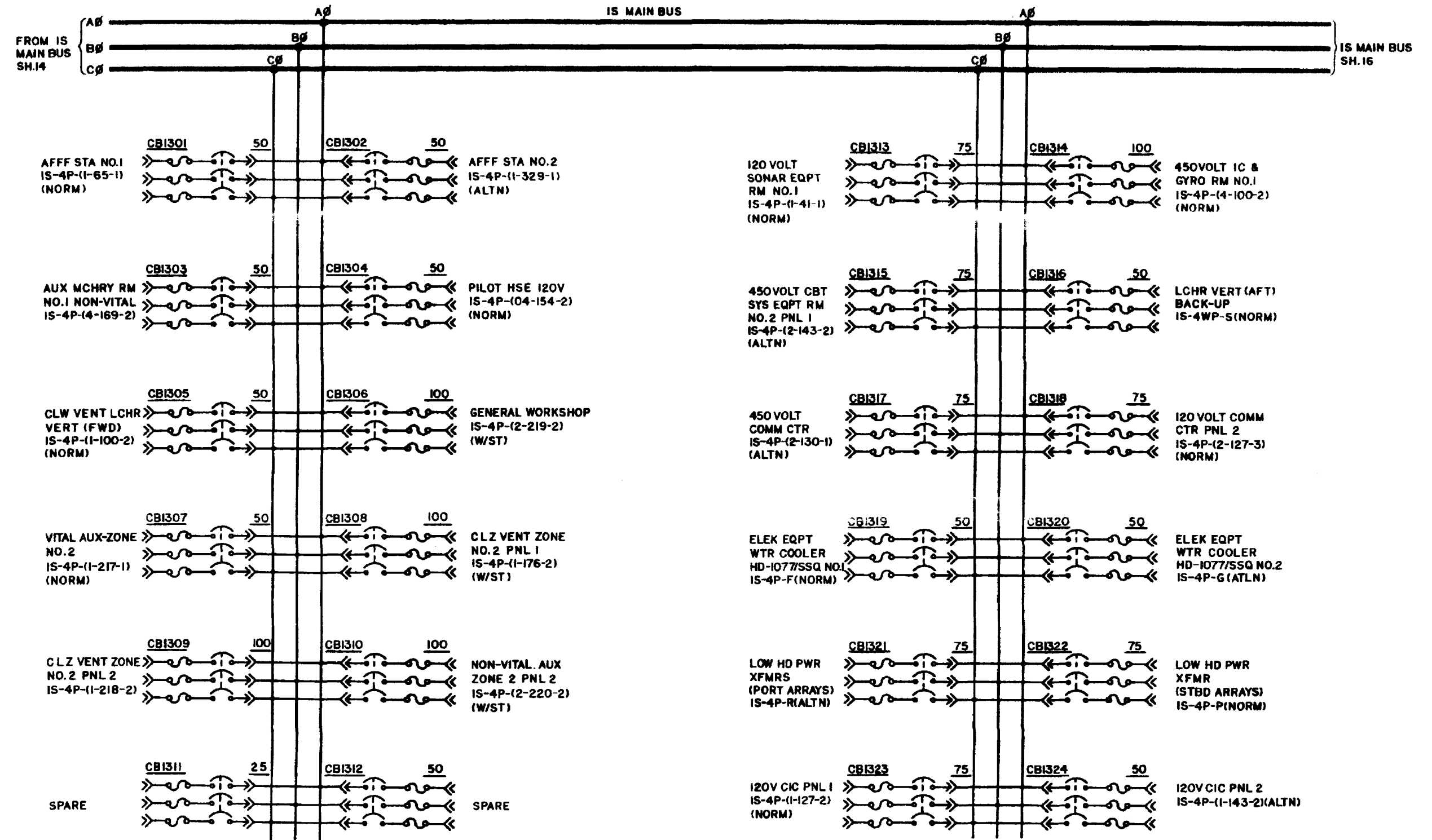


Figure 5-18. 1S Switchboard System; Schematic (Sheet 15 of 20)

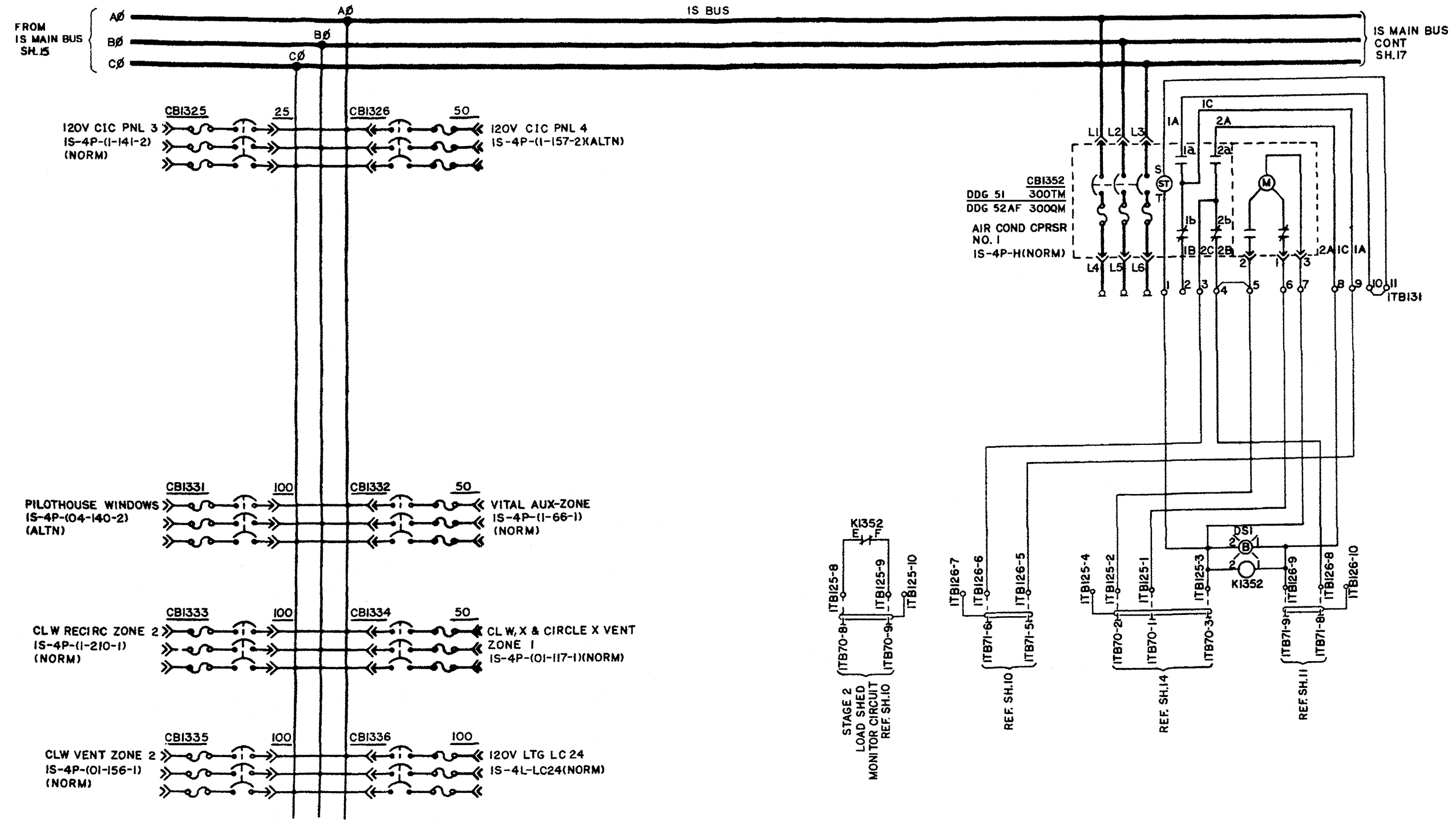


Figure 5-18. 1S Switchboard System; Schematic (Sheet 16 of 20)

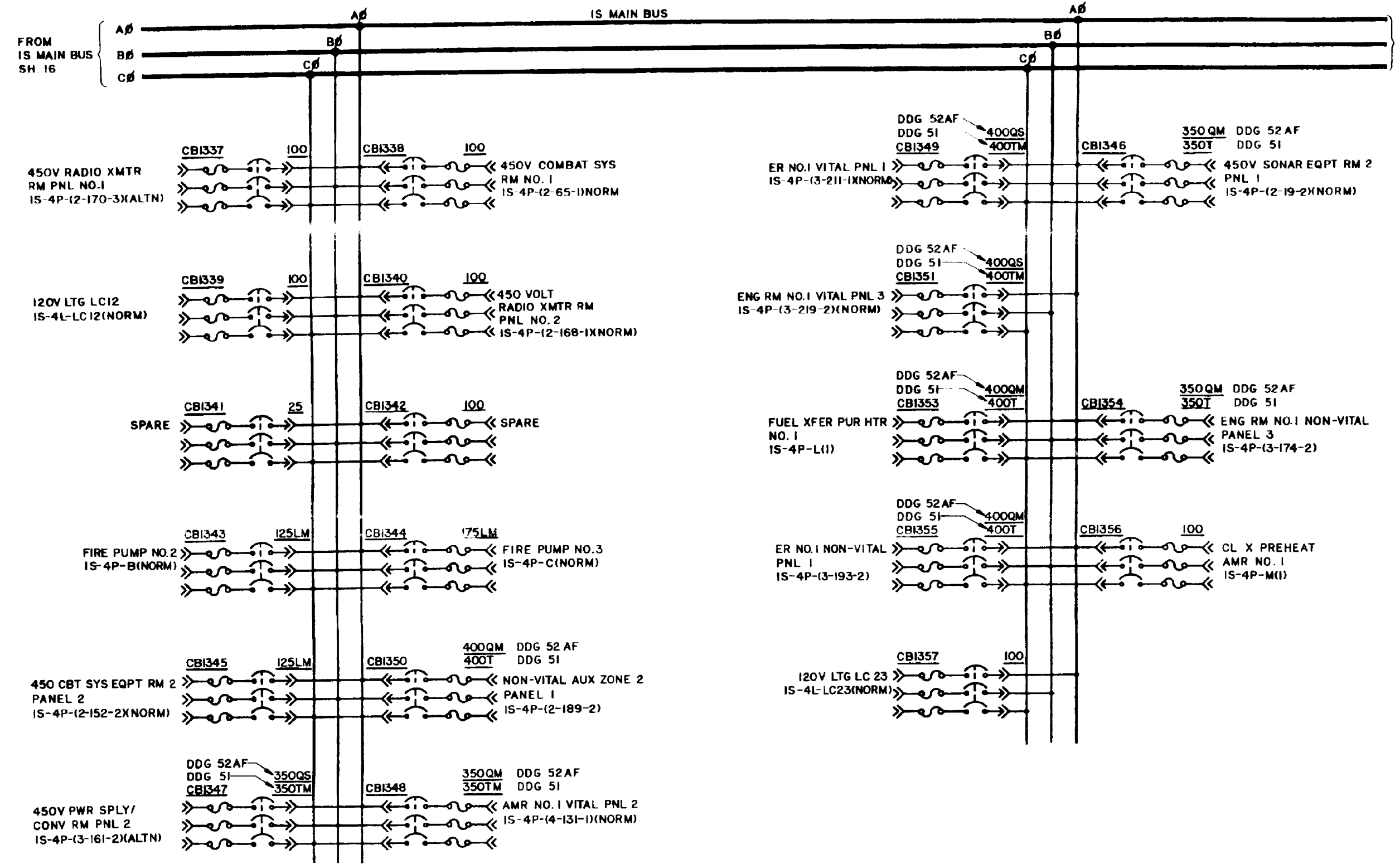


Figure 5-18. 1S Switchboard System; Schematic (Sheet 17 of 20)

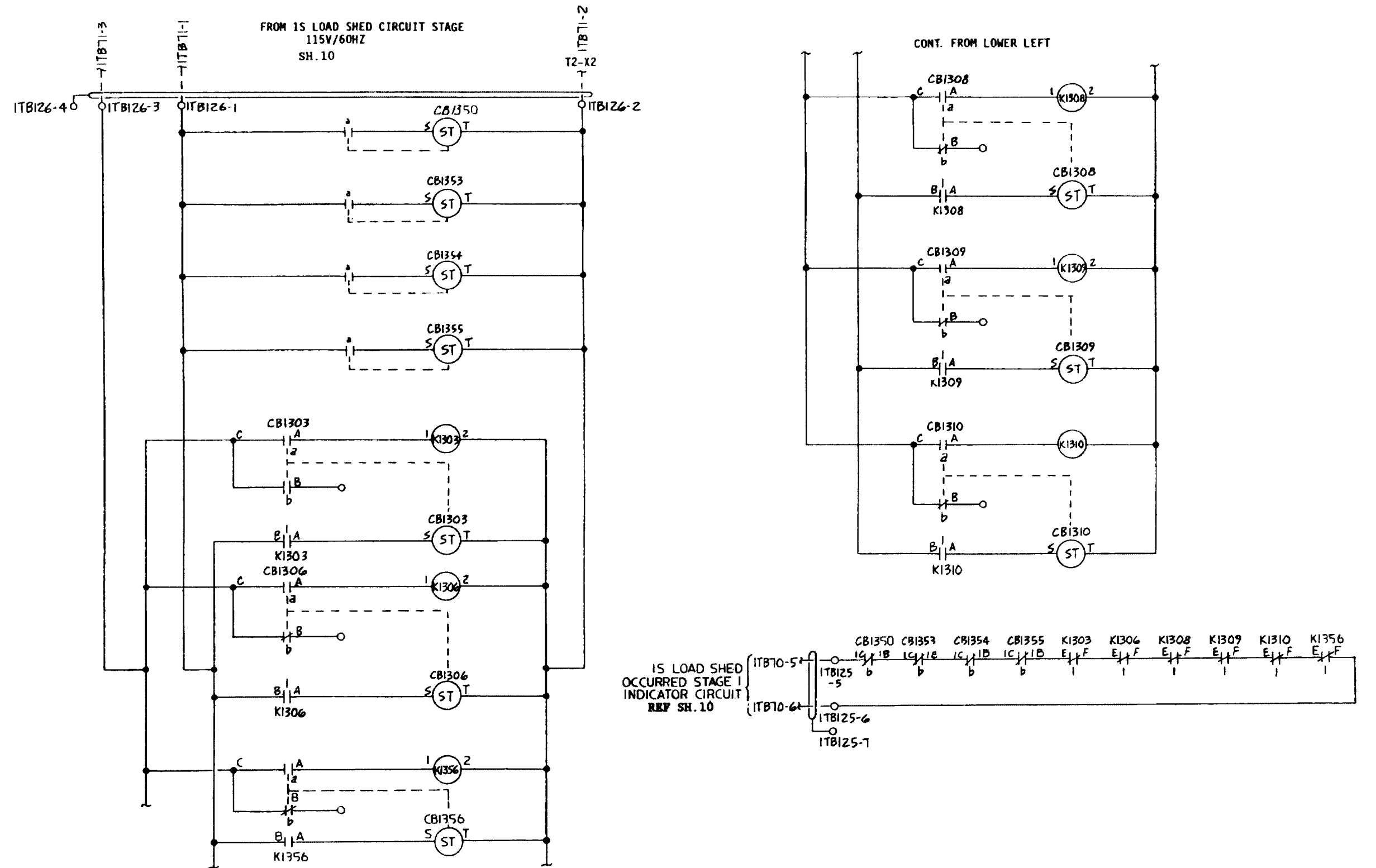


Figure 5-18. 1S Switchboard System; Schematic (Sheet 18 of 20)

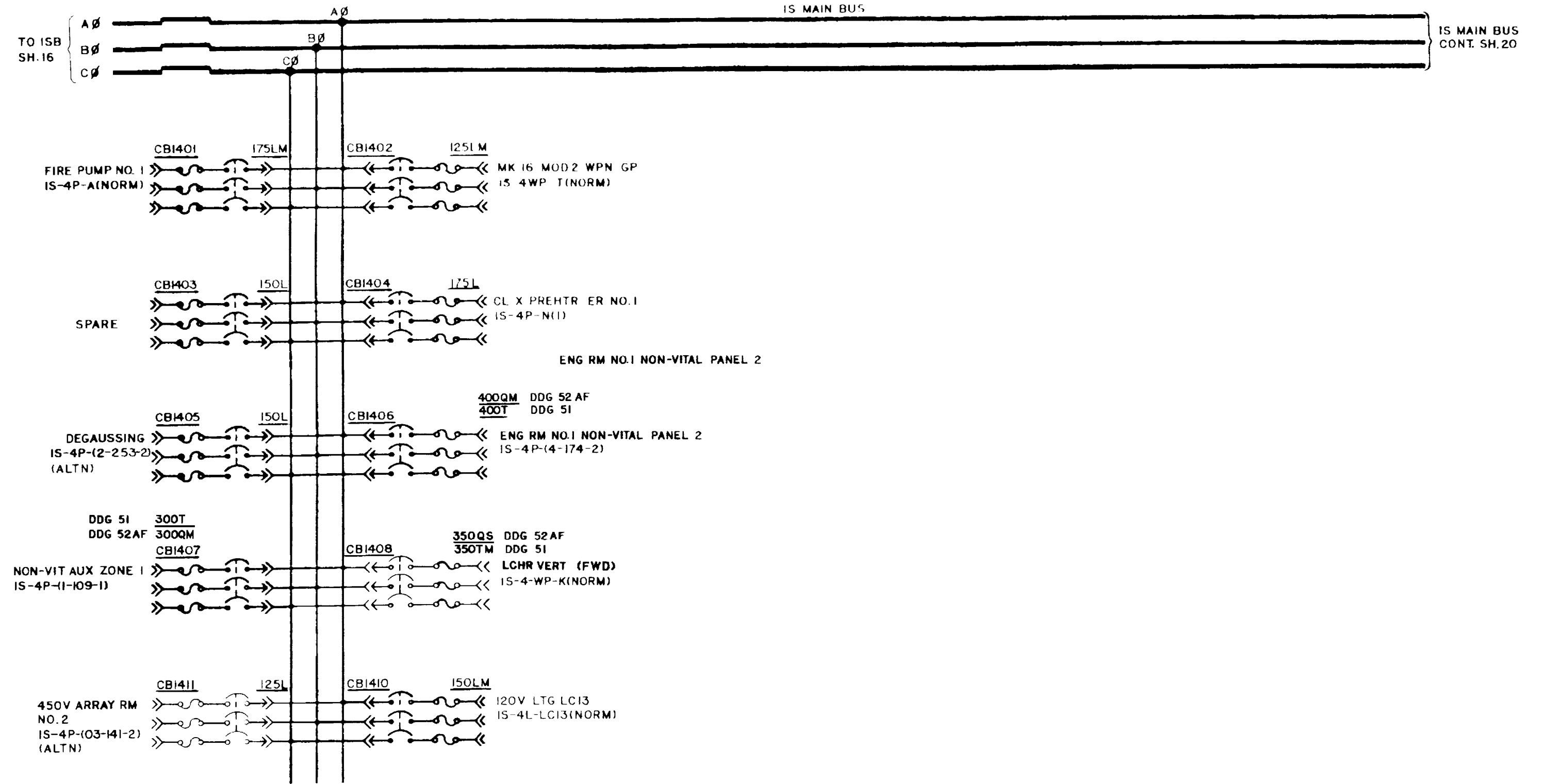


Figure 5-18. 1S Switchboard System; Schematic (Sheet 19 of 20)

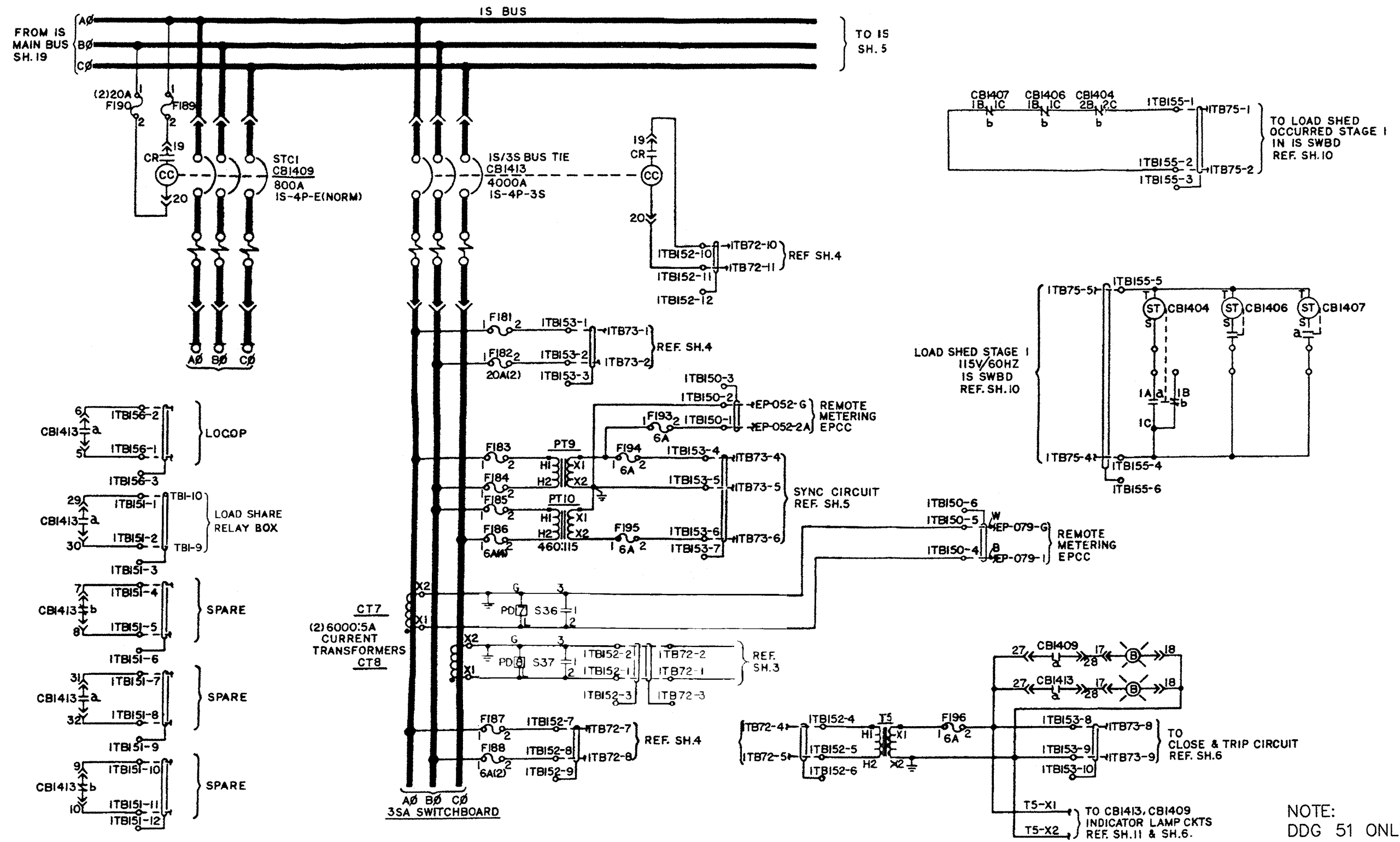


Figure 5-18. 1S Switchboard System; Schematic (Sheet 20 of 20)

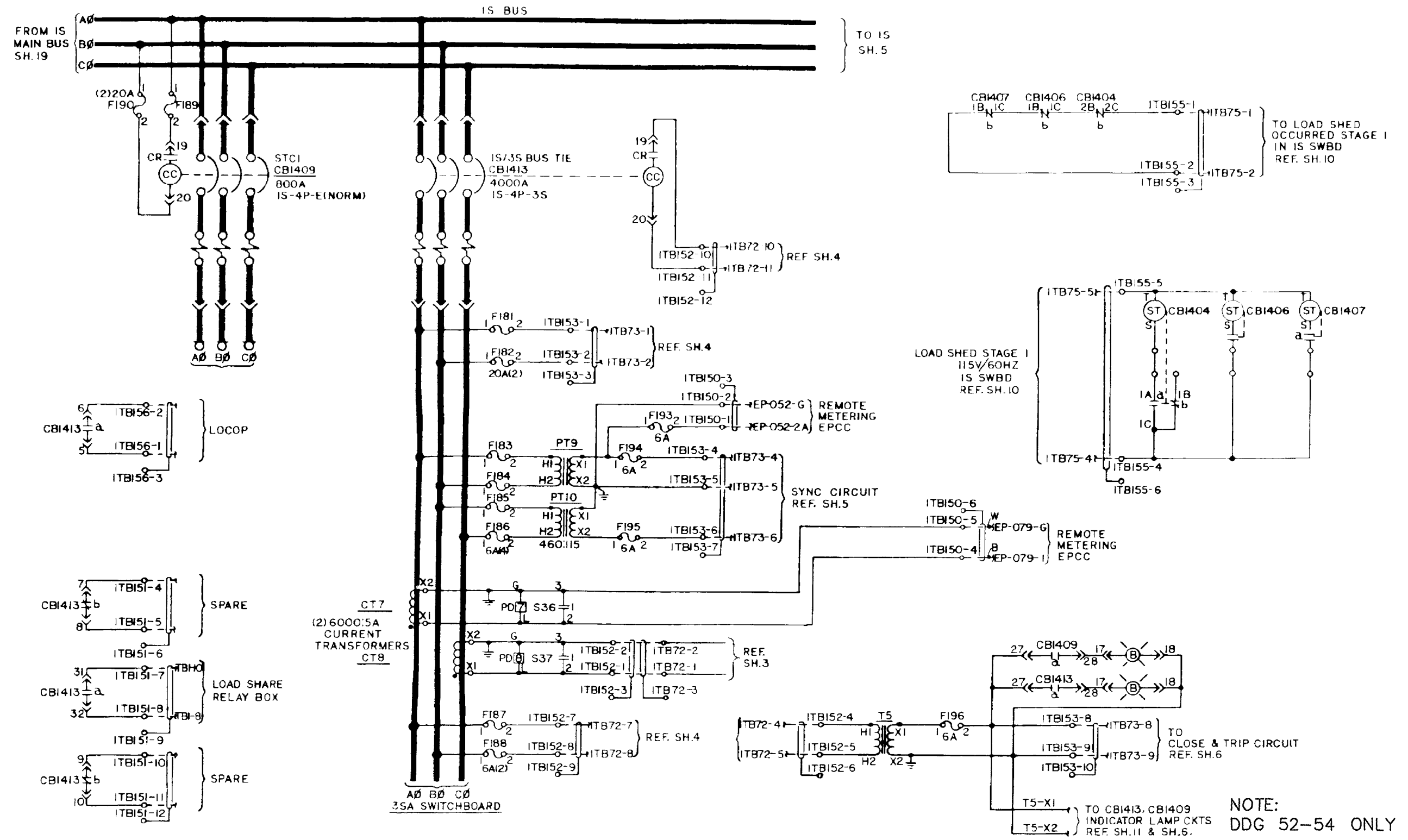


Figure 5-18. 1S Switchboard System; Schematic (Sheet 20 of 20)

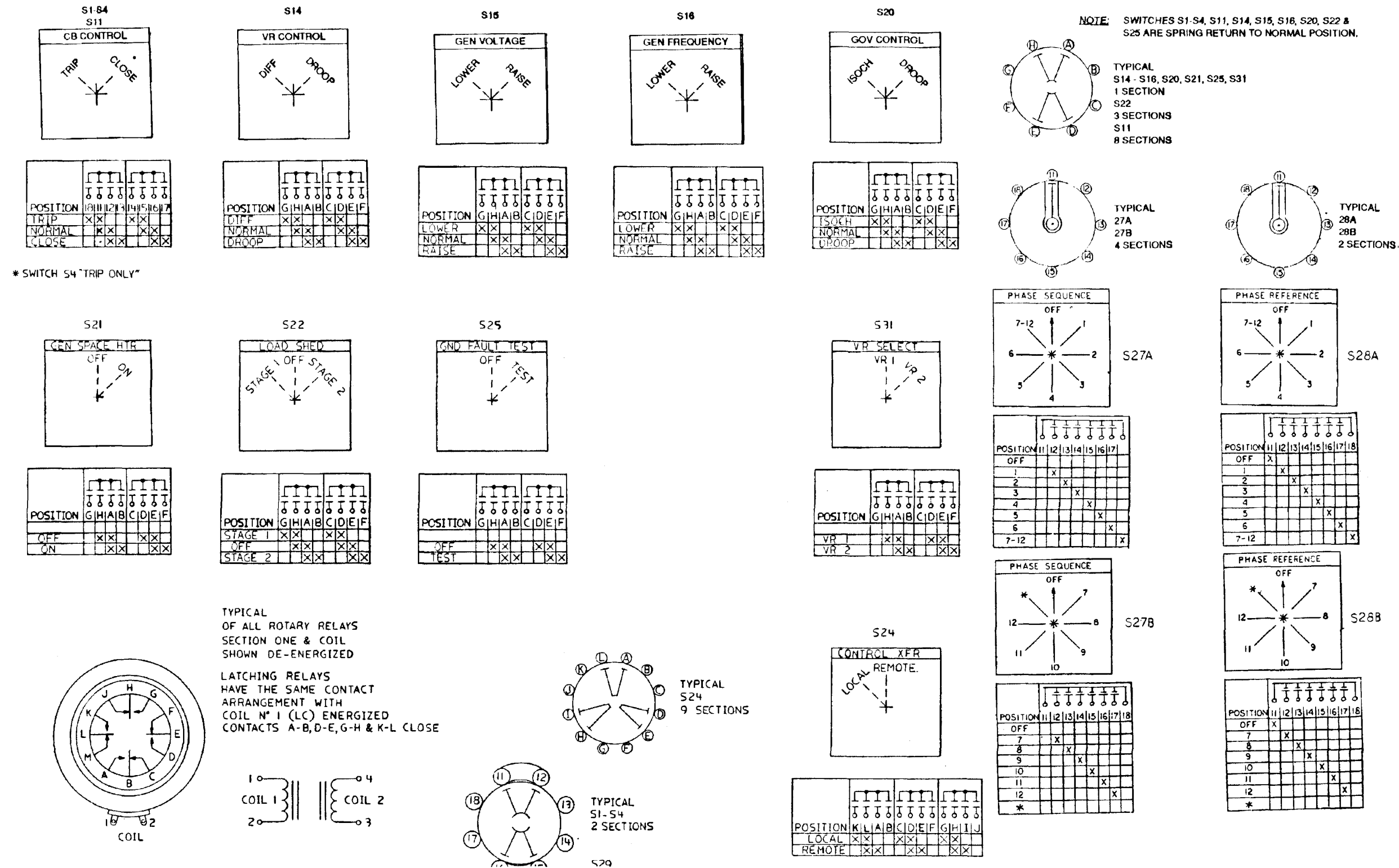
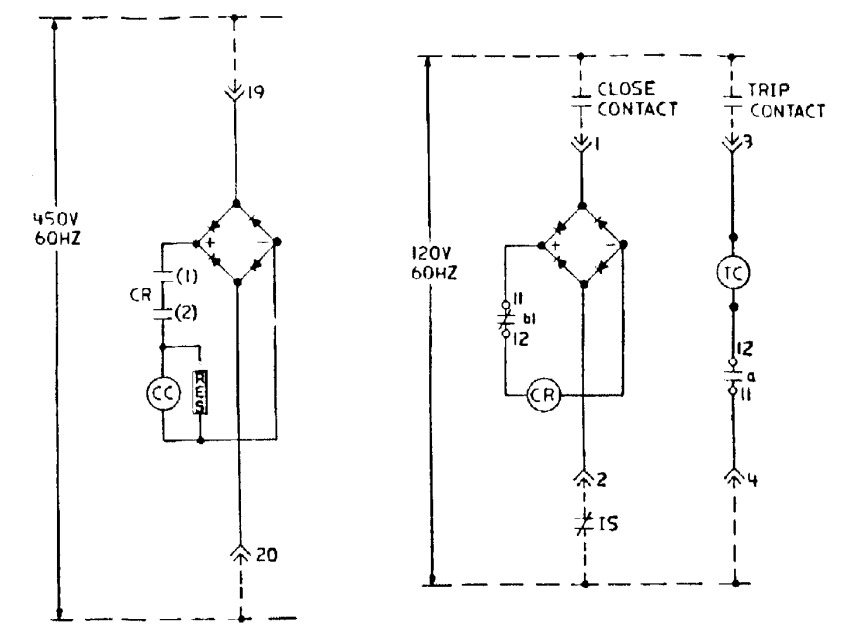
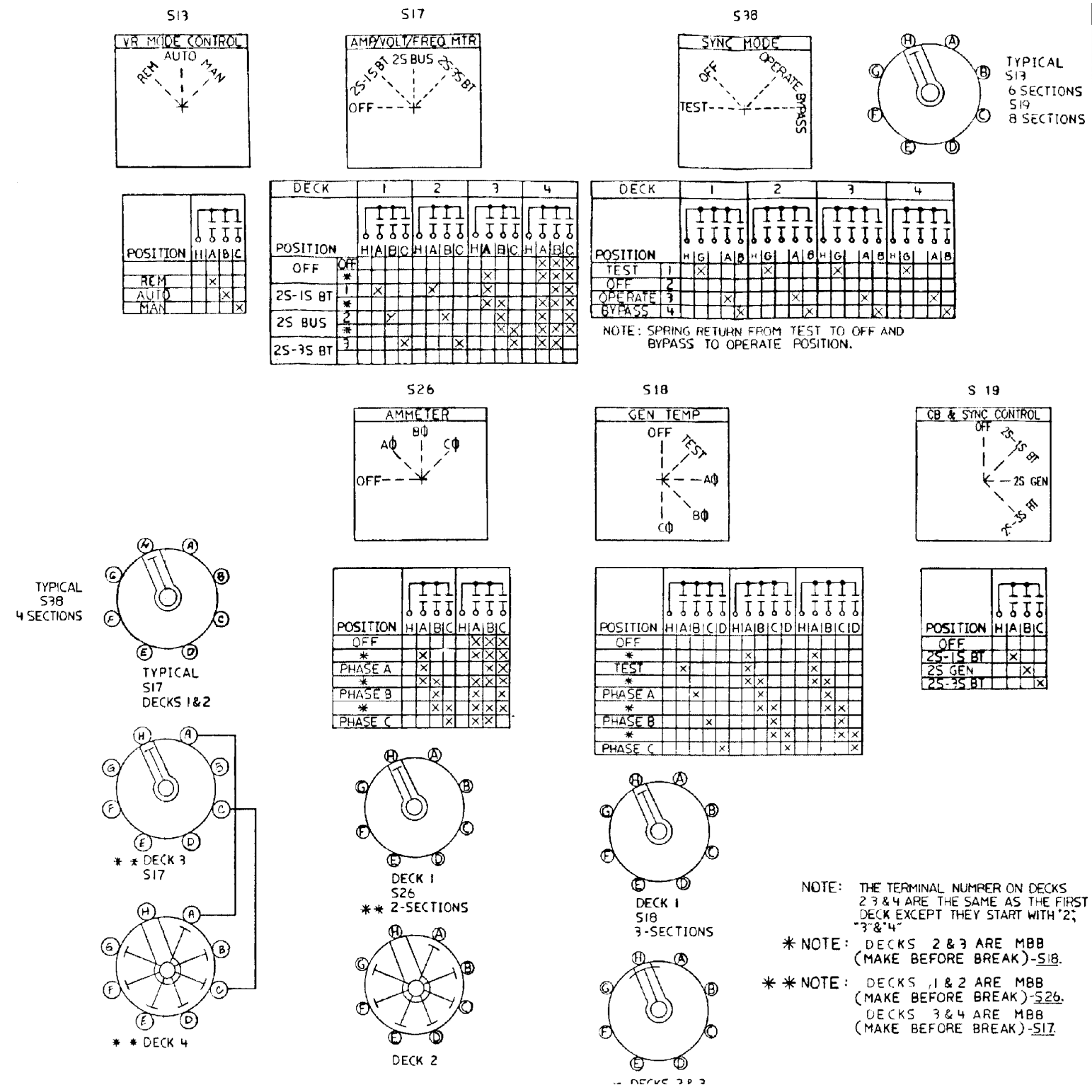
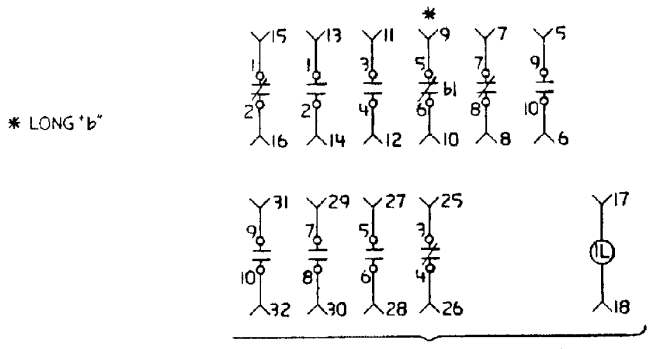


Figure 5-19. 2S Switchboard System; Schematic (Sheet 1 of 17)



BREAKER ELEMENTARY DIAGRAM (ITE TYPICAL 4000A)



SECONDARY DISCONNECTS (REAR VIEW)

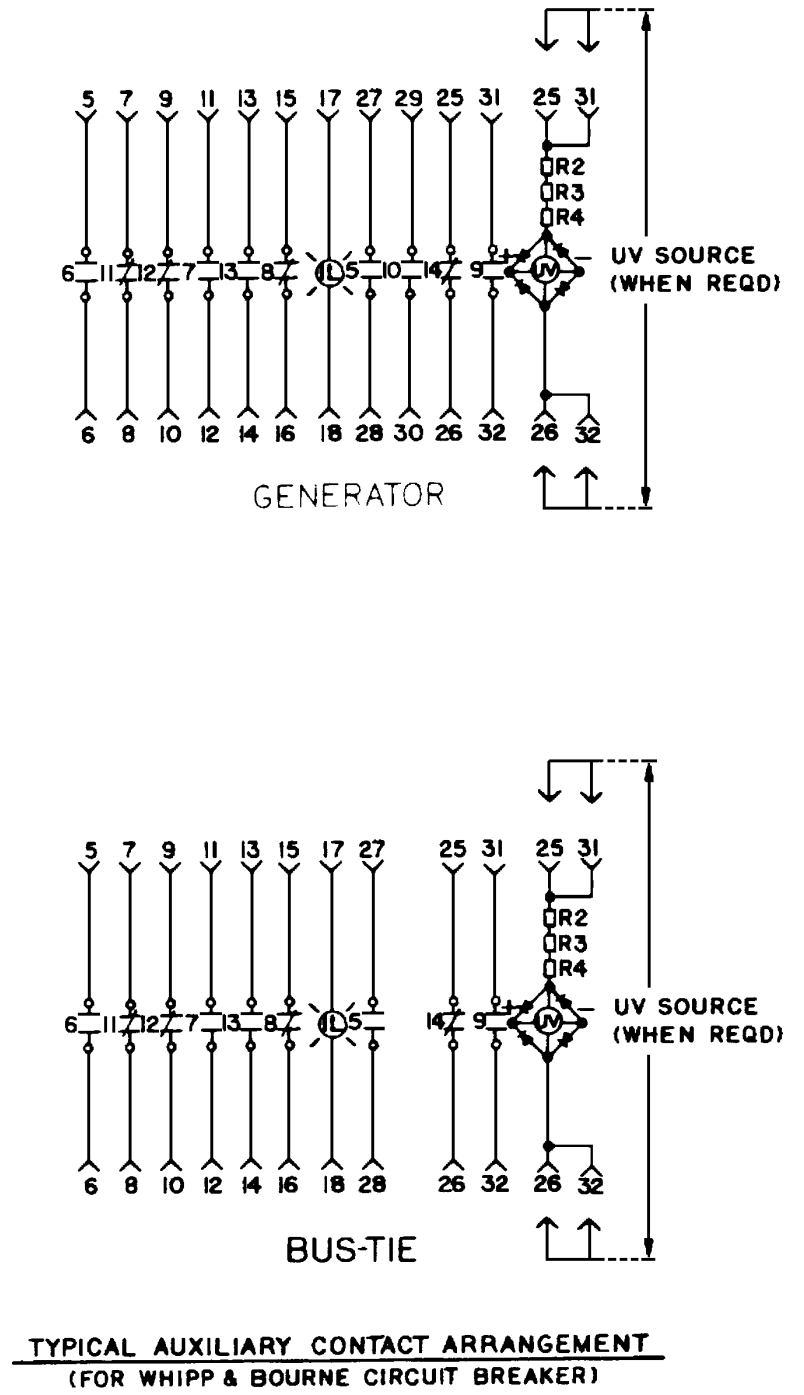
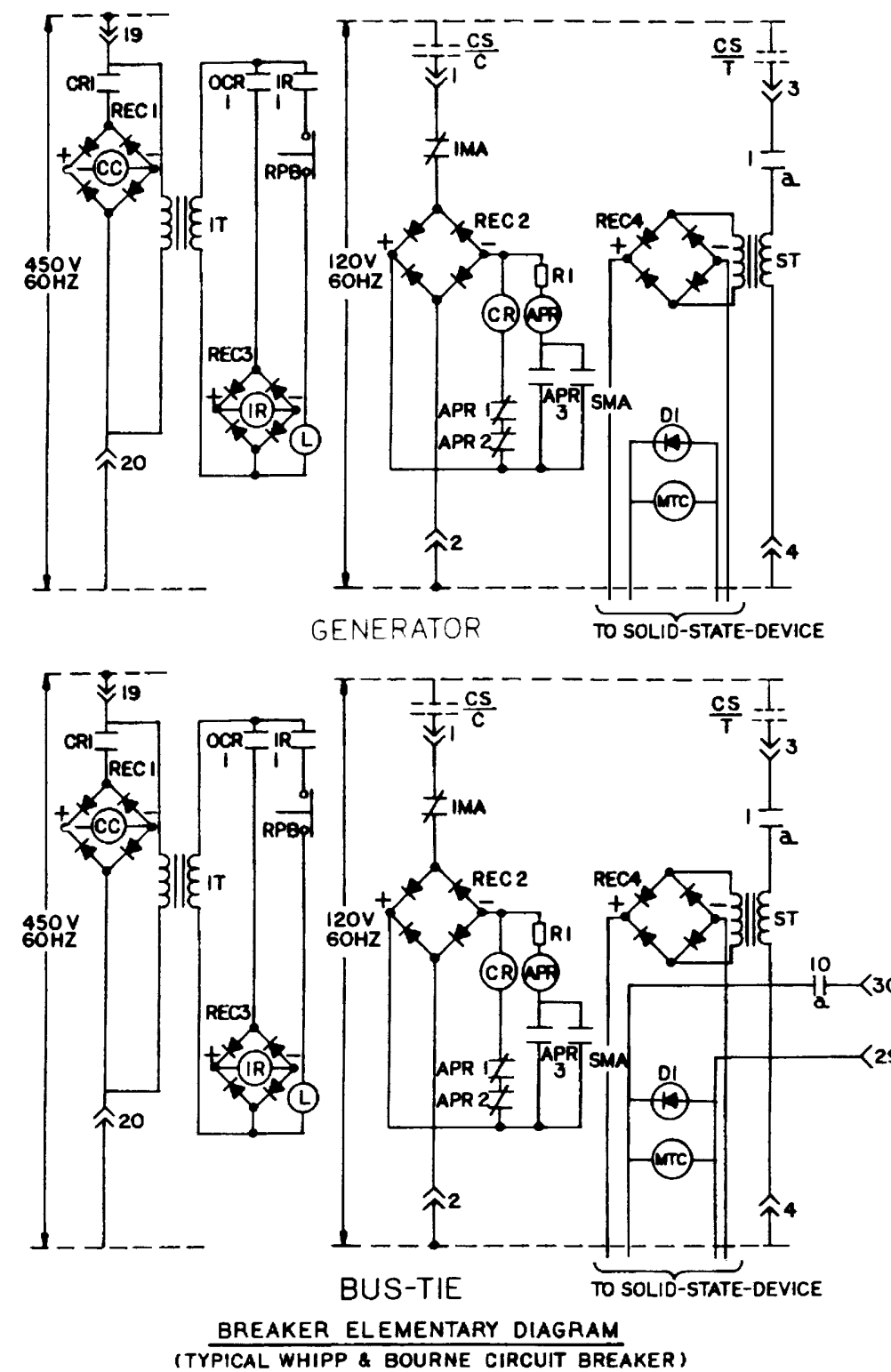
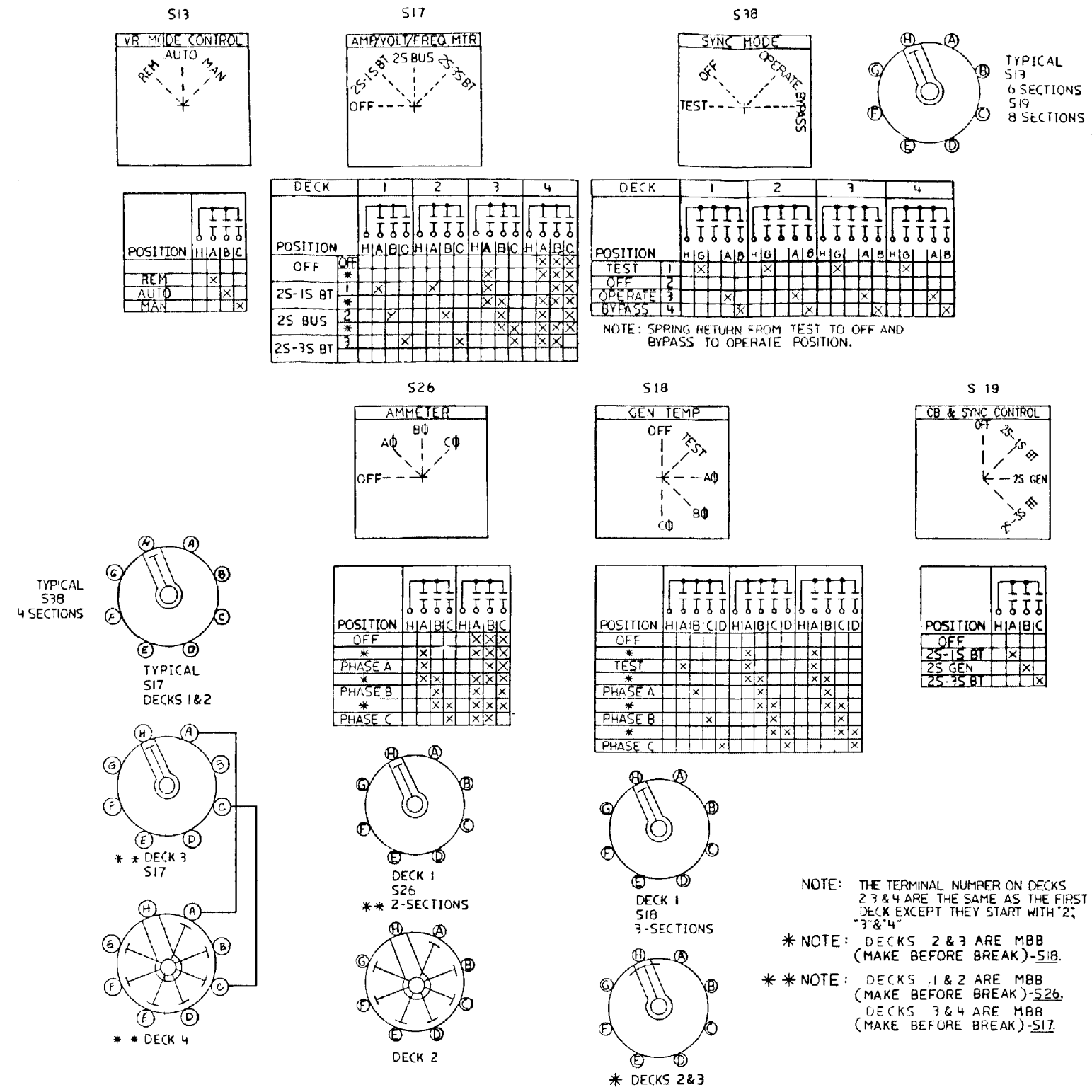
TYPICAL AUXILIARY CONTACT ARRANGEMENT

NOTE: THE TERMINAL NUMBER ON DECKS 2 & 3 & 4 ARE THE SAME AS THE FIRST DECK EXCEPT THEY START WITH '2', '3' & '4'

*** NOTE:** DECKS 2 & 3 ARE MBB (MAKE BEFORE BREAK)-S18.

**** NOTE:** DECKS 1 & 2 ARE MBB (MAKE BEFORE BREAK)-S26. DECKS 3 & 4 ARE MBB (MAKE BEFORE BREAK)-S17.

Figure 5-19. 2S Switchboard System; Schematic (Sheet 2 of 17)



NOTE: DDG 52-54 ONLY

Figure 5-19. 2S Switchboard System; Schematic (Sheet 2 of 17)

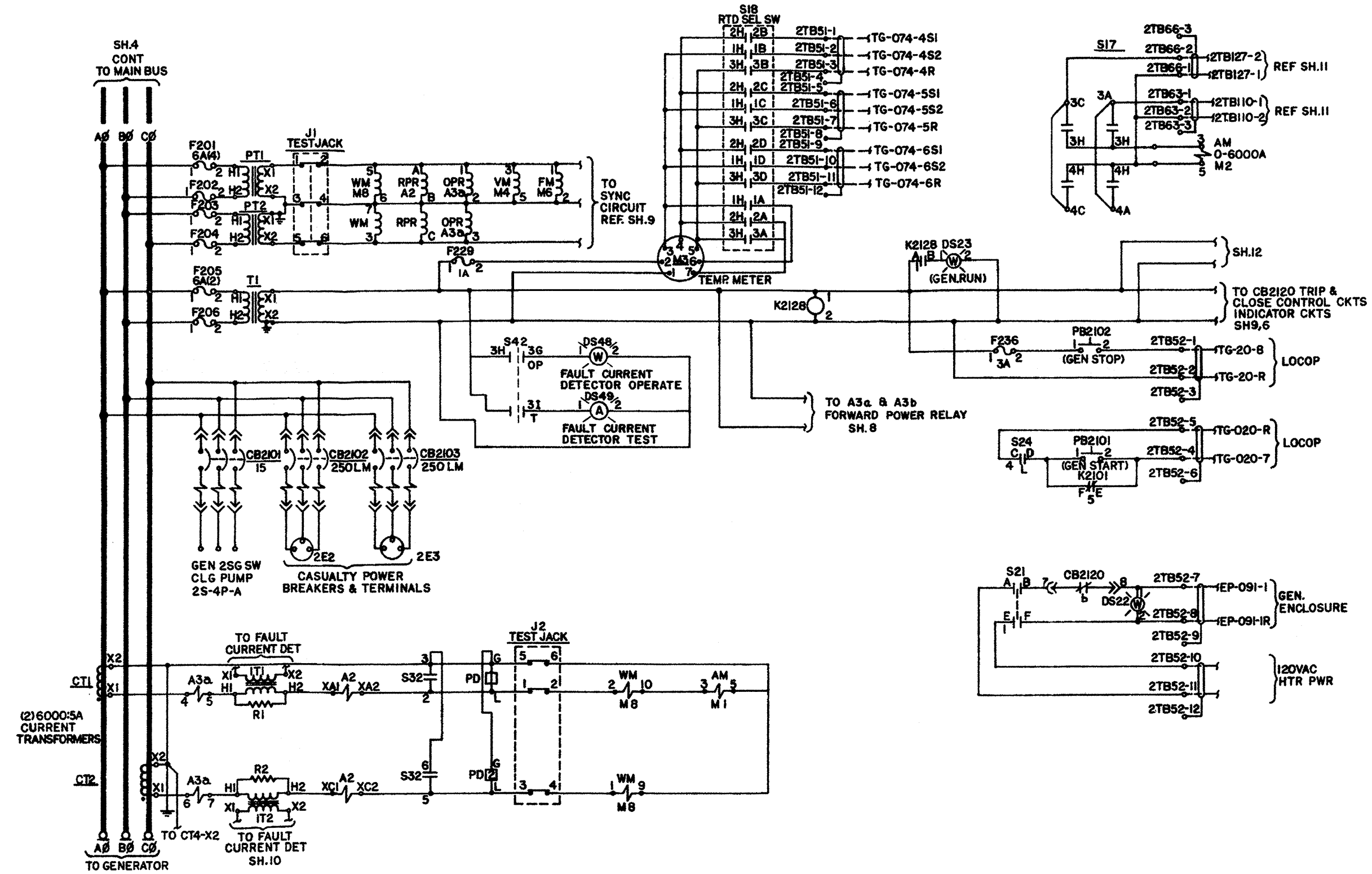


Figure 5-19. 2S Switchboard System; Schematic (Sheet 3 of 17)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

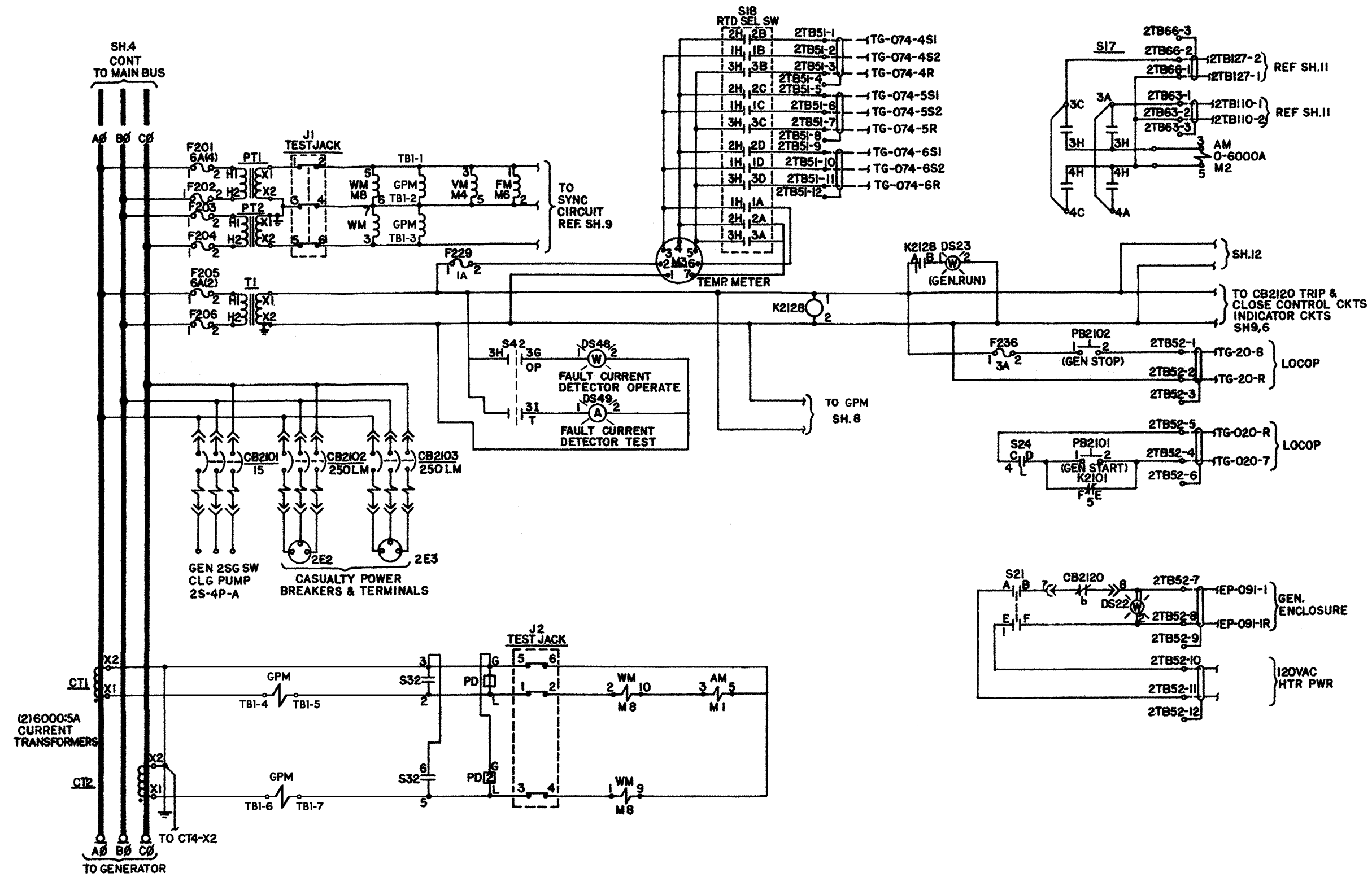


Figure 5-19. 2S Switchboard System; Schematic (Sheet 3 of 17)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

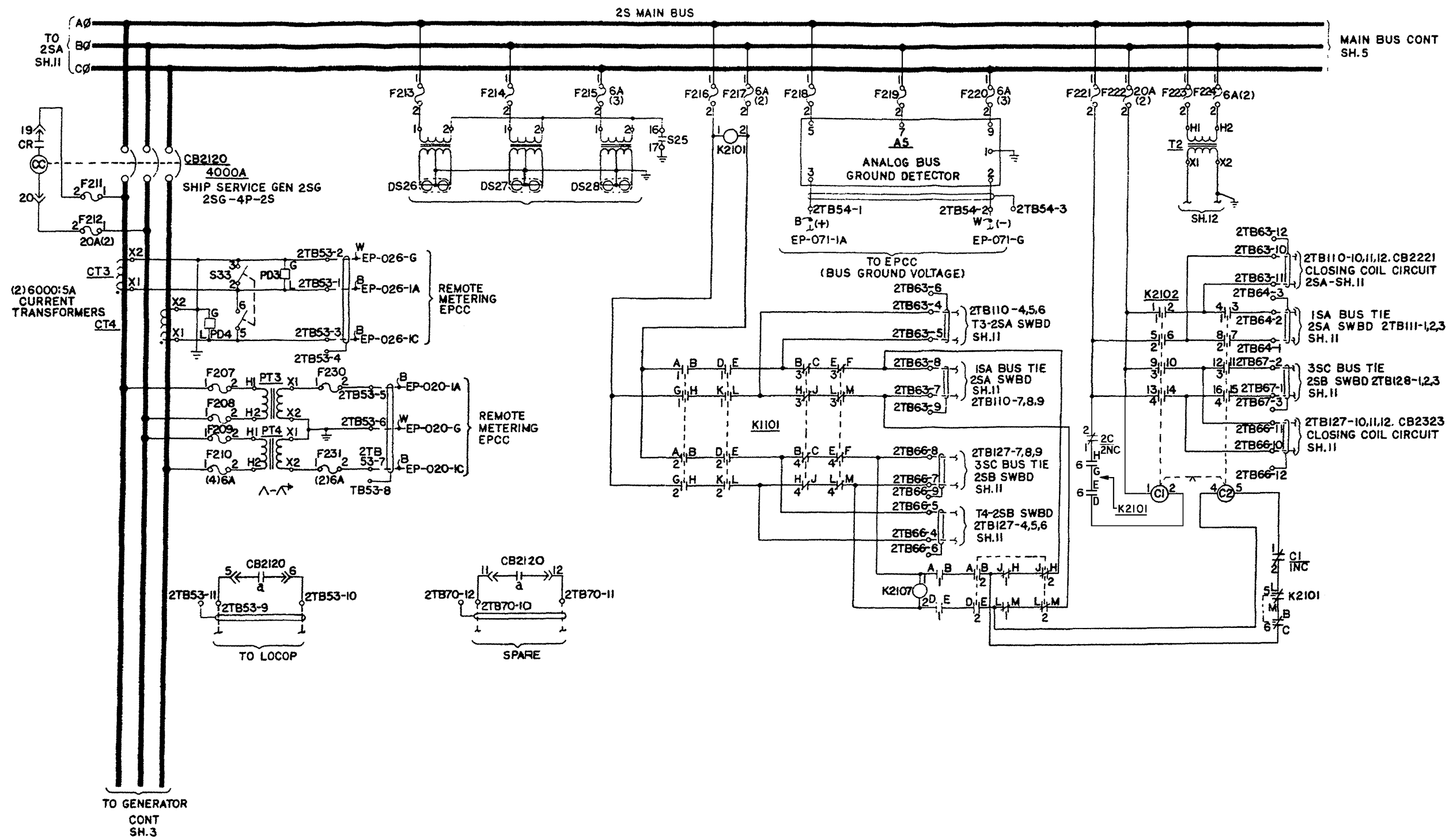


Figure 5-19. 2S Switchboard System; Schematic (Sheet 4 of 17)

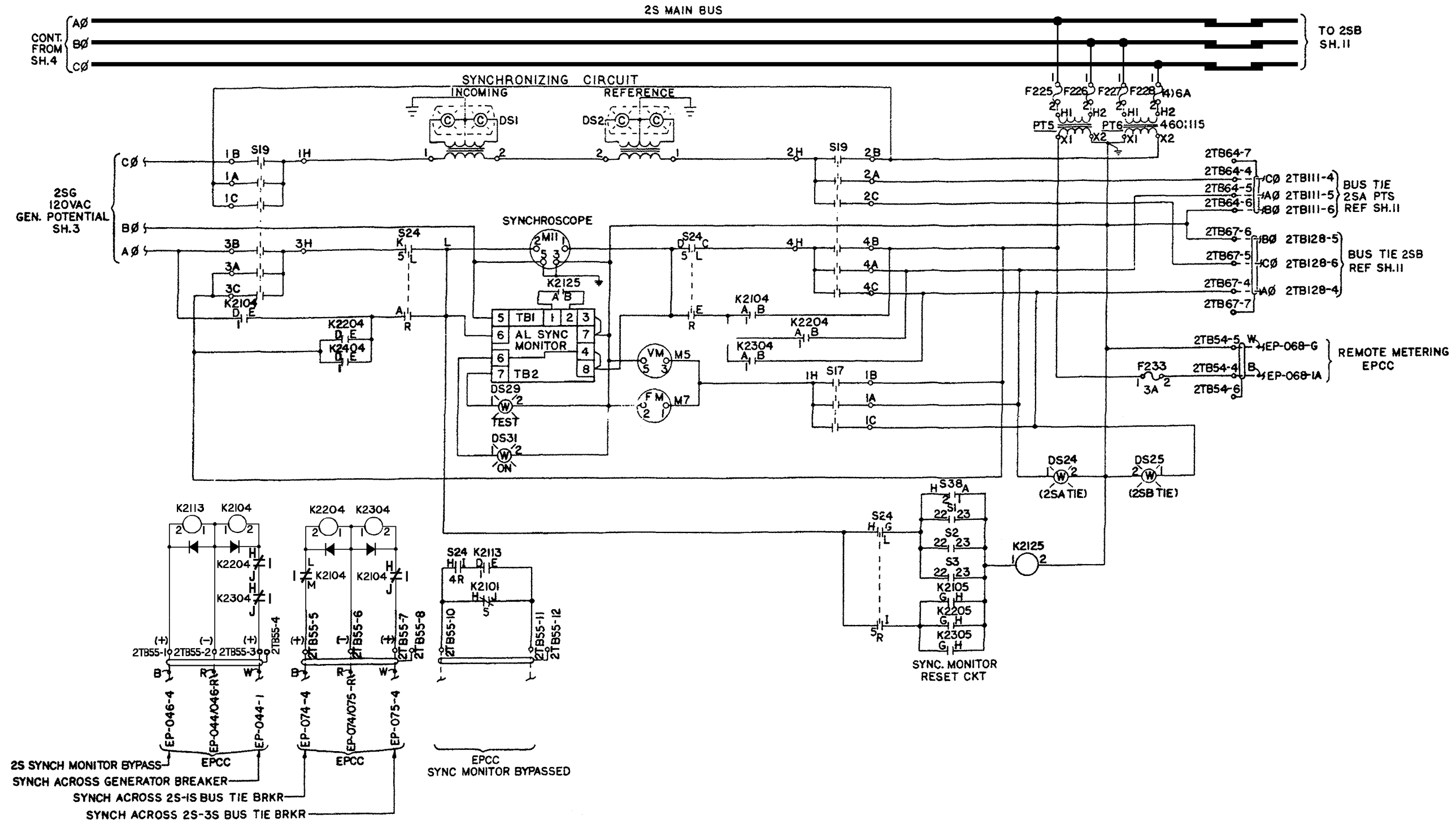


Figure 5-19. 2S Switchboard System; Schematic (Sheet 5 of 17)

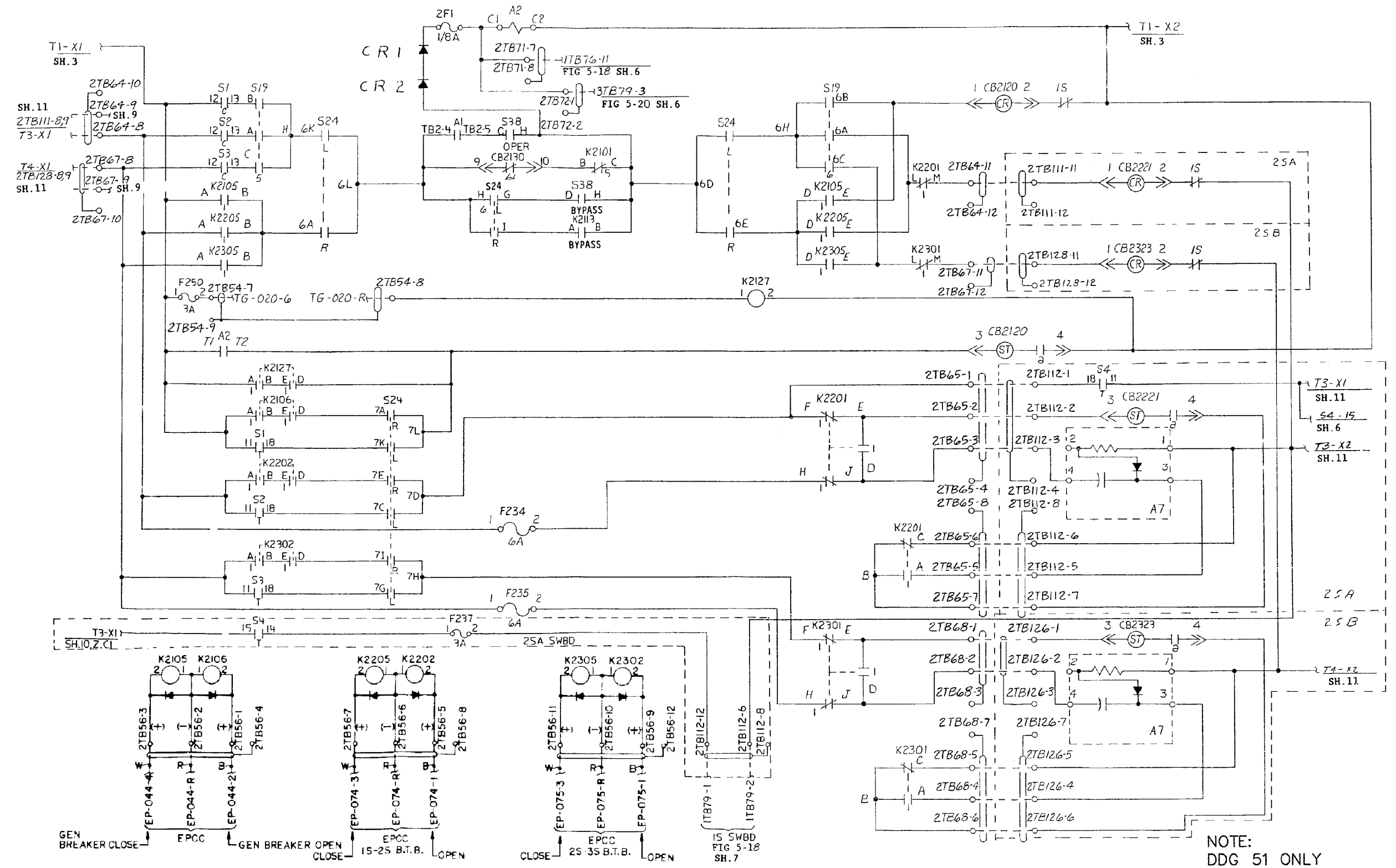


Figure 5-19. 2S Switchboard System; Schematic (Sheet 6 of 17)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

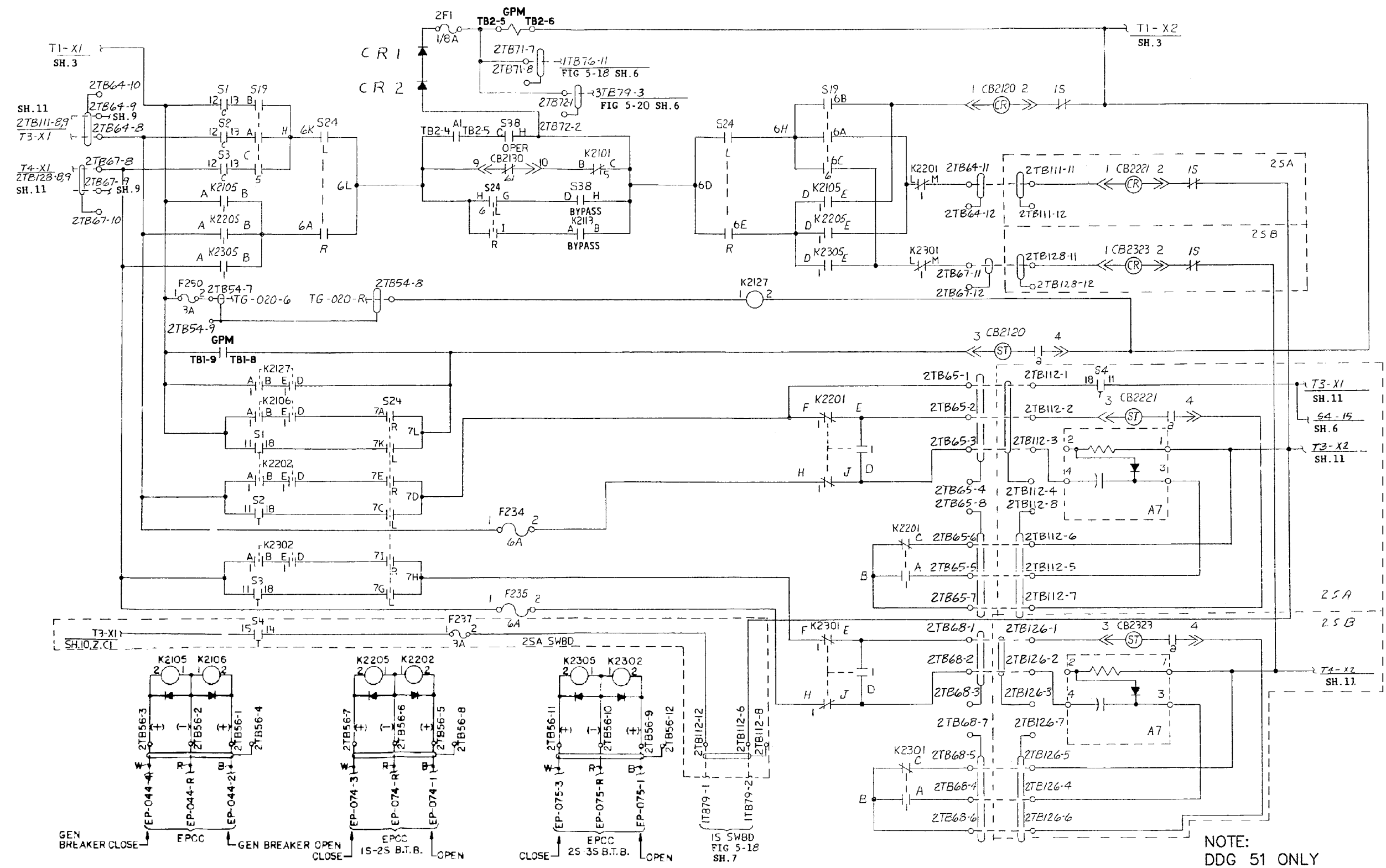


Figure 5-19. 2S Switchboard System; Schematic (Sheet 6 of 17)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

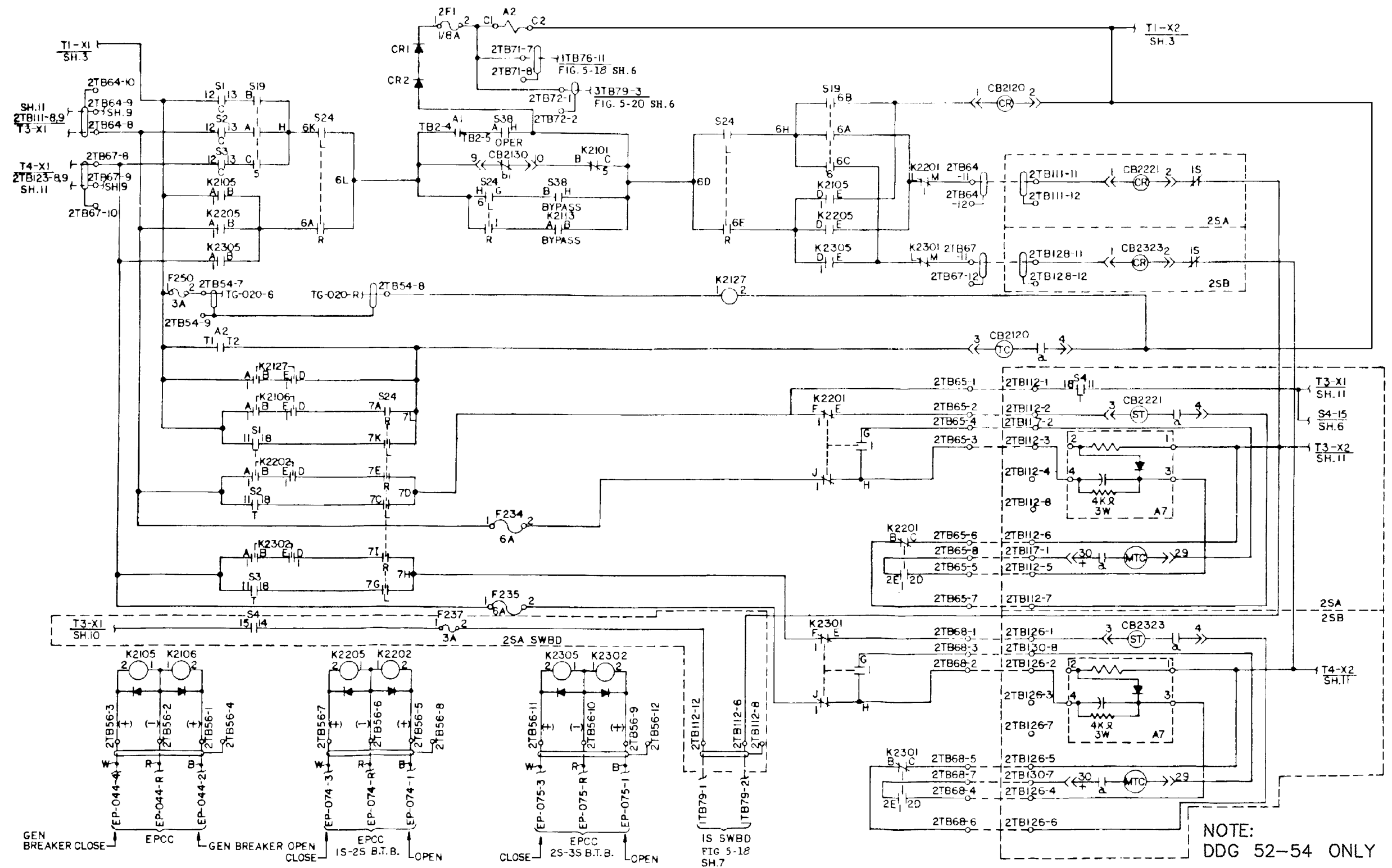


Figure 5-19. 2S Switchboard System; Schematic (Sheet 6 of 17)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

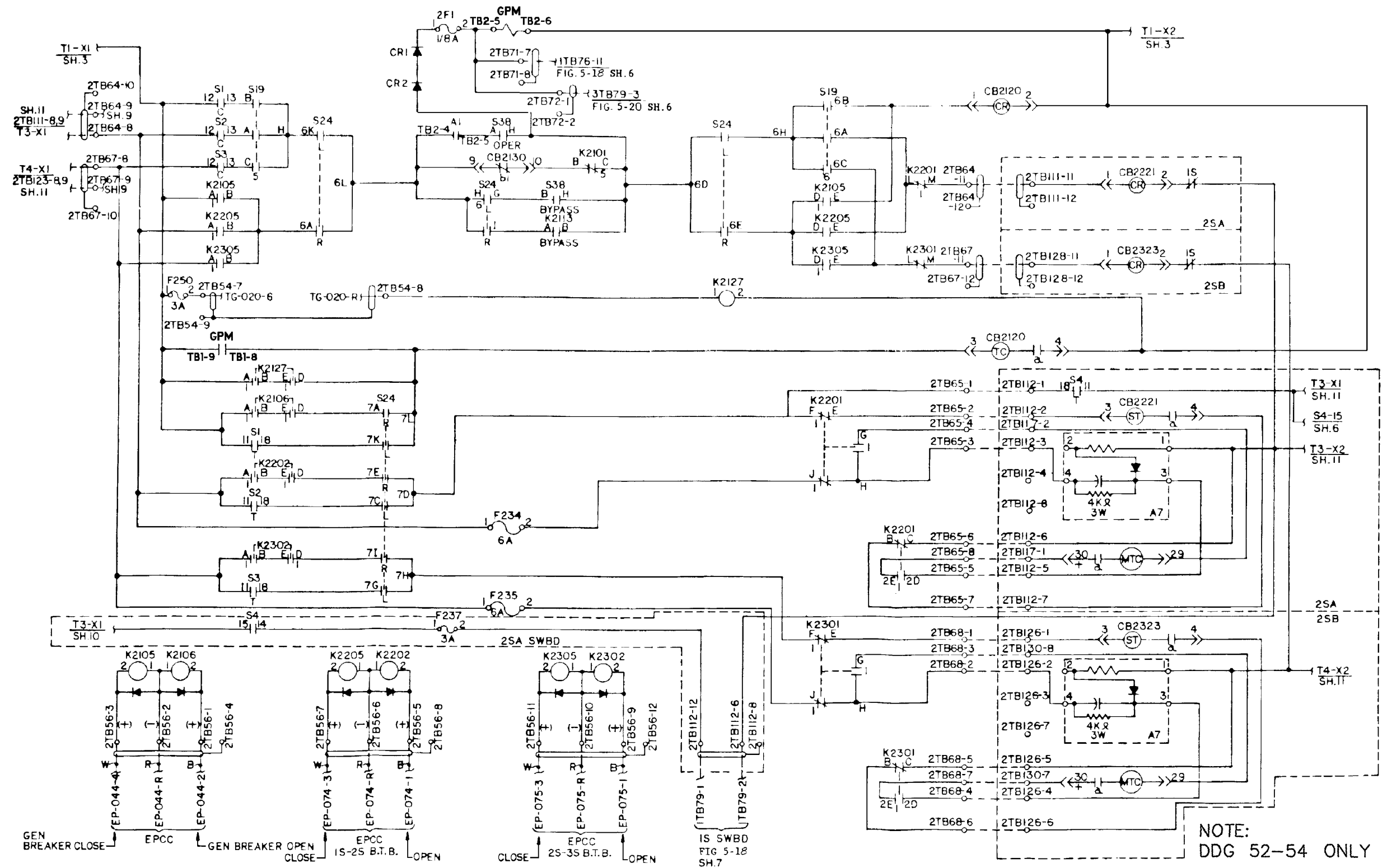


Figure 5-19. 2S Switchboard System; Schematic (Sheet 6 of 17)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

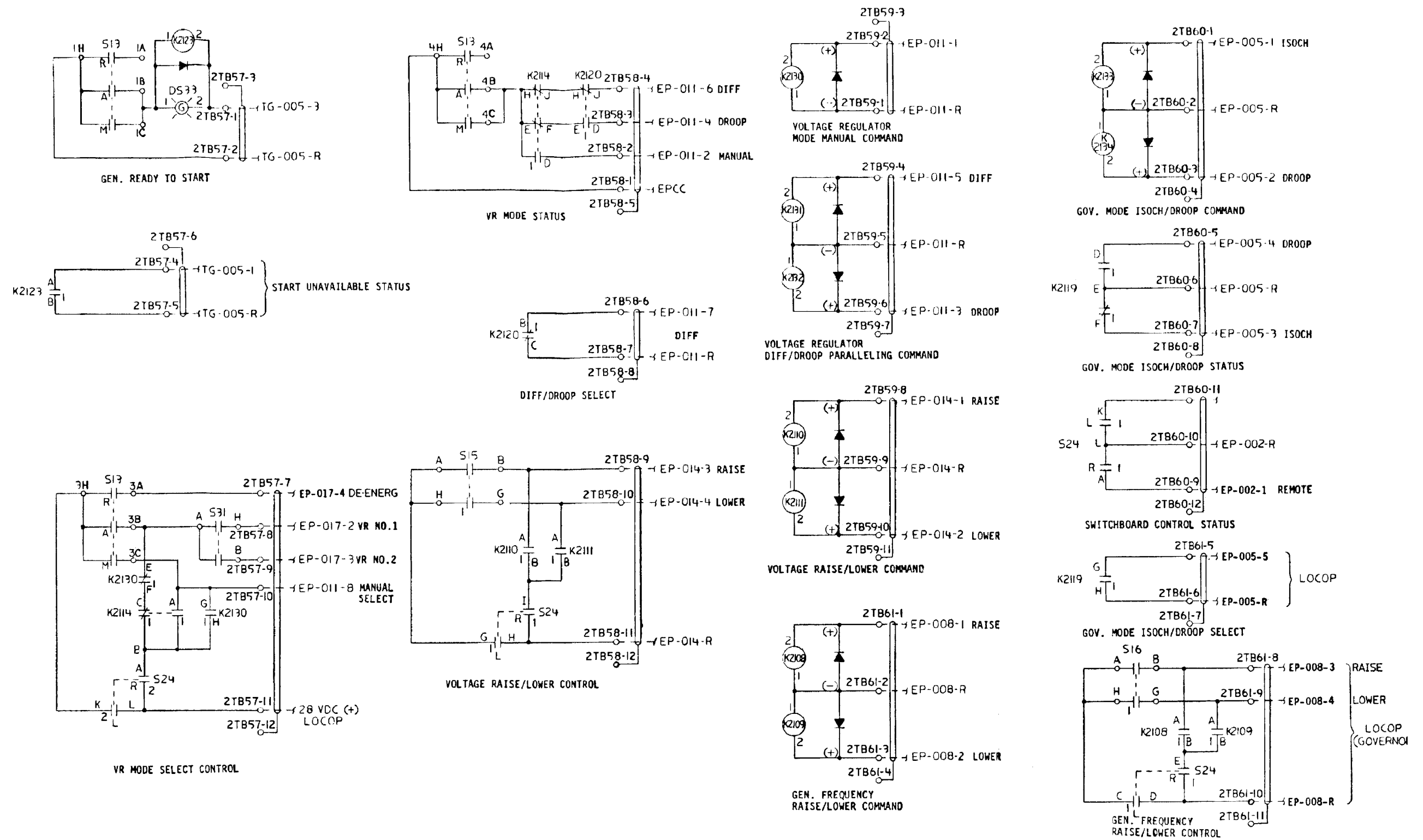


Figure 5-19. 2S Switchboard System; Schematic (Sheet 7 of 17)

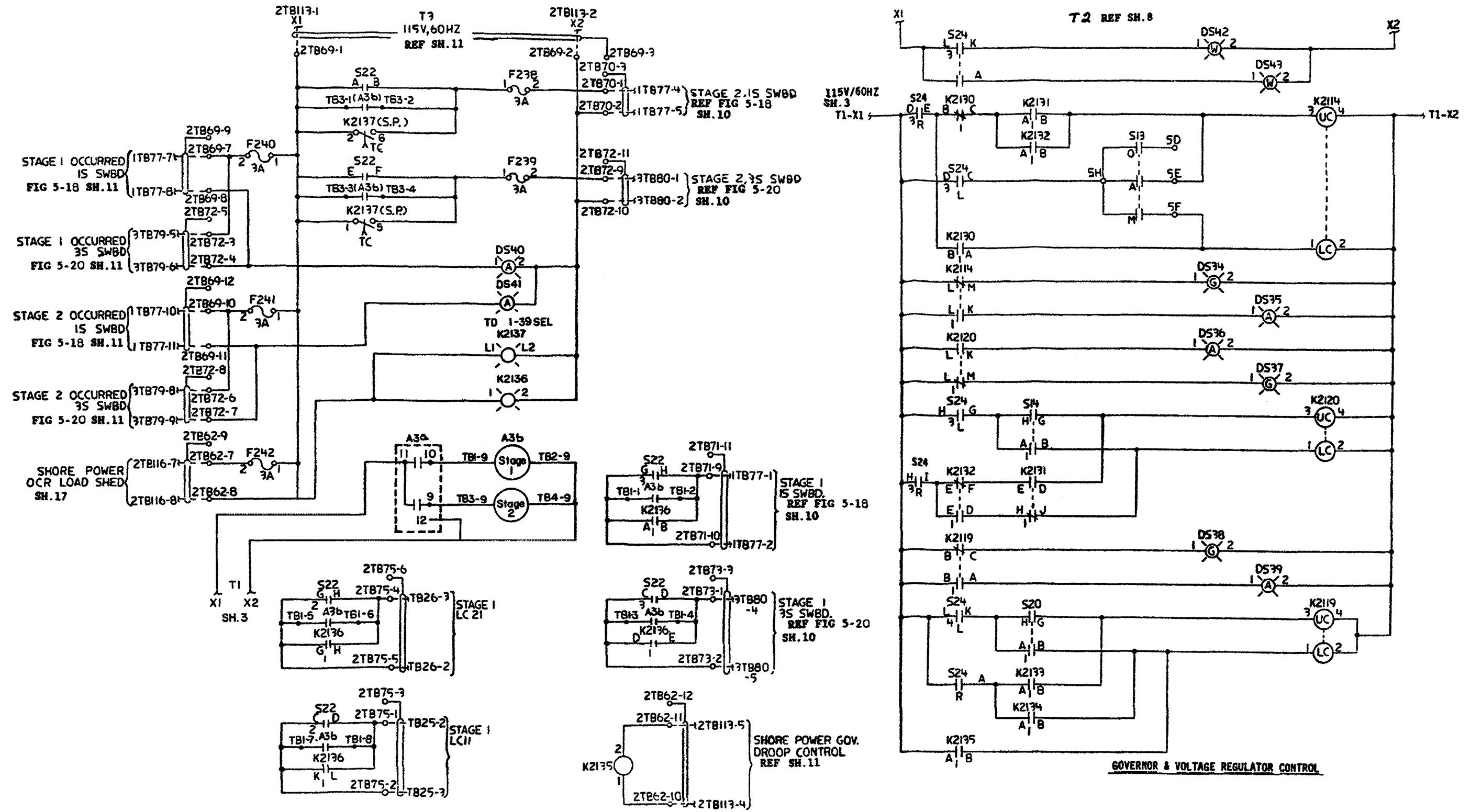


Figure 5-19. 2S Switchboard System; Schematic (Sheet 8 of 17)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

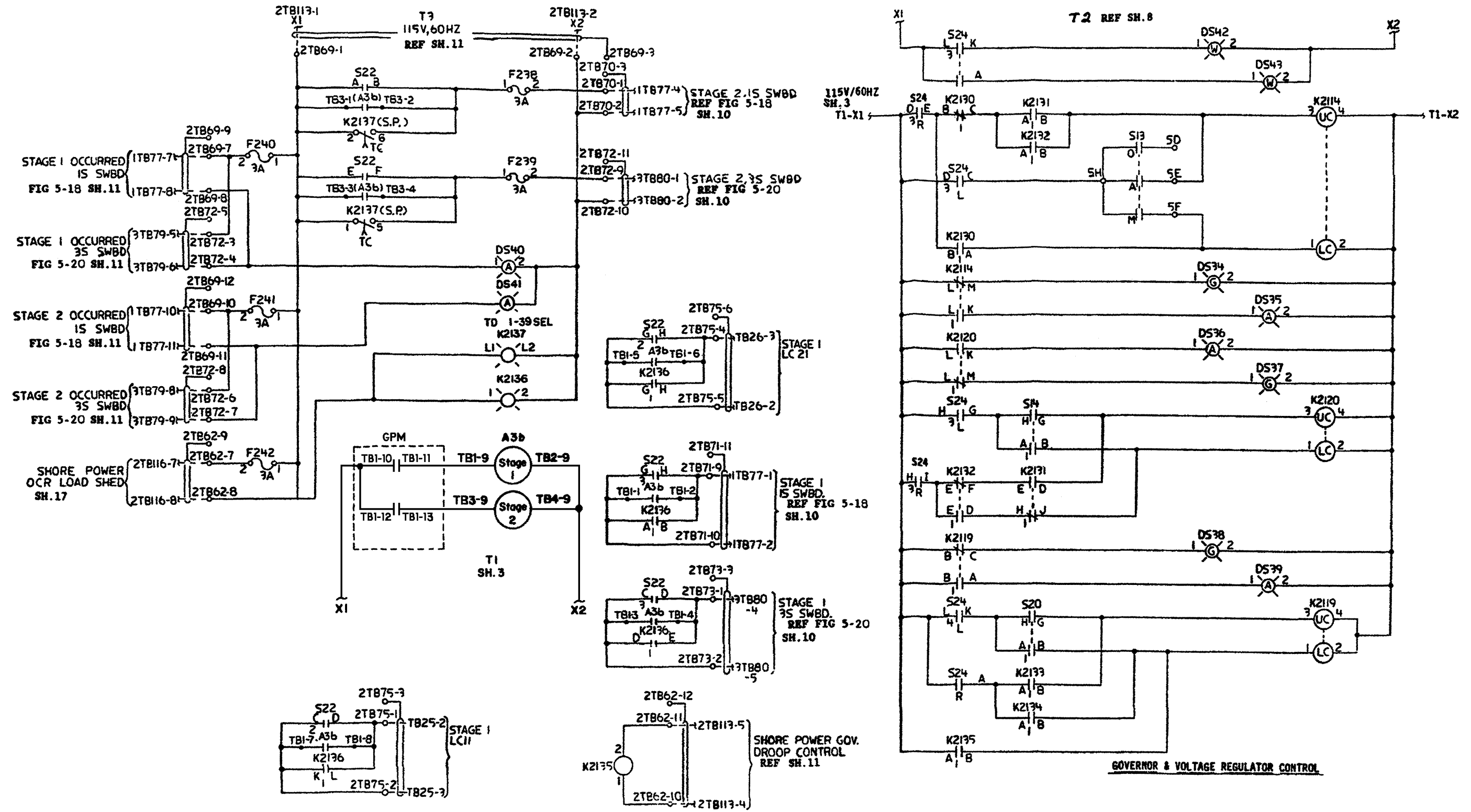


Figure 5-19. 2S Switchboard System; Schematic (Sheet 8 of 17)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

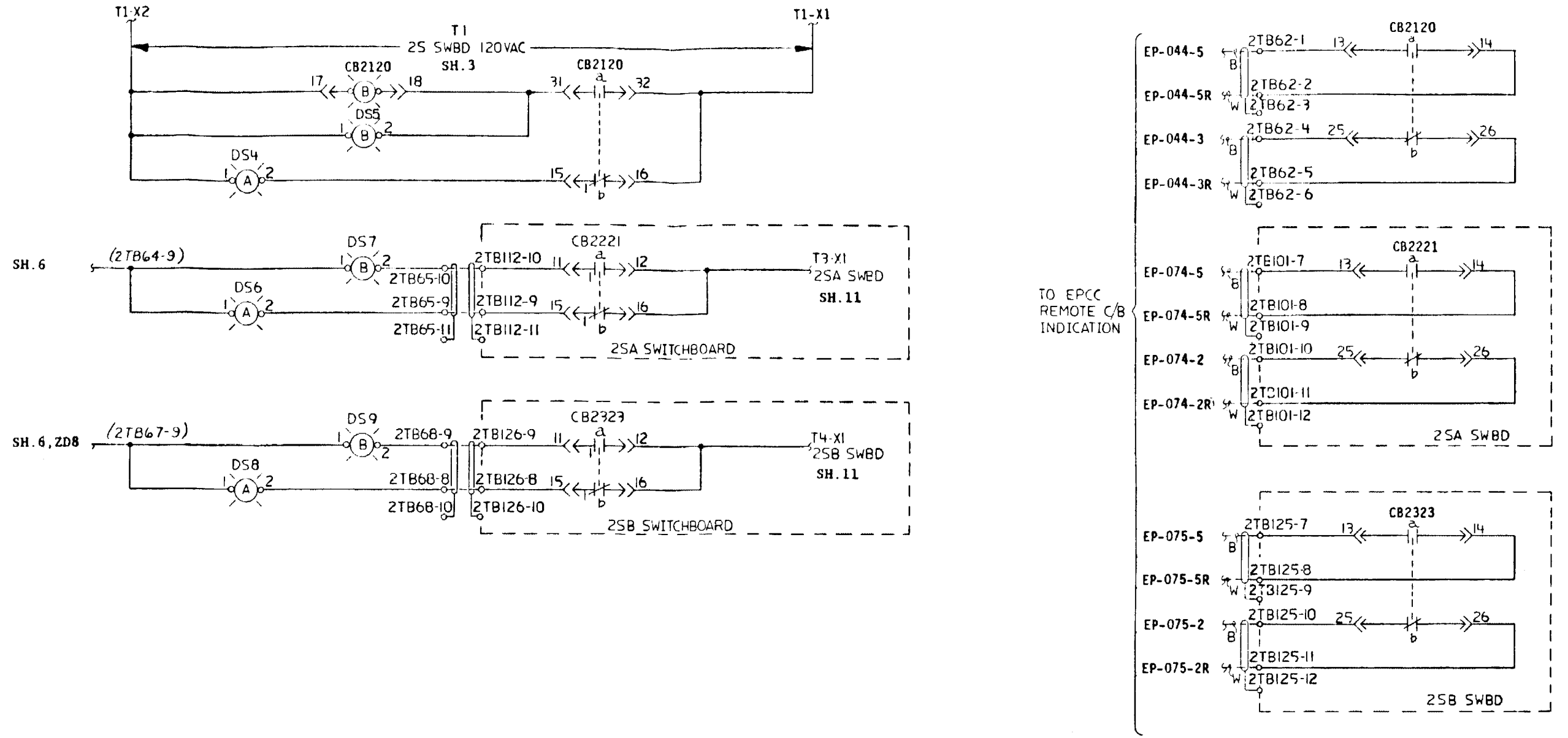


Figure 5-19. 2S Switchboard System; Schematic (Sheet 9 of 17)

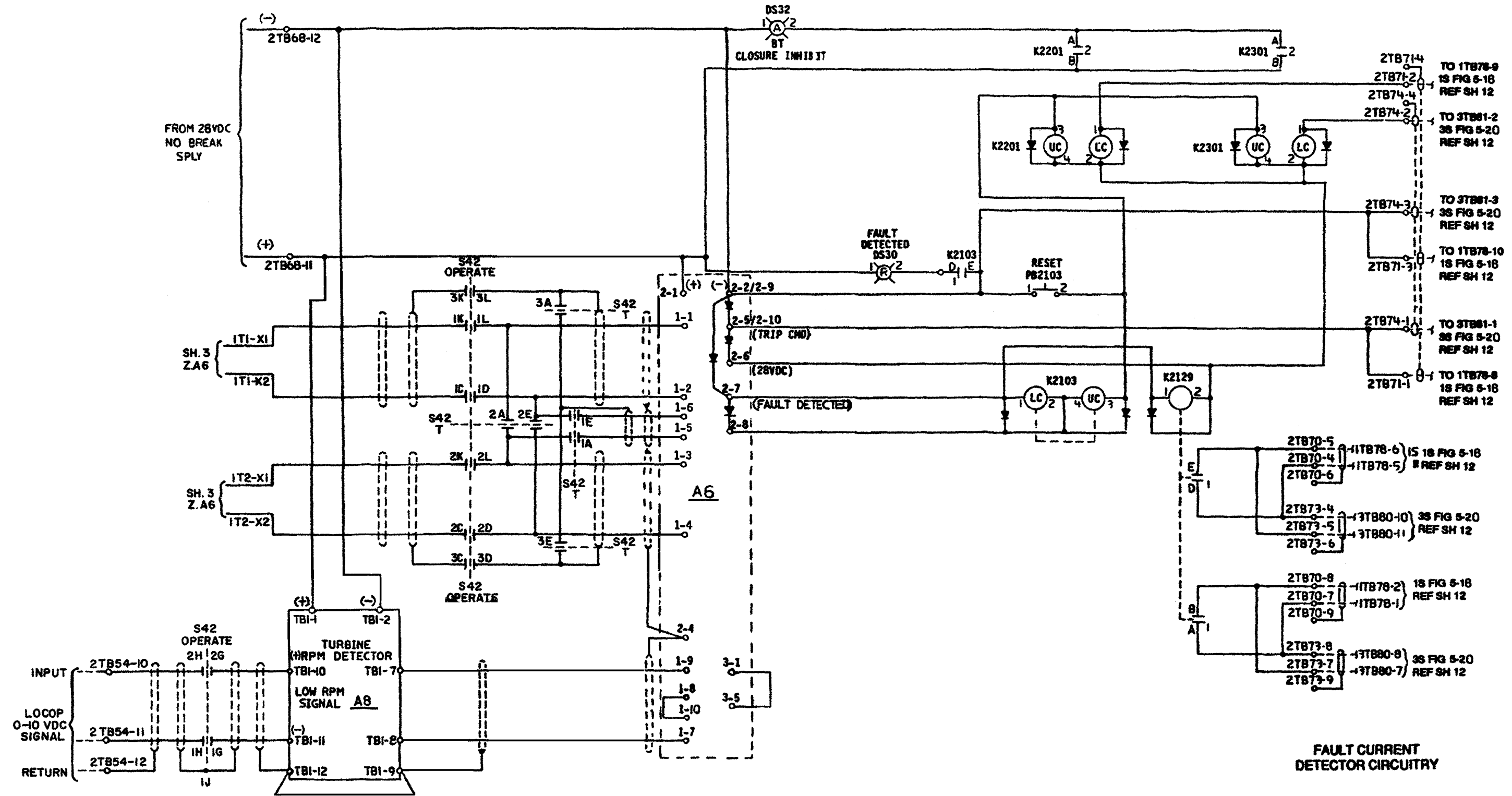


Figure 5-19. 2S Switchboard System; Schematic (Sheet 10 of 17)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

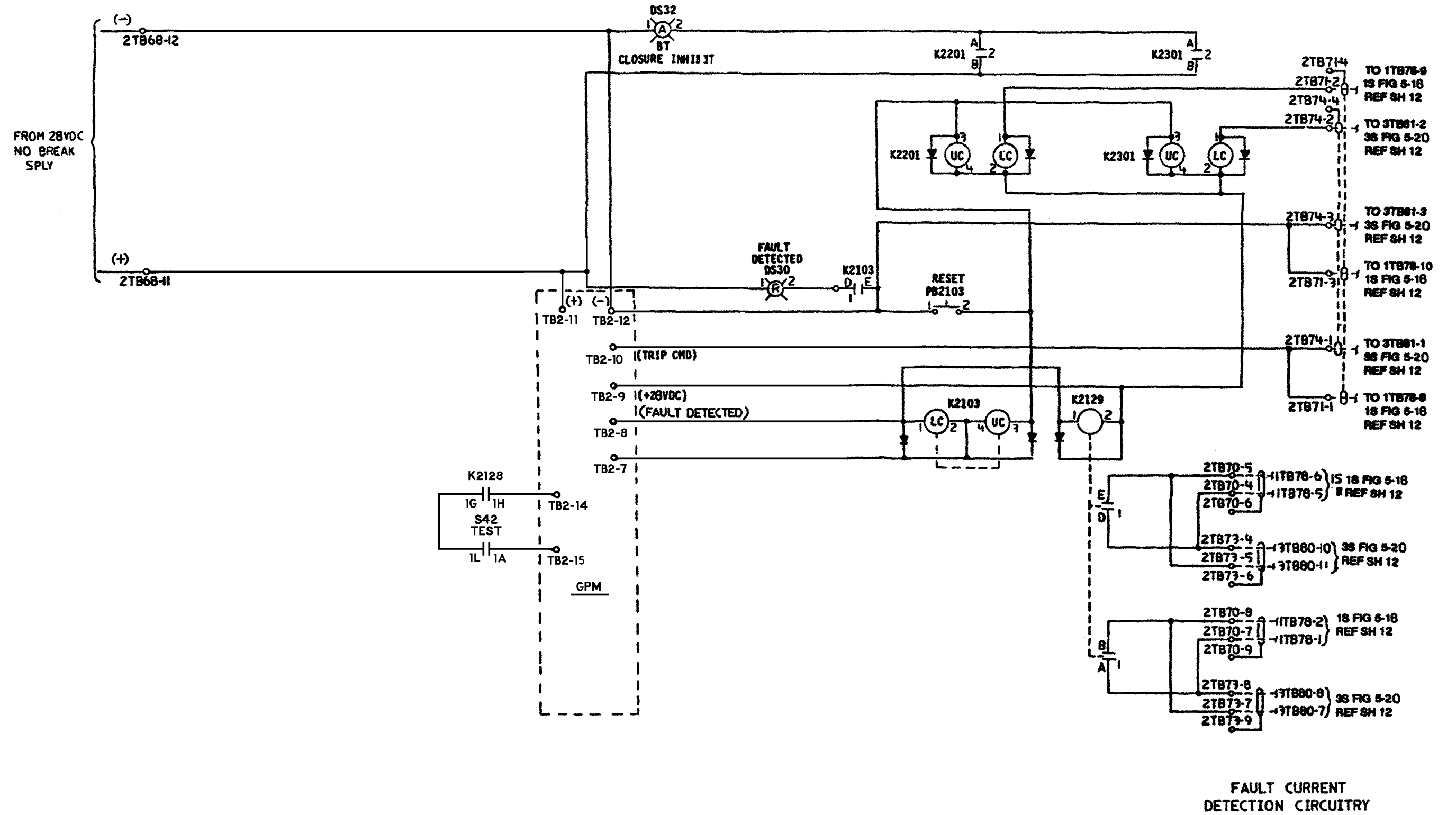


Figure 5-19. 2S Switchboard System; Schematic (Sheet 10 of 17)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

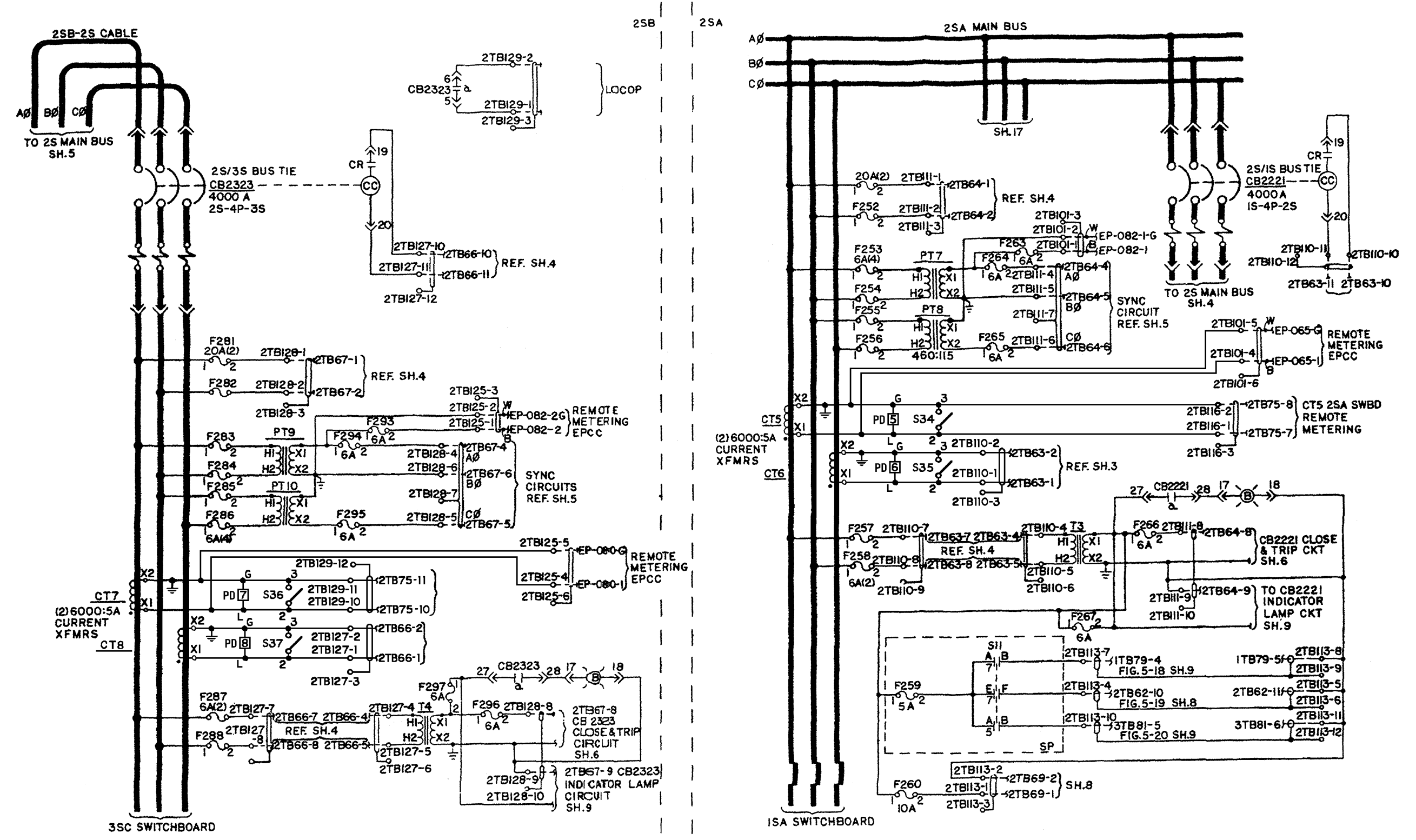


Figure 5-19. 2S Switchboard System; Schematic (Sheet 11 of 17)

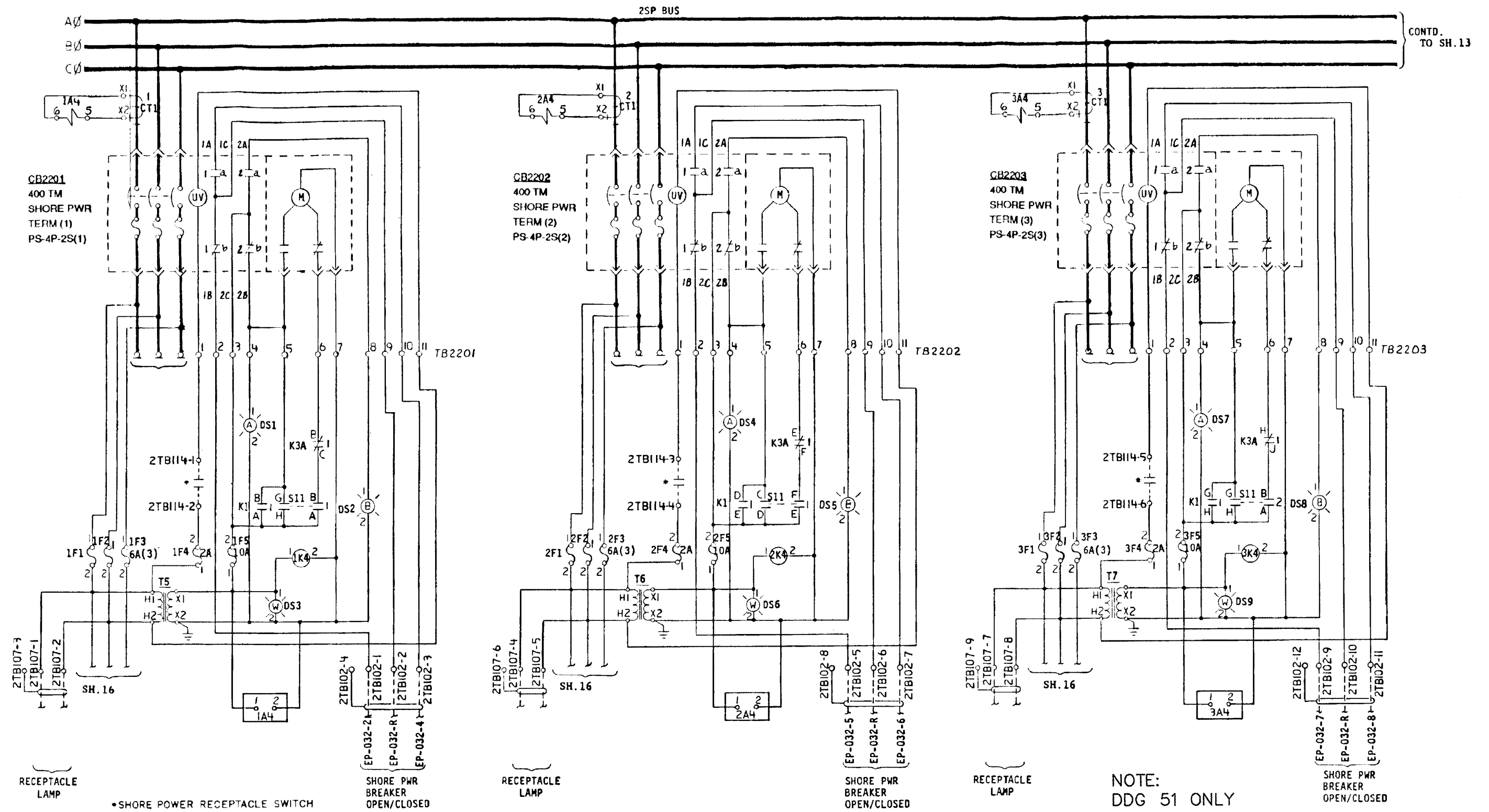


Figure 5-19. 2S Switchboard System; Schematic (Sheet 12 of 17)

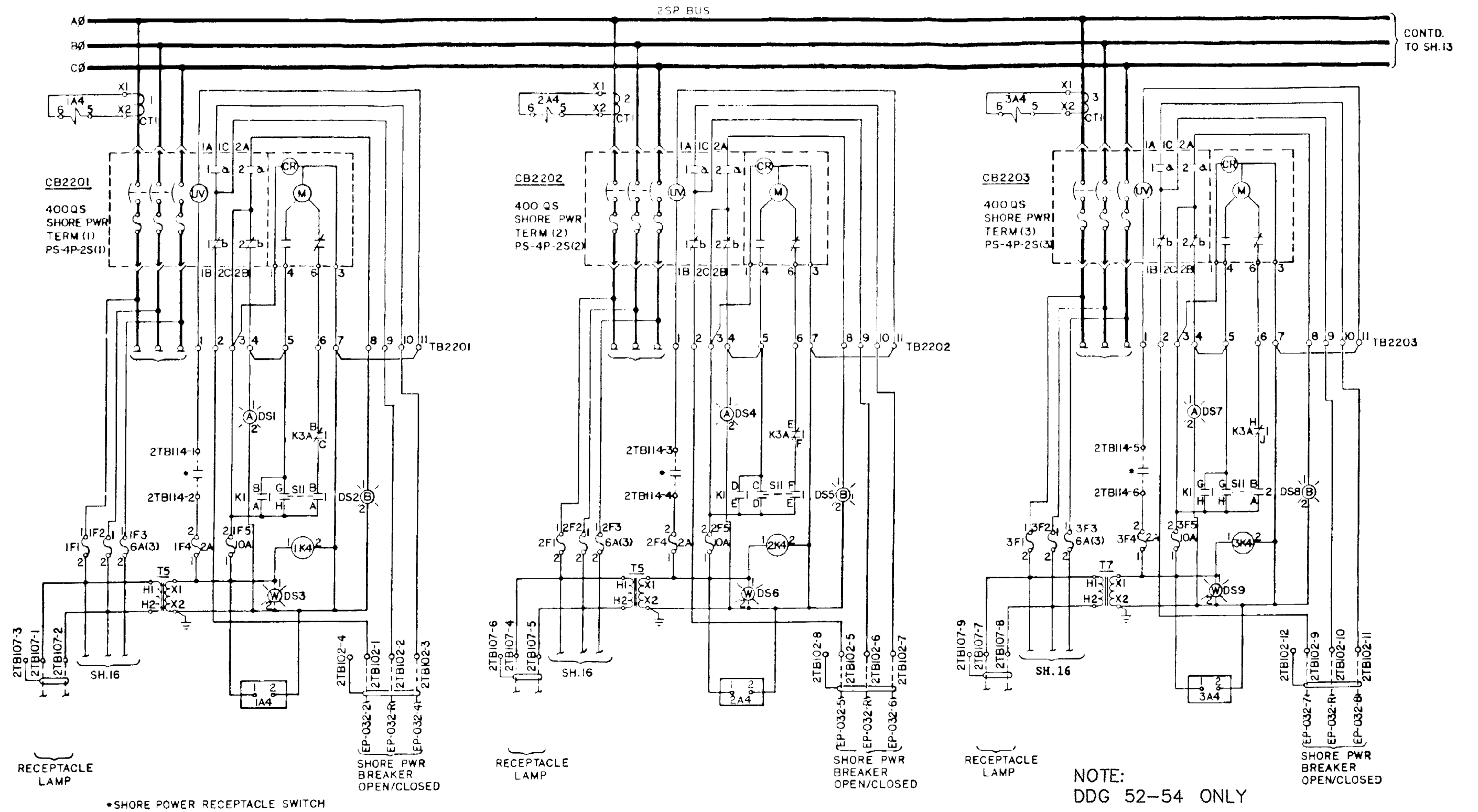


Figure 5-19. 2S Switchboard System; Schematic (Sheet 12 of 17)

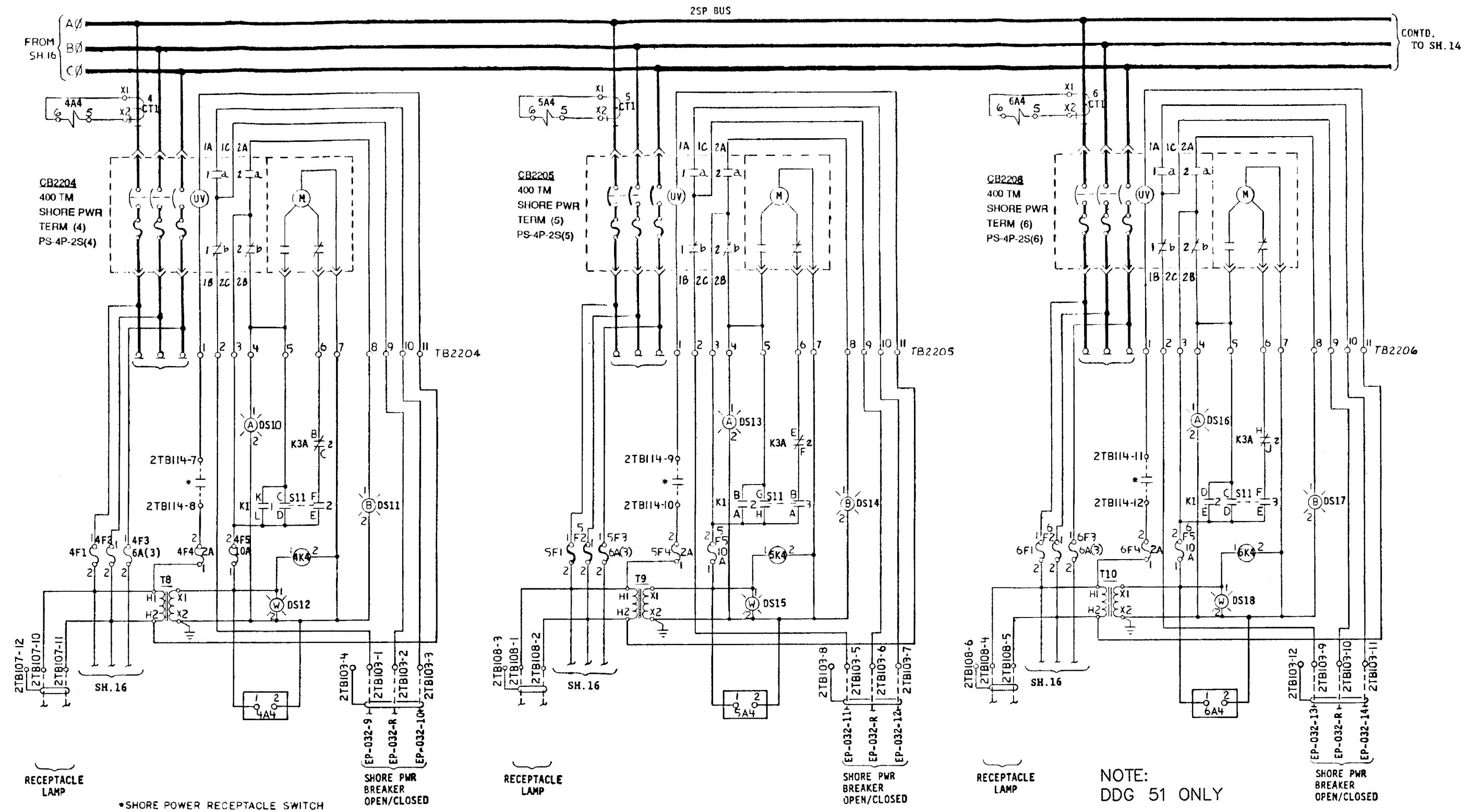


Figure 5-19. 2S Switchboard System; Schematic (Sheet 13 of 17)

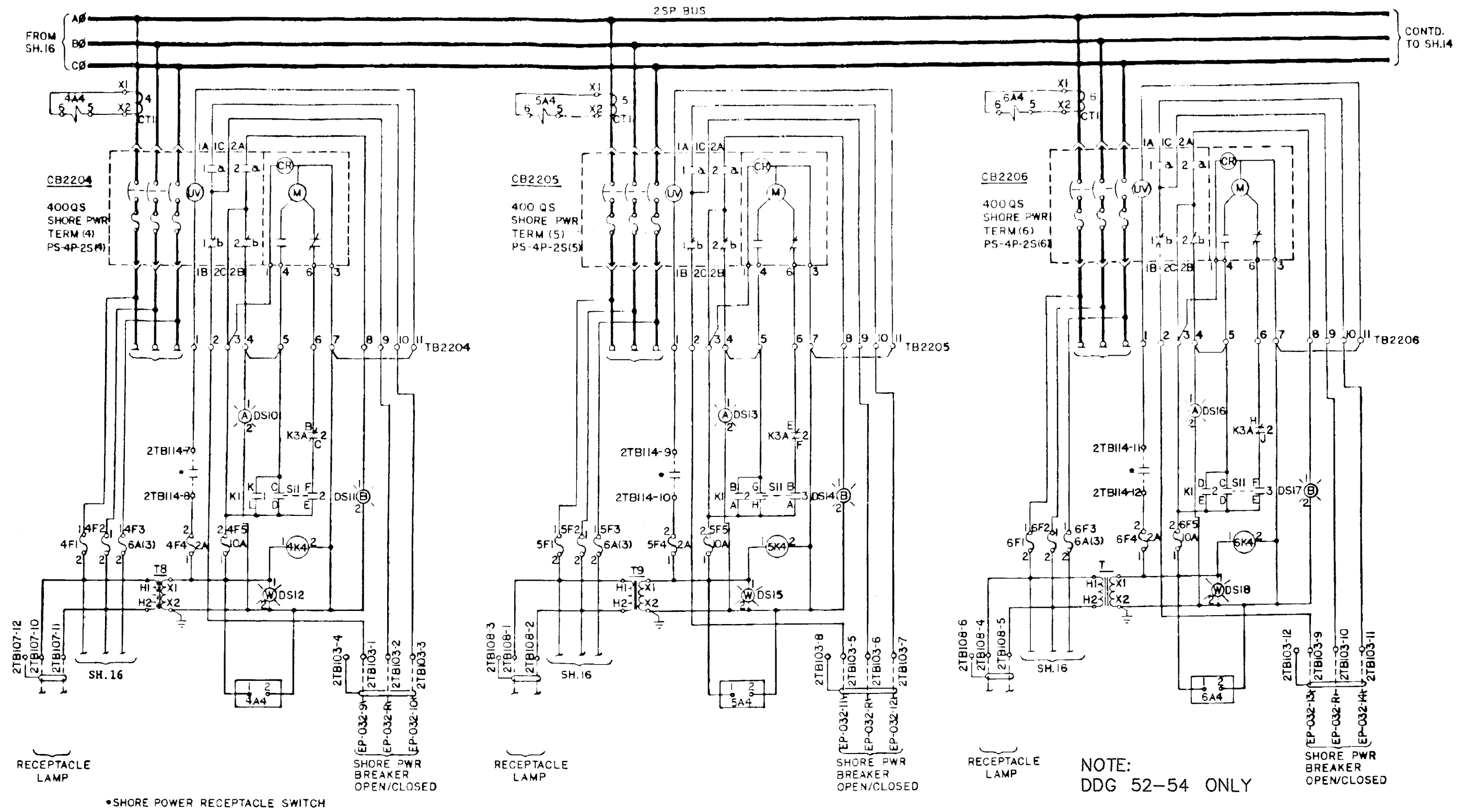


Figure 5-19. 2S Switchboard System; Schematic (Sheet 13 of 17)

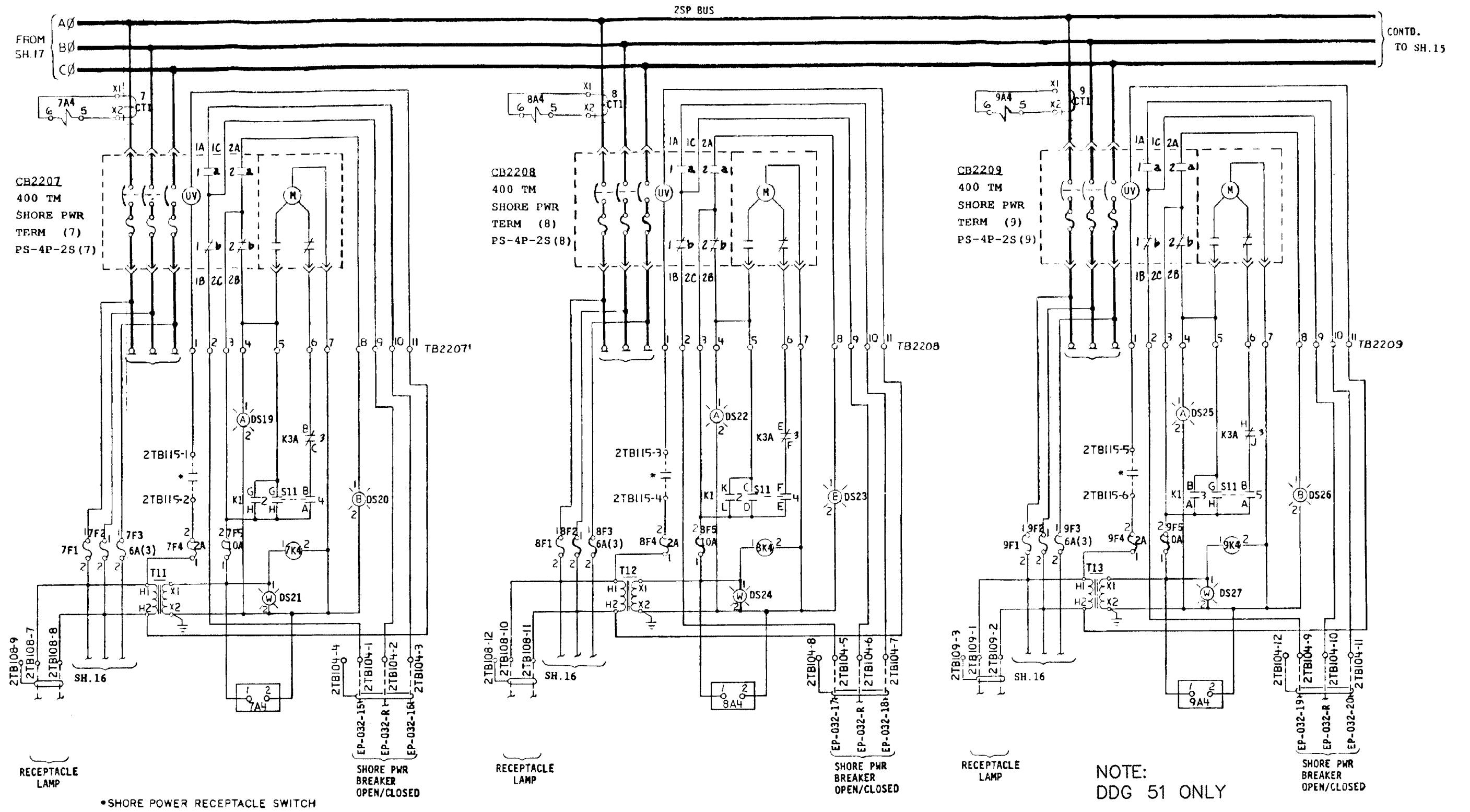


Figure 5-19. 2S Switchboard System; Schematic (Sheet 14 of 17)

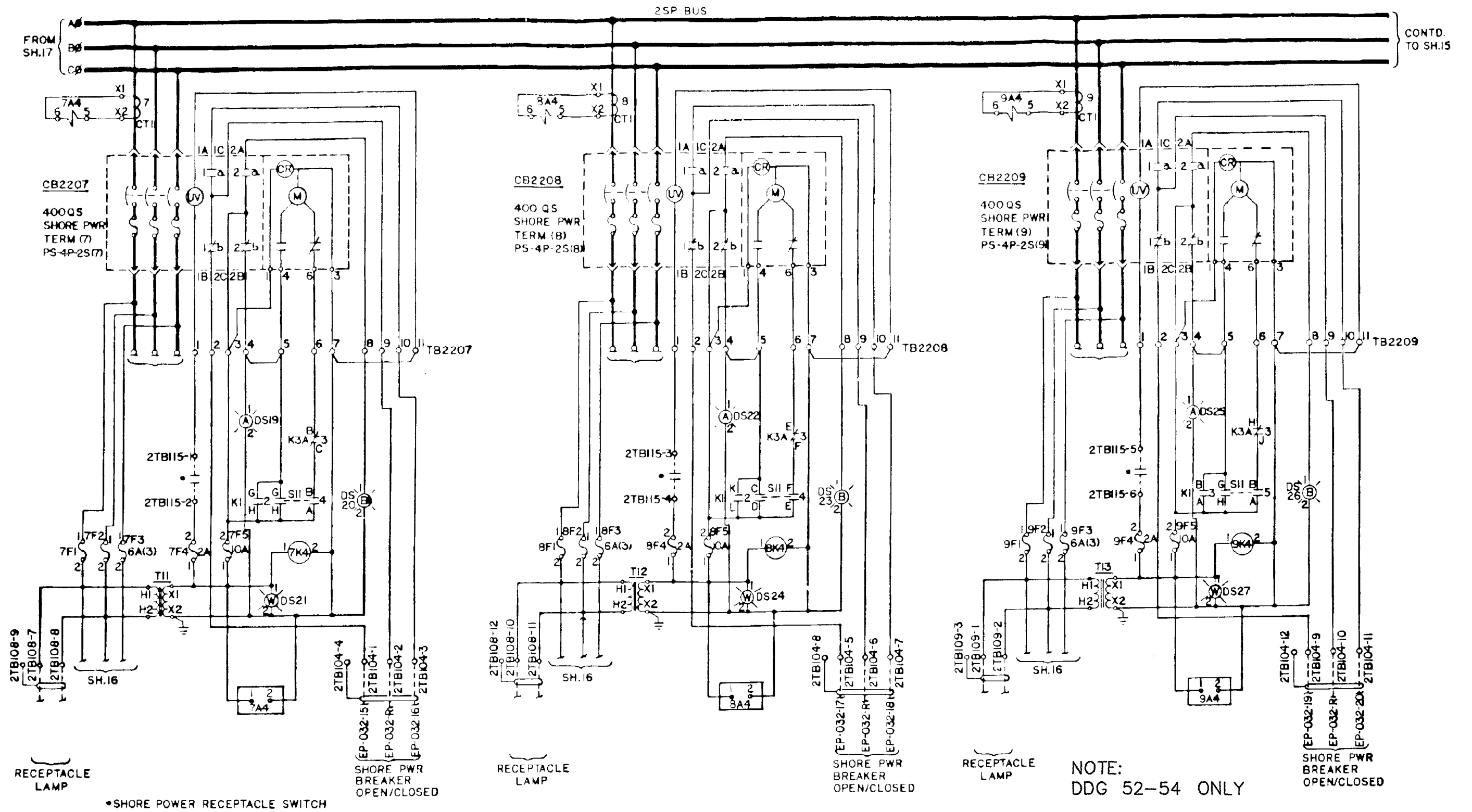


Figure 5-19. 2S Switchboard System; Schematic (Sheet 14 of 17)

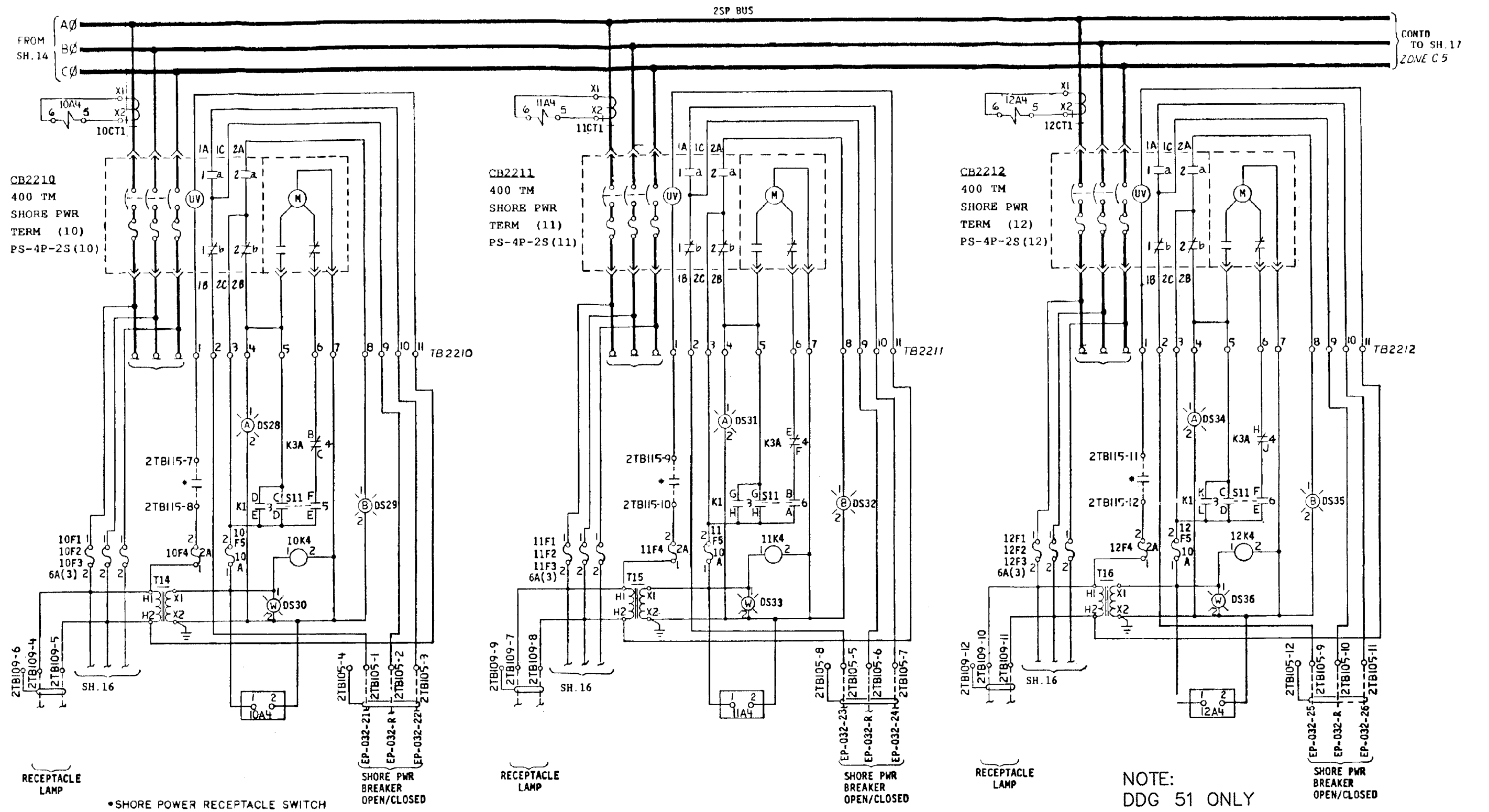


Figure 5-19. 2S Switchboard System; Schematic (Sheet 15 of 17)

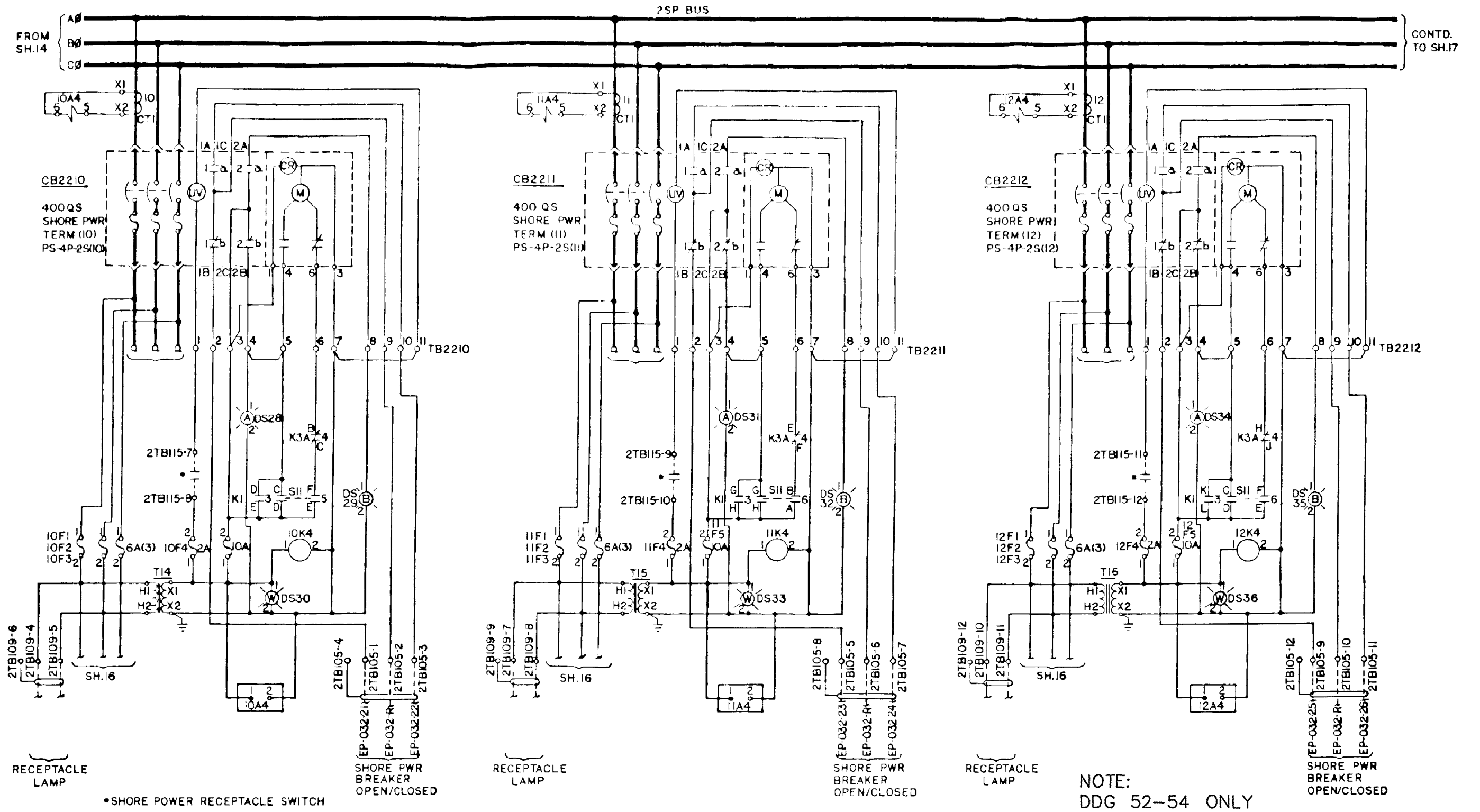
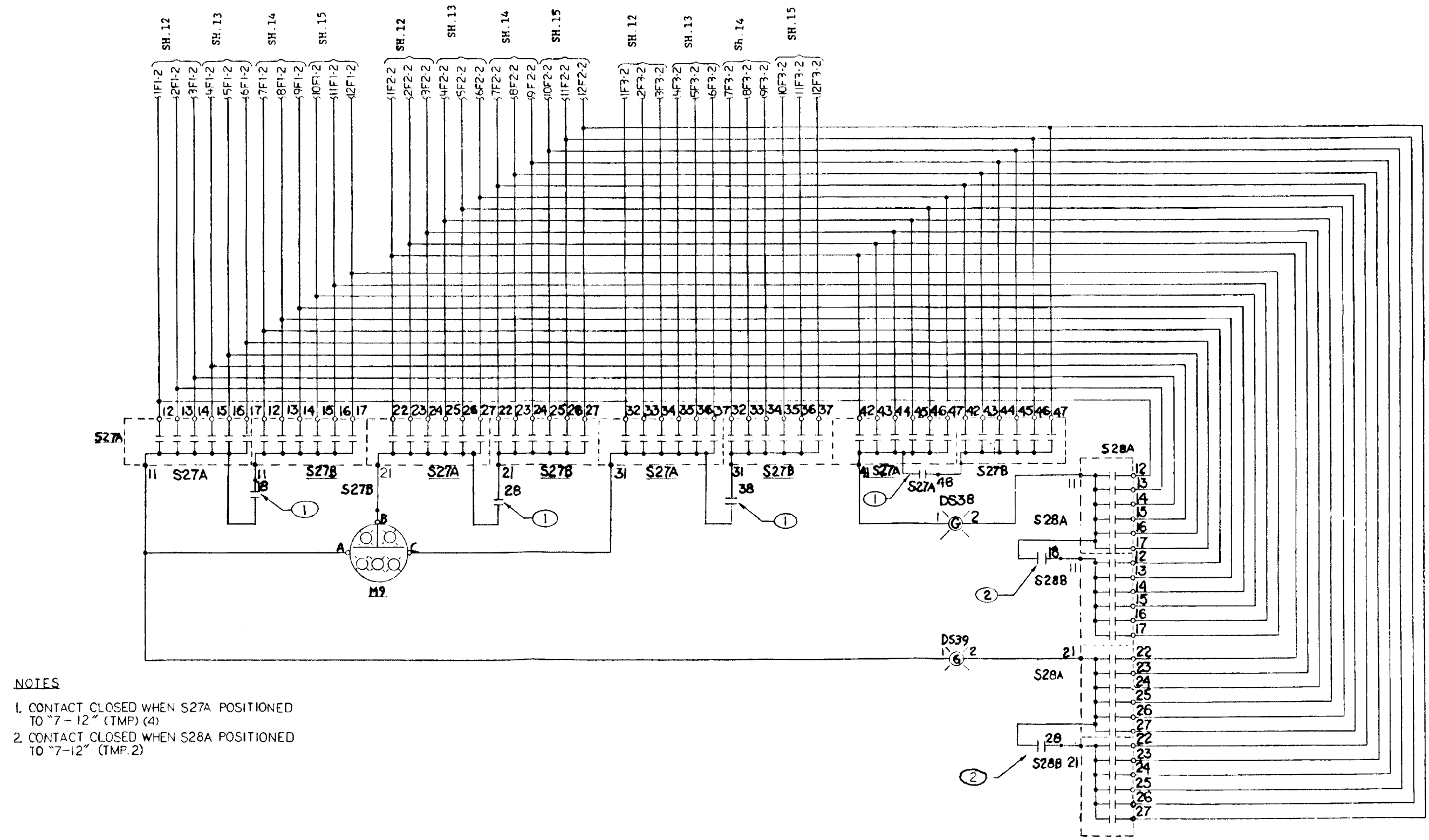
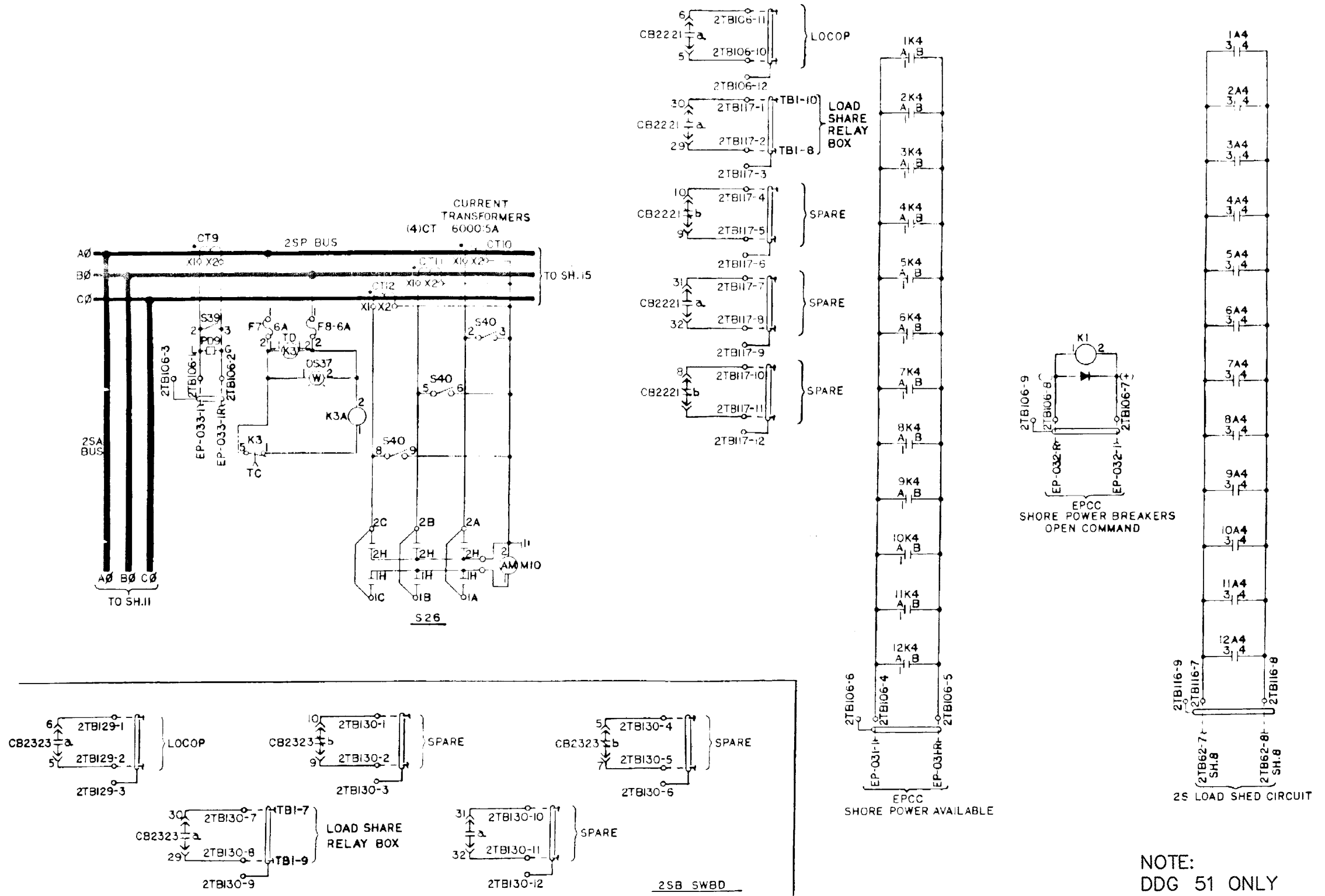


Figure 5-19. 2S Switchboard System; Schematic (Sheet 15 of 17)



- NOTES
1. CONTACT CLOSED WHEN S27A POSITIONED TO "7-12" (TMP) (4)
 2. CONTACT CLOSED WHEN S28A POSITIONED TO "7-12" (TMP) (2)

Figure 5-19. 2S Switchboard System; Schematic (Sheet 16 of 17)



NOTE:
DDG 51 ONLY

Figure 5-19. 2S Switchboard System; Schematic (Sheet 17 of 17)

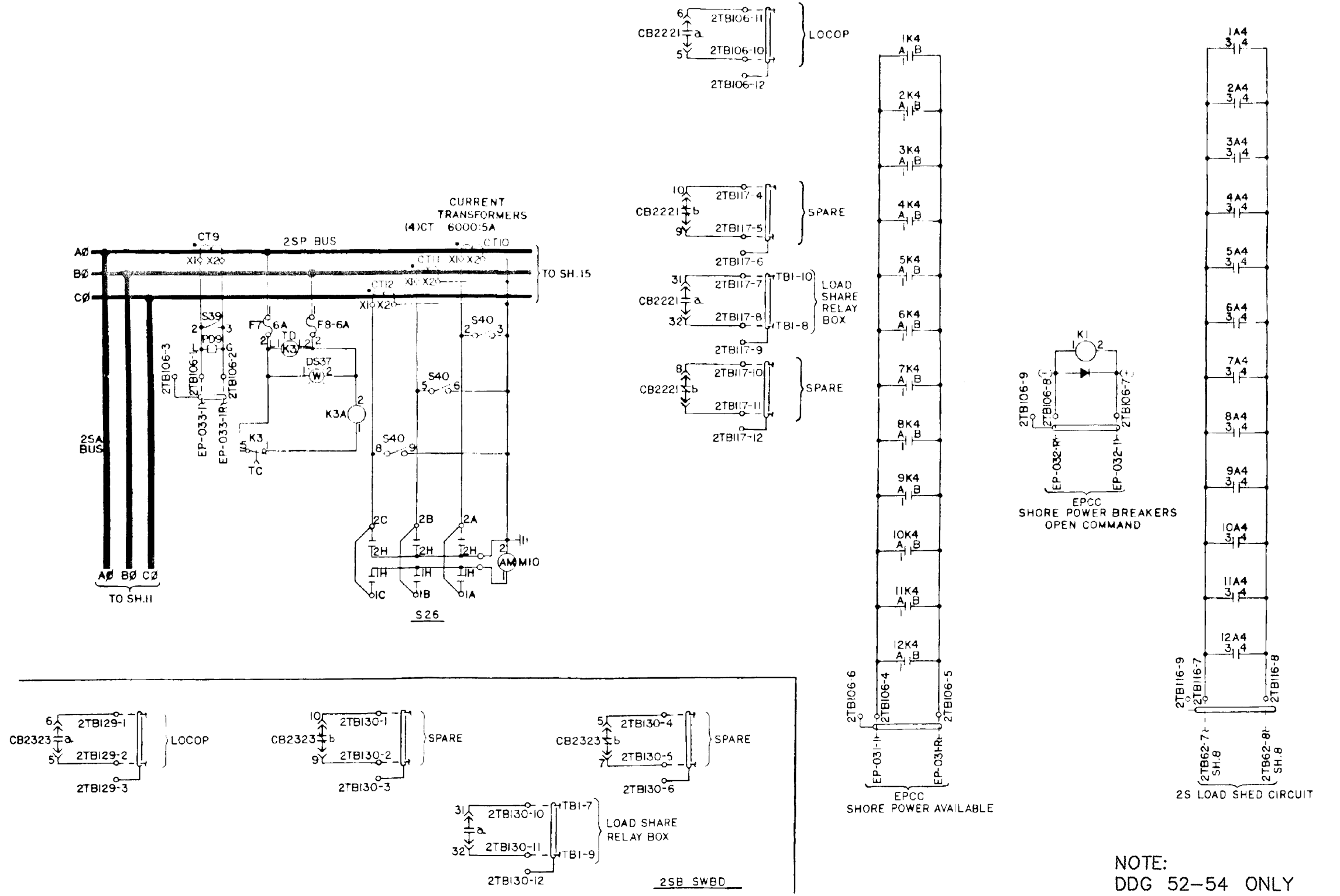
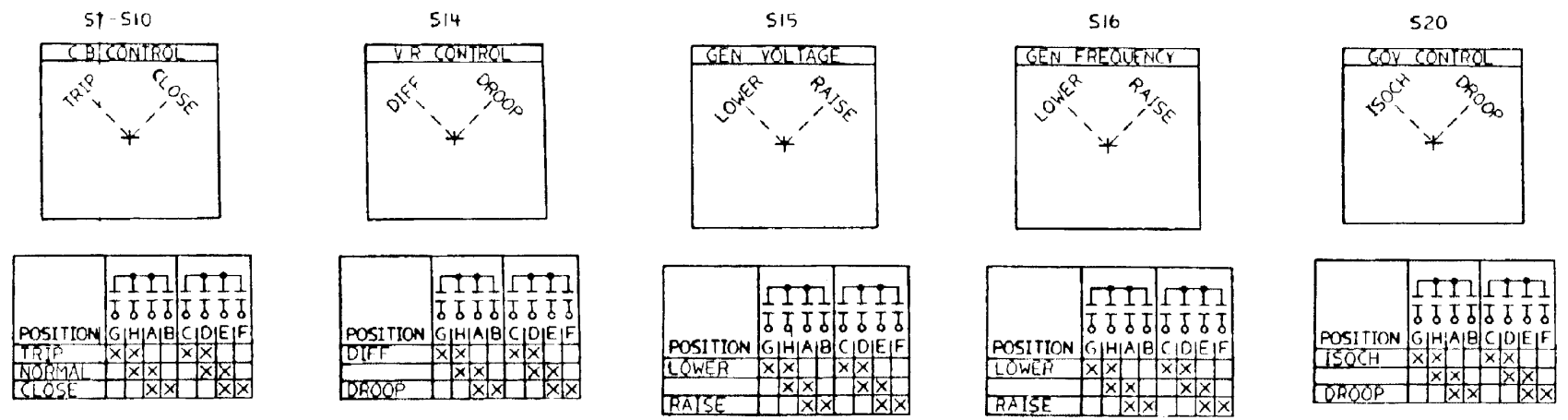
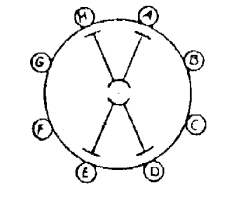


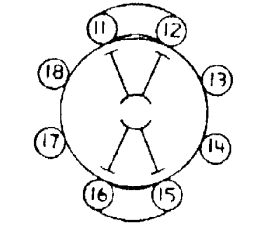
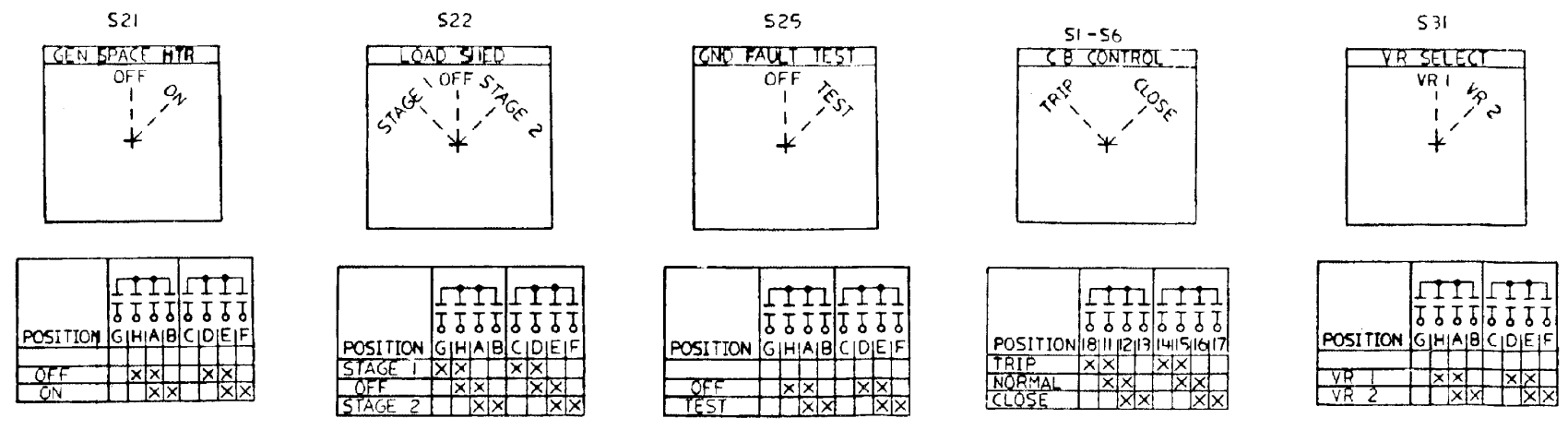
Figure 5-19. 2S Switchboard System; Schematic (Sheet 17 of 17)



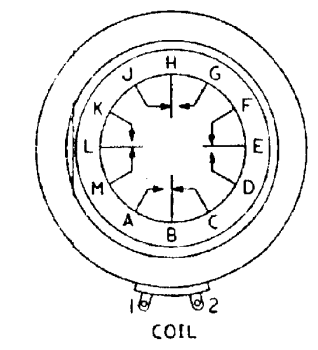
NOTE: SWITCHES S7-S10, S14-S16, S20, S22 & S25 ARE SPRING RETURN TO NORMAL/OFF POSITION.



TYPICAL
S14-S16, S20-S21, S25, S31.
1 SECTION
S7-S10
2 SECTIONS
S22
3 SECTIONS

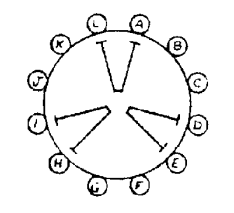
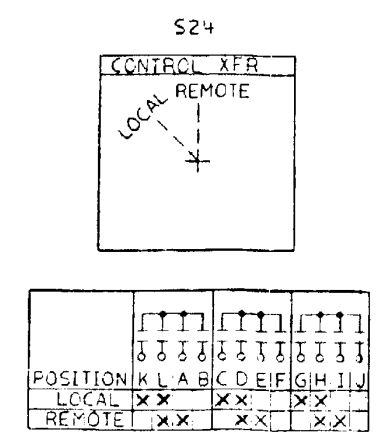
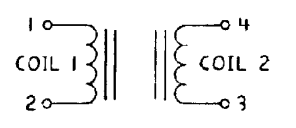


TYPICAL
S1-S6
2 SECTIONS
(SPRING RETURN TO NORMAL)



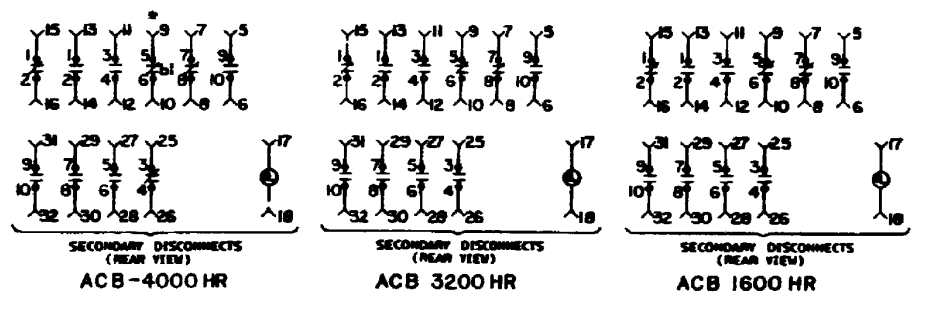
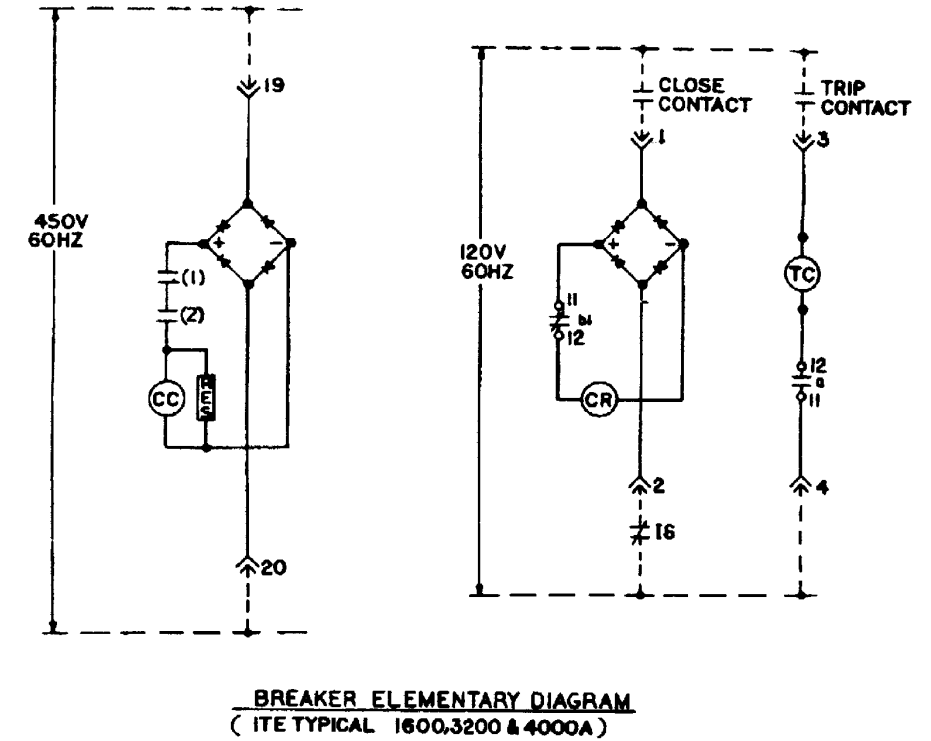
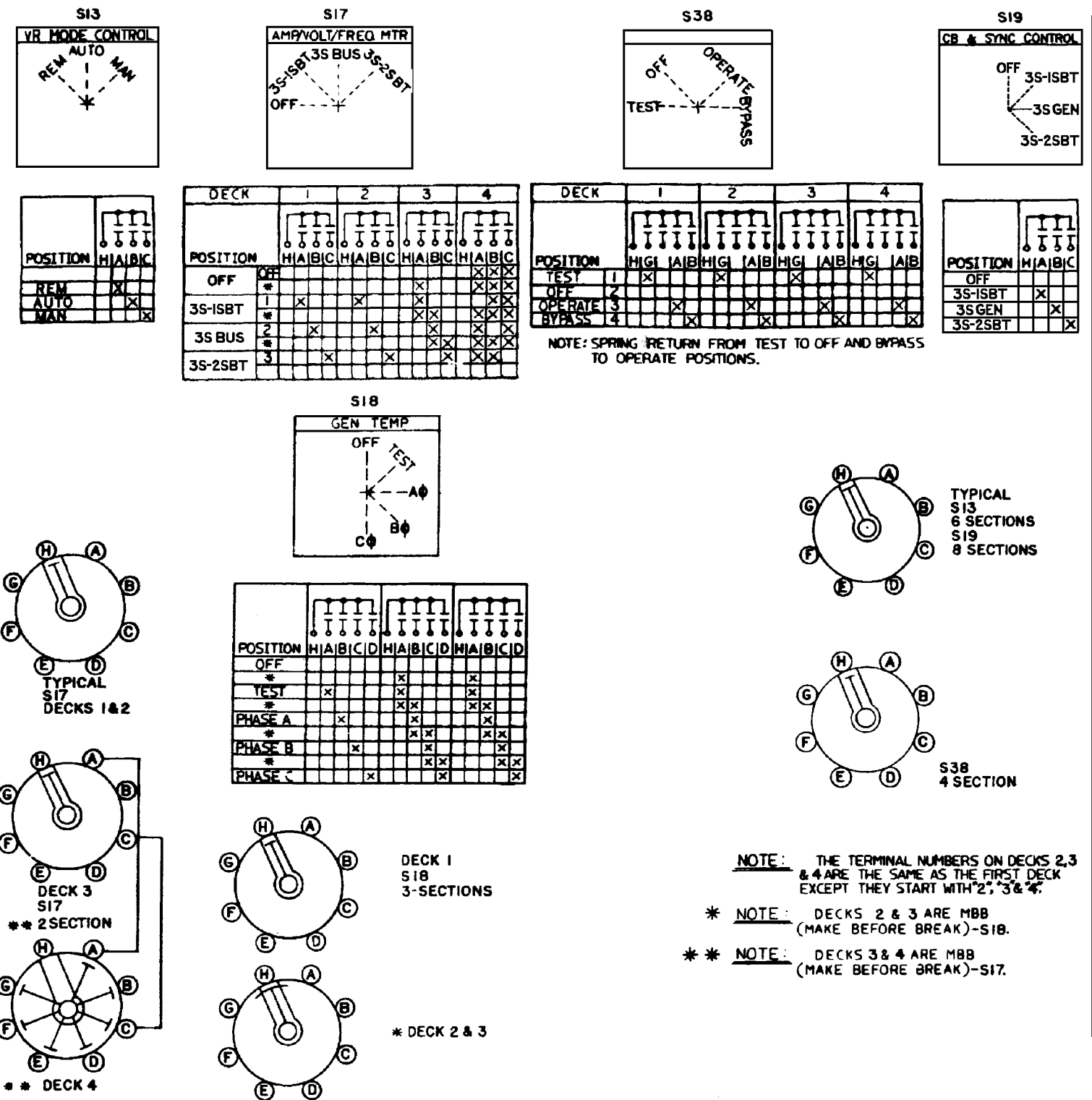
TYPICAL OF ALL ROTARY RELAYS SECTION ONE & COIL SHOWN DE-ENERGIZED

LATCHING RELAYS HAVE THE SAME CONTACT ARRANGEMENT WITH COIL N° 1 (LC) ENERGIZED CONTACTS A-B, D-E, G-H & K-L CLOSE



TYPICAL
S24
9 SECTIONS

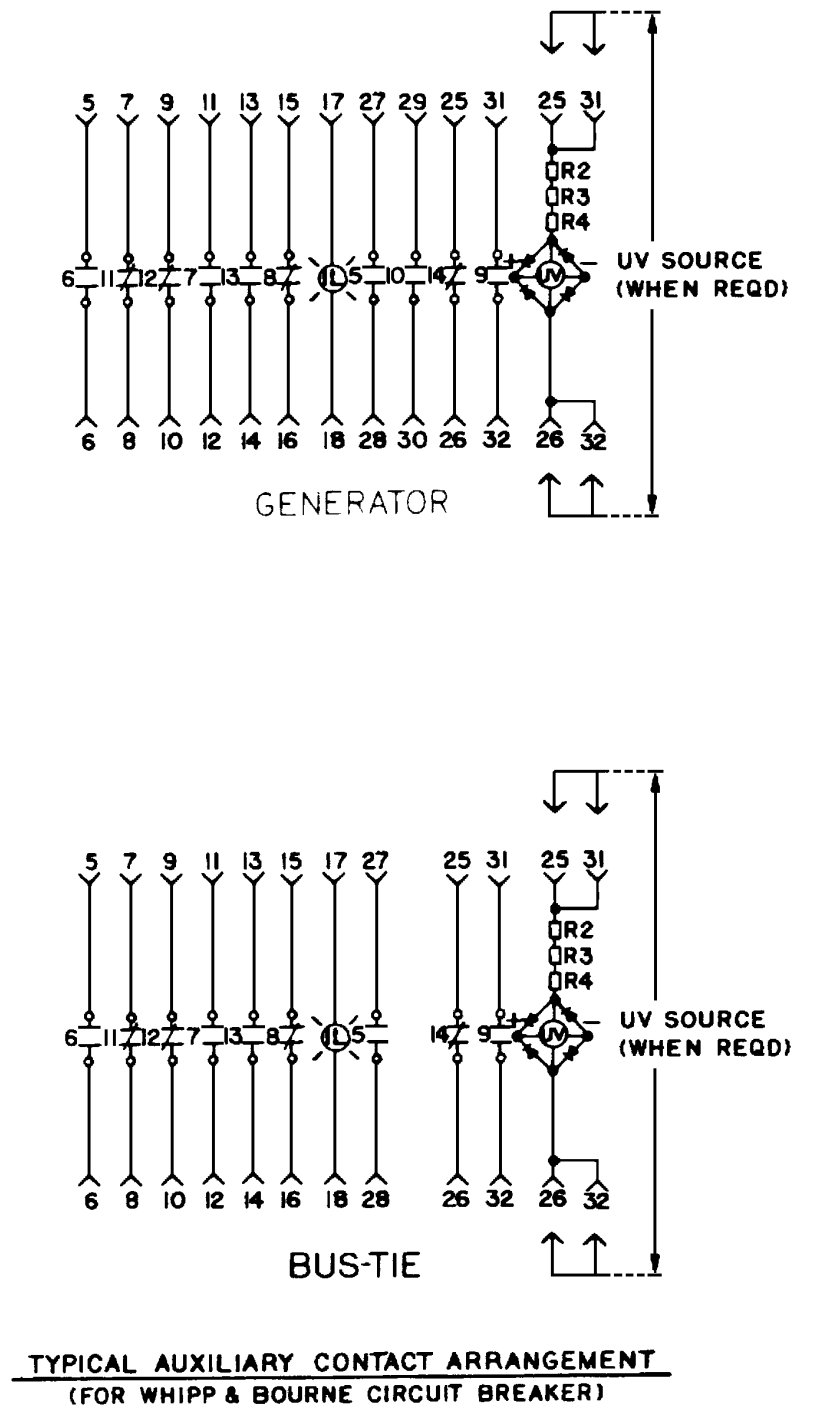
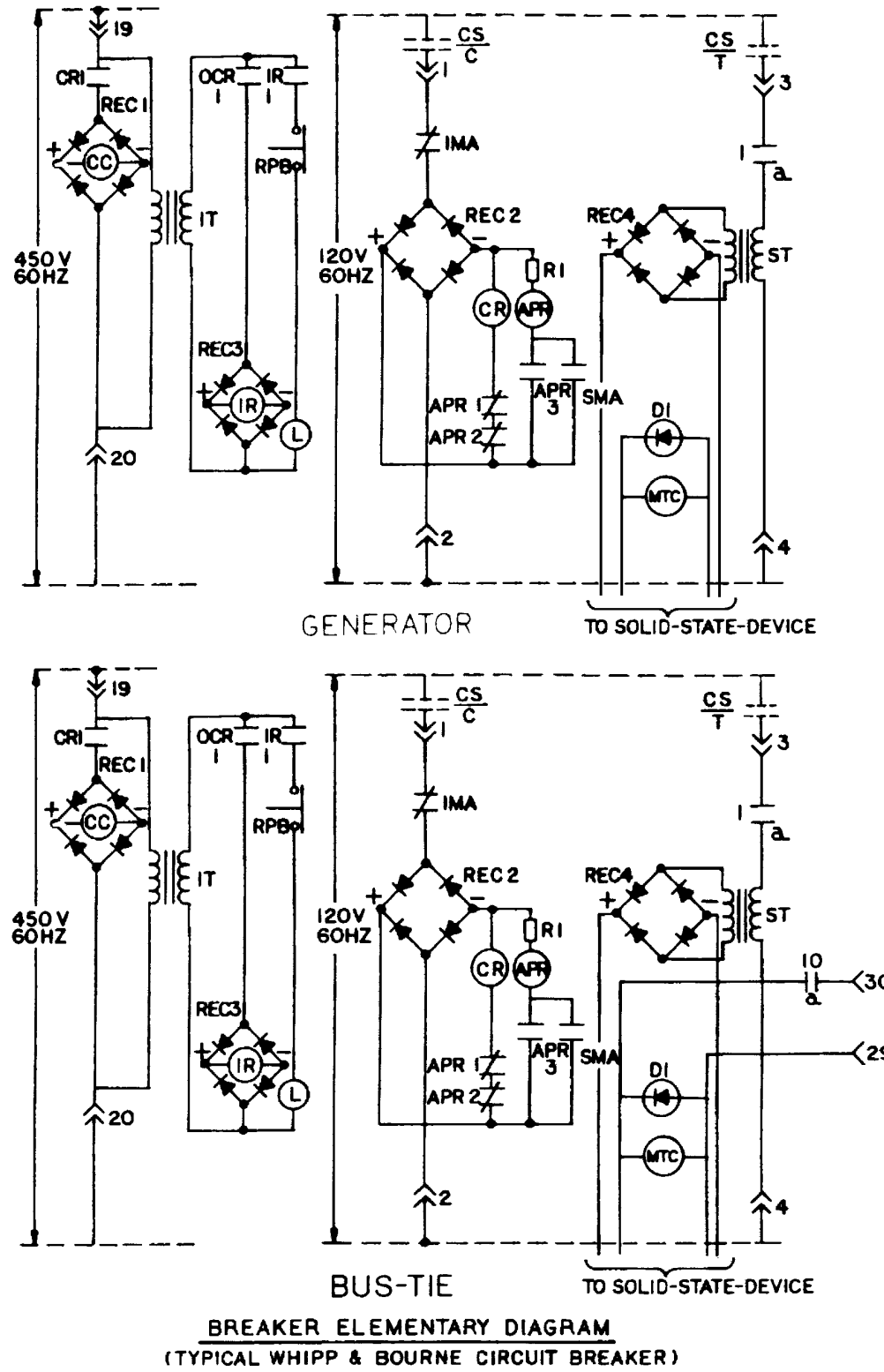
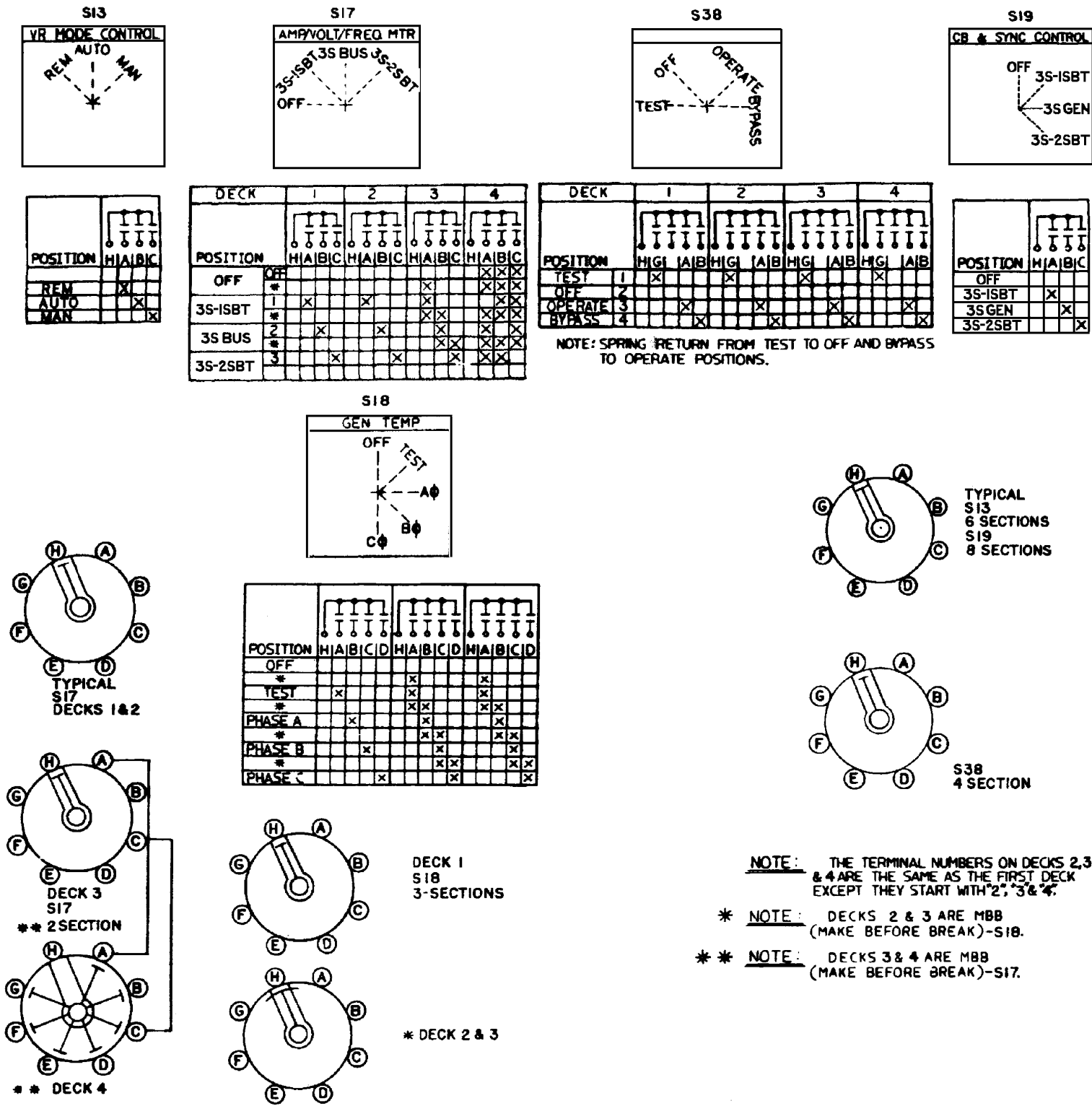
Figure 5-20. 3S Switchboard System; Schematic (Sheet 1 of 20)



* LONG 'b'

NOTE:
DDG 51 ONLY

Figure 5-20. 3S Switchboard System; Schematic (Sheet 2 of 20)



NOTE:
DDG 52-54 ONLY

Figure 5-20. 3S Switchboard System; Schematic (Sheet 2 of 20)

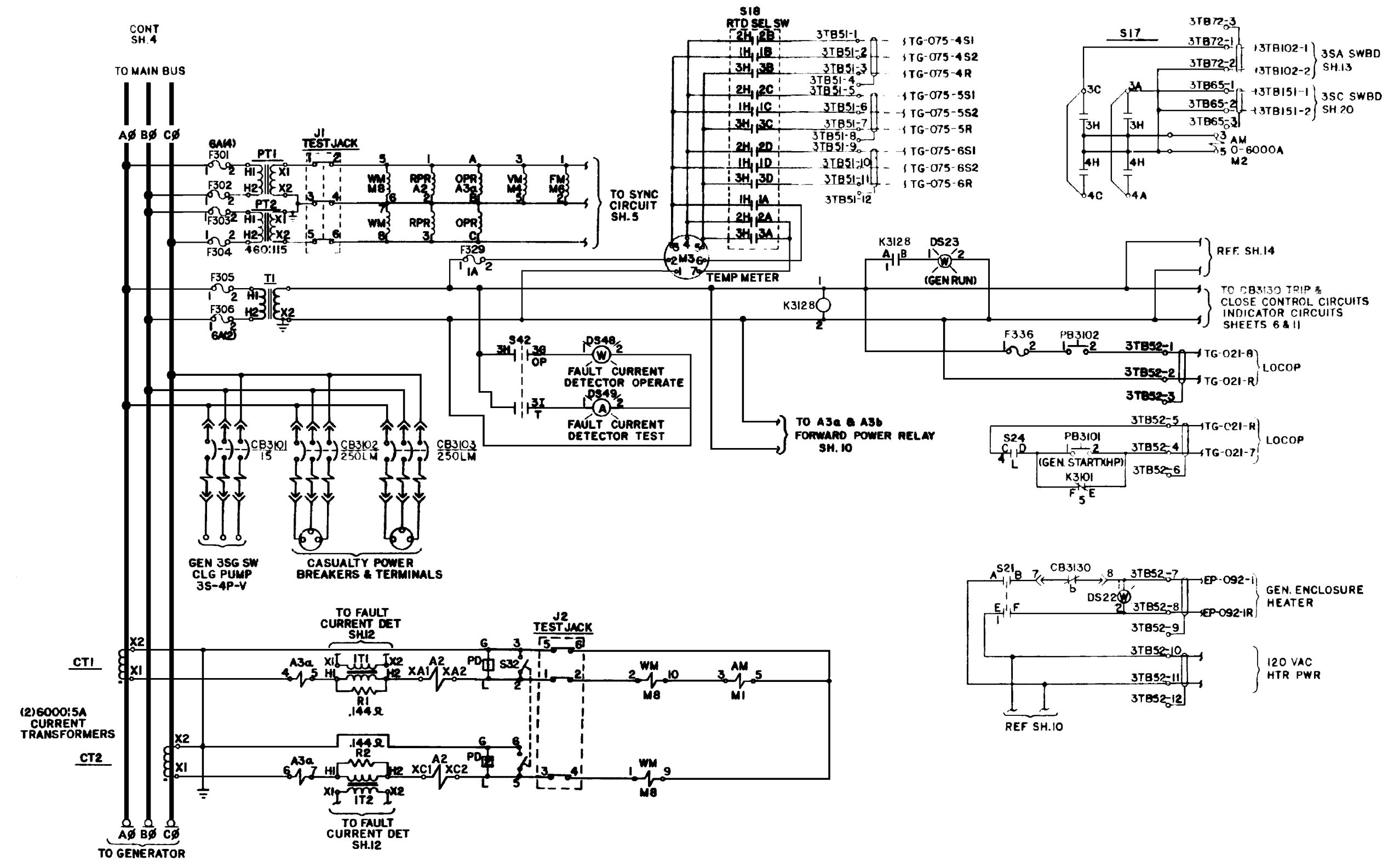


Figure 5-20. 3S Switchboard System; Schematic (Sheet 3 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

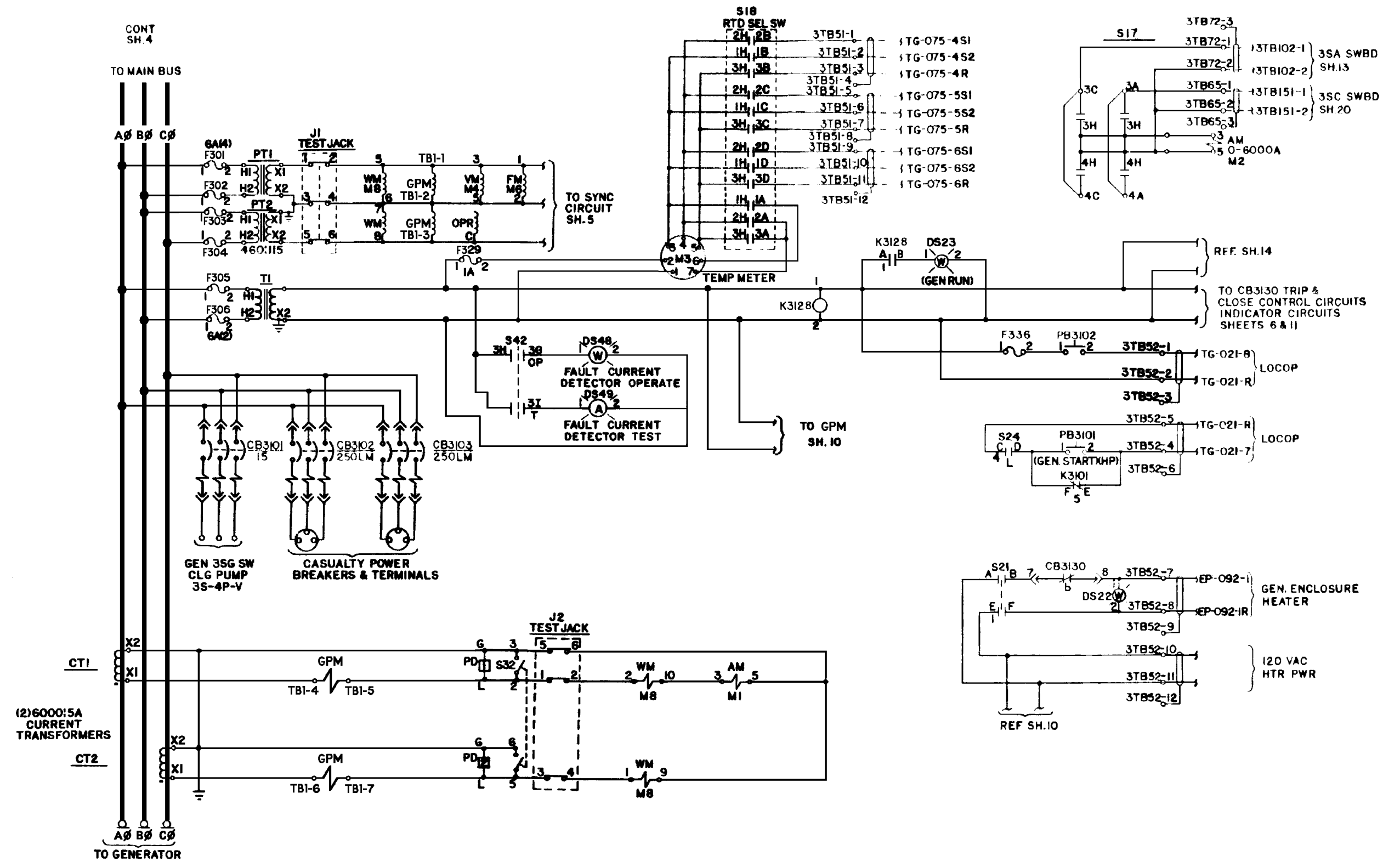


Figure 5-20. 3S Switchboard System; Schematic (Sheet 3 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

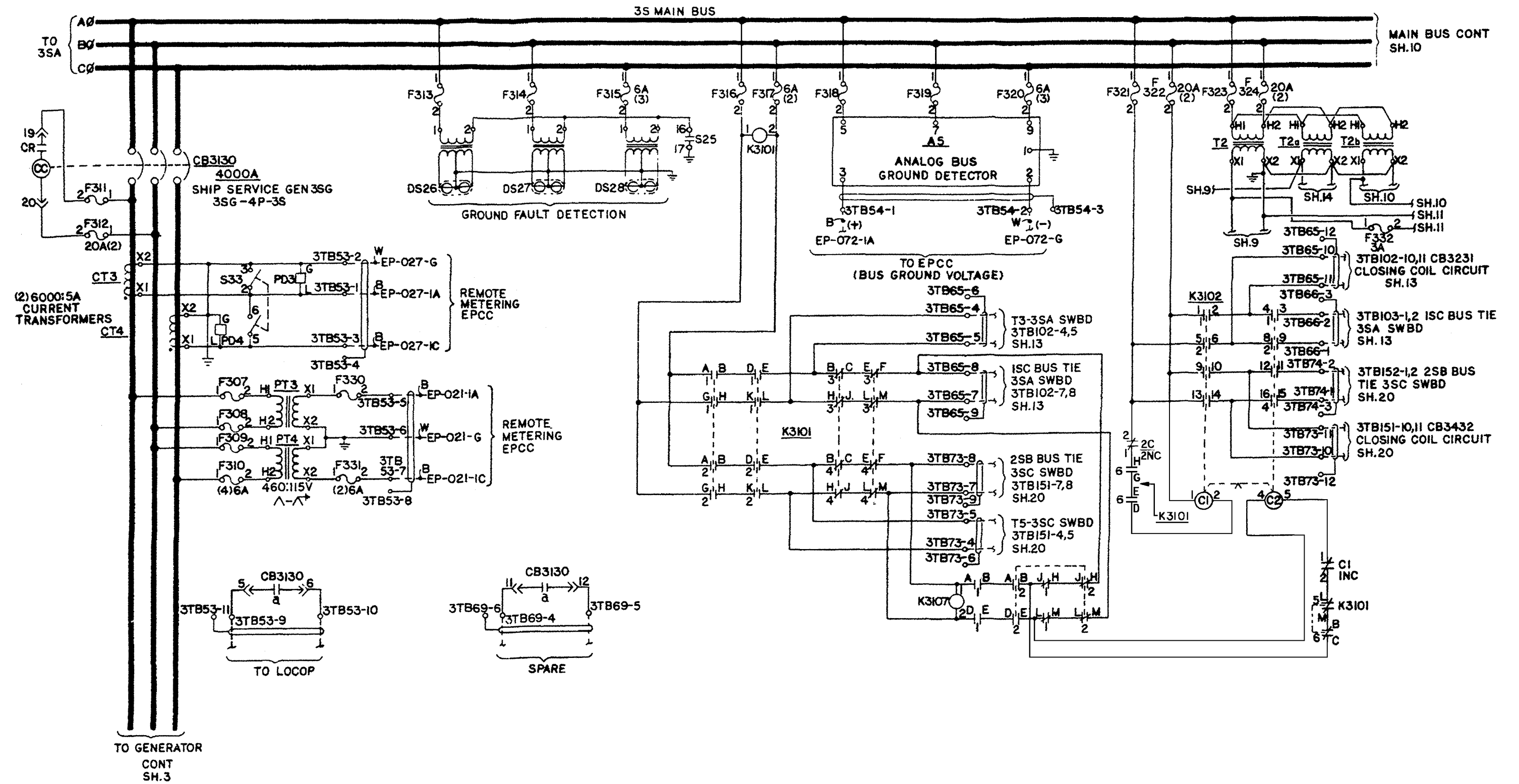


Figure 5-20. 3S Switchboard System; Schematic (Sheet 4 of 20)

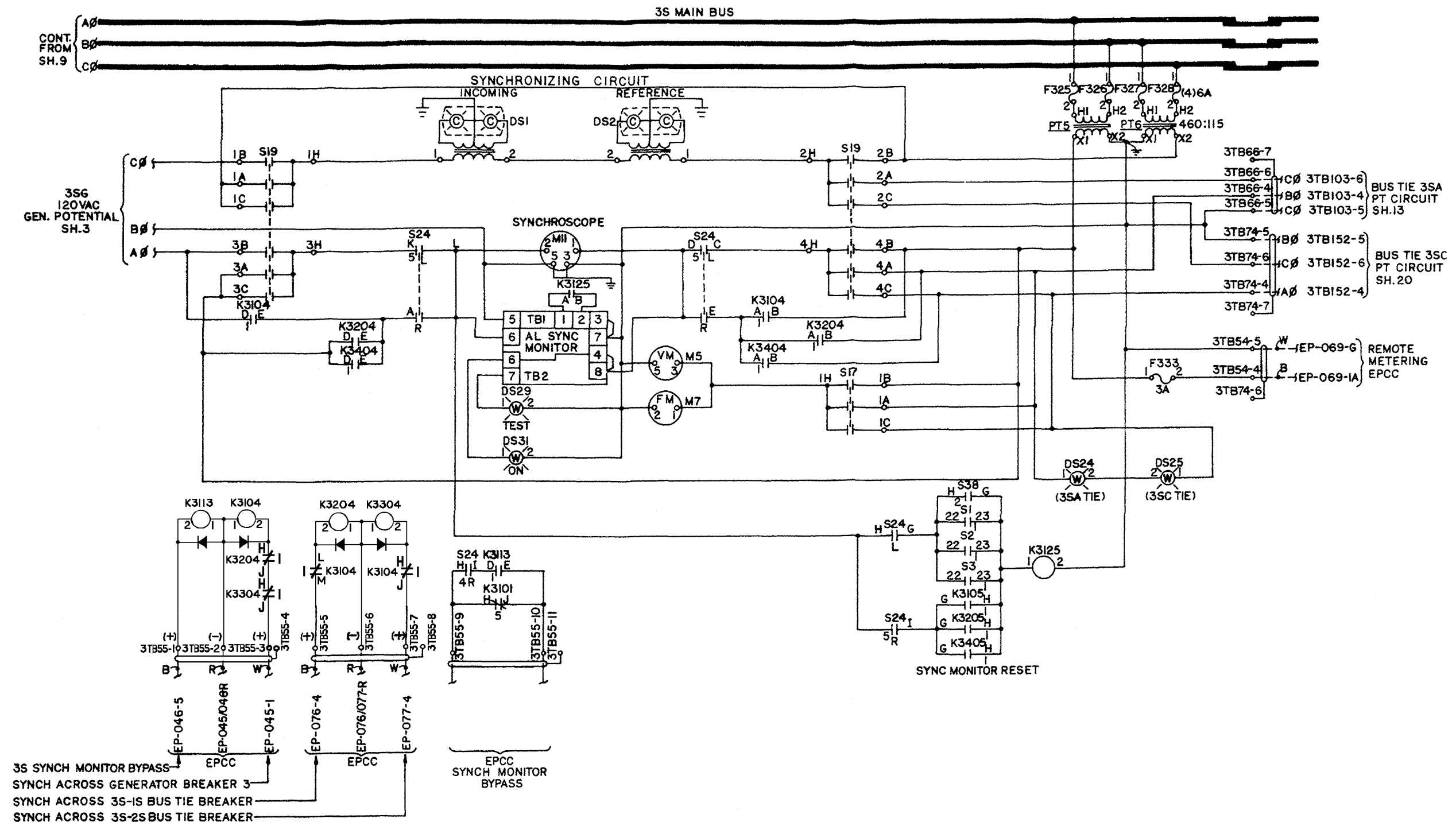


Figure 5-20. 3S Switchboard System; Schematic (Sheet 5 of 20)

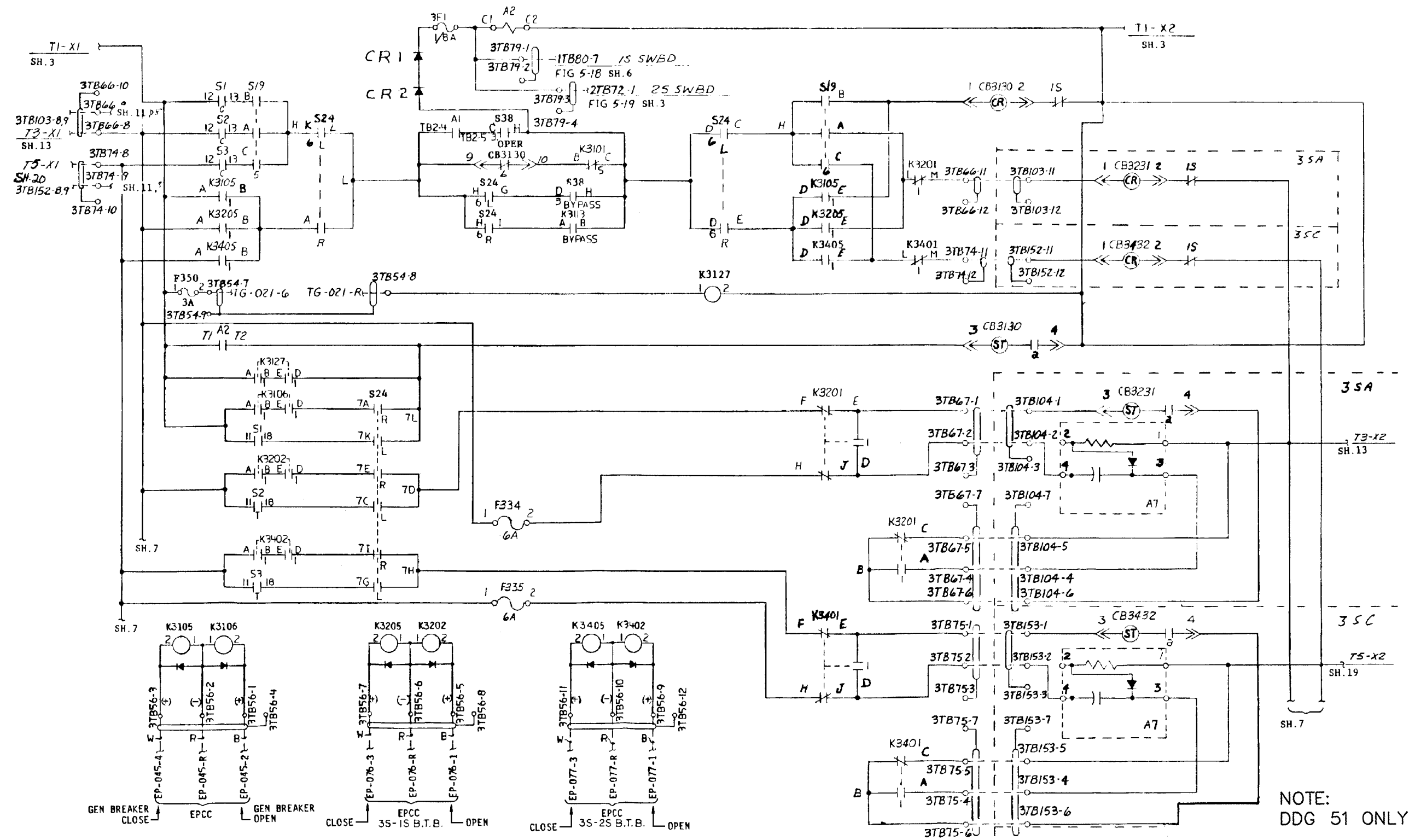


Figure 5-20. 3S Switchboard System; Schematic (Sheet 6 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

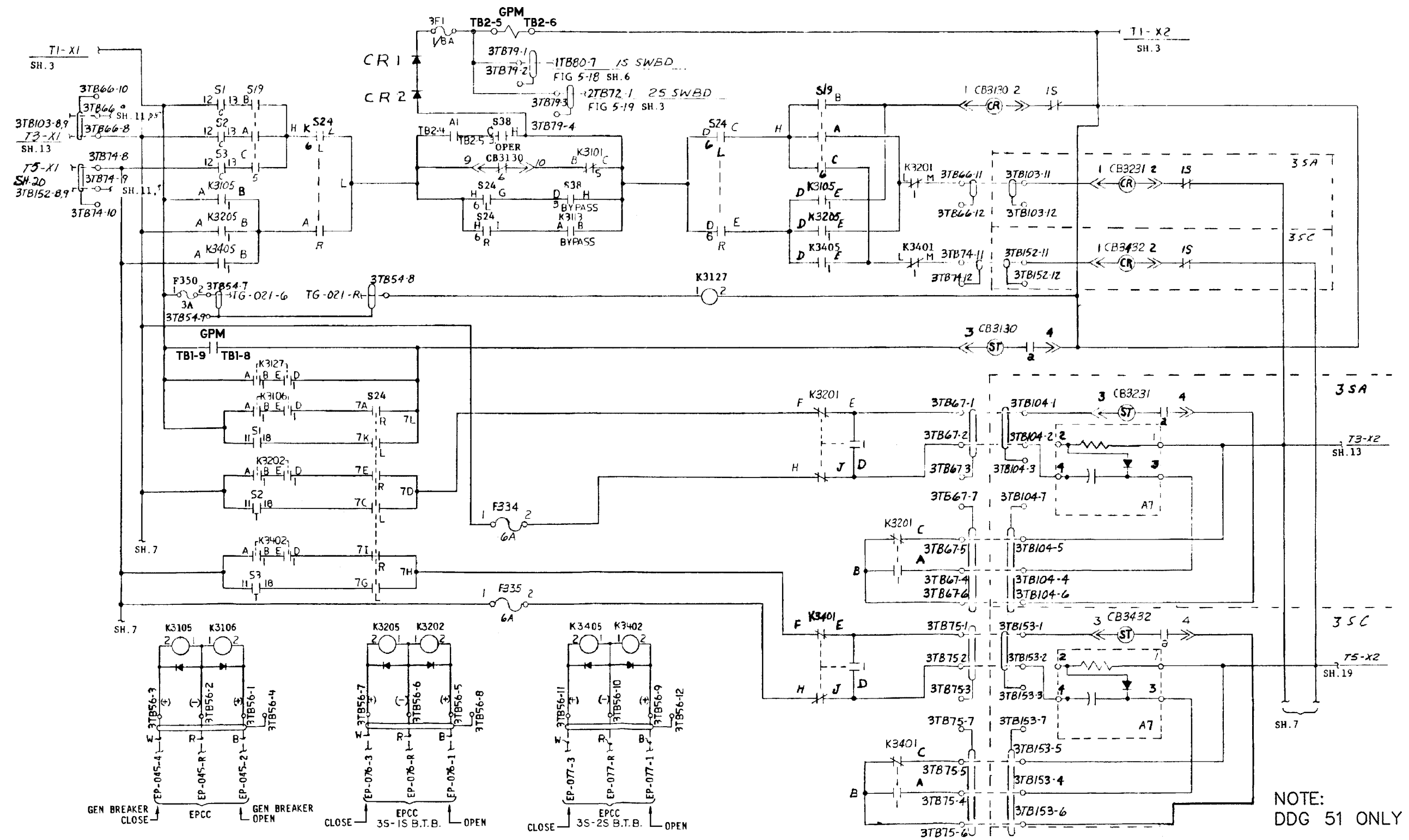


Figure 5-20. 3S Switchboard System; Schematic (Sheet 6 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

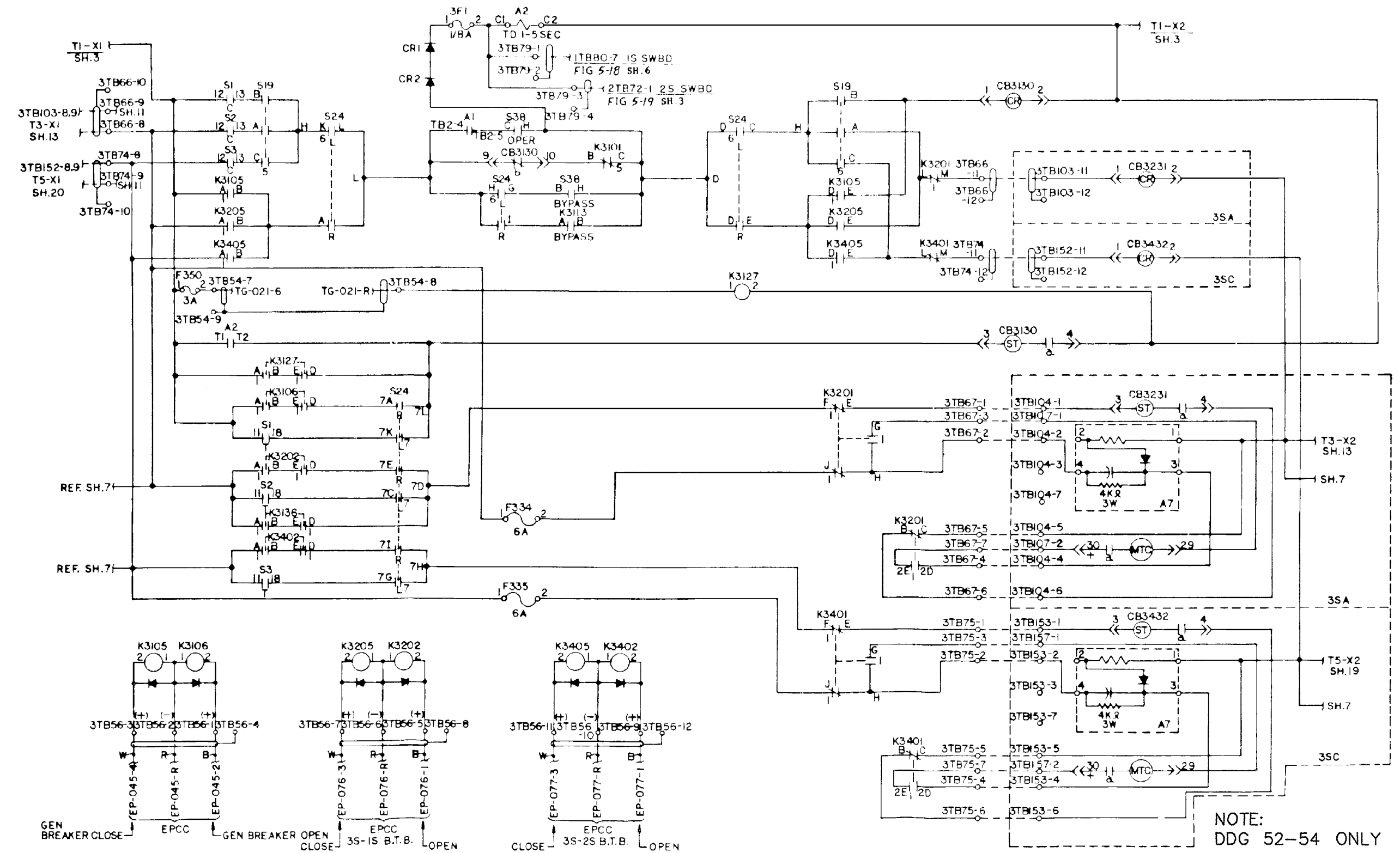


Figure 5-20. 3S Switchboard System; Schematic (Sheet 6 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

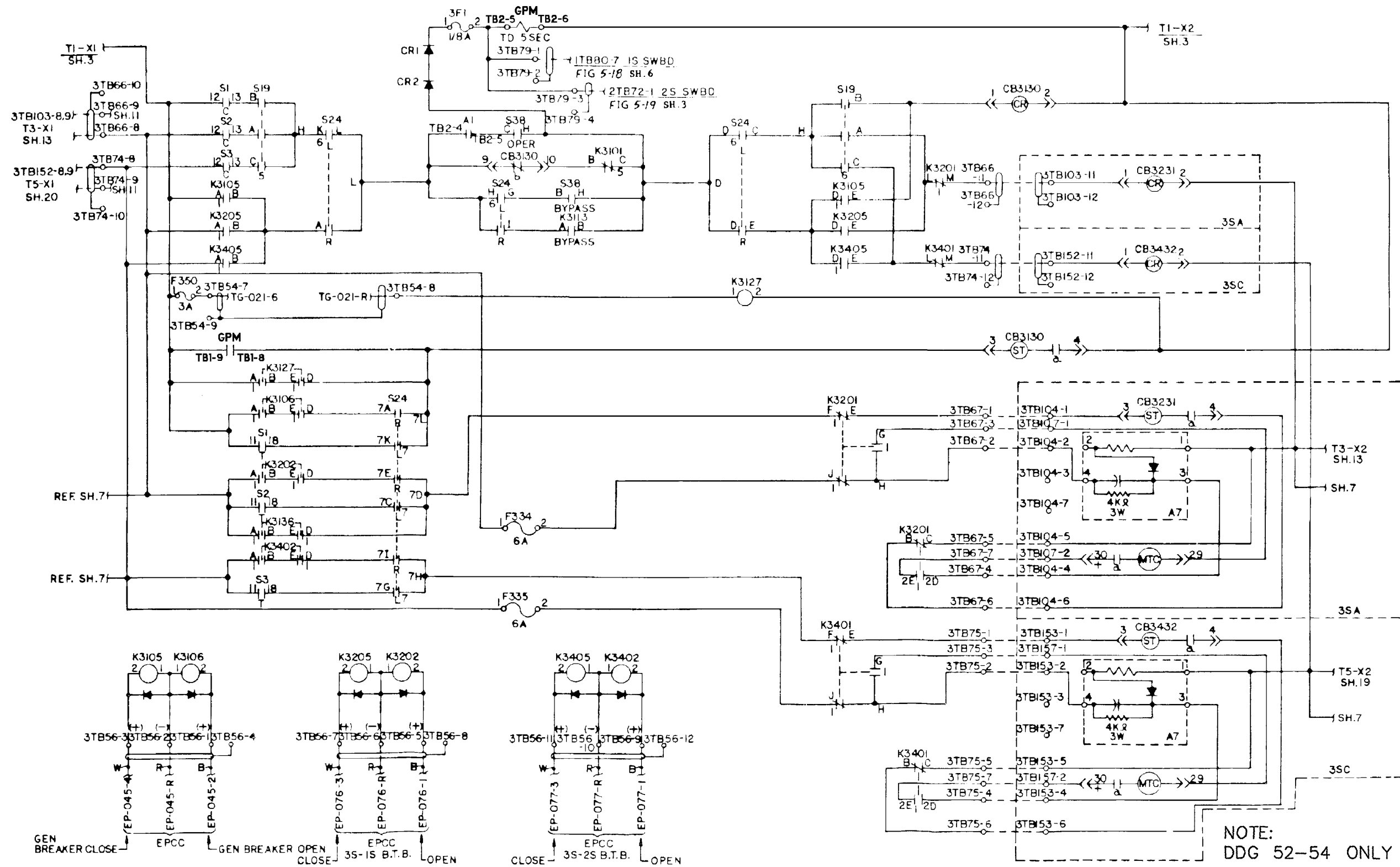
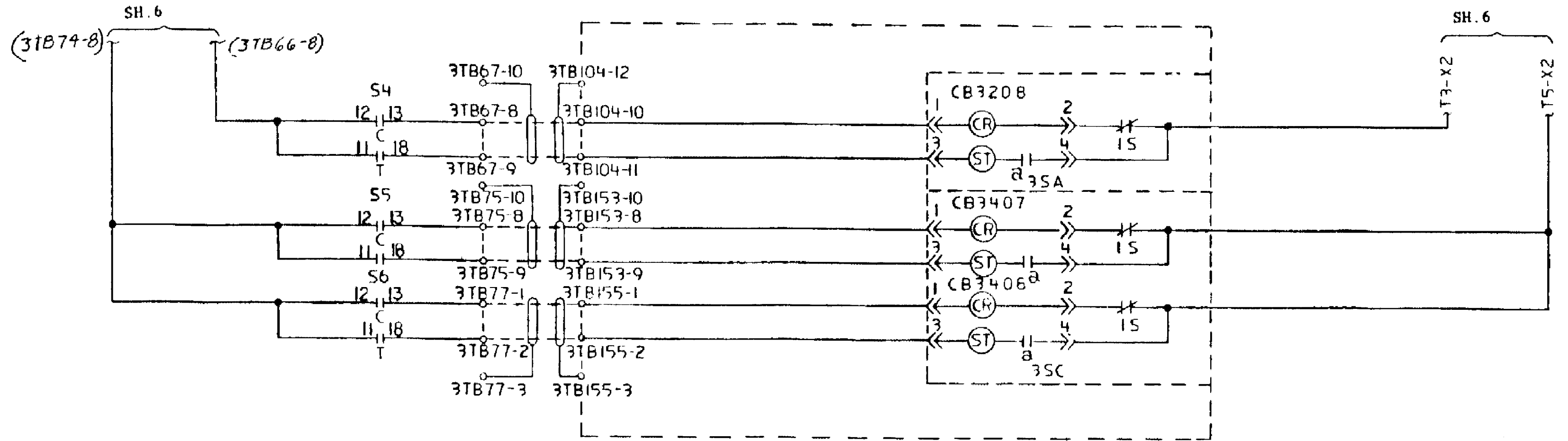
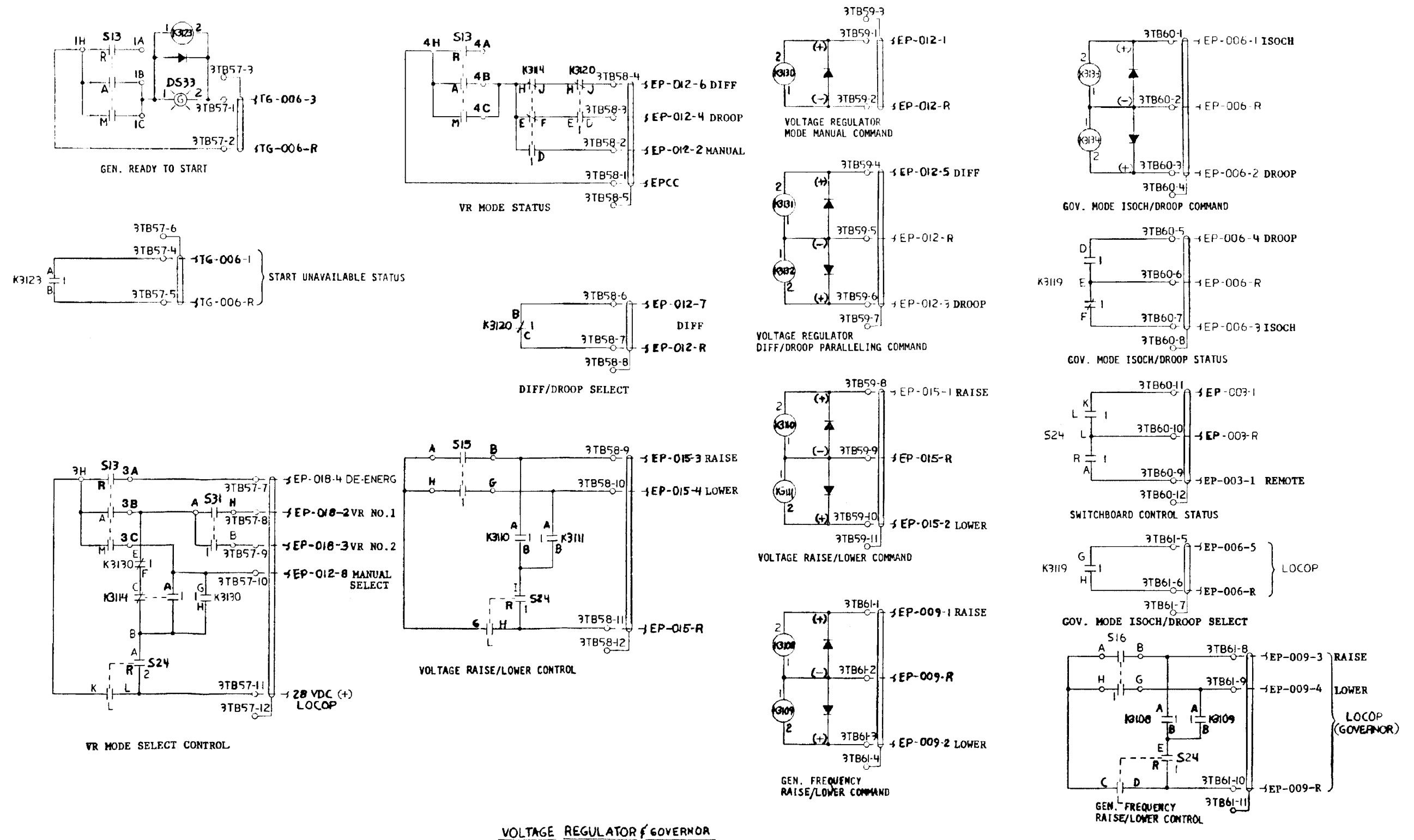


Figure 5-20. 3S Switchboard System; Schematic (Sheet 6 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



FEEDER BREAKER CLOSE & TRIP CIRCUITS

Figure 5-20. 3S Switchboard System; Schematic (Sheet 7 of 20)



VOLTAGE REGULATOR / GOVERNOR

Figure 5-20. 3S Switchboard System; Schematic (Sheet 8 of 20)

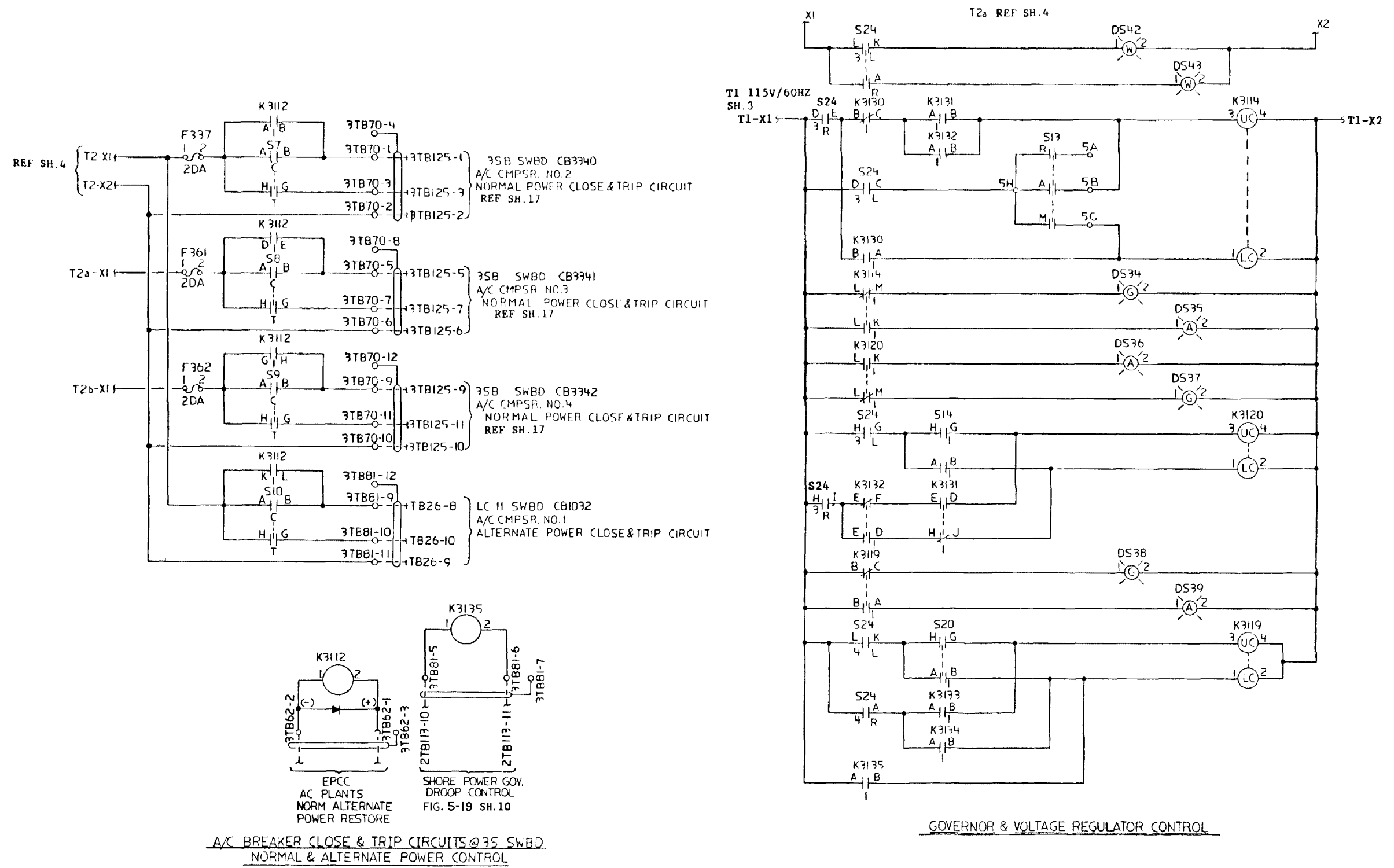


Figure 5-20. 3S Switchboard System; Schematic (Sheet 9 of 20)

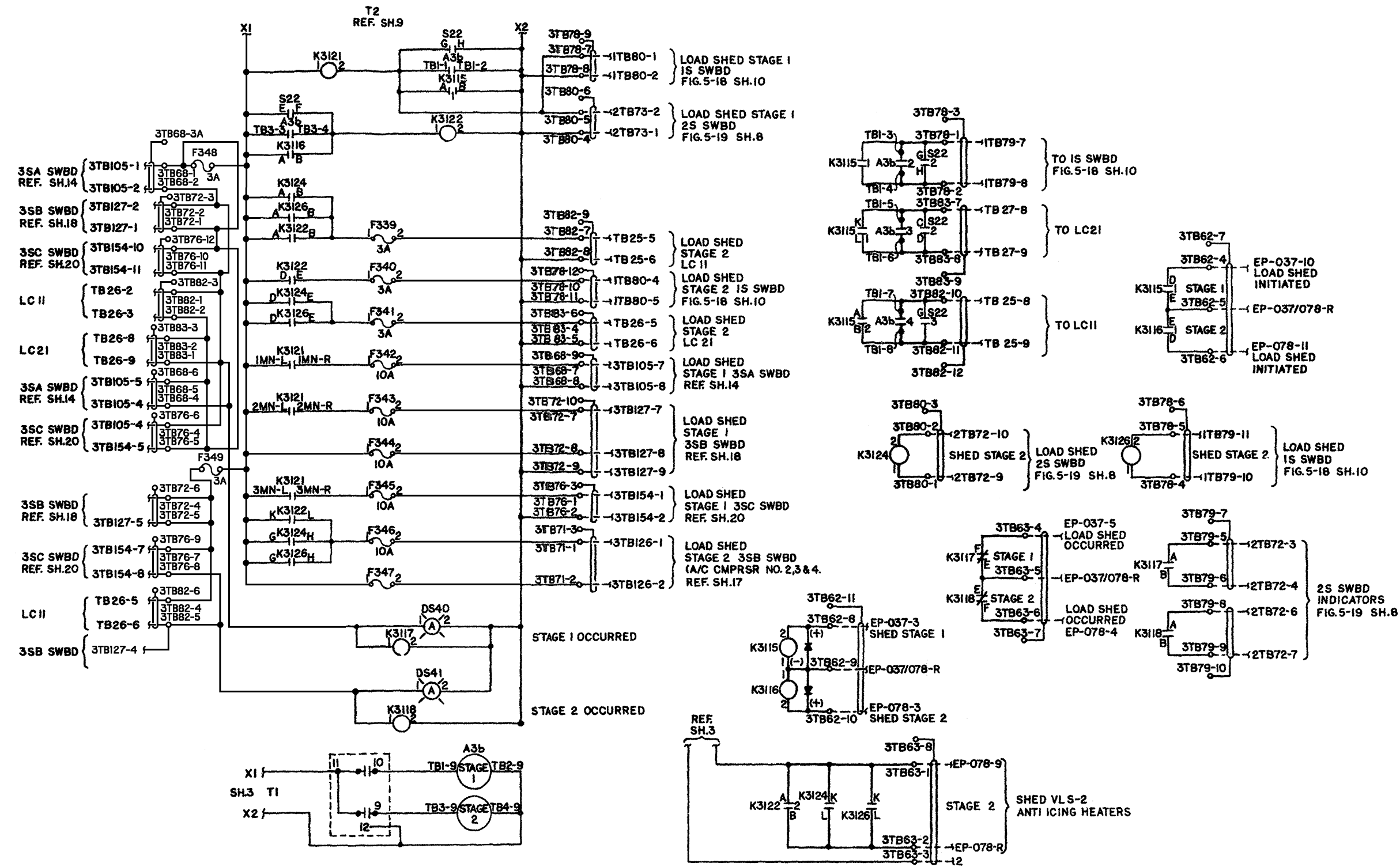


Figure 5-20. 3S Switchboard System; Schematic (Sheet 10 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

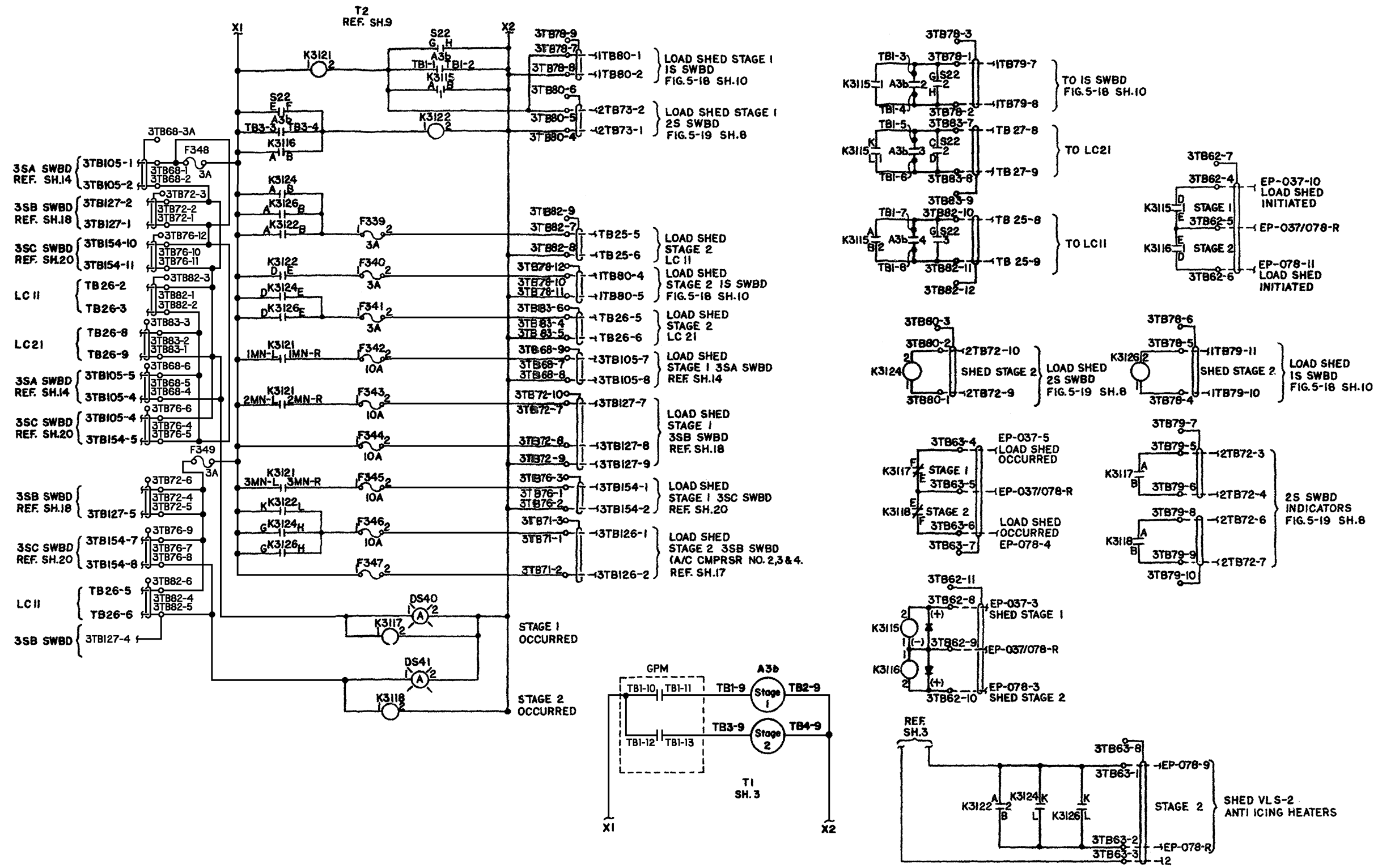


Figure 5-20. 3S Switchboard System; Schematic (Sheet 10 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

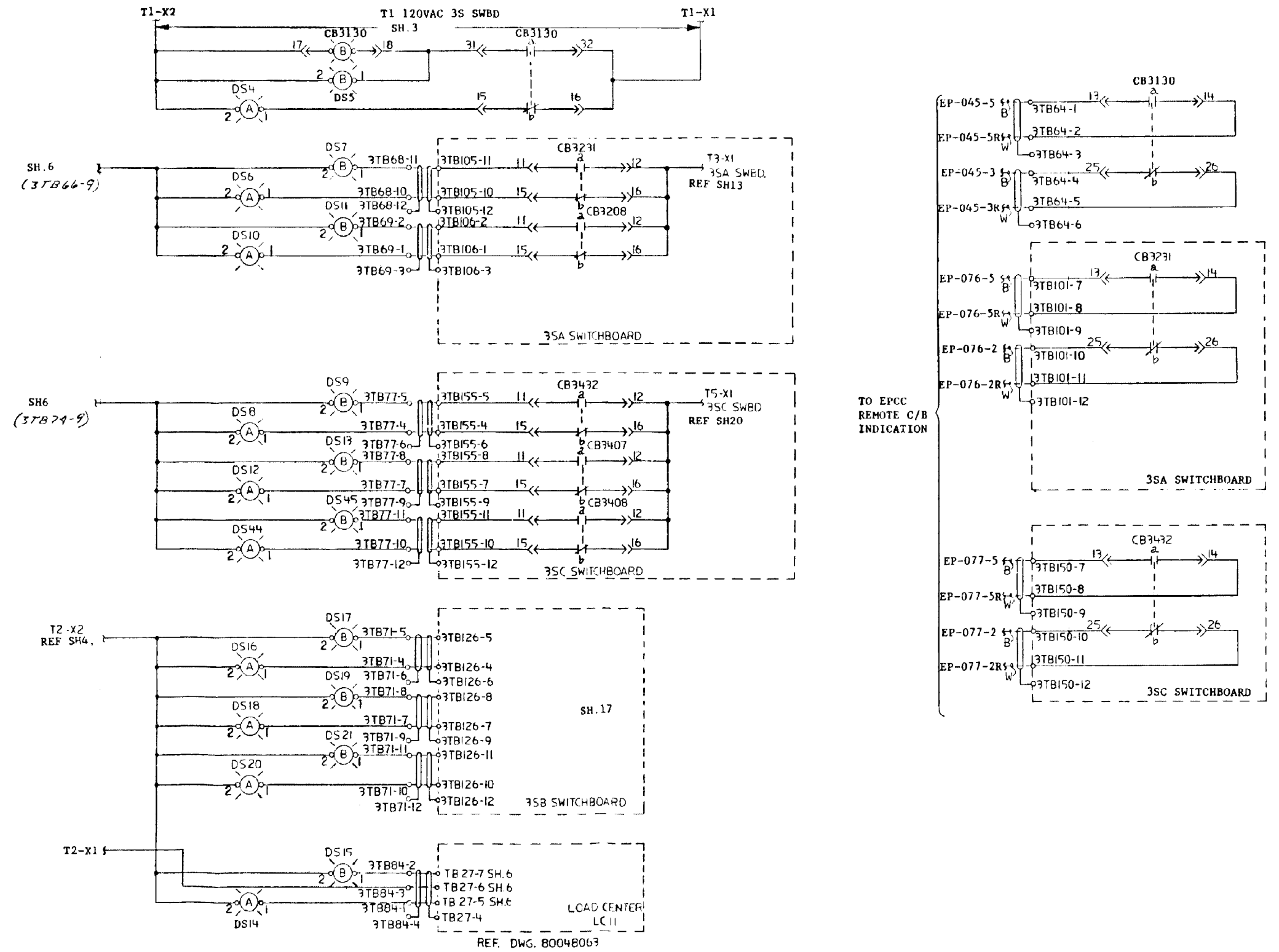
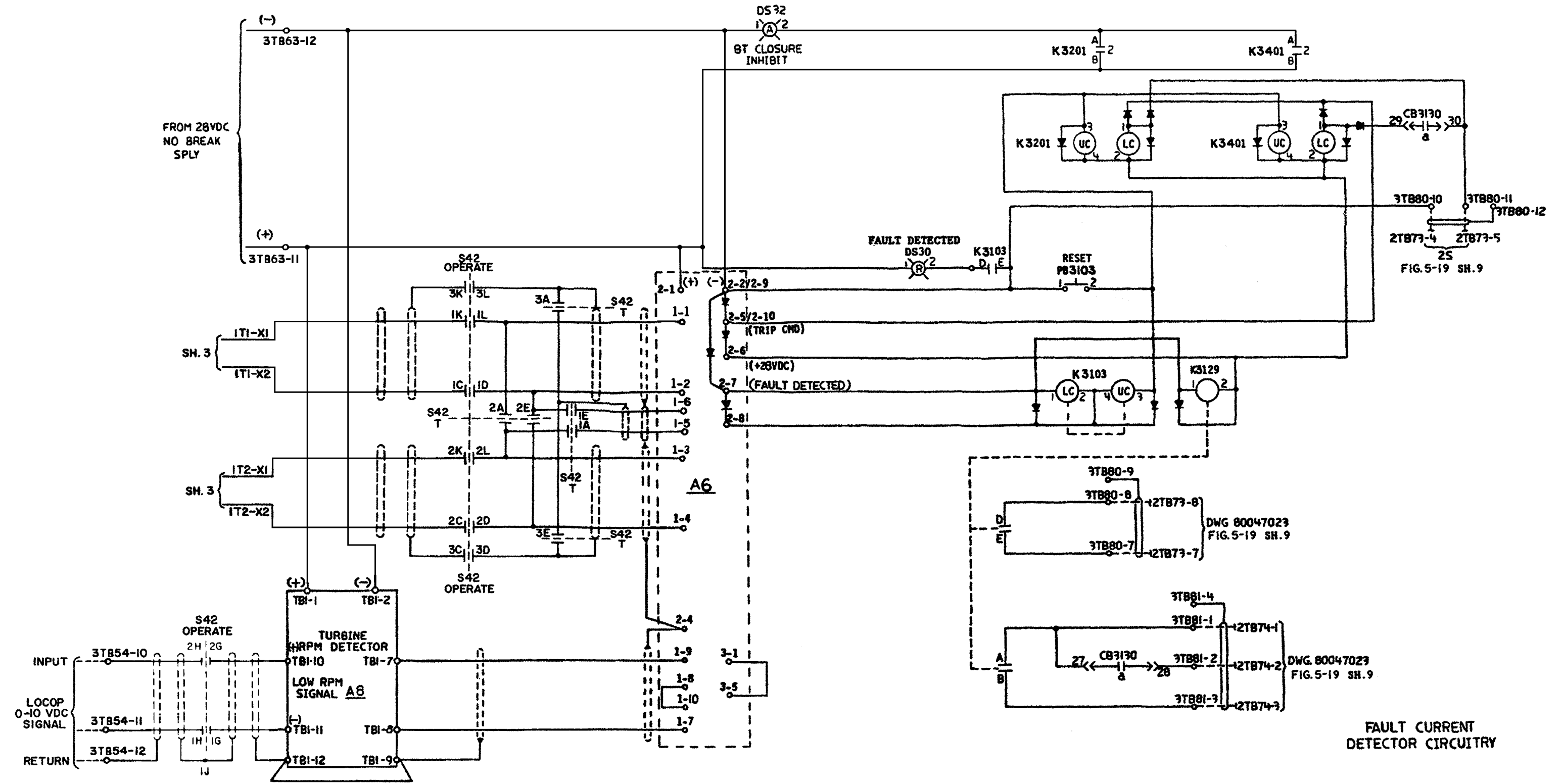
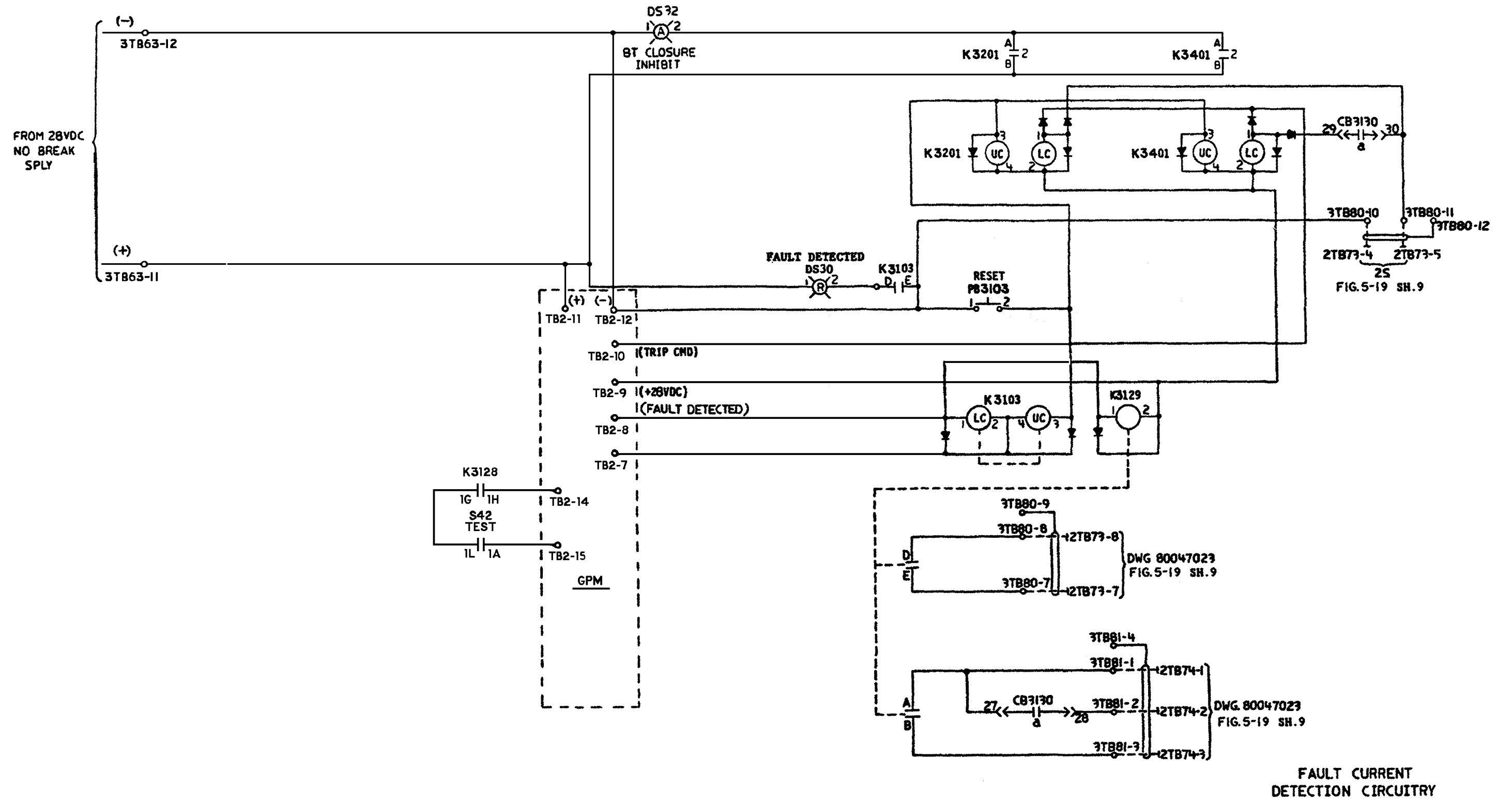


Figure 5-20. 3S Switchboard System; Schematic (Sheet 11 of 20)



FAULT CURRENT DETECTOR CIRCUITRY

Figure 5-20. 3S Switchboard System; Schematic (Sheet 12 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



**FAULT CURRENT
DETECTION CIRCUITRY**

Figure 5-20. 3S Switchboard System; Schematic (Sheet 12 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

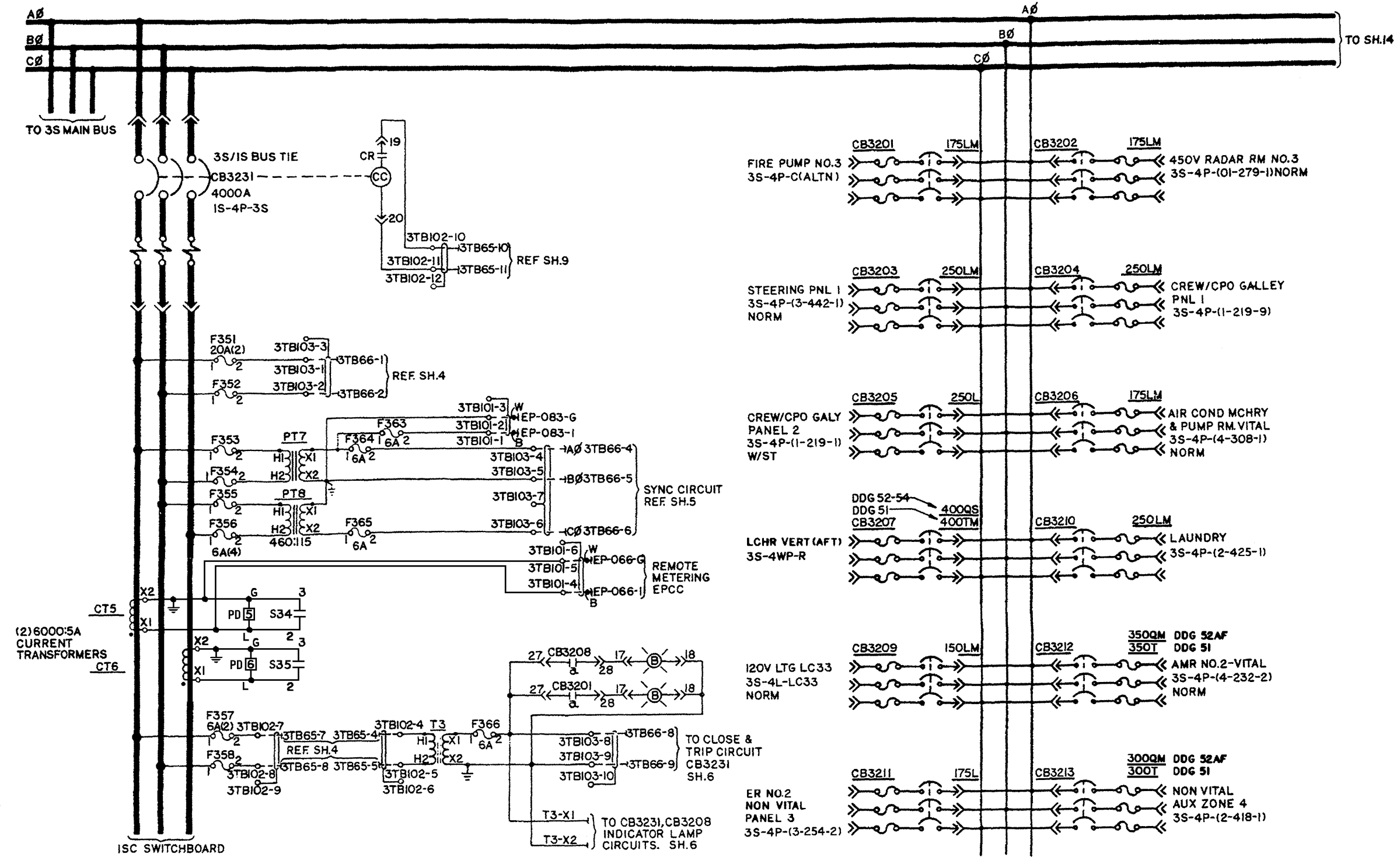


Figure 5-20. 3S Switchboard System; Schematic (Sheet 13 of 20)

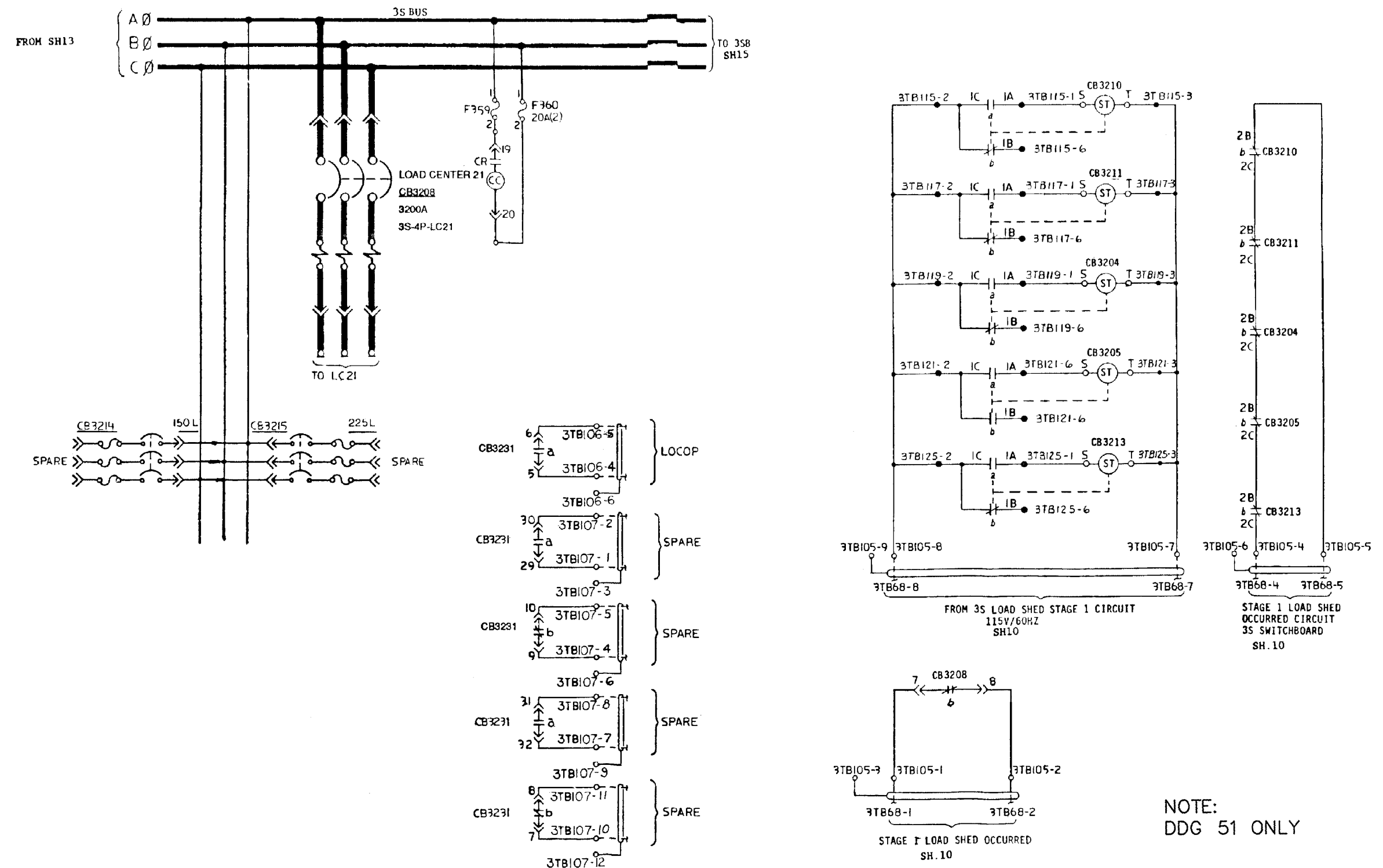


Figure 5-20. 3S Switchboard System; Schematic (Sheet 14 of 20)

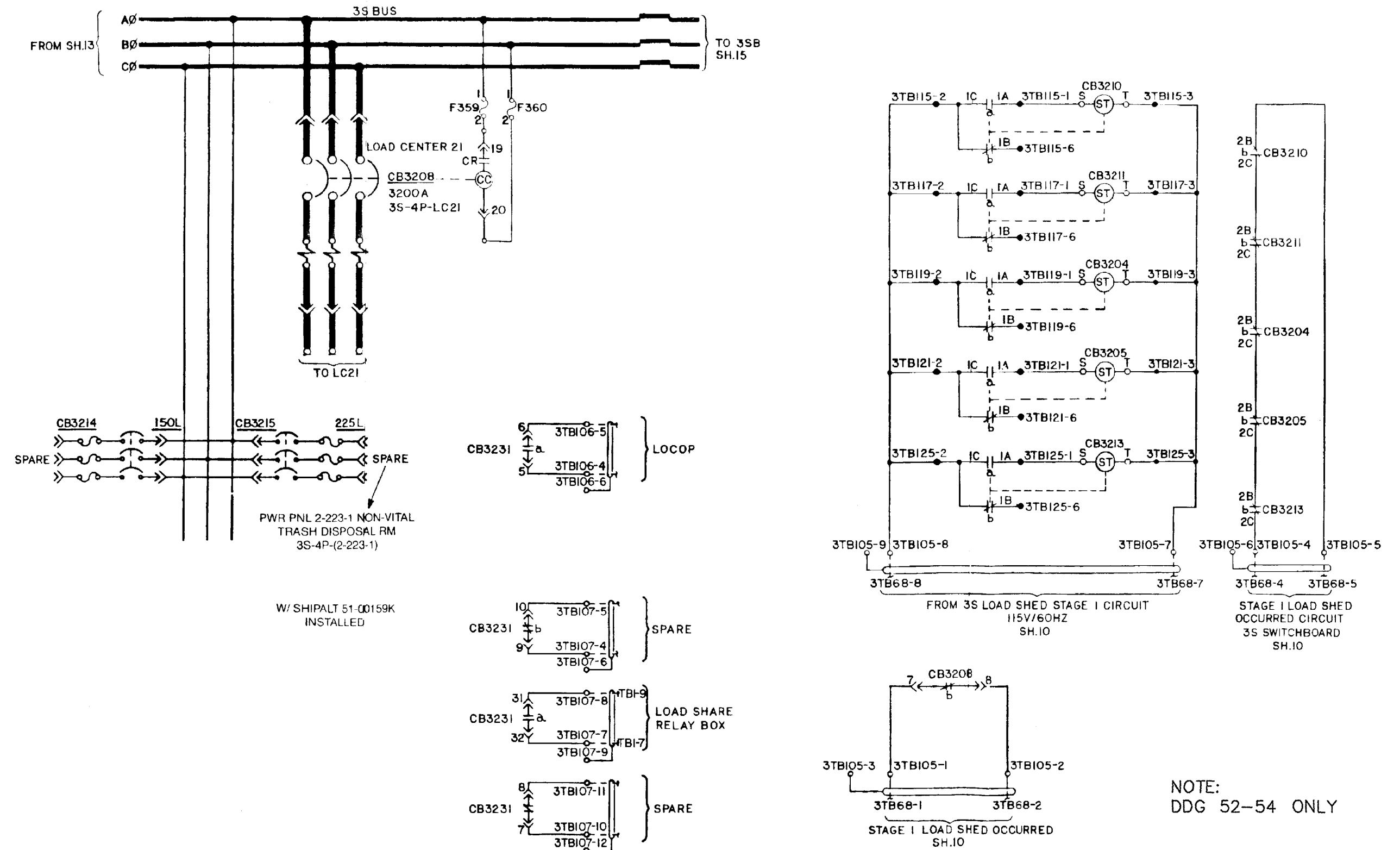


Figure 5-20. 3S Switchboard System; Schematic (Sheet 14 of 20)

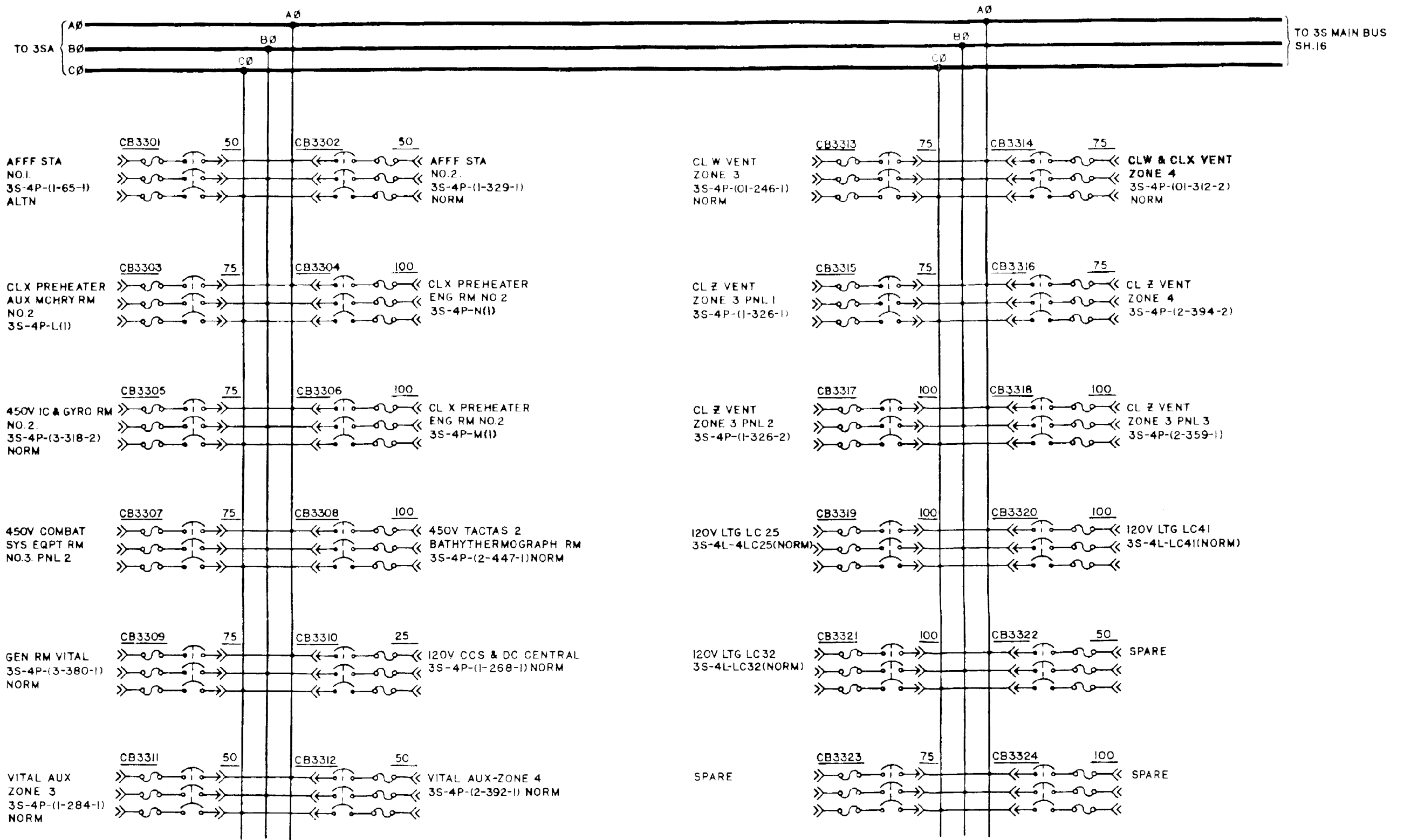


Figure 5-20. 3S Switchboard System; Schematic (Sheet 15 of 20)

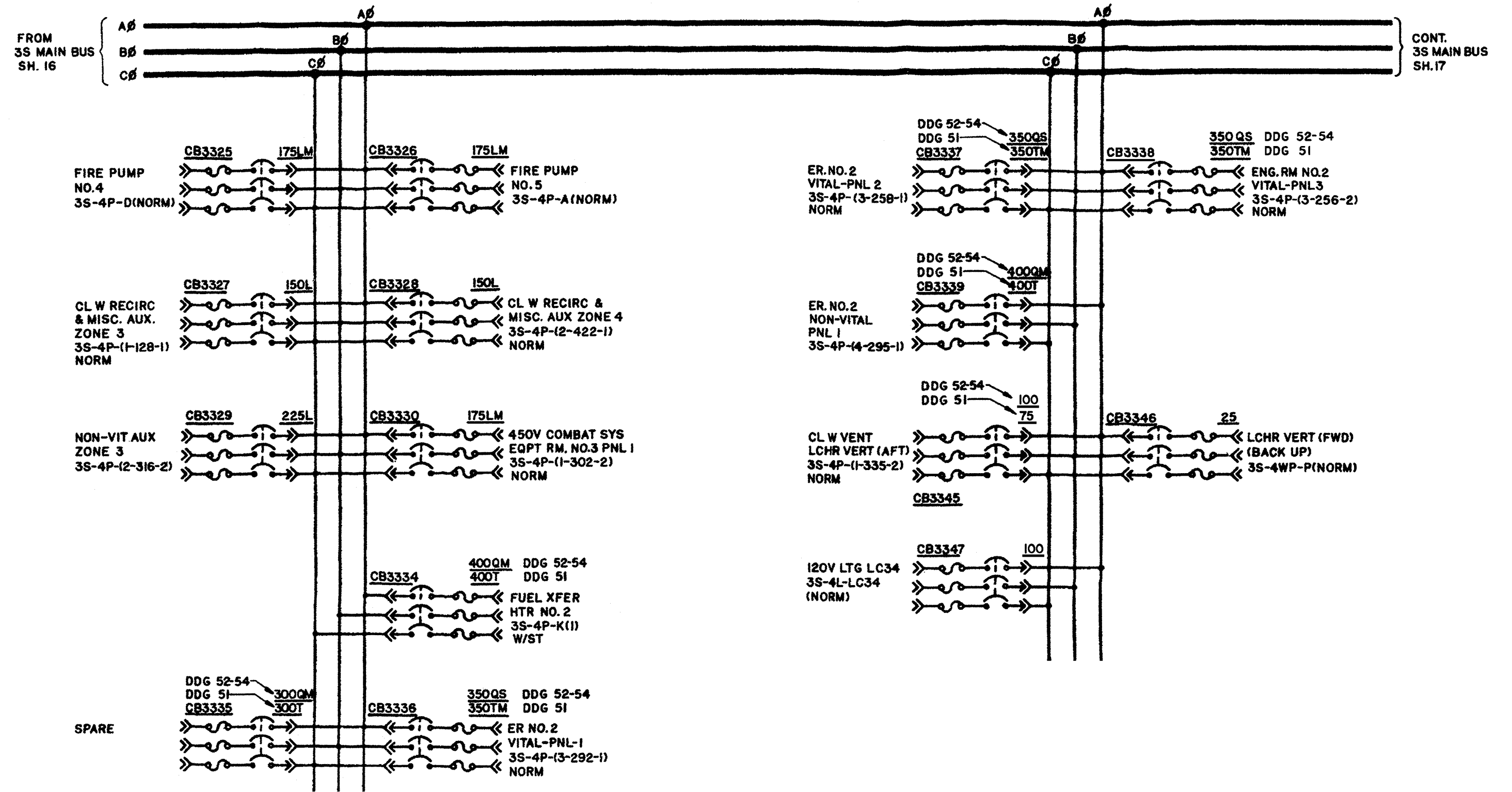


Figure 5-20. 3S Switchboard System; Schematic (Sheet 16 of 20)

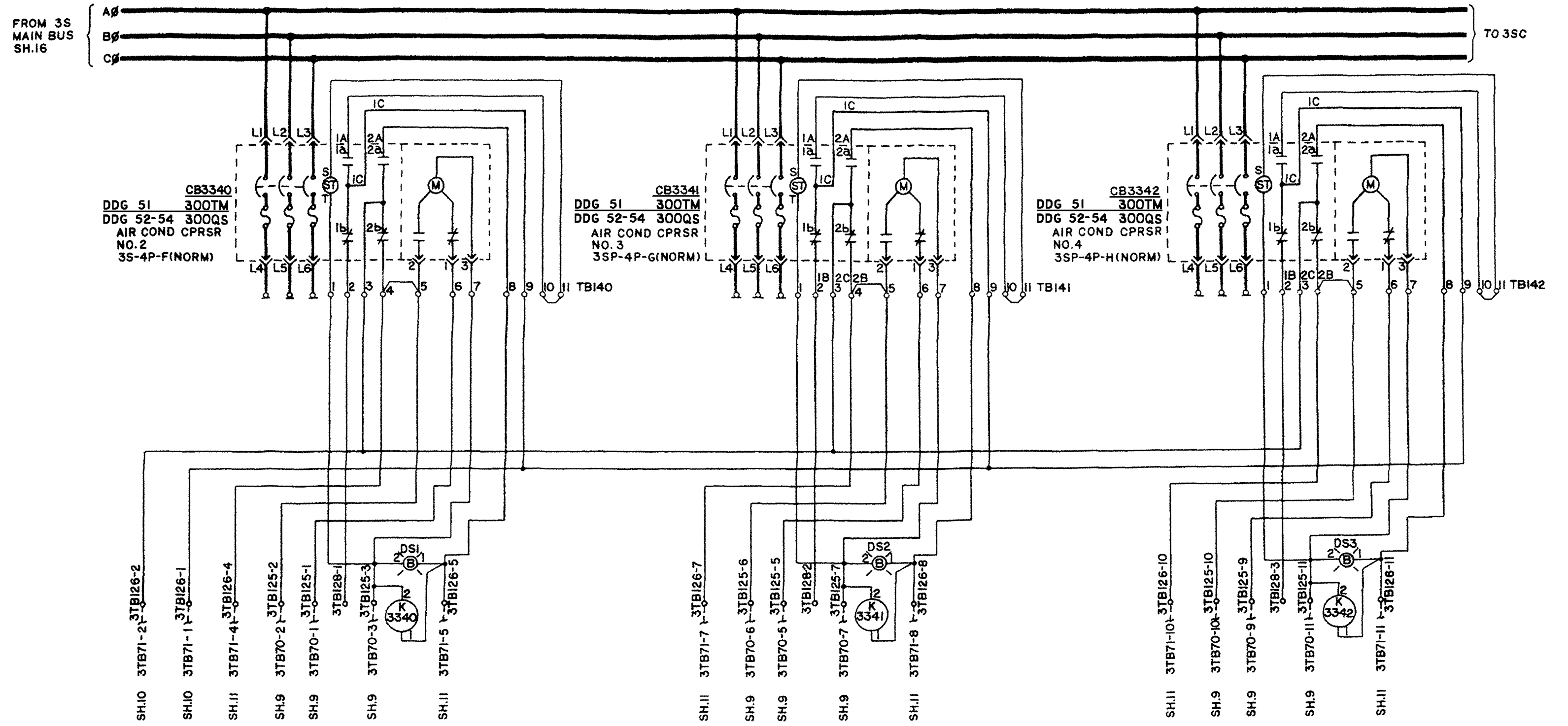


Figure 5-20. 3S Switchboard System; Schematic (Sheet 17 of 20)

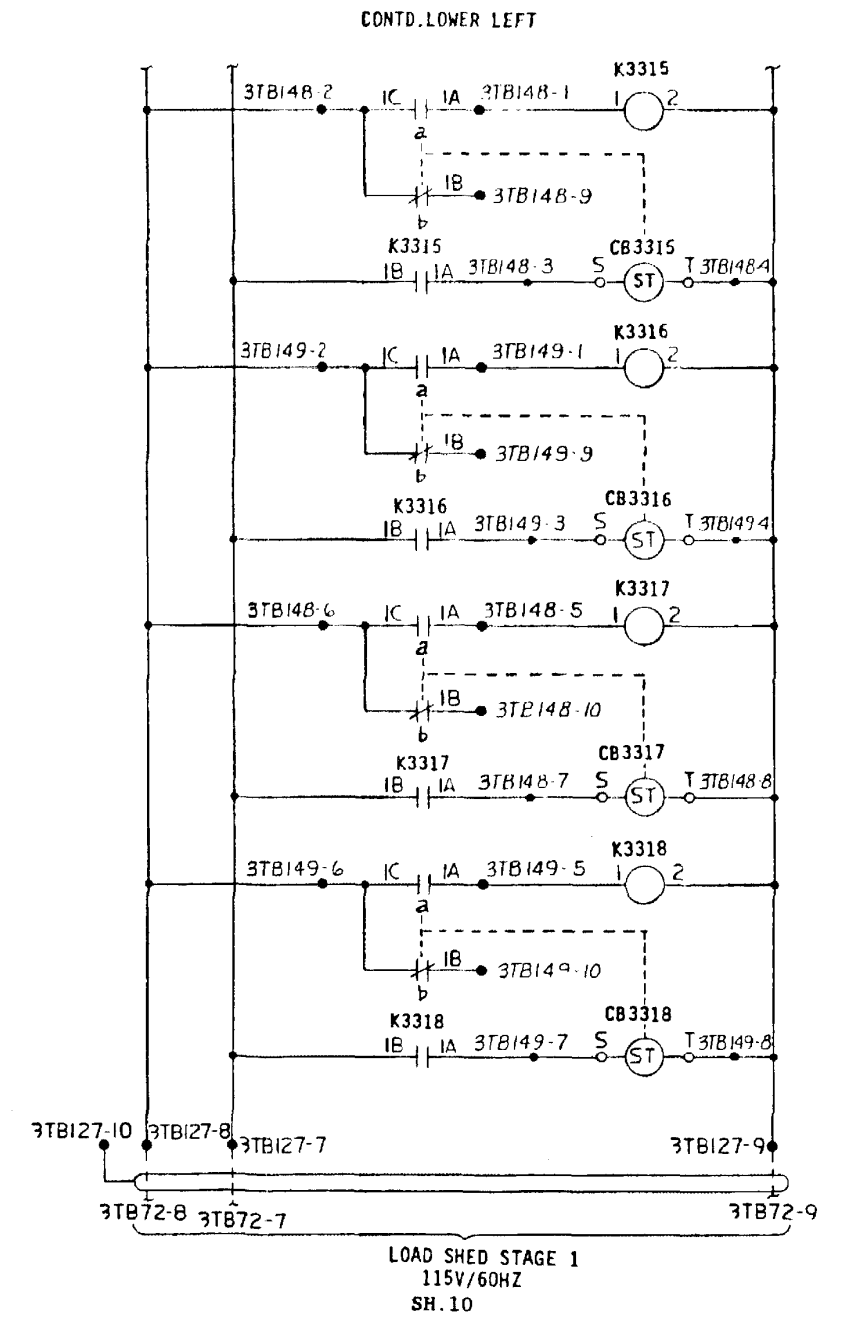
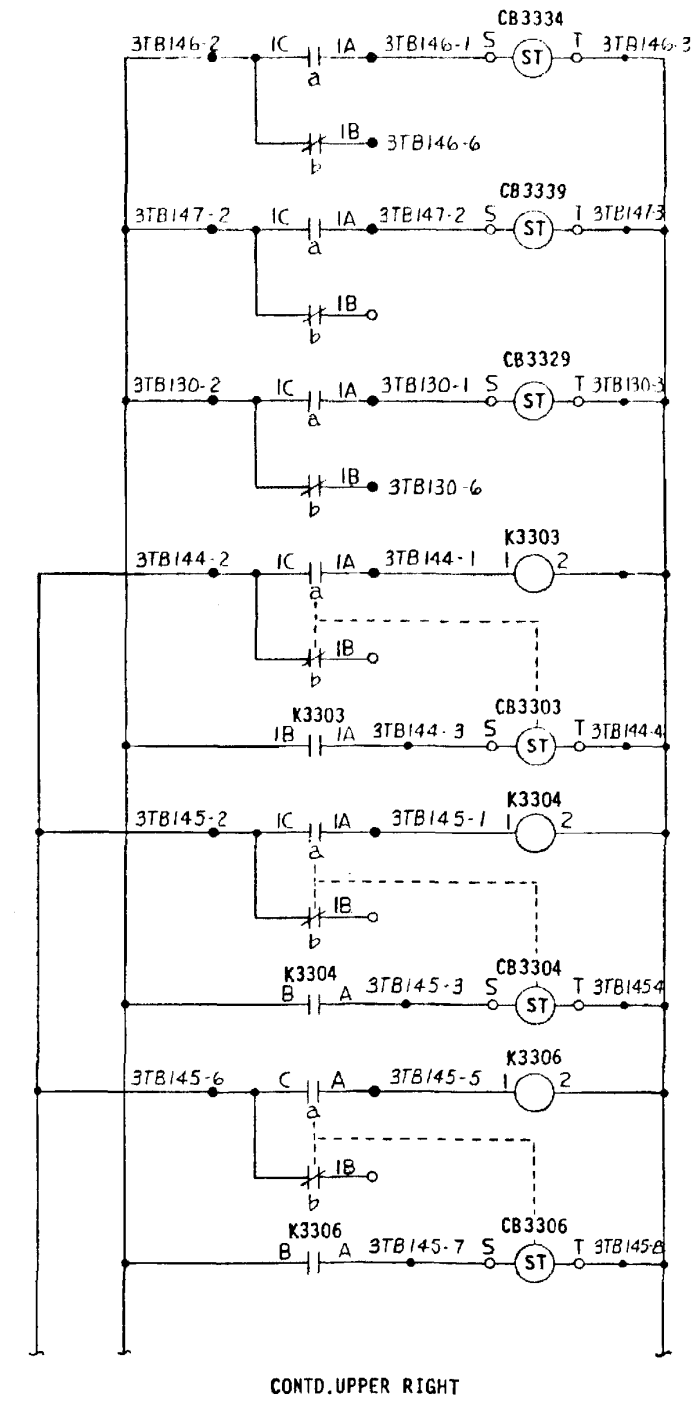
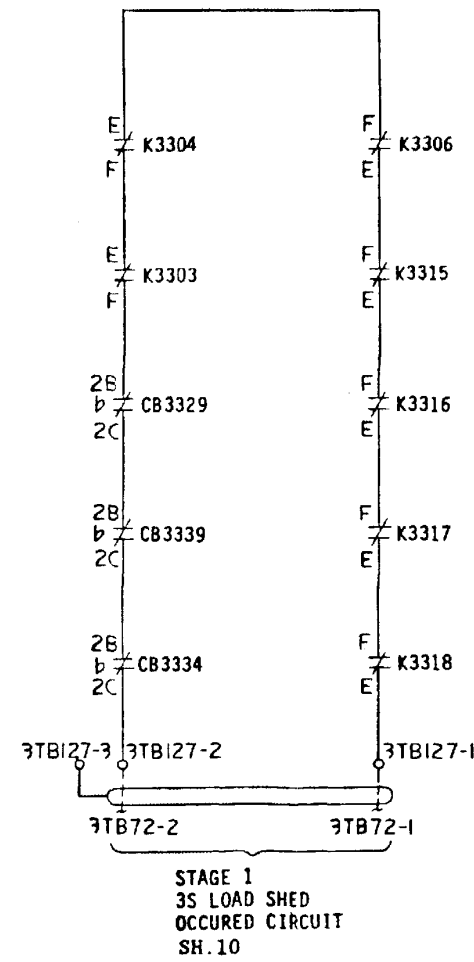
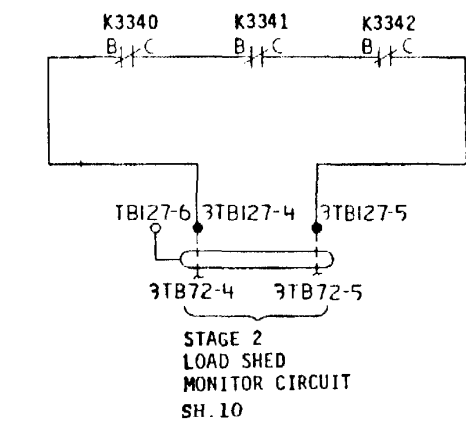


Figure 5-20. 3S Switchboard System; Schematic (Sheet 18 of 20)

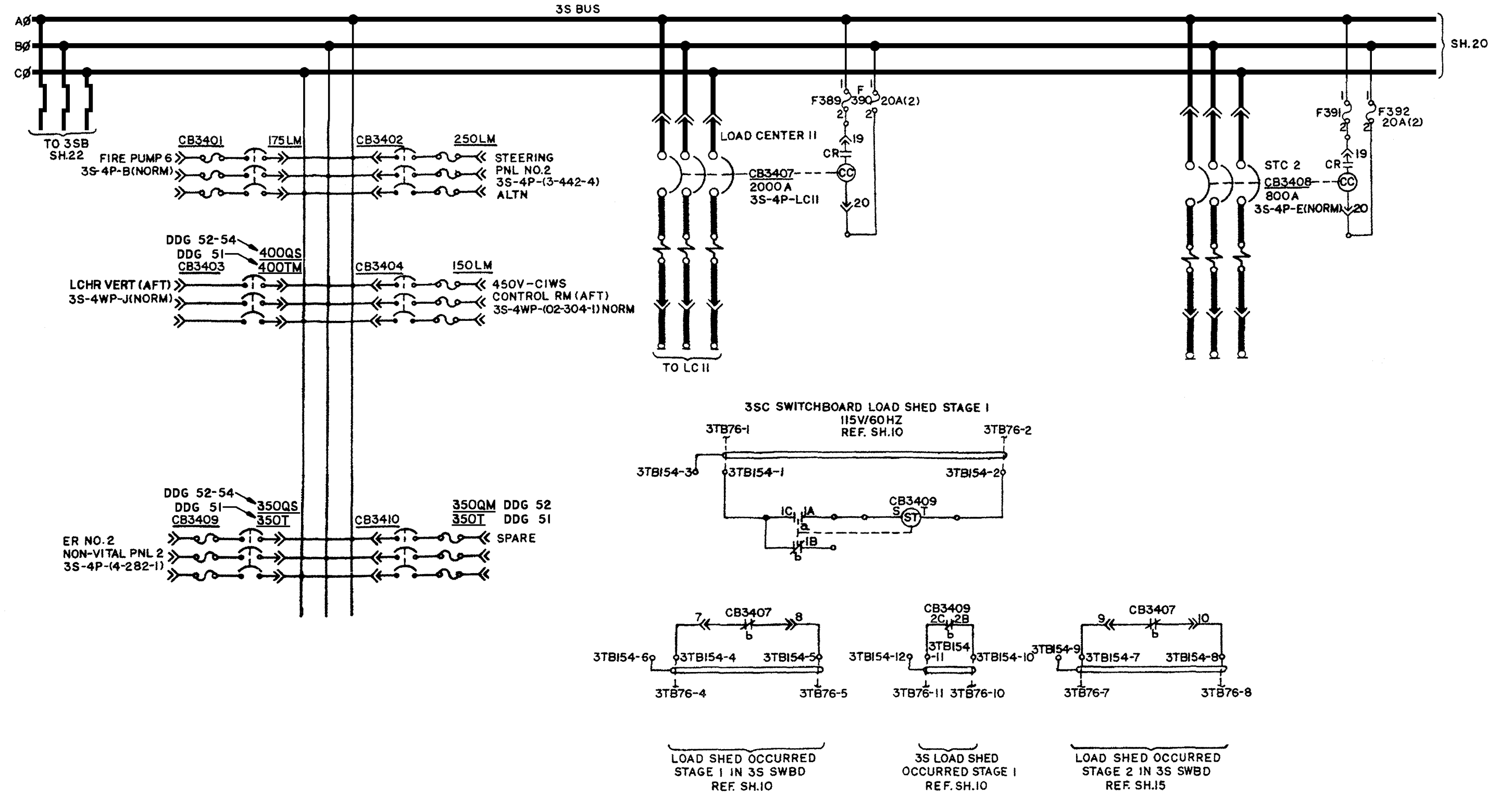


Figure 5-20. 3S Switchboard System; Schematic (Sheet 19 of 20)

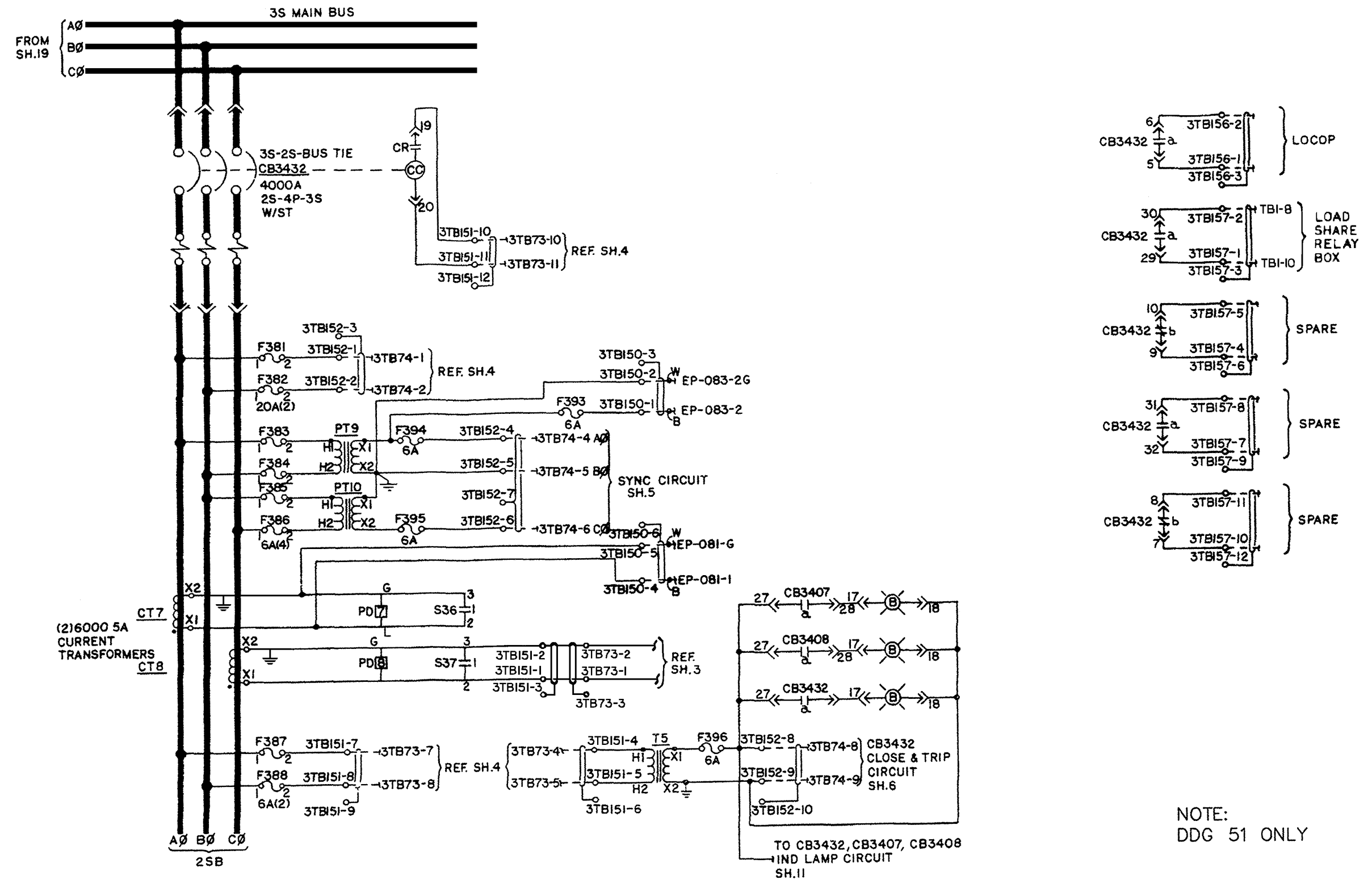
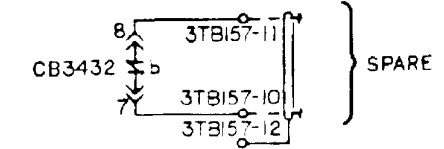
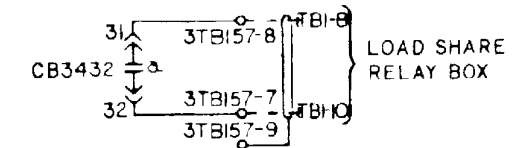
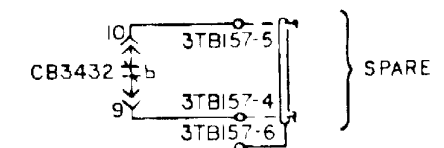
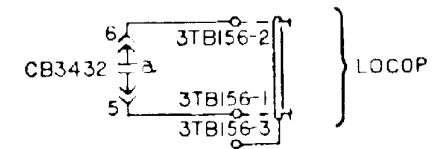
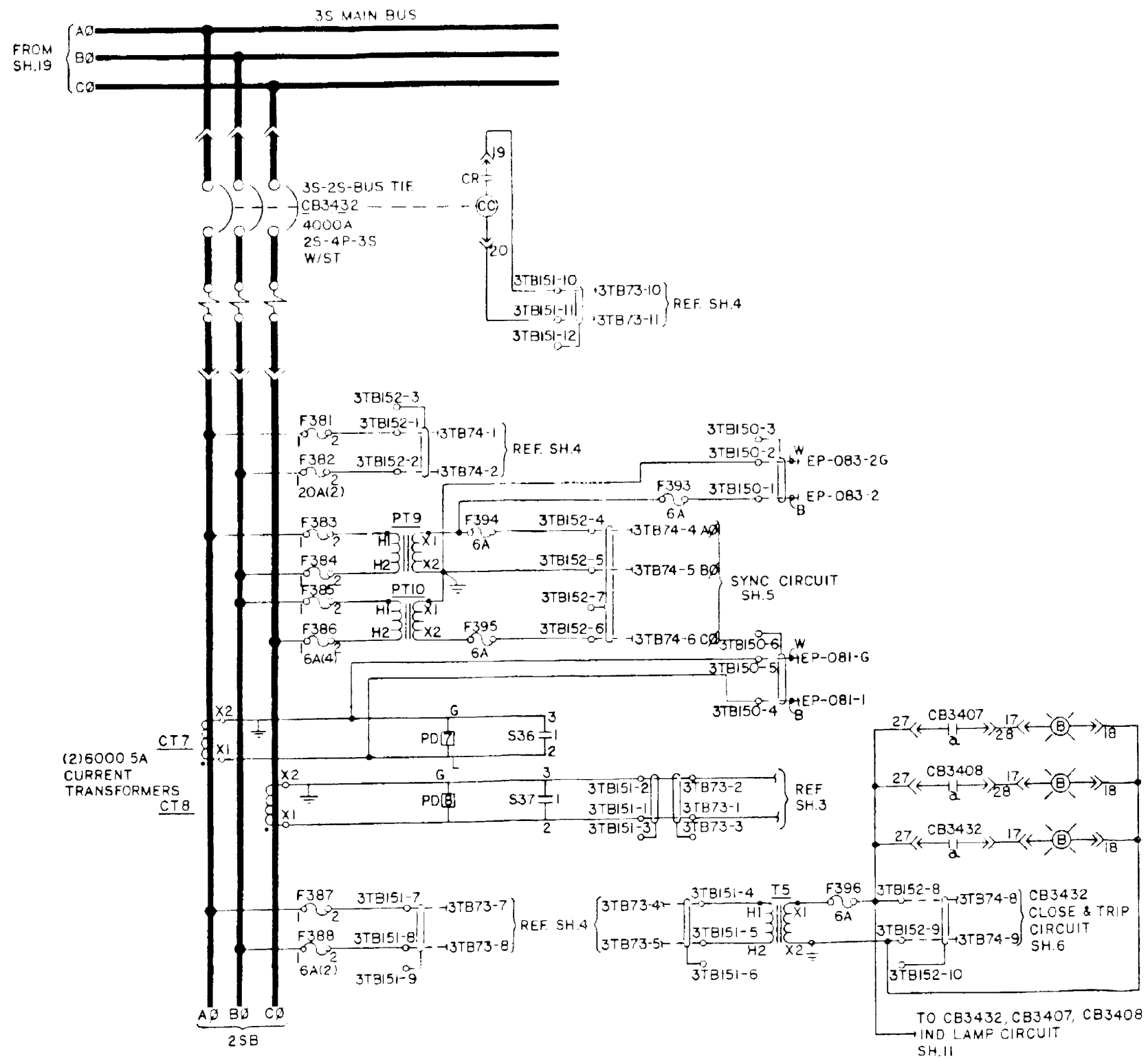


Figure 5-20. 3S Switchboard System; Schematic (Sheet 20 of 20)



NOTE:
DDG 52-54 ONLY

Figure 5-20. 3S Switchboard System; Schematic (Sheet 20 of 20)

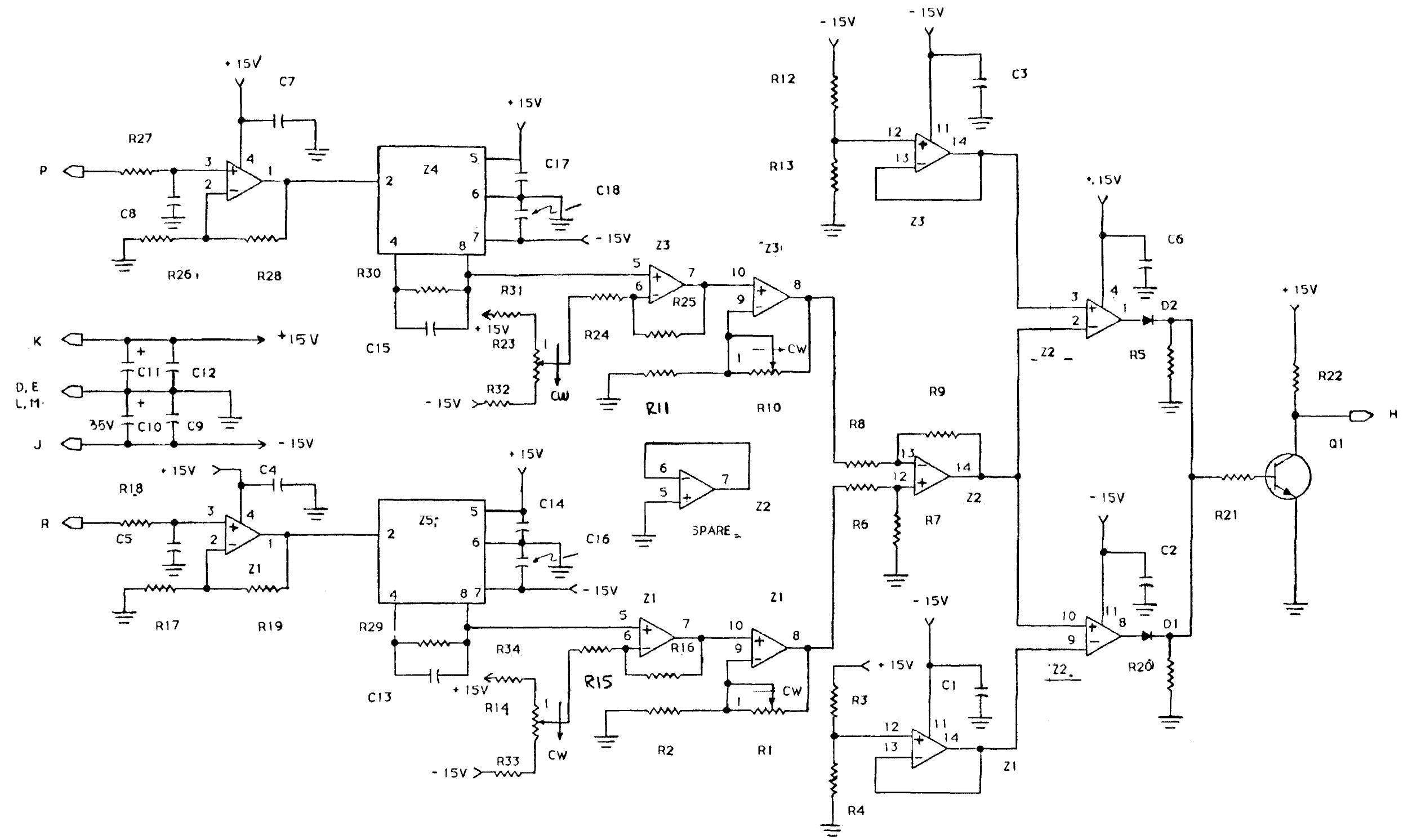


Figure 5-21. Frequency PCB Schematic Layout

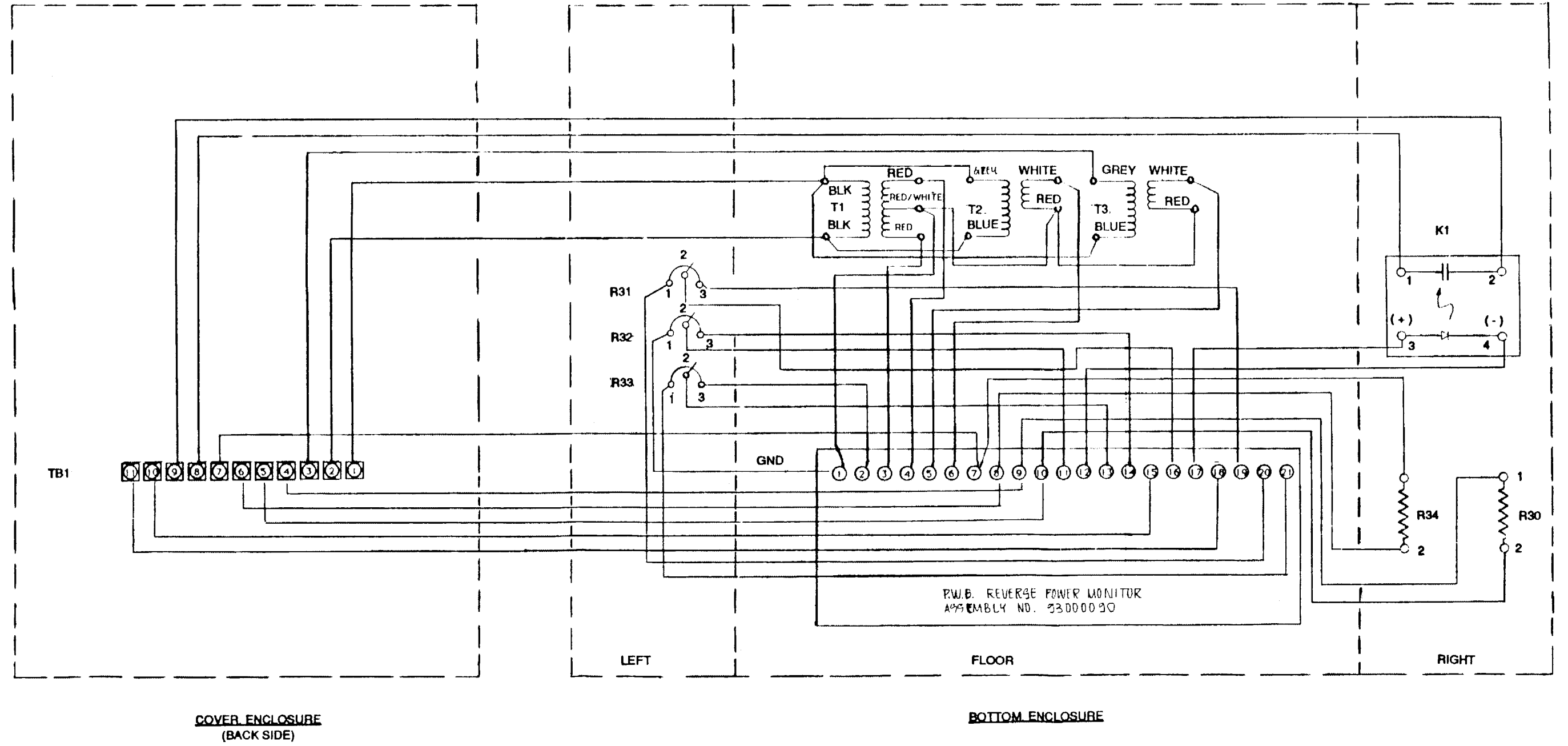
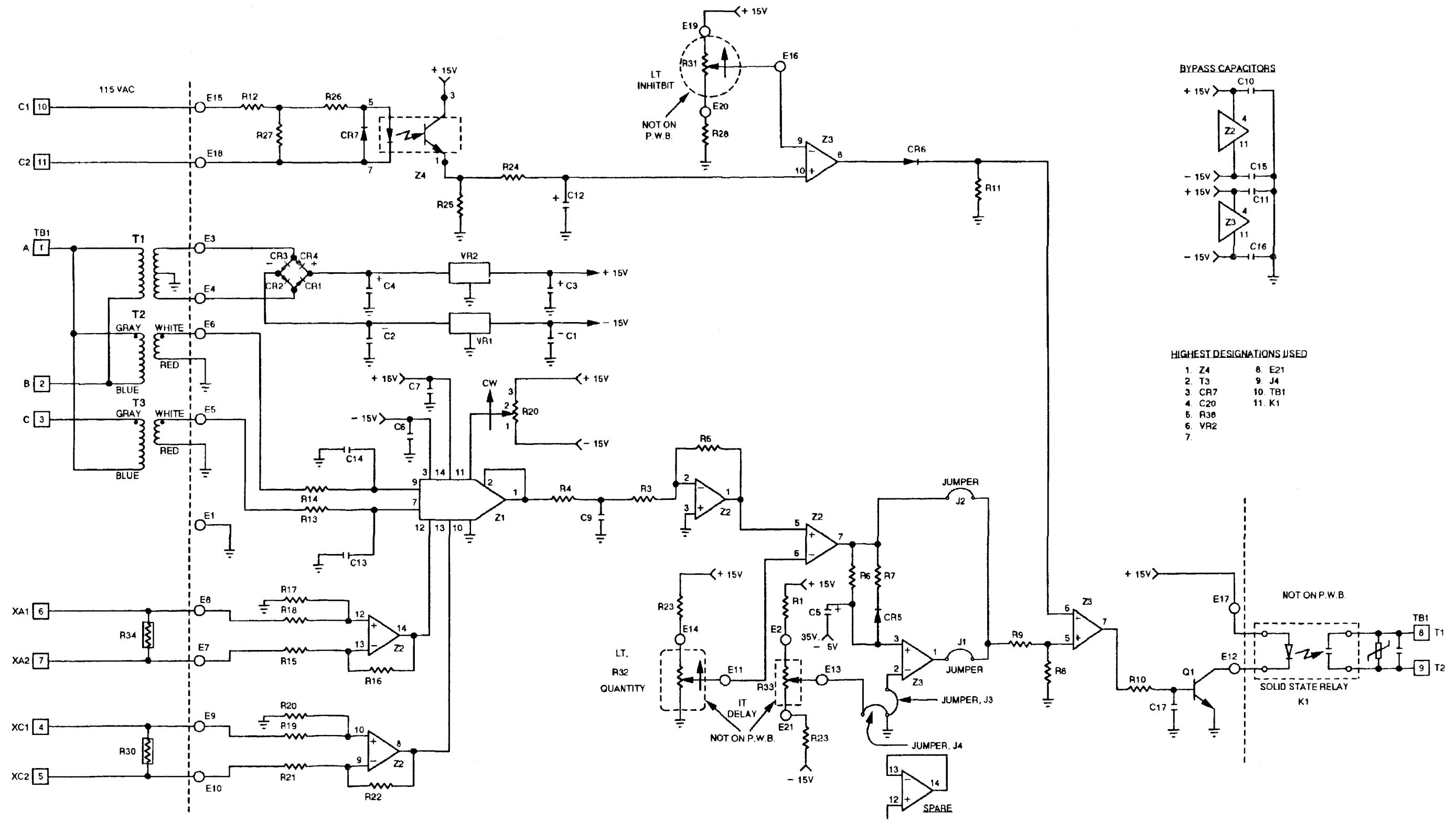
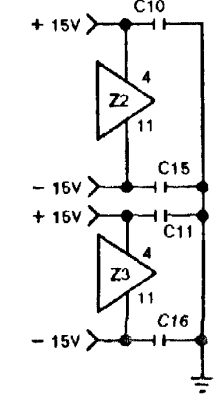


Figure 5-22. Reverse Power Relay Module Schematic



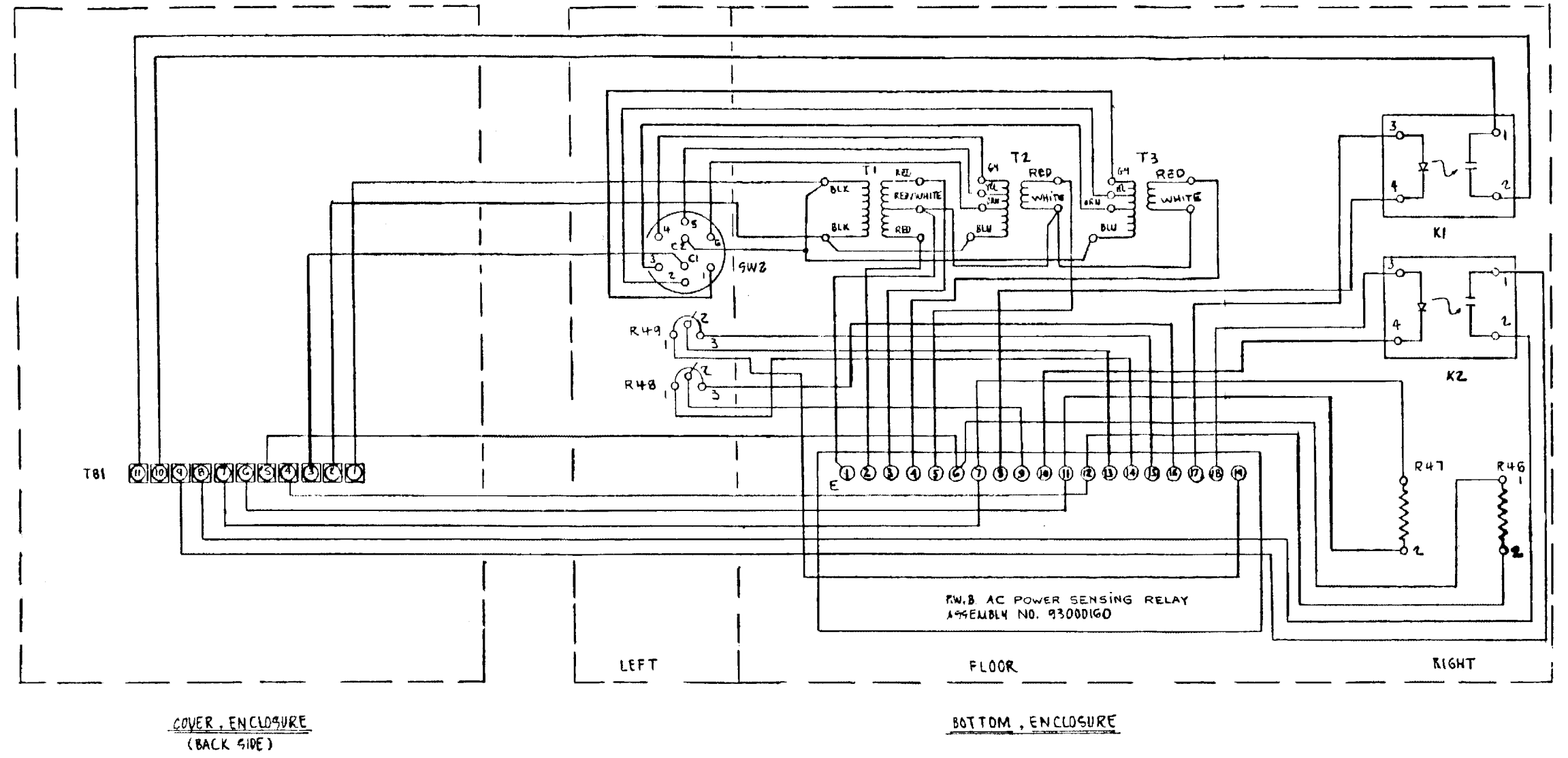
BYPASS CAPACITORS



HIGHEST DESIGNATIONS USED

- 1. Z4
- 2. T3
- 3. CR7
- 4. C20
- 5. R36
- 6. VR2
- 7.
- 8. E21
- 9. J4
- 10. TB1
- 11. K1

Figure 5-23. Reverse Power Relay PCB Schematic Layout



NOTE:
ALL WIRING FOR AC POWER SENSING RELAY
MODULE SHOULD BE #18 AWG.

Figure 5-24. AC Power Sensing Relay Wiring Diagram

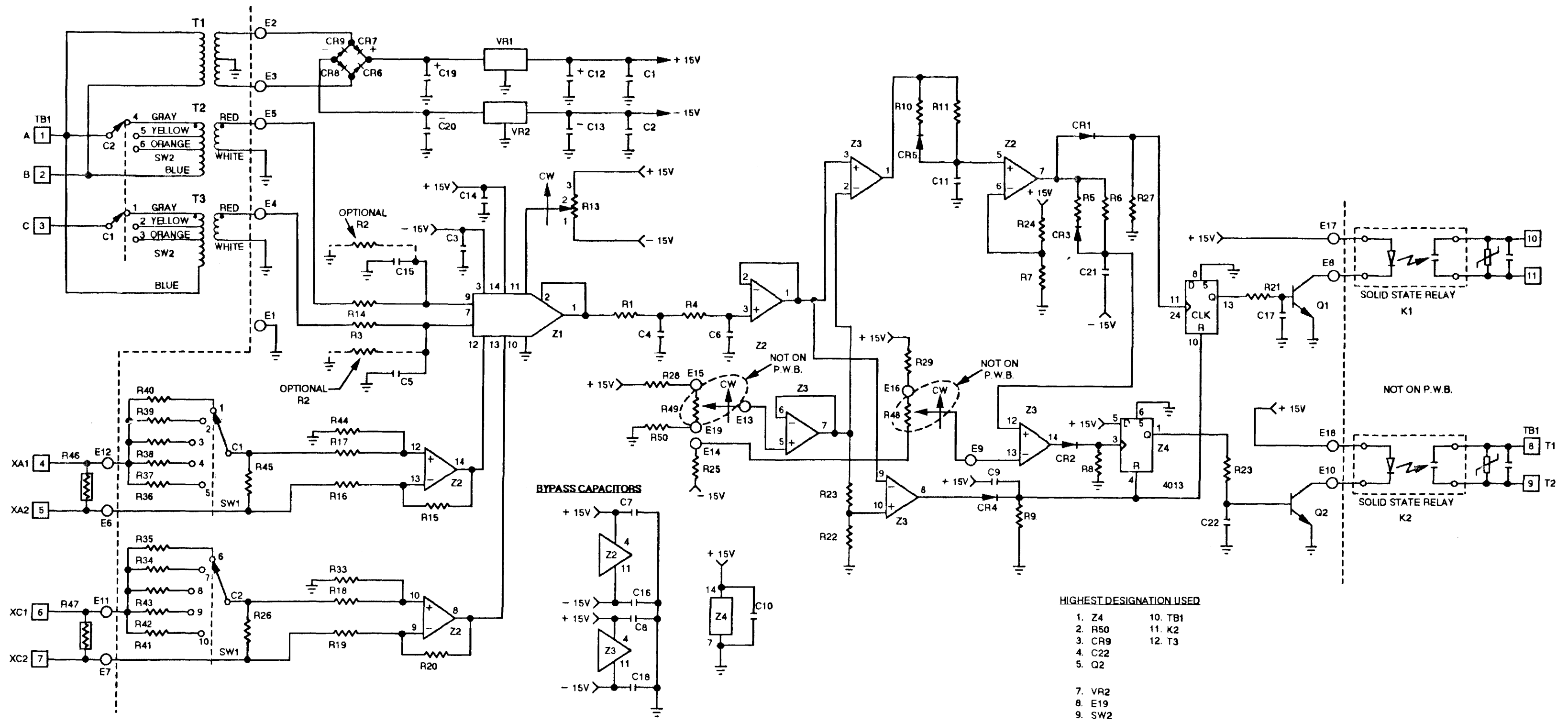


Figure 5-25. AC Power Sensing Relay Schematic

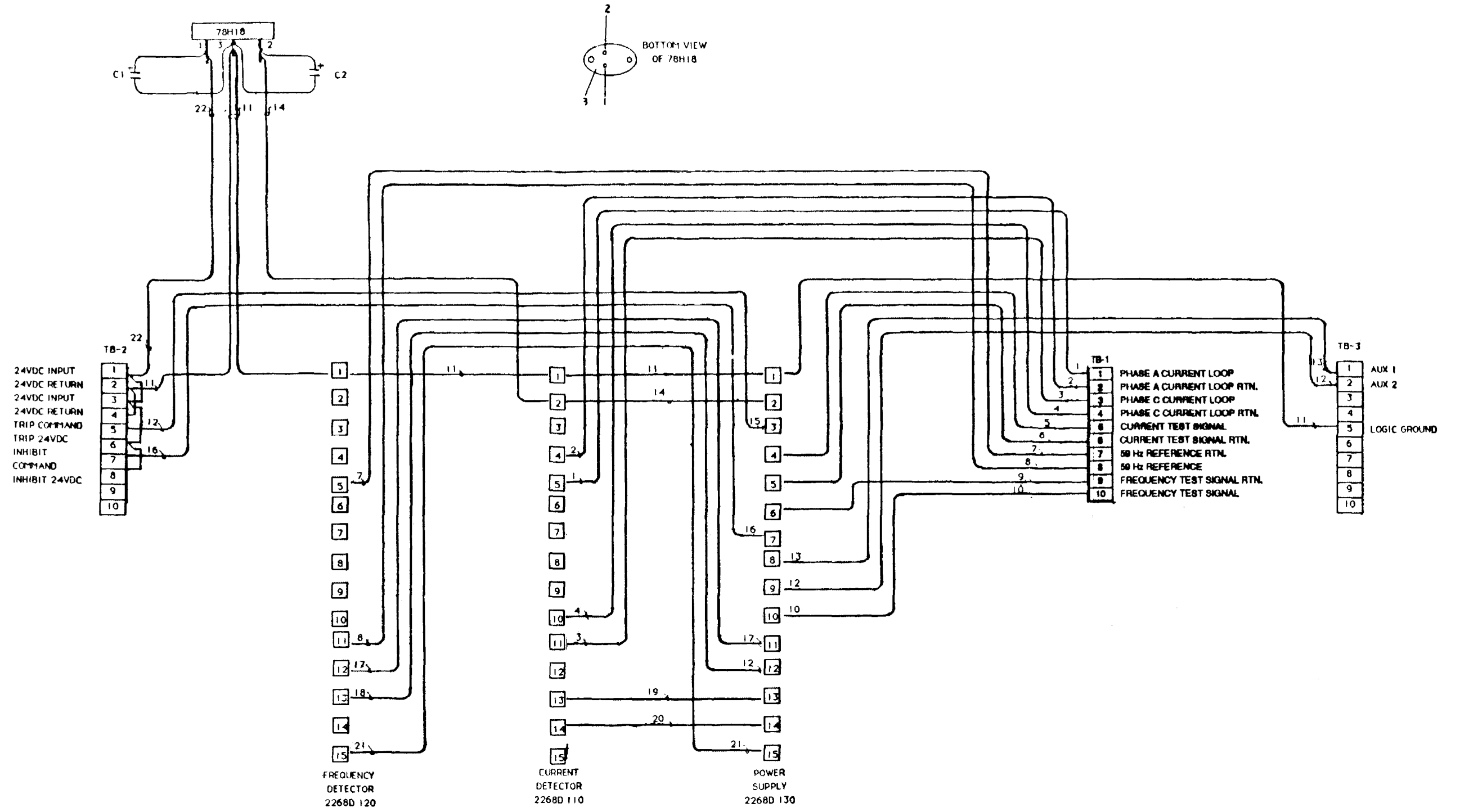


Figure 5-26. Fault Current Detector Schematic
(Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed)

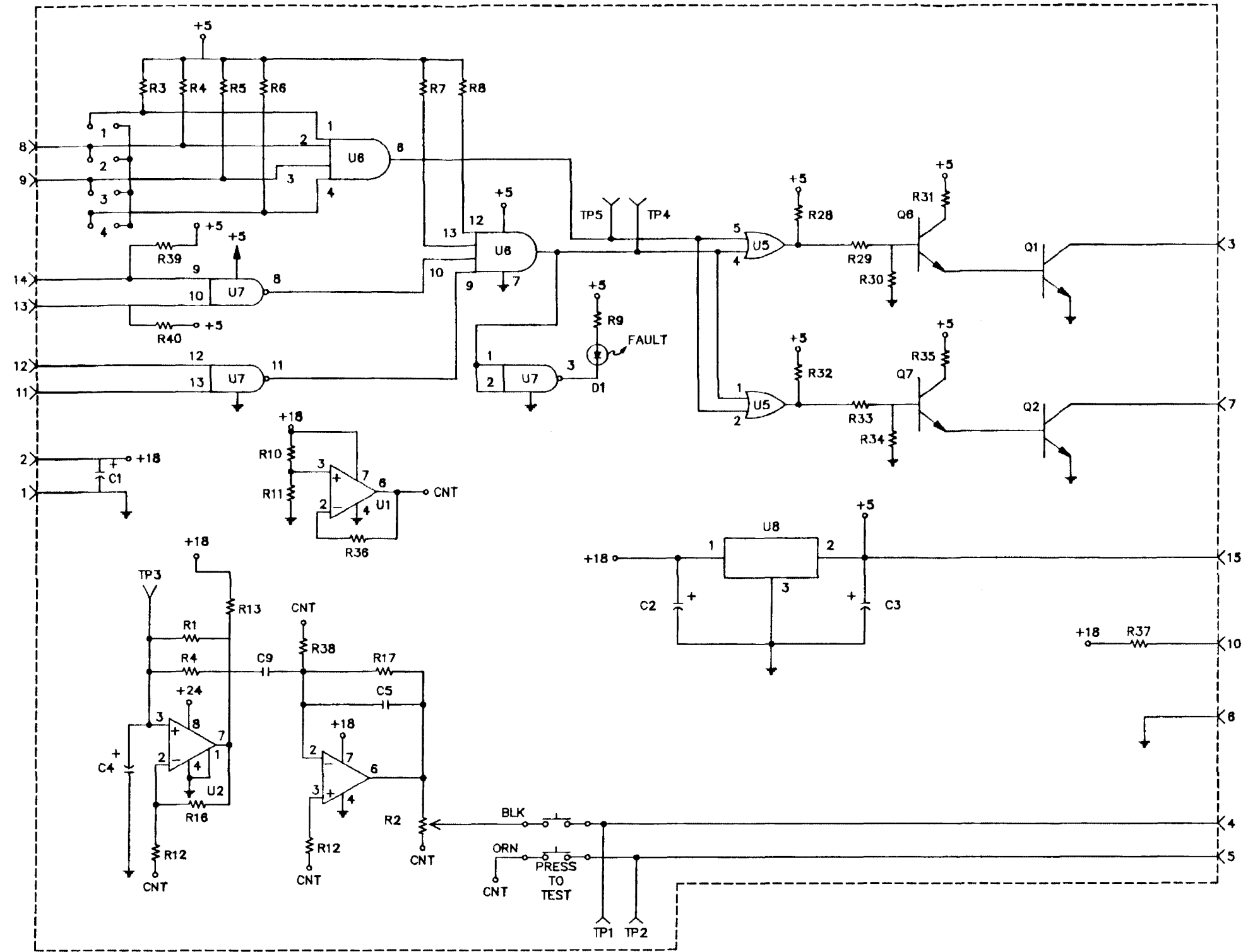


Figure 5-27. Power Supply PCB Schematic
(Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed)

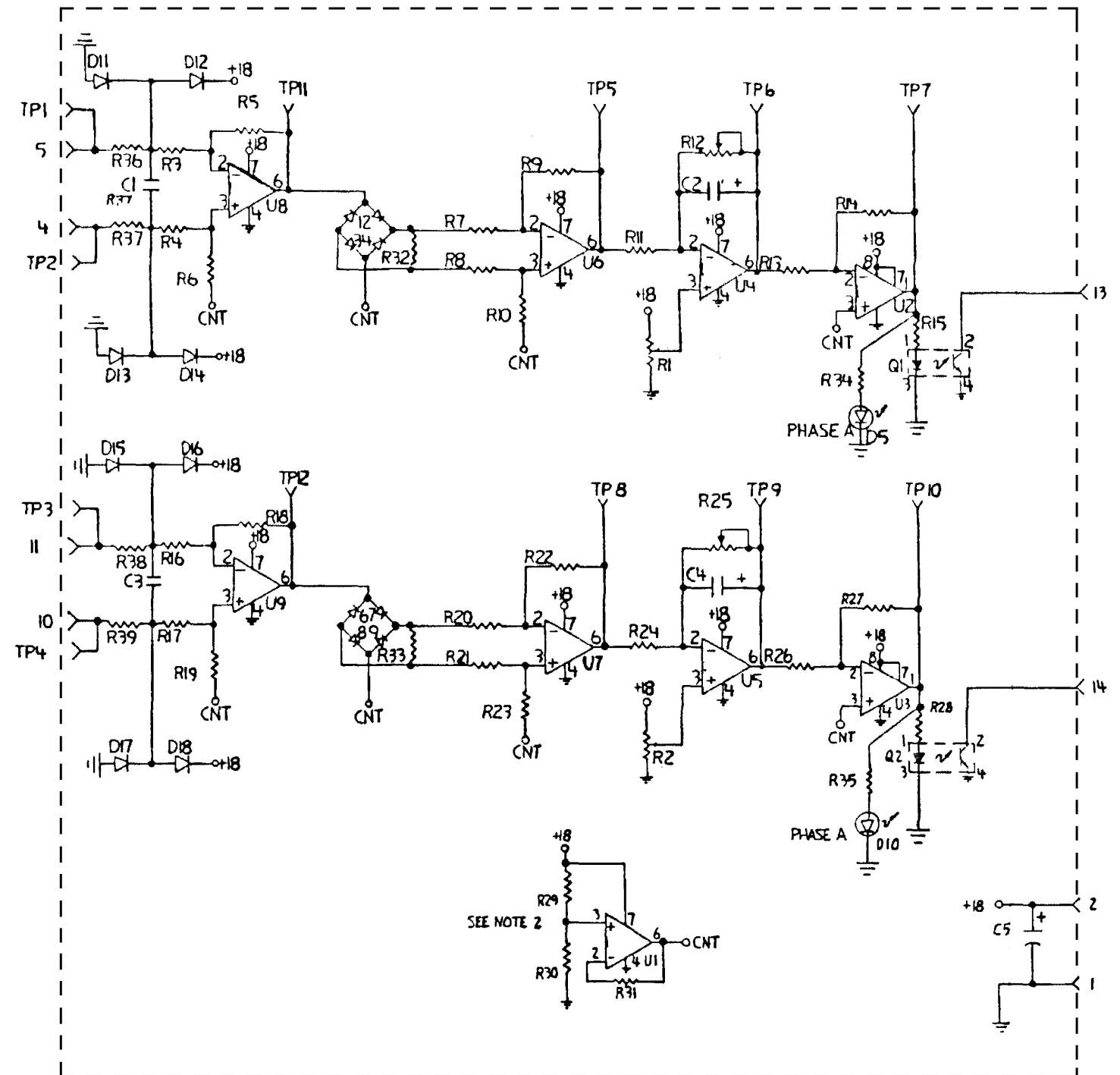


Figure 5-28. Current Detection PCB Schematic
 (Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed)

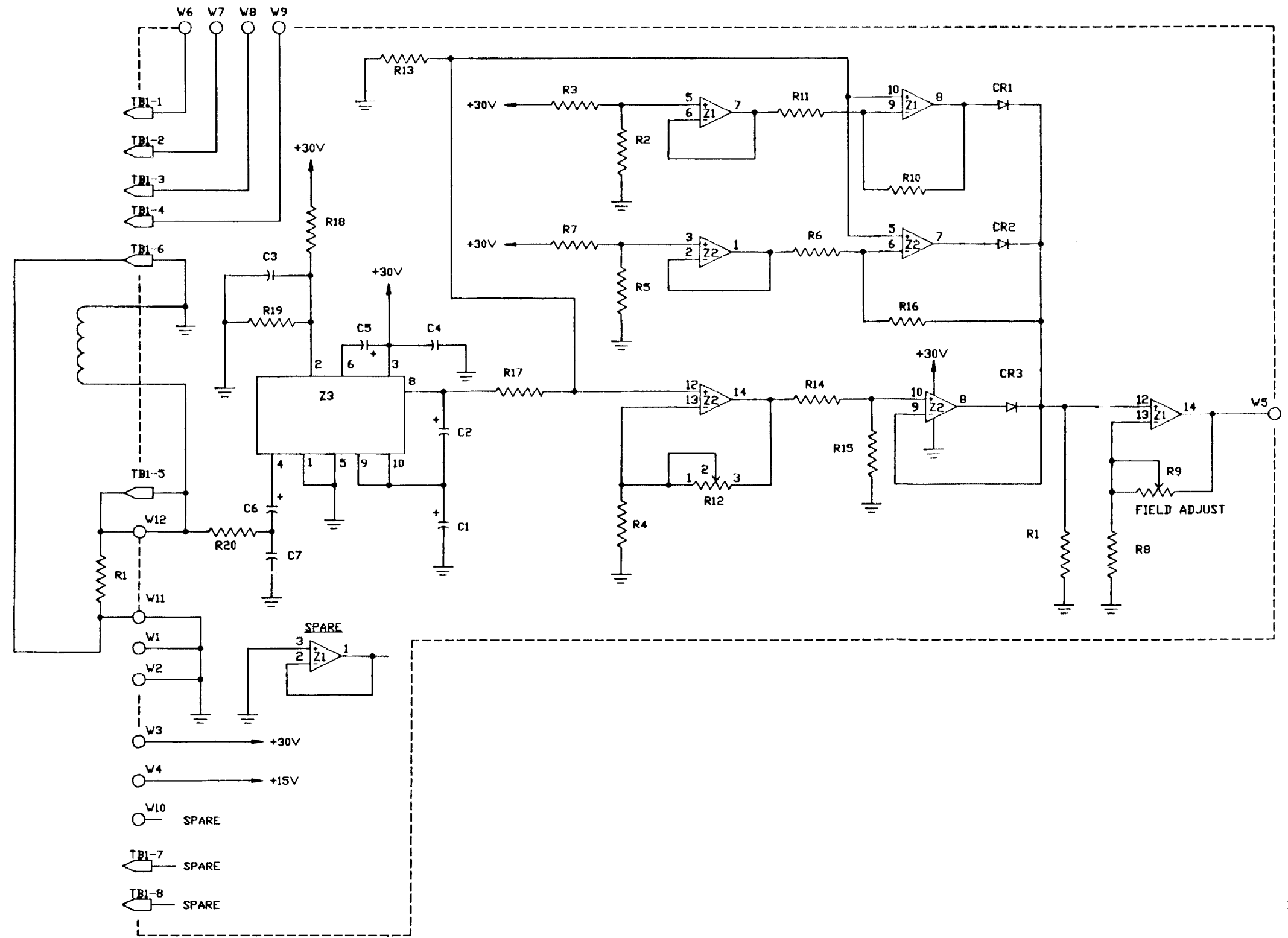


Figure 5-29. Overcurrent Sensing Device RMS to DC Board
 (Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed)

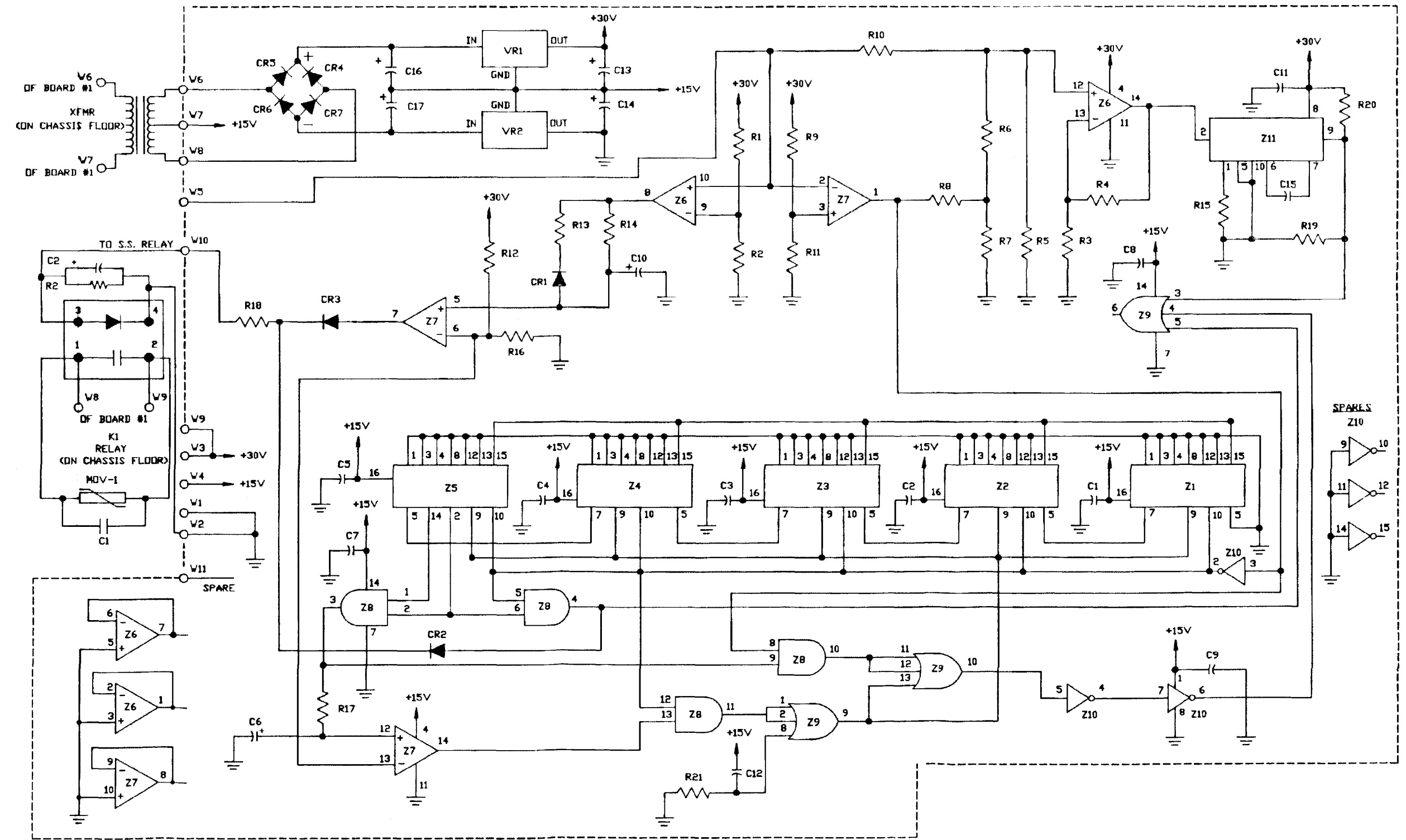


Figure 5-30. Overcurrent Sensing Device PCB Schematic
(Not Applicable to Ships With MACHALT 320-59006 (ECP-515) Installed)

CHAPTER 6

CORRECTIVE MAINTENANCE

6-1. INTRODUCTION

This chapter contains instructions to adjust, align, remove, and replace parts as required. Corrective maintenance instructions are provided as necessary. Most electrical parts such as relays, indicators, fuses, etc., are not repairable and must be replaced. [Section I](#) contains information for adjustment of the solid-state devices. Although these devices and other components are adjustable, they are adjusted at the factory prior to shipment and should not be adjusted except as specified in shipboard procedures. [Section II](#) contains removal and replacement procedures for components used in these switchboards. Components with detailed repair procedures already existing in previously published NAVSEA publications are listed in [table 6-1](#).

NOTE

Solid-state devices are repairable/replaceable to the card level only. Repair or adjustments to individual card components may result in a damaged or ineffective circuit. Damaged cards should be returned to the manufacturer for replacement/refurbishment.

Table 6-1. Publications/NAVSEA Drawings Required But Not Supplied

Nomenclature	Publication	Application
AQB-A101F Circuit Breaker	NAVSEA 0962-LP-042-1010	Maintenance/Repair
AQB-LF2500 Circuit Breaker	NAVSEA 0362-LP-160-1000	Maintenance/Repair
AQB-LF400 Circuit Breaker	NAVSEA 0362-LP-233-3020	Maintenance/Repair
ACB-1600HR/2000HR Circuit Breaker	NAVSEA 0362-LP-240-5000	Maintenance/Repair
ACB-3200HR/4000HR Circuit Breaker	NAVSEA 0362-LP-240-6000	Maintenance/Repair
Rotary Switch, Style SJR	MIL-S-21604/4 NAVSEA 9000-S6202-73826	Maintenance/Repair
Rotary Switch, Style 24G	NAVSEA 9000-S6202-73827	Maintenance/Repair
Rotary Switch, Style SJM	NAVSEA 815-1853019	Maintenance/Repair

SECTION I

ADJUSTMENT AND ALIGNMENT

6-2. ADJUSTMENTS

The 60 Hz main switchboards are shipped ready to operate. There are no adjustments required prior to initial start-up. However, adjustments that can be made are discussed in this section.

6-2.1 RELAYS.

6-2.1.1 Relay K2137.

WARNING

Adjustments can be made while the switchboard is energized. Extreme care must be exercised to avoid lethal voltages.

Relay K2137 of the shore power circuit located in 2S (see [figure 5-19](#)) initiates LOAD SHED 2. This relay is adjustable from 1 to 39 seconds for tripping after the LOAD SHED 1 relay trips. Adjustment of the relay potentiometer, located on the top, should be made in accordance with shipboard requirements for load shedding.

6-2.1.2 Shore Power Breaker Relay (K3).

WARNING

Adjustments can be made while the switchboard is energized. Extreme care must be exercised to avoid lethal voltages.

The Shore Power Breaker Relay, K3, located in switchboard 2SA, has an external adjustment of 1 to 5 seconds. This adjustable relay is provided to prevent the interruption of a closing signal to the 12 shore power breakers upon connection to the main bus. This adjustment will normally be set by the installing shipyard and should be set to allow for the completion of all breakers closing (see [figure 5-19](#)).

NOTE

[Paragraph 6-2.2](#) is not applicable to ships with MACHALT 320-59006 (ECP-515) installed. Refer to [paragraph 6-2.4](#) for information on the GPM.

6-2.2 REVERSE POWER MONITOR (A2). Adjustments to the Reverse Power Monitor should be made according to shipboard requirements. Theory of operation is discussed in [Chapter 3](#) with bench testing and troubleshooting information in [Chapter 5](#). See [figure 6-1](#) for a view of the adjustments available on the Reverse Power Monitor.

6-2.2.1 Trip Delay. The Trip Delay potentiometer may be adjusted from 1 to 5 seconds as needed by ship's requirements. This adjustment is provided to allow time for the generator circuit breaker to close when paralleling with an energized bus.

6-2.2.2 Trip Select. The Trip Select potentiometer may be adjusted from 50 to 400 mA. This amount corresponds to the maximum reverse current tolerable as specified by the turbine generator manufacturer. A minimum setting of 50 mA is suggested. Refer to [Chapter 5](#) for additional information.

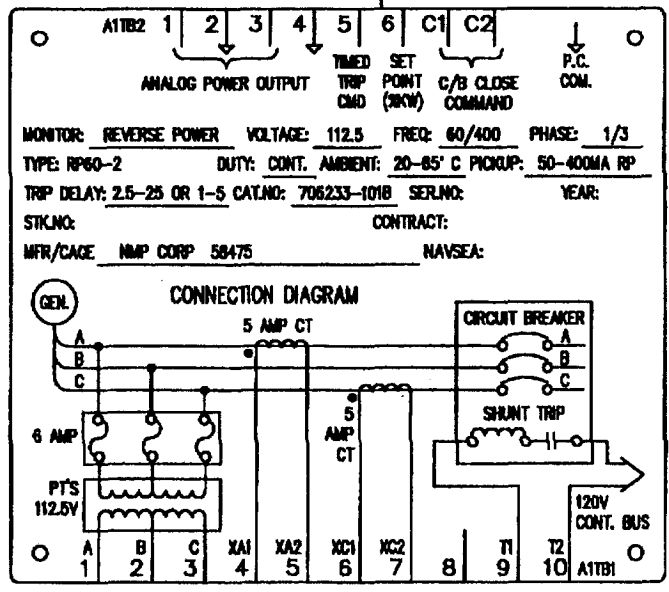
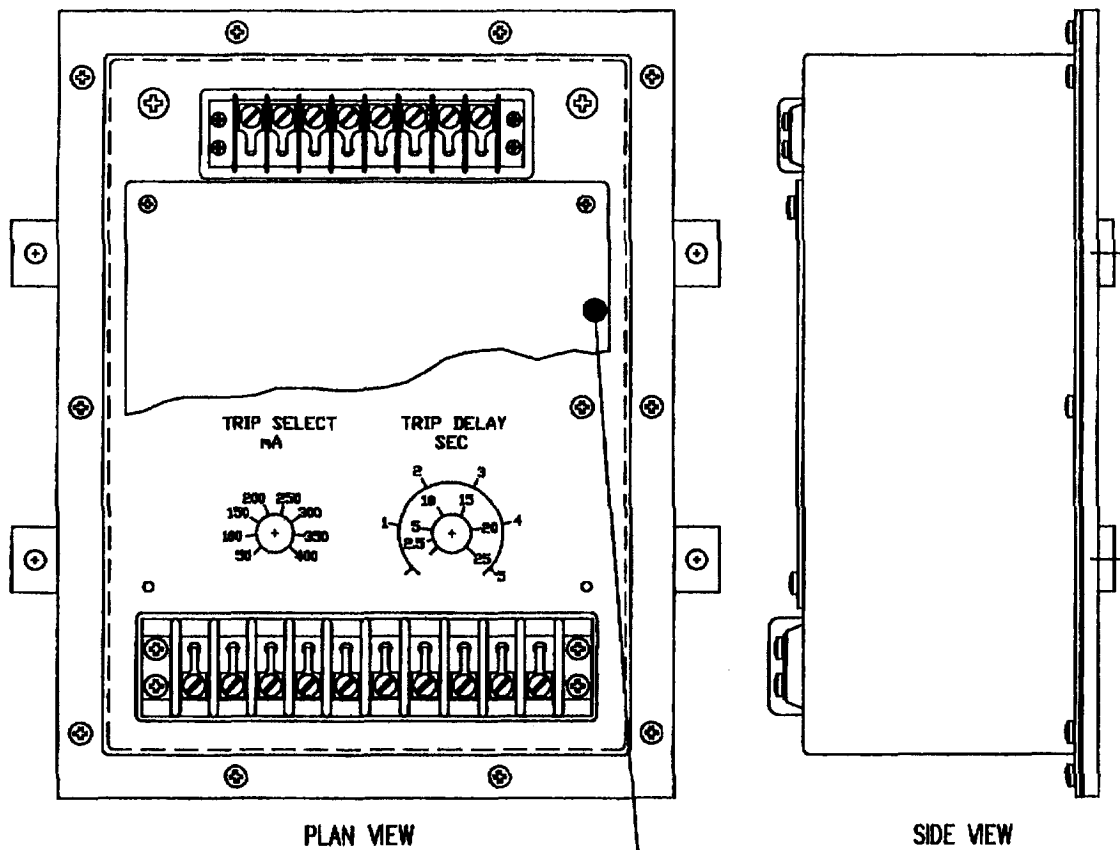


Figure 6-1. Reverse Power Monitor Adjustments

NOTE

Paragraph 6-2.3 is not applicable to ships with MACHALT 320-59006 (ECP-515) installed. Refer to paragraph 6-2.4 for information on the GPM.

6-2.3 AC POWER SENSING RELAY (A3).

WARNING

Adjustments can be made while the switchboard is energized. Extreme care must be exercised to avoid lethal voltages.

CAUTION

Exercise extreme care when adjusting the AC Power Sensing Relay (A3) while energized. If the trigger point is adjusted below the amount of power presently being used by the system, load shed will initiate.

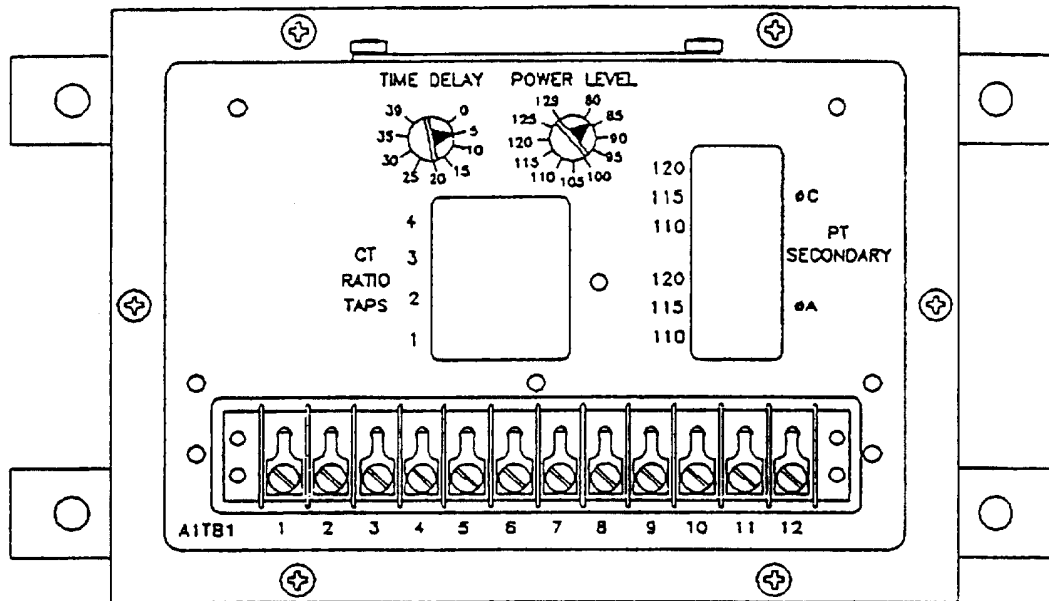
This device has adjustments which are normally preset by the manufacturer as required in accordance with the ship's specifications. Actual adjustments must be made in accordance with ship's requirements. See [figure 6-2](#) for a view of the adjustments available on the AC Power Sensing Relay. Refer to [Chapter 3](#) for functional description and [Chapter 5](#) for troubleshooting.

6-2.3.1 Time Delay. The Time Delay for Load Shed Stage 2 is adjustable by this potentiometer. A setting of 0 to 39 seconds is available. Refer to ship's specifications for this setting.

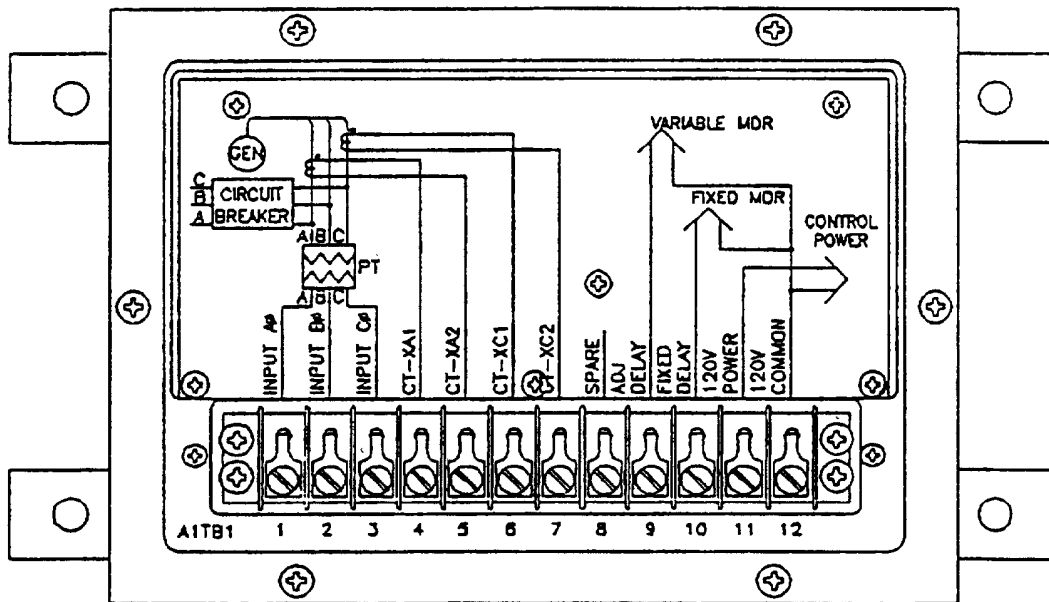
6-2.3.2 Power Level. The Power Level is the adjustment potentiometer for Load Shed Stage 1. Settings available are for 80 to 129 percent of rated generator capacity. Refer to ship's specifications for this setting.

6-2.3.3 CT Ratio Taps. The Current Transformer (CT) ratio is adjustable by connection of the jumper straps in this area on the AC Power Sensing Relay. The CT Ratio is determined by using the formula: $CT\ Ratio = \frac{CT\ Primary}{Generator\ Full\ Load\ Amps}$. The Ratio Tap Installation Table (as shown on the equipment) is shown in [figure 3-5](#). Refer to ship's specifications for this setting.

6-2.3.4 PT Secondary. The Primary Transformer (PT) secondary settings must be set to the desired ship's nominal operating voltage 115 VAC. If required, connection of the adjustable jumper straps provides the additional setting of 110 VAC or 120 VAC. The PT Secondary of both A and C phase must be set identically.



FRONT VIEW WITH SHIELD PLATE REMOVED



FRONT VIEW WITH SHIELD PLATE INSTALLED

Figure 6-2. AC Power Sensing Relay Adjustments

NOTE

Paragraph 6-2.4 is applicable only to ships with MACHALT 320-59006 (ECP-515) installed.

6-2.4 GENERATOR PROTECTION MODULE.

WARNING

Adjustments can be made while the switchboard is energized. Extreme care must be exercised to avoid lethal voltages.

This device has adjustments which are normally preset by the manufacturer as required in accordance with the ship's specifications. Actual adjustments must be made in accordance with ship's requirements. Refer to [paragraph 5-10.8](#) for adjustment procedures. Refer to [Chapter 3](#) for functional description and [Chapter 5](#) for troubleshooting.

6-2.5 ADJUSTABLE INSTANTANEOUS TRIP SETTING.

6-2.5.1 AQB-LF400 Adjustable Instantaneous Trip Setting. To change adjustable instantaneous trip setting, proceed as follows:

WARNING

These switchboards contain lethal voltages. Tag "Out of Service" in accordance with shipboard procedures.

- a. Open circuit breaker by moving handle to OFF position.
- b. Remove motor operator in accordance with [paragraph 6-6.1](#) if applicable.

WARNING

All three poles must be set to identical positions in accordance with shipboard specifications.

- c. Depress button fully and turn placing arrow on desired setting (see [figure 6-3](#)).

6-2.5.2 AQB-A101 Adjustable Instantaneous Trip Setting. AQB-A101 circuit breakers are equipped with externally adjustable instantaneous trip features on each pole with five settings which can be readily changed by field activities (see [figure 6-3](#)). Circuit breakers are shipped from the factory with the instantaneous trips set at the LO position. Only LO and HI settings are shown and guaranteed for accuracy. To change adjustable trip setting proceed as follows:

WARNING

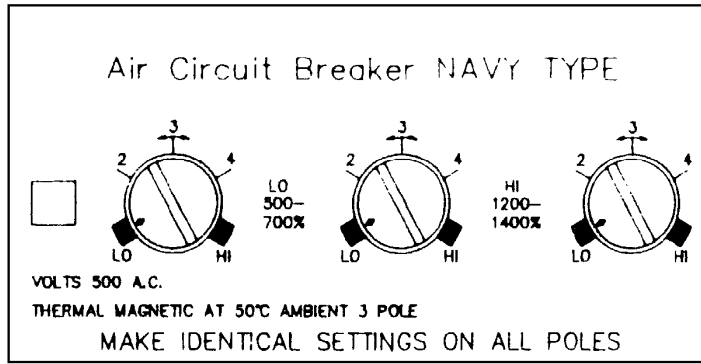
These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Open circuit breaker by moving handle to OFF position.

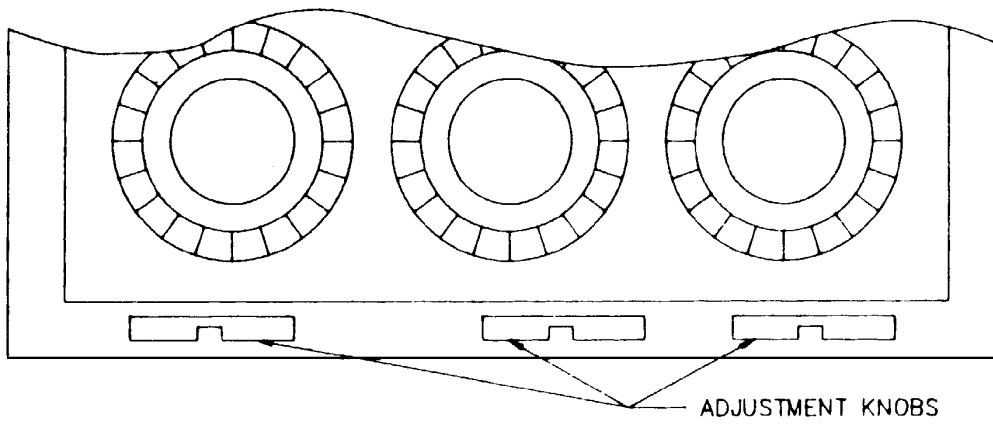
WARNING

All three poles must be set to identical positions in accordance with shipboard specifications.

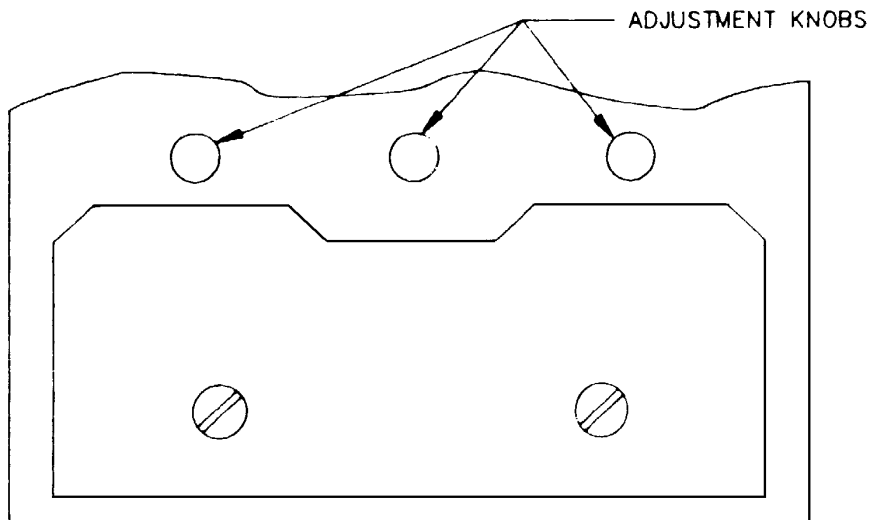
- b. Turn button placing arrow on desired setting.



AQB-A101 ADJUSTMENTS



AQB-LF250 ADJUSTMENTS (FUSE UNIT REMOVED)



AQB-LF400 ADJUSTMENTS

Figure 6-3. Instantaneous Trip Setting Adjustments

SECTION II

REPAIR

6-3. GENERAL

The 60 Hz main switchboards have a minimum number of parts that may require repair. Instructions for removal and replacement of components are included. For detailed repair procedures of components, reference the publications in [table 6-1](#).

6-4. SPECIAL TOOLS

Special tools required to service the 60 Hz main switchboards are listed in [table 6-2](#). Ordinary mechanic's tools such as screwdrivers and/or a socket set are all that will be necessary unless otherwise specified. Any test equipment needed is listed in [table 1-5](#).

Table 6-2. Special Tools Required

Nomenclature	Part Number	Manufacturer's Code
AQB4000HR/3200HR Wrench	30086-S-50A	30086
AQB4000HR/3200HR Extension	30085-S121P	30086
Crimping Tool	WT145A-1	30086
Maintenance Handle	703430-K1	30086
Lifting Yoke (1,600 Amp)	229381-K2	30086
Lifting Yoke (3,200/4,000 Amp)	229083-K2	30086
Extension (1,600/2,000 Amp)	S-121T	30086
Wrench, circuit breaker (1,600/2,000 Amp)	SA-50A	30086
Beam, Lifting (4,000/1,600 Amp)	4284026-9	30086
Handle, closing (4,000 Amp)	4294030-1	30086
Handle, isolating (4,000 Amp)	4294032-8	30086
Handle, isolating (1,600/2,000 Amp)	4284029-3	30086
Handle, closing (1,600/2,000 Amp)	4284028-5	30086
Fuse Puller	87F2748 Type 34-002	30119

6-5. LARGE AIR CIRCUIT BREAKERS

WARNING

Complete removal of power to the switchboard is required for all maintenance tasks to prevent injury to personnel. This requires removing distribution power (450 VAC, 60 Hz, 3 Phase), control power (115 VAC), and command power (28 VDC). Isolate switchboard in accordance with [tables 5-7](#) through [5-9](#), and tag out of service in accordance with local procedures.

NOTE

Distribution power: The output breaker of the associated external distribution equipment shall be opened and tagged “Out-of-Service.” The input and BUS TIE breakers of the 60 Hz main distribution switchboards should be opened and tagged also.

Command power shall be disconnected at the external sources and tagged appropriately.

The Large Air Circuit Breakers (LACBs) are located in the lower units of their respective switchboard cubicles. These LACBs consist of two major assemblies; the removal assembly and the stationary assembly. Removal and replacement of the removable assembly is shown. Information for specific repair of the LACBs may be referenced from the publications listed in [table 6-1](#). These publications contain additional figures and reference data.

WARNING

Lethal voltages are present in the cabinet. Ensure bus tie breakers and Disconnect Links have isolated the cabinet prior to LACB maintenance.

6-5.1 ACB-1600HR/ACB-2000HR AIR CIRCUIT BREAKER REMOVAL (REMOVABLE ASSEMBLY).

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Manually trip the LACB to the OPEN position if required.
- c. Gain access by removing the switchboard cover of the breaker.

NOTE

A nameplate, on the lower left-hand side of the removable assembly, contains instructions for rack out.

- d. Turn the two yellow locking bolts (1) CCW until loose (see [figure 6-4](#)) using the appropriate circuit breaker wrench and extension listed in [table 6-2](#) and shown in [figure 6-5](#).
- e. Depress the interlock lever (2) located on the bottom flange of the stationary component. This exposes the square head lead screw (3) and opens the interlock switch. In this position, the circuit breaker cannot be closed electrically.
- f. Turn the lead screw (3) CCW using the specified wrench and extension. Withdraw the removable assembly (4) the full length of the lead screw.

- g. Using a 3/8-inch socket head wrench, remove six of the eight attaching bolts (5), leaving the upper two bolts. Retain hardware.
- h. Attach the proper sized lifting yoke (see [figure 6-5](#)) to the lifting hook (6).

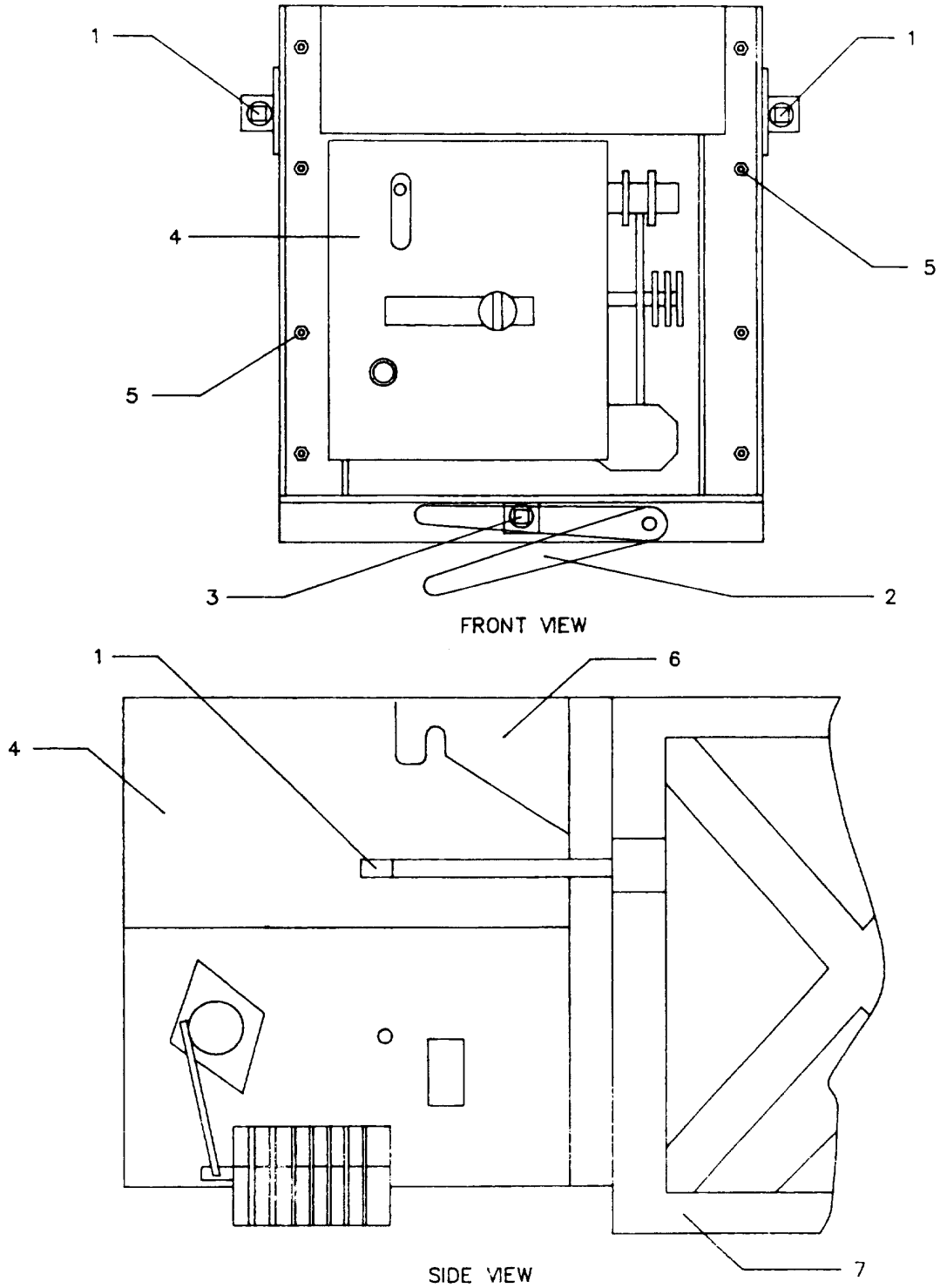
WARNING

This circuit breaker weighs 709 pounds. Use a hoist capable of lifting a minimum of 1/2 ton.

- i. Raise the removable assembly until the hoist is supporting the full weight. Remove the remaining attaching bolts. Retain hardware.
- j. Raise the assembly until the positioning bracket (7) is disengaged. Remove the circuit breaker.

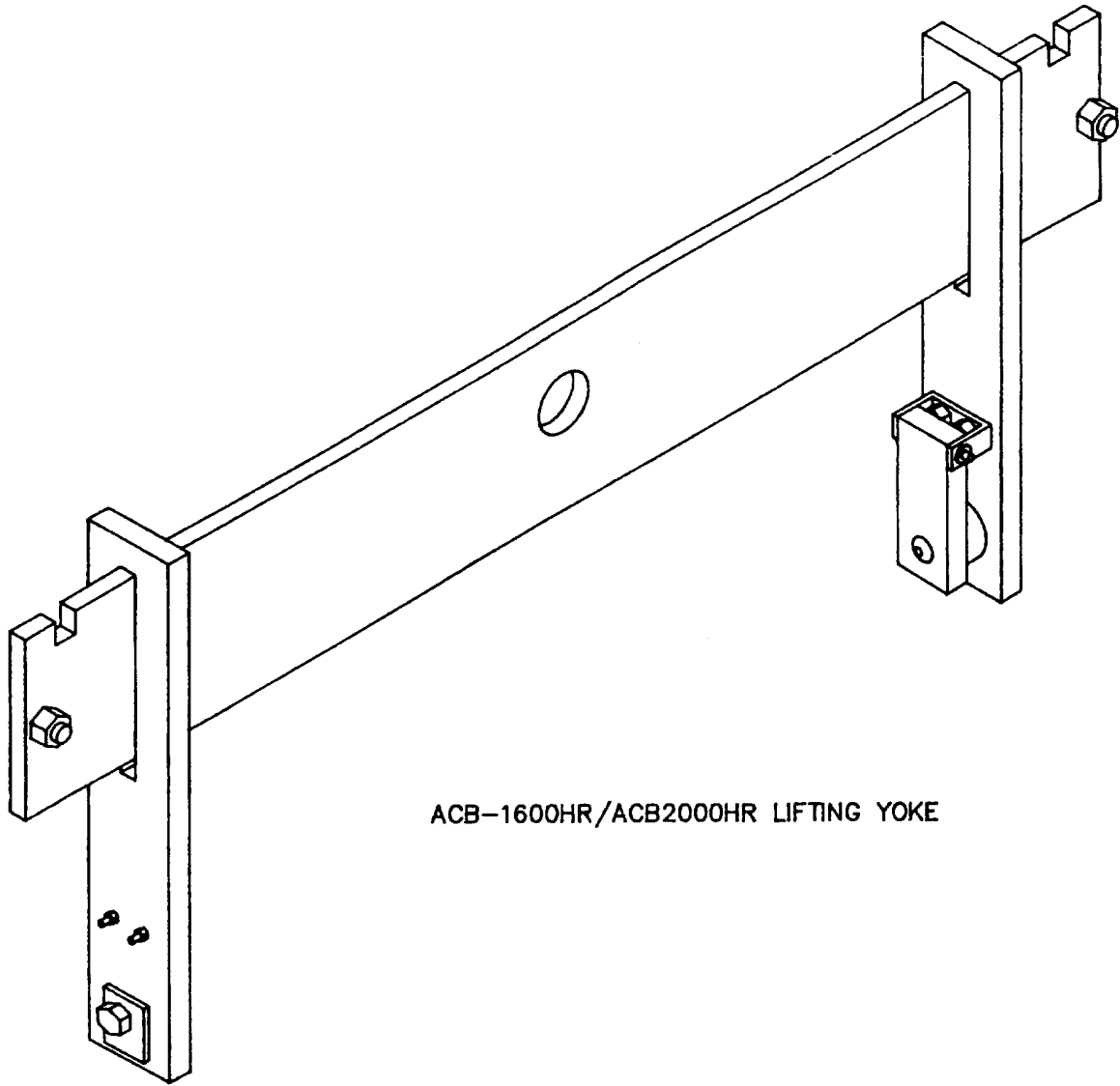
6-5.2 ACB-1600HR/2000HR AIR CIRCUIT BREAKER REPLACEMENT.

- a. Reverse procedure above using the 3/8-inch socket head wrench to replace attaching bolts.
- b. Using circuit breaker wrench and extension, turn lead screw (3) CW until the breaker is moved into the connected position.
- c. Tighten both locking bolts after breaker has been returned to the connected position.
- d. Replace and secure switchboard breaker cover.
- e. Remove “Out of Service” tags and reenergize circuits.

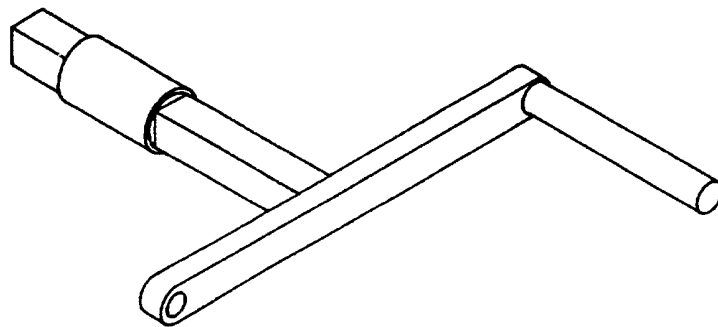


ACB-1600HR/ACB-2000HR AIR CIRCUIT BREAKER ASSEMBLY

Figure 6-4. ACB-1600HR/ACB-2000HR Air Circuit Breaker Assembly



ACB-1600HR/ACB2000HR LIFTING YOKE



ACB-1600HR/ACB-200HR CIRCUIT BREAKER WRENCH

Figure 6-5. 1600A/2000A Lifting Yoke and Circuit Breaker Wrench

6-5.3 ACB-3200HR/ACB-4000HR AIR CIRCUIT BREAKER REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Manually trip the LACB to the OPEN position if required.
- c. Gain access by removing the switchboard cover of the malfunctioning breaker. Loosen thumbscrews.

NOTE

A nameplate, on the lower left-hand side of the removable assembly, contains instructions for rack out.

- d. Using the appropriate circuit breaker wrench and extension, turn the two yellow locking bolts (1), located at each top corner of the stationary component CCW until loose (see [figure 6-6](#)). Refer to [table 6-2](#) and [figure 6-7](#) for the tools required.
- e. Depress the interlock lever (2) located on the bottom flange of the stationary component. This exposes the square head lead screw (3) and opens the interlock switch. In this position, the circuit breaker cannot be closed electrically.
- f. Turn the lead screw (3) CCW using the specified wrench and extension. Withdraw the removable assembly (4) the full length of the lead screw.
- g. Using a 3/8-inch socket head wrench, remove six of the eight attaching bolts (5), leaving the two upper bolts in place. Retain hardware.
- h. Attach the lifting yoke (see [figure 6-7](#) and [table 6-2](#)) to the lifting hook.

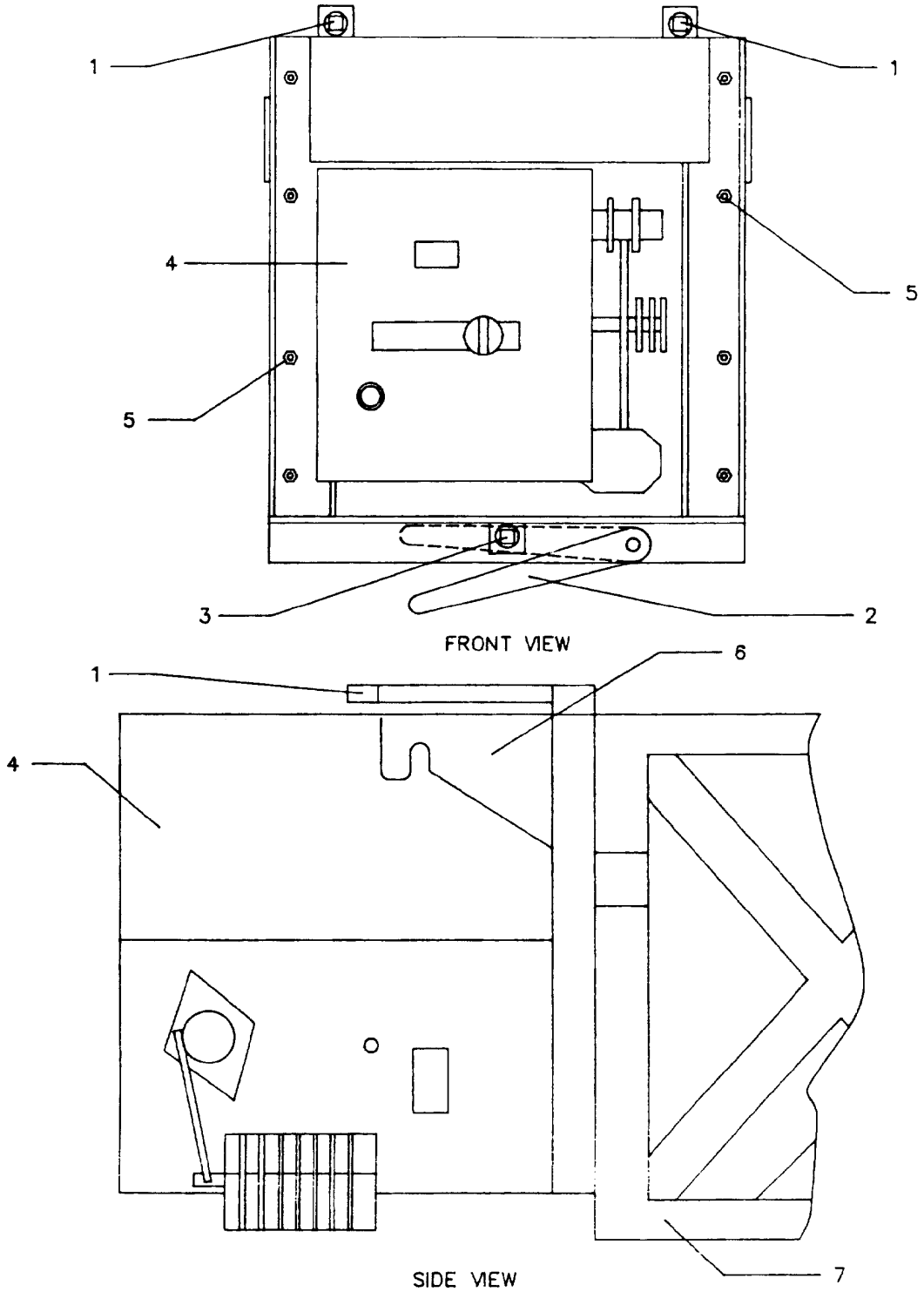
WARNING

This circuit breaker weighs 1,171 pounds. Use a hoist capable of lifting a minimum of 1 ton.

- h. Raise the removable assembly until the hoist fully supports the weight. Remove the remaining two attaching bolts. Lift the assembly until it disengages from the positioning bracket (7). Remove the assembly.

6-5.4 ACB-3200HR/ACB-4000HR AIR CIRCUIT BREAKER REPLACEMENT.

- a. Reverse procedure above using a 3/8-inch socket head wrench to replace the eight attaching bolts.
- b. Using the required circuit breaker wrench and extension, turn lead screw (3) CW until the breaker is moved into the connected position.
- c. Tighten both locking bolts after the breaker has been returned to the connected position.
- d. Replace and secure the switchboard breaker cover.
- e. Remove “Out of Service” tags and reenergize circuits.



ACB-3200HR/ACB-4000HR AIR CIRCUIT BREAKER ASSEMBLY

Figure 6-6. ACB-3200HR/ACB-4000HR Air Circuit Breaker Assembly

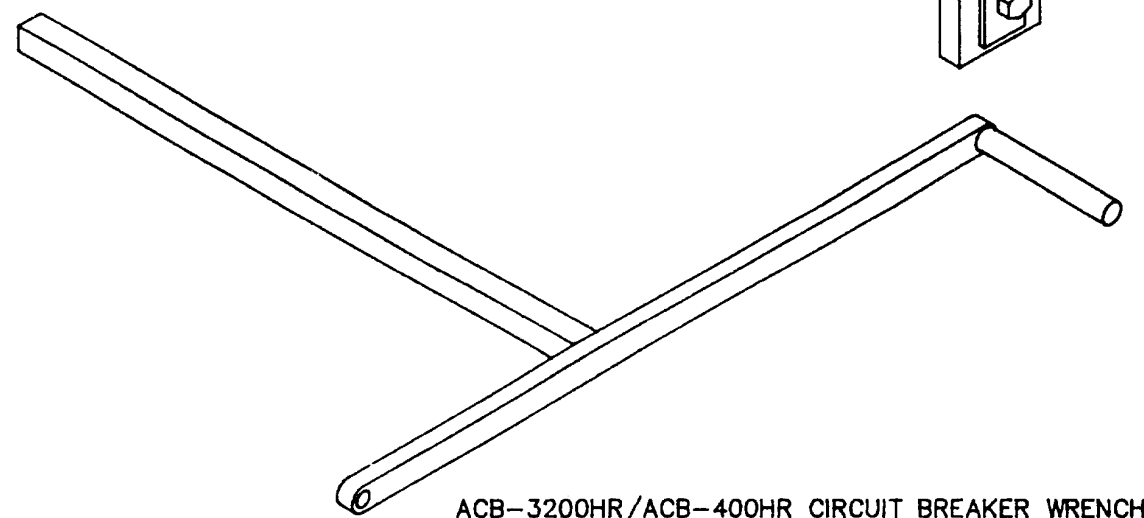
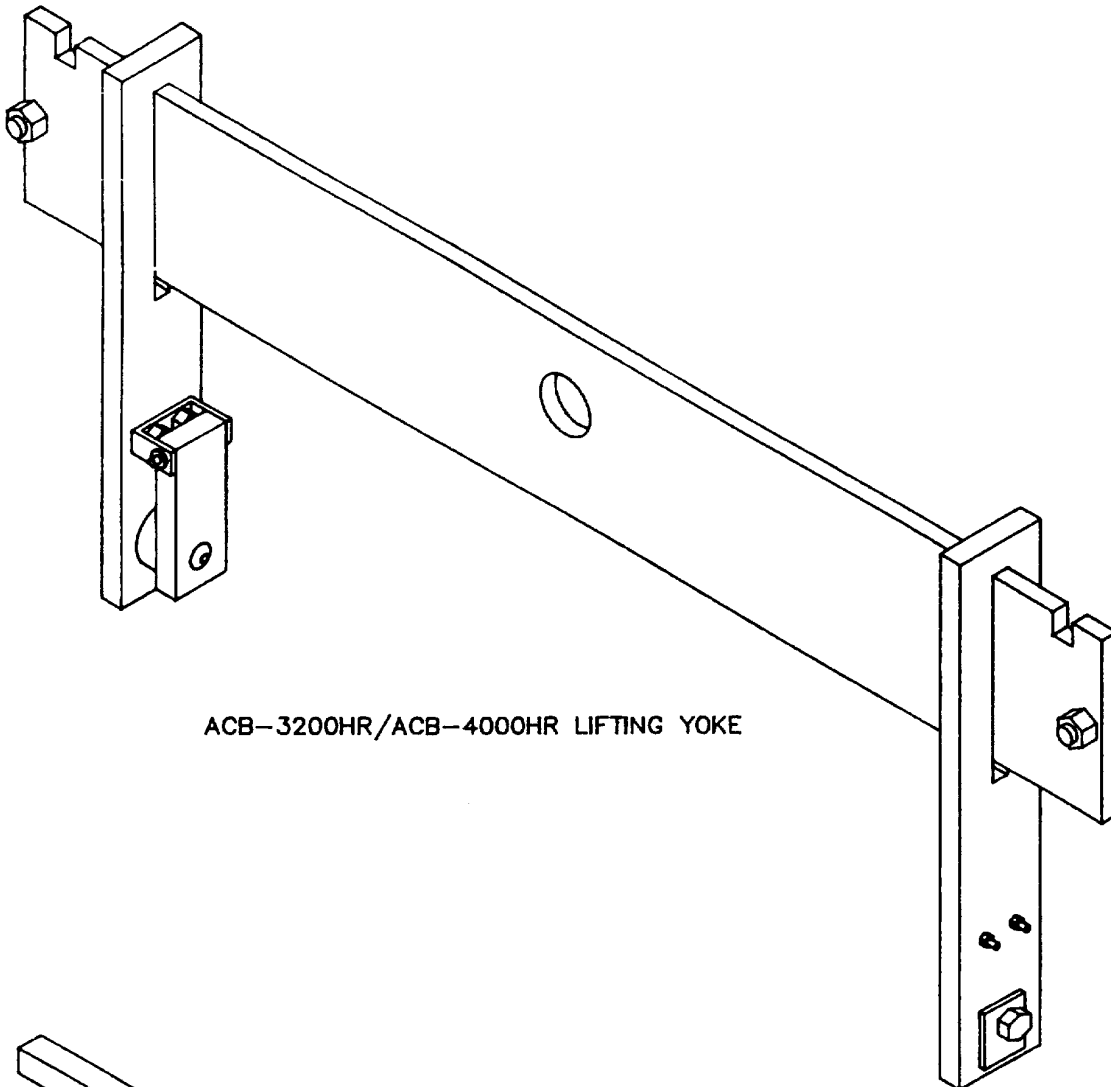


Figure 6-7. 3200A/4000A Lifting Yoke and Circuit Breaker Wrench

6-6. AQB-LF400 MOLDED CASE CIRCUIT BREAKER WITH MOTOR OPERATOR

See [figure 6-8](#). For detailed repair or replacement of internal components, refer to the corresponding publication in [table 6-1](#).

6-6.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. With the handle furnished for the motor-operator (5), turn to the OFF position. This opens the circuit breaker and moves the breaker operating handle to the OFF position.
- c. Gain access by removing cover or opening door as applicable. Retain hardware.
- d. Disengage the motor lead plug connector (1) located on the upper face of the motor mechanism (see [figure 6-8](#)).
- e. Remove the control wiring from the terminal block. Be sure all wires are labeled for correct replacement.
- f. Remove the screws (3) at the rear of the mounting bracket of the motor-operator (2). Retain the hardware. Remove the two hex nuts (4) on the through bolt. Retain hardware. Pull the entire motor mechanism (2) away from the circuit breaker (see [figure 6-8](#)).
- g. Loosen fuse cover retaining screws (6) and pull fuse unit cover (7) away from circuit breaker.
- h. Loosen lower circuit breaker mounting screws (8) and remove circuit breaker by pulling away from stabs.

6-6.2 REPLACEMENT. Reverse the above procedure to replace the breaker.

- a. Position circuit breaker over mounting block and press firmly to engage. Tighten lower circuit breaker mounting screws. Reinstall fuse unit.
- b. Establish control lead connection and replace control wiring.
- c. On electric motor operator; set mechanism in the OFF position.
 1. Place manual operating handle extension in place on shaft.
 2. Depress handle firmly onto square shoulder of operating shaft, to a depth of approximately 1-1/8 inches.
 3. Rotate handle to OFF position and remove handle.
- d. Connect motor lead plug.

NOTE

Ensure operating cam of motor mechanism is positioned over circuit breaker handle.

- e. Place motor operator onto breaker face and align mounting holes. Tighten retaining hardware.
- f. Close access door and tighten thumbscrews.
- g. Remove “Out of Service” tags and reenergize circuits.

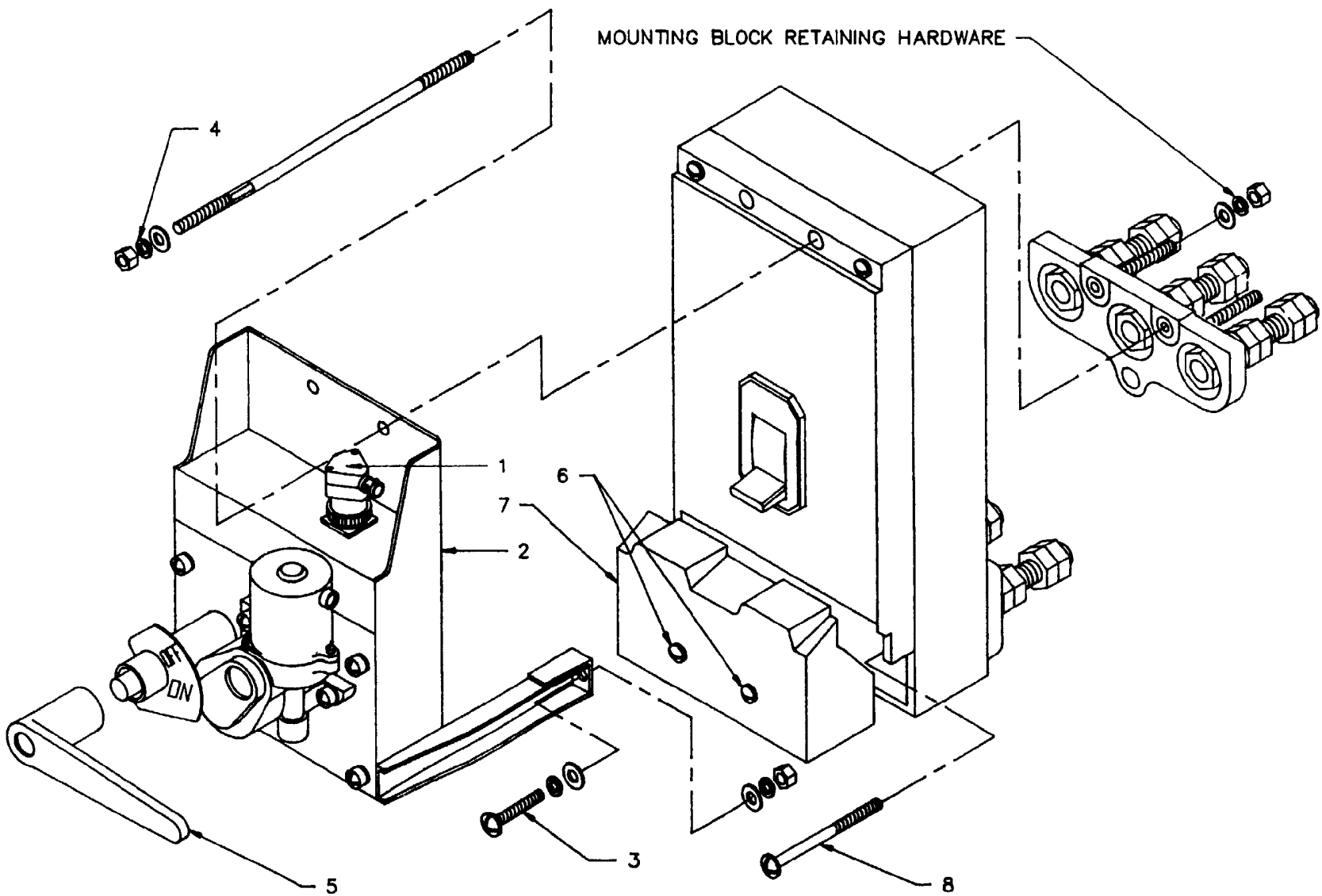


Figure 6-8. AQB-LF400 Molded Case Circuit Breaker with Motor Operator

6-7. AQB-LF250/AQB-LF400 MOLDED CASE CIRCUIT BREAKER

See [figure 6-9](#). For detailed repair or replacement of internal components, refer to the corresponding publication in [table 6-2](#).

6-7.1 REMOVAL.

WARNING

These switchboards contain lethal voltage. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access by loosening the thumbscrews on the cover panel.
- c. Mark if necessary and remove control wiring from terminal blocks where applicable. Retain hardware.
- d. Remove the current limiting fuse unit (1) by loosening two bolts (2) and pulling the unit forward, disengaging it from its connections. This action automatically trips the circuit breaker.
- e. Loosen the four mounting screws (3) located at 1-1/2 inch left and right of center, top, and bottom, recessed holes. Retain hardware.
- f. Draw circuit breaker (4) forward, disengaging from its mounting studs (5).

6-7.2 REPLACEMENT.

- a. Reverse the above procedure to replace the circuit breaker.
- b. Position circuit breaker over mounting studs and press firmly until all studs are fully engaged. Tighten the four mounting screws.
- c. Replace fuse unit in correct position and press firmly until fully seated. Tighten hex bolts.
- d. Replace control wiring to correct terminal board contacts.
- e. Reinstall and secure cover by tightening thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

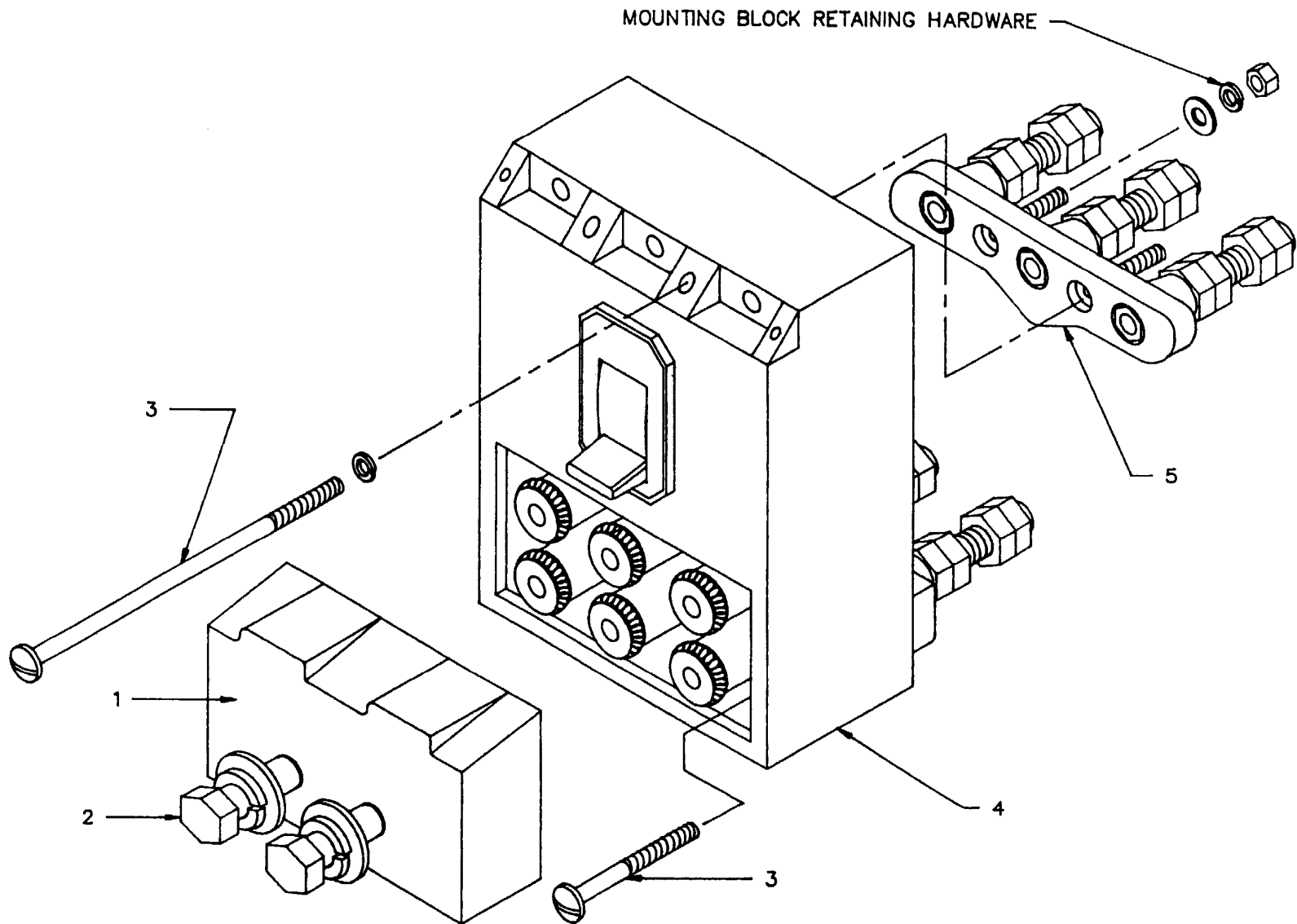


Figure 6-9. AQB-LF250 Molded Case Circuit Breaker

6-8. AQB-A101, MOLDED CASE CIRCUIT BREAKER

For detailed repair and replacement of internal components, refer to the corresponding publication in [table 6-2](#). See [figure 6-10](#) for a detailed view.

6-8.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access by loosening the thumbscrews on the cover panel.
- c. Mark if necessary and remove control wiring from contacts on terminal board.

CAUTION

Circuit breaker must be placed in the open position before the fuse unit is installed or removed.

- d. Remove two mounting screws (1) on fuse unit.
- e. Place two mounting screws into opposite threaded inserts (2).
- f. Using the screws, pull the fuse unit (3) out or away from the fuse mounting base (4).
- g. Remove the four larger mounting screws (5). Retain hardware.
- h. Thread two mounting screws into inserts (6) located upper right and lower left.
- i. Pull circuit breaker (7) out or away from mounting base (8).

6-8.2 REPLACEMENT.

- a. Reverse above procedures to replace the circuit breaker.
- b. Position circuit breaker over mounting stabs and press firmly. Secure with four mounting screws.
- c. Replace and secure fuse unit by tightening mounting screws.
- d. Replace control wiring to correct contacts on terminal board.
- e. Replace and secure cover panel by tightening thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

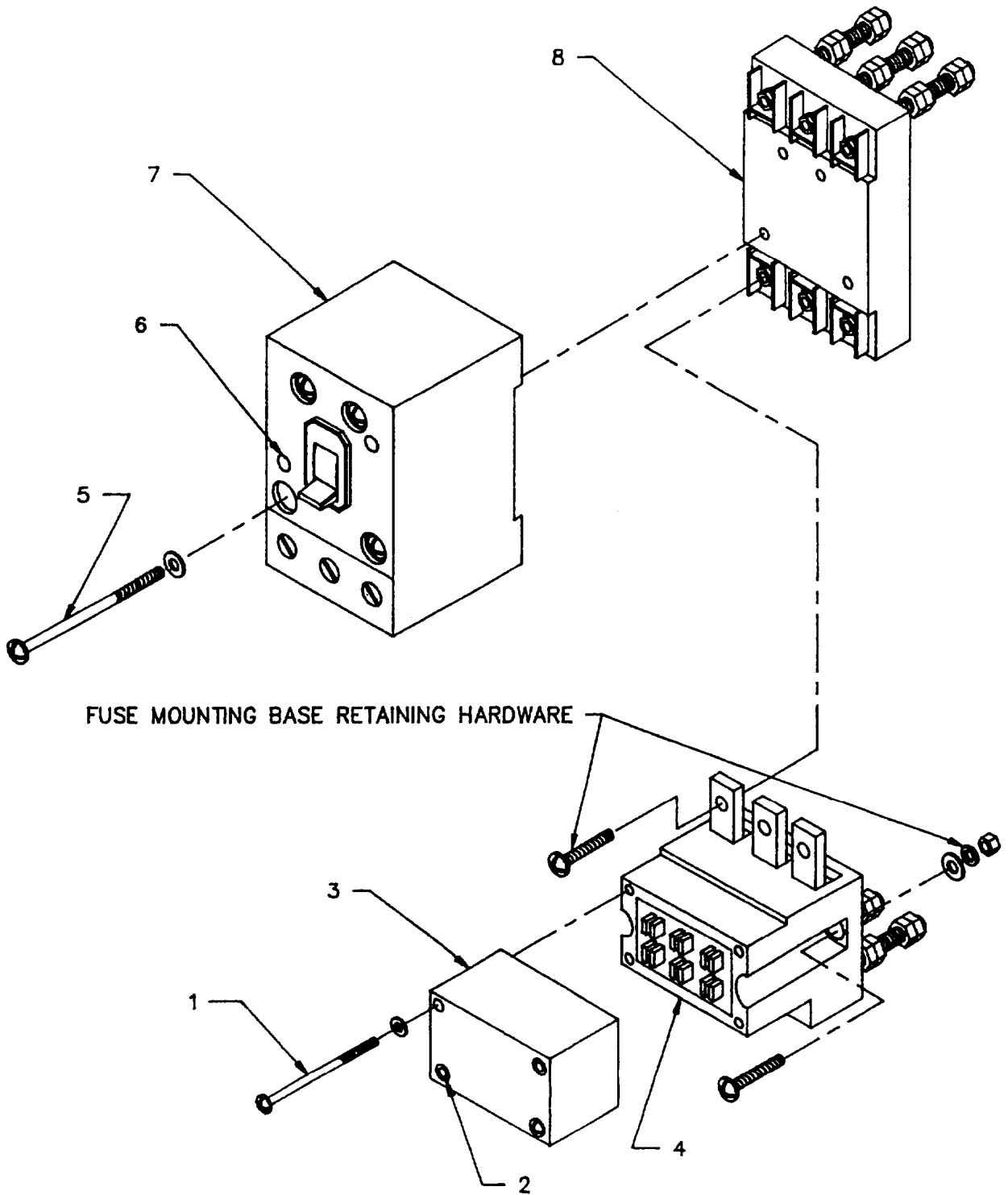


Figure 6-10. AQB-A101F Molded Case Circuit Breaker

6-9. ROTARY SWITCH, STYLE SJR

See [figure 6-11](#) for a detailed view. For more detailed information, refer to the corresponding publication in [table 6-1](#).

6-9.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove all wires from terminals on rear of switch. Label each according to its position, if necessary. Retain hardware.
- d. Remove the handle by removing the retaining screw. Pull handle off of square shaft.
- e. Remove four mounting screws. Retain hardware. Remove the escutcheon plate.
- f. Remove switch body from door by pulling backwards through mounting hole.

6-9.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place switch body through the rear of mounting surface and through bolt to escutcheon plate. Tighten mounting screws.
- c. Push handle onto shaft and tighten retaining screw.
- d. Replace wires to proper contacts as labeled.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

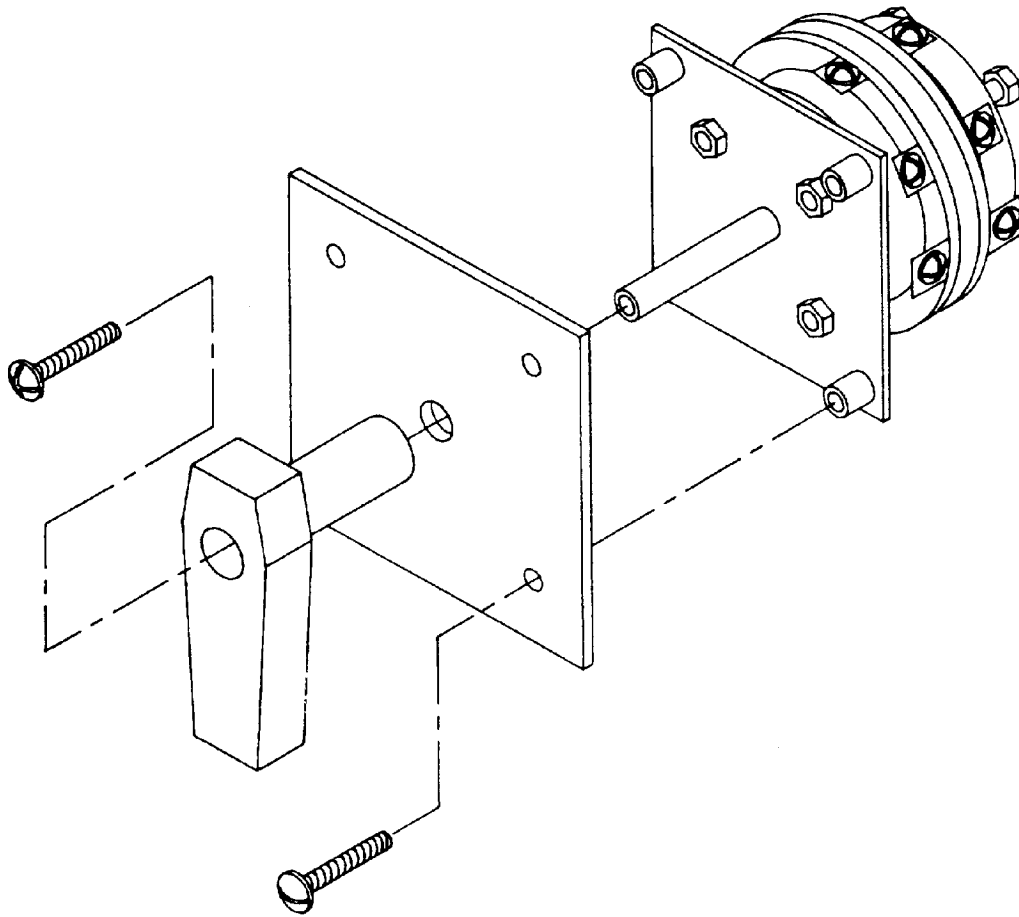


Figure 6-11. Rotary Switch, Style SJR

6-10. ROTARY SWITCH, STYLE 24G

See [figure 6-12](#) for a detailed view. For more detailed information, refer to the corresponding publication in [table 6-1](#).

6-10.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.

- c. Remove all wires from terminals on rear of switch. Label each according to its position, if necessary. Retain hardware.
- d. Remove the handle by removing the retaining screw. Pull handle off of square shaft.
- e. Remove the three mounting screws. Retain hardware.
- f. Pull escutcheon plate off of front of door and pull switch body through rear of mounting surface.

6-10.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place switch body through rear of mounting surface. Through-bolt escutcheon plate onto front of door to switch body.
- c. Place handle on square shaft. Tighten retaining screw.
- d. Replace wires to proper contacts.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

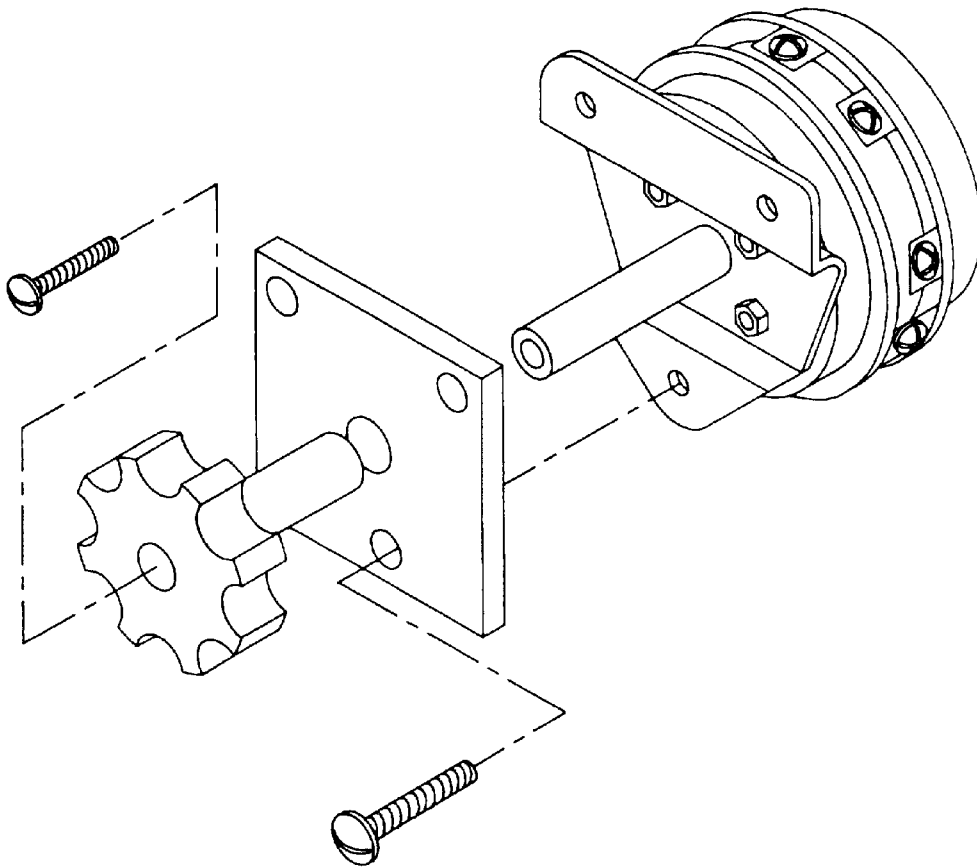


Figure 6-12. Rotary Switch, Style 24G

6-11. ROTARY SWITCH, STYLE SJM

See [figure 6-13](#) for a detailed view. For more detailed information, refer to the corresponding publication in [table 6-1](#).

6-11.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove all wires from terminals on rear of switch. Label each according to its position, if necessary. Retain hardware.
- d. Remove the handle by removing the retaining screw. Pull handle off of square shaft.
- e. Remove the four mounting screws. Retain hardware.
- f. Pull switch body through rear of mounting area and escutcheon plate from front of door.

6-11.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place switch body through rear of mounting surface area. Through-bolt escutcheon plate to switch body and tighten mounting screws.
- c. Replace handle. Tighten retaining screw.
- d. Replace wires to proper contacts.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

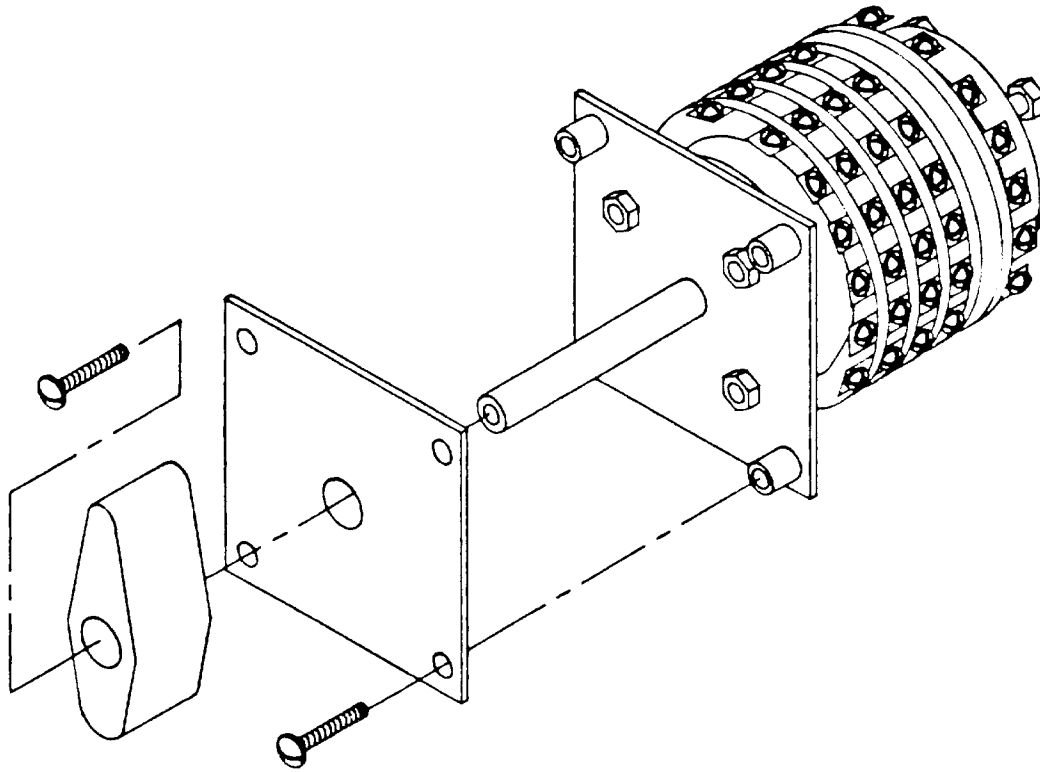


Figure 6-13. Rotary Switch, Style SJM

6-12. TOGGLE SWITCH

See [figure 6-14](#) for a detailed view.

6-12.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- Deenergize circuits and tag “Out of Service.”
- Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- Remove all wires from terminals on rear of switch. Label each according to its position, if necessary. Retain hardware.
- Remove front bushing from toggle switch (see [figure 6-14](#)). Retain nameplate if applicable.
- Pull switch body through rear of mounting area.

6-12.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place switch body through rear of mounting area. Tighten bushing.
- c. Replace wiring to proper contacts.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

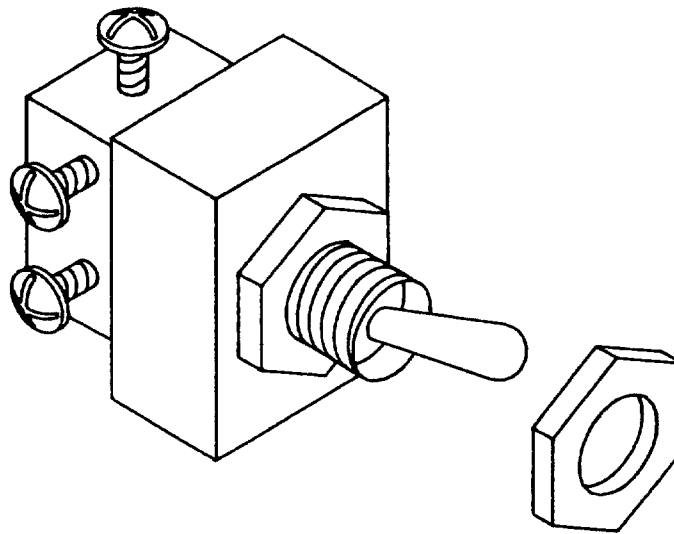


Figure 6-14. Toggle Switch

6-13. METERS

There are numerous types of meters in the 60 Hz main switchboards, but all are of a typical mounting configuration (see [figure 6-15](#)).

6-13.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.

- c. Depending on meter, remove connections on back with a 3/8-inch or 1/4-inch nut driver. Examine connectors and mark according to position.
- d. Remove four mounting screws and nuts. Retain hardware.
- e. Pull meter through front of mounting area.

6-13.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place meter into mounting area through front.
- c. Secure with mounting hardware.
- d. Replace wires to proper contacts.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

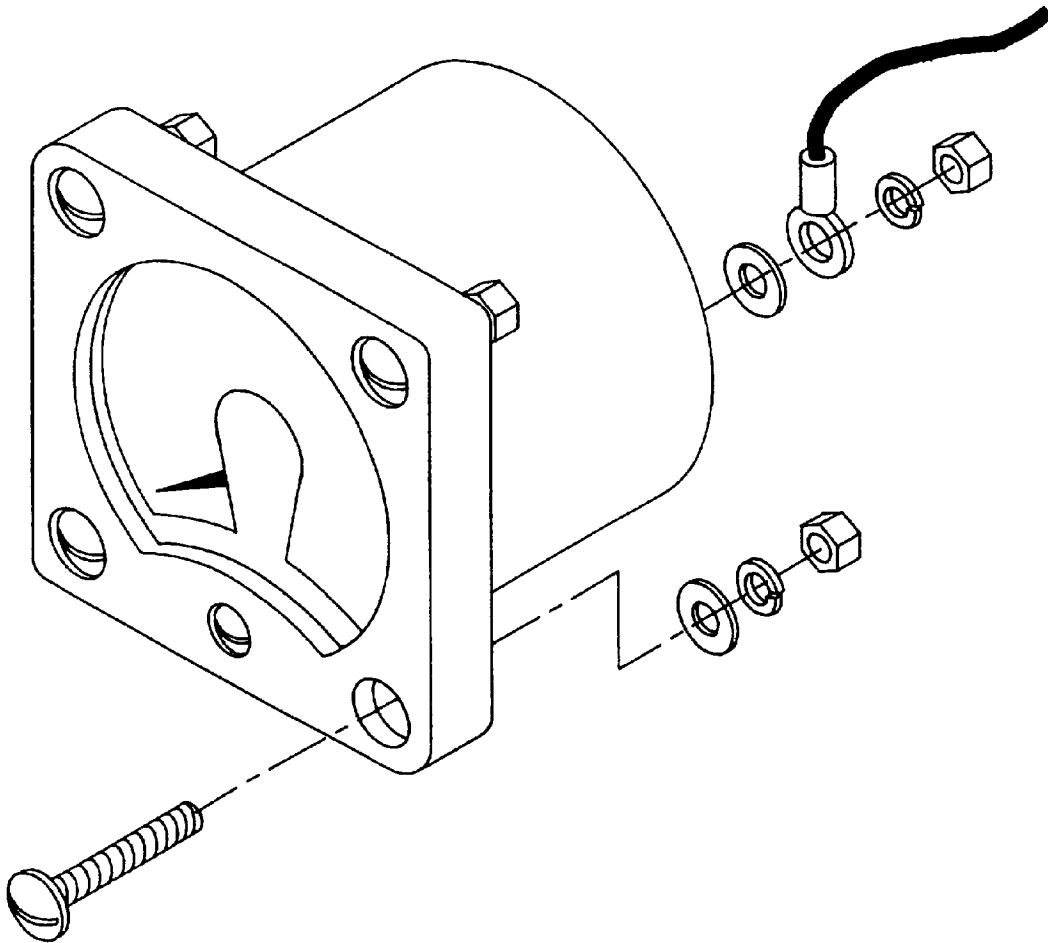


Figure 6-15. Typical Meter

6-14. CAPACITOR-DIODE ASSEMBLY

See [figure 6-16](#).

6-14.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews. Swing door into lockout position.

WARNING

The capacitor may still contain a charge. The charge should be dissipated using a 5 kohm resistor across the two output terminals. Do not touch until a voltmeter has been used to test for total discharge.

- c. Check capacitor for adequate discharge.
- d. Remove input and output wires from contacts on terminal board. Mark if necessary.
- e. Remove four mounting bolts and attaching hardware. Retain hardware.
- f. Pull assembly away from mounting surface.

6-14.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Align assembly with mounting holes and the terminal board at the top. Replace and tighten mounting hardware.
- c. Replace wires to proper contacts.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

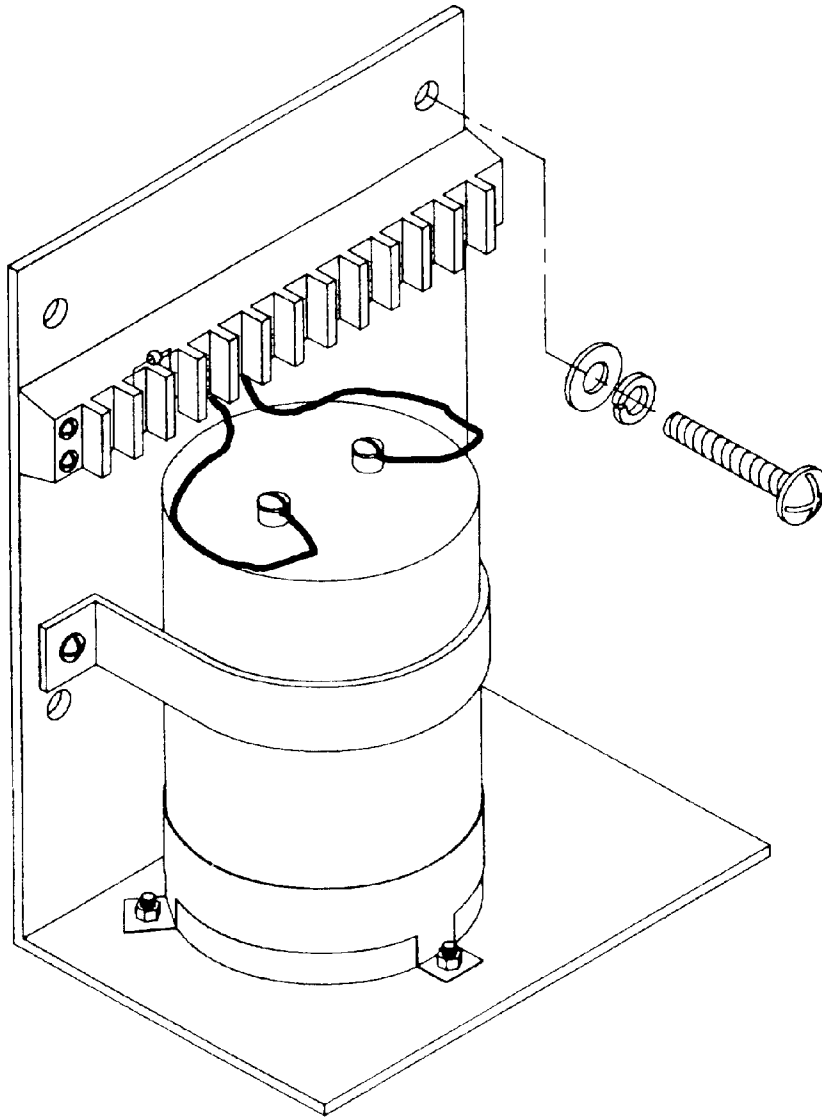


Figure 6-16. Capacitor Diode Assembly

6-15. TRANSFORMERS

There are three types of transformers contained in the 60 Hz main switchboards. For a detailed view, see [figures 6-17 through 6-19](#). When a transformer is defective, it should be replaced.

6-15.1 STEP-DOWN TRANSFORMER. See [figure 6-17](#).

6-15.1.1 Removal.

WARNING

These switchboards contain lethal voltages. Tag "Out of Service" in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the cover. Remove cover and retain hardware.
- c. Remove wiring from terminals X1, X2, H1, and H2 and mark accordingly. Retain hardware.
- d. Remove four mounting bolts on bottom plate of transformer. Retain hardware.
- e. Pull Transformer out of switchboard.

6-15.1.2 Replacement.

- a. Reverse the above procedures for replacement.
- b. Place transformer over mounting holes. Replace mounting hardware and tighten.
- c. Replace wires to proper contacts.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

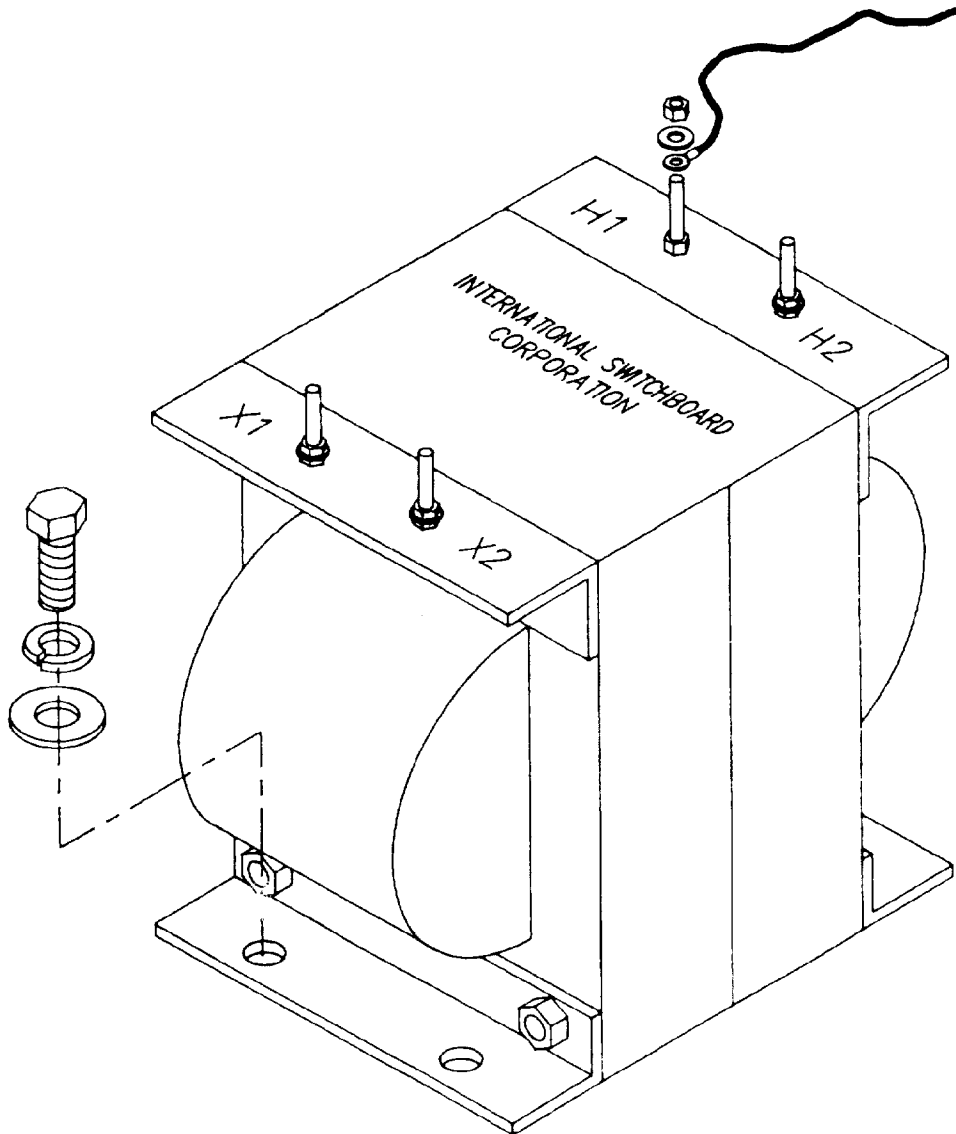


Figure 6-17. Step-Down Transformer

6-15.2 CURRENT TRANSFORMER. See [figure 6-18](#).

6-15.2.1 Removal.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- Deenergize circuits and tag “Out of Service.”
- Gain access into the switchboard by removing the bolts on cover. Remove cover and retain hardware.
- Remove wiring from two terminals. Mark if necessary.

- d. Remove bolts attaching cabling or bussing that runs through the center of the transformer. Retain all hardware. Remove bus (or cabling) from center.
- e. Loosen four mounting bolts and lift transformer from mounting base.

6-15.2.2 Replacement.

- a. Reverse the above procedures for replacement.
- b. Place current transformer over mounting holes. Secure with mounting hardware.
- c. Replace (or reroute) bussing (or cabling) to pass through center of transformer. Secure with retained hardware. Torque bus (or cabling) hardware in accordance with [table 8-1](#).
- d. Replace wires to proper terminals.
- e. Close and secure cover with hardware.
- f. Remove “Out of Service” tags and reenergize circuits.

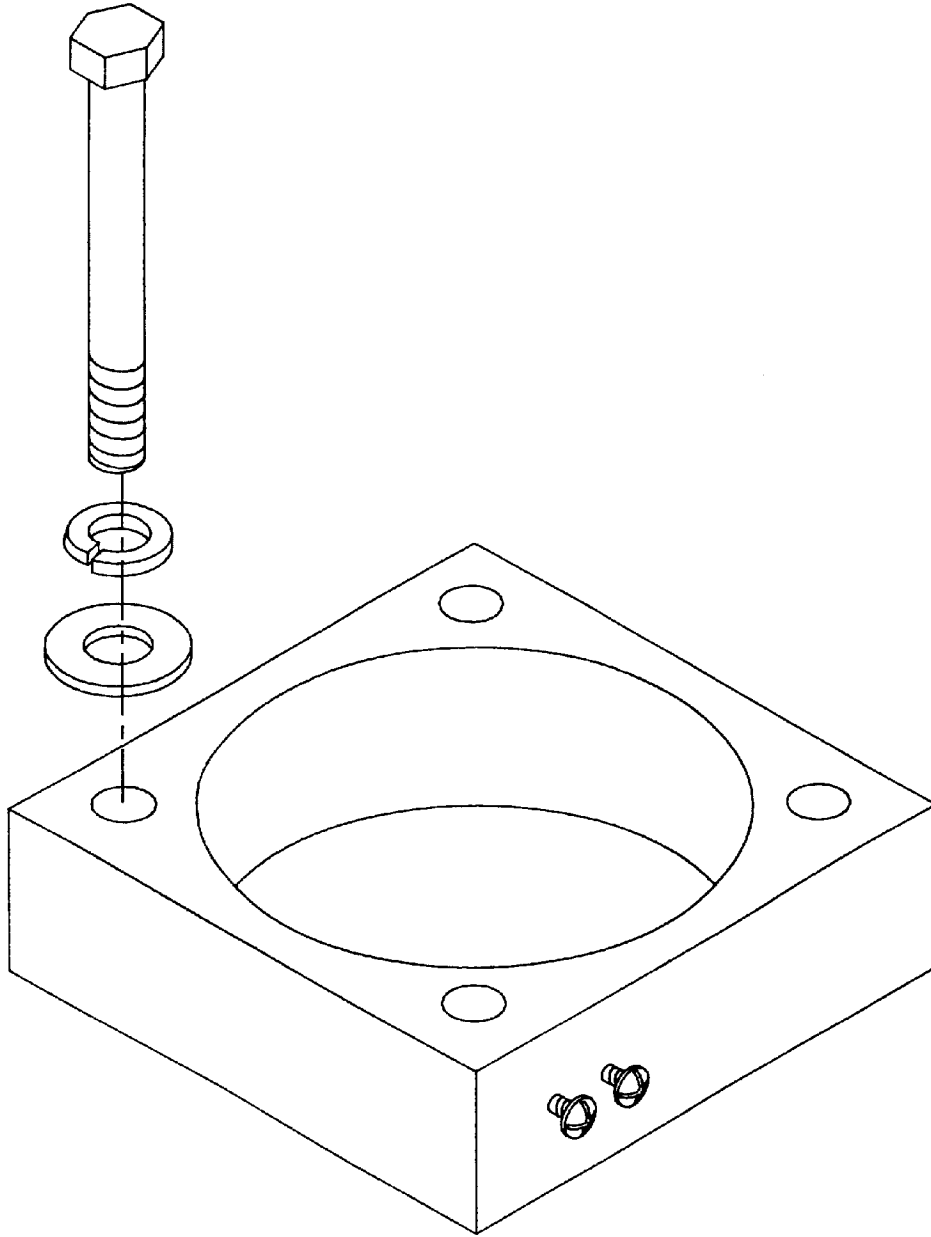


Figure 6-18. Current Transformer

6-15.3 POTENTIAL TRANSFORMER. See [figure 6-19](#).

6-15.3.1 Removal.

WARNING

These switchboards contain lethal voltages. Tag "Out of Service" in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove wiring from input and output terminals by loosening terminal nuts. Mark wires, if necessary.
- d. Remove four mounting bolts from base of transformer. Lift out transformer. Retain hardware.

6-15.3.2 Replacement.

- a. Reverse the above procedures for replacement.
- b. Place transformer over mounting holes and secure with retained hardware.
- c. Replace wires to proper terminals.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

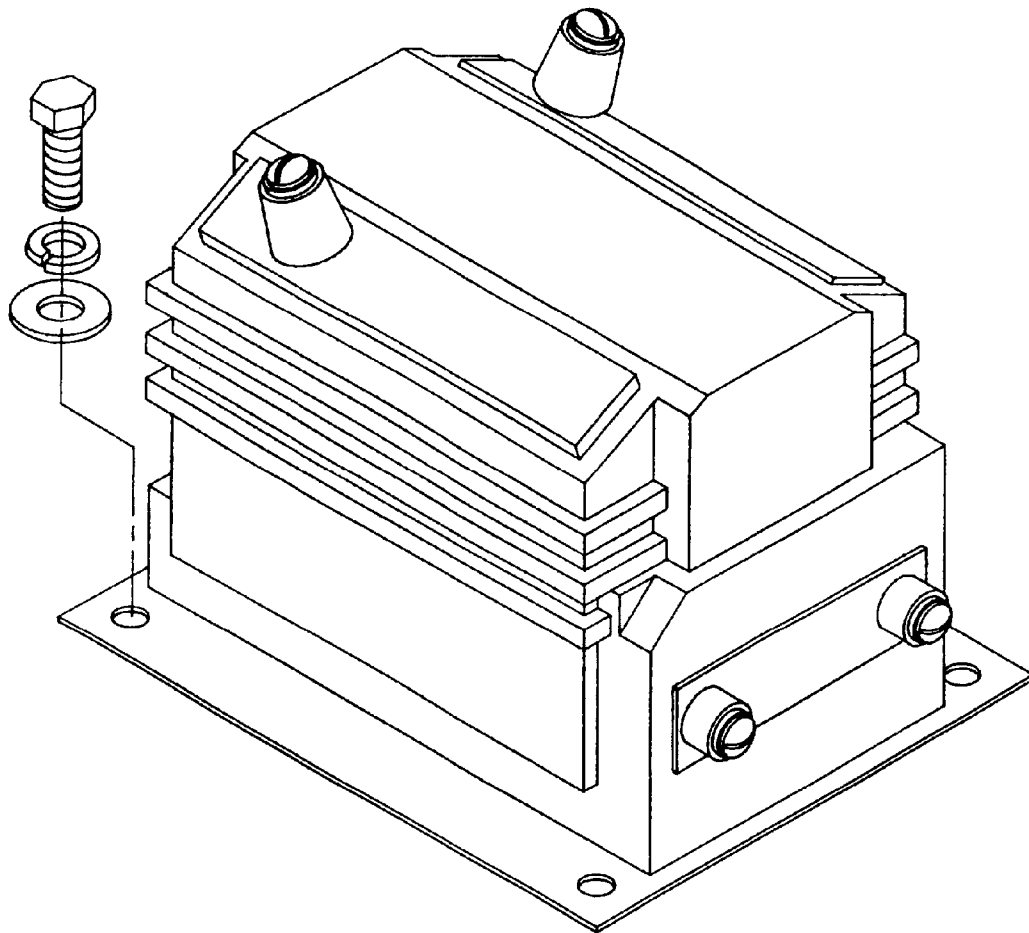


Figure 6-19. Potential Transformer

6-16. THYRITE PROTECTIVE DEVICE

See [figure 6-20](#) for a detailed view.

6-16.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove two wires from terminals, on side of device. Retain hardware.
- d. Remove mounting nuts from studs on mounting base with the proper open-ended wrench. Retain hardware.
- e. Lift protective device off of studs.

6-16.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place device over studs on mounting base and secure with retained hardware.
- c. Replace wires to correct terminals.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

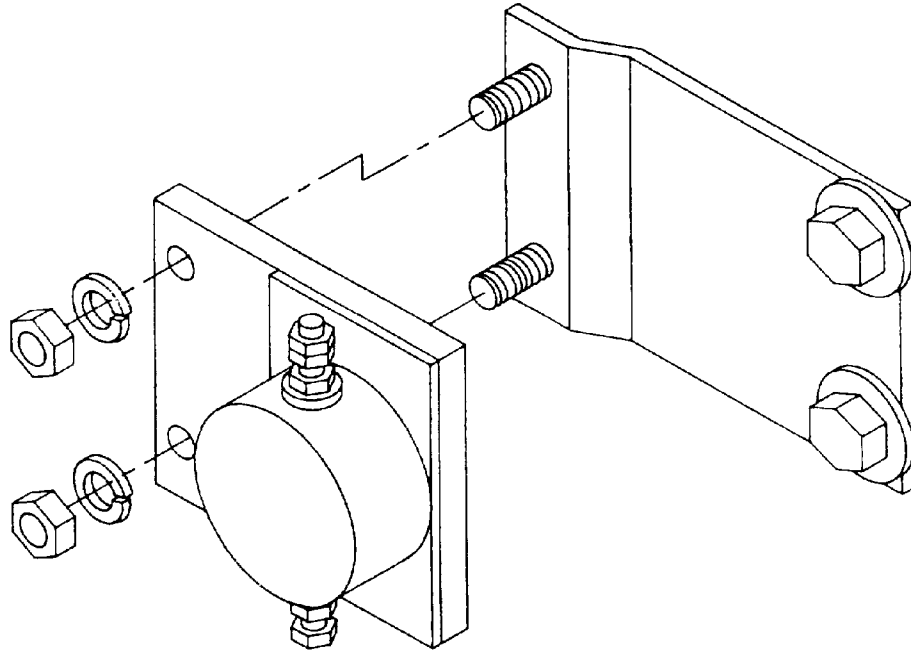


Figure 6-20. Protective Device

6-17. PUSHBUTTON SWITCH

See [figure 6-21](#). This item is not repairable and should be replaced upon failure.

6-17.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove wires from rear terminals. Mark wires, if necessary. Retain hardware.
- d. Remove two mounting screws from front of switch. Retain hardware.
- e. Pull switch body through rear of mounting area.

6-17.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place switch through rear of mounting area and align mounting holes. Secure with retained hardware.

- c. Replace wires to rear of terminals.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

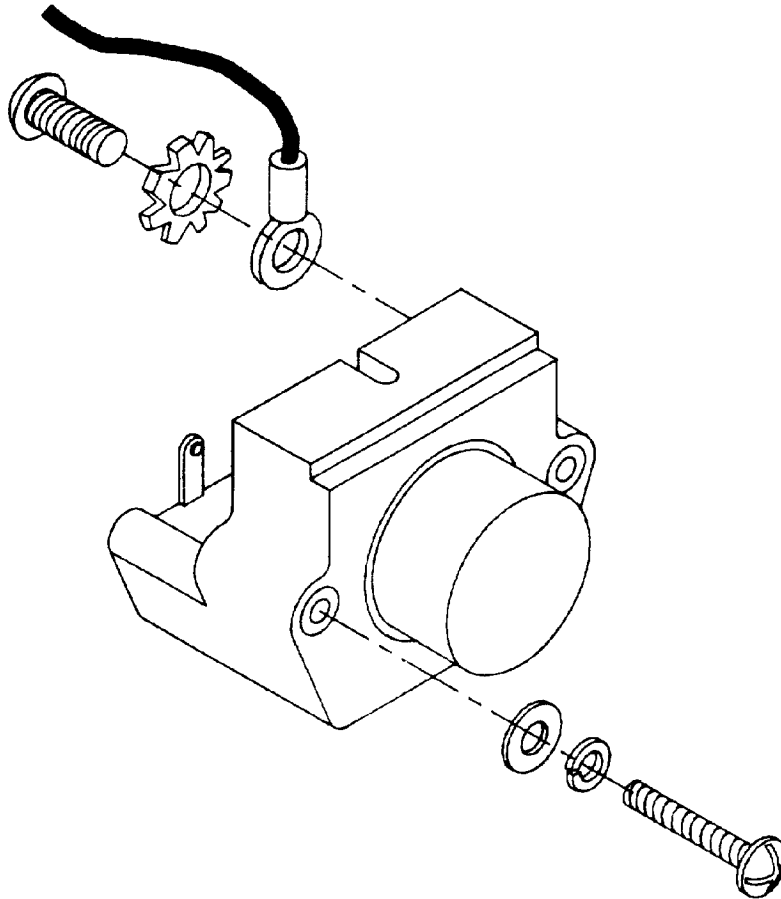


Figure 6-21. Pushbutton Switch

6-18. TEST BLOCK

See [figure 6-22](#) for a detailed view.

6-18.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”

- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove wires from rear terminals. Mark wires, if necessary. Retain hardware.
- d. Remove cotter pin from front cover and retain if reusable.
- e. Pull front cover disengaging from interior stabs.
- f. Remove mounting screw from block and retain hardware.
- g. Pull test block body through rear of mounting area.

6-18.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place block through rear of mounting area. Align mounting holes and secure with mounting hardware.
- c. Push front cover until stabs are engaged fully. Replace cotter pin.
- d. Replace wires to correct terminals.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

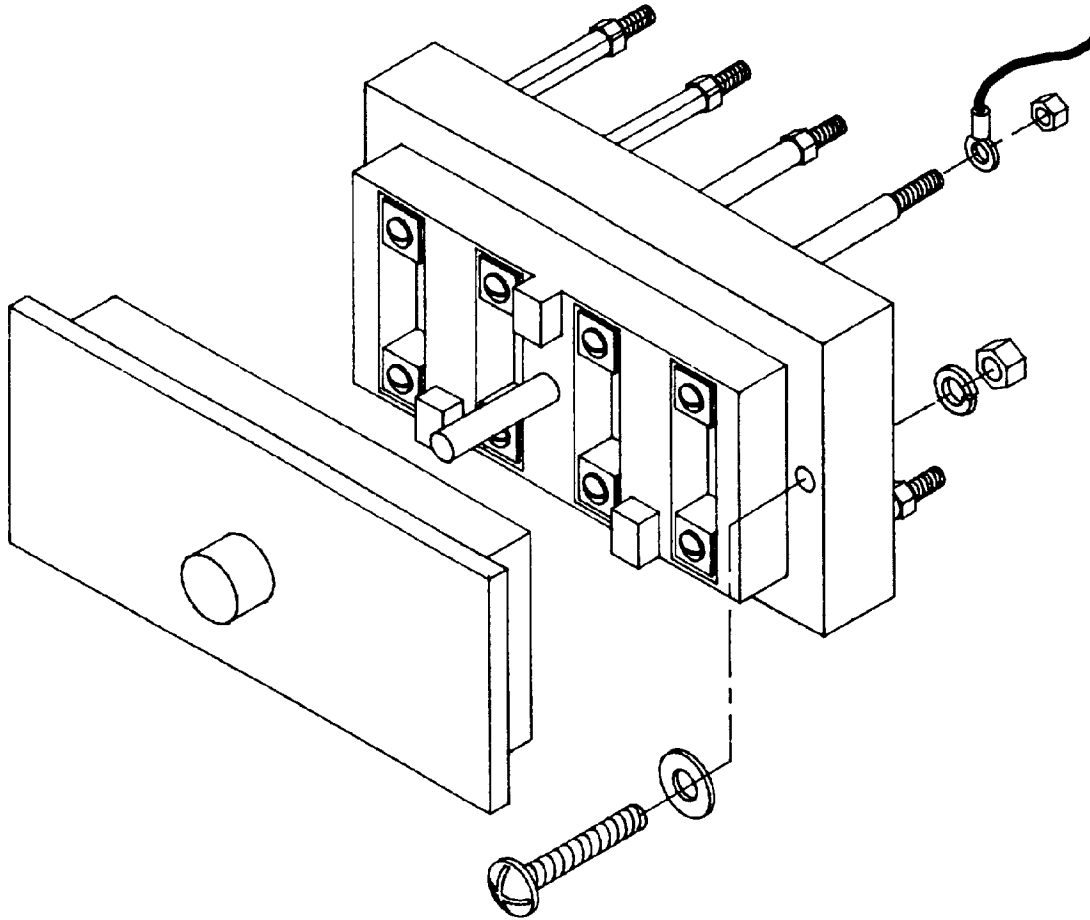


Figure 6-22. Test Block

6-19. CONTACTOR

Contactors should be replaced upon failure. See [figure 6-23](#) for detailed view.

6-19.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove wiring (1) from terminals. Mark if necessary.
- d. Remove subpan bracket (2) by loosening four hex head bolts (3). Retain hardware.

- e. Remove contactor assembly mounting screws (4). Retain hardware.
- f. Pull contactor assembly (5) from mounting base.
- g. Repeat [step e](#) and [step f](#) for second contactor assembly.
- h. Inspect mechanical interlock (6) for damage and replace if necessary.

6-19.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Align contactor onto mechanical interlock.
- c. Align assembly with bracket mounting holes and secure with screws.
- d. Replace subpan bracket to back subpan, tighten hardware.
- e. Replace wires to proper contacts.
- f. Close door and secure by tightening captive thumbscrews.
- g. Remove “Out of Service” tags and reenergize circuits.

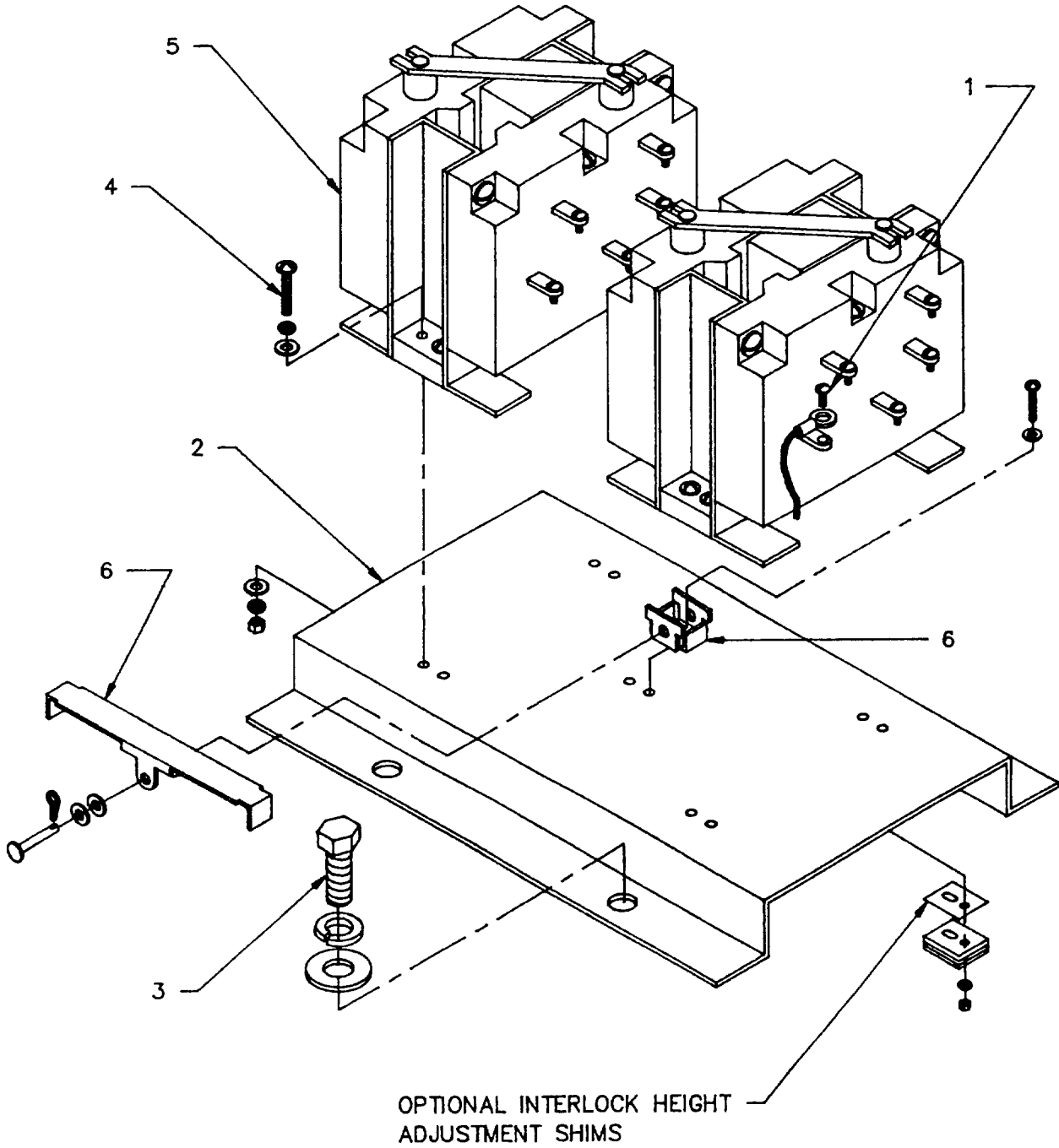


Figure 6-23. Contactor with Mechanical Interlock

6-20. RESISTOR

See [figure 6-24](#) for a detailed view.

6-20.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Locate the resistor on the contacts and remove. Retain hardware.
- d. Pull resistor from contact point and dispose.
- e. Retain plastic lead cover and/or replace as required.

6-20.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Crimp ring lugs (Type RB1333, MS25036-106) to each end of leads with the proper crimping tool (Type WT145A-1) (refer to [table 6-2](#)).
- c. Reinstall to proper contacts and secure with hardware.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

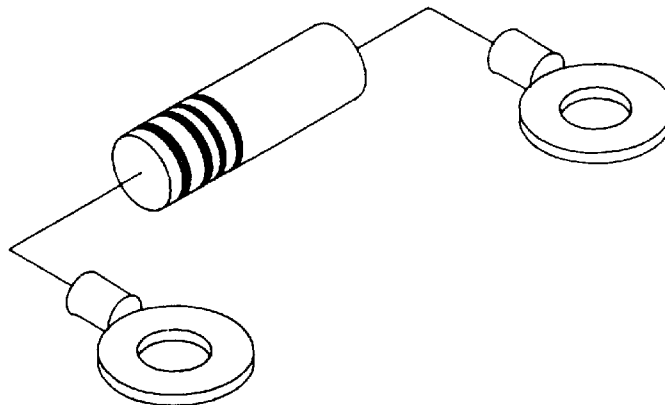


Figure 6-24. Resistor

6-21. DIODE

See [figure 6-25](#) for a detailed view.

6-21.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Locate the diode across the terminals and remove contact hardware. Retain hardware.
- d. Remove diode leads from contacts. Cut off ring lugs and retain plastic lead covers. Dispose of defective item.

6-21.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Obtain diode and crimp ring lugs (Type RB1333, MS25036-106) with crimping tool (Type WT145A-1) (refer to [table 6-2](#)).
- c. Replace diode to position on contacts. Secure with retained hardware.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

6-22. LAMPHOLDER AND INDICATOR LAMPS

See [figure 6-26](#) for a detailed view.

6-22.1 LAMPHOLDER REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove wires (1) from terminals at rear of lampholder (2). Mark wires if necessary. Retain hardware.
- d. Remove plastic lens cap (3) by turning CCW.
- e. Remove front bushing (4). Remove and retain O-rings (5). Pull lampholder body (2) from rear of mounting area.

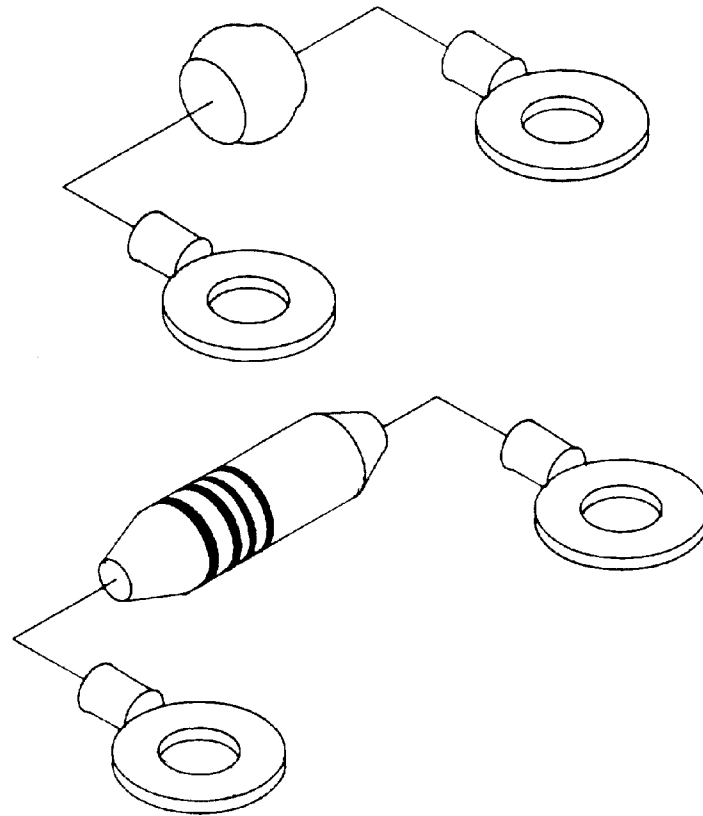


Figure 6-25. Diode

6-22.2 LAMPHOLDER REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place lampholder body through mounting area, replace O-rings, and tighten front bushing securely to door.
- c. Replace wires to proper contacts.
- d. Replace plastic lens cap.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

6-22.3 LAMP REMOVAL AND REPLACEMENT.

- a. Power need not be removed to remove and replace lamps. Caution should be used since electrical power still exists across lamp contacts.
- b. Access into the switchboard is not needed. Turn the plastic lens cap (3), CCW until it is removed (see [figure 6-26](#)).
- c. Unscrew defective lamp (6) and replace with proper rated type lamp.

CAUTION

This is a typical procedure for indicator lamp replacement. Care should be taken to correctly identify which type of lamp should be used.

d. Replace lens cap and tighten.

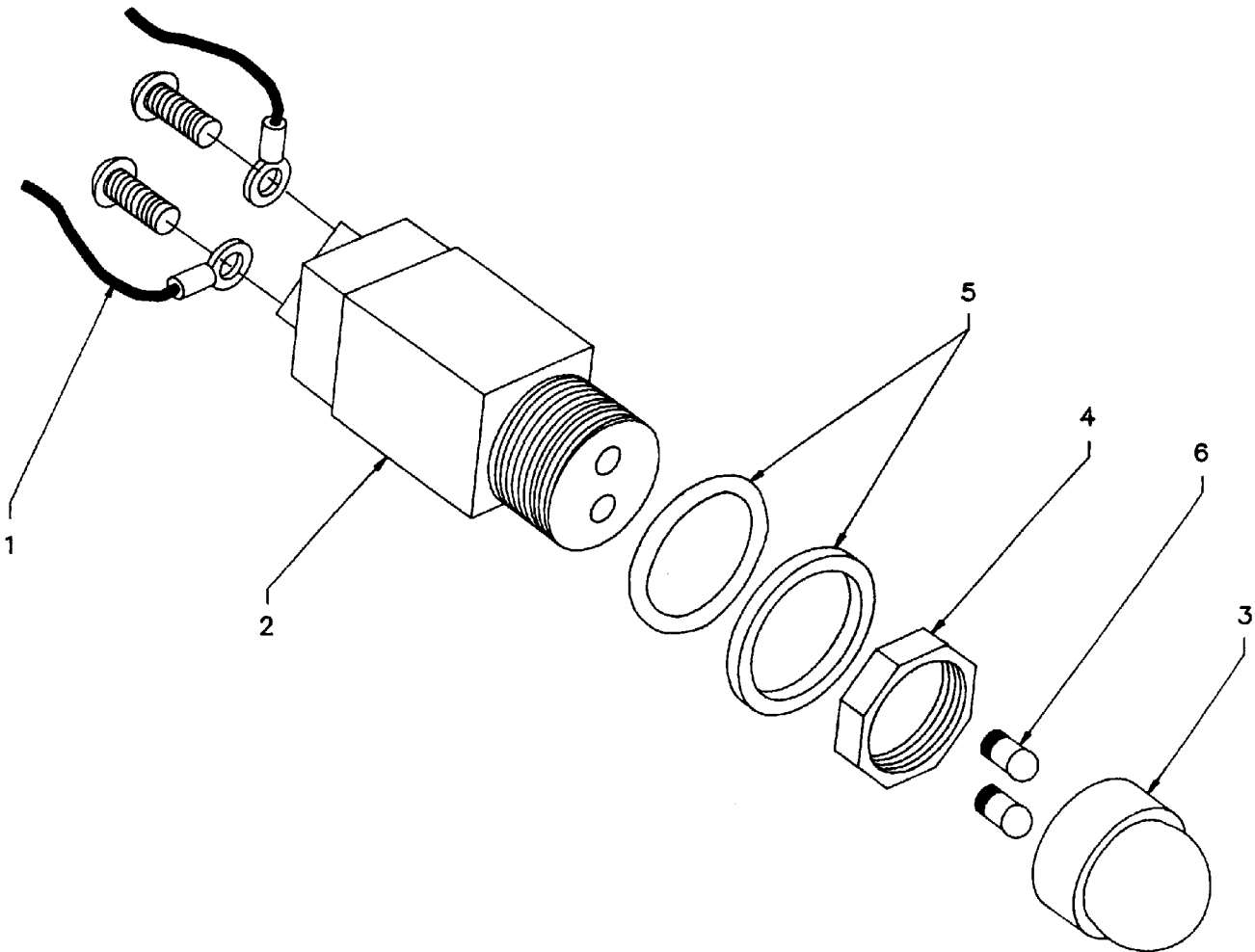


Figure 6-26. Typical Lampholder and Indicator Lamps

6-23. FUSEHOLDER, BLOWN FUSE INDICATING

This component, located on the 2SA switchboard, should be replaced upon failure. See [figure 6-27](#) for detailed view.

6-23.1 FUSEHOLDER REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Remove all wires (2) from rear terminals. Mark if necessary. Retain hardware.
- c. Remove crosshead mounting screws (3) from front of mounting area. Retain hardware.
- d. Pull fuseholder (1) through rear of mounting area. Remove gaskets (4) and retaining ring (5).

6-23.2 FUSEHOLDER REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place fuseholder and gaskets through rear of mounting area and align mounting holes. Secure with hardware.
- c. Replace wires to proper contacts.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

6-23.3 FUSE REMOVAL AND REPLACEMENT.

- a. Locate blown fuse on front of door.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

CAUTION

Do not install fuses of different types or ratings. Damage to the circuit may result from an improperly protected circuit.

- b. Deenergize circuits and tag “Out of Service.”
- c. Ensure power has been removed by testing with a multimeter at test point.
- d. Twist the cap (6) 1/4 turn CCW and pull to remove the fuse carrier (see [figure 6-27](#)).
- e. Pull defective fuse (7) from clips.
- f. Replace fuse (properly rated) into fuse carrier clips.
- g. Replace fuse carrier into body and push and rotate 1/4 turn CW to lock into place.

h. Remove “Out of Service” tags and reenergize circuits.

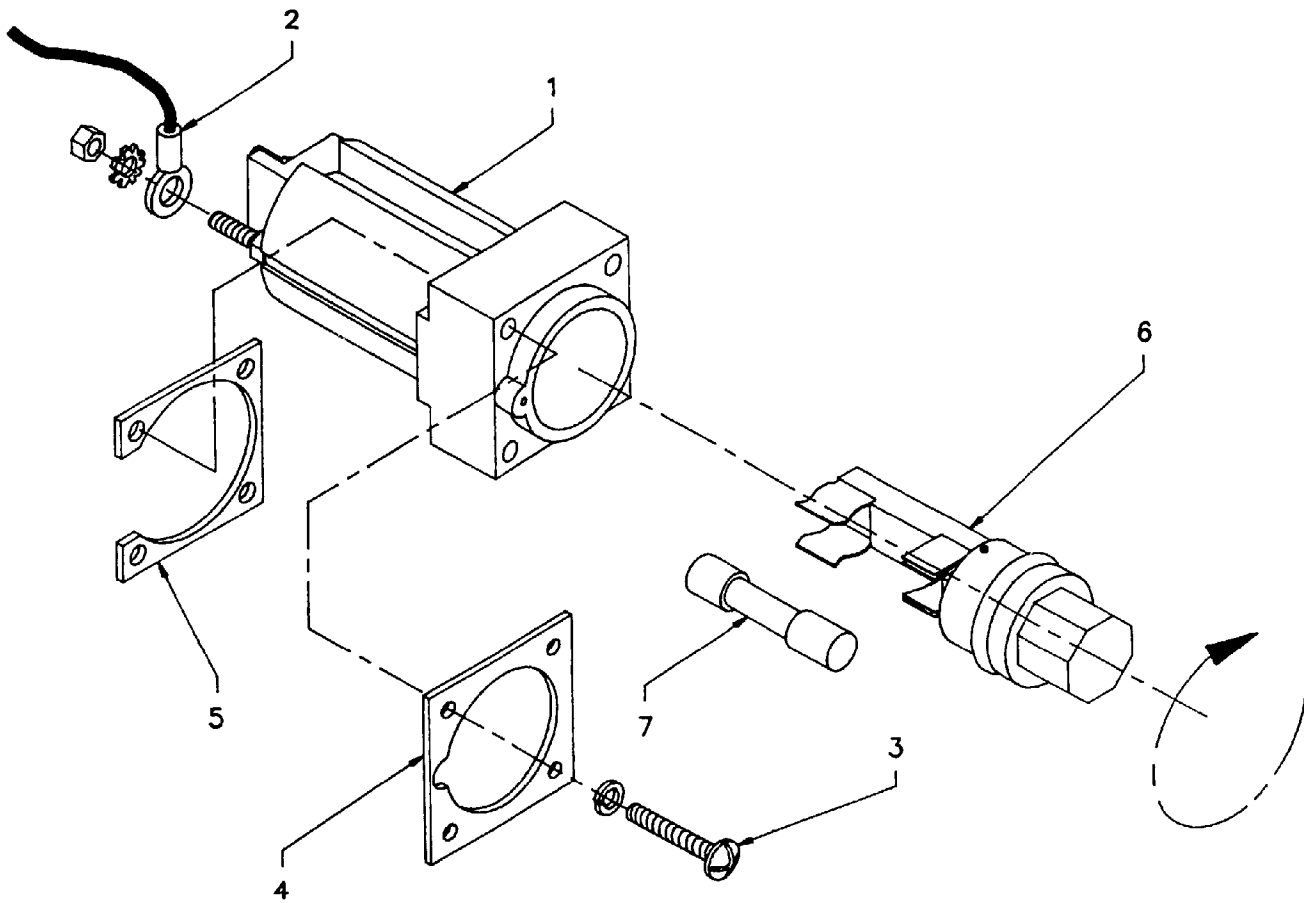


Figure 6-27. Fuseholder, Blown Fuse Indicating, Type FHL12U

6-24. FUSE CLIPS AND FUSE

See [figure 6-28](#) for detailed view.

6-24.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the Fuse Compartment by loosening the captive thumbscrews on the door. Swing open to a lockout position.
- c. Remove fuse from clip using fuse pullers (87F2748 Type 34-002). See [table 6-2](#).

- d. Remove fuse board retaining hardware and tilt board to gain access to rear of clips.
- e. Remove wires from rear of fuse clip. Retain hardware.
- f. Clips are now free to be replaced.

6-24.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Replace fuse clips and wires. Secure with original hardware.
- c. Reinstall fuse board.
- d. Place properly rated fuse into clips.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

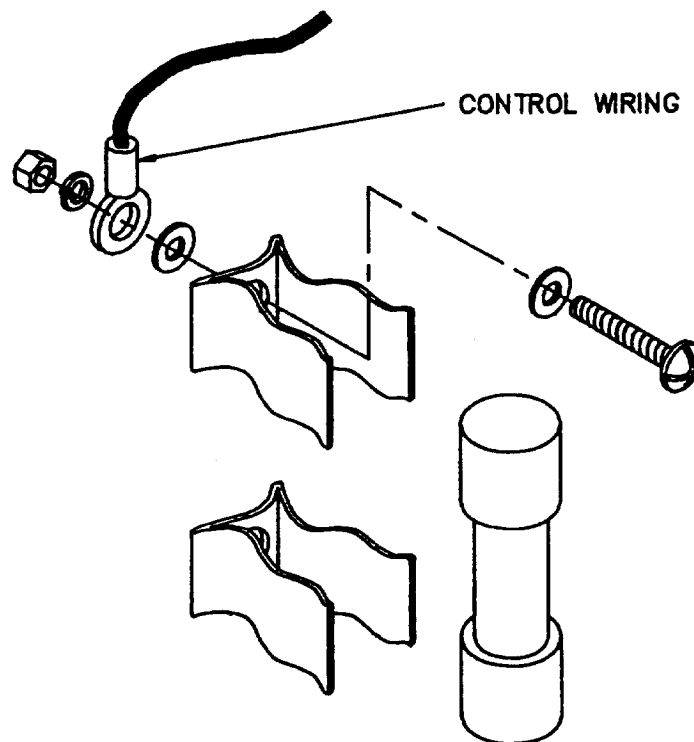


Figure 6-28. Fuse Clip and Fuse

6-25. RELAYS

There are two types of relays in the 60 Hz main switchboards. Each should be replaced upon failure following the procedures provided. See [figures 6-29](#) and [6-30](#) for a detailed view.

6-25.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access by loosening the captive thumbscrews on the door. Swing open to a lockout position.
- c. Remove the wires from contacts. Mark wires if necessary.
- d. Remove the mounting hardware. Retain hardware.
- e. Remove relay assembly from subpan.
- f. Remove mounting bracket hardware (if required) and remove mounting bracket.

6-25.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place relay on mounting bracket (if required). Align mounting holes. Secure with hardware. Place relay assembly on subpan and secure with hardware.
- c. Replace wires to correct contacts.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

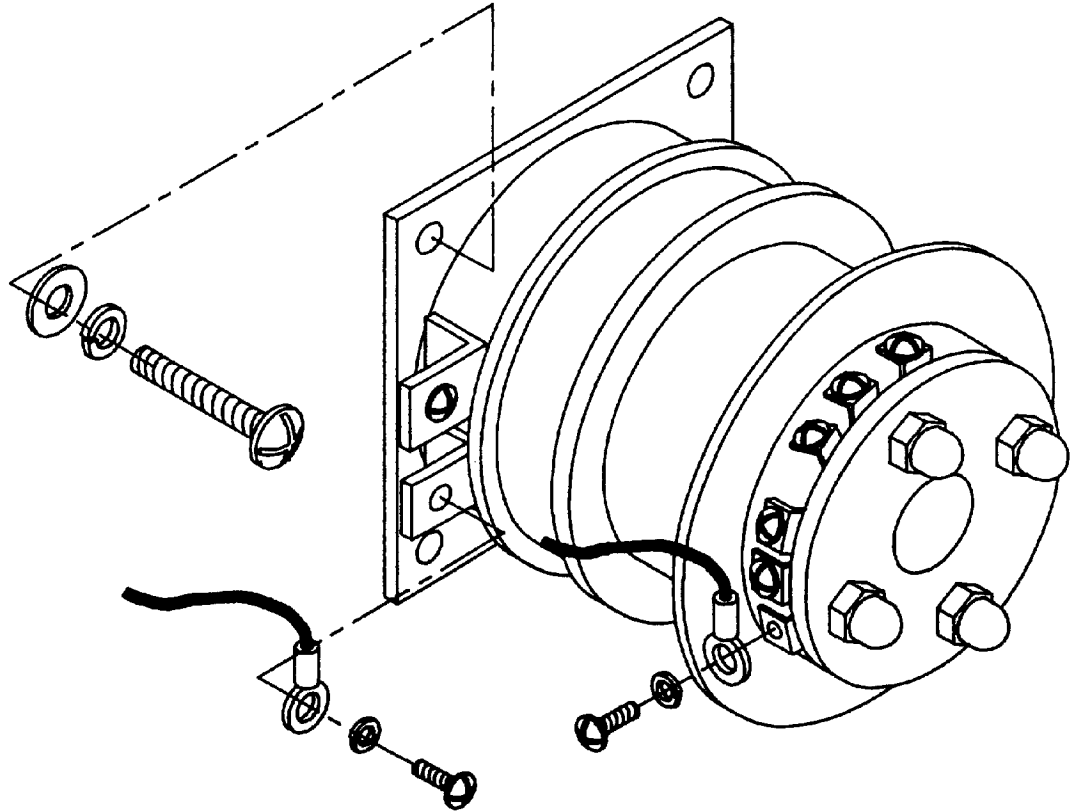


Figure 6-29. MDR Type Relay

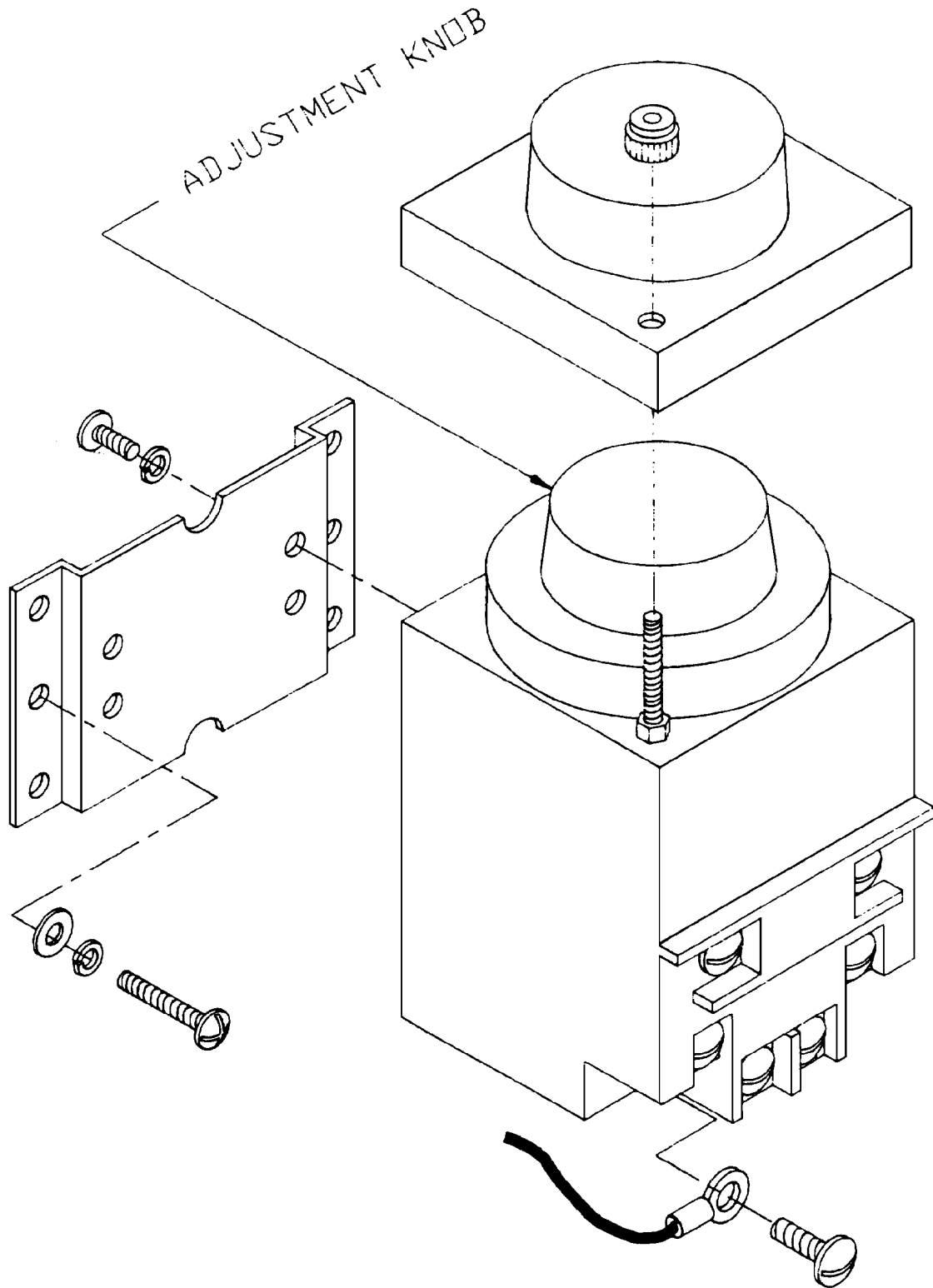


Figure 6-30. Electropneumatic Relay

6-26. TERMINAL BOARDS

These components should be replaced upon damage to contacts or body. See [figure 6-31](#) for a detailed view.

6-26.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive the hardware on the cover or door.
- c. Remove all wires and mark if necessary.
- d. Remove four mounting screws. Retain hardware.
- e. Remove the terminal board and marking strip.

6-26.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Place marking strip and terminal board over mounting holes. Secure with hardware retained.
- c. Replace wires to proper contacts.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

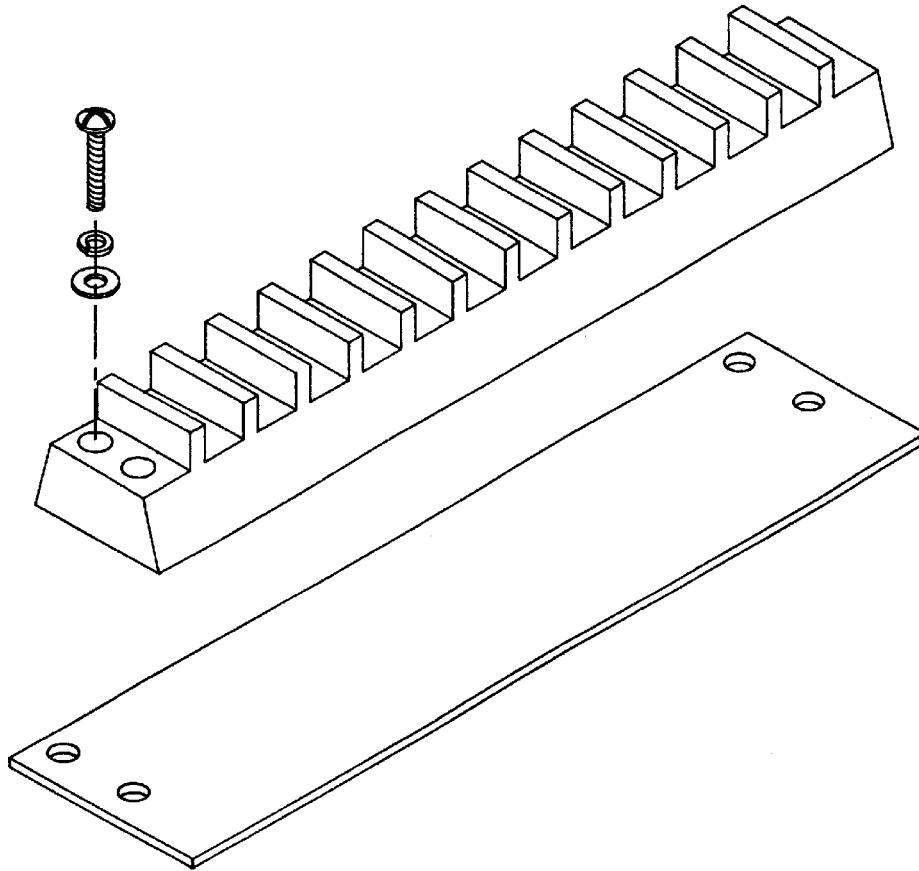


Figure 6-31. Terminal Block

NOTE

Paragraph 6-27 is not applicable to ships with MACHALT 320-59006 (ECP-515) installed. Refer to paragraph 6-34 for information on the GPM.

6-27. FAULT CURRENT DETECTOR

This solid-state device shall be repaired to the card level. Troubleshooting and bench testing are outlined in Chapter 5. See figure 6-32 for a detailed view.

6-27.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”

- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. For removal of device; remove all external connections on terminal boards. Mark wires for identification if necessary. Retain hardware.
- d. Remove four mounting bolts at rear of enclosure. Retain hardware.
- e. Pull device free of mounting surface.
- f. For removal of a card; identify the defective card module. Loosen the two captive thumbscrews.
- g. Grasp the handle of the card module cover and pull straight back until card is free of enclosure.
- h. Loosen the two nuts on the rear of the module cover that attach the handle. This will allow the handle and the card with bracket to be separated from the cover. Retain hardware.

6-27.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. For replacement of card, place new card on bracket and secure with hardware.
- c. Align card bracket with mounting holes of module cover and insert handle through holes of cover and bracket. Secure with hardware.
- d. Holding card module by the handle; feed card into guide rail until the card is seated into the hard connection in rear of enclosure. Tighten captive thumbscrews.
- e. For replacement of enclosure; align enclosure mounting holes to mounting surface. Tighten hardware.
- d. Replace wires to proper terminal board contacts. Tighten hardware.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove "Out of Service" tags and reenergize circuits.

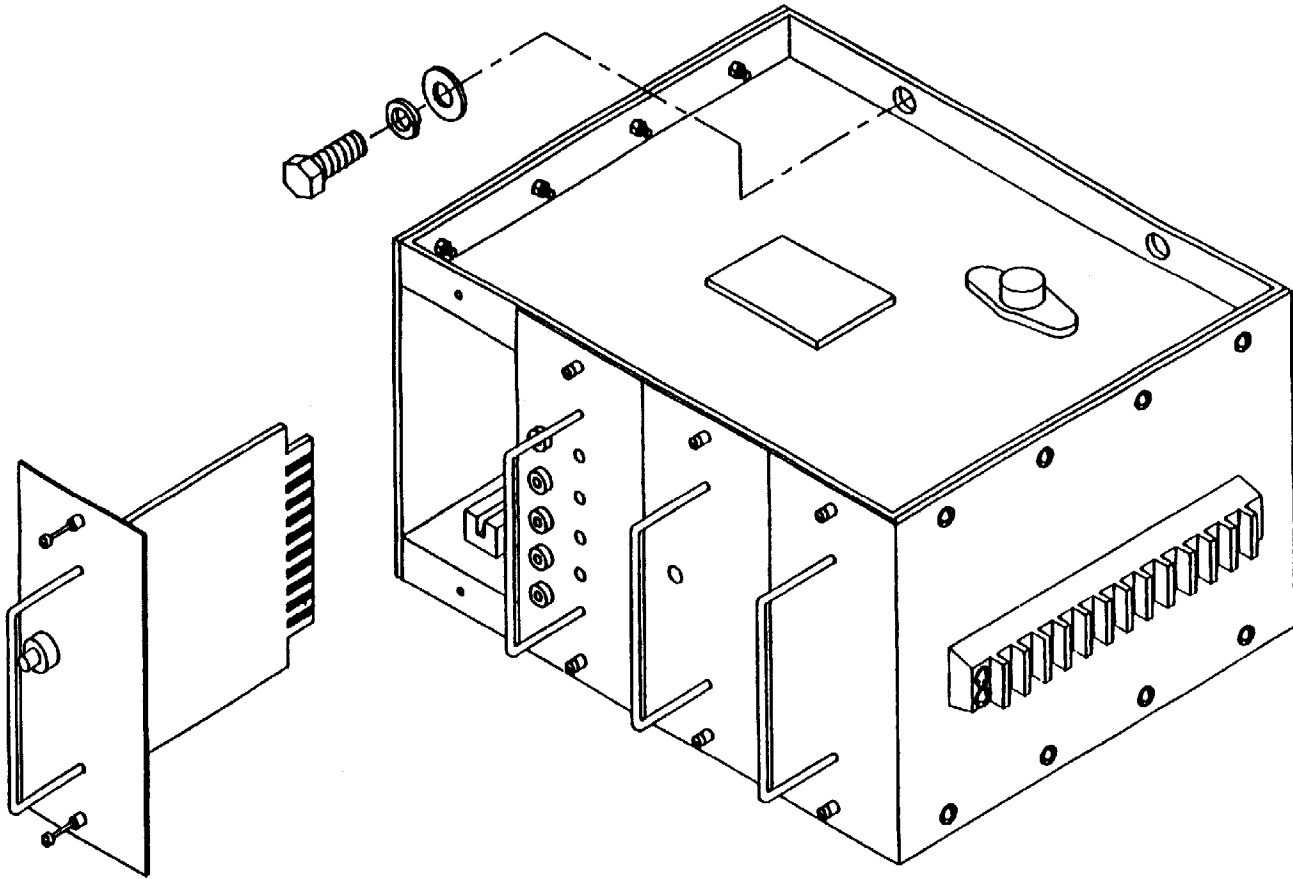


Figure 6-32. Fault Current Detector

NOTE

Paragraph 6-28 is not applicable to ships with MACHALT 320-59006 (ECP-515) installed. Refer to paragraph 6-34 for information on the GPM.

6-28. TURBINE RPM DETECTOR

This solid-state device shall be repaired to the card level. Troubleshooting and bench testing are outlined in Chapter 5. See figure 6-33 for a detailed view.

6-28.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”

- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing to a lockout position.
- c. Removal of the card, in this device, requires the removal of the enclosure (1). Remove the input wires to the device on the right-hand side of the terminal board. Retain hardware.
- d. Remove the mounting screws (2) attaching the device to the subpan. Retain hardware.
- e. Unsolder the wires on the card (3) at terminals 1 through 8. Mark if necessary.
- f. Remove four nuts (4) and washers from card standoff mounts. Retain hardware. Lift card off of standoffs.

6-28.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Replace new card onto standoffs and tighten nuts to secure.
- c. Solder marked wires to correct terminals (1 through 8) on card.
- d. Align enclosure with mounting holes in subpan. Tighten hardware.
- e. Replace input wires to right-hand side of terminal board.
- f. Close door and secure by tightening captive thumbscrews.
- g. Remove "Out of Service" tags and reenergize circuits.

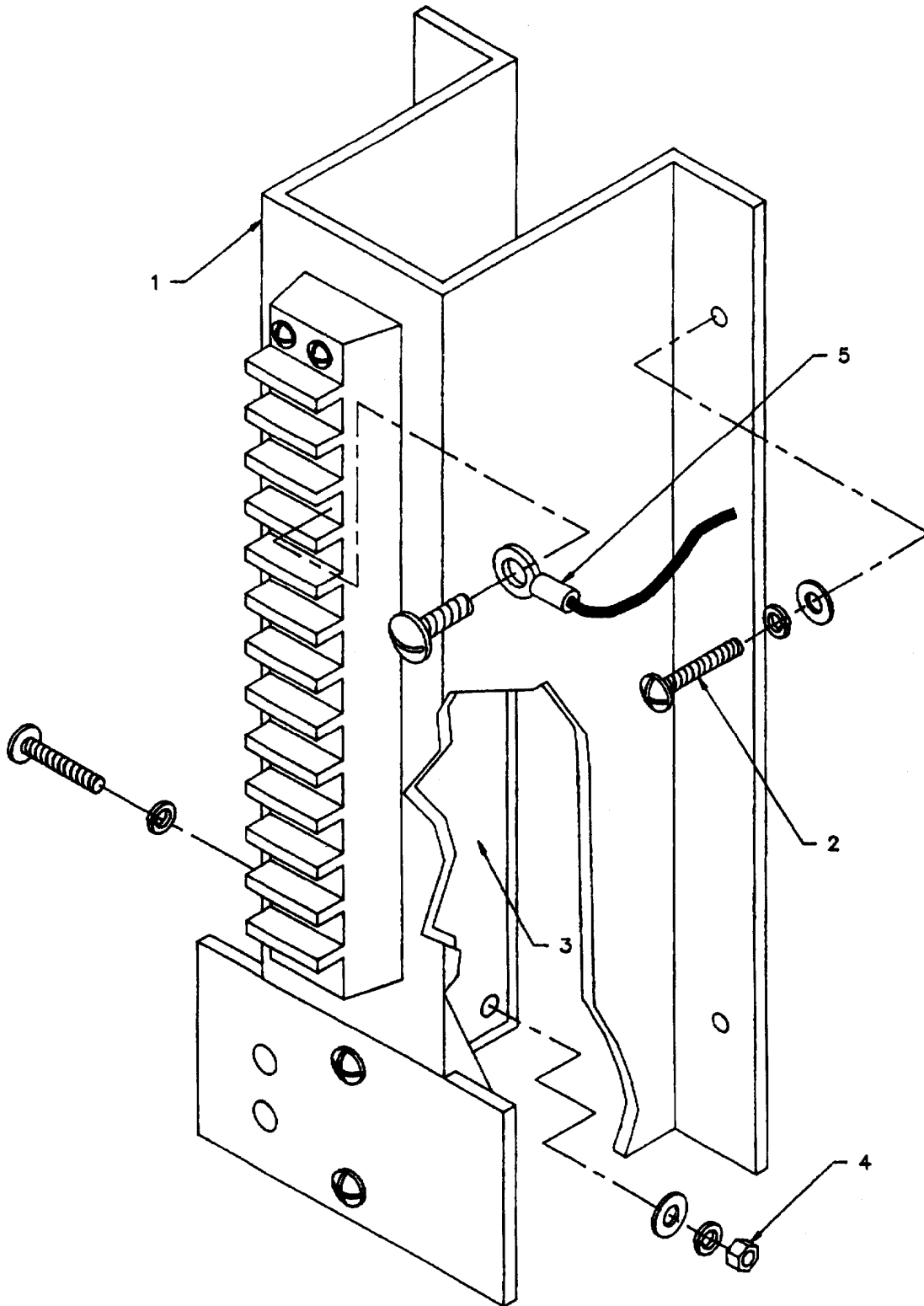


Figure 6-33. Turbine RPM Detector

6-29. AC POWER SENSING RELAY (A3)

The AC Power Sensing Relay is comprised of two separate units. After replacement, adjustment of relay in accordance with [paragraph 6-2.3](#) is required.

NOTE

[Paragraph 6-29.1](#) is not applicable to ships with MACHALT 320-59006 (ECP-515) installed. Refer to [paragraph 6-34](#) for information on the GPM.

6-29.1 A3a MODULE The A3a module is mounted to the vertical section of the switchboard, behind the A3b module. See [figure 6-34](#) for a detailed view.

6-29.1.1 Removal.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. For removal of enclosure, disconnect all external connections on terminal board. Ensure the wires are marked for identification. Retain hardware.
- d. Remove four enclosure mounting screws. Retain hardware.
- e. Pull device free of mounting surface.

6-29.1.2 Replacement.

- a. Reverse the procedure outlined in [paragraph 6-29.1.1](#) for replacement. Ensure fasteners are torqued to the values listed in [table 8-1](#).
- b. For replacement of enclosure, align enclosure mounting holes to mounting surface. Install hardware and tighten.
- c. Replace wires to proper terminal board contacts. Tighten hardware.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

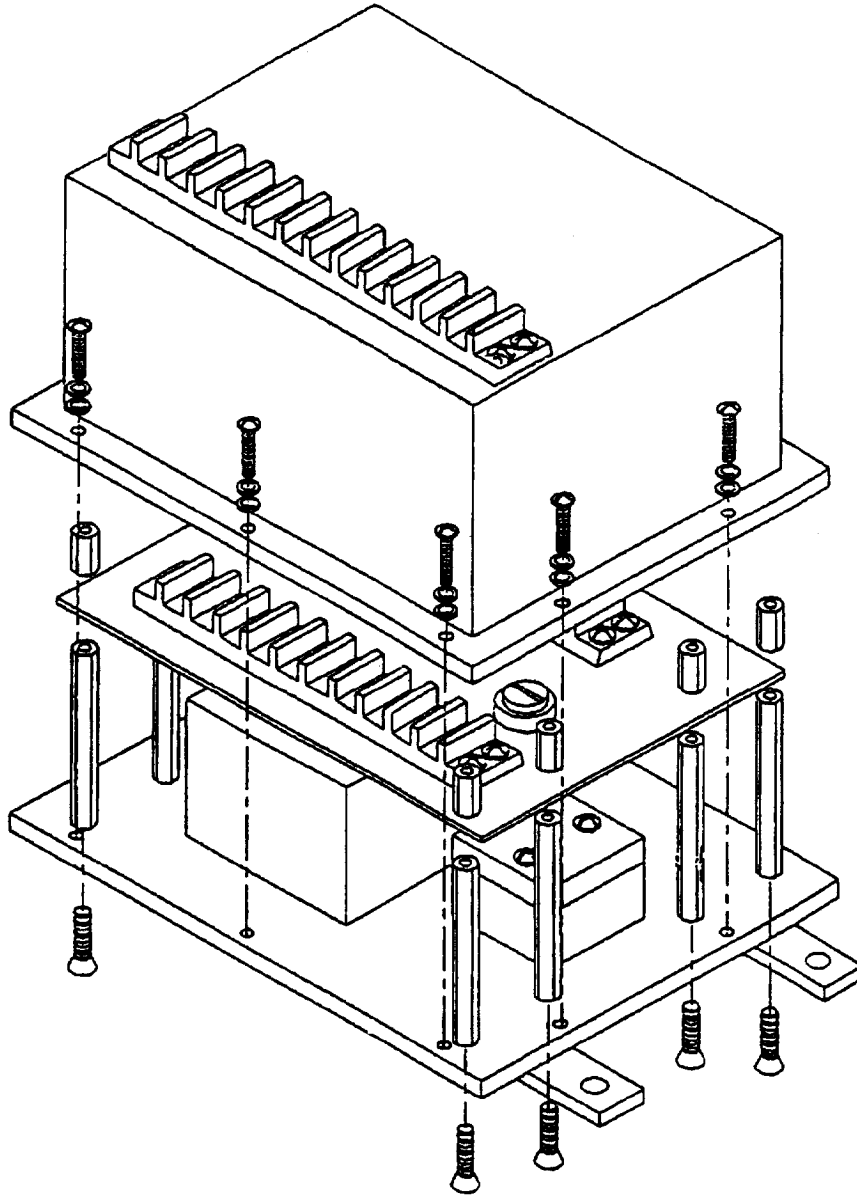


Figure 6-34. AC Power Sensing Relay (A3a Module)

6-29.2 A3b MODULE See [figure 6-35](#) for a detailed view.

6-29.2.1 Removal.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

a. Deenergize circuits and tag “Out of Service.”

- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. For removal of enclosure, disconnect all external connections on terminal boards. Ensure the wires are marked for identification. Retain hardware.
- d. Remove four enclosure mounting screws. Retain hardware.
- e. Pull device free of mounting surface.

6-29.2.2 Replacement.

- a. Reverse the procedure outlined in [paragraph 6-29.2.1](#) for replacement. Ensure fasteners are torqued to the values listed in [table 8-1](#).
- b. For replacement of enclosure, align enclosure mounting holes to mounting surface. Install hardware and tighten.
- c. Replace wires to proper terminal board contacts. Tighten hardware.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

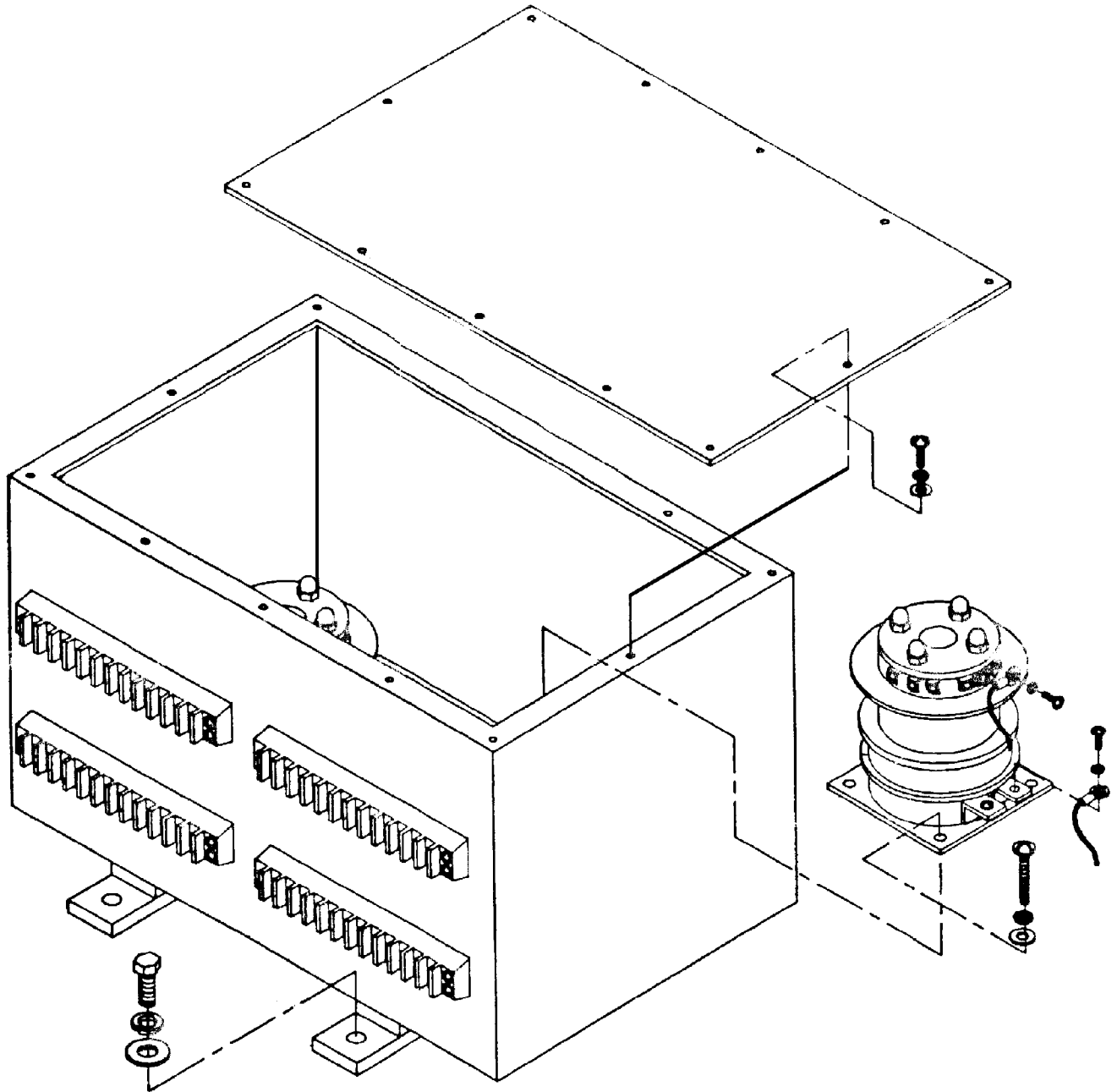


Figure 6-35. AC Power Sensing Relay (A3b Module)

6-30. SYNCHRONIZING CONTROL EQUIPMENT

This solid-state device shall be repaired to the card level. Troubleshooting and bench testing are outlined in [Chapter 5](#). See [figure 6-36](#) for a detailed view.

6-30.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Removal of card; loosen two captive thumbscrews and pull card by handle, straight back until card is free of enclosure.
- c. Remove mounting screws from card mounting cover. Pull card free.
- d. Removal of enclosure; remove wires to exterior terminal boards. Retain hardware.
- e. Remove four mounting bolts from rear mounting base. Retain hardware.
- f. Pull enclosure free of cubicle.

6-30.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Replacement of card. Secure card to bracket and to module cover with hardware.
- c. Place card in guide rail in interior and push until hard connector is fully engaged.
- d. Tighten two captive thumbscrews.
- e. Replacement of enclosure. Mount enclosure and secure with four bolts.
- d. Replace wires to proper terminal board contacts.
- e. Close door and secure by tightening captive thumbscrews.
- f. Remove “Out of Service” tags and reenergize circuits.

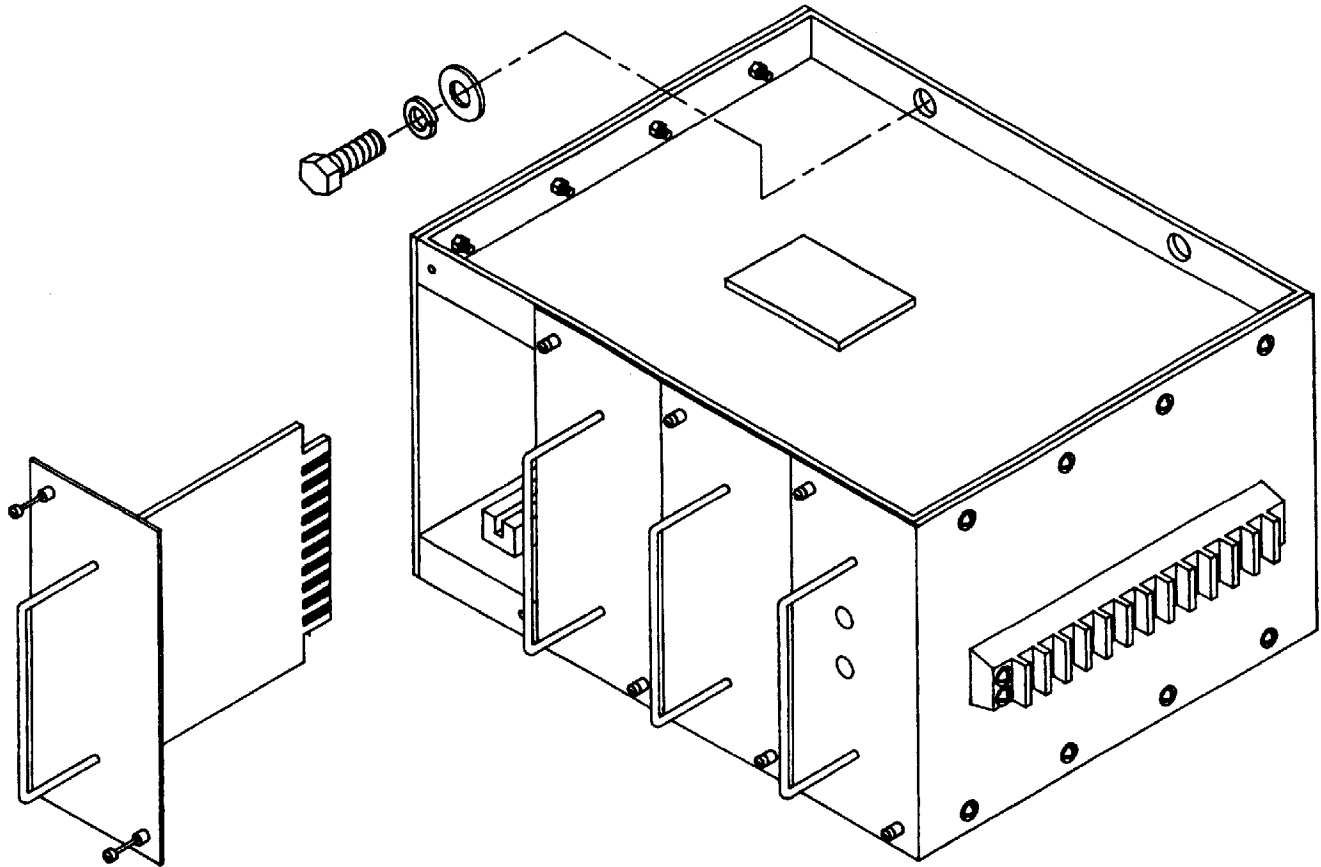


Figure 6-36. Synchronizing Control Equipment

6-31. ANALOG BUS GROUND DETECTOR

Troubleshooting and bench testing are outlined in [Chapter 5](#). See [figure 6-37](#) for a detailed view.

6-31.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing to a lockout position.
- c. Remove all wires from external terminal board connections. Mark wires if necessary. Retain hardware.
- d. Remove four mounting screws and pull device free. Retain hardware.

6-31.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Replace device over mounting holes and secure with hardware.
- c. Replace wires to proper terminal board connections.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

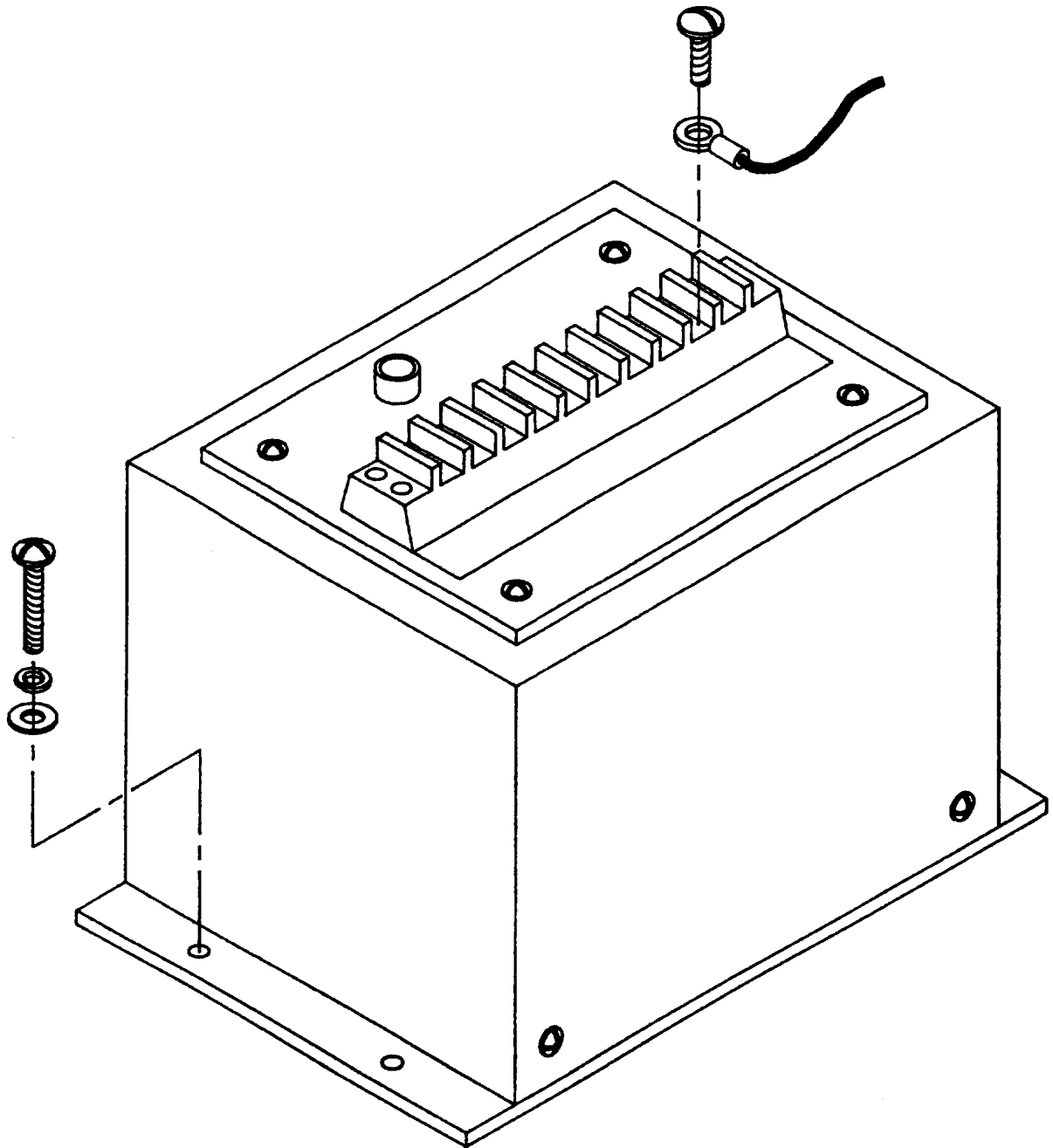


Figure 6-37. Analog Bus Ground Detector

6-32. OVERCURRENT RELAY

This device contains a removable circuit card or may be removed as a unit. See [figure 6-38](#) for a detailed view.

6-32.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing to a lockout position.
- c. Remove wires from exterior contacts (1) on terminal board. Retain hardware.
- d. Remove four mounting screws (2), mounting device to subpan, and lift device (3) out.
- e. Remove two nuts (4) on adjusting knob. Retain hardware.
- f. Remove mounting screws (5) from side of enclosure (two on each side). Remove four mounting screws on top of enclosure (6). Retain hardware.
- g. Slide cover (7) up to reveal cards.
- h. Remove wires connected to terminals on card. Mark if necessary.
- i. Remove mounting screws from card standoffs (8) as required. Retain hardware.
- g. Pull card (9) out of enclosure.

6-32.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. Reinstall wires to proper board connections. Secure card to standoffs with retained hardware.
- c. Replace cover and secure with hardware. Reinstall nuts on adjusting knob.
- d. Align device with mounting holes on subpan. Secure with four screws retained.
- e. Replace external wires to terminal boards. Secure with hardware.
- f. Close door and secure by tightening captive thumbscrews.
- g. Remove “Out of Service” tags and reenergize circuits.

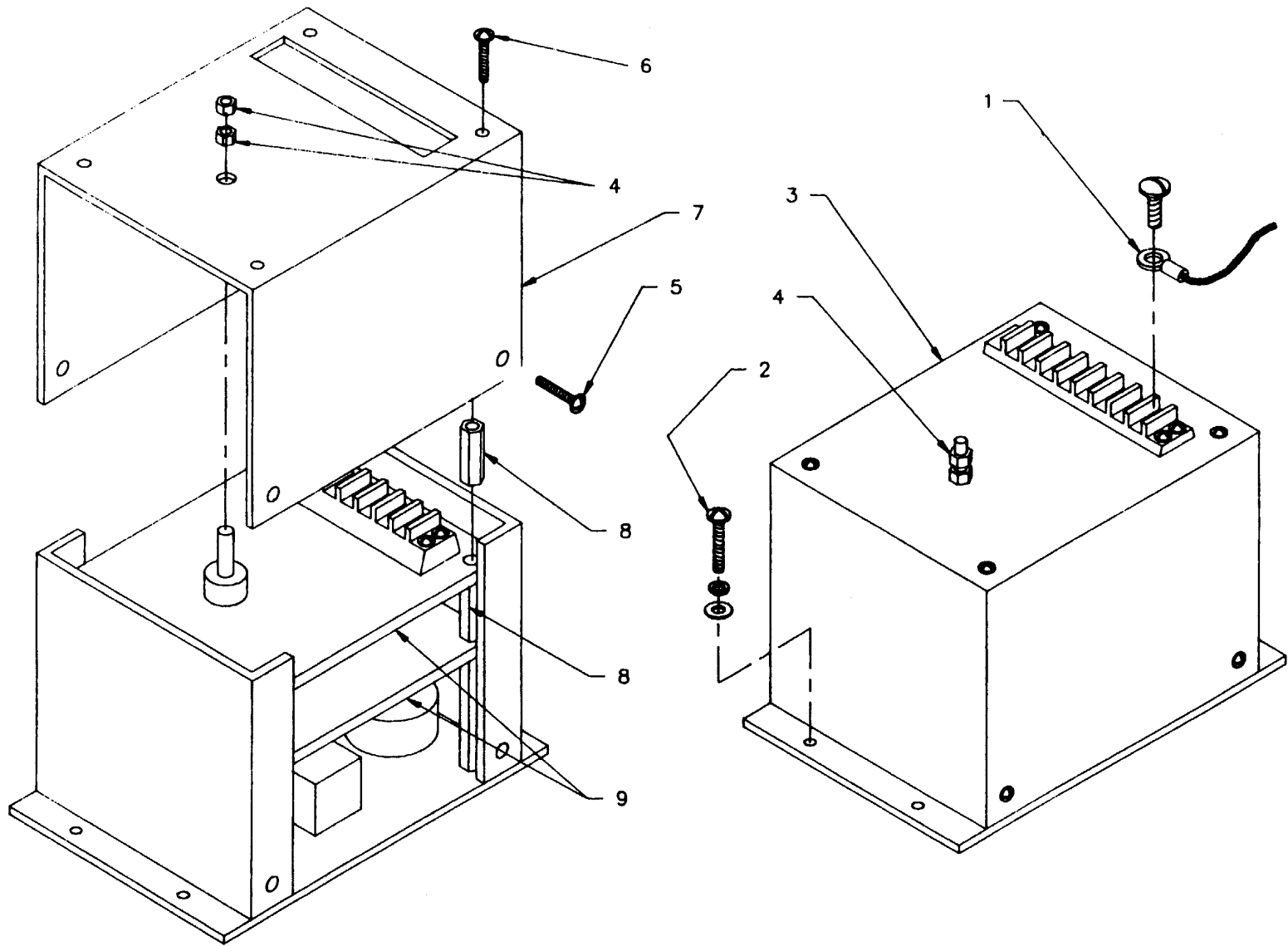


Figure 6-38. Overcurrent Relay

NOTE

Paragraph 6-33 is not applicable to ships with MACHALT 320-59006 (ECP-515) installed. Refer to paragraph 6-34 for information on the GPM.

6-33. REVERSE POWER MONITOR

See figure 6-39 for a detailed view.

6-33.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.
- c. Remove wires from terminal blocks. Mark wires if necessary. Retain hardware.
- d. Remove four mounting hex head bolts from rear mounting base at subpan. Retain hardware.
- e. Lift enclosure free of cubicle.

6-33.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. For replacement of enclosure, align enclosure mounting holes to mounting surface. Install hardware and tighten
- c. Replace wires to proper terminal board contacts. Tighten hardware.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove “Out of Service” tags and reenergize circuits.

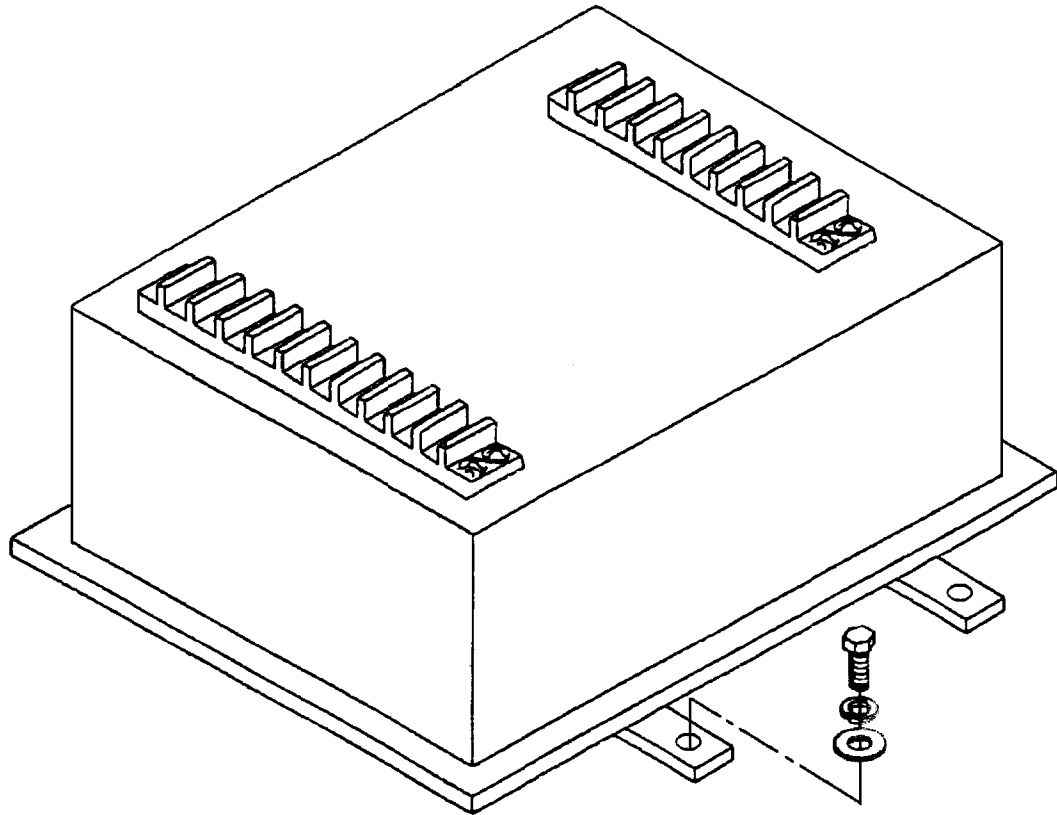


Figure 6-39. Reverse Power Monitor

NOTE

Paragraph 6-34 is applicable only to ships with MACHALT 320-59006 (ECP-515) installed.

6-34. GENERATOR PROTECTION MODULE

See figure 6-40 for a detailed view.

6-34.1 REMOVAL.

WARNING

These switchboards contain lethal voltages. Tag “Out of Service” in accordance with shipboard procedures.

- a. Deenergize circuits and tag “Out of Service.”
- b. Gain access into the switchboard by loosening the captive thumbscrews on the door. Swing open to a lock-out position.

- c. Remove wires from terminal blocks. Mark wires if necessary. Retain hardware.
- d. Remove four mounting hex head bolts from rear mounting base at subpan. Retain hardware.
- e. Lift enclosure free of cubicle.

6-34.2 REPLACEMENT.

- a. Reverse the above procedures for replacement.
- b. For replacement of enclosure, align enclosure mounting holes to mounting surface. Install hardware and tighten
- c. Replace wires to proper terminal board contacts. Tighten hardware.
- d. Close door and secure by tightening captive thumbscrews.
- e. Remove "Out of Service" tags and reenergize circuits.

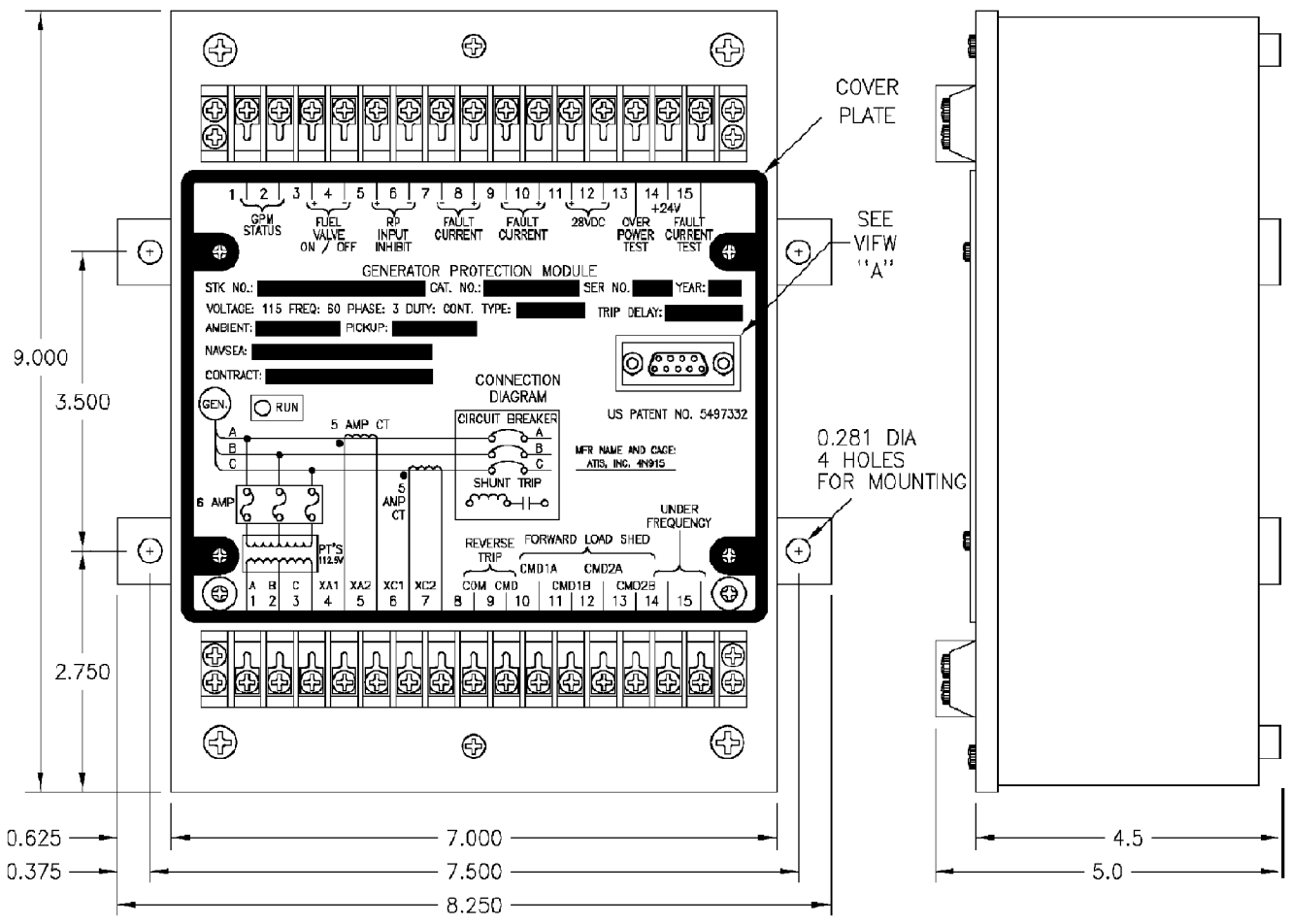
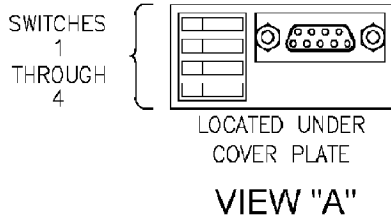


Figure 6-40. Generator Protection Module

CHAPTER 7

PARTS LIST

7-1. INTRODUCTION

This chapter provides information needed to locate and identify replacement repair parts for the DDG 51 through DDG 54 60 Hz main power distribution switchboards. [Table 7-1](#) is a listing of the major items included in this section and can be used as an index to locate a specific switchboard unit.

7-2. PARTS LISTS

[Tables 7-2](#) through [7-12A](#) contain the parts lists for switchboard units. These parts lists are used to identify and describe all components, assemblies, subassemblies, and detail parts required to repair the switchboard. Each listed part is located on an illustration ([figures 7-1](#) through [7-11](#)). Parts list columns, reading from left to right, are headed as follows: Figure/Index No., Description, Qty., CAGE, and Part No.

7-2.1 FIGURE/INDEX NO. The first number in this column is the figure number on which the part appears. The second item is the index number of the part. This number corresponds to the item call out on the particular illustration. For example, 7-2/2 refers to item number 2 located on figure 7-2.

7-2.2 DESCRIPTION. This column contains the part name and descriptive information used to identify the components in the switchboard. Descriptive information will include physical characteristics and other necessary data used in ordering replacement parts. The military specification to which the part conforms may also be listed.

7-2.3 QTY. This column contains the total quantity (Qty) of like kind items used per switchboard assembly.

7-2.4 CAGE. This column contains the 5-digit Commercial and Government Entity (CAGE) code which represents the manufacturer as listed in the Federal Supply Code of Manufacturers H4-1 Cataloging Handbook. A complete listing of all represented manufacturers can be found in [table 7-13](#).

7-2.5 PART NO. This column contains the part number assigned by the original equipment manufacturer.

Table 7-1. List of Major Units

CID	Qty	Nomenclature	Table No.
80047010	1	Main Switchboard, 60 Hz, No. 1SG	7-2 or 7-2A
80047011	1	Main Switchboard, 60 Hz, No. 1SA	7-3 or 7-3A
80047012	1	Main Switchboard, 60 Hz, No. 1SB	7-4 or 7-4A
80047080	1	Main Switchboard, 60 Hz, No. 1SC	7-5 or 7-5A
80047020	1	Main Switchboard, 60 Hz, No. 2SG	7-6 or 7-6A
80047021	1	Main Switchboard, 60 Hz, No. 2SA	7-7 or 7-7A
80047022	1	Main Switchboard, 60 Hz, No. 2SB	7-8
80047030	1	Main Switchboard, 60 Hz, No. 3SG	7-9 or 7-9A
80047031	1	Main Switchboard, 60 Hz, No. 3SA	7-10 or 7-10A
80047032	1	Main Switchboard, 60 Hz, No. 3SB	7-11 or 7-11A
80047090	1	Main Switchboard, 60 Hz, No. 3SC	7-12 or 7-12A

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/1	Lamp, incandescent, 6 volt, type T-1 3/4 midget screwbase, W-L-111	6	56694	MS15612-5
7-1/2	Landholder, lights indicator (housing), style 96/3, 28 VDC, w/o lamps	3	56694	MIL-L-3661/63 LH96/3
7-1/3	Lens, indicator light, style LC40, amber translucent plastic (DS4, DS6, DS8, DS10, DS12, DS14, DS16, DS18, DS20, DS32, DS35, DS36, DS39-DS41, DS49)	16	56694	MIL-L-3661/54
7-1/4	Switch, pushbutton, momentary action, 1 NO 1 NC contact (PB1103, PB1101)	2	02989	Type 1C5845 5729215G1
7-1/5	Lens, indicator light, style LC40, red translucent plastic (DS30)	1	56694	MIL-L-3661/54 LC40EN3
7-1/6	Ammeter, AC, 4-1/2 inch, 205° scale, 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M1, M2)	2	15309	MR49W006ACKAH
7-1/7	Wattmeter, AC, 4-1/2 inch, 250° scale 0-5,000 KW, 60 Hz, PT ratio 460:115 VAC, CT ratio 6,000:5 amp, MIL-W-19088 (M8)	1	15309	MR492W005ACGWH
7-1/8	Meter, temperature, selective, manual remote, 115 VAC/60 Hz, platinum RTE, 0-200°C, 4-1/2 inch, 250° scale meter in accordance with MIL-M-16034, MIL-T-15377 (M3)	1	15309	4951-366
7-1/9	Lens, indicator light, style LC40, green translucent plastic (DS33, DS38)	2	56694	MIL-L-3661/54
7-1/10	Switch, rotary selector, 10 amp, type S3JR3, 5-position, 3-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (sections 2 and 3 are make-before-break), MIL-S-21604 (S18)	1	82121	23303LN
7-1/11	Switch, pushbutton, momentary action, 2 NO contacts, MIL-C-2212 (PB1102)	1	02989	Type 1C5845 5729215G23
7-1/12	Lampholder, lights indicator (housing), style 98, 115 VAC w/o lamps	38	56694	MIL-L3661/65LH98- LH98-3
7-1/13	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	82	56694	MS15612-3
7-1/14	Lens, indicator light, style LC40, white translucent plastic (DS22, DS25, DS34, DS37, DS42, DS43, DS48)	9	56694	MIL-L-3661/54 LC40WT3
7-1/15	Switch, rotary, multiple, 10 amp type S2JR1 2-position, 1-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S21, S31)	2	82121	23201LG
7-1/16	Switch, rotary, multipole, 10 amp type 3-position, 1-section, spring return to center, Navy gray, round knob, white pointer, blank escutcheon plate, MIL-S-21604 (S14-S16, S20)	4	82121	71201LP
7-1/17	Voltmeter, AC, 4-1/2 inch, 250° scale 0-600 VAC, 60 Hz, PT ratio 460:115 VAC, MIL-M-16034 (M4, M5) (M4, M5)	2	15309	MR49W600ACVVH
7-1/18	Switch, rotary, selector, 10 amp type S3JR6, 3-position, 6-section, maintained, Navy gray, oval handle, white pointer, blank escutcheon plate, MIL-S-21604 (S13)	1	82121	23306LT
7-1/19	Lens, indicator light style LC40, blue translucent plastic (DS5, DS7, DS11, DS13, DS15, DS17, DS19, DS21)	9	56694	MIL-L-3661/54 LC40BN3
7-1/20	Switch, rotary, meter & control, type 24G class 2 4PDT, spring return to center (Off) position, 500 VAC, Navy gray, pistol drip handle, white pointer, MIL-S-18396 (S1-S5)	5	82121	74202J-001

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/21	Test block with cover type PK2 4 pole (1 current and 1 potential) (J1, J2)	2	71669	6422120G4
7-1/22	Test plug with 4 pole type PK2	2	71669	6129533G1
7-1/23	Links, test plug	2	71669	V2453076
7-1/24	Switch, rotary, multipole, 10 amp, type S2JRM2, 3-position, 2-section, spring return to center with Navy gray, pistol grip handle, white pointer, MIL-S-21604 (S6-S9)	4	82121	71202LS
7-1/25	Switch, rotary, multipole, 7 1/2 amp, type S5JM9, 2-position, 9-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-2604 (S24)	1	82121	26509LC
7-1/26	Switch, rotary, meter & control, type 24G, class 2, 2PST (Off-On), spring return to center (Off), 500 VAC, Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-18396 (S25)	1	82121	74201J-003
7-1/27	Switch, rotary, multipole, 10 amp, type S2JRM3, 3-position, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S22) (S22)	1	82121	71203MA
7-1/28	Lens, indicator light, style LC40, clear, colorless plastic (DS1, DS2, DS26-DS29, DS31)	7	56694	MIL-L-3661/54 LC40TN3
7-1/29	Lampholder, lights, indicator (housing), style 98, 450 VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98-4
7-1/30	Switch, rotary, meter & control type 24G, 4-position, 4-section, spring return from extreme left & right positions, maintained in 315° & 360° positions, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-18396 (S38)	1	82121	71304LH
7-1/31	Switch, rotary, selector, 10 amp, type S3JR8, 4-position, 8-section, maintained Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S19)	1	82121	23308LF
7-1/32	Switch, rotary, meter & control, type 24G, class 2, 4-position, 4-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (section 3-4/ammeter circuit (MBB), section 1-2/voltmeter circuit) MIL-S-18396 (S17)	1	82121	23904LJ
7-1/33	Synchroscope, 4-1/2 inch, 360° scale, slow-fast, 115 VAC/60 Hz, MIL-I-16104 (M11)	1		MR4SW060SYH
7-1/34	Meter, electrical, frequency, 4-1/2 inch, 250° scale, 55-65Hz, 115 VAC (self contained), MIL-M-16125 (M6, M7)	2	15309	4991-008
7-1/35	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 15I trip element (INST only), MIL-C-17361D (CB1101)	1	30086	ETN2760
7-1/36	Mounting base, single back connected, MIL-C-17361D	1	30086	ETN2767
7-1/37	Mounting base, fuse unit back connected, MIL-C-17361D	1	30086	ETN2787
7-1/38	Fuse unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	1	30086	ETN2798
7-1/39	Circuit breaker, air, removable element, type ACB-4000HR frame, 500 VAC, 60 Hz, 3 pole, 450V/60 Hz closing coil, 115V/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-10000A, INST-48000A, time band 3, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1110)	1	30086	

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/40	Stationary element 4000A frame, 3 pole, MIL-C-1587	1	30086	
7-1/41	Terminal board, molded barrier screw type, class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG, cres	62		MIL-T-55164/2 38TB12 MS35338-137
7-1/42	Marker strip	62		MIL-T-55164/2 38TB12Z
7-1/43	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat, 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	4		JCB-0 827X71 MS27183-15 MS35338-46
7-1/44	Terminal, casualty power receptacle type, back connected, 200 amp, 450 VAC/60 Hz (2E2, 2E3) Attaching hardware: . Washer, flat, 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	2		M24552/1-001 MS27183-19 MS27183-18 MS35338-48
7-1/45	Terminal, casualty power seal	2		M24552/3-001
7-1/46	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB1102, CB1103)	2	30086	ETN5310
7-1/47	Mounting block, switchboard type, MIL-C-17361D	4	30086	ETN5314
7-1/48	Disconnect link	3	56425	94000037-001
7-1/49*	Turbine RPM detector assembly (A8) Attaching hardware: . Washer, flat, no. 6 . Nutsert, Avdel, 6-32 UNC . Washer, lock, split no. 6 . Screw, mach., pn hd., no. 6-32 x 5/8 LG	1	56425	2268D150-5-1 MS15795-805 MS35338-136
7-1/50	Transformer, power, step down, type SA 1 phase, 450:120 VAC, 1.5 KVA, continuous duty, MIL-T-16315 (T2) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-07 C30096-3816 MS35338-46
7-1/51*	Fault current detector main assembly (A6) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC	1	56425	2268D100-2 C30096-3816 MS35338-46

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/52	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG Analog bus ground detector (A5) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4	1	56425	94000170 9504-08 MS27183-10 MS35338-44
7-1/53	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG Contactor, size 1, 27 amp, 450 VAC/60 Hz, 4 pole, 2 NO and 2 NC aux switches, 440V/60 Hz coil, MIL-C-2212 Attaching hardware: . Washer, flat no. 10 . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 5/8 LG	2	27192	6957ED25-1A MS15795-808 MS35338-138 MS35650-304
7-1/54	Mechanical interlock, size 1, MIL-C-2212	1	27192	10-2468
7-1/55	Synchronizing control equipment 450 VAC/60 Hz, MIL-S-24188 (Modified) (A1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	94080020-001 C30096-3816 MS35338-46
7-1/56	Relay, control category A, 28 VDC, continuous duty, 65°C ambi- ent, shock class I, 4PDT, MIL-R-19523 (K1104-K1106, K1108- K1111, K1113, K1116, K1123, K1129, K1130, K1133, K1134, K1135, K1202, K1204, K1205, K1402, K1404, K1405) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	21	77342	MDR135-1 9507-10 MS35338-138 MS35650-304
7-1/57	Semiconductor device, diode, silicon, power rectifier, fast recov- ery 600 pin/3 amp, MIL-S-19500/411	40		JANTXIN5416
7-1/58	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 (PT1-6) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	6	03516	JNP-0 C30096-3816 MS35338-46
7-1/59*	Monitor, reverse power, time delay, adjustable 1-5 sec, MIL-M- 24350A (Modified) (A2)	1	56425	194000090-001
7-1/59**	Module, Generator Protection, MIL-M-24350A (GPM) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4	1	4N915	2310-701-01 9504-08 MS27183-10 MS35338-44

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/60	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG Transformer, power, step down, type SA, 450:115 VAC, 5 KVA with primary and secondary terminals, MIL-T-16315 (T1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC	1	56425	STD-ISC-010-01 C30096-3816 MS35338-46
7-1/61	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG Relay assembly, MIL-R-24563 (Modified) (A3b) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC	1	56425	94000160-1 C30096-3816 MS35338-46
7-1/62*	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG Relay, alternating current, power sensing, 2 stage time delay, adjustable 0-39 sec, MIL-R-24563 (Modified) (A3a) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4	1	56425	94000140-001 9504-08 MS27183-10 MS35338-44
7-1/63	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG Switch, toggle, DPST, On-Off-None, sealed, MIL-S-83731	6	27191	MS35059-24
7-1/64*	Resistor, fixed, wire wound (power type) style RW79, 0.144 ohm/3 watt, MIL-R-26/5 (R1, R2)	2	81349	RW79UR144F
7-1/65	Fuse clip, electrical, type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	144	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-28A
7-1/66	Fuse, style F60, 500 VAC, 3 amp, characteristic C, MIL-F-15160 (F132, F133, F136, F137, F147, F148, F150)	7	71400	F60C500V3A
7-1/67	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F- 15160 (F111, F112, F121, F122)	4	71400	F60C500V20A
7-1/68	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F101-F110, F113-F120, F125-F128, F130, F131, F134, F135)	26	71400	F60C500V6A
7-1/69	Fuse, style F60, 500 VAC, 1/8 amp, characteristic C, MIL-F- 15160	1	71400	F60C500V1/8A
7-1/70	Fuse, style F60, 500 VAC, 1 amp, characteristic C, MIL-F-15160 (F129)	1	71400	F60C500V1A
7-1/71	Fuse, style F60, 500 VAC, 10 amp, characteristic C, MIL-F- 15160 (F123, F124, F138-F145)	10	71400	F60C500V10A
7-1/72	Relay, control category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1122, K1124, K1126) Attaching hardware: . Nutsert, Avdel, 10-32 UNC	4	77342	MDR134-1 9507-10

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/73	. Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category A, 440V AC, 60 Hz, continuous duty, 65°C ambient, shock class I, MIL-R-19523 (K1107) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	1	77342	M535338-138 M535650-304 MDR-134-2
7-1/74	Relay, control, category B, 28 VDC, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1201, K1401) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach. pan hd., no. 10-32 x 1/2 LG	2	77342	MDR5035 9507-10 M535338-138 M535650-304
7-1/75	Relay, control category B, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1114, K1119, K1120) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach. pan hd., no. 10-32 x 1/2 LG	3	77342	MDR4076 9507-10 MS35338-138 MS35650-304
7-1/76	Relay, control, category A, 28 VDC, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1112, K1115, K1131, K1132) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	4	77342	MDR136-1 9507-10 MS35338-138 MS35650-304
7-1/77	Relay, control category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K1117, K1118, K1125, K1127, K1128, K1136) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	6	77342	MDR131-1 9507-10 MS35338-138 MS35650-304
7-1/78	Relay, control, category B, 28 VDC, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K1103) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	1	77342	MDR-67-3 9507-10 MS35338-138 MS35650-304

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/79	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control category B, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 24PDT, MIL-R-19523 (K1101) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	77342	MDR141-2 9504-08 MS27183-10 MS35338-44
7-1/80	Protective Device, thyrite, MIL-I-1361 (PD1-4) Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	4	03516	8360185G1S63 MS27183-19 MS27183-18 MS35338-48
7-1/81*	Isolation transformer (IT1, IT2) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	2	56425	STD-ISC-010-04 9507-10 MS35338-138 MS35650-304
7-1/82	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-001 91000001-907 91000001-911 91000001-912
7-1/84	Door Attaching hardware: . Knee brace (right-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90410004-040 91000001-907 91000001-911 91000001-912
7-1/85	Structure assembly	1	56425	90110101
7-1/86	Cover	1	56425	90510004-039
7-1/87	Grab handle	2	56425	91000001-901 91000001-916
7-1/88	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-047 91000001-907 91000001-911 91000001-912
7-1/89	Cover	1	56425	90410005-025
7-1/90	Cover	1	56425	90410005-024
7-1/91	Cover	1	56425	90410005-027

Table 7-2. Parts List For Switchboard 1SG – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-1/92	Cover	1	56425	90410005-028
7-1/93	Cover	1	56425	90410005-029
7-1/94	Door	2	56425	90510004-049 90510004-048
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-1/95	Drip shield	1	56425	90510004-018
7-1/96	Thumbscrew, captive	29	56425	91000001-934
7-1/97	Subpan	1	56425	90410004-007
7-1/98	Subpan	1	56425	90410004-011
7-1/99	Subpan	1	56425	90410004-014
7-1/100	Subpan	1	56425	90410004-005
7-1/101	Subpan	1	56425	90410004-006
7-1/102	Switch mounting plate	1	56425	90510004-019
7-1/103	Fuseboard	1	56425	91240002-009
7-1/104	Fuseboard	1	56425	91240002-001
7-1/105	Subpan	1	56425	90410004-009
7-1/106	Subpan	2	56425	90410004-012
7-1/107	Subpan	1	56425	90410004-004
7-1/108	Subpan	1	56425	90410004-017
7-1/109	Subpan	1	56425	90410004-016
7-1/110	Structure Assembly	1	56425	90110100
7-1/111	Contact, size 1, 27 amp, 115 VAC/60 Hz, 4 pole, 115V coil	1	27192	6957ED25-4C
7-1/112	Switch, rotary, multipole, 7.5A, 2-position, 3 decks, type S5JM3, Navy gray, oval shank knob, white pointer, blank escutcheon plate, NSN 5930-01-006-8595	1	82121	26503G
	* Removed by MACHALT 320-59006 (ECP-515)			
	** Installed by MACHALT 320-59006 (ECP-515)			

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-1/1	Lamp, incandescent, 6 volt, type T-1 3/4, midget screwbase, W-L-111	6	56694	MS15612-5
7-1/2	Lampholder, lights indicator (housing), style 96, 28 VDC, w/o lamps	3	56694	MIL-L-3661/63 LH96/3
7-1/3	Lens, indicator light, style LC40, amber translucent plastic (DS4, DS6, DS8, DS10, DS12, DS14, DS16, DS18, DS20, DS32, DS35, DS36, DS39-DS41)	15	56694	MIL-L-3661/54
7-1/4	Switch, pushbutton, momentary action, 1 NO 1 NC contact, MIL-C-2212 (PB1103, PB1101)	2	02989	Type 1C5845 5729215G1
7-1/5	Lens, indicator light, style LC40, red translucent plastic (DS30)	1	56694	MIL-L-3661/54 LC40EN3

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-1/6	Ammeter, AC, 4-1/2 inch, 205° scale, 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M1, M2)	2	15309	MR49W006ACKAH
7-1/7	Wattmeter, AC, 4-1/2 inch, 250° scale, 0-5,000 KW, 60 Hz, PT ratio 460:115 VAC, CT ratio 6,000:5 amp, MIL-W-19088 (M8)	1	15309	MR492W005ACGWH
7-1/8	Meter, temperature, selective, manual remote, 115 VAC/60 Hz, platinum RTE, 0-200°C, 4-1/2 inch, 250° scale, meter in accordance with MIL-M-16034, MIL-T-15377 (M3)	1	15309	4951-366
7-1/9	Lens, indicator light, style LC40, green translucent plastic (DS33, DS38)	2	56694	MIL-L-3661/54
7-1/10	Switch, rotary, selector, 10 amp, type S3JR3, 5-position, 3-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (sections 2 and 3 are make-before-break) MIL-S-21604 (S18)	1	82121	23303LN
7-1/11	Switch, pushbutton, momentary action, 2 NO contacts, MIL-C-2212 (PB1102)	1	02989	Type 1C5845 5729215G23
7-1/12	Lampholder, lights indicator (housing), style 98, 115 VAC, w/o lamps	36	56694	MIL-L-3661/65 LH98-3
7-1/13	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	78	56694	MS15612-3
7-1/14	Lens, indicator light, style LC40, white translucent plastic (DS22, DS25, DS34, DS37, DS42, DS43)	8	56694	MIL-L-3661/54 LC40WT3
7-1/15	Switch, rotary, multiple, 10 amp type S2JR1, 2-position, 1-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S21, S31)	2	82121	23201LG
7-1/16	Switch, rotary, multipole, 10 amp, 3-position, 1-section, spring return to center, Navy gray, round knob, white pointer, blank escutcheon plate, MIL-S-21604 (S14-S16, S20)	4	82121	71201LP
7-1/17	Voltmeter, AC, 4-1/2 inch, 250° scale 0-600 VAC, 60 Hz, PT ratio 460:115 VAC, MIL-M-16034 (M4, M5)	2	15309	MR49W600ACVVH
7-1/18	Switch, rotary, selector, 10 amp, type S3JR6, 3-position, 6-section, maintained, Navy gray, oval handle, white pointer, blank escutcheon plate, MIL-S-21604 (S13)	1	82121	23306LT
7-1/19	Lens, indicator light, style LC40, blue translucent plastic, (DS5, DS7, DS11, DS13, DS15, DS17, DS19, DS21)	9	56694	MIL-L-3661/54 LC40BN3
7-1/20	Switch, rotary, meter & control, type 24G, class 2, 4PDT, spring return to center (Off) position, 500 VAC, Navy gray, pistol drip handle, white pointer, MIL-S-18396 (S1-S5)	5	82121	74202J-001
7-1/21	Test block with cover, type PK2, 4 pole (1 current and 1 potential) (J1, J2)	2	71669	6422120G4
7-1/22	Test plug with 4 pole, type PK2	2	71669	6129533G1
7-1/23	Links, test plug	2	71669	V2453076
7-1/24	Switch, rotary, multipole, 10 amp type S2JRM2, 3-position, 2-section, spring return to center, Navy gray, pistol grip handle, white pointer, MIL-S-21604 (S6-S9)	4	82121	71202LS
7-1/25	Switch, rotary, multipole, 7.5 amp, type S5JM9, 2-position, 9-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S24)	1	82121	26509LC

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-1/26	Switch, rotary, meter & control, type 24G, class 2, 2PST (Off-On), spring return to center (Off), 500 VAC, Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-18396 (S25)	1	82121	74201J-003
7-1/27	Switch, rotary, multiple, 10 amp type S2JRM3, 3-position, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S22)	1	82121	71203MA
7-1/28	Lens, indicator light, style LC40, clear colorless plastic, (DS1, DS2, DS26-DS29, DS31)	7	56694	MIL-L-3661/54 LC40TN3
7-1/29	Lampholder, lights, indicator (housing), type 98, 450 VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98-4
7-1/30	Switch, rotary, meter & control type 24G, 4-position, 4-section, spring return from extreme left & right positions, maintained in 315° & 360° positions, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-18396 (S38)	1	82121	71304LH
7-1/31	Switch, rotary, selector, 10 amp, type S3JR8, 4-position, 8-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S19)	1	82121	23308LF
7-1/32	Switch, rotary, meter & control, type 24G, class 2, 4-position, 4-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (section 3-4/ammeter circuit (MBB), section 1-2/voltmeter circuit) MIL-S-18396 (S17)	5	82121	74202J-001
7-1/33	Synchroscope, 4-1/2 inch, 360° scale, slow-fast, 115 VAC/60 Hz, MIL-I-16104 (M11)	1		MR4SW060SYH
7-1/34	Meter electrical, frequency, 4-1/2 inch, 250° scale, 55-65 Hz, 115 VAC (self contained), MIL-M-16125 (M6, M7)	2	15309	4991-008
7-1/35	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 100 amp frame, 15I (INST only) MIL-C-17361D (CB1101)	1	89946	458D511G11
7-1/36	Mounting base, single back connected, MIL-C-17361D	1	89946	315C364G02
7-1/37	Mounting base, fuse unit, 50-75-100A, MIL-C-17361D	1	89946	655D258G06
7-1/38	Fuse Unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	1	89946	504C010H01
7-1/39	Circuit breaker, air, removable element, type AQB-4000HR and 4000A frame, 500 VAC, 60 Hz, 3 pole, 450V/60 Hz closing coil, 115V/60 Hz control relay and shunt trip, wired per dwg. Coil-4000A, LTD-6000A, STD-10000A, INST-48000A, ST delay 0.3 sec, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, 1 long b contact to be wired out to secondary terminal 9 & 10, MIL-C-17587 (CB1110)	1	39805	4294025-9
7-1/40	Stationary element, 4000A frame, 3 pole MIL-C-17587	1	39805	4294006-1
7-1/41	Terminal board, molded barrier screw type, class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	62		MI1-T-55164/2 38TB12 MS35338-137
7-1/42	Marker strip	62		MIL-T-55164/2 38TB12Z
7-1/43	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361	4		JCB-0

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-1/44	Attaching hardware: . Washer, flat, 3/8 . Washer, lock, split, 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., Gr 5, 3/8-16 x 4 LG	2		MS27183-15 MS35338-46
	Terminal, casualty power receptacle type, back connected, 200 amp, 450 VAC/60 Hz, MIL-T-24552 (2E2, 2E3) Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG			M24552/1-001 MS27183-19 MS27183-18 MS35338-48
7-1/45	Terminal, casualty power seal	2		M24552/3-001
7-1/46	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB1102, CB1103)	2	89946	313C748G27
7-1/47	Mounting block, switchboard type, MIL-C-17361D	4	89946	313C680G02
7-1/48	Disconnect link	3	56425	94000037-001
7-1/49*	Turbine RPM detector assembly (A8) Attaching hardware: . Washer, flat, no. 6 . Nutsert, Avdel, 6-32 UNC . Washer, lock, split no. 6	1	56425	2268D150-5-1 MS15795-805 MS35338-136
7-1/50	Transformer, power step down, type SA 1, 450:120 VAC, 1.5 KVA, continuous duty, MIL-T-16315 (T2) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56245	STD-ISC-010-07 C30096-3816 M35338-46
7-1/51*	Fault current detector main assembly (A6) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	2268D100-2 C30096-3816 MS35338-46
7-1/52	Analog bus ground detector (A5) Attaching hardware . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000170 9504-08 MS27183-10 MS35338-44
7-1/53	Contactors size 1, 27 amp, 450 VAC/60 Hz, 4 pole 2 NO and 2 NC aux switches, 440V/60 Hz coil, MIL-C-2212	2	27192	6957ED25-1A

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	Attaching hardware: . Washer, flat no. 10 . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 5/8 LG			MS15795-808 MS35338-138 MS35650-304
7-1/54	Mechanical interlock, size 1, MIL-C-2212	1	27192	10-2468
7-1/55	Synchronizing control equipment, 450 VAC/60 Hz, MIL-S-24188 (Modified) (A1)	1	56425	94080020-001
	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			C30096-3816 M535338-46
7-1/56	Relay, control category A, 28 VDC, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K1104-K1106, K1108-K1111, K1113, K1116, K1123, K1129, K1130, K1133, K1134, K1135, K1202, K1204, K1205, K1402, K1404, K1405)	21	77342	MDR135-1
	Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG			9507-10 MS35338-138 MS356S0-304
7-1/57	Semiconductor device, diode silicon, power rectifier, fast recovery, 600 pin/3 amp, MIL-S-19500/411	40		JANTXIN5416
7-1/58	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75 VA, MIL-I-1361 (PT1-6)	6	03516	JNP-0 C30096-3816 MS35338-46
	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			
7-1/59*	Monitor, reverse power, time delay, adjustable 1-5 sec, MIL-M-24350A (Modified) (A2)	1	56425	194000090-001
7-1/59**	Module, Generator Protection, MIL-M-24350A (GPM)	1	4N915	2310-701-01
	Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG			9504-08 MS27183-10 MS35338-44
7-1/60	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315 (T1)	1	56425	STD-ISC-010-01
	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16			C30096-3816 MS35338-46
7-1/61	Relay assembly, MIL-R-24563 (Modified) (A3b)	1	56425	94000160-1

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			C30096-3816 MS35338-46
7-1/62*	Relay, AC, power sensing, 2 stage time delay, adjustable 0-39 sec, MIL-R-24563 (Modified) (A3a) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000140-001
7-1/63	Switch, toggle, DPST, On-Off-None sealed, MIL-S-83731	6	27191	9504-08 MS27183-10 MS35338-44 MS35059-24
7-1/64*	Resistor, fixed, wire wound (power type), style RW79, 0.144 ohm/3 watt, MIL-R-26/5 (R1, R2)	2	81349	RW79UR144F
7-1/65	Fuse clip, electrical, type FC21CF Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	144	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-1/66	Fuse, style F60, 500 VAC, 3 amp, characteristic C, MIL-F-15160 (F132, F133, F136, F137, F147, F148, F150)	6	71400	F60C500V3A
7-1/67	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F111, F112, F121, F122)	4	71400	F60C500V20A
7-1/68	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F101-F110, F113-F120, F125-F128, F130, F131, F134, F135)	26	71400	F60C500V6A
7-1/69	Fuse, style F60, 500 VAC, 1/8 amp, characteristic C, MIL-F-15160	1	71400	F60C500V1/8A
7-1/70	Fuse, style F60, 500 VAC, 1 amp, characteristic C, MIL-F-15160 (F129)	1	71400	F60C500V1A
7-1/71	Fuse, style F60, 500 VAC, 10 amp, characteristic C, MIL-F-15160 (F123, F124, F138-F145)	10	71400	F60C500V10A
7-1/72	Relay, control, category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1121, K1122, K1124, K1126) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	4	77342	MDR134-1 9507-10 M535338-138 M535650-304
7-1/73	Relay, control, category A, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, MIL-R-19523 (K1107) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	1	77342	MDR-134-2 9507-10 M535338-138 M535650-304

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-1/74	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category B, 28 VDC, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1201, K1401) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	2	77342	MDR5035 9507-10 MS35338-138 MS35650-304
7-1/75	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control category B, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1114, K1119, K1120) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	3	77342	MDR4076 9507-10 MS35338-138 MS35650-304
7-1/76	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control category A, 28 VDC continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K1112, K1115, K1131, K1132) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	4	77342	MDR136-1 9507-10 MS35338-138 MS35650-304
7-1/77	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control category A, 115 VAC/60 Hz, continuous duty, 65°C, ambient, shock class I, 4PDT, MIL-R-19523 (K1117, K1118, K1125, K1127, K1128, K1136) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	6	77342	MDR131-1 9507-1 MS35338-138 MS35650-304
7-1/78	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category B, 28 VDC, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K1103) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	1	77342	MDR-67-3 9507-10 MS35338-138 MS35650-304
7-1/79	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control category B, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 24PDT, MIL-R-19523 (K1101) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4	1	77342	MDR141-2 9504-08 MS27183-10 MS35338-44
7-1/80	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG Protective device, thyrite, MIL-I-1361 (PD1-8)	8	03516	8360185G1S63

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-1/81*	Attaching hardware:	2		MS27183-19
	. Washer, flat 1/2			MS27183-18
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS35338-48
	. Washer, lock, split 1/2			
	. Nut, hex, no. 1/2-13 UNC			
7-1/82	. Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	1	56425	STD-ISC-010-0
	Isolation transformer (IT1, IT2)			
	Attaching hardware:			9507-10
	. Nutsert, Avdel, 10-32 UNC			MS35338-138
	. Washer, lock, split no. 10			MS35650-304
7-1/83	. Nut, hex, no. 10-32 UNC	1	56425	90510004-001
	. Screw, mach., pan hd., no. 10-32 x 1/2 LG			
	Door			91000001-907
	Attaching hardware:			91000001-911
	. Knee brace (left-hand)			91000001-912
7-1/84	. Hinge half	1	56425	90410004-009
	. Hinge half			
	. Cotter pin			91000001-907
	Door			91000001-911
	Attaching hardware:			91000001-912
7-1/85	. Knee brace (left-hand)	1	56425	90110101
	. Hinge half			90510004-039
	. Hinge half			91000001-901
	. Cotter pin			91000001-916
	Structure assembly			90510004-047
7-1/86	. Knee brace (right-hand)	1	56425	91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
	Cover			
7-1/87	Grab handle	2	56425	91000001-901
				91000001-916
7-1/88	Door	1	56425	90510004-047
	Attaching hardware:			91000001-907
	. Knee brace (left-hand)			91000001-911
	. Hinge half			91000001-912
	. Hinge half			
7-1/89	. Cotter pin	1	56425	90410005-025
	Cover			90410005-024
	Cover			90410005-027
	Cover			90410005-028
	Cover			90410005-029

Table 7-2A. Parts List For Switchboard 1SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-1/94	Door	2	56425	90510004-049 90510004-048
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-1/95	Drip shield	1	56425	90510004-018
7-1/96	Thumbscrew, captive	29	56425	91000001-934
7-1/97	Subpan	1	56425	90410004-007
7-1/98	Subpan	1	56425	90410004-011
7-1/99	Subpan	1	56425	90410004-014
7-1/100	Subpan	1	56425	90410004-005
7-1/101	Subpan	1	56425	90410004-006
7-1/102	Switch mounting plate	1	56425	90510004-19
7-1/103	Fuseboard	1	56425	91240002-009
7-1/104	Fuseboard	1	56425	91240002-001
7-1/105	Subpan	1	56425	90410004-009
7-1/106	Subpan	2	56425	90410004-012
7-1/107	Subpan	1	56425	90410004-004
7-1/108	Subpan	1	56425	90410004-017
7-1/109	Subpan	1	56425	90410004-016 90110100
7-1/110	Structure Assembly	1	56425	
	* Removed by MACHALT 320-59006 (ECP-515)			
	** Installed by MACHALT 320-59006 (ECP-515)			

Table 7-3. Parts List For Switchboard 1SA – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-2/1	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB1202, CB1214, CB1215, CB1216)	4	30086	ETN5310
7-2/2	Mounting block, switchboard type, MIL-C-17361D	24	30086	ETN5314
7-2/3	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125L trip element, MIL-C-17361D (CB1203-CB1205, CB1211, CB1213)	5	30086	ETN5301
7-2/4	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350T trip element, MIL-C-17361D (CB1217)	1	30086	ETN6906
7-2/5	Mounting block, switchboard type, MIL-C-17361D	6	30086	ETN6743
7-2/6	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 300T trip element, MIL-C-17361D (CB1207, CB1208)	2	30086	ETN6904

Table 7-3. Parts List For Switchboard 1SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-2/7	Circuit Breaker, air, removable element, type ACB-3200HR, 3200A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-3200A, LTD-4800A, STD-6400A, INST-None, time band 1, 10 aux switches (5a & 5b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1209)	1	30086	
7-2/8	Stationary element 3200A frame, 3 pole, MIL-C-17587	1	30086	
7-2/9	Circuit Breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-8000A, INST-None, time band 2, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1212)	1	30086	
7-2/10	Stationary element 4000A frame, 3 pole, MIL-C-17587	1	30086	
7-2/11	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 225L trip element, element, MIL-C-17361D (CB1206)	1	30086	ETN5307
7-2/12	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB1201)	1	30086	ETN5306
7-2/13	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB1210)	1	30086	ETN5304
7-2/14	Terminal board, molded barrier screw type, class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	16		MIL-T-55164/2 38TB12 MS35338-137
7-2/15	Marker strip	16		MIL-T-55164/2 38TB12Z JCB-0
7-2/16	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	2		MS27183-15 MS35338-46
7-2/17	Disconnect link	3	56425	94000037-001
7-2/20	Fuse clip, electrical, type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no, 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	32	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-2/21	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F153-F158, F163-F164)	10	71400	F60C500V6A
7-2/22	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F151, F152, F159, F160)	4	71400	F60C500V20A
7-2/23	Capacitor diode assembly (A7) Attaching hardware: . Washer, flat 1/4	1	56425	2268D140-1 MS27183-10

Table 7-3. Parts List For Switchboard 1SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Washer, lock, split 1/4			MS35338-44
	. Nut, hex, no. 1/4-20 UNC			
	. Screw, mach., pan hd., 1/4-20 x 1 LG			
7-2/24	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315	1	56425	STD-ISC-010-01
7-2/25	Transformer, potential, 450:115V, 60 Hz, NPS accuracy 75VA, MIL-I-1361	2	03516	JNP-0760X40G2
	Attaching hardware:			
	. Nut, cage, 3/8-16 UNC (.250 thick pnl)			C30096-3816
	. Washer, lock, split 3/8			MS35338-46
	. Nut, hex, no. 3/8-16 UNC			
	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			
7-2/26	Structure assembly	1	56425	90110103
7-2/27	Structure assembly	1	56425	90110106
7-2/28	Cover	1	56425	90510004-039
7-2/29	Cover	1	56425	90510004-097
7-2/30	Cover	1	56425	90510004-093
7-2/31	Cover	1	56425	90510004-092
7-2/32	Cover	1	56425	90410005-058
7-2/33	Cover	1	56425	90410005-059
7-2/34	Door	2	56425	90510004-048
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-2/35	Cover	1	56425	90410005-060
7-2/36	Cover	1	56425	90410005-020
7-2/37	Dripshield	1	56425	90510004-100
7-2/38	Grab handle	2	56425	91000001-901
				91000001-916
7-2/39	Thumbscrew, captive	42	56425	91000001-934
7-2/40	Fuse board	1	56425	91240002-009
7-2/41	Subpan	1	56425	90410005-086
7-2/42	Subpan	1	56425	90510004-090
7-2/43	Subpan	1	56425	90420006-076
7-2/44	Switch, toggle, DPST, On-Off-None sealed, MIL-S-83731	2	27191	MS35059-24
7-2/45	Protective device, thyrite, MIL-I-1361 (PD5, PD6)	2	03516	8360185G1S63
	Attaching hardware:			
	. Washer, flat 1/2			MS27183-19
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS27183-18
	. Washer, lock, split 1/2			MS35338-48
	. Nut, hex, no. 1/2-13 UNC			
	. Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG			

Table 7-3A. Parts List For Switchboard 1SA – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-2/1	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB1202, CB1214, CB1215, CB1216)	4	89946	313C748G27
7-2/2	Mounting block, switchboard type, MIL-C-17361D	24	89946	313C680G02
7-2/3	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125L trip element, MIL-C-17361D (CB1203-CB1205, CB1211, CB1213)	5	89946	313C748G18
7-2/4	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, 350T trip element, MIL-C-17361D (CB1217)	1	89946	1230C83G03
7-2/5	Mounting block, switchboard type, MIL-C-17361D	6	89946	1230C81G01
7-2/6	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, 300T trip element, MIL-C-17361E (CB1207, CB1208)	2	89946	1230684G02
7-2/7	Circuit breaker, air, removable element, type ACB-3200HR, 3200A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. Coil-3200A, LTD-4800A, STD-6400A, INST-None, ST delay 0.1 sec (min), 10 aux switches (5a & 5b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1209)	1	39805	4294027-5
7-2/8	Stationary element 3200A frame, 3 pole, MIL-C-17587	1	39805	4294006-1
7-2/9	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, Coil-4000A, LTD-6000A, STD-8000A, INST-None, ST delay 0.2 sec, 10 aux switches (7a & 3b), 120 VAC indicator light blue lens, MIL-C-17587 (CB1212)	1	39805	4294026-7
7-2/10	Stationary element 4000A frame, 3 pole, MIL-C-17587	1	39805	4294006-1
7-2/11	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 225L trip element, MIL-C-17361D (CB1206)	1	89946	313C748G24
7-2/12	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB1201)	1	89946	313C748G21
7-2/13	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB1210)	1	89946	313C748G21
7-2/14	Terminal board, molded barrier screw type class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd. no. 8-32 x 3/4 LG cres	16		MIL-T-55164/2 38TB12
7-2/15	Marker Strip	16		MIL-T-55164/38TB12Z
7-2/16	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	2		JCB-0 MS27183-15 MS35338-46
7-2/17	Disconnect link	3	56425	94000037-001
7-2/20	Fuse clip, electrical, type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8	32	71400	M21346/1-04 MS15795-807

Table 7-3A. Parts List For Switchboard 1SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Washer, lock, split no. 8			MS35338-137
	. Nut, hex, no. 8-32 UNC			MS35649-284
	. Screw, mach., pan hd., no. 8-32 x 7/8 LG			
7-2/21	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F153-F158, F163-F164)	10	71400	F60C500V6A
7-2/22	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F151, F152, F159, F160)	4	71400	F60C500V20A
7-2/23	Capacitor diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock, split 1/4 . Nut, hex, no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MS35338-44
7-2/24	Transformer, power, step down, type SA 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315	1	56425	STD-ISC-010-01
7-2/25	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	2	03516	JNP-0 760X40G2 C30096-3816 MS35338-46
7-2/26	Structure assembly	1	56425	90110103
7-2/27	Structure assembly	1	56425	90110106
7-2/28	Cover	1	56425	90510004-039
7-2/29	Cover	1	56425	90510004-097
7-2/30	Cover	1	56425	90510004-093
7-2/31	Cover	1	56425	90510004-092
7-2/32	Cover	1	56425	90510005-058
7-2/33	Cover	1	56425	90410005-059
7-2/34	Door Attaching hardware: . Knee brace (right-hand) . Hinge half . Hinge half . Cotter pin	2	56425	90510004-048 91000001-907 91000001-911 91000001-912
7-2/35	Cover	1	56425	90410005-060
7-2/36	Cover	1	56425	90410005-020
7-2/37	Dripshield	1	56425	90510005-020
7-2/38	Grab handle	2	56425	90510004-100
7-2/39	Thumbscrew, captive	42	56425	91000001-934
7-2/40	Fuse board	1	56425	91240002-009
7-2/41	Subpan	1	56425	90410005-086
7-2/42	Subpan	1	56425	90510004-090
7-2/43	Subpan	1	56425	90420006-076

Table 7-4. Parts List For Switchboard 1SB – DDG 51 Only

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-3/1	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125LM trip element, MIL-C-17361D (CB1345)	1	30086	ETN5321
7-3/2	Mounting block, switchboard type, MIL-C-17361D	6	30086	ETN5314
7-3/4	Mounting block, switchboard type, MIL-C-17361D	20	30086	ETN6743
7-3/5	Terminal board, molded barrier screw type class 38TB12, MIL-T-55164 Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	13		MIL-T-55164/2 38TB12 MS35338-137
7-3/6	Marker strip	13		MIL-T-55164/2 38TB12Z
7-3/7	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 300TM trip, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1352)	1	30086	ETN690510S31 (Modified)
7-3/8	Motor operator 115 VAC/60 Hz, MIL-C-17361	1	30086	ETN6797
7-3/9	Lampholder, lights indicator (housing), style 98, 115 VAC, w/o lamps	1	56694	MIL-L-3661/65 LH98-3
7-3/10	Lens, indicator light style LC40, blue translucent plastic (DS1)	1	56694	MIL-L-3661/54 LC40BN3
7-3/11	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	2	56694	MS15612-3
7-3/12	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 400TM trip element, MIL-C-17361D (CB1349, CB1351)	2	30086	ETN6908
7-3/13	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350T trip element, MIL-C-17361D (CB1346, CB1354)	2	30086	ETN6906
7-3/15	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350TM trip element, MIL-C-17361D (CB1347, CB1348)	2	30086	ETN6907
7-3/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB1343, CB1344)	2	30086	ETN5306
7-3/17	Mounting base, fuse unit back connected, MIL-C-17361D	40	30086	ETN2787
7-3/18	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 50 trip element, MIL-C-17361D (CB1301, CB1302, CB1304, CB1305, CB1307, CB1312, CB1316, CB1319, CB1320, CB1324, CB1326, CB1332, CB1334)	13	30086	ETN2752
7-3/19	Fuse unit, type AQB-F101B, 50-100 amp, MIL-C-17361D	37	30086	ETN2791
7-3/20	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75 trip element, 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1309, CB1356)	2	30086	ETN275300S01 (Modified)
7-3/21	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole back connected, 100 trip element, 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-1736D (CB1306, CB1308, CB1310)	3	30086	ETN275400S01 (Modified)

Table 7-4. Parts List For Switchboard 1SB – DDG 51 Only - Continued

Figure/ Index No.	Description	Qty	CAGE	Part No.
7-3/22	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole back connected, 100 trip element, MIL-C-17361D (CB1314, CB1331, CB1333, CB1335-CB1340, CB1342, CB1357)	11	30086	ETN2754
7-3/23	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75 trip element, MIL-C-17361D (CB1313, CB1315, CB1317, CB1318, CB1321, CB1322, CB1323)	7	30086	ETN2753
7-3/24	Fuse unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	3	30086	ETN2790
7-3/25	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 25 trip element, MIL-C-17361D (CB1311, CB1325, CB1341)	3	30086	ETN2751
7-3/26	Mounting base, double back connected, MIL-C-17361D	20	30086	ETN2769
7-3/27	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 50 trip element, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1303)	1	30086	ETN275200S01
7-3/28	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 400T trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361E (CB1350, CB1353, CB1355)	3	30086	ETN690810S31
7-3/30	Relay, control category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 4PDT, (K1303, K1306, K1308, K1309, K1310, K1352, K1356) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach. pan hd., no. 10-32 x 1/2 LG	7	77342	MDR131-1 9507-10 MS35338-138 MS35650-304
7-3/31	Structure Assembly	1	56425	90110108
7-3/32	Structure Assembly	1	56425	90110113
7-3/33	Structure Assembly	1	56425	90110109
7-3/34	Cover	1	56425	90510004-023
7-3/35	Cover	1	56425	90510004-024
7-3/36	Cover	1	56425	90510004-025
7-3/37	Cover	1	56425	90510004-042
7-3/38	Cover	1	56425	90510004-043
7-3/39	Cover	1	56425	90510004-044
7-3/40	Grab handle	2	56425	91000001-901 91000001-916
7-3/41	Thumbscrew, captive	52	56425	91000001-934
7-3/42	Dripshield	1	56425	90510004-036
7-3/43	Cover	2	56425	90410005-012
7-3/44	Cover	2	56425	90410005-011
7-3/45	Cover	1	56425	90410005-015
7-3/46	Cover	1	56425	90410005-014
7-3/47	Subpan	1	56425	90510004-021

Table 7-4A. Parts List For Switchboard 1SB – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-3/1	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125LM trip element, MIL-C-17361D (CB1345)	1	89946	313C748G19
7-3/2	Mounting block, switchboard type, MIL-C-7361D	6	89946	313C680G02
7-3/4	Mounting block, AQB-LL400 Circuit breaker 3 pole, MIL-C-1736E	20	89946	1230C81G01
7-3/5	Terminal board, molded barrier screw type class 38TB12 Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	13		MIL-T-55164/2 38TB12 MS35338-137
7-3/6	Marker strip	13		MIL-T-55164/2 38TB12Z
7-3/7	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 115 VAC/60 Hz shunt trip with 5 aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361E (CB1352) 300QS trip element, MIL-C-17361E	1	89946	1241C32G07 1230C84G02
7-3/8	Motor operator, 115 VAC/60 Hz, MIL-C-17361	1	89946	1234C53G01
7-3/9	Lampholder, lights indicator (housing), style 90, 115 VAC, w/o lamps	1	56694	MIL-L-3661/65 LH98-3
7-3/10	Lens, indicator light style LC40, blue translucent plastic (DS1)	1	56694	MIL-L-3661/54 LC40BN3
7-3/11	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	2	56694	MS15612-3
7-3/12	Circuit breaker, type AQB-LL400, 500 VAC, 60 Hz, 3 pole, connected, MIL-C-17361E (CB1349, CB1351) 400QS trip element, MIL-C-17361E	2	89946	1230C83G01 1230C83G04
7-3/13	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, MIL-C-17361E (CB1346, CB1348) 350QM trip element MIL-C-17361E	2	89946	1230C83G03 1230C83G03
7-3/15	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, MIL-C-17361E (CB1347) 350QS trip element MIL-C-17361E	1	89946	1230C83G01 1230C84G03
7-3/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB1343, CB1344)	2	89946	313C748G23
7-3/17	Mounting base, fuse unit, 50-75-100A, MIL-C-17361D	40	89946	655D258G06
7-3/18	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 50 trip element, MIL-C-17361D (CB1301, CB1302, CB1304, CB1305, CB1307, CB1312, CB1316, CB1319, CB1320, CB1326, CB1332, CB1334)	12	89946	458D509G13
7-3/19	Fuse unit, type AQB-F101B, 50-100 amp, MIL-C-17361D	37	89946	504C010H02
7-3/20	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75 trip element 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1309, CB1356)	2	89946	5682D24G16

Table 7-4A. Parts List For Switchboard 1SB – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-3/21	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole back connected, 100 trip element. 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-1736D (CB1306, CB1308, CB1310)	3	89946	5682D24G17
7-3/22	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole back connected, 100 trip element, MIL-C-17361D (CB1314, CB1331, CB1333, CB1335-CB1340, CB1342, CB1357)	11	89946	458D509G15
7-3/23	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75 trip element, MIL-C-17361D (CB1313, CB1315, CB1317, CB1318, CB1321, CB1322, CB1323, CB1341)	8	89946	458D509G14
7-3/24	Fuse unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	3	89946	504C010H01
7-3/25	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 25 trip element, MIL-C-17361D (CB1311, CB1324, CB1325)	3	89946	458D509G12
7-3/26	Mounting base, double back connected MIL-C-17361D	20	89946	458D569G03
7-3/27	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 50 trip element, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1303)	1	89946	5682D24G15
7-3/28	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361E (CB1350, CB1353, CB1355)	3	89946	1241C32G09
	400QM trip element, MIL-C-17361E	4	89946	1230C84G04
7-3/30	Relay, control, category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 4PDT, (K1303, K1306, K1308, K1309, K1310, K1352, K1356)	1	77342	MDR131-1
	Attaching hardware:			
	. Nutsert, Avdel, 10-32 UNC			9507-10
	. Washer, lock, split no. 10			MS35338-138
	. Nut, hex, no. 10-32 UNC			MS35650-304
	. Screw, mach., pan hd., no. 10-32 x 1/2 LG			
7-3/31	Structure Assembly	1	56425	90110108
7-3/32	Structure Assembly	1	56425	90110113
7-3/33	Structure Assembly	1	56425	90110109
7-3/34	Cover	1	56425	90510004-023
7-3/35	Cover	1	56425	90510004-024
7-3/36	Cover	1	56425	90510004-025
7-3/37	Cover	1	56425	90510004-042
7-3/38	Cover	1	56425	90510004-043
7-3/39	Cover	1	56425	90510004-044
7-3/40	Grab handle	2	56425	91000001-901
7-3/41	Thumbscrew, captive	52	56425	91000001-934
7-3/42	Dripshield	1	56425	90510004-036
7-3/43	Cover	2	56425	90410005-012
7-3/44	Cover	2	56425	90410005-011
7-3/45	Cover	1	56425	90410005-015

Table 7-4A. Parts List For Switchboard 1SB – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-3/46	Cover	1	56425	90410005-014
7-3/47	Subpan	1	56425	90510004-021

Table 7-5. Parts List For Switchboard 1SC – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-4/1	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole back connected, 300T trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1407)	1	30086	ETN690410S31 (Modified)
7-4/2	Mounting block, switchboard type, MIL-C-17361D	6	30086	ETN6743
7-4/3	Terminal board molded barrier screw type class 38TB, MIL-T-555164 Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	16		MIL-T-55164/2 38TB12 MS35338-137
7-4/4	Marker strip	16		MIL-T-55164/2 38TB12Z
7-4/5	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150L trip element, MIL-C-17361D (CB1403, CB1405)	2	30086	ETN5303
7-4/6	Mounting block, switchboard type, MIL-C-17361D	14	30086	ETN5314
7-4/7	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-8000A, INST-None, time band 2, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1413)	1	30086	
7-4/8	Stationary element 4000A frame, 3 pole, MIL-C-17587	1	30086	
7-4/9	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LH trip element, MIL-C-17361D (CB1401)	1	30086	ETN5306
7-4/10	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125LM trip element, MIL-C-17361D (CB1402)	1	30086	ETN5302
7-4/11	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350TM trip element, MIL-C-17361D (CB1408)	1	30086	ITN6907
7-4/12	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 400T trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1406)	1	30086	ETN690810S31
7-4/13	Transformer, potential, 450:115 VAC, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	2	03516	JNP-0 760X40G2 C30096-3816 MS35338-46

Table 7-5. Parts List For Switchboard 1SC – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-4/14	Transformer, power, step down, type SA, 450:115 VAC, 5 KVA, with primary and secondary terminals, MIL-T-16315 (T1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-01 C30096-3816 MS35338-46
7-4/15	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected. 125L trip element, MIL-C-17361D (CB1411)	1	30086	ETN5301
7-4/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB1410)	1	30086	ETN5304
7-4/17	Circuit breaker, air, removable element, type ACB-1600HR, 1600A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-800A, LTD-1200A, STD-None, INST-8000A, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1409)	1	30086	
7-4/18	Stationary element 4000A frame, 3 pole, MIL-C-17587		30086	
7-4/19	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175L trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1404)	1	30086	ETN530510S31 (Modified)
7-4/20	Capacitor diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock, split 1/4 . Nut, hex, no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MS35338-44
7-4/21	Disconnect link	3	56425	94000037-001 JCB-0
7-4/22	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG			MS27183-15 MS35338-46
7-4/23	Fuse clip, electrical, type FC21CF Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	32	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-4/24	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F181, F182, F189, F190)	4	71400	F60C500V20A
7-4/25	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F183-F188, F193-F196)	10	71400	F60C500V6A
7-4/26	Structure Assembly	1	56425	90110102

Table 7-5. Parts List For Switchboard 1SC – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-4/27	Structure Assembly	1	56425	90110112
7-4/28	Cover	1	56425	90510004-103
7-4/29	Cover	1	56425	90510004-039
7-4/30	Door	1	56425	90510004-128
	Attaching hardware:			
	Knee brace (left-hand)			91000001-907
	Hinge half			91000001-911
	Hinge half			91000001-912
	Cotter pin			
7-4/31	Cover	1	56425	90510004-127
7-4/32	Cover	1	56425	90510004-126
7-4/33	Subpan	1	56425	90510004-110
7-4/34	Subpan	1	56425	90510004-111
7-4/35	Grab handle	1	56425	91000001-901
				91000001-916
7-4/36	Thumbscrew, captive	45	56425	91000001-934
7-4/37	Dripshield	1	56425	90410004-018
7-4/38	Cover	1	56425	90410005-168
7-4/39	Cover	1	56425	90410005-169
7-4/40	Door	1	56425	90510004-049
7-4/41	Cover	1	56425	90410005-060
7-4/42	Cover	1	56425	90410005-020
7-4/43	Fuse board	1	56425	91240002-009
7-4/44	Subpan	2	56425	90410005-009
7-4/45	Subpan	1	56425	90510004-086
7-4/46	Switch, toggle, DPST, On-Off-None sealed, MIL-S-83731	2	27191	MS35059-24
7-4/47	Protective device, thyrite, MIL-I-1361 (PD7, PD8)	2	03516	8360185G1S63
	Attaching hardware:			
	. Washer, flat 1/2			MS27183-19
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS27183-18
	. Washer, lock, split 1/2			MS35338-48
	. Nut, hex, no. 1/2-13 UNC			
	. Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG			

Table 7-5A. Parts List For Switchboard 1SC – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-4/1	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1407)	1	89946	1241C32G09
	300QM trip element, MIL-C-17361E	1	89946	1230C84G02
7-4/2	Mounting block, AQB-LL400 Circuit breaker, 3 pole, MIL-C-17361E	6	89946	1230C81G01
7-4/3	Terminal board, molded barrier screw type class 38TB	16		MIL-T-55164/2 38TB12

Table 7-5A. Parts List For Switchboard 1SC – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres			
7-4/4	Marker strip	16		MIL-T-55164/2
7-4/5	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150L trip element, MI1-C-17361D (CB1403, CB1405)	2	89946	313C748G20
7-4/6	Mounting block, switchboard type, MIL-C-17361D	14	89946	313C680G02
7-4/7	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, Coil-4000A, LTD-6000A, STD-8000A, INST-None, ST delay 0.2 sec, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1413)	1	39805	4294026-7
7-4/8	Stationary element 4000A frame, 3 pole MIL-C-17587	1	39805	4294006-1
7-4/9	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB1401)	1	89946	313C748G23
7-4/10	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125LM trip element, MIL-C-17361D (CB1402)	1	89946	313C748G19
7-4/11	Circuit breaker, type AQB-LL400, 500 VAC, 60 Hz, 3 pole, back connected, 350QS trip element, MIL-C-17361E (CB1408)	1	89946	1230C83G01
7-4/12	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, 400QM trip element, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361E (CB1406)	1	89946	1241C32G09
7-4/13	Transformer, potential, 450:115 VAC, 60 Hz, NSS accuracy 50VA, MIL-I-1361	2	03516	JNP-0 760X40G2
	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			C30096-3816 MS35338-46
7-4/14	Transformer, power, step down, type SA, 450:115 VAC, 5 KVA, with primary and secondary terminals, MIL-T-16315 (T1)	1	56425	STD-ISC-010-01
	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			C30096-3816 MS35338-46
7-4/15	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125L trip element, MIL-C-17361D (CB1411)	1	89946	313C748G18
7-4/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB1410)	1	89946	313C748G21

Table 7-5A. Parts List For Switchboard 1SC – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-4/17	Circuit breaker, air, removable element, type ACB-1600HR, 1600A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-800A, LTD-1200A, STD-1600A, INST-8000A, ST delay 0.1 sec (min), 10 aux switches (5a & 5b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB1409)	1	39805	4284065-5
7-4/18	Stationary element 4000A frame, 3 pole MIL-C-17587	1	39805	429006-1
7-4/19	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175L trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB1404)	1	89946	313C748G22
7-4/20	Capacitor diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock, split 1/4 . NUT, hex, no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MS35338-44
7-4/21	Disconnect link	3	56425	94000037-001
7-4/22	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG			JCB-0 MS27183-15
7-4/23	Fuse clip, electrical, type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	32	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-4/24	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F181, F182, F189, F190)	4	71400	F60C500V20A
7-4/25	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F183-F188, F193-F196)	10	71400	F60C500V6A
7-4/26	Structure Assembly	1	56425	90110102
7-4/27	Structure Assembly	1	56425	90110112
7-4/28	Cover	1	56425	90510004-103
7-4/29	Cover	1	56425	90510004-039
7-4/30	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-128 91000001-907 91000001-911 91000001-912
7-4/31	Cover	1	56425	90510004-127
7-4/32	Cover	1	56425	90510004-126

Table 7-5A. Parts List For Switchboard 1SC – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-4/33	Subpan	1	56425	90510004-110
7-4/34	Sub pan	1	56425	90510004-111
7-4/35	Grab handle	1	56425	91000001-901
7-4/36	Thumbscrew, captive	45	56425	91000001-934
7-4/37	Dripshield	1	56425	90410004-018
7-4/38	Cover	1	56425	90410005-168
7-4/39	Cover	1	56425	90410005-169
7-4/40	Door	1	56425	90510004-049
7-4/41	Cover	1	56425	90410005-060
7-4/42	Cover	1	56425	90410005-020
7-4/43	Fuse board	1	56425	91240002-009
7-4/44	Subpan	2	56425	90410005-009
7-4/45	Subpan	1	56425	90510004-086

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/1	Lampholder, lights, indicator (housing), style 96, 28 VDC, w/o lamps	3	56694	MIL-L-3661/63 LH96-3
7-5/2	Lamp, incandescent, 6 volt, type T-1 3/4, midget screwbase, W-L-111	6	56684	MS15612-5
7-5/3	Lens, indicator light, style LC40, amber translucent plastic (DS4, DS6, DS8, DS32, DS35, DS36, DS40, DS41, DS49)	10	56694	MIL-L-3661/54 LC40AN3
7-5/4	Switch, pushbutton momentary action, 1 NO and 1 NC contact, MIL-C-2212 (PB2101, PB2103)	2	02989	Type 1C5845
7-5/5	Lens, indicator light, style LC40, red translucent plastic (DS30)	1	56694	MIL-L-3661/54 LC40EN3
7-5/6	Ammeter, AC, 4-1/2 inch, 250° scale, 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M1, M2)	2	15309	MR49W006ACKAH
7-5/7	Wattmeter, AC, 4-1/2 inch, 250° scale, 0-5,000KW, 60 Hz, PT ratio 460:115 VAC, CT ratio 6,000:5 amp, MIL-W-19088 (M8)	1	15309	MR492W005ACGWH
7-5/8	Meter, temperature, selective, manual readout remote, 115 VAC/60 Hz, platinum RTE, 0-200°C, 4-1/2 inch, 250° scale meter in accordance with MIL-M-16034, MIL-T-15377 (M3)	1	15309	4951-366
7-5/9	Lens, indicator light, style LC40, green translucent plastic (DS33, DS34 DS37, DS38)	4	56694	MIL-L-3661/54 LC40GN3
7-5/10	Switch, rotary, selector, 10 amp, type S3JR3, 5-position, 3-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (sections 2 and 3 are make-before-break), MIL-S-21604 (S18)	1	82121	23303LN
7-5/11	Switch pushbutton, momentary action, 2 NO contacts, MIL-C-2212 (PB2102)	1	02989	Type 1C5845 5729215G23
7-5/12	Lampholder, lights indicator (housing), style 98, 115 VAC, w/o lamps	26	56694	MIL-L-3661/65 LH98-3
7-5/13	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	58	56694	MS15612-3

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/14	Lens, indicator light style LC40, white translucent plastic (DS22, DS23, DS24, DS25, DS29, DS31, DS42, DS43, DS48)	9	56694	MIL-L-3661/54 LC40WT3
7-5/15	Switch, rotary, multipole, 10 amp, type S2JR1, 2-position, 1-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S21, S31)	2	82121	23201LG
7-5/16	Switch, rotary, multipole, 10 amp, type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, round knob, white pointer, blank escutcheon plate, MIL-S-21604 (S16, S20)	2	82121	71201LN
7-5/17	Voltmeter, AC, 4-1/2 inch, 250° scale, 0-6,000 VAC, 60 Hz, PT ratio 460:115 VAC	2	15309	MR49W600ACVVH
7-5/18	Switch, rotary, multipole, 10 amp, type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S14, S15)	2	82121	71201LN
7-5/19	Switch, rotary, selector, 10 amp, type S3JR6, 3-position, 6-section, maintained, Navy gray, oval shank handle, white pointer, MIL-S-21604 (S13)	1	82121	23306LT
7-5/20	Lens, indicator light, style LC40, blue translucent plastic (DS5, DS7, DS9)	3	56694	MIL-L-3661/54 LC40BN3
7-5/21	Switch, rotary, meter & control, type 24G, class 2, 4PDT, spring return to center (off), 500 VAC, Navy gray, pistol grip handle, white pointer, MIL-S-18396 (S1, S2, S3)	3	82121	74202J-001
7-5/22	Test block with cover, type PK2, 4 pole (1 current and 1 potential)	2	71669	6422120G4
7-5/23	Test plug with 4 pole, type PK2	2	71669	6129533G1
7-5/24	Links, test plug	2	71669	V2453076
7-5/25	Switch, rotary, multipole, 7.5 amp, type S5JM9, 2-position, 9-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S24)	1	82121	26509LC
7-5/26	Switch, rotary, meter & control, type 24G, class 2, 2PST (off-on), spring return to center (off), 500 VAC, Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-18396 (S25)		82121	74201J-003
7-5/27	Switch, rotary, multipole, 10 amp, type S2JRM3, 3-position, 3-section, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S22)	1	82121	71203MA
7-5/28	Lens, indicator light, style LC40, clear colorless plastic (DS1, DS2, DS26, DS27, DS28)	5	56694	MIL-L-3661/54 LC40TN3
7-5/29	Lampholder, lights, indicator (housing), style 98, 450 VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98-4
7-5/30	Switch, rotary, meter & control, type 24G, 4-position, 4-section, spring return from extreme left & right positions, maintained in 315° & 360° positions, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-18396 (S38)	1	82121	71304LH
7-5/31	Switch, rotary, selector, 10 amp, type S3JR8, 4-position, 8-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S19)	1	82121	23308LF

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/32	Switch, rotary, meter & control, type 24G, 4-position, 1-section, spring return to center, Navy gray, knurled knob, white pointer, blank escutcheon plate (section 3-4/ammeter circuit (MBB), section 1-2/voltmeter circuit), MIL-S-21604 (S17)	1	82121	23904LJ
7-5/33	Synchroscope, switchboard, 4-1/2 inch, 360° scale, slow-fast, 115 VAC/60 Hz, MIL-1-16104 (M1)	1		MR4SW060SYH
7-5/34	Meter, electrical, frequency, 4-1/2 inch, 250° scale, 55-65Hz, 115 VAC (self contained), MIL-M-16125 (M6, M7)	2		MR49W60BH
7-5/35	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 15I trip element (INST only), MIL-C-17361D (CB2101)	1	30086	ETN2760
7-5/36	Mounting base, single back connected (Group 1) MIL-C-17361D	1	30086	ETN2767
7-5/37	Mounting base, fuse unit back connected, MIL-C-17361D	1	30086	ETN2787
7-5/38	Fuse unit, Type AQB-F101A, 15-25 amp MIL-C-17361D	1	30086	ETN2790
7-5/39	Circuit breaker, air, removable, type ACB-4000A, frame size 4000A, 500 VAC, 60 Hz, 3 pole, 450V/60 Hz closing coil, 115V/60 Hz control relay and shunt trip, wired per dwg. 7127298, Coil-4000A, LTD-6000A, STD-10000A, INST-48000A, time band 3, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB2120)	1	30086	
7-5/40	Stationary element 4000A frame, 3 pole, MIL-C-17587	1	30086	
7-5/41	Terminal board, molded barrier screw type class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	62		MIL-T-55164/2 38TB12 MS35338-137
7-5/42	Marker strip	62		MIL-T-55164/2 38T12Z
7-5/43	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	4	03516	JCB-0827X71 MS27183-15 MS35338-46
7-5/44	Circuit breaker, Type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB2102, CB2103)	2	30086	ETN5310
7-5/45	Mounting block, switchboard type, MIL-C-17361D	4	30086	ETN5314
7-5/46	Terminal, casualty power receptacle type, back connected, 200 amp, 450 VAC/60 Hz, MIL-T-24552 Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	2		M24352/1-001 MS27183-19 MS27183-18 MS35338-48
7-5/47	Terminal, casualty power seal, MIL-T-24552	4		M24553/3-001
7-5/48	Disconnect link	2	56425	84000037-001

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/49*	Turbine RPM detector assembly Attaching hardware: . Washer, flat no. 6 . Nutsert, Avdel, 6-32 UNC . Washer, lock, split no. 6 . Screw, mach., pn hd., no. 6-32 x 5/8 LG	1	56425	2268D150-5-1 MS15795-805 MS35338-136
7-5/50	Transformer, power, step down, type SA, 1 phase, 450:120 VAC, 1.5 KVA, continuous duty, MIL-T-16315 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-07 C30096-3816 MS35338-46
7-5/51*	Fault current detector main assembly (A6) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	2268D100-2 C30096-3816 MS35338-46
7-5/52	Analog bus ground detector Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000170 9504-08 MS 27 18 3-10 MS35338-44
7-5/53	Contacting, size 1, 27 amp, 450 VAC/60 Hz, 4 pole, 2 NO and 2 NC aux switches, 440V/60 Hz coil, MIL-C-2212 Attaching hardware: . Washer, flat no. 10 . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 5/8 LG	2	27192	6957ED25-1A MS15795-808 MS35338-138 MS35650-304
7-5/54	Mechanical interlock, size 1, MIL-C-2212	1	27192	10-2468
7-5/55	Synchronizing control equipment, 450 VAC/60 Hz, MIL-S-24188 (Modified) (A1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	94080020-001 C30096-3816 MS35338-46
7-5/56	Relay, control, category A, 28 VDC continuous duty, 65° ambient, shock class I, 4PDT, MIL-R-19523 (K2104, K2105, K2106, K2108, K2109, K2110, K2111, K2113, K2123, K2129, K2130, K2131, K2132, K2133, K2134, K2202, K2204, K2205, K2302, K2304, K2305) Attaching hardware: . Nutsert, Avdel, 10-32 UNC	21	77342	MDR-135-1 9507-10

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG			MS35338-138 MS35650-304
7-5/57	Semiconductor device, diode silicon, power rectifier, fast recovery, 600 PIV/3 amp, MIL-S-19500/411	29		JANTXIN5416
7-5/58	Relay, control, category B, 28 VDC continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K2103) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no 10-32 x 1/2 LG	1	77342	MDR-67-3 9507-10 MS35338-138 MS35650-304
7-5/59	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75A, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	6	03516	JNP-0 760X40G2 C30096-3816 MS35338-46
7-5/60*	Monitor, reverse power, time delay, adjustable 1-5 sec, MIL-M-24350A (Modified) (A2)	1	4N915	2185-101-03
7-5/60**	Module, Generator Protection, MIL-M-24350A (GPM) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	4N915	2310-701-01 9504-08 MS27183-10 MS35338-44
7-5/61	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA with primary and secondary terminals (MIL-T-16315) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-01 C30096-3816 MS35338-46
7-5/62	Relay Assembly, MIL-R-24563 (Modified) (A3b) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000160-1 9504-08 MS27183-10 MS35338-44
7-5/63*	Relay, AC power sensing, 2 stage time delay, adjustable 0-39 sec, MIL-R-24563 (Modified) (A3a) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4	1	4N915	2170-105-03 9504-08 MS27183-10 MS35338-44

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/64	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG	2	27191	MS35059-24
7-5/65*	Switch, toggle, DPST, On-Off-None sealed, MIL-S-83731	2	56425	STC-ISC-010-04
	Isolation transformer (IT1, IT2)			
	Attaching hardware:			
	. Nutsert, Avdel, 10-32 UNC			9507-10
	. Washer, lock, split no. 10			MS35338-138
	. Nut, hex, no. 10-32 UNC			MS35650-304
7-5/66*	Resistor, fixed, wire wound (power type), style RW79, 0.144 ohm/3 watts, MIL-R-26/5 (R1, R2)	2	81349	RW79UR144F
7-5/67	Fuse clip, electrical type FC21CF, MIL-F-21346	144	71400	M21346/1-04
	Attaching hardware:			
	. Washer, flat no. 8			MS15795-807
	. Washer, lock, split no. 8			MS35338-137
	. Nut, hex, no. 8-32 UNC			MS35649-284
	. Screw, mach., pan hd., no. 8-32 x 7/8 LG			
7-5/68	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F211, F212, F221, F222)	4	71400	F60C500V20A
7-5/69	Fuse, style F60, 400 VAC, 6 amp, characteristic C, MIL-F-15160 (F201-F205, F207-F210, F213-F220, F223-F228, F230, F231, F234, F235)	28	71400	F60C500V6A
7-5/70	Fuse, style F60, 500 VAC, 1 amp, characteristic C, MIL-F-15160 (F229)	1	71400	F60C500V1A
7-5/71	Fuse, style F60, 500 VAC, 3 amp, characteristic C, MIL-F-15160 (F233, F236, F238-F242, F250)	8	71400	F60C500V3A
7-5/72	Fuse, style F60, 500 VAC, 1/8 amp, characteristic C, MIL-F-15160 (2F1)	1	71400	F60C500V1/8A
7-5/73	Relay, control, category A, 450 VAC, 60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K2107)	1	77342	MDR-134-2
	Attaching hardware:			
	. Nutsert, Avdel, 10-32 UNC			9507-10
	. Washer, lock, split no. 10			MS35338-138
	. Nut, hex, no. 10-32 UNC			MS35650-304
	. Screw, mach., pan hd., no. 10-32 x 1/2 LG			
7-5/74	Relay, control category A, 28 VDC, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K2125, K2127, KI2128, K2135, K2136)	5	77342	MDR135-1
	Attaching hardware:			
	. Nutsert, Avdel, 10-32 UNC			9507-10
	. Washer, lock, split no. 10			MS35338-138
	. Nut, hex, no. 10-32 UNC			MS35650-304
	. Screw, mach., pan hd., no. 10-32 x 1/2 LG			
7-5/75	Relay, electropneumatic timer, 115 VAC/60 Hz, continuous duty, 2FDT, time range 5-50 sec. on delay with stops at 1-39 sec	1	98403	7012L8DSN
	Attaching hardware:			
	. Nutsert, Avdel, 1/4-20 UNC			9504-08
	. Washer, flat 1/4			MS27183-10
	. Washer, lock, split 1/4			MS35338-44

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/76	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG Relay, control, category B, 28 VDC continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K2201, K2301) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4	2	77342	MDR5035 9504-08 MS27183-10 MS35338-44
7-5/77	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG Relay, control, category B, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 24PDT, MIL-R-19523 (K2101) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4	1	77342	MDR141-2 9504-08 MS27183-10 MS35338-44
7-5/78	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG Protective device, thyrite Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC	4	03516	8360185G1S63 MS27183-19 MS27183-18 MS35338-48
7-5/79	. Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG Relay, control, category B, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K2114, K2119, K2120) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	3	77342	MDR4076 9507-10 MS35338-138 MS35650-304
7-5/80	Structure assembly	1	56425	90110100
7-5/81	Structure assembly	1	56425	90110101
7-5/82	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-001 91000001-907 91000001-911 91000001-912
7-5/83	Door Attaching hardware: . Knee brace (right-hand) . Hinge half . Hinge half . Cotter Pin	1	56425	90510004-010 91000001-907 91000001-911 91000001-912
7-5/84	Door Attaching hardware:	1	56425	90510004-040

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-5/85	Cover	1	56425	90510004-039
7-5/86	Dripshield	1	56425	90410004-018
7-5/87	Door	2	56425	90510004-049 90510004-048
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-5/88	Cover	1	56425	90410005-160
7-5/89	Cover	1	56425	90410005-157
7-5/90	Cover	1	56425	90410005-159
7-5/91	Door	1	56425	90510004-047
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-5/92	Cover	1	56425	90410005-25
7-5/93	Cover	1	56425	90410005-24
7-5/94	Grab handle	2	56425	91000001-901 91000001-916
7-5/95	Thumbscrew, captive	32	56425	91000001-934
7-5/96	Cover	1	56425	90410005-158
7-5/97	Subpan	1	56425	90510004-007
7-5/98	Subpan	1	56425	90510004-011
7-5/99	Subpan	1	56425	90510004-014
7-5/100	Switch mounting plate	1	56425	90410004-019
7-5/101	Subpan	1	56425	90510004-005
7-5/102	Subpan	1	56425	90510004-006
7-5/103	Fuseboard	1	56425	91240002-009
7-5/104	Fuseboard	1	56425	90410002-001
7-5/105	Subpan	1	56425	90410005-009
7-5/106	Subpan	2	56425	90510004-012
7-5/107	Subpan	1	56425	90510004-020
7-5/108	Subpan	1	56425	90510004-010
7-5/109	Subpan	1	56425	90510004-016
7-5/110	Switch, rotary, multipole, 7.5A, 2-position, 3 decks, type S5JM3, Navy gray, oval shank knob, white pointer, blank escutcheon plate, NSN 5930-01-006-8595	1	82121	265030

Table 7-6. Parts List For Switchboard 2SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
* Removed by MACHALT 320-59006 (ECP-515)				
** Installed by MACHALT 320-59006 (ECP-515)				

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/1	Lampholder, lights, indicator (housing), style 96, 28 VDC, w/o lamps	3	56694	MIL-L-3661/63 LH96-3
7-5/2	Lamp, incandescent, 6 volt, type T-1 3/4, midget screwbase, W-L-111	6	56684	MS15612-5
7-5/3	Lens, indicator light, style LC40, amber translucent plastic (DS4, DS6 DS8, DS32, DS35, DS36, DS40, DS41)	9	56694	MIL-L-3661/54 LC40AN3
7-5/4	Switch, pushbutton, momentary action, 1 NO and 1 NC contact, MIL-C-2212 (PB2101, PB2103)	2	02989	Type 1C5845
7-5/5	Lens, indicator light, style LC40, red translucent plastic (DS30)	1	56694	MIL-L-3661/54 LC40EN3
7-5/6	Ammeter, AC, 4-1/2 inch, 250° scale 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M1, M2)	2	15309	MR49W006ACKAH
7-5/7	Wattmeter, AC, 4-1/2 inch, 250° scale 0-5,000KW, 60 Hz, PT ratio 460:115 VAC, CT ratio 6,000:5 amp, MIL-W-19088 (M8)	1	15309	MR492W005ACGWH
7-5/8	Meter, temperature, selective, manual readout remote, 115 VAC/60 Hz, platinum RTE, 0-200°C, 4-1/2 inch, 250° scale meter in accordance with MIL-M-16034, MIL-T-15377 (M3)	1	15309	4951-366
7-5/9	Lens, indicator light, style LC40, green translucent plastic (DS33, DS34, DS37, DS38)	4	56694	MIL-L-3661/54 LC40GN3
7-5/10	Switch, rotary, selector, 10 amp type S3JR3,5-position, 3-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (sections 2 and 3 are make-before-break), MIL-S-21604 (S18)	1	82121	23303LN
7-5/11	Switch, pushbutton, momentary action, 2 NO contacts, MIL-C-2212 (PB2102)	1	02989	Type 105645 572921SG23
7-5/12	Lampholder, lights indicator (housing), style 98, 115 VAC w/o lamps	24	56694	MIL-L-3661/65 LH98-3
7-5/13	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	54	56694	MS15612-3
7-5/14	Lens, indicator light style LC40, white translucent plastic (DS22, DS23, DS24, DS25, DS29, DS31, DS42, DS43)	8	56694	MIL-L-3661/54 LC40WT3
7-5/15	Switch, rotary, multipole, 10 amp, type S2JR1, 2-position, 1-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S21, S31)	2	82121	23201LG
7-5/16	Switch, rotary, multipole, 10 amp type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, round knob, white pointer, blank escutcheon plate, MIL-S-21604 (S16, S20)	2	82121	71201LN
7-5/17	Voltmeter, AC, 4-1/2 inch, 250° scale 0-6,000 VAC, 60 Hz, PT ratio 460:115 VAC	2	15309	MR49W600ACWH

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/18	Switch, rotary, multipole, 10 amp type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S14, S15)	2	82121	71201LN
7-5/19	Switch, rotary, selector, 10 amp, type S3JR6, 3-position, 6-section, maintained, Navy gray, oval shank handle, white pointer, MIL-S-21604 (S13)	1	82121	23306LT
7-5/20	Lens, indicator light, style LC40, blue translucent plastic (DS5, DS7, DS9)	3	56694	MIL-L-3661/54 LC40BN3
7-5/21	Switch, rotary, meter & control, type 24G, class 2, 4PDT, spring return to center (off), 500 VAC, Navy gray, pistol grip handle, white pointer, MIL-S-18396 (S1, S2, S3)	3	82121	74202J-001
7-5/22	Test block with cover, type PK2, 4 pole (1 current and 1 potential)	2	71669	6422120G4
7-5/23	Test plug with 4 pole, type PK2	2	71669	6129533G1
7-5/24	Links, test plug	2	71669	V2453076
7-5/25	Switch, rotary, multipole, 7.5 amp, type S5JM9, 2-position, 9-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S24)	1	82121	26509LC
7-5/26	Switch, rotary, meter & control, type 24G, class 2, 2PST (off-on), spring return to center (off), 500 VAC, Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-18396 (S25)		82121	74201J-003
7-5/27	Switch, rotary, multipole, 10 amp, type S2JRM3, 3-position, 3-section, spring return to center Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S22)	1	82121	71203MA
7-5/28	Lens, indicator light, style LC40, clear colorless plastic (DS1, DS2, DS26, DS27, DS28)	5	56694	MIL-L-3661/54 LC40TN3
7-5/29	Lampholder, lights, indicator (housing), style 98, 450 VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98-4
7-5/30	Switch, rotary, meter & control, type 24G, 4-position, 4-section, spring return from extreme left & right positions, maintained in 315° & 360° positions, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-18396 (S38)	1	82121	71304LH
7-5/31	Switch, rotary, selector, 10 amp, type S3JR8, 4-position, 8-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S19)	1	82121	23308LF
7-5/32	Switch, rotary, meter & control, type 24G, 4-position, 1-section, spring return to center, Navy gray, knurled knob, white pointer, blank escutcheon plate (section 3-4 ammeter/circuit (MBB), section 1-2/voltmeter circuit)	1	82121	23904LJ
7-5/33	Synchroscope, 4-1/2 inch, 360° scale slow-fast, 115 VAC/60 Hz MIL-I-16104 (M1)	1		MR4SW060SYH
7-5/34	Meter, electrical, frequency, 4-1/2 inch, 250° scale, 55-65Hz, 115 VAC (self contained)	2		MR49W60BH
7-5/35	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 15I trip element (inst. only), MIL-C-17361D (CB2101)	1	89946	458D511G11
7-5/36	Mounting base, single, back connected, MIL-C-17361D	1	89946	315C364G02
7-5/37	Mounting base, fuse unit, 50-75-100A, MIL-C-17361D	1	89946	655D258G06

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/38	Fuse unit, Type AQB-F101A, 15-25 amp, MIL-C-17361D	1	89946	504C010H01
7-5/39	Circuit breaker, air, removable element, type 4000A frame 500 VAC, 60 Hz, 3 pole, 450V/60 Hz closing coil, 115V/60 Hz control relay and shunt trip, Coil-4000A, LTD-6000A, STD-10000A, Inst-48000A, ST delay 0.3 sec, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, 1 long b contact to be wired out to secondary terminal 9 and 10, MIL-C-17587 (CB2120)	1	39805	4294025-9
7-5/40	Stationary element 4000A frame, 3 pole MIL-C-17587	1	39805	4294006-1
7-5/41	Terminal board, molded barrier screw type, class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	62		MIL-T-55164/2 38TB12 MS35338-137
7-5/42	Marker strip	62		MIL-T-55164/2 38T12Z
7-5/43	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA MIL-1-1361 Attaching hardware: . Washer, flat, 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5 3/8-16 x 4 LG	4	03516	JCB-0827X71 MS27183-15 MS35338-46
7-5/44	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB2102, CB2103)	2	89946	313C748G27
7-5/45	Mounting block, switchboard type	4	89946	313C680G02
7-5/46	Terminal, casualty power receptacle type, back connected, 200 amp, 450 VAC/60 Hz, MIL-T-24552 Attaching hardware: . Washer, flat, 1/2 . Washer, flat, 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	2		M24552/1-001 MS27183-19 MS27183-18 MS35338-48
7-5/47	Terminal, casualty power seal, MIL-T-24552	2		M24553/3-001
7-5/48	Disconnect link	2	56425	84000037-001
7-5/49*	Turbine RPM detector assembly Attaching hardware: . Washer, flat no. 6 . Nutsert, Avdel, 6-32 UNC . Washer, lock, split no. 6 . Screw, mach., pn hd., no. 6-32 x 5/8 LG	1	56425	2268D150-5-1 MS15795-805 MS35338-136
7-5/50	Transformer, power, step down, type SA 1 phase, 450:120 VAC, 1.5 KVA, continuous duty, MIL-T-16315 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split, 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-07 C30096-3816 MS35338-46

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/51*	Fault current detector main assembly (A6) . Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	2268D100-2 C30096-3816 MS35338-46
7-5/52	Analog bus ground detector Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat, 1/4 . Washer, lock, split, 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000170 9504-08 MS27183-10 MS35338-44
7-5/53	Contactor, size 1, 27 amp, 450 VAC/60 Hz, 4 pole, 2 NO and 2 NC aux switches, 440V/60 Hz coil, MIL-C-2212 Attaching hardware: . Washer, flat, no. 10 . Washer, lock, split, no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 5/8 LG	2	27192	6957BD25-1A MS15795-808 MS35338-138 MS35650-304
7-5/54	Mechanical interlock, size 1, MIL-C-2212	1	27192	10-2468
7-5/55	Synchronizing control equipment, 450 VAC/60 Hz, MIL-S-24188 (Modified) (A1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	94080020-001 C30096-3816 MS35338-46
7-5/56	Relay, control category A, 28 VDC continuous duty, 65° ambient, shock class I, 4PDT, MIL-R-19523 (K2104, K2105, K2106, K2108, K2109, K2110, K2111, K2113, K2123, K2129, K2130, K2131, K2132, K2133, K2134, K2202, K2204, K2205, K2302, K2304, K2305) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	21	77342	MDR-135-1 9507-10 MS35338-138 MS35650-304
7-5/57	Semiconductor device, diode silicon, power rectifier, fast recovery, 600 PIV/3 amp, MIL-S-19500/411	29		JANTXIN5416
7-5/58	Relay, control, category B, 28 VDC continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K2103) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no 10-32 x 1/2 LG	1	77342	MDR-67-3 9507-10 MS35338-138 MS35650-304

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/59	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75A, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	6	03516	JNP-0 760X40G2 C30096-3816 MS35338-46
7-5/60*	Monitor, reverse power, time delay, adjustable 1-5 sec, MIL-M-24350A (Modified) (A2)	1	56425	94000090-01
7-5/60**	Module, Generator Protection, MIL-M-24350A (GPM) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	4N915	2310-701-01 9504-08 MS27183-10 MS35338-44
7-5/61	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA, with primary and secondary terminals (MIL-T-16315) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-01 C30096-3816 MS35338-46
7-5/62	Relay Assembly, MIL-R-24563 (Modified) (A3b) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000160-1 9504-08 MS27183-10 MS35338-44
7-5/63*	Relay, AC power sensing, 2 stage, time delay adjustable 0-39 sec, MIL-R-24563 (Modified) (A3a) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000140-001 9504-08 MS27183-10 MS35338-44
7-5/64	Switch, toggle, DPST, On-Off-None sealed, MIL-S-83731	6	27191	MS35059-24
7-5/65*	Isolation transformer (IT1, IT2) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	2	56425	STC-ISC-010-04 9507-10 MS35338-138 MS35650-304
7-5/66*	Resistor, fixed, wire wound (power type), style RW79, 0.144 ohm/3 watts, MIL-R-26/5 (R1, R2)	2	81349	RW79UR144F
7-5/67	Fuse clip, electrical type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8	144	71400	M21346/1-04 MS15795-807

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Washer, lock, split no. 8			MS35338-137
	. Nut, hex, no. 8-32 UNC			MS35649-284
	. Screw, mach., pan hd., no. 8-32 x 7/8 LG			
7-5/68	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F211, F212, F221, F222)	4	71400	F60C500V20A
7-5/69	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F201-F205, F207-F210, F213-F220, F223-F228, F230, F231, F234, F235)	28	71400	F60C500V6A
7-5/70	Fuse, style F60, 500 VAC, 1 amp, characteristic C, MI1-F-15160 (F229)	1	71400	F60C500V1A
7-5/71	Fuse, style F60, 500 VAC, 3 amp, characteristic C, MI1-F-15160 (F233, F236, F238-F242, F250)	8	71400	F60C500V3A
7-5/72	Fuse, style F60, 500 VAC, 1/8 amp, characteristic C, MIL-F-15160 (2F1)	1	71400	F60C500V1/8A
7-5/73	Relay, control, category A, 450 VAC, 60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K2107) Attaching hardware:	1	77342	MDR-134-2
	. Nutsert, Avdel, 10-32 UNC			9507-10
	. Washer, lock, split no. 10			MS35338-138
	. Nut, hex, no. 10-32 UNC			MS35650-304
	. Screw, mach., pan hd., no. 10-32 x 1/2 L6			
7-5/74	Relay, control category A, 28 VDC, continuous duty, 65° ambient, shock class I, 4PDT, MIL-R-19523 (K2125, K2127, K2128, K2135, K2136) Attaching hardware:	5	77342	MDR135-1
	. Nutsert, Avdel, 10-32 UNC			9507-10
	. Washer, lock, split no. 10			MS35338-138
	. Nut, hex, no. 10-32 UNC			MS35650-304
	. Screw, mach. pan hd., no. 10-32 x 1/2 LG			
7-5/75	Relay, electropneumatic timer, 115 VAC/60 Hz, continuous duty, 2PDT, time range 5-50 sec. on delay, with stops at 1-39 sec Attaching hardware:	1	98403	7012L8DSN
	. Nutsert, Avdel, 1/4-20 UNC			9504-08
	. Washer, flat 1/4			MS27183-10
	. Washer, lock, split 1/4			MS35338-44
	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG			
7-5/76	Relay, control, category B, 28 VDC continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K2201, K2301) Attaching hardware:	2	77342	MDR5035
	. Nutsert, Avdel, 1/4-20 UNC			9504-08
	. Washer, flat 1/4			MS27183-10
	. Washer, lock, split 1/4			MS35338-44
	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG			
7-5/77	Relay, control category B, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 24-PDT, MIL-R-19523 (K2101) Attaching Hardware:	1	77342	MDR141-2
	. Nutsert, Avdel, 1/4-20 UNC			9504-08

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-5/78	. Washer, flat 1/4	8	03516	MS27183-10
	. Washer, lock, split 1/4			MS35338-44
	. Bolt, hex hd., GR 5 1/4-20 x 1 LG			8360185G1S63
	Protective device, thyrite,			
7-5/79	Attaching hardware:	3	77342	MS27183-19
	. Washer, flat 1/2			MS27183-18
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS35338-48
	. Washer, lock, split 1/2			
	. Nut, hex, no. 1/2-13 UNC			
	. Bolt, hex hd., GR 5 1/2-13 x 2 1/4 LG			MDR4076
	Relay, control category B, 115 VAC/60 Hz, continuous duty,			
	65°C ambient, shock class I, 8PDT, MIL-R-19523 (K2114,			
	K2119, K2120)			
	Attaching hardware:			
. Nutsert, Avdel, 10-32 UNC	9507-10			
. Washer, lock, split no. 10	MS35338-138			
. Nut, hex, no. 10-32 UNC	MS3560-304			
. Screw, mach., pan hd., no. 10-32 x 1/2 LG				
7-5/80	Structure assembly	1	56425	90110100
7-5/81	Structure assembly	1	56425	90110101
7-5/82	Door	1	56425	90510004-001
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-5/83	Door	1	56425	90510004-010
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-5/84	Door	1	56425	90510004-040
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-5/85	Cover	1	56425	90510004-039
7-5/86	Dripshield	1	56425	90410004-018
7-5/87	Door	2	56325	90510004-049
				90510004-048
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Knee brace (right-hand)			91000001-907
. Hinge half	91000001-911			

Table 7-6A. Parts List For Switchboard 2SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Hinge half			91000001-912
	. Cotter pin			
7-5/88	Cover	1	56425	90410005-160
7-5/89	Cover	1	56425	90410005-157
7-5/90	Cover	1	56425	90410005-159
7-5/91	Door	1	56425	90510004-047
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-5/92	Cover	1	56425	90410005-25
7-5/93	Cover	1	56425	90410005-24
7-5/94	Grab handle	2	56425	91000001-901
				91000001-916
7-5/95	Thumbscrew, captive	32	56425	91000001-934
7-5/96	Cover	1	56425	90410005-158
7-5/97	Subpan	1	56425	90510004-007
7-5/98	Subpan	1	56425	90510004-011
7-5/99	Subpan	1	56425	90510004-014
7-5/100	Switch mounting plate	1	56425	90410004-019
7-5/101	Subpan	1	56425	90510004-005
7-5/102	Subpan	1	56425	90510004-006
7-5/103	Fuseboard	1	56425	91240002-009
7-5/104	Fuseboard	1	56425	90410002-001
7-5/105	Subpan	1	56425	90410005-009
7-5/106	Subpan	2	56425	90510004-012
7-5/107	Subpan	1	56425	90510004-020
7-5/108	Subpan	1	56425	90510004-010
7-5/109	Subpan	1	56425	90510004-016
7-5/110	Switch, rotary, multipole, 7.5A, 2-position, 3 decks, type S5JM3, Navy gray, oval shank knob, white pointer, blank escutcheon plate, NSN 5930-01-006-8595	1	82121	265030
	* Removed by MACHALT 320-59006 (ECP-515)			
	** Installed by MACHALT 320-59006 (ECP-515)			

Table 7-7. Parts List For Switchboard 2SA – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/1	Terminal board, molded barrier screw type class 38TB	52		MIL-T-55164/2 38TB12
	Attaching hardware:			
	. Washer, lock, split no. 8			MS35338-137
	. Screw, mach., pan hd., no. 8-32 x 3/4 LG cres			
7-6/2	Marker strip	52		MIL-T-55164/2 38TB12Z

Table 7-7. Parts List For Switchboard 2SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/3	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 400TM trip element, 450 VAC/60 Hz UV trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB2201-CB2212)	12	30086	ETN690920U06 MOD
7-6/4	Motor operator, 115 VAC/60 Hz, MIL-C-17361	12	30086	ETN6797
7-6/5	Mounting block, switchboard type, MIL-C-17361D	24	30086	ETN6743
7-6/6	Lens, indicator light, style LC40, white translucent plastic (DS3, DS6, DS9, DS12, DS15, DS18, DS21, DS24, DS27, DS30, DS33, DS36, DS37)	13	56694	MIL-L-3661/54 LC40WT3
7-6/7	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	78	56694	MS15612-3
7-6/8	Landholder, lights, indicator (housing), style 98, 115 VAC, w/o lamps	36	56694	MIL-L-3661/65 LH98-3
7-6/9	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-8000A, INST-None, time band 2, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB2221)	1	30086	
7-6/10	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	30086	
7-6/11	Relay, control category B 28 VDC continuous duty 65°C ambient, shock class I, 16PDT, MIL-R-19523 (KI) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	77342	MDR172-1 9504-08 MS27183-10 MS35338-44
7-6/12	Semiconductor device, diode, power rectifier, fast recovery, 100 VDC, 3 amp, MIL-S-19500/411	1		JANTXIN5416
7-6/13	Relay, control, category B, 450 VAC/60 Hz, continuous duty, 60°C ambient, shock class I, 16PDT, MIL-R-19523 (K3A) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	77342	MDR170-2 9504-08 MS27183-10 MS35338-44
7-6/14	Relay, control, category A, 115 VAC/60 Hz, continuous duty, 60°C ambient, shock class I, 4PDT, MIL-R-19523 (1K4, 2K4, 3K4, 4K4, 5K4, 6K4, 7K4, 8K4, 9K4, 10K4, 11K4, 12K4) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	12	77342	MDR131-1 9507-10 MS35338-138 MS35650-304
7-6/15	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315 Attaching hardware:	13	56425	STD-ISC-010-01

Table 7-7. Parts List For Switchboard 2SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/16	. Nut, cage, 3/8-16 UNC (.250 thick pnl)	12	56425	C30096-3816
	. Washer, lock, split 3/8			MS35338-46
	. Nut, hex, no. 3/8-16 UNC			
	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			
	Relay, overcurrent, shore power monitor, 115 VAC/60 Hz, CT rated, CT ratio 800:5 amp, automatic reset MIL-I-1361			94000150-001
7-6/17	Attaching hardware:	1	27191	
	. Nutsert, Avdel, 10-32 UNC			9507-10
	. Washer, lock, split no. 10			MS35338-138
	. Nut, hex, no. 10-32 UNC			MS35650-304
	. Screw, mach., pan hd., no. 10-32 x 3/4 LG			
7-6/18	Switch, toggle, DPST, On-Off-None sealed, MIL-S-83731 (S39)	1	27191	MS35059-24
7-6/19	Switch, toggle 4PST, On-Off-None sealed, MIL-S-83731 (S40)	1	27191	MS25068-24
7-6/20	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361	2	03516	JNP-0 760X40G2
	Attaching hardware:			
	. Nut, cage, 3/8-16 UNC (.250 thick pnl)			C30096-3816
	. Washer, lock, split 3/8			MS35338-46
	. Nut, hex, no. 3/8-16 UNC			
7-6/21	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56694	
	Lens, indicator light, style LC40, amber translucent plastic (DS1, DS4, DS7, DS10, DS13, DS16, DS19, DS22, DS25, DS28, DS31, DS34)			MIL-L-3661/54 LC40AN3
	Lens, indicator light, style LC40 blue translucent plastic (DS2, DS4, DS8, DS11, DS14, DS17, DS20, DS23, DS26, DS29, DS32, DS25)			MIL-L-3661/54 LC40BN3
	Indicator, phase sequence, 4-1/2 inch square flange, 450 VAC/60 Hz, MIL-I-16103 (M9)			MR4SW4ACPHS
	Switch, meter & control, type 24G, class 2, 8-position, 2-section, maintained, 500 VAC, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-18396 (S28A, S28B)			2
7-6/24	Lampholder, lights indicator (housing) style 98, w/o lamps	3	56694	MIL-L-3661/65 LH98-4
7-6/25	Switch, rotary, meter & control type 24G class 2, 3-position, 2-section, spring return to center with Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-21604 (S4)	1	82121	74202J-001
7-6/26	Fuseholder, extractor post type blown fuse indicating type FHL12U	60	71400	MIL-F-19207/3 FHL12U
7-6/27	Fuse, style F60, 500 VAC, 10 amp, characteristic C, MIL-F-15160 (1F5, 2F5, 3F5, 4F5, 6F5, 7F5, 8F5, 9F5, 10F5, 11F5, 12F5, F260)	13	71400	F60C500V10 A
7-6/28	Fuse, style F60, 500 VAC, 2 amp, characteristic C, MIL-F-5160 (1F4, 2F4, 3F4, 4F4, 5F4, 6F4, 7F4, 8F4, 9F4, 10F4, 11F4, 12F4)	12	71400	F60C500V2A

Table 7-7. Parts List For Switchboard 2SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/29	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (1F1, 1F2, 1F3, 2F1, 2F2, 2F3, 3F1, 3F2, 3F3, 4F1, 4F2, 4F3, 5F1, 5F2, 5F3, 6F1, 6F2, 6F3, 7F1, 7F2, 7F3, 8F1, 8F2, 8F3, 9F1, 9F2, 9F3, 10F1, 10F2, 10F3, 11F1, 11F2, 11F3, 12F1, 12F2, 12F3, F7, F8, F242, F257, F258, F253-F256, F263-F267)	49	71400	F60C500V6A
7-6/30	Switch, rotary, selector, 10 amp, type S3JR2, 4-position, 2-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (section 2 is make-before-break), MIL-S-21604 (S26)	1	82121	23902LJ
7-6/31	Switch, meter & control, type 24G, class 2, 8-position, 4-section, maintained, 500 VAC, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-18396 (S27A, S27B)	2	82121	24304G
7-6/32	Switch, rotary, multipole, 10 amp, type S2JRM8, 3-position, 8-section, spring return to center with Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-21604 (S11)	1	82121	71208LB
7-6/33	Ammeter, AC, 4-1/2 inch, 250° scale 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M10)	1	15309	MR49006ACKAH
7-6/34	Lens, indicator light, style LC40 green LC40 green translucent plastic (DS38, DS39)	2	56694	MIL-L-3661/54 LC40GN
7-6/35	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	6		JCB-0 827X71 MS27183-15 MS35338-46
7-6/36	Transformer, current, 800:5 amp, 60 Hz, accuracy GU 5VA, MIL-I-1361 Attaching Hardware: . Nut, cage 3 8/-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	12	03516	JNH-0 C30096-3816 MS35338-46
7-6/37	Disconnect link	3	56425	94000037-001
7-6/38	Capacitor diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock, split 1/4 . Nut, hex, no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MS35338-44
7-6/39	Protective device, thyrite (dwg. 671A905), 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 1/2 . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	1	03516	8360185G1S63 MS27183-19 MS35338-48

Table 7-7. Parts List For Switchboard 2SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/40	Relay, electropneumatic timer, 450 VAC/60 Hz, continuous duty, 2PDT, time range 0.1-1.0 sec on duty, MIL-C-2212 (K3) Attaching hardware: . Nutsert, Avdel, 8-32 UNC . Washer, flat, no. 8 . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 1/2 LG cres	1	98403	7012L10AN 9505-08 MS15795-807 MS35338-137
7-6/41	Fuse clip, electrical type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	40	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-6/42	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F251, F252)	2	71400	F60C500V20A
7-6/43	Fuse, style F60, 500 VAC, 3 amp, characteristic C, MIL-F-15160 (F237)	1	71400	F60C500V3A
7-6/44	Fuse, style F60, 500 VAC, 5 amp, characteristic C, MIL-F-15160 (F259)	1	71400	F60C500V5A
7-6/45	Structure assembly	1	56425	9011011 6
7-6/46	Structure assembly	1	56425	90110115
7-6/47	Structure assembly	1	56425	90110101
7-6/48	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-035 91000001-907 91000001-911 91000001-912
7-6/49	Door Attaching hardware: . Knee brace (right-hand) . Hinge half . Hinge half . Cotter pin	2	56425	90510004-038 91000001-907 91000001-911 91000001-912
7-6/50	Door	1	56425	90510004-003
7-6/51	Dripshield	1	56425	90510004-037
7-6/52	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-041 91000001-907 91000001-911 91000001-912
7-6/53	Cover	1	56425	90510004-039
7-6/54	Grab handle	3	56425	91000001-901 91000001-916
7-6/55	Thumbscrew, captive	38	56425	91000001-934

Table 7-7. Parts List For Switchboard 2SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/56	Subpan	1	56425	90510004-026
7-6/57	Subpan	1	56425	90510004-028
7-6/58	Subpan	1	56425	90510004-031
7-6/59	Switch mounting plate	1	56425	90510004-19
7-6/60	Cover	1	56425	90410005-021
7-6/61	Cover	1	56425	90410005-020
7-6/62	Door	1	56425	90410005-034
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-6/63	Cover	1	56425	90410005-019
7-6/64	Cover	1	56425	90410005-023
7-6/65	Cover	1	56425	90410005-022
7-6/66	Cover	1	56425	90410005-018
7-6/67	Subpan	1	56425	90510004-030
7-6/68	Subpan	1	56425	90410005-009
7-6/69	Fuseboard	1		91240002-009
7-6/70	Subpan	1	56425	90510004-029
7-6/71	Subpan	1	56425	90510004-027
7-6/72	Subpan	1	56425	90510004-032
7-6/73	Subpan	1	56425	90510004-033
7-6/74	Switch, toggle, DPST On-Off-None sealed, MIL-S-83731	2	27191	MS35059-24
7-6/75	Protective device, thyrite, MIL-I-1361 (PD5, PD6)	2	03516	8360185G1S63
	Attaching hardware:			
	. Washer, flat 1/2			MS27183-19
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS27183-18
	. Washer, lock split 1/2			MS3533S-48
	. Nut, hex, no. 1/2-13 UNC			
	. Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG			

Table 7-7A. Parts List For Switchboard 2SA – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/1	Terminal board, molded barrier screw type, class 38TB	52		MIL-T-55164/2 38TB12
	Attaching hardware:			
	. Washer, lock, split no. 8			MS35338-137
	. Screw, mach., pan hd., no. 8-32 x 3/4 LG cres			
7-6/2	Marker strip	52		MIL-T-55164/2 38TB12Z
7-6/3	Circuit breaker, type AQB-LL400, 500 VAC, 60 Hz, 3 pole, back connected, 450 VAC/60 Hz UV trip with 2 aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361E (CB2201-CB2212)	12	89946	1241C34G0E

Table 7-7A. Parts List For Switchboard 2SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	400QS trip element	12	89946	1230C84G04
7-6/4	Motor operator 115 VAC/60 Hz, MXL-C-17361E	12	89946	1234C53G01
7-6/5	Mounting block, AQB-LL400 Circuit Breaker 3 pole (MIL-C-17361F)	24	89946	1230C81G01
7-6/6	Lens, indicator light style LC40, white translucent plastic (DS3, DS6, DS9, DS12, DS15, DS18, DS21, DS24, DS27, DS30, DS33, DS36, DS37)	13	56694	MIL-L-3661/54 LC40WT3
7-6/7	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	78	56694	MS15612-3
7-6/8	Lampholder, lights indicator (housing), style 98, 115/VAC, w/o lamps	36	56694	MIL-L-3661/65 LH98-3
7-6/9	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, Coil-4000A, LTD-6000A, STD-8000A, INST-None, Time ST delay 0.2 sec, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB2221)	1	39805	4294026-7
7-6/10	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	39805	4294006-1
7-6/11	Relay, control, category B, 28 VDC continuous duty, 65° ambient, shock class, MIL-R-19523 (K1) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5 1/4-20 x 1 LG	1	77342	MDR172-1 9504-08 MS27183-10 MS35338-44
7-6/12	Semiconductor device, diode, fast recovery, 100 VDC, 3 amp, MIL-S-19500/411	1		JANTXIN5416
7-6/13	Relay, control, category B, 450 VAC/60 Hz, continuous duty, 60°C ambient, shock class I, 16PDT, MIL-R-19523 (K3A) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5 1/4-20 x 1 LG	1	77342	MDR170-2 9504-08 MS27183-10 MS35338-44
7-6/14	Relay, control, category A, 115 VAC/60 Hz, continuous duty, 60°C ambient, shock class I, 4PDT, MIL-R-19523 (1K4, 2K4, 3K4, 4K4, 5K4, 6K4, 7K4, 8K4, 9K4, 10K4, 11K4, 12K4) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	12	77342	MDR131-1 9507-10 MS35338-138 MS35650-304
7-6/15	Transformer, power, step down, type SA 450:115 VAC, 5 KVA with primary and secondary terminals, MIL-T-16315 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8	13	56425	STD-ISC-010-01 C30096-3816 MS35338-46

Table 7-7A. Parts List For Switchboard 2SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/16	. Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG Relay, overcurrent, shore power monitor, 115 VAC/60 Hz, CT ratio 800:5 amp, automatic reset, MIL-I-1361 Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no, 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 3/4 LG	12	56425	94000150-001 9507-10 MS35338-138 MS35650-304
7-6/17	Switch, toggle, DPST, On-Off-None, sealed, MIL-S-83731 (S39)	1	27191	MS35059-24
7-6/18	Switch, toggle 4PST, ON-Off-None, sealed, MIL-S-83731 (S40)	1	27191	MS25068-24
7-6/19	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5 3/8-16 x 1-1/4 LG	2	03516	JNP-0 760X40 G2 C30096-3816 MS35338-46
7-6/20	Lens, indicator light, style LC40, amber translucent plastic (DS1, DS4, DS7, DS10, DS13, DS16, DS19, DS22, DS25, DS28, DS31, DS34)	1	56694	MIL-L-3661/54 LC40AN3
7-6/21	Lens, indicator light, style LC40 blue translucent plastic (DS2, DS4, DS8, DS11, DS14, DS17, DS20, DS23, DS25, DS26, DS29, DS32)	24	89946	1230C81G01 LC40BN3
7-6/22	Indicator, phase sequence, 4-1/2 inch square flange, 450 VAC/60 Hz, MIL-I-16103 (M9)			MR4SW4ACPHS
7-6/23	Switch, meter & control, type 24G, class 2, 8-position, 2-section, maintained, 500 VAC, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-18396 (S28A, S28B)	2	82121	24302G
7-6/24	Lampholder, lights indicator (housing), style 98, 115/VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98-4
7-6/25	Switch, rotary, meter & control, type 24G, class 2, 3-position, 2-section, spring return to center with Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-21604	1	82121	74202J
7-6/26	Fuseholder, extractor, post type, blown indicating type, FHL12U	60	71400	MIL-F-19207/3 FHL12U
7-6/27	Fuse, style F60, 500 VAC, 10 amp, characteristic C, MIL-F-15160 (1F5, 2F5, 3F5, 4F5, 6F5, 7F5, 8F5, 9F5, 10F5, 11F5, 12F5, F260)	13	71400	F60C500V10A
7-6/28	Fuse, style F60, 500 VAC, 2 amp, characteristic C, MIL-F-5160 (1F4, 2F4, 3F4, 4F4, 5F4, 6F4, 7F4, 8F4, 9F4, 10F4, 11F4, 12F4)	12	71400	F60C500V2A
7-6/29	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (1F1, 1F2, 1F3, 2F1, 2F2, 2F3, 3F1, 3F2, 3F3, 4F1, 4F2, 4F3, 5F1, 5F2, 5F3, 6F1, 6F2, 6F3, 7F1, 7F2, 7F3, 8F1, 8F2, 8F3, 9F1, 9F2, 9F3, 10F1, 10F2, 10F3, 11F1, 11F2, 11F3, 12F1, 12F2, 12F3, F7, F8, F242, F257, F258, F253-F256, F263-F267)	49	71400	F60C500V6A

Table 7-7A. Parts List For Switchboard 2SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/30	Switch, rotary, selector, 10 amp, type S3JR2, 4-position, 2-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (section 2 is make-before-break), MIL-S-21604 (S26)	1	82121	23902LJ
7-6/31	Switch, meter & control, type 24G, class 2, 8-position, 4-section, maintained, 500 VAC, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-18396 (S27A, S27B)	2	82121	24304G
7-6/32	Switch, rotary, multipole, 10 amp, type S2JRM8, 3-position, 8-section, spring return to center with Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-21604 (S11)	1	82121	71208LB
7-6/33	Ammeter, AC, 4-1/2 inch, 250° scale 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M10)	1	15309	MR49006ACKAH
7-6/34	Lens, indicator light, style LC40, green translucent plastic (DS38, DS39)	2	56694	MIL-L-3661/54 LC40GN3
7-6/35	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no, 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	6		JCB-0 827X71 MS27183-15 MS35338-46
7-6/36	Transformer, current, 800:5 amp, 60 Hz, accuracy GU 5VA, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5 3/8-16 x 1-1/4 LG	12	03516	JNH-0 C30096-3816 MS35338-46
7-6/37	Disconnect link	3	56425	94000037-001
7-6/38	Capacitor diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock, split 1/4 . Nut, hex, no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MS35338-44
7-6/39	Protective device, thyrite (dwg. 671A905), 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 1/2 . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5 1/2-13 x 2-1/4 LG	1	03516	8360185G1S63 MS27183-1 MS35338-48
7-6/40	Relay, electropneumatic timer, 450 VAC/60 Hz, continuous duty, 2PDT, time range 0.1-1.0 on delay, MIL-C-2212 (K3) Attaching hardware: . Nutsert, Avdel, 8-32 UNC . Washer, flat, no. 8 . Washer, lock, split no. 8	1	98403	7012L10AN 9505-08 MS15795-807 MS35338-137

Table 7-7A. Parts List For Switchboard 2SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-6/41	. Screw, mach., pan hd., no. 8-32 x 1/2 LG cres Fuse clip, electrical, type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	40	71400	M21346/1-40 MS15795-807 MS35338-137 MS35649-284
7-6/42	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F251, F252)	2	71400	F60C500V20
7-6/43	Fuse, style F60 500 VAC, 3 amp, characteristic C, MIL-F-15160 (F237)		71400	F60C500V3A
7-6/44	Fuse, style F60, 500 VAC, 5 amp, characteristic, MIL-F-15160 (F259)	1	71400	F60C500V5A
7-6/45	Structure assembly	1	56425	90110116
7-6/46	Structure assembly	1	56425	90110115
7-6/47	Structure assembly	1	56425	90110101
7-6/48	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-035 91000001-907 91000001-911 91000001-912
7-6/49	Door Attaching hardware: . Knee brace (right-hand) . Hinge half . Hinge half . Cotter pin	2	56425	90510004-038 91000001-907 91000001-911 91000001-912
7-6/50	Door	1	56425	90510004-003
7-6/51	Dripshield	1	56425	90510004-037
7-6/52	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-041 91000001-907 91000001-911 91000001-912
7-6/53	Cover	1	56425	90510004-039
7-6/54	Grab handle	3	56425	91000001-901
7-6/55	Thumbscrew, captive	38	56425	91000001-934
7-6/56	Subpan	1	56425	90510004-026
7-6/57	Subpan	1	56425	90510004-028
7-6/58	Subpan	1	56425	90510004-031
7-6/59	Switch mounting plate	1	56425	90510004-19
7-6/60	Cover	1	56425	90410005-021
7-6/61	Cover	1	56425	90410005-020
7-6/62	Door	1	56425	90410005-034

Table 7-7A. Parts List For Switchboard 2SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	Attaching hardware: . Knee brace (right-hand) . Hinge half . Hinge half . Cotter pin			91000001-907 91000001-911 91000001-912
7-6/63	Cover	1	56425	90410005-019
7-6/64	Cover	1	56425	90410005-023
7-6/65	Cover	1	56425	90410005-022
7-6/66	Cover	1	56425	90410005-018
7-6/67	Subpan	1	56425	90510004-030
7-6/68	Subpan	1	56425	90410005-009
7-6/69	Fuseboard	1		91240002-009
7-6/70	Subpan	1	56425	90510004-029
7-6/71	Subpan	1	56425	90510004-027
7-6/72	Subpan	1	56425	90510004-032
7-6/73	Subpan	1	56425	90510004-033

Table 7-8. Parts List For Switchboard 2SB

Figure/ Index No	Description	Qty	CAGE	Part No.
7-7/1	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole 450V/60 Hz closing coil, 115V/60 Hz control relay and shunt trip, wired per dwg. 7122728, Coil-4000A, LTD-6000A, STD-8000A, INST-none, time band 2, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB2323)	1	30086	
DDG 52 -54	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450V/60 Hz closing coil, 115V/60 Hz control relay and shunt trip, Coil-4000A, LTD-6000A, STD-8000A, INST-none, time ST delay 0.2 sec, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB2323)	1	39805	4294026-7
7-7/2	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	30086	
DDG 52 -54	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	39805	4294006-1
7-7/3	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	2	03516	JNP-0 C30096-3816 MS35338-46
7-7/4	Transformer, power, step down, type SA 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl)	1	56425	STD-ISC-010-01 C30096-3816

Table 7-8. Parts List For Switchboard 2SB - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Washer, lock, split 3/8			MS35338-46
	. Nut, hex, no. 3/8-16 UNC			
	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			
7-7/5	Capacitor, diode device (A7)	1	56425	22680140-1
	Attaching hardware:			
	. Washer, flat 1/4			MS27183-10
	. Washer, lock, split 1/4			MS35338-44
	. Nut, hex, no. 1/4-20 UNC			
	. Screw, mach., pan hd., 1/4-20 x 1 LG			
7-7/6	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA	2		JCB-0
	Attaching hardware:			
	. Washer, flat 3/8			MS27183-15
	. Washer, lock, split 3/8			MS35338-46
	. Nut, hex, no. 3/8-16 UNC			
	. Bolt, hex hd., GHR 5, 3/8-16 x 4 LG			
7-7/7	Fuse clip, electrical, type FC21CF	30	71400	M21346/1-04
	Attaching hardware:			
	. Washer, flat no. 8			MS15795-807
	. Washer, lock, split no			MS35338-137
	. Nut, hex, no. 8-32 UNC			MS35649-284
	. Screw, mach., pan hd., no. 8-32 x 7/8 LG			
7-7/8	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F283-F288, F293-F297)	11	71400	F60C500V6A
7-7/9	Fuse, Style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160	2	71400	F60C50020A
7-7/10	Terminal board, molded barrier screw type, class 38TB	9		MIL-T-55164/2 38TB12
	Attaching hardware:			
	. Washer, lock, split no. 8			MS35338-137
	. Screw, mach., pan hd., no. 8-32 x 3/4 LG cres			
7-7/11	Marker strip	9		MIL-T-55164/2 38TB12Z
7-7/12	Structure assembly	1	56425	90110116
7-7/13	Door	1	56425	90510004-041
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-7/14	Cover	1	56425	90510004-039
7-7/15	Thumbscrew, captive	18	56425	91000001-934
7-7/16	Grab handle	1	56425	91000001-901
				91000001-916
7-7/17	Dripshield	1		90510004-131
7-7/18	Door	2	56425	90510004-044
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907

Table 7-8. Parts List For Switchboard 2SB - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-7/19	Cover	1	56425	90410005-19
7-7/20	Cover	1	56425	90410005-20
7-7/21	Fuseboard	1	56425	91240002-009
7-7/22	Subpan	1	56425	90410005-090
7-7/23	Subpan	1	56425	90410005-009
7-7/24	Switch, toggle, DPST, On-Off-None, sealed, MIL-S-83731	2	27191	MS35059-24
7-7/25	Protective device, thyrite, MIL-I-1361 (PD7, PD8)	2	03516	8360185G1S63
	Attaching hardware:			
	. Washer, flat 1/2			MS27183-19
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS27183-18
	. Washer, lock, split 1/2			MS35338-48
	. Nut, hex, no. 1/2-13 UNC			
	. Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG			

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/1	Lamp, incandescent, 6 volt, type T-1 3/4, midget screwbase, W-L-111	6	56694	MS15612-5
7-8/2	Lampholder, lights indicator (housing), Style 95, 28 VDC, w/o lamps	3	56694	MIL-L-3661/62 LH95
7-8/3	Lens, indicator light, style LC40, red translucent plastic (DS30)	1	56694	MIL-L-3661/54 LH40EN3
7-8/4	Ammeter, AC, 4-1/2 inch, 250° scale 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M1, M2)	2	15309	MR49W006ACKAH
7-8/5	Wattmeter, AC, 4-1/2 inch, 250° scale, 0-5000 KW, 60 Hz, PT ratio 450:115 VAC, CT ratio 6,000:5 amp, MIL-W-19088 (M8)	1	15309	MR492W005ACGWH
7-8/6	Meter, temperature, selective, manual readout, remote, 115 VAC/60 Hz, platinum RTE, 0-200°C, 4-1/2 inch, 250° scale meter in accordance with MIL-M-16034, MIL-T-15377 (M3)	1	15309	4951-366
7-8/7	Lens, indicator light, style LC40, green translucent plastic (DS33, DS34, DS37, DS38)	4	56694	MIL-L-3661/54 LC40GN3
7-8/8	Switch, rotary, selector, 10 amp, type S3JR3, 5-position, 3-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (sections 2 and 3 are make-before-break), MIL-5-21604 (S18)	1	82121	23303LN
7-8/9	Switch, pushbutton, momentary action, 2 NO contacts, MIL-C-2212 (PB3102)	1	02989	Type 1C5845 572921G23
7-8/10	Switch, pushbutton, momentary action, 1 NO and 1 NC contact, MIL-C2212 (PB3101, PB3103)	2	02989	Type 1C5845 5729215G1
7-8/11	Lampholder, lights indicator (housing), style 98, 115 VAC, w/o lamps	40	56694	MIL-L-3661/65 LH98-3

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/12	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	86	56694	MS15612-3
7-8/13	Lens, indicator light, style LC40, amber translucent plastic (DS4, DS6, DS8, DS10, DS12, DS14, DS16, DS18, D520, DS32, DS35, DS36, DS39, DS40, DS41, DS44, DS49)	16	56694	MIL-L-3661/54 LC40AN3
7-8/14	Lens, indicator light, style LC40, white translucent plastic (DS22 -DS25, DS29, DS31, DS42, DS43, DS48)	8	56694	MIL-L-3661/54 LC40WT3
7-8/15	Switch, rotary, multipole, 10 amp, type S2JR1, 2-position, 1-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S21, S31)	2	82121	23201LG
7-8/16	Switch, rotary, multipole, 10 amp, type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, round knob, white pointer, blank escutcheon plate, MIL-S-21604 (S16, S20)	2	82121	71201LP
7-8/17	Voltmeter, AC, 4-1/2 inch, 250° scale 0-600 VAC, 60 Hz, PT ratio 450:115 VAC, MIL-M-16034 (M4, M5)	2	15309	MR49W600ACVVH
7-8/18	Switch, rotary, multipole, 10 amp, type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S14, S15)	2	82121	71201LN
7-8/19	Switch, rotary, selector, 10 amp, type S3JR6, 3-position, 6-section, maintained, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S13)	1	82121	23306LT
7-8/20	Lens, indicator light, style LC40, blue translucent plastic (DS5, DS7, DS9, DS11, DS13, DS15, DS17, DS19, DS21, DS45)	10	56694	MIL-L-3661/54 LG40BN3
7-8/21	Switch, rotary, meter & control, type 24G, class 2, 4PDT, spring return to center (Off) position, 500 VAC, Navy gray, pistol grip handle, white pointer, MIL-5-18396 (S1-S6)	6	82121	742026
7-8/22	Test block with cover, type PK2, 4 pole (2 current and 2 potential), (J1-J2)	2	71669	6422120G4
7-8/23	Test plug with 4 pole, type PK2	2	71669	6129533G1
7-8/24	Links, test plug	2	71669	V2453076
7-8/25	Switch, rotary, multipole, 10 amp, type S2JRM2, 3-position, 2-section, spring return to center with Navy gray, pistol grip handle, white pointer, MIL-S-21604 (S7-S10)	4	82121	71202LS
7-8/26	Switch, rotary, multipole, 7.5 amp, type S5JM9, 2-position, 9-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S24)	1	82121	26509LC
7-8/27	Switch, rotary, meter & control, type 24G, class 2, 2PST (Off-On), spring return to center (Off), 500 VAC, Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-18396 (S25)	1	82121	74201J-003
7-8/28	Switch, rotary, multipole, 10 amp, type 3-position, 3-section, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate (S22)	1	82121	71203MA
7-8/29	Lampholder, lights indicator (housing), style 98, 450 VAC, w/o lamps	3	56694	MIL-L-3661/65
7-8/30	Lens, indicator light, style LC40, clear colorless plastic (DS1, DS2, DS26-DS28)	1	82121	71304LH

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/31	Switch, rotary, meter & control, type 24G, class 2, 4-position, 4-section, spring return from extreme left & right positions, maintained in 315° & 360° positions, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-18396 (S8)	1	82121	71304LH
7-8/32	Switch, rotary, selector, 10 amp, type S3JR8, 4-position, 8-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S19)	1	82121	23904LJ
7-8/33	Switch, rotary, meter & control, type 24G, class 2, 4-position, 4-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (section 3-4/ammeter circuit (MBB), section 1-3/voltmeter circuit), MIL-S-18396 (S17)	1	82121	23904LJ
7-8/34	Synchroscope, 4-1/2 inch, 360° scale, slow-fast, 115 VAC/60 Hz, MIL-I-16104 (M11)	1		MR4SW060SYH
7-8/35	Meter, electrical, frequency, 4-1/2 inch, 250° scale, 55-65Hz, 115 VAC (self-contained), MIL-M-16125 (M6, M7)	2		MR49W60BH
7-8/36	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 15I trip element (inst. only), MIL-C-17361D (CB3101)	1	30086	ETN2760
7-8/37	Mounting base, fuse unit, back connected, MIL-C-17361D	1	30086	ETN2767
7-8/38	Mounting base, fuse unit, back connected, MIL-C-17361D	1	30086	ETN2787
7-8/39	Fuse unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	1	30086	ETN2790
7-8/40	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450V/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-10000A, INST-48000A, time band 3, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3130)	1	30086	
7-8/41	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	30086	
7-8/42	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB3102, CB3103)	2	30086	ETN5310
7-8/43	Mounting block, switchboard type, MIL-C-17361D	4	30086	ETNS31 4
7-8/44	Terminal, casualty power receptacle type, back connected, 200 amp, 450 VAC/60 Hz, MIL-T-24552 (2E2, 2E3) Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	2		M24552/1-001
7-8/45	Terminal, casualty power seal	2		M24552/3-001
7-8/46	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC	4		JCB-0 827X71
				MS27183-19 MS27183-18 MS35338-48 MS27183-15 MS35338-46

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/47	. Bolt, hex hd., GR 5, 3/8-16 x 4 LG Terminal board, molded barrier screw type, class 38TB Attaching hardware: . Washer, lock, split no. 8	62		MIL-T-55164/2 38TB12 MS35338-137
7-8/48	. Screw, mach., pan hd., no. 8-32 x 3/4 LG cres Marker strip	62		MIL-T-55164/2 38TB12Z
7-8/49	Relay, control, category A, 28 VDC, continuous duty, 60°C ambi- ent, shock class I, 4PDT, MIL-R-19523 (K3104-K3106, K3108- K3111, K3113, K3116, K3123, K3129, K3030, K3133, K3134, K3202, K3204, K3205, K3402, K3404, K3405) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no, 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	20	77342	MDR135-1 9507-10 MS35338-138 MS35650-304
7-8/50	Semiconductor device, diode silicon, power rectifier, fast recov- ery, 600 PIV/3 amp, MIL-S-19500/411	40		JANTXIN5416
7-8/51	Synchronizing control equipment, 450 VAC/60 Hz, MIL-S-34188 (Modified) (A1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	94080020-001 C30096-3816 MS35338-46
7-8/52	Contactor, size 1, 27 amp, 450 VAC/60 Hz, 4 pole, 2 NO and 2 NC aux switches, 440V/60 Hz coil, MIL-C-2212 Attaching hardware: . Washer, flat no. 10 . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 1-32 x 5/8 LG	2	27192	6957ED25-1A MS15795-808 MS35338-138 MS35650-304
7-8/53	Mechanical interlock, size 1, MIL-C-2212	1	27192	10-2468
7-8/54	Analog bus ground detector (A5) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000170 9504-08 MS27183-10 MS35338-44
7-8/55*	Fault current detector main assembly (A6) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	2268D100-2 C30096-3816 MS35338-46
7-8/56	Transformer, power, step down, type SA, 1 phase, 450:120 VAC, 1.5 KVA, continuous duty, MIL-T-16315 (T2)	1	56425	STD-ISC-010-07

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/57*	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	C30096-3816 MS35338-46
	Turbine RPM detector assembly			2680150-5-1
7-8/58	Attaching hardware: . Nutsert, Avdel, 6-32 UNC . Washer, flat no. 6 . Washer, lock, split no. 6 . Screw, mach., pn hd., no. 6-32 x 5/8 LG	2	27191	MS15795-805 MS35338-136
	Switch, toggle, DPST, On-Off-None sealed, MIL-S-83731			MS35059-24
7-8/59*	Relay, AC power sensing, 2 state time delay, adjustable 0-39 sec., MIL-R-24563 (Modified) (A3a)	1	4N915	2170-105-03
7-8/60	Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	54625	9504-08 MS 27183-10 MS35338-44
	Relay assembly, MIL-R-24563 (Modified)(A3b)			94000160-1
7-8/61	Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5 1/4-20 x 1 LG	1	56425	9504-08 MS27183-10 MS35338-44
	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315 (T1)			STD-ISC-01001
7-8/62*	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5 3/8-16 x 1-1/4 LG	1	4N915	C30096-3816 MS35338-46
	Monitor, reverse power, time delay, adjustable 1-5 sec, MIL-M-24350A (Modified) (A2)			2185-101-03
7-8/62**	Module, Generator Protection, MIL-M-24350A (GPM)	1	4N915	2310-701-01
7-8/63	Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	6	03516	9504-08 MS27183-10 MS35338-44
	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 (PT1-6)			JNP-0 760X4G2
	Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC			C30096-3816 MS35338-46

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/64	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG Fuse clip, electrical, type FC21CF Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach. pan hd., no. 8-32 x 7/8 LG	144	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-8/65	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F311, F312, F321, F322)	4	71400	F60C500V20 A
7-8/66	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F301-310, F313-F320, F325, F331, F334, F335)	26	71400	P60C500V6A
7-8/67	Fuse, style F60, 500 VAC, 3 amp, characteristic C, MIL-F-15160 (F333, F336, F337, F339-F341, F348, F349, F350, F352)	10	71400	F60C500V3A
7-8/68	Fuse, style F60, 500 VAC, 1 amp, characteristic C, MIL-F-15160 (F329)	1	71400	F60C500V1A
7-8/69	Fuse, style F60, 500 VAC, 10 amp, characteristic C, MIL-F-15160 (F323, F324, F342, F347)	8	71400	F60C500V10A
7-8/70	Fuse, style F60, 500 VAC, 1/8 amp, characteristic C, MIL-F-15160 (3F1)	1	71400	F60C500V1/8A
7-8/71	Relay, control, category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K3117, K3118, K3125, K3127, K3128, K3135) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	1	77342	MDR131-1 9507-10 MS35338-138 MS35650-304
7-8/72	Relay, control, category B, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 24PDT, MIL-R-19523 (K3101) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	77342	M0R141-2 9504-08 MS27183-10 MS35338-4
7-8/73	Relay, control, category B, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 24PDT, MIL-R-19523 (K3101) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	4	77342	MDR134-1 9507-10 MS35338-138 MS35650-304
7-8/74	Relay, control, category B, 28 VDC continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K3103) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	1	77342	MDR-67-3 9507-10 MS35338-138 MS35650-304

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/75	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category A, 28 VDC, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K3112, K3115, K3131, K3132) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	4	77342	MDR136-1 9507-10 MS35338-138 MS35650-304
7-8/76	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category B, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K3214, K3419, K3120) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	3	77342	MDR4076 9507-10 MS35338-138 MS35650-304
7-8/77	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category B, 28 VDC continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-195-23 (K3201, K3401) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	2	77342	MDR5035 9507-10 MS35338-138 MS35650-304
7-8/78	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category A, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class 1, 8PDT, MIL-R-19523 (K3107) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	1	77342	MDR-134-2 9507-10 MS35338-138 MS35650-304
7-8/79	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Protective device, thyrite, MIL-I-1361 (PD1-PD8) Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	8	03516	8360185G1S63 MS27183-19 MS27183-18 MS35338-48
7-8/80	Disconnect link	3	36425	94000037-001
7-8/81*	Isolation transformer (IT1, IT2) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC	2	56425	STD-ISC-010-04 9507-10 MS35338-138 MSS5650-304
7-8/82*	. Screw, mach., pan hd., no. 10-32 x 1/2 LG Resistor, fixed, wire wound, (power type), style R79, 0.144 ohm/3 watts, MIL-R-26/5 (R1, R2)	2	81349	RW79UR144F

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/83	Structure assembly	1	56425	90110100
7-8/84	Structure assembly	1	56425	90110101
7-8/85	Door	1	56425	90510004-001
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/86	Door	1	56425	90510004-002
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/87	Door	1	56425	90510004-040
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/88	Cover	1	56425	90510004-039
7-8/89	Cover	1	56425	90410005-027
7-8/90	Cover	1	56425	90410005-028
7-8/91	Cover	1	56425	90410005-029
7-8/93	Door	1	56425	90510004-048
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/94	Door	1	56425	90510004-047
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/95	Cover	1	56425	90410005-025
7-8/96	Cover	1	56425	90410005-024
7-8/97	Dripshield	1	56425	90510004-018
7-8/98	Grab handle	2	56425	91000001-901
				91000001-916
7-8/99	Thumbscrew, captive	35	56425	91000001-934
7-8/100	Subpan	1	56425	90510004-007
7-8/101	Subpan	1	56425	90510004-011
7-8/102	Switch mounting plate	1	56425	90510004-019
7-8/103	Subpan	1	56425	90510004-014

Table 7-9. Parts List For Switchboard 3SG – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/104	Subpan	1	56425	90510004-005
7-8/105	Subpan	1	56425	90510004-006
7-8/106	Fuseboard	1	56425	91240002-001
7-8/107	Fuseboard	1	56425	91230002-009
7-8/108	Subpan	1	56425	90410005-009
7-8/109	Subpan	1	56425	90510004-016
7-8/110	Subpan	1	56425	90510004-004
7-8/111	Subpan	1	56425	90510004-017
7-8/112	Subpan	2	56425	90510004-012
7-8/113	Contact, size 1, 27 amp, 115 VAC, 60 Hz, 4 pole, 115V coil	1	27192	6957ED25-4C
7-8/114	Switch, rotary, multipole, 7.5 amp, 2-position, 3 decks, type S5JM3, Navy gray, oval shank knob, white pointer, blank escutcheon plate, NSN 5930-01-006-8595	1	82121	26503G
* Removed by MACHALT 320-59006 (ECP-515)				
** Installed by MACHALT 320-59006 (ECP-515)				

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/1	Lamp, incandescent, 6 volt, type T-1 3/4, midget screwbase, W-L-111	6	56694	MS15612-5
7-8/2	Lampholder, lights indicator (housing), Style 95, 28 VDC, w/o lamps	3	56694	MIL-L-3661/62 LH95
7-8/3	Lens, indicator light, style LC40, red translucent plastic (DS30)	1	56694	MIL-L-3661/54 LH40EN3
7-8/4	Ammeter, AC, 4-1/2 inch, 250° scale 0-6,000 amp, 60 Hz, CT ratio 6,000:5 amp, MIL-M-16034 (M1, M2)	2	15309	MR49W006ACKAH
7-8/5	Wattmeter, AC, 4-1/2 inch, 250° scale 0-5000 KW, 60 Hz, PT ratio 460:115 VAC, CT ratio 6,000:5 amp, MIL-W-19088 (M8)	1	15309	MR492W005ACGWH
7-8/6	Meter, temperature, selective, manual readout, remote, 115 VAC/60 Hz, platinum RTE, 0-200°C, 4-1/2 inch, 250° scale meter in accordance with MIL-M-16034, MIL-T-15377 (M3)	1	15309	4951-366
7-8/7	Lens, indicator light, style LC40, green translucent plastic (DS33, DS34, DS37, DS38)	4	56694	MIL-L-3661/54 LC40GN3
7-8/8	Switch, rotary, selector, 10 amp, type S3JR3, 5-position, 3-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (sections 2 and 3 are make-before-break), MIL-5-21604 (S18)	1	82121	23303LN
7-8/9	Switch, pushbutton, momentary action, 2 NO contacts, MIL-C-2212 (PB3102)	1	02989	Type 1C5845 572921G23
7-8/10	Switch, pushbutton, momentary action, 1 NO and 1 NC contact, MIL-02212 (PB3101, PB3103)	2	02989	Type 1C5845 5729215G1
7-8/11	Lampholder, lights indicator (housing), style 98, 115 VAC, w/o lamps	38	56694	MIL-L-3661/65 LH98-3
7-8/12	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	82	56694	MS15612-3

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/13	Lens, indicator light, style LC40, amber translucent plastic (DS4, DS6, DS8, DS10, DS12, DS14, DS16, DS18, D520, DS32, DS35, DS36, DS39, DS40, DS41, DS44)	16	56694	MIL-L-3661/54 LC40AN3
7-8/14	Lens, indicator light style LC40, white translucent plastic (DS22-DS25, DS29, DS31, DS42, DS43)	8	56694	MIL-L-3661/54 LC40WT3
7-8/15	Switch, rotary, multipole, 10 amp, type S2JR1, 2-position, 1-section, maintained, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-21604 (S21, S31)	2	82121	23201LG
7-8/16	Switch, rotary, multipole, 10 amp, type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, round knob, white pointer, blank escutcheon plate, MIL-S-21604 (S16, S20)	2	82121	71201LP
7-8/17	Voltmeter, AC, 4-1/2 inch, 250° scale 0-600 VAC, 60 Hz, PT ratio 450:115 VAC, MIL-M-16034 (M4, M5)	2	15309	MR49W600ACVVH
7-8/18	Switch, rotary, multipole, 10 amp, type S2JRM1, 3-position, 1-section, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S14, S15)	2	82121	71201LN
7-8/19	Switch, rotary, selector, 10 amp, type S3JR6, 3-position, 6-section, maintained, Navy gray, oval shank handle, white pointer, blank escutcheon plate, MIL-S-21604 (S13)	1	82121	23306LT
7-8/20	Lens, indicator light, style LC40, blue translucent plastic (DS5, DS7, DS9, DS11, DS13, DS15, DS17, DS19, DS21, DS45)	10	56694	MIL-L-3661/54 LC40BN3
7-8/21	Switch, rotary, meter & control, type 24G, class 2, 4 PDT, spring return to center (Off) position, 500 VAC, Navy gray, pistol grip handle, white pointer, MIL-5-18396 (S1-S6)	6	82121	74202G
7-8/22	Test block with cover, type PK2, 4 pole (2 current and 2 potential) (J1-J2)	2	71669	642212064
7-8/23	Test plug with 4 pole, type PK2	2	71669	6129533G1
7-8/24	Links, test plug	2	71669	V2453076
7-8/25	Switch, rotary, multipole, 10 amp, type S2JRM2, 3-position, 2-section, spring return to center, Navy gray, pistol grip handle, white pointer, MIL-S-21604 (S7-S10)	4	82121	71202LS
7-8/26	Switch, rotary, multipole, 7.5 amp, type S5JM9, 2-position, 9-section, maintained, Navy gray, oval shank knob, white pointer, black escutcheon plate, MIL-S-21604 (S24)	1	82121	26509LC
7-8/27	Switch, rotary, meter & control, type 24G, class 2, 2PST (Off-On), spring return to center (Off), 500 VAC, Navy gray, pistol grip handle, white pointer, blank escutcheon plate, MIL-S-18396 (S25)	1	82121	74201J-003
7-8/28	Switch, rotary, multipole, 10 amp, type S2JRM3, 3-position, 3-section, spring return to center, Navy gray, oval shank handle, white pointer, blank escutcheon plate (S22)	1	82121	71203MA
7-8/29	Lampholder, lights indicator (housing), style 98, 450 VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98-4
7-8/30	Lens, indicator light, style LC40, clear colorless plastic (DS1, DS2, DS26-DS28)	5	56694	MIL-L-3661/54 LC40TN3

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/31	Switch, rotary, meter & control, type 24G, class 2, 4-position, 4-section, spring return from extreme left & right positions, maintained in 315° & 360° positions, Navy gray, oval shank knob, white pointer, blank escutcheon plate, MIL-S-18396 (S8)	1	82121	71304LH
7-8/32	Switch, rotary, selector, 10 amp, type 4-position, 8-section, maintained, Navy gray, oval knob, white pointer, blank escutcheon plate, MIL-S-21604 (S19)	1	82121	23904LJ
7-8/33	Switch, rotary, meter & control, type 24G, class 2, 4-position, 4-section, maintained, Navy gray, round knurled knob, white pointer, blank escutcheon plate (section 3-4/ammeter circuit (MBB), section 1-3/volt-meter circuit), MIL-S-18396 (S17)	1	82121	23904LJ
7-8/34	Synchroscope, 4-1/2 inch, 360° scale, slow-fast, 115 VAC/60 Hz, MIL-I-16104 (M11)	1		MR4SW060SYH
7-8/35	Meter, electrical, frequency, 4-1/2 inch, 250° scale, 55-65Hz, 115 VAC (self contained) MIL-M-16125 (M6, M7)	2		MR49W60BH
1 7-8/36	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 15I trip element (inst. only), MIL-C-17361D (CB3101)	1	89946	458D511G11
7-8/37	Mounting base, single, back connected, MIL-C-17361D	1	89946	315C364G02
7-8/38	Mounting base, fuse unit, 50-75-100A MIL-C-17361D	1	89946	655D258G06
7-8/39	Fuse unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	1	89946	504C010H01
7-8/40	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450V/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-10000A, INST-48000A, ST delay 0.3 sec, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, 1 long b contact to be wired out to secondary terminal 9 & 10, MIL-C-17587 (CB3130)	1	39805	4294025-9
7-8/41	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	39805	4294006-1
7-8/42	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB3102, CB3103)	2	89946	313C748G27
7-8/43	Mounting block, switchboard type, MIL-C-17361D	4	89946	313C680G02
7-8/44	Terminal, casualty power receptacle type, back connected, 200 amp, 450 VAC/60 Hz, MIL-T-24552 (2E2, 2E3) Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd. GR 5, 1/2-13 x 2-1/4 LG	2		M24552/1-001
7-8/45	Terminal, casualty power seal	2		M24552/3-001
7-8/46	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8	4		JCB-0 827X71
				MS27183-19 MS27183-18 MS35338-48
				MS27183-15 MS35338-46

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/47	. Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG Terminal board, molded barrier screw type, class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	62		MIL-T-55164/2 38TB12 MS35338-137
7-8/48	Marker strip	62		MIL-T-55164/2 38TB12Z
7-8/49	Relay, control, category A, 28 VDC continuous duty, 60° ambi- ent, shock class I, 4PDT, MIL-R-19523 (K3106, K3108-K3111, K3113, K3116, K3123, K3129, K3030, K3133, K3134, K3202, K3204, K3205, K3402, K3404, K3405) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no, 10-32 UNC . Screw, mach. pan hd., No. 10-32 x 1/2 LG	20	77342	MDR135-1 9507-10 MS35338-138 MS35650-304
7-8/50	Semiconductor device, diode silicon, power rectifier, fast recov- ery, 600 PIV/3 amp, MIL-S-19500/411	40		JANTXIN5416
7-8/51	Synchronizing control equipment, 450 VAC/60 Hz, MIL-S-34188 (Modified) (A1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	94080020-001 C30096-3816 MS35338-46
7-8/52	Contacting, size 1, 27 amp, 450 VAC/60 Hz, 4 pole, 2 NO and NC aux switches, 440V/60 Hz coil, MIL-C-2212 Attaching hardware: . Washer, flat no. 10 . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., 10-32 x 5/8 LG	2	27192	6957ED25-1A MS15795-808 MS35338-138 MS35650-304
7-8/53	Mechanical interlock, size 1, MIL-C-2212	1	27192	10-2468
7-8/54	Analog bus ground detector, (A5) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000170 9504-08 MS27183-10 MS35338-44
7-8/55*	Fault current detector main assembly (A6) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	2268D100-2 C30096-3816 MS35338-46

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/56	Transformer, power, step down, type SA, 1 phase, 450:120 VAC, 1.5 KVA, continuous duty, MIL-T-16315 (T2) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-07 C30096-3816 MS35338-46
7-8/57*	Turbine RPM detector assembly Attaching hardware: . Washer, flat no. 6 . Nutsert, Avdel, 6-32 UNC . Washer, lock, split no. 6 . Screw, mach., pn hd, no. 6-32 x 5/8 LG	1	56425	2268D150-5-1 MS15795-805 MS35338-136
7-8/58	Switch, toggle, DPST, On-Off-None, sealed, MIL-S-83731	6	27191	MS35059-24
7-8/59*	Relay, AC power sensing, 2 state time delay, adjustable 0-39 sec., MIL-R-24563 (Modified) (A3a) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	94000140-001 9504-08 MS27183-10 MS35338-44
7-8/60	Relay assembly, MIL-R-24563 (Modified)(A3b) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5 1/4-20 x 1 LG	1	54625	94000160-1 9504-08 MS27183-10 MS35338-44
7-8/61	Transformer, power, step down, type SA, 450:115 VAC, 5 KVA with primary and secondary terminals, MIL-T-16315 (T1) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5 3/8-16 x 1-1/4 LG	1	56425	STD-ISC-010-01 C30096-3816 MS35338-46
7-8/62*	Monitor, reverse power, time delay 1-5 sec, MIL-M-24350A (Modified) (A2)	1	56425	94000090-001
7-8/62**	Module, Generator Protection, MIL-M-24350A (GPM) Attaching hardware: . Nutsert, Avdel, 1/4-20 UNC . Washer, flat 1/4 . Washer, lock, split 1/4 . Bolt, hex hd., GR 5 1/4-20 x 1 LG	1	4N915	2310-701-01 9504-08 MS35338-44
7-8/63	Transformer, potential, pri 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 (PT1-6) Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl)	6	03516	JNP-0 760X4G2 C30096-3816

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/64	. Washer, lock, split 3/8	144	71400	MS35338-46
	. Nut, hex, no. 3/8-16 UNC			
	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			
	Fuse clip, electrical, type FC21CF, MIL-F-21346			M21346/1-04
	Attaching hardware:			
7-8/65	. Washer, flat no. 8	4	71400	MS15795-807
	. Washer, lock, split no. 8			MS35338-137
	. Nut, hex, no. 8-32 UNC			MS35649-284
	. Screw, mach., pan hd., no. 8-32 x 7/8 LG			
	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F311, F312, F321, F322)			F60C500V20A
7-8/66	Fuse, style F60, 500 VAC, 6 amp characteristic C, MIL-F-15160 (F301-F310, F313-F320, F325, F331, F334, F335)	26	71400	F60C500V6A
7-9/67	Fuse, style F60, 500 VAC, 3 amp, characteristic C, MIL-F-15160 (F333, F336, F337, F339-F341, F348, F349, F350, F3S2)	10	71400	F60C500V3A
7-8/68	Fuse, style F60, 500 VAC, 1 amp, characteristic C, MIL-F-15160 (F329)	1	71400	F60C500V1A
7-8/69	Fuse, style F60, 500 VAC, 10 amp, characteristic C, MIL-F-15160 (F323, F324, F342-F347)	8	71400	F60C500V10A
7-8/70	Fuse, style F60, 500 VAC, 1/8 amp, characteristic C, MIL-F-15160 (3F1)	1	71400	F60C500V1/8A
7-8/71	Relay, control category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K3117, K3118, K3125, K3127, K3128, K3135)	1	77342	MDR131-1
7-8/72	Attaching hardware:	1	77342	. Nutsert, Avdel, 10-32 UNC
	. Washer, lock, split no. 10			9507-10
	. Nut, hex, no. 10-32 UNC			HS35338-138
	. Screw, mach., pan hd., no. 10-32 x 1/2 LG			MS35650-304
	Relay, control, category B, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 24PDT, MIL-R-19523 (K3101)			MDR141-2
7-8/73	Attaching hardware:	4	77342	. Nutsert, Avdel, 1/4-20 UNC
	. Washer, flat 1/4			9504-08
	. Washer, lock, split 1/4			MS27183-10
	. Bolt, hex hd., GR 5, 1/4-20 x 1 LG			MS35338-44
	Relay, control, category A, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K3121, K3122, K3124, K3126)			MDR134-1
7-8/74	Attaching hardware:	1	77342	. Nutsert, Avdel, 10-32 UNC
	. Washer, lock, split no. 10			9507-10
	. Nut, hex, no. 10-32 UNC			MS35338-138
	. Screw, mach. pan hd., no. 10-32 x 1/2 LG			MS35650-304
	Relay, control, category B, 28 VDC, continuous duty, 65°C ambient, shock class I, 4PDT, MIL-R-19523 (K3103)			MDR-67-3

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/75	. Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG Relay, control, category A, 28 VDC, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K3112, K3115, K3131, K3132) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	4	77342	9507-10 MS35338-138 MS35650-304 MDR136-1
7-8/76	Relay, control, category B, 115 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K3214, K3419, K3120) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	3	77342	9507-10 MS35338-138 MS35650-304 MDR4076
7-8/77	Relay, control, category B, 28 VDC, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K3201, K3401) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	2	77342	9507-10 MS35338-138 MS35650-304 MDR503 5
7-8/78	Relay, control, category A, 450 VAC/60 Hz, continuous duty, 65°C ambient, shock class I, 8PDT, MIL-R-19523 (K3107) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	1	77342	9507-10 MS35338-138 MS35650-304 MDR-134-2
7-8/79	Protective device, thyrite, MIL-I-1361 (PD1-PD8) Attaching hardware: . Washer, flat 1/2 . Washer, flat 1/2 (special - SAE 13/16 dia) . Washer, lock, split 1/2 . Nut, hex, no. 1/2-13 UNC . Bolt, hex hd., GR 5, 1/2-13 x 2-1/4 LG	8	03516	8360185G1S63 MS27183-19 MS27183-18 MS35338-48
7-8/80	Disconnect link	3	56425	94000037-001
7-8/81*	Isolation transformer (IT1, IT2) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10	2	56425	STD-ISC-010-04 9507-10 MS35338-138

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
	. Nut, hex, no. 10-32 UNC			MS35650-304
	. Screw, mach., pan hd., no. 10-32 x 1/2 LG			
7-8/82*	Resistor, fixed, wire wound (power type), style R79, 0.144 ohm/3 watts, MIL-R-26/5 (R1, R2)	2	81349	RW79UR144F
7-8/83	Structure assembly	1	56425	90110100
7-8/84	Structure assembly	1	56425	90110101
7-8/85	Door	1	56425	90510004-001
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/86	Door	1	56425	90510004-002
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/87	Door	1	56425	90510004-040
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/88	Cover	1	56425	90510004-039
7-8/89	Cover	1	56425	90410005-027
7-8/90	Cover	1	56425	90410005-028
7-8/91	Cover	1	56425	90410005-029
7-8/92	Door	1	56425	90510004-049
	Attaching hardware:			
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/93	Door	1	56425	90510004-048
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-8/94	Door	1	56425	90510004-047
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			

Table 7-9A. Parts List For Switchboard 3SG – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-8/95	Cover	1	56425	90410005-025
7-8/96	Cover	1	56425	90410005-024
7-8/97	Dripshield	1	56425	90510004-018
7-8/98	Grab handle	2	56425	91000001-901 91000001-916
7-8/99	Thumbscrew, captive	35	56425	91000001-934
7-8/100	Subpan	1	56425	90510004-007
7-8/101	Subpan	1	56425	90510004-011
7-8/102	Switch mounting plate	1	56425	90510004-019
7-8/103	Subpan	1	56425	90510004-014
7-8/104	Subpan	1	56425	90510004-005
7-8/105	Subpan	1	56425	90510004-006
7-8/106	Fuseboard	1	56425	91240002-001
7-8/107	Fuseboard	1	56425	91230002-009
7-8/108	Subpan	1	56425	90410005-009
7-8/109	Subpan	1	56425	90510004-016
7-8/110	Subpan	1	56425	90510004-004
7-8/111	Subpan	1	56425	90510004-017
7-8/112	Subpan	2	56425	90510004-012
7-8/113	Contact, size 1, 27 amp, 115 VAC, 60 Hz, 4 pole, 115V coil	1	27192	6957ED25-4C
7-8/114	Switch, rotary, multipole, 7.5 amp, 2-position, 3 decks, type S5JM3, Navy gray, oval shank knob, white pointer, blank escutcheon plate, NSN 5930-01-006-8595	1	82121	26503G
* Removed by MACHALT 320-59006 (ECP-515)				
** Installed by MACHALT 320-59006 (ECP-515)				

Table 7-10. Parts List For Switchboard 3SA – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-9/1	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175L trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3211)	1	30086	ETN530510S31 (Modified)
7-9/2	Mounting block, switchboard type, MIL-C-17361D	22	30086	ETN5314
7-9/3	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150L trip element, MIL-C-17361D (CB3214)	1	30086	ETN5303
7-9/4	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 225L trip element, MIL-C-17361D (CB3215)	1	30086	ETN5307
7-9/5	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 400TH trip element, MIL-C-17361D (CB3207)	1	30086	ETN6908
7-9/6	Mounting block, switchboard type, MIL-C-17361D	6	30086	ETN6743
7-9/7	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350T trip element, MIL-C-17361D (CB3212)	1	30086	ETN6917

Table 7-10. Parts List For Switchboard 3SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-9/8	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 300T trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3213)	1	30086	ETN690410S31
7-9/9	Circuit breaker, air, removable element, type ACB-3200HR, 3200A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-3200A, LTD-4800A, STD-6400A, INST-None, time band 1, 10 aux switches (5a & 5b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3208)	1	30086	
7-9/10	Stationary element, 3200A frame, 3 pole	1	30086	
7-9/11	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-8000A, INST-None, time band 2, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3231)	1	30086	
7-9/12	Stationary element, 4000A frame, 3 pole	1	30086	
7-9/13	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3204, CB3205, CB3210)	3	30086	ETN531010S31 (Modified)
7-9/14	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB3209)	1	30086	ETN5304
7-9/15	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB3201, CB3202, CB3206)	3	30086	ETN5306
7-9/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB3203)	1	30086	ETN5310
7-9/18	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F351, F352, F359, F360)	4	71400	F60C500V20A
7-9/19	Fuse clip, electrical, type FC21CF, MIL-F-21346	28	71400	M21346/1-04
	Attaching hardware:			
	. Washer, flat no. 8			MS15795-807
	. Washer, lock, split no. 8			MS35338-137
	. Nut, hex, no. 8-32 UNC			MS35649-284
	. Screw, mach., pan hd., no. 8-32 x 7/8 LG			
7-9/20	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F353-F358, F363-F366)	10	71400	F60C500V6A
7-9/21	Capacitor diode assembly (A7)	1	56425	2268D140-1
	Attaching hardware:			
	. Washer, flat 1/4			MS27183-10
	. Washer, lock, split 1/4			MS35338-44
	. Nut, hex, no. 1/4-20 UNC			
	. Screw, mach., pan hd., 1/4-20 x 1 LG			
7-9/22	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315	1	56425	STD-ISC-010-01
	Attaching hardware:			

Table 7-10. Parts List For Switchboard 3SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-9/23	. Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 Attaching hardware:	2	03516	C30096-3816 MS35338-46 JNP-0 760X50G2
	. Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			C30096-3816 MS35338-46
7-9/24	Disconnect link	3	56425	94000037-001
7-9/25	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	2		MS27183-15 MS35338-46
7-9/26	Terminal board, molded barrier screw type class 38TB Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	21		MIL-T-55164/2 38TB12 MS35338-137
7-9/27	Marker strip, MIL-T-55164/2	21		38TB12Z
7-9/28	Structure assembly	1	56425	90110103
7-9/29	Structure assembly	1	56425	90110106
7-9/30	Structure assembly	1	56425	90110118
7-9/31	Cover	1	56425	90510004-097
7-9/32	Cover	1	56425	90510004-039
7-9/33	Cover	1	56425	90510004-093
7-9/34	Cover	1	56425	90510004-092
7-9/35	Door Attaching hardware: . Knee brace (left-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-129 91000001-907 91000001-911 91000001-912
7-9/36	Door Attaching hardware: . Knee brace (right-hand) . Hinge half . Hinge half . Cotter pin	1	56425	90510004-130 91000001-907 91000001-911 91000001-912
7-9/37	Fuseboard	1		91240002-009
7-9/38	Grab handle	2	56425	91000001-901 91000001-916

Table 7-10. Parts List For Switchboard 3SA – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-9/39	Thumbscrew, captive	54	56425	91000001-934
7-9/40	Dripshield	1		90410004-134
7-9/41	Subpan	1	56425	90510004-094
7-9/42	Cover	1	56425	90410005-063
7-9/43	Cover	1	56425	90410005-064
7-9/44	Cover	1	56425	90410005-059
7-9/45	Cover	1	56425	90410005-058
7-9/46	Door	2	56425	90510004-
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-9/47	Cover	1	56425	90410005-060
7-9/48	Cover	1	56425	90410005-020
7-9/49	Subpan	1	56425	90510004-090
7-9/50	Switch, toggle, DPST, On-Off-None, sealed, MIL-S-83731	2	27191	MS35059-24
7-9/51	Protective device, thyrite, MIL-I-1361 (PD5, PD6)	2	03516	8360185G1S63
	Attaching hardware:			
	. Washer, flat 1/2			MS27183-19
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS27183-18
	. Washer, lock split 1/2			MS35338-48
	. Nut, hex, no. 1/2-13 UNC			
	. Bolt, hex hd., GR 5 1/2-13 x 2-1/4 LG			

Table 7-10A. Parts List For Switchboard 3SA – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-9/1	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175L trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3211)	1	89946	313C748G22
7-9/2	Mounting block, switchboard type, MIL-C-17361D	22	89946	313C680G02
7-9/3	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150L trip element, MIL-C-17361D (CB3214)	1	89946	313C748G20
7-9/4	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 225L trip element, MIL-C-17361D (CB3215)	1	89946	313C748G24
7-9/5	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 Pole, back connected, MIL-C-17361E (CB3207)	1	89946	1230C83G01
	400QS trip element	1	89946	1230C84G04
7-9/6	Mounting block AQB-LL400 Circuit Breaker, 3 pole, MIL-C-17361F	6	89946	1230C81G01
7-9/7	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, MIL-C-17361D (CB3212)	1	89946	1230683G03
	300QM trip element MIL-C-17361E	1	89946	1230684G02

Table 7-10A. Parts List For Switchboard 3SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-9/8	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3213) 300QM trip element	1	89946	1241C32G09
7-9/9	Circuit breaker, air, removable element, type ACB-3200HR, 3200A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-3200A, LTD-4800A, STD-6400A, INST-none, ST delay 0.1 sec (min), 10 aux switches (5a & 5b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3208)	1	89946	1230C84G02
7-9/10	Stationary element, 3200A frame, 3 pole	1	39805	4294027-5
7-9/11	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC/60 Hz control relay and shunt trip, Coil-4000A, LTD-6000A, STD-8000A, INST-None, time ST delay 0.2 sec, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3231)	1	39805	4294006-1
7-9/12	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	39805	4294026-7
7-9/13	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3204, CB3205, CB3210)	3	89946	4294006-1
7-9/14	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB3209)	1	89946	313C748G21
7-9/15	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB3201, CB3202, CB3206)	3	89946	313C748G23
7-9/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB3203)	1	89946	313C748G27
7-9/18	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F351, F352, F359, F360)	4	71400	F60C500V20A
7-9/19	Fuse clip, electrical, type FC21CF Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no 8-32 UNC	28	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-9/20	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F353-F358, F363-F366)	10	71400	F60C500V6A
7-9/21	Capacitor diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock split 1/4 . Nut, hex, no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MSJ5338--44
7-9/35	Door Attaching hardware: . Knee brace (left-hand)	1	56425	90510004-129 91000001-907

Table 7-10A. Parts List For Switchboard 3SA – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-9/36	. Hinge half	1	56425	91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
	Door			90510004-130
	Attaching hardware:			
7-9/37	. Knee brace (right-hand)	1	56425	91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
	Fuseboard			91240002-009
7-9/38	Grab handle	2	56425	91000001-901
7-9/39	Thumbscrew, captive	54	56425	91000001-934
7-9/40	Dripshield	1		90410004-134
7-9/41	Subpan	1	56425	90510004-094
7-9/42	Cover	1	56425	90410005-063
7-9/43	Cover	1	56425	90410005-064
7-9/44	Cover	1	56425	90410005-059
7-9/45	Cover	1	56425	90410005-058
7-9/46	Door	2	56425	90510004-
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
7-9/47	. Hinge half	1	56425	91000001-912
	. Cotter pin			
	Cover			90410005-060
7-9/48	Cover	1	56425	90410005-020
7-9/49	Subpan	1	56425	90510004-090

Table 7-11. Parts List For Switchboard 3SB – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-10/1	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 50 trip element, MIL-C-17361D (CB3301, CB3302, CB3311, CB3312, CB3322)	5	30086	ETN2752
7-10/2	Mounting base, double, back connected, MIL-C-17361D	12	30086	ETN2769
7-10/3	Fuse unit, type AQB-F101B, 50-100 amp	24	30086	ETN2791
7-10/4	Mounting base, fuse unit, back connected, MIL-C-17361D	27	30086	ETN2787
7-10/5	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 100T trip element, 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3304, CB3306, CB3317, CB3318)	4	30086	ETN2754000S01
7-10/6	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75 trip element, MIL-C-17361D (CB3305, CB3307, CB3309, CB3313, CB3314, CB3323, CB3345)	7	30086	ETN2753

Table 7-11. Parts List For Switchboard 3SB – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-10/7	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 25 trip element, MIL-C-17361D (CB3310, CB3346)	2	30086	ETN2751
7-10/8	Fuse unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	3	30086	ETM2790
7-10/9	Lampholder, lights indicator (housing), style 98, 115 VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98
7-10/10	Lens, indicator light, style LC40, blue translucent plastic (DS1, DS2, DS3)	3	56694	MIL-L-3661/54 LC40BN3
7-10/11	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	6	56694	MS15612-3
7-10/12	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 300TM trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3340, CB3341, CB3342)	3	30086	ETN690510S3 1
7-10/13	Motor operator 115 VAC/60 Hz, MIL-C-17361D	3	30086	ETN6797
7-10/14	Mounting block, switchboard type, MIL-C-17361D	18	30086	ETN6743
7-10/15	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150L trip element, MIL-C-17361D (CB3327)	1	30086	ETN5303
7-10/16	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 300T trip element, MIL-C-17361D (CB3335)	1	30086	ETN6904
7-10/17	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350TM trip element, MIL-C-17361D (CB3336-CB3338)	3	30086	ETN6907
7-10/18	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 400T trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3334, CB3339)	2	30086	ETN690810S31
7-10/20	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75 trip element, 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3303, CB3315, CB3316)	3	30086	ETN275300S01
7-10/21	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 100 trip element, MIL-C-17361D (CB3308, CB3319, CB3320, CB3321, CB3324, CB3347)	6	30086	ETN2754
7-10/22	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 125L trip element, MIL-C-17361D (CB3328)	1	30086	ETN5301
7-10/23	Mounting block, switchboard type	12	30086	ETN5314
7-10/24	ITEM DELETED			
7-10/25	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 225L trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3329)	1	30086	ETN530710S31
7-10/26	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB3325, CB3326, CB3330)	3	89946	313C748G23
7-10/27	Mounting base, single, back connected, MIL-C-17361D	3	30086	ETN2767
7-10/28	Terminal board, molded barrier screw type, Class 38TB12 Attaching hardware: . Washer, lock split no. 8	15		MIL-T-55164/2 38TB12 MS35338-137

Table 7-11. Parts List For Switchboard 3SB – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-10/29	. Screw, mach., pan hd., no. 8-32 x 3/4 LG cres Marker strip	15		MIL-T-55164/2 38TB12Z
7-10/30	Relay, control, category A, 115 VAC/60 Hz, 4PDT, continuous duty, 65°C ambient, shock class I, MIL-R-19523 (K3303-K3306, K3315-K3318, K3340-K3342) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	10	77342	MDR131-1 9507-10 MS35338-138 MS35650-304
7-10/31	Structure assembly	1	56425	90110114
7-10/32	Structure assembly	1	56425	90110117
7-10/33	Structure assembly	1	56425	90110111
7-10/34	Cover	1	56425	90510004-112
7-10/35	Cover	1	56425	90510004-109
7-10/36	Cover	1	56425	90510004-116
7-10/37	Cover	1	56425	90510004-113
7-10/38	Cover	1	56425	90510004-106
7-10/39	Cover	1	56425	90510004-107
7-10/40	Grab handle	2	56425	91000001-901 91000001-916
7-10/41	Thumbscrew, captive	48	56425	91000001-934
7-10/42	Cover	1	56425	90410005-065
7-10/43	Cover	1	56425	90410005-066
7-10/44	Cover	1	56425	90410005-067
7-10/45	Cover	1	56425	90410005-068
7-10/46	Cover	1	56425	90410005-014
7-10/47	Cover	1	56425	90410005-015
7-10/48	Subpan	1	56425	90510004-086
7-10/49	Subpan	1	56425	90510004-117
7-10/50	Dripshield	1	56425	90510004-118

Table 7-11A. Parts List For Switchboard 3SB – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-10/1	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 50 trip element, MIL-C-17361D (CB3301, CB3302, CB3311, CB3312, CB3322)	5	89946	458D509G13
7-10/2	Mounting base, double, back connected, MIL-C-17361D	12	89946	458D569G03
7-10/3	Fuse unit, type AQB-F101B, 50-100 amp	24	89946	504C010H02
7-10/4	Mounting base, fuse unit, 50-75-100A, MIL-C-17361D	27	89946	655D258G06

Table 7-11A. Parts List For Switchboard 3SB – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-10/5	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 100T trip element, 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-1736 ID (CB3304, CB3306, CB3317, CB3318)	4	89946	5682D24G17
7-10/6	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75 trip element, MIL-C-17361D (CB3305, CB3307, CB3309, CB3313, CB3314, CB3323)	6	89946	458D509G14
7-10/7	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 25 trip element, MIL-C-17361D (CB3310, CB3346)	2	89946	458D509G12
7-10/8	Fuse Unit, type AQB-F101A, 15-25 amp, MIL-C-17361D	3	89946	504C010H01
7-10/9	Lampholder, lights indicator (housing), style 98, 115 VAC, w/o lamps	3	56694	MIL-L-3661/65 LH98
7-10/10	Lens, indicator light, style LC40, blue translucent plastic (DS1, DS2, DS3)	3	56694	MIL-L-3661/54 LC40BN3
7-10/11	Lamp, incandescent, 2.5 volt, type T-1 3/4, midget screwbase, W-L-111	6	56694	MS15612-3
7-10/12	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3340, CB3341 CB3342)	3	89946	1241C32G07
	300QS trip element	3	89946	1230C84G02
7-10/13	Motor operator 115 VAC/60 Hz, MIL-C-17361E	3	89946	1234C53G01
7-10/14	Mounting block, AQB-LL400 Circuit breaker, 3 pole, MIL-C-17361F	18	89946	1230C81G01
7-10/15	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150L trip element, MIL-C-17361D (CB3327, CB3328)	2	89946	313C748G20
7-10/16	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, MIL-C-17361F (CB3209)	1	89946	1230683G03
	300QM trip element	1	89946	1230684G02
7-10/17	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, MIL-C-17361E (CB3336-CB3338)	3	89946	1230C83G01
	350QS trip element	3	89946	1230C84G03
7-10/18	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 115 VAC/60 Hz shunt trip with aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361E (CB3334, CB3339)	2	89946	1241C32G09
	400QM trip element MIL-C-17361F	2	89946	1230C84G04
7-10/20	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 75T trip element 115 VAC/60 Hz shunt trip with aux switch, all five connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3303, CB3315 CB3316)	3	89946	5682D24G16
7-10/21	Circuit breaker, type AQB-A101F, 500 VAC, 60 Hz, 3 pole, back connected, 100 trip element, MIL-C-17361D (CB3308, CB3319, CB3320, CB3321, CB3324, CB3345, CB3347)	7	89946	458D509G15
7-10/23	Mounting block, switchboard type (MIL-C-17361D)	12	89946	313C6080G02

Table 7-11A. Parts List For Switchboard 3SB – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-10/25	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 225L trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3329)	1	89946	313C748G24
7-10/26	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB3325, CB3326, CB3330)	3	89946	313C748G23
7-10/27	Mounting base, single, back connected, MIL-C-17361D	3	89946	315C364G02
7-10/28	Terminal board, molded barrier screw type, class 38TB12 Attaching hardware: . Washer, lock split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	15		MIL-T-55164/2 38TB12 MS35338-137
7-10/29	Marker strip	15		MIL-T-55164/2 38TB12Z
7-10/30	Relay, control, category A, 115 VAC/60 Hz, 4PDT, continuous duty, 65°C ambient, shock class I, MIL-R-19523 (K3303, K3306, K3315-K3318, K3340-K3342) Attaching hardware: . Nutsert, Avdel, 10-32 UNC . Washer, lock, split no. 10 . Nut, hex, no. 10-32 UNC . Screw, mach., pan hd., no. 10-32 x 1/2 LG	10	77342	MDR131-1 9507-10 MS35338-138 MS35650-304
7-10/31	Structure assembly	1	56425	90110114
7-10/32	Structure assembly	1	56425	90110117
7-10/33	Structure assembly	1	56425	90110111
7-10/34	Cover	1	56425	90510004-112
7-10/35	Cover	1	56425	90510004-109
7-10/36	Cover	1	56425	90510004-116
7-10/37	Cover	1	56425	90510004-113
7-10/38	Cover	1	56425	90510004-106
7-10/39	Cover	1	56425	90510004-107
7-10/40	Grab handle	2	56425	91000001-901 91000001-916
7-10/41	Thumbscrew, captive	48	56425	91000001-934
7-10/42	Cover	1	56425	90410005-065
7-10/43	Cover	1	56425	90410005-066
7-10/44	Cover	1	56425	90410005-067
7-10/45	Cover	1	56425	90410005-068
7-10/46	Cover	1	56425	90410005-014
7-10/47	Cover	1	56425	90410005-015
7-10/48	Subpan	1	56425	90510004-086
7-10/49	Subpan	1	56425	90510004-117
7-10/50	Dripshield	1	56425	90510004-118

Table 7-12. Parts List For Switchboard 3SC – DDG 51 Only

Figure/ Index No	Description	Qty	CAGE	Part No.
7-11/1	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361 Attaching hardware: . Nut, cage, 3/8-16 UNC (.250 thick pnl) . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG	2	03516	JNP-0 760X40G2 C30096-3816 MS35338-46
7-11/2	Circuit breaker, air, removable element, type ACB-2000HR, 2000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-2000A, LTD-3000A, STD-6000A, INST-None, time band 1, 10 aux switches (5a & 5b), 120 VAC indicator, MIL-C- 17587 (CB3407)	1	30086	
7-11/3	Stationary element, 2000A frame, 3 pole, MIL-C-17587	1	30086	
7-11/4	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-4000A, LTD-6000A, STD-8000A, INST-None, time band 2, 10 aux switches (7a & 3b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3432)	1	30086	
7-11/5	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	30086	
7-11/6	Transformer, power, step down, type SA, 450:115 VAC, 0.5 KVA with primary and secondary terminals, MIL-T-16315 Attaching hardware: . Washer, flat, 1/4 . Washer, lock, split 1/4 . Nut, hex, no. 1/4-20 UNC . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	STD-ISC-010-01 MS27183-10 MS35338-44
7-11/7	Capacitor, diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock, split 1/4 . Nut, hex, no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MS35338-44
7-11/8	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB3402)	1	30086	ETN5310
7-11/9	Mounting block, switchboard type, MIL-C-17361D	6	30086	ETN5314
7-11/10	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350T trip element, MIL-C-17361D (CB3410)	1	30086	ETN6906
7-11/11	Mounting block, switchboard type, MIL-C-17361D	6	30086	ETN6743
7-11/12	Circuit breaker, air, removable element, type ACB-1600HR, 1600A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-800A, LTD-1200A, STD-None, INST-8000A, 10 aux switches (5a & 5b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3408)	1	30086	
7-11/13	Stationary element, 1600A frame, 3 pole, MIL-C-17587	1	30086	

Table 7-12. Parts List For Switchboard 3SC – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-11/14	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3pole, back connected, 400TM trip element, MIL-C-17361D (CB3403)	1	30086	ETN6909
7-11/15	Circuit breaker, type AQB-LF400, 500 VAC, 60 Hz, 3 pole, back connected, 350T trip element, 115 VAC/60 Hz shunt trip with 2 aux switches, all eight connections to be wired out with 36 inch long conductors, MIL-C-17361D (CB3409)	1	30086	ETN690610S31 (Modified)
7-11/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB3404)	1	30086	ETN5304
7-11/17	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB3401)	1	30086	ETN5306
7-11/18	Disconnect link	3	56425	94000037-001
7-11/19	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	2		JCB-0 MS27183-15 MS35338-46
7-11/20	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F383-F388, F393-F396)	10	71400	F60C500V6A
7-11/21	Fuse clip, electrical, type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	40	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-11/22	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F381, F382, F389-F392)	6	71400	F60C500V20A
7-11/23	Terminal board, molded barrier screw type, class 38TB12 Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	16		MIL-T-55164/2 38TB12 MS35338-137
7-11/24	Marker strip	16		MIL-T-55164/2 38TB12Z
7-11/25	Structure assembly	1	56425	90110104
7-11/26	Structure assembly	1	56425	90110110
7-11/27	Cover	1	56425	90510004-120
7-11/28	Cover	1	56425	90510004-119
7-11/29	Cover	1	56425	90S10004-039
7-11/30	Cover	1	56425	9051004-124
7-11/31	Cover	1	56425	9051004-122
7-11/32	Cover	1	56425	90510004-121
7-11/33	Grab handle	2	56425	91000001-901 91000001-916
7-11/34	Thumbscrew, captive	48	56425	91000001-934
7-11/35	Subpan	1	56425	90510004-031
7-11/36	Subpan	1	56425	90510004-125

Table 7-12. Parts List For Switchboard 3SC – DDG 51 Only - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-11/37	Cover	1	56425	90410005-069
7-11/38	Cover	1	56425	90410005-070
7-11/39	Door	2	56425	90510004-048
	Attaching hardware:			
	. Knee brace (left-hand)			91000001-907
	. Knee brace (right-hand)			91000001-907
	. Hinge half			91000001-911
	. Hinge half			91000001-912
	. Cotter pin			
7-11/40	Cover	1	56425	90410005-060
7-11/41	Cover	1	56425	90410005-020
7-11/42	Fuseboard	1	56425	91230002-009
7-11/43	Subpan	1	56425	90510004-090
7-11/44	Subpan	1	56425	90510004-009
7-11/45	Subpan	1	56425	90410005-086
7-11/46	Switch, toggle, DPST, On-Off-None, sealed, MIL-S-83731	2	27191	MS35059-24
7-11/47	Protective device, thyrite, MIL-I-1361 (PD7, PD8)	2	03516	8360185G1S63
	Attaching hardware:			
	. Washer, flat 1/2			MS27183-19
	. Washer, flat 1/2 (special - SAE 13/16 dia)			MS27183-18
	. Washer, lock, split 1/2			MS35338-48
	. Nut, hex, no. 1/2-13 UNC			
	. Bolt, hex hd., GR 5, 1/2 -13 x 2-1/4 LG			

Table 7-12A. Parts List For Switchboard 3SC – DDG 52-54

Figure/ Index No	Description	Qty	CAGE	Part No.
7-11/1	Transformer, potential, 450:115 VAC, 60 Hz, NPS accuracy 75VA, MIL-I-1361	2	03516	JNP-0 760XOG2
	Attaching hardware:			
	. Nut, cage. 3/8-16 UNC (.250 thick pnl)			C30096-3816
	. Washer, lock, split 3/8			MS35338-46
	. Nut hex, no. 3/8-16 UNC			
	. Bolt, hex hd., GR 5, 3/8-16 x 1-1/4 LG			
7-11/2	Circuit breaker, air, removable element, type ACB-2000HR, 2000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-2000A, LTD-3000A, STD-6000A, INST-None, ST delay 0.1 sec, 10 aux switches (5a & 5b), 120V AC indicator light with blue lens, MIL-C-17587 (CB3407)	1	39805	4284067-7
7-11/3	Stationary element, 2000A frame, 3 pole, MIL-C-17587	1	39805	4284006-1

Table 7-12A. Parts List For Switchboard 3SC – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-11/4	Circuit breaker, air, removable element, type ACB-4000HR, 4000A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, Coil-4000A, LTD-6000A, STD-8000A, INST-None Time ST delay 0.2 sec, 10 aux switches (7a & 7b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3432)	1	39805	4294026-7
7-11/5	Stationary element, 4000A frame, 3 pole, MIL-C-17587	1	39805	4294006-1
7-11/6	Transformer, power step down, type SA, 450:115 VAC, 5 KVA with primary and secondary terminals, MIL-T-16315 Attaching hardware: . Washer, flat, 1/4 . Washer, lock, split 1/4 . Nut, hex, no. 1/4-20 UNC . Bolt, hex hd., GR 5, 1/4-20 x 1 LG	1	56425	STD-ISC-010-01 MS17183-10 MS35338-44
7-11/7	Capacitor, diode assembly (A7) Attaching hardware: . Washer, flat 1/4 . Washer, lock, split 1/4 . Nut, hex no. 1/4-20 UNC . Screw, mach., pan hd., 1/4-20 x 1 LG	1	56425	2268D140-1 MS27183-10 MS35338-44
7-11/8	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 250LM trip element, MIL-C-17361D (CB3402)	1	89946	313C748G27
7-11/9	Mounting block, switchboard type, MIL-C-17361D	6	89946	313C680G02
7-11/10	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, MIL-C-17361E (CB3410) 350QM trip element MIL-C-17361E	1	89946	1230C83G03 1230C84G03
7-11/11	Mounting block, AQB-LL400 circuit breaker, 3 pole, MIL-C-17361F	6	89946	1230C81G01
7-11/12	Circuit breaker, air, removable element, type ACB-1600HR, 1600A frame, 500 VAC, 60 Hz, 3 pole, 450 VAC/60 Hz closing coil, 115 VAC/60 Hz control relay and shunt trip, wired per dwg. 712728, Coil-800A, LTD-1200A, STD-1600A, INST-8000A, ST delay 0.1 sec (min), 10 aux switches (5a & 5b), 120 VAC indicator light with blue lens, MIL-C-17587 (CB3408)	1	39805	4284065-5
7-11/13	Stationary element 1600A frame, 3 pole, MIL-C-17587	1	39805	4284016-5
7-11/14	Circuit breaker, type AQB-LL400, 500 VAC, 60 Hz, 3 pole, back connected, MIL-C-17361E (CB3403) 400QS trip element	1 1	89946 89946	1230C83G01 1230C84G03
7-11/15	Circuit breaker, type AQB-L400, 500 VAC, 60 Hz, 3 pole, back connected, 115 VAC/60 Hz shunt trip with aux switches, all five connections to be wired out with 36 inch long conductors, MIL-C-17361E (CB3409)	1	89946	1241C32G09
7-11/16	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 150LM trip element, MIL-C-17361D (CB3404)	1	89946	313C748G21
7-11/17	Circuit breaker, type AQB-LF250, 500 VAC, 60 Hz, 3 pole, back connected, 175LM trip element, MIL-C-17361D (CB3401)	1	89946	313748G23
7-11/18	Disconnect link	3	56425	94000037-001

Table 7-12A. Parts List For Switchboard 3SC – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-11/19	Transformer, current, 6,000:5 amp, 60 Hz, NSS accuracy 50VA, MIL-I-1361 Attaching Hardware: . Washer, flat 3/8 . Washer, lock, split 3/8 . Nut, hex, no. 3/8-16 UNC . Bolt, hex hd., GR 5, 3/8-16 x 4 LG	2		JCB-0 MS27183-15 MS35338-46
7-11/20	Fuse, style F60, 500 VAC, 6 amp, characteristic C, MIL-F-15160 (F383-F388, F393-F396)	10	71400	F60C500V6A
7-11/21	Fuse clip, electrical, type FC21CF, MIL-F-21346 Attaching hardware: . Washer, flat no. 8 . Washer, lock, split no. 8 . Nut, hex, no. 8-32 UNC . Screw, mach., pan hd., no. 8-32 x 7/8 LG	40	71400	M21346/1-04 MS15795-807 MS35338-137 MS35649-284
7-11/22	Fuse, style F60, 500 VAC, 20 amp, characteristic C, MIL-F-15160 (F381, F382, F389-F392)	6	71400	F60C500V20A
7-11/23	Terminal board, molded barrier screw type, class 38TB12 Attaching hardware: . Washer, lock, split no. 8 . Screw, mach., pan hd., no. 8-32 x 3/4 LG cres	16		MIL-T-55164/2 38TB12 MS35338-137
7-11/24	Marker strip	16		MIL-T-55164/2 38TB12Z
7-11/25	Structure assembly	1	56425	90110104
7-11/26	Structure assembly	1	56425	90110110
7-11/27	Cover	1	56425	90510004-120
7-11/28	Cover	1	56425	90510004-119
7-11/29	Cover	1	56425	90510004-039
7-11/30	Cover	1	56425	90510004-124
7-11/31	Cover	1	56425	90510004-122
7-11/32	Cover	1	56425	90510004-121
7-11/33	grab handle	2	56425	91000001-901 91000001-916
7-11/34	Thumbscrew, captive	48	56425	91000001-934
7-11/35	Subpan	1	56425	90510004-031
7-11/36	Subpan	1	56425	90510004-125
7-11/37	Cover	1	56425	90410005-069
7-11/38	Cover	1	56425	90410005-070
7-11/39	Door Attaching hardware: . Knee brace (left-hand) . Knee brace (right-hand) . Hinge half . Hinge half . Cotter pin	2	56425	90510004-048 91000001-907 91000001-907 91000001-911 91000001-912
7-11/40	Cover	1	56425	90410005-060

Table 7-12A. Parts List For Switchboard 3SC – DDG 52-54 - Continued

Figure/ Index No	Description	Qty	CAGE	Part No.
7-11/41	Cover	1	56425	90410005-020
7-11/42	Fuseboard	1	56425	91230002-009
7-11/43	Subpan	1	56425	90510004-090
7-11/44	Subpan	1	56425	90510004-009
7-11/45	Subpan	1	56425	90410005-086

Table 7-13. List of Manufacturers

CAGE	Manufacturer/Address
02989	General Electric Co., Drive System Department, 215 Maple St., Salem, VA 24153
03516	General Electric Co. Meter Business Dept. 130 Main St., Somersworth, NH 03878
15309	A & M Instruments, Inc., 850 Perimeter Rd., Manchester, NH 03103
27191	Cutler Hammer, Inc., Power Dist. & Control Div., 4201 N. 27 St., Milwaukee, WI 53216
27192	Eaton Corp., Cutler-Hammer Group Power Control Division, 4265 No. 30th St., Milwaukee, WI 53216
30086	SPD Technologies, Inc., 13500 Roosevelt Blvd., Philadelphia, PA 19116
39805	Whipp & Bourne, Inc., 2500 Alameda Ave, Ste. 115, Norfolk, VA 23513-2403
4N915	Automatic Terminal Information Systems (ATIS), 7110 Satsuma Drive, Houston, TX 77041
56425	International Switchboard Corp., 730 Sartarita Rd., Sugarland, TX 77487
56694	J & H Smith Light Corp., 39 Wisner Ave., Newburgh, NY 12550
58475	NMP Corp., 12437 East 60th Street, P.O. Box 35493, Tulsa, OK 74153-049
71400	Cooper Bussman, Inc., 114 Old State Rd., Ballwin, MO 63021
71669	General Electric Co., Switchgear and Control Division of Apparatus Gear, Philadelphia, PA
77342	Tyco Electronics Corporation, 8010 Piedmont Triad Pkwy, Greensboro NC, 27409
81349	Military Specifications Promulgated by Military Depts/Agencies Under Authority of Defense Standardization Manual 4120 3-M
82121	Electro Switch Corp., King Avenue, Weymouth, MA 01288
89946	Westinghouse Electric, Corp., One Tuscarawas Rd., Beaver, PA 15009-1720
98403	Amerace Corp, Control Products Div., 1000 Hickory, Grafton, WI 53024

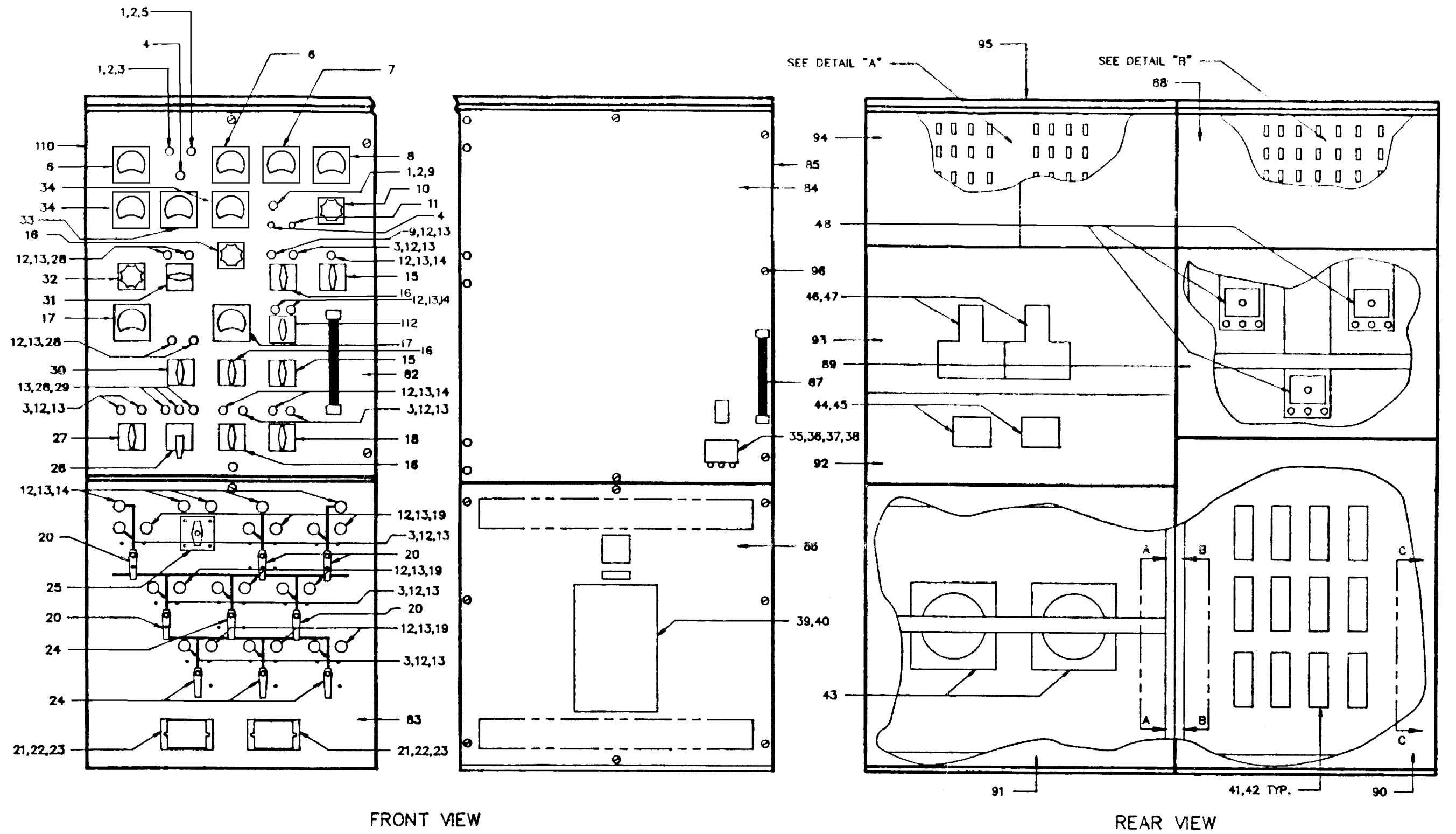


Figure 7-1. ISG Switchboard Assembly (Sheet 1 of 3)

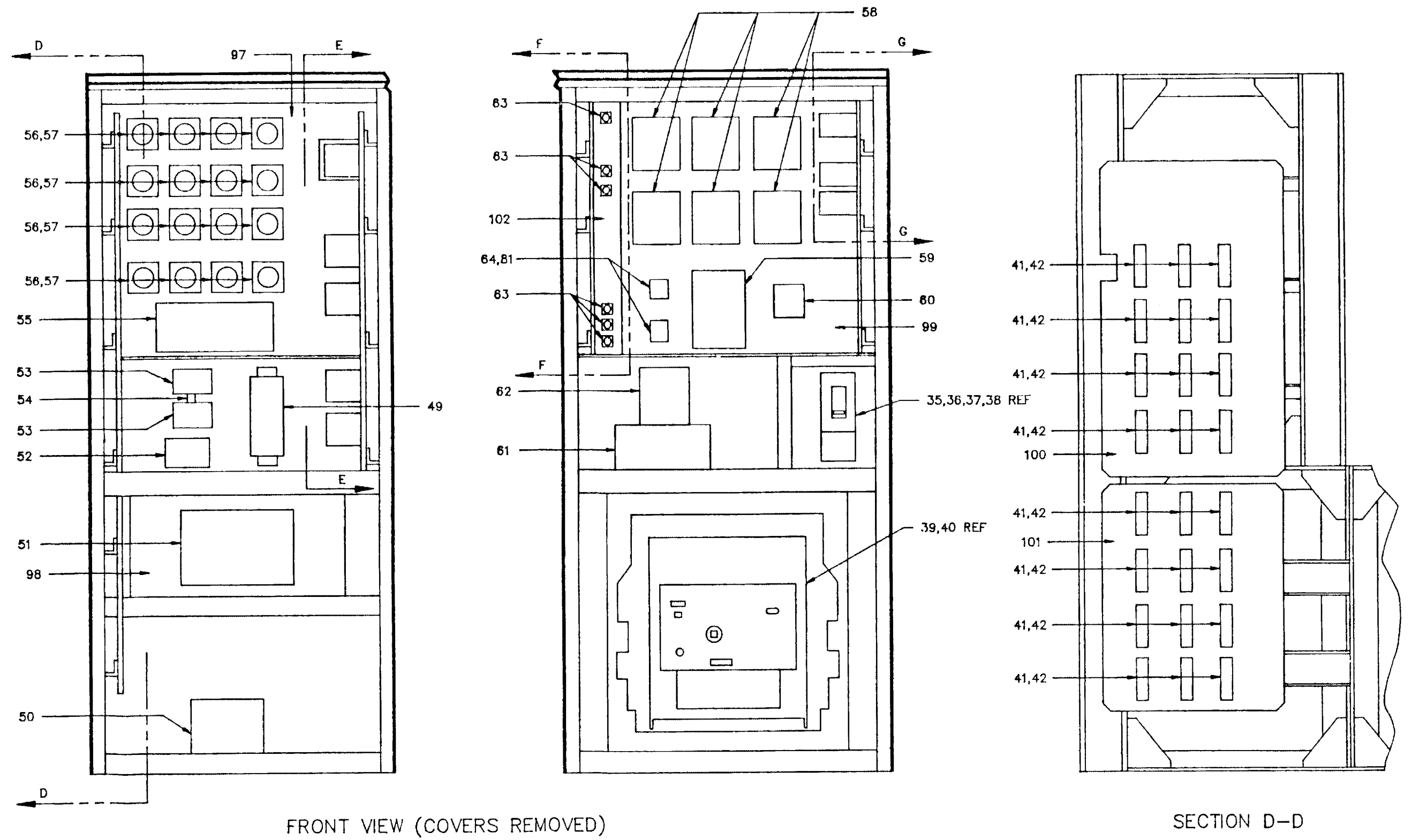


Figure 7-1. ISG Switchboard Assembly (Sheet 2 of 3)

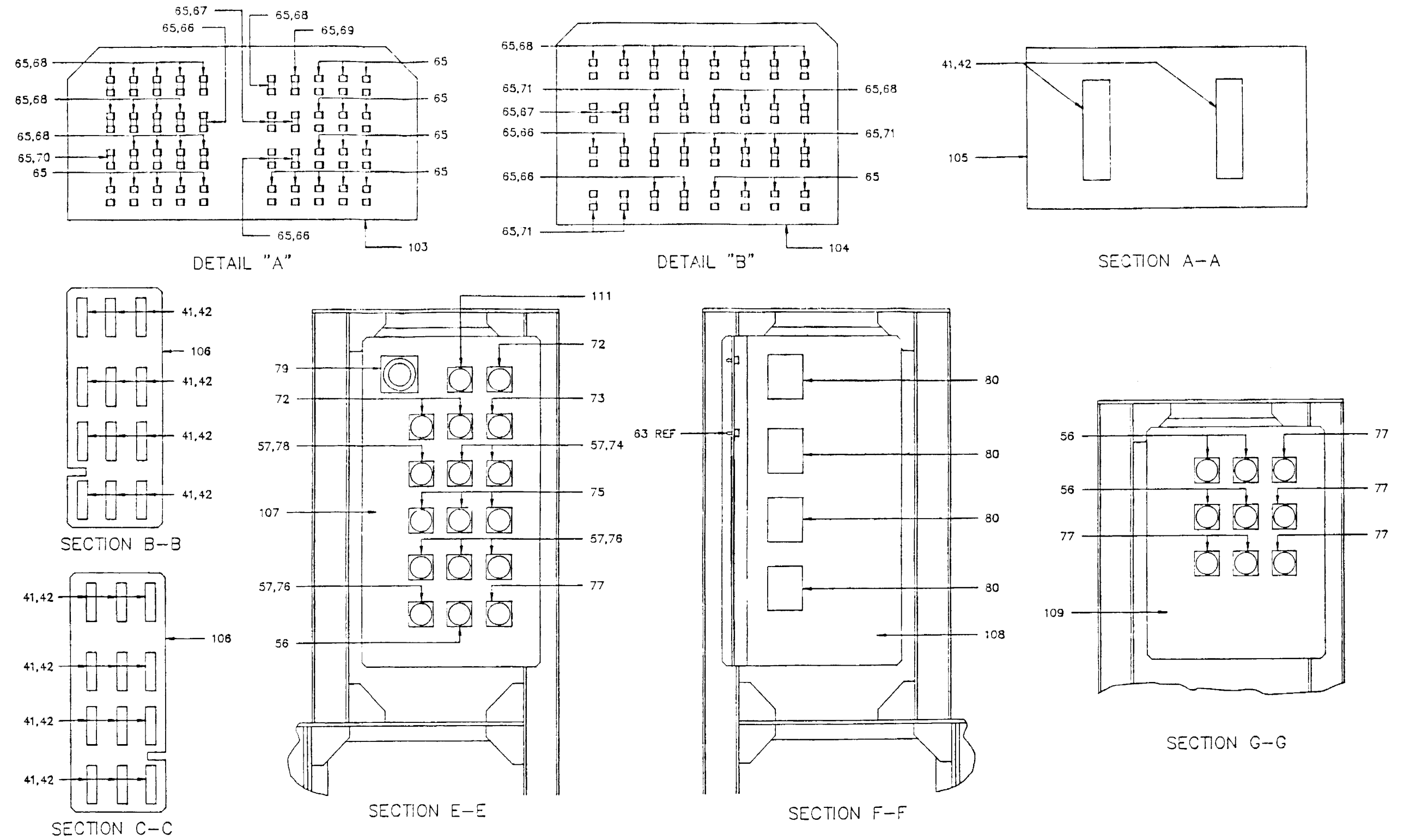


Figure 7-1. 1SG Switchboard Assembly (Sheet 3 of 3)

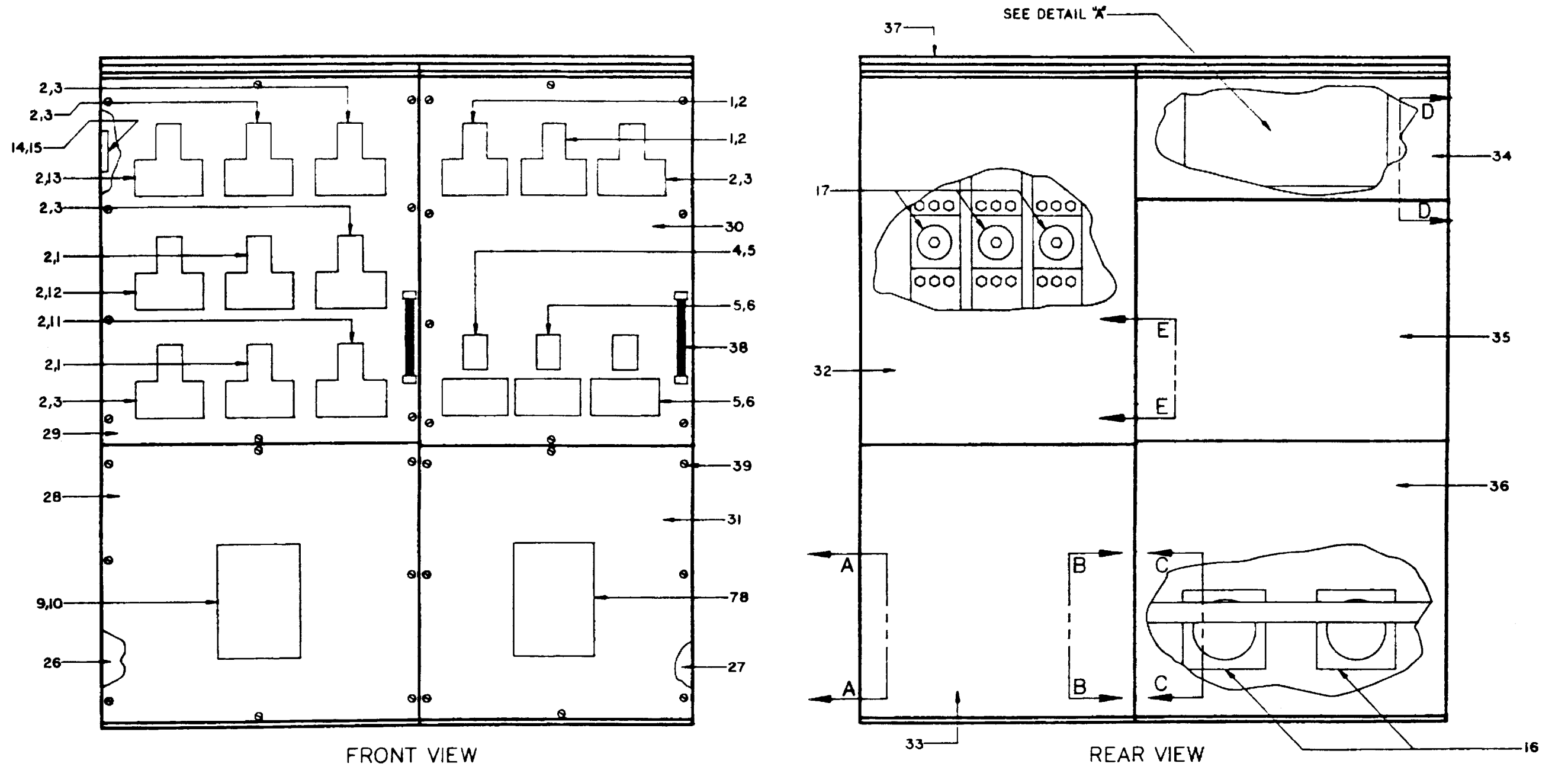


Figure 7-2. ISA Switchboard Assembly (Sheet 1 of 2)

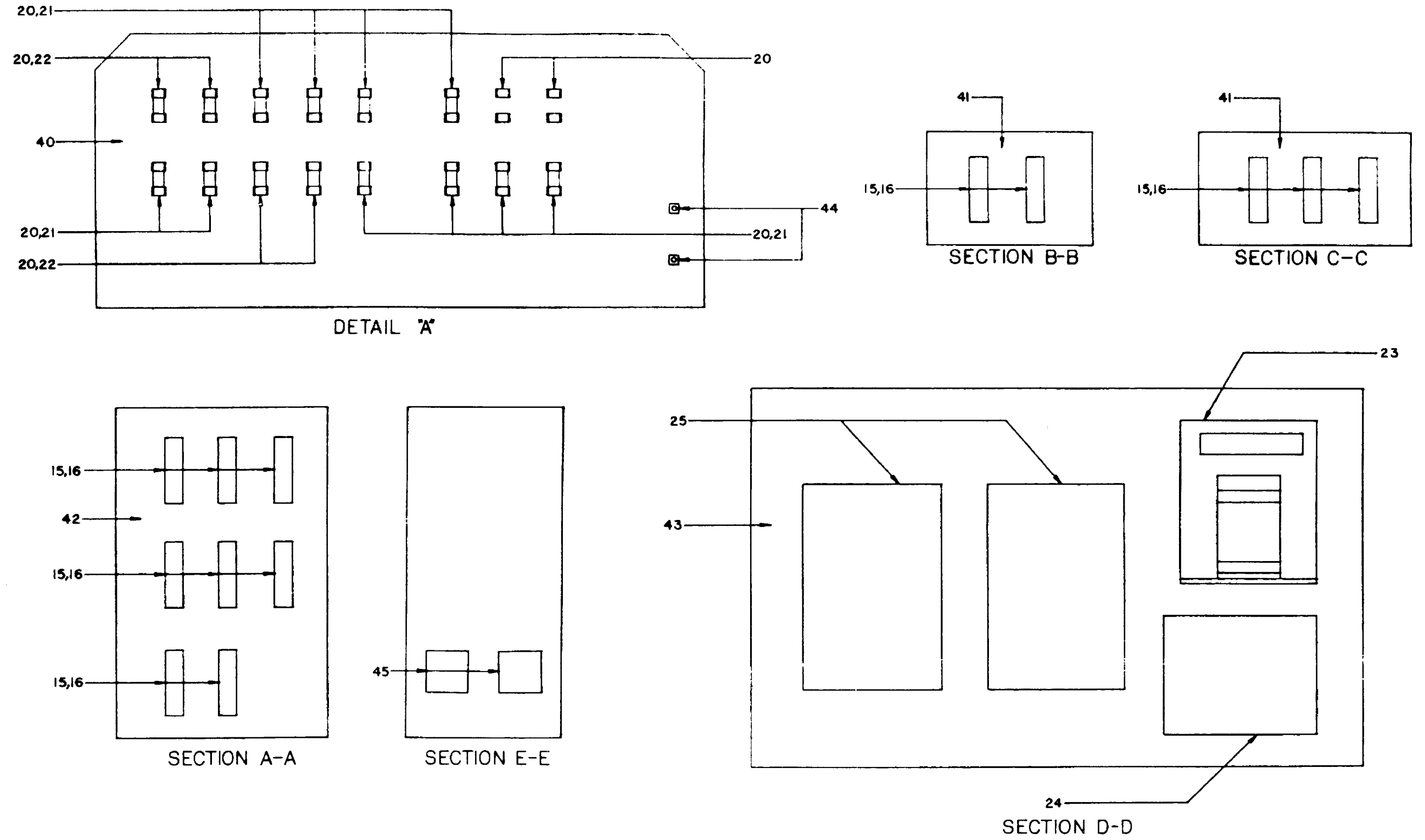


Figure 7-2. ISA Switchboard Assembly (Sheet 2 of 2)

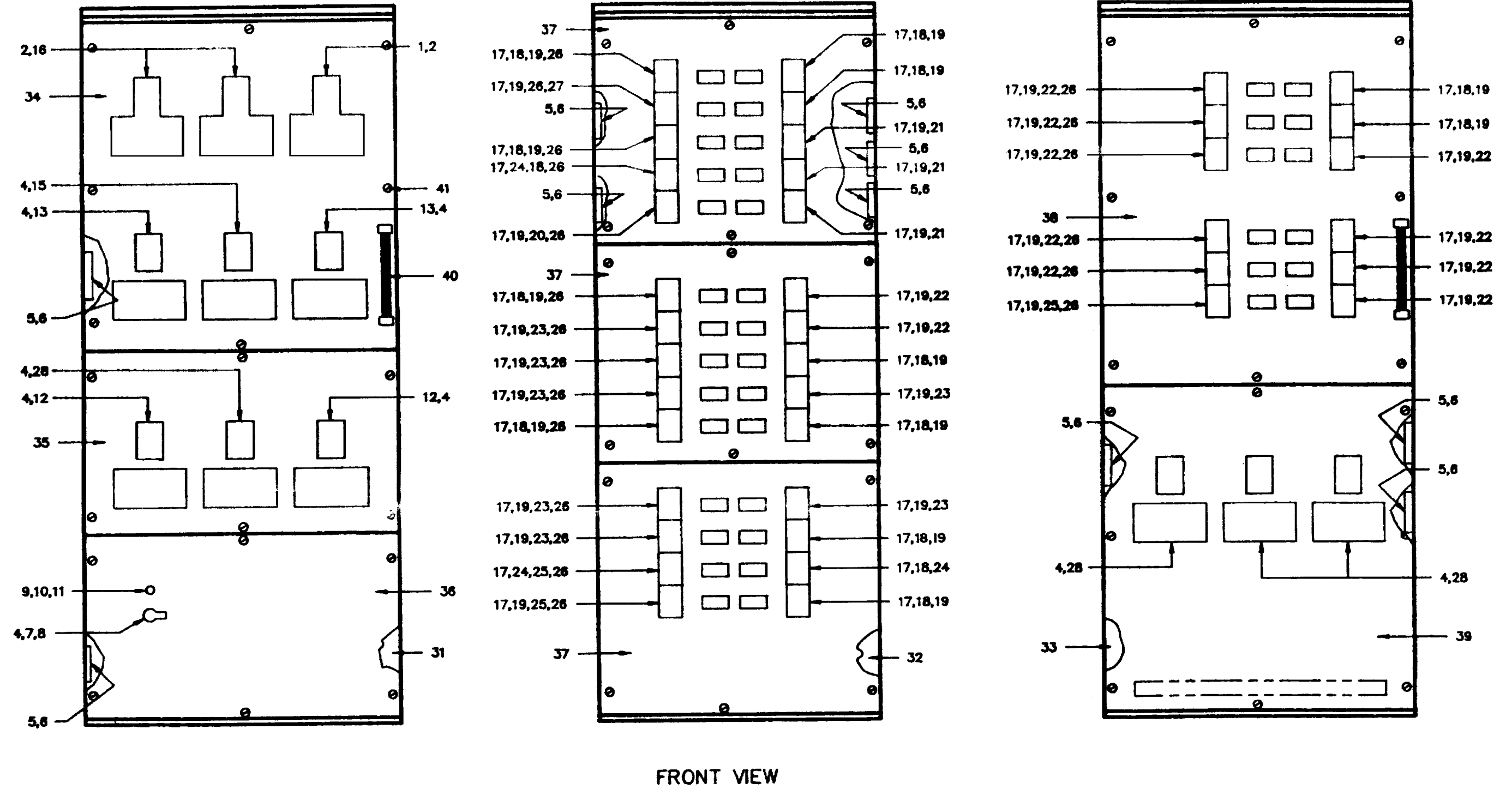


Figure 7-3. ISB Switchboard Assembly (Sheet 1 of 2)

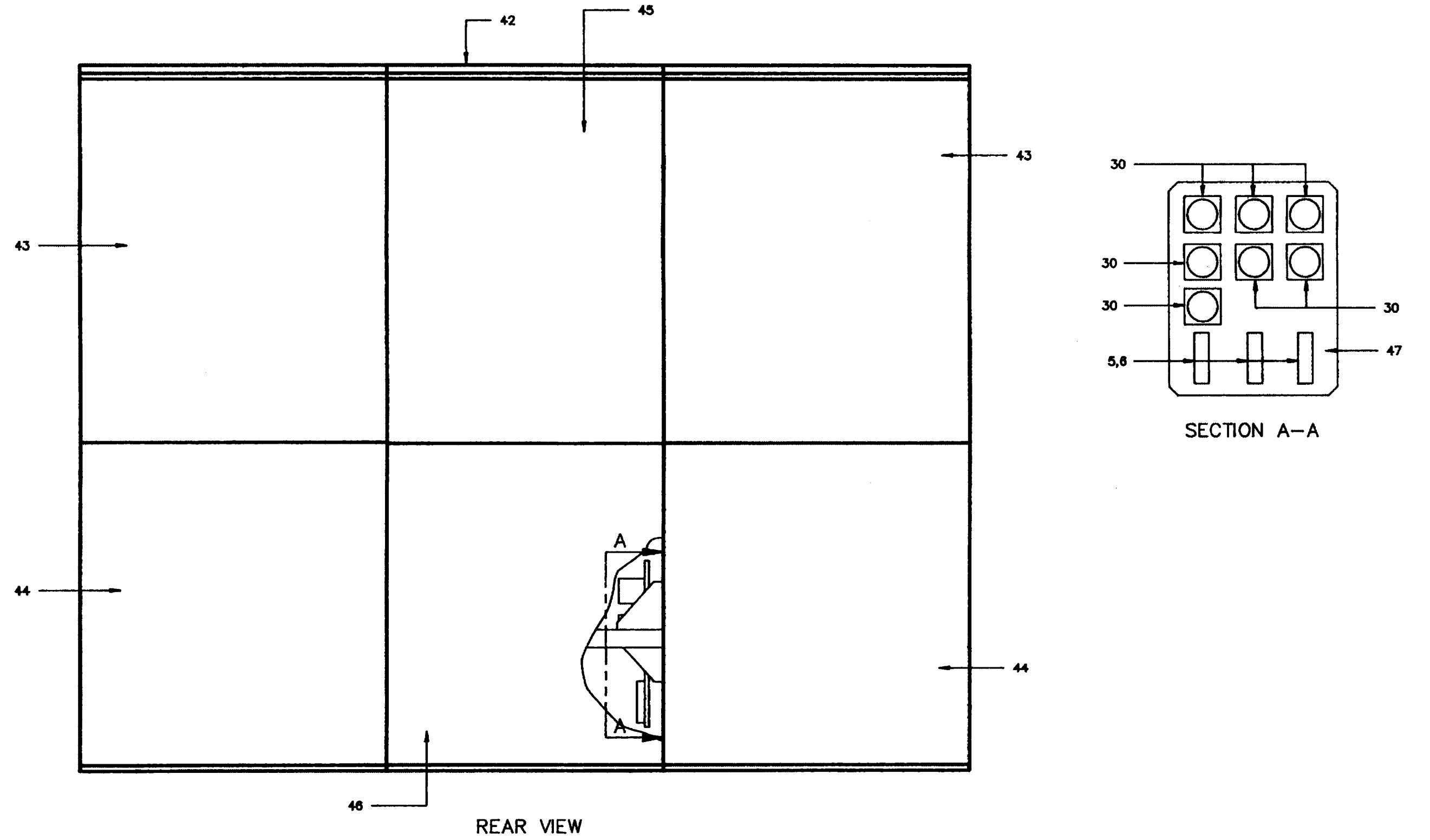
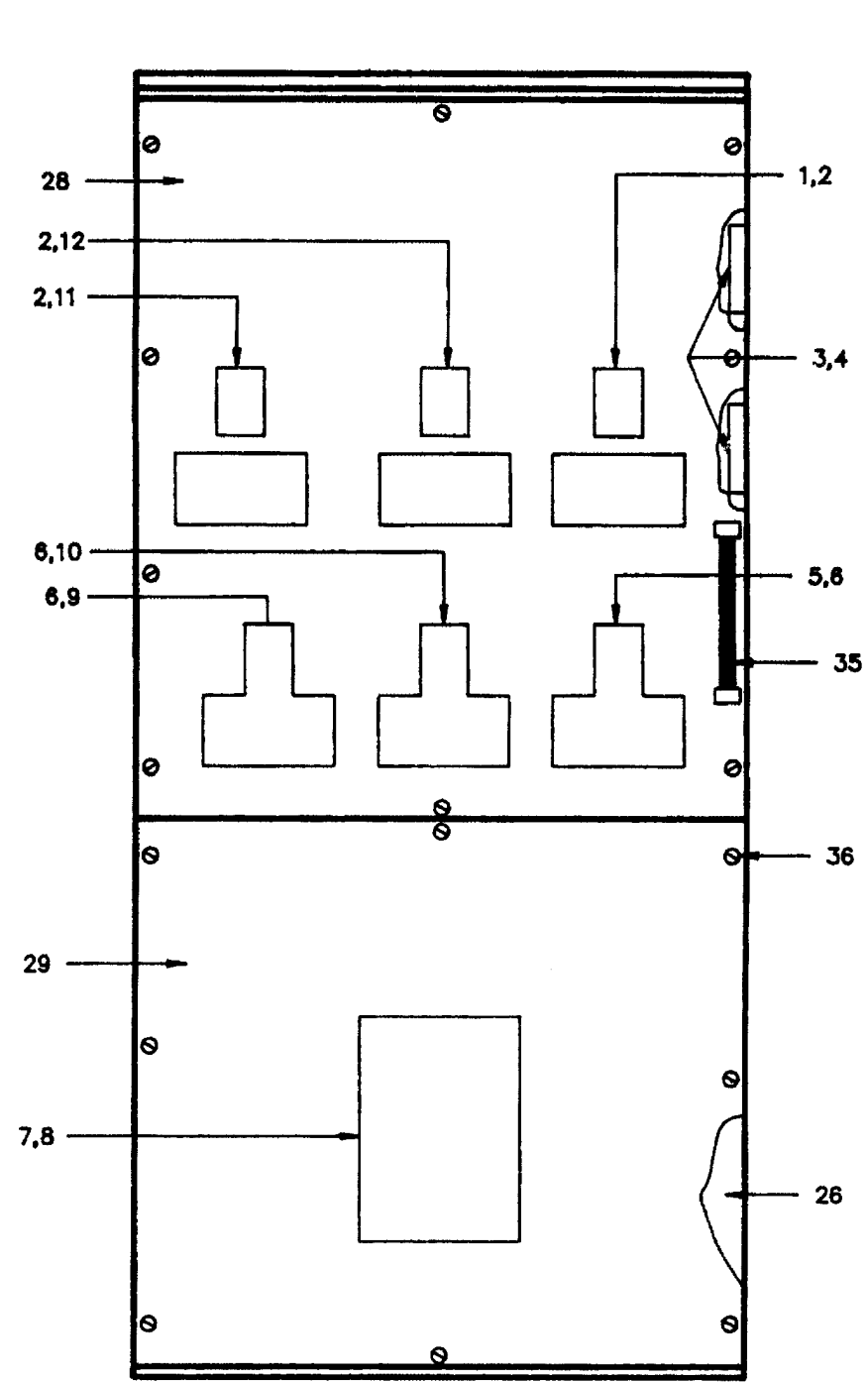


Figure 7-3. 1SB Switchboard Assembly (Sheet 2 of 2)



FRONT VIEW

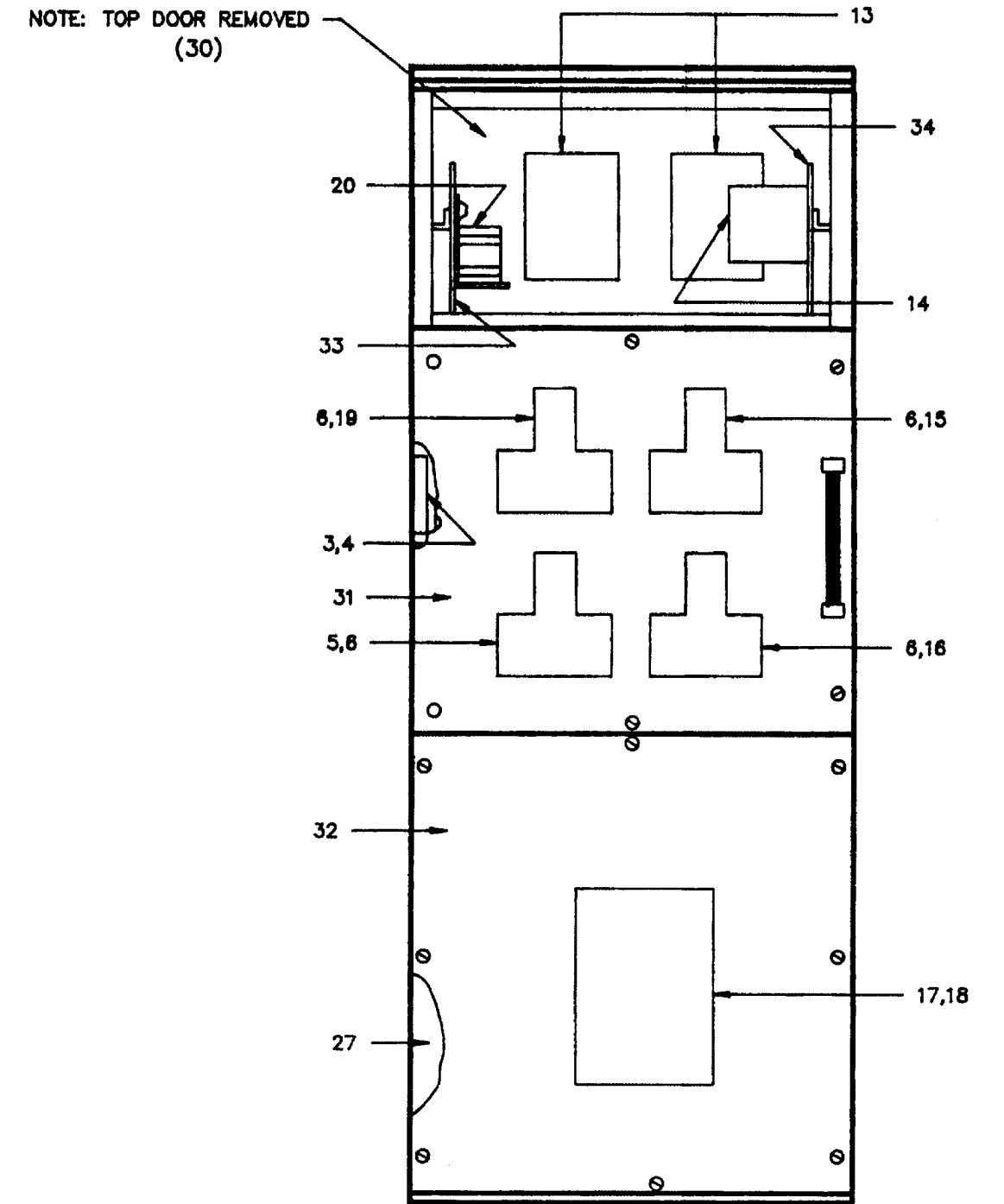


Figure 7-4. ISC Switchboard Assembly (Sheet 1 of 2)

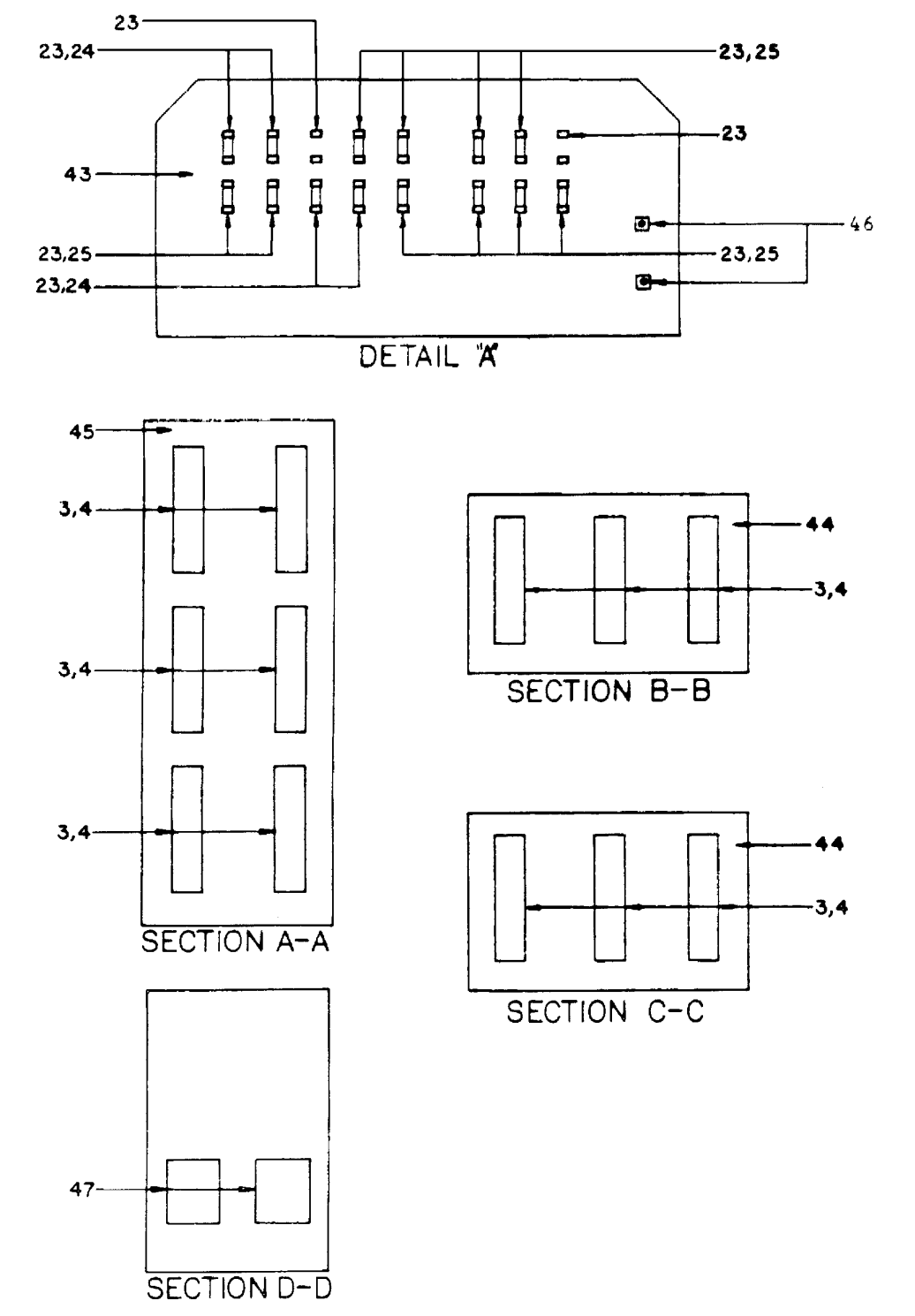
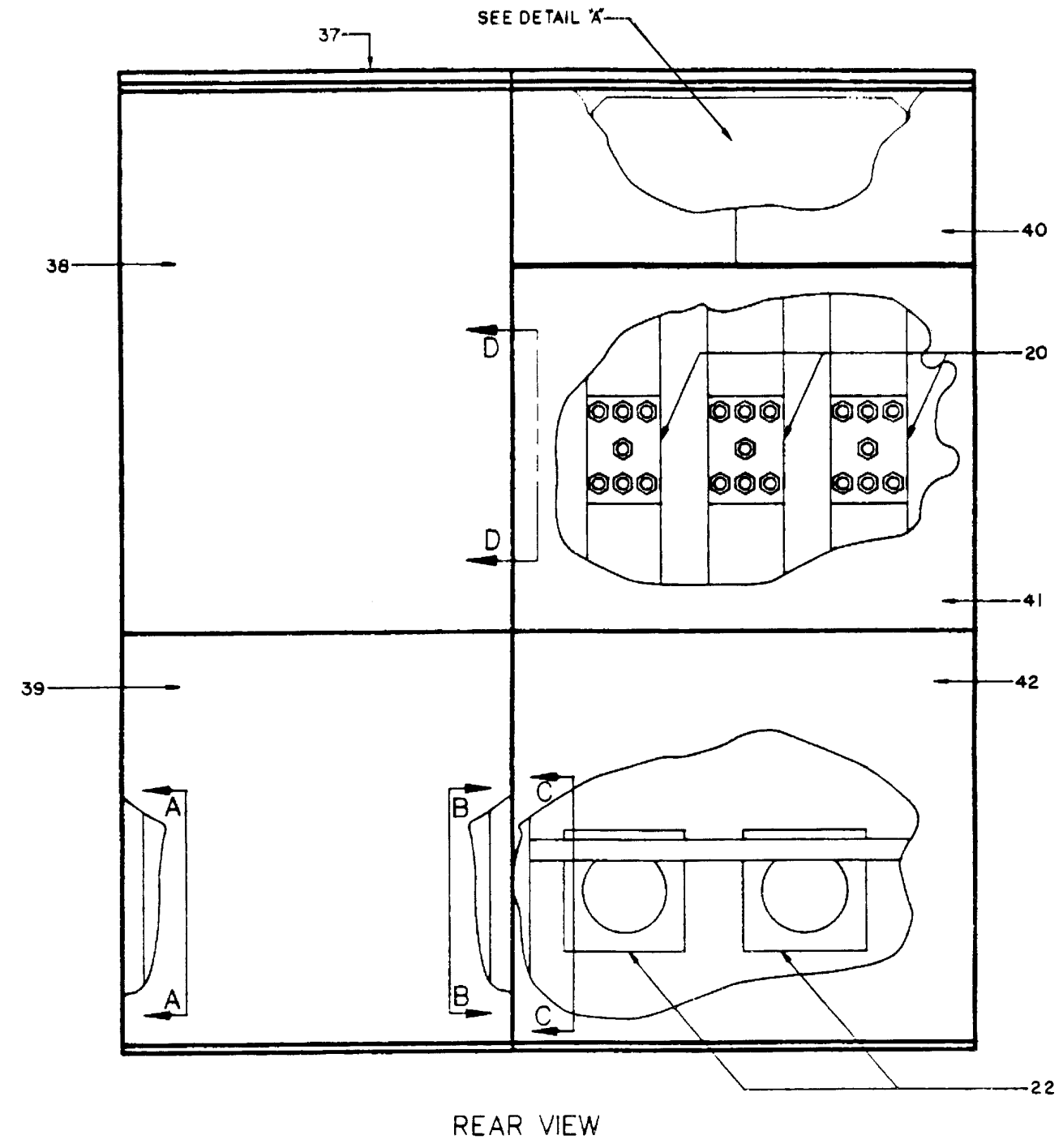
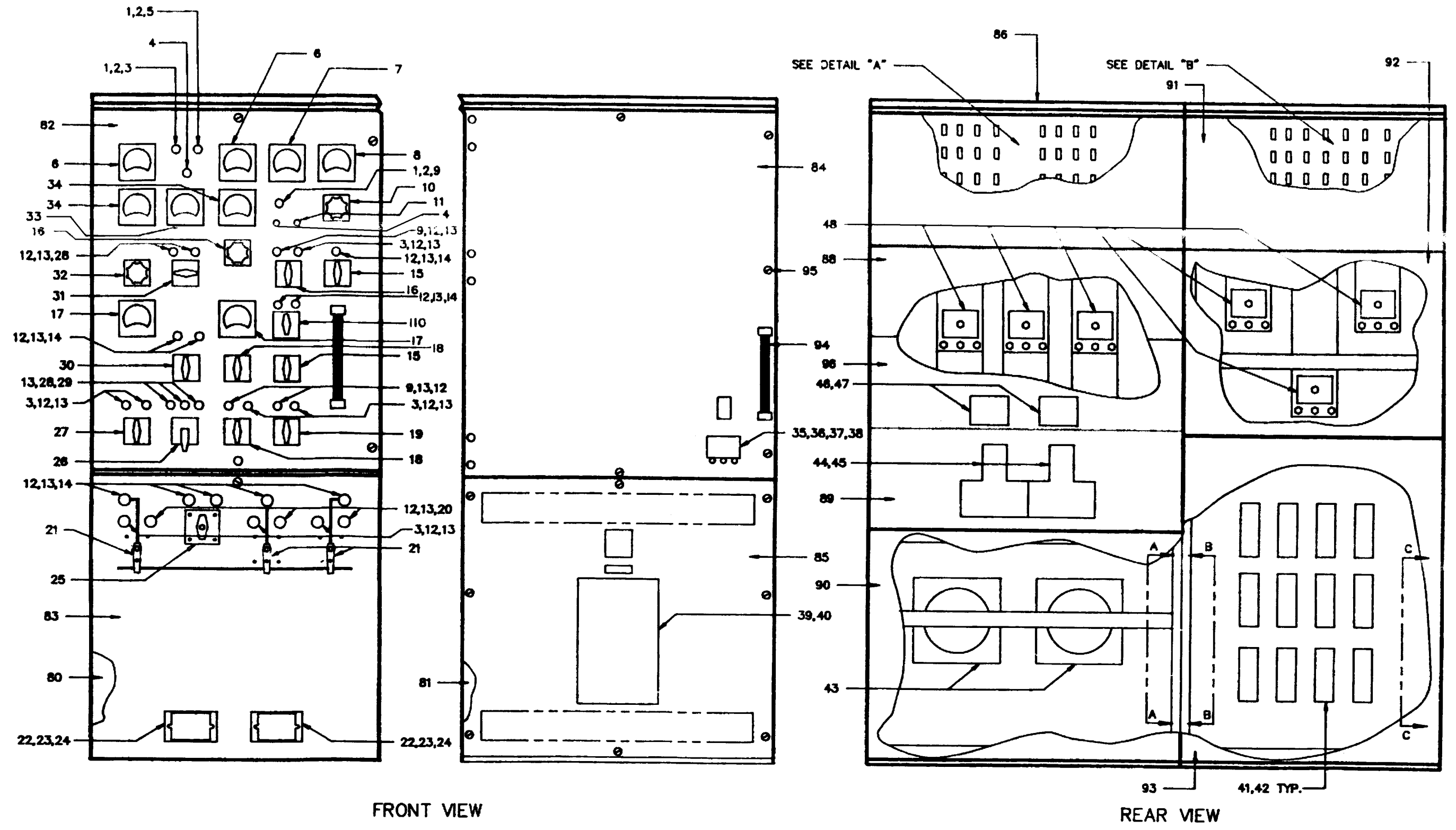


Figure 7-4. ISC Switchboard Assembly (Sheet 2 of 2)



FRONT VIEW

REAR VIEW

Figure 7-5. 2SG Switchboard Assembly (Sheet 1 of 3)

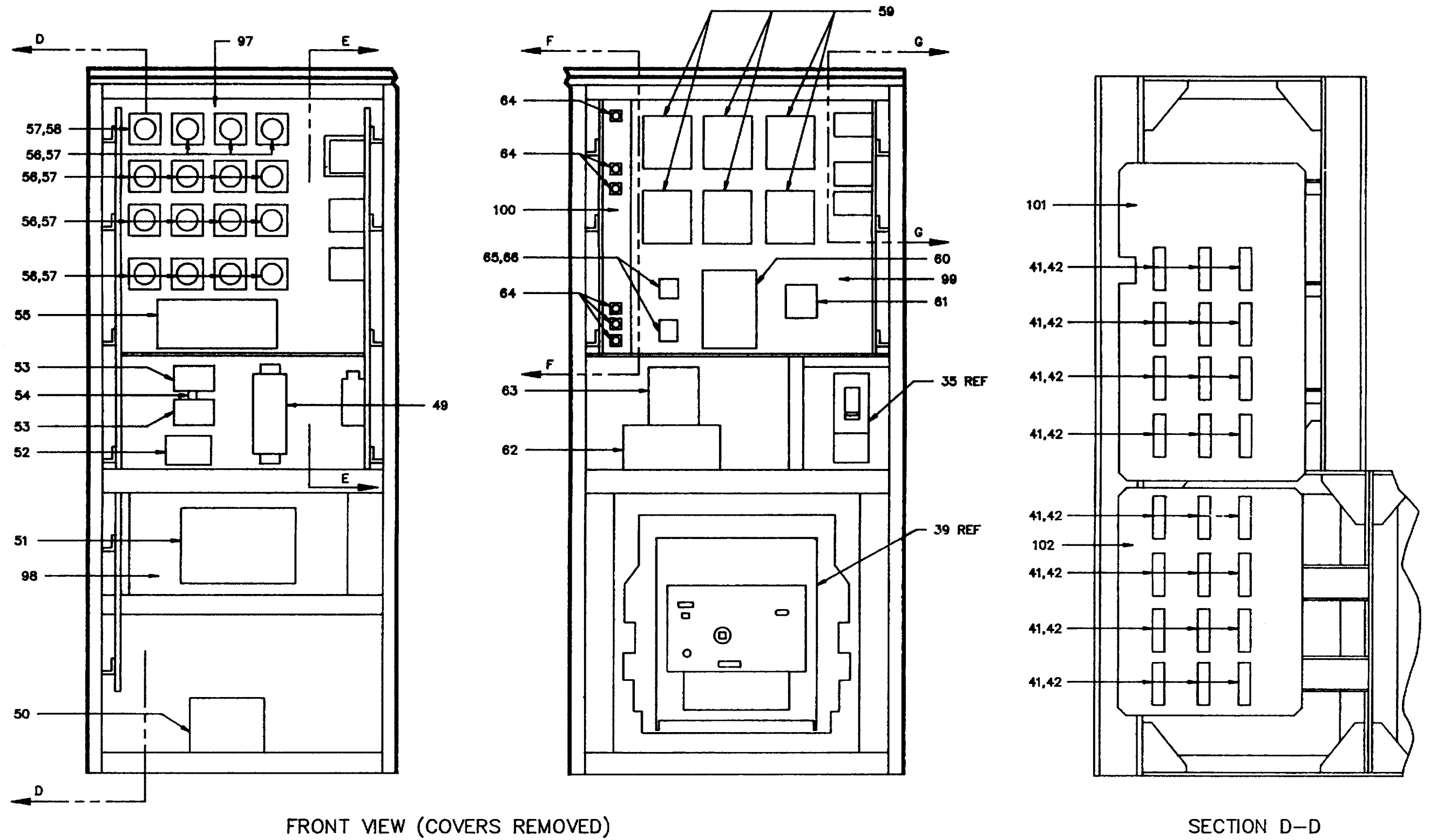


Figure 7-5. 2SG Switchboard Assembly (Sheet 2 of 3)

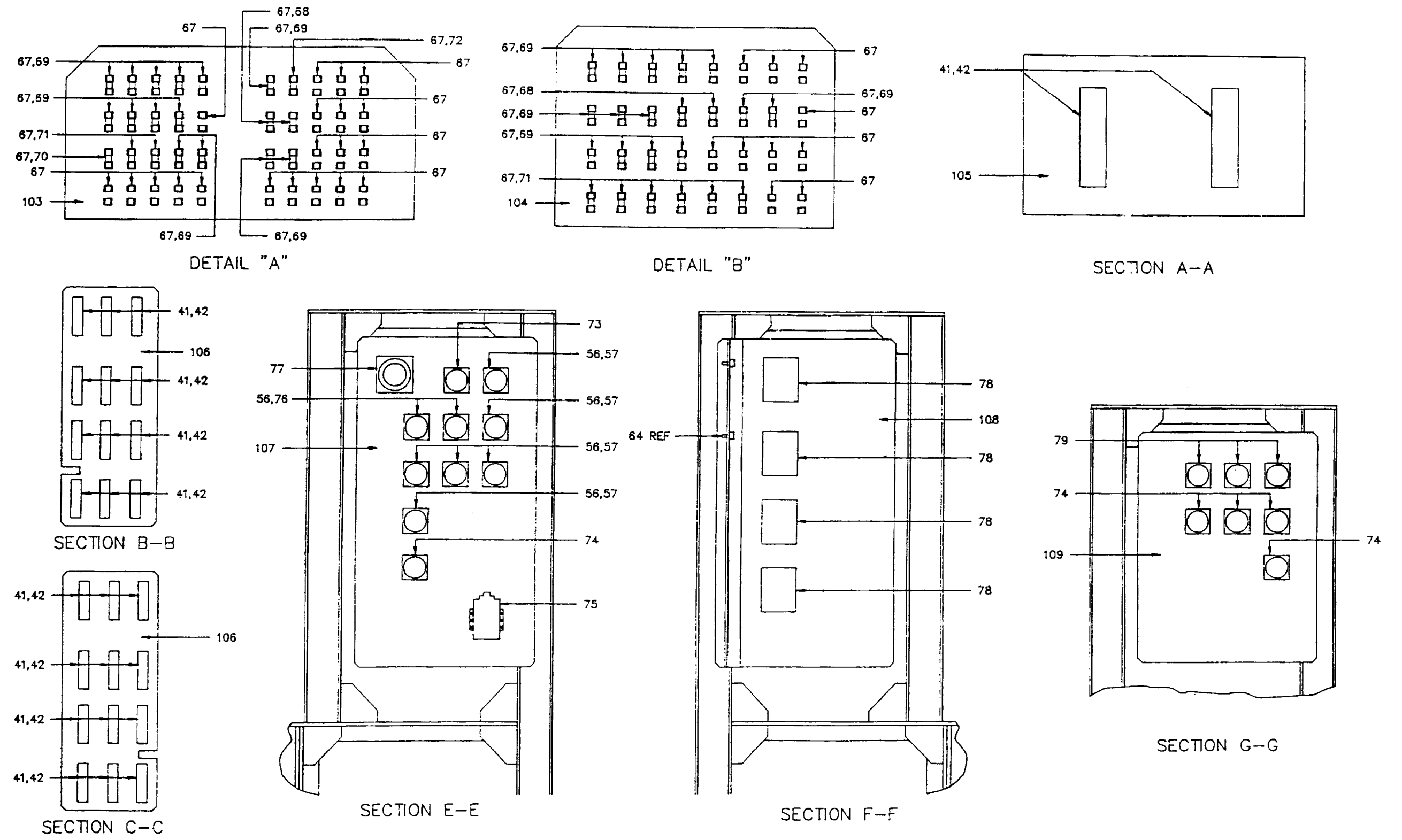


Figure 7-5. 2SG Switchboard Assembly (Sheet 3 of 3)

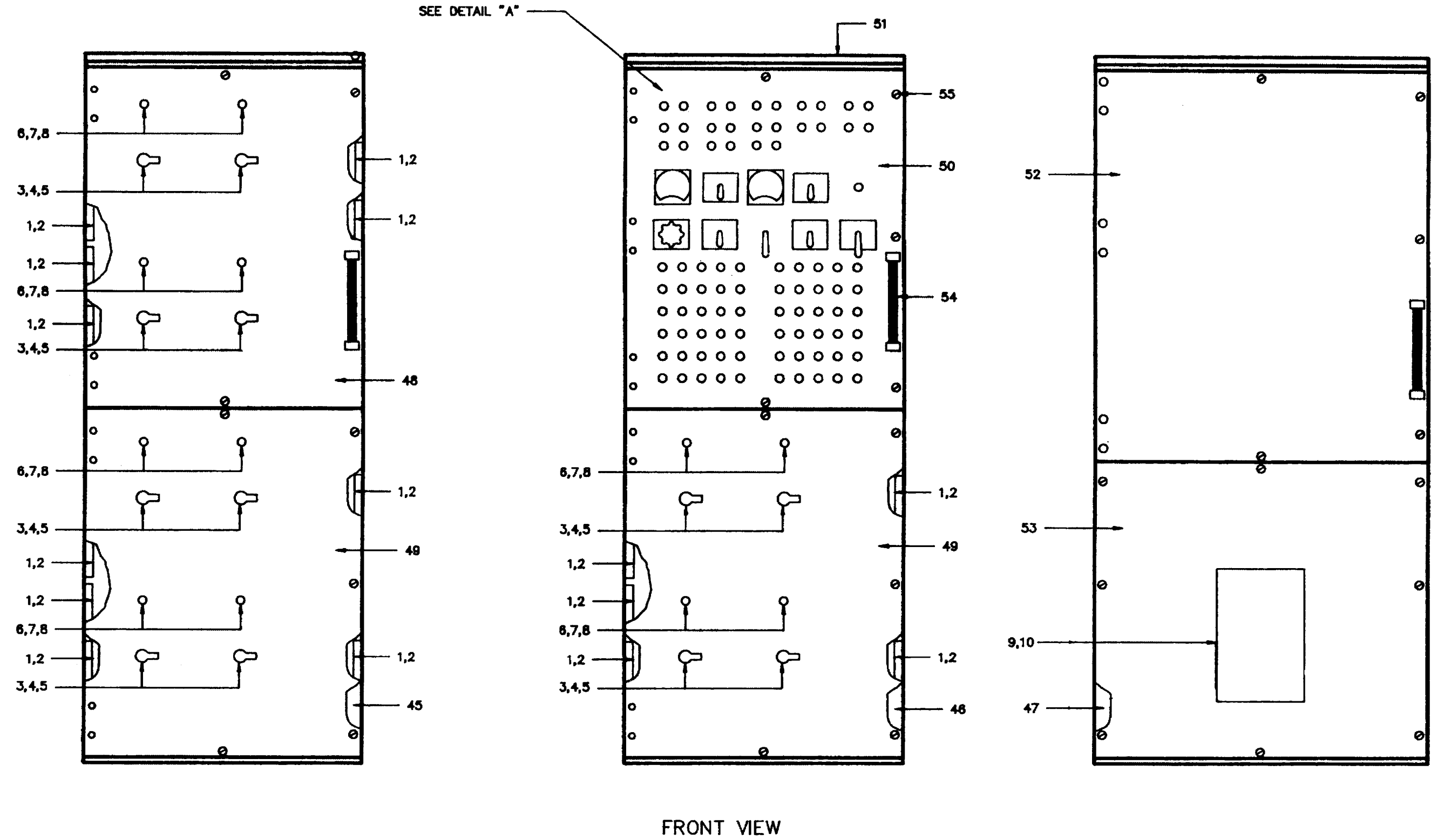
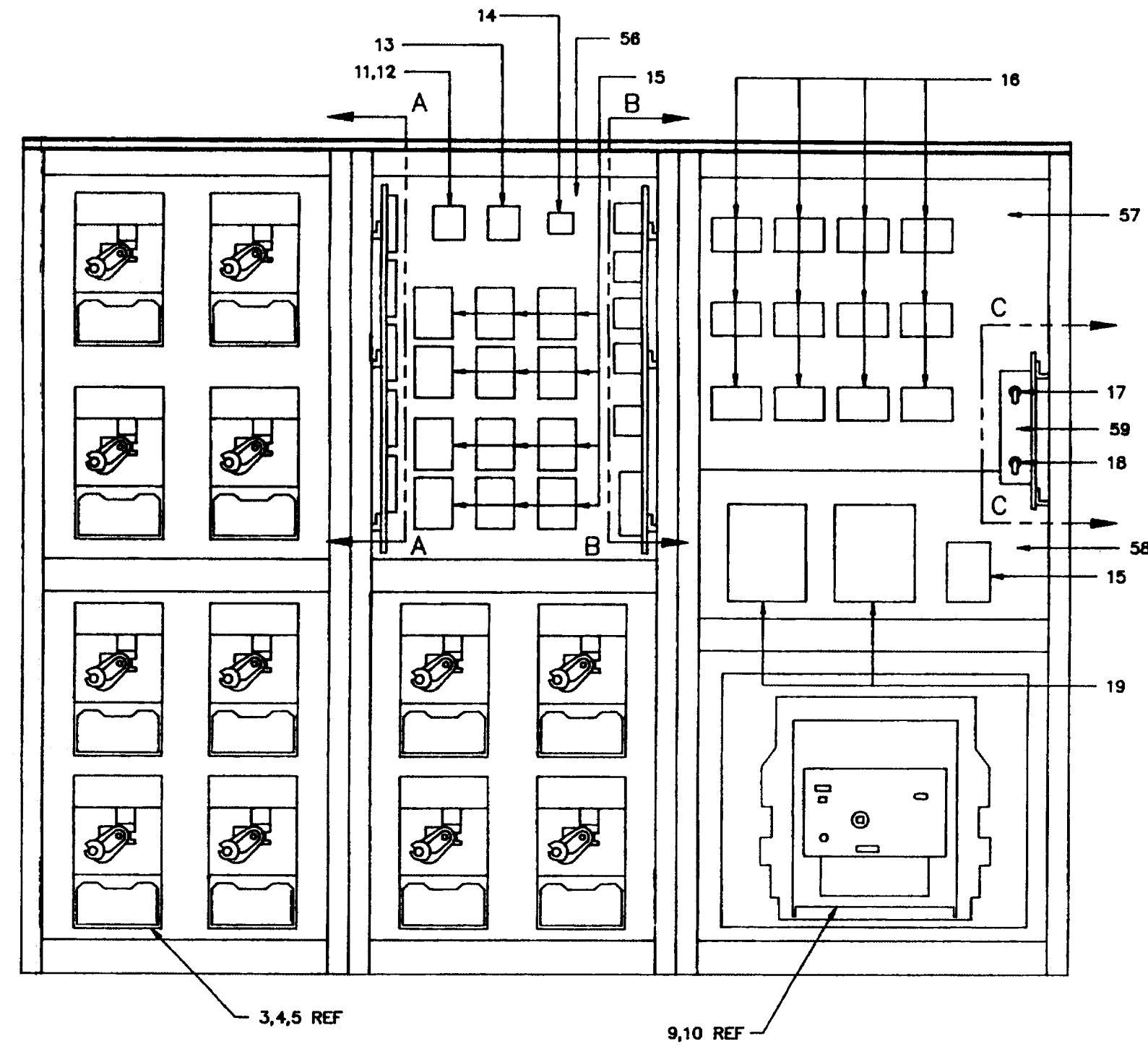
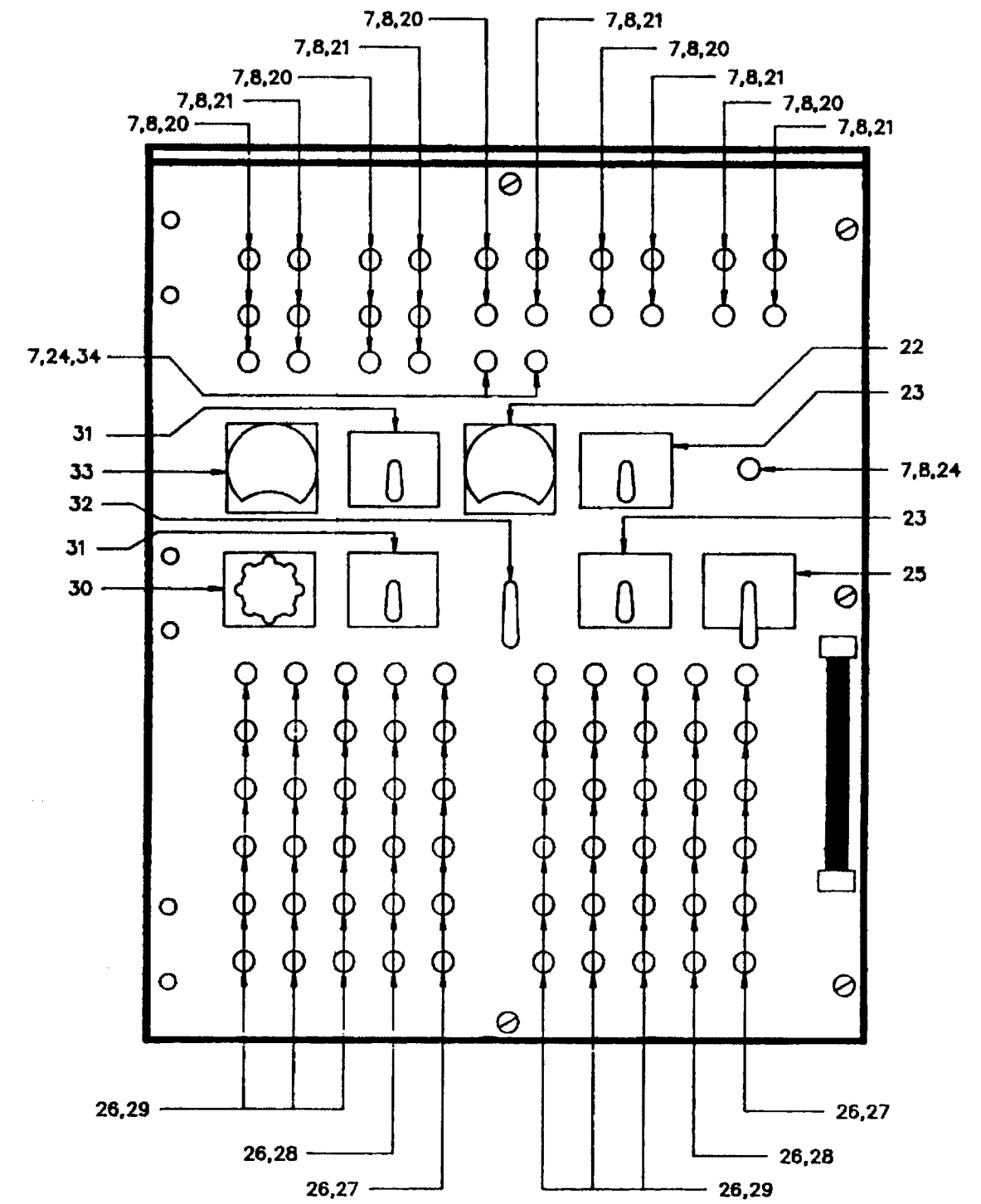


Figure 7-6. 2SA Switchboard Assembly (Sheet 1 of 4)



FRONT VIEW (COVERS REMOVED)



DETAIL "A"

Figure 7-6. 2SA Switchboard Assembly (Sheet 2 of 4)

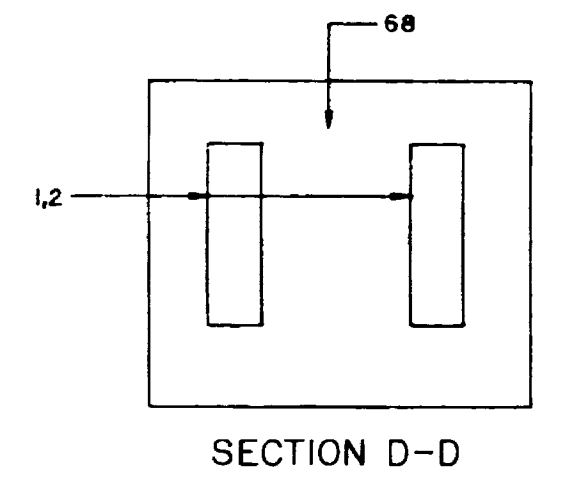
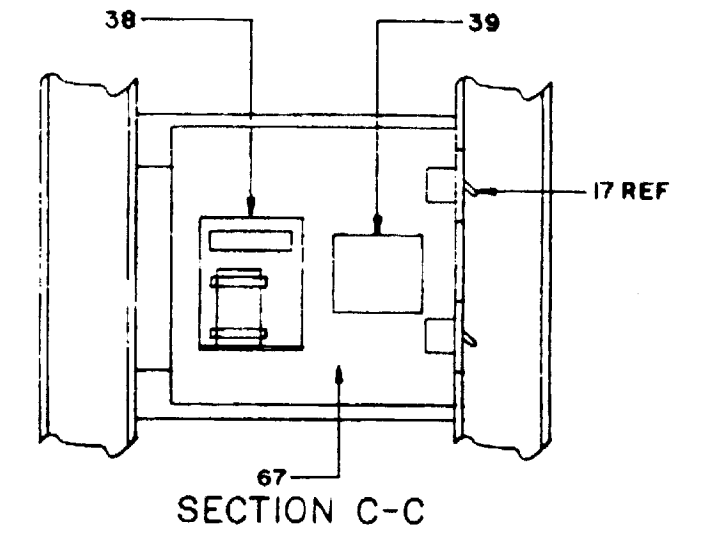
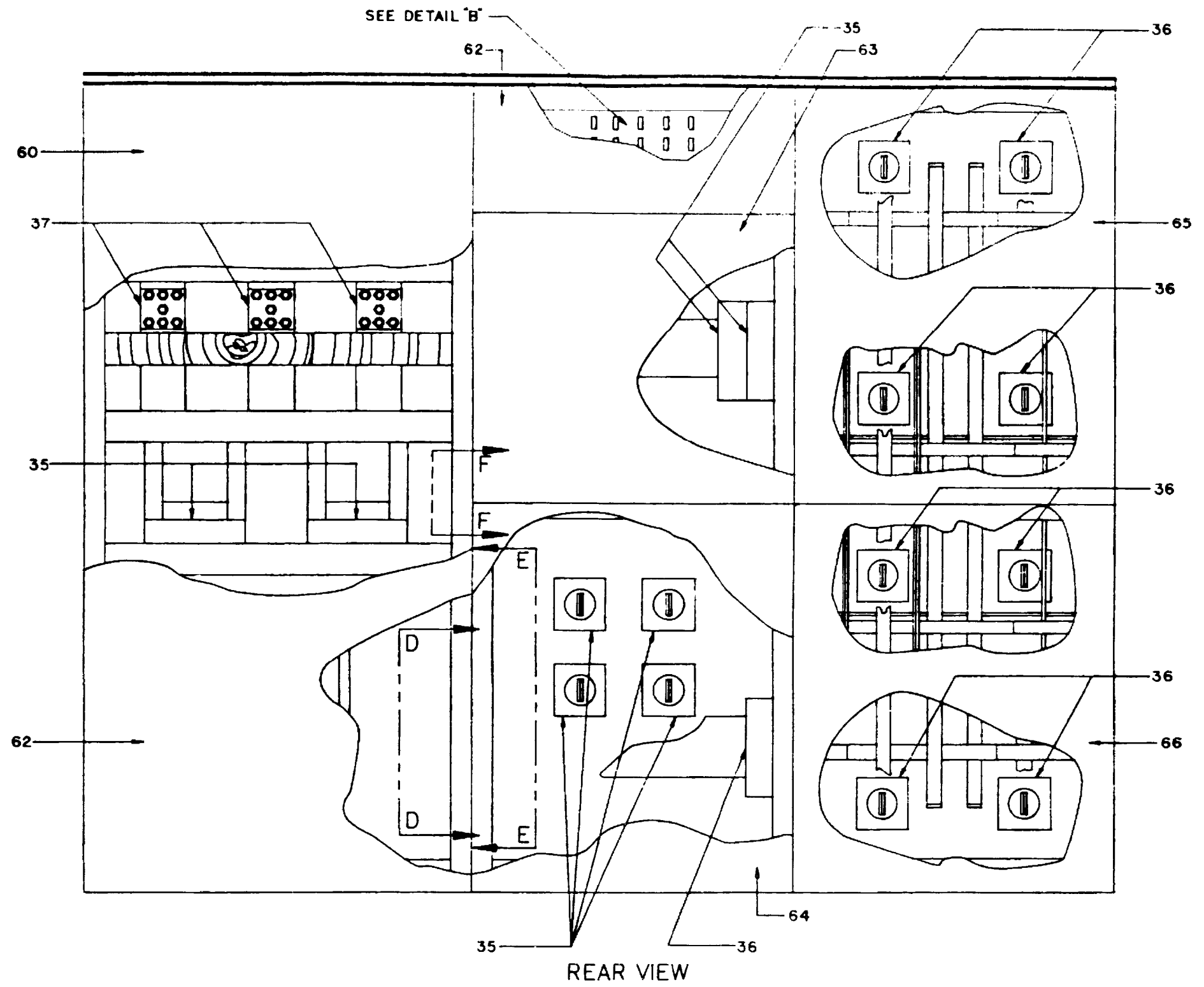


Figure 7-6. 2SA Switchboard Assembly (Sheet 3 of 4)

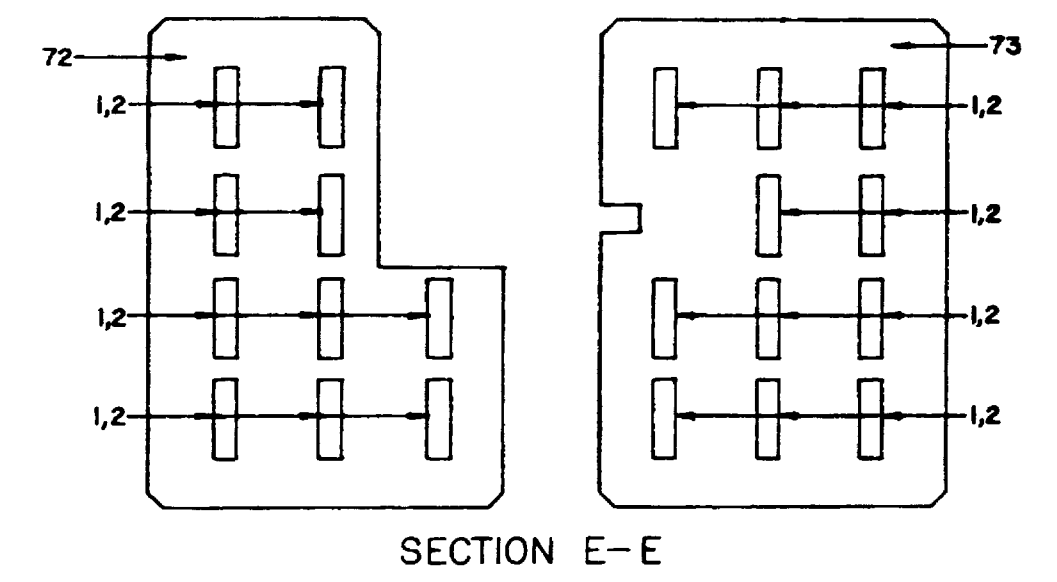
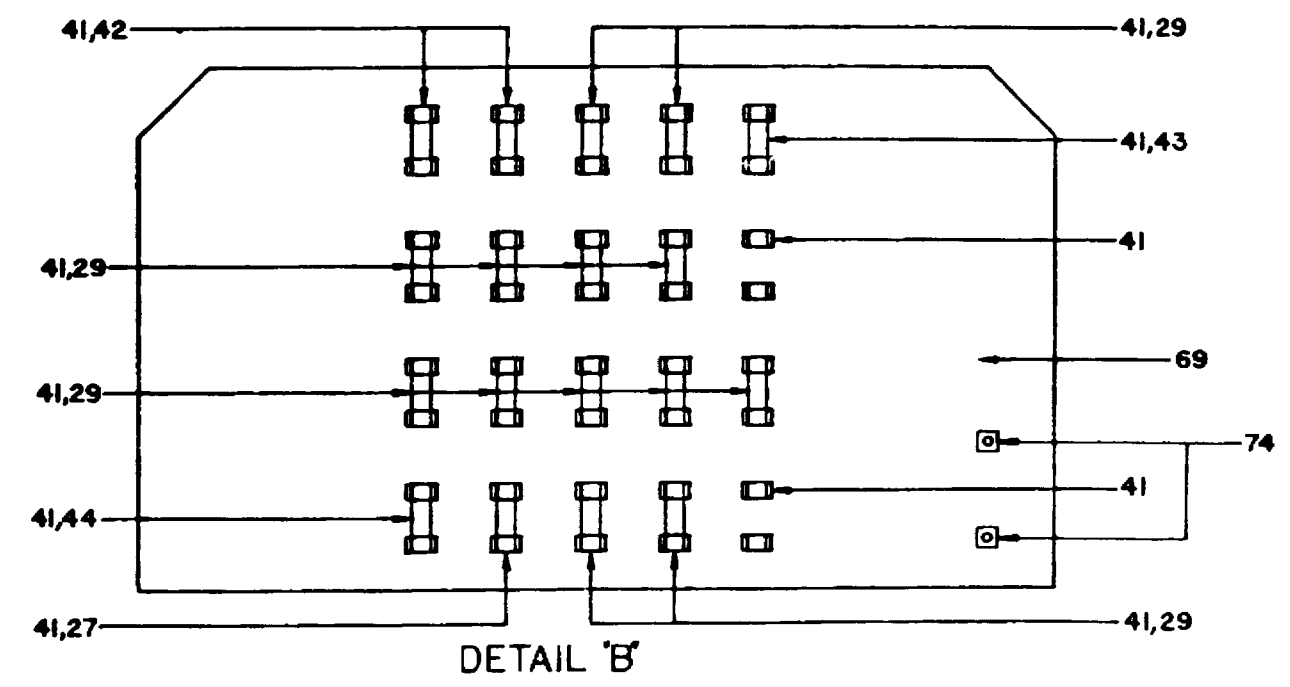
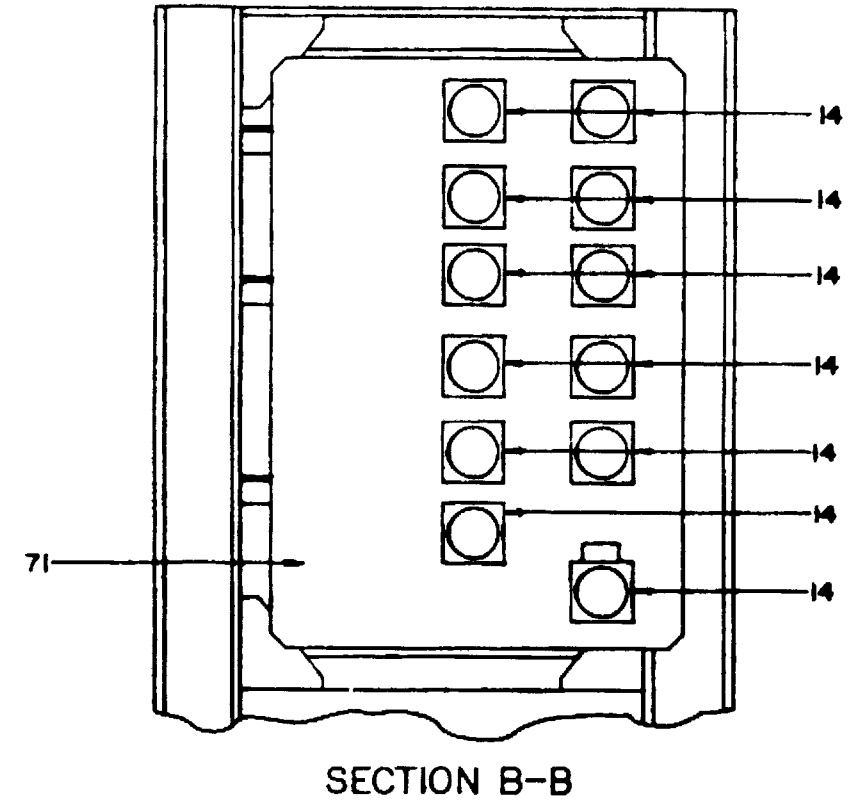
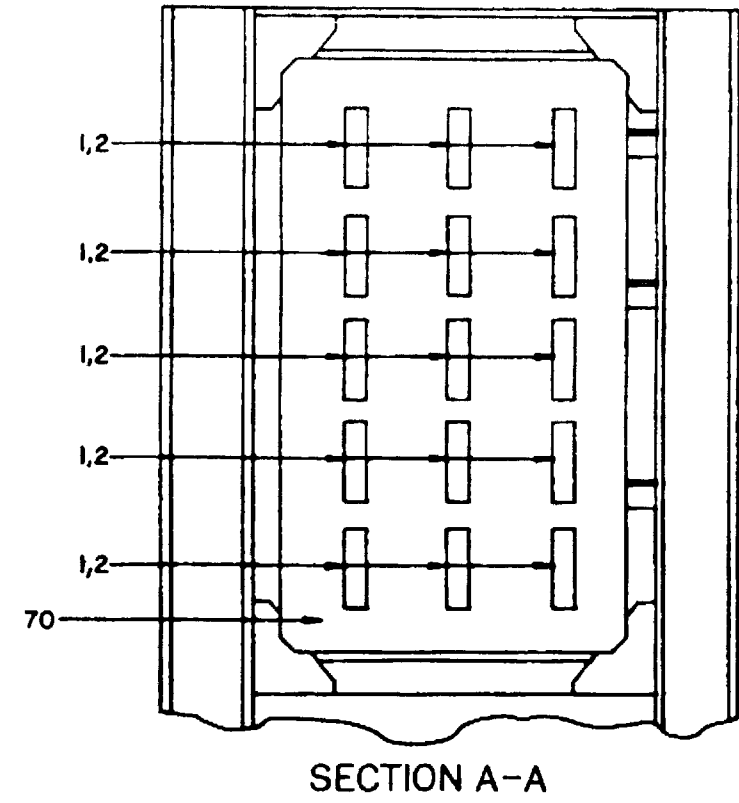
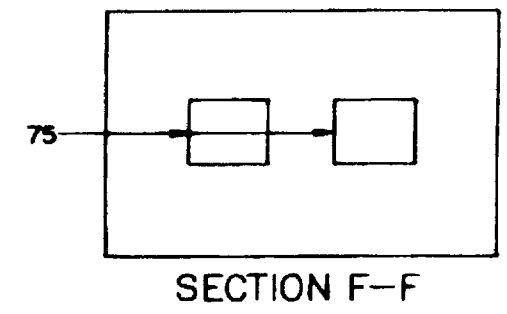
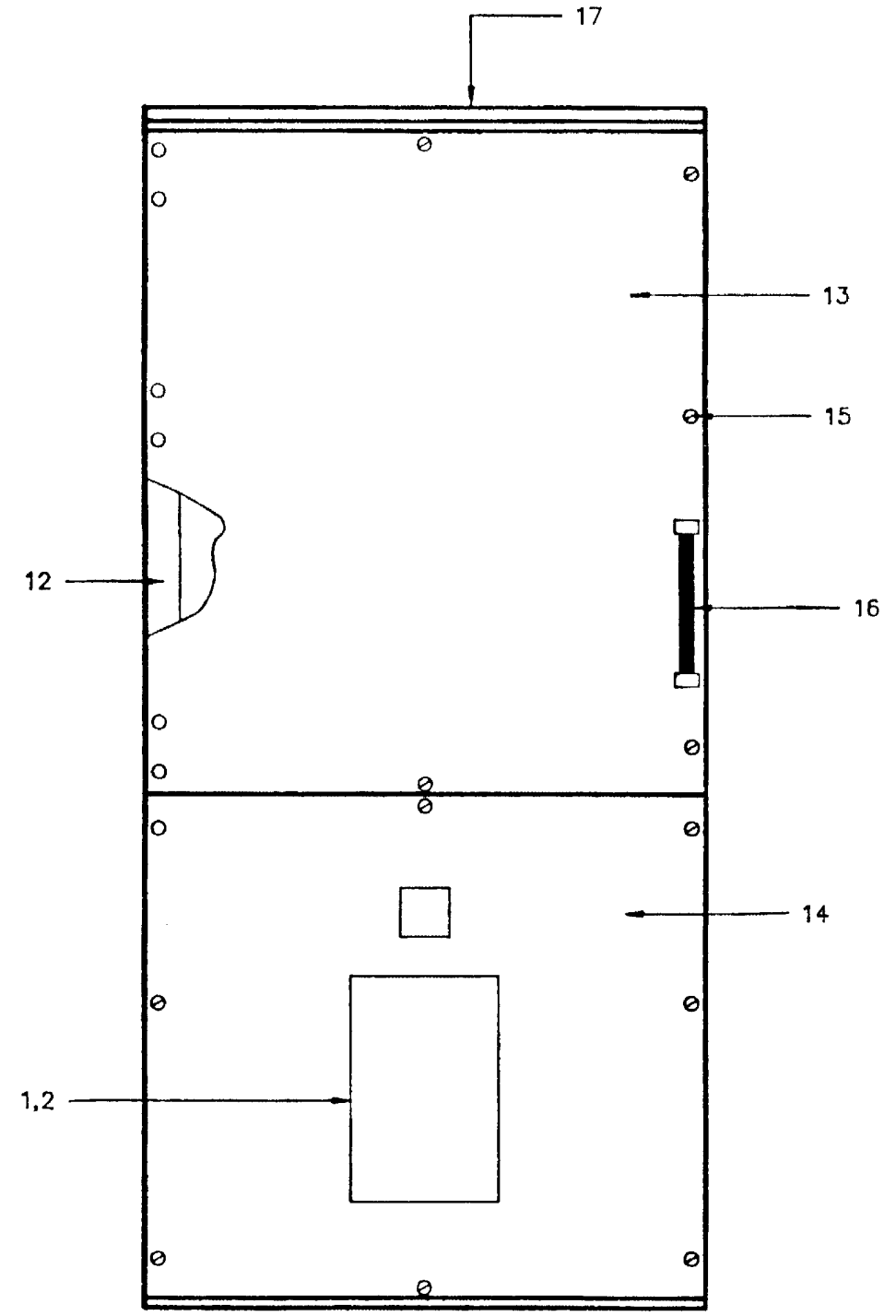
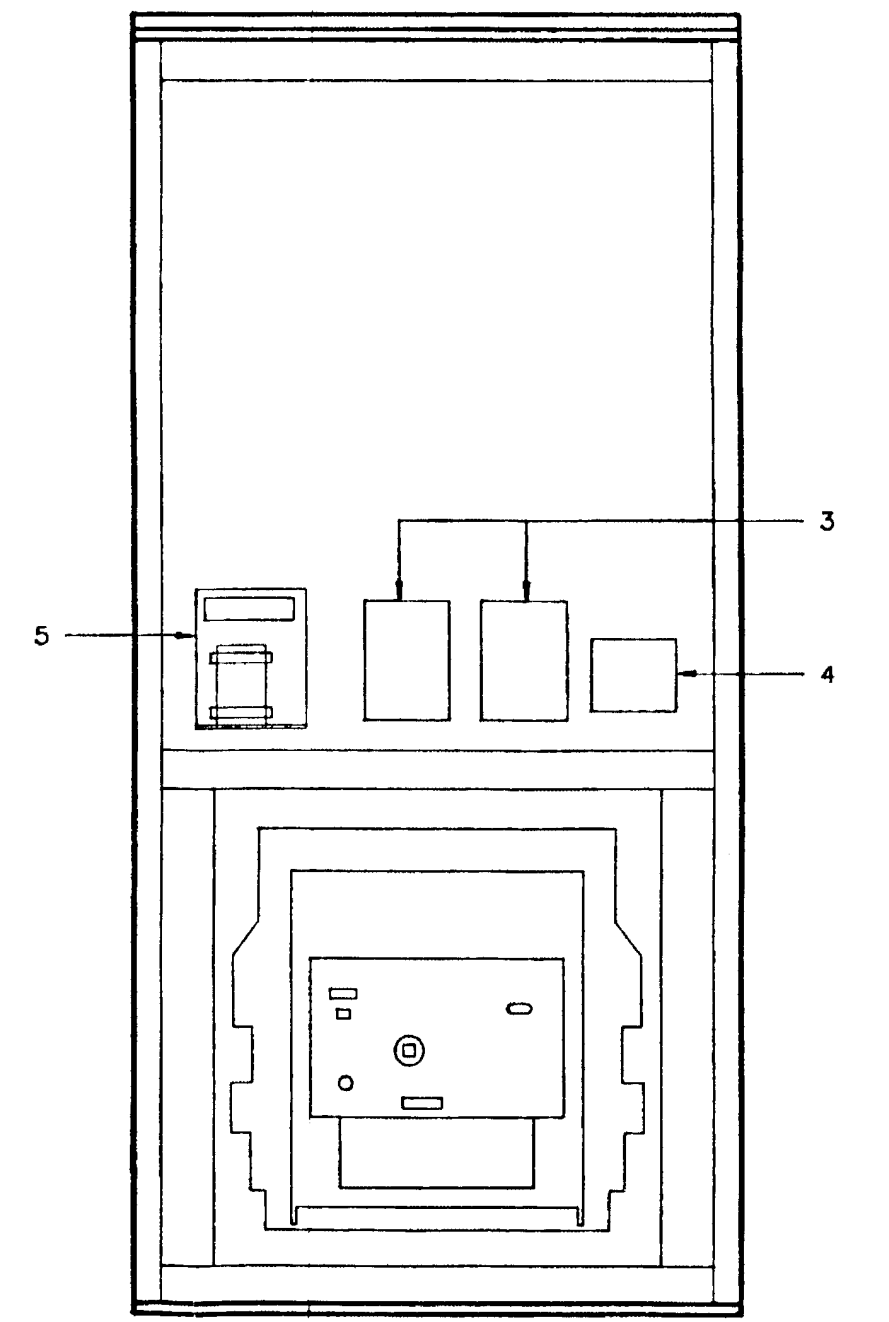


Figure 7-6. 2SA Switchboard Assembly (Sheet 4 of 4)



FRONT VIEW



FRONT VIEW (COVERS REMOVED)

Figure 7-7. 2SB Switchboard Assembly (Sheet 1 of 2)

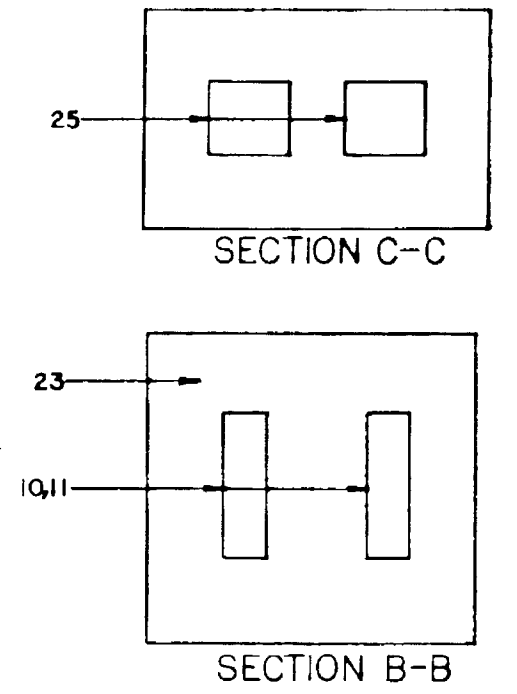
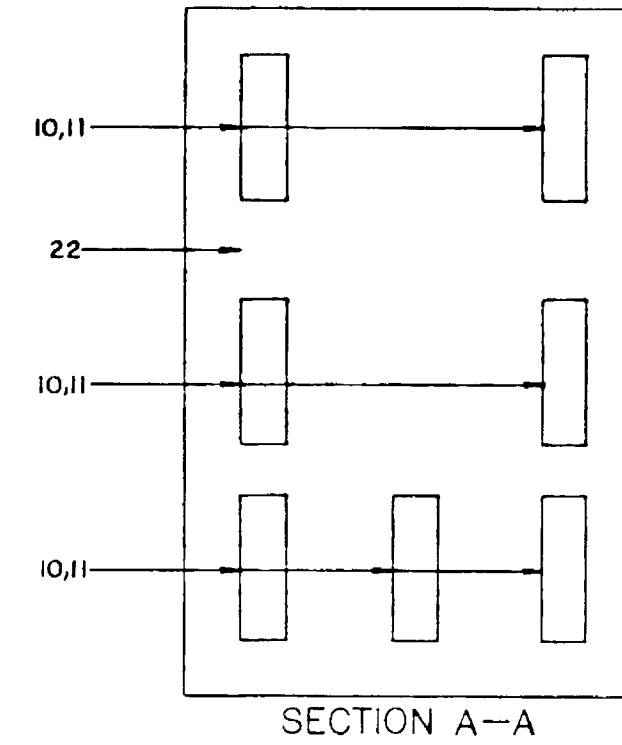
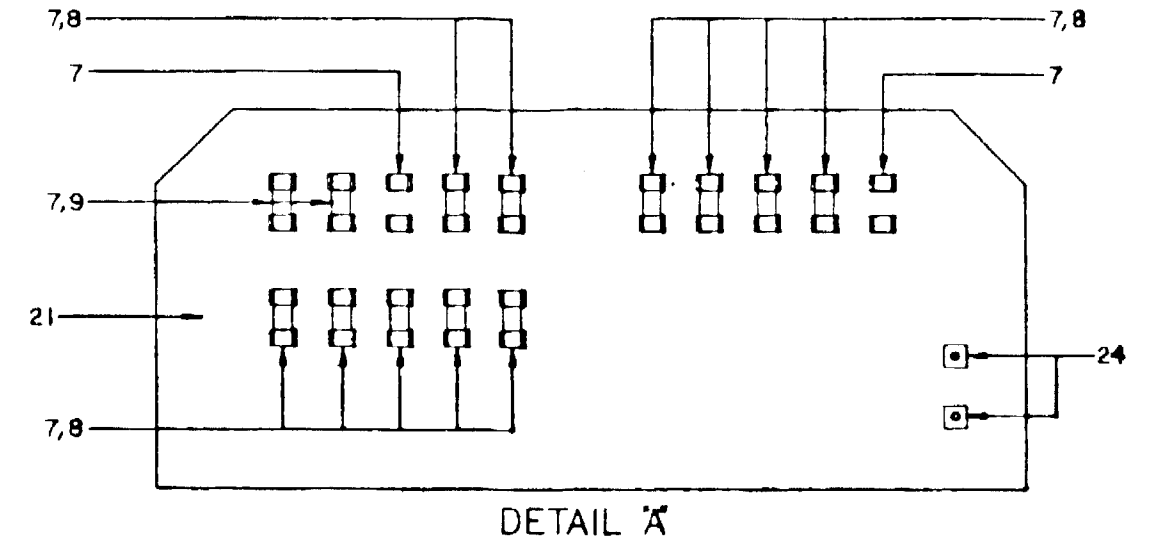
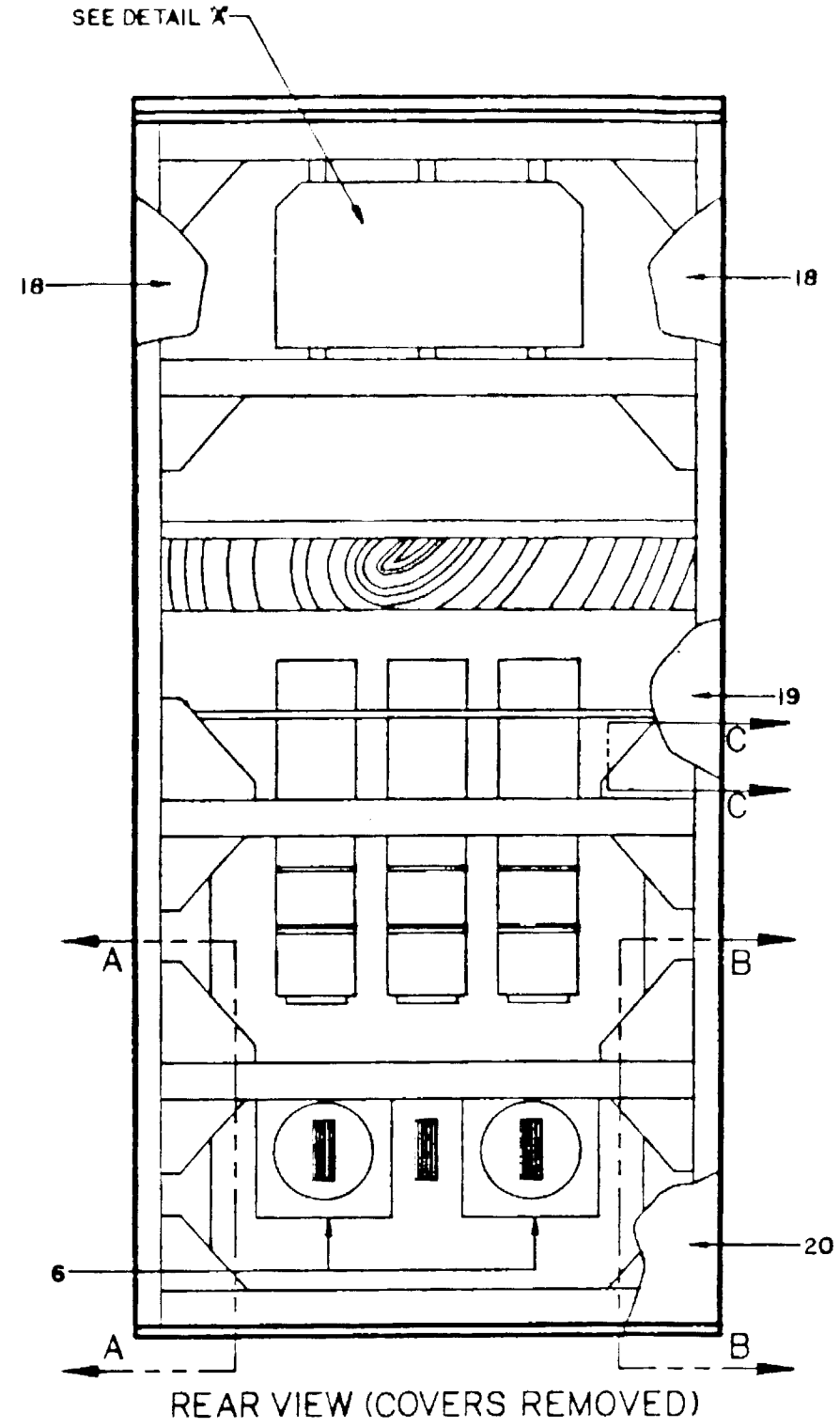


Figure 7-7. 2SB Switchboard Assembly (Sheet 2 of 2)

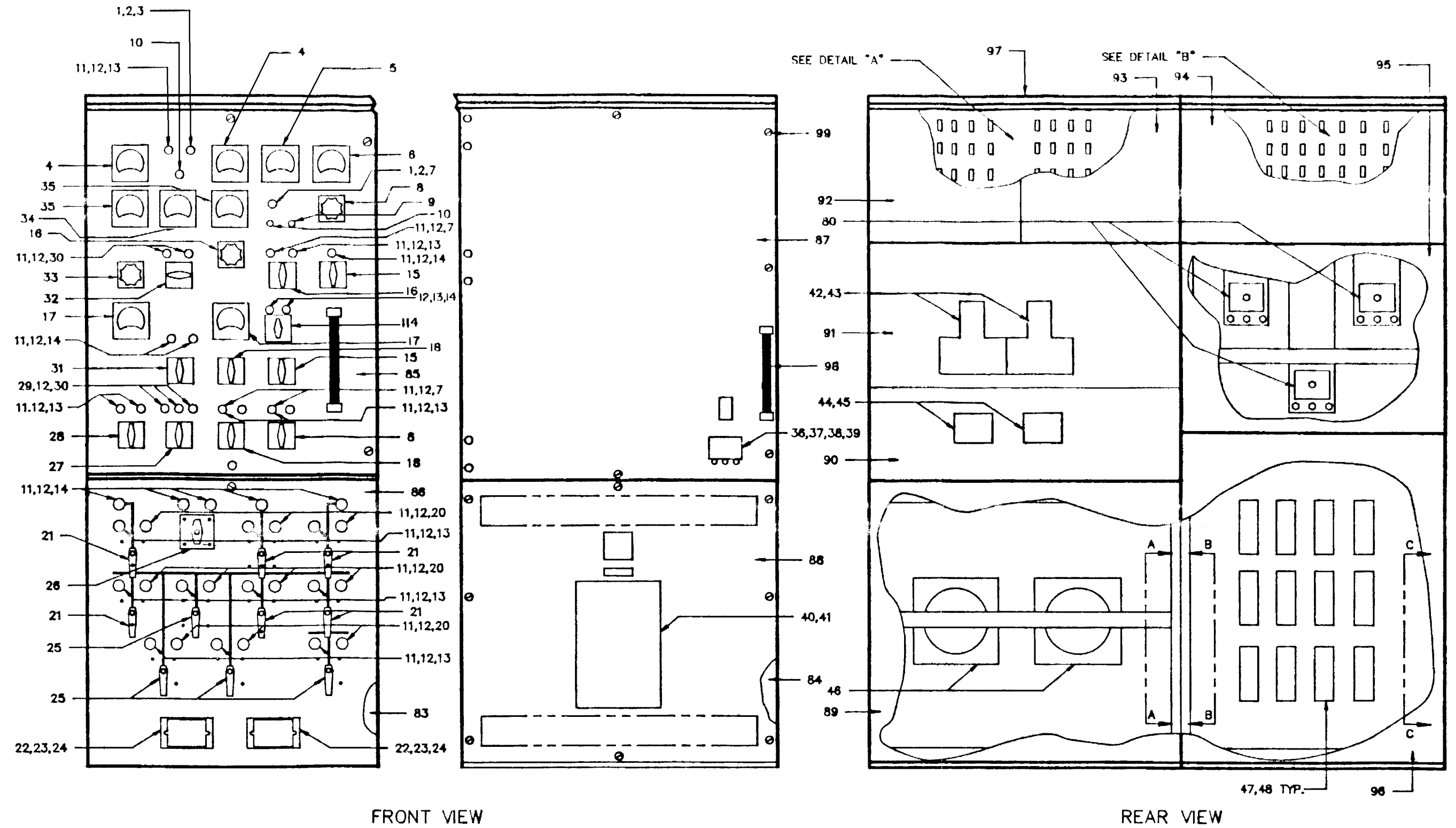


Figure 7-8. 3SG Switchboard Assembly (Sheet 1 of 3)

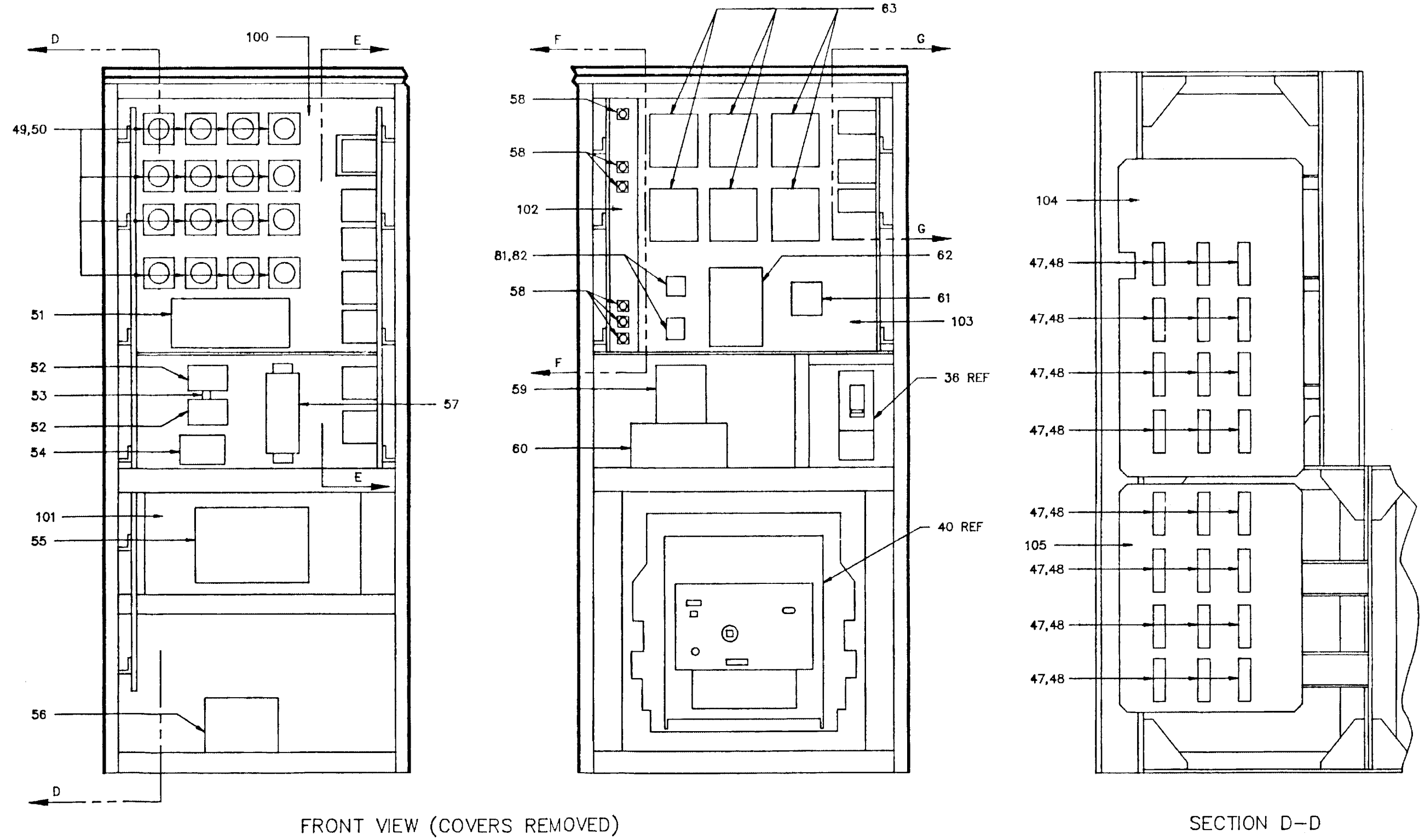


Figure 7-8. 3SG Switchboard Assembly (Sheet 2 of 3)

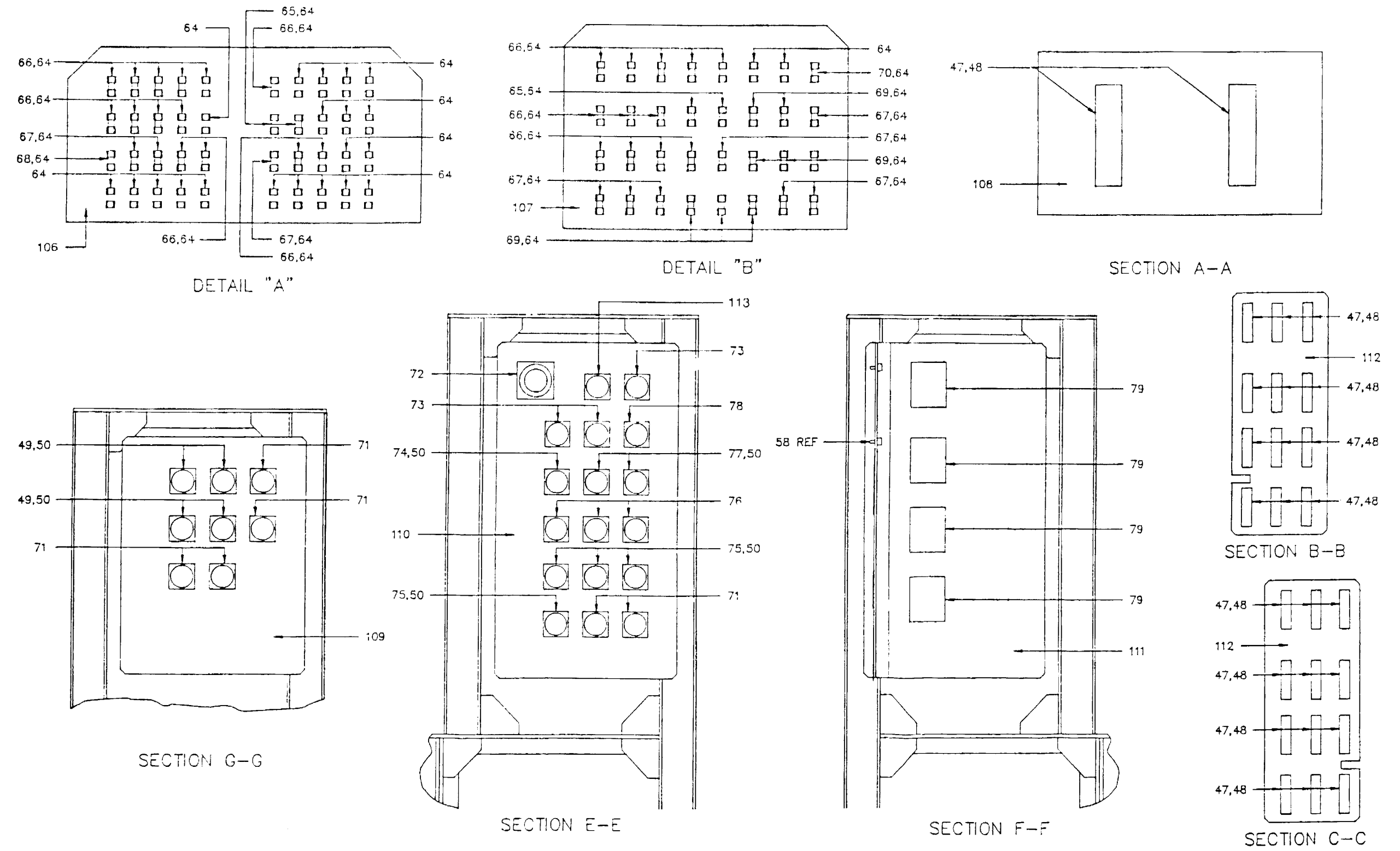


Figure 7-8. 3SG Switchboard Assembly (Sheet 3 of 3)

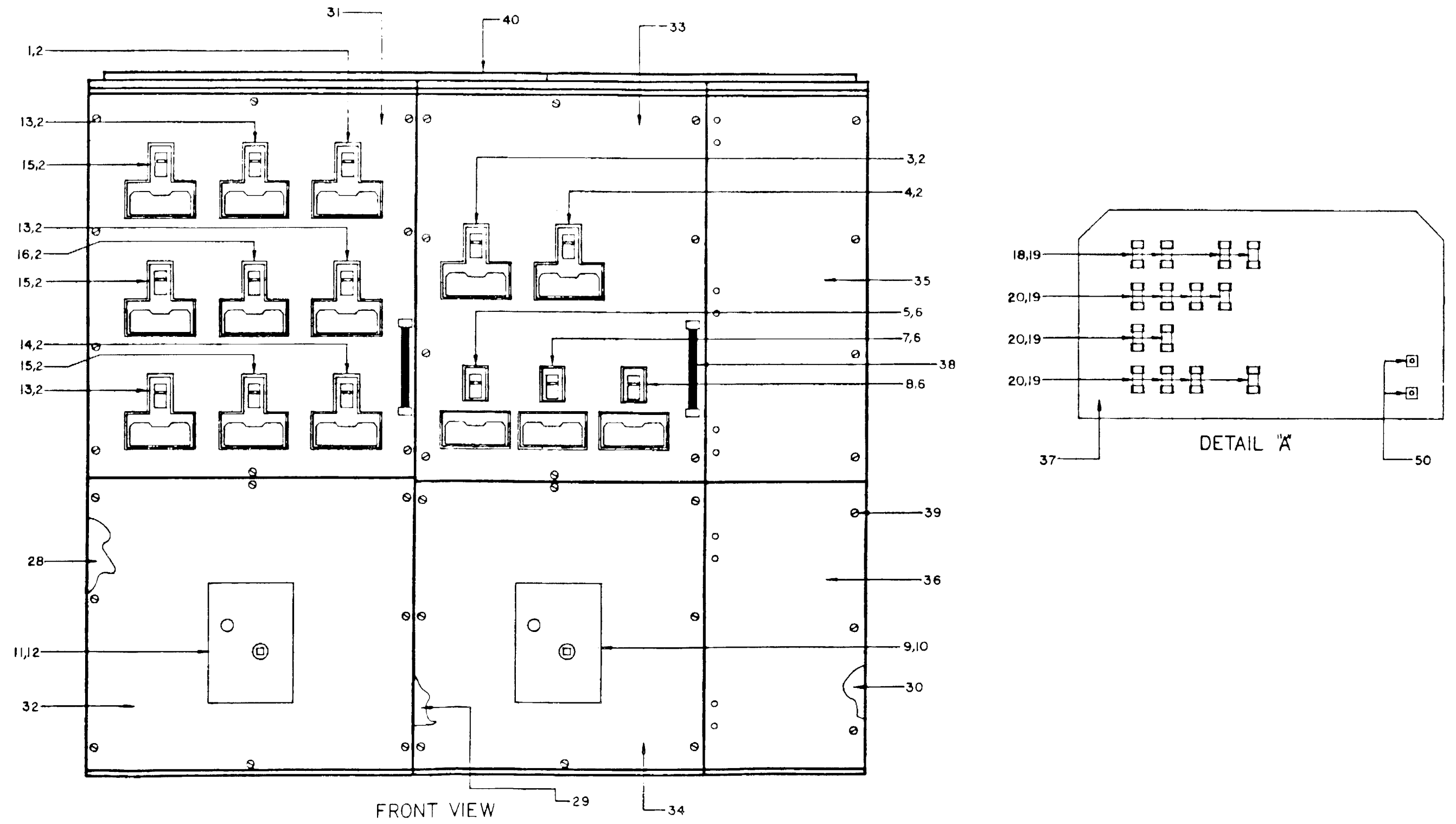
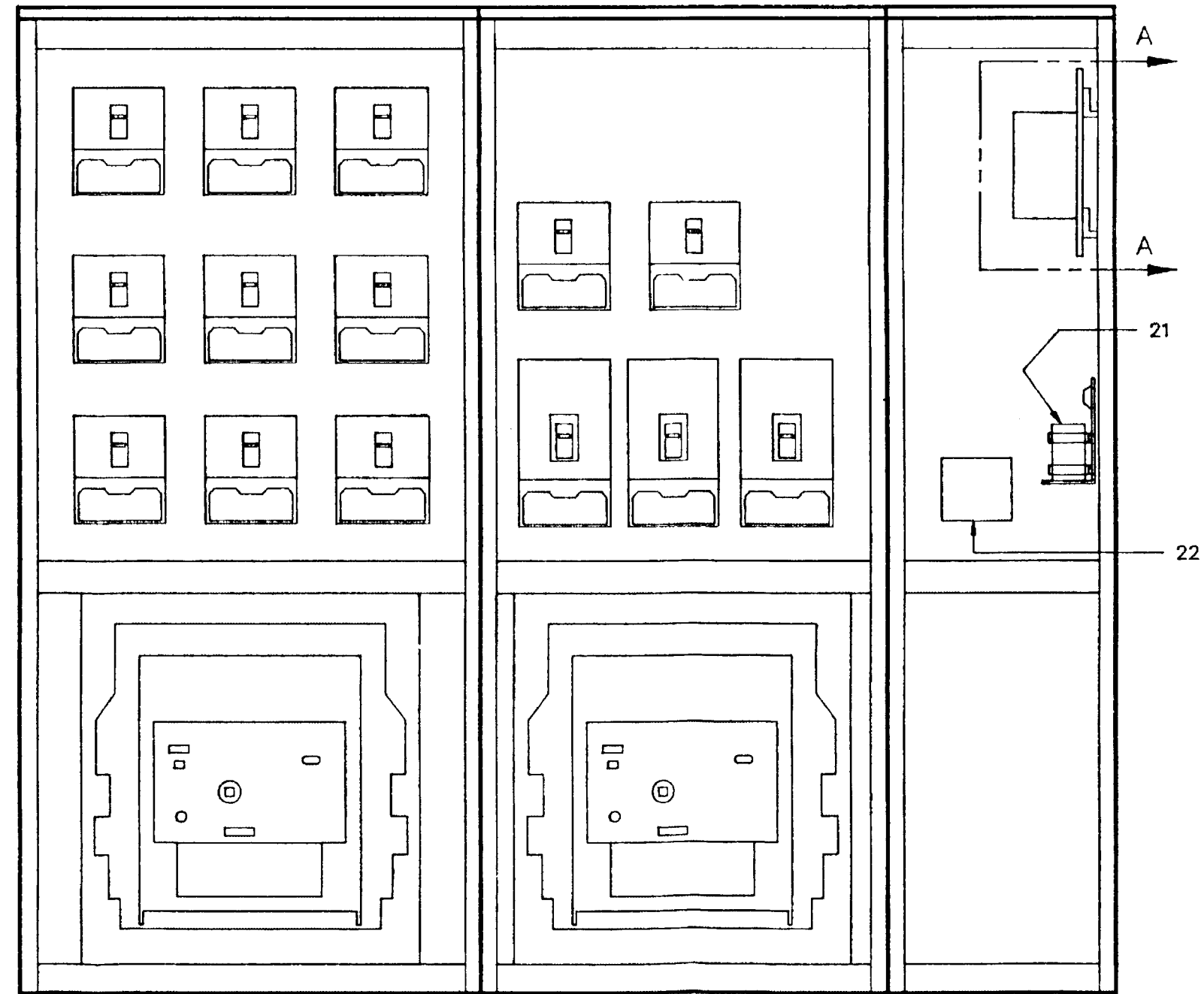


Figure 7-9. 3SA Switchboard Assembly (Sheet 1 of 3)



FRONT VIEW (COVERS REMOVED)

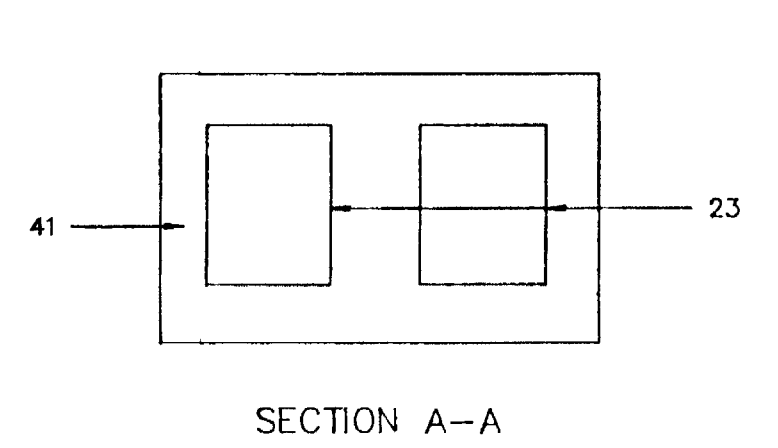


Figure 7-9. 3SA Switchboard Assembly (Sheet 2 of 3)

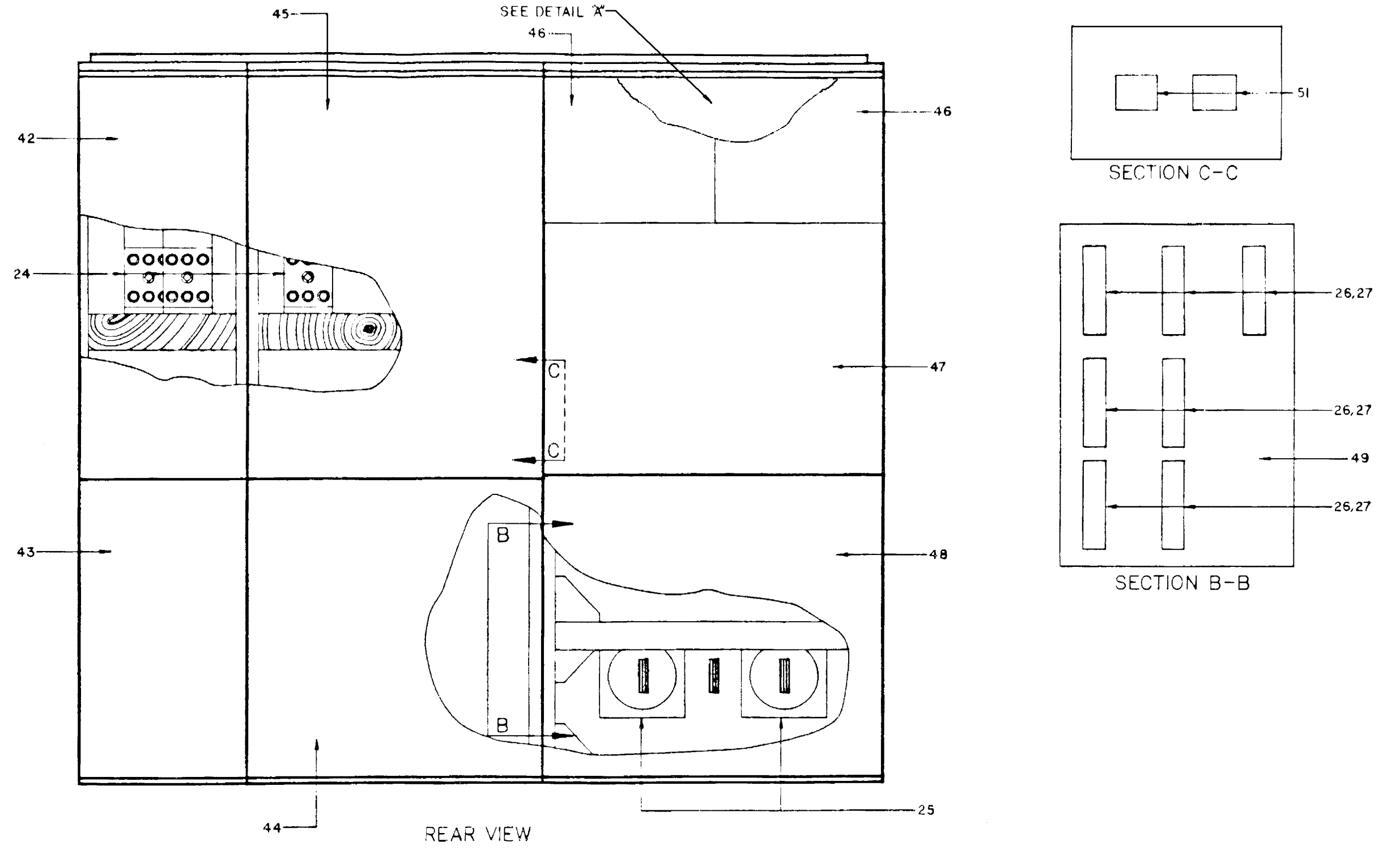
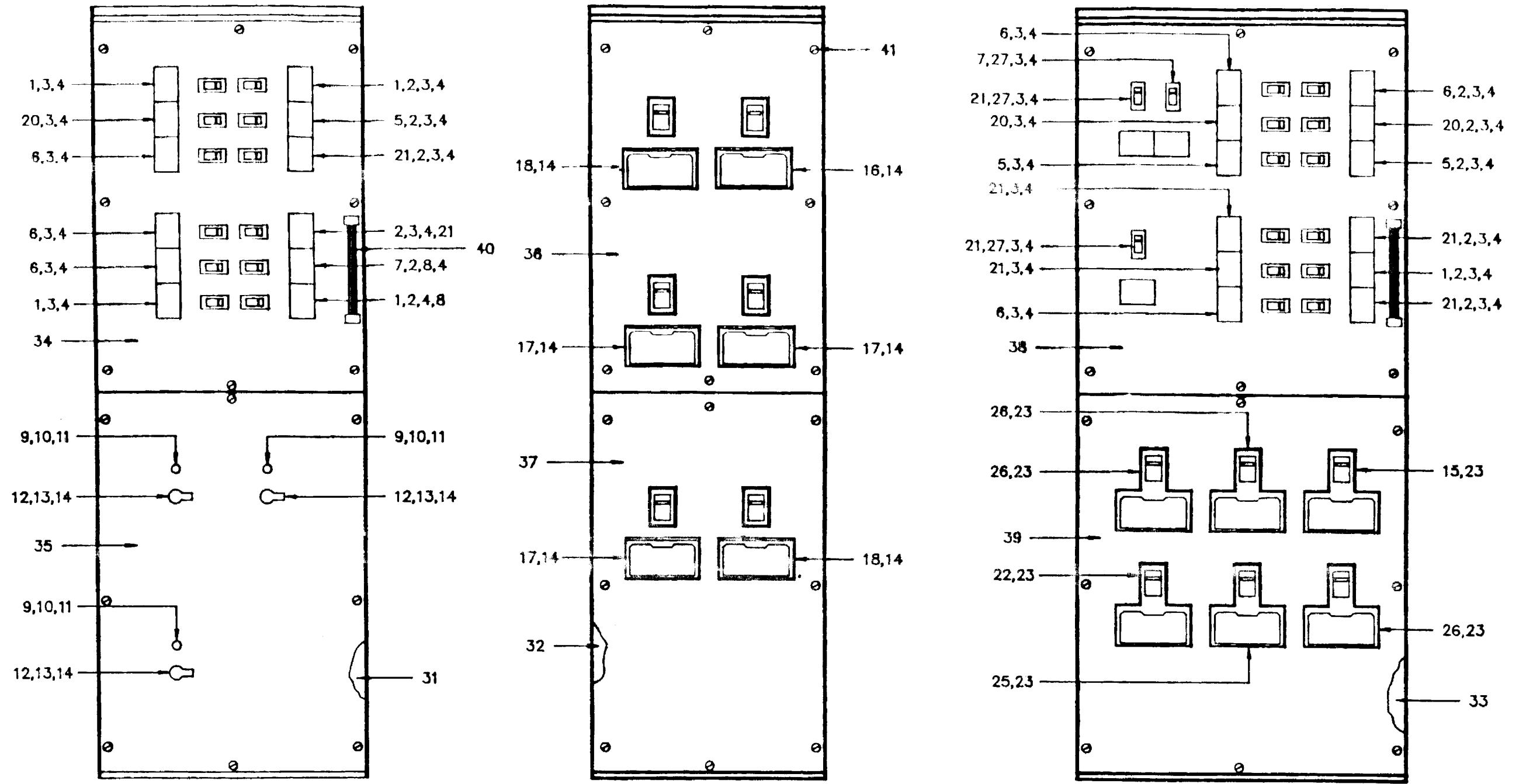


Figure 7-9. 3SA Switchboard Assembly (Sheet 3 of 3)



FRONT VIEW

Figure 7-10. 3SB Switchboard Assembly (Sheet 1 of 2)

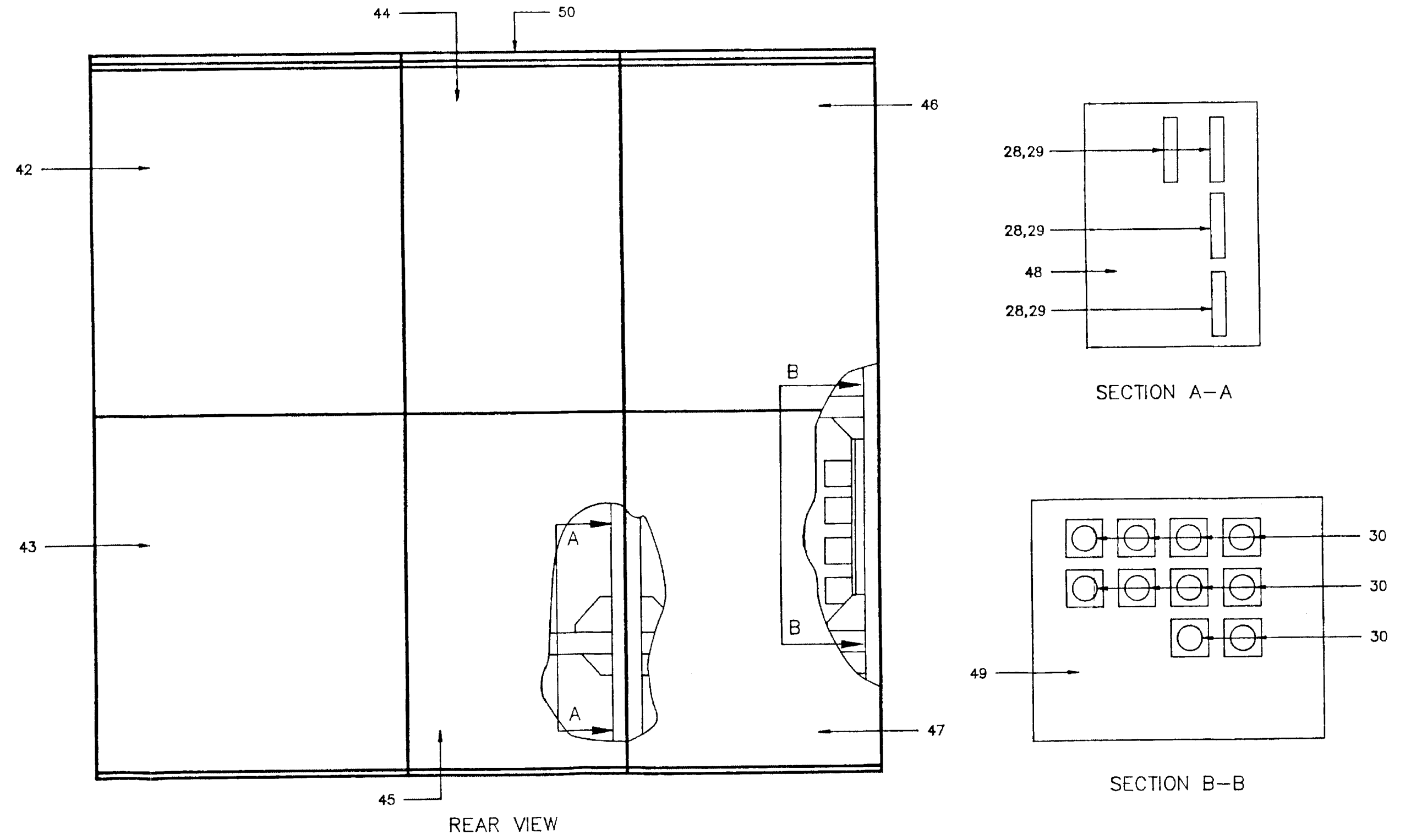
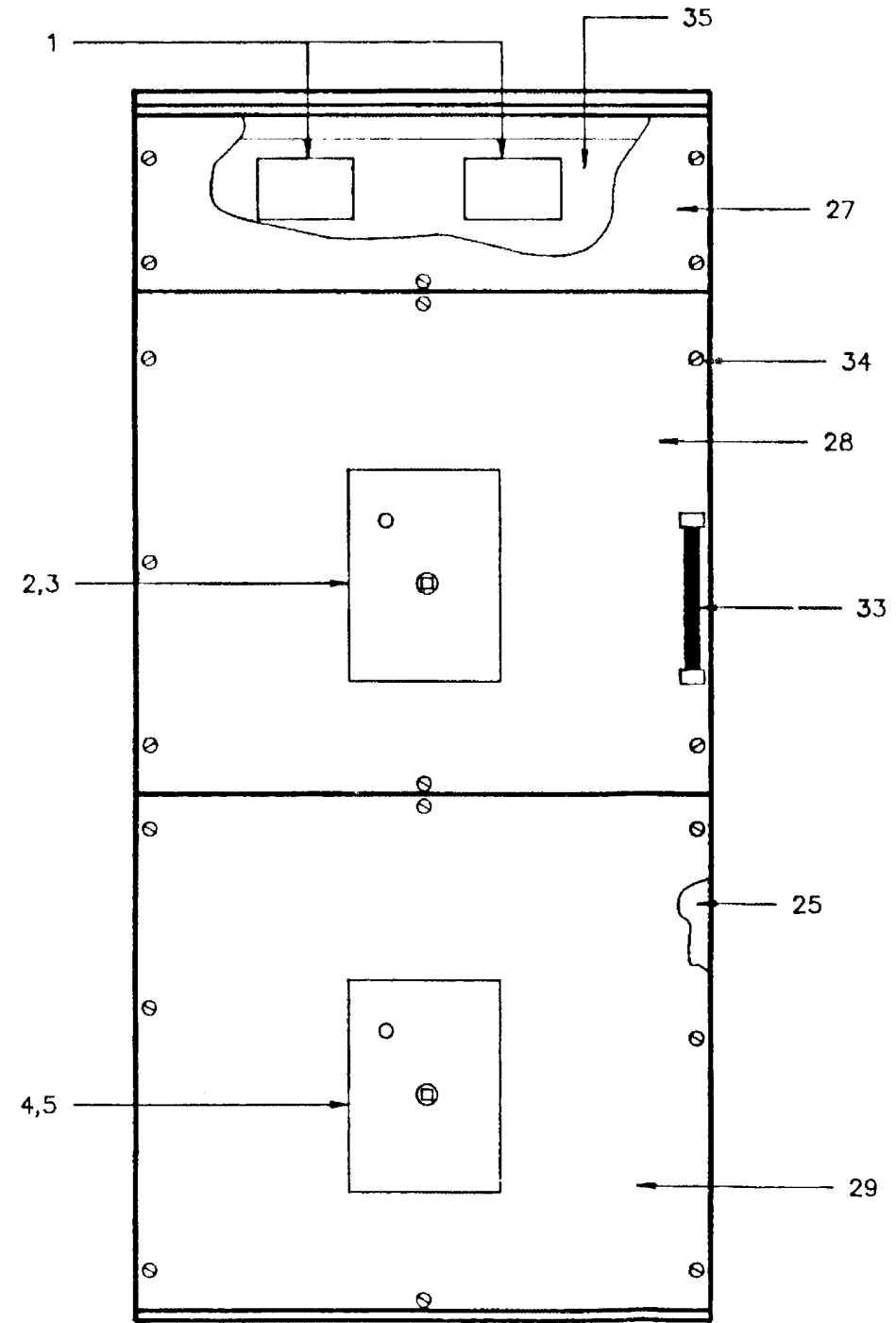


Figure 7-10. 3SB Switchboard Assembly (Sheet 2 of 2)



FRONT VIEW

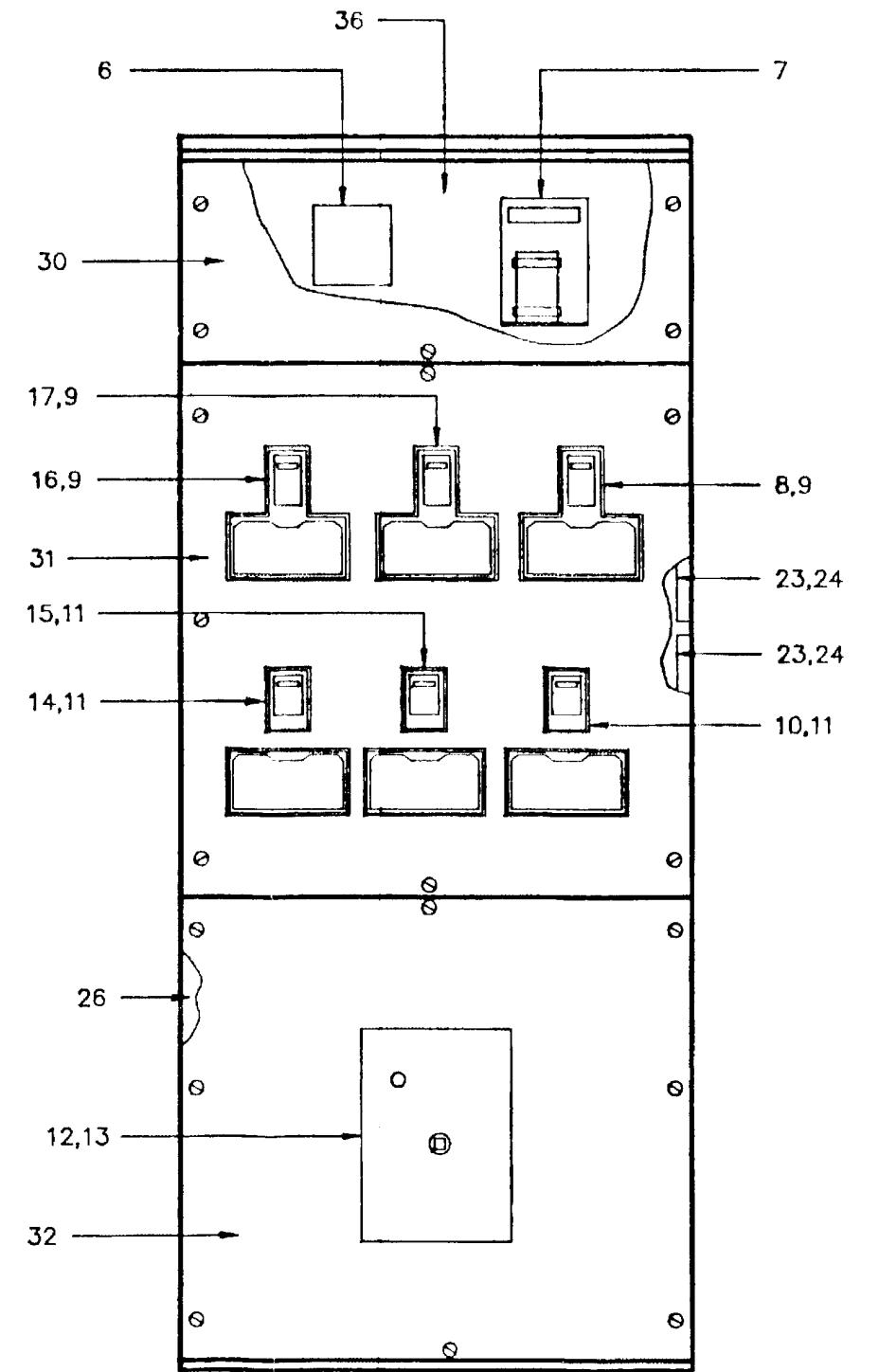


Figure 7-11. 3SC Switchboard Assembly (Sheet 1 of 2)

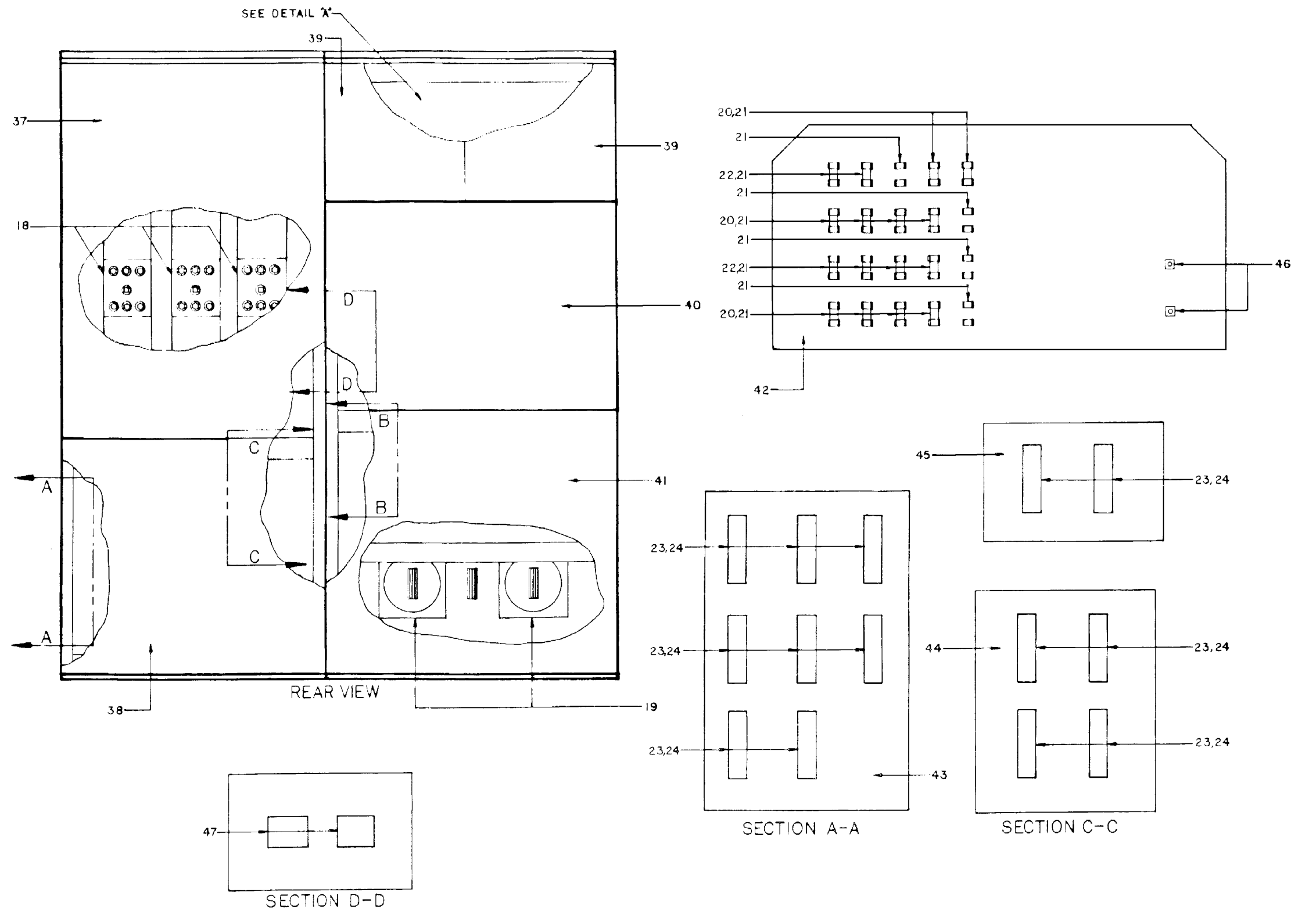


Figure 7-11. 3SC Switchboard Assembly (Sheet 2 of 2)

CHAPTER 8

INSTALLATION

8-1. INSTALLATION

The purpose of this chapter is to provide drawings and information concerning installation of the 60 Hz main power distribution switchboards aboard ship. Switchboards are furnished completely assembled and must be bolted to the shipbuilder foundation. No additional braces or supports are required.

WARNING

Personnel engaged in supervising or performing the installation must be thoroughly familiar with these instructions. Failure to install the equipment as specified can result in its premature failure and/or injury to personnel.

8-2. INSTALLATION DRAWINGS

The following illustrations are to be used during installation;

- a. [Figure 8-1](#); Switchboard Foundation Bolting.
- b. [Figures 8-2](#) through [8-12](#); Switchboard Lifting Data.
- c. [Figures 8-13](#) through [8-23](#); Outline and Mounting of Switchboards.
- d. NAVSEA Drawings (Dwg.) 320-6218728 and 324-6218734.

8-3. STORAGE REQUIREMENTS

The nature of the 60 Hz switchboards dictates no care and preservation requirements other than those used in good commercial practices. If equipment is to be stored for any length of time, the following precautions should be taken:

- a. The switchboard should be stored indoors. The polywrap which will provide protection during shipment should be retained to keep the switchboard clean. An adequate desiccant should be added to prevent moisture accumulation.
- b. Equipment should be stored in a dry clean area. The temperature should be above 40°F, but not exceed a maximum of 140°F.
- c. If the storage area is damp or cool, a space heater should be placed in the equipment to prevent condensation from forming in the equipment.

8-4. SWITCHBOARD MOUNTING

For general switchboard installation, refer to “Electric Plant Installation Standard Methods,” DOD-STD-2003. See [figures 8-13](#) through [8-23](#) for switchboard outline and mounting information. The following tools and materials are required for installation:

- a. 1/2-inch ratchet wrench
- b. Socket set to include 1-1/8-inch diameter socket for 3/4-inch diameter bolt
- c. Flathead screwdriver
- d. 3/4-inch diameter foundation mounting bolts; 126 pieces required per 1S switchboard group, 81 pieces required per 2S switchboard group, and 138 pieces required per 3S switchboard group.
- e. Cable lugs as required for installation to be provided by installation activity.

8-5. INSTALLATION UNPACKING AND PROTECTION

WARNING

To prevent equipment damage or injury, always use lifting equipment, chains, and overhead hoist with adequate lifting capacity. Refer to table 1-1 for weights and volume of this equipment.

60 Hz main switchboards are furnished completely assembled and mounted on oak 4x4 shipping timbers. These timbers must be removed before bolting the switchboards to the ship's foundation. Switchboards shall be prepared for shipboard installation as follows:

- a. Move units to desired location aboard ship. See figures 8-2 through 8-12 for main switchboard lifting data.
- b. Installation (foundation).
 - 1. Remove the polywrap sufficiently to gain access to foundation bolting.
 - 2. Mount main switchboard to foundation in accordance with ship's specification. See figure 8-1.
 - 3. Once the main switchboard is anchored to its foundation, resecure polywrap for protection.
 - 4. The base of each main switchboard shall be adequately secured to the foundation and shall be in a level plane (with reference to ship's baseline) when secure.
 - (a) In order to ensure that there is no warping of the main switchboard framework or misalignment of component parts, the base of each section shall not be out-of-plane by more than 1/8 inch after installation, with all foundation bolts tightened.
 - (b) Main switchboards shall be located so that the base can be bolted directly to the deck stiffeners and not bolted to a thin deck plate.
 - (c) Foundation bolts of the main switchboard shall be fastened to metal whose thickness in the immediate vicinity of the bolts is at least equivalent to the bolt diameter.
 - (d) The addition of pads may be necessary to obtain the required thickness or to compensate for the lack of flanges on the deck stiffeners.
- c. Inspect visually for physical damage of instruments, components, or switchboard.
- d. Provide protective barrier over front of main switchboards for use during installation and cabling. Barrier may be of wood, particle board or metal and shall be temporarily affixed over instrumentation and circuit breakers to prevent damage.
- e. Installation (shipboard). When switchboard and foundation is landed aboard ship and in position for cabling.
 - 1. Remove polywrap. Take care not to damage equipment with cutting tool.

2. Anchor switchboard to foundation.
3. Close and secure all doors when work is completed in that area.
 - (a) Access covers, etc., will be removed during this period and the switchboard will be subjected to debris and dirt.
 - (b) Access covers should be stored in a safe area until needed to complete the installation.
 - (c) Normal daily housecleaning practices employed by the shipbuilder will be sufficient for maintenance purposes.
- f. Should the main switchboards need packaging for shipment, repacking procedures are the reversal of unpacking (Step b, items 1 through 3). For reshipment, the main switchboards should be installed on 4x4 shipping timbers to avoid damaging the main switchboard.

8-6. INPUT REQUIREMENTS

The following considerations are necessary to permit the proper function and maintenance of the 60 Hz main switchboards.

- a. Normal input power 2500 KW, at 450 VAC, 60 Hz, 3 Phase.
- b. 28 VDC.
- c. Ventilation maintaining a 122°F ambient temperature.
- d. Cabling and maintenance clearances around main switchboards are:
 1. Forty-two inches in front of main switchboards.
 2. Twenty-four inches between the rear and sides of the main switchboards and the adjacent ship's structure.
 3. Six inches between the top of the units and the ship's structure and other equipment such as pipes, ducts, and cableways.
 4. In no case shall the sections be directly connected by structural members, except at the base.

8-7. INSTALLATION PROCEDURES

8-7.1 ASSEMBLY. The 60 Hz main switchboards are completely assembled when installed and require only the following verifications to insure proper operation:

- a. Inspect all instruments and components for damage, replacing if necessary.
- b. Inspect internal subpans and subassemblies for missing hardware, and tightness. Retighten if necessary.
- c. Inspect component mounting for missing hardware, and tightness.
- d. Inspect torque seal used on all bus connections. If seal is broken, remove torque seal and retighten as required in accordance with [table 8-1](#).
- e. Inspect foundation bolts for tightness to ship's specification. Foundation bolts shall be steel, 3/4-inch diameter to MIL-S-1222.

8-7.2 ELECTRICAL CONNECTIONS. Refer to "Electric Plant Installation Standard Methods," NAVSEA Dwg. No. 803-5001027. For main switchboard connections, refer to schematics [figures 5-18](#) through [5-20](#), and NAVSEA drawings 320-6218728 and 324-6218734.

8-7.3 GROUNDING. Switchboard ground straps shall be installed in accordance with standard Navy shipyard practice.

8-8. INSTALLATION CHECKOUT

The installation checkout provides step-by-step procedures to demonstrate the equipment operates properly. This checkout consists of two test phases, as set forth in the following paragraphs.

- a. Phase 1 - Installation, Inspection, and Pre-energizing Procedures. Refer to [table 8-2](#).
- b. Phase 2 - Turn-on and Test. Refer to [table 2-12](#).

Table 8-1. Specification for Torquing Bus Bar Joints and Circuit Breaker Studs

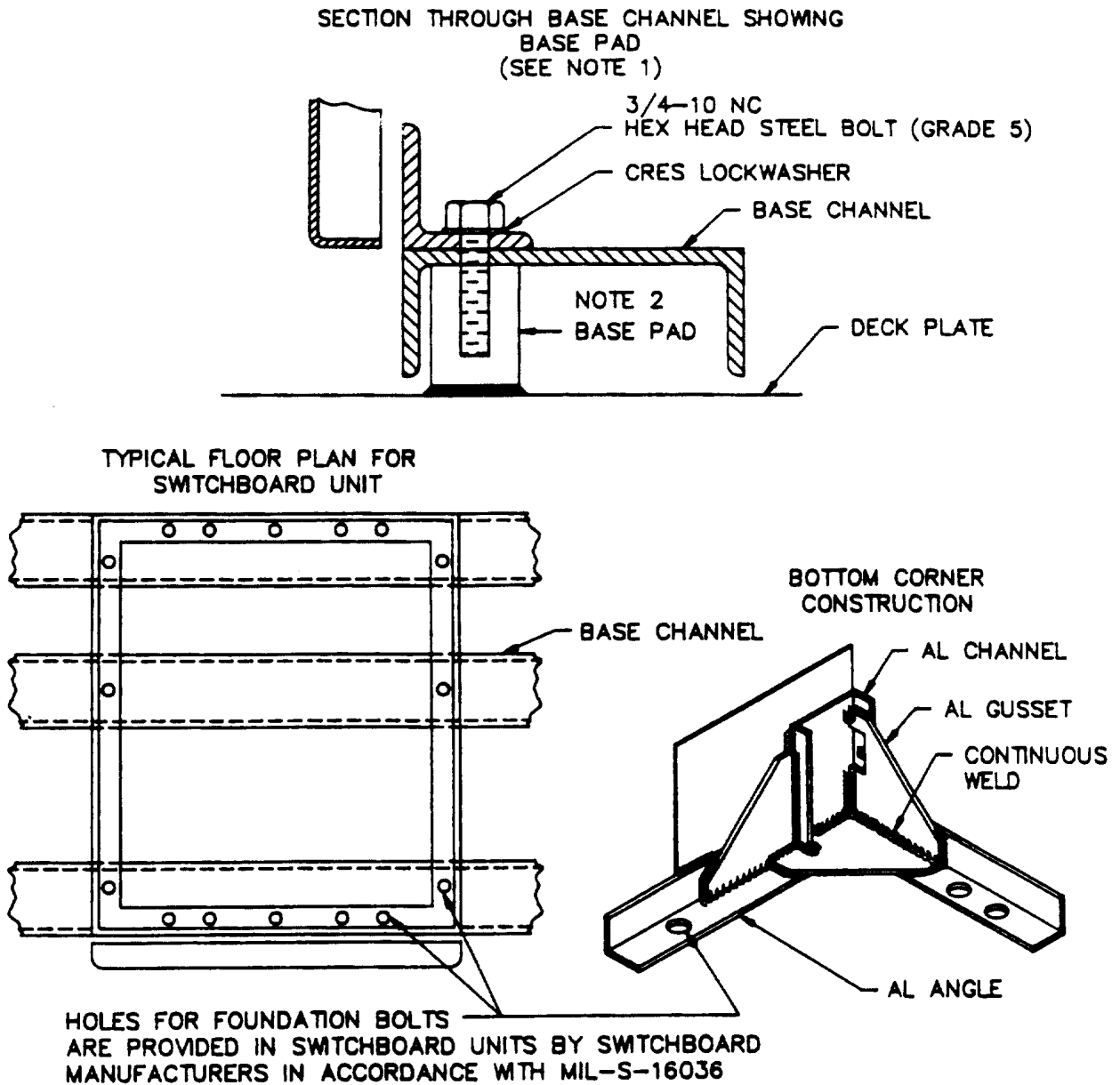
Contact Pressure of Bus Bars	Bolt Diameter (Inches)	Torque (Foot-Lbs., Min.)	
		Steel	Silicon Bronze
	3/8	14	10
	1/2	30	15
	5/8	50	35
Connections to CB Studs	Copper Stud Size	Steel Cap Screw Size	Torque (Foot-Lbs., Min)
	3/8-16	-	7
	1/2-13	-	15
	3/4-16	-	25
	1-1/8-12	-	40
	-	5/8-11	20
	-	1-8	(130 Inch-Lbs.)

NOTE: All values to be torqued to a tolerance of +10 percent.

Table 8-2. Installation, Inspection, and Pre-Energizing Procedures Checklist

The following tasks shall be performed before energizing the equipment for the first time.

1. All units of equipment and required auxiliary equipment are installed and orientation is correct.
2. All cables have been installed in accordance with plans and specifications.
3. All interconnection continuity is correct.
4. All cable dielectric and insulation resistance tests have been performed by shipyard.
5. Test equipment listed in [table 1-5](#) is onboard and calibrated.
6. All field changes, ShipAlts, and mandatory retrofits have been accomplished.
7. Adequate access for equipment maintenance has been allowed.
8. All pre-energizing servicing procedures have been accomplished. These include at a minimum:
 - a. Check all disconnect links for tightness.
 - b. Check all air circuit breakers for contact grease on primary and secondary disconnects.
9. All panels, sheets, and access plates have been installed and that all loose and foreign matter has been removed from the switchboard.
10. All personnel are clear of switchboard.

**NOTES:**

1. BASE CHANNEL WEB STRENGTHENING PIECES LOCATED ON EACH SIDE OF FOUNDATION BOLTS SHALL BE PROVIDED WHEN BASE PADS ARE NOT USED WELD WEBS IN PLACE ON UNDERSIDE OF BASE CHANNEL TO FORM A SQUARE WITH FOUNDATION BOLT IN CENTER.

2. CRES WASHER SHALL BE USED WHEN SWITCHBOARD FRAMING IS ALUMINUM AND BASE PAD IS STEEL

Figure 8-1. Switchboard Foundation Bolting

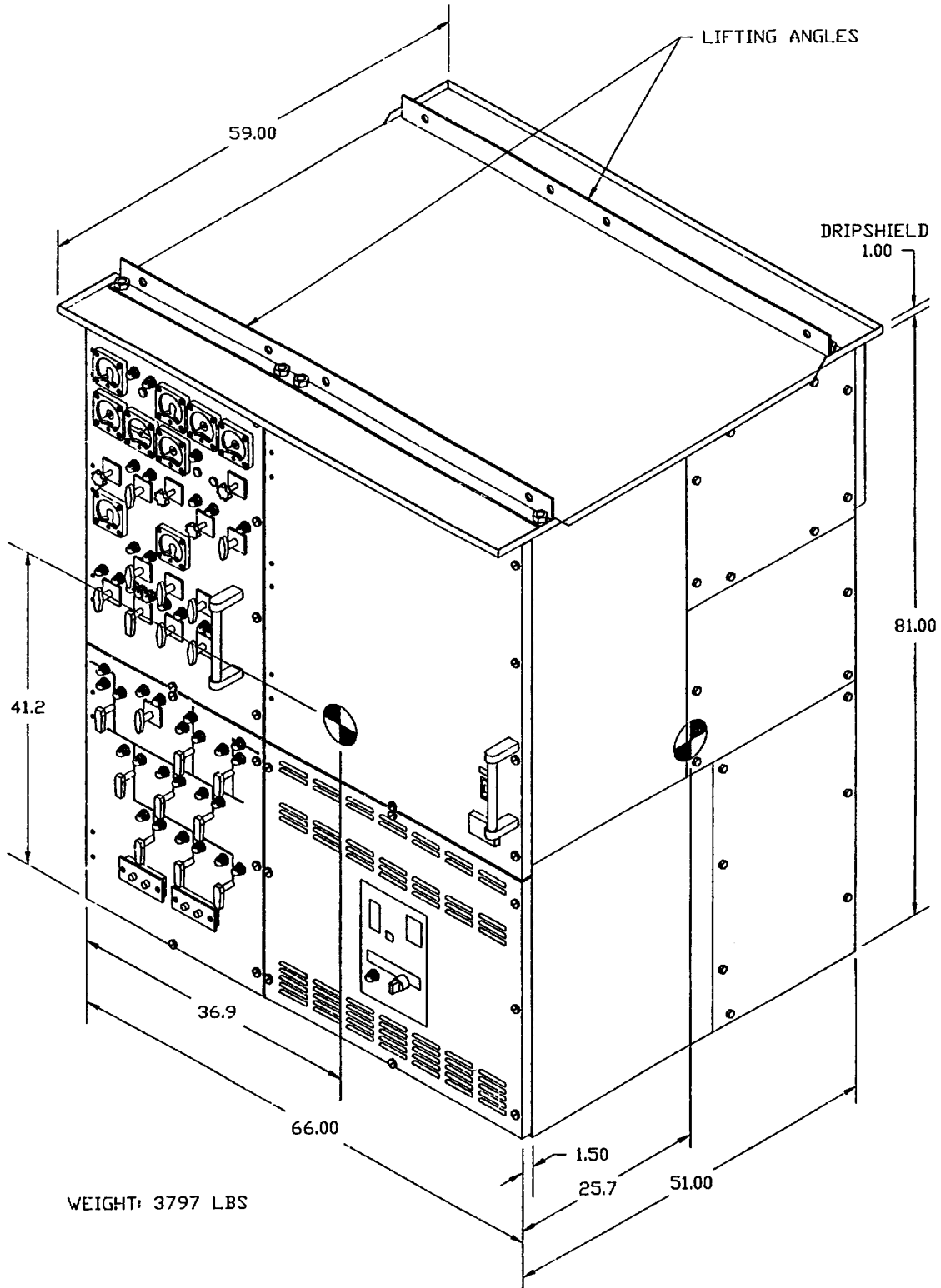


Figure 8-2. Lifting Data, Switchboard ISG

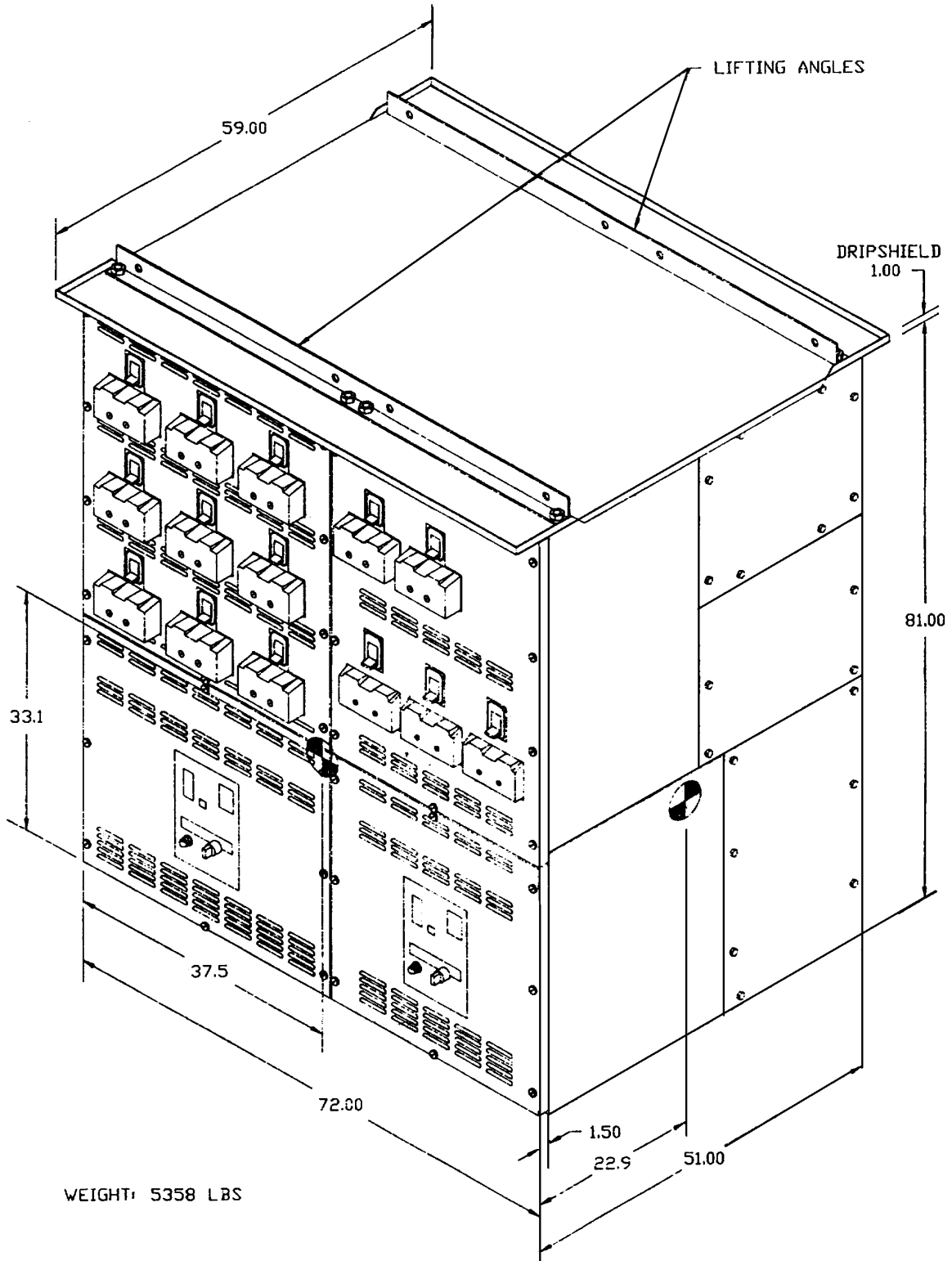


Figure 8-3. Lifting Data, Switchboard 1SA

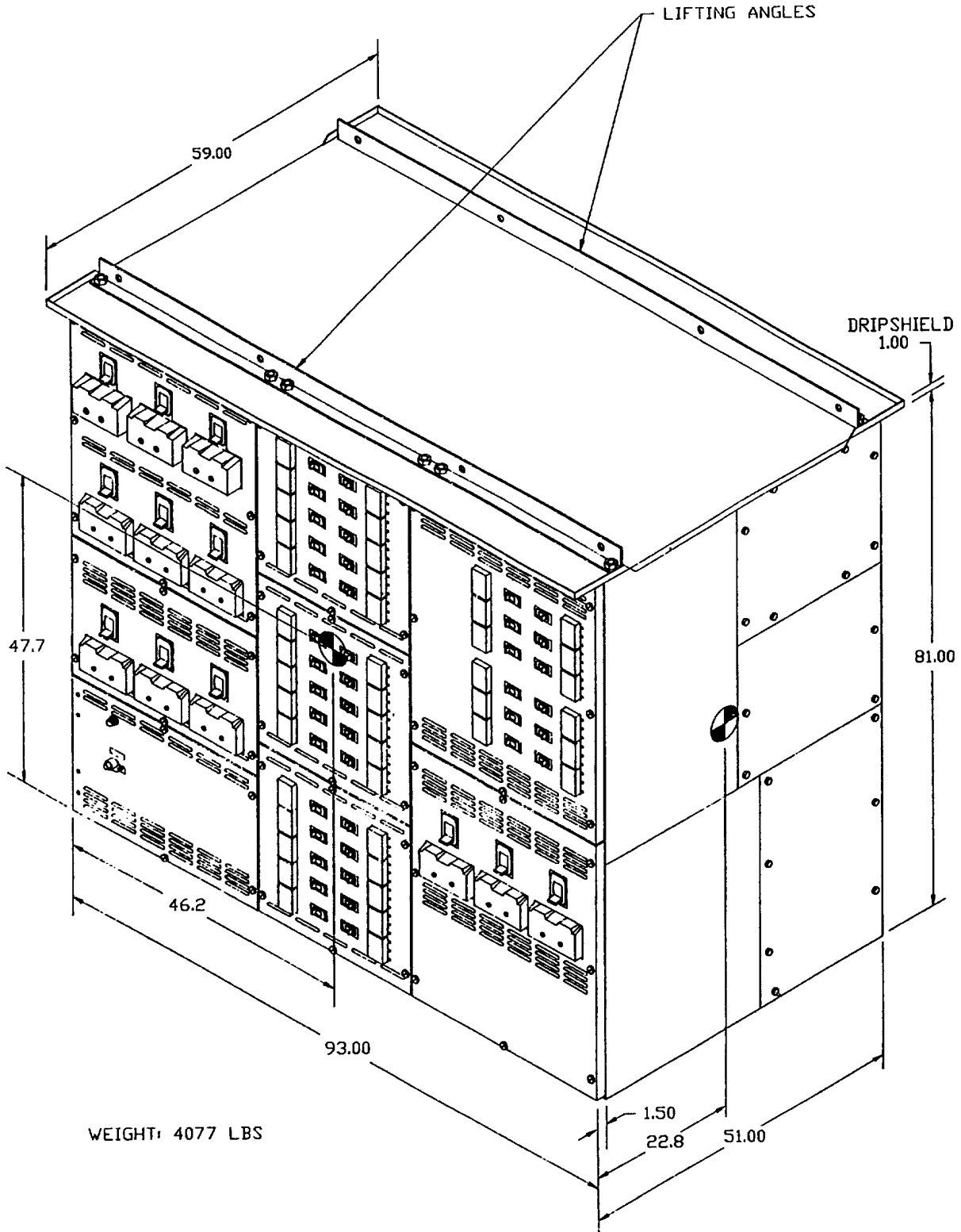


Figure 8-4. Lifting Data, Switchboard 1SB

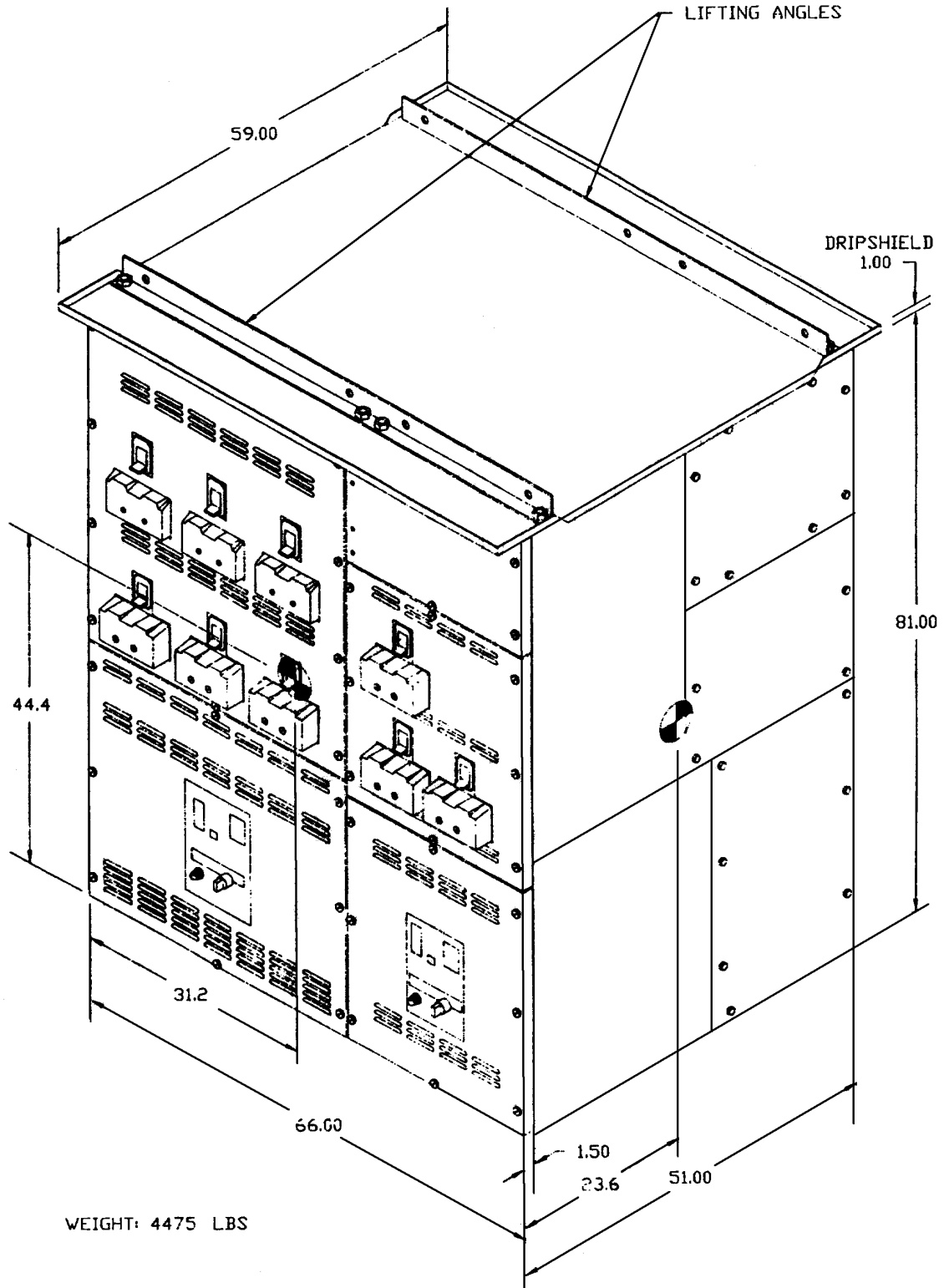


Figure 8-5. Lifting Data, Switchboard 1SC

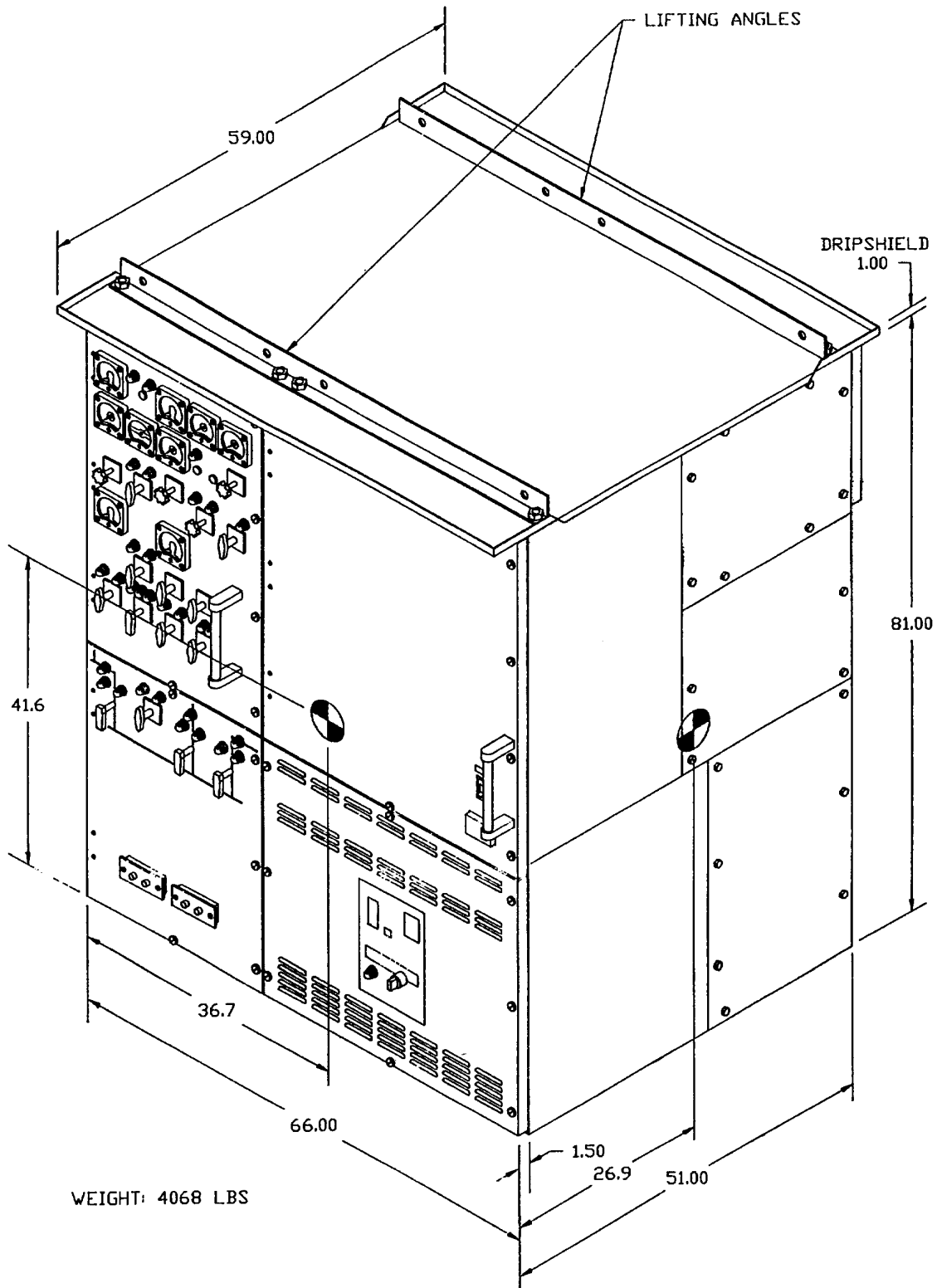


Figure 8-6. Lifting Data, Switchboard 2SG

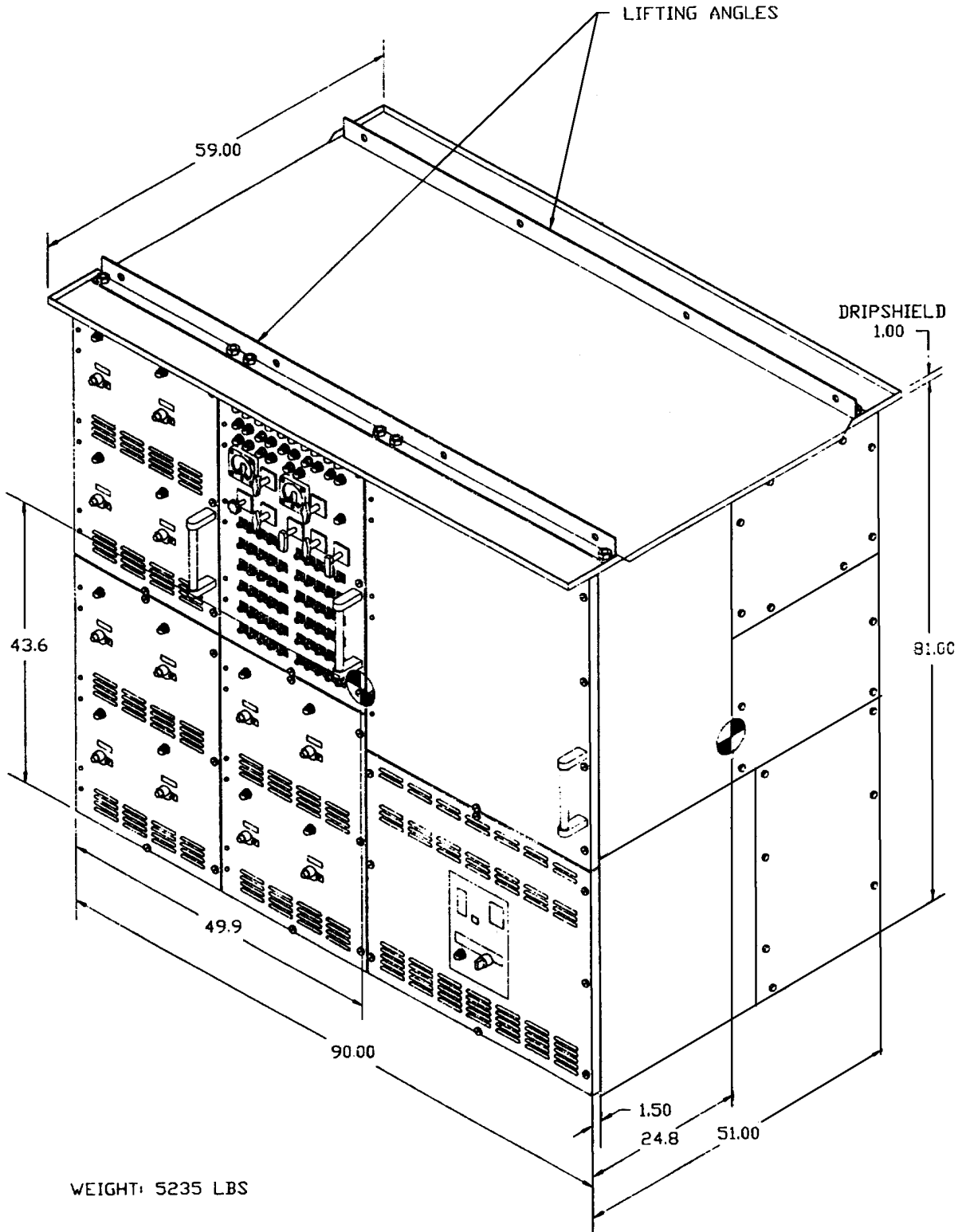


Figure 8-7. Lifting Data, Switchboard 2SA

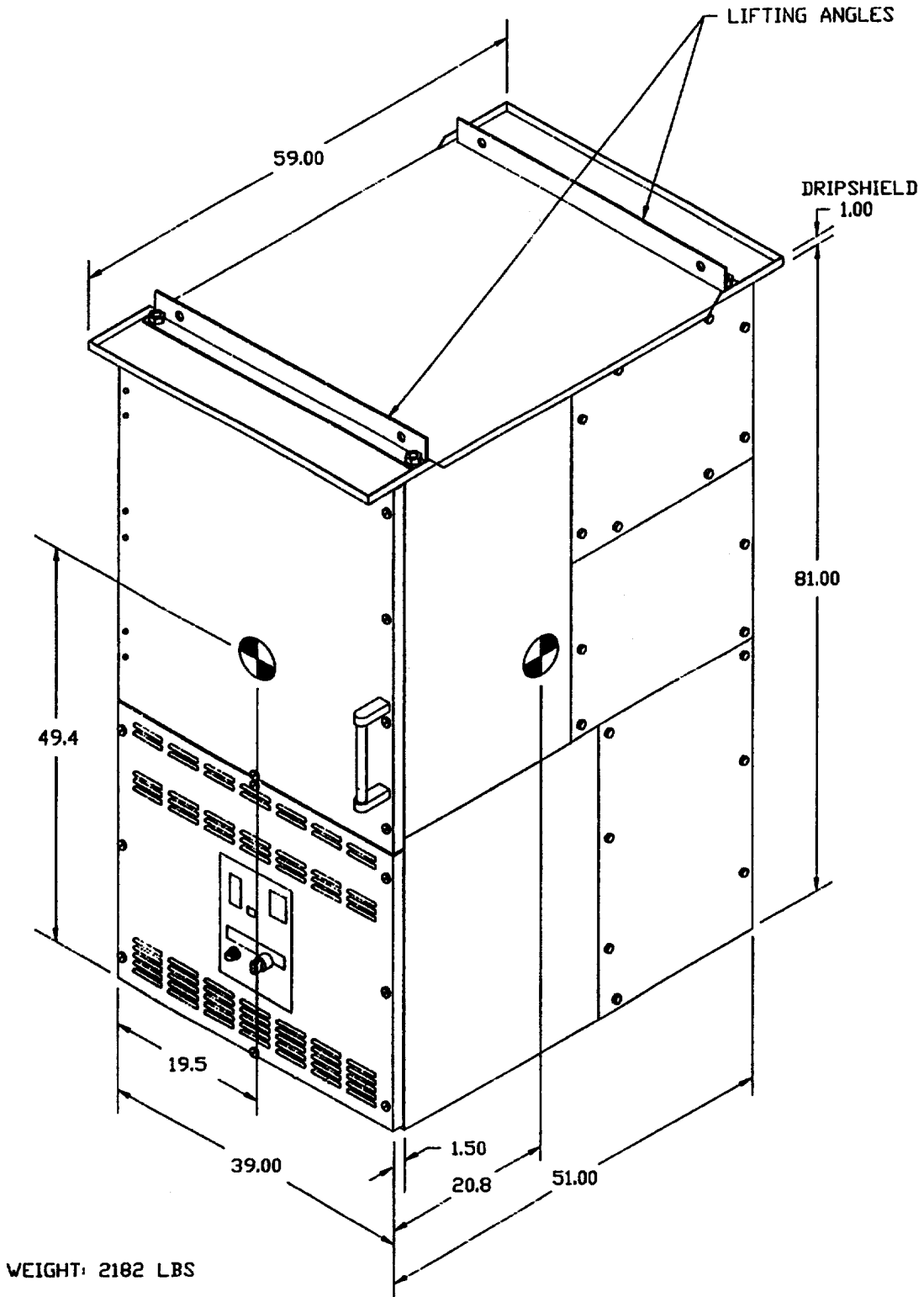


Figure 8-8. Lifting Data, Switchboard 2SB

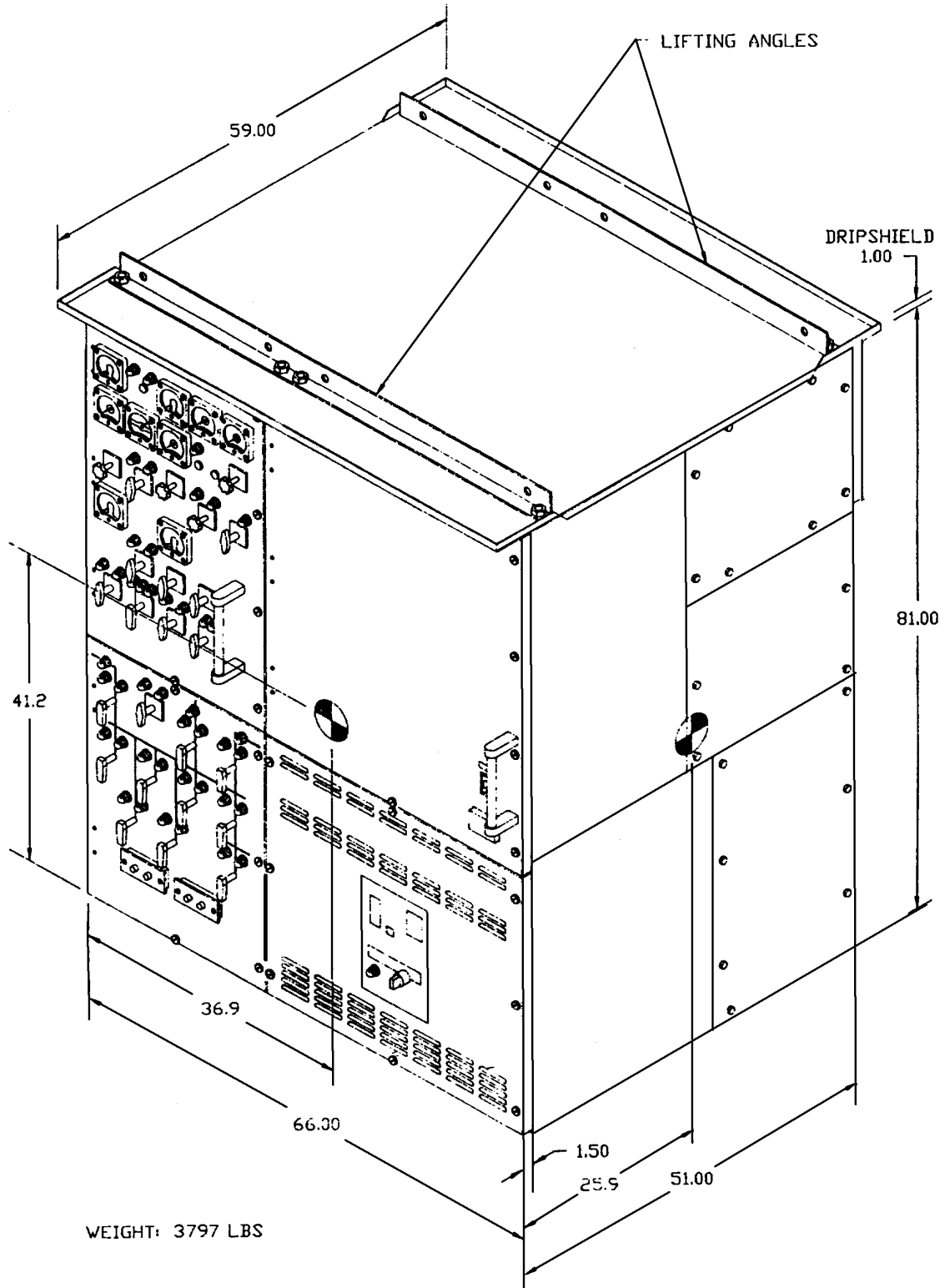


Figure 8-9. Lifting Data, Switchboard 3SG

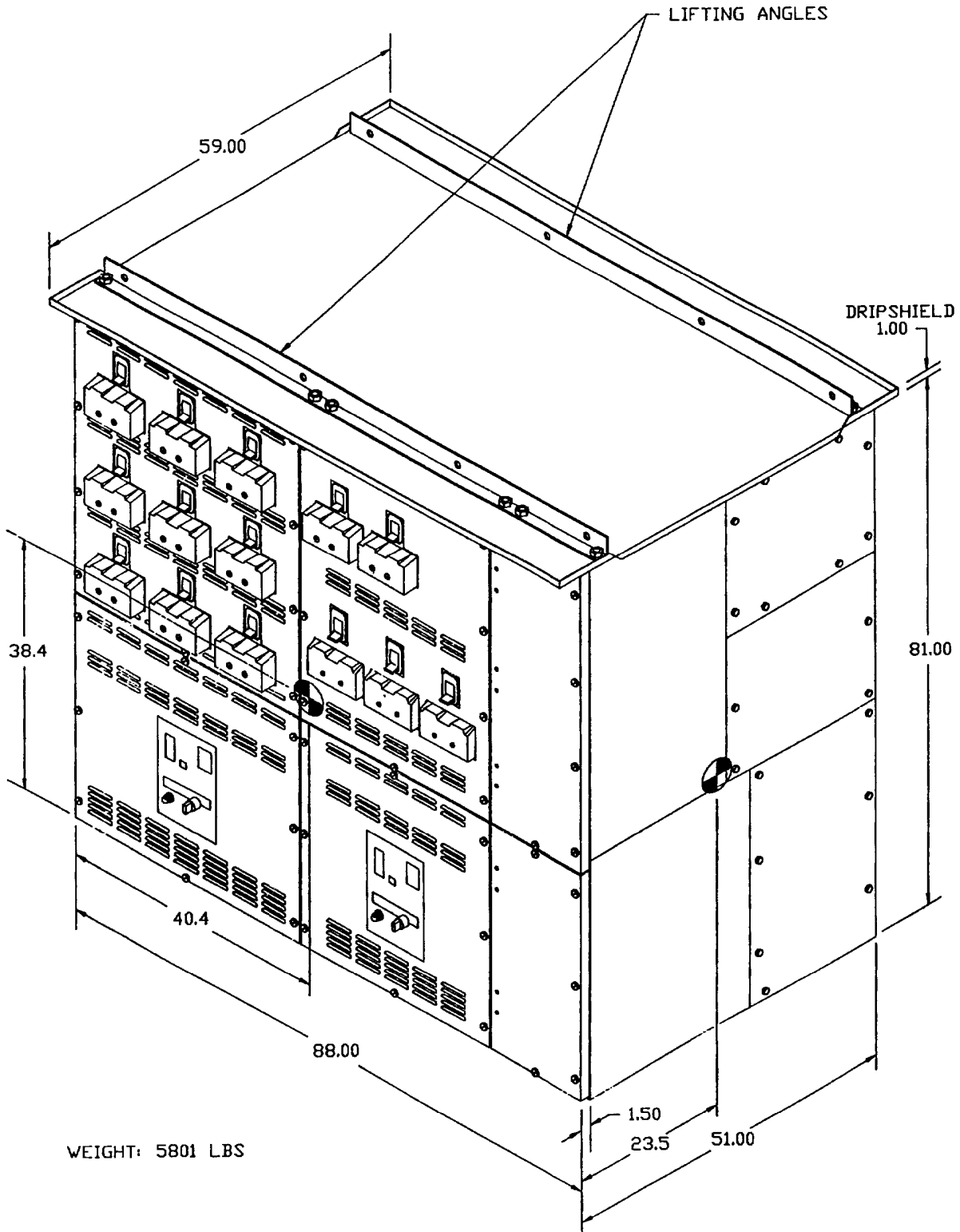


Figure 8-10. Lifting Data, Switchboard 3SA

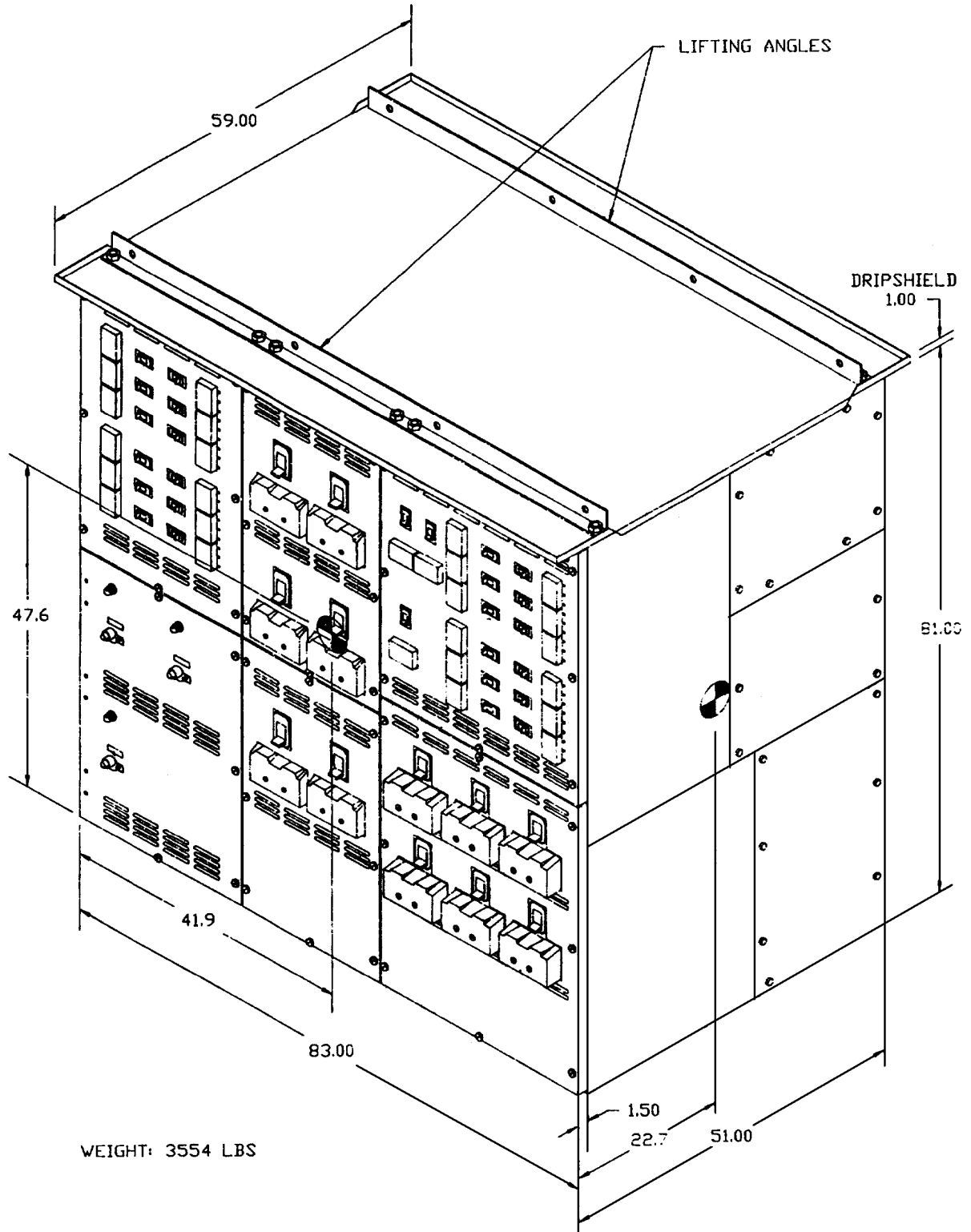


Figure 8-11. Lifting Data, Switchboard 3SB

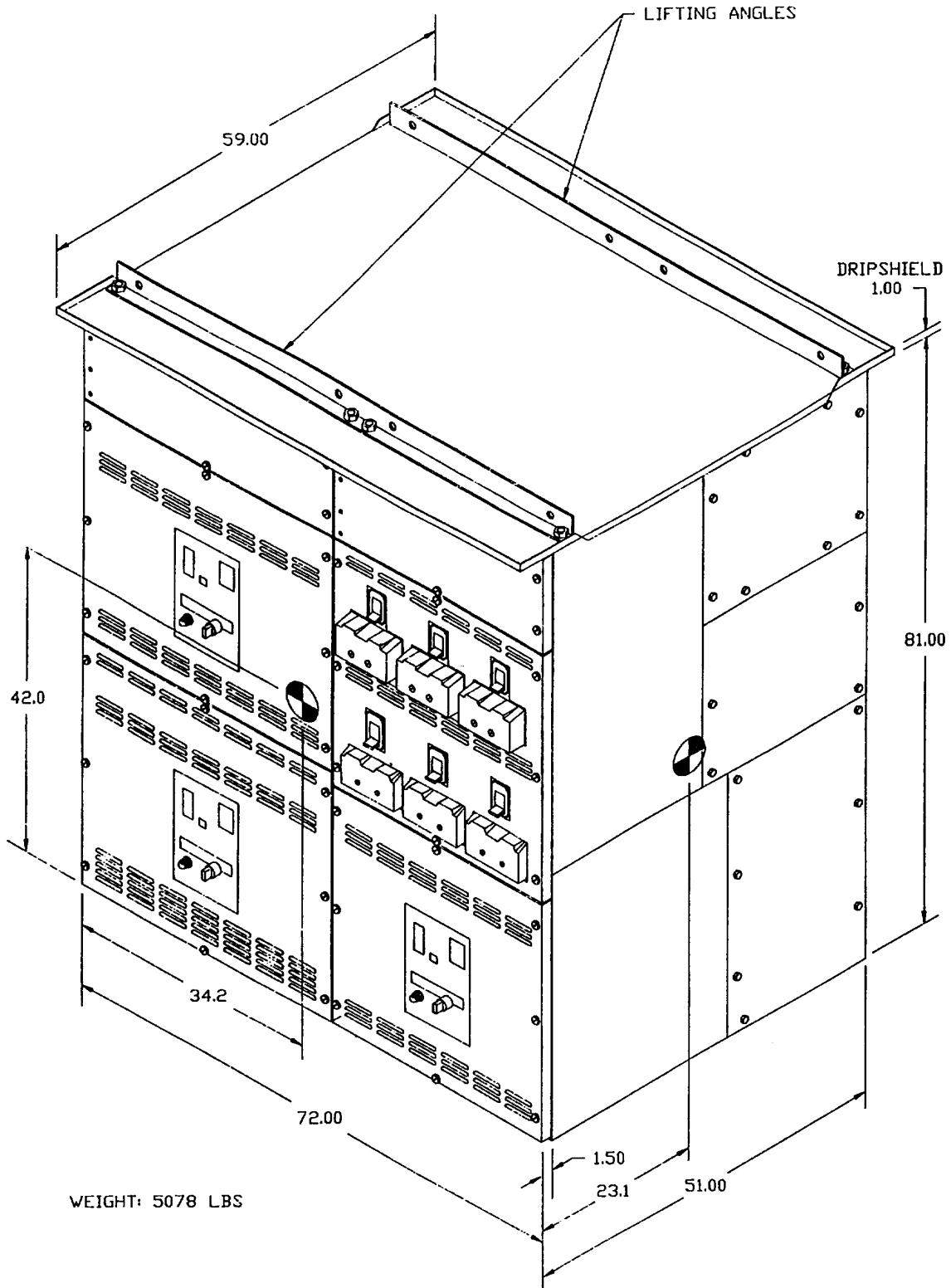


Figure 8-12. Lifting Data, Switchboard 3SC

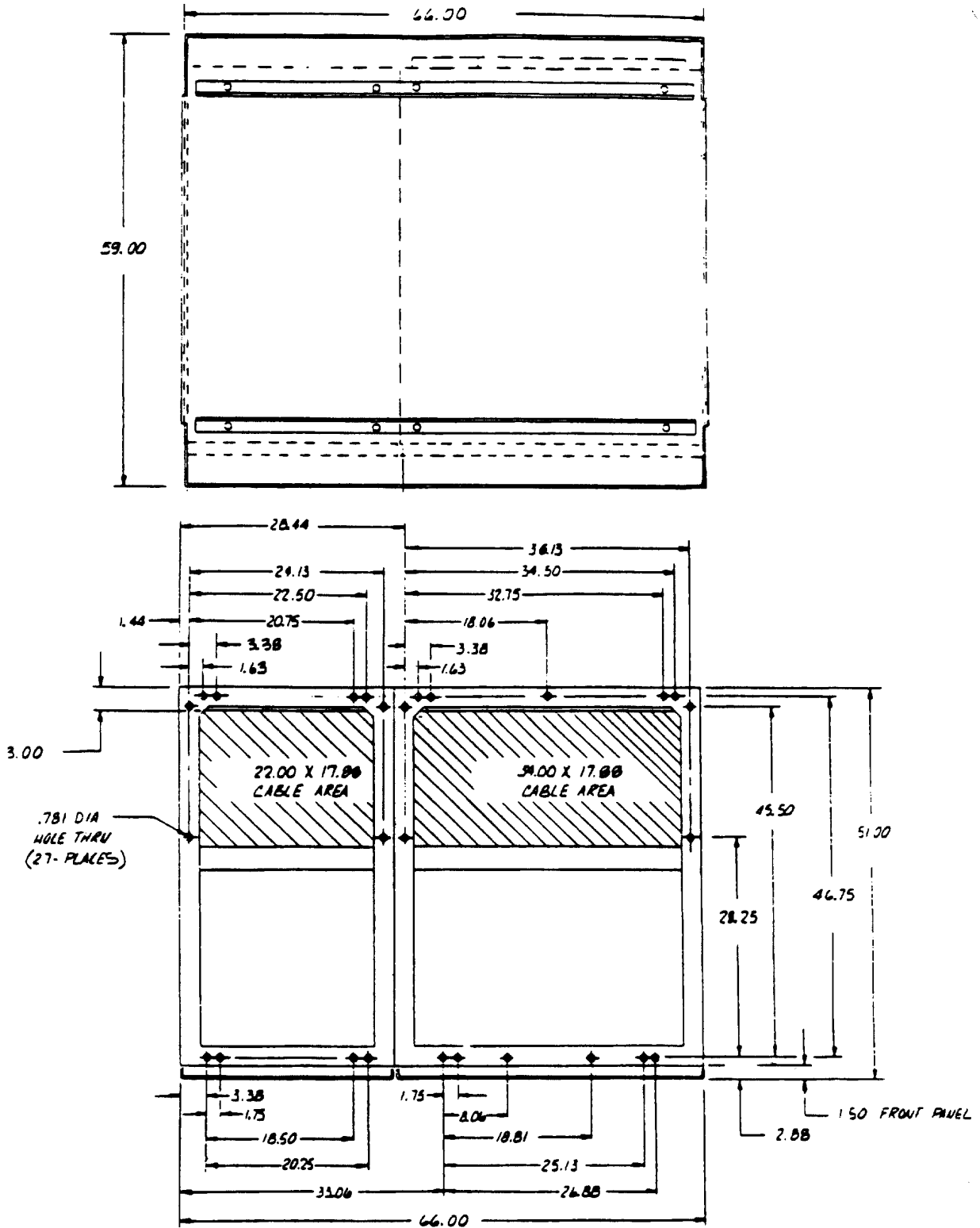


Figure 8-13. Outline and Mounting Data, Switchboard 1SG

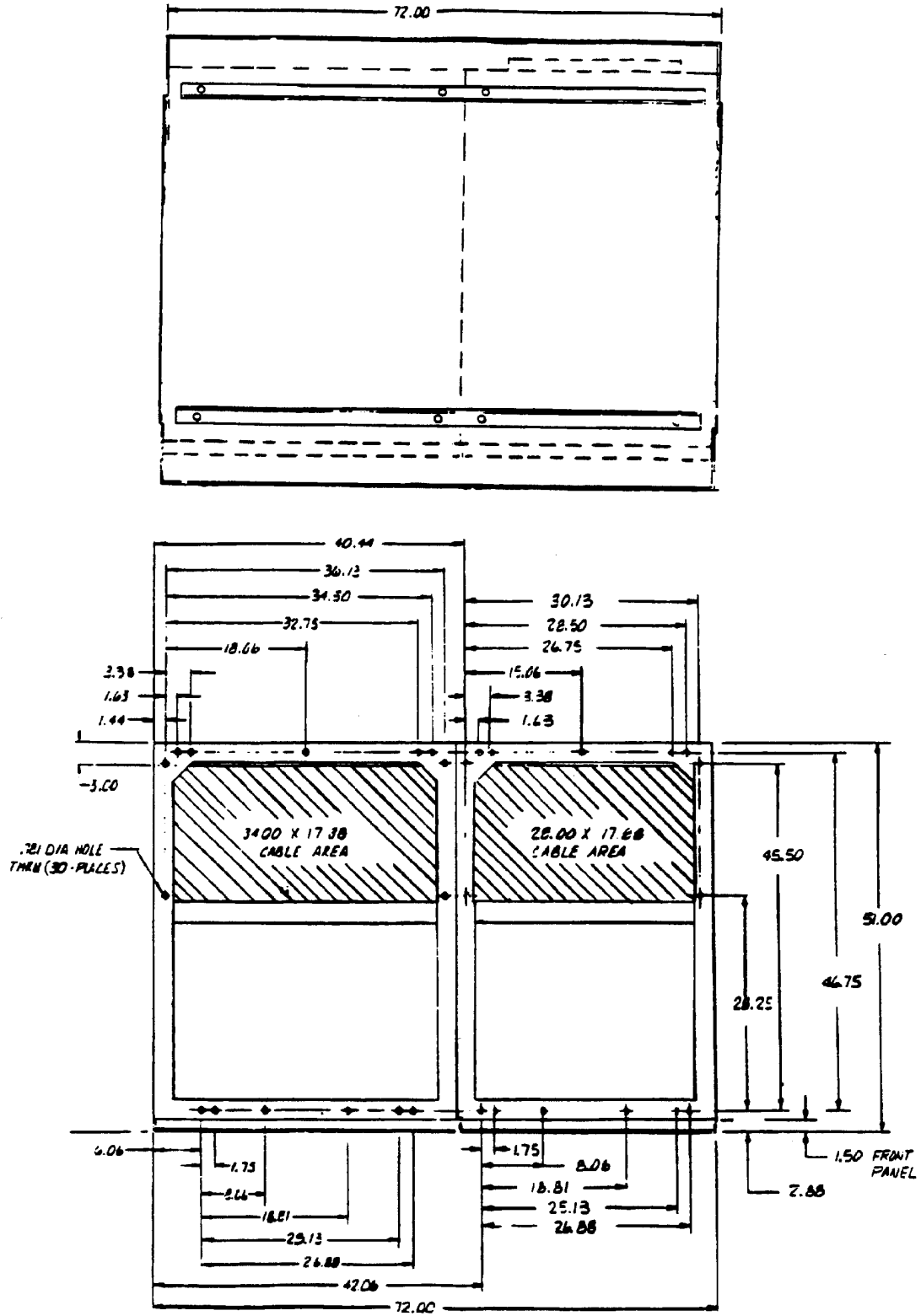


Figure 8-14. Outline and Mounting Data, Switchboard 1SA

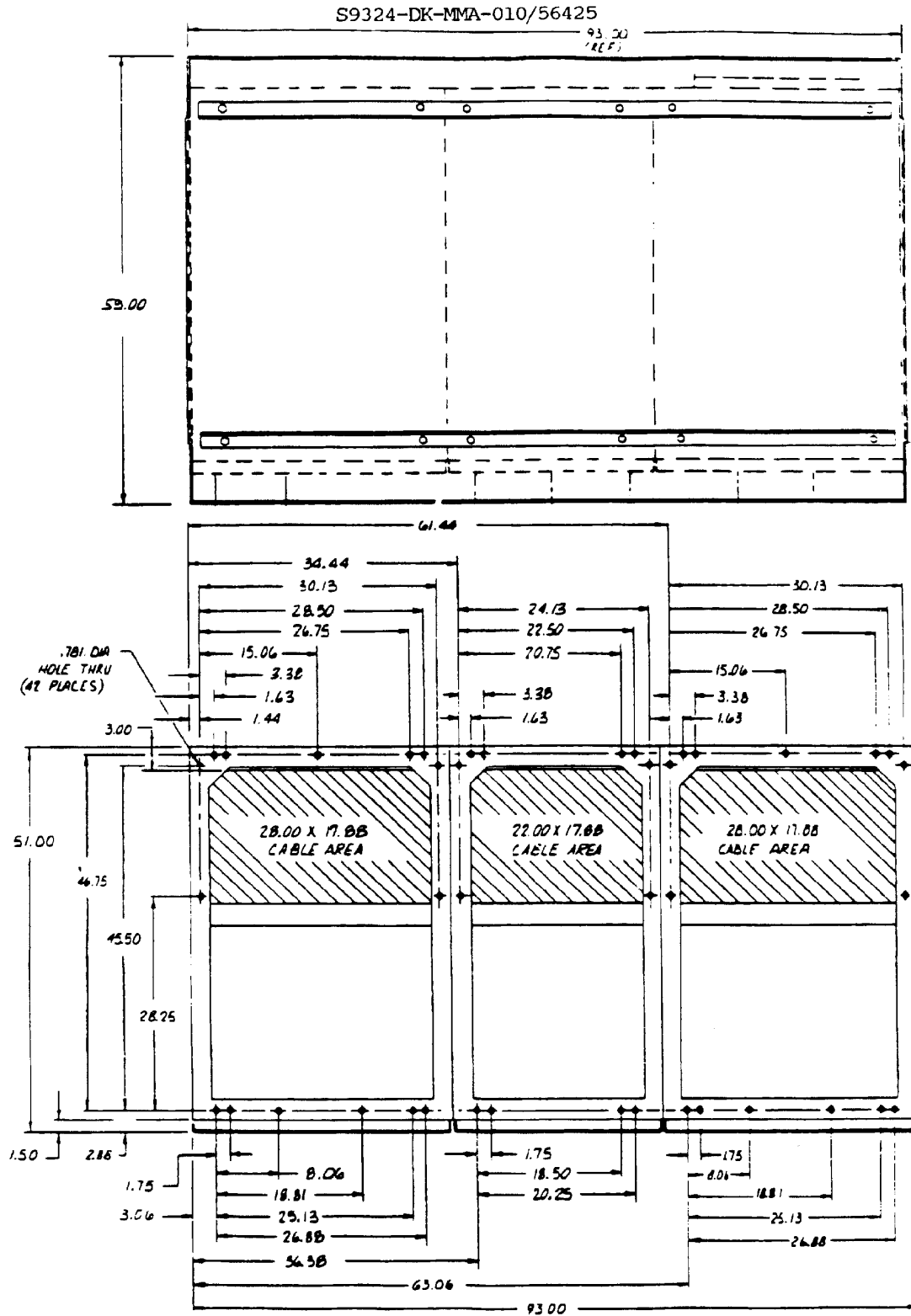


Figure 8-15. Outline and Mounting Data, Switchboard 1SB

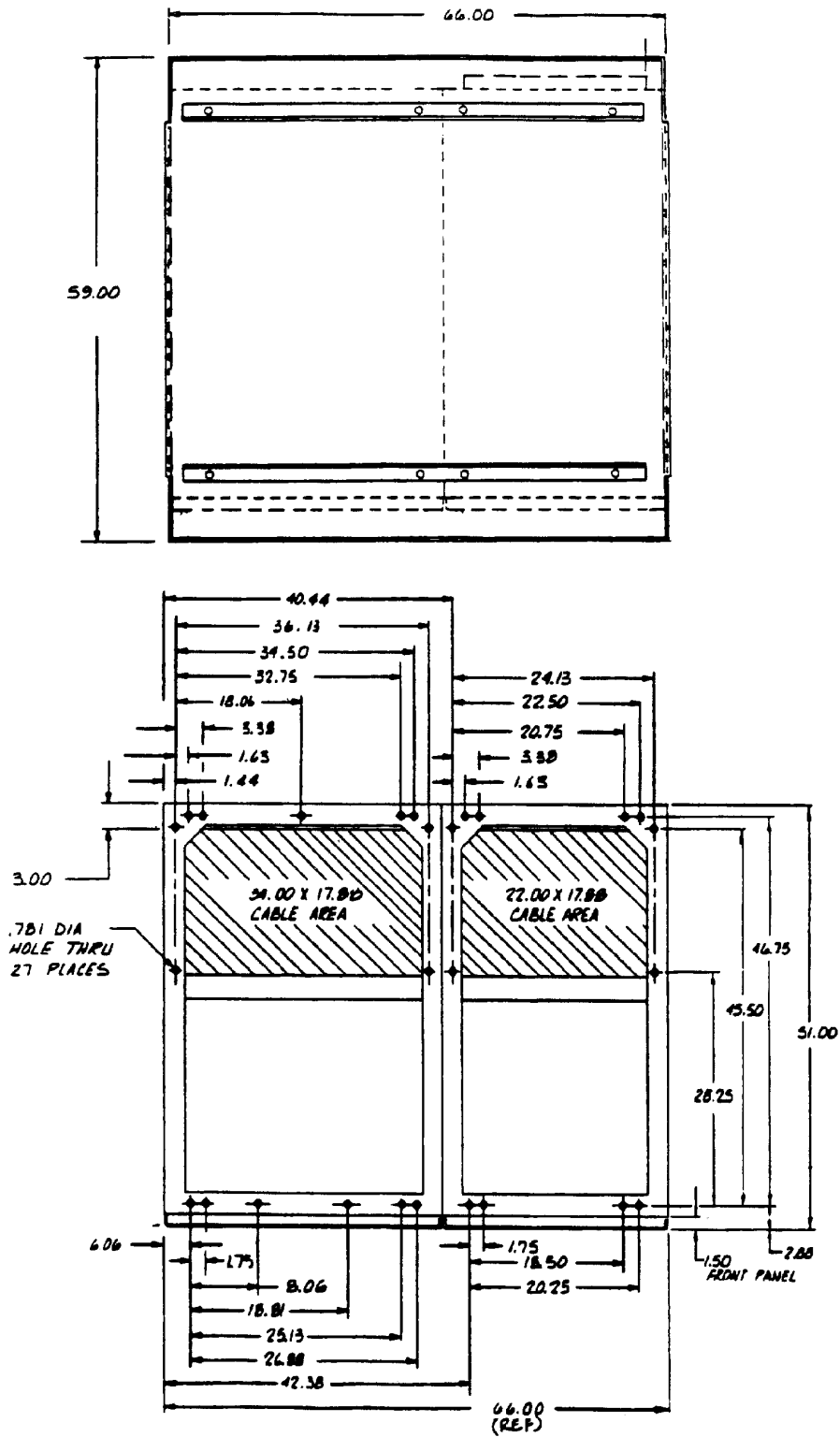


Figure 8-16. Outline and Mounting Data Switchboard 1SC

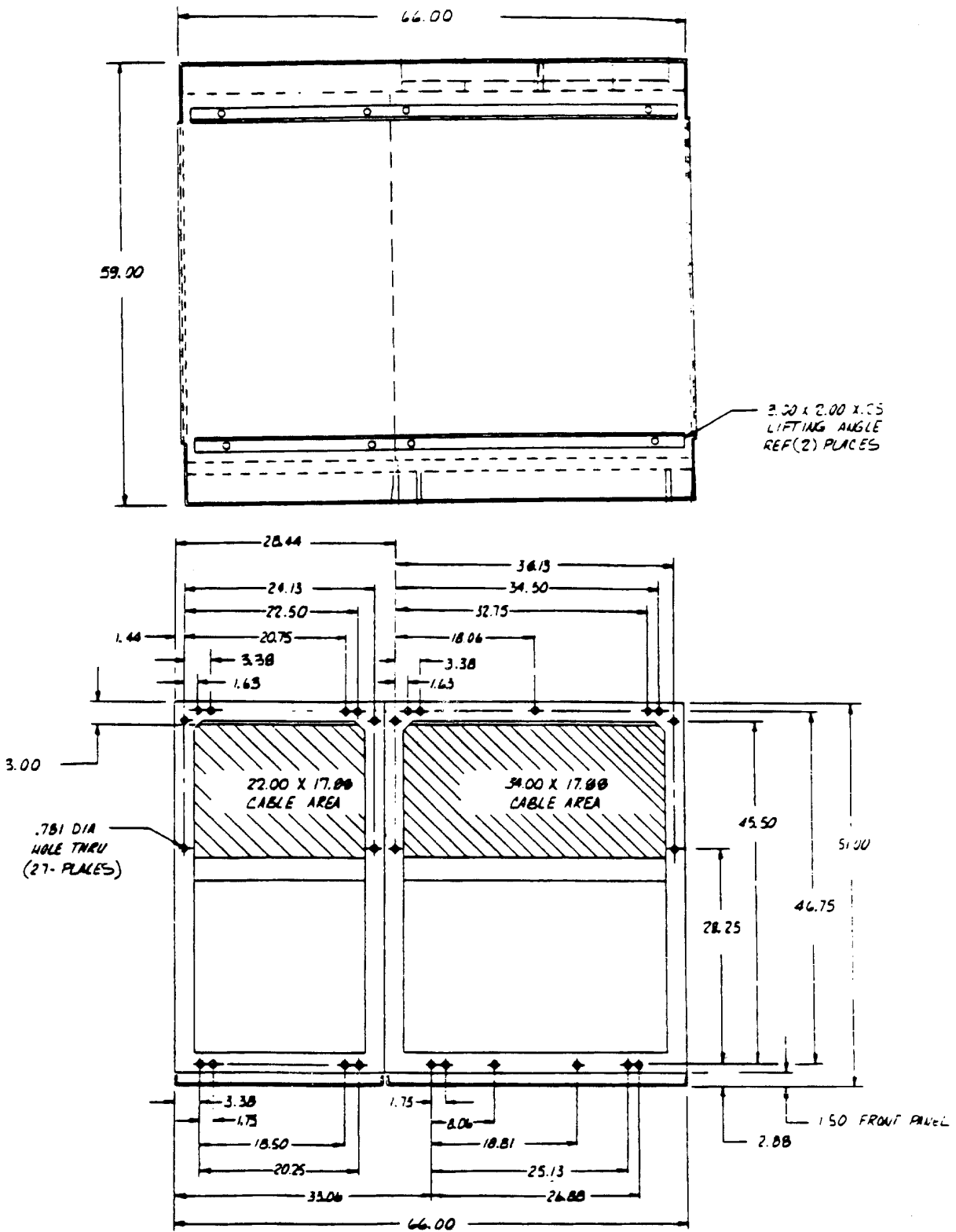


Figure 8-17. Outline and Mounting Data, Switchboard 2SG

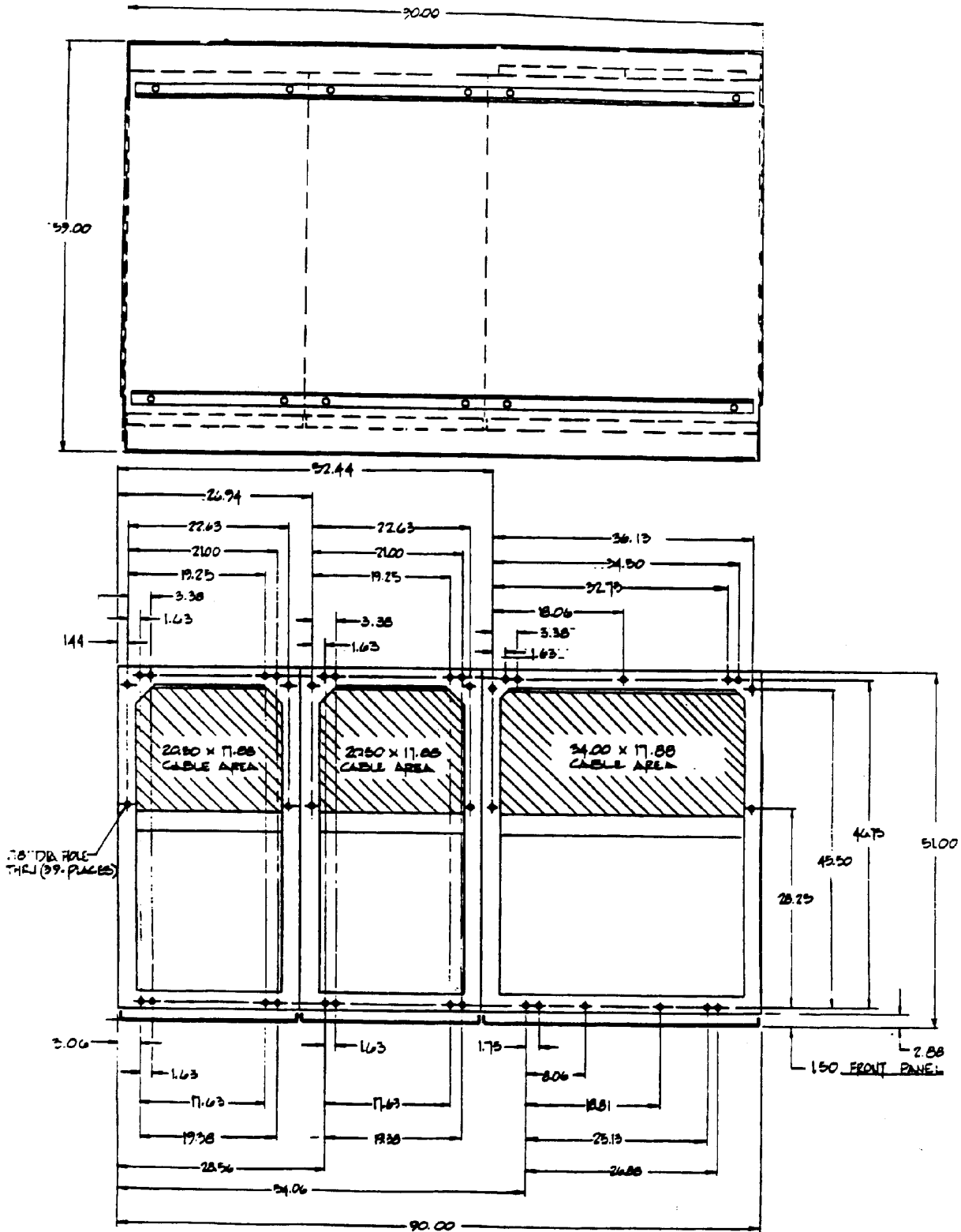


Figure 8-18. Outline and Mounting Data, Switchboard 2SA

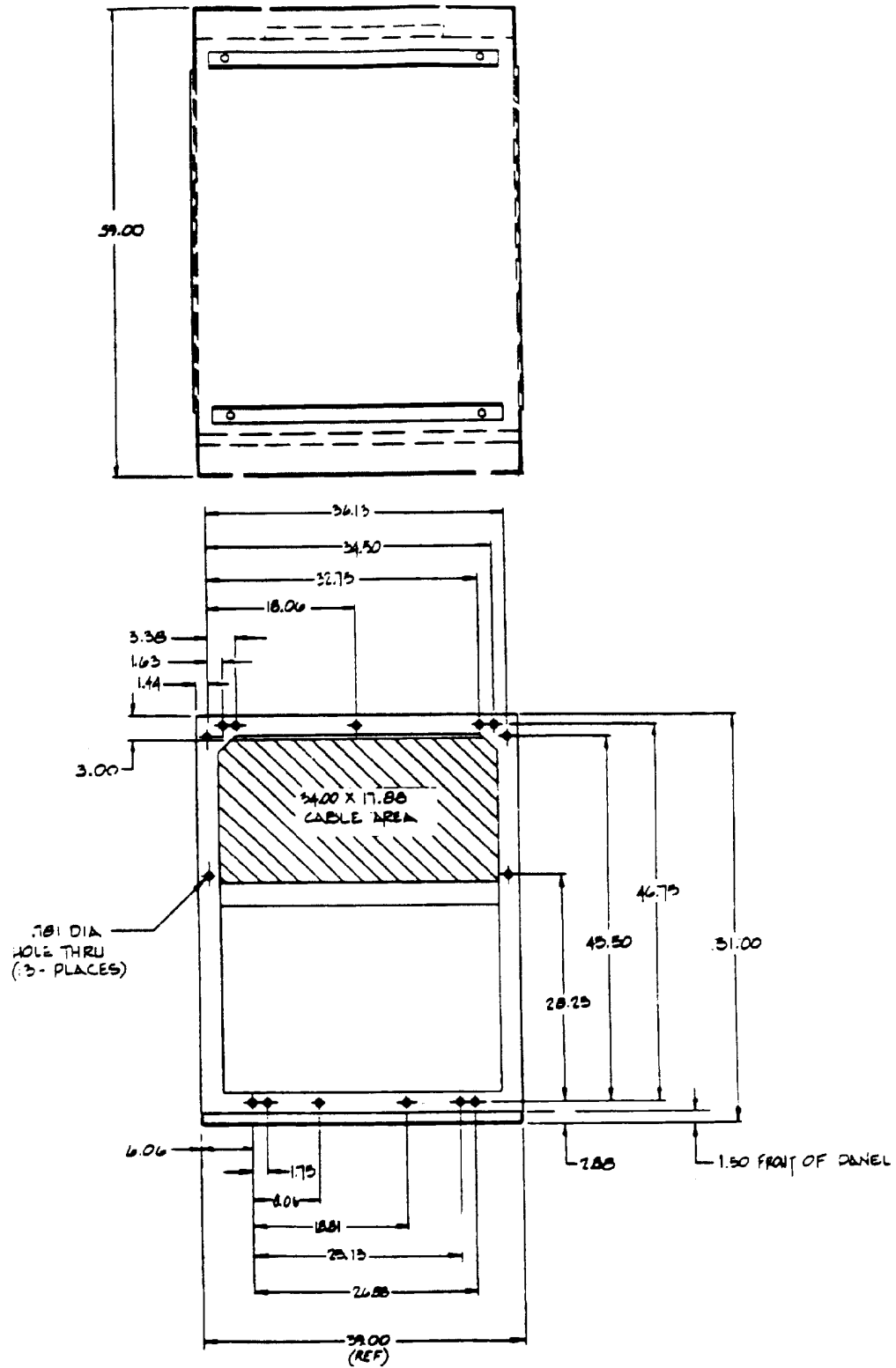


Figure 8-19. Outline and Mounting Data, Switchboard 2SB

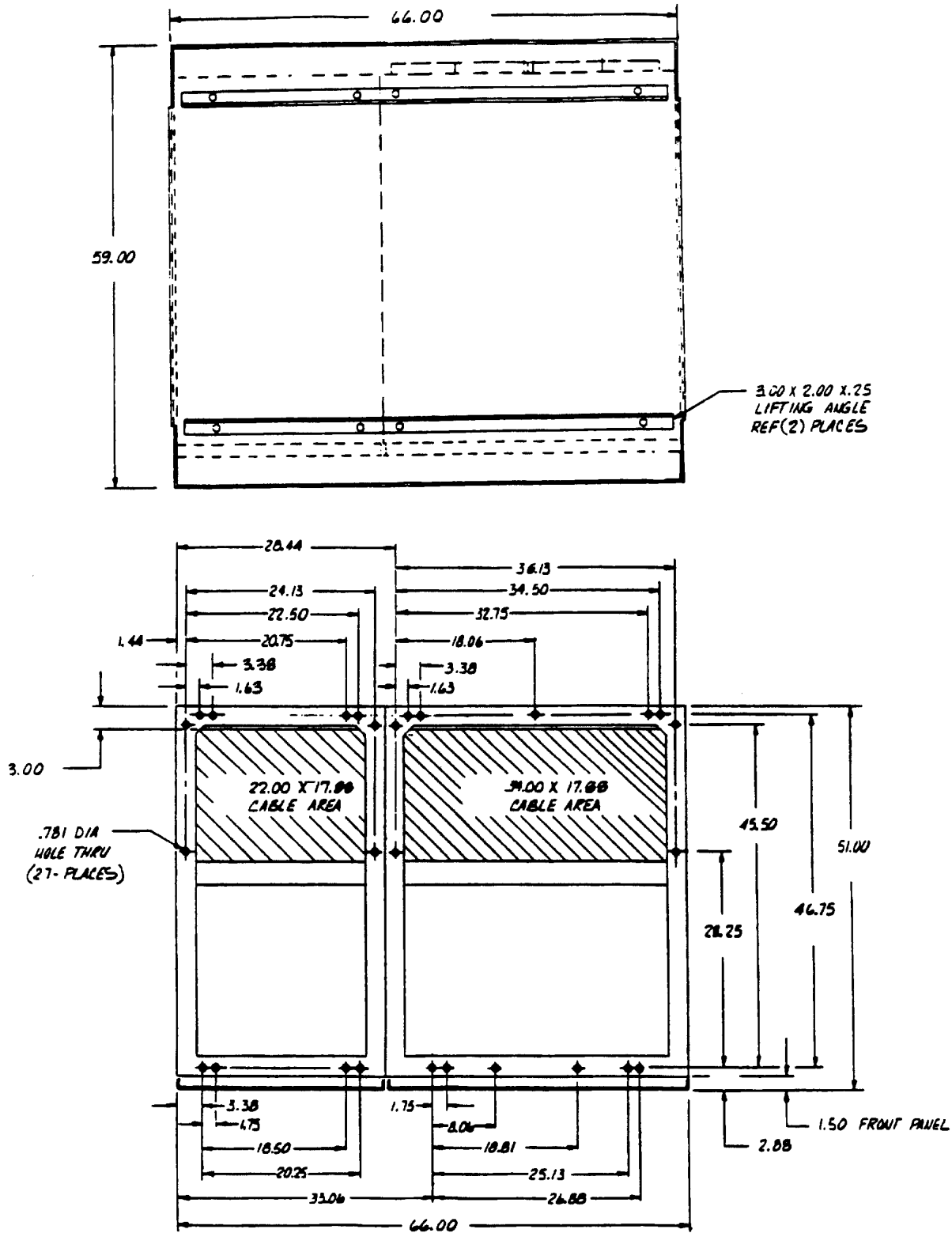


Figure 8-20. Outline and Mounting Data, Switchboard 3SG

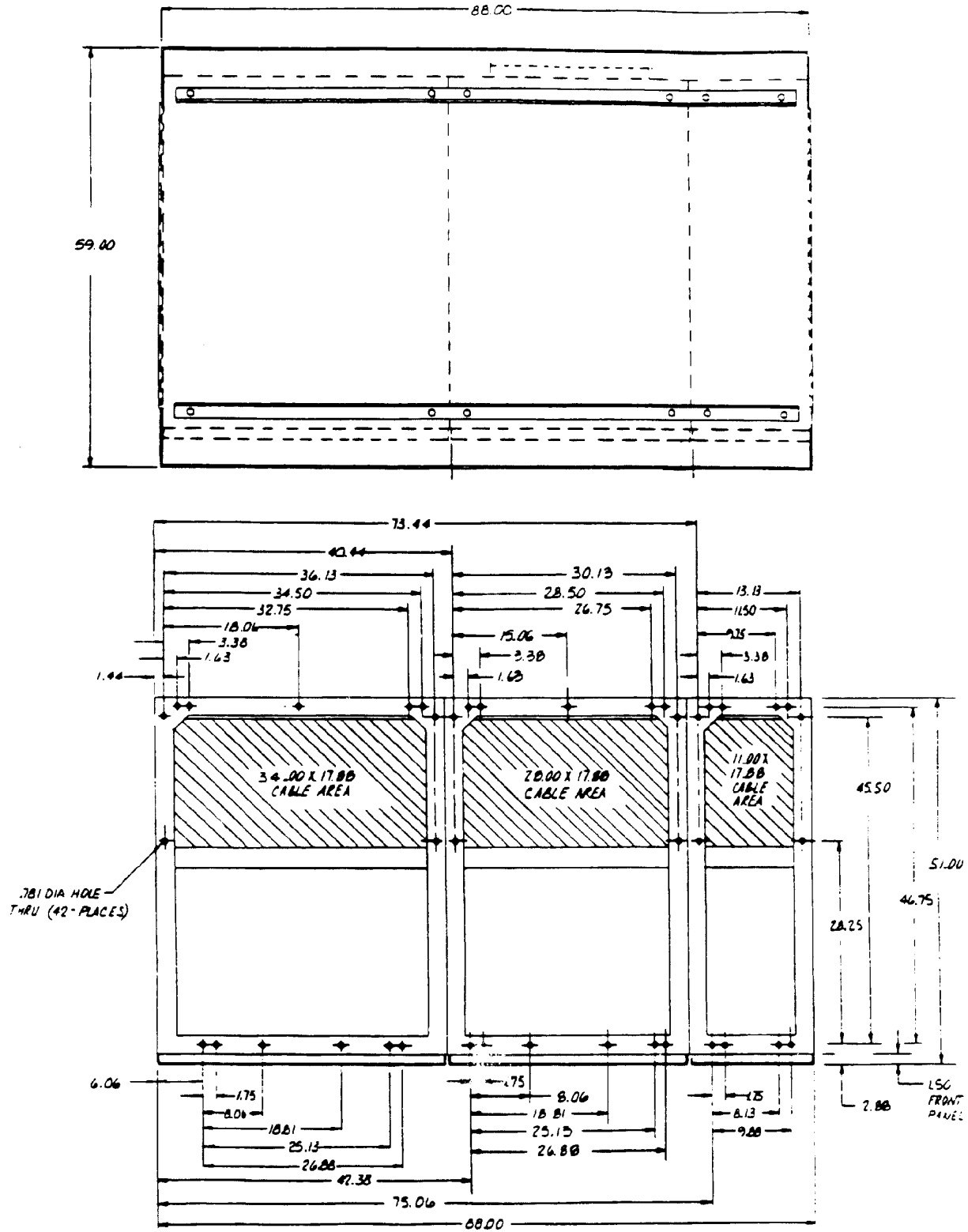


Figure 8-21. Outline and Mounting Data, Switchboard 3SA

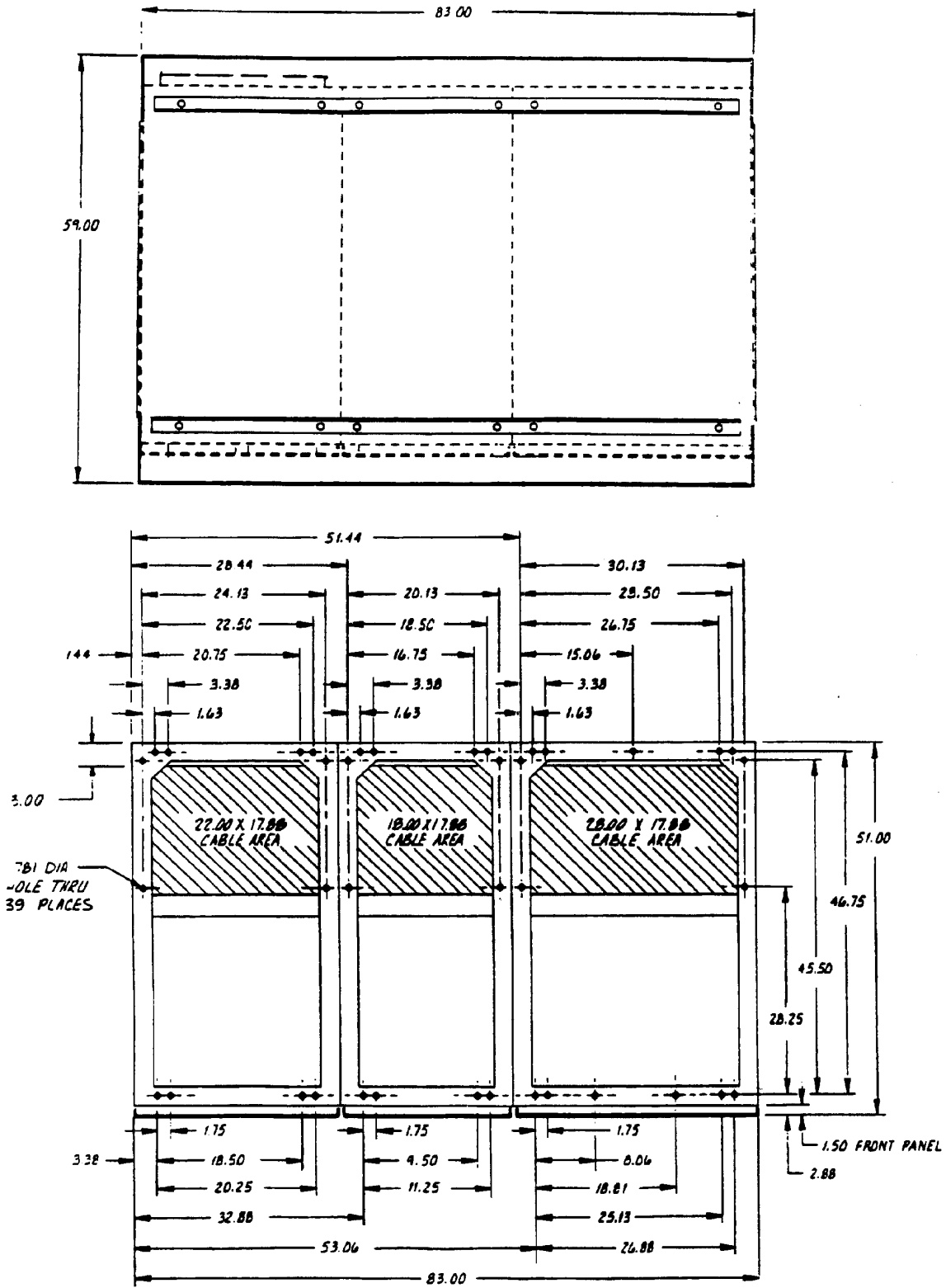


Figure 8-22. Outline and Mounting Data, Switchboard 3SB

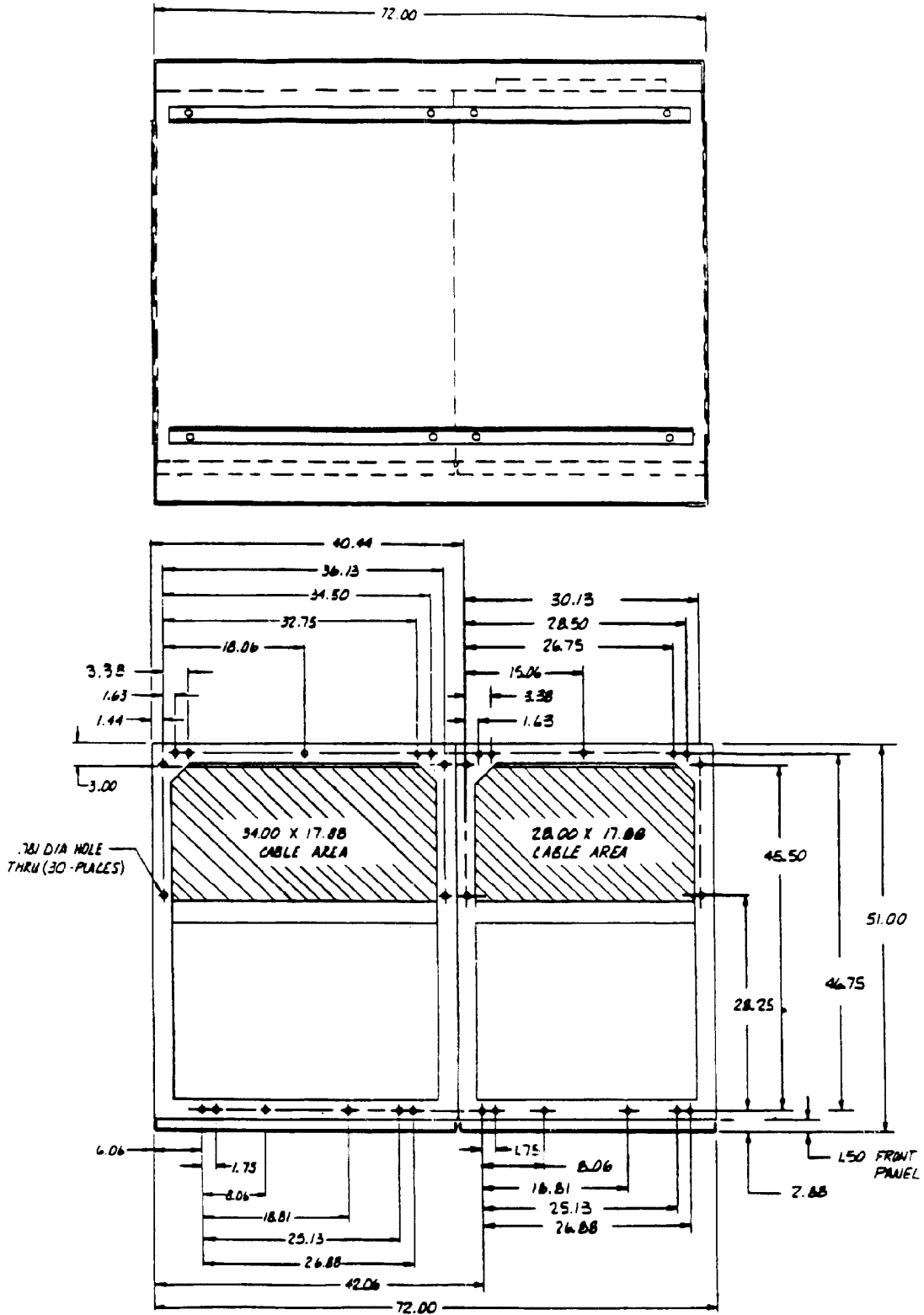
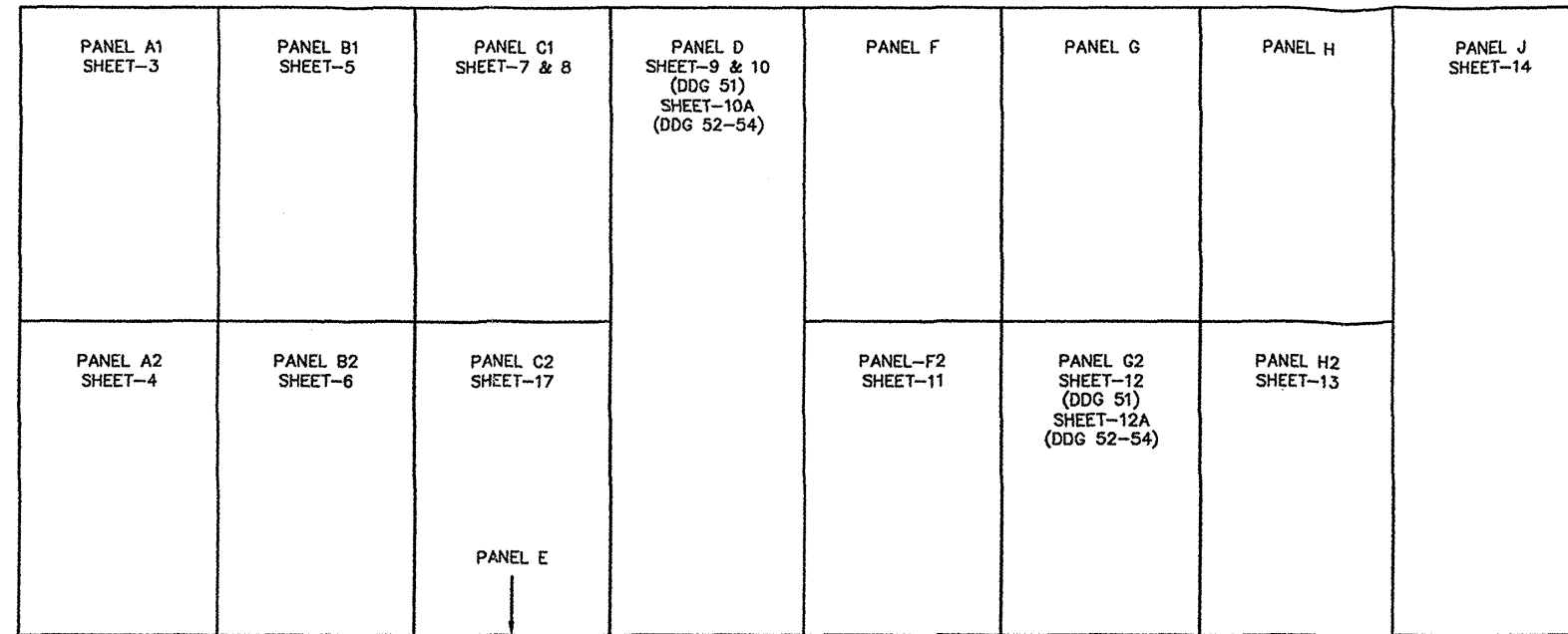


Figure 8-23. Outline and Mounting Data, Switchboard 3SC

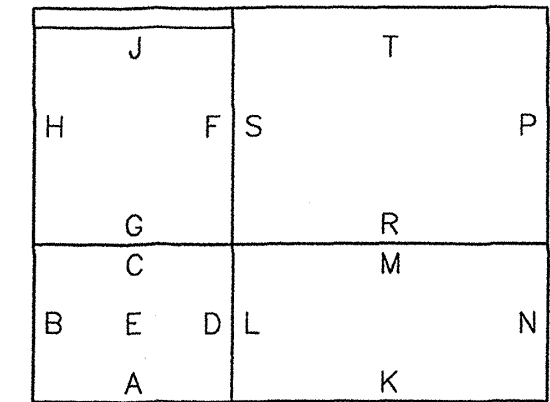
CHAPTER 9**WIRING DIAGRAMS**

This chapter provides wiring diagrams in support of maintenance and installation instructions.

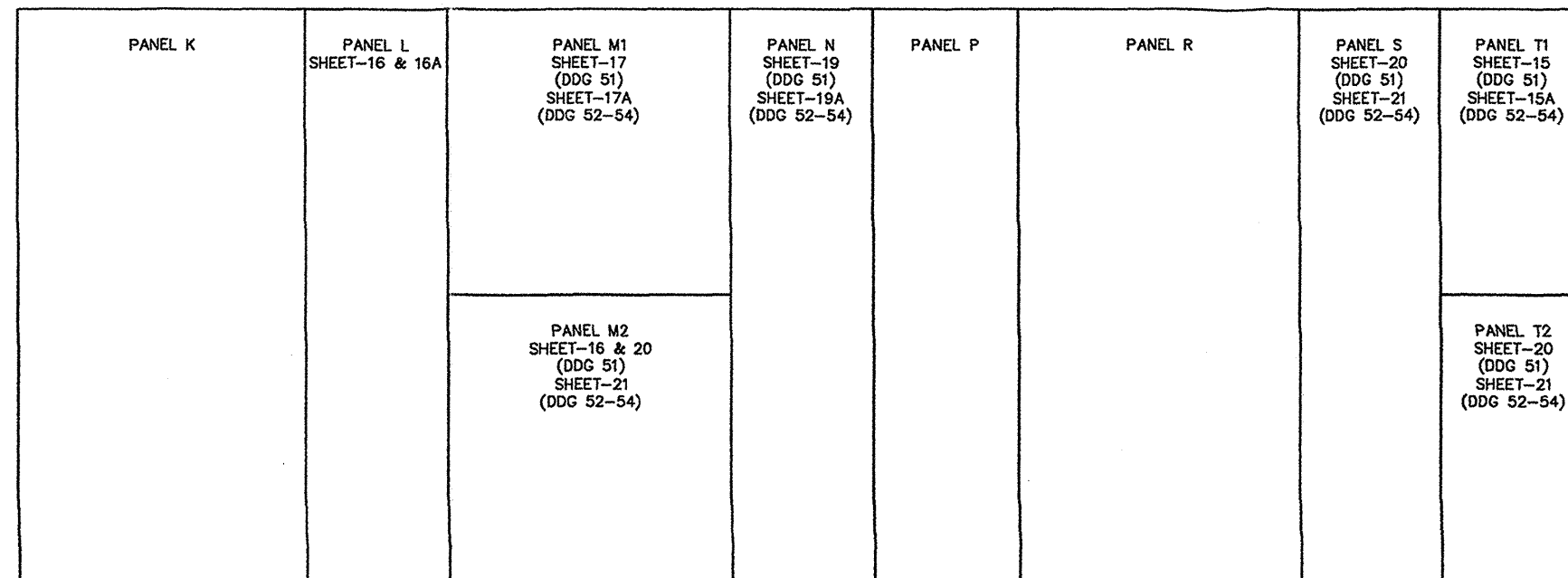
Switchboard	Figure
1SG	9-1
1SA	9-2
1SB	9-3
1SC	9-4
2SG	9-5
2SA	9-6
2SB	9-7
3SG	9-8
3SA	9-9
3SB	9-10
3SC	9-11



UNIT-1



UNIT-1 UNIT-2
TOP VIEW-PANEL LOCATION
SWITCHBOARD "1S"



UNIT-2

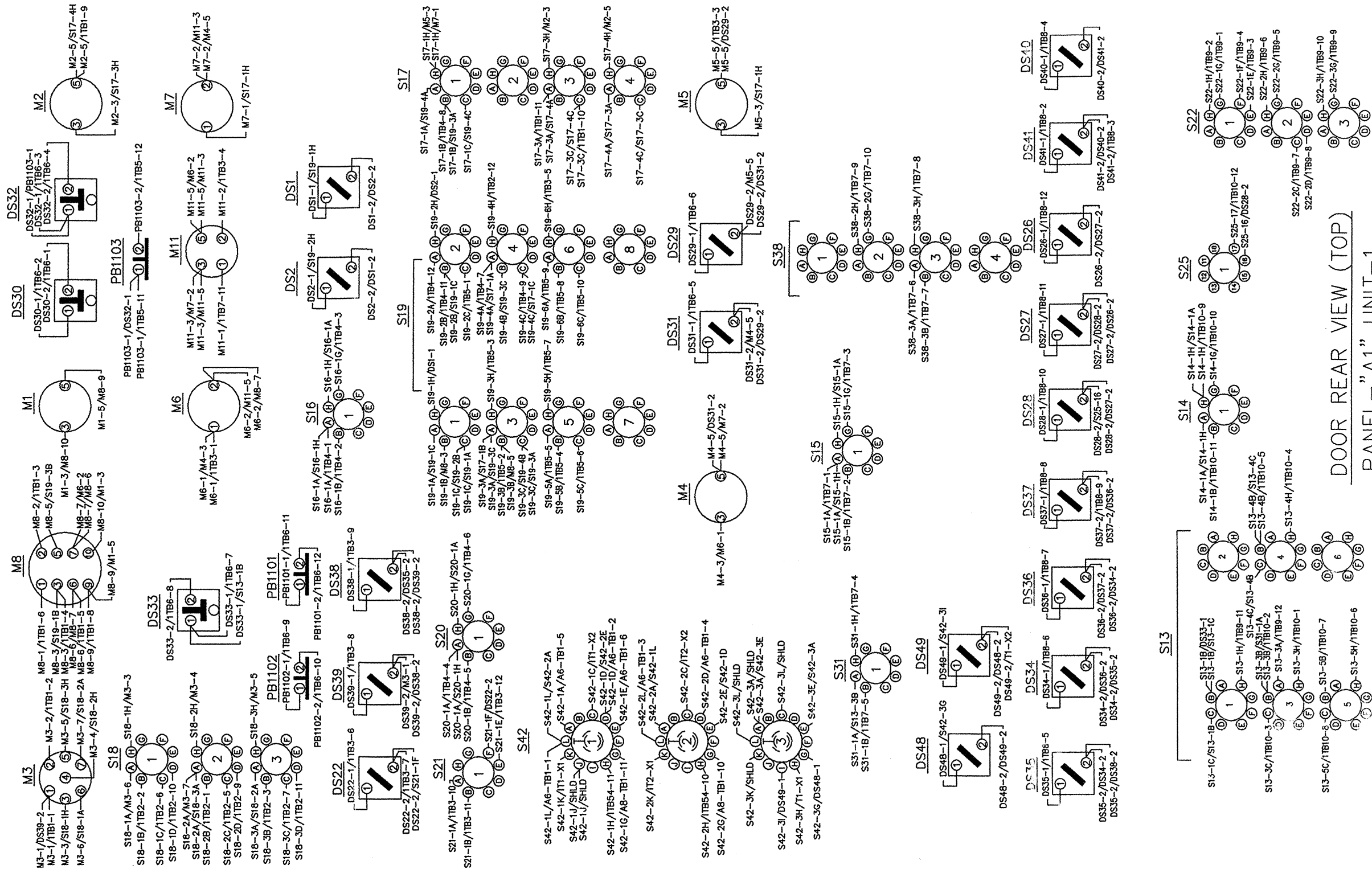
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 1 of 20)

COMPONENT LOCATIONS

PANEL NO														
A1	M1-M8	M11	DS1-DS2	DS22	DS26-DS41	S13-S22	S25	S38	S31	PB1101-PB1103		DS48-DS49	S42	
A2	DS4-DS21	DS23-DS25	DS42-DS43	S1-S9	S24	J1-J2								
B1	1TB1-1TB12													
B2	1TB13-1TB24													
C1	K1104-K1106	K1108-K1111	K1113	K1116	K1123	K1129-K1130	K1133-K1134	K1202	K1204	A1				
C2	K1102	A5	A8 *	A6 *	T2									
D	K1101,K1107	K1121-K1122	K1124	K1126	K1103	K1114,K1112	K1115	K1117	K1120	K1131-K1132	K1135	K1201	K1401	K1119
F2	1TB51-1TB62													
T1	F101-F112	F129-F132	F134-F136	F150										
H2	1TB75-1TB86													
G2	1TB63-1TB74													
K														
L	S32-S37	PD1-PD4	A3b (DDG 52-54)											
M1	PT1-PT6	IT1-IT2 *	T1	A2 *	A3a *	GPM **								
M2	CB1110	A3b (DDG 51)												
N	K1205	K1402	K1118	K1404	K1405	K1125	K1127	K1128	K1136					
P														
J	F113-F128	F133	F137-F145	F147-148										
S	1TB48-1TB49													
T2	CT1-CT4													

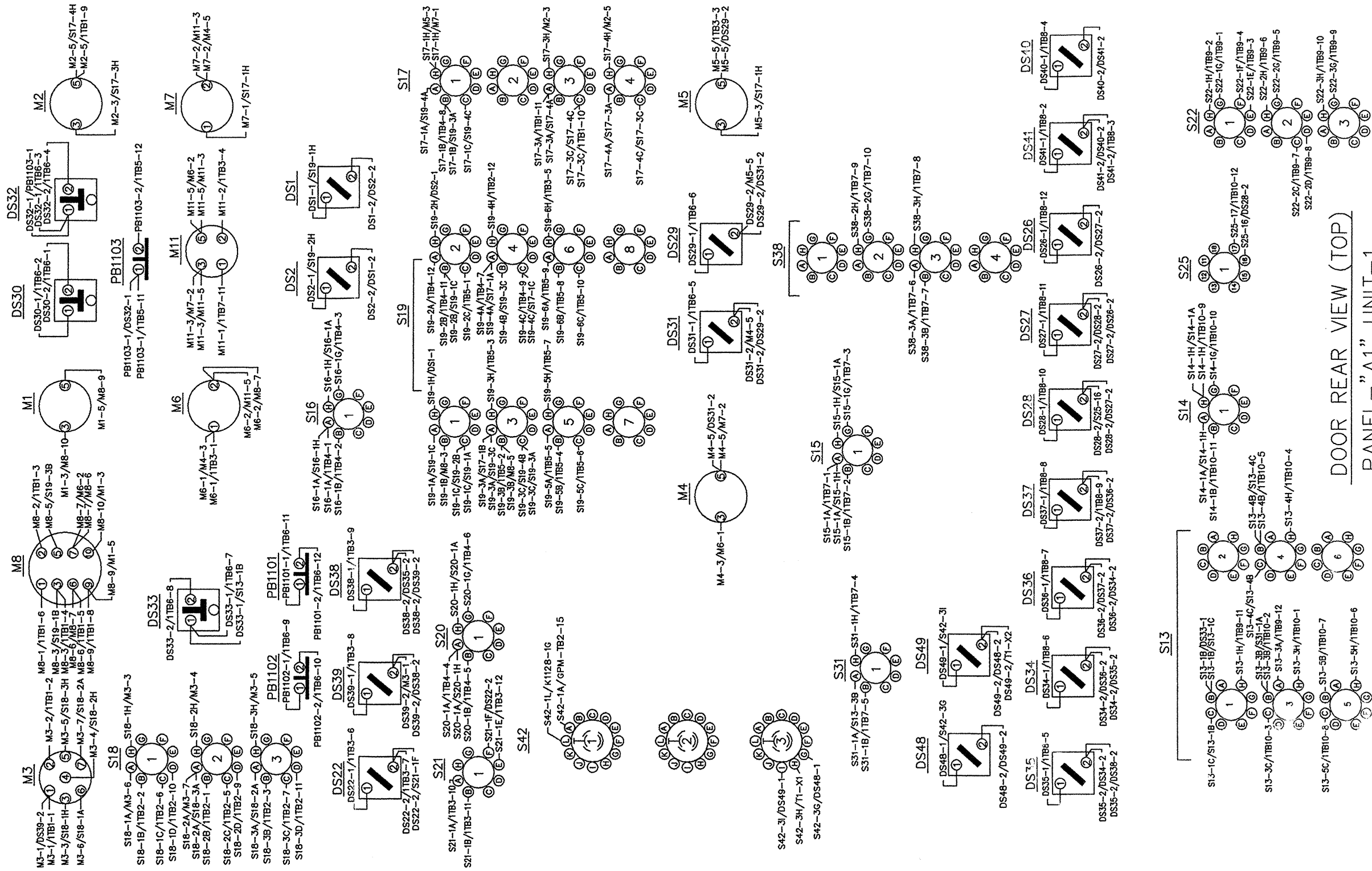
* REMOVED BY MACHALT 320-59006 (ECP-515)
 ** INSTALLED BY MACHALT 320-59006 (ECP-515)

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 2 of 20)



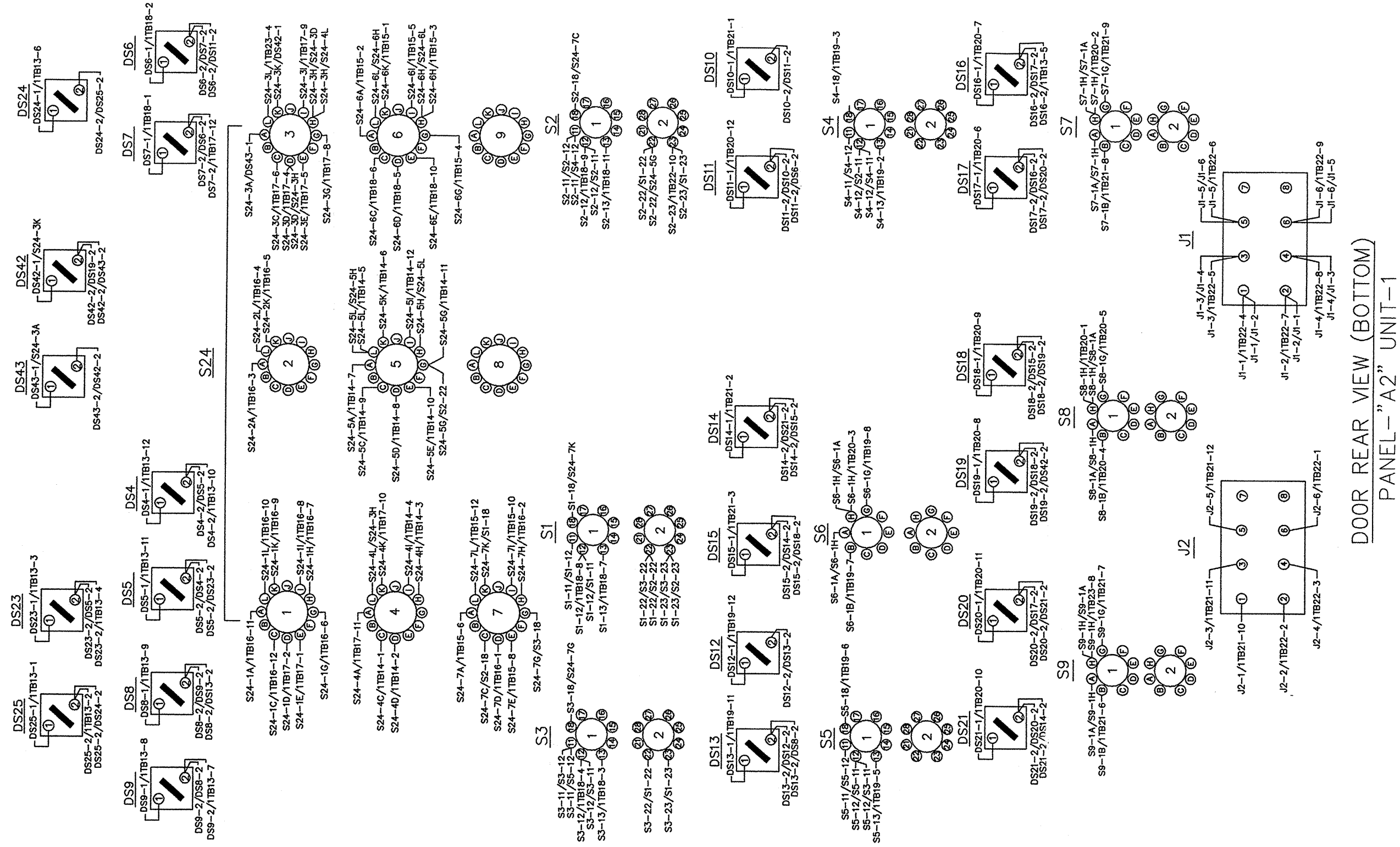
DOOR REAR VIEW (TOP)
PANEL - "A1" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 3 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



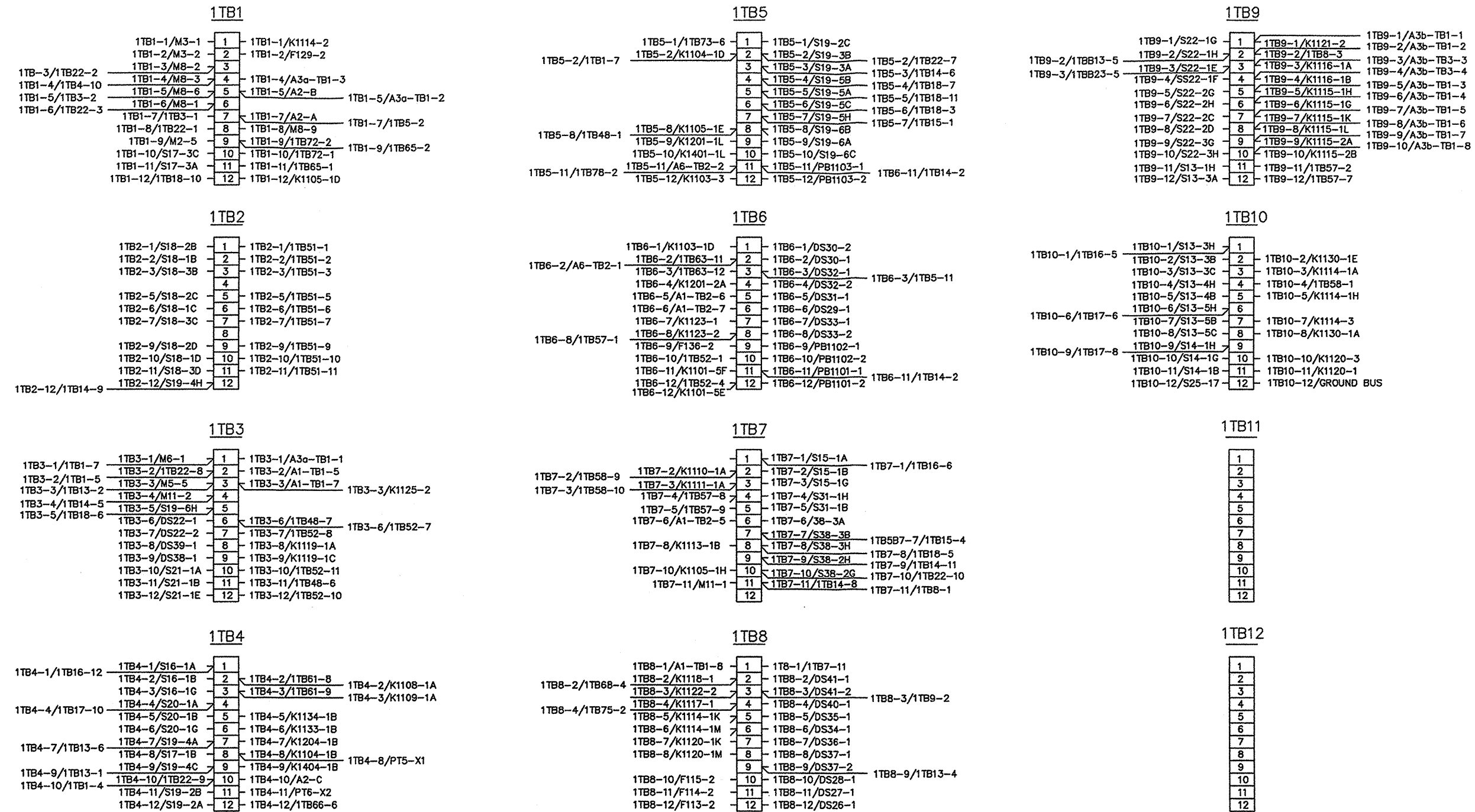
DOOR REAR VIEW (TOP)
 PANEL - "A1" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 3 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



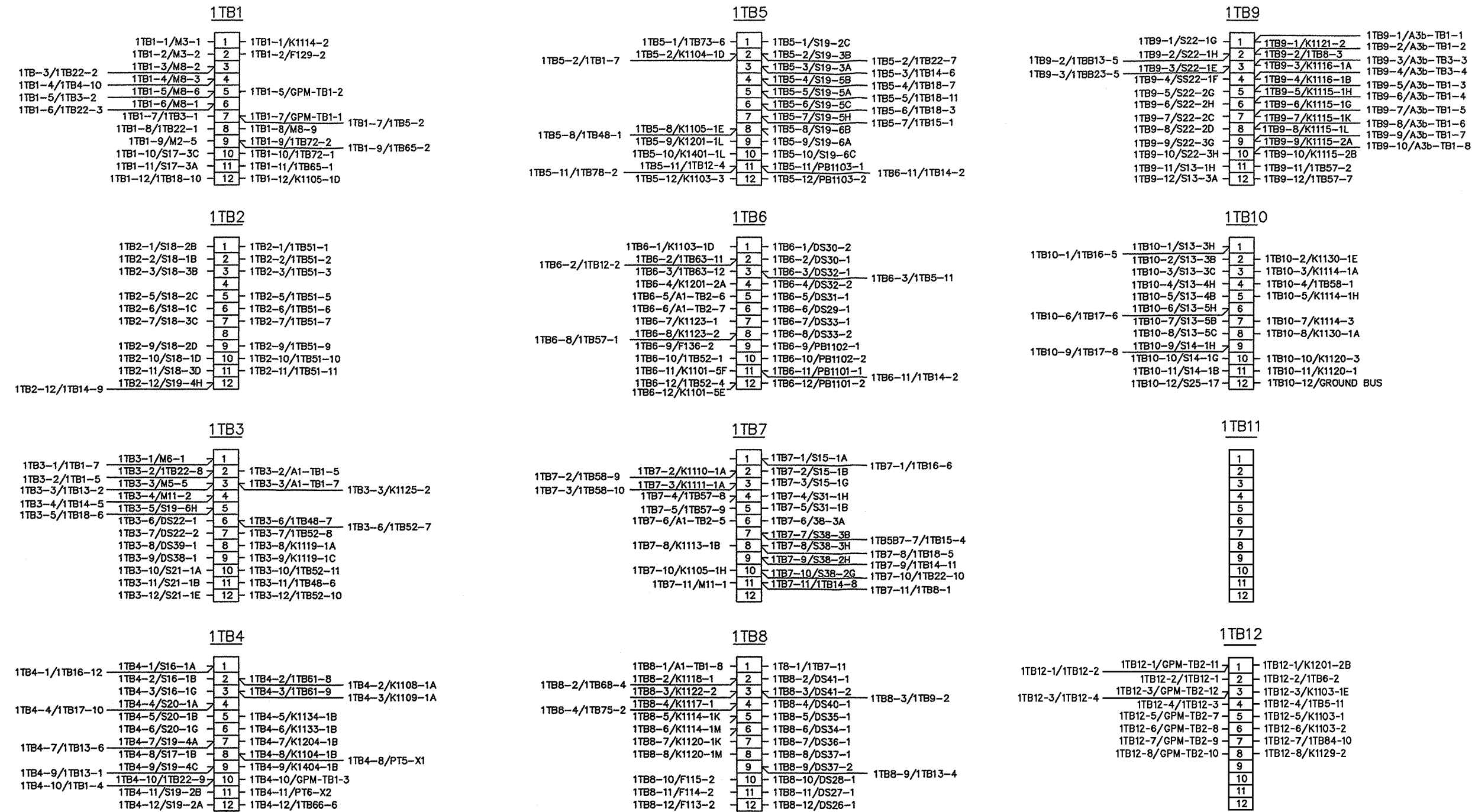
DOOR REAR VIEW (BOTTOM)
"A2" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 4 of 20)



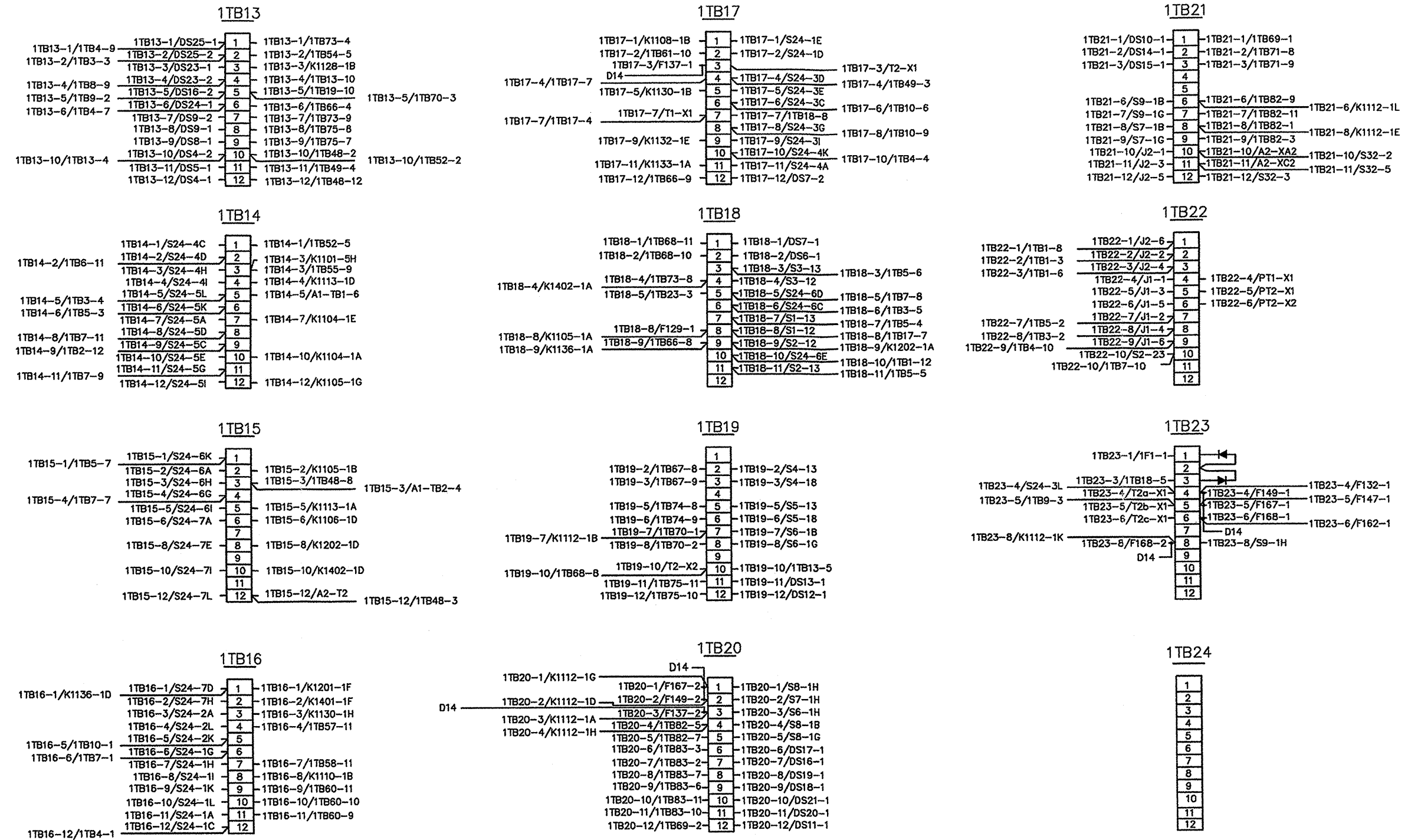
FRONT VIEW LEFT HAND SIDE
 PANEL-"B1" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 5 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



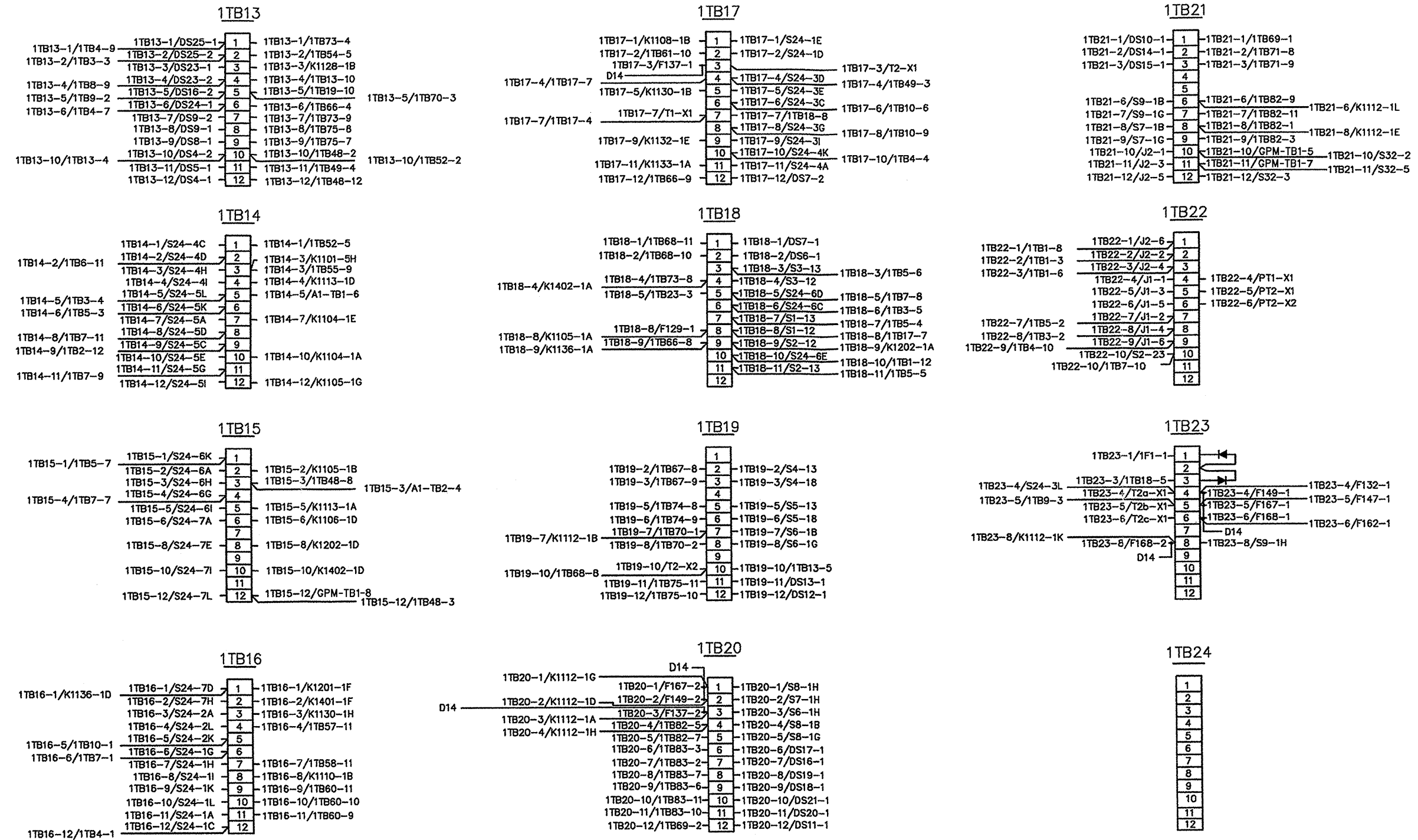
FRONT VIEW LEFT HAND SIDE
 PANEL-"B1" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 5 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



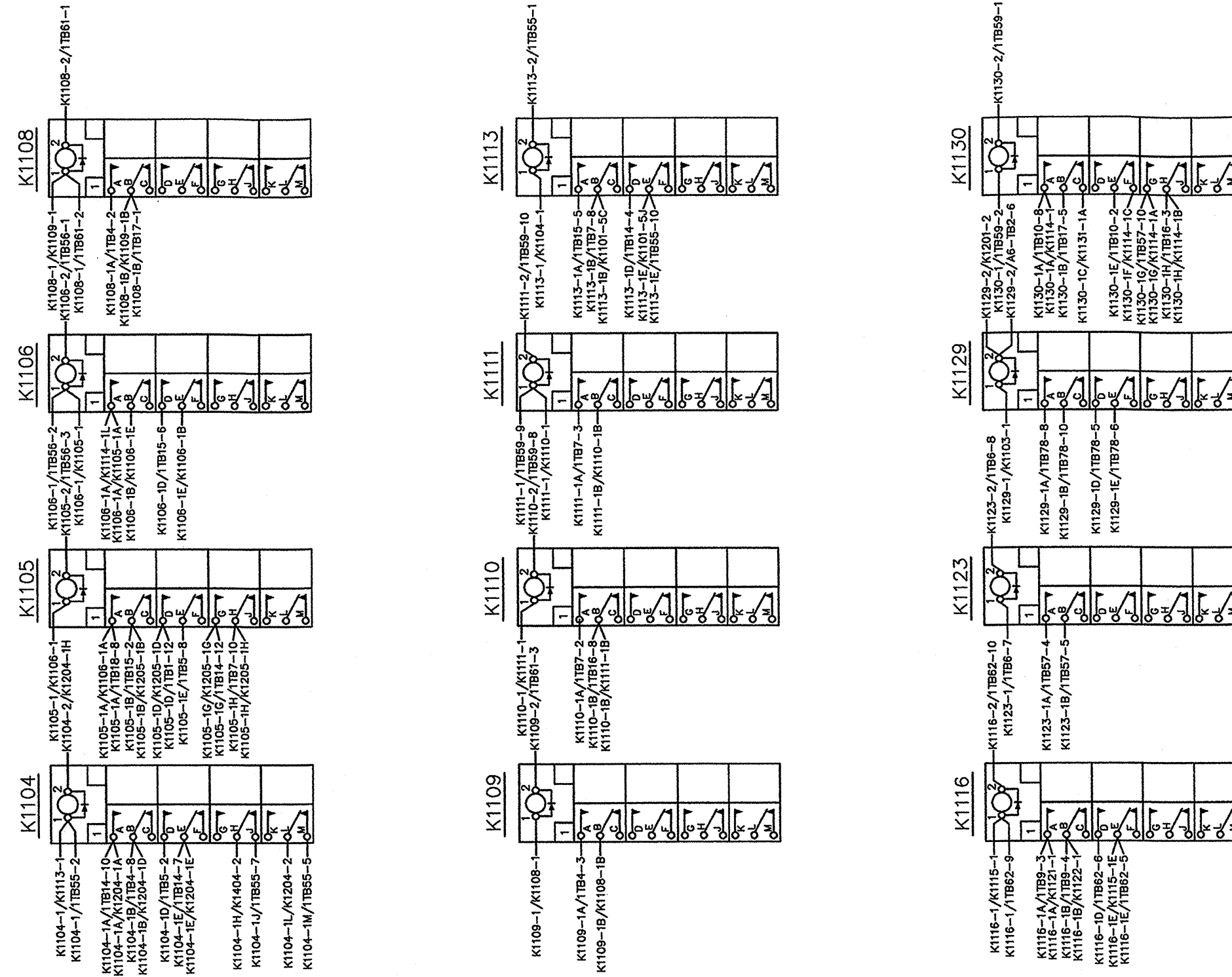
FRONT VIEW LEFT HAND SIDE (BOTTOM)
PANEL-"B2 UNIT-1"

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 6 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



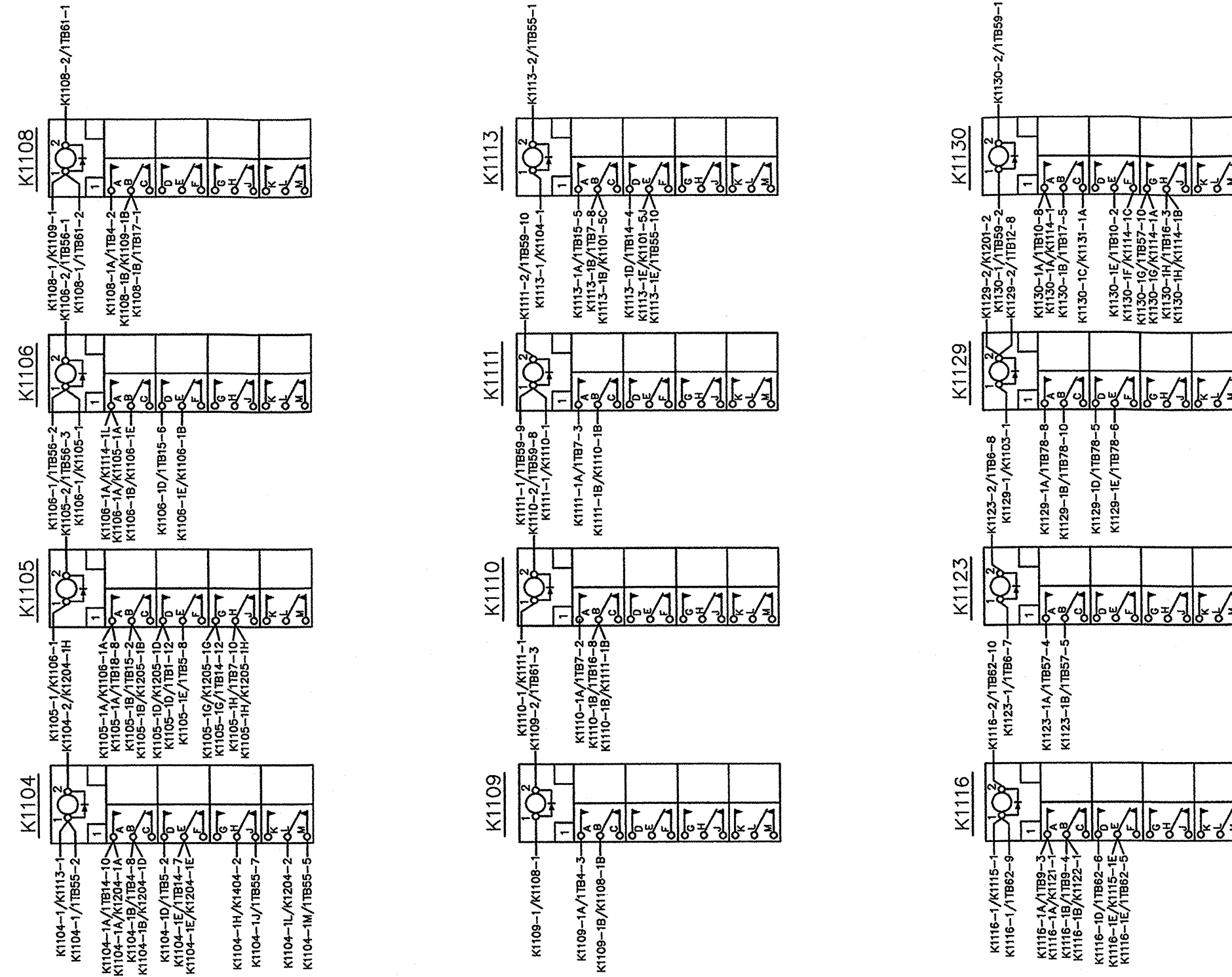
FRONT VIEW LEFT HAND SIDE (BOTTOM)
PANEL-"B2 UNIT-1"

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 6 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



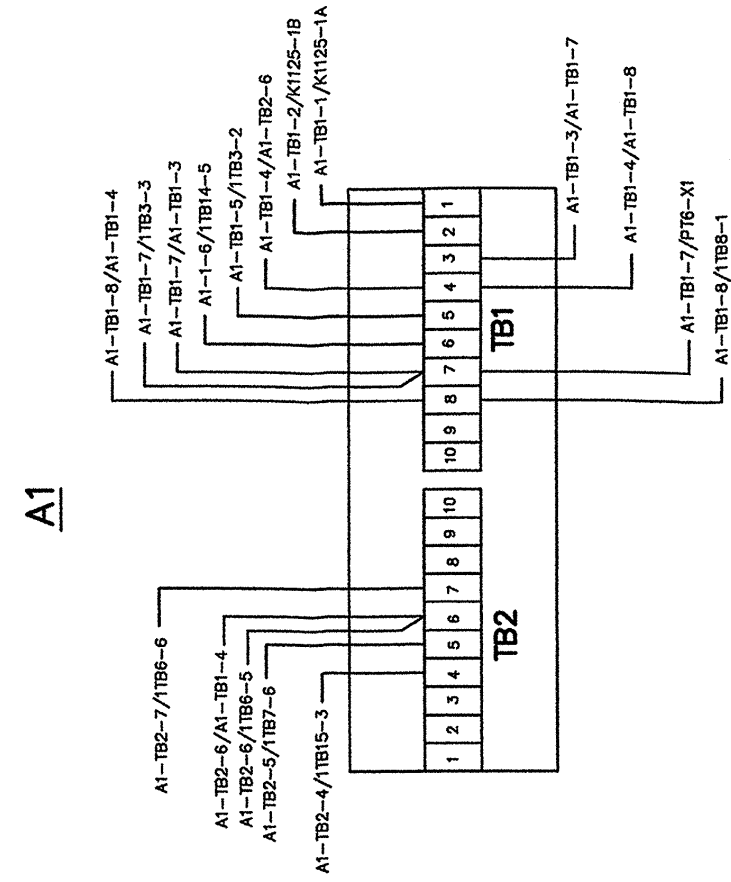
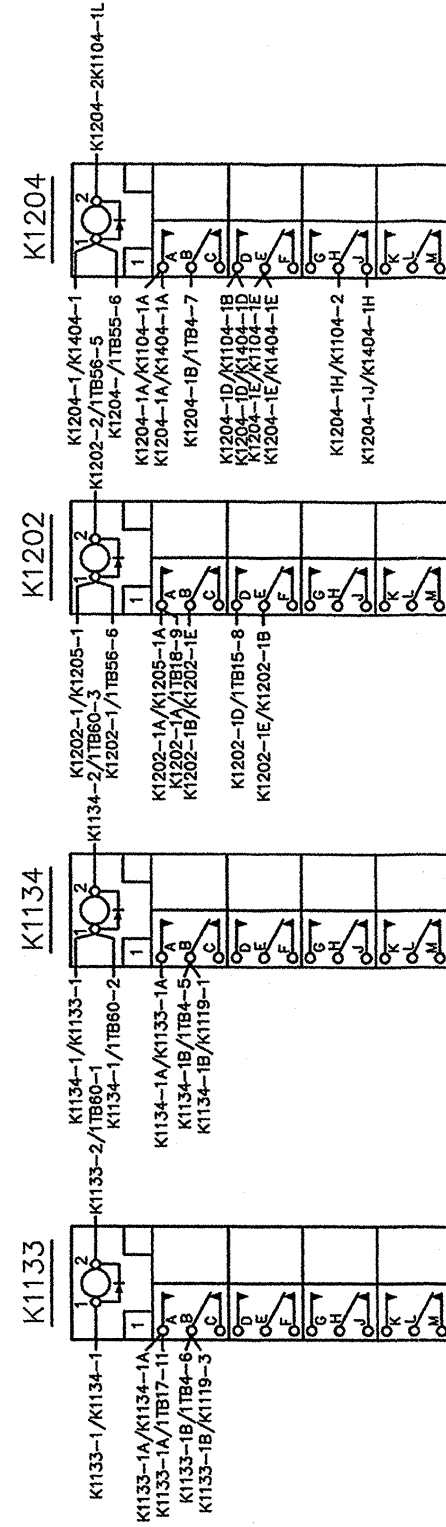
RELAY SUBPAN
PANEL-"C1" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 7 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



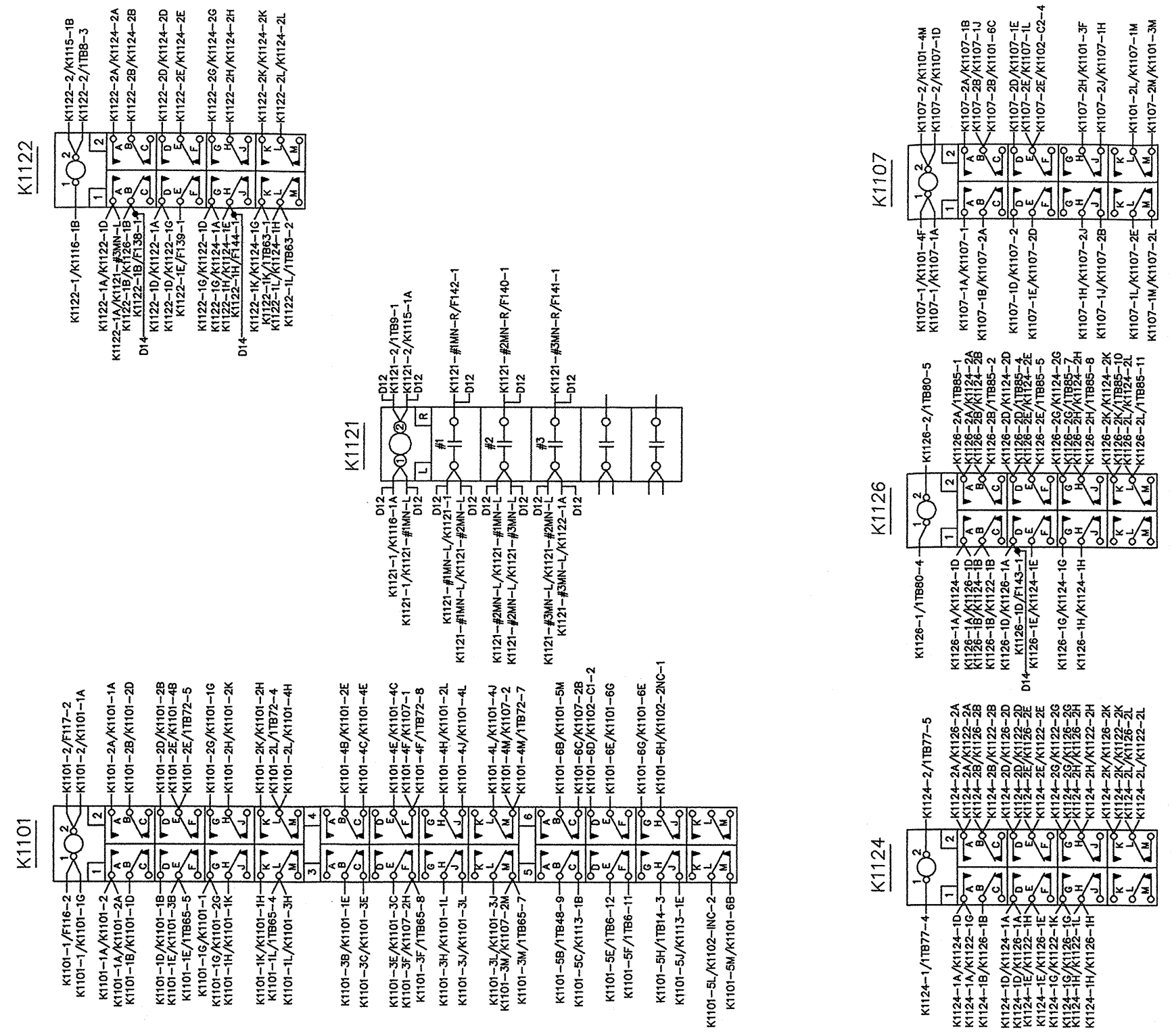
RELAY SUBPAN
PANEL-"C1" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 7 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



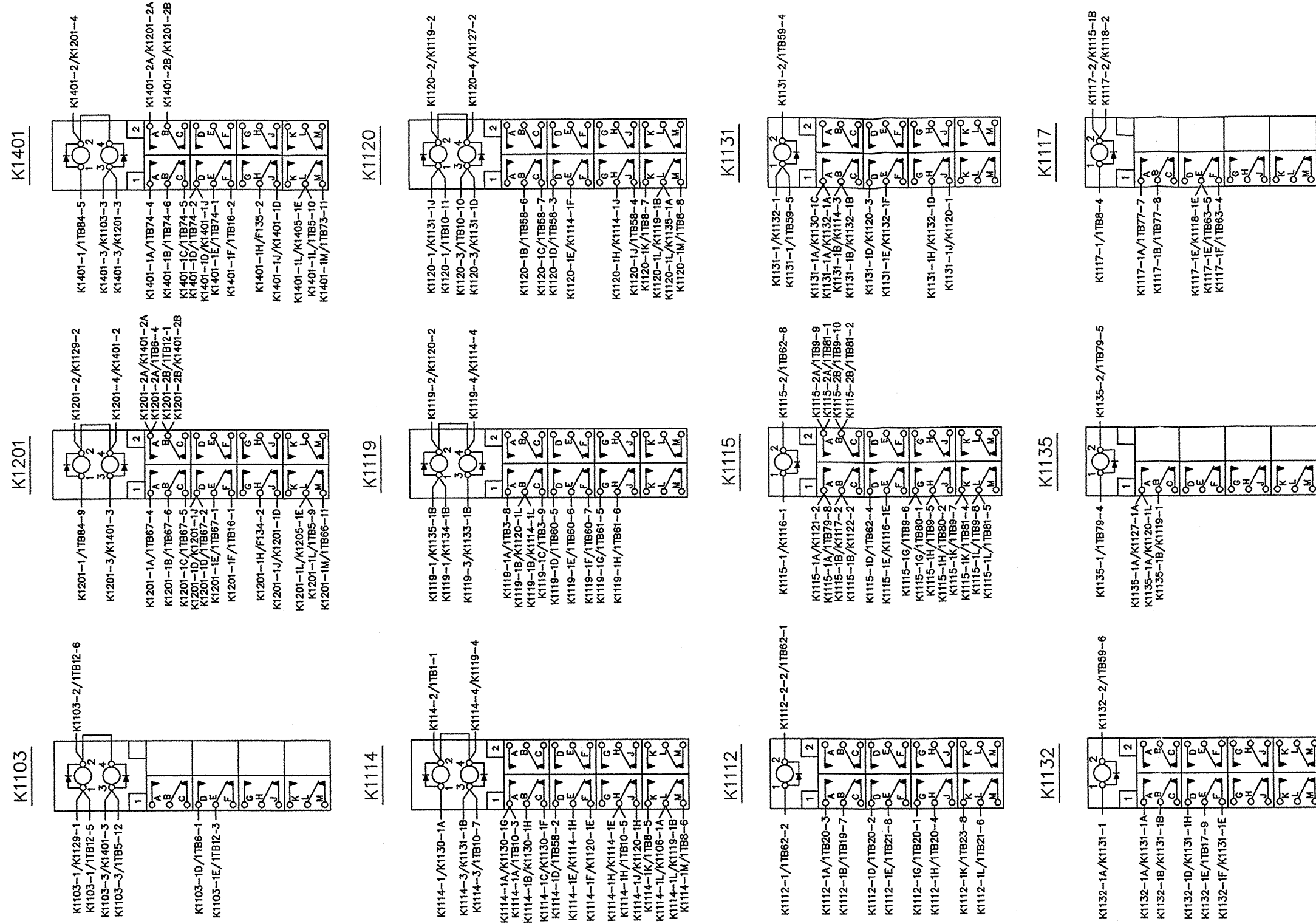
RELAY SUBPAN
PANEL-"C1" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 8 of 20)



RELAY SUBPAN TOP HALF
 PANEL-"D" UNIT-1

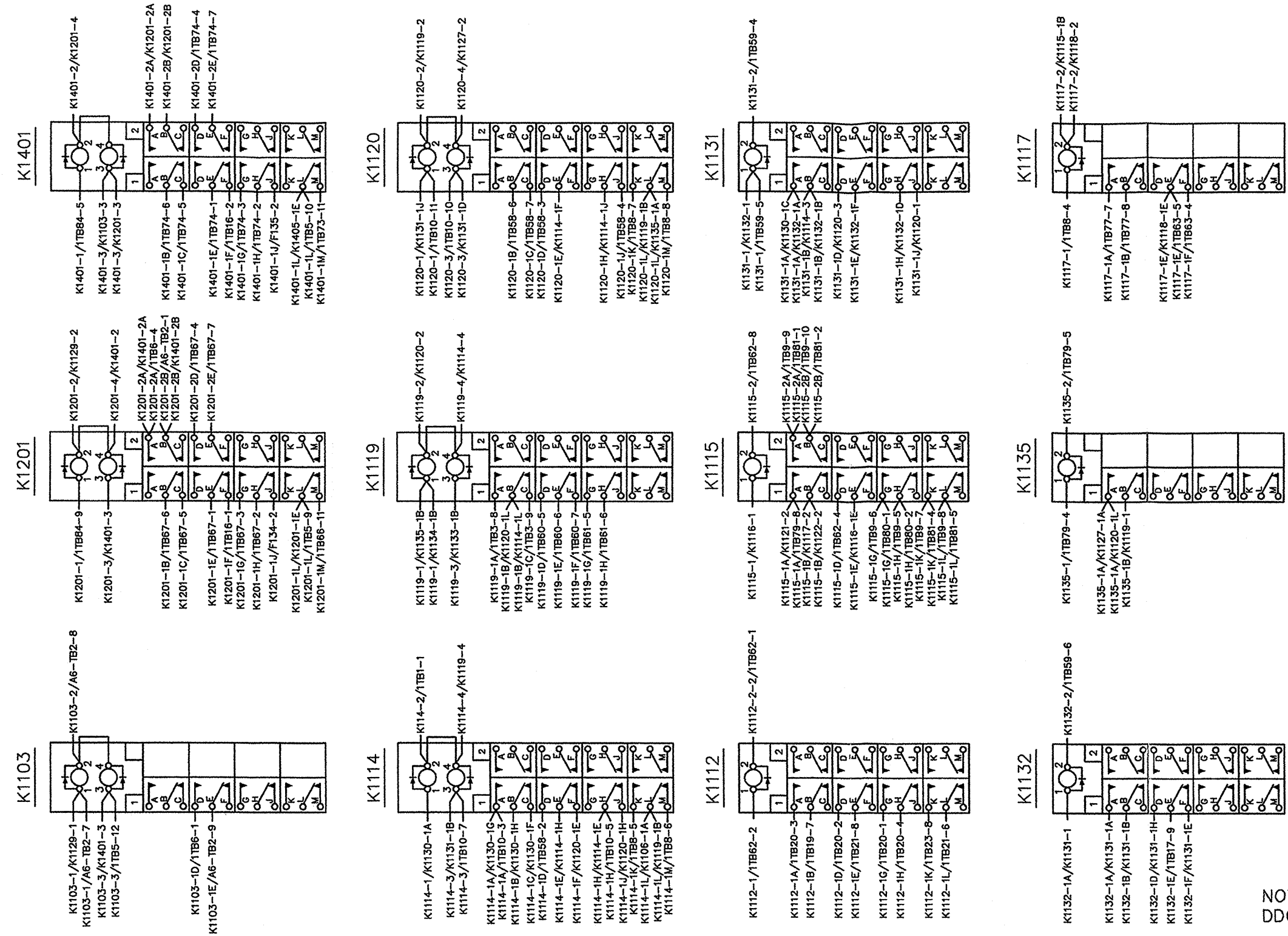
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 9 of 20)



NOTE:
DDG 51 ONLY

RELAY SUBPAN (TOP)
PANEL "D" UNIT-1

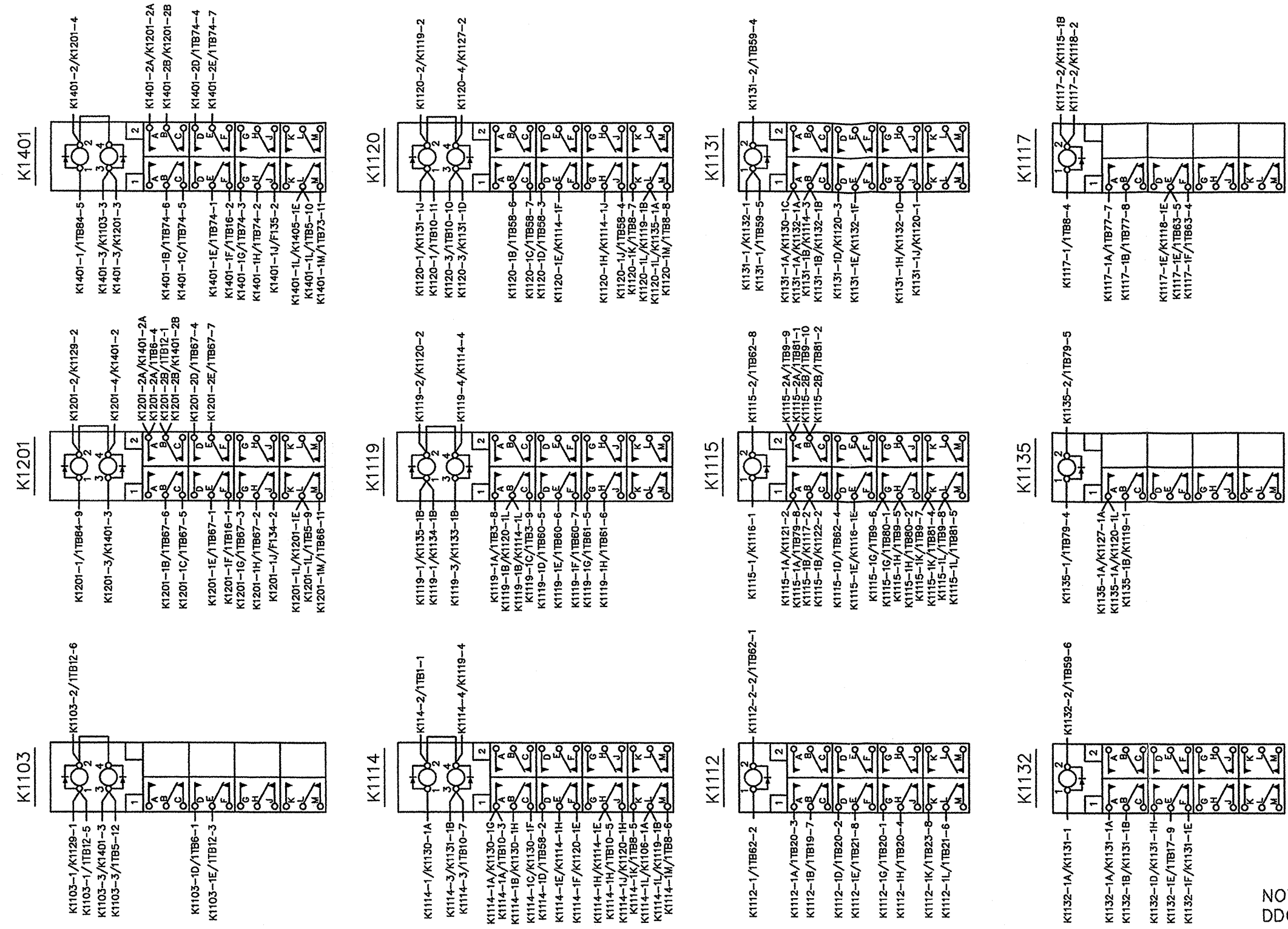
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 10 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 52-54 ONLY

RELAY SUBPAN (TOP)
PANEL "D" UNIT-1

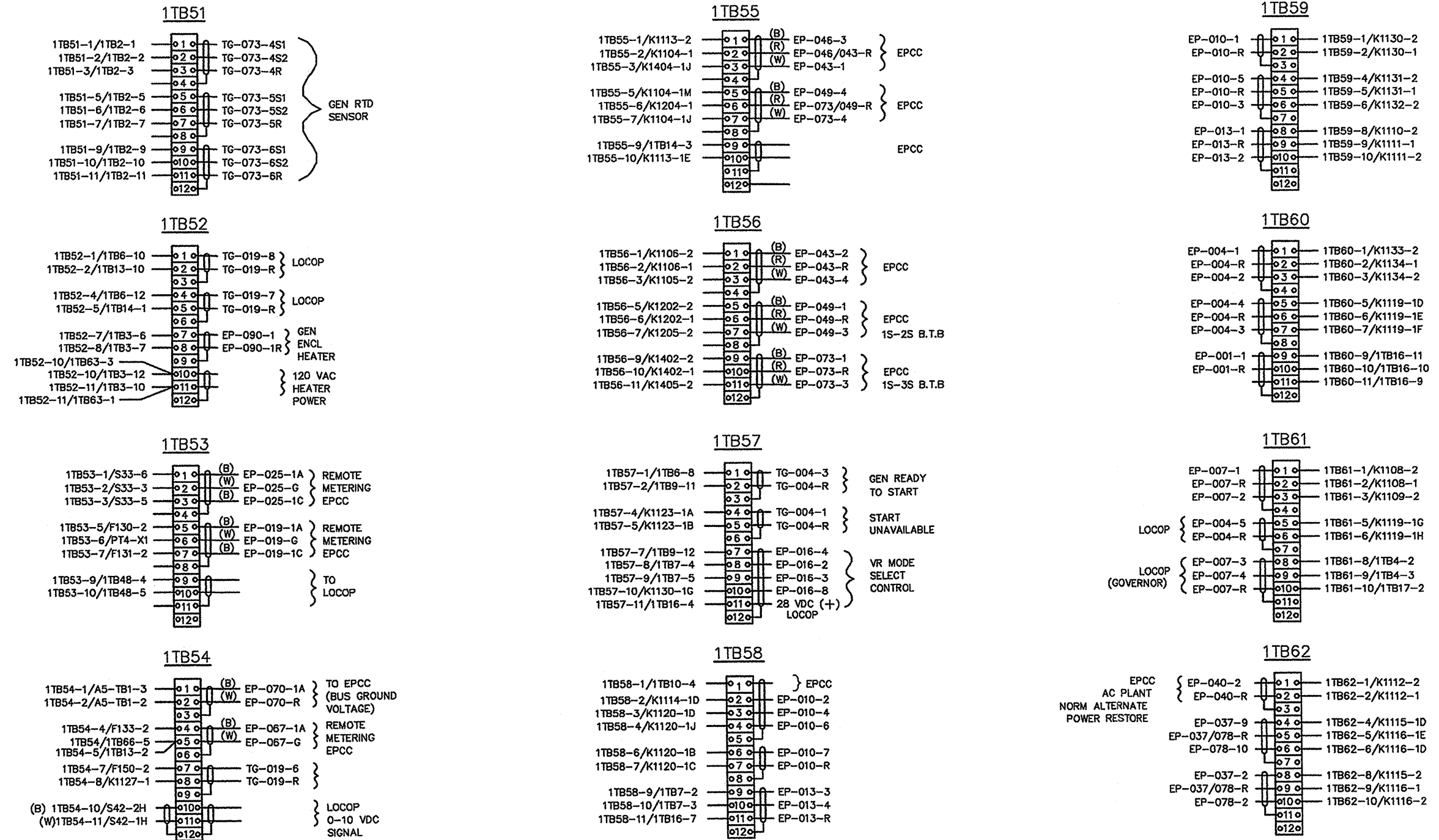
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 10 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 52-54 ONLY

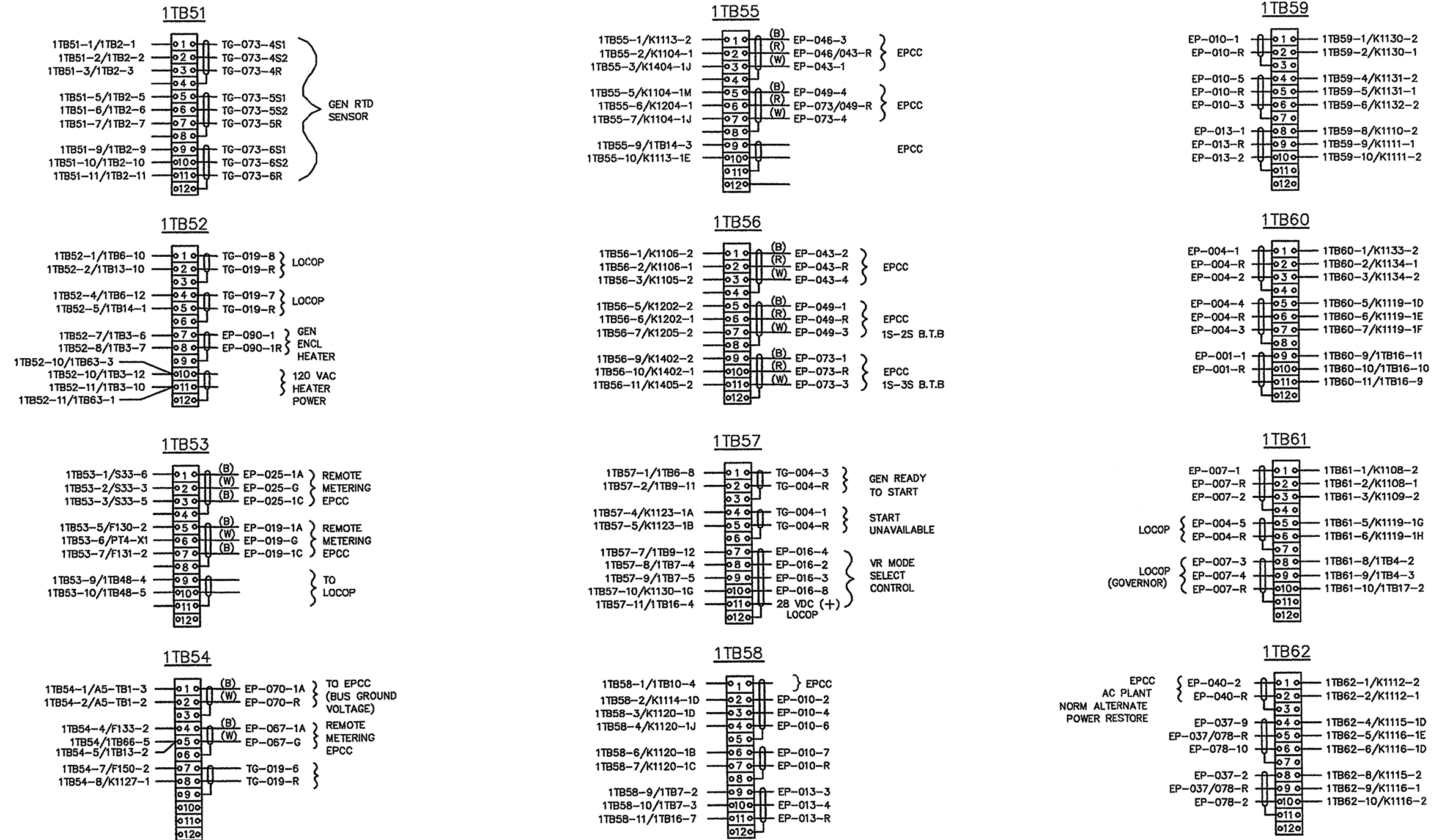
RELAY SUBPAN (TOP)
PANEL "D" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 10 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



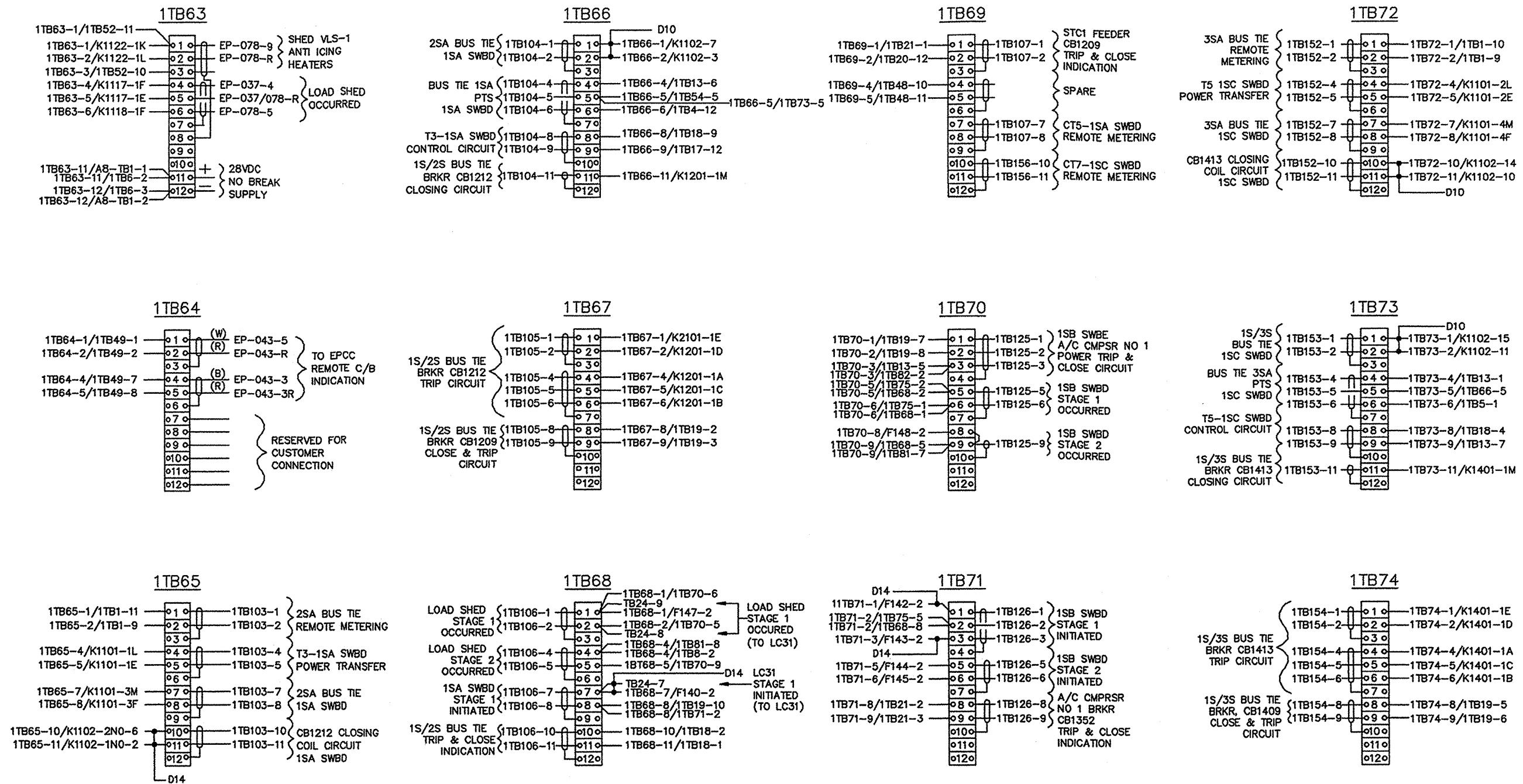
REAR VIEW LEFT SIDE (BOTTOM)
PANEL-F2 UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 11 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW LEFT SIDE (BOTTOM)
PANEL-F2 UNIT-1

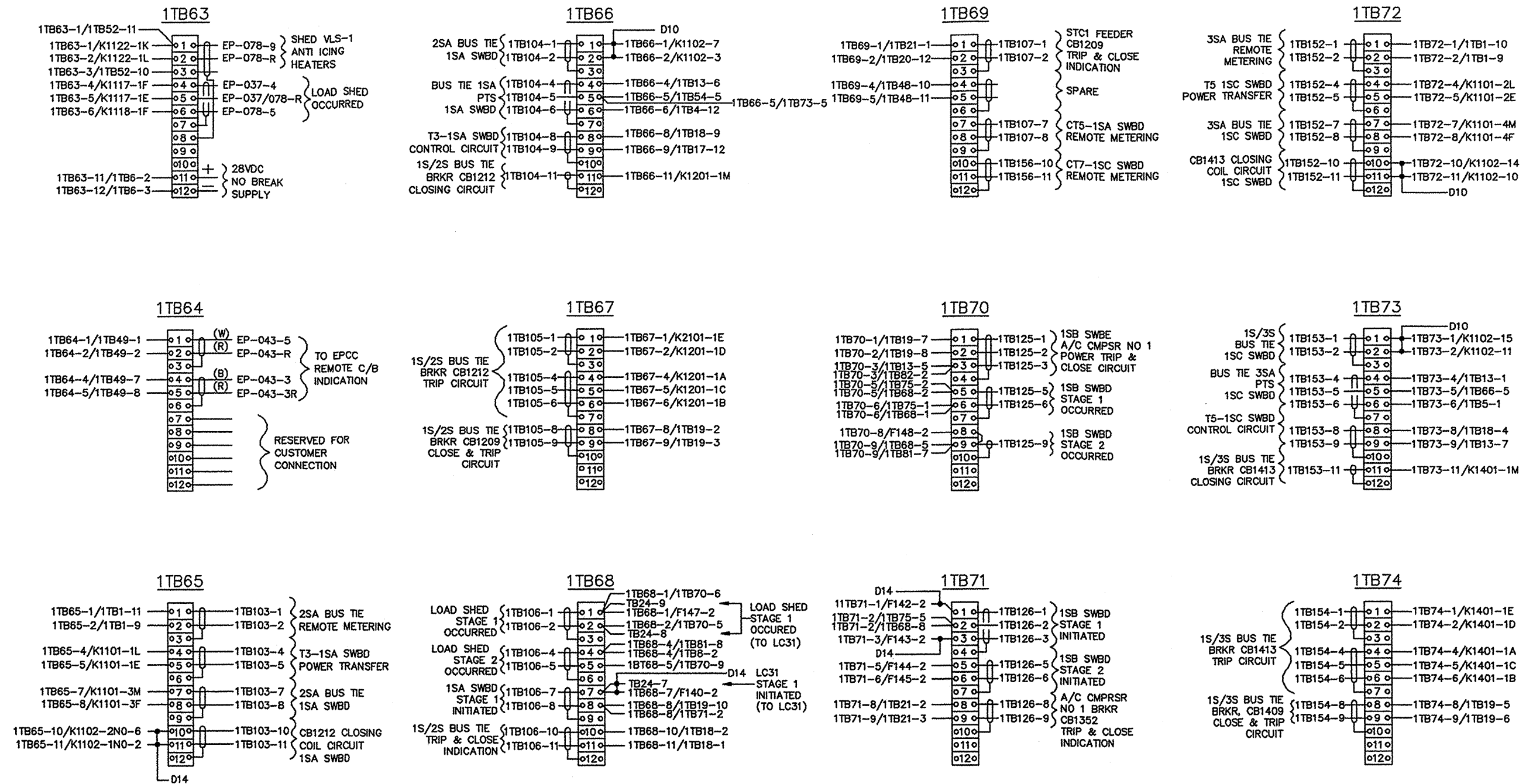
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 11 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



TERMINAL REAR VIEW (BOTTOM)
 PANEL-"G2" UNIT-1

NOTE:
 DDG 51 ONLY

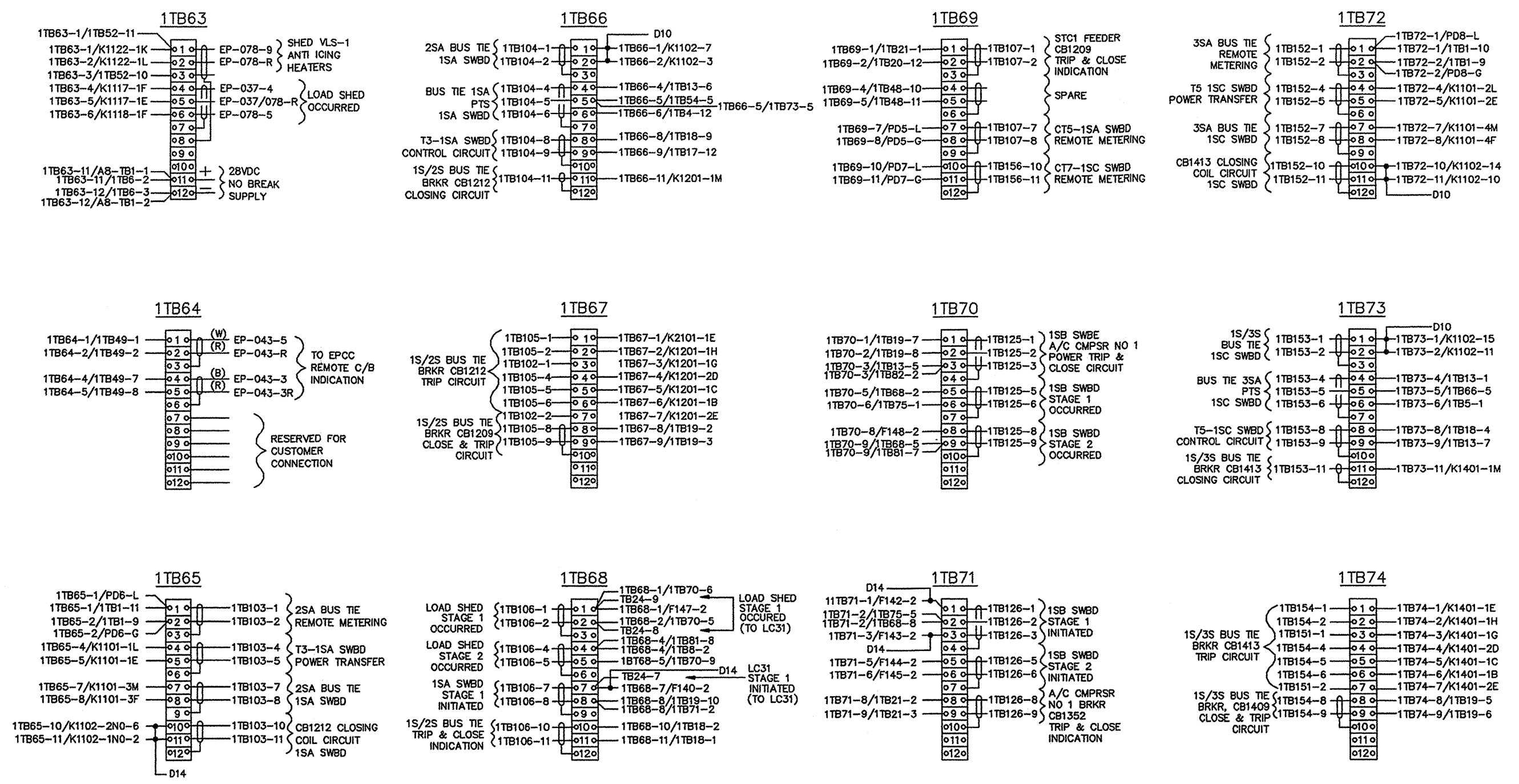
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 12 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



TERMINAL REAR VIEW (BOTTOM)
 PANEL-"G2" UNIT-1

NOTE:
 DDG 51 ONLY

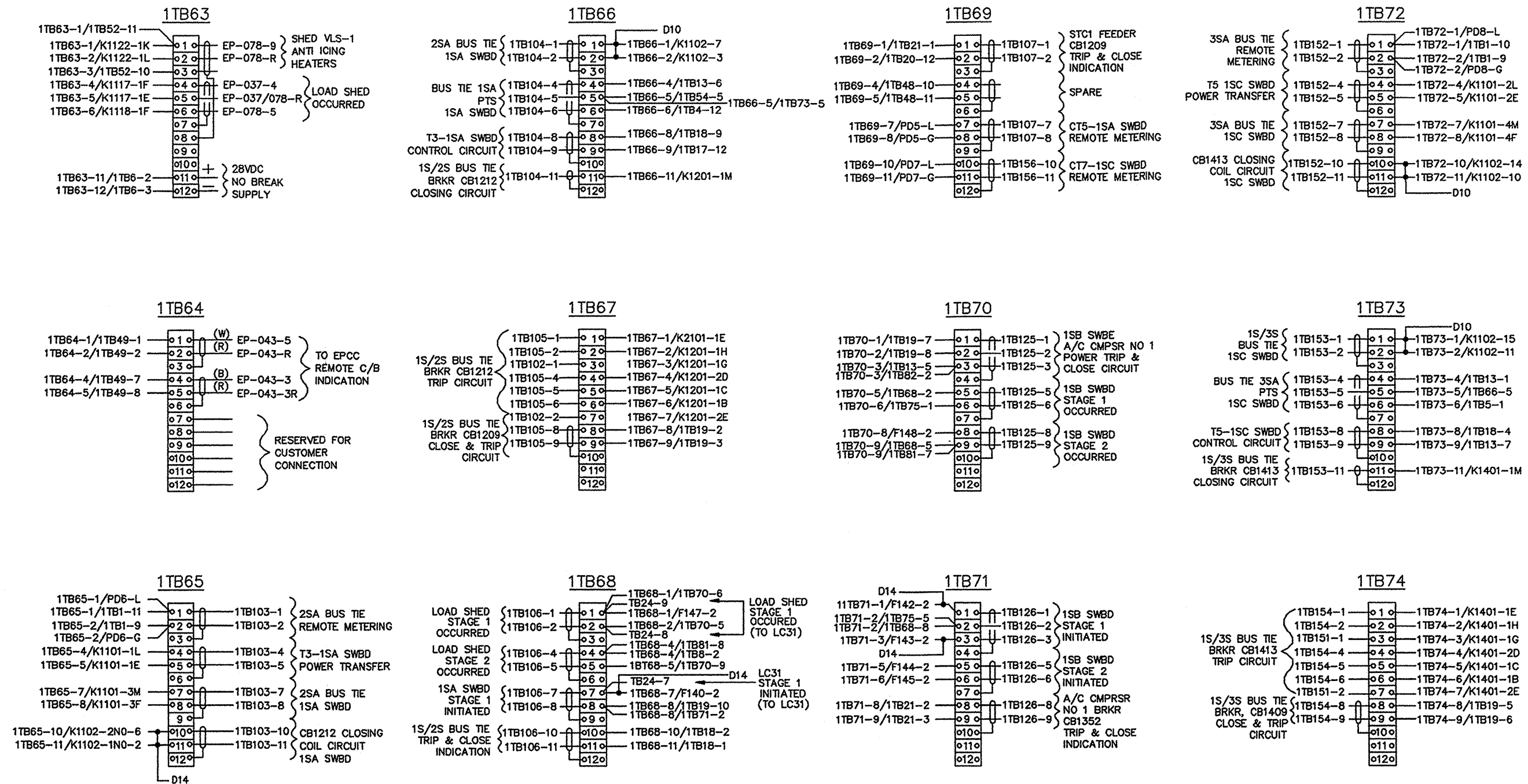
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 12 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



TERMINAL REAR VIEW (BOTTOM)
 PANEL-"G2" UNIT-1

NOTE:
 DDG 52-54 ONLY

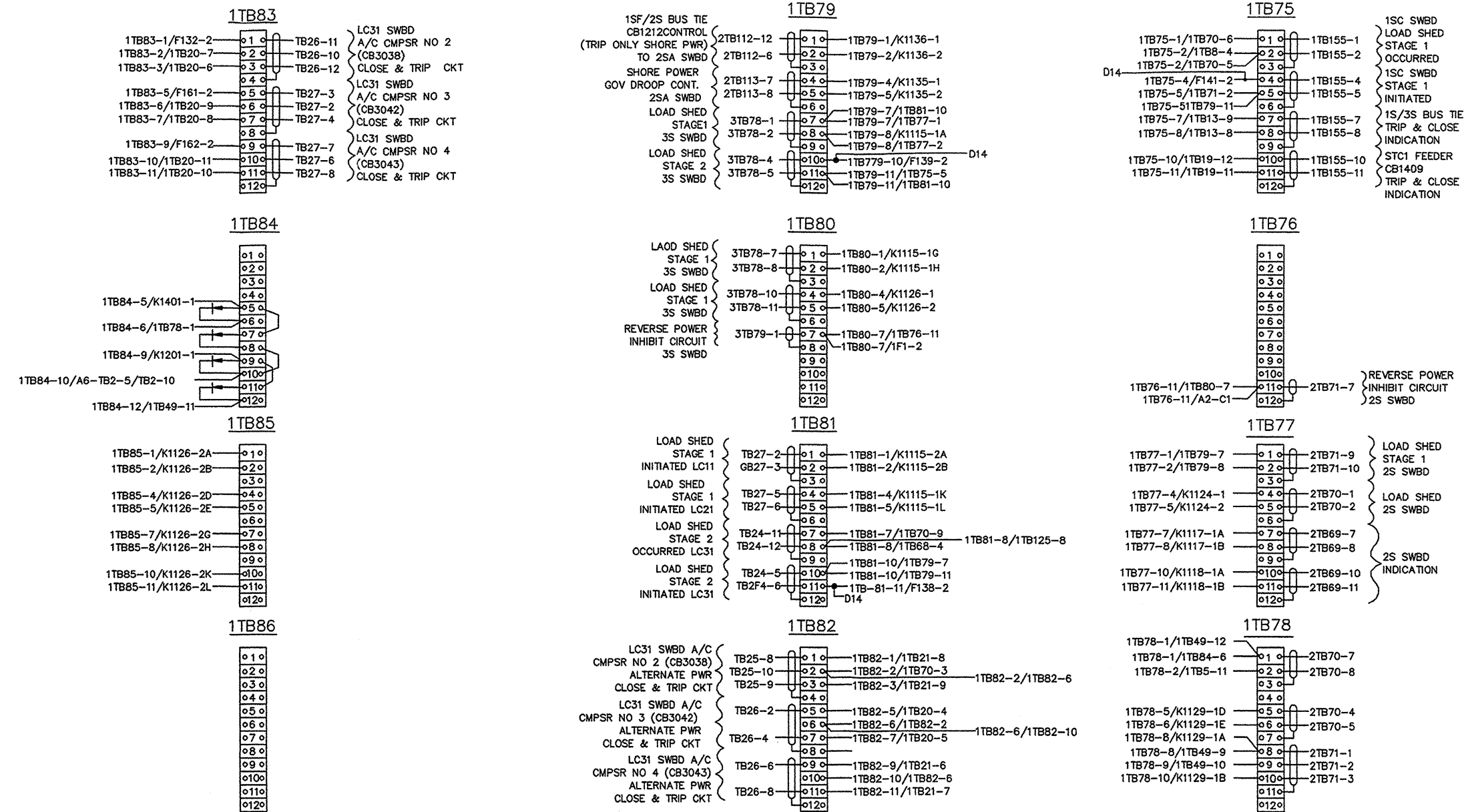
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 12 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



TERMINAL REAR VIEW (BOTTOM)
PANEL-"G2" UNIT-1

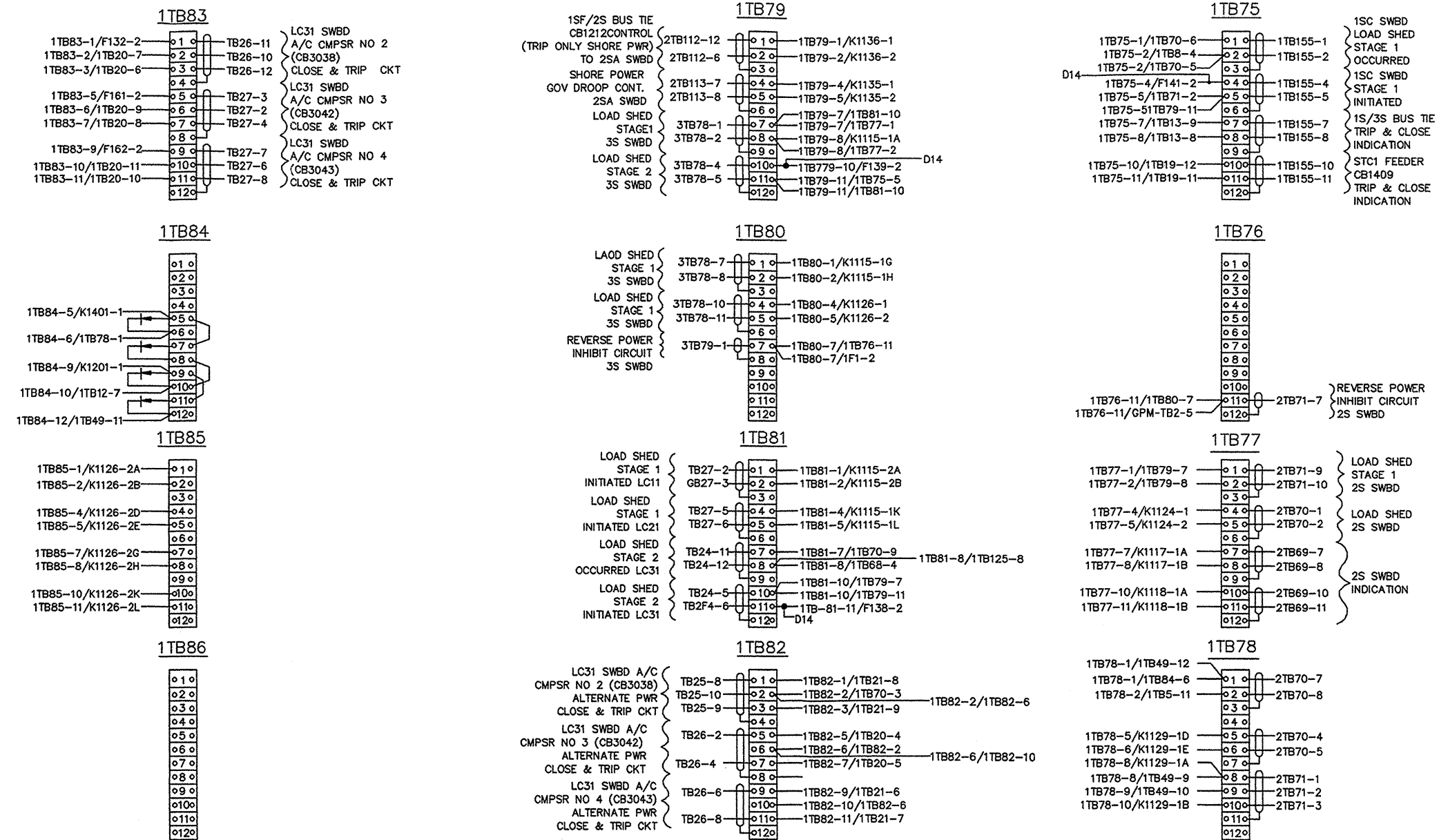
NOTE:
DDG 52-54 ONLY

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 12 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



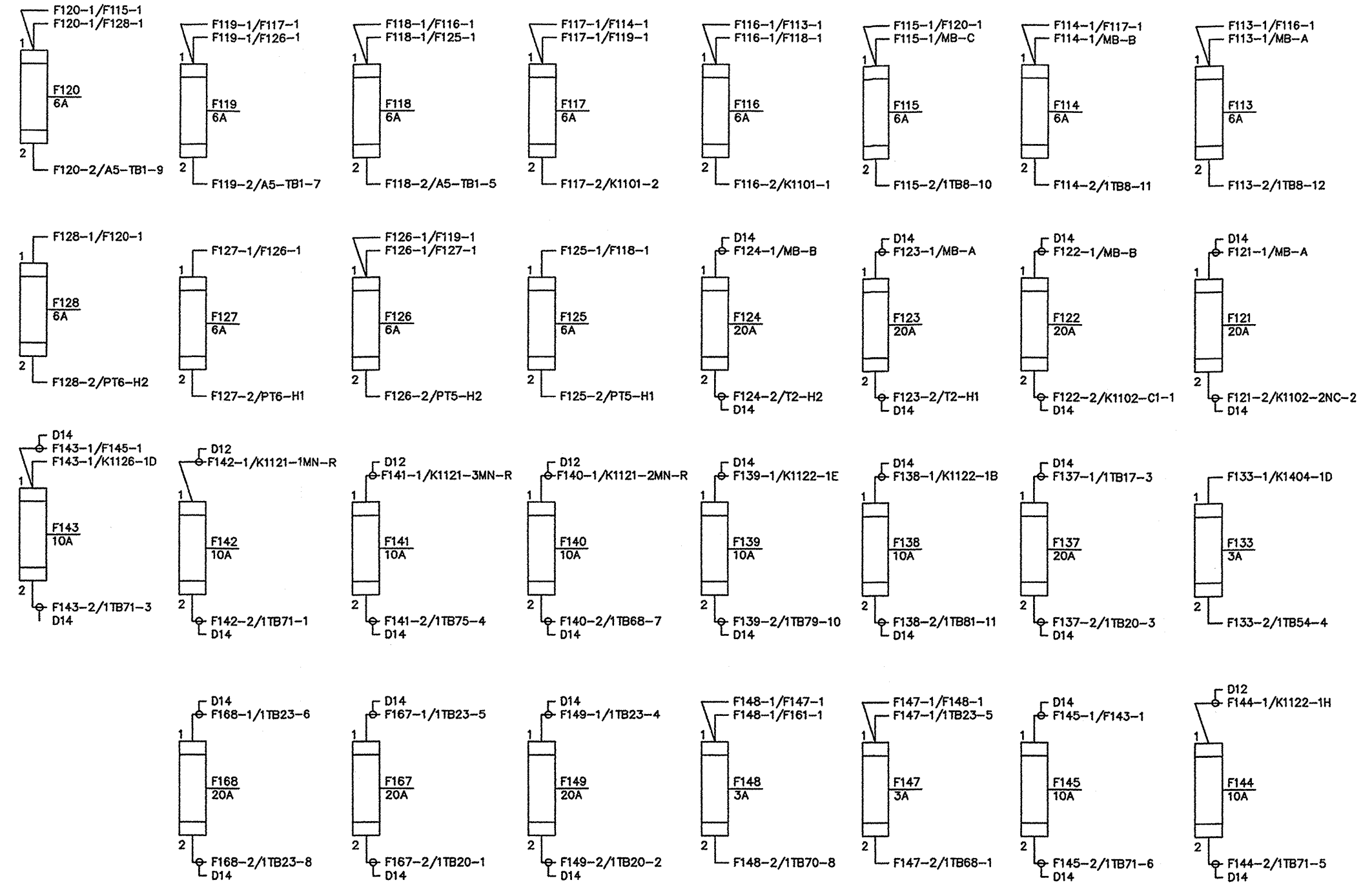
TERMINAL REAR VIEW RIGHT HAND SIDE
 PANEL-"H2" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 13 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



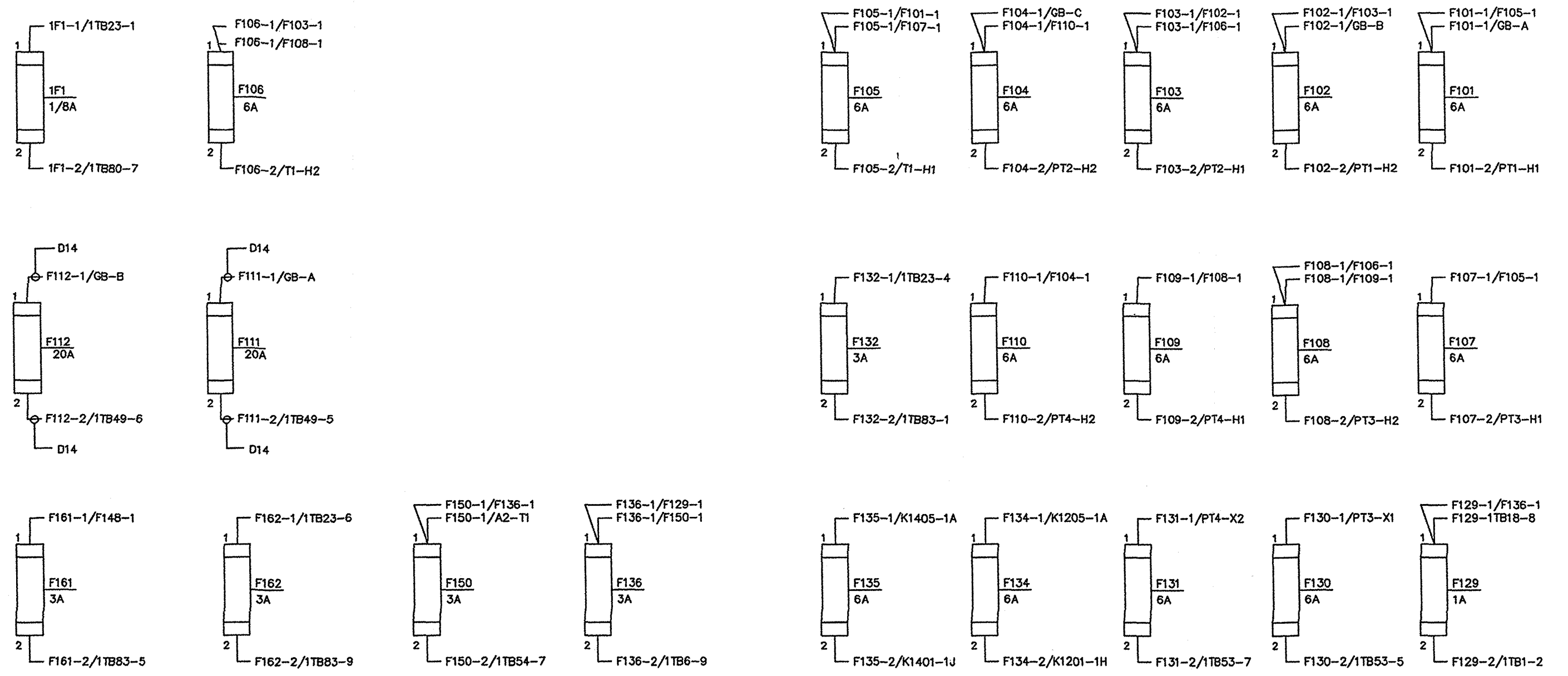
TERMINAL REAR VIEW RIGHT HAND SIDE
PANEL-"H2" UNIT-1

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 13 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



FUSE REAR VIEW (TOP)
PANEL-"J" UNIT-1

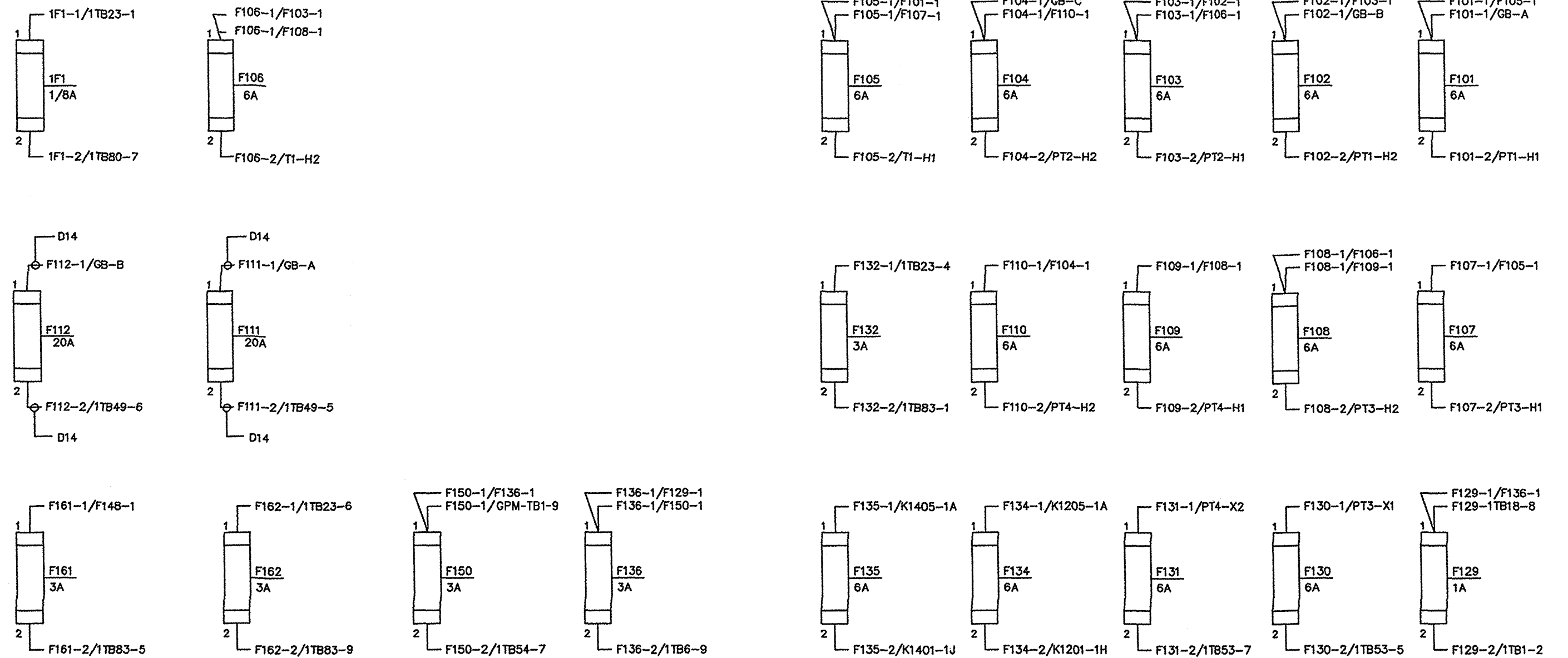
Figure 9-1. ISG Switchboard; Wiring Diagram (Sheet 14 of 20)



FUSE REAR VIEW (TOP)
 PANEL-"T" UNIT-2

NOTE:
 DDG 51 ONLY

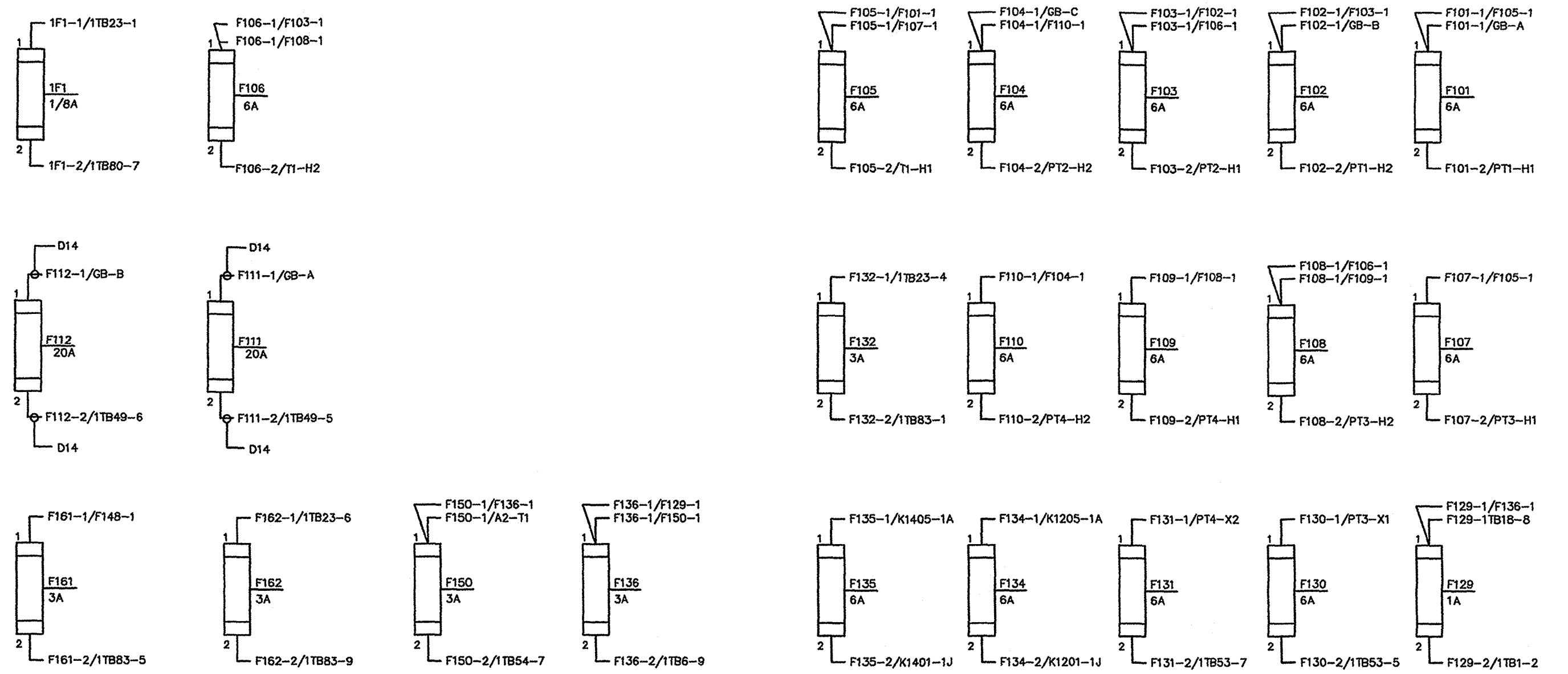
Figure 9-1. ISG Switchboard; Wiring Diagram (Sheet 15 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FUSE REAR VIEW (TOP)
 PANEL-"T" UNIT-2

NOTE:
 DDG 51 ONLY

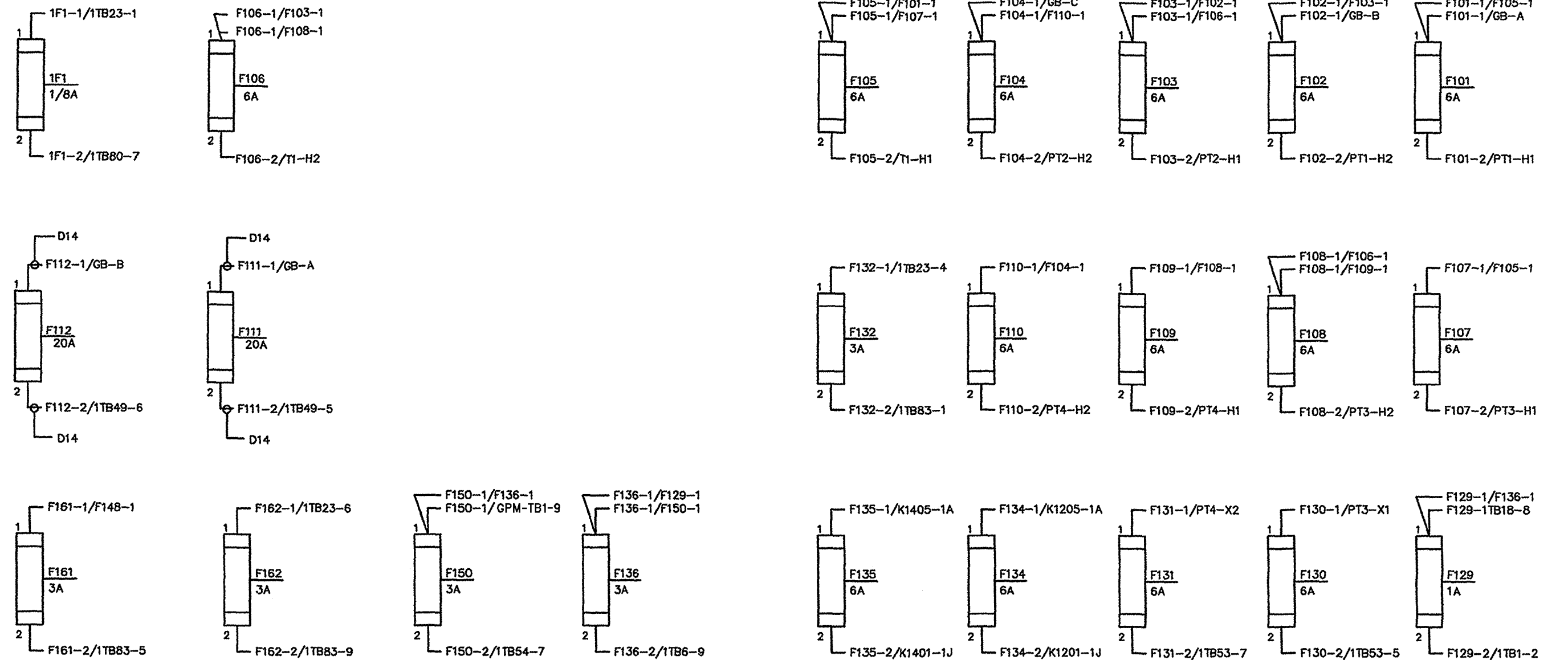
Figure 9-1. ISG Switchboard; Wiring Diagram (Sheet 15 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



FUSE REAR VIEW (TOP)
PANEL-"T" UNIT-2

NOTE:
 DDG 52-54 ONLY

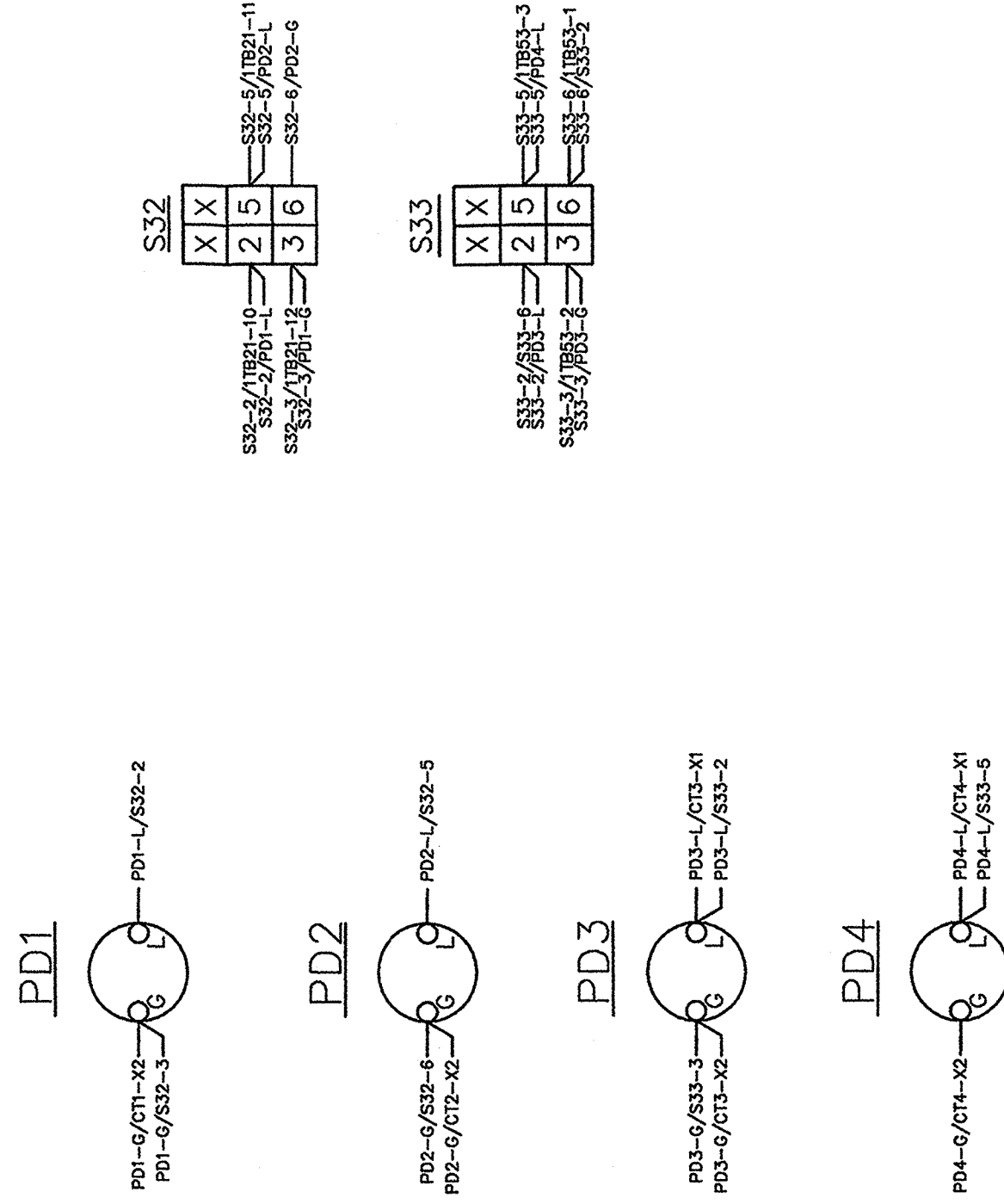
Figure 9-1. ISG Switchboard; Wiring Diagram (Sheet 15 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



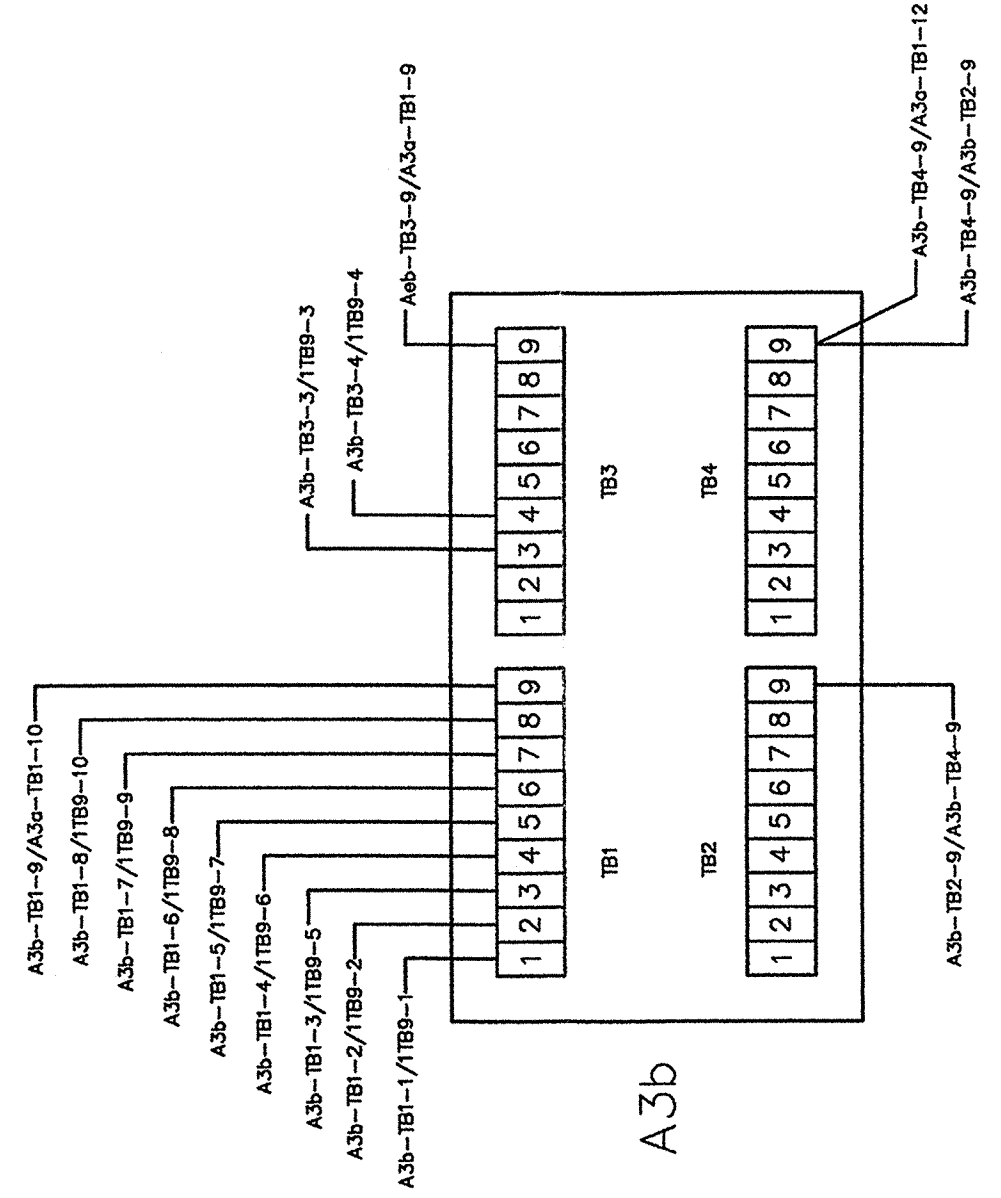
FUSE REAR VIEW (TOP)
PANEL-"T" UNIT-2

NOTE:
 DDG 52-54 ONLY

Figure 9-1. ISG Switchboard; Wiring Diagram (Sheet 15 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

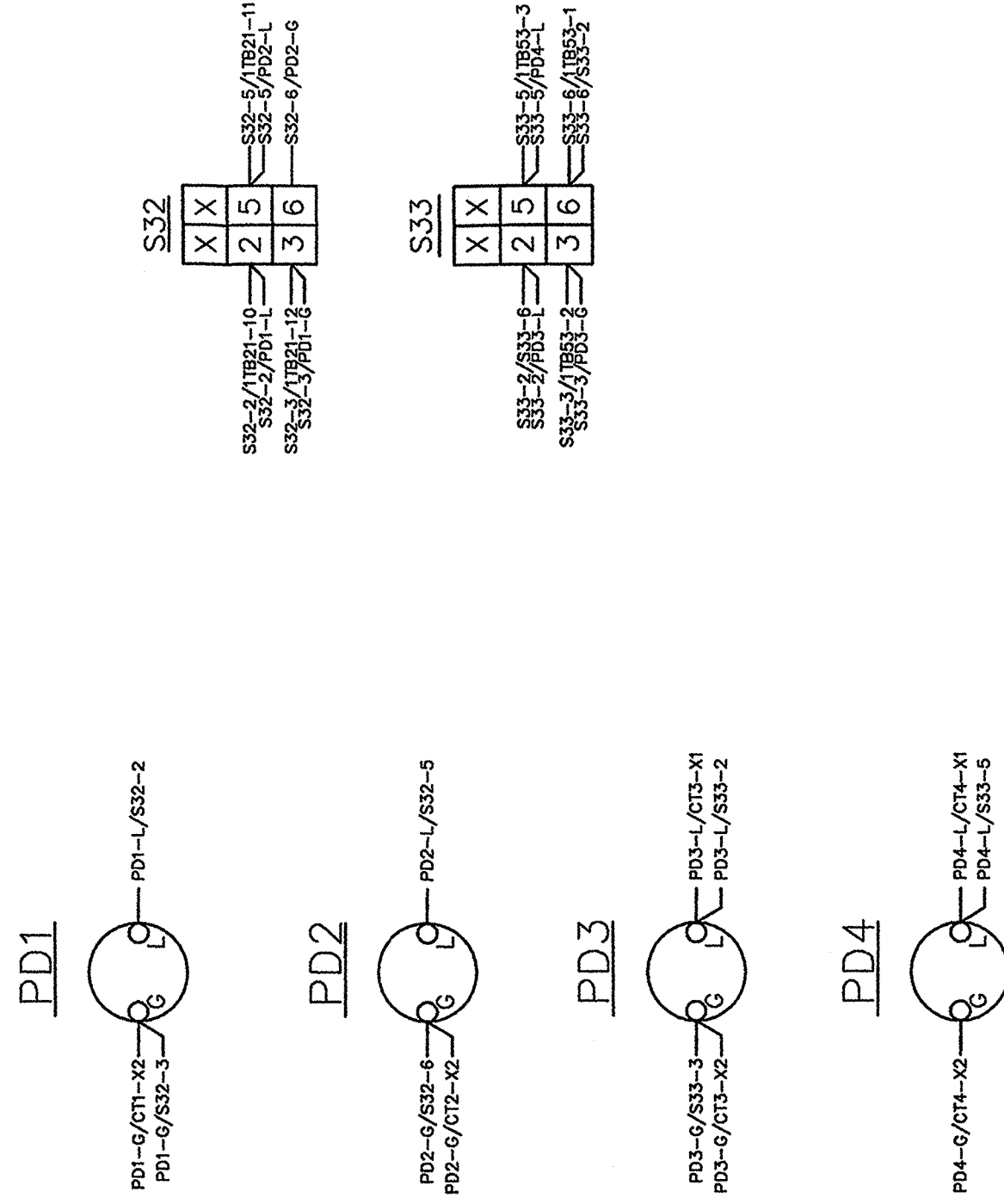


TOGGLE, THYRITE FRONT VIEW LEFT HAND SIDE
PANEL "L" UNIT 2

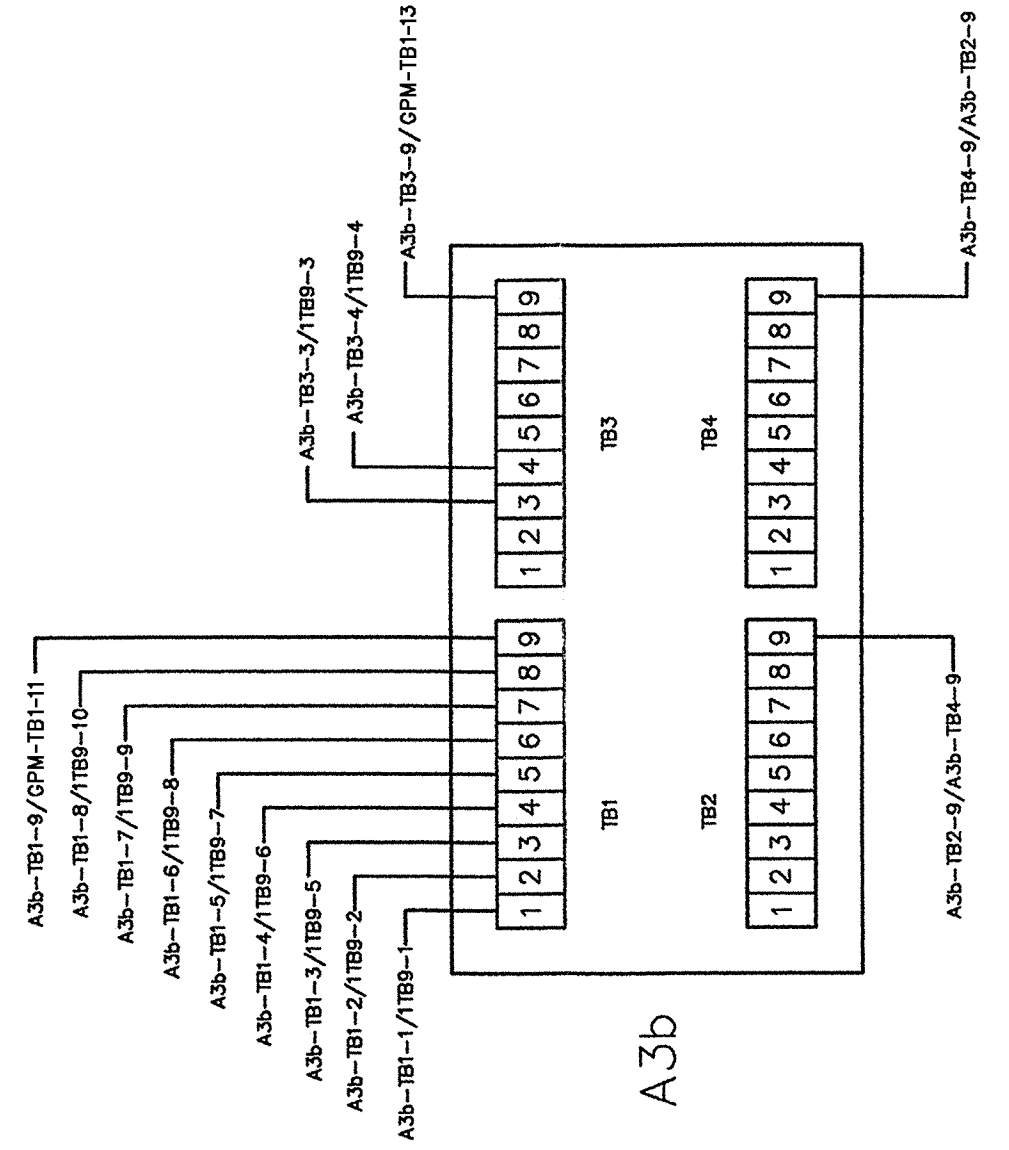


NOTE:
 DDG 51 ONLY

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 16 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



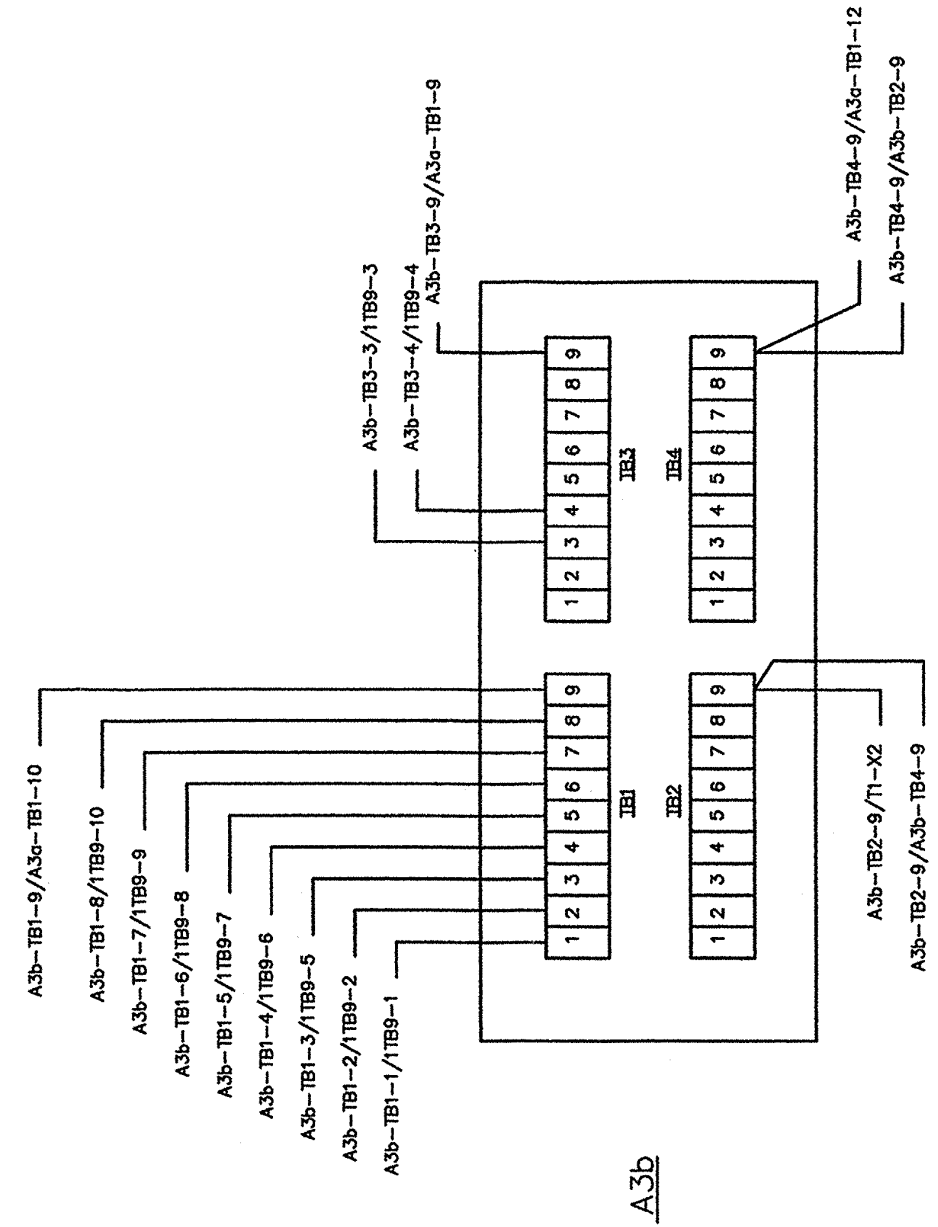
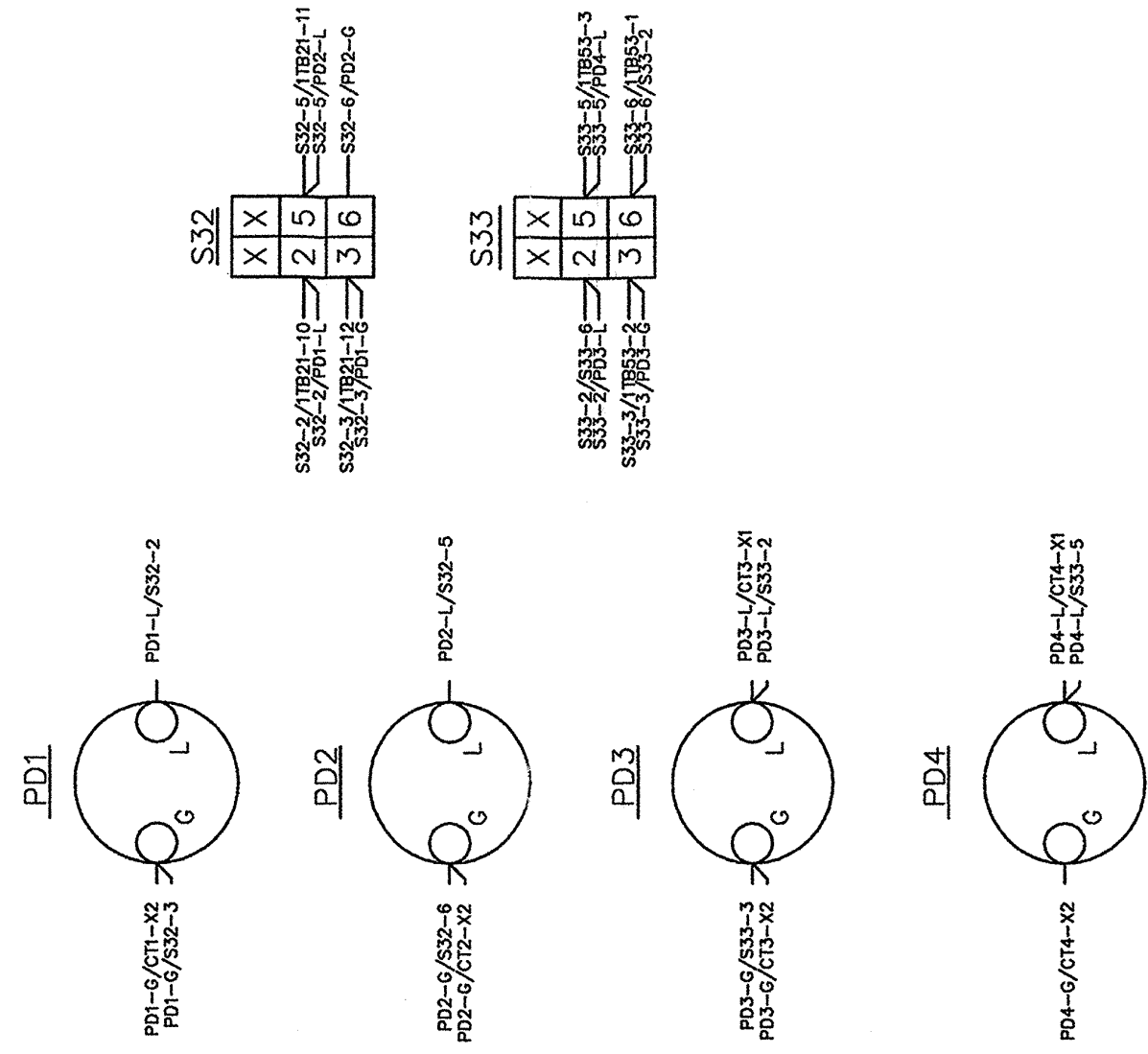
**TOGGLE, THYRITE FRONT VIEW LEFT HAND SIDE
 PANEL "L" UNIT 2**



NOTE:
 DDG 51 ONLY

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 16 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

PANEL "M2" UNIT 2

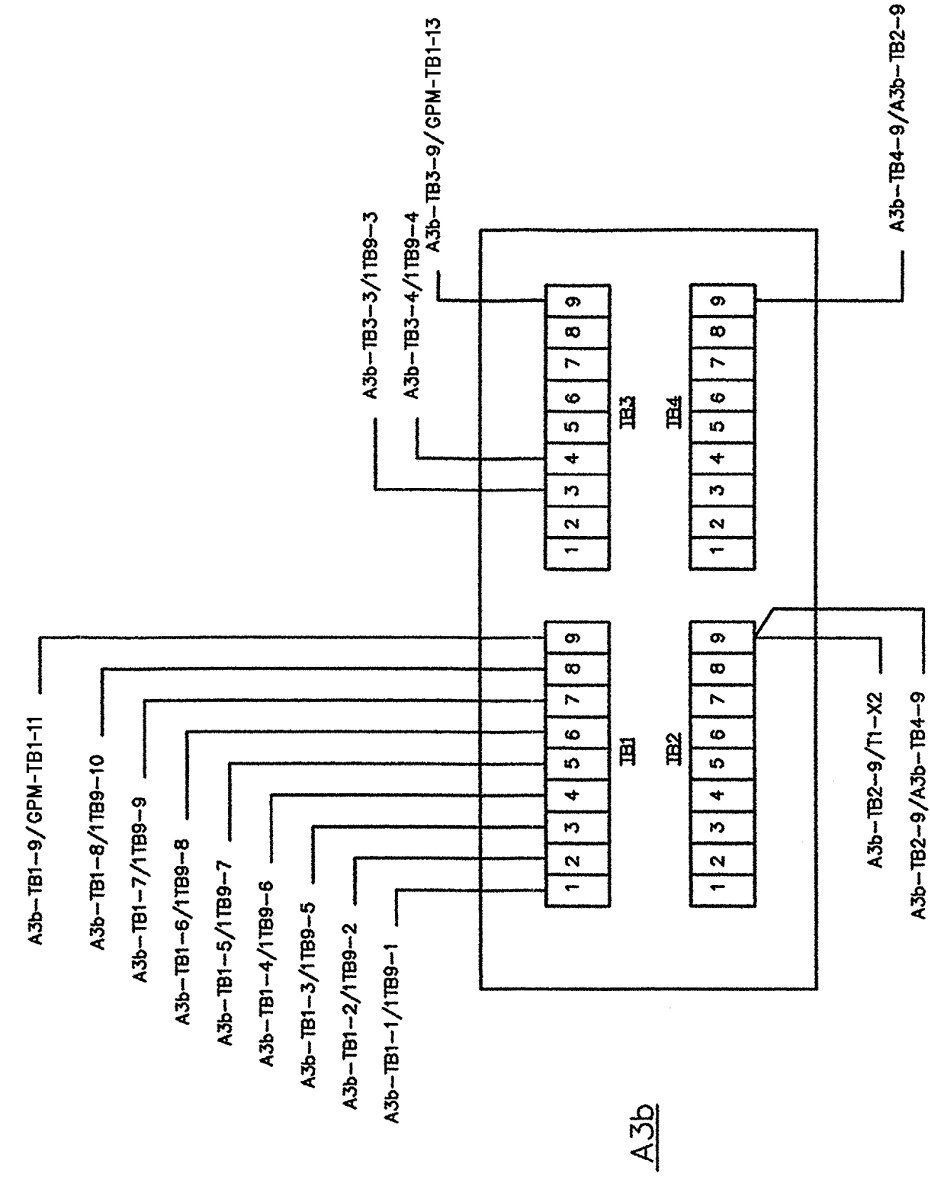
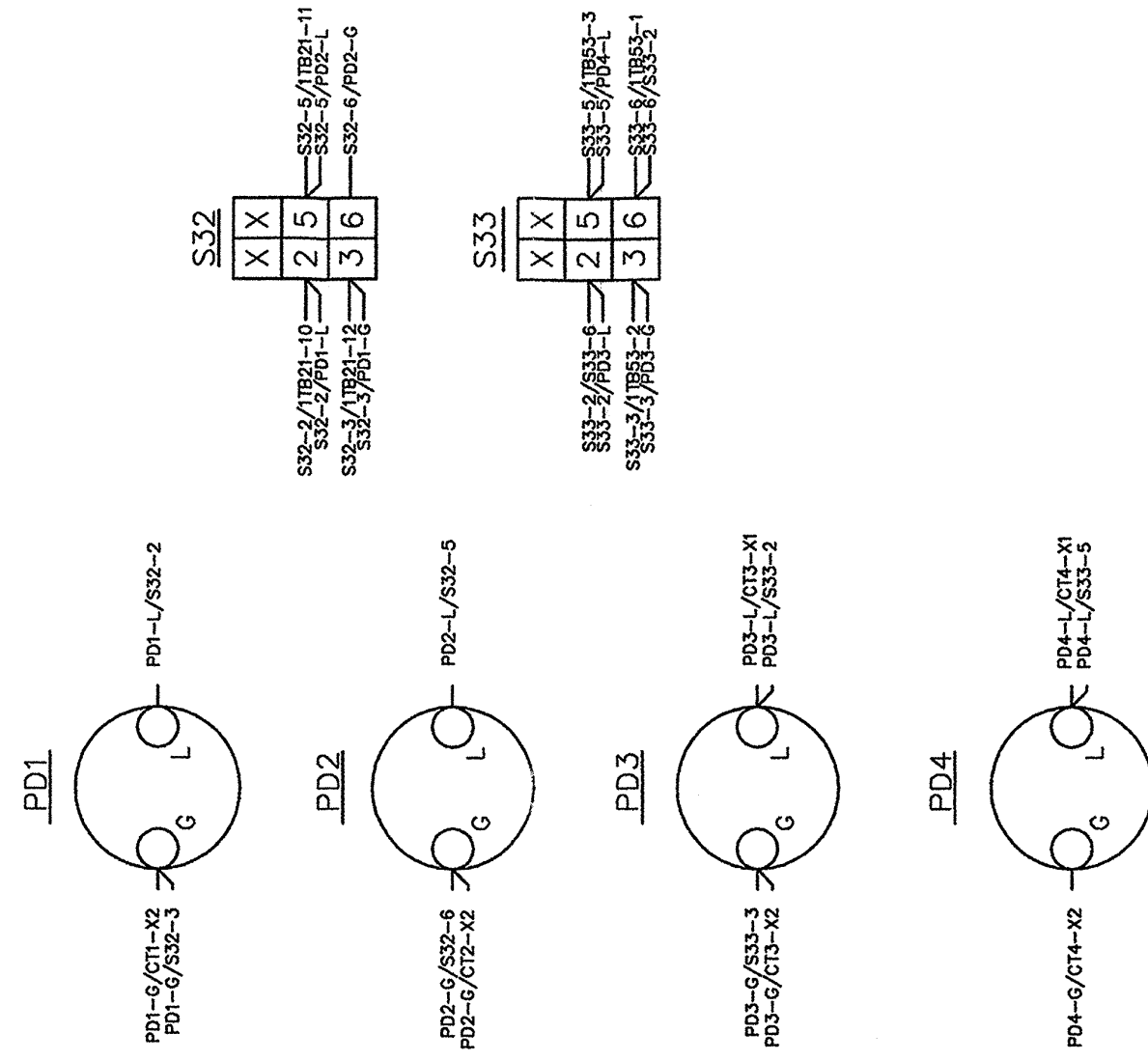


NOTE:
DDG 52-54 ONLY

TOGGLE, THYRITE FRONT VIEW LEFT HAND SIDE

PANEL - "L" UNIT-2

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 16 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

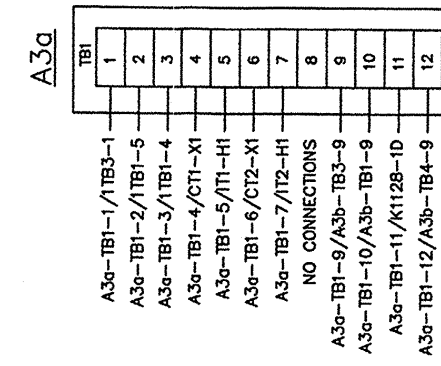
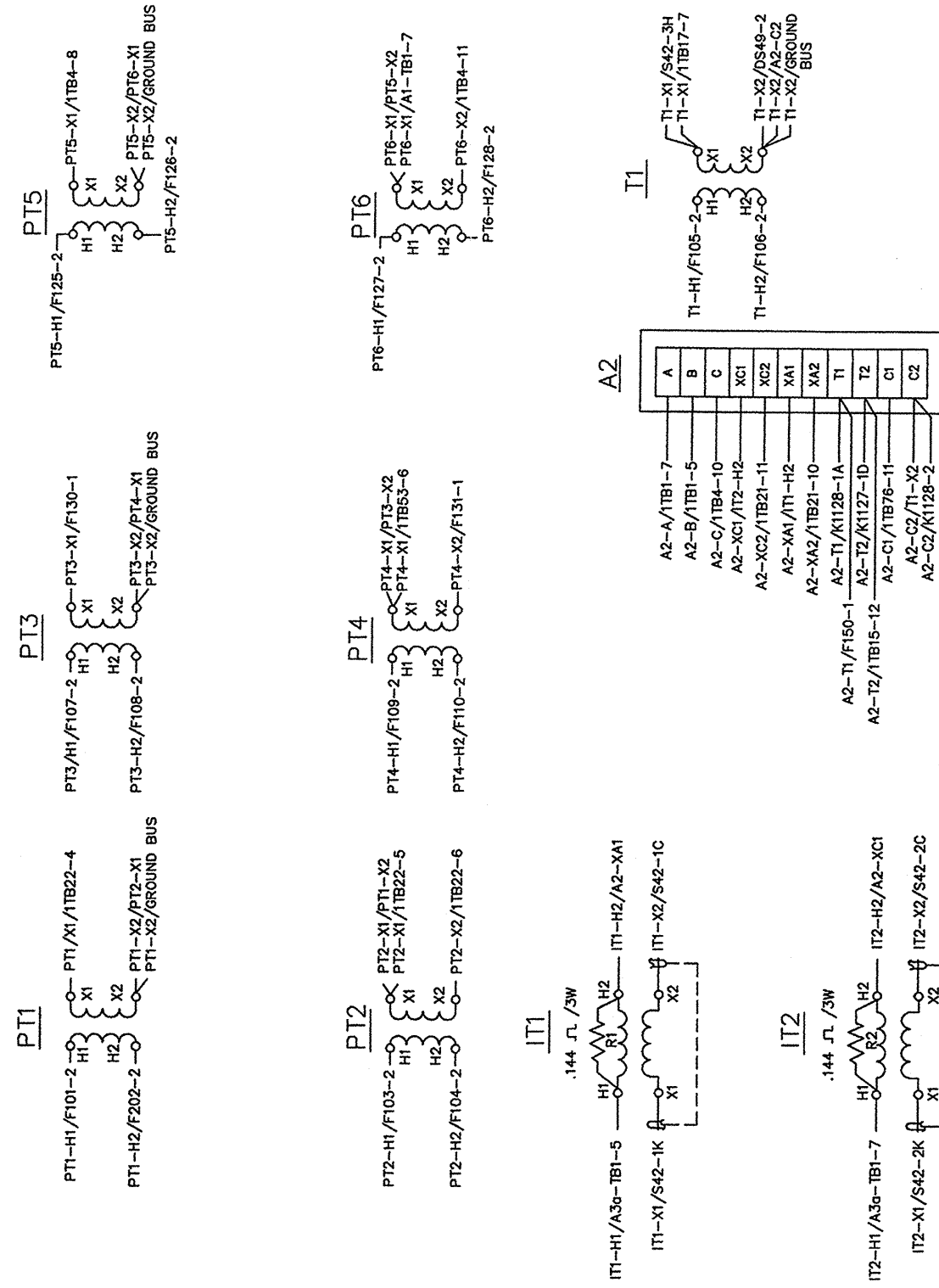


NOTE:
DDG 52-54 ONLY

TOGGLE, THYRITE FRONT VIEW LEFT HAND SIDE

PANEL - "L" UNIT-2

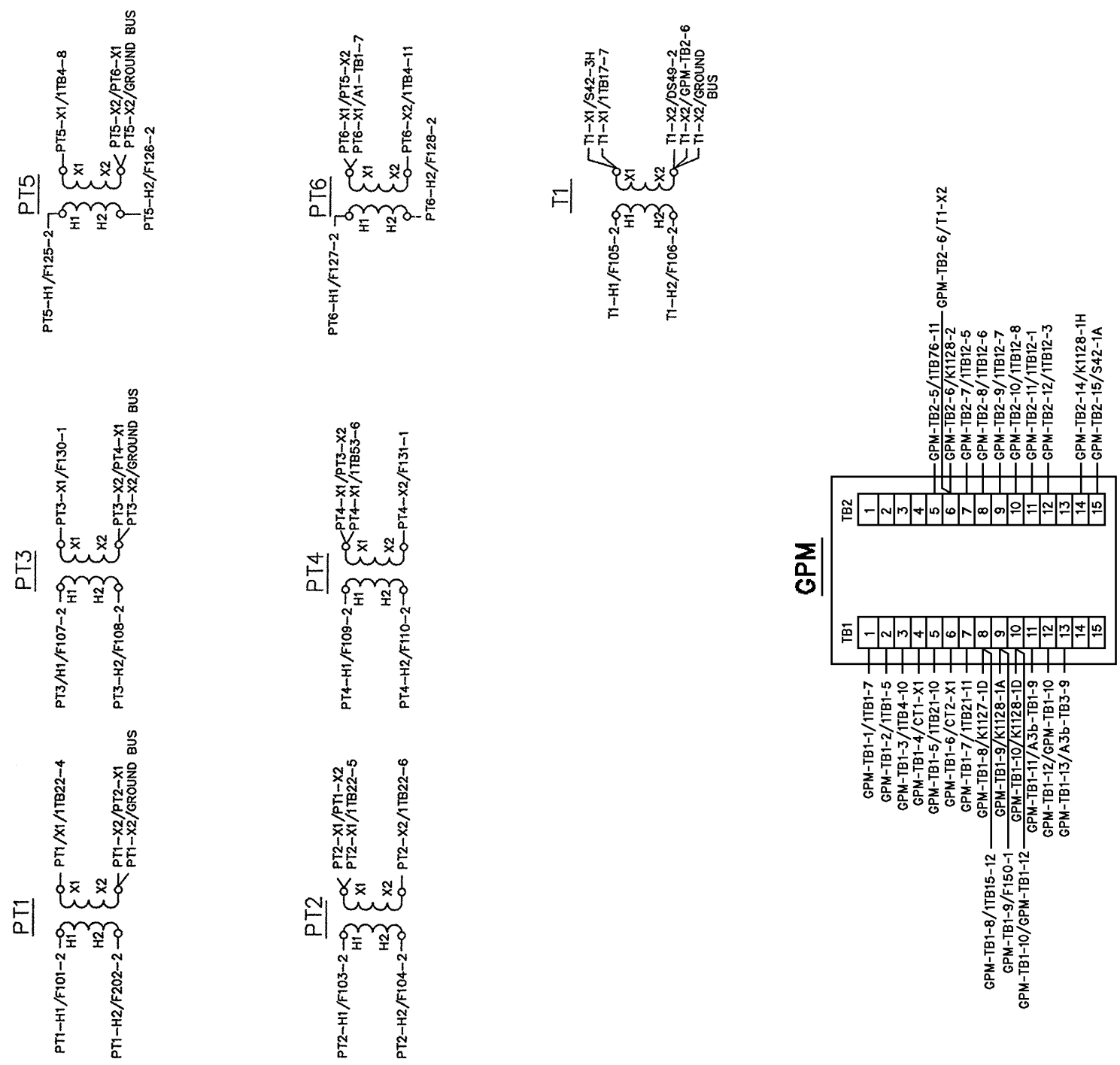
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 16 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 51 ONLY

FRONT VIEW (TOP)
PANEL-"M1" UNIT-2

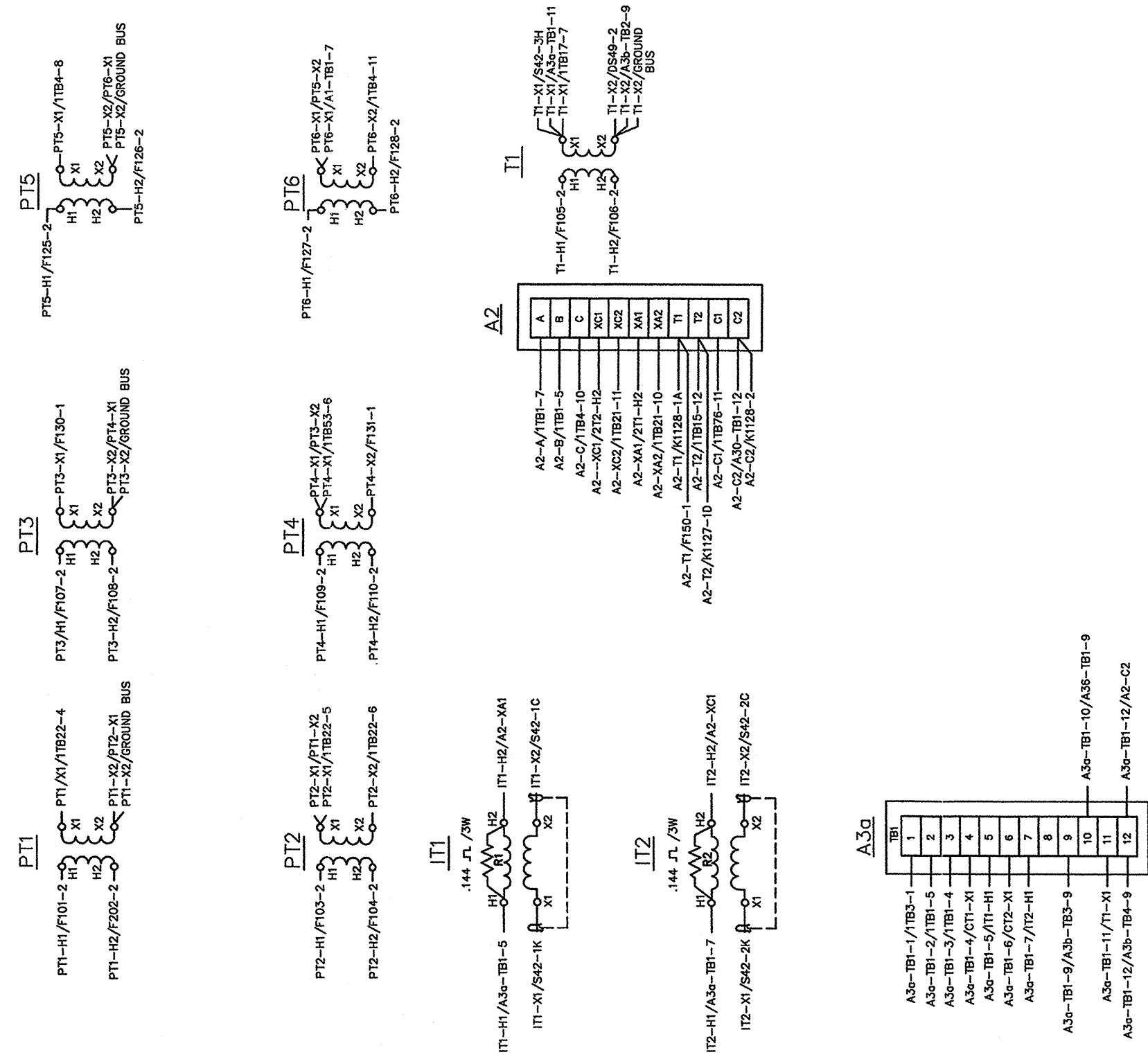
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 17 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW (TOP)
 PANEL-"M1" UNIT-2

NOTE:
 DDG 51 ONLY

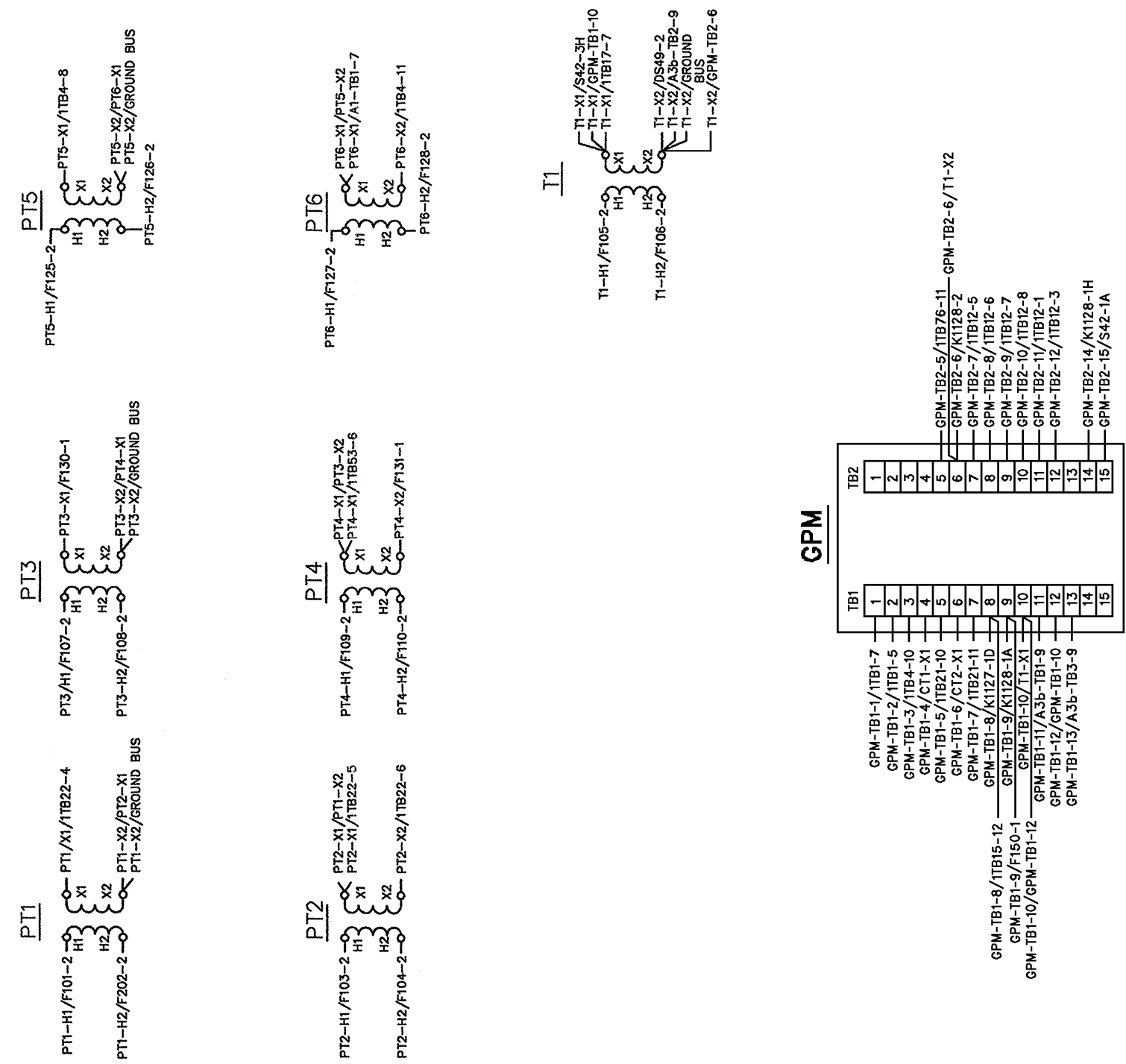
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 17 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 52-54 ONLY

FRONT VIEW (TOP)
PANEL-"M1" UNIT-2

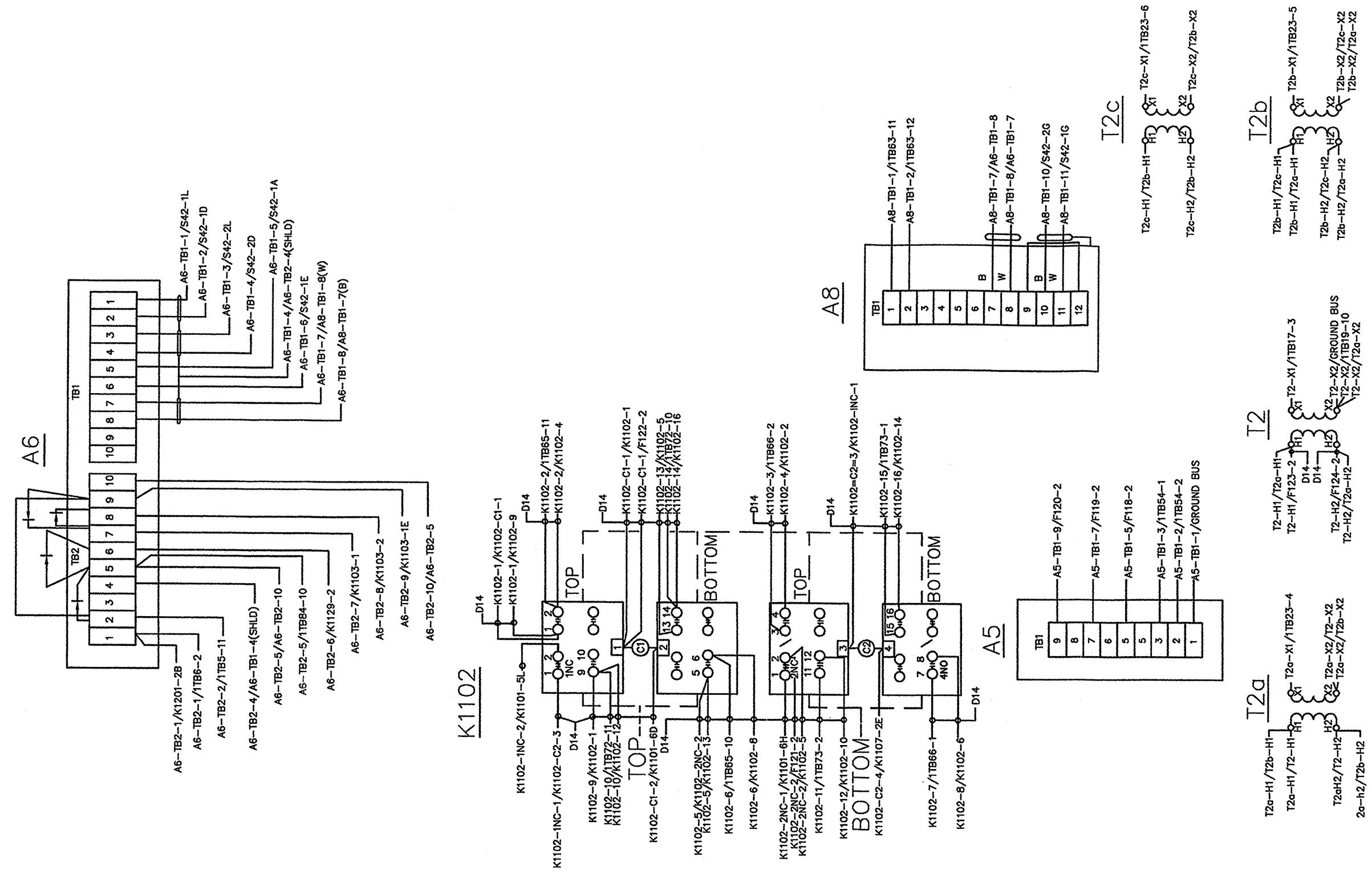
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 17 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 52-54 ONLY

FRONT VIEW (TOP)
PANEL-"M1" UNIT-2

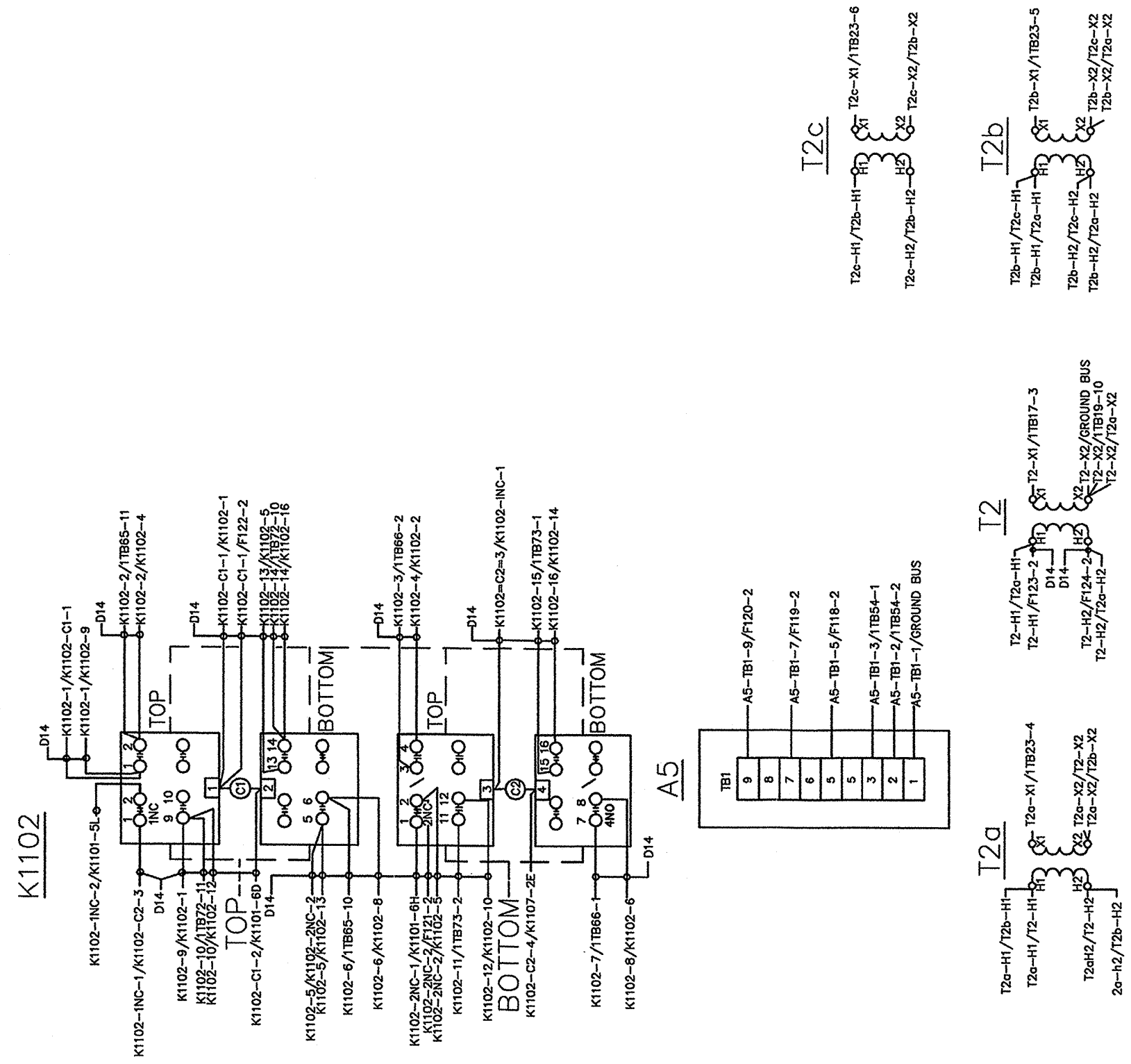
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 17 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW (BOTTOM)

PANEL - "C2" UNIT-1

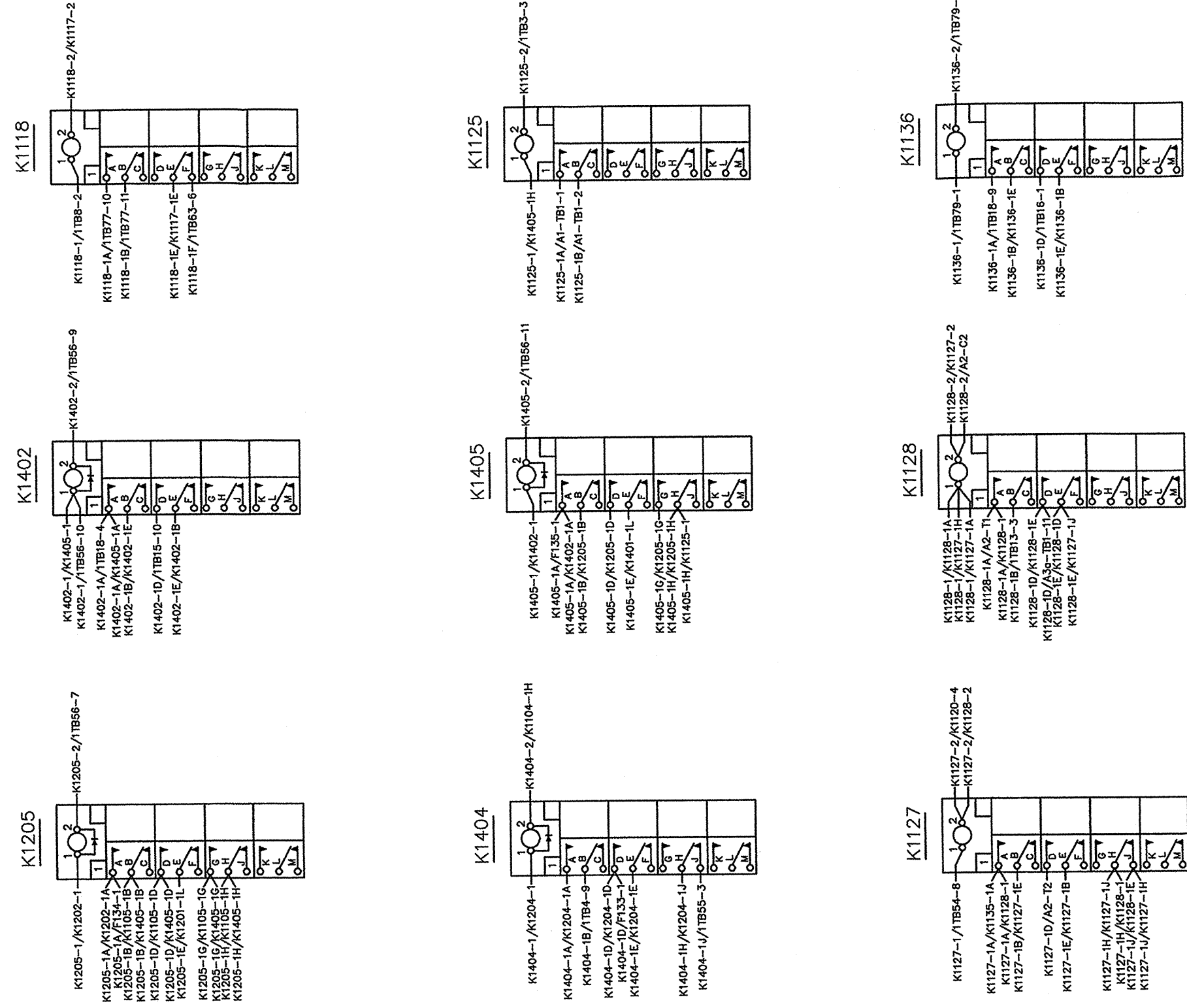
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 18 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW (BOTTOM)

PANEL - "C2" UNIT-1

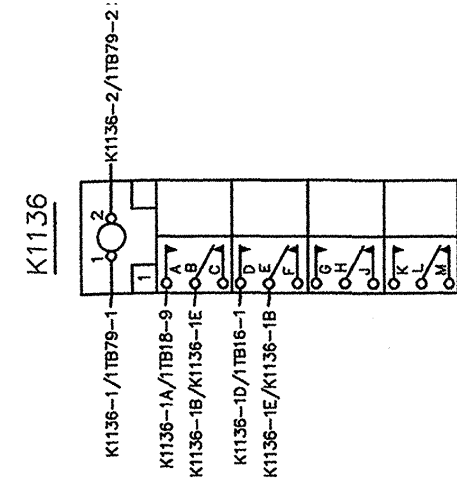
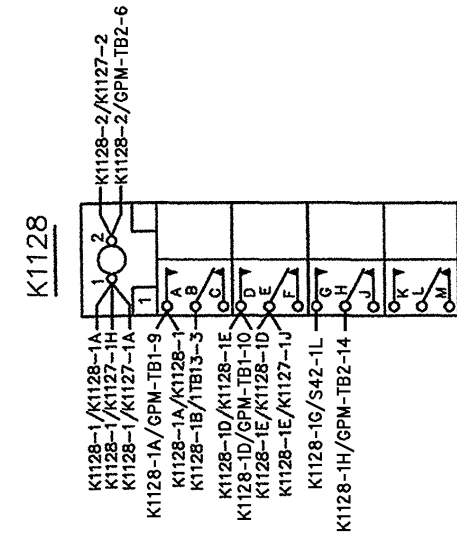
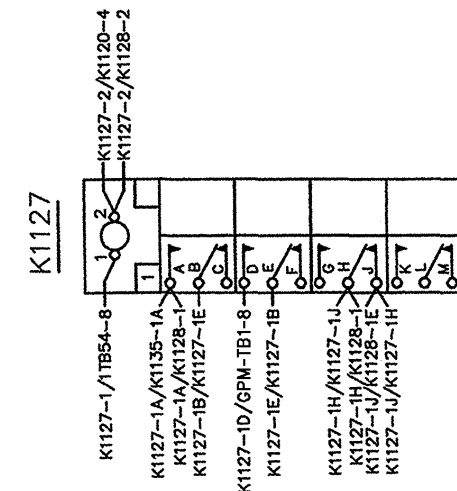
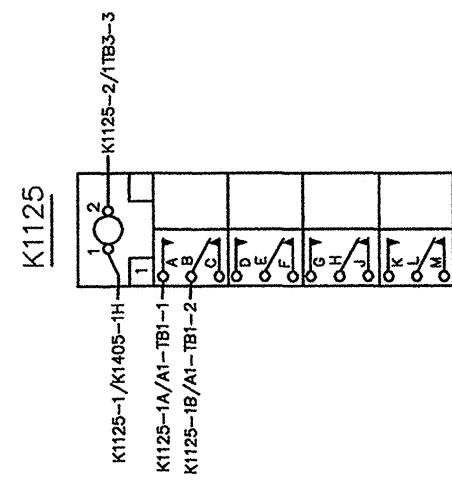
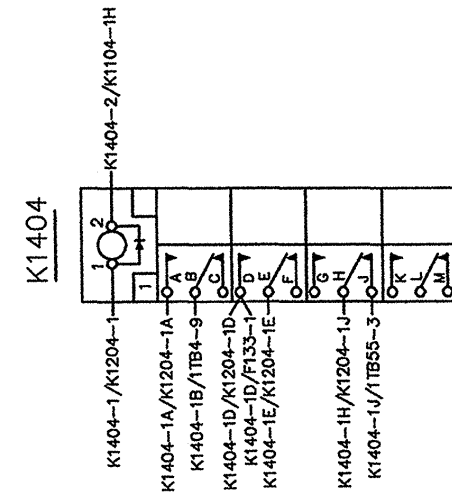
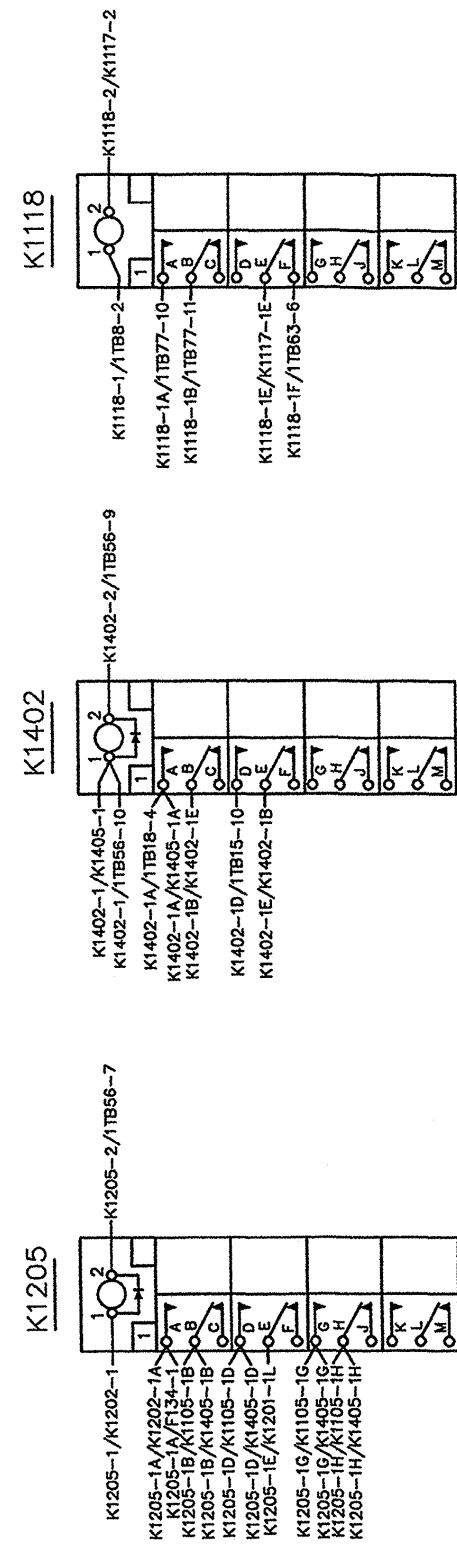
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 18 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



RELAY SUBPAN LEFT HAND SIDE
PANEL-"N" UNIT-2

NOTE:
 DDG 51 ONLY

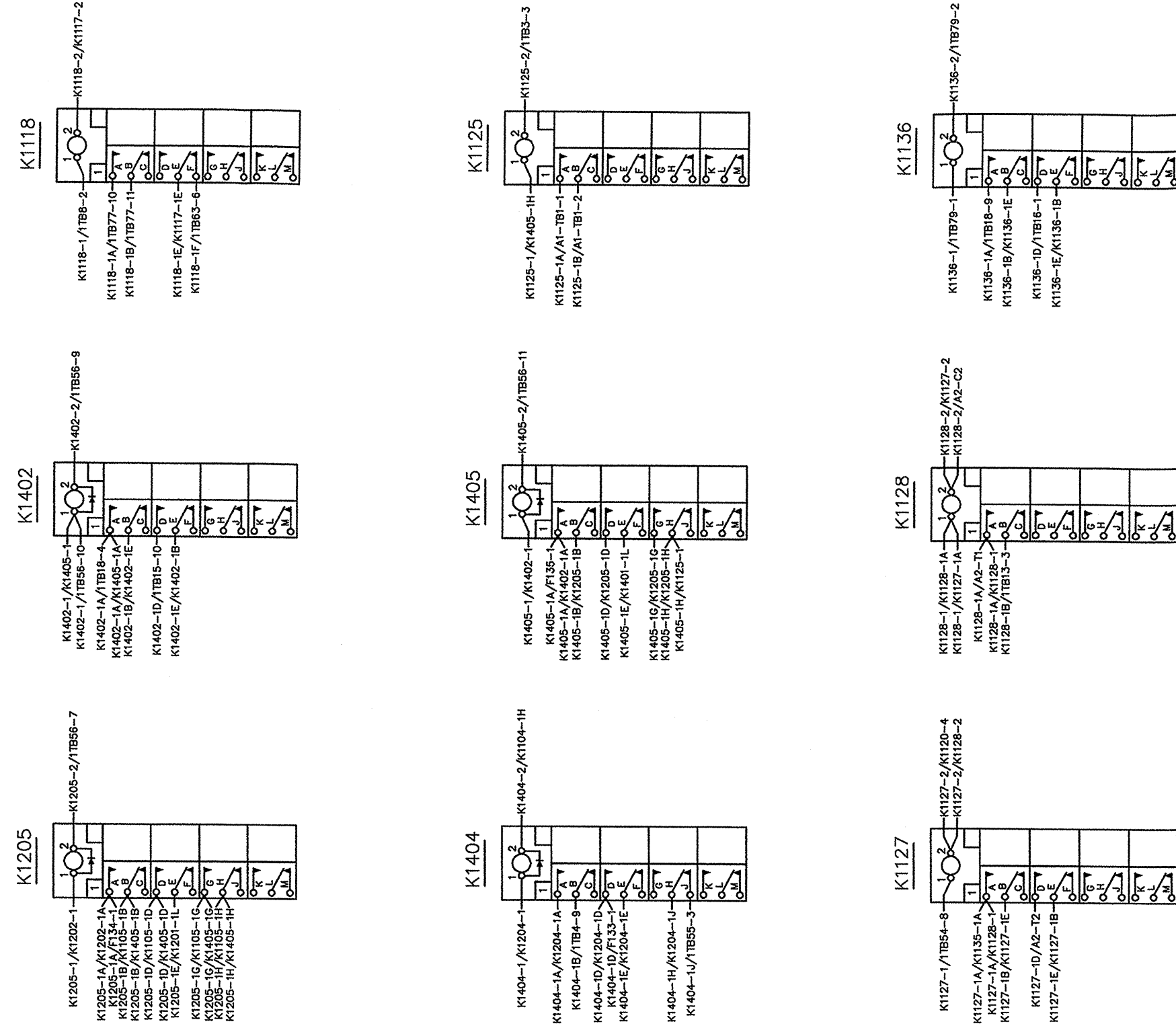
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 19 of 20)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 51 ONLY

RELAY SUBPAN LEFT HAND SIDE
PANEL-"N" UNIT-2

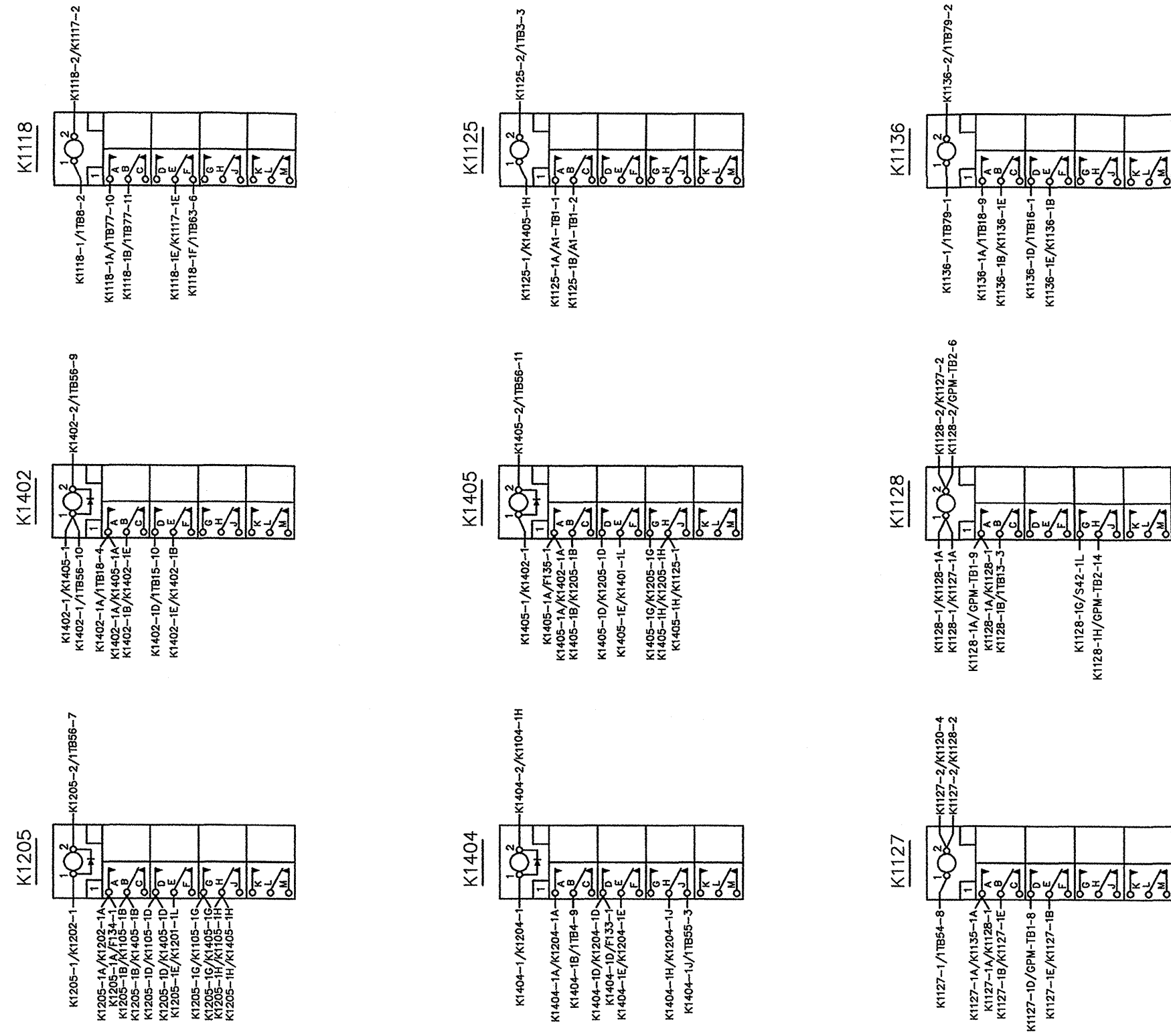
Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 19 of 20)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



RELAY SUBPAN LEFT HAND SIDE
PANEL-"N" UNIT-2

NOTE:
DDG 52-54 ONLY

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 19 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



**RELAY SUBPAN LEFT HAND SIDE
 PANEL-"N" UNIT-2**

NOTE:
 DDG 52-54 ONLY

Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 19 of 20)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

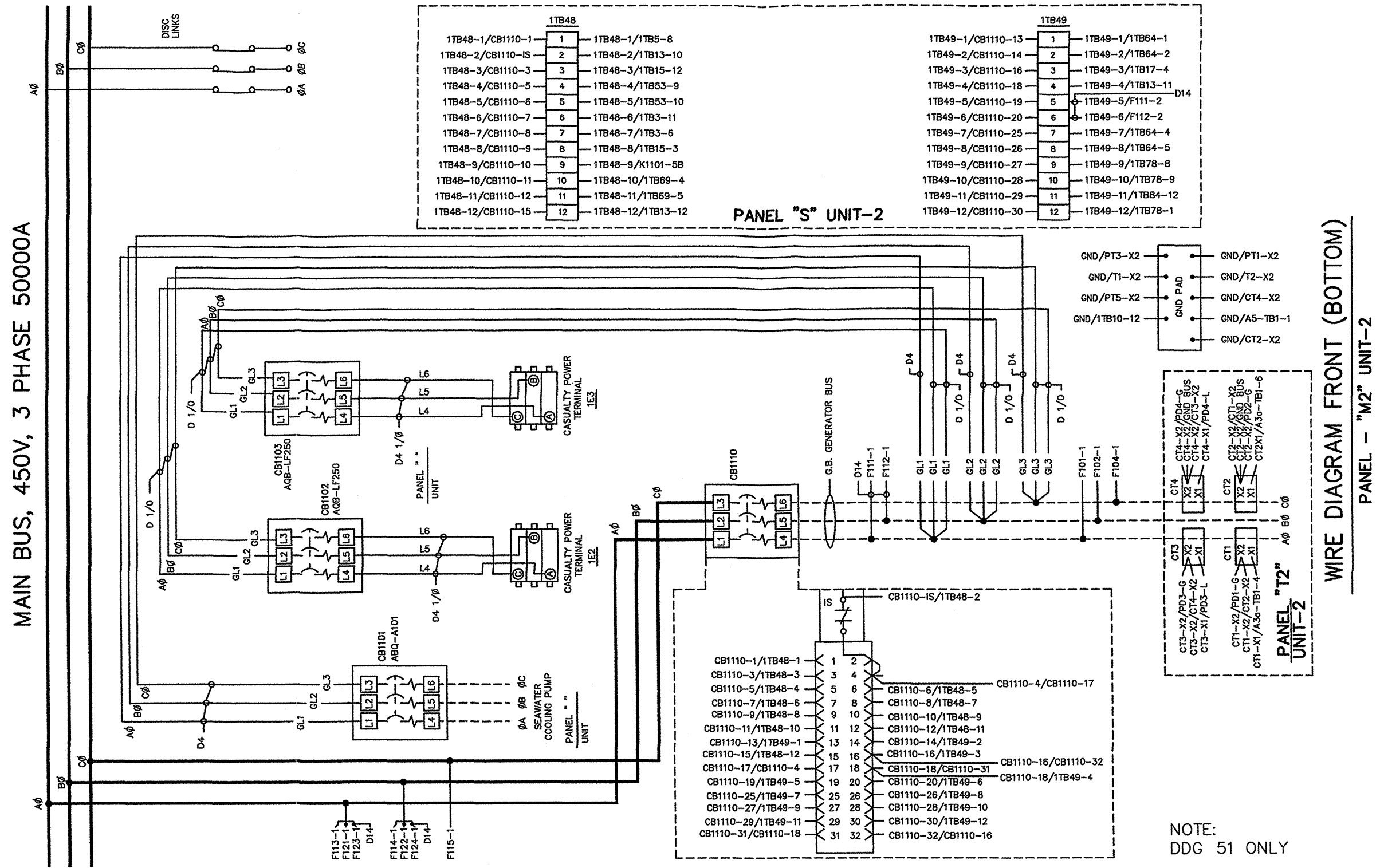


Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 20 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

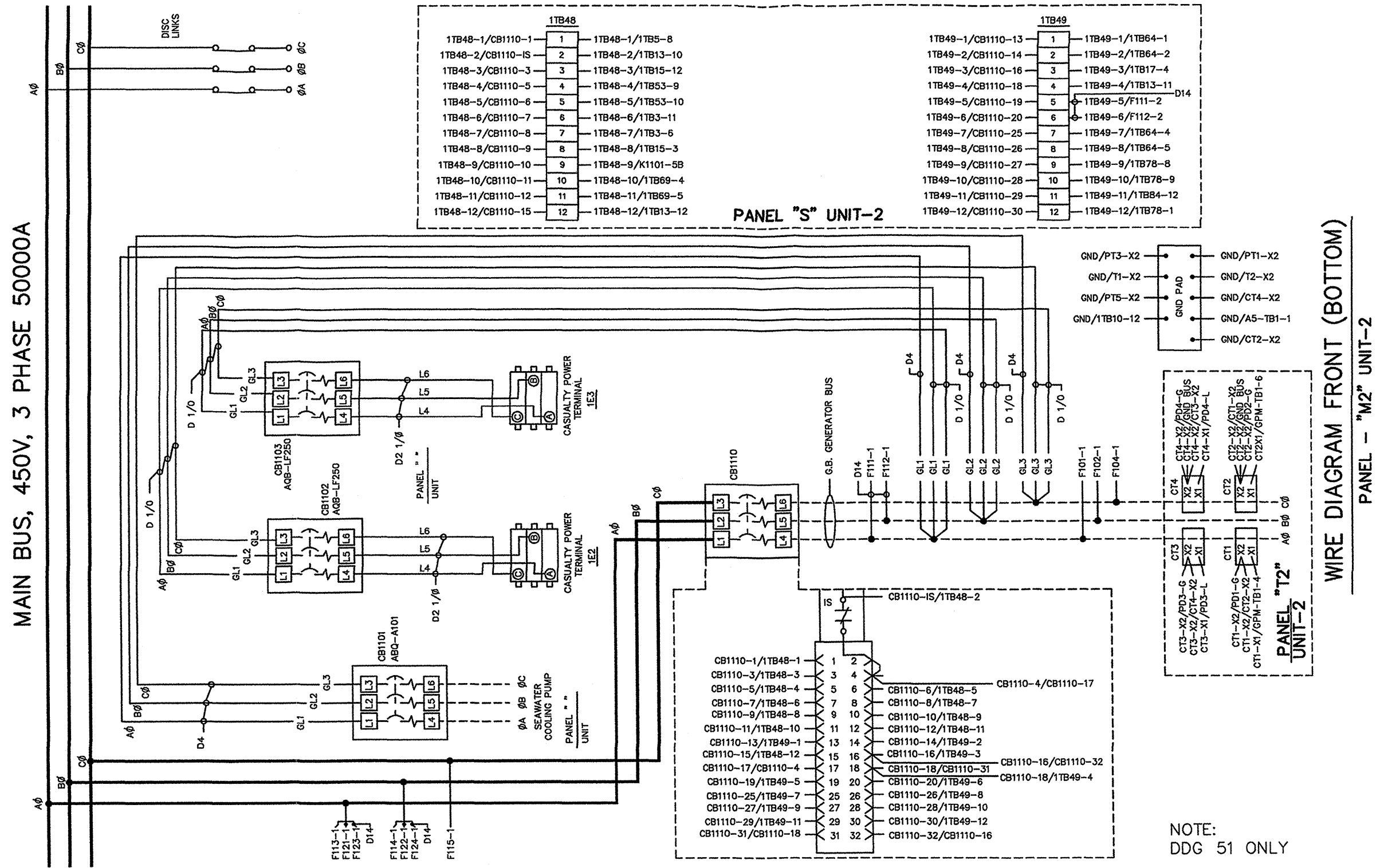


Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 20 of 20)
(For Ships With MACHALTs 320-59006 (ECP-515) and 320-42001 (ECP-597) Installed)

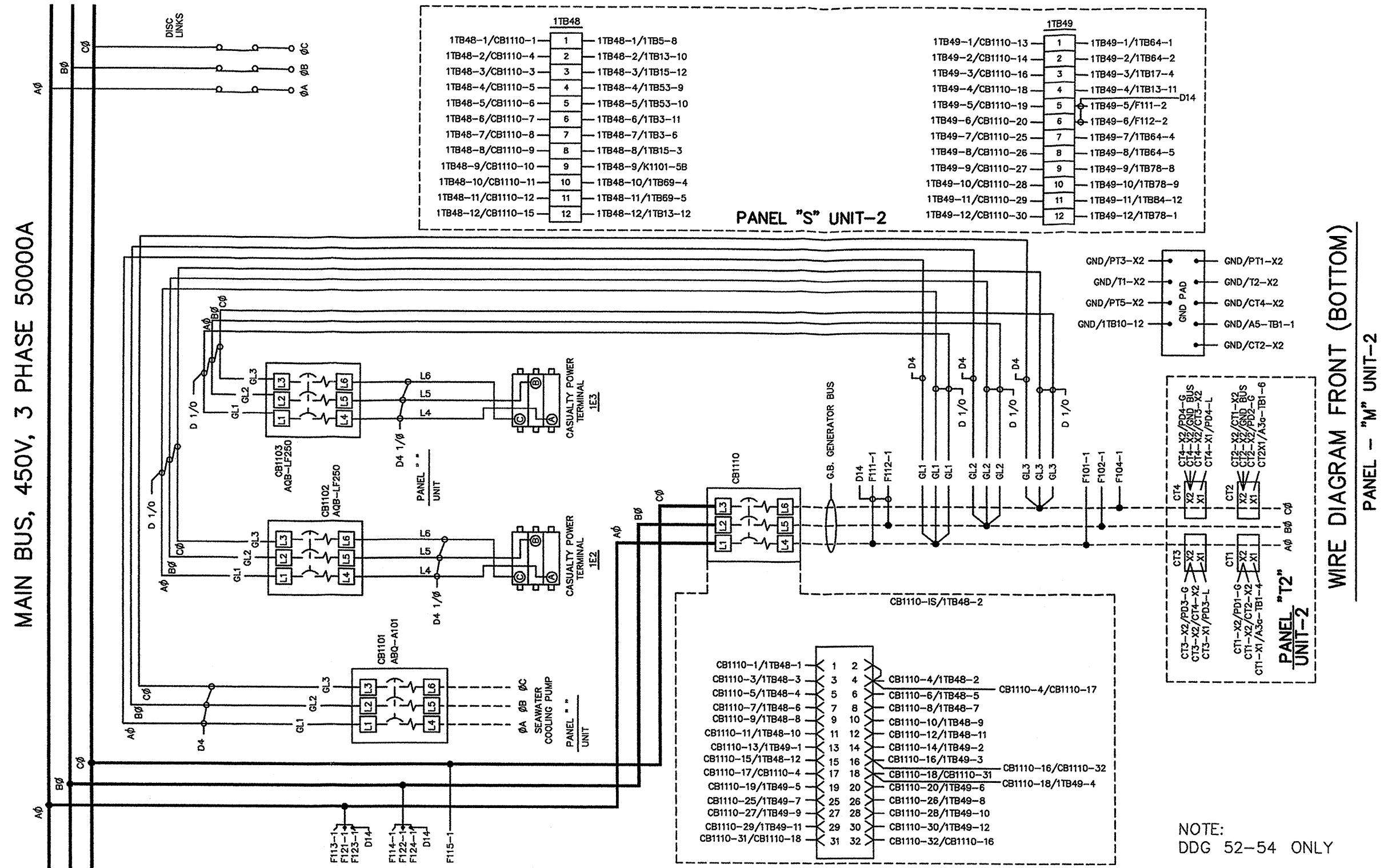


Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 20 of 20)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

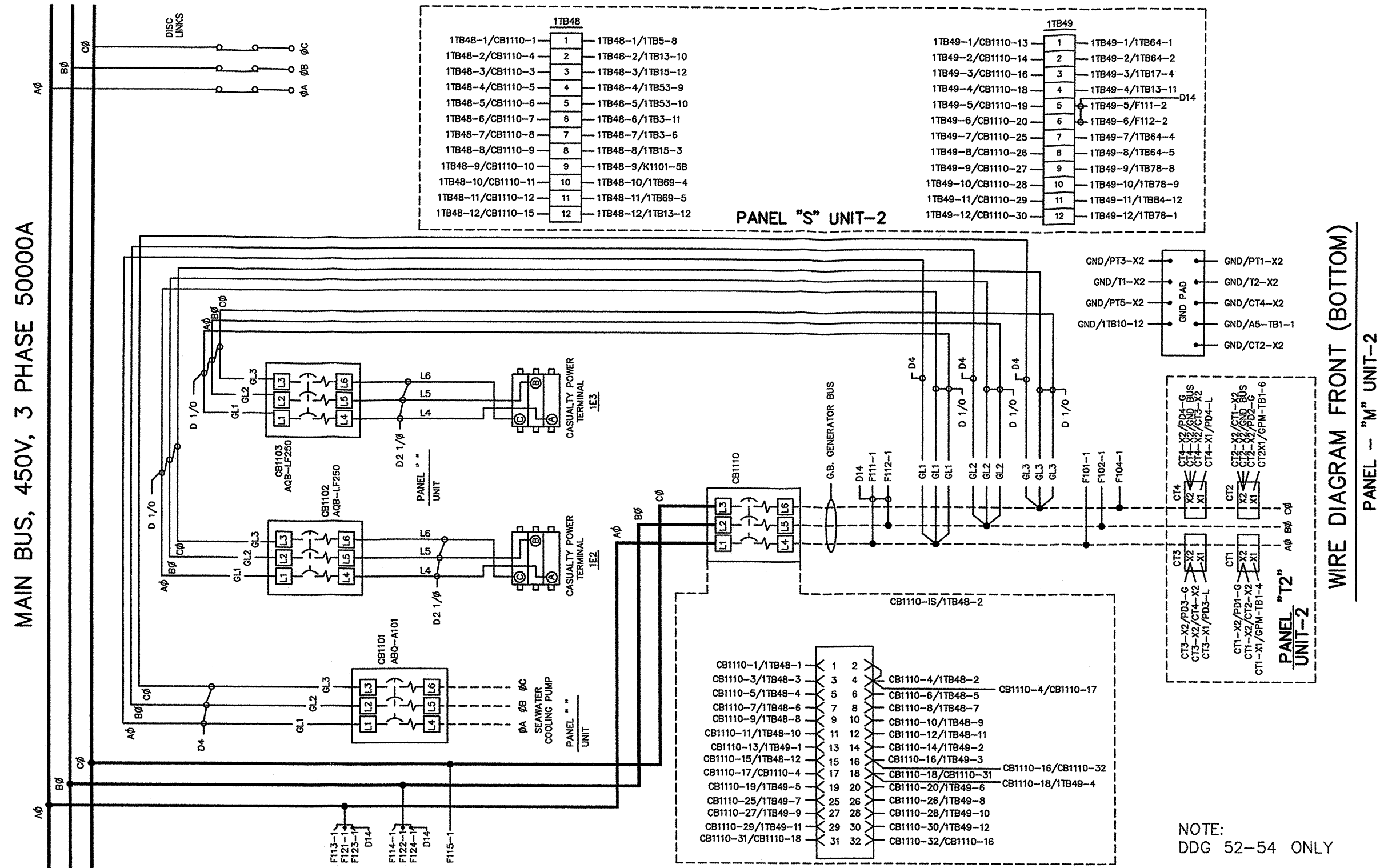
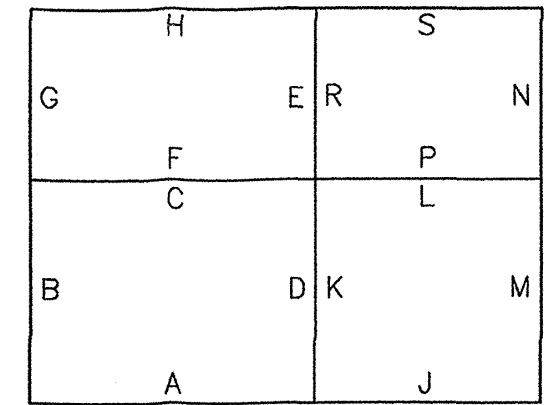
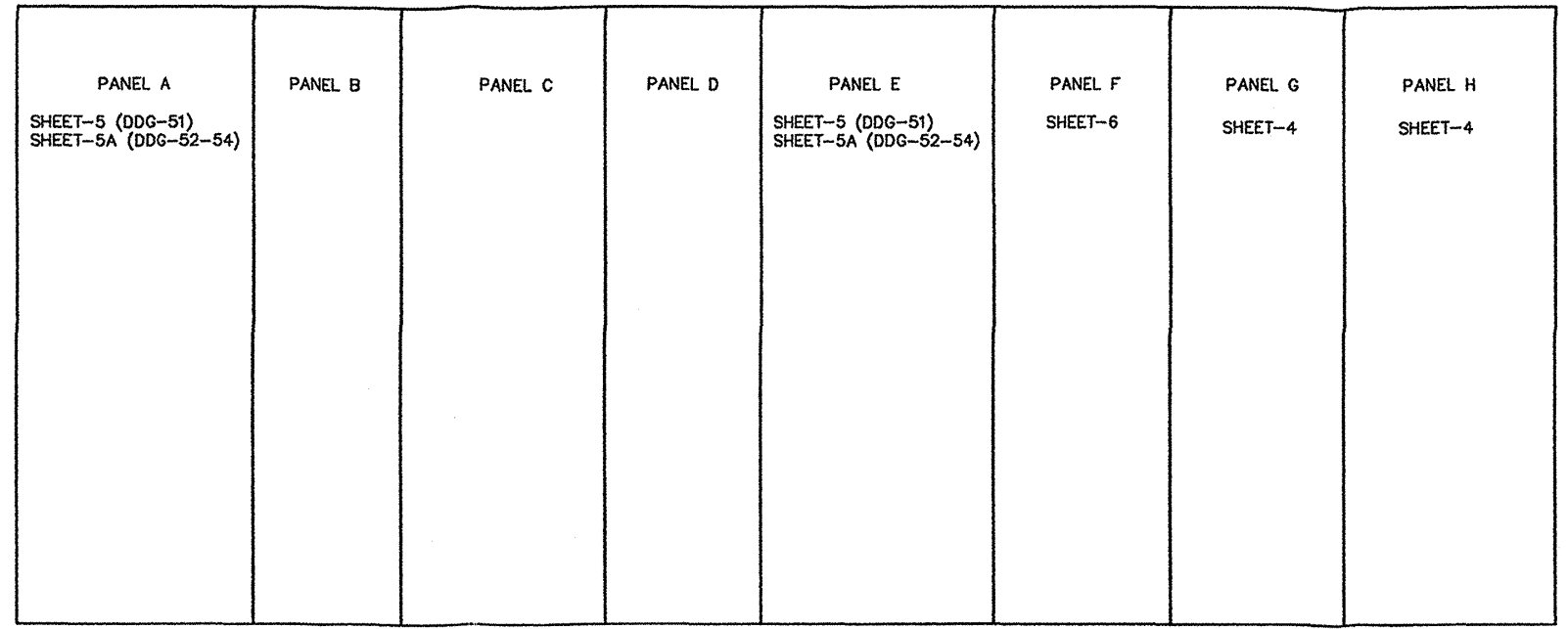
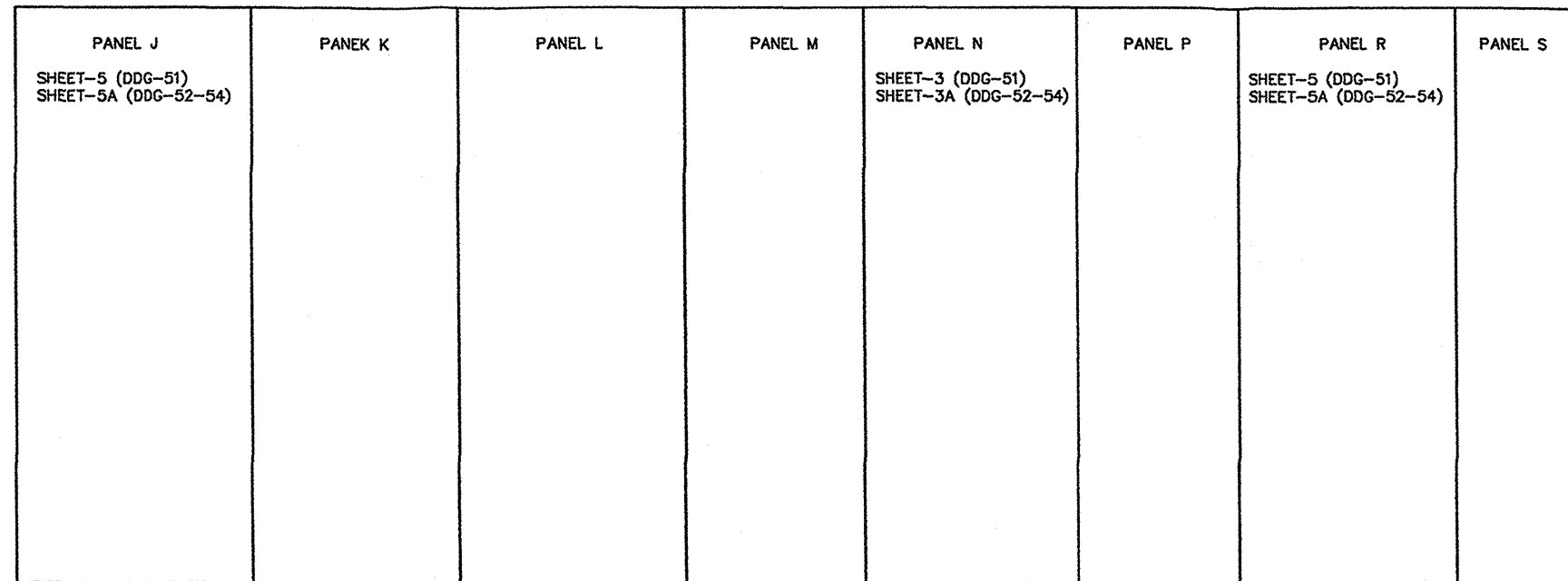


Figure 9-1. 1SG Switchboard; Wiring Diagram (Sheet 20 of 20)
(For Ships With MACHALTs 320-59006 (ECP-515) and 320-42001 (ECP-597) Installed)



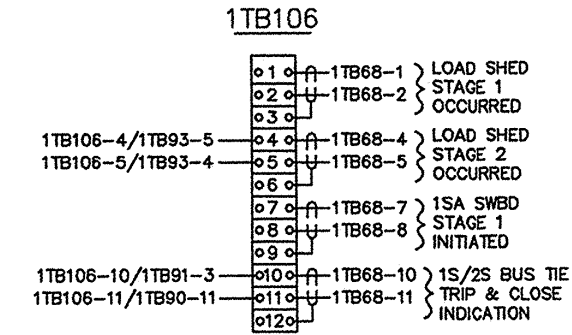
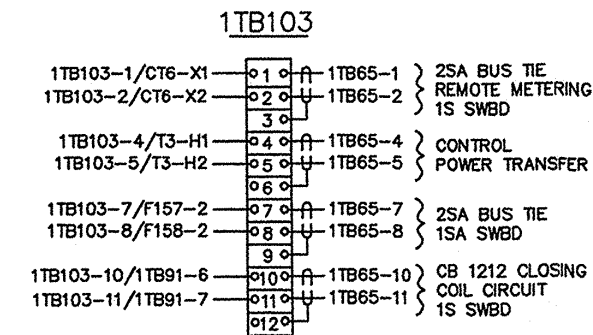
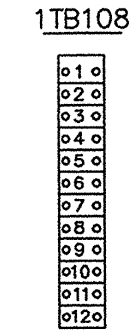
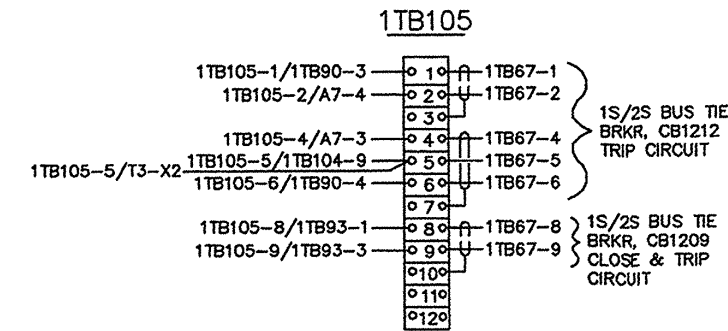
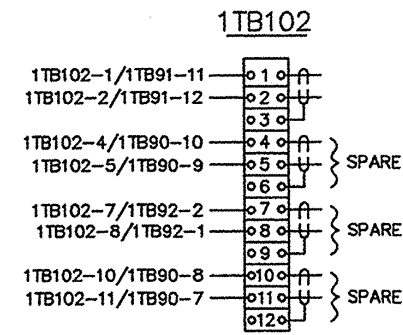
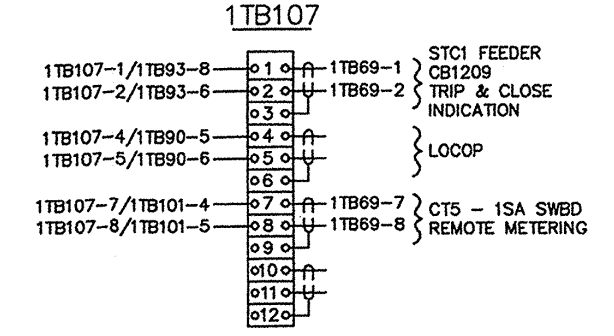
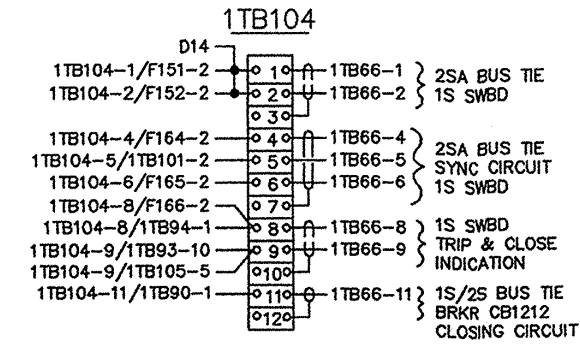
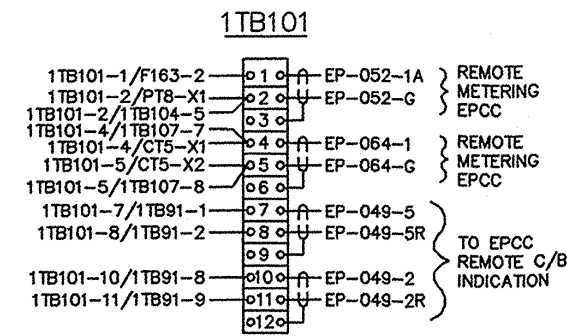
UNIT-1 UNIT-2
TOP VIEW-PANEL LOCATION
SWITCHBOARD "1SA"

UNIT-1



UNIT-2

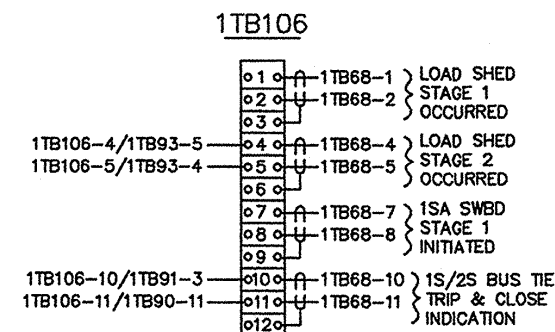
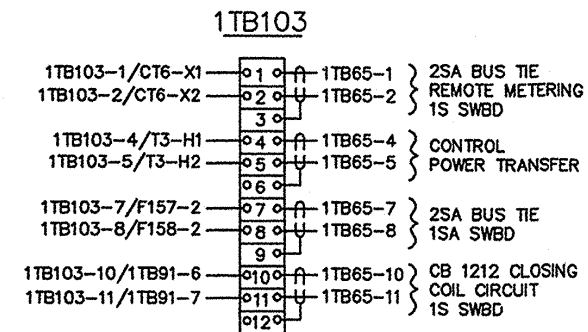
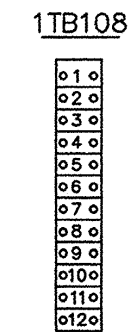
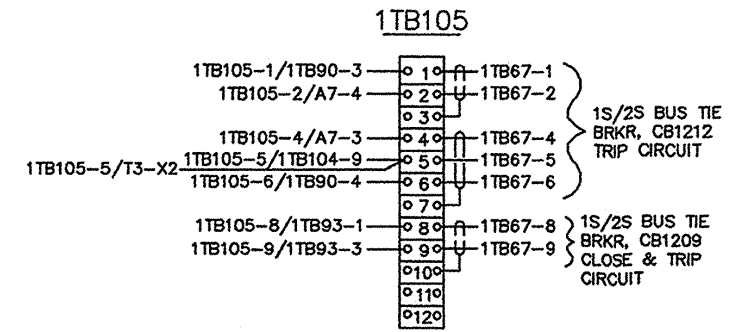
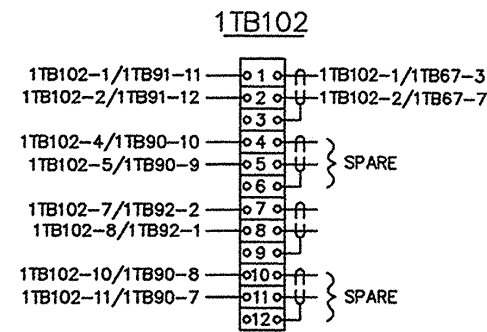
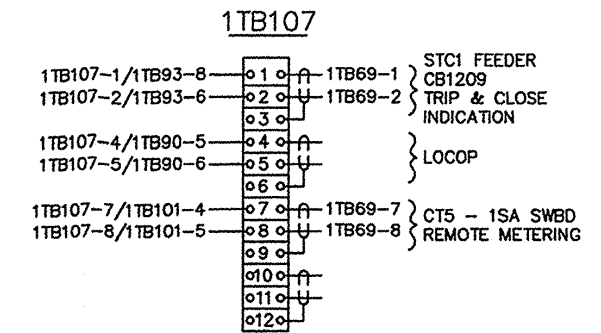
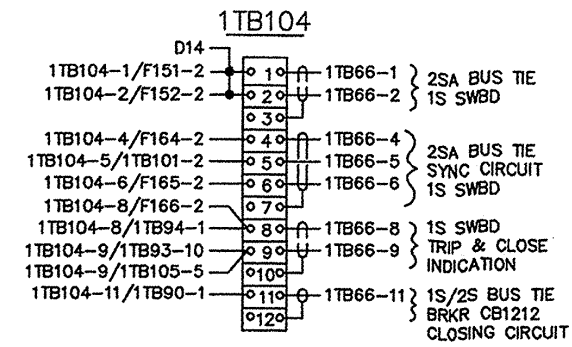
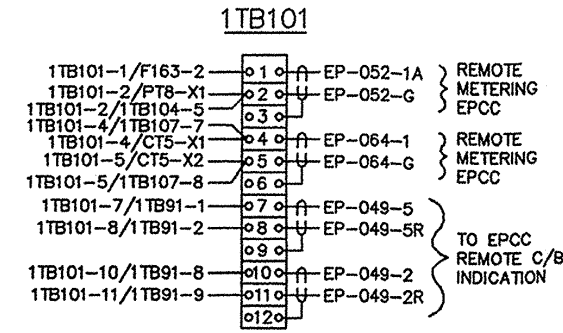
Figure 9-2. 1SA Switchboard; Wiring Diagram (Sheet 1 of 6)



REAR VIEW LEFT HAND SIDE (BOTTOM)
 PANEL-"N" UNIT-2

NOTE:
 DDG 51 ONLY

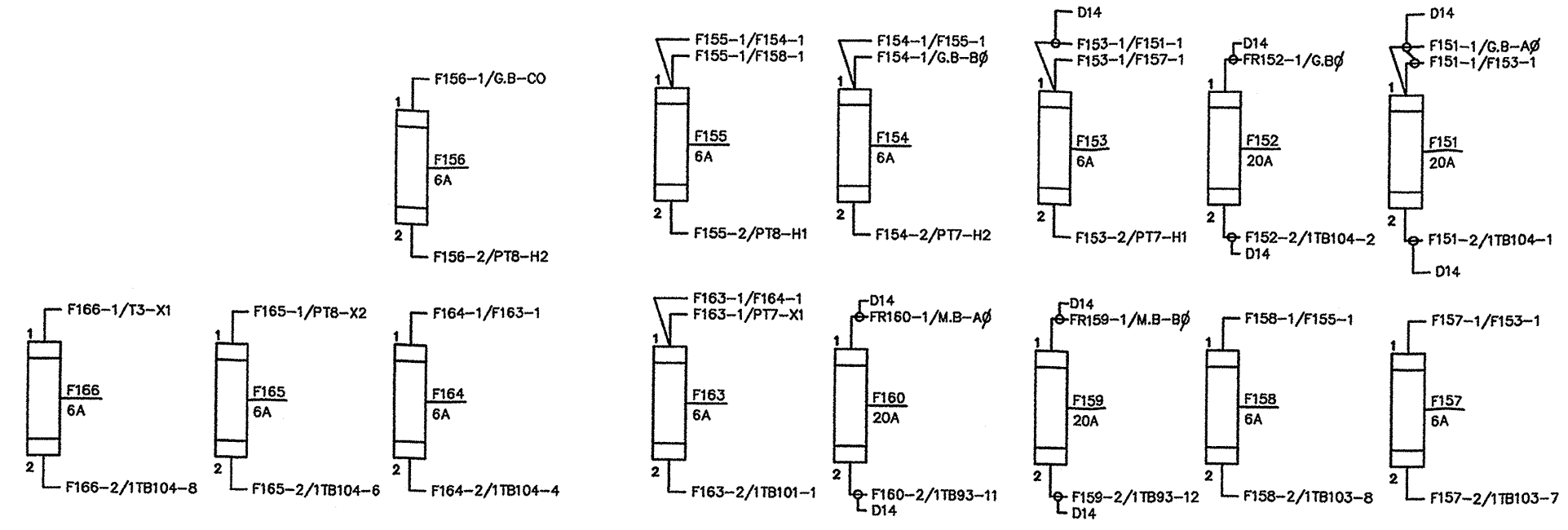
Figure 9-2. 1SA Switchboard; Wiring Diagram (Sheet 3 of 6)



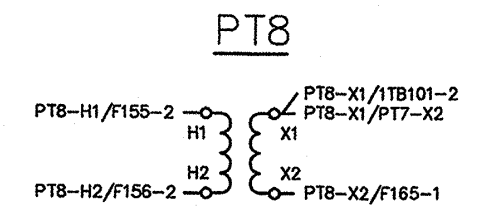
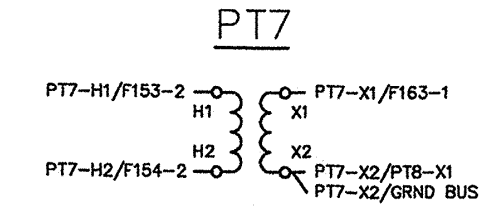
REAR VIEW LEFT HAND SIDE (BOTTOM)
 PANEL-"N" UNIT-2

NOTE:
 DDG 52-54 ONLY

Figure 9-2. 1SA Switchboard; Wiring Diagram (Sheet 3 of 6)



REAR VIEW (TOP)
PANEL-"H" UNIT-1



INSIDE VIEW
PANEL-"G" UNIT-1

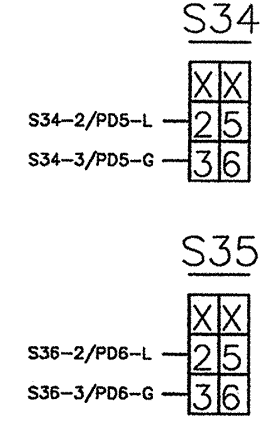
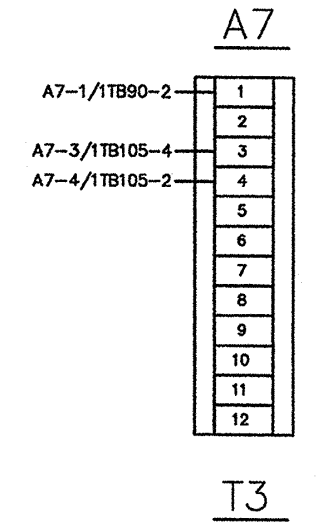
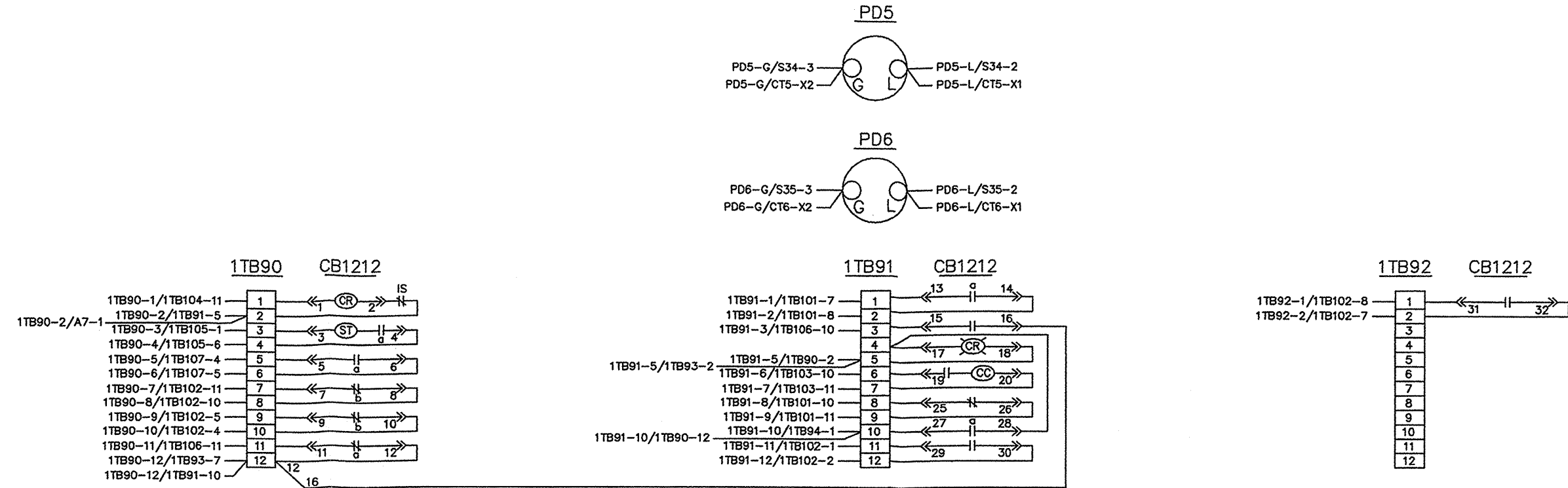
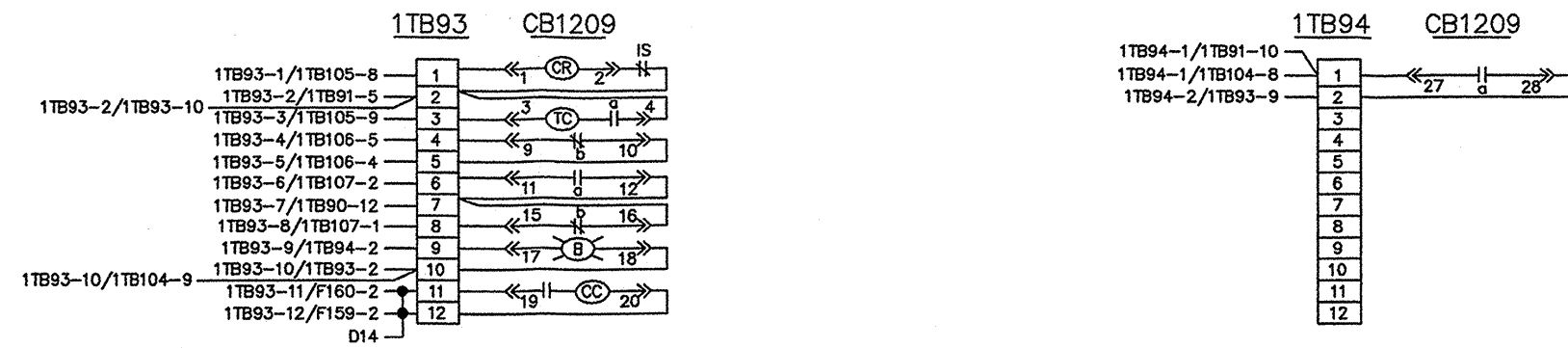


Figure 9-2. 1SA Switchboard; Wiring Diagram (Sheet 4 of 6)



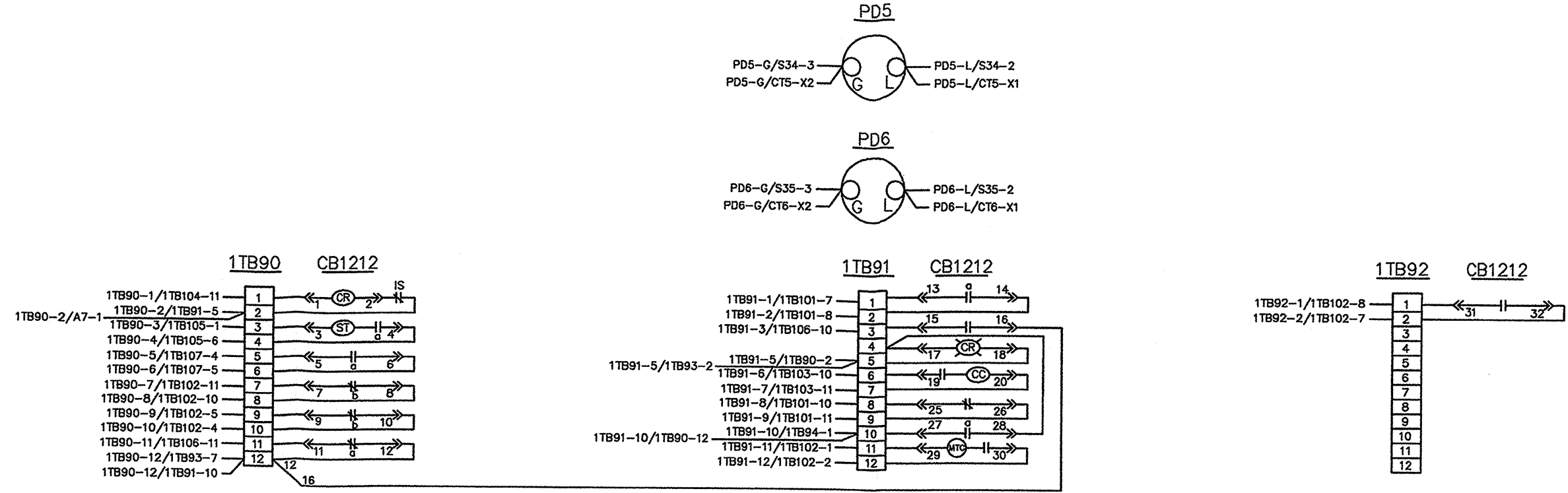
INSIDE VIEW
 PANEL-"E" UNIT-1
 PANEL-"A" UNIT-1



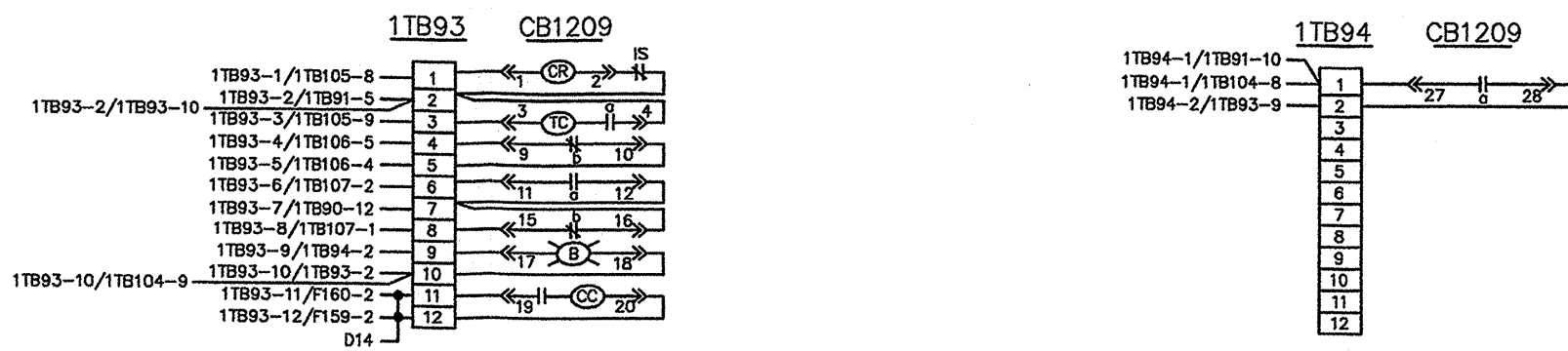
INSIDE VIEW
 PANEL-"R" UNIT-2
 PANEL-"J" UNIT-2

NOTE:
 DDG 51 ONLY

Figure 9-2. ISA Switchboard; Wiring Diagram (Sheet 5 of 6)



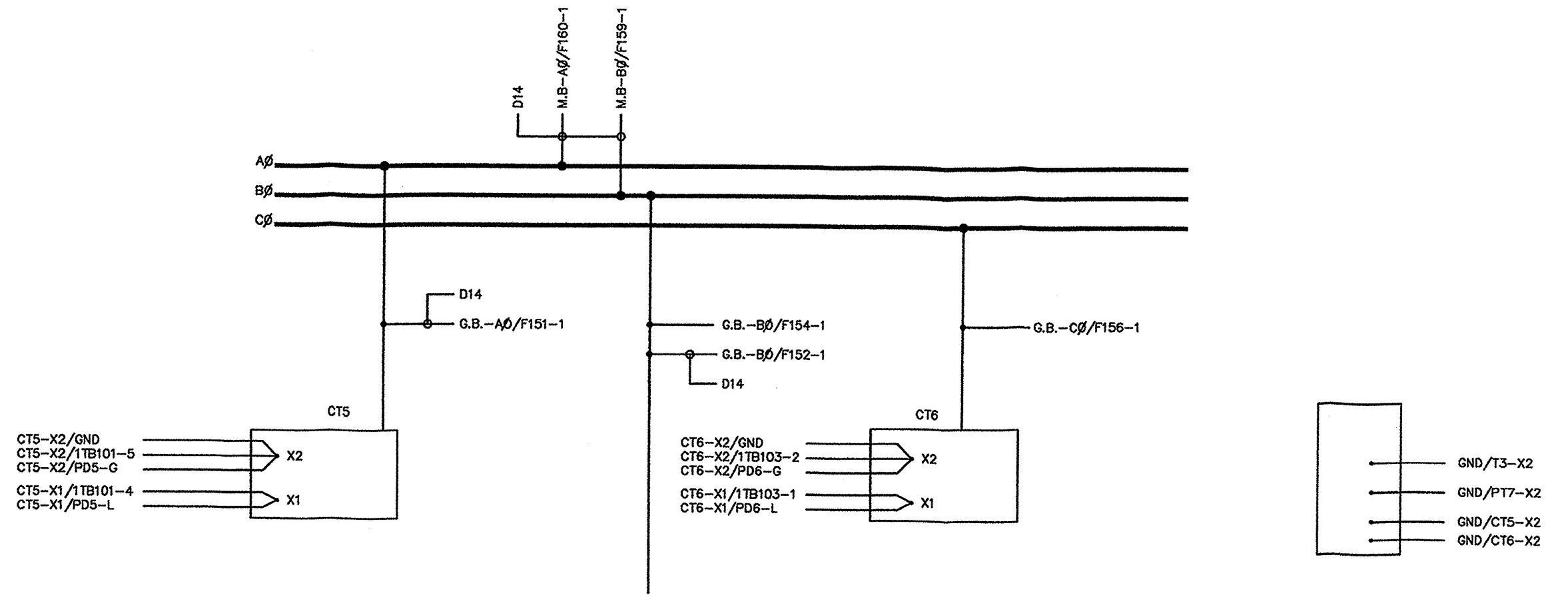
INSIDE VIEW
PANEL-"E" UNIT-1
PANEL-"A" UNIT-1



INSIDE VIEW
PANEL-"R" UNIT-2
PANEL-"J" UNIT-2

NOTE:
 DDG 52-54 ONLY

Figure 9-2. ISA Switchboard; Wiring Diagram (Sheet 5 of 6)



TERMINAL REAR LEFT HAND SIDE

PANEL - "F" UNIT - 1

Figure 9-2. 1SA Switchboard; Wiring Diagram (Sheet 6 of 6)

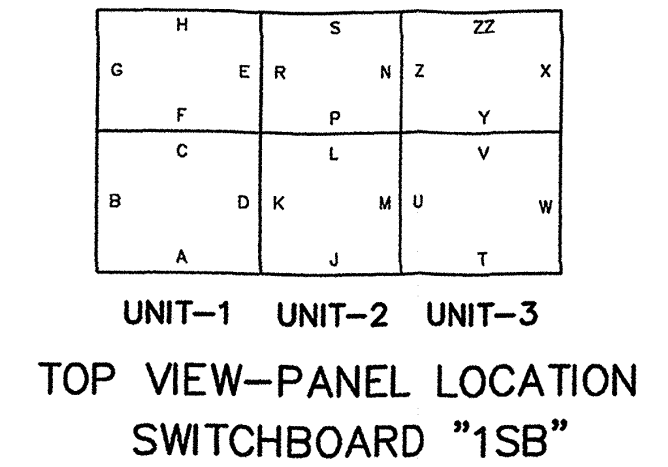
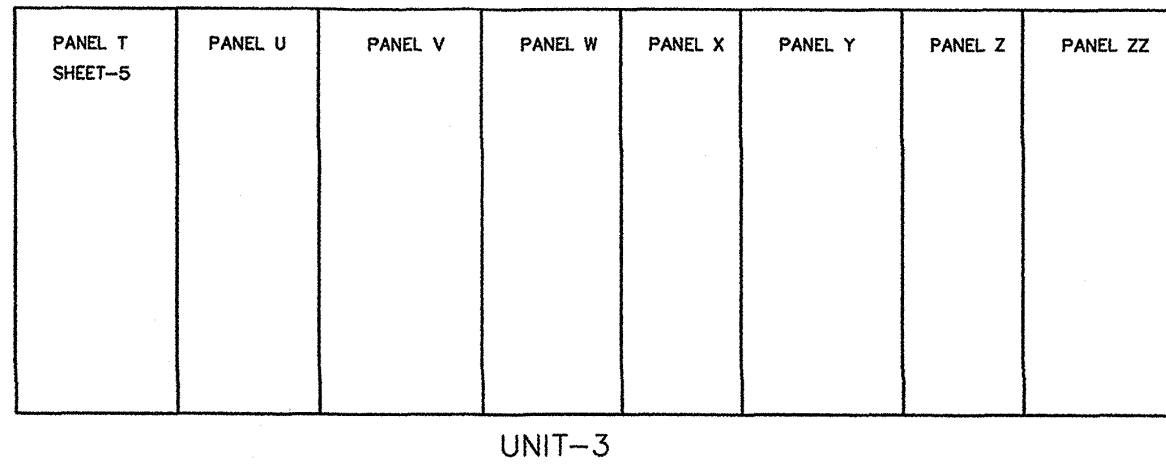
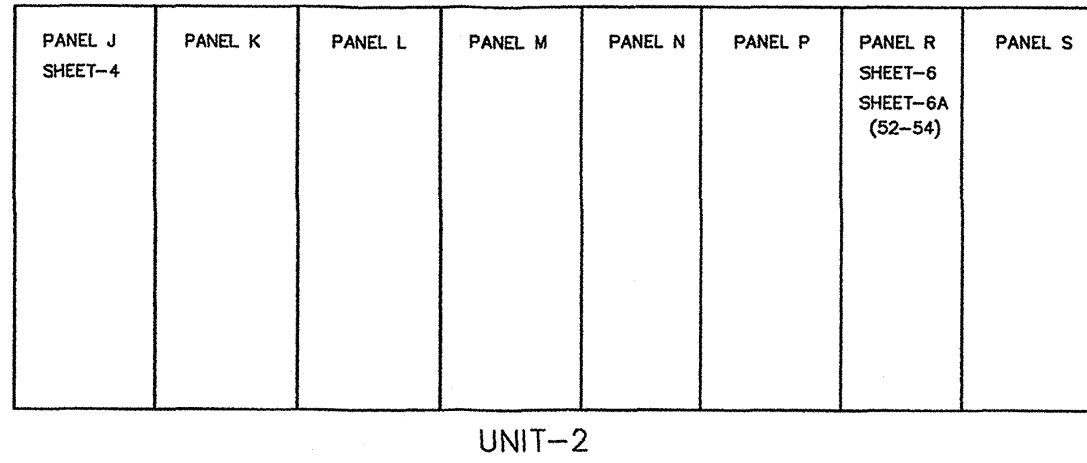
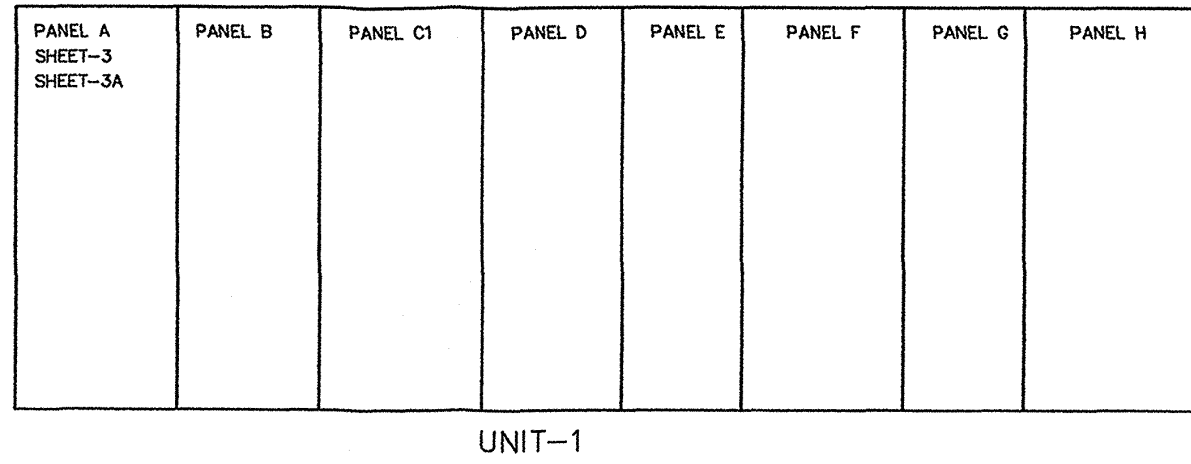


Figure 9-3. 1SB Switchboard; Wiring Diagram (Sheet 1 of 7)

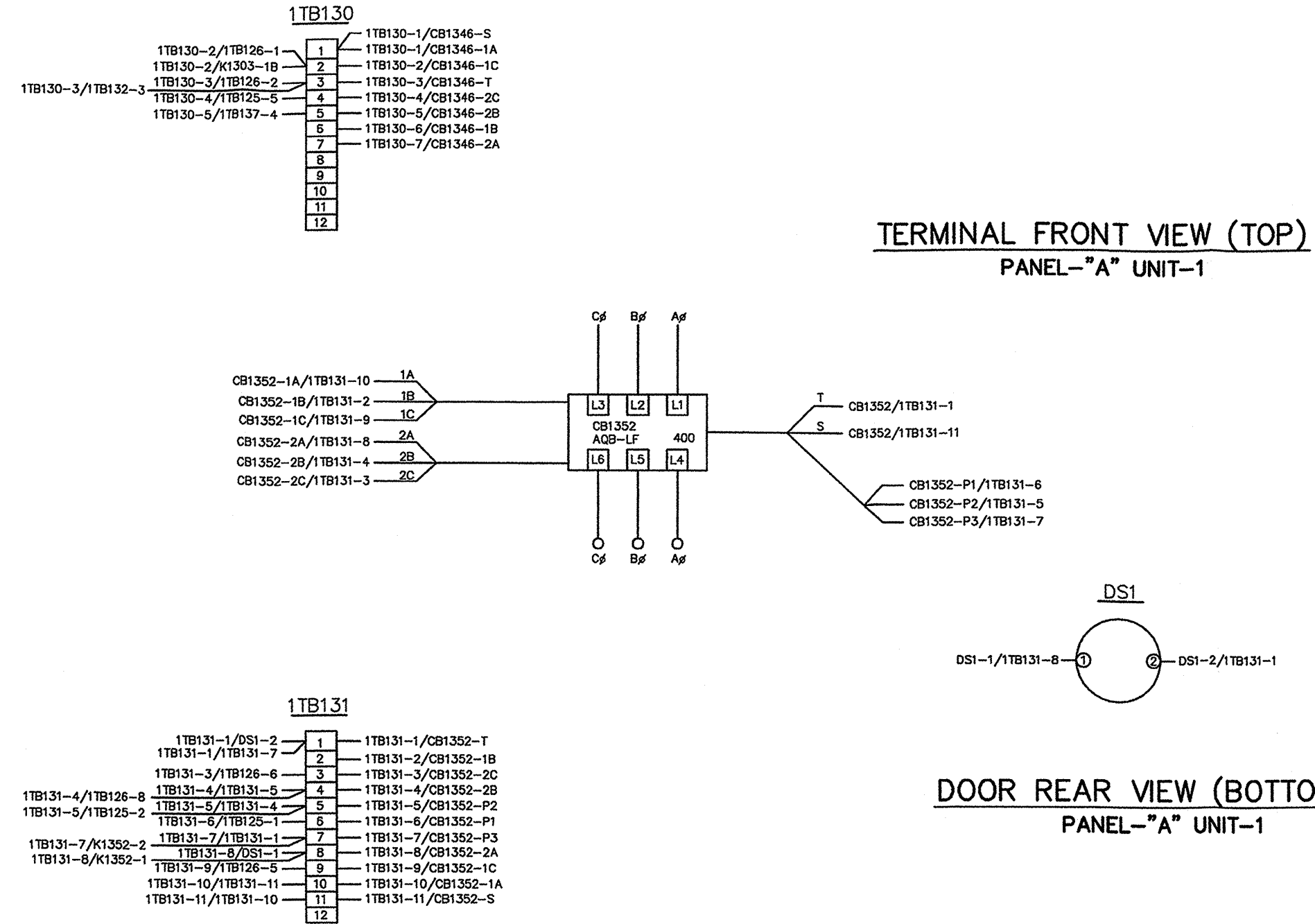


Figure 9-3. ISB Switchboard; Wiring Diagram (Sheet 3 of 7)

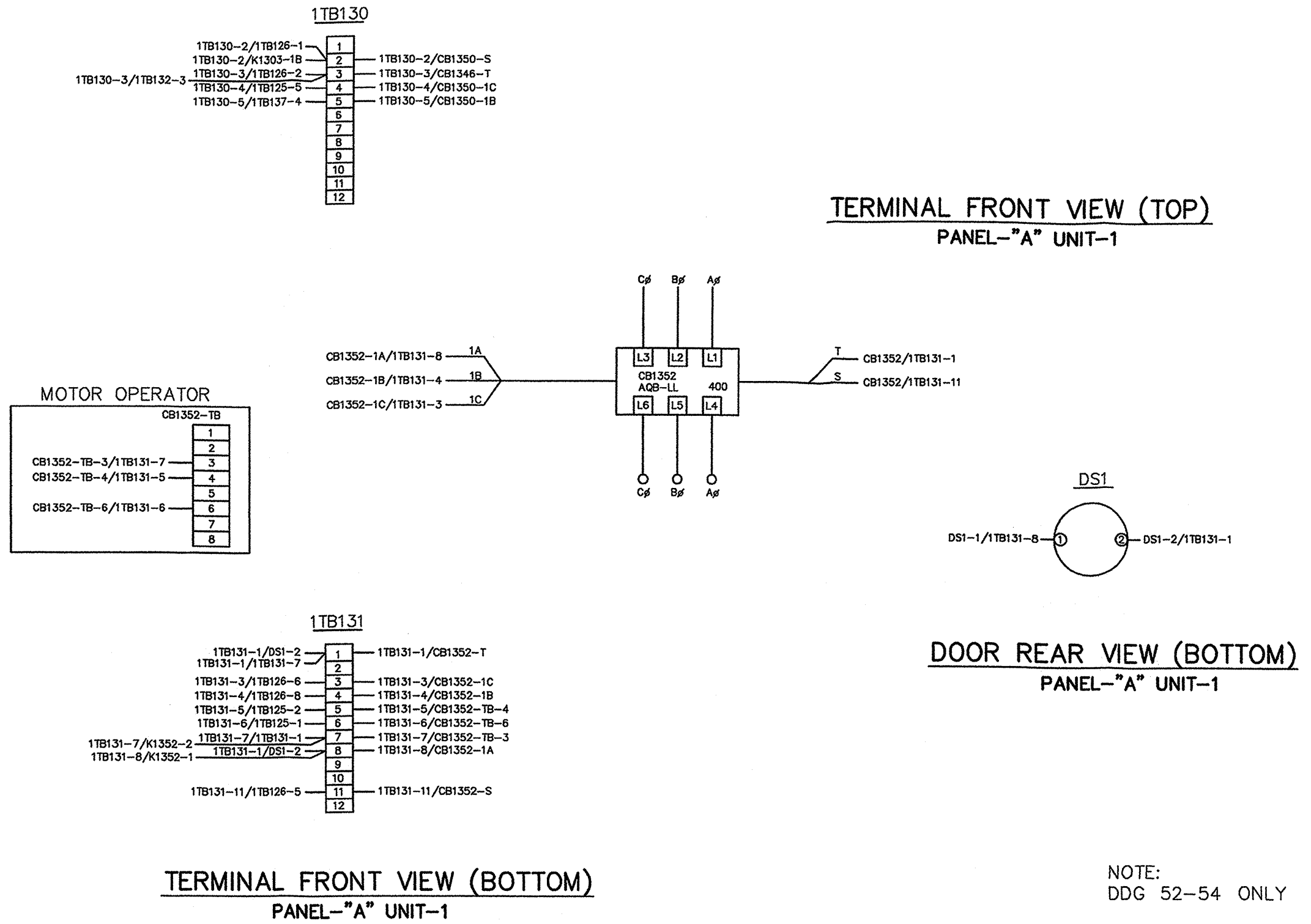


Figure 9-3. 1SB Switchboard; Wiring Diagram (Sheet 3 of 7)

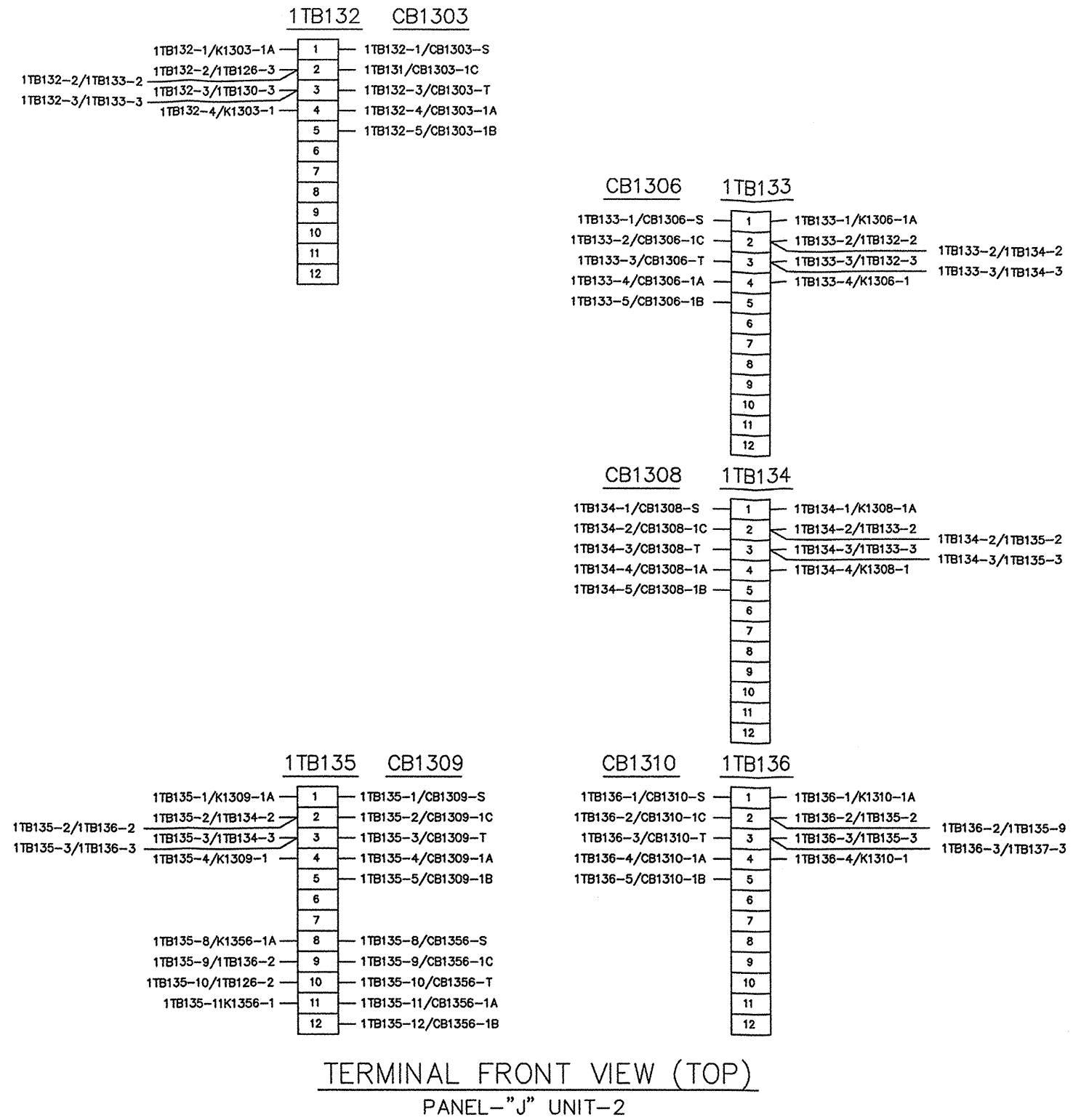
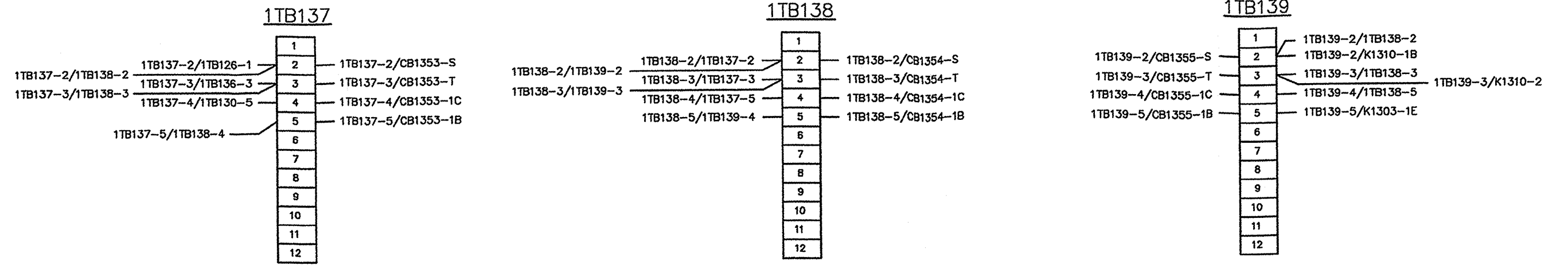
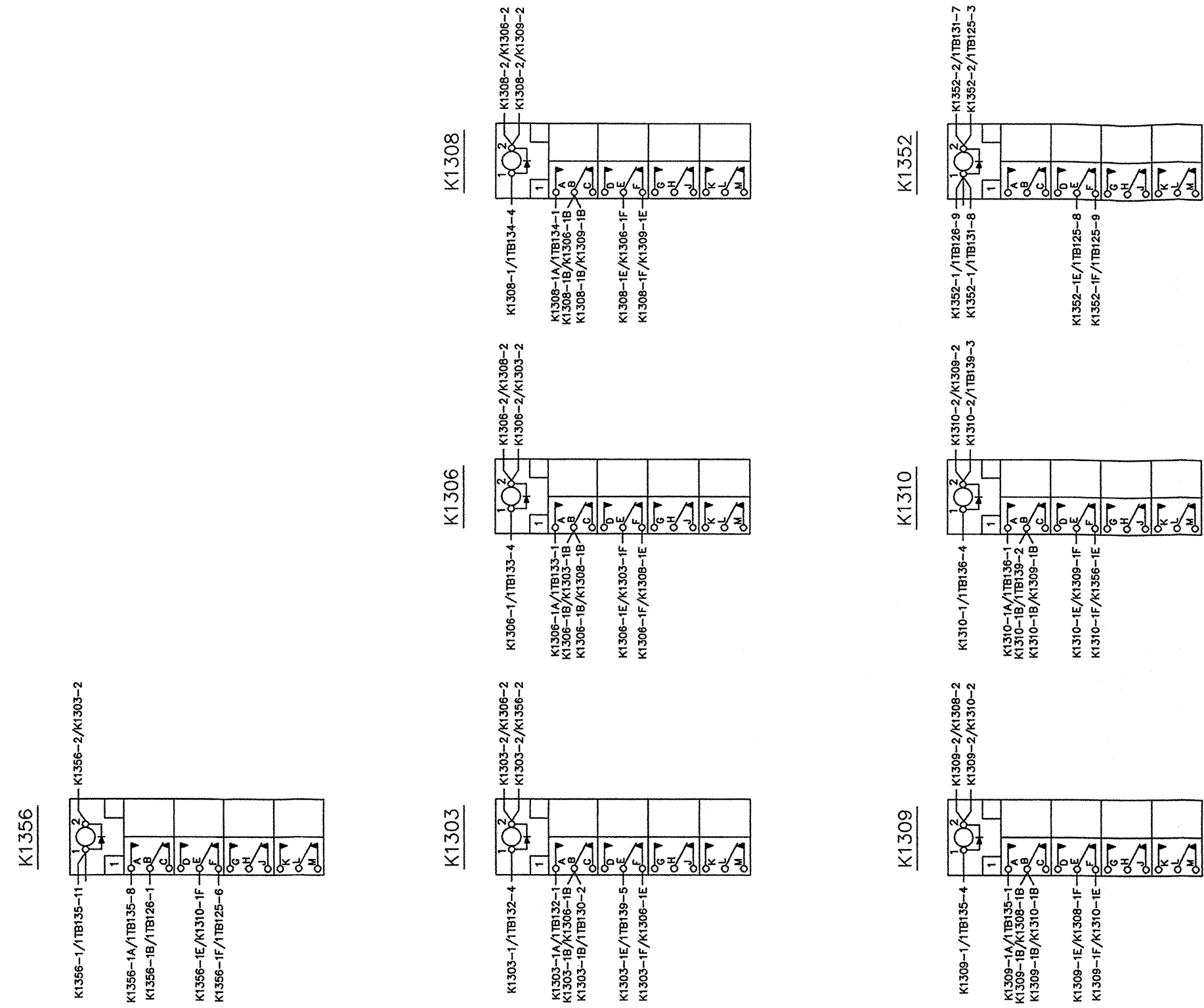


Figure 9-3. 1SB Switchboard; Wiring Diagram (Sheet 4 of 7)



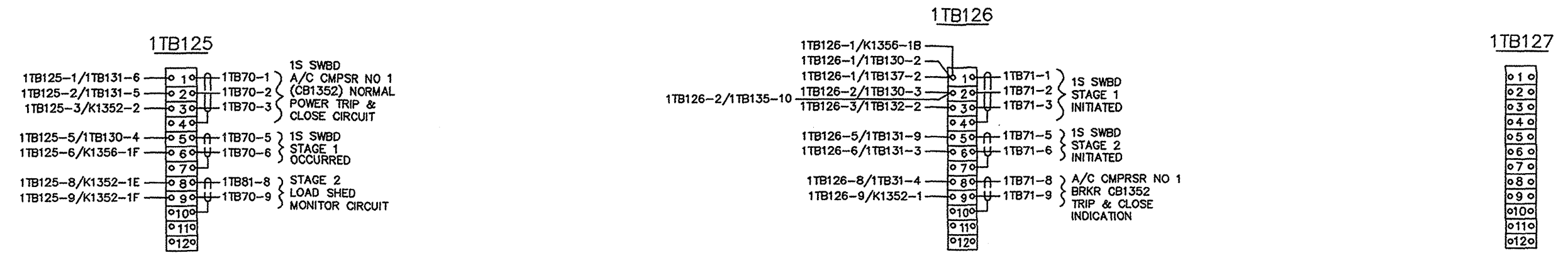
TERMINAL FRONT VIEW (BOTTOM)
 PANEL-"T" UNIT-3

Figure 9-3. ISB Switchboard; Wiring Diagram (Sheet 5 of 7)



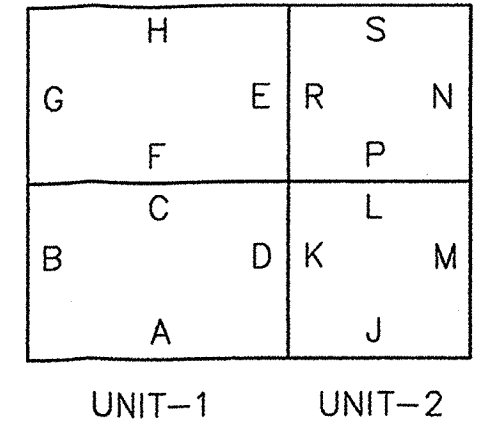
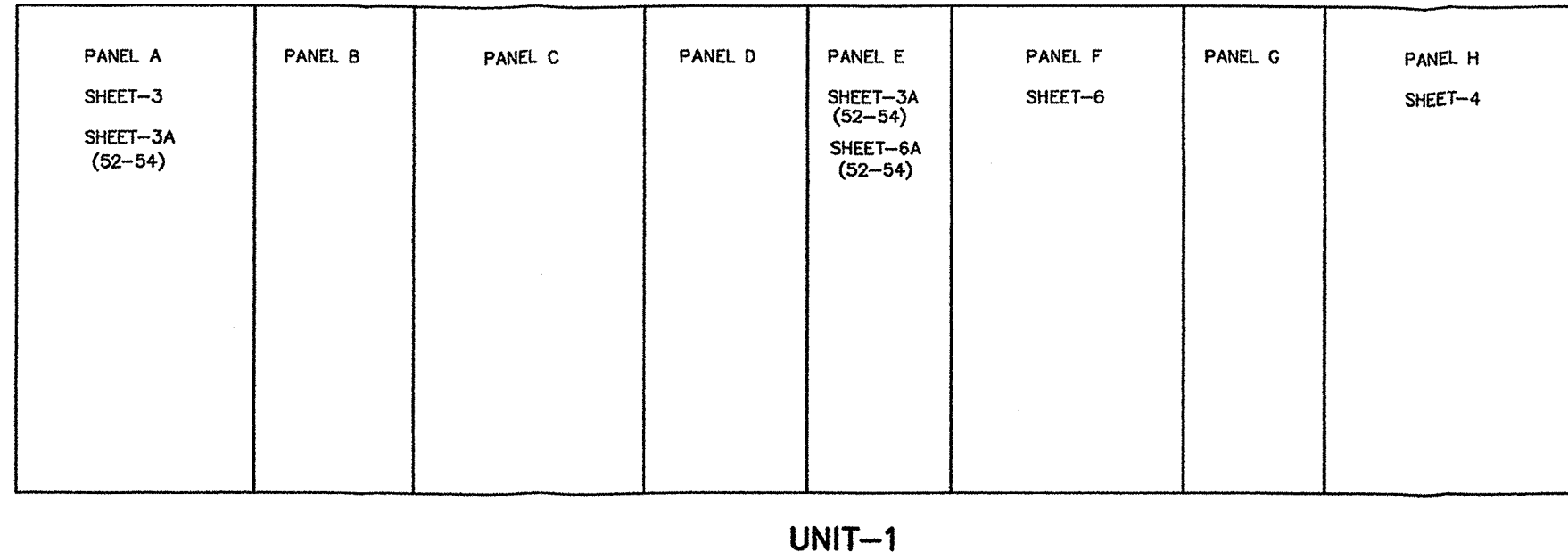
RELAY, TERMINAL REAR (BOTTOM)
PANEL "R" UNIT-2

Figure 9-3. 1SB Switchboard; Wiring Diagram (Sheet 6 of 7)



RELAY, TERMINAL REAR (BOTTOM)
PANEL-"R" UNIT-2

Figure 9-3. 1SB Switchboard; Wiring Diagram (Sheet 7 of 7)



**TOP VIEW-PANEL LOCATION
SWITCHBOARD "1SC"**

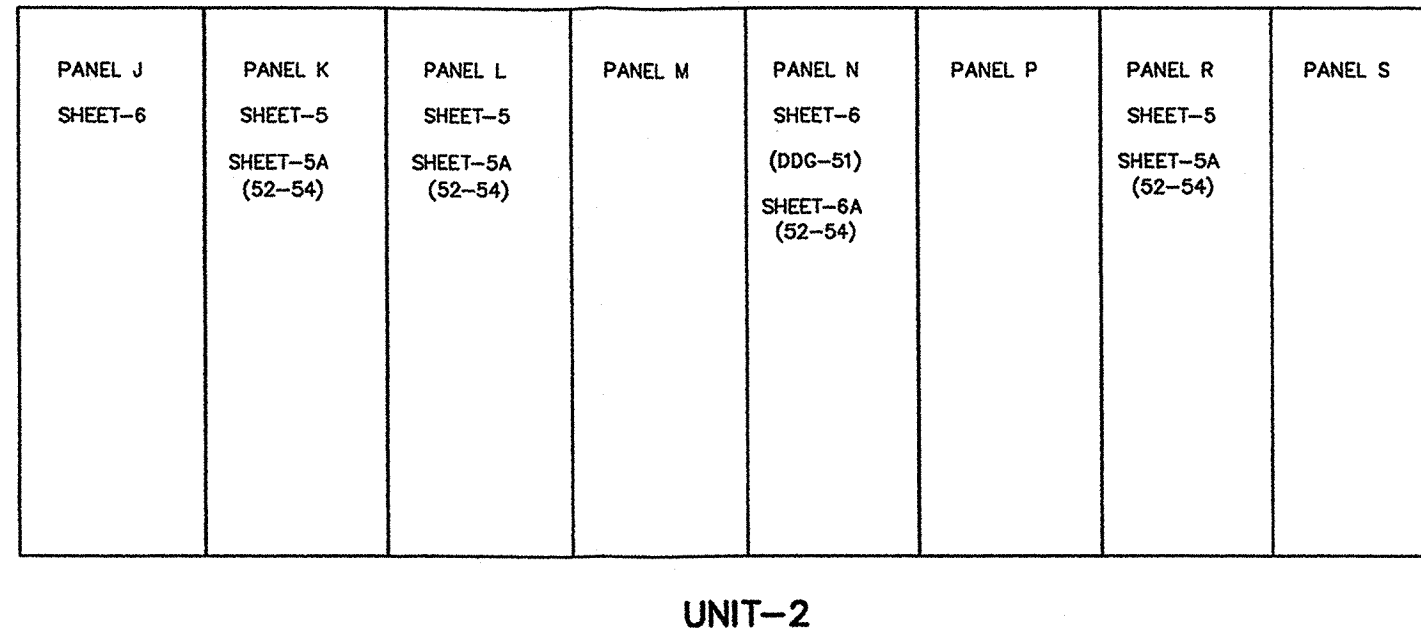
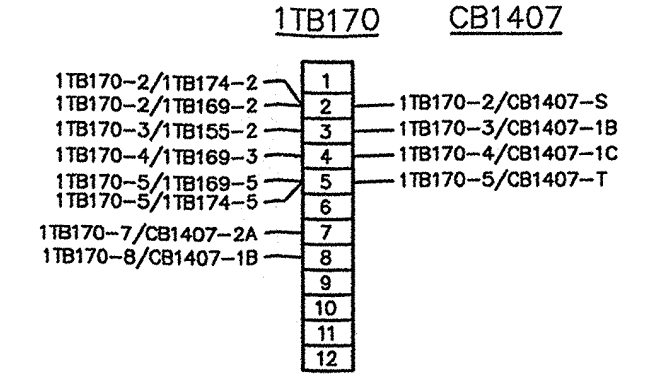
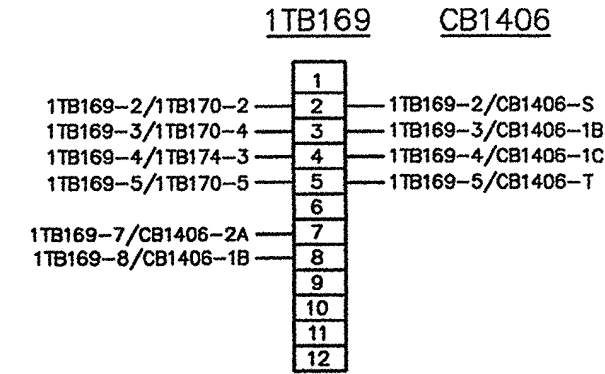


Figure 9-4. 1SC Switchboard; Wiring Diagram (Sheet 1 of 6)

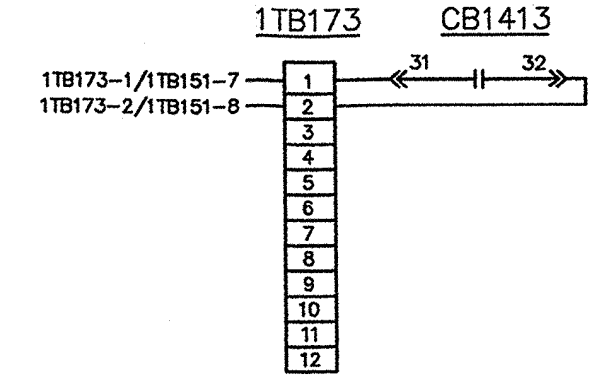
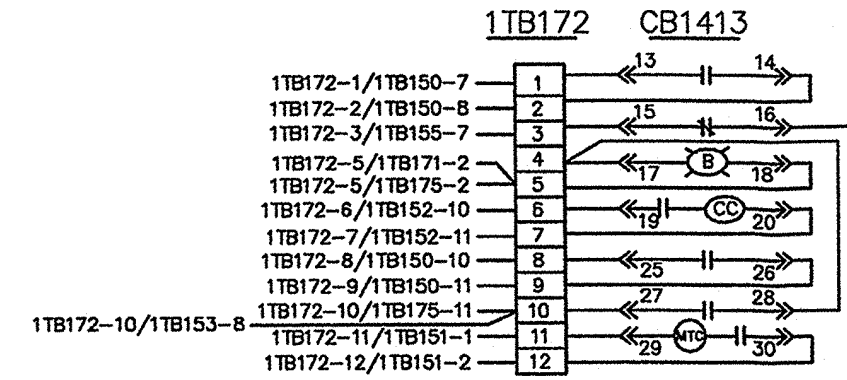
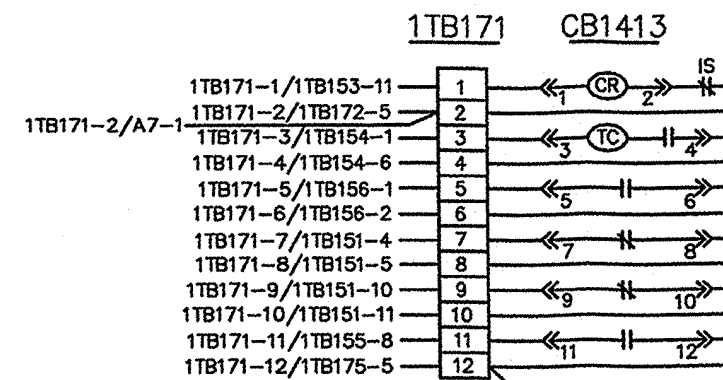
COMPONENT LOCATIONS

PANEL NO.															
A	1TB169-1TB170	CB1413	CB1406-CB1407												
H	F181-F190	F193-F196	S36-S37												
M	PT9	PT10													
N	1TB150-1TB155														
K	T5	A7													
J	1TB174	CB1409	CB1404												
R	1TB156	1TB157	1TB175												
F	CT7-CT8														
E	1TB171-1TB173	PD7-PD8	GND												

Figure 9-4. 1SC Switchboard; Wiring Diagram (Sheet 2 of 6)



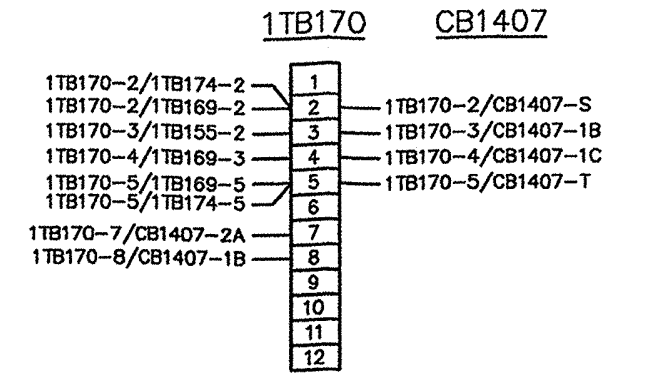
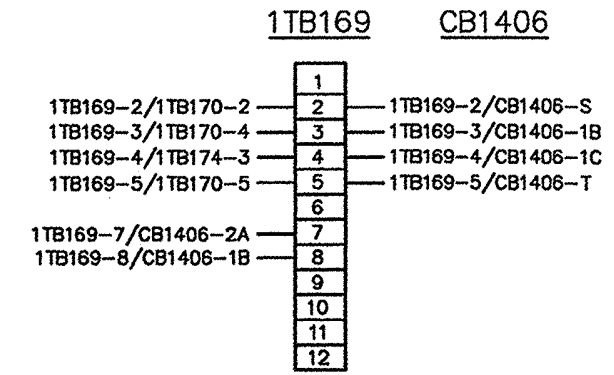
**INSIDE VIEW
PANEL "A" UNIT-1**



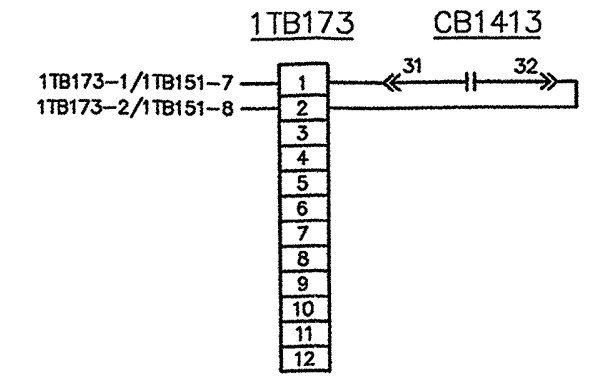
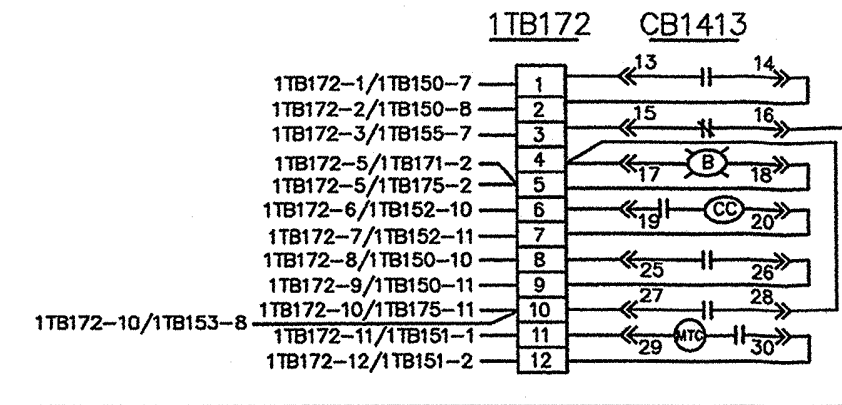
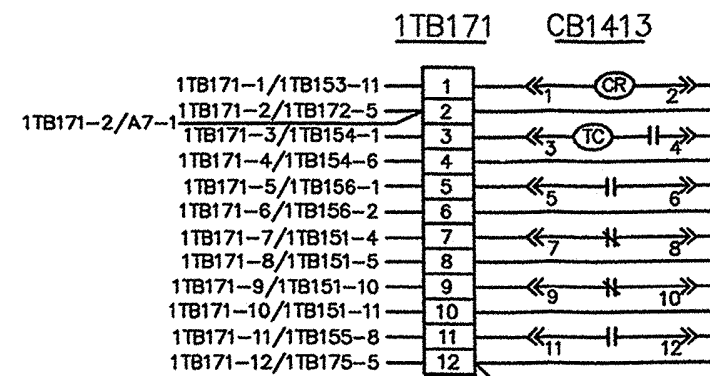
**REAR, LEFT SIDE VIEW
PANEL-"E" UNIT-1**

NOTE:
DDG 51 ONLY

Figure 9-4. ISC Switchboard; Wiring Diagram (Sheet 3 of 6)



**INSIDE VIEW
PANEL "A" UNIT-1**



**REAR, LEFT SIDE VIEW
PANEL-"E" UNIT-1**

NOTE:
DDG 52-54 ONLY

Figure 9-4. ISC Switchboard; Wiring Diagram (Sheet 3 of 6)

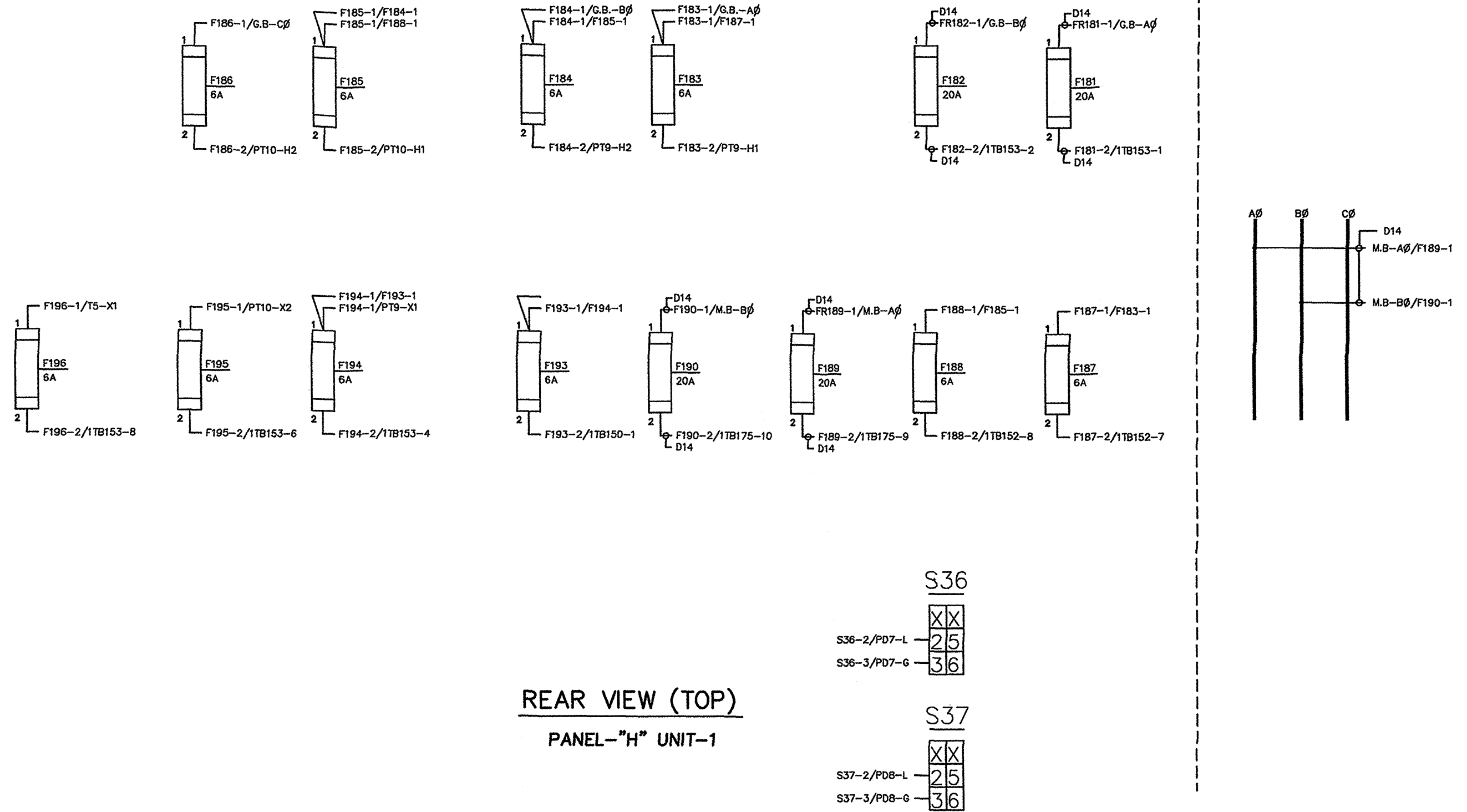
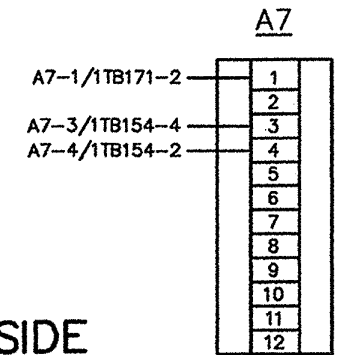
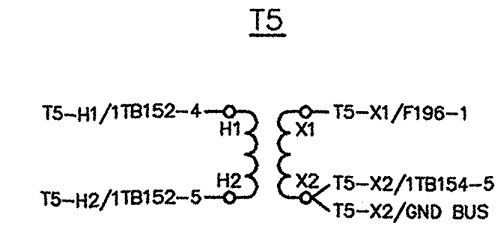
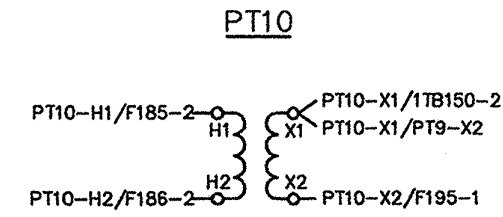
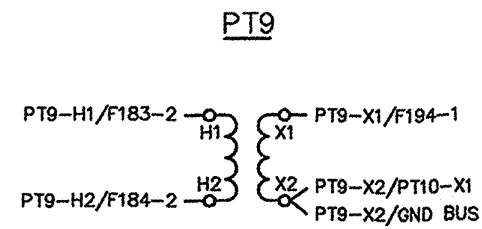
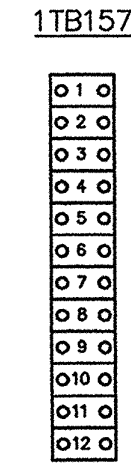
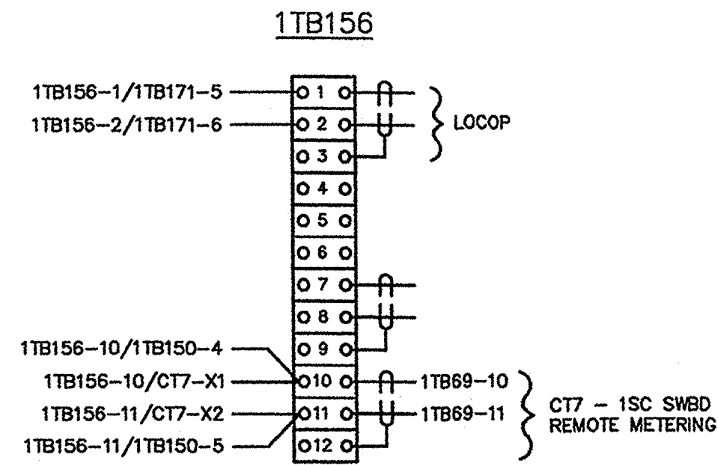


Figure 9-4. ISC Switchboard; Wiring Diagram (Sheet 4 of 6)

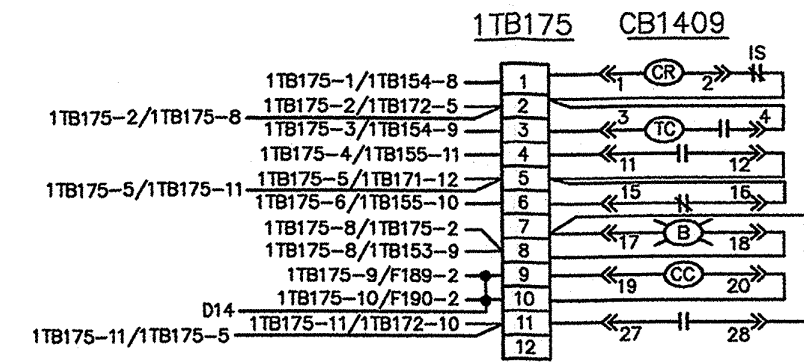


FRONT, RIGHT SIDE
PANEL-"M" UNIT-2

FRONT, LEFT SIDE
PANEL-"K" UNIT-2

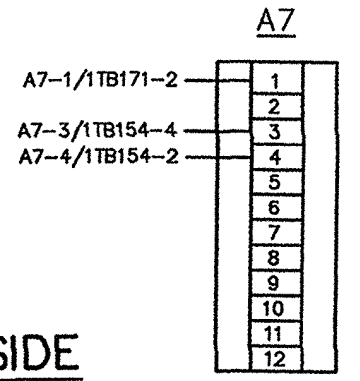
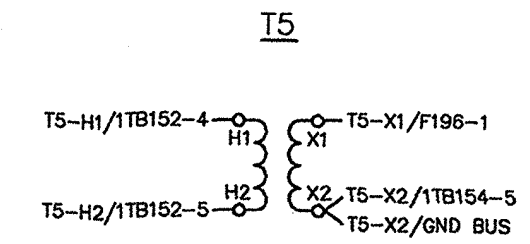
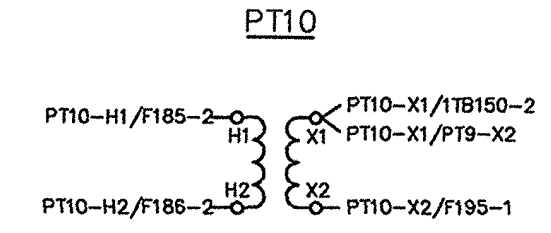
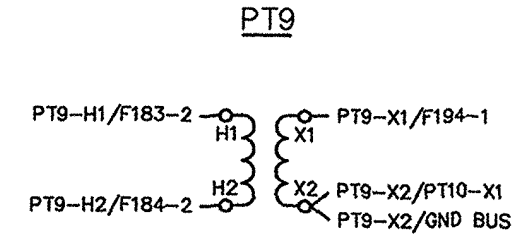


REAR RIGHT SIDE
PANEL-"R" UNIT-2



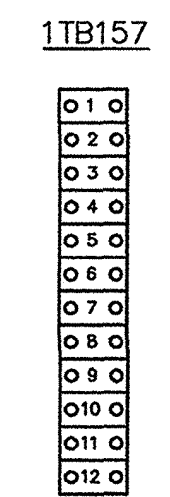
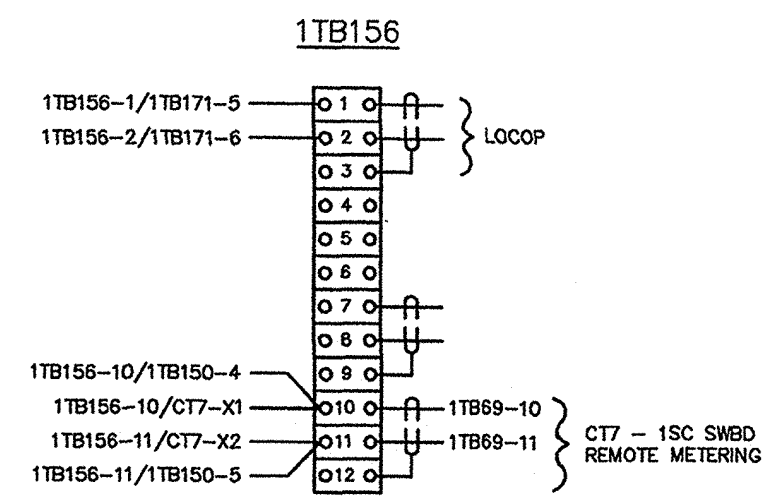
NOTE:
DDG 51 ONLY

Figure 9-4. 1SC Switchboard; Wiring Diagram (Sheet 5 of 6)

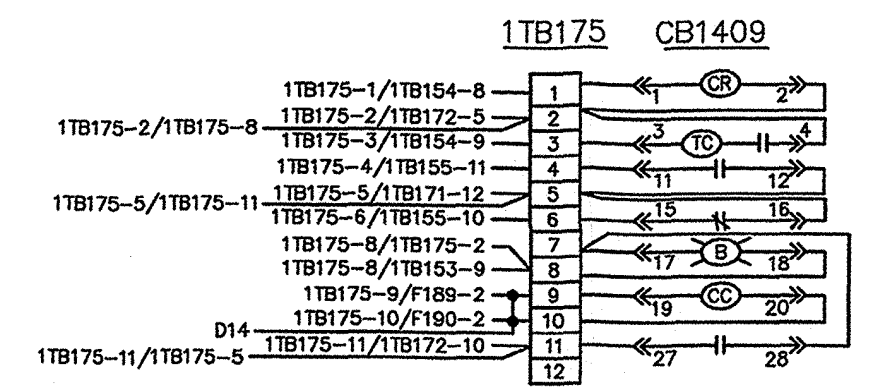


FRONT, RIGHT SIDE
PANEL-"M" UNIT-2

FRONT, LEFT SIDE
PANEL-"K" UNIT-2

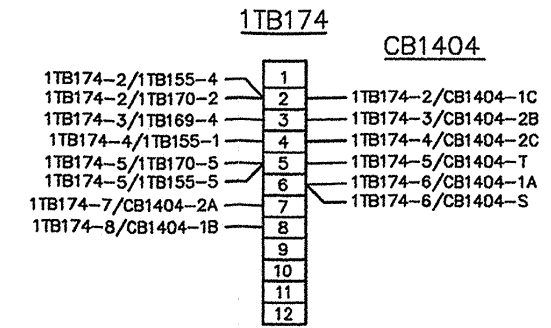
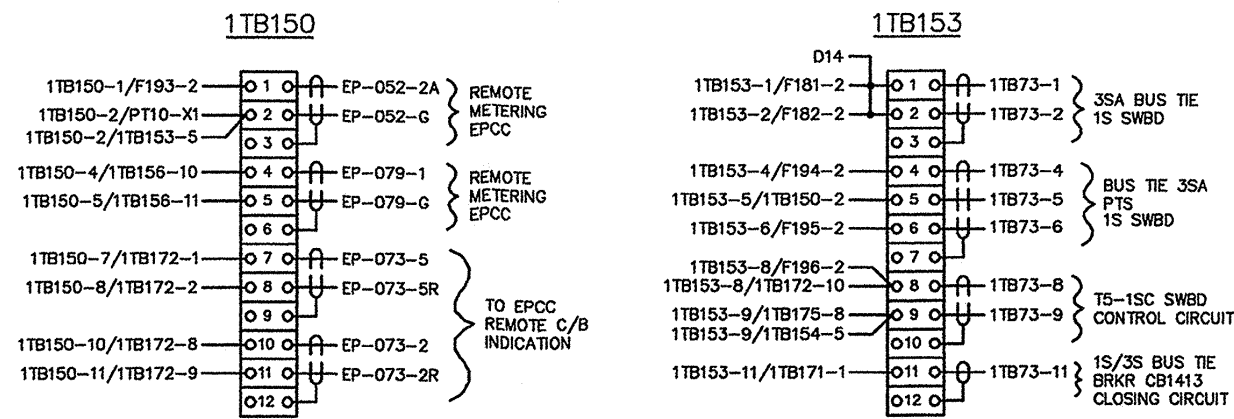


REAR RIGHT SIDE
PANEL-"R" UNIT-2

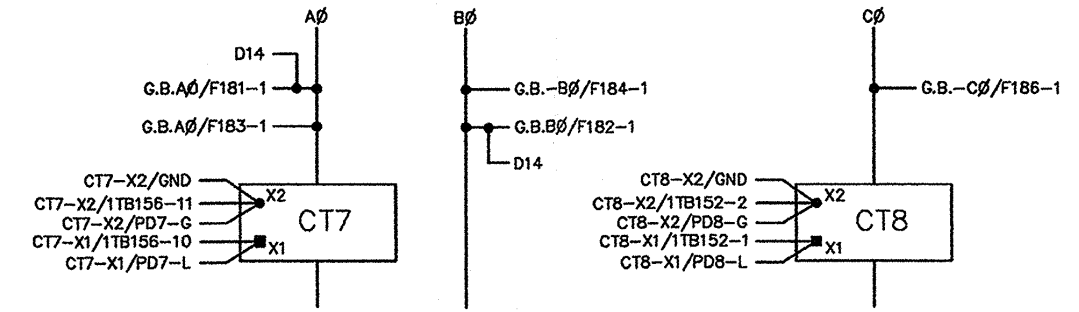
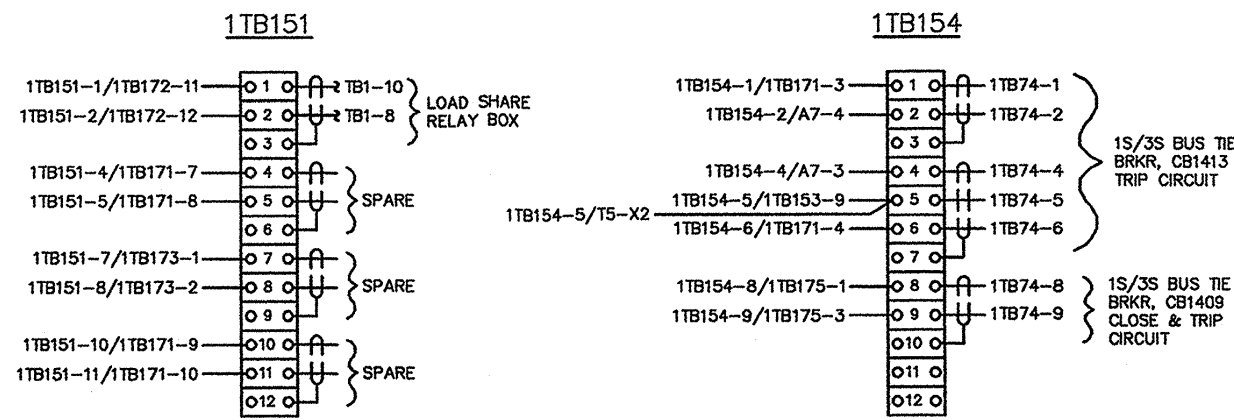


NOTE:
DDG 52-54 ONLY

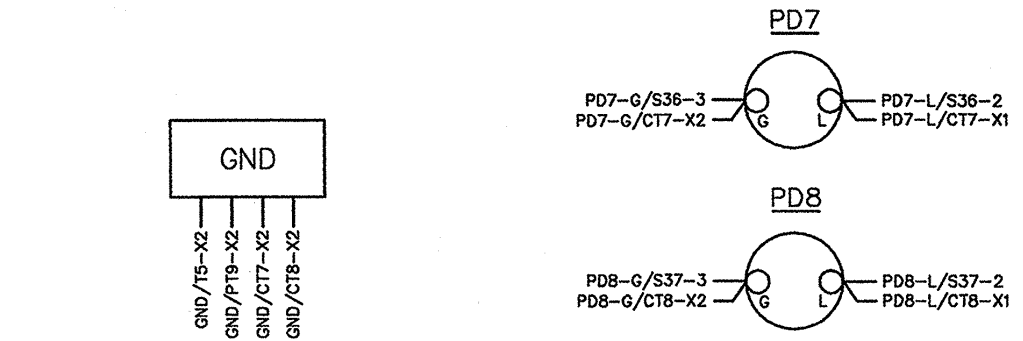
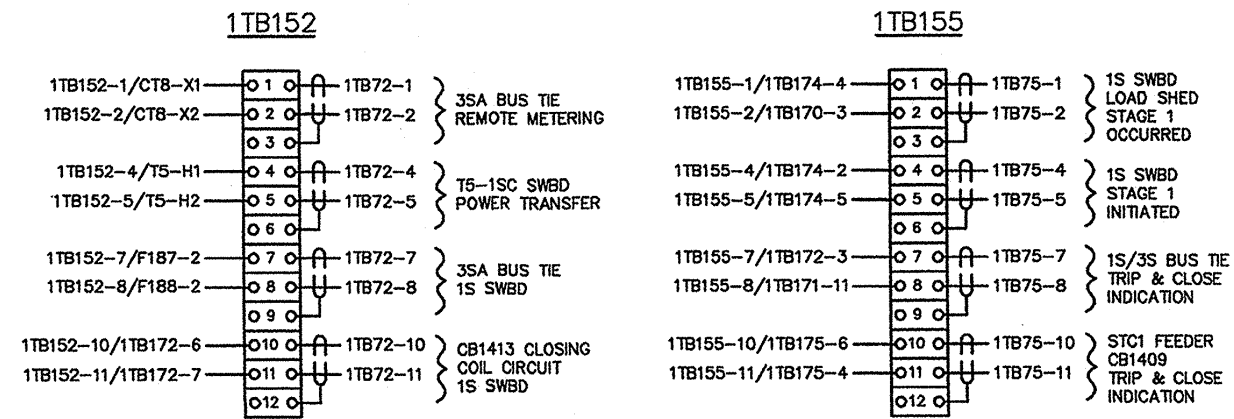
Figure 9-4. 1SC Switchboard; Wiring Diagram (Sheet 5 of 6)



REAR VIEW
PANEL "J" UNIT-2



REAR VIEW
PANEL "F" UNIT-1

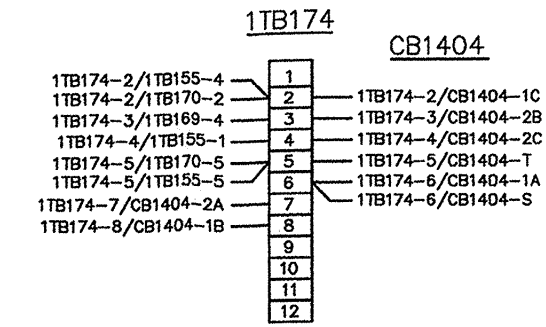
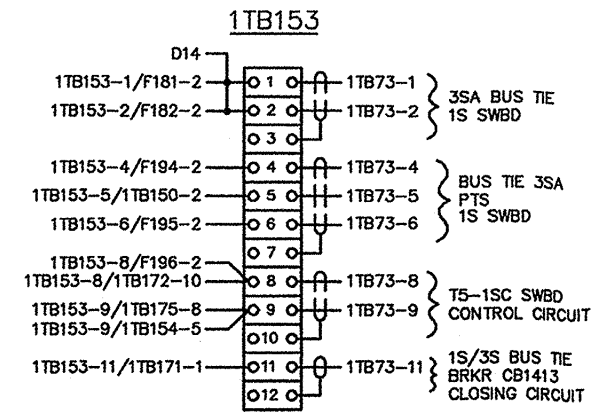
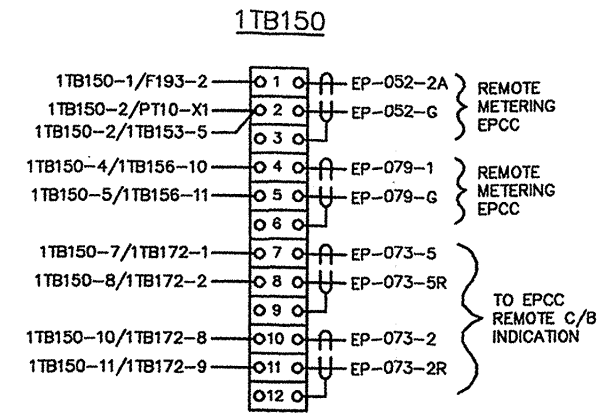


REAR VIEW LEFT HAND SIDE
PANEL "E" UNIT-1

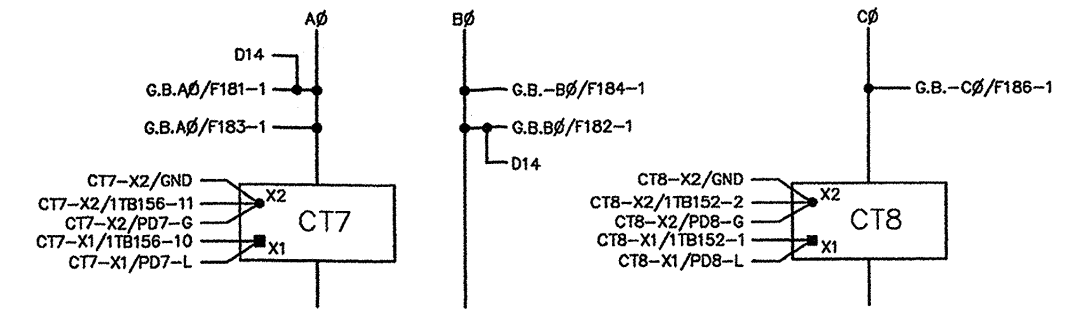
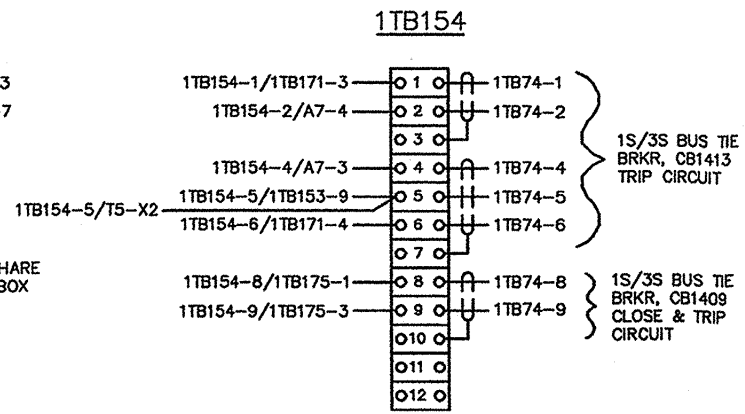
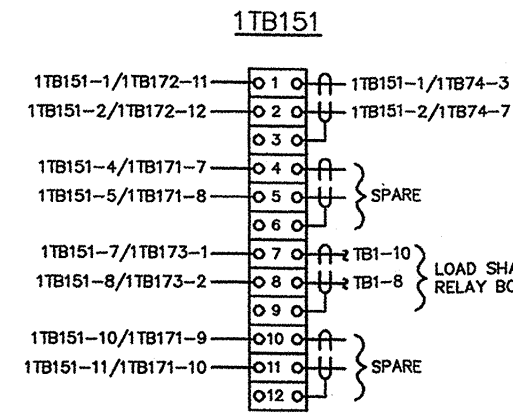
REAR VIEW LEFT HAND SIDE
PANEL-"N" UNIT-2

NOTE:
DDG 51 ONLY

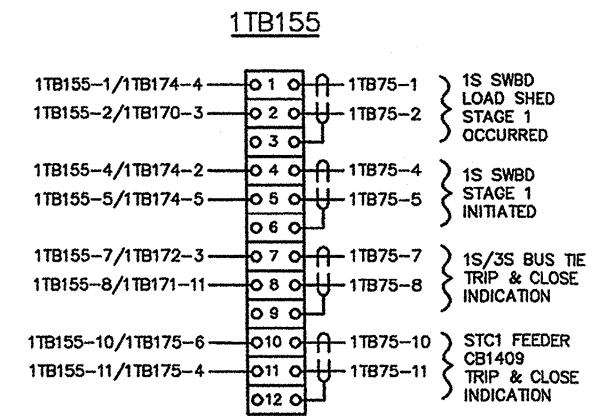
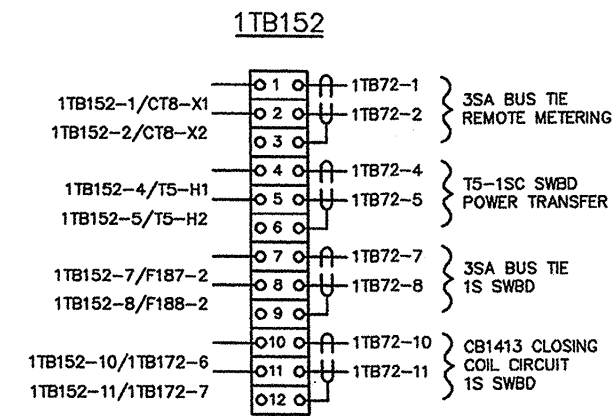
Figure 9-4. 1SC Switchboard; Wiring Diagram (Sheet 6 of 6)



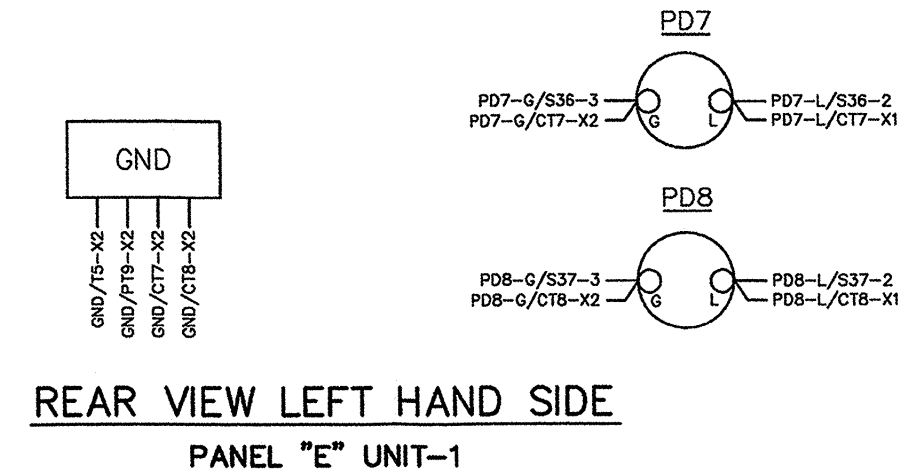
REAR VIEW
PANEL "J" UNIT-2



REAR VIEW
PANEL "F" UNIT-1



REAR VIEW LEFT HAND SIDE
PANEL-"N" UNIT-2



NOTE:
DDG 52-54 ONLY

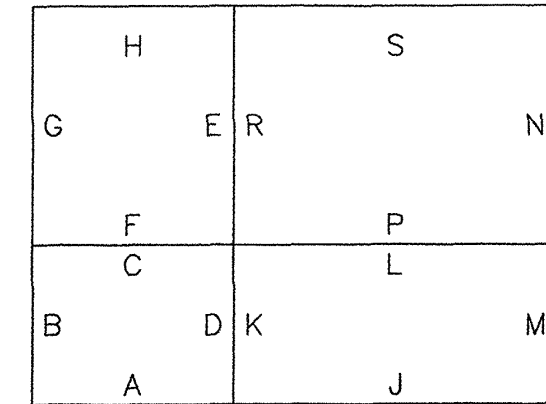
Figure 9-4. 1SC Switchboard; Wiring Diagram (Sheet 6 of 6)

PANEL A1 SHEET-3	PANEL B1 SHEET-5	PANEL C1 SHEET-7&8	PANEL D SHEET-9&10 (DDG 51) SHEET-9A&10 (DDG 52-54)	PANEL E SHEET-11	PANEL F SHEET-12 (DDG 51) SHEET-12A (DDG 52-54)	PANEL G SHEET-13	PANEL H SHEET-14 (DDG 51) SHEET-14A (DDG 52-54)
PANEL A2 SHEET-4	PANEL B2 SHEET-6	PANEL C2 SHEET-17					

UNIT-1

PANEL J	PANEL K SHEET-15 (DDG 51-54) SHEET-16A (DDG 52-54)	PANEL L SHEET-16&19 (DDG 51) SHEET-16A&19A (DDG 52-54) SHEET-19B TRAINING SITE	PANEL M SHEET-18 (DDG 51) SHEET-18A (DDG 52-54)	PANEL N	PANEL P	PANEL R SHEET-19 (DDG 51) SHEET-19A (DDG 52-54) SHEET-19B TRAINING SITE	PANEL S1 SHEET-14 (DDG 51) SHEET-14A (DDG 52-54)
PANEL J2 SHEET-19 (DDG 51) SHEET-19A (DDG 52-54) SHEET-19B TRAINING SITE							PANEL S2 SHEET-19 (DDG 51) SHEET-19A (DDG 52-54) SHEET-19B TRAINING SITE

UNIT-2



UNIT-1 UNIT-2

TOP VIEW-PANEL LOCATION
SWITCHBOARD "2S"

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 1 of 19)

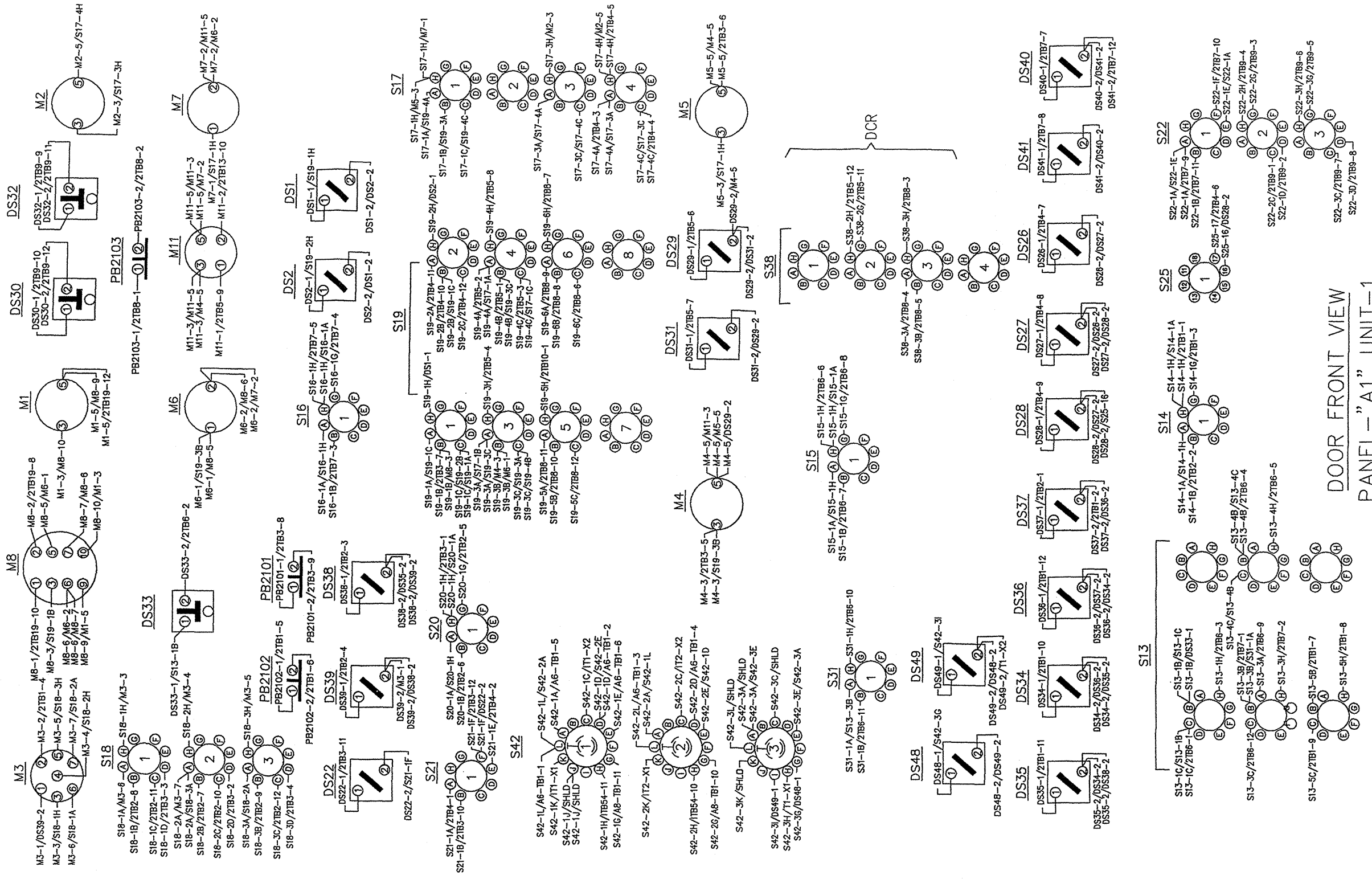
COMPONENT LOCATIONS

PANEL NO													
A1	M1-M8	M11	DS1-DS2	DS22	DS26-DS41	S13-S22	S25	S38	S31	PB2101-PB2103		DS48-DS49	S42
A2	DS4-DS9	DS23-DS25	DS42-DS43	S1-S3	S24	J1-J2							
B1	2TB1-2TB12												
B2	2TB13-2TB24												
C1	K2103-K2106	K2108-K2111	K2113	K2123	K2129-K2134	A1							
C2	K2102	A5	A8 *	A6 *	T2								
D	K2101	K2107	K2125	K2137	K2201-K2202	K2204-K2205	K2301-K2302	K2304-K2305					
E	2TB51-2TB62												
H	F201-F212	F229-F231	F234-F236	F250	2F1								
G	2TB75-2TB86												
J													
F	2TB63	2TB74											
K	S32-S37	PD1-PD4	A3b (DDG 52-54)										
L	PT1-PT6	IT1-IT2 *	T1	A2 *	A3a *	A3b(DDG 51)	GPM **	CB2101 — CB2103	CT1-CT4	GND			
J2	CB2120												
M	K2114	K2119	K2120	K2127-K2128	K2135-K2136								
S1	F213-F228	F233	F238-242										
S2	CT1-CT4												
R	2TB48-2TB49												

* REMOVED BY MACHALT 320-59006 (ECP-515)

** INSTALLED BY MACHALT 320-59006 (ECP-515)

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 2 of 19)



DOOR FRONT VIEW
 PANEL-"A1" UNIT-1

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 3 of 19)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

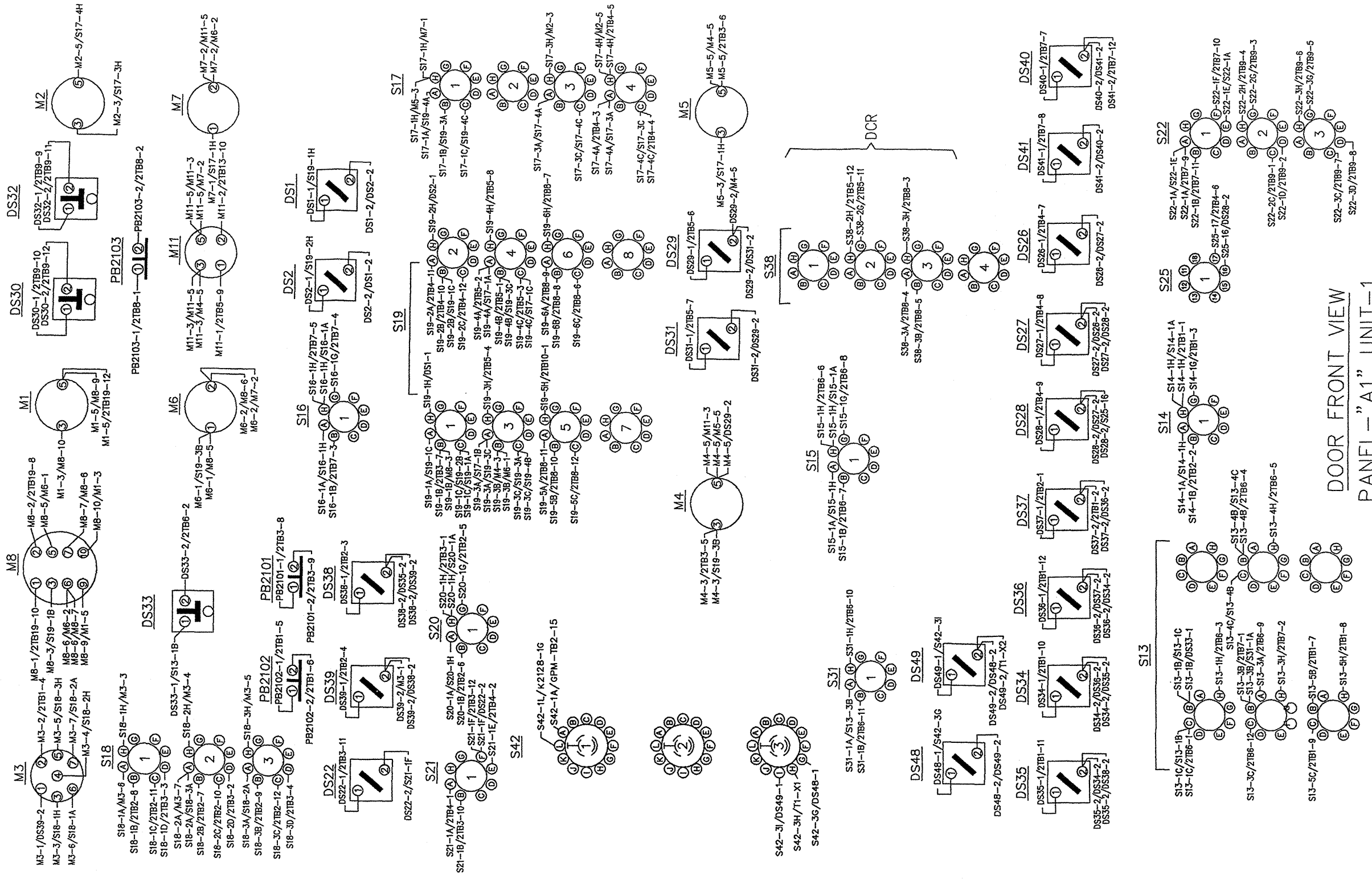
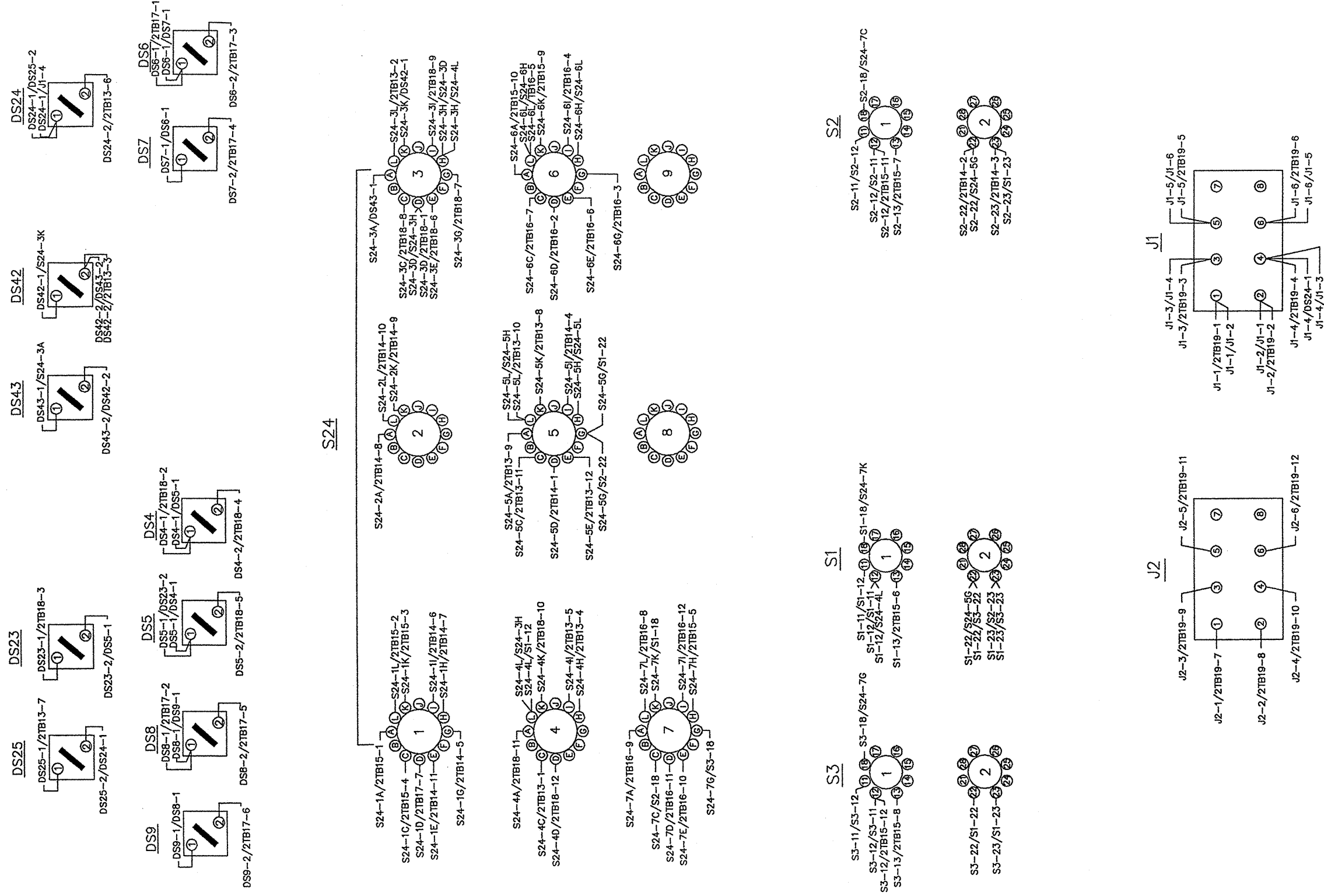
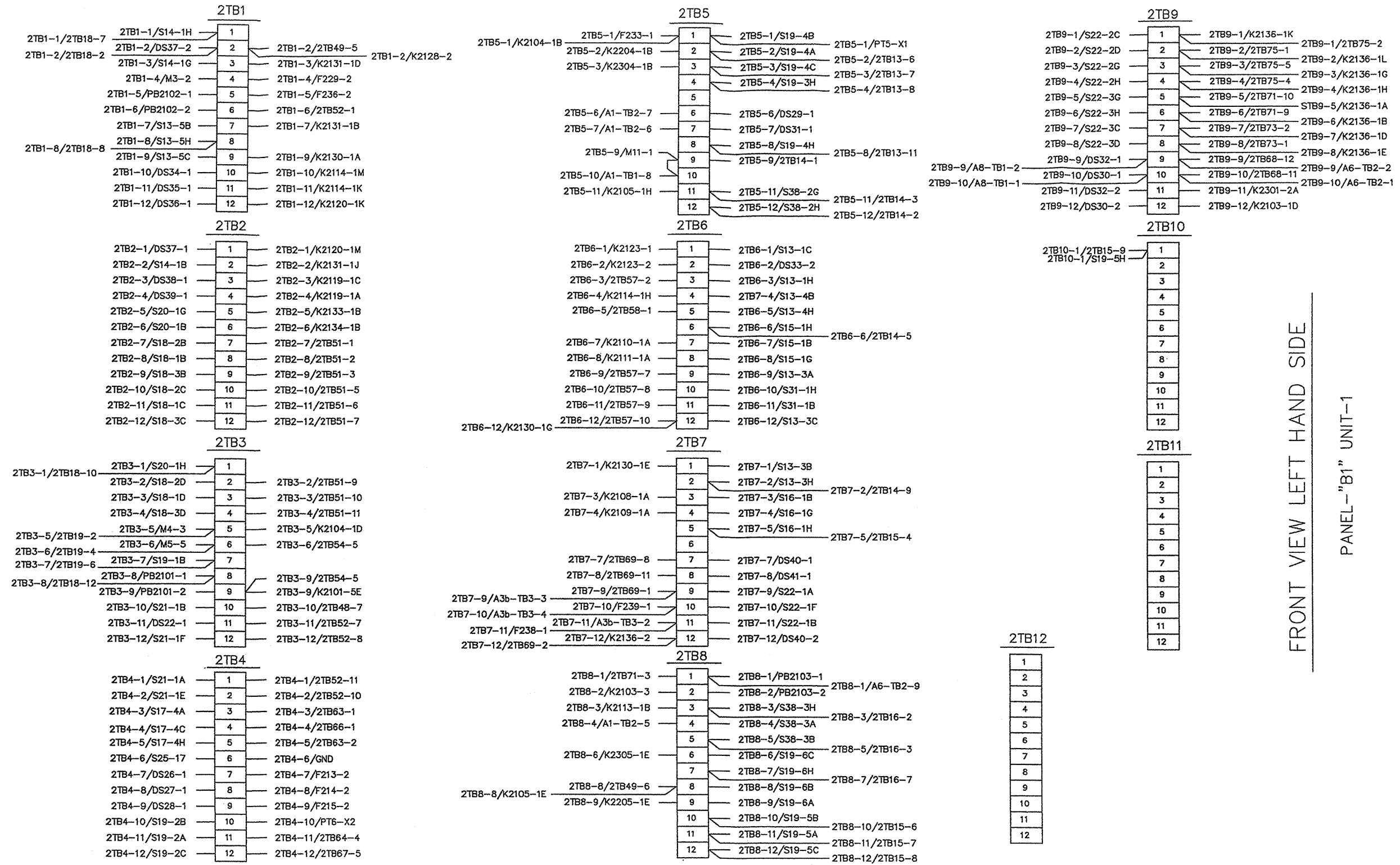


Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 3 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



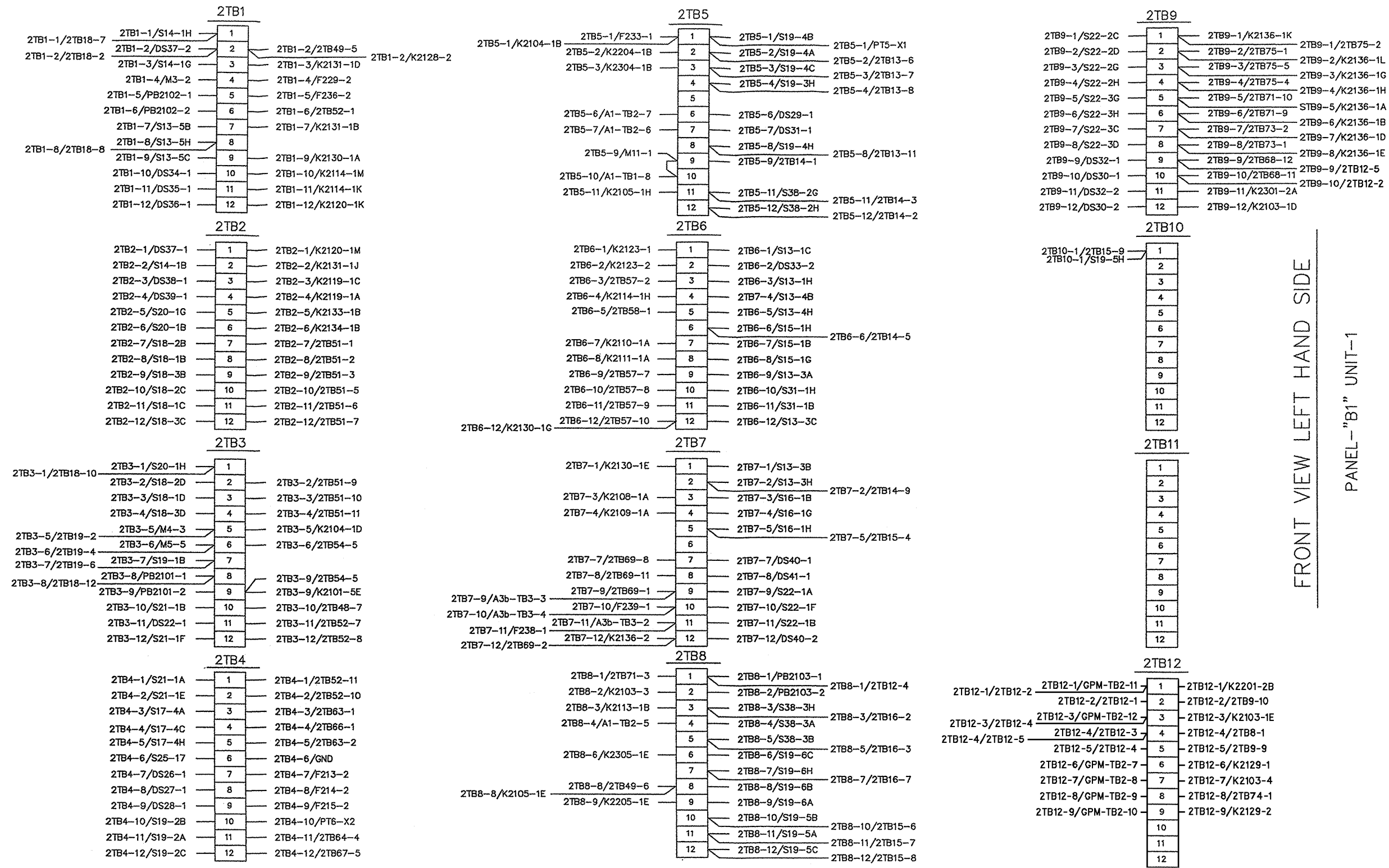
FRONT DOOR REAR VIEW (BOTTOM)
 PANEL—"A2" UNIT-1

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 4 of 19)



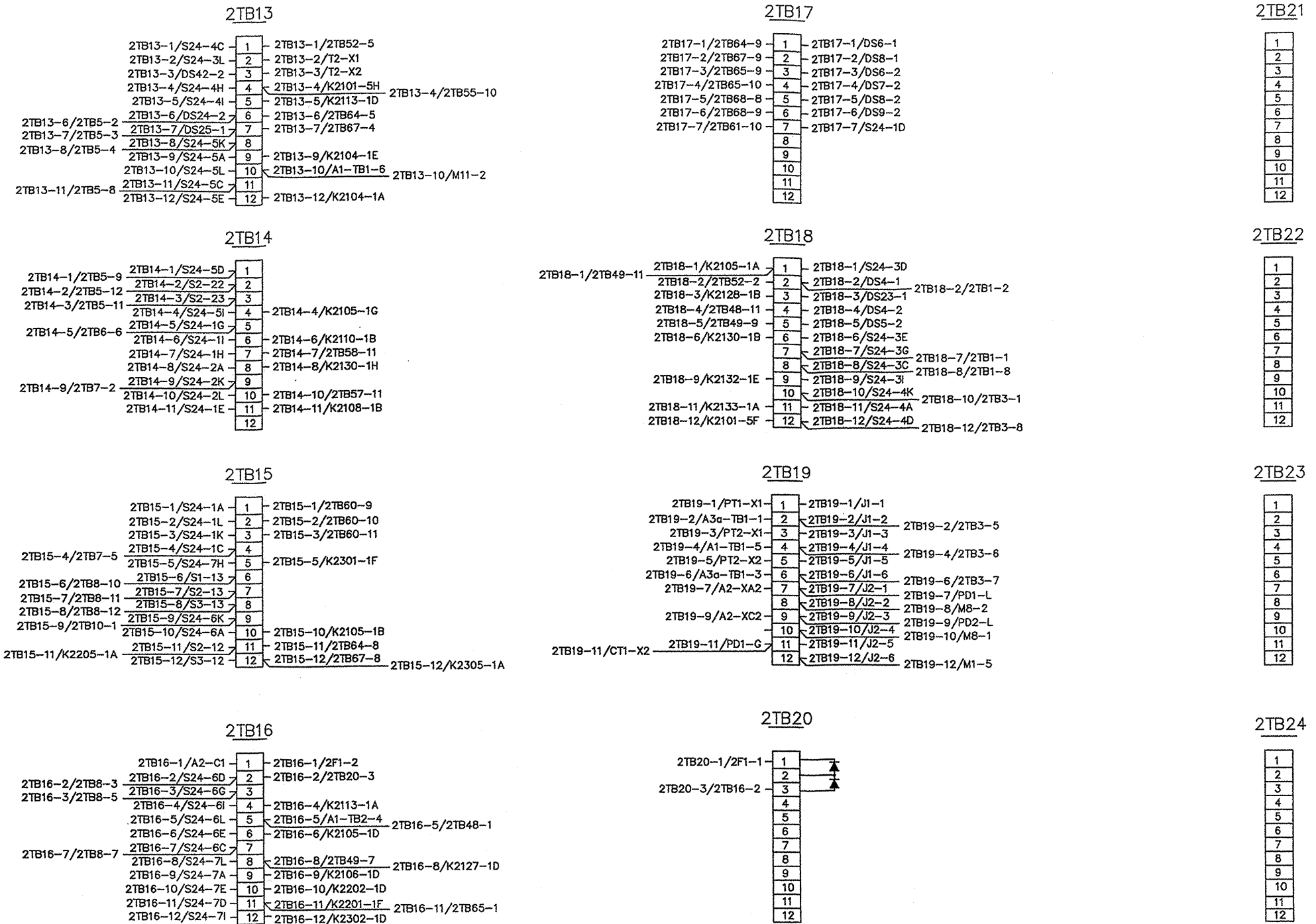
FRONT VIEW LEFT HAND SIDE
PANEL - "B1" UNIT-1

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 5 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE
PANEL - "B1" UNIT - 1

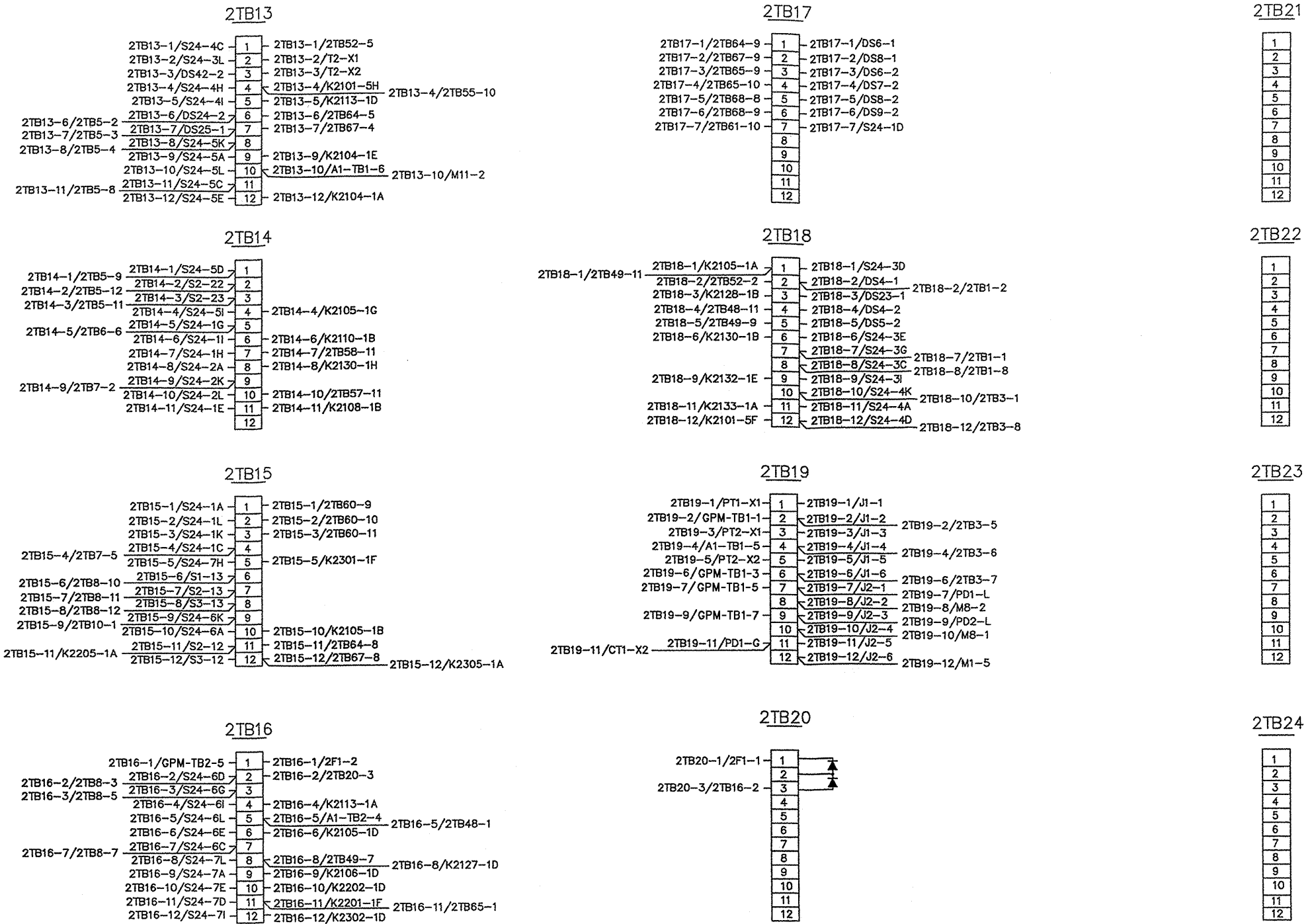
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 5 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE (BOTTOM)
PANEL-"B2 UNIT-1"

NOTE:
DDG 51 ONLY

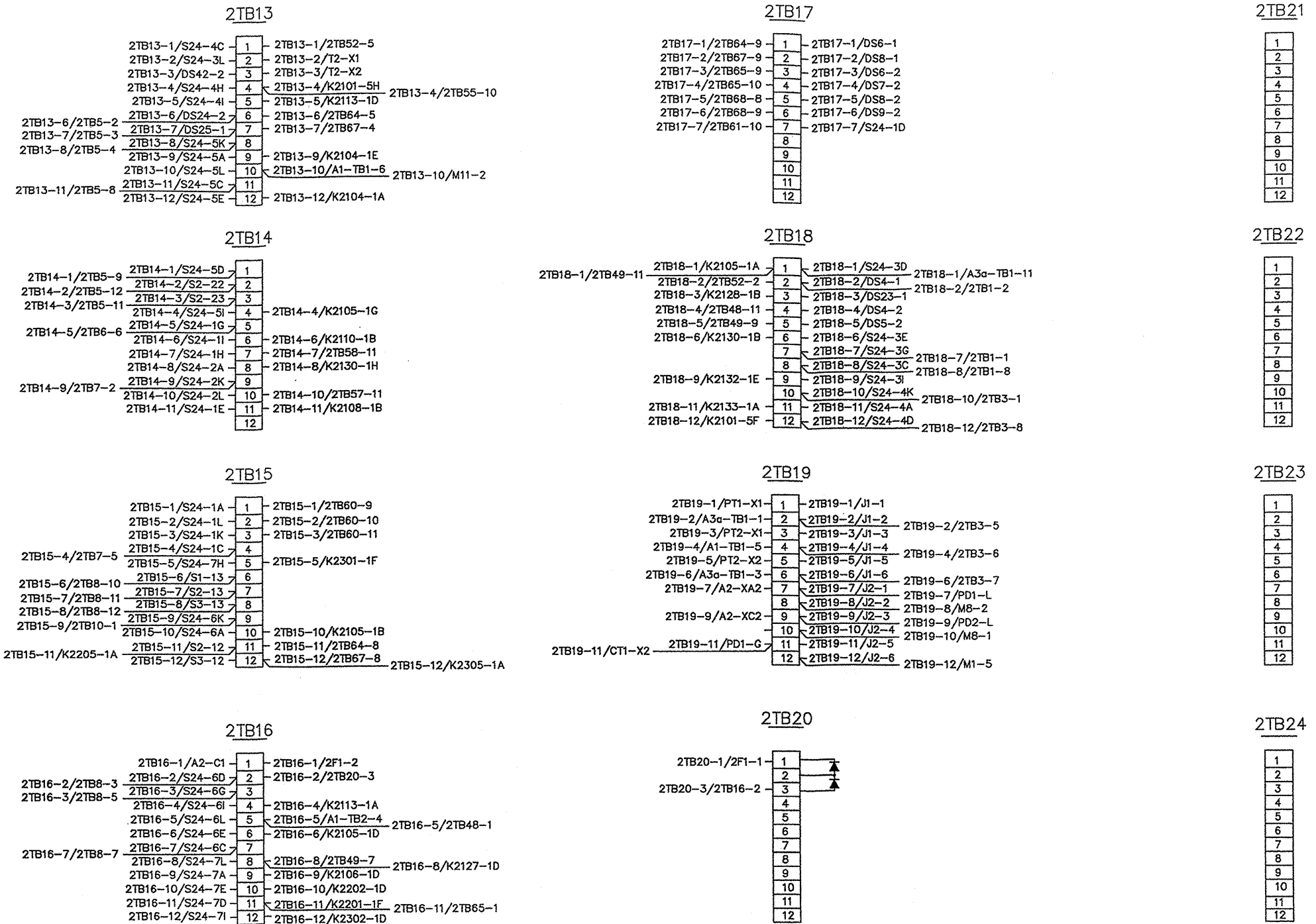
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 6 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE (BOTTOM)
PANEL-"B2 UNIT-1"

NOTE:
DDG 51 ONLY

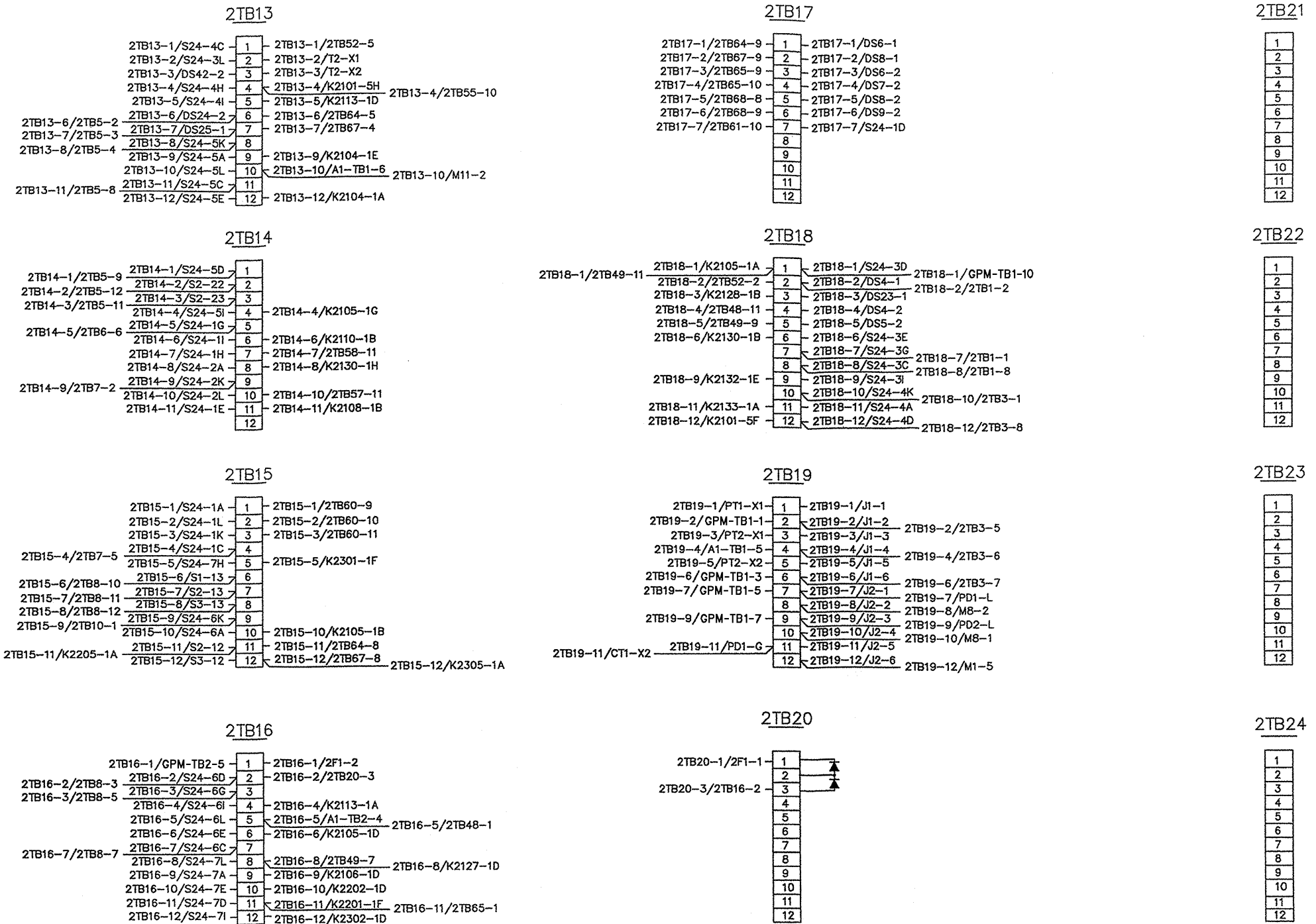
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 6 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE (BOTTOM)
PANEL-"B2 UNIT-1"

NOTE:
DDG 52-54 ONLY

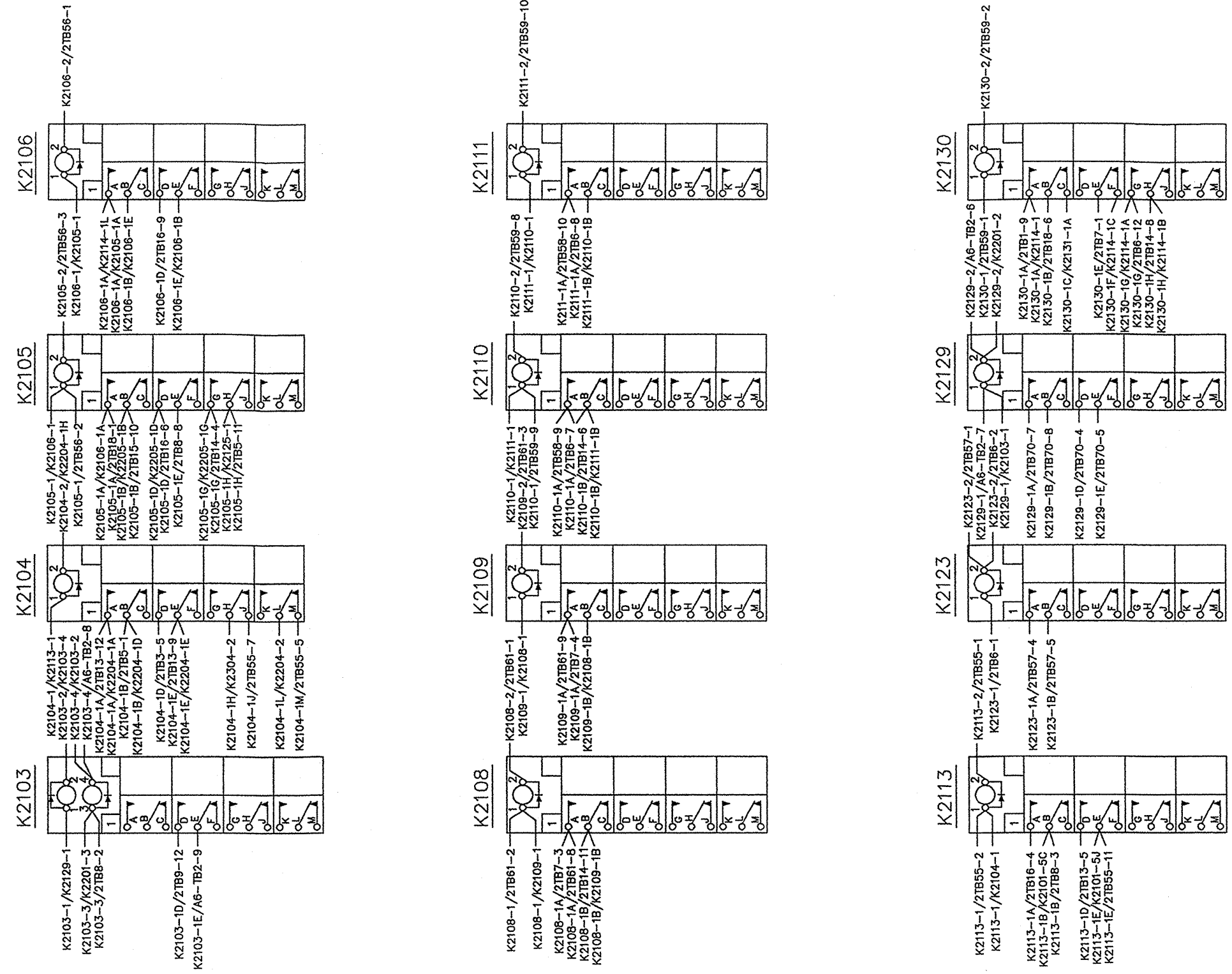
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 6 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE (BOTTOM)
 PANEL-"B2 UNIT-1"

NOTE:
 DDG 52-54 ONLY

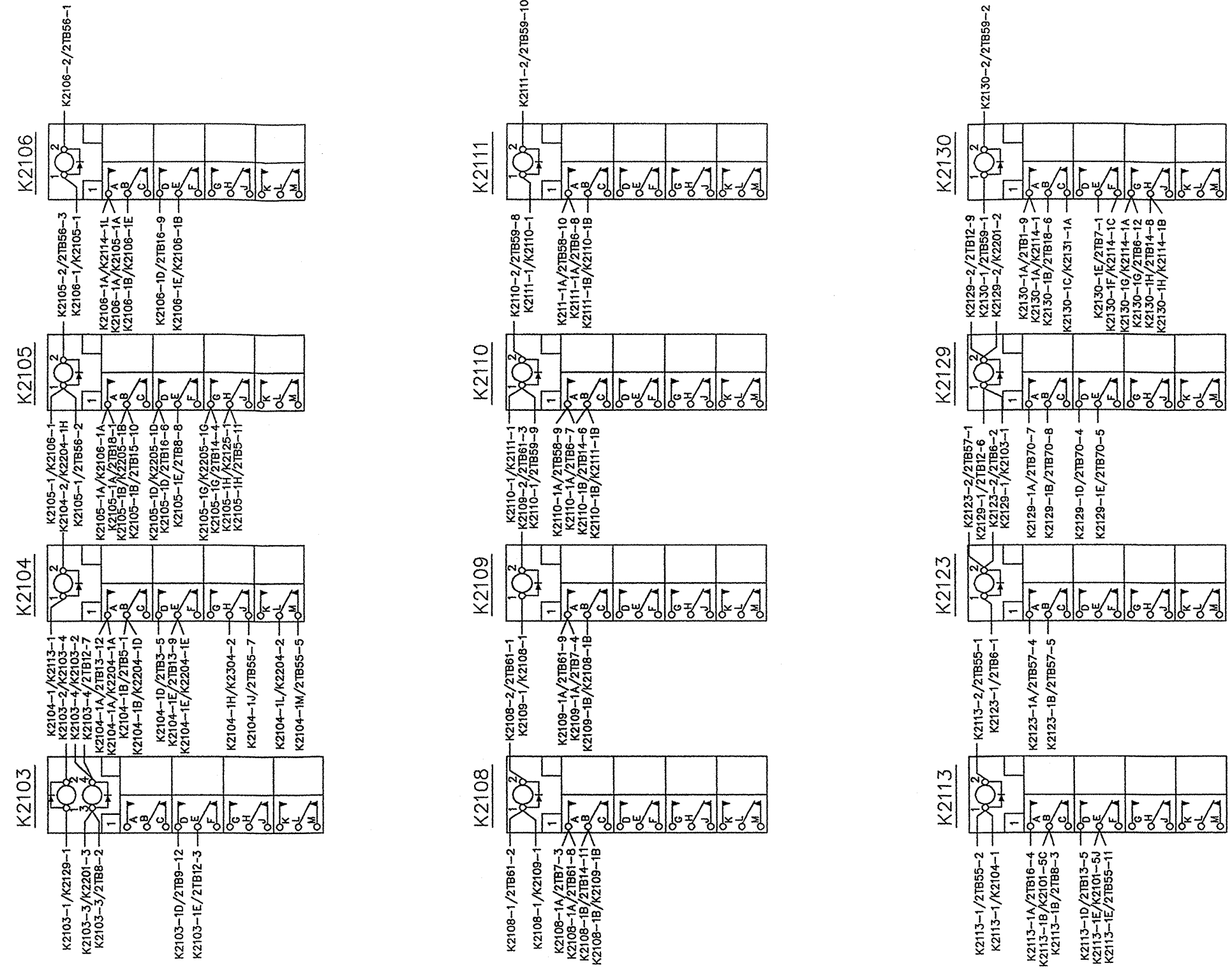
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 6 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



RELAY FRONT VIEW (TOP)

PANEL-"C1" UNIT-1

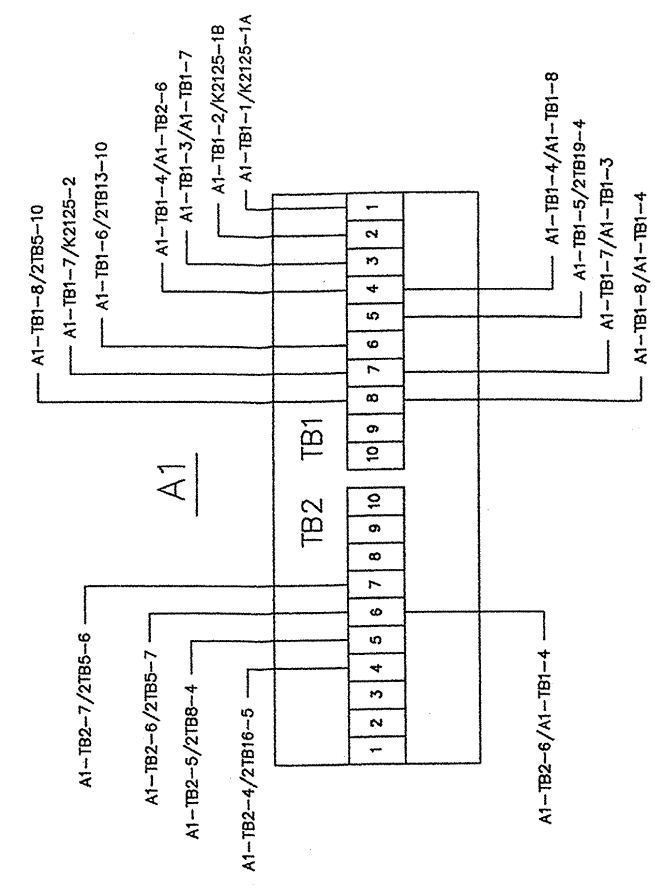
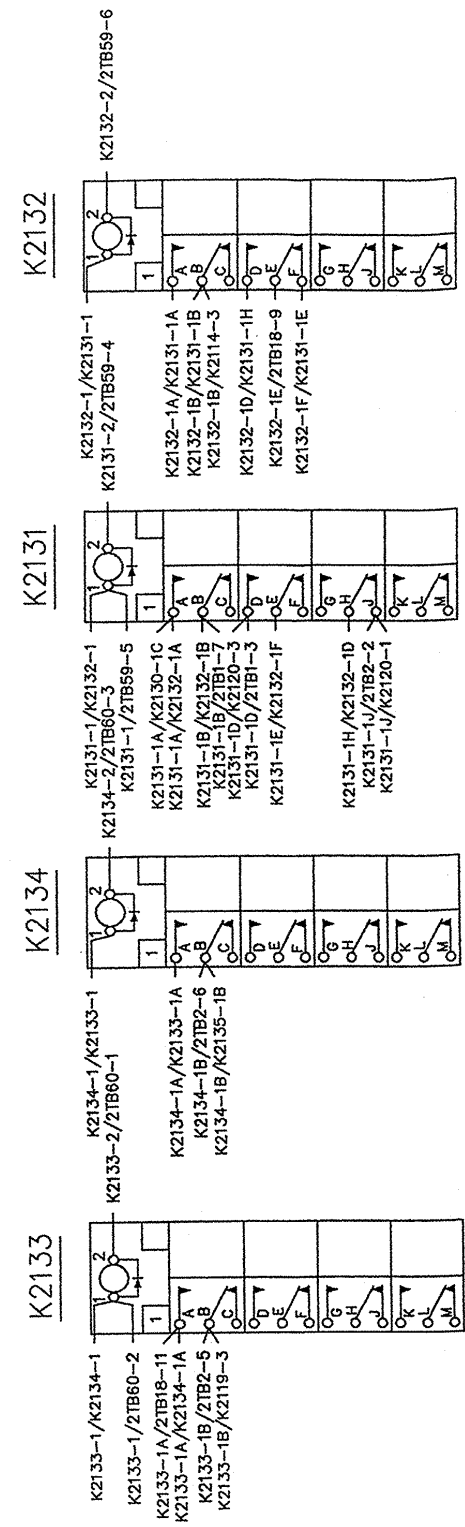
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 7 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



RELAY FRONT VIEW (TOP)

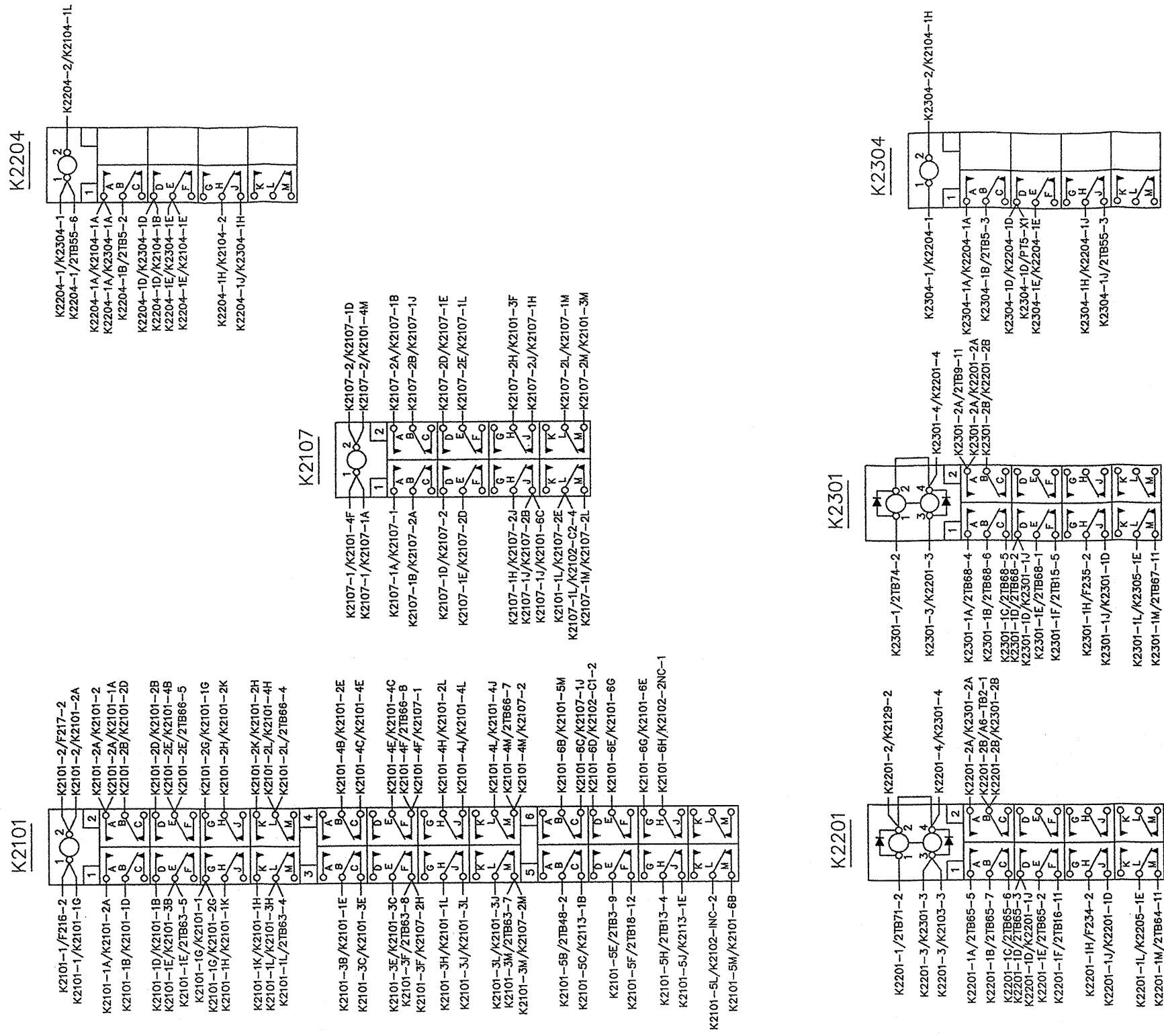
PANEL-"C1" UNIT-1

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 7 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



RELAY FRONT VIEW (TOP)
 PANEL-"C1" UNIT-1

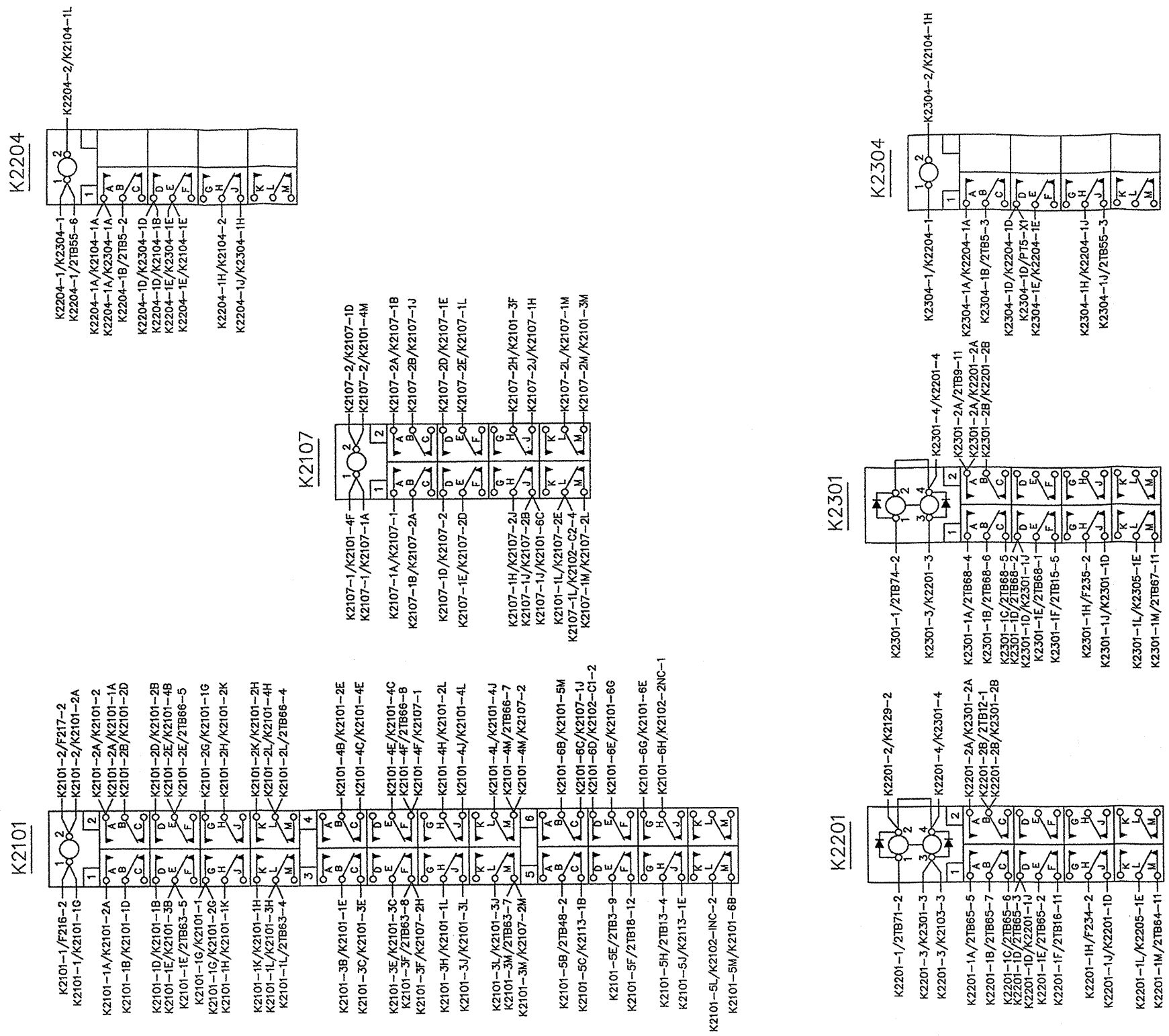
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 8 of 19)



FRONT VIEW RIGHT HAND SIDE
PANEL-"D" UNIT-1

NOTE:
DDG 51 ONLY

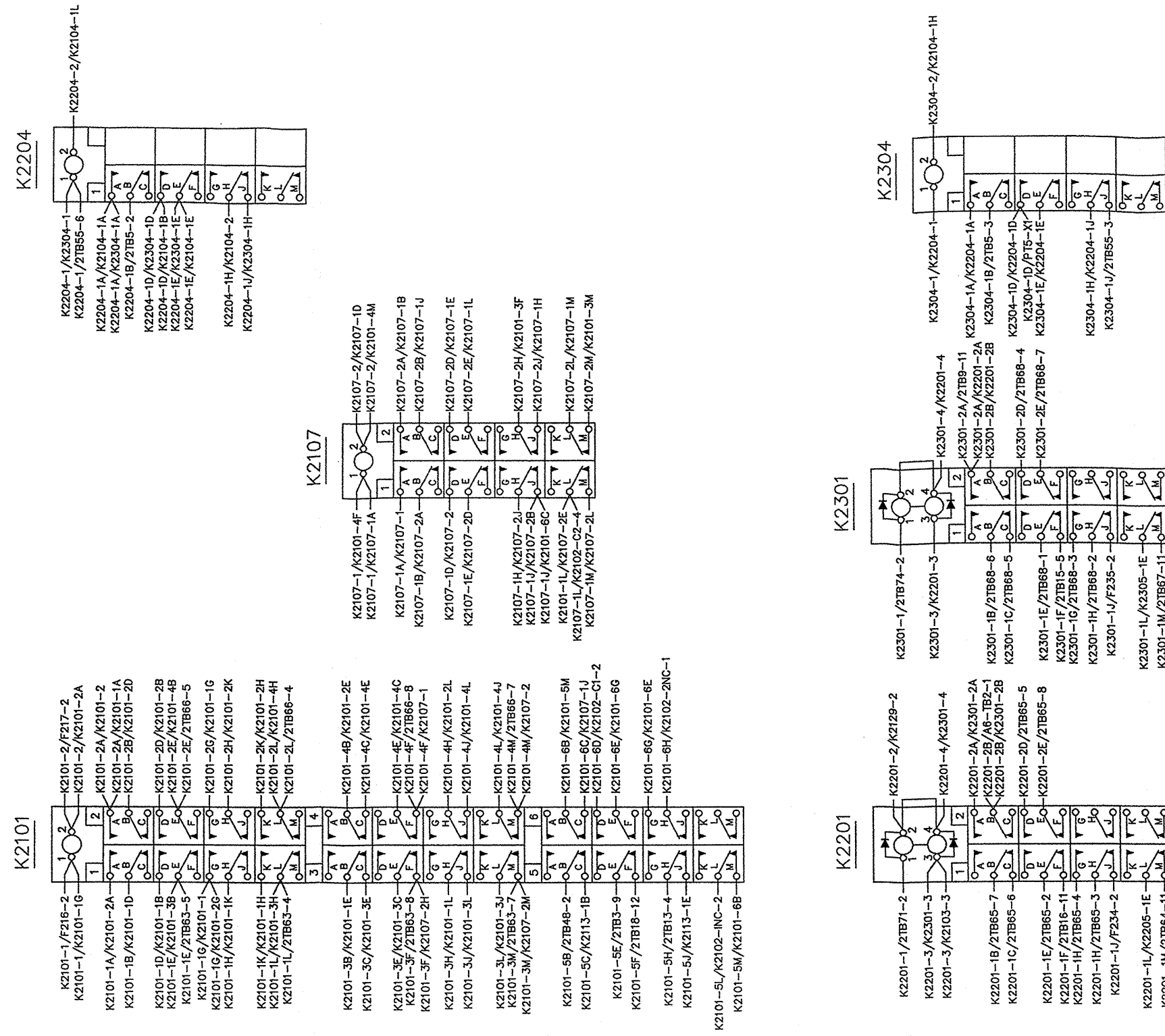
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 9 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW RIGHT HAND SIDE
PANEL-"D" UNIT-1

NOTE:
DDG 51 ONLY

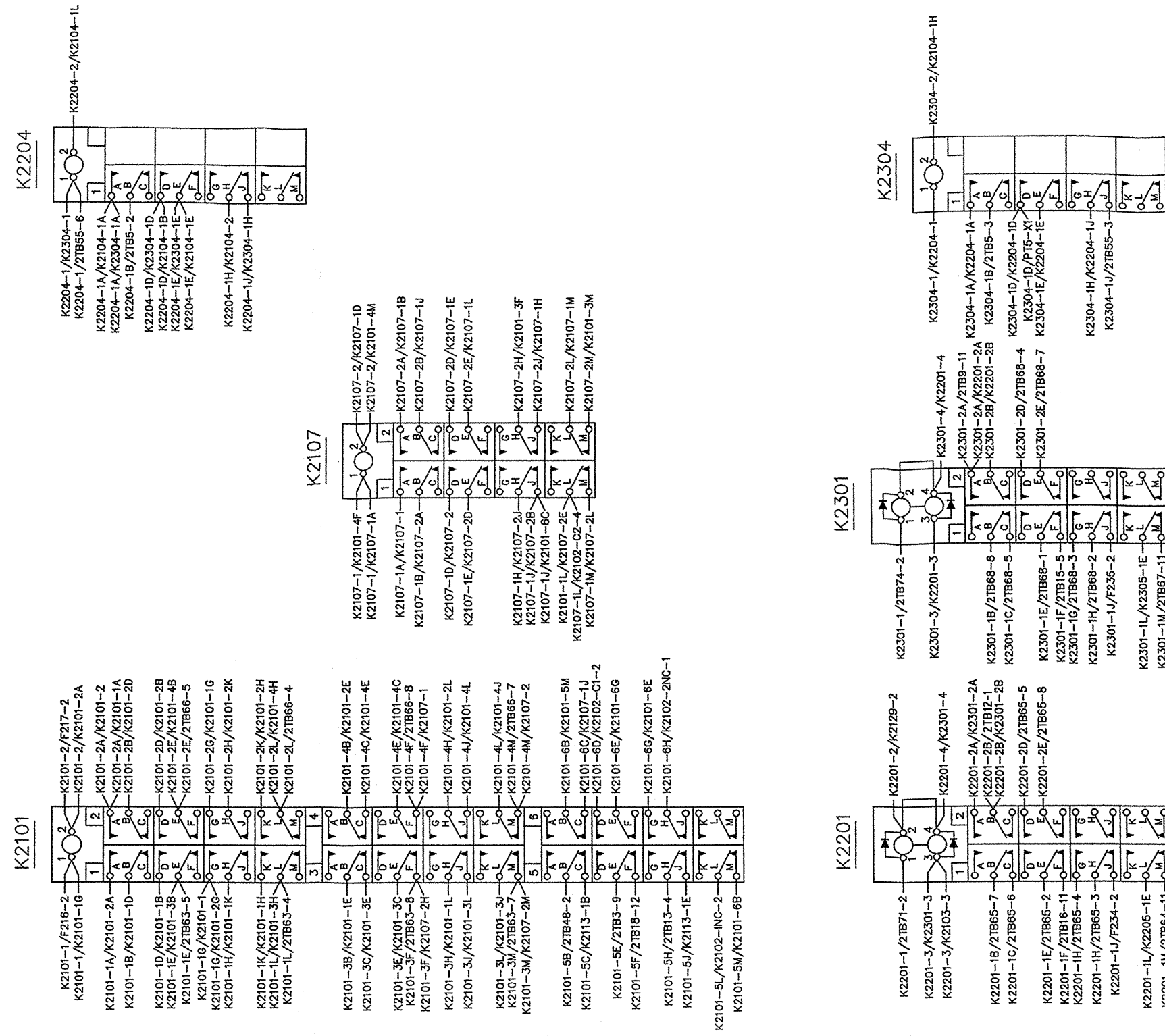
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 9 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 52-54 ONLY

FRONT VIEW RIGHT HAND SIDE
PANEL - "D" UNIT - 1

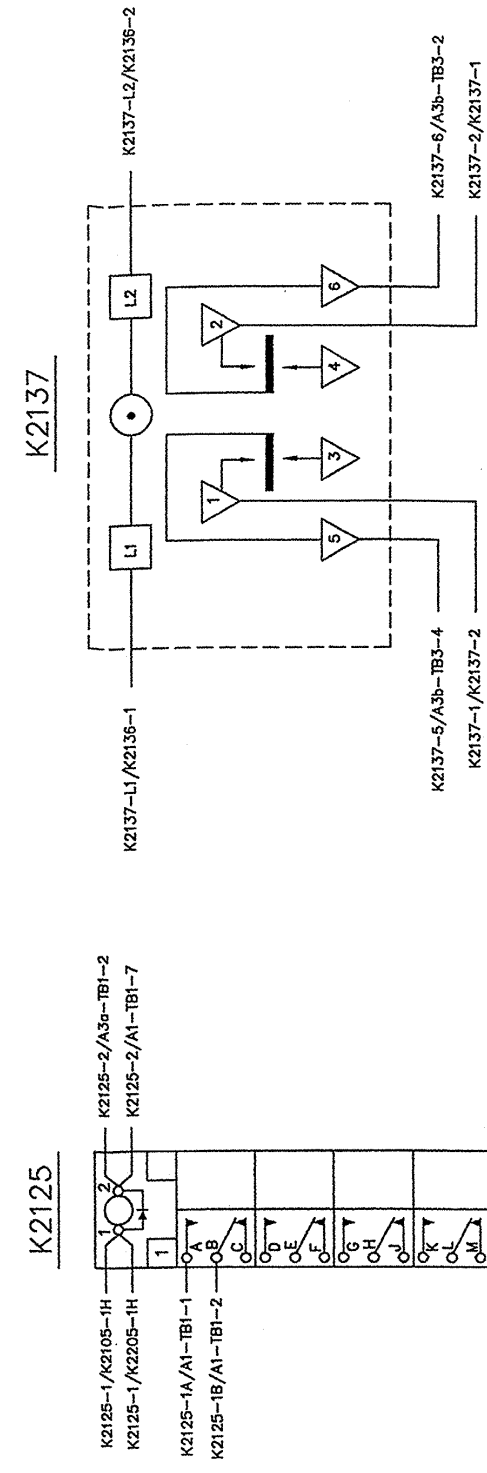
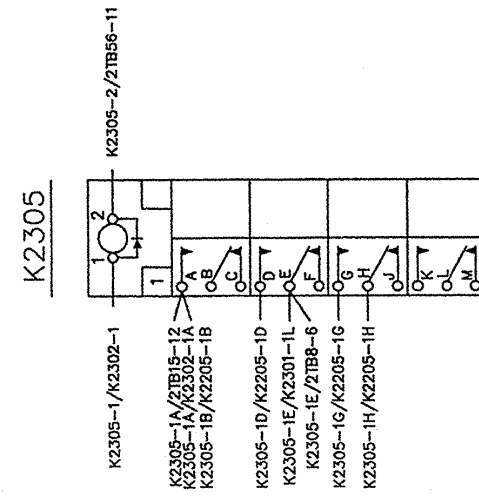
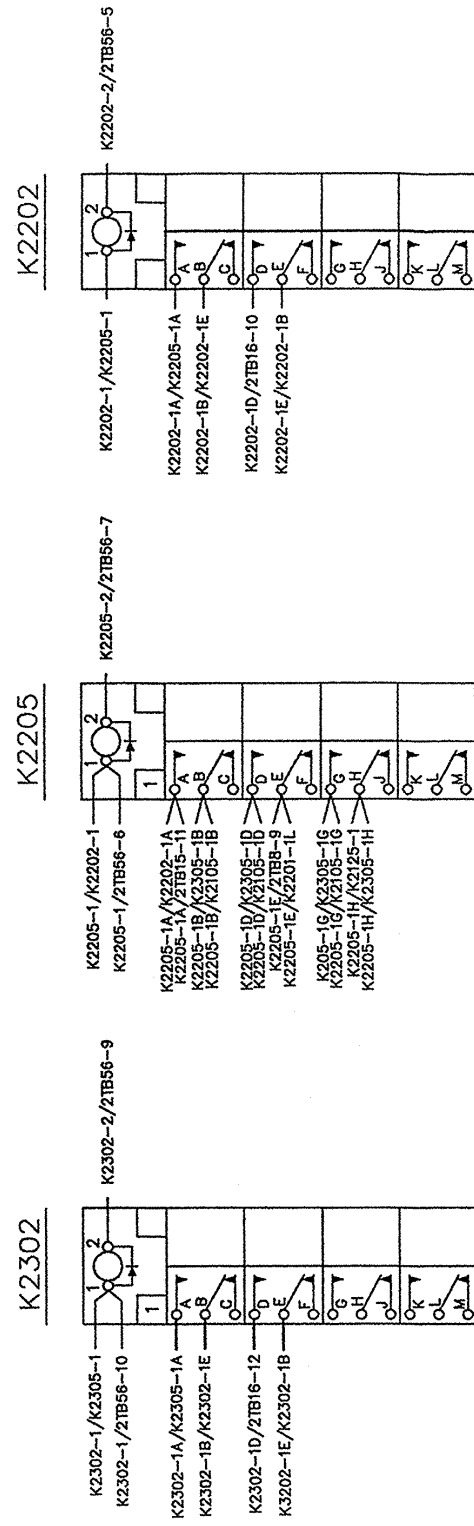
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 9 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 52-54 ONLY

FRONT VIEW RIGHT HAND SIDE
PANEL - "D" UNIT - 1

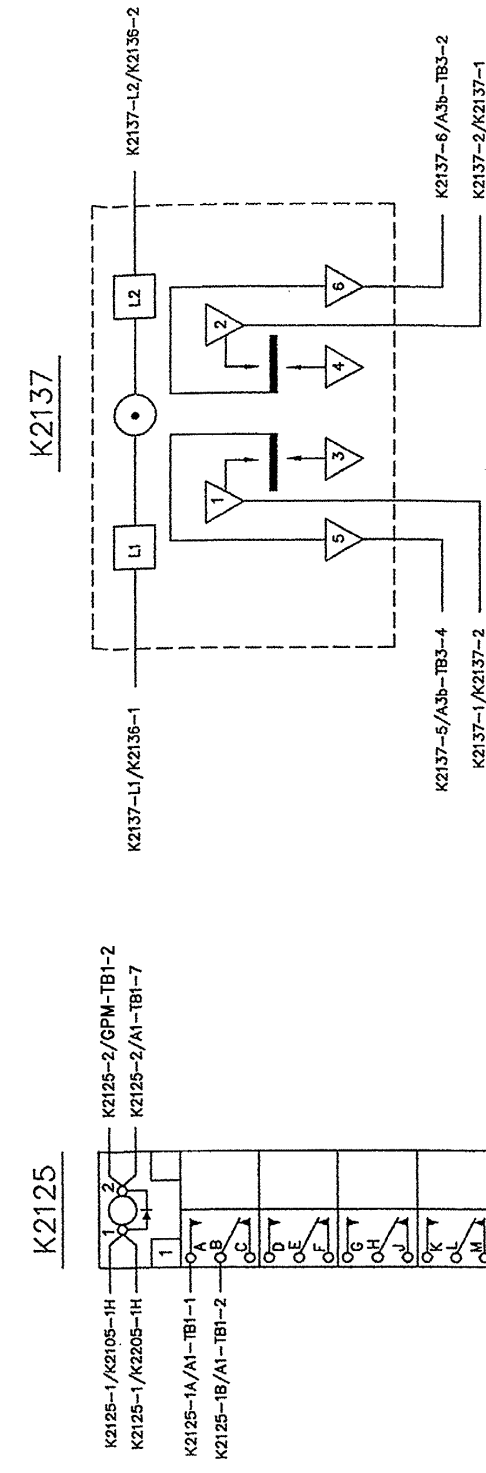
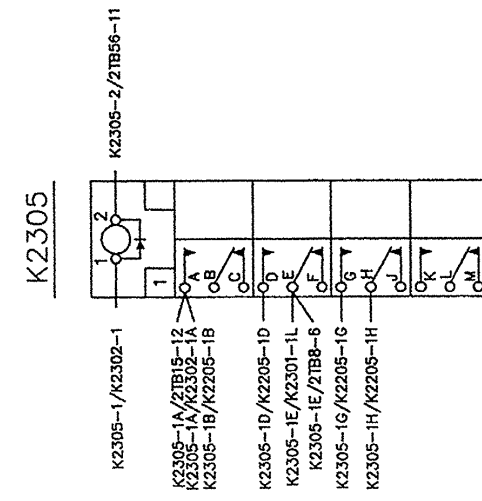
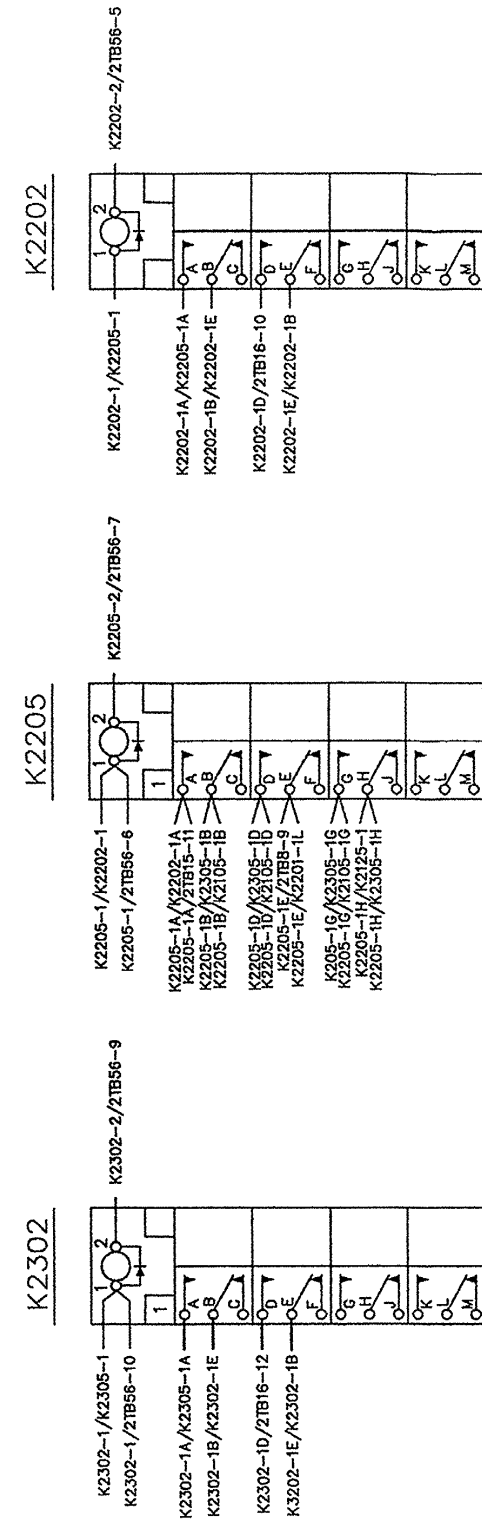
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 9 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW RIGHT HAND SIDE (TOP)

PANEL - "D" UNIT-1

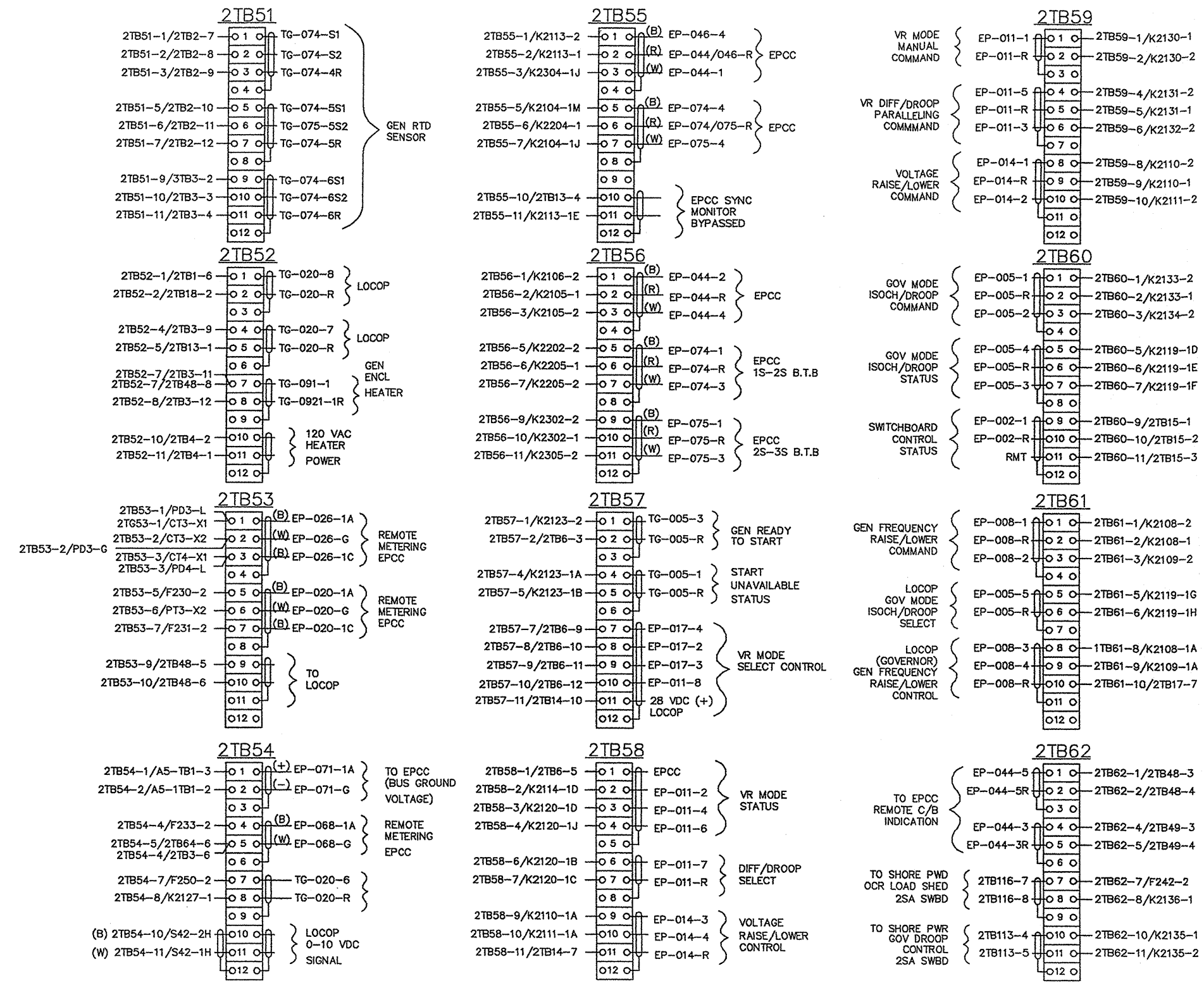
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 10 of 19) (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW RIGHT HAND SIDE (TOP)

PANEL - "D" UNIT-1

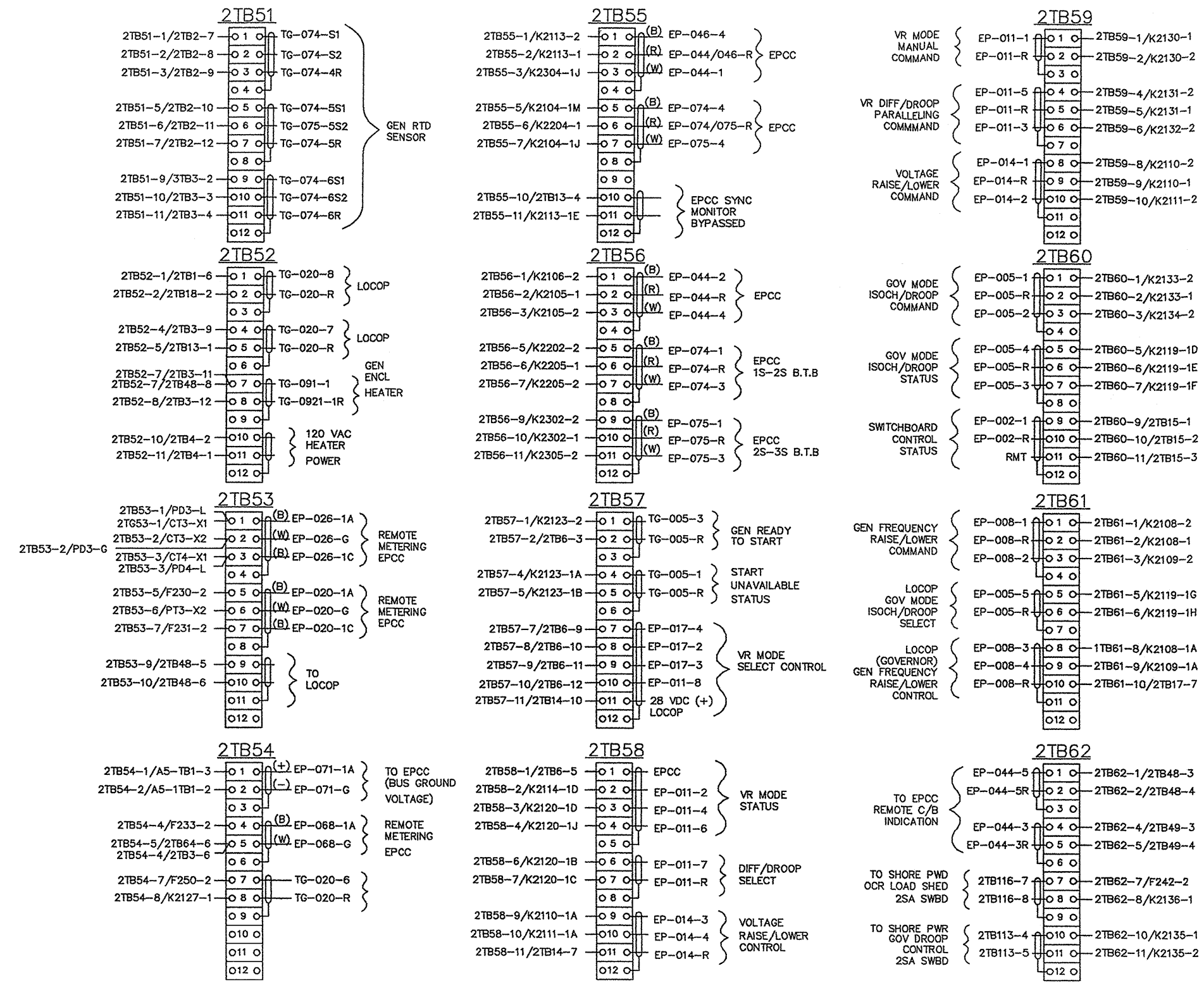
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 10 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW LEFT HAND SIDE (BOTTOM)

PANEL "E" UNIT-1

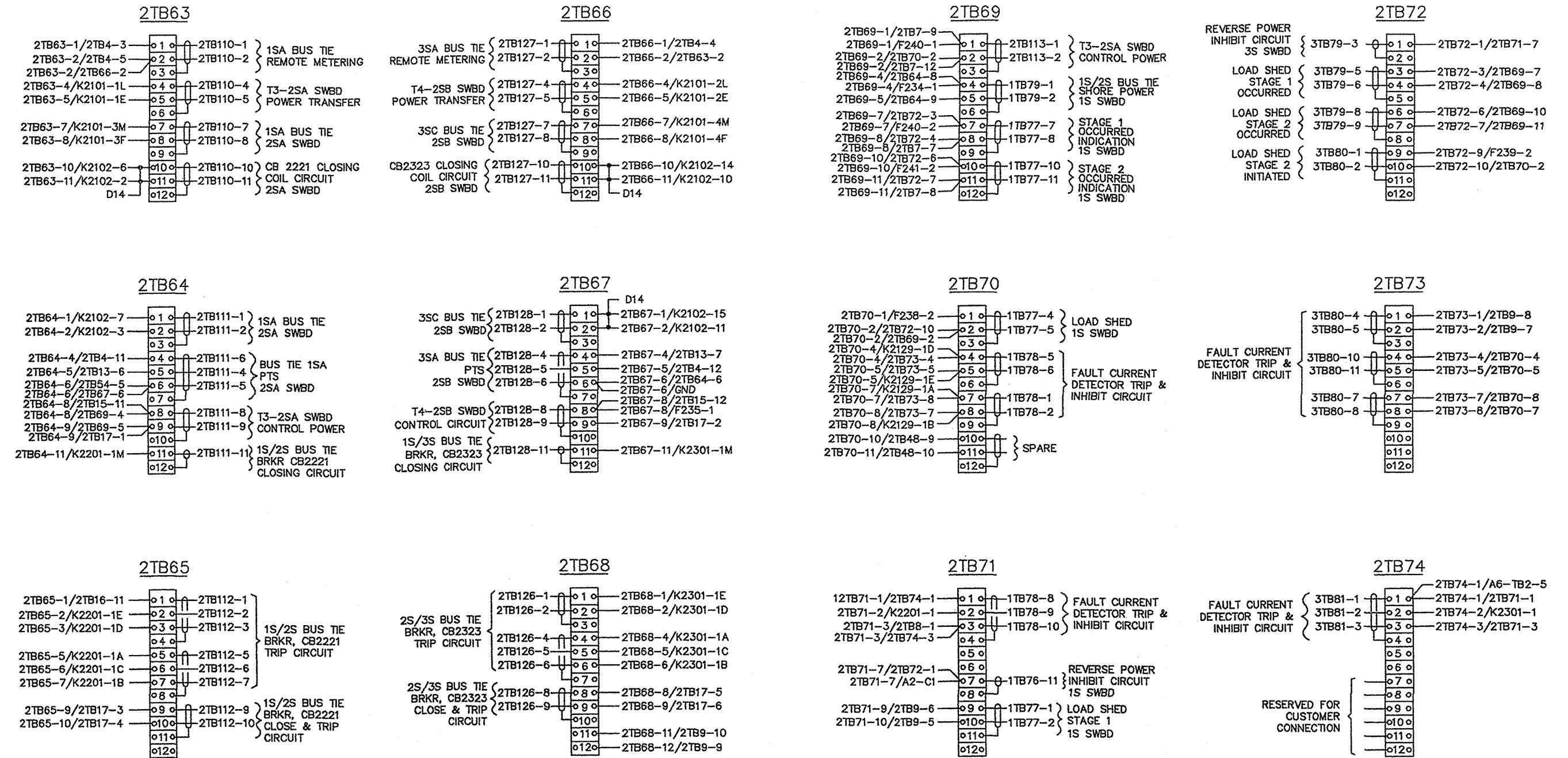
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 11 of 19) (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW LEFT HAND SIDE (BOTTOM)

PANEL "E" UNIT-1

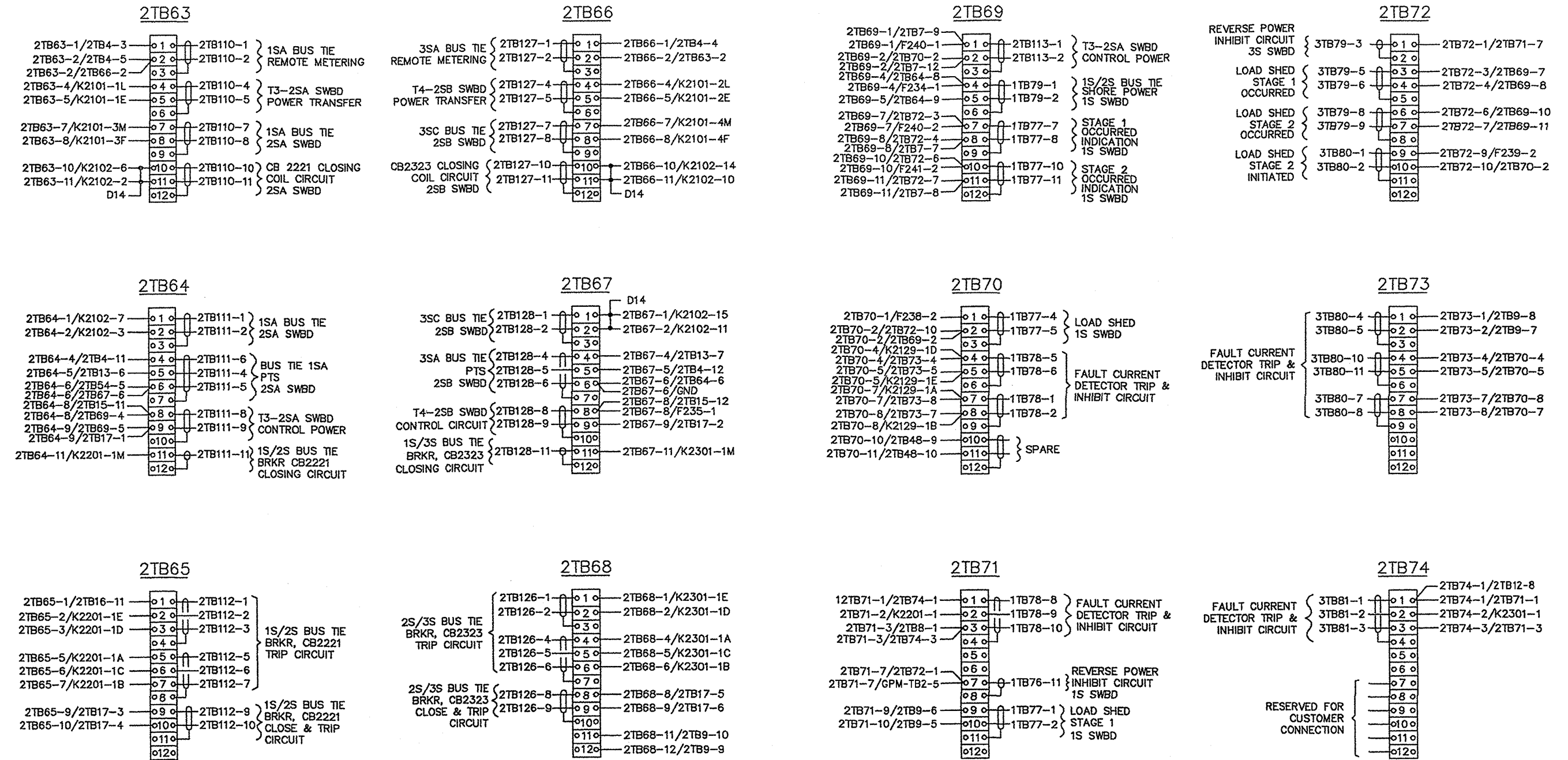
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 11 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW (BOTTOM)
 PANEL-"F" UNIT-1

NOTE:
 DDG 51 ONLY

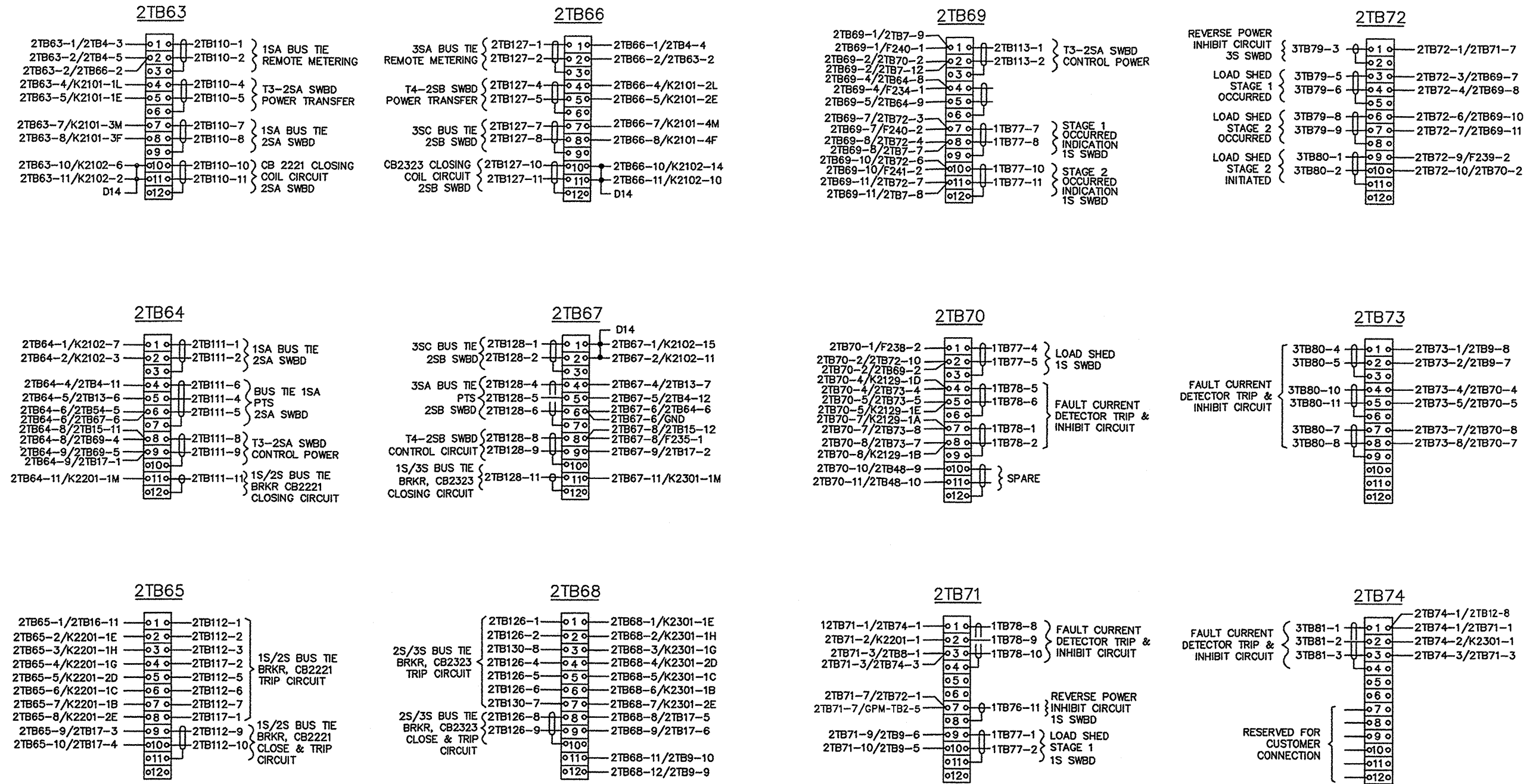
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 12 of 19)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW (BOTTOM)
 PANEL-"F" UNIT-1

NOTE:
 DDG 51 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 12 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

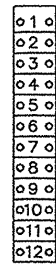


REAR VIEW (BOTTOM)
 PANEL-"F" UNIT-1

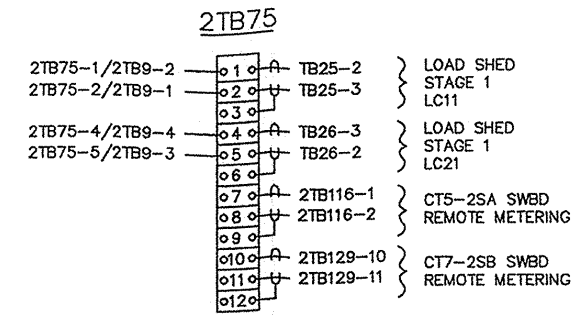
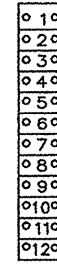
NOTE:
 DDG 52-54 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 12 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

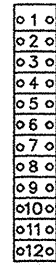
2TB83



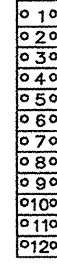
2TB79



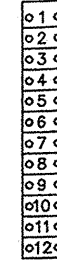
2TB84



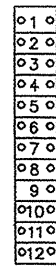
2TB80



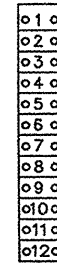
2TB76



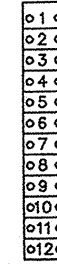
2TB85



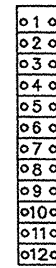
2TB81



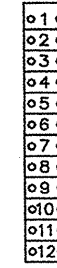
2TB77



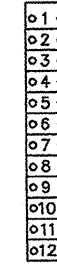
2TB86



2TB82

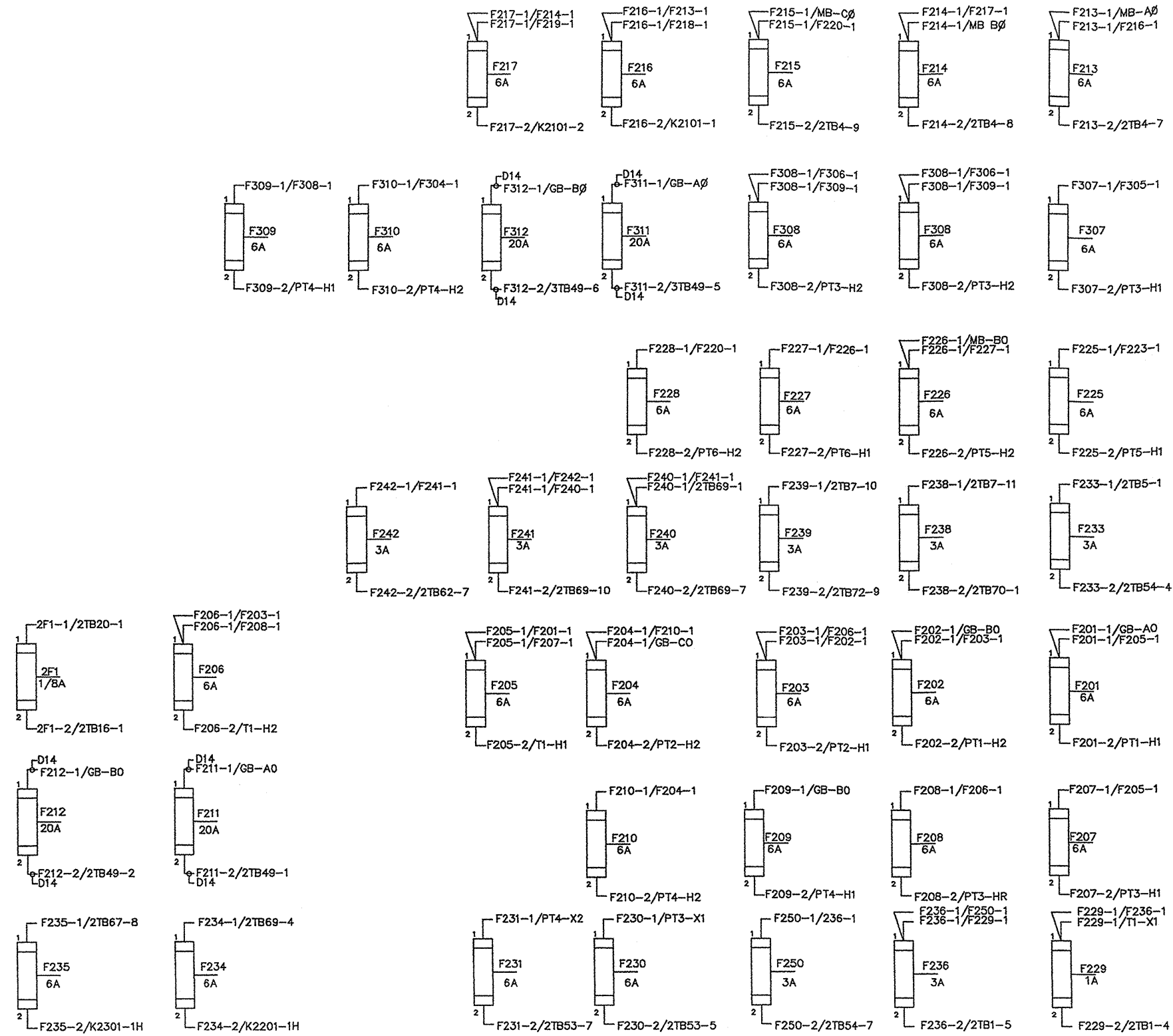


2TB78



REAR VIEW RIGHT HAND SIDE (BOTTOM)
 PANEL-"G" UNIT-1

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 13 of 19)

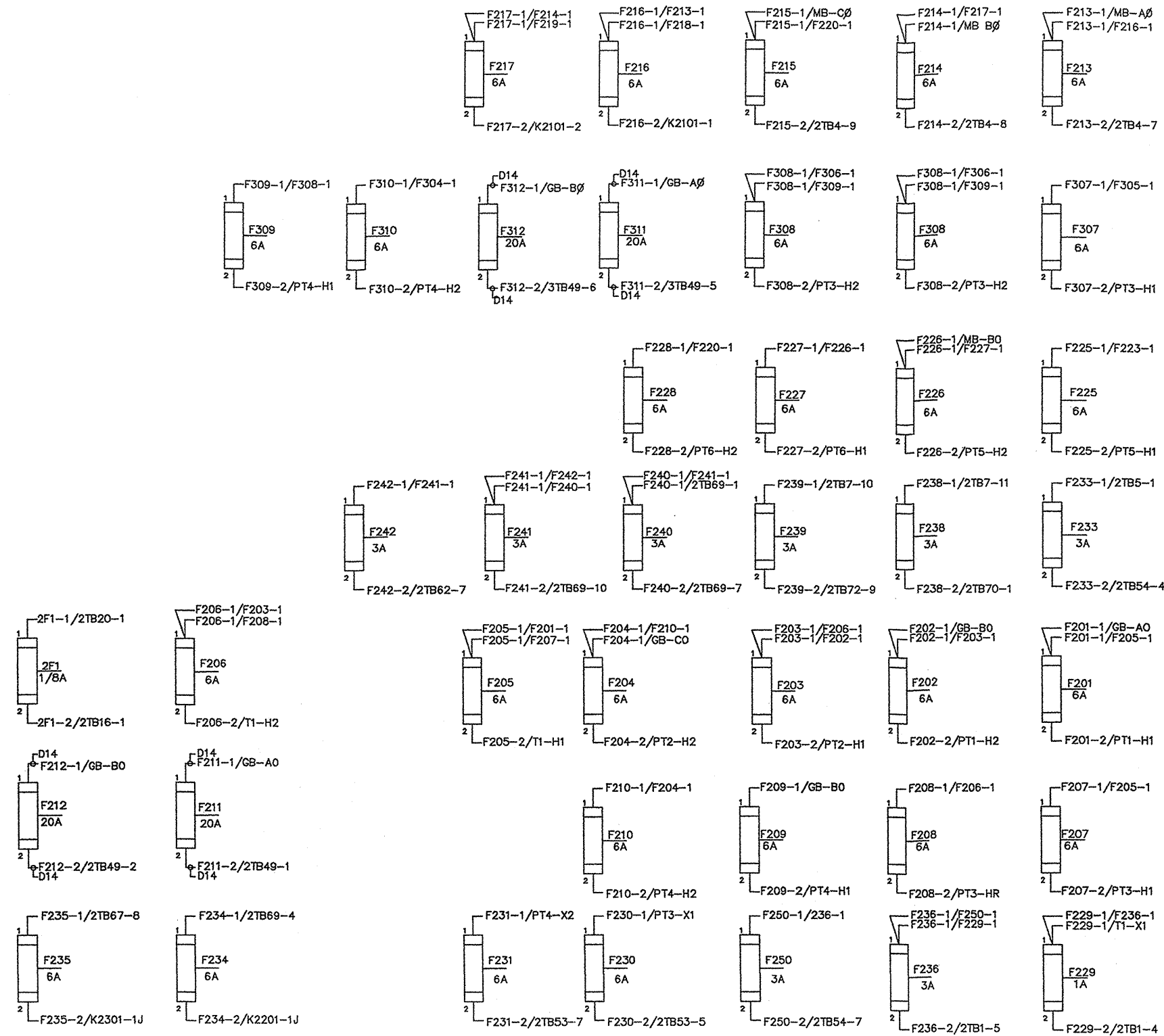


REAR VIEW
 PANEL-"S1" UNIT-2

REAR VIEW
 PANEL-"H" UNIT-2

NOTE:
 DDG 51 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 14 of 19)

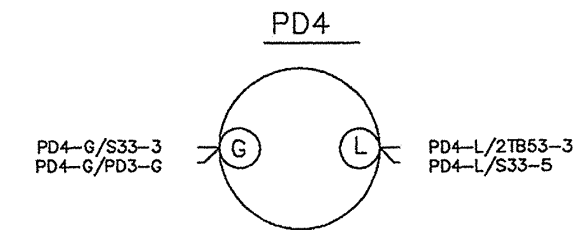
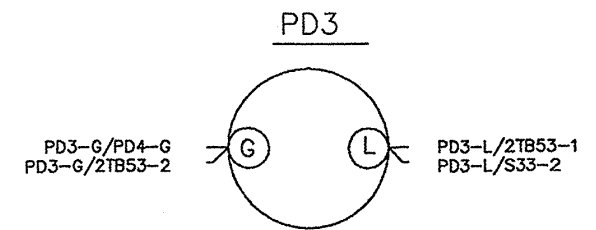
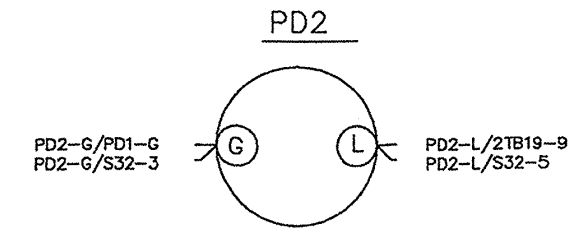
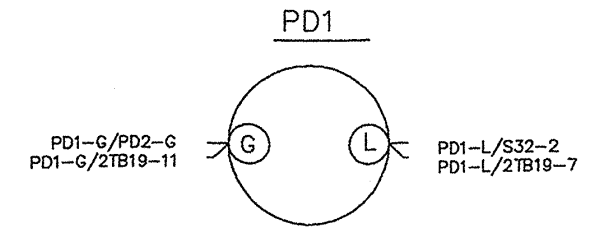
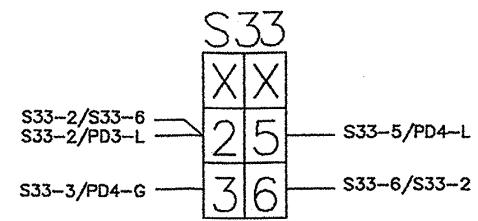
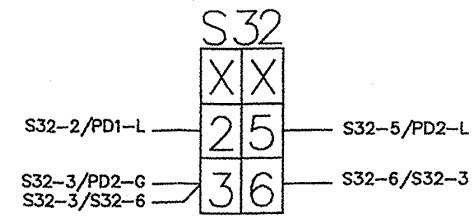


REAR VIEW
 PANEL-"S1" UNIT-2

REAR VIEW
 PANEL-"H" UNIT-2

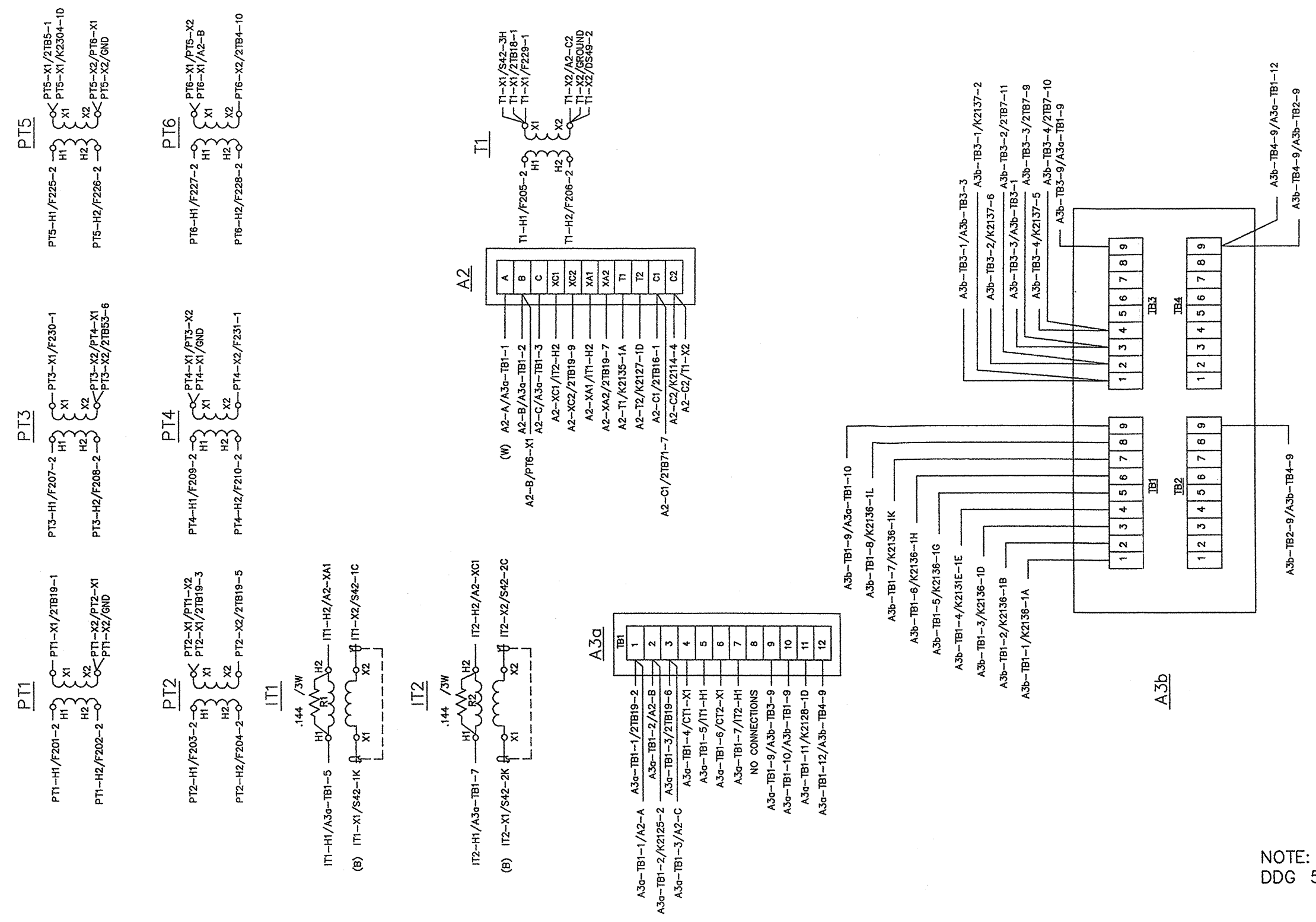
NOTE:
 DDG 52-54 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 14 of 19)



FRONT VIEW LEFT HAND SIDE
PANEL-"K" UNIT-2

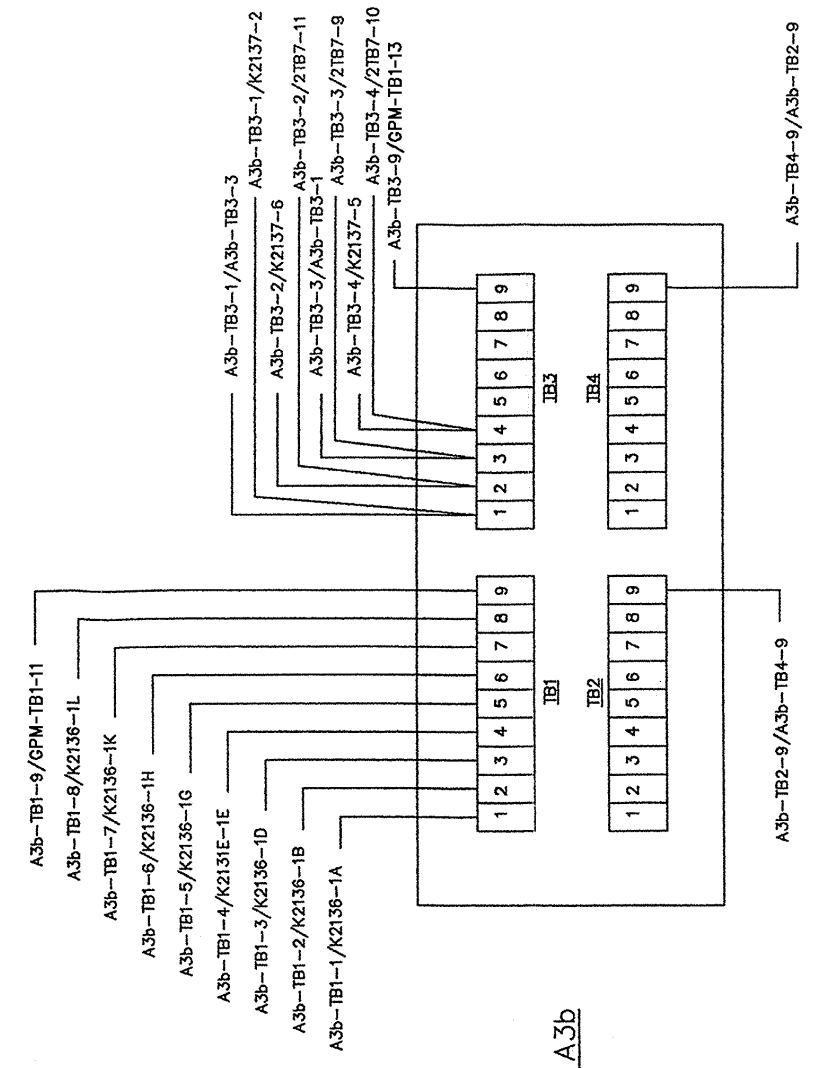
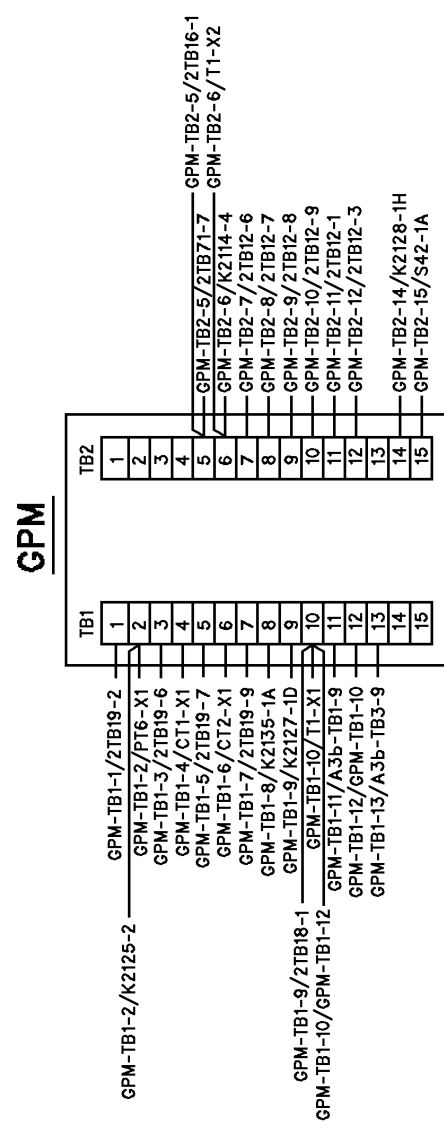
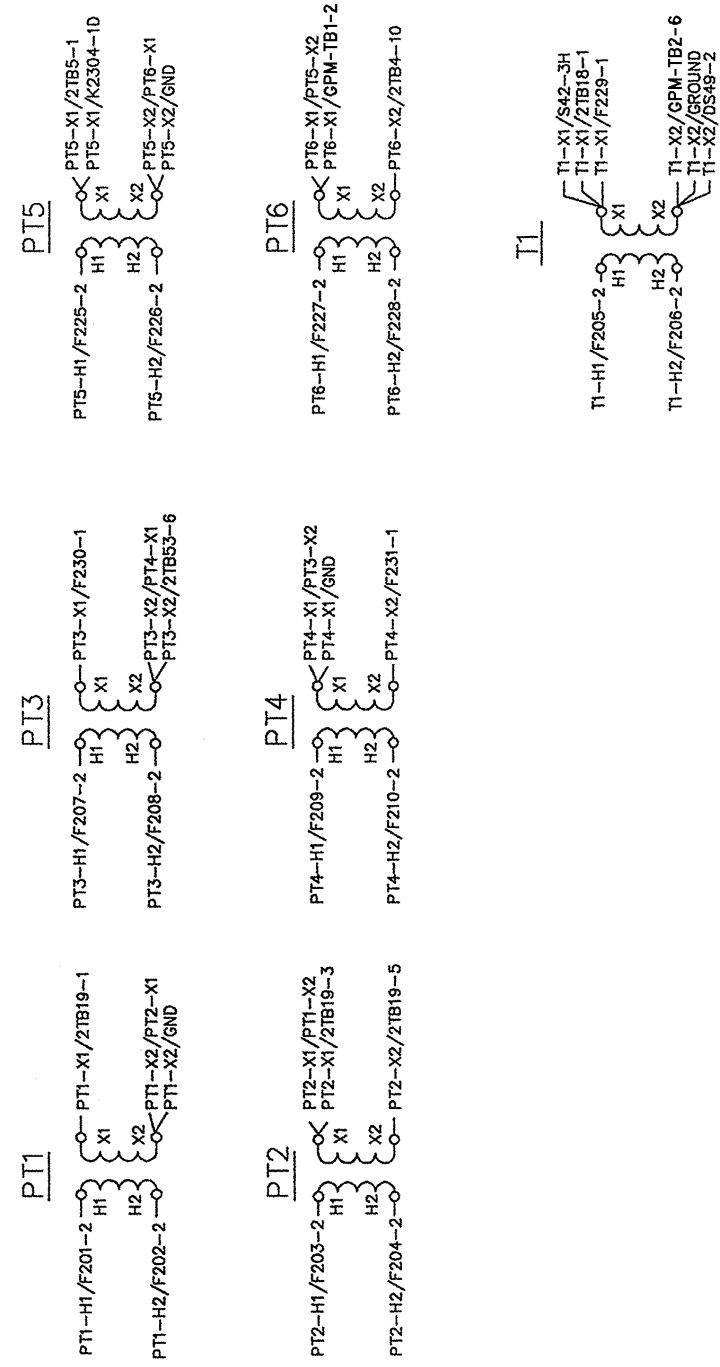
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 15 of 19)



FRONT VIEW (TOP)
PANEL-"L" UNIT-2

NOTE:
DDG 51 ONLY

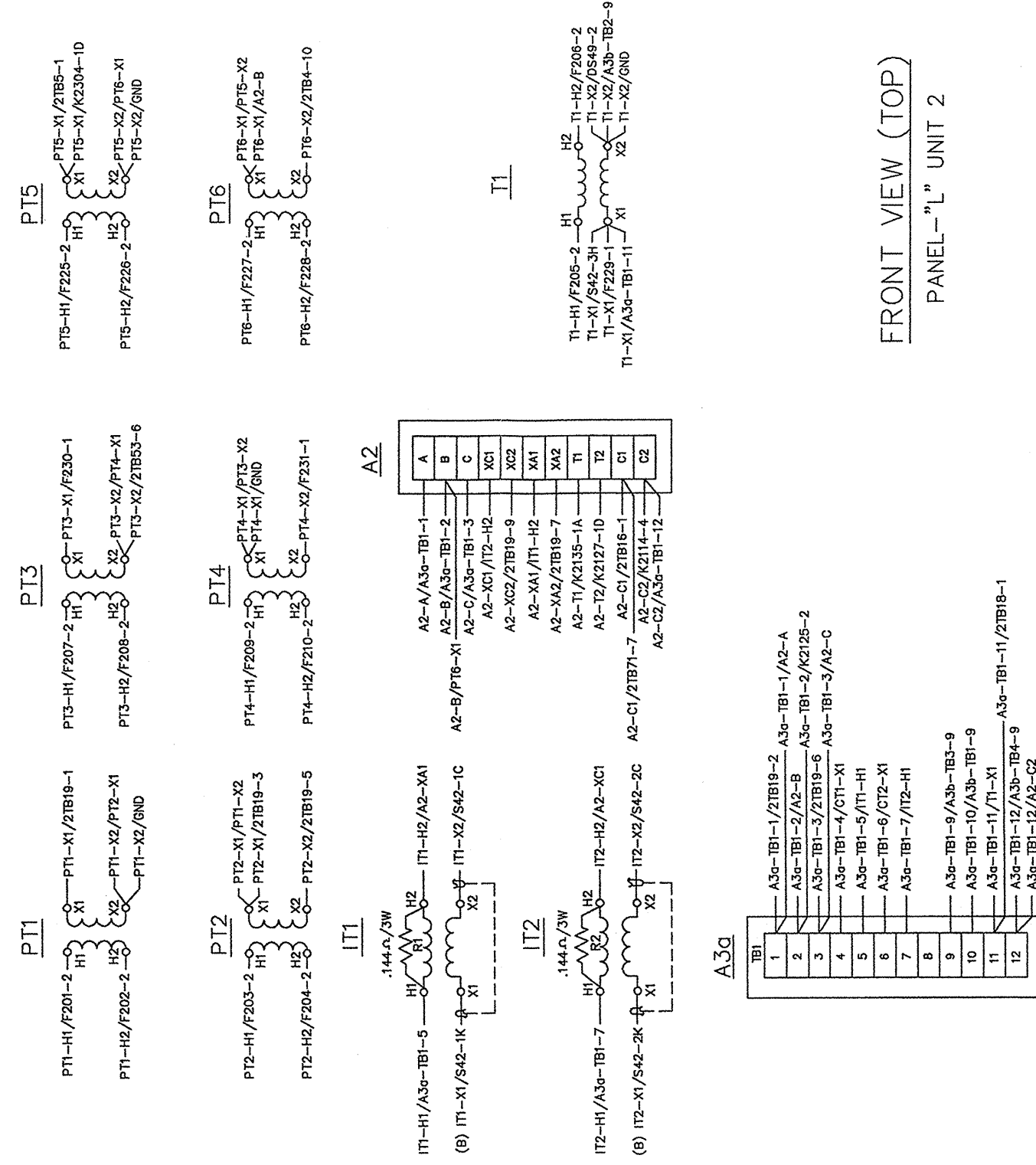
Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 16 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



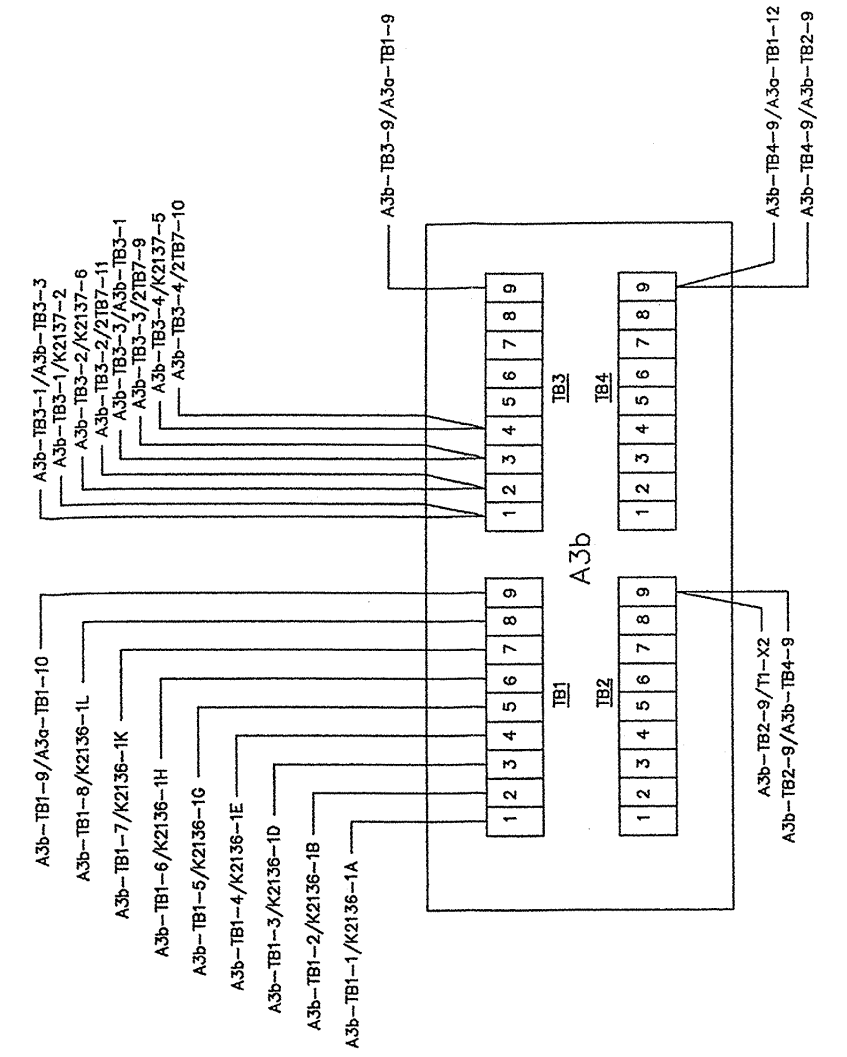
FRONT VIEW (TOP)
 PANEL-"L" UNIT-2

NOTE:
 DDG 51 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 16 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

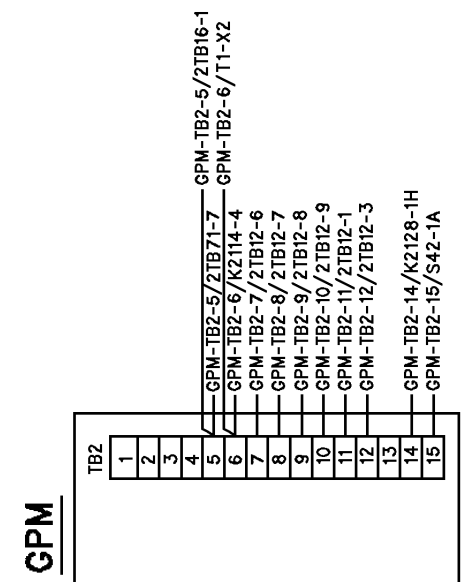
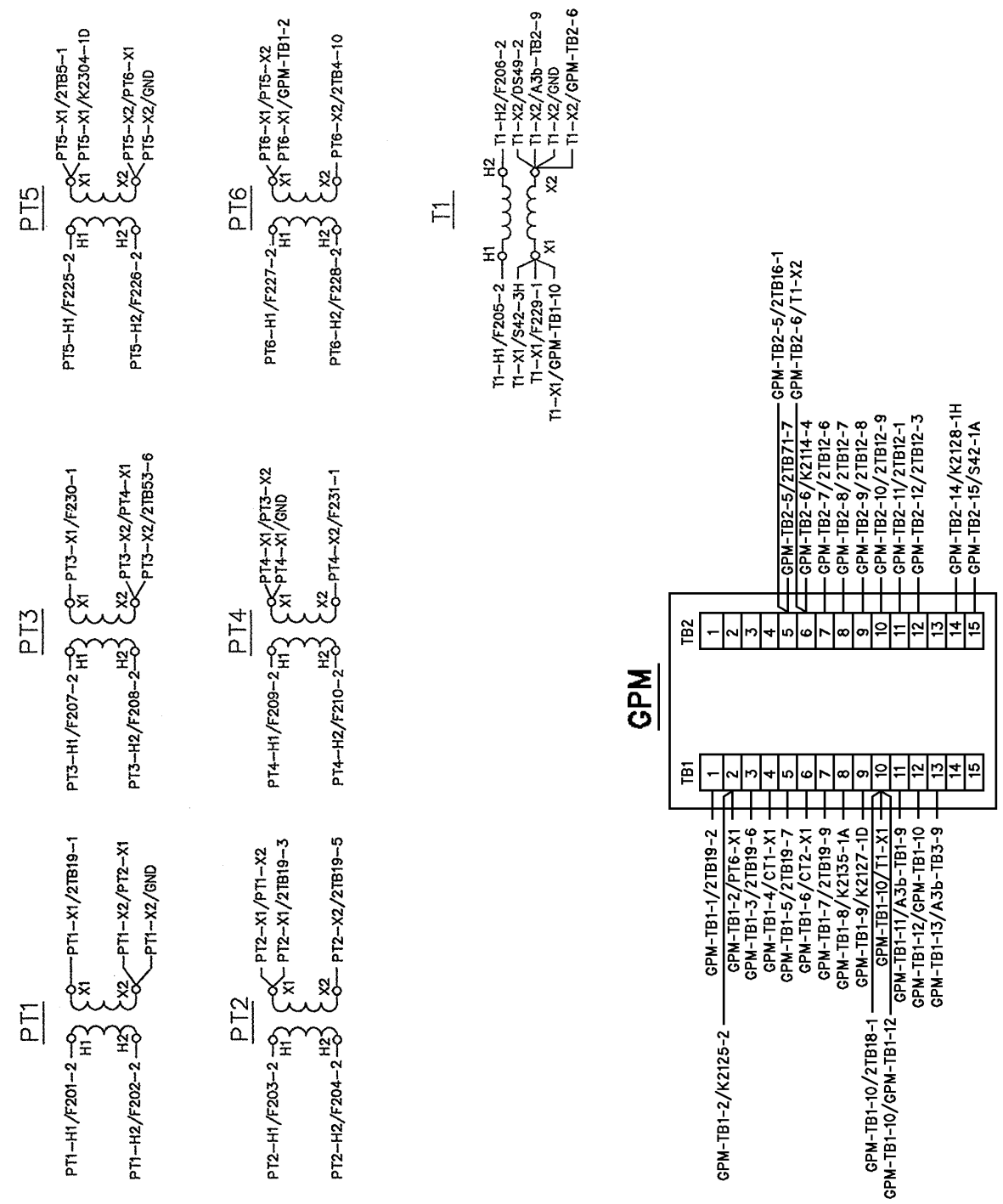


FRONT VIEW (TOP)
 PANEL-"L" UNIT 2

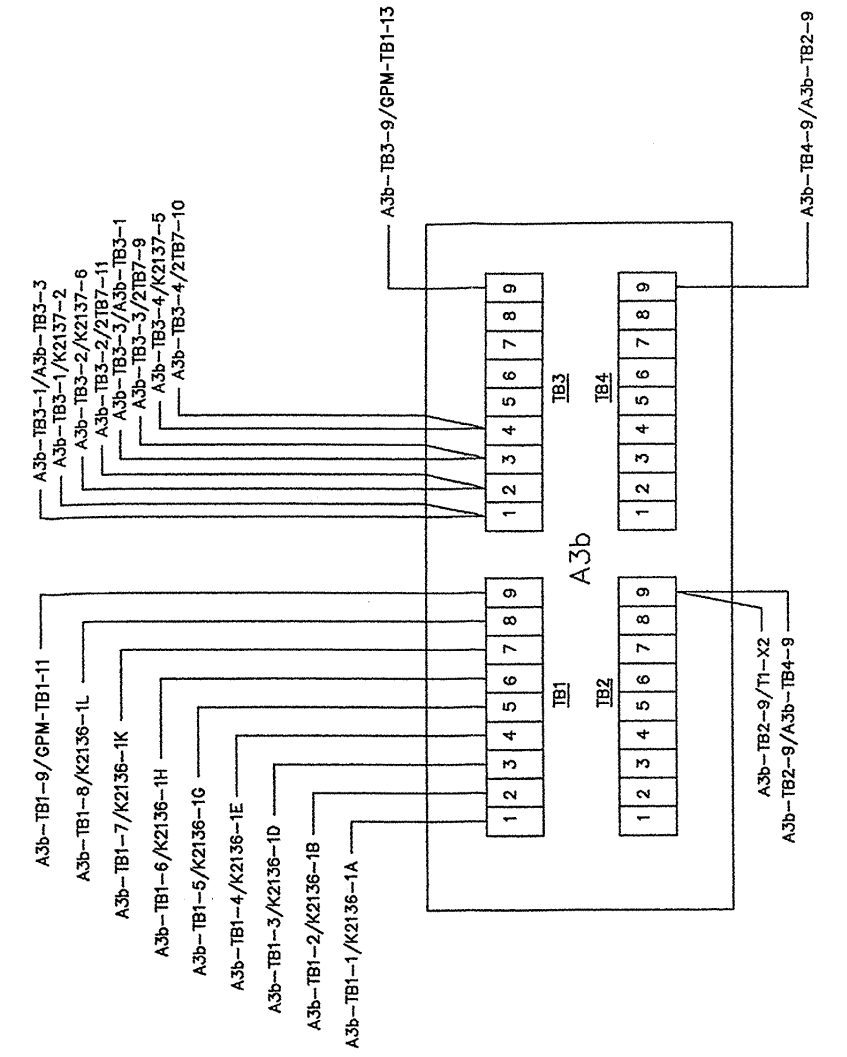


NOTE:
 DDG 52-54 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 16 of 19)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



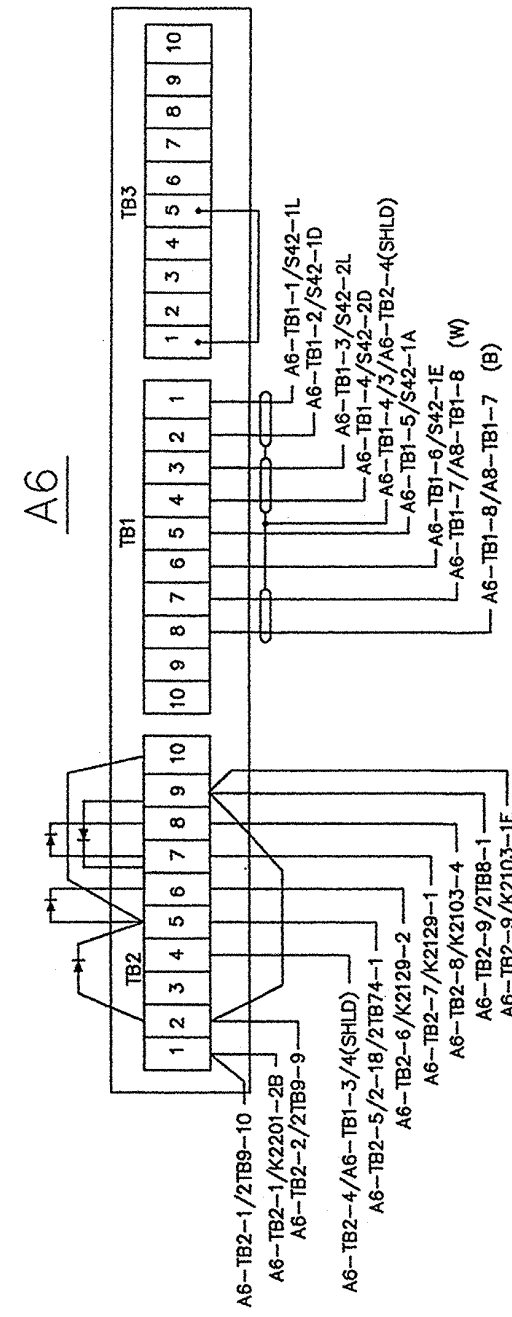
FRONT VIEW (TOP)
PANEL-"L" UNIT 2



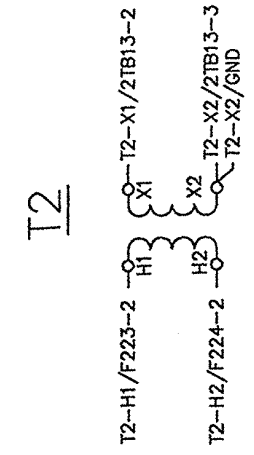
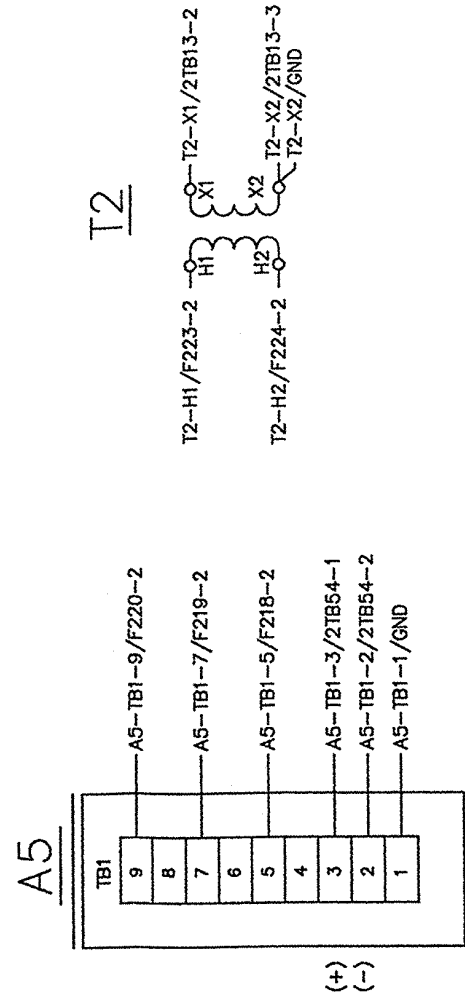
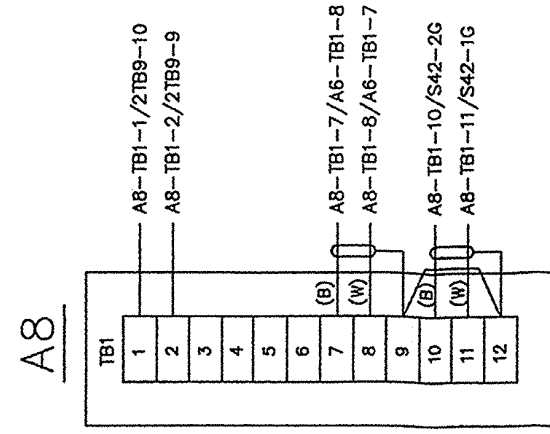
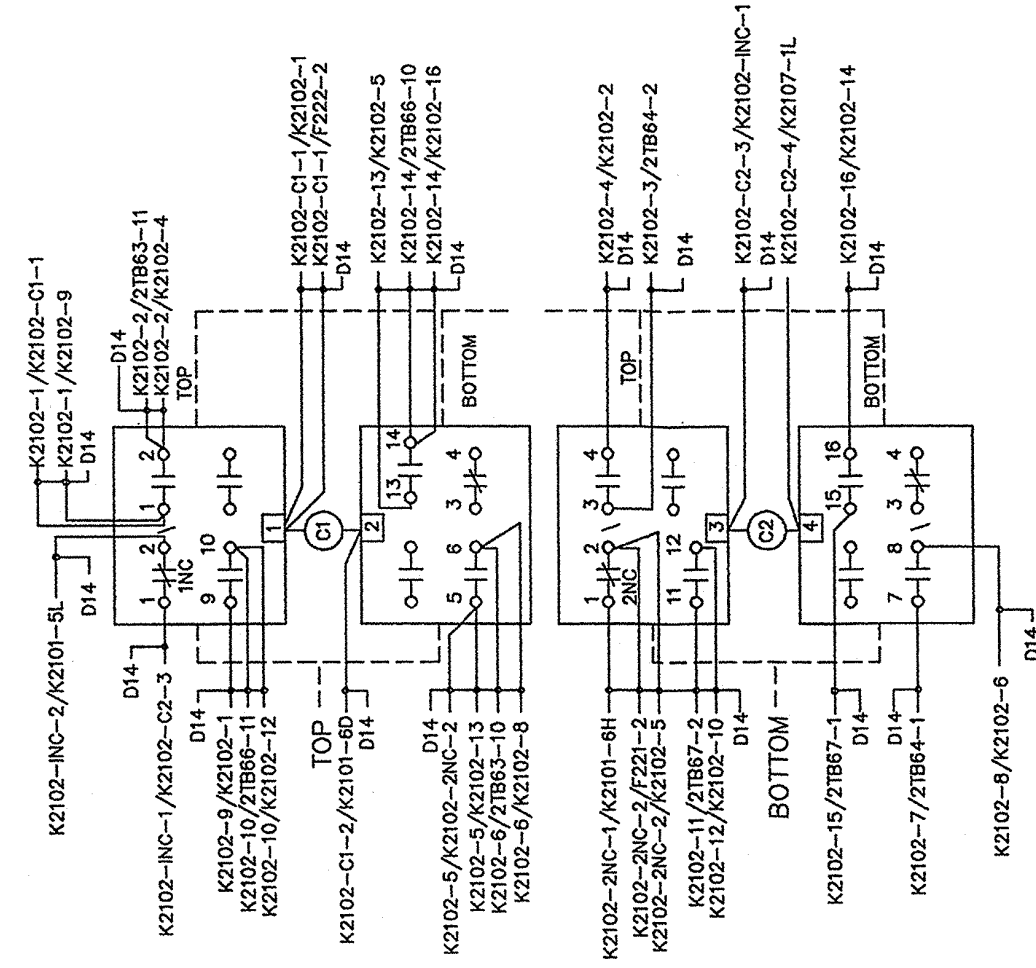
NOTE:
 DDG 52-54 ONLY

FRONT VIEW LEFT HAND SIDE
PANEL-"K" UNIT 2

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 16 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



K2102



FRONT VIEW
PANEL "C2" UNIT-1

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 17 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

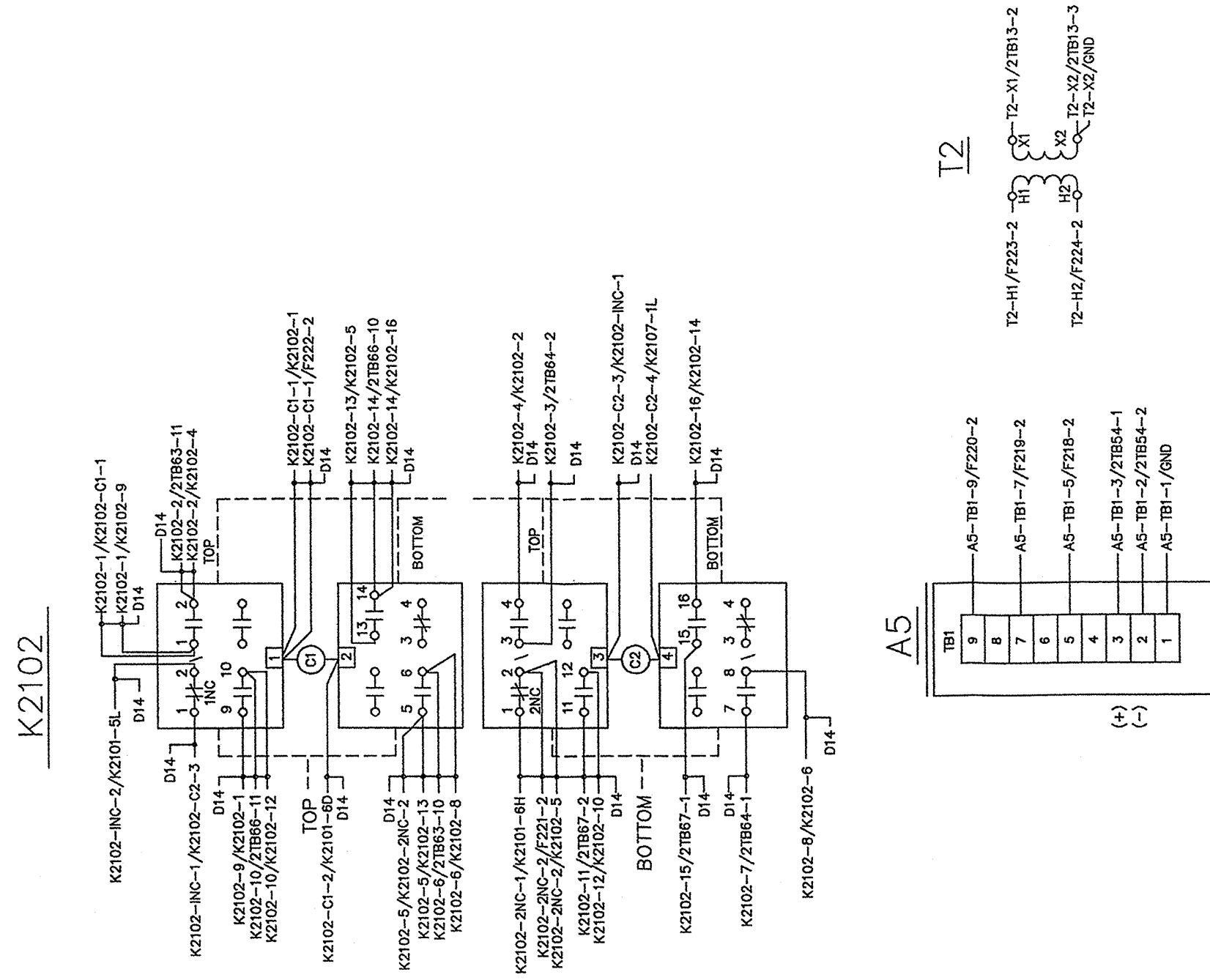
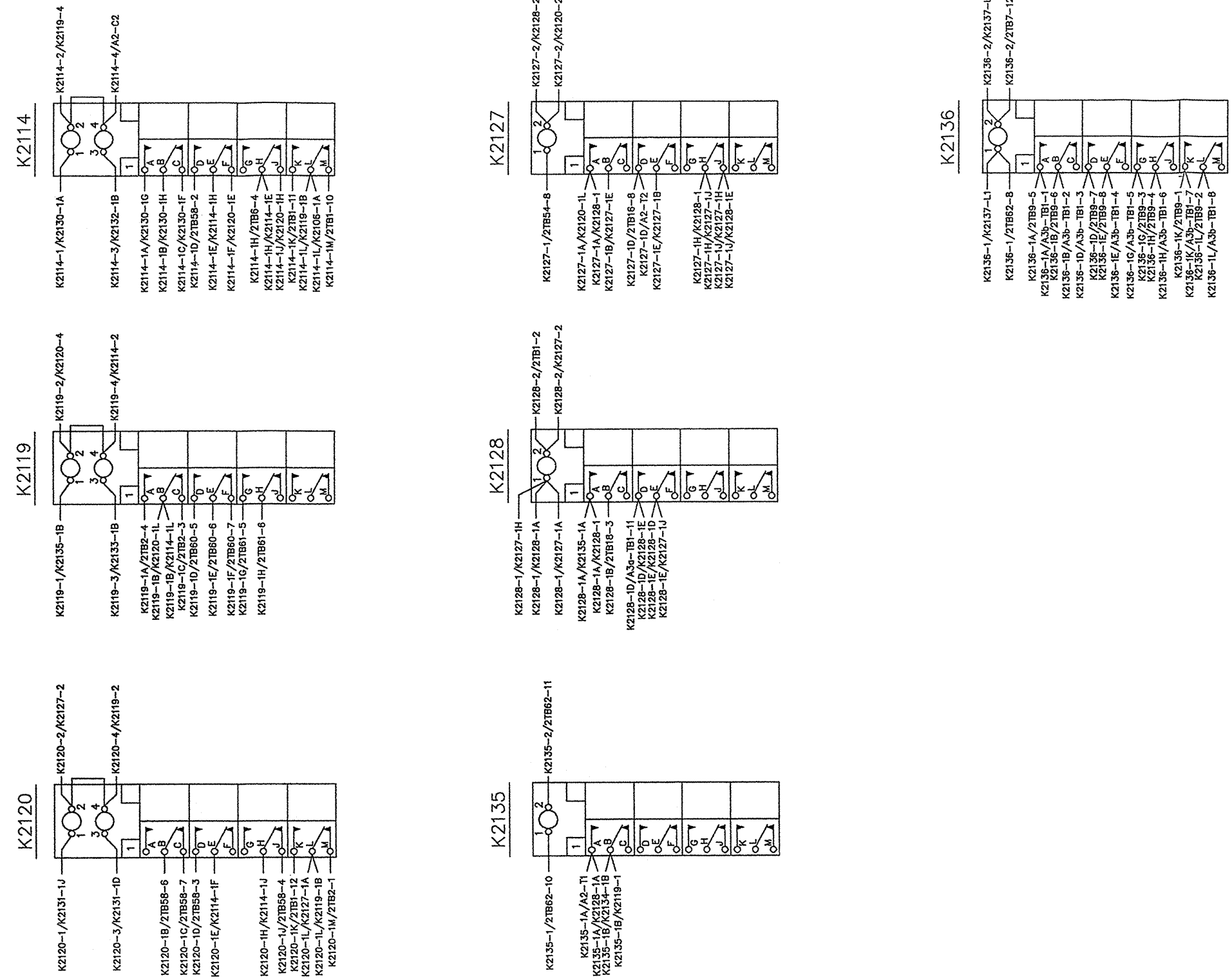


Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 17 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

FRONT VIEW
 PANEL "C2" UNIT-1

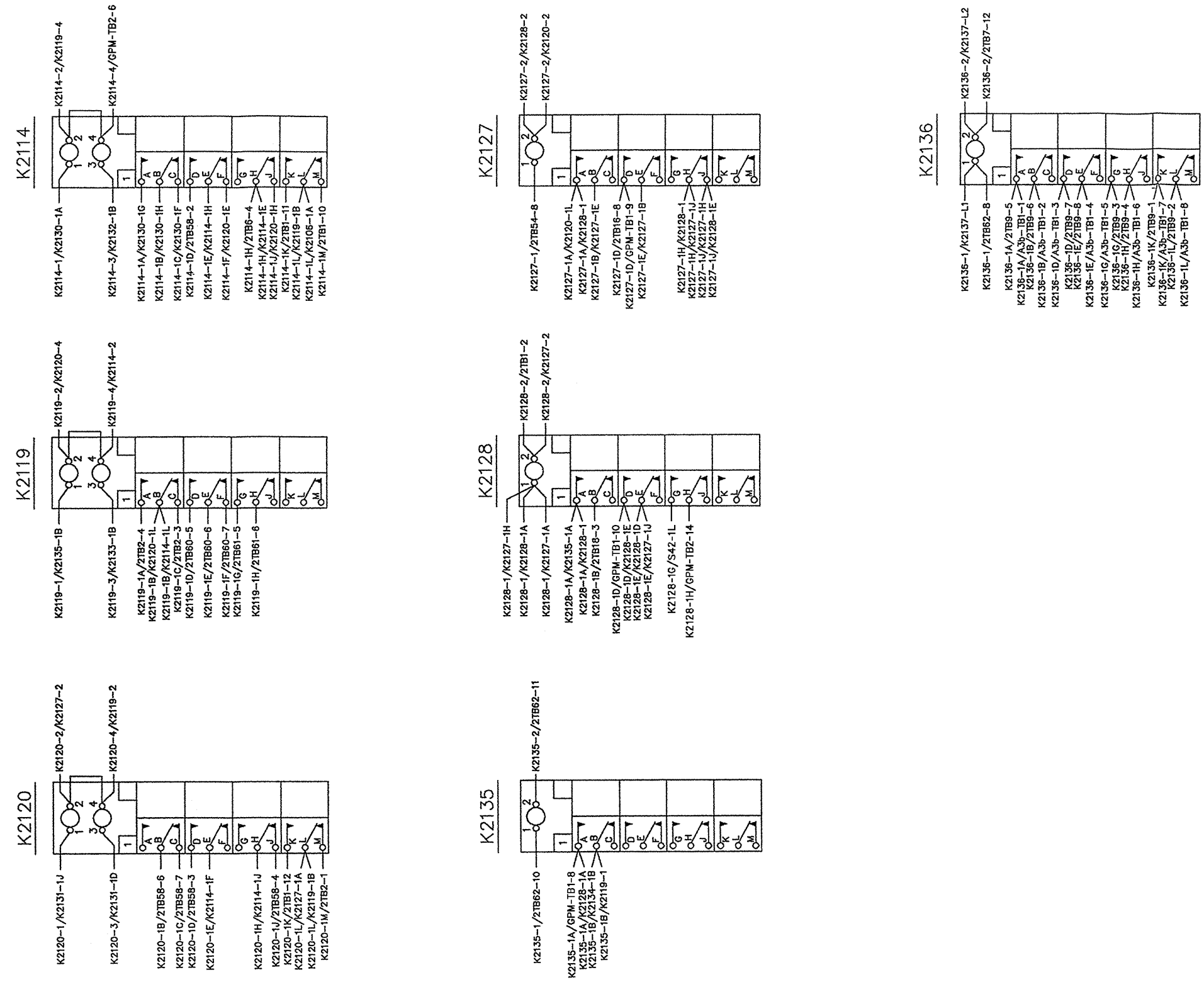


FRONT VIEW LEFT HAND SIDE

PANEL - "M" UNIT-2

NOTE:
DDG 51 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 18 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

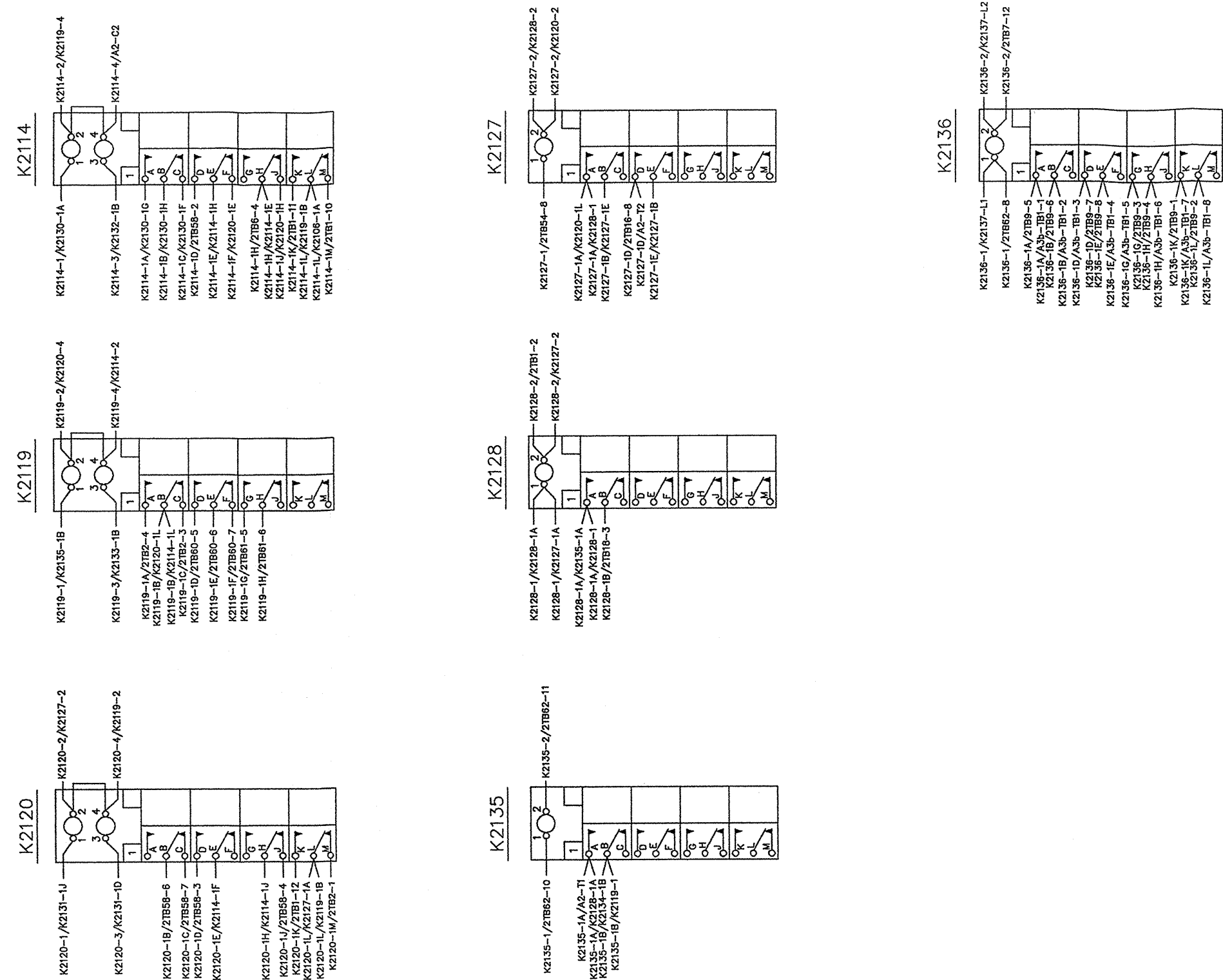


FRONT VIEW LEFT HAND SIDE

PANEL - "M" UNIT-2

NOTE:
DDG 51 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 18 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

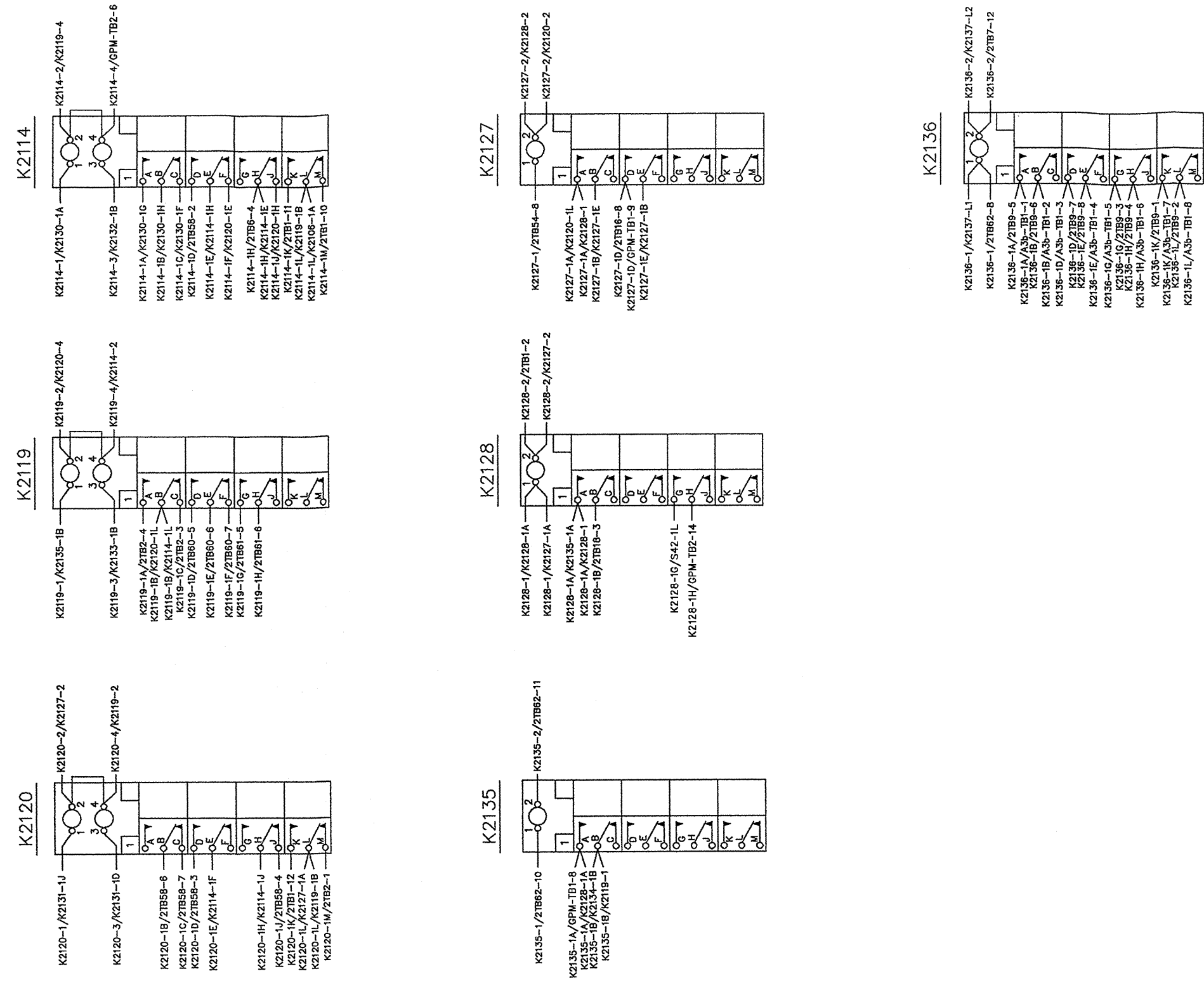


FRONT VIEW LEFT HAND SIDE

PANEL - "M" UNIT-2

NOTE:
DDG 52-54 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 18 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE

PANEL - "M" UNIT-2

NOTE:
DDG 52-54 ONLY

Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 18 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

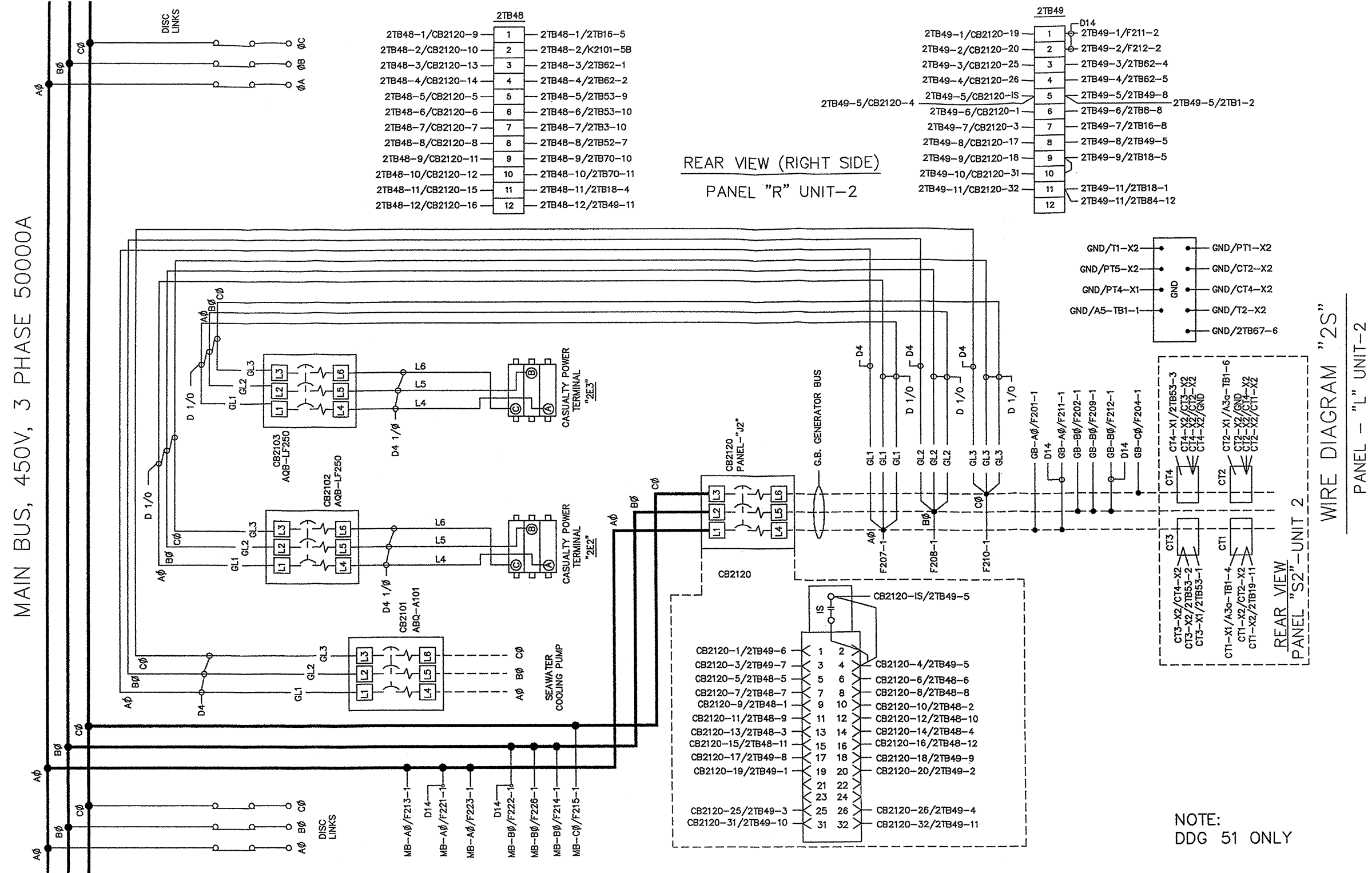


Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 19 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

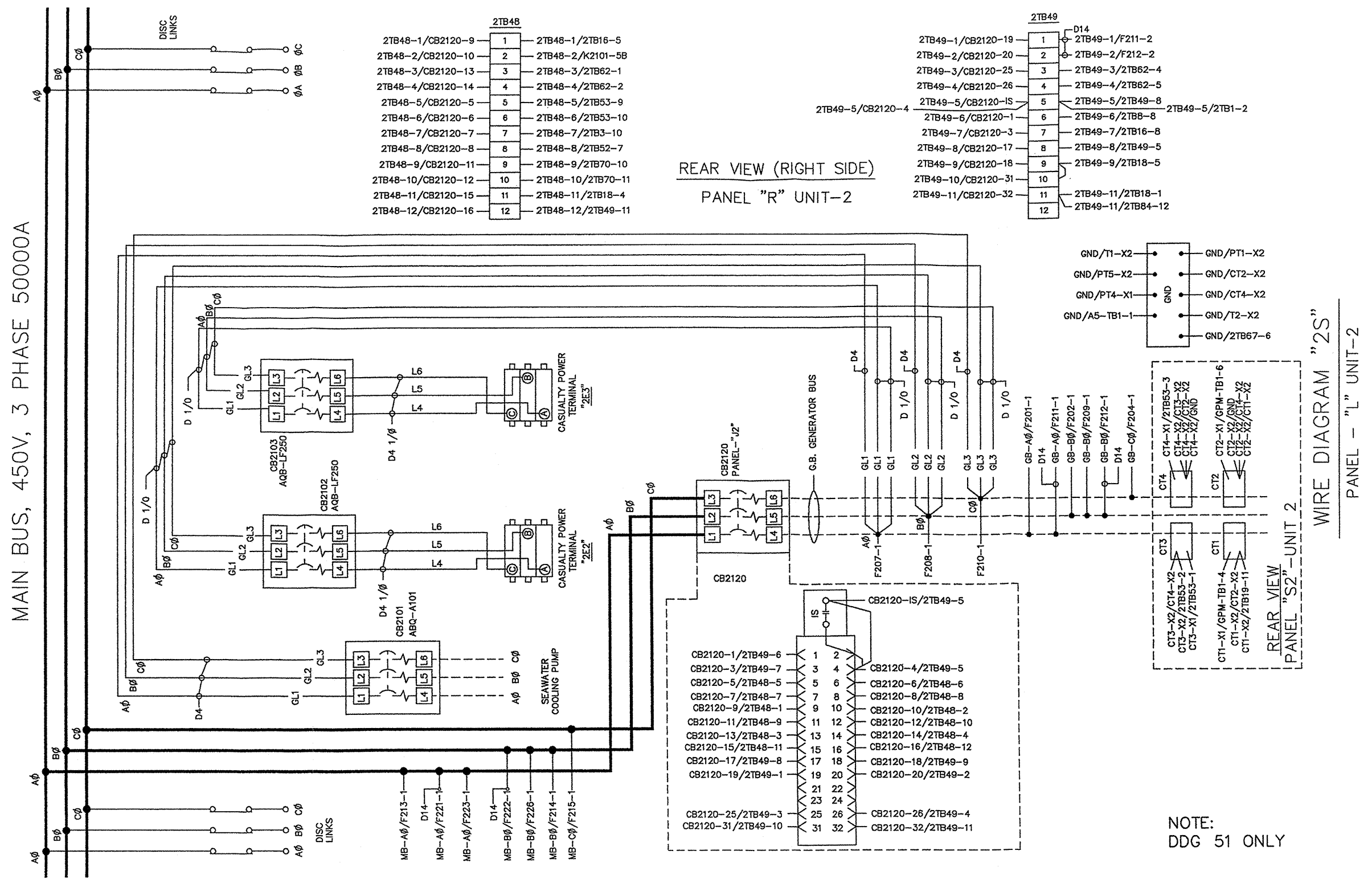


Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 19 of 19)
(For Ships With MACHALTs 320-59006 (ECP-515) and 320-42001 (ECP-597) Installed)

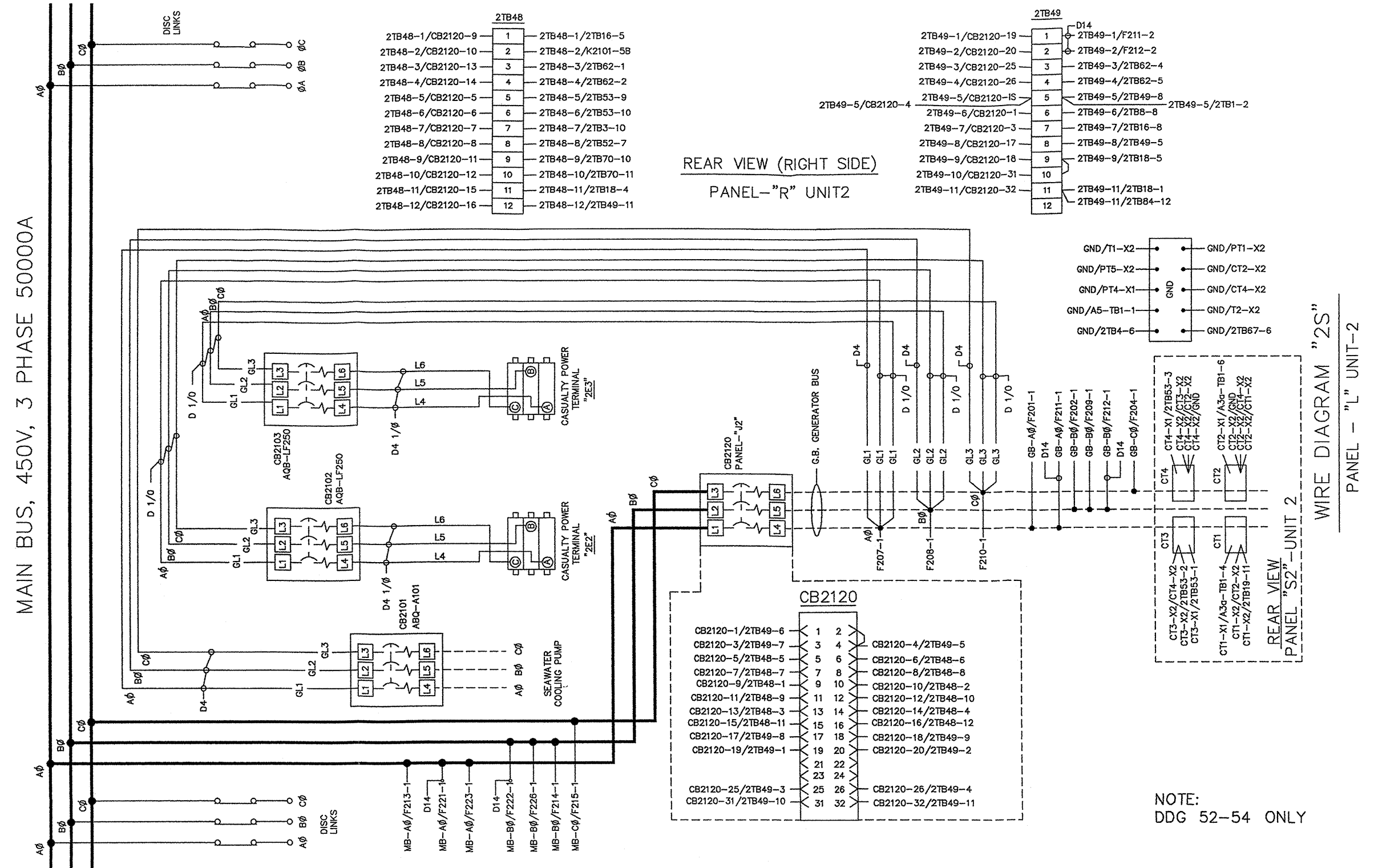


Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 19 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

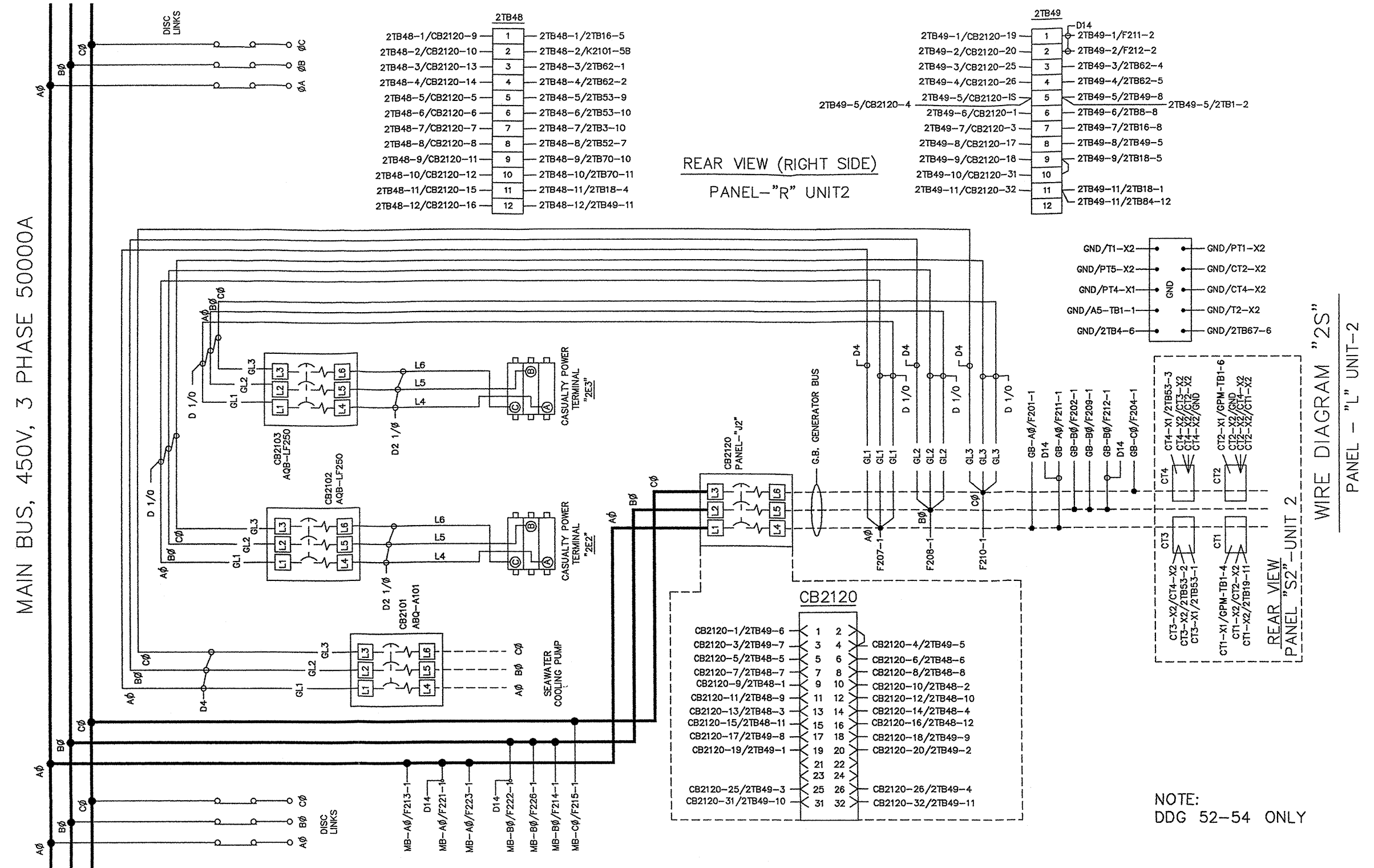


Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 19 of 19)
 (For Ships With MACHALTs 320-59006 (ECP-515) and 320-42001 (ECP-597) Installed)

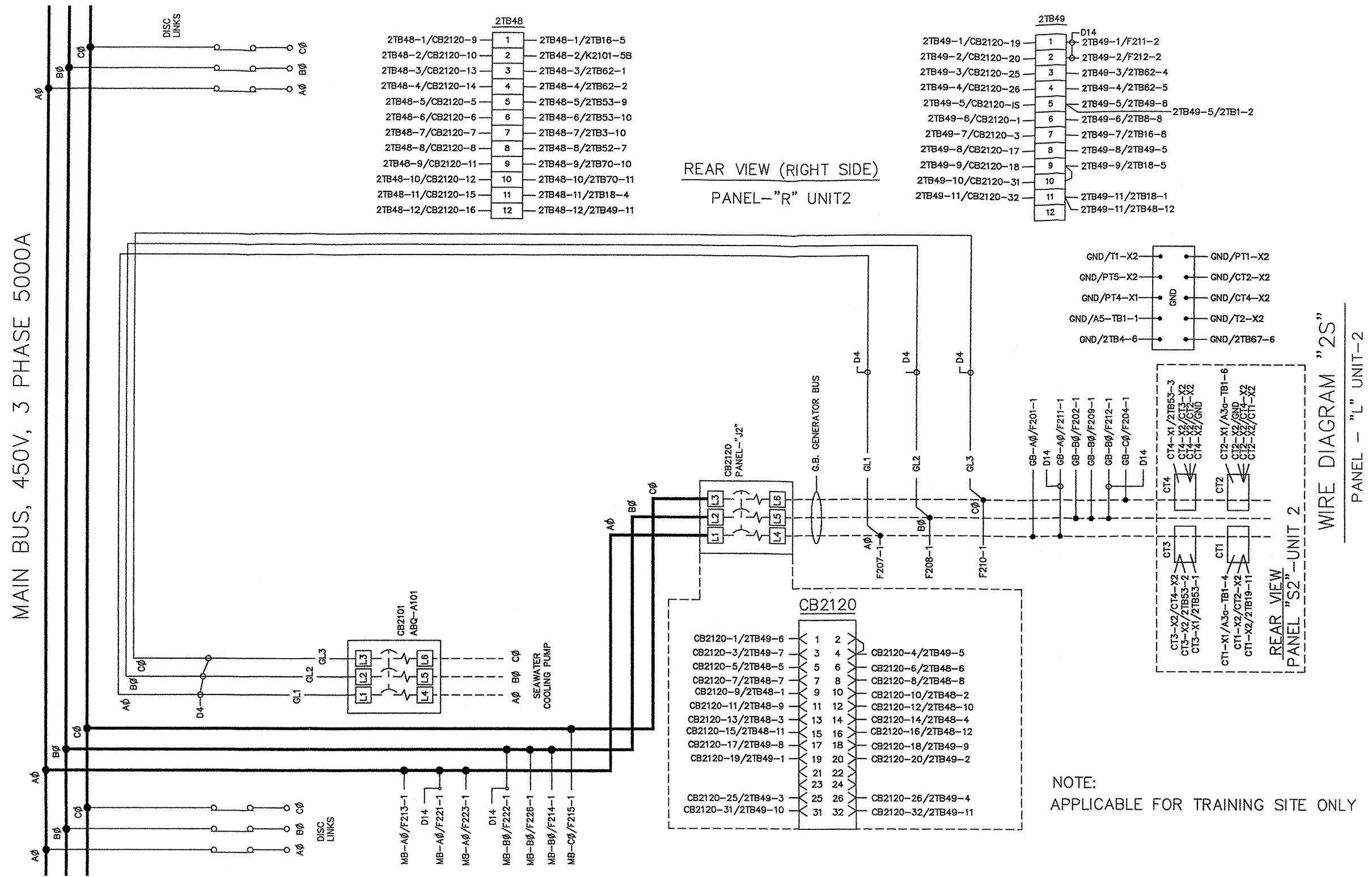


Figure 9-5. 2SG Switchboard; Wiring Diagram (Sheet 19 of 19)

PANEL A SHEET-3A (DDG 51) SHEET 8,14&15 (DDG 52-53) SHEET 8A,14A&15A (DDG 54) SHEET 8B,14A&15A	PANEL B	PANEL C	PANEL D	PANEL E	PANEL F	PANEL G	PANEL H (DDG 51) SHEET 14 (DDG 52-54) SHEET 14A
--	---------	---------	---------	---------	---------	---------	---

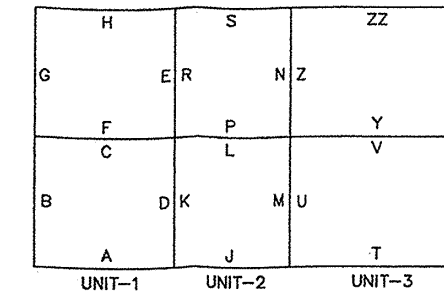
UNIT-1

PANEL J SHEET 3,3A (DDG 51) SHEET 4,12&15 (DDG 52-53) SHEET 4A,12A&15A (DDG 54) SHEET 4B,12B&15B	PANEL K (DDG 51) SHEET 9,10 (DDG 52-54) SHEET 9A,10A	PANEL L (DDG 51) SHEET 5 (DDG 52-53) SHEET 5A (DDG 54) SHEET 5B	PANEL M SHEET 11	PANEL N SHEET 6 (DDG 51) SHEET 7 (DDG 52-54) SHEET 7A	PANEL P SHEET-6 (DDG 51) SHEET 7 (DDG 52-54) SHEET 7A	PANEL R	PANEL S
--	--	---	---------------------	--	--	---------	---------

UNIT-2

PANEL T (DDG 51) SHEET 12 (DDG 52-53) SHEET 12A (DDG 54) SHEET 12A	PANEL U (DDG 51) SHEET 5 (DDG 52-54) SHEET 5A (DDG 54) SHEET 5B	PANEL V SHEET-13	PANEL W SHEET-13	PANEL X	PANEL Y	PANEL Z SHEET-13	PANEL ZZ
--	---	---------------------	---------------------	---------	---------	---------------------	----------

UNIT-3



TOP VIEW-PANEL LOCATION
SWITCHBOARD "2SA"

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 1 of 16)

COMPONENT LOCATIONS

PANEL NO															
A	2TB2201-2TB2208		CB2201-CB2208		DS3	DS6	DS9	DS12	DS15	DS18	DS21	DS24	2TB78-2TB79		
J	1F1-1F5	2F1-2F5	3F1-3F5	4F1-4F5	5F1-5F5	6F1-6F5	7F1-7F5	8F1-8F5	9F1-9F5	10F1-10F5	11F1-11F5	12F1-12F5	DS1-DS2	DS4-DS5	S34-S35
	DS7-DS8	DS10-DS11	DS13-DS14	DS16-DS17	DS19-DS20	DS22-DS23	DS25-DS26	DS28-DS29	DS31-DS32	DS34-DS35	DS37-DS39	M9-M10	S26-S28	S11	
	S4	2TB2209-2TB2212		CB2209-CB2212		DS27	DS30	DS33	DS36	2TB80					
K	2TB83-2TB87	2TB88-2TB92	2TB93-2TB97												
L	K1	K3A	1K4	T9-T16	T5-T8 (DDG-51)										
M	2K4-12K4				K3										
N	2TB101-2TB120														
P	F251-F260	F237	F7-F8	F263-F267											
T	2TB81-2TB82	CB2221													
V	1A4-12A4	PT7-PT8	T3												
W	A7	S39	S40	CT5-CT6	CT9-CT12	PD-9									
H	1CT1-12CT1														
U	T5-T8 (DDG 52-54)														
Z	PD5-PD6														

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 2 of 16)

FRONT DOOR REAR VIEW
 PANEL-"J" UNIT-2

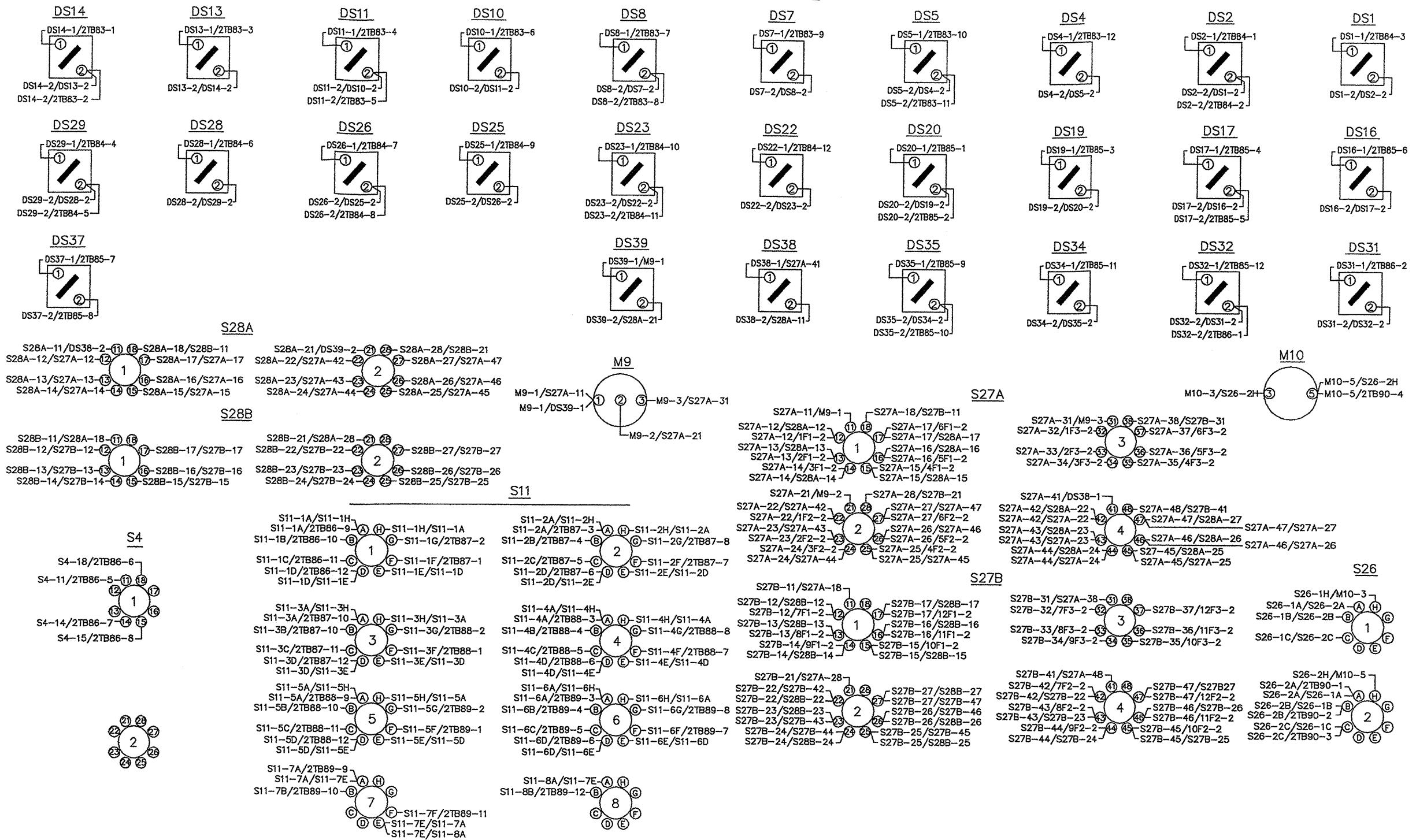
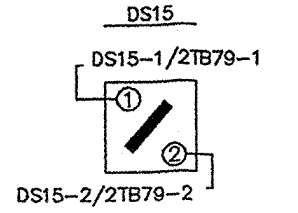
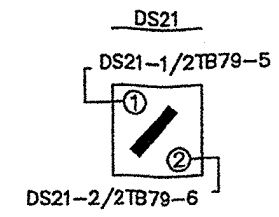
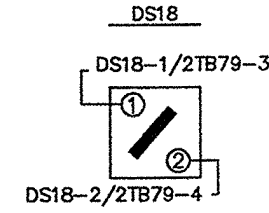
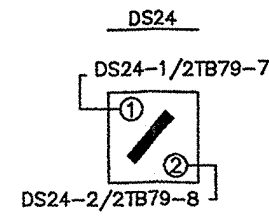
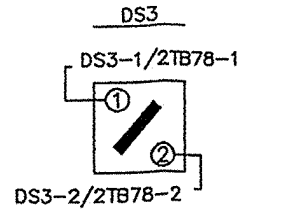
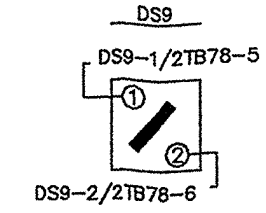
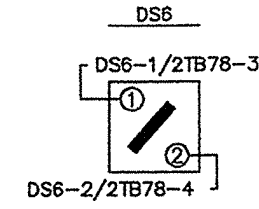
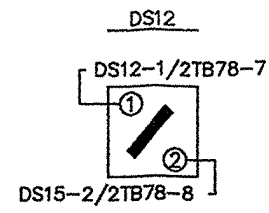


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 3 of 16)

FRONT DOOR REAR VIEW (BOTTOM)

PANEL-"A" UNIT-1



FRONT DOOR REAR VIEW (BOTTOM)

PANEL-"J" UNIT-2

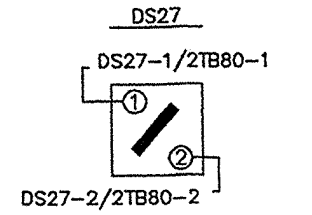
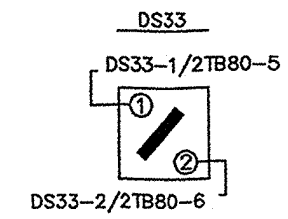
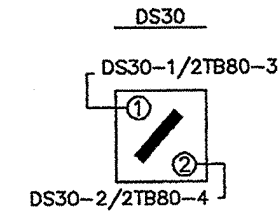
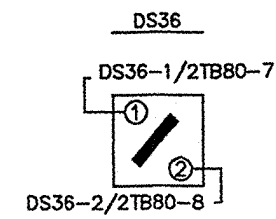
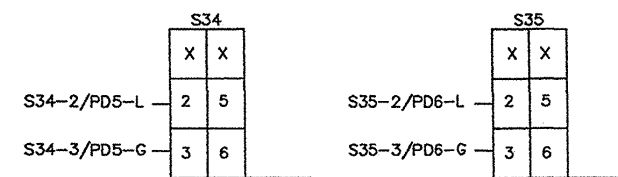
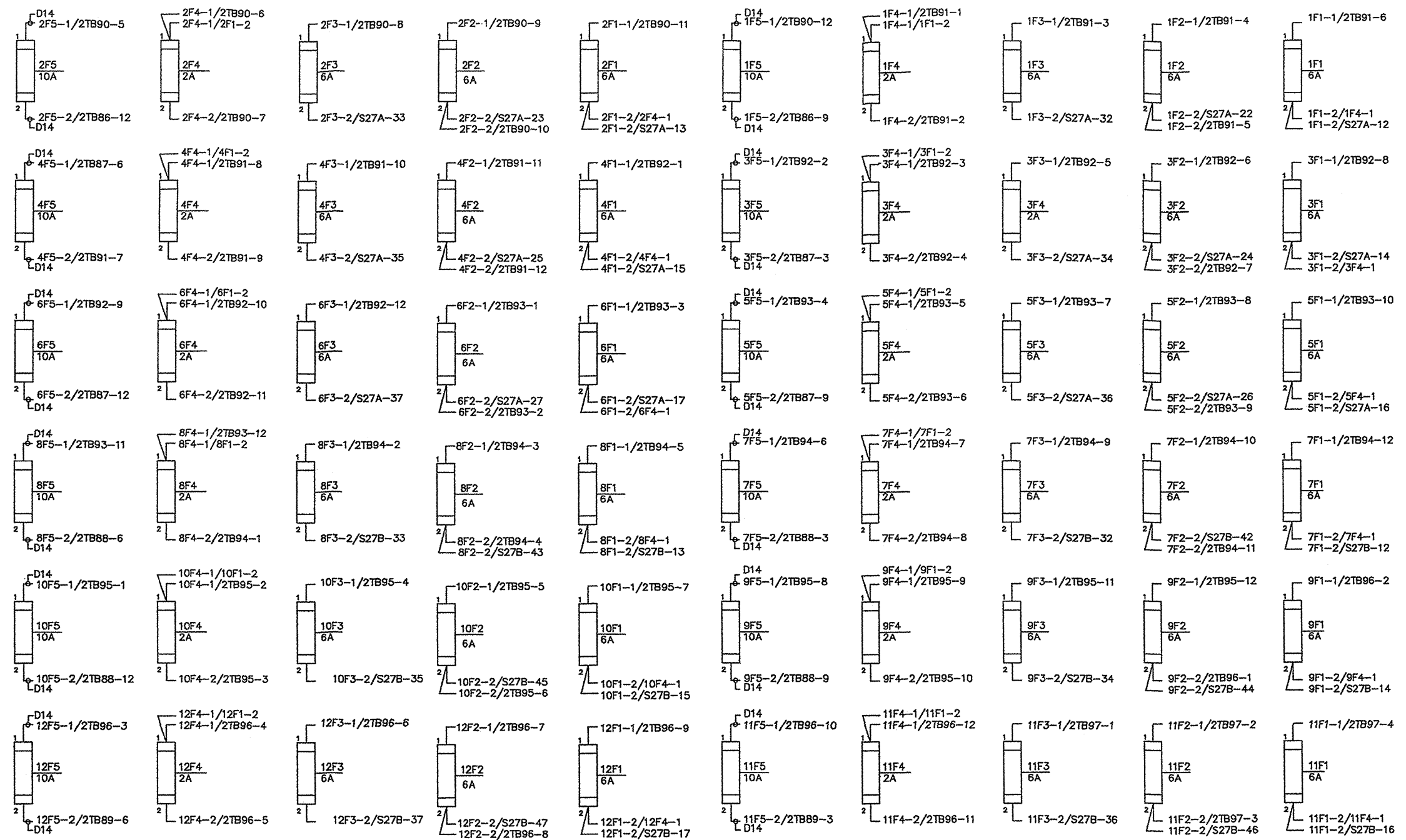


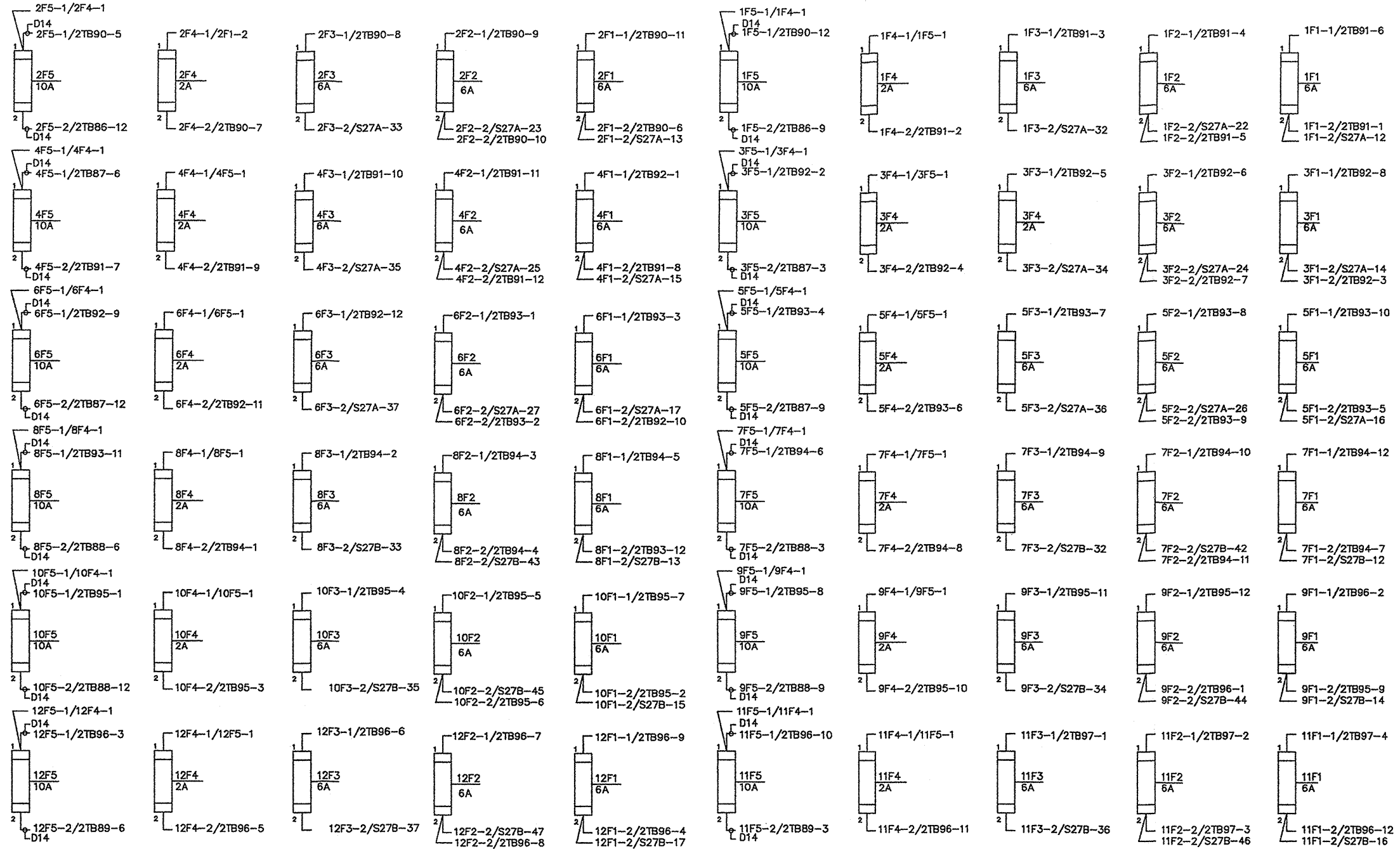
Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 4 of 16)



FRONT DOOR REAR VIEW
PANEL-"J" UNIT-2

NOTE:
DDG 51 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 5 of 16)

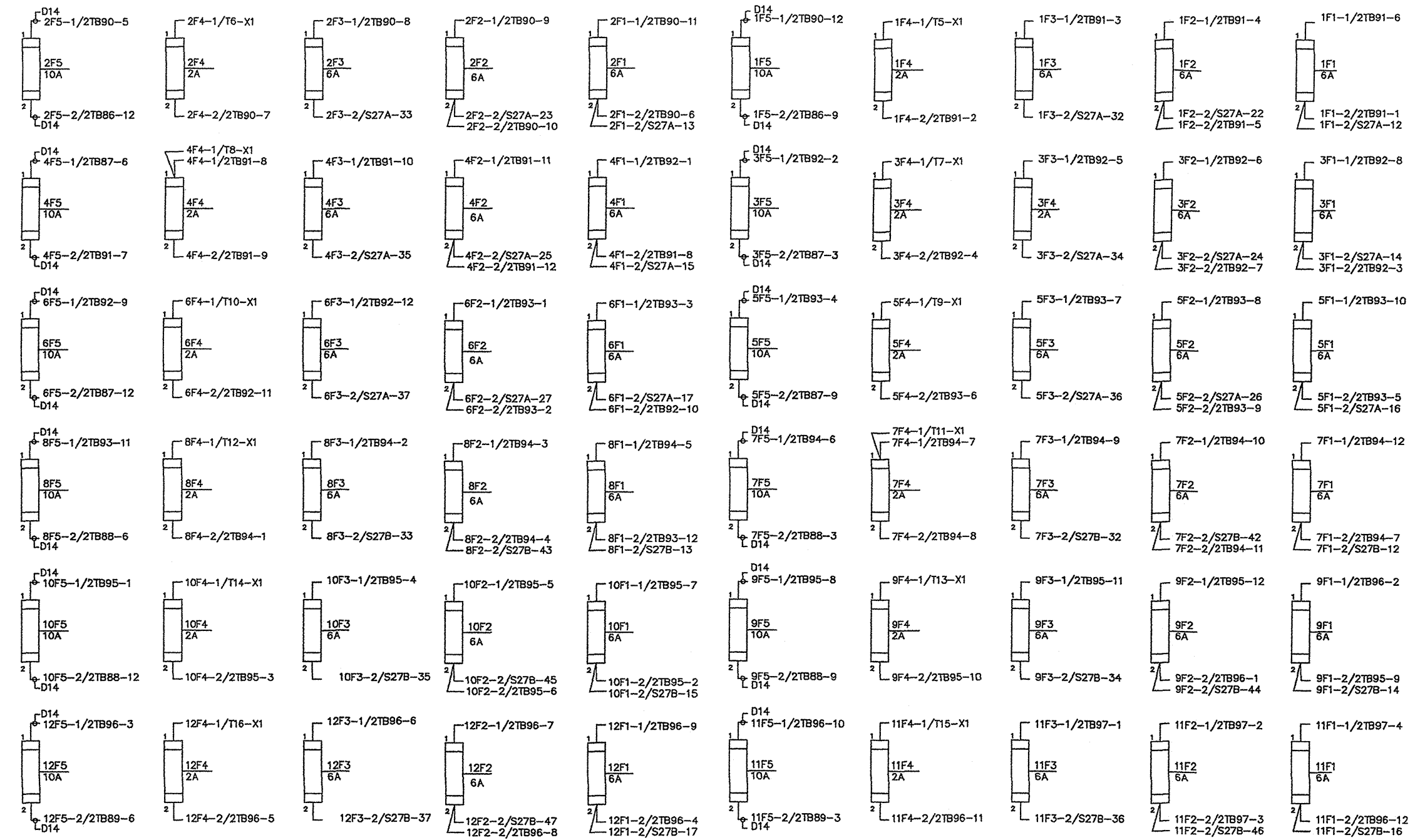


S34		S35	
	X	X	
S34-2/PD5-L	2	5	S35-2/PD6-L
S34-3/PD5-G	3	6	S35-3/PD6-G

FRONT DOOR REAR VIEW
 PANEL-"J" UNIT-2

NOTE:
 DDG 52-53 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 5 of 16)

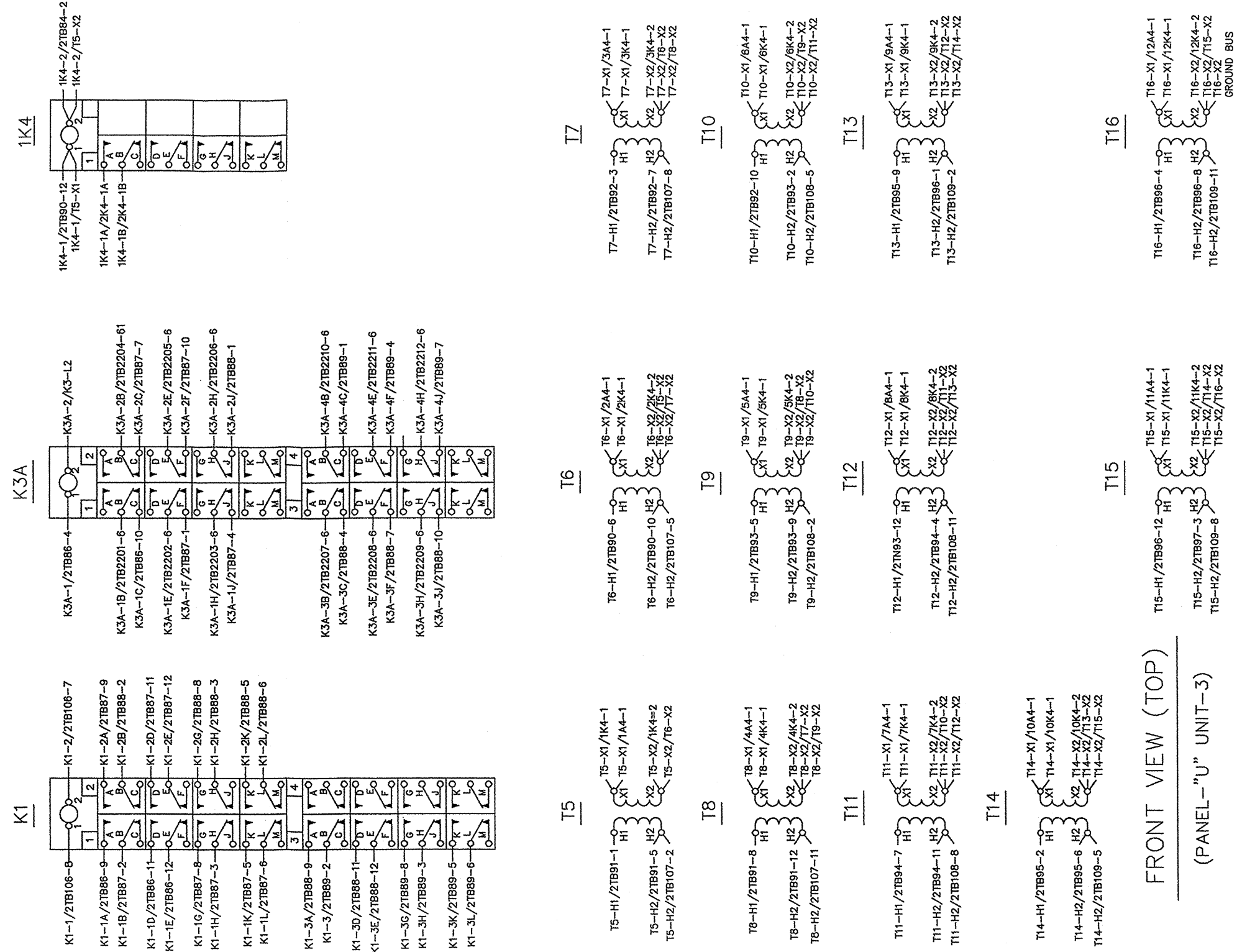


S34		S35	
	X	X	
S34-2/PD5-L	2	5	S35-2/PD6-L
S34-3/PD5-G	3	6	S35-3/PD6-G

FRONT DOOR REAR VIEW
 PANEL-"J" UNIT-2

NOTE:
 DDG 54 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 5 of 16)

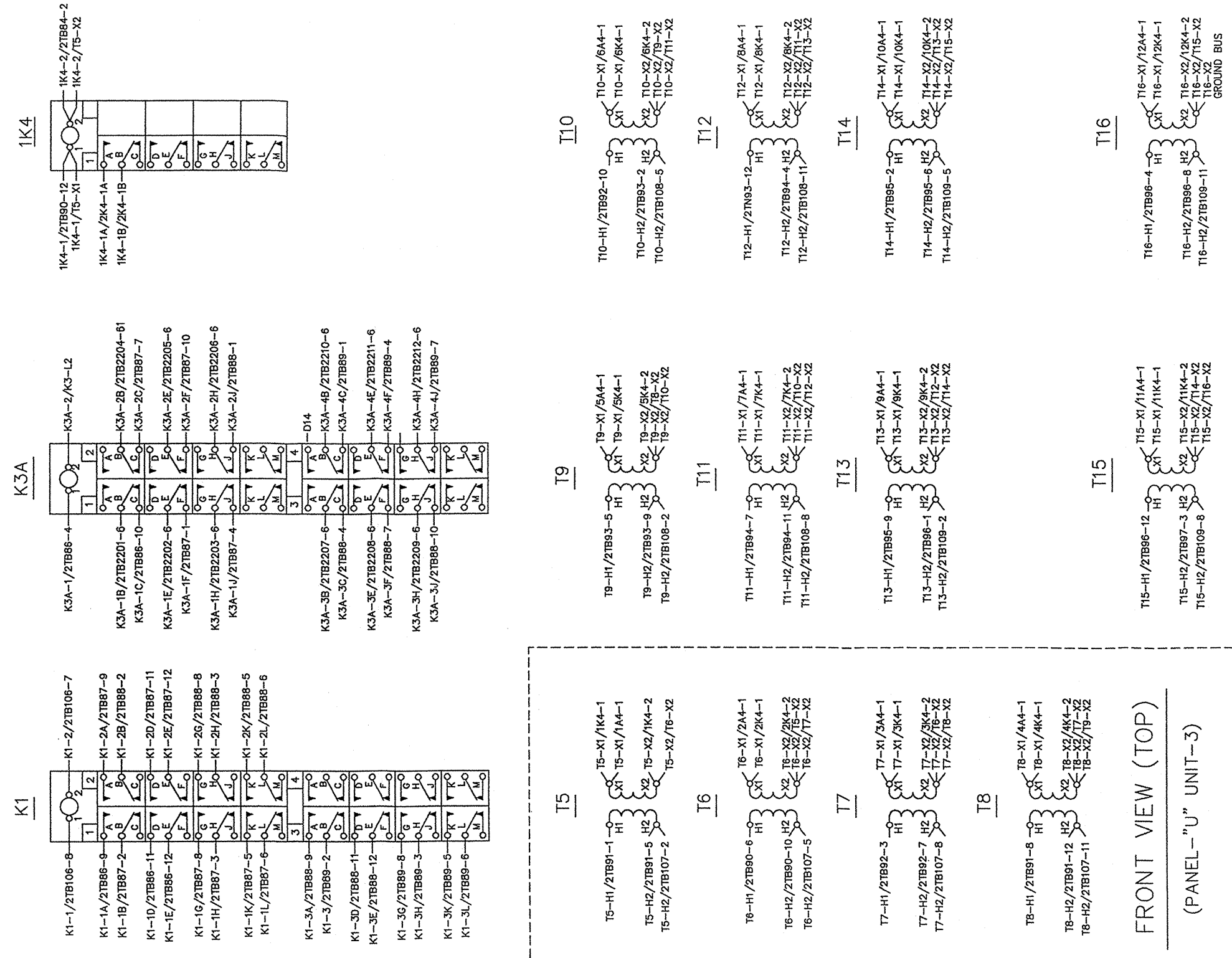


NOTE:
DDG 51 ONLY

FRONT VIEW (TOP)
PANEL - "L" UNIT-2

FRONT VIEW (TOP)
(PANEL-"U" UNIT-3)

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 6 of 16)

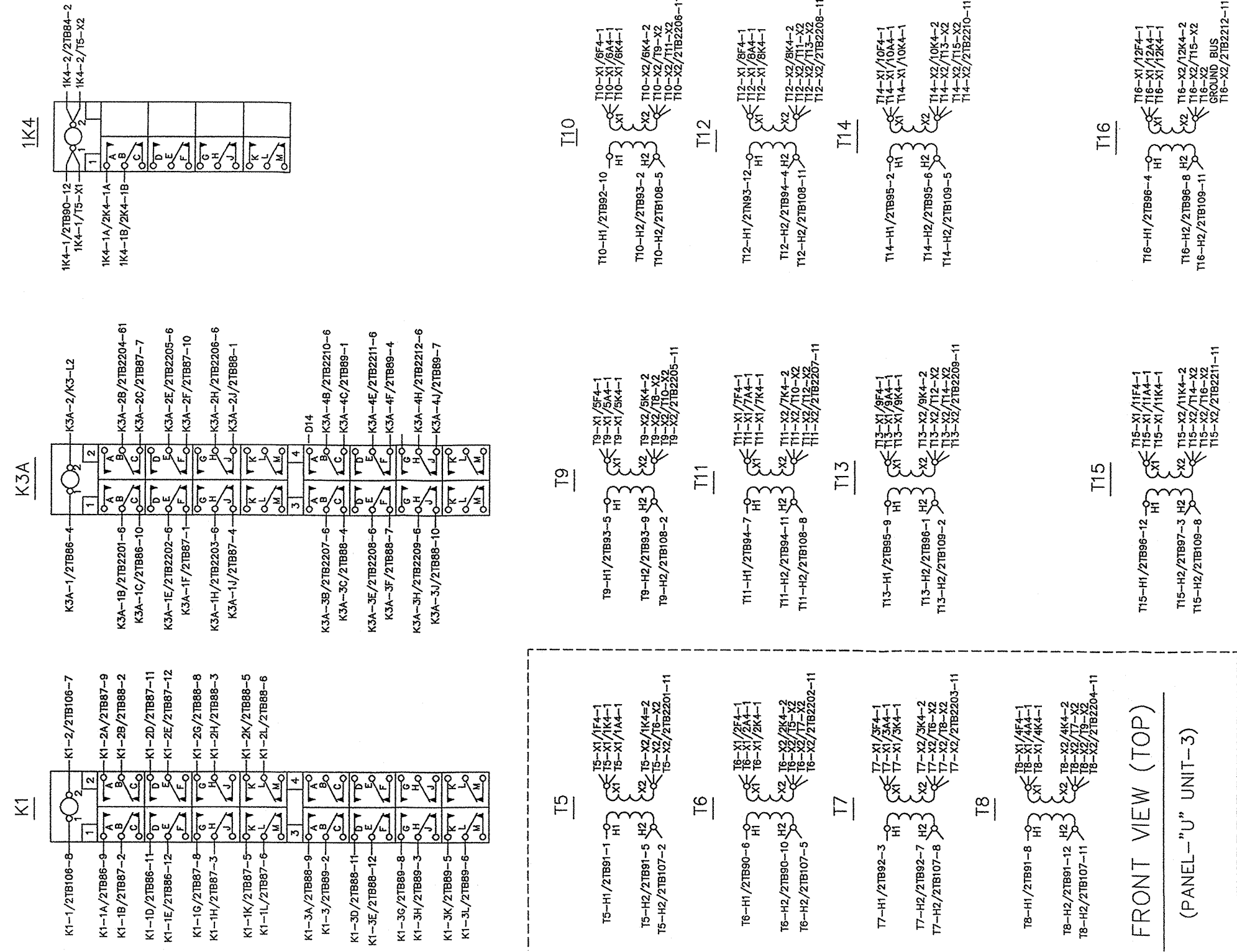


FRONT VIEW (TOP)
 PANEL - "L" UNIT-2

FRONT VIEW (TOP)
 (PANEL-"U" UNIT-3)

NOTE:
 DDG 52-53 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 6 of 16)



NOTE:
DDG 54 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 6 of 16)

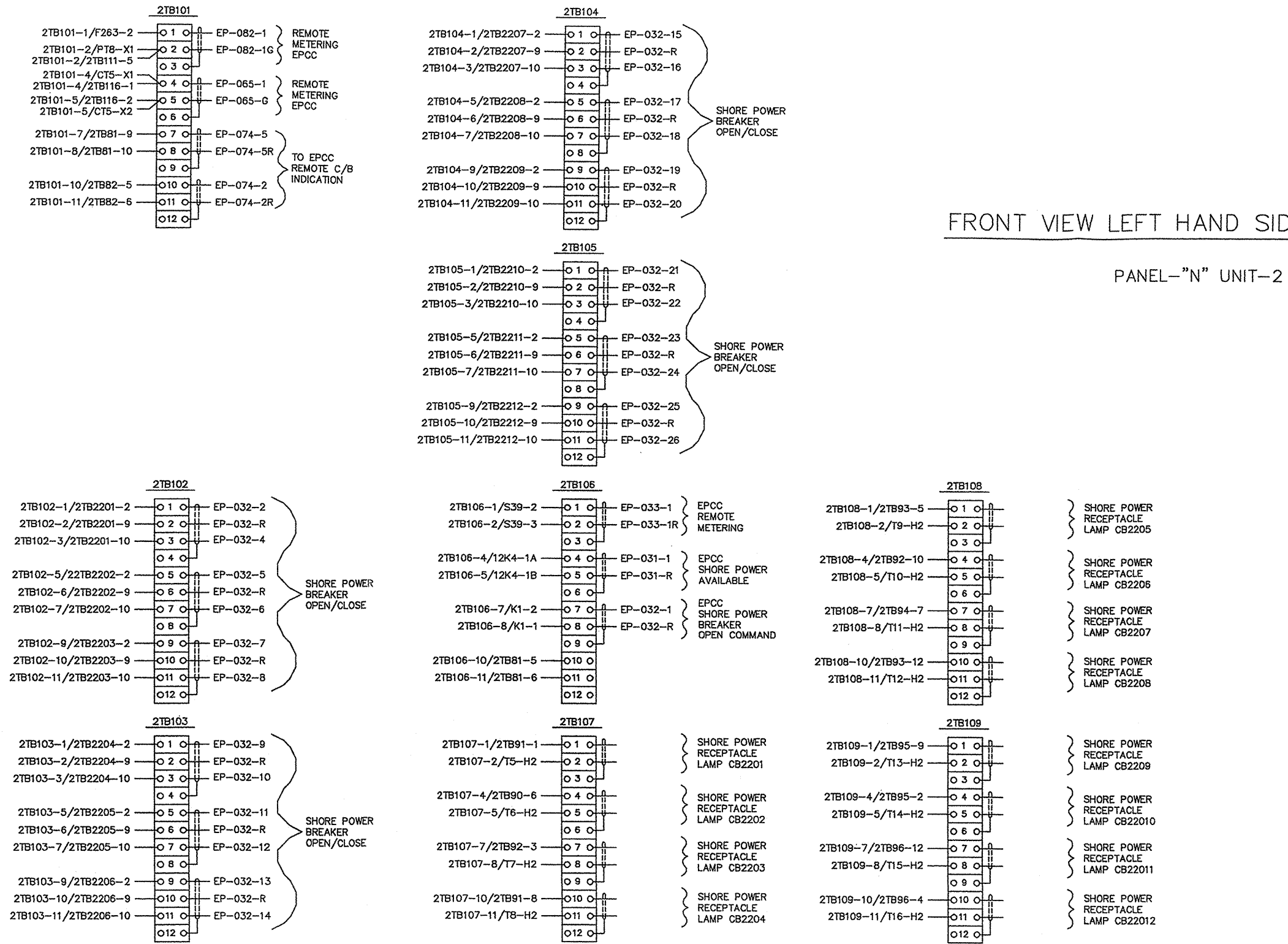
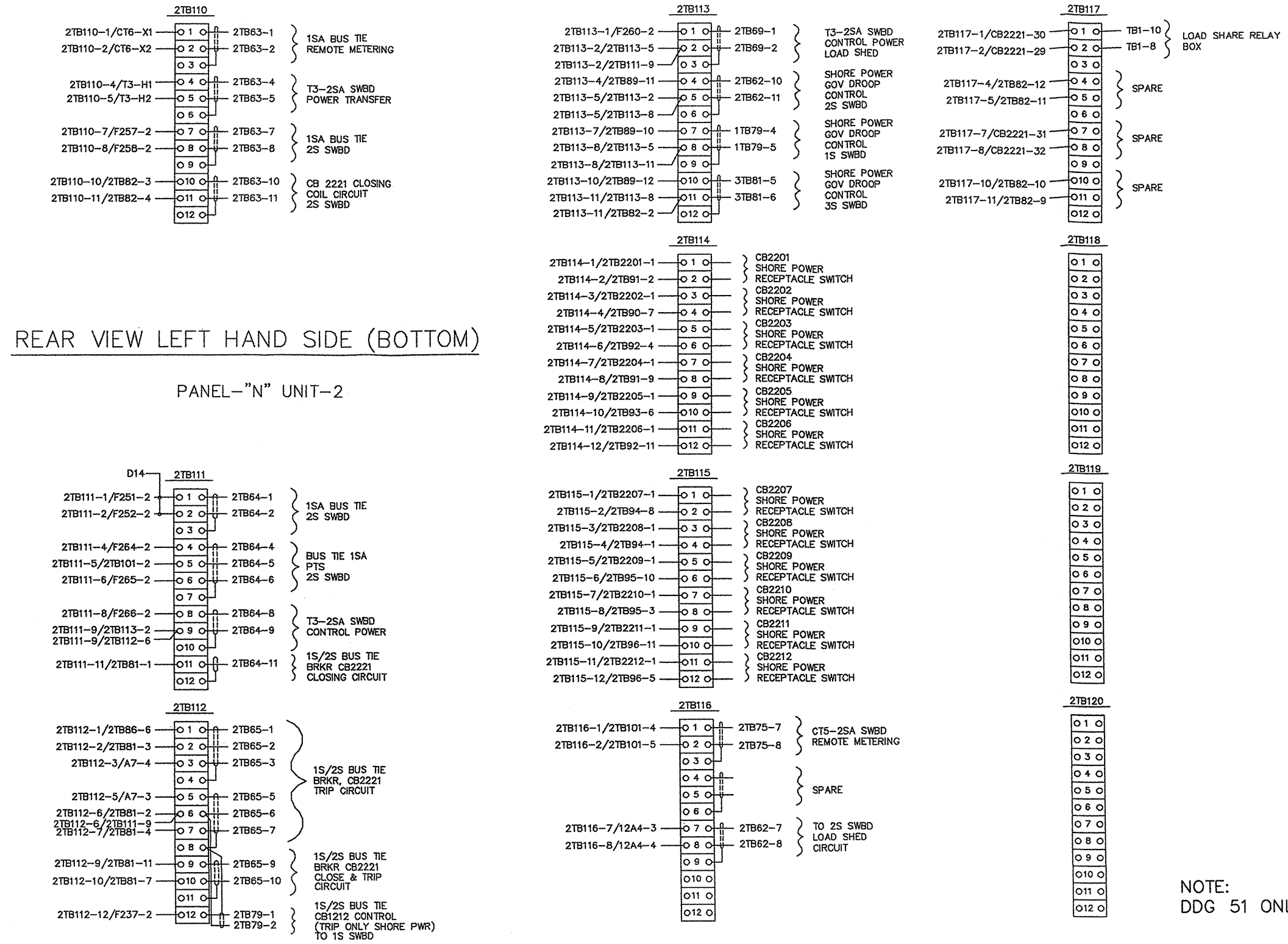


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 7 of 16)



NOTE:
DDG 51 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 8 of 16)

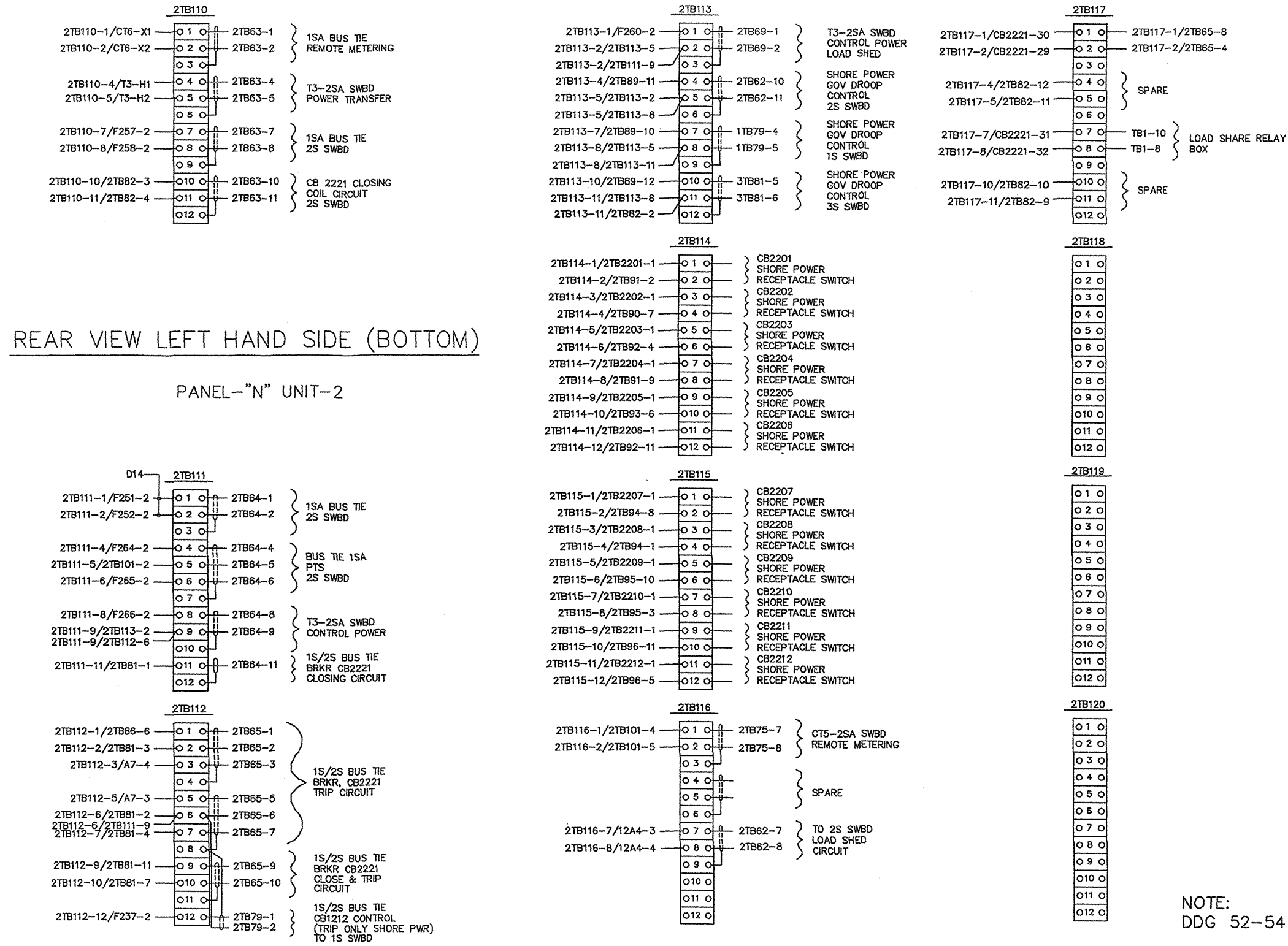
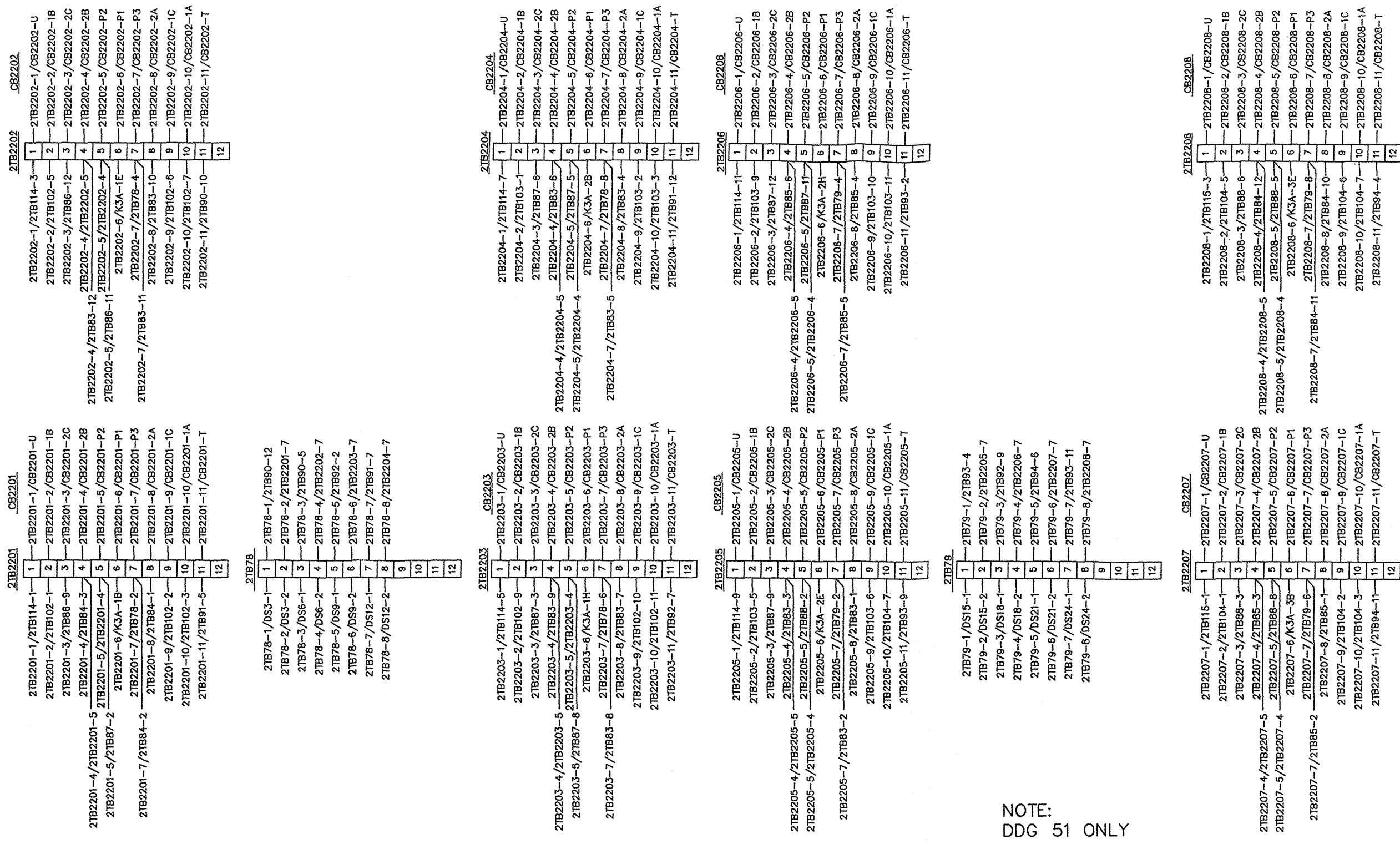


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 8 of 16)



NOTE:
DDG 51 ONLY

FRONT DOOR VIEW
PANEL -- "A" UNIT--1

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 9 of 16)

2TB2201		CB2201	
1	2TB2201-1/2TB114-1	1	2TB2201-1/CB2201-U
2	2TB2201-2/2TB102-1	2	2TB2201-2/CB2201-1B
3	2TB2201-3/2TB86-9	3	2TB2201-3/CB2201-2C
4	2TB2201-4/2TB84-3	4	2TB2201-4/CB2201-2B
5	2TB2201-5/2TB2201-4	5	2TB2201-5/CB2201-P2
6	2TB2201-6/K3A-1B	6	2TB2201-6/CB2201-F1
7	2TB2201-7/2TB78-2	7	2TB2201-7/CB2201-F3
8	2TB2201-8/2TB84-1	8	2TB2201-8/CB2201-2A
9	2TB2201-9/2TB102-2	9	2TB2201-9/CB2201-1C
10	2TB2201-10/2TB102-3	10	2TB2201-10/CB2201-1A
11	2TB2201-11/2TB2201-7	11	2TB2201-11/CB2201-T
12		12	

2TB2202		CB2202	
1	2TB2202-1/2TB114-3	1	2TB2202-1/CB2202-U
2	2TB2202-2/2TB102-5	2	2TB2202-2/CB2202-1B
3	2TB2202-3/2TB86-12	3	2TB2202-3/CB2202-2C
4	2TB2202-4/2TB84-5	4	2TB2202-4/CB2202-2B
5	2TB2202-5/2TB2202-4	5	2TB2202-5/CB2202-P2
6	2TB2202-6/K3A-1E	6	2TB2202-6/CB2202-F1
7	2TB2202-7/2TB78-4	7	2TB2202-7/CB2202-F3
8	2TB2202-8/2TB83-10	8	2TB2202-8/CB2202-2A
9	2TB2202-9/2TB102-6	9	2TB2202-9/CB2202-1C
10	2TB2202-10/2TB102-7	10	2TB2202-10/CB2202-1A
11	2TB2202-11/2TB90-10	11	2TB2202-11/CB2202-T
12		12	

2TB78	
1	2TB78-1/DS3-1
2	2TB78-2/DS3-2
3	2TB78-3/DS6-1
4	2TB78-4/DS6-2
5	2TB78-5/DS9-1
6	2TB78-6/DS9-2
7	2TB78-7/DS12-1
8	2TB78-8/DS12-2
9	
10	
11	
12	

2TB2203		CB2203	
1	2TB2203-1/2TB114-5	1	2TB2203-1/CB2203-U
2	2TB2203-2/2TB102-9	2	2TB2203-2/CB2203-1B
3	2TB2203-3/2TB87-3	3	2TB2203-3/CB2203-2C
4	2TB2203-4/2TB83-9	4	2TB2203-4/CB2203-2B
5	2TB2203-5/2TB2203-4	5	2TB2203-5/CB2203-P2
6	2TB2203-6/K3A-1H	6	2TB2203-6/CB2203-F1
7	2TB2203-7/2TB78-6	7	2TB2203-7/CB2203-F3
8	2TB2203-8/2TB83-7	8	2TB2203-8/CB2203-2A
9	2TB2203-9/2TB102-10	9	2TB2203-9/CB2203-1C
10	2TB2203-10/2TB102-11	10	2TB2203-10/CB2203-1A
11	2TB2203-11/2TB2203-7	11	2TB2203-11/CB2203-T
12		12	

2TB2205		CB2205	
1	2TB2205-1/2TB114-9	1	2TB2205-1/CB2205-U
2	2TB2205-2/2TB103-5	2	2TB2205-2/CB2205-1B
3	2TB2205-3/2TB87-9	3	2TB2205-3/CB2205-2C
4	2TB2205-4/2TB83-3	4	2TB2205-4/CB2205-2B
5	2TB2205-5/2TB88-2	5	2TB2205-5/CB2205-P2
6	2TB2205-6/K3A-2E	6	2TB2205-6/CB2205-F1
7	2TB2205-7/2TB78-2	7	2TB2205-7/CB2205-F3
8	2TB2205-8/2TB83-1	8	2TB2205-8/CB2205-2A
9	2TB2205-9/2TB103-6	9	2TB2205-9/CB2205-1C
10	2TB2205-10/2TB104-7	10	2TB2205-10/CB2205-1A
11	2TB2205-11/2TB2205-7	11	2TB2205-11/CB2205-T
12		12	

2TB79	
1	2TB79-1/DS15-1
2	2TB79-2/DS15-2
3	2TB79-3/DS18-1
4	2TB79-4/DS18-2
5	2TB79-5/DS21-1
6	2TB79-6/DS21-2
7	2TB79-7/DS24-1
8	2TB79-8/DS24-2
9	
10	
11	
12	

NOTE:
DDG 52-53 ONLY

2TB2204		CB2204	
1	2TB2204-1/2TB114-7	1	2TB2204-1/CB2204-U
2	2TB2204-2/2TB103-1	2	2TB2204-2/CB2204-1B
3	2TB2204-3/2TB87-6	3	2TB2204-3/CB2204-2C
4	2TB2204-4/2TB83-6	4	2TB2204-4/CB2204-2B
5	2TB2204-5/2TB87-5	5	2TB2204-5/CB2204-P2
6	2TB2204-6/K3A-2B	6	2TB2204-6/CB2204-F1
7	2TB2204-7/2TB78-8	7	2TB2204-7/CB2204-F3
8	2TB2204-8/2TB83-4	8	2TB2204-8/CB2204-2A
9	2TB2204-9/2TB103-2	9	2TB2204-9/CB2204-1C
10	2TB2204-10/2TB103-3	10	2TB2204-10/CB2204-1A
11	2TB2204-11/2TB2204-7	11	2TB2204-11/CB2204-T
12		12	

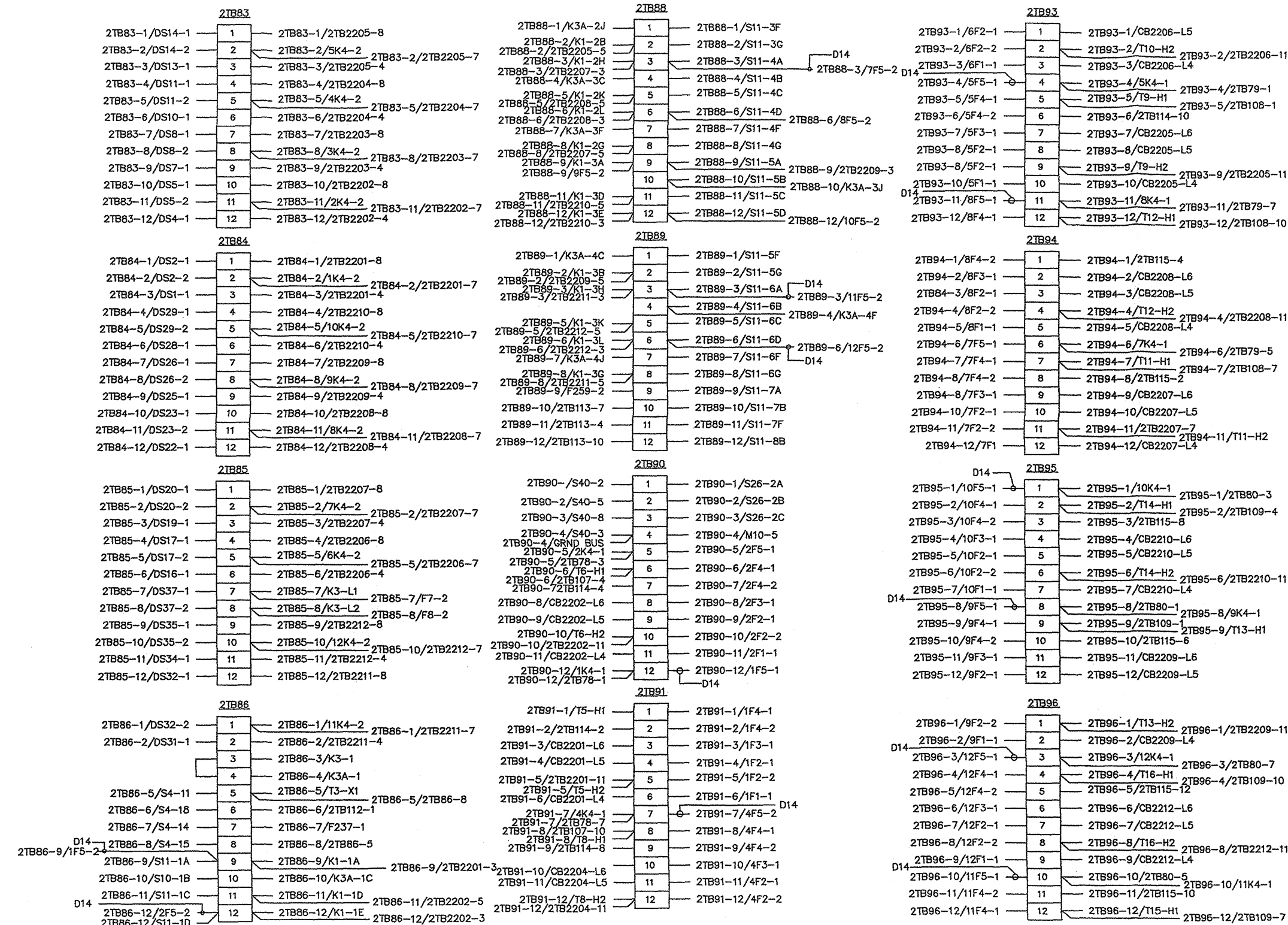
2TB2206		CB2206	
1	2TB2206-1/2TB114-11	1	2TB2206-1/CB2206-U
2	2TB2206-2/2TB103-9	2	2TB2206-2/CB2206-1B
3	2TB2206-3/2TB87-12	3	2TB2206-3/CB2206-2C
4	2TB2206-4/2TB85-6	4	2TB2206-4/CB2206-2B
5	2TB2206-5/2TB87-11	5	2TB2206-5/CB2206-P2
6	2TB2206-6/K3A-2H	6	2TB2206-6/CB2206-F1
7	2TB2206-7/2TB78-4	7	2TB2206-7/CB2206-F3
8	2TB2206-8/2TB85-4	8	2TB2206-8/CB2206-2A
9	2TB2206-9/2TB103-10	9	2TB2206-9/CB2206-1C
10	2TB2206-10/2TB103-11	10	2TB2206-10/CB2206-1A
11	2TB2206-11/2TB2206-7	11	2TB2206-11/CB2206-T
12		12	

2TB2207		CB2207	
1	2TB2207-1/2TB115-1	1	2TB2207-1/CB2207-U
2	2TB2207-2/2TB104-1	2	2TB2207-2/CB2207-1B
3	2TB2207-3/2TB88-3	3	2TB2207-3/CB2207-2C
4	2TB2207-4/2TB84-12	4	2TB2207-4/CB2207-2B
5	2TB2207-5/2TB88-8	5	2TB2207-5/CB2207-P2
6	2TB2207-6/K3A-3B	6	2TB2207-6/CB2207-F1
7	2TB2207-7/2TB79-6	7	2TB2207-7/CB2207-F3
8	2TB2207-8/2TB85-1	8	2TB2207-8/CB2207-2A
9	2TB2207-9/2TB104-2	9	2TB2207-9/CB2207-1C
10	2TB2207-10/2TB104-3	10	2TB2207-10/CB2207-1A
11	2TB2207-11/2TB2207-7	11	2TB2207-11/CB2207-T
12		12	

2TB2208		CB2208	
1	2TB2208-1/2TB115-3	1	2TB2208-1/CB2208-U
2	2TB2208-2/2TB104-5	2	2TB2208-2/CB2208-1B
3	2TB2208-3/2TB88-6	3	2TB2208-3/CB2208-2C
4	2TB2208-4/2TB84-12	4	2TB2208-4/CB2208-2B
5	2TB2208-5/2TB88-5	5	2TB2208-5/CB2208-P2
6	2TB2208-6/K3A-3E	6	2TB2208-6/CB2208-F1
7	2TB2208-7/2TB79-8	7	2TB2208-7/CB2208-F3
8	2TB2208-8/2TB84-10	8	2TB2208-8/CB2208-2A
9	2TB2208-9/2TB104-6	9	2TB2208-9/CB2208-1C
10	2TB2208-10/2TB104-7	10	2TB2208-10/CB2208-1A
11	2TB2208-11/2TB2208-7	11	2TB2208-11/CB2208-T
12		12	

FRONT DOOR VIEW
PANEL - "A" UNIT-1

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 9 of 16)



FRONT VIEW LEFT HAND SIDE (TOP)
PANEL - "K" UNIT - 2

NOTE:
DDG 51 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 10 of 16)

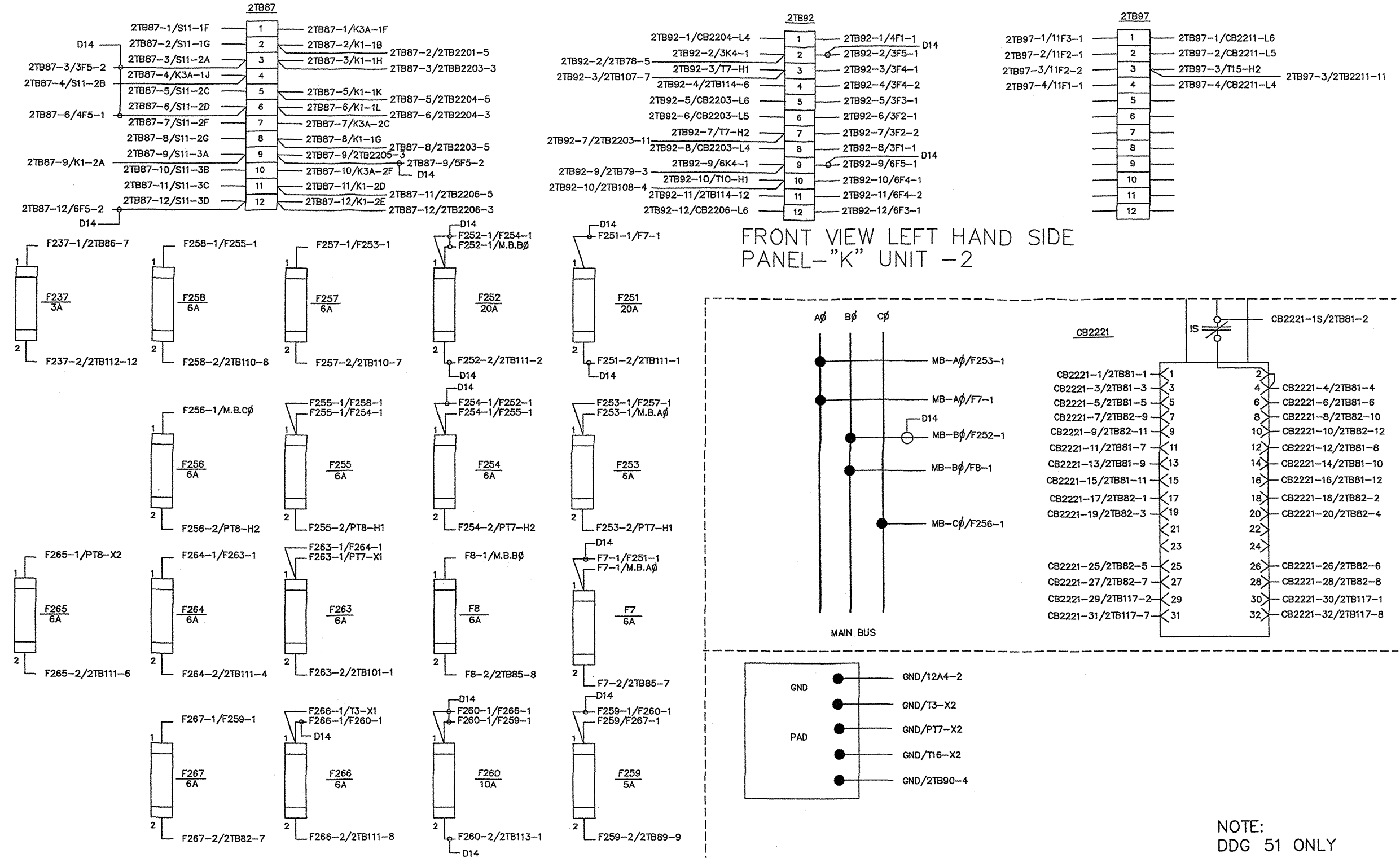


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 11 of 16)

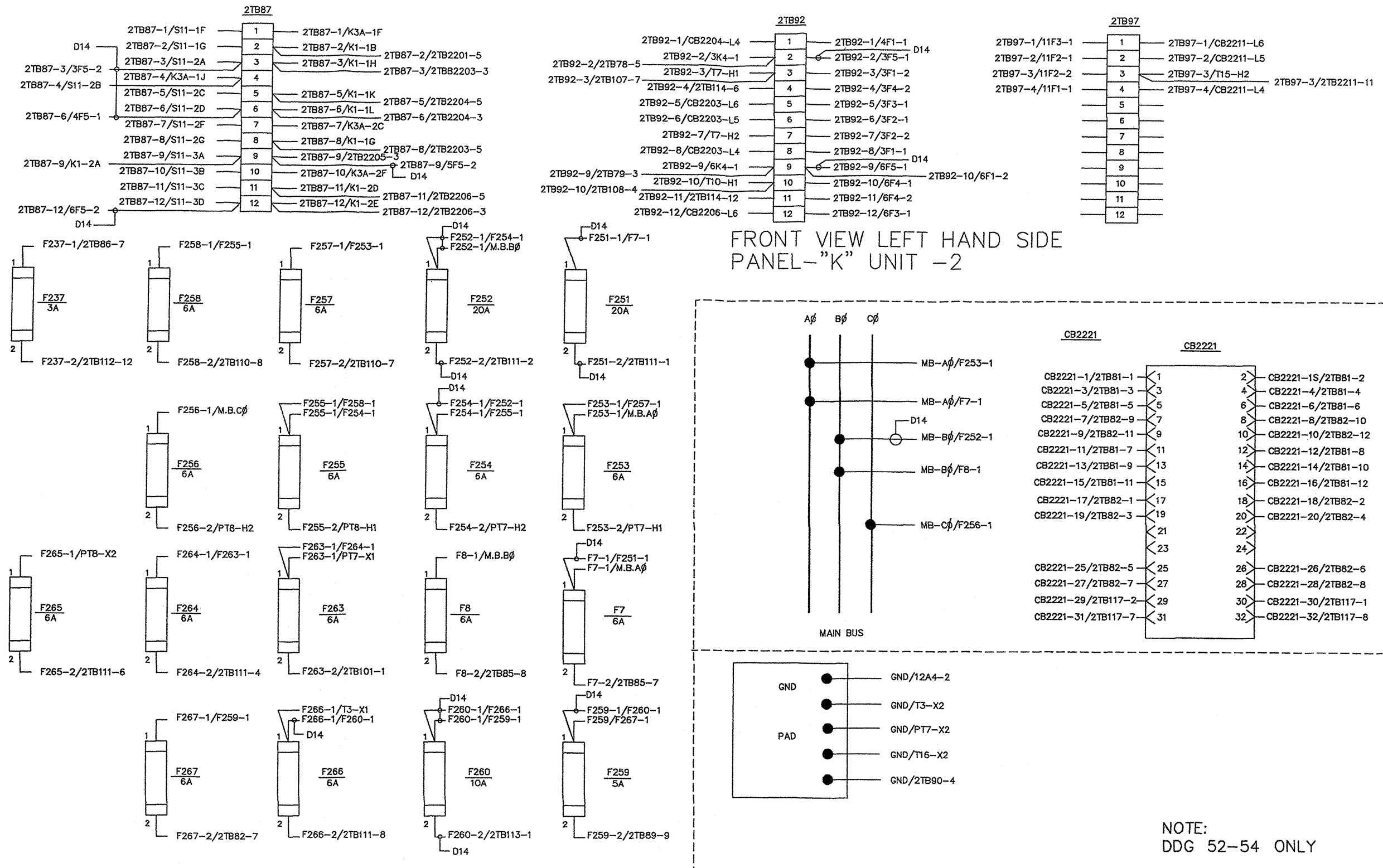
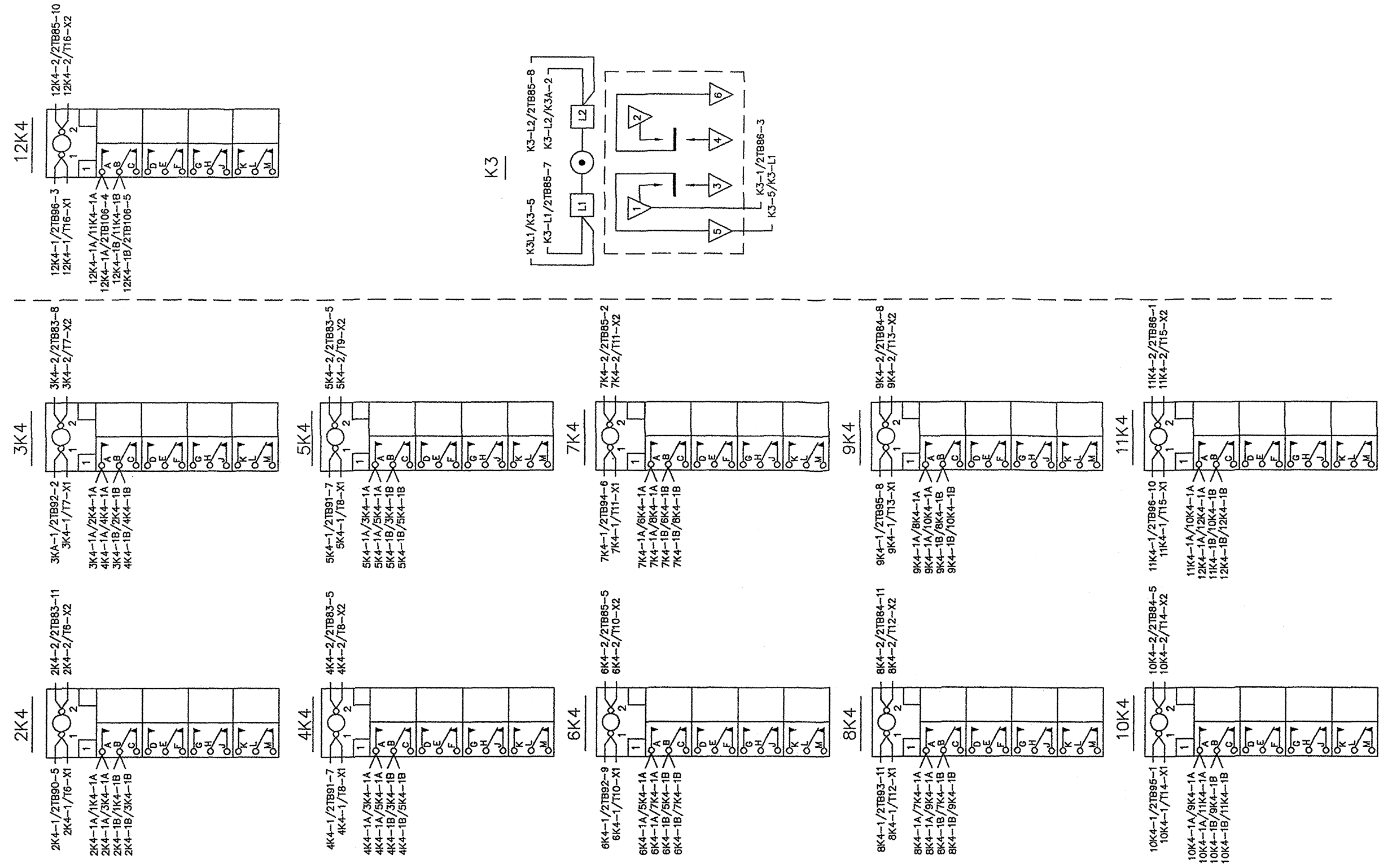


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 11 of 16)



FRONT VIEW RIGHT HAND SIDE
 PANEL-"M" UNIT-2

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 12 of 16)

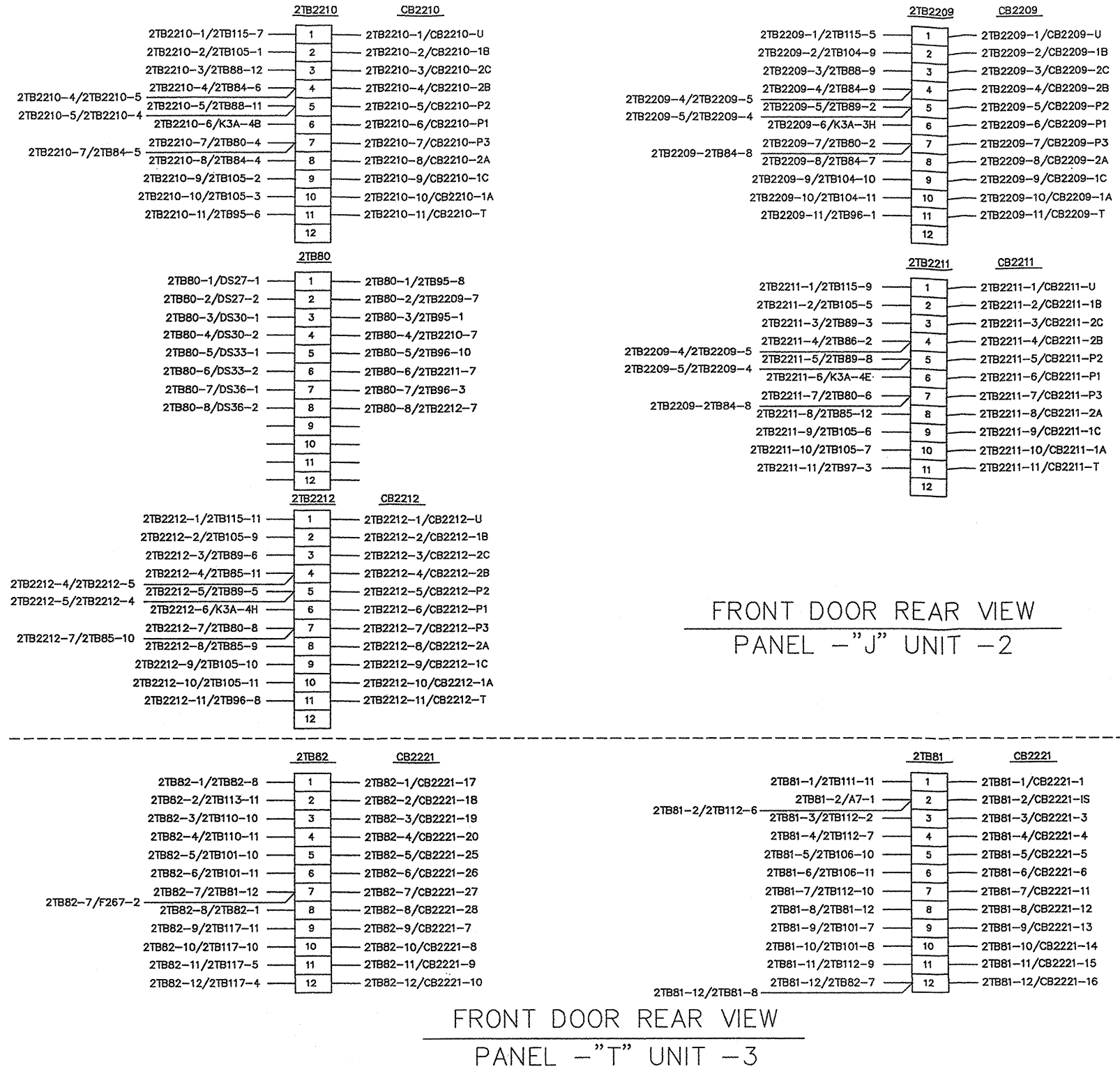
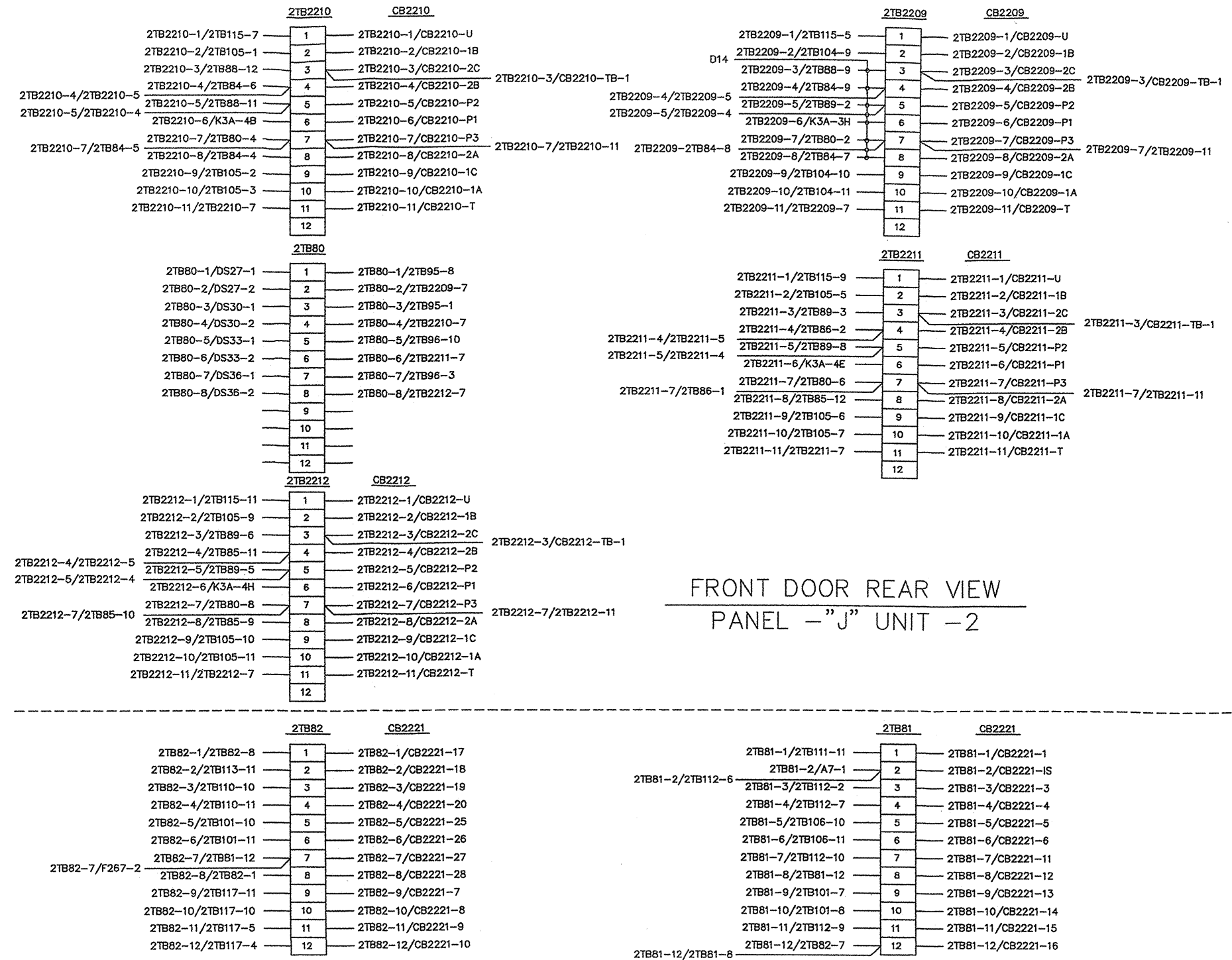


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 13 of 16)

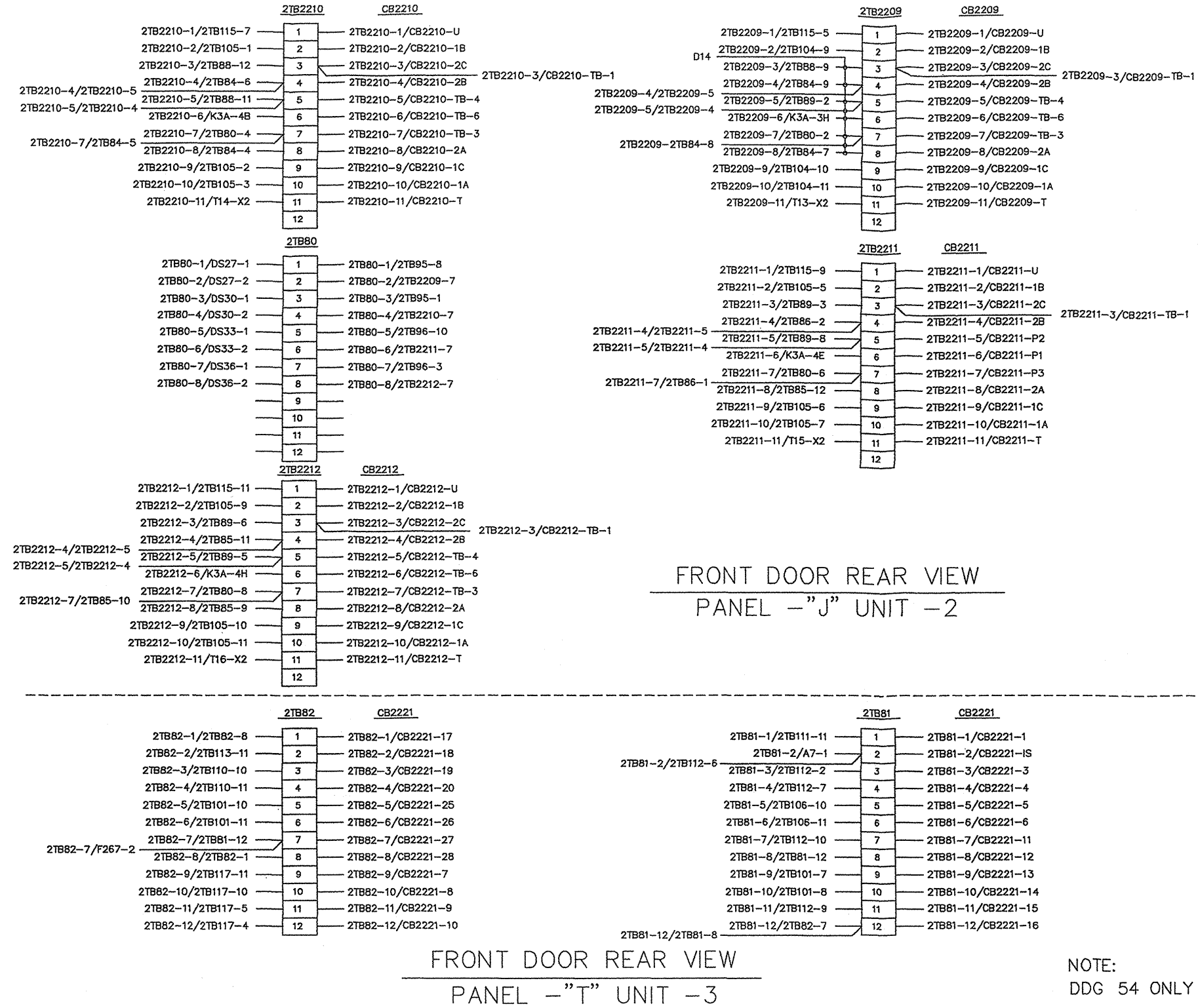


FRONT DOOR REAR VIEW
 PANEL - "J" UNIT - 2

FRONT DOOR REAR VIEW
 PANEL - "T" UNIT - 3

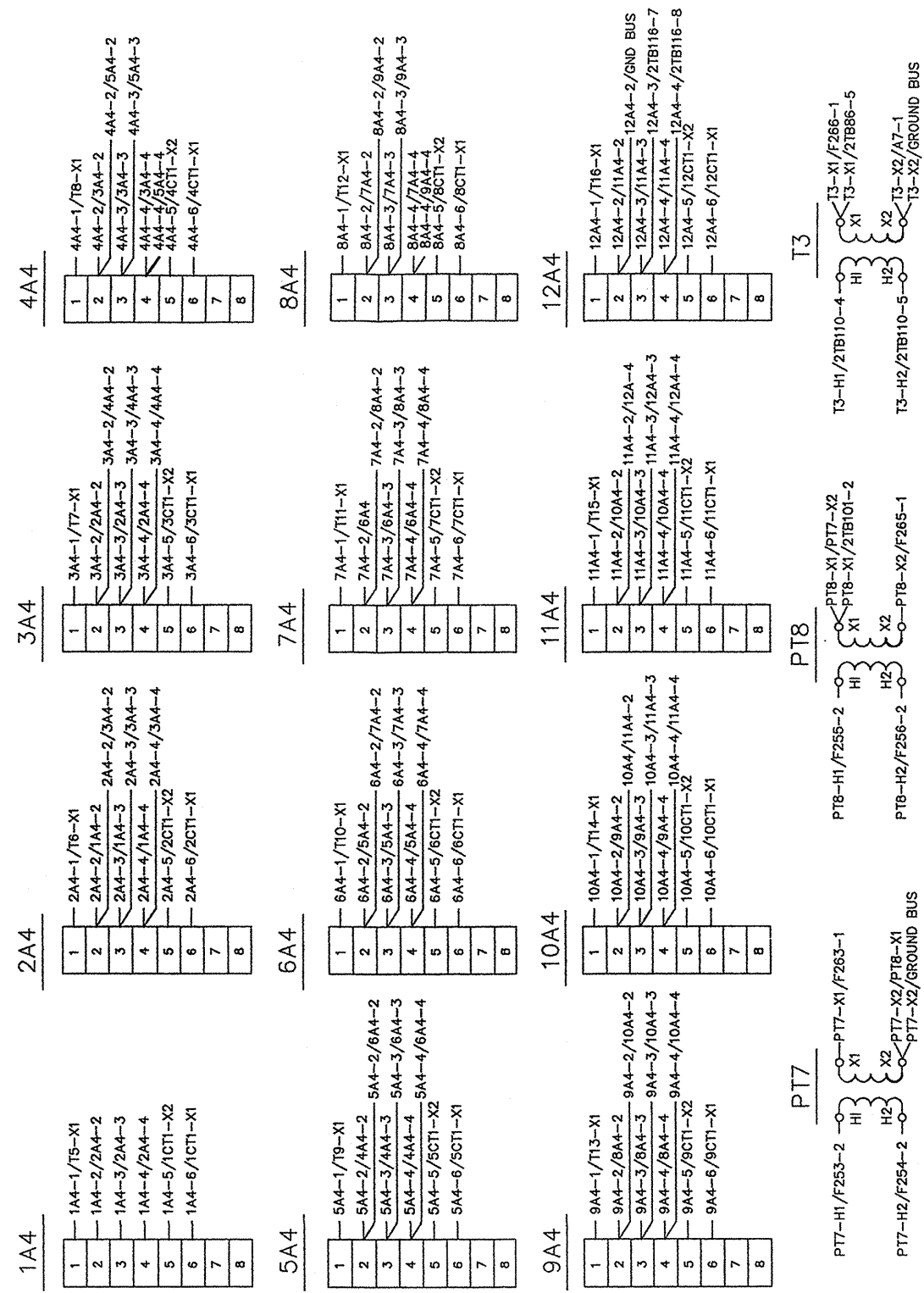
NOTE:
 DDG 52-53 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 13 of 16)



NOTE:
DDG 54 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 13 of 16)



FRONT VIEW (TOP)
PANEL - "V" UNIT - 3

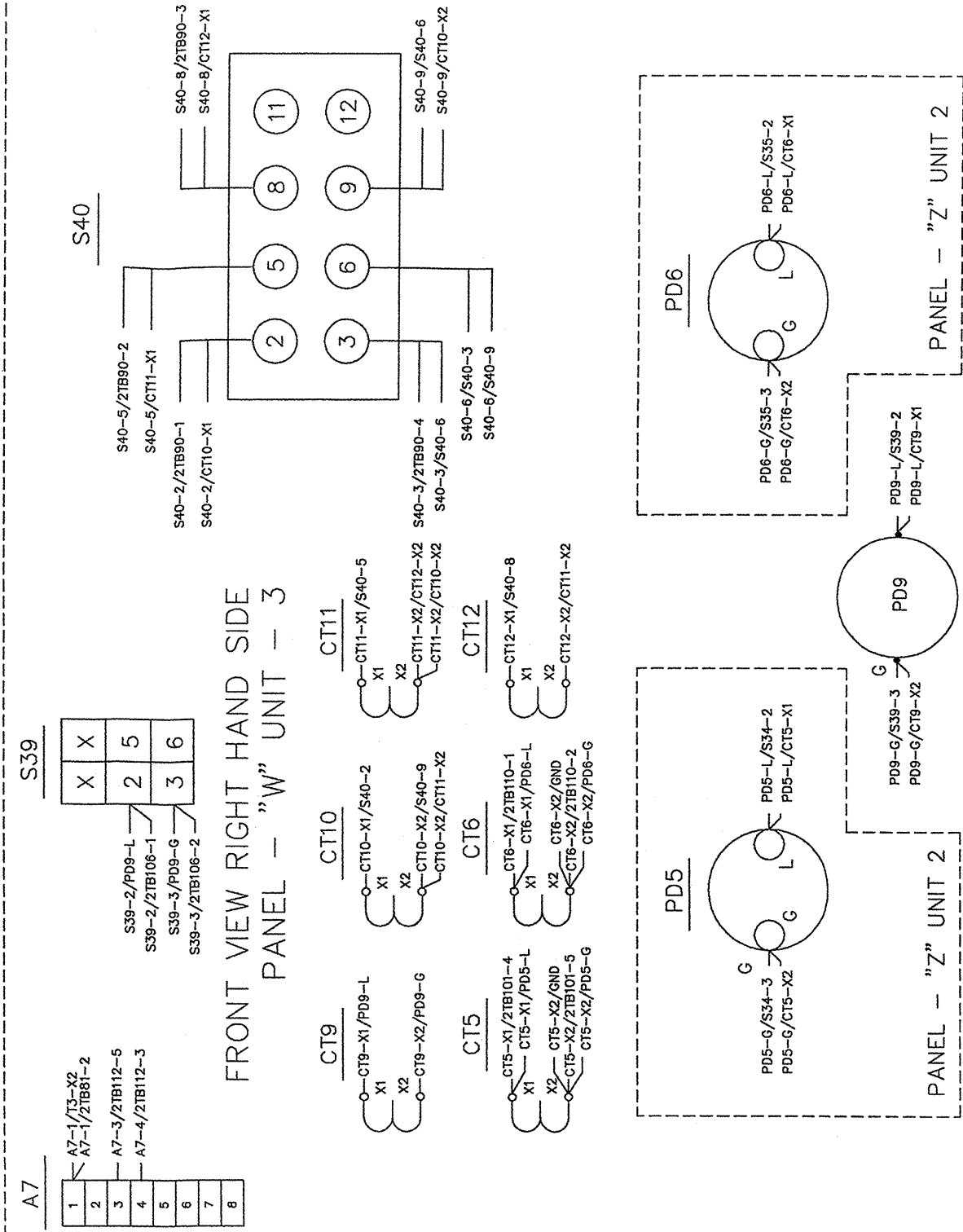
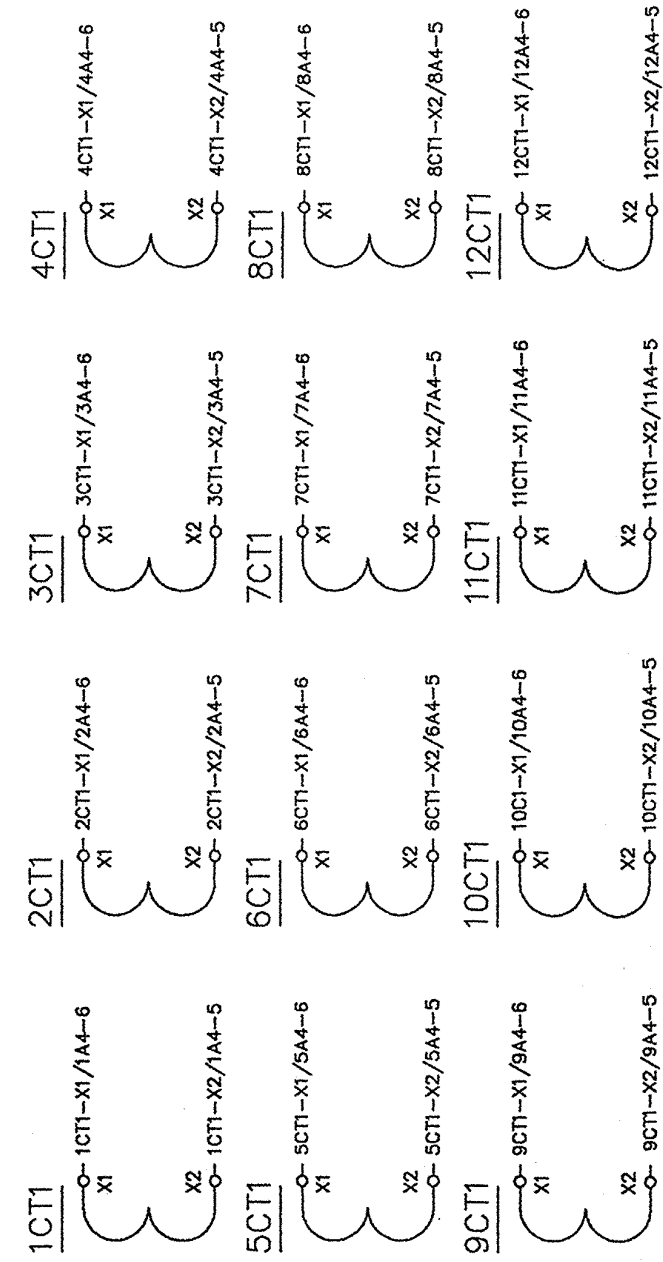
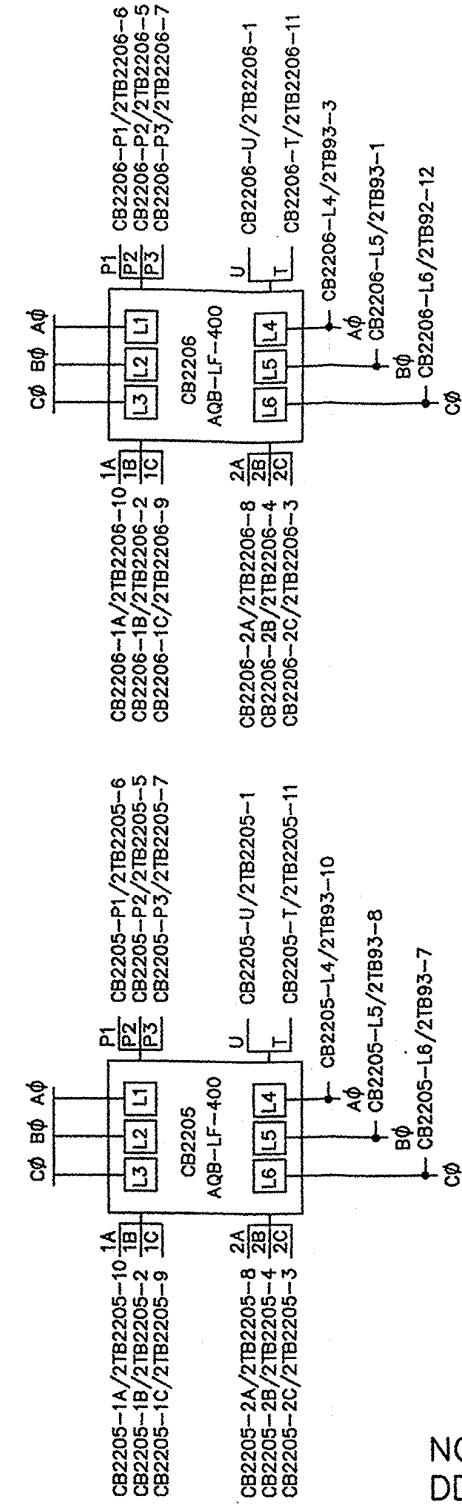
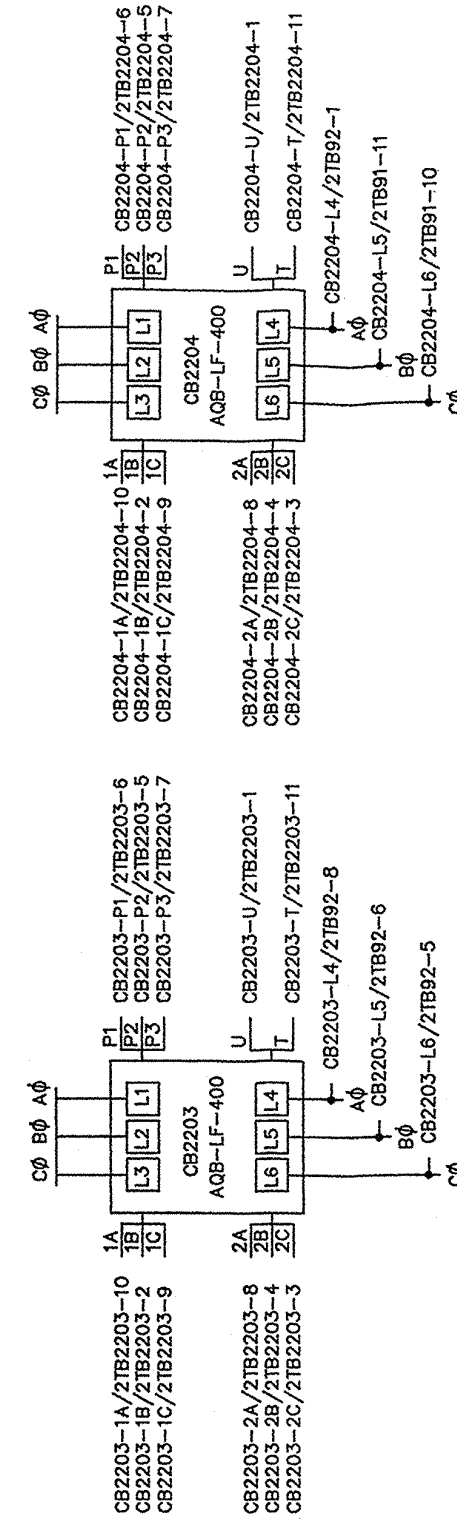
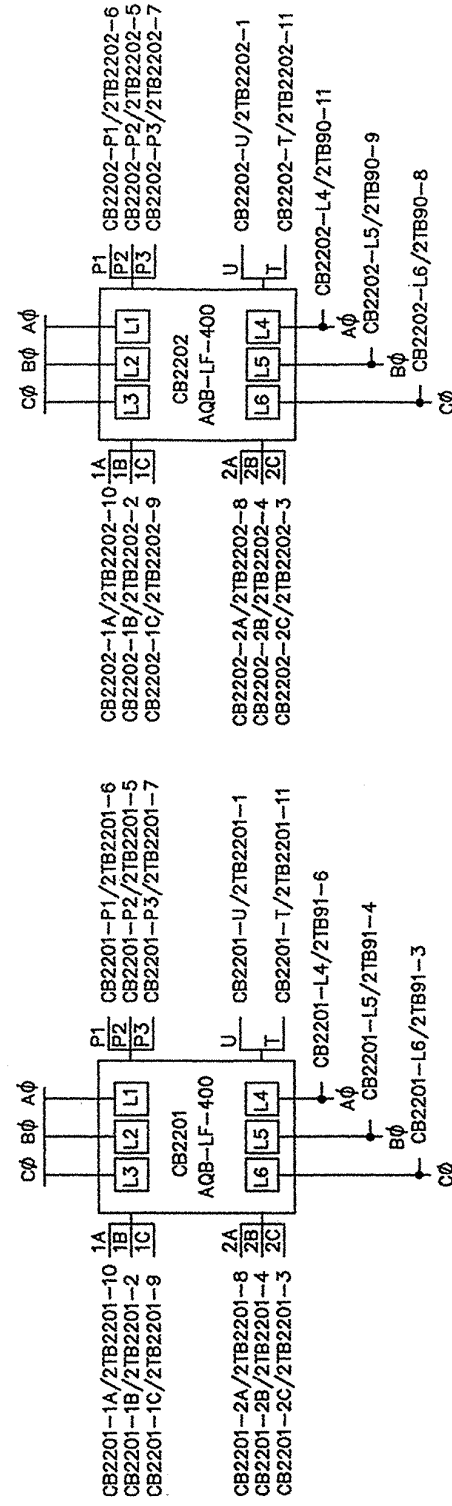


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 14 of 16)



PANEL "H" UNIT-1



PANEL "A" UNIT-1

NOTE:
DDG 51 ONLY

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 15 of 16)

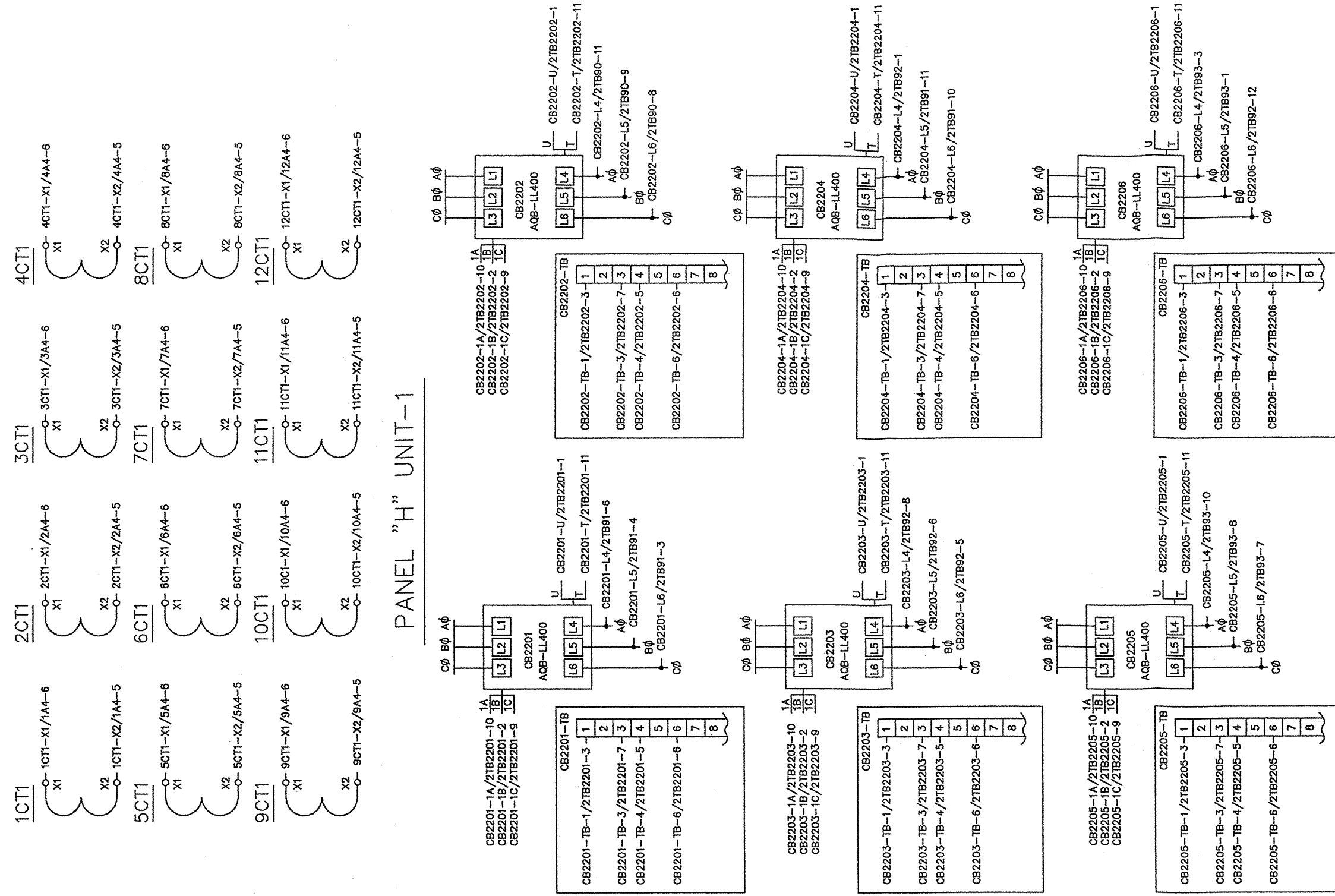
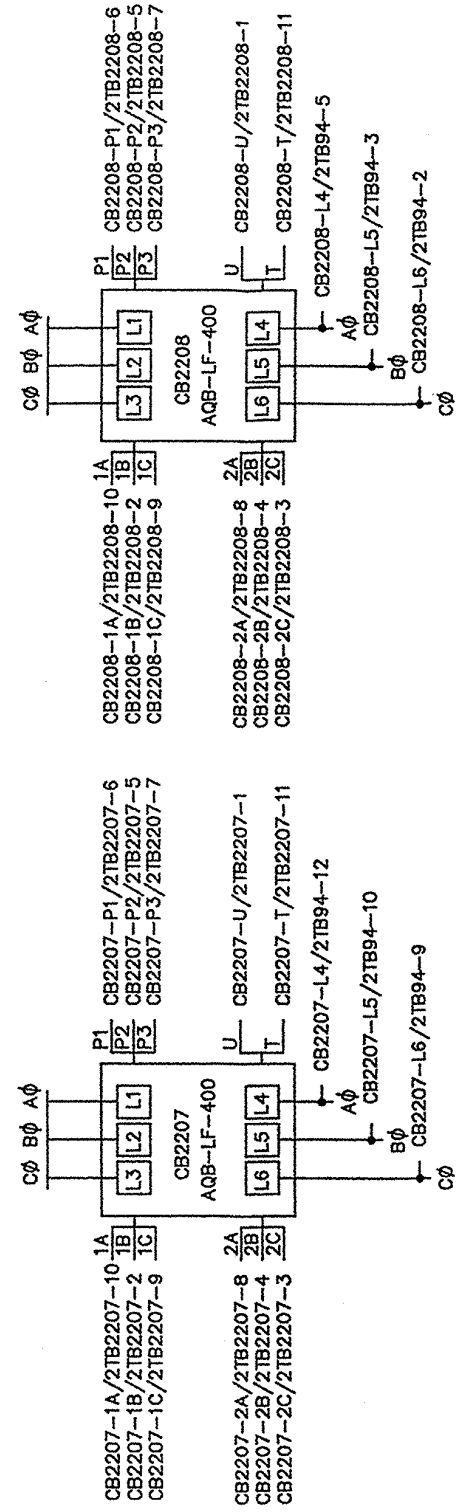
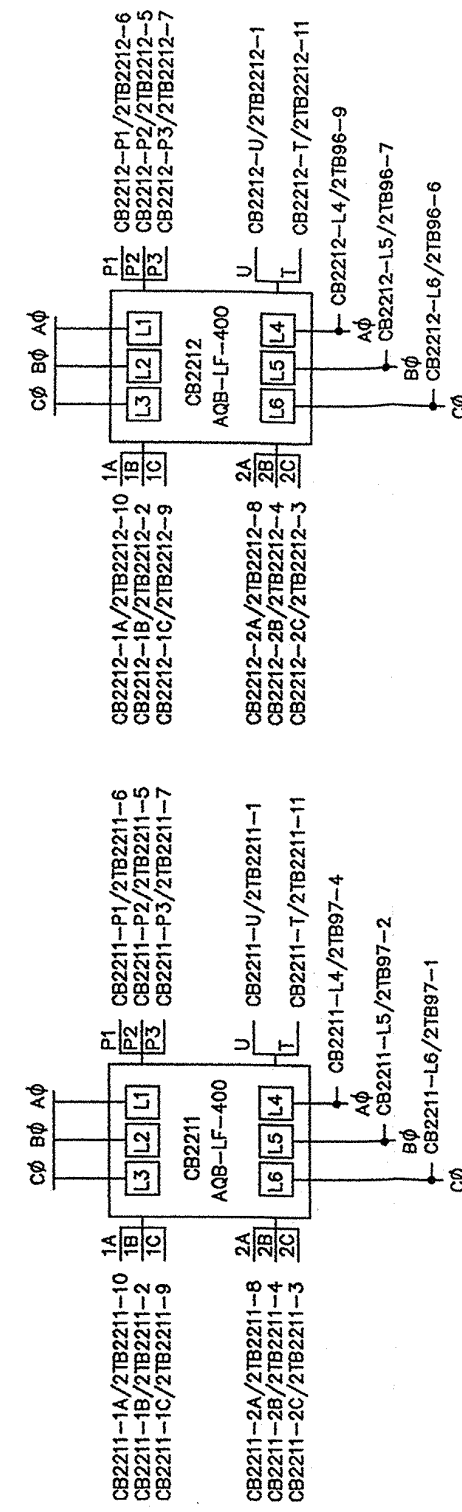
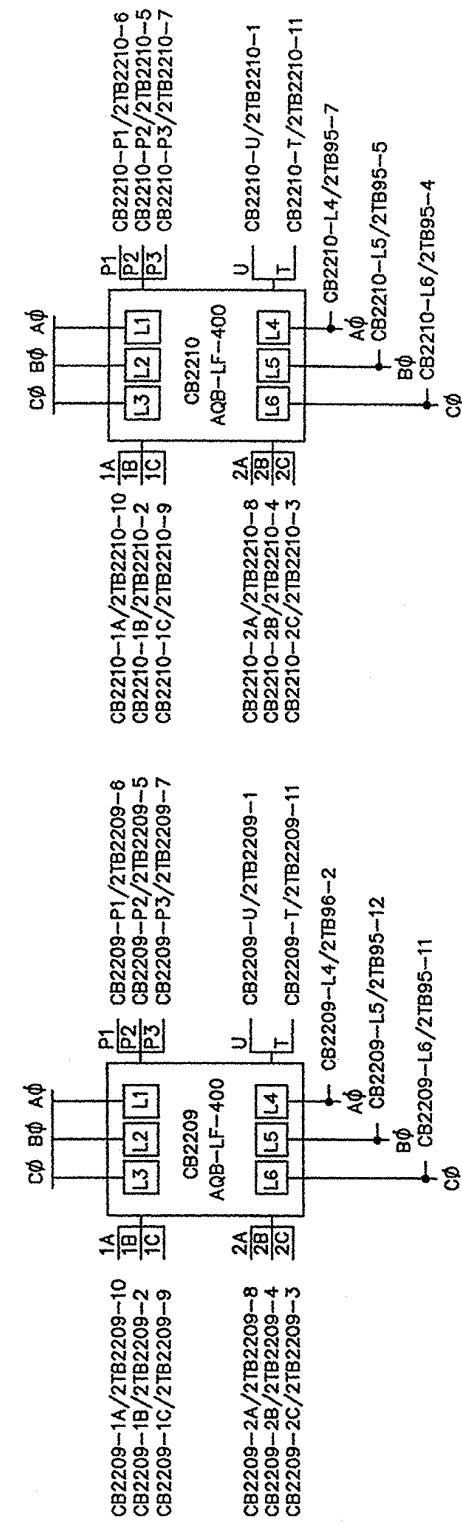


Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 15 of 16)



PANEL "A" UNIT-1

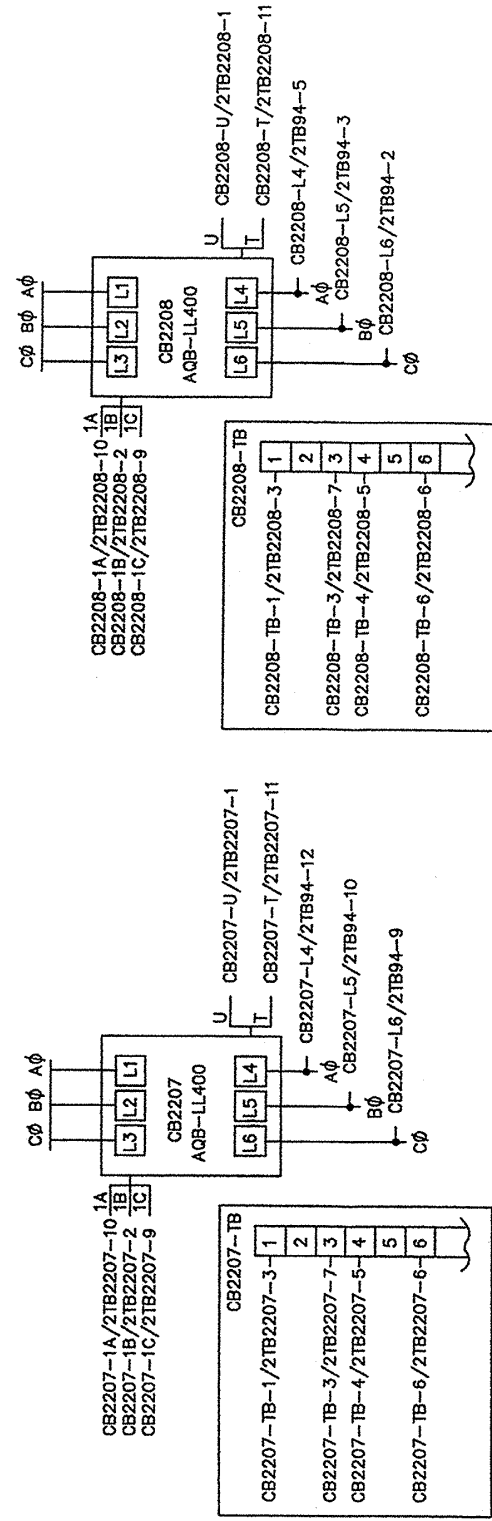
CONTINUED FROM SHEET 14



NOTE:
DDG 51 ONLY

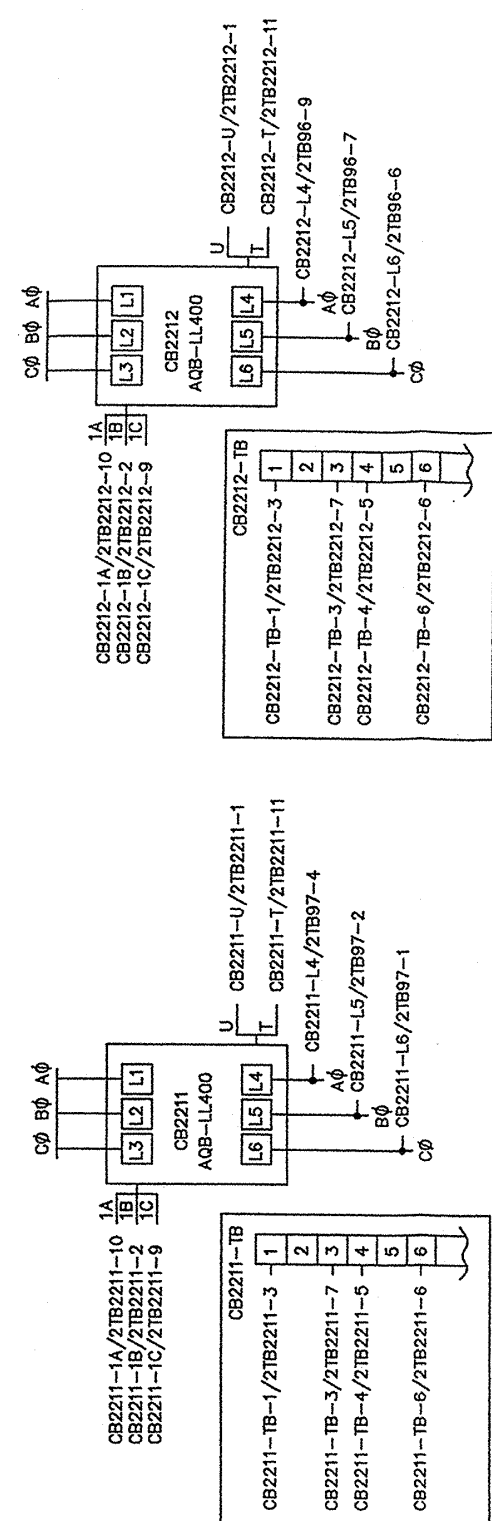
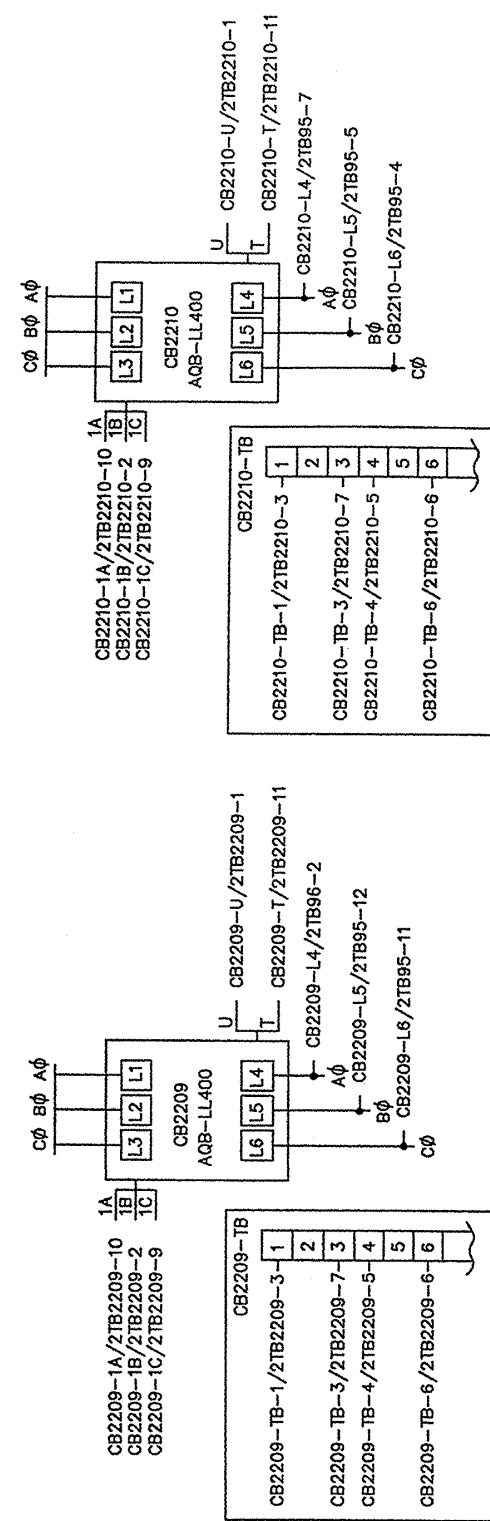
PANEL "J" UNIT-2

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 16 of 16)



PANEL "A" UNIT-1

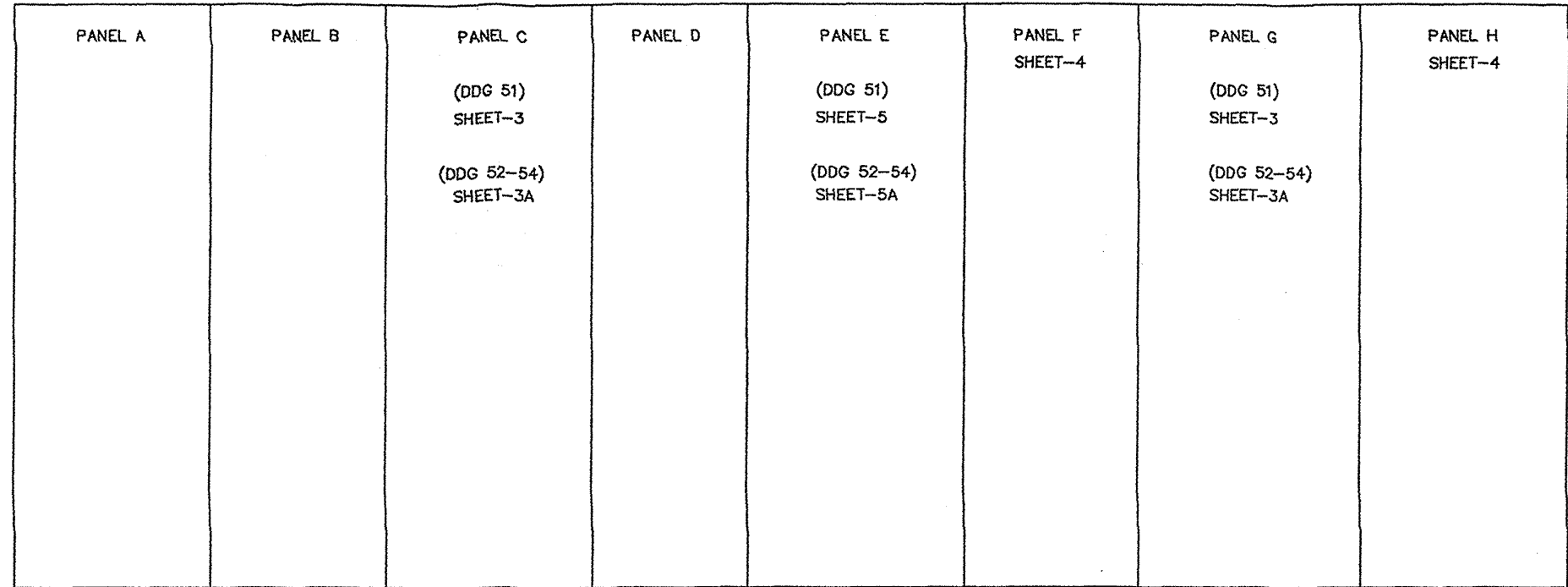
CONTINUED FROM SHEET 14



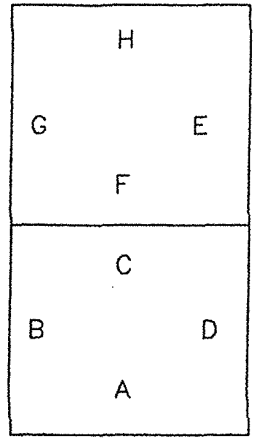
NOTE:
DDG 52-54 ONLY

PANEL "J" UNIT-2

Figure 9-6. 2SA Switchboard; Wiring Diagram (Sheet 16 of 16)



UNIT-1



UNIT-1

TOP VIEW-PANEL LOCATION SWITCHBOARD "2SB"

Figure 9-7. 2SB Switchboard; Wiring Diagram (Sheet 1 of 5)

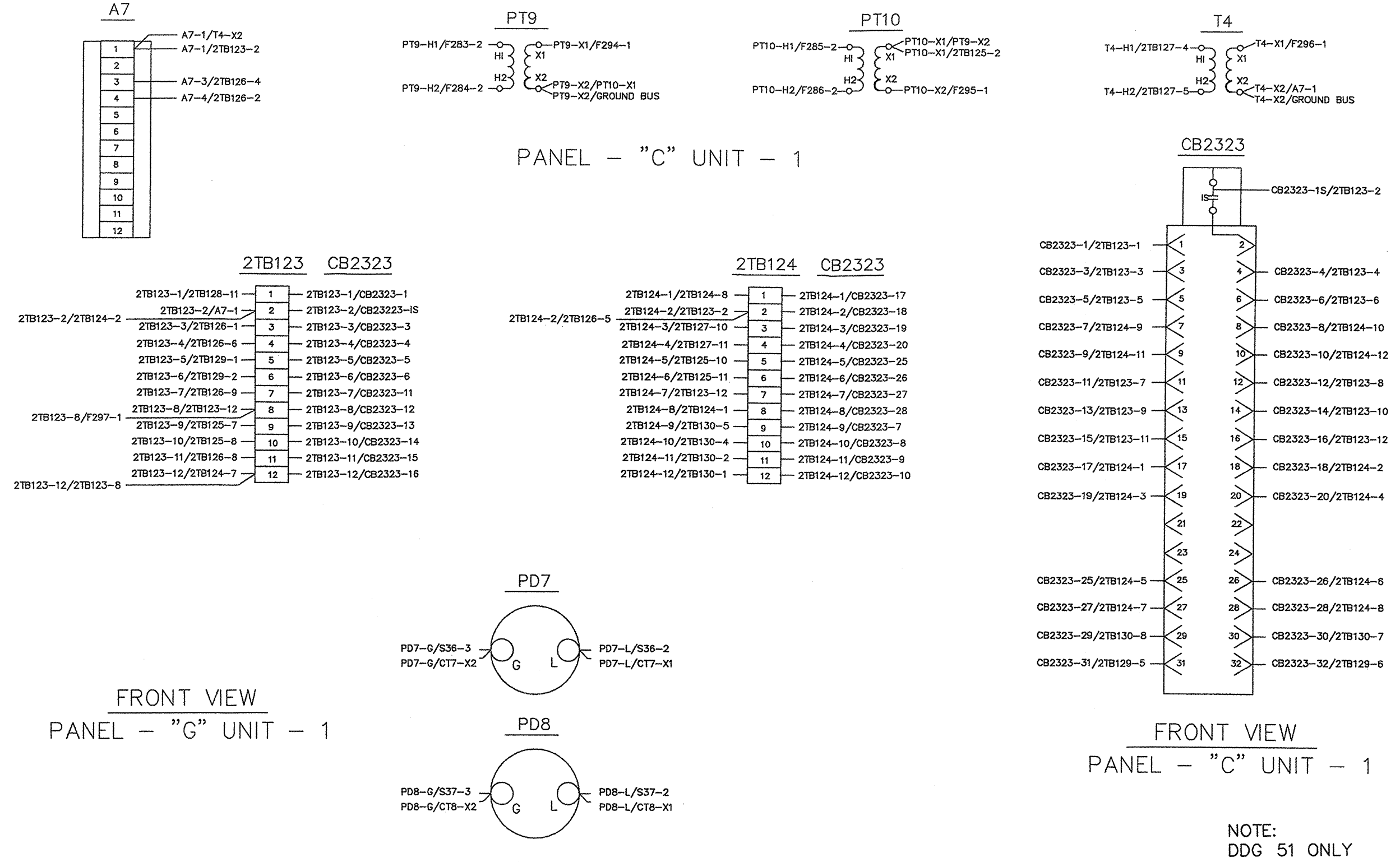


Figure 9-7. 2SB Switchboard; Wiring Diagram (Sheet 3 of 5)

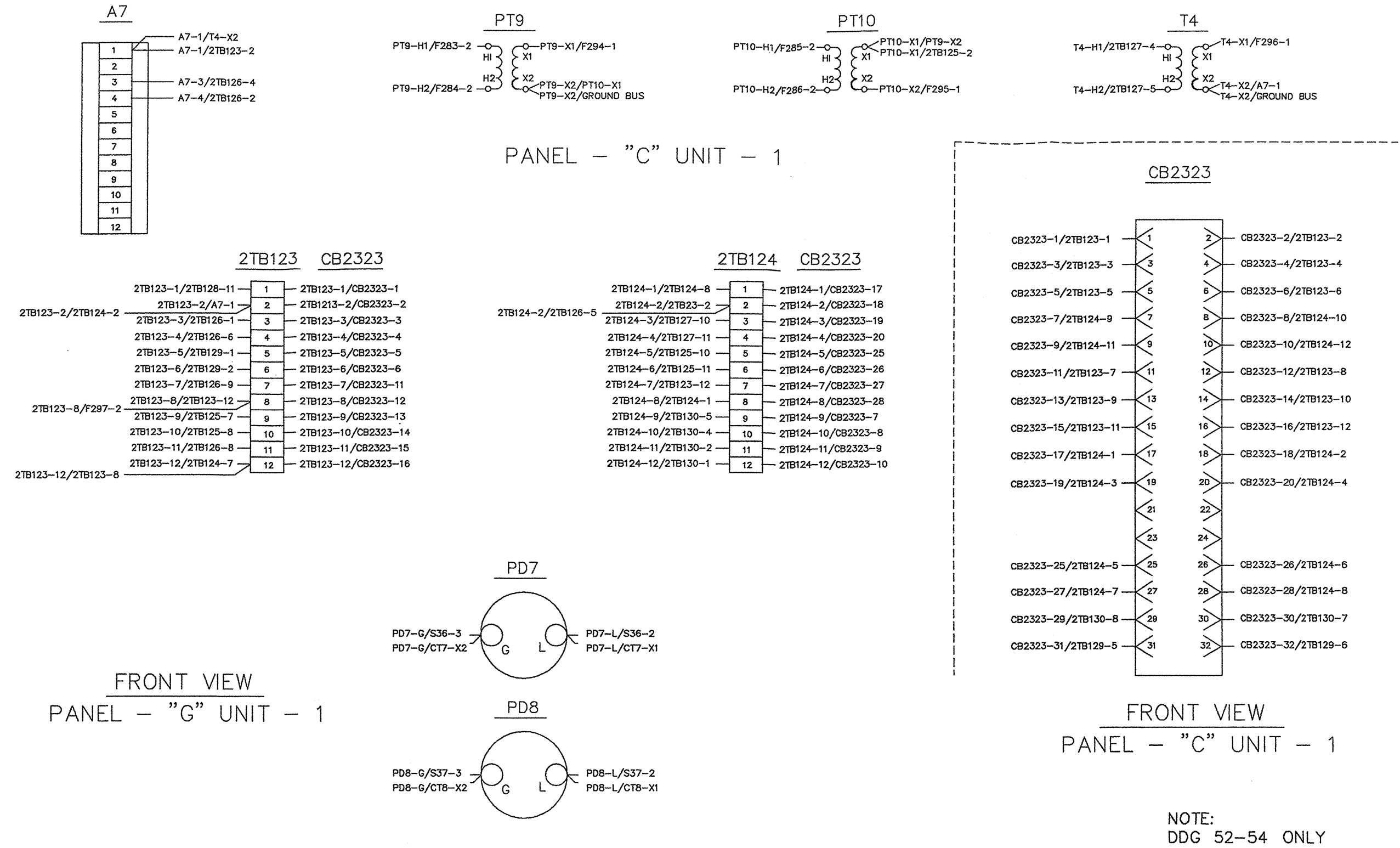


Figure 9-7. 2SB Switchboard; Wiring Diagram (Sheet 3 of 5)

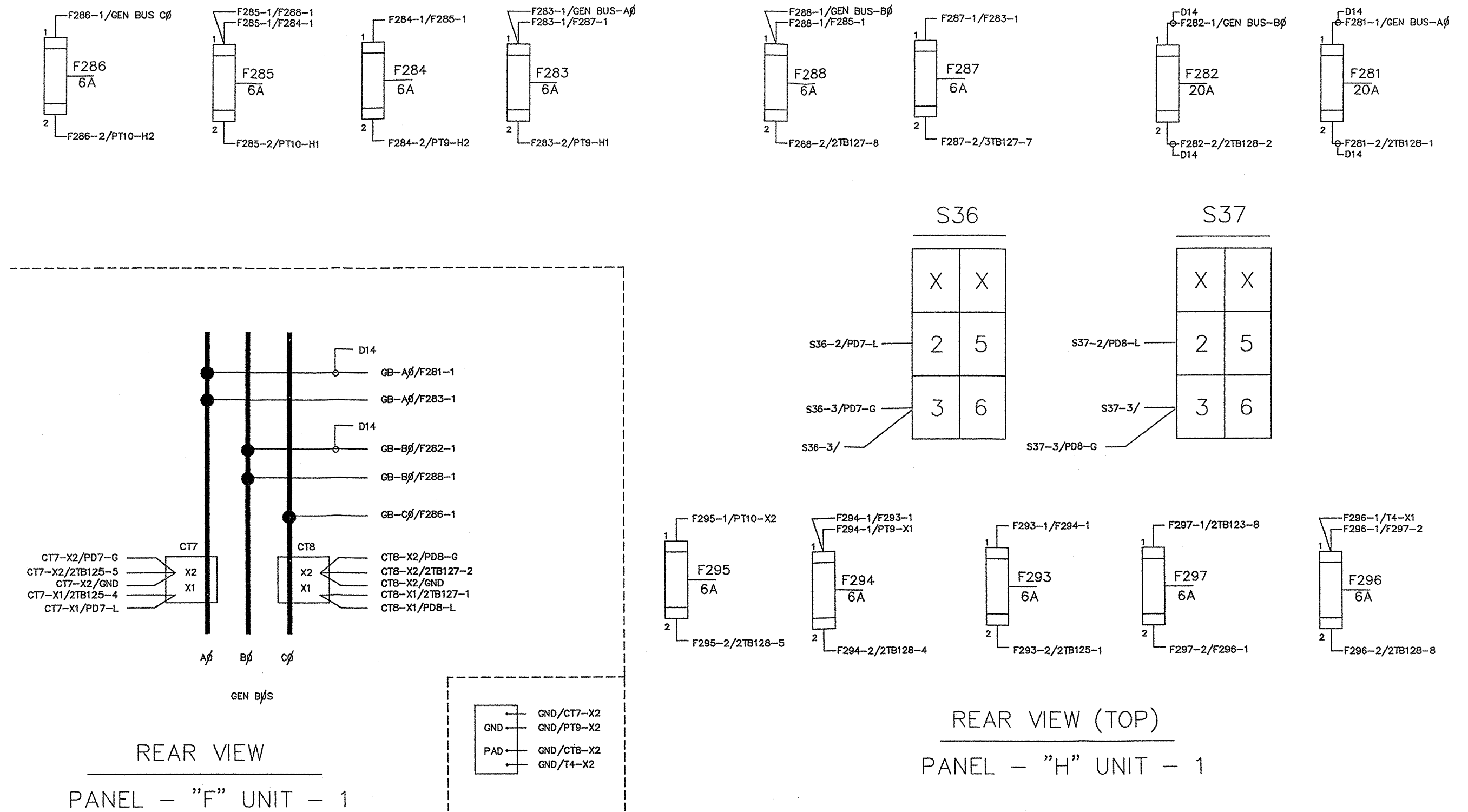
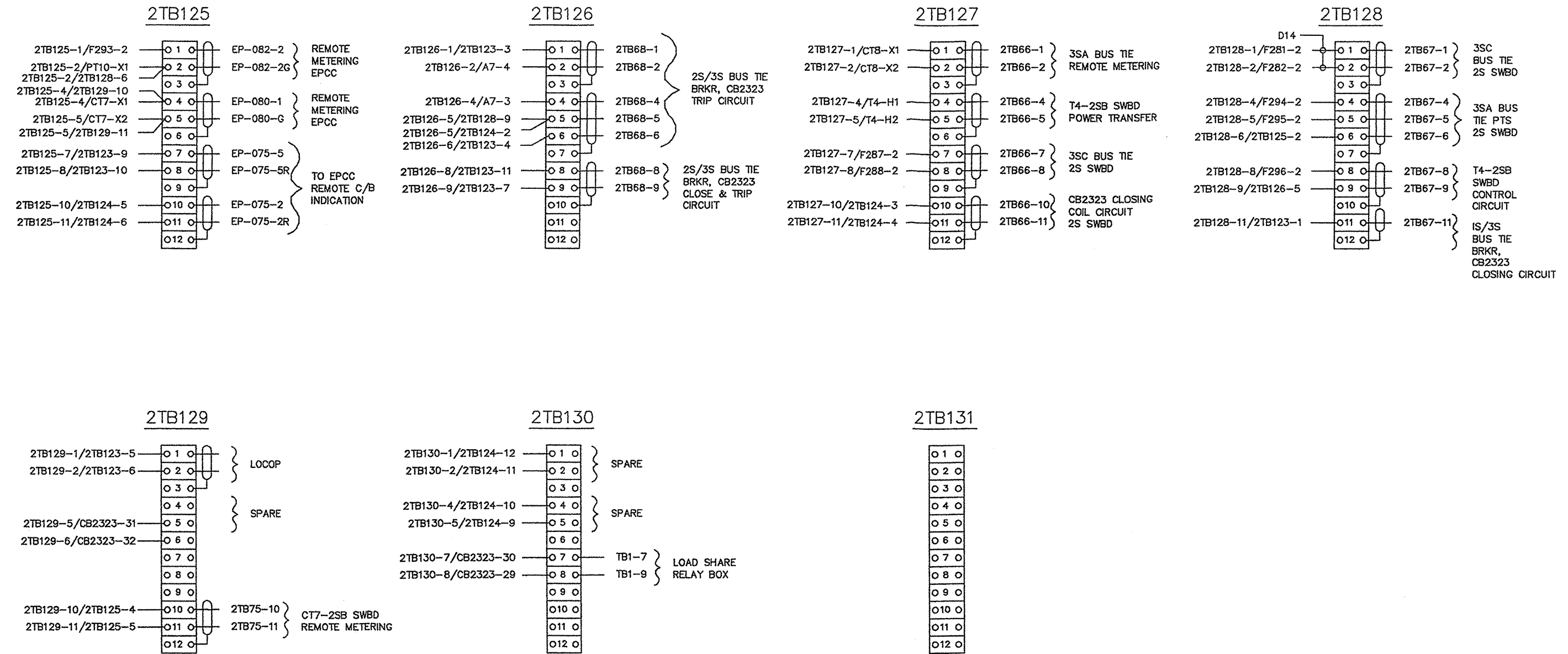


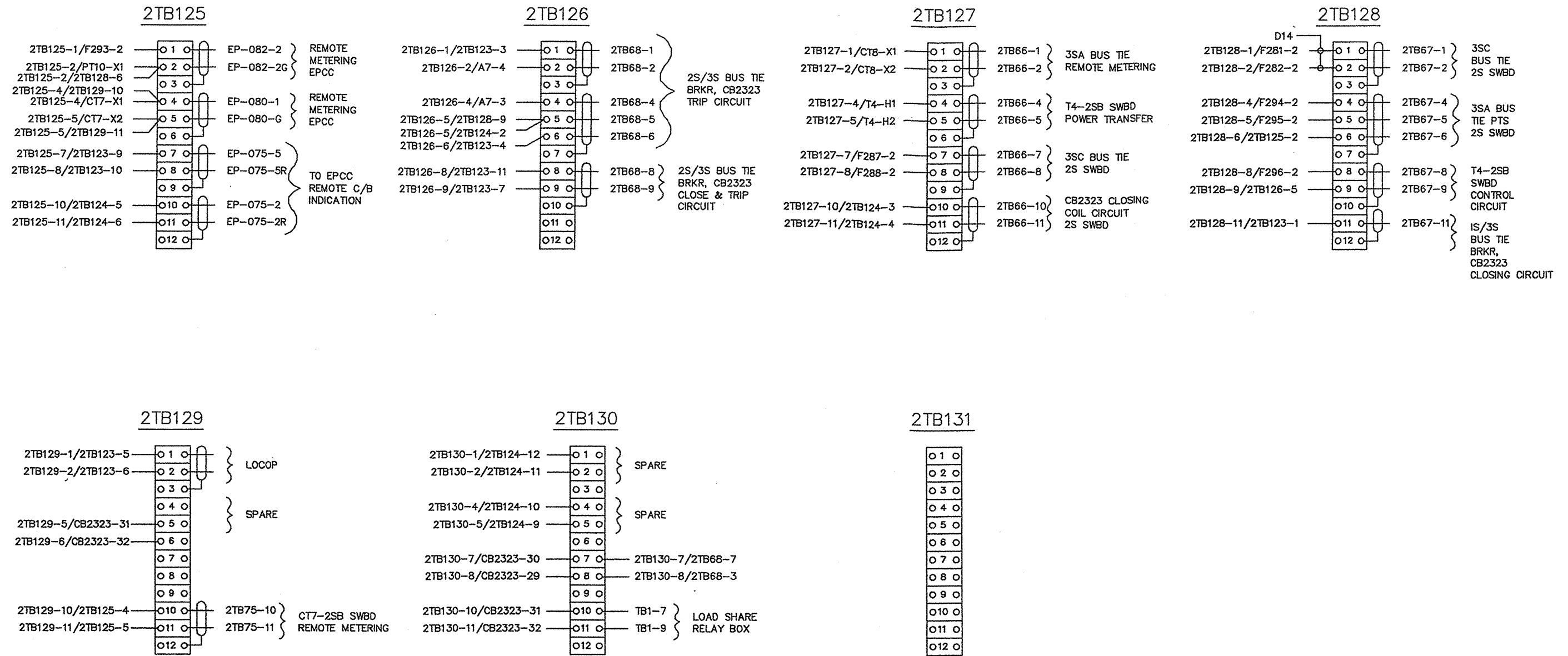
Figure 9-7. 2SB Switchboard; Wiring Diagram (Sheet 4 of 5)



REAR VIEW LEFT HAND SIDE
 PANEL - "E" UNIT - 1

NOTE:
 DDG 51 ONLY

Figure 9-7. 2SB Switchboard; Wiring Diagram (Sheet 5 of 5)



REAR VIEW LEFT HAND SIDE
 PANEL - "E" UNIT - 1

NOTE:
 DDG 52-54 ONLY

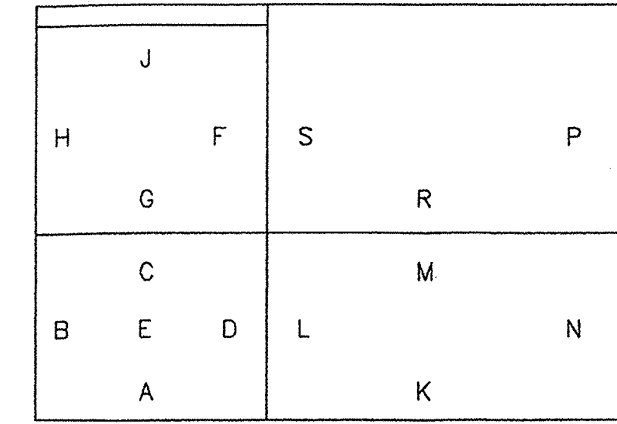
Figure 9-7. 2SB Switchboard; Wiring Diagram (Sheet 5 of 5)

PANEL A1 SHEET-3	PANEL B1 SHEET-5	PANEL C1 SHEET 7 & 8	PANEL D SHEET-9 & 10 (DDG 51) SHEET-10A (DDG 52-54)	PANEL F SHEET-11	PANEL G1 SHEET-14 (DDG 51) SHEET-14A (DDG 52-54)	PANEL H SHEET-13 (DDG 51) SHEET-13A (DDG 52-54)	PANEL J
PANEL A2 SHEET-4	PANEL B2 SHEET-6	PANEL C2 SHEET-19			PANEL G2 SHEET-12 (DDG-51) SHEET-12A (DDG-52-54)		

UNIT-1

PANEL K	PANEL L SHEET-15 (DDG 51) SHEET-17 (DDG 52-54)	PANEL M1 SHEET-16 (DDG-51) SHEET-17 (DDG 52-54)	PANEL N SHEET-18 (DDG 51) SHEET-18A (DDG 52-54)	PANEL P	PANEL RI SHEET-14 (DDG 51) SHEET-14A (DDG 52-54)	PANEL S SHEET-20 (DDG 51) SHEET-21 (DDG 52-54)
---------	--	---	---	---------	--	--

UNIT-2



UNIT-1

UNIT-2

TOP VIEW-PANEL LOCATION
SWITCHBOARD "3S"

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 1 of 19)

COMPONENT LOCATIONS

PANEL NO															
A1	M1-M8	M11	DS1-DS2	DS22	DS26-DS41	S13-S22	S25	S38	S31	PB3101-PB3103	DS48-DS49	S42			
A2	DS4-DS21		DS42-DS45	S1-S10	S24	J1-J2									
B1	3TB1-3TB12														
B2	3TB13-3TB24														
C1	K3104-K3106	K3108-K3111	K3113	K3116	K3123	K3129-K3130	K3133-K3134	K3202	K3204	A1					
C2	K3102	A5	A8 *	A6 *	T2	T2a	T2b								
D	K3101,K3103,K3107		K3121-K3122	K3124	K3126	K3103	K3114	K3115	K3117,K3112	K3120	K3131-K3132	K3135	K3201	K3401	K3119
F	3TB51-3TB62														
G1	F301-F312	F329-F332	F334-336	F350	F361-F362										
H	3TB75-3TB86														
G2	3TB63-3TB74														
K															
L	S32-S33	PD1-PD4	A3b (DDG 52-54)												
M1	PT1-PT6	IT1-IT2 *	T1	A2 *	A3a *	A3b(DDG 51)	GPM **								
M2	CB3130														
N	K3205	K3402	K3118	K3404	K3405	K3125	K3127	K3128							
P															
R1	F313-F328	F333	F343-F349	F339-342	3F1										
S	3TB48-3TB49	CT1-CT4	GND	CB3101-CB3103											

* REMOVED BY MACHALT 320-59006 (ECP-515)
 ** INSTALLED BY MACHALT 320-59006 (ECP-515)

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 2 of 19)

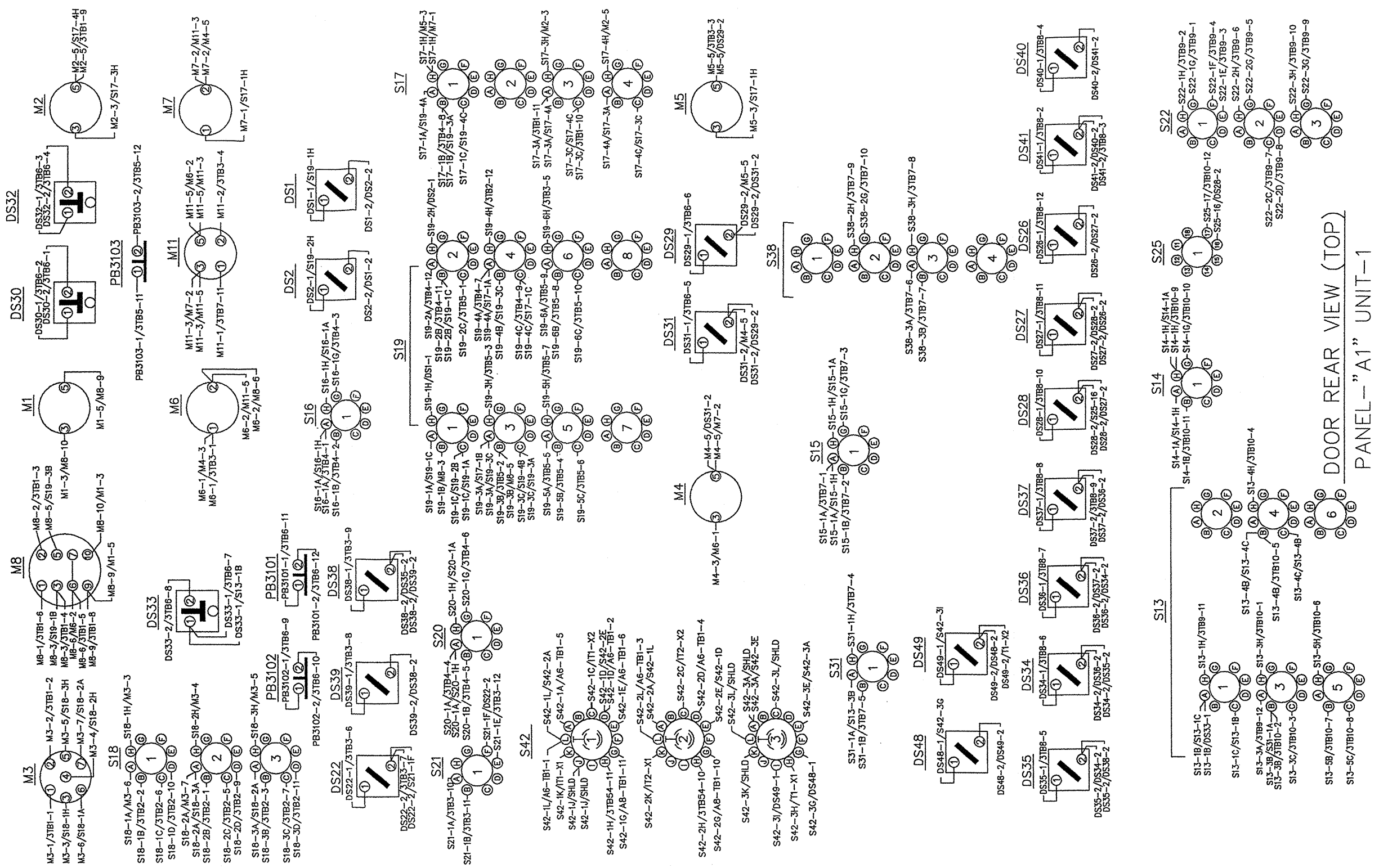


Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 3 of 19) (For Ships Without MACHALT 320-59006 (ECP-515) Installed)

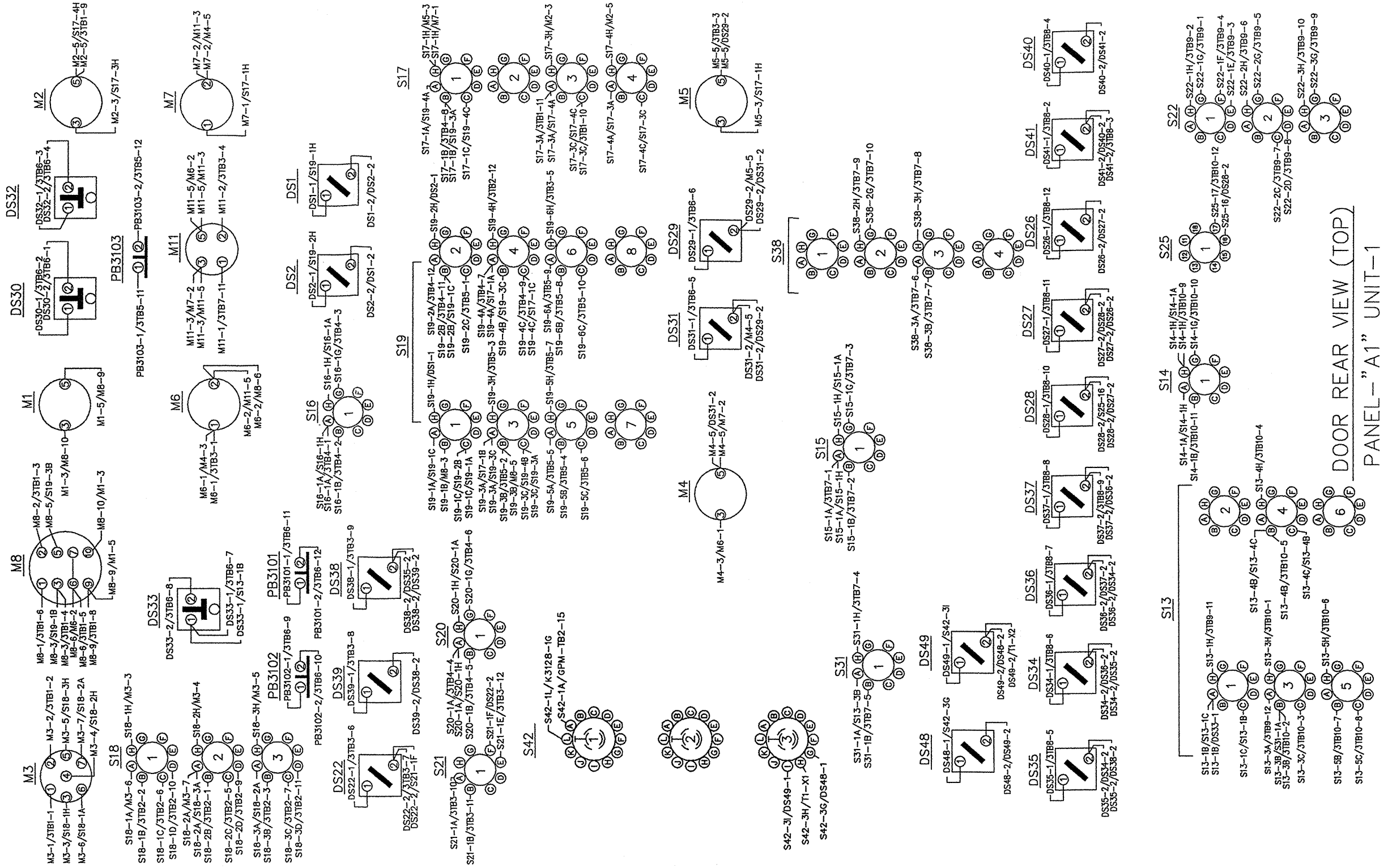
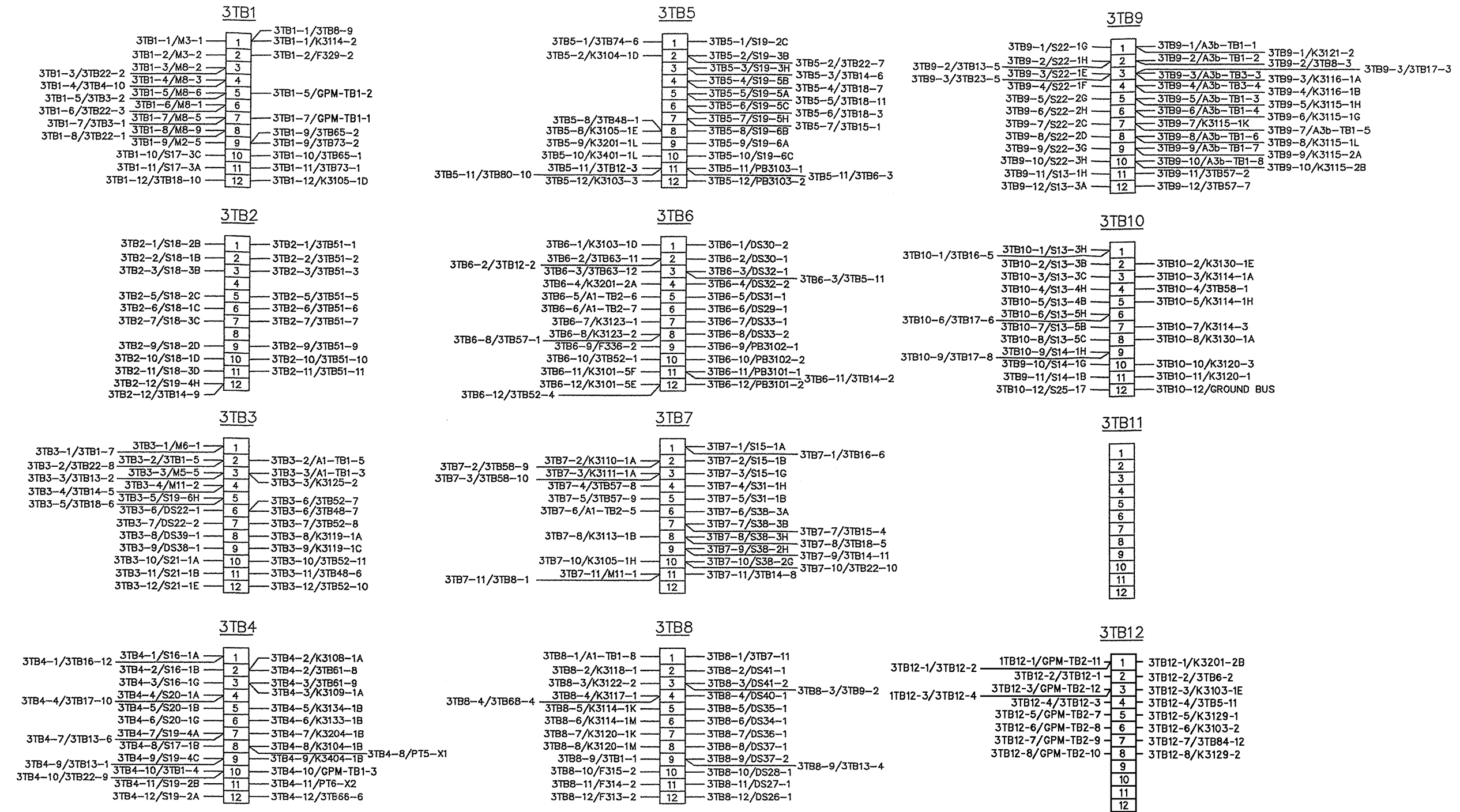
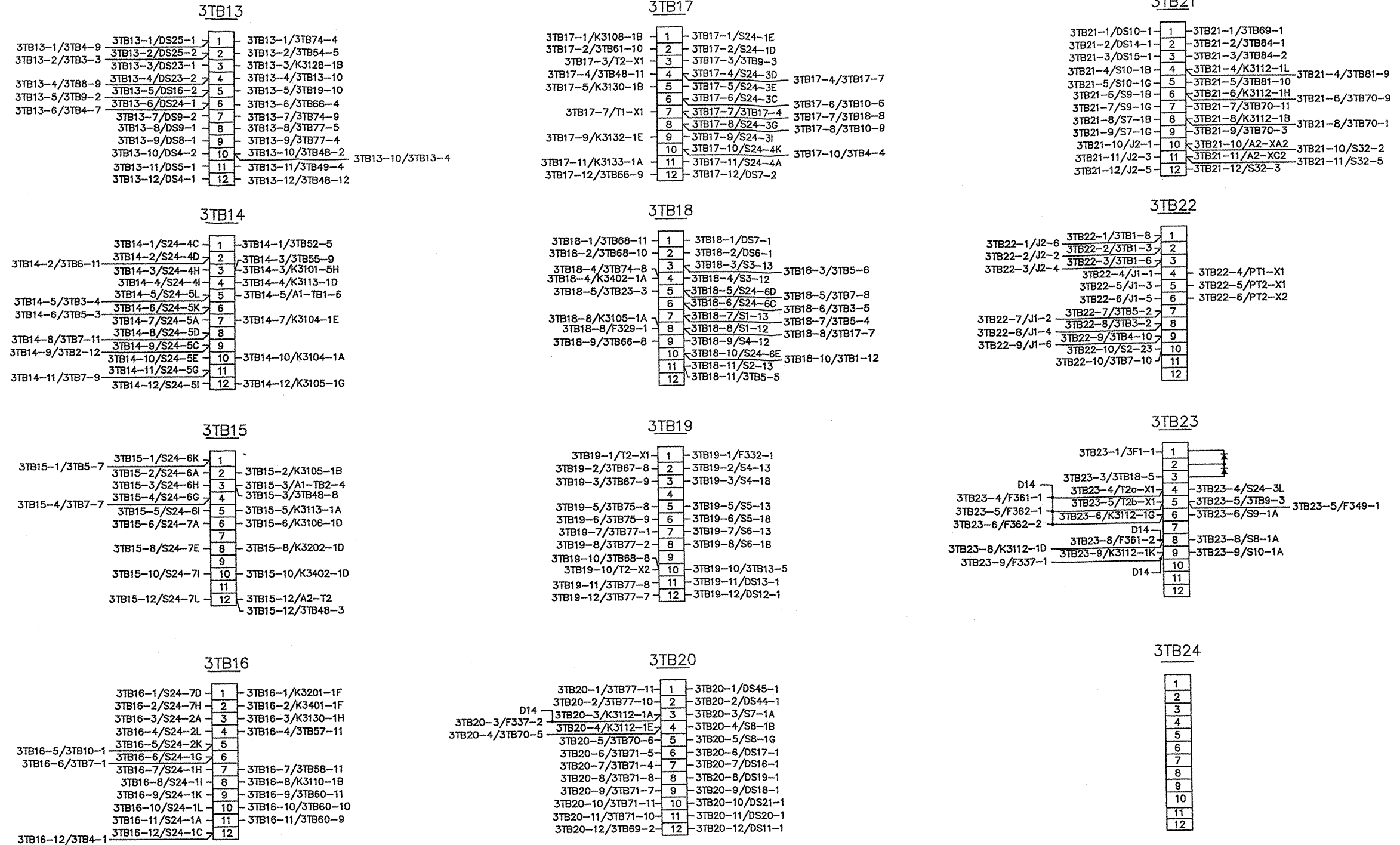


Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 3 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



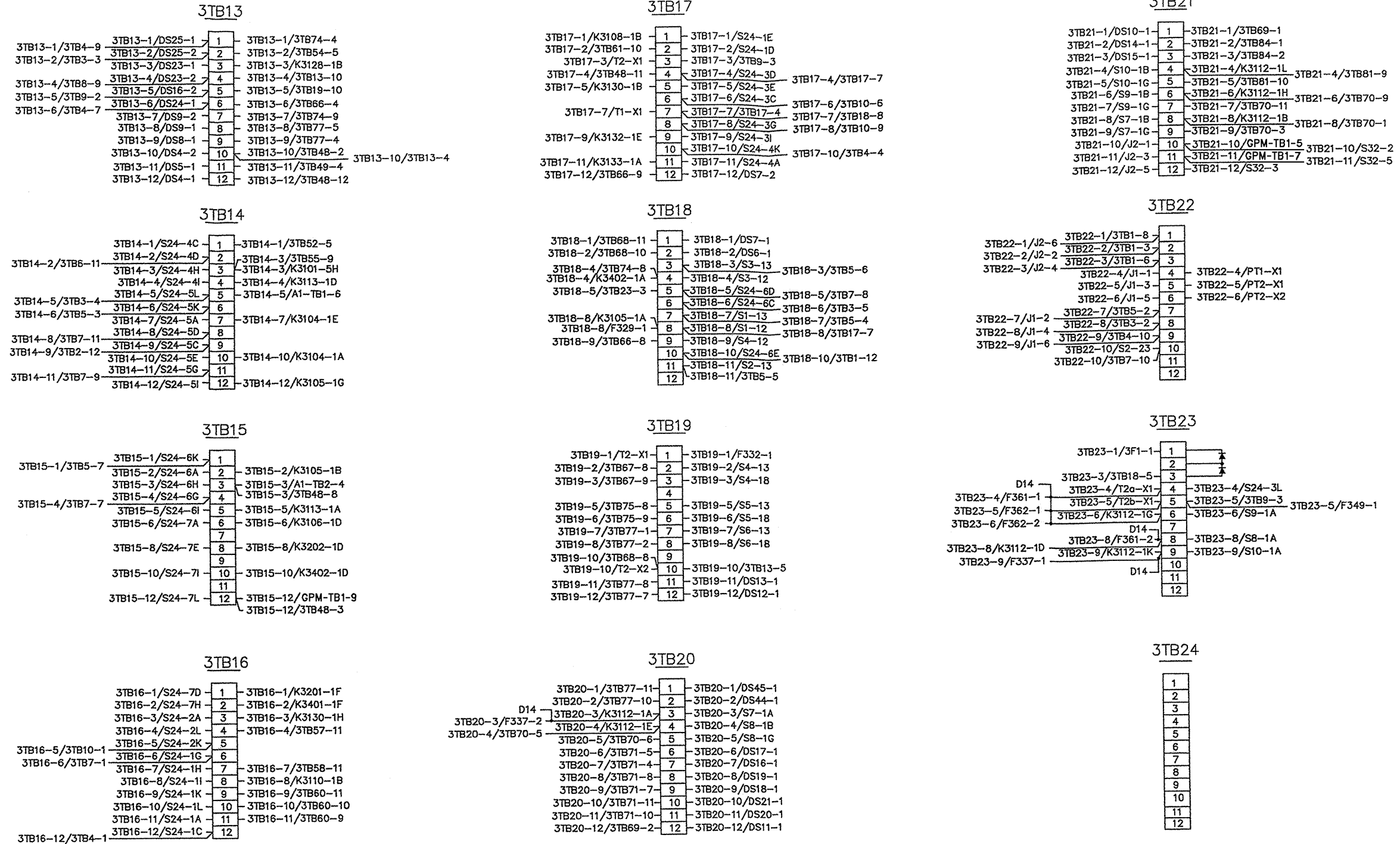
FRONT VIEW LEFT HAND SIDE (TOP)
 PANEL "B1" UNIT-1

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 5 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



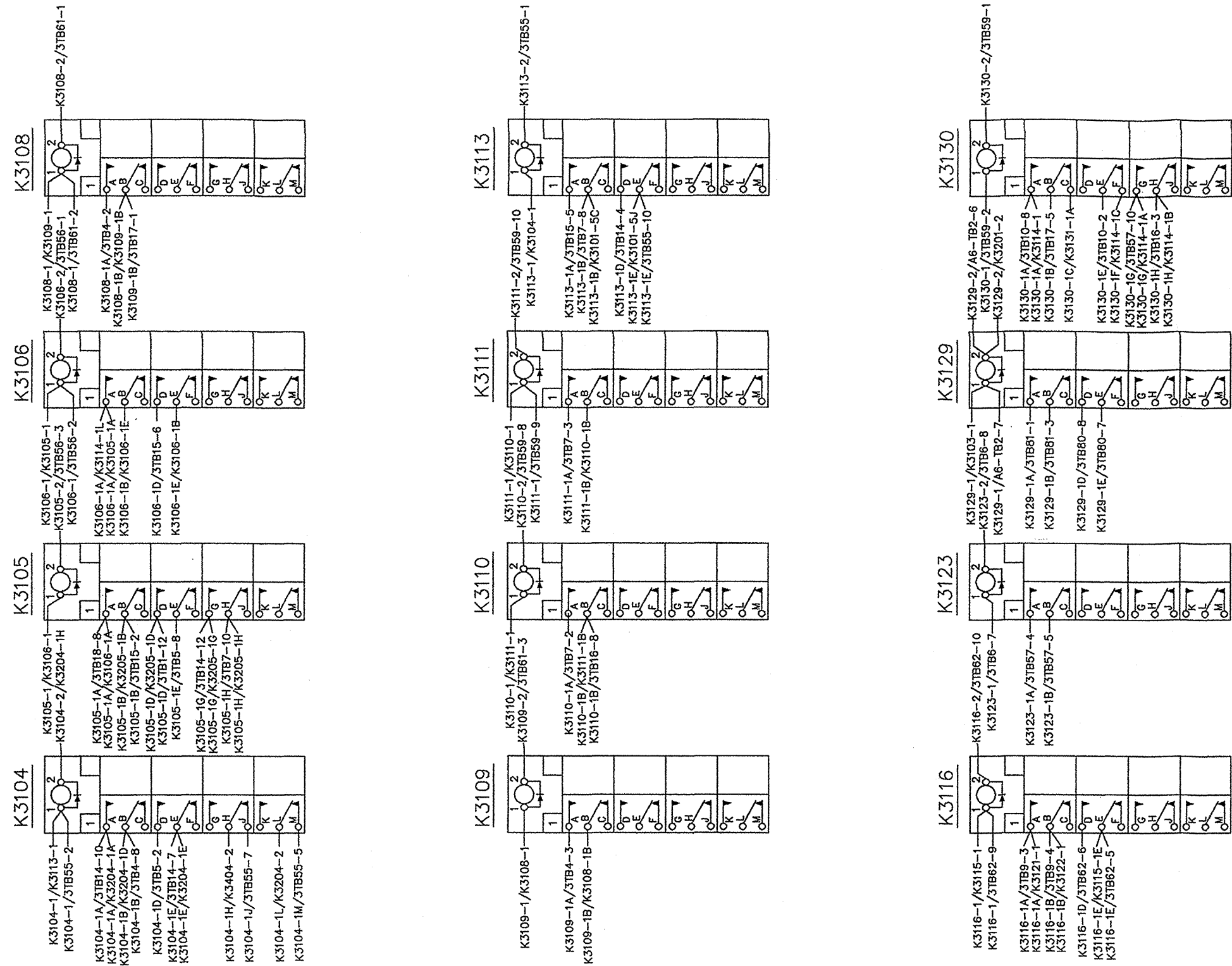
FRONT VIEW LEFT HAND SIDE (BOTTOM)
 PANEL-"B2" UNIT-1

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 6 of 19)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE (BOTTOM)
 PANEL-"B2" UNIT-1

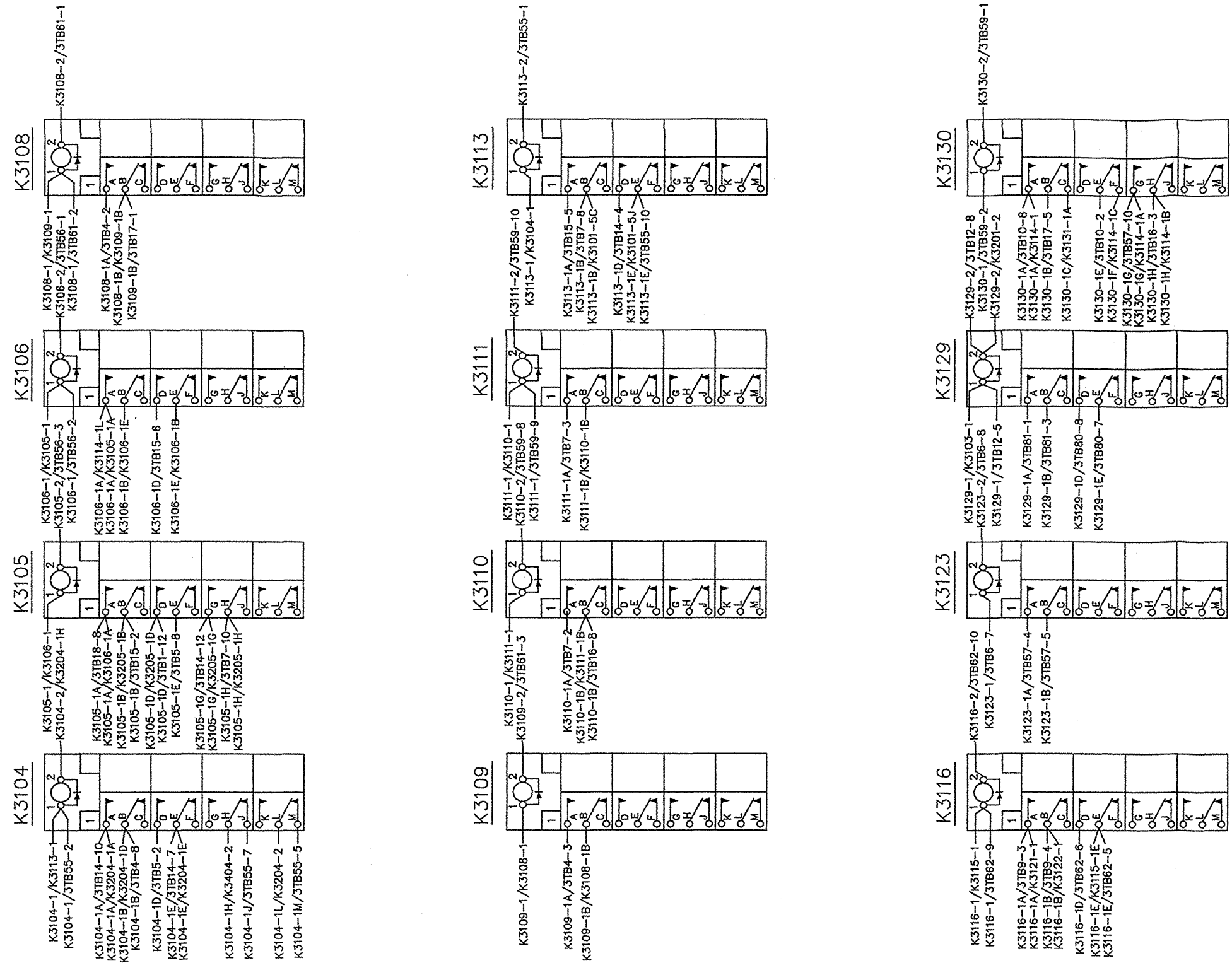
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 6 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW (TOP)

PANEL-"C1" UNIT-1

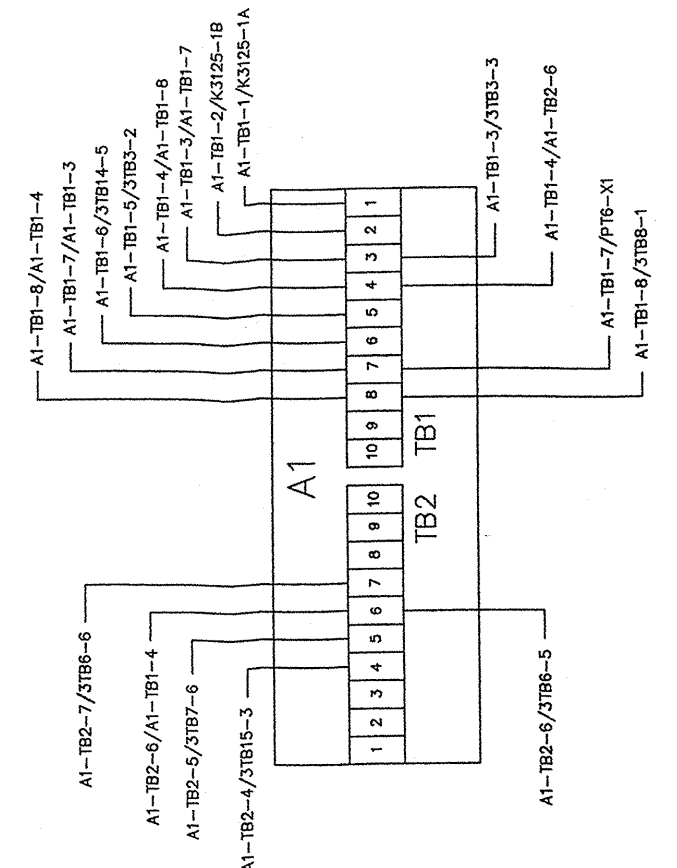
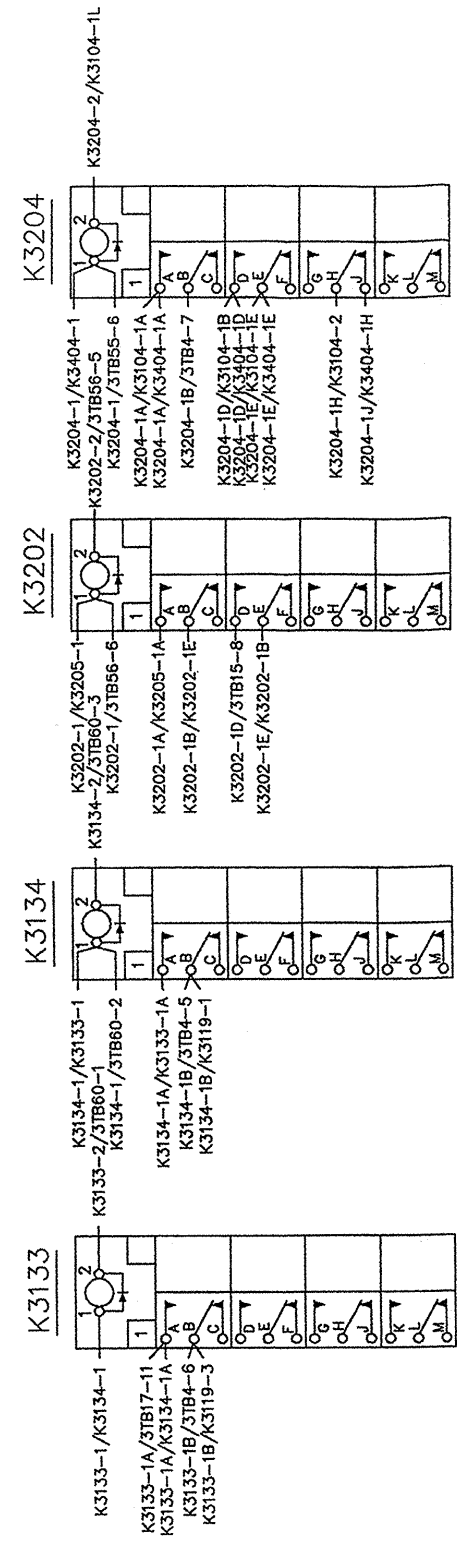
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 7 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW (TOP)

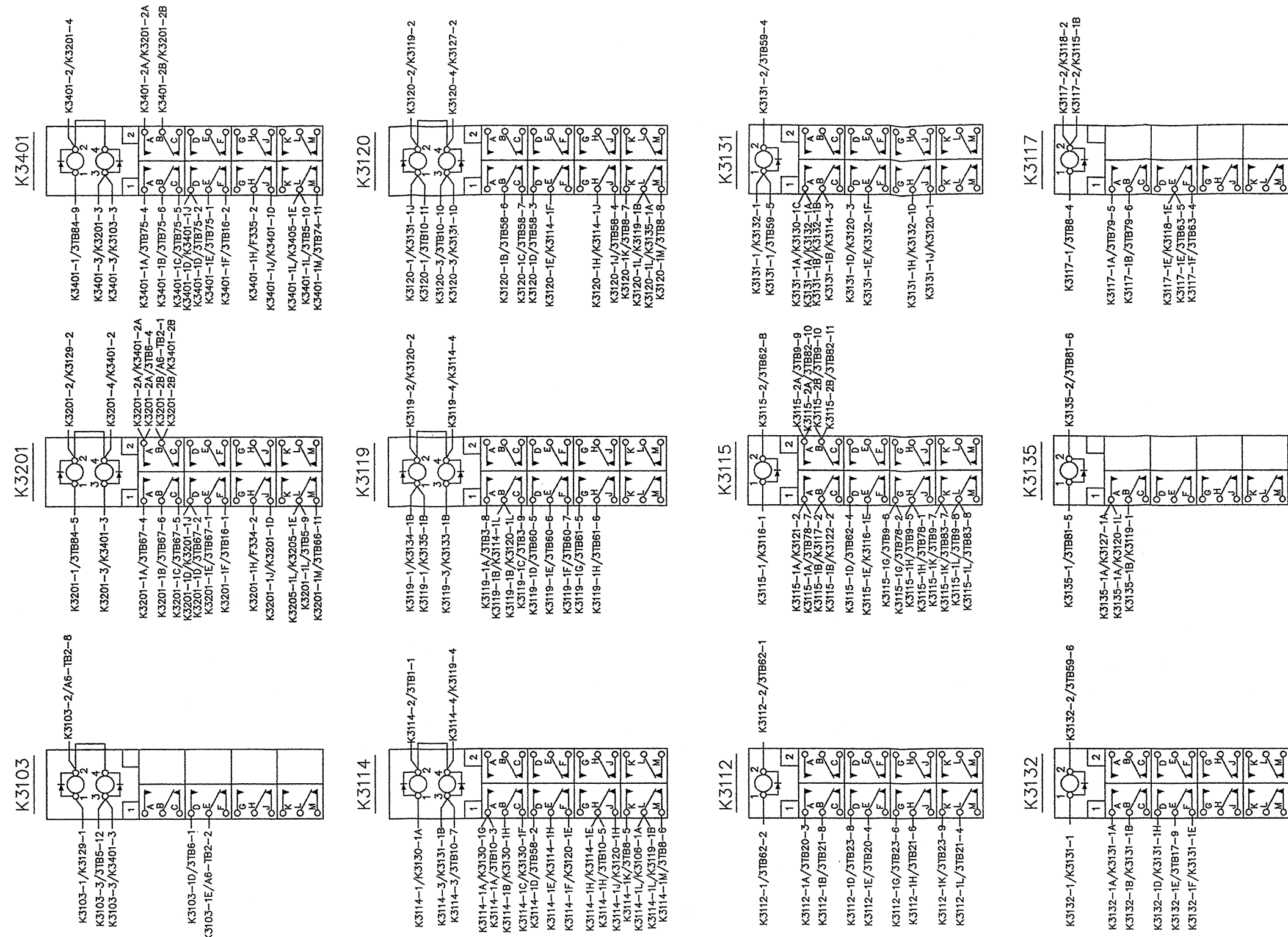
PANEL-"C1" UNIT-1

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 7 of 19) (For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW (BOTTOM)
PANEL- "C1" UNIT-1

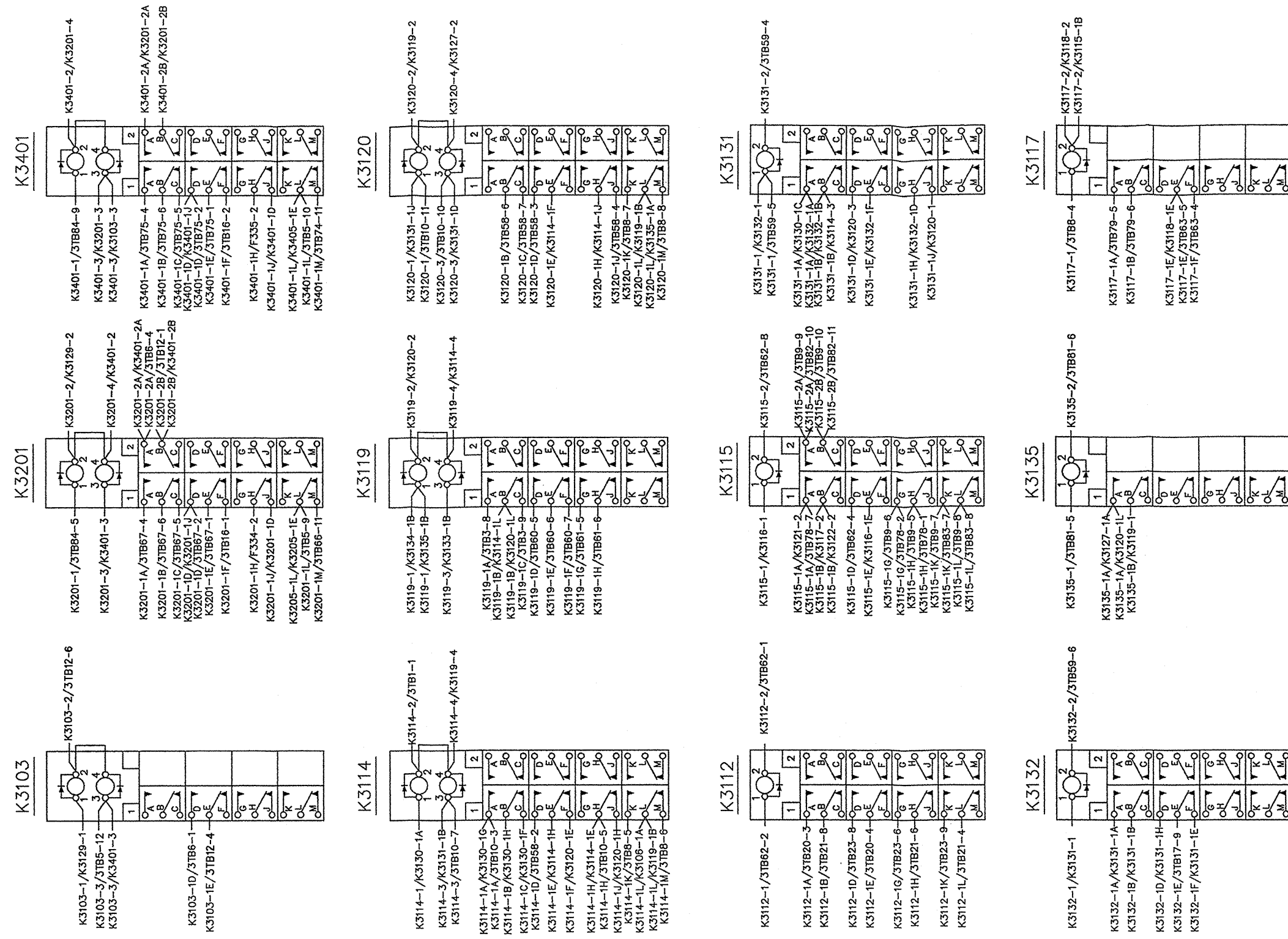
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 8 of 19)



NOTE:
DDG 51 ONLY

FRONT VIEW RIGHT HAND SIDE
PANEL—"D" UNIT-1

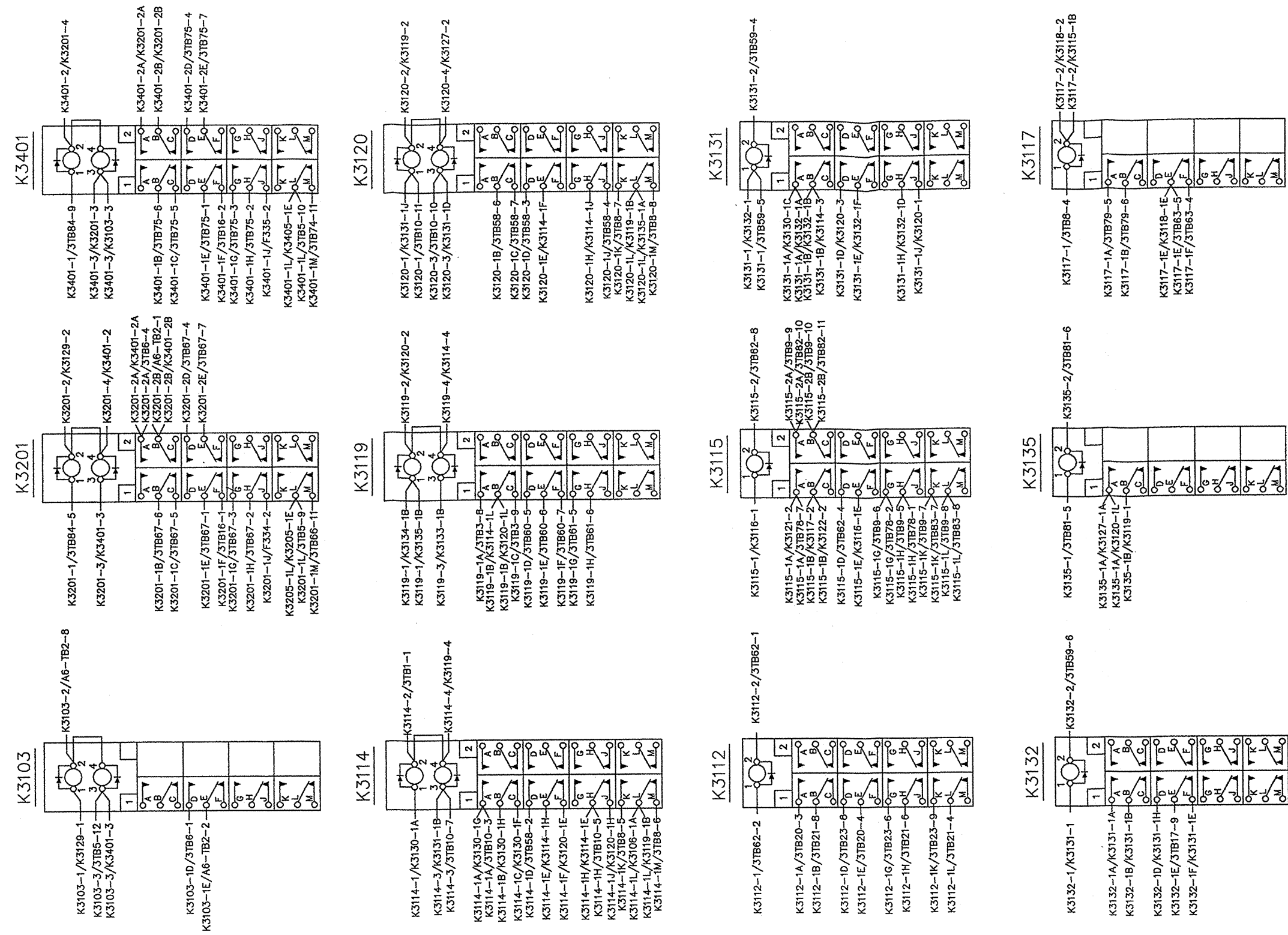
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 10 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW RIGHT HAND SIDE
 PANEL—"D" UNIT-1

NOTE:
 DDG 51 ONLY

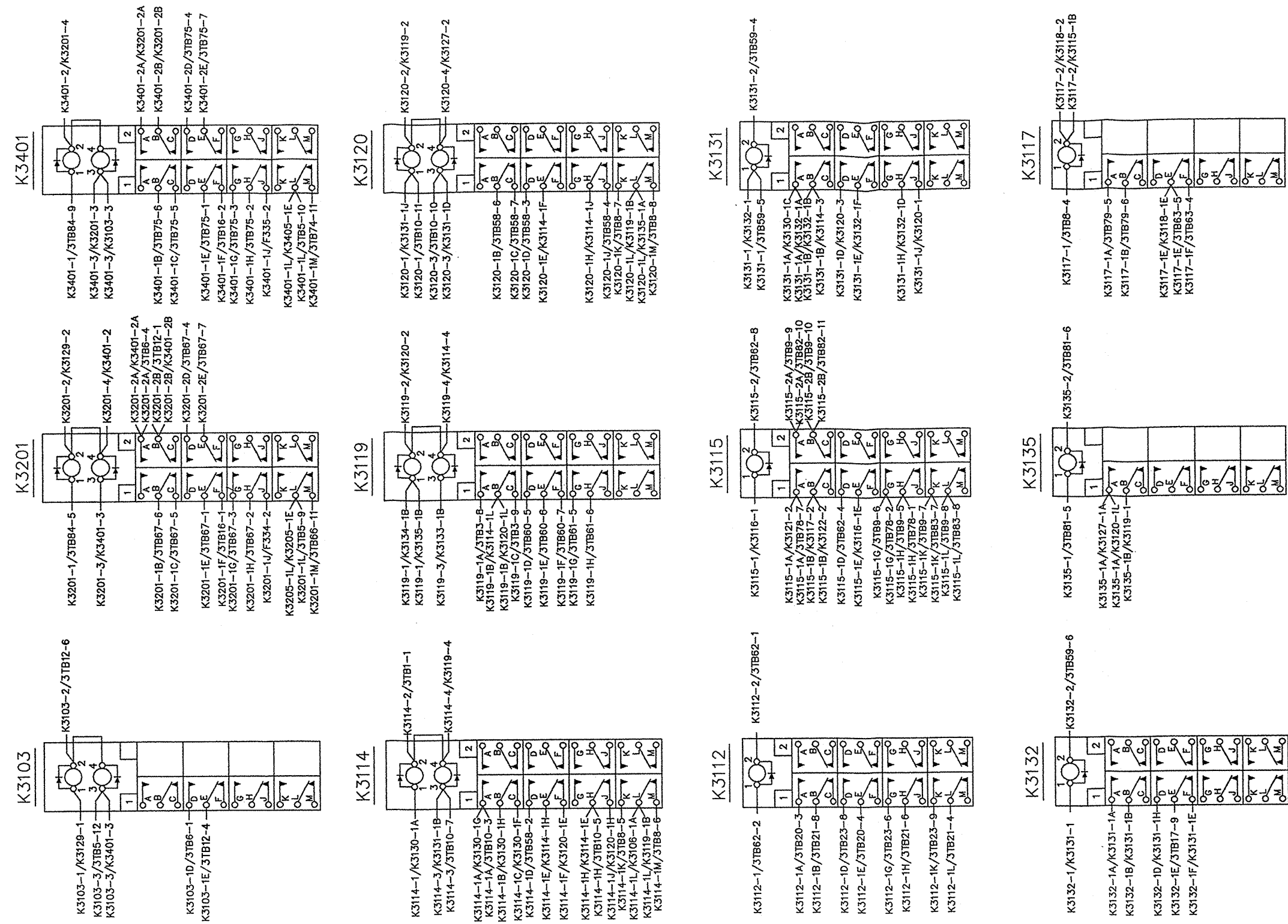
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 10 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 52-54 ONLY

FRONT VIEW RIGHT HAND SIDE
PANEL-"D" UNIT-1

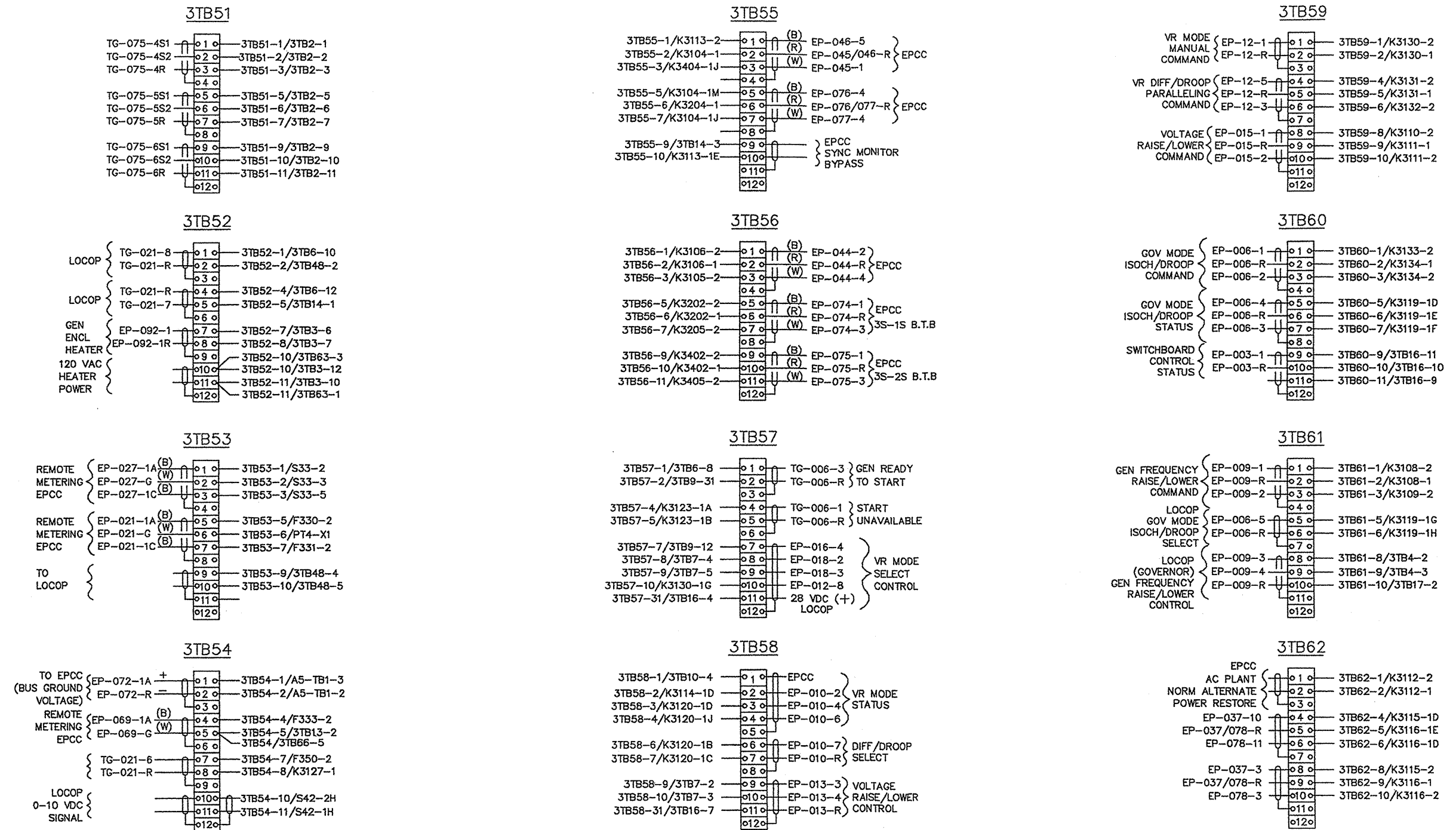
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 10 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW RIGHT HAND SIDE
 PANEL-"D" UNIT-1

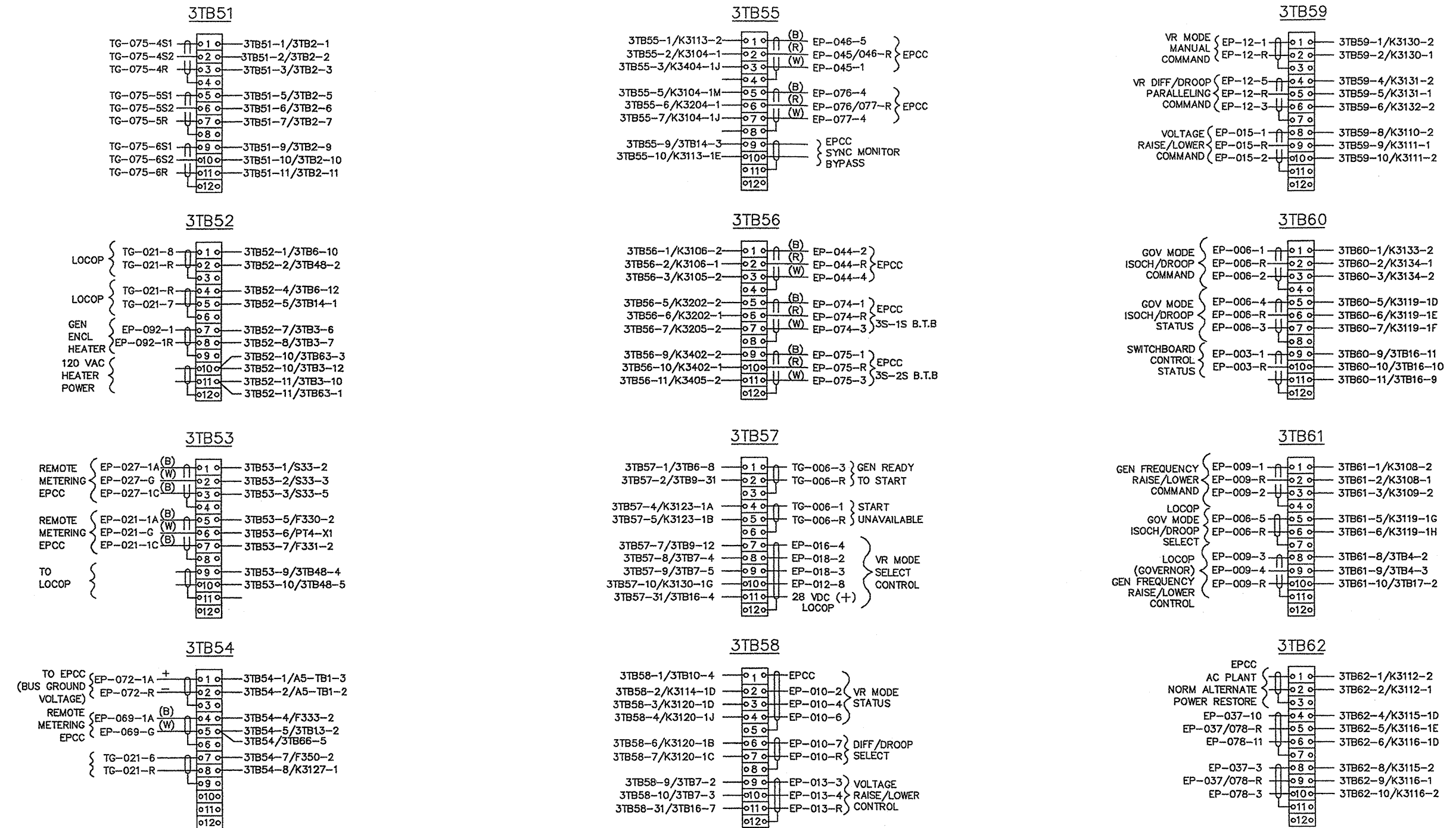
NOTE:
 DDG 52-54 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 10 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



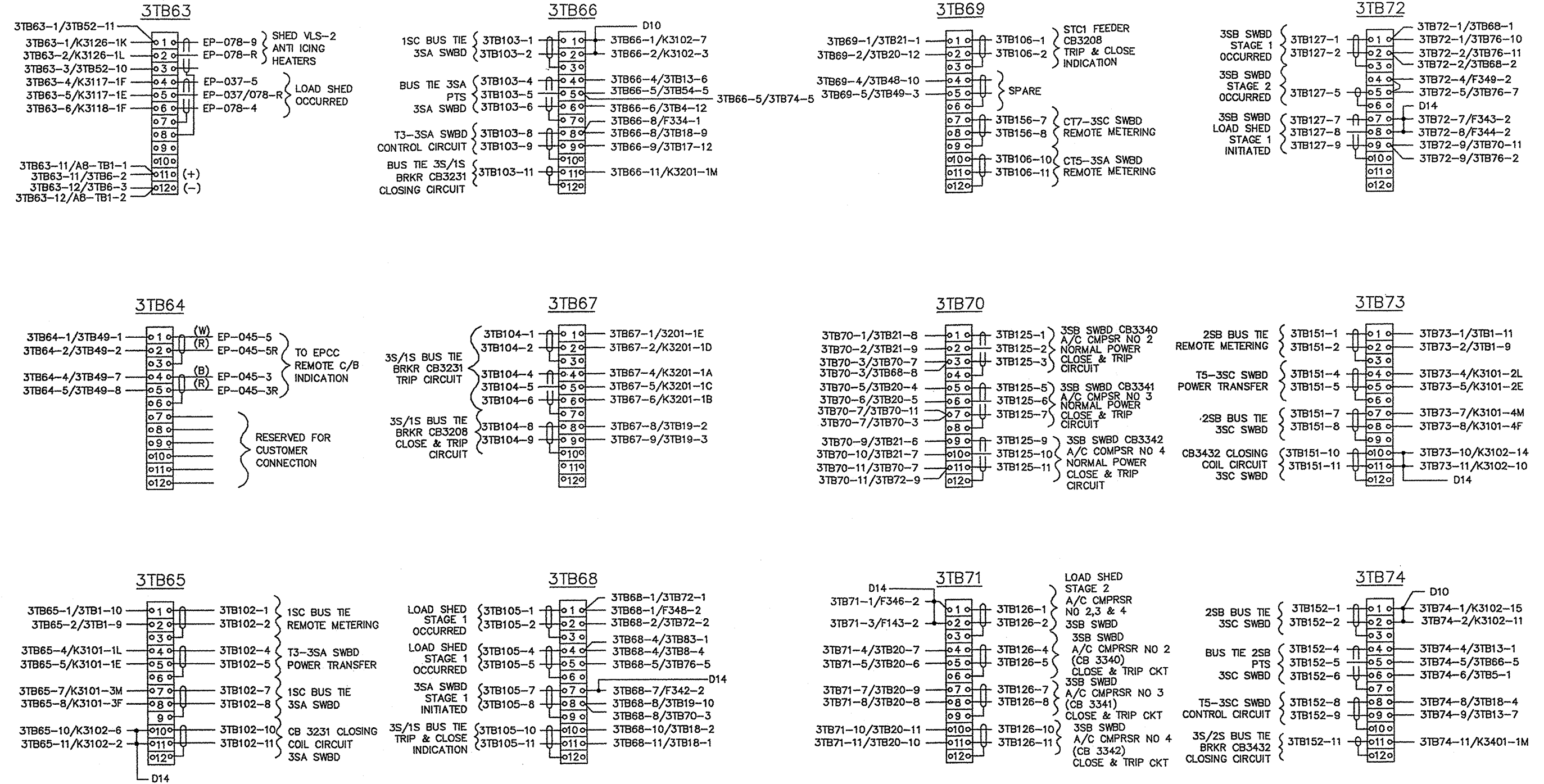
REAR VIEW LEFT SIDE
PANEL-"F" UNIT-1

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 11 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW LEFT SIDE
PANEL-"F" UNIT-1

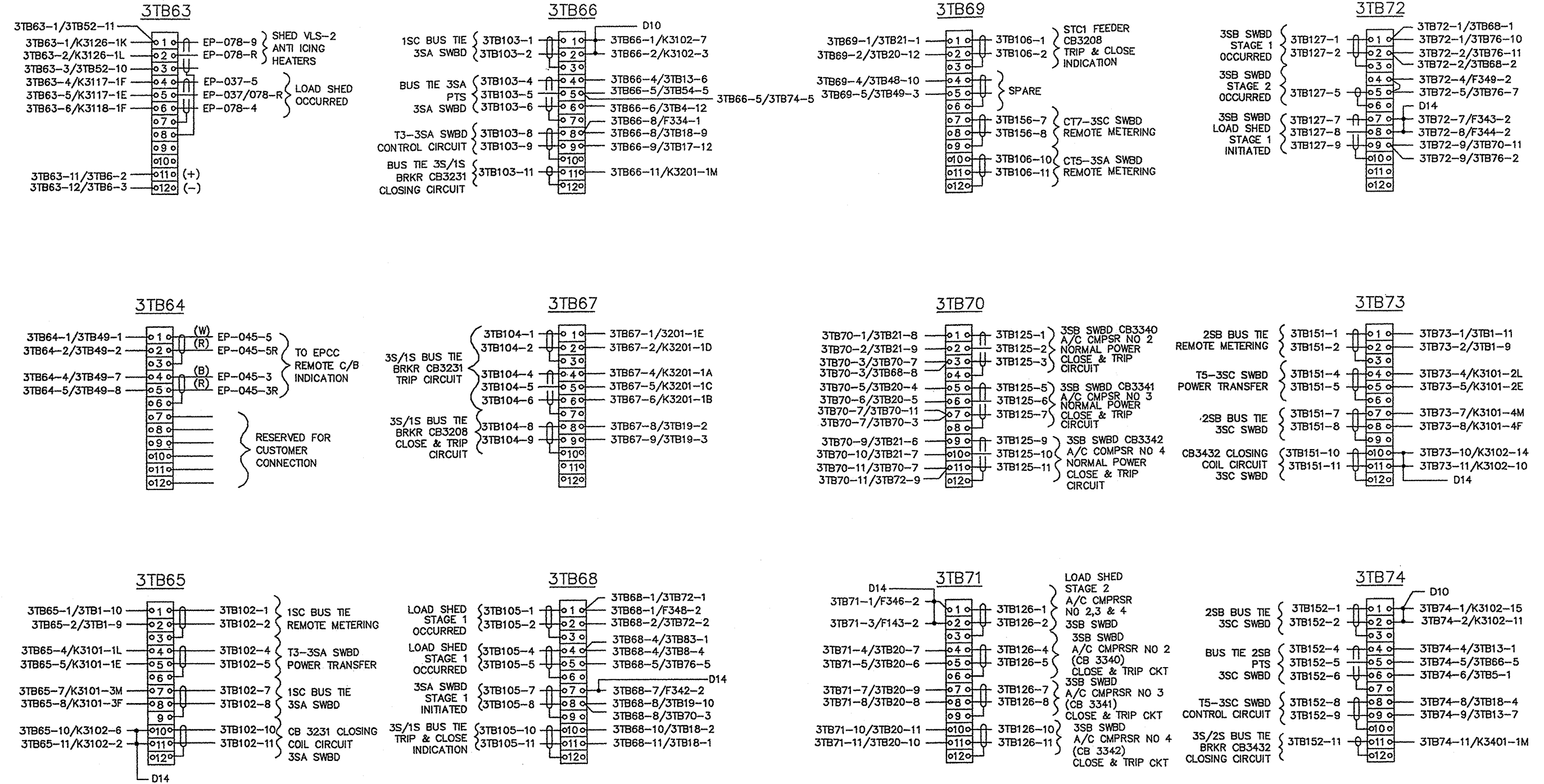
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 11 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW (BOTTOM)
 PANEL-"G2" UNIT-1

NOTE:
 DDG 51 ONLY

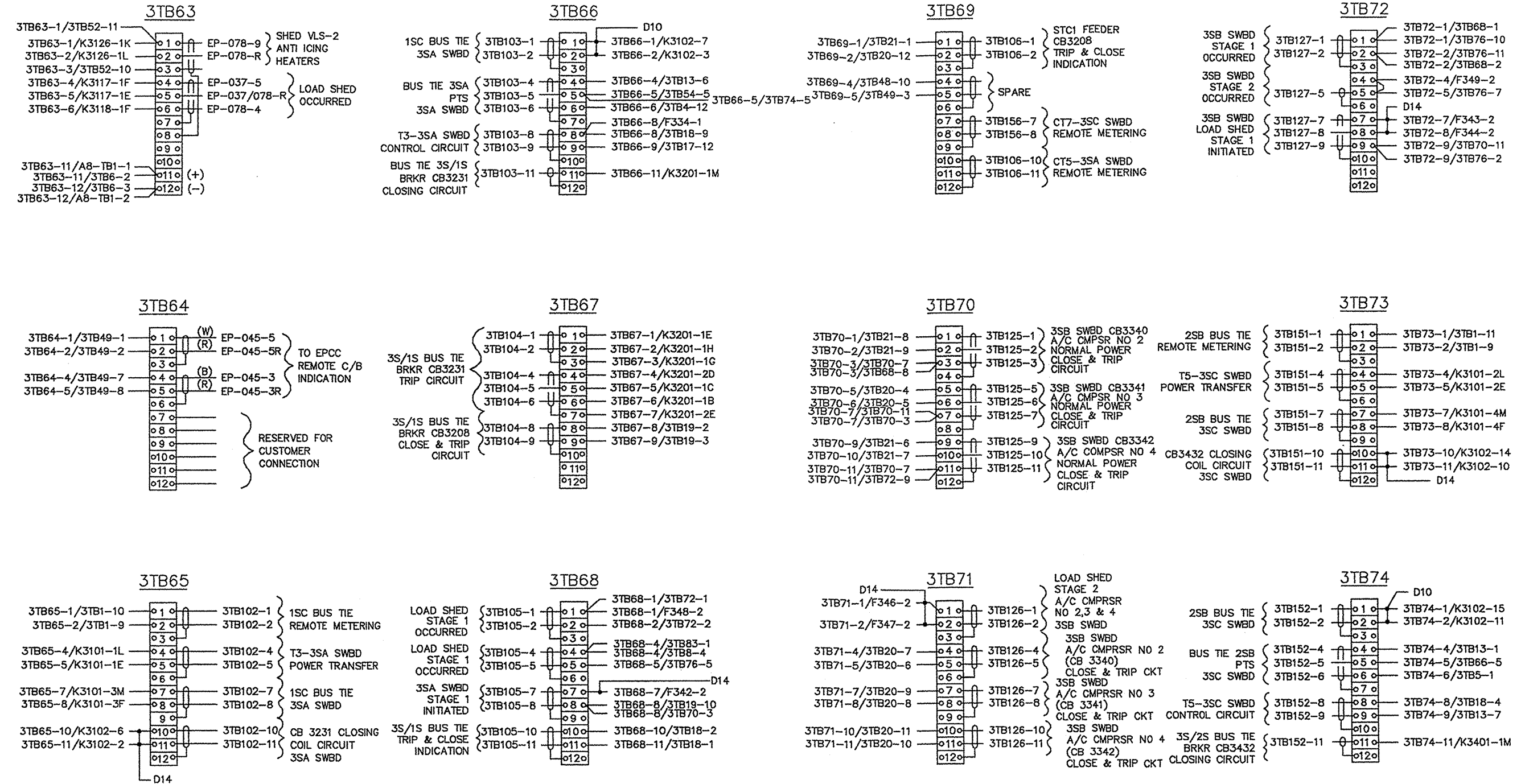
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 12 of 19)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW (BOTTOM)
 PANEL-"G2" UNIT-1

NOTE:
 DDG 51 ONLY

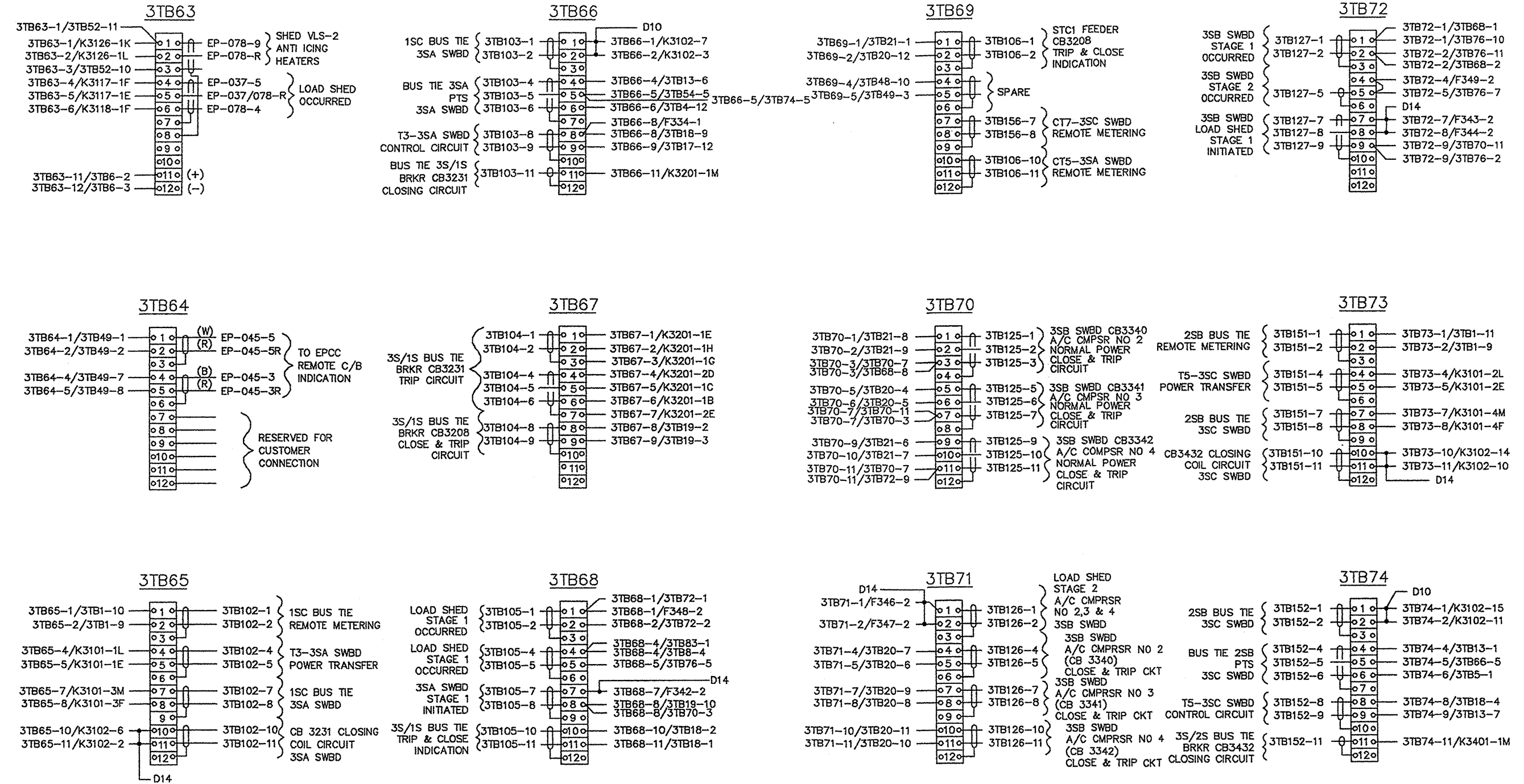
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 12 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW (BOTTOM)
PANEL-"G2" UNIT-1

NOTE:
DDG 52-54 ONLY

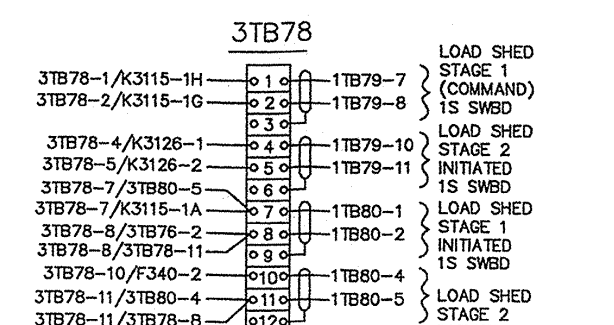
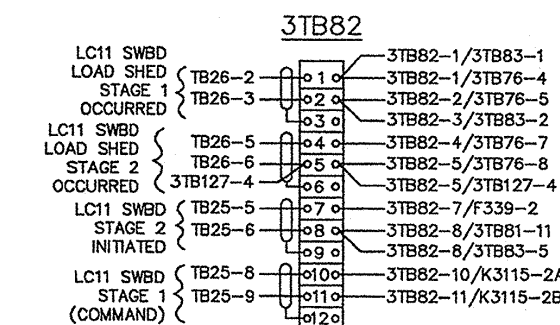
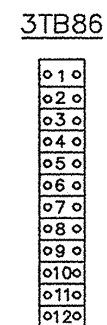
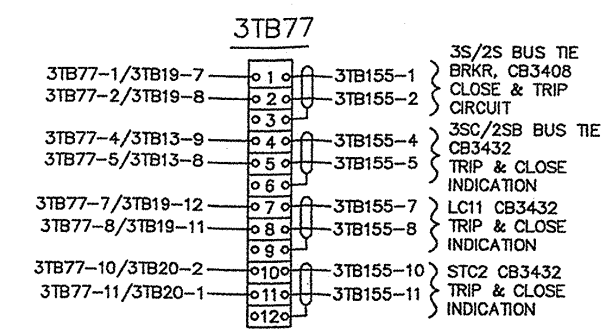
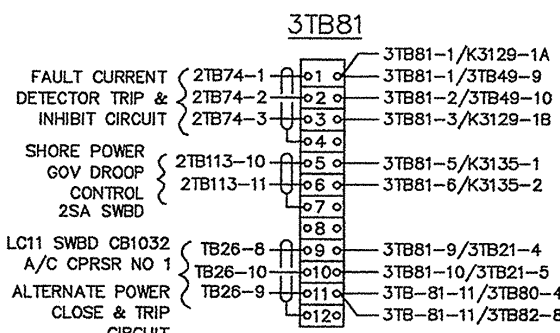
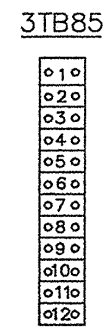
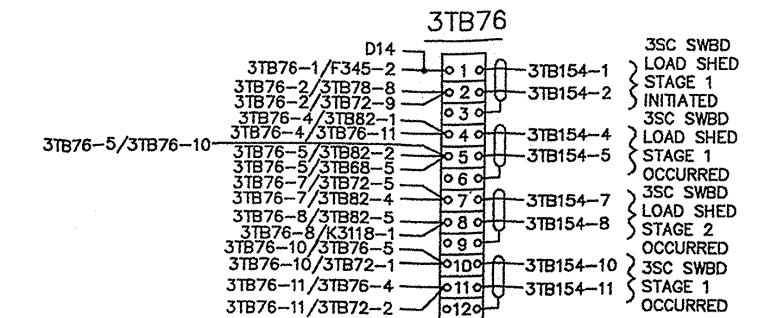
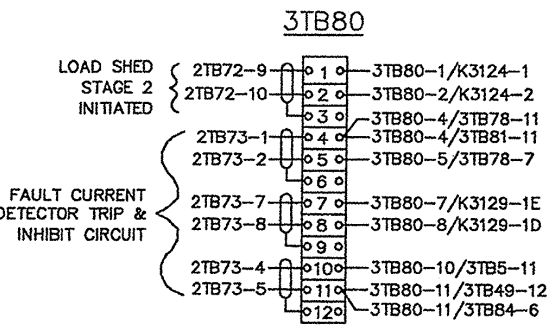
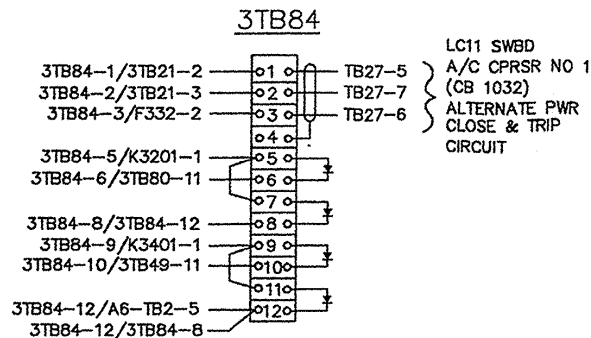
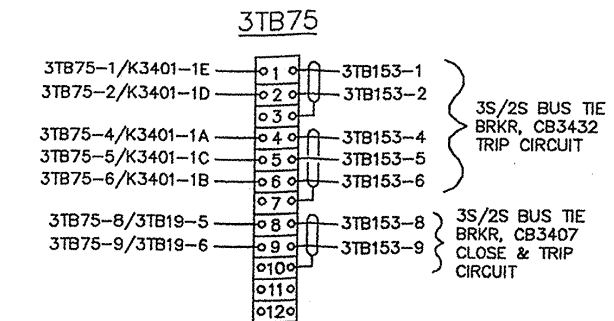
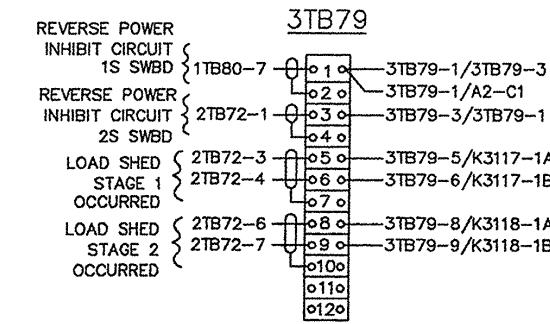
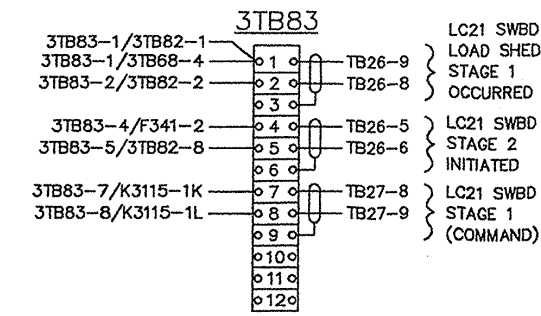
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 12 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW (BOTTOM)
 PANEL-"G2" UNIT-1

NOTE:
 DDG 52-54 ONLY

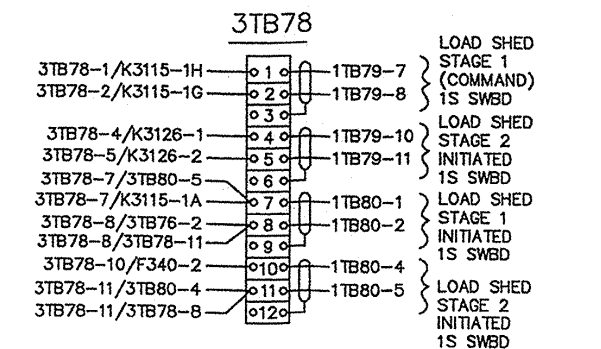
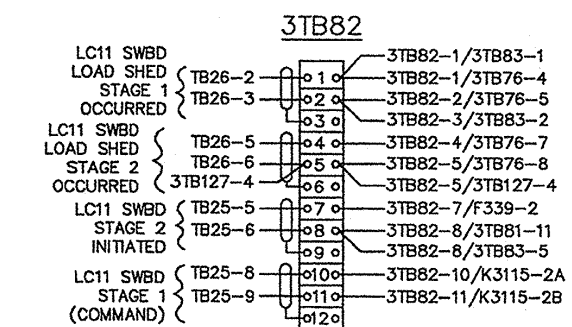
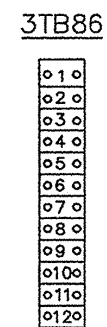
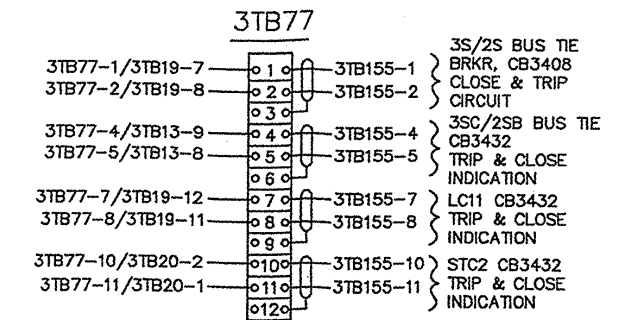
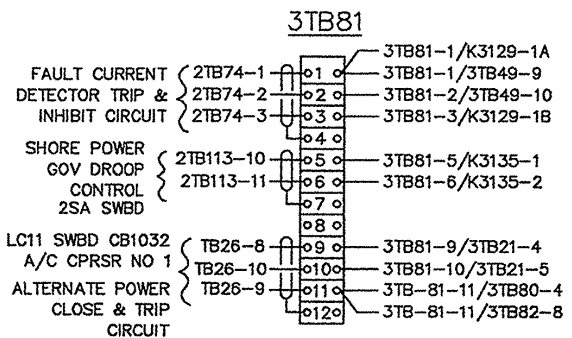
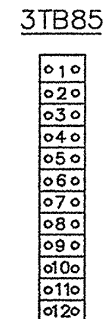
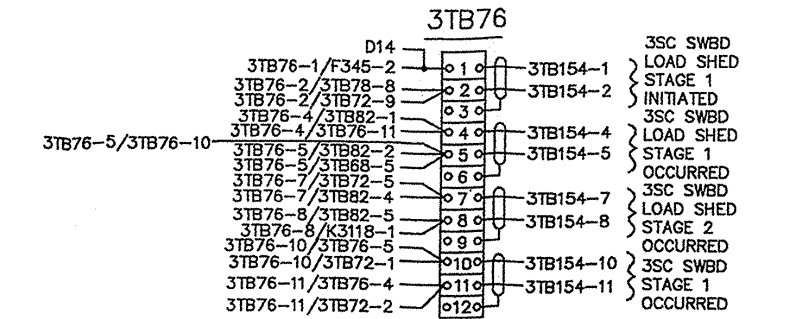
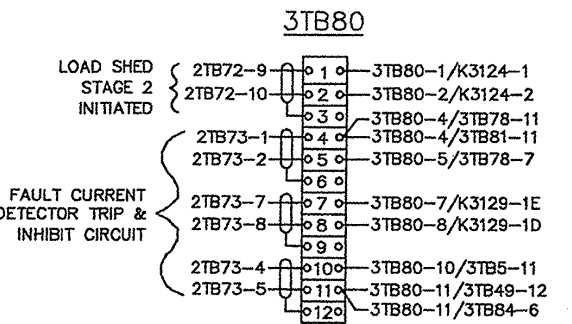
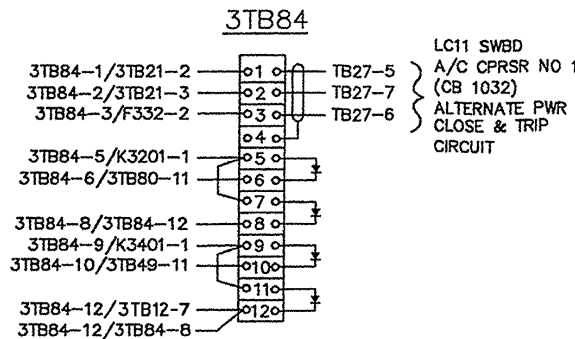
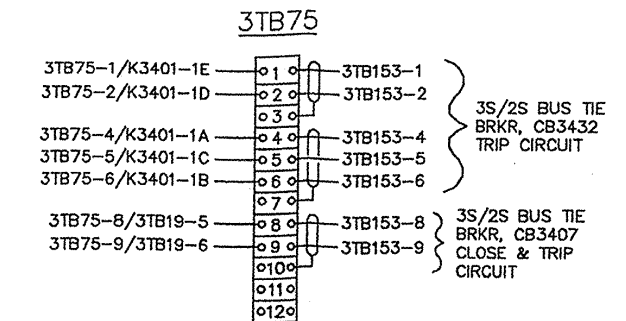
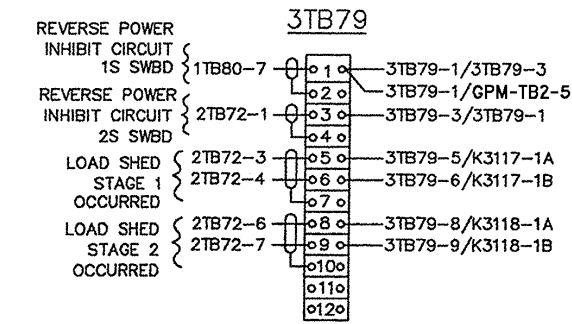
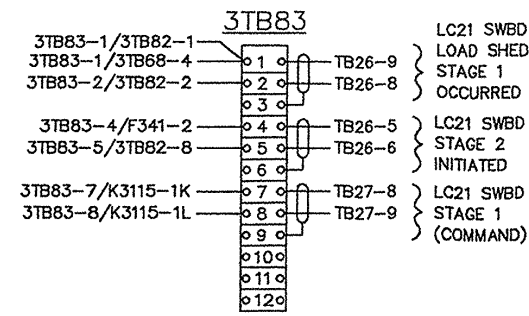
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 12 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW RIGHT SIDE
PANEL-"H" UNIT-1

NOTE:
DDG 51 ONLY

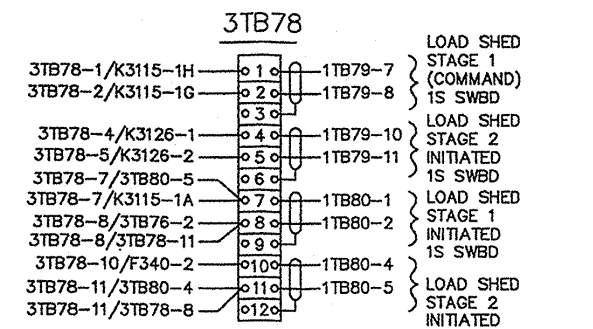
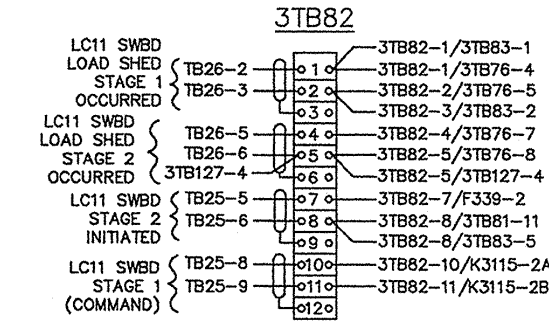
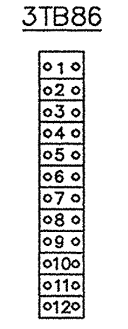
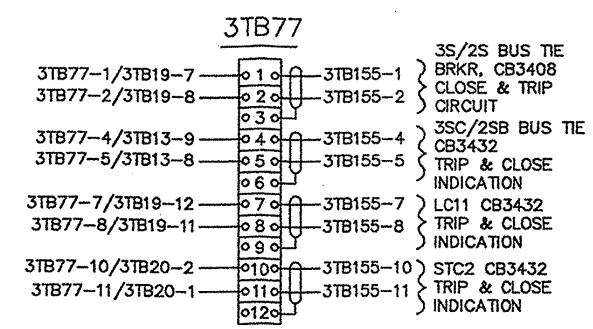
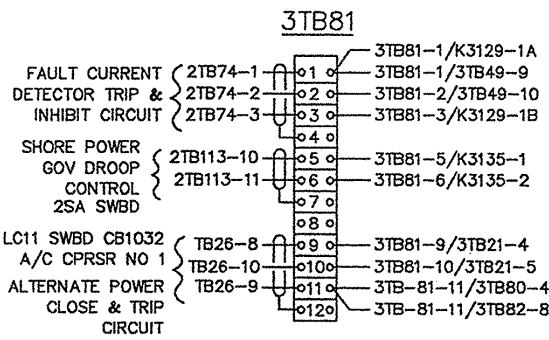
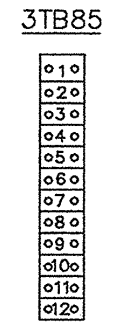
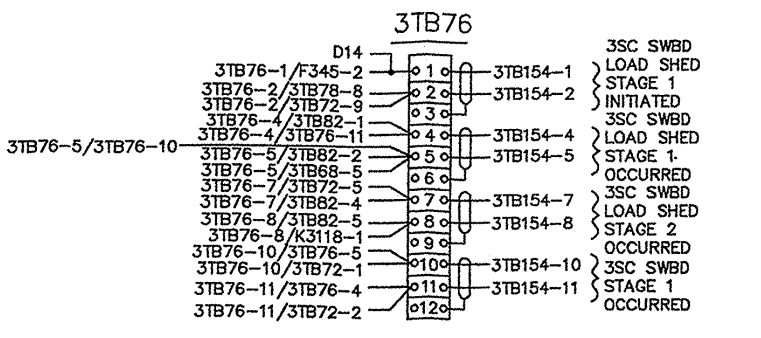
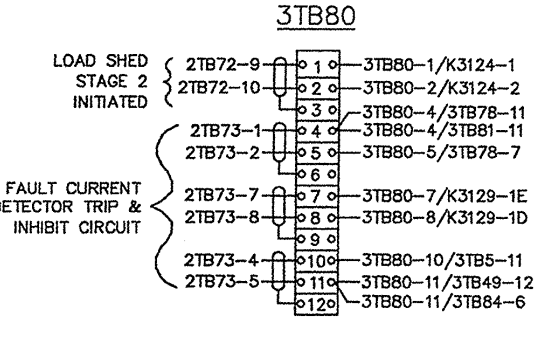
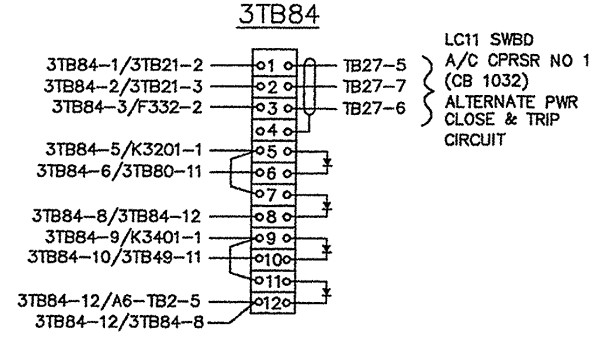
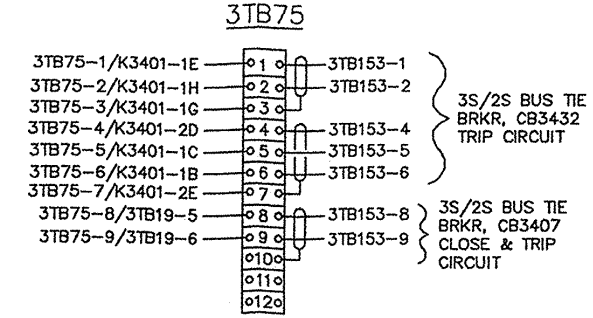
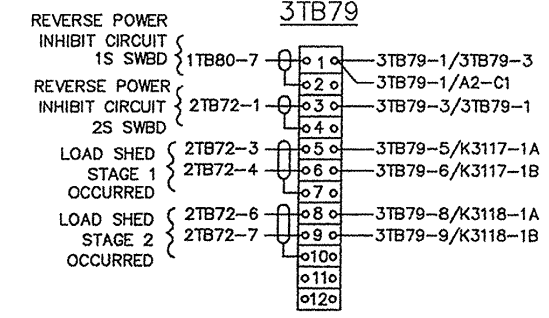
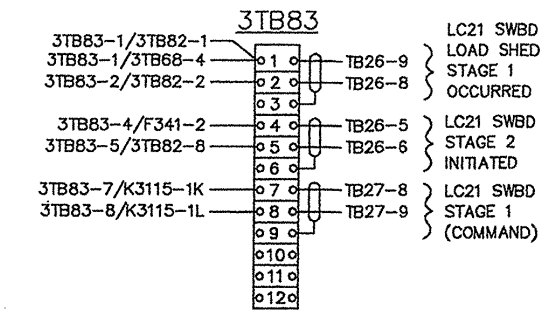
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 13 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW RIGHT SIDE
PANEL-"H" UNIT-1

NOTE:
DDG 51 ONLY

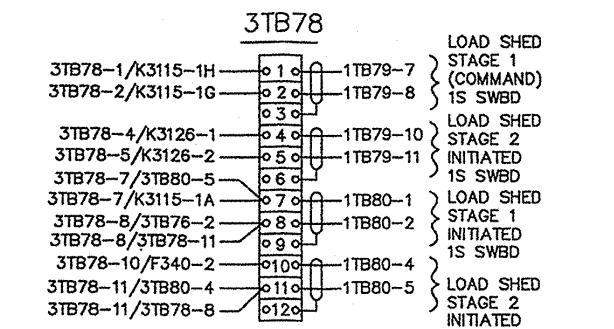
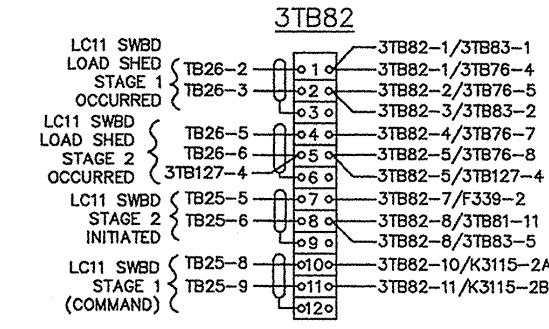
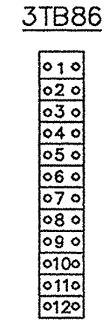
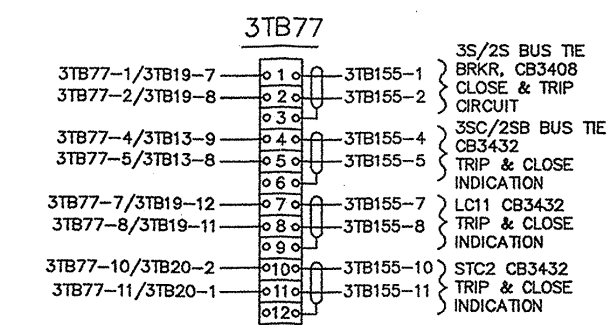
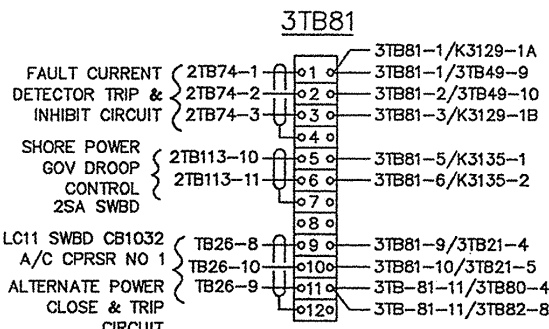
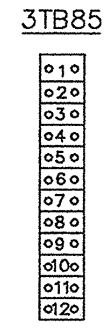
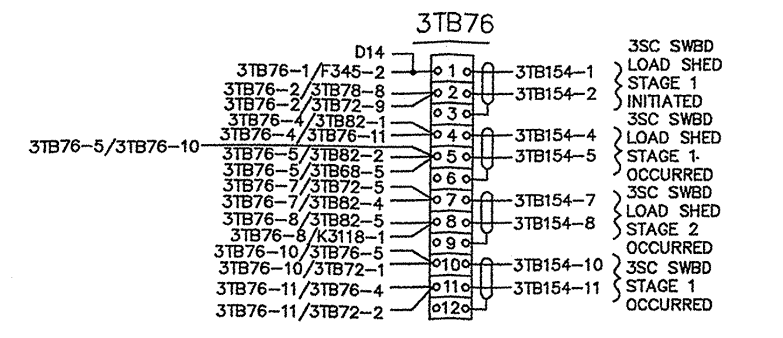
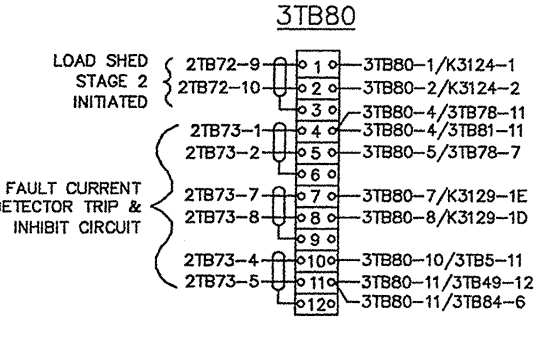
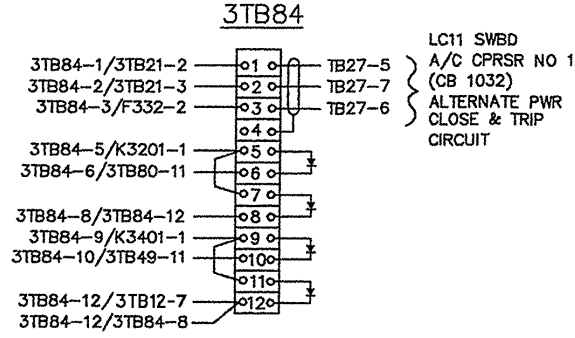
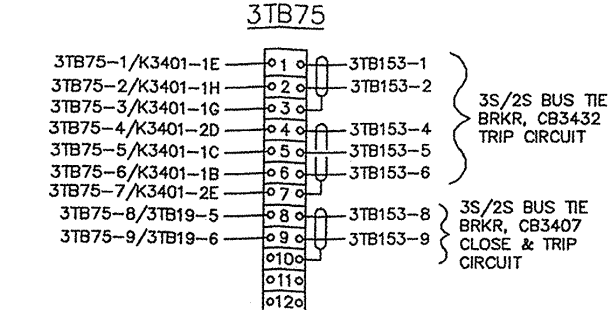
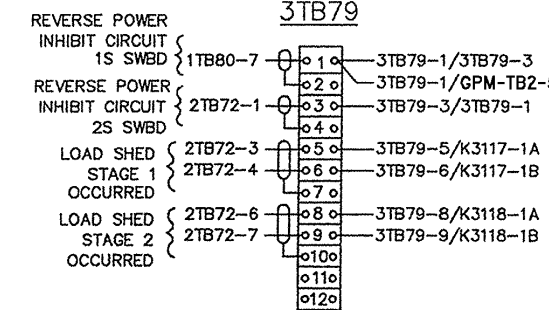
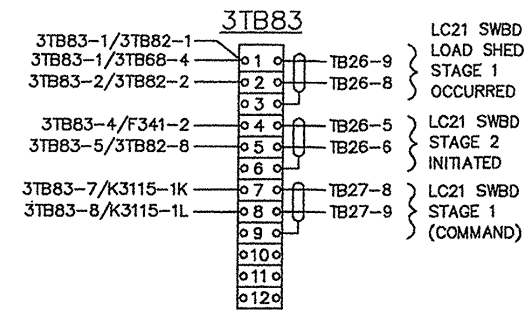
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 13 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



REAR VIEW RIGHT SIDE
PANEL-"H" UNIT-1

NOTE:
DDG 52-54 ONLY

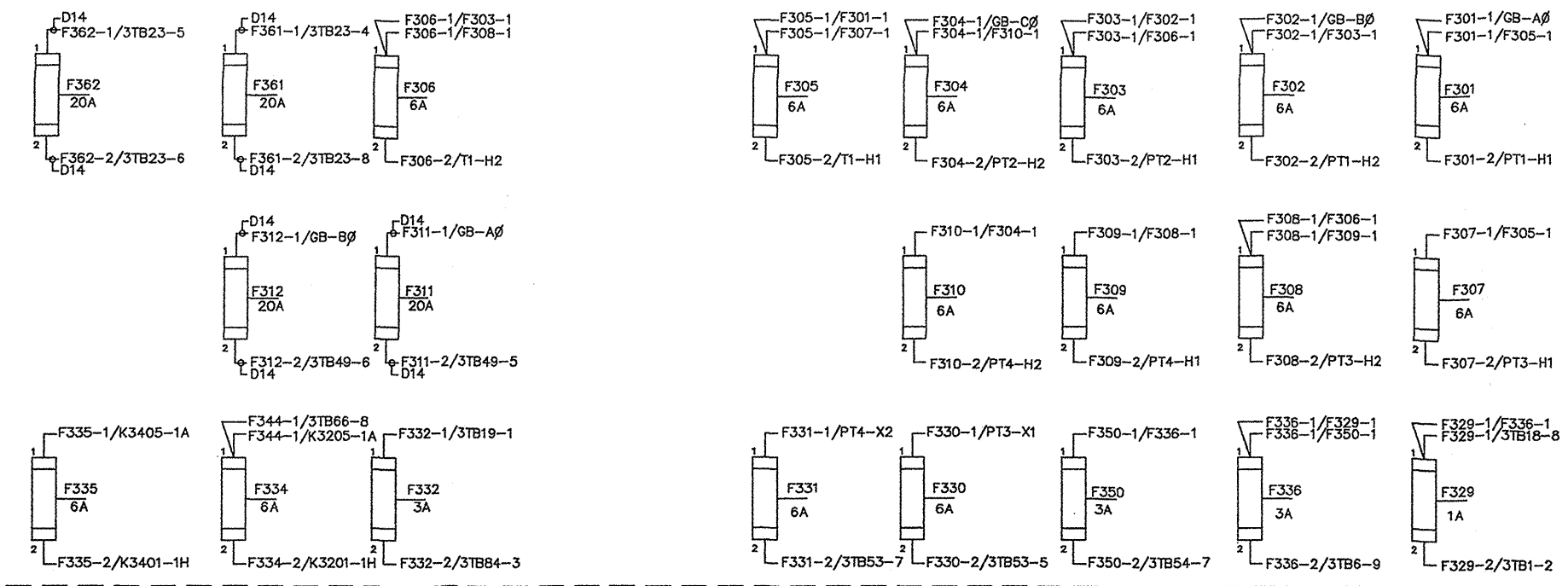
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 13 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



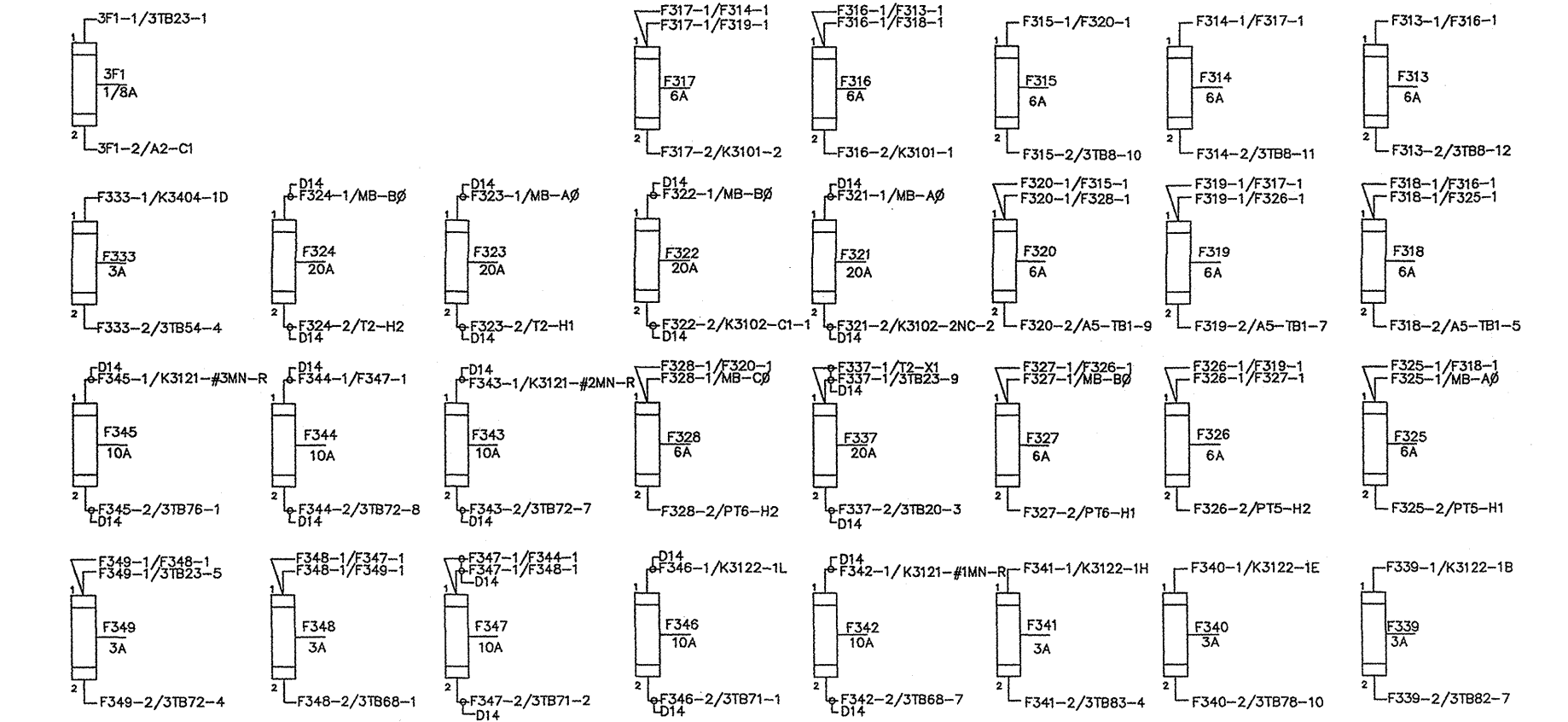
REAR VIEW RIGHT SIDE
PANEL-"H" UNIT-1

NOTE:
DDG 52-54 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 13 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



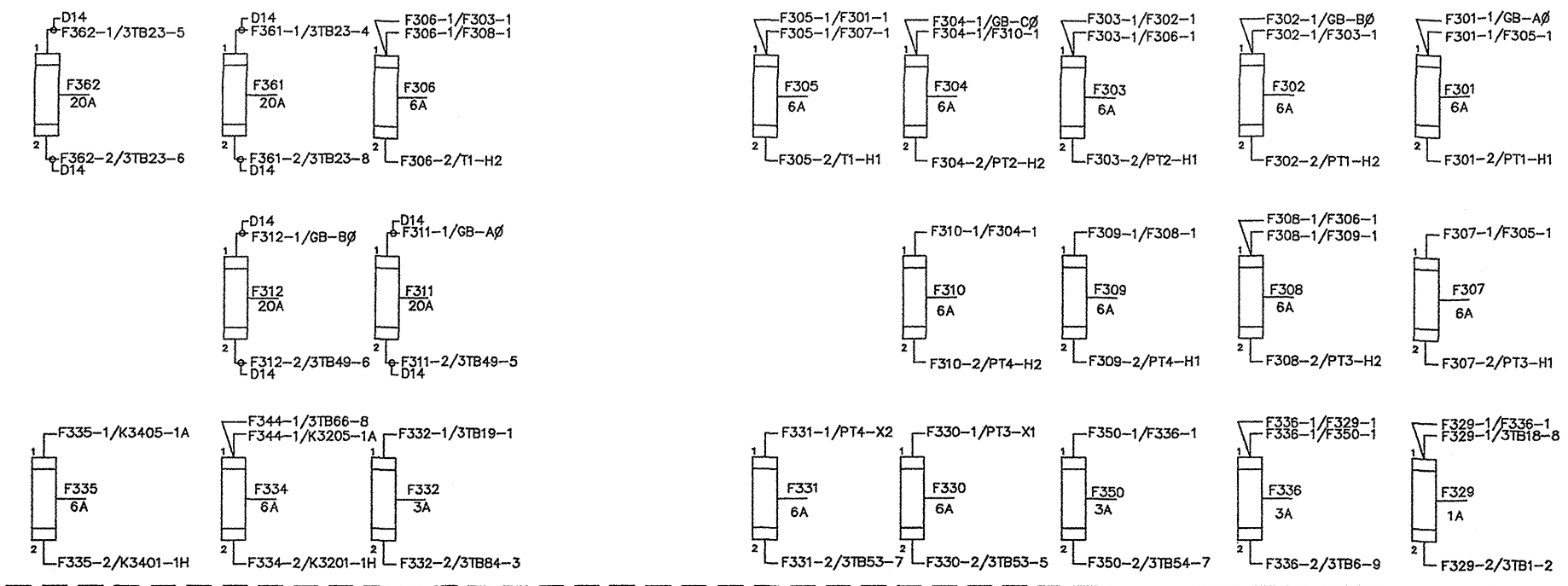
REAR VIEW (TOP)
 PANEL-"R1" UNIT-2



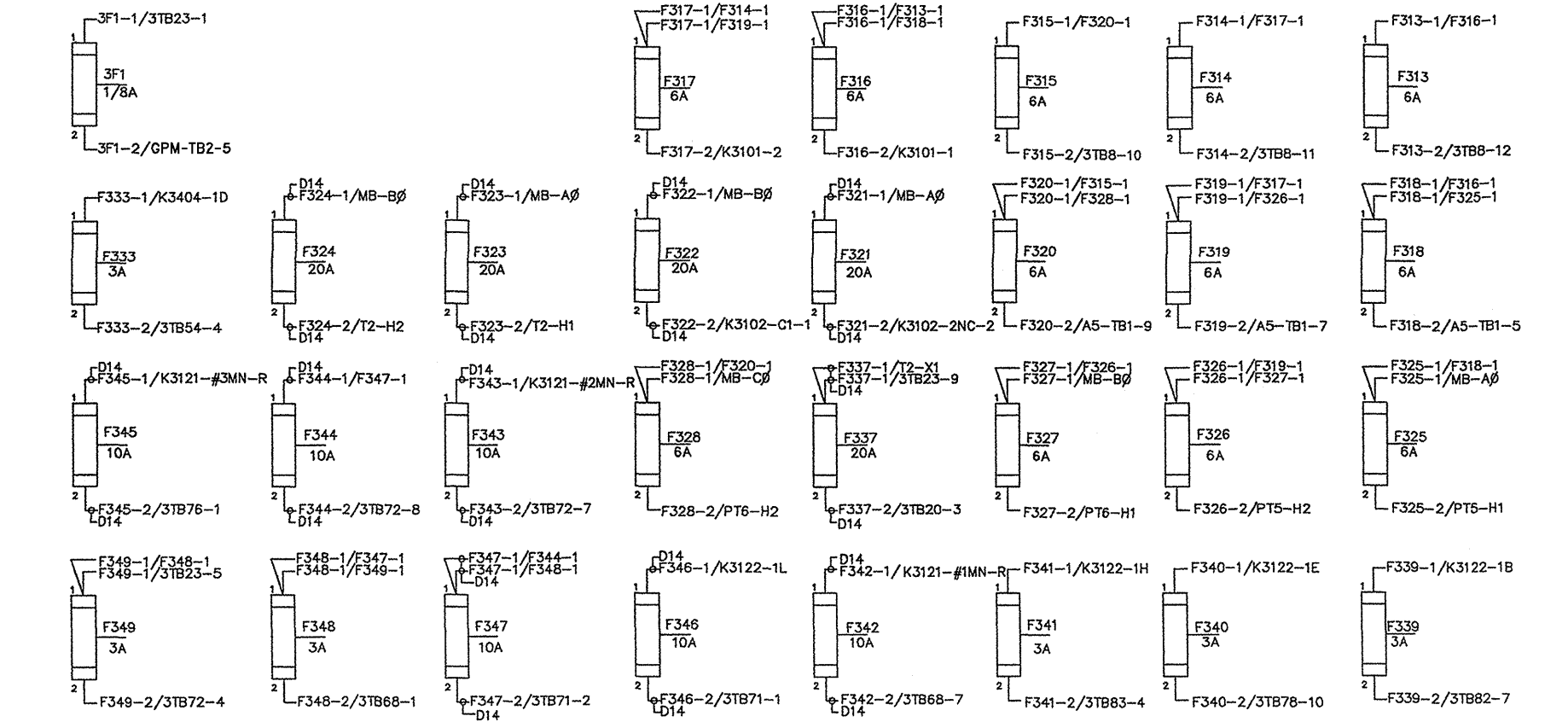
REAR VIEW (TOP)
 PANEL-"G1" UNIT-1

NOTE:
 DDG 51 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 14 of 19)
 (For Ships Without MACHALT 320-59006 (ECP-515) Installed)



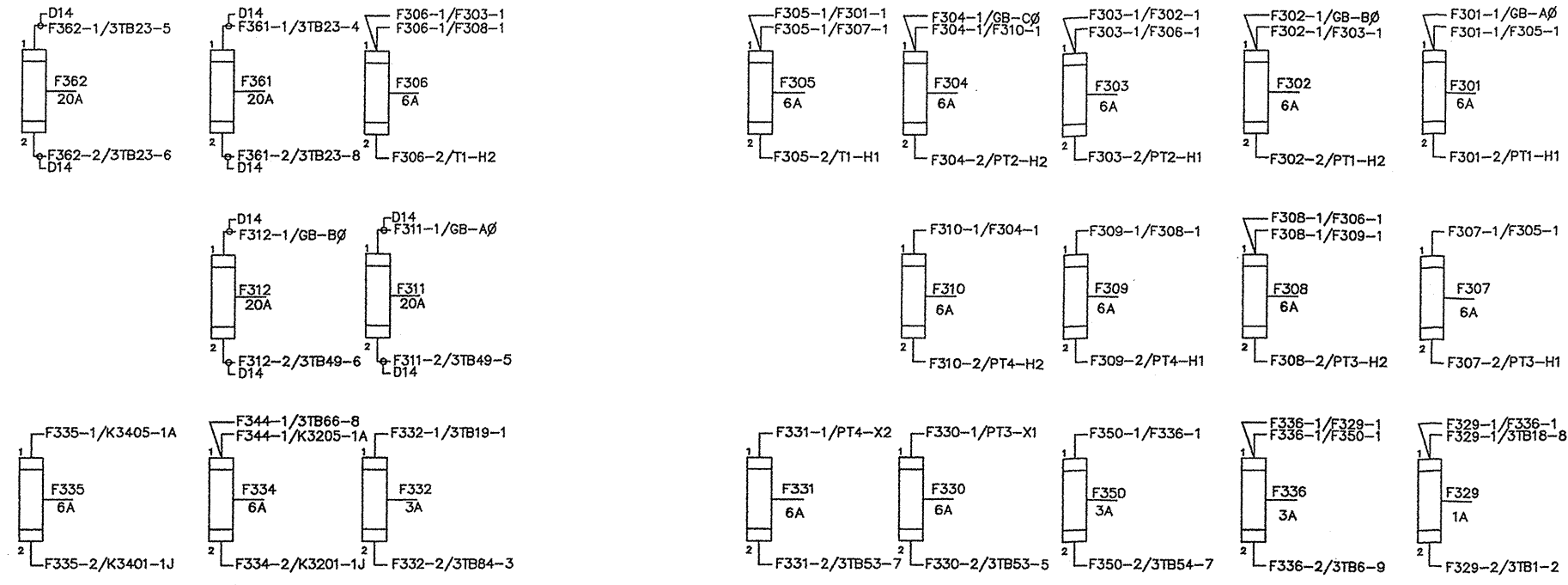
REAR VIEW (TOP)
PANEL-"R1" UNIT-2



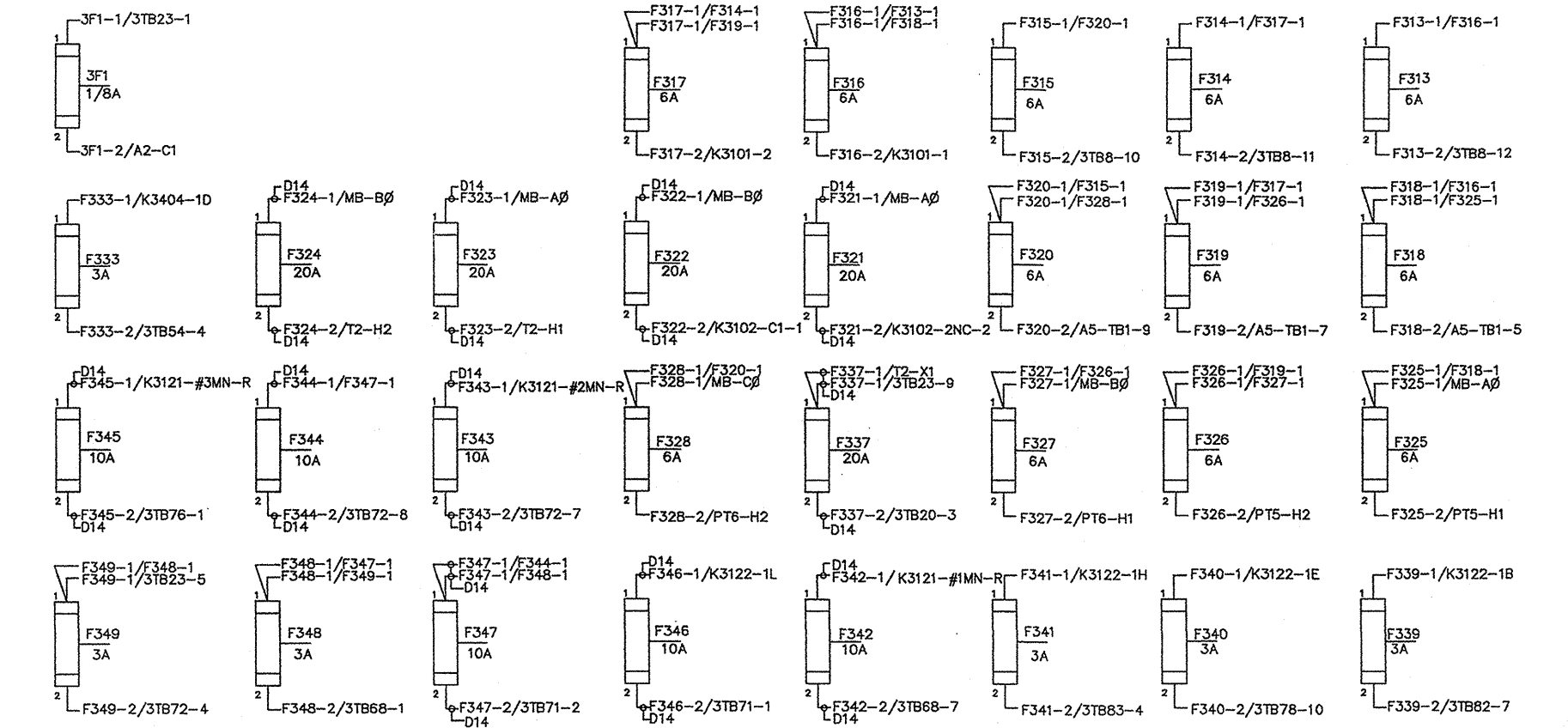
REAR VIEW (TOP)
PANEL-"G1" UNIT-1

NOTE:
DDG 51 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 14 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



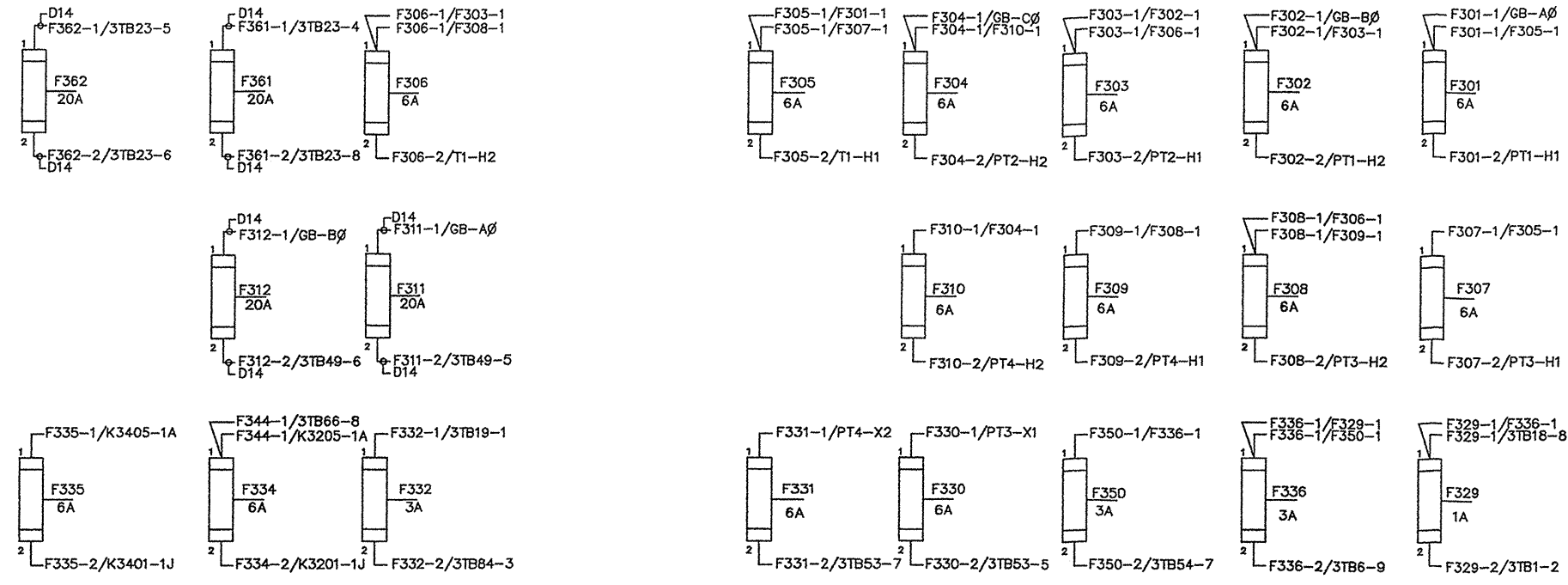
REAR VIEW (TOP)
PANEL-"R1" UNIT-2



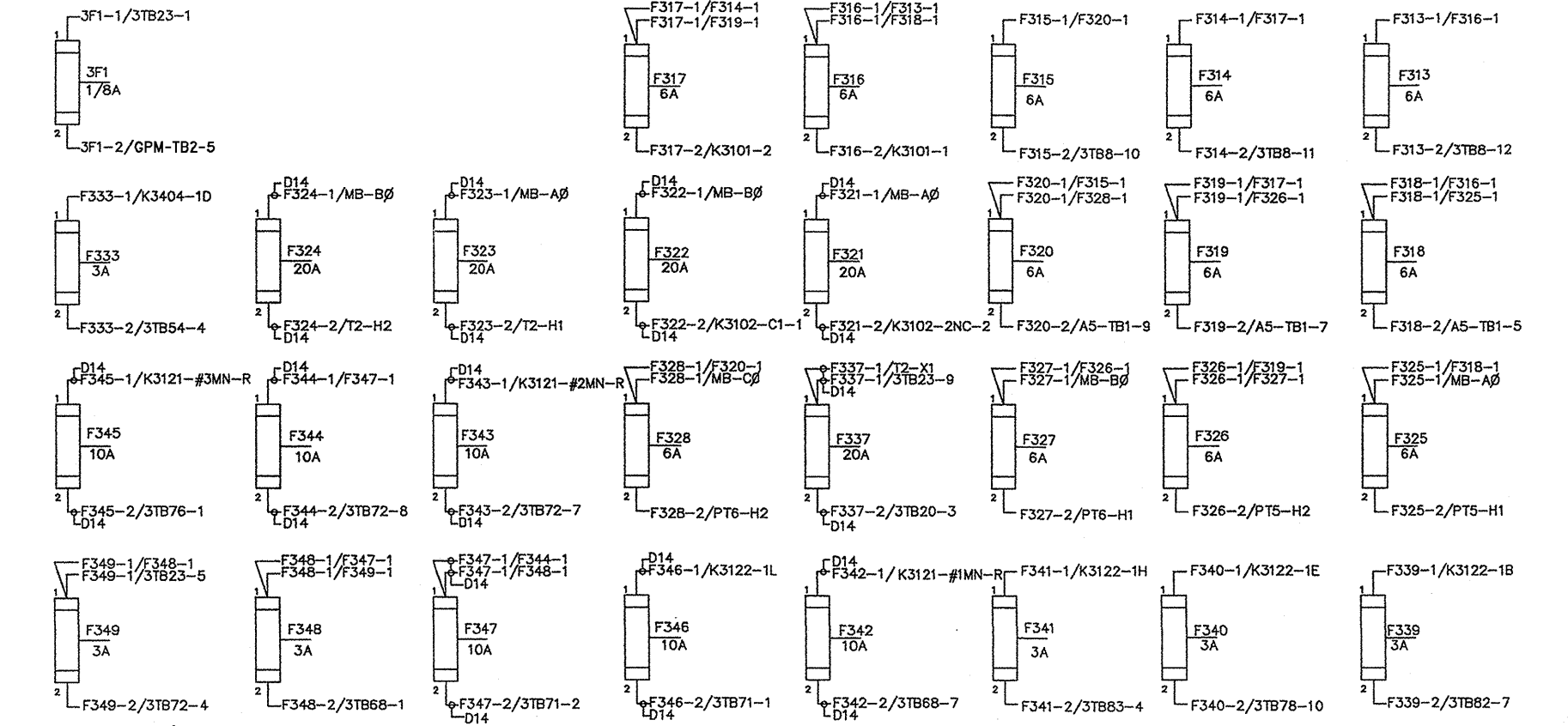
REAR VIEW (TOP)
PANEL-"G1" UNIT-1

NOTE:
DDG 52-54 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 14 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



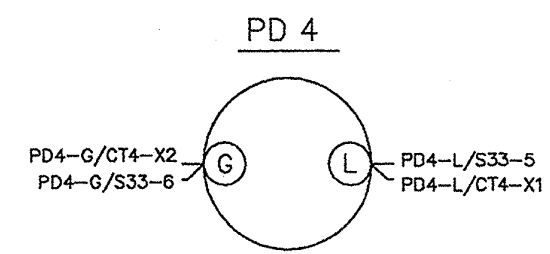
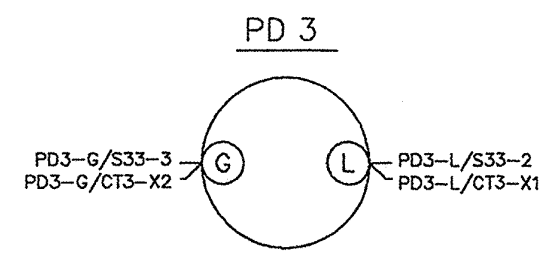
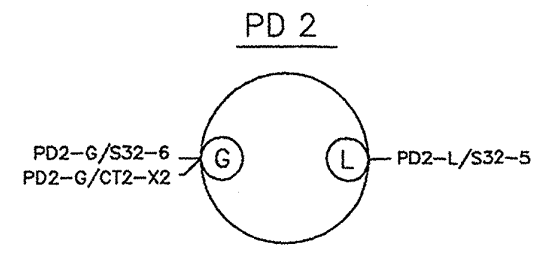
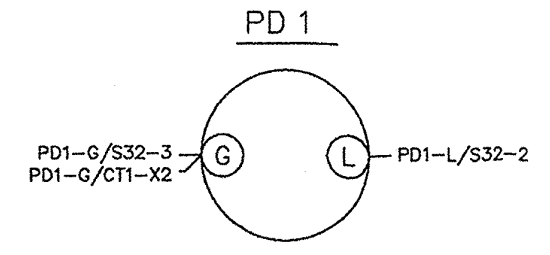
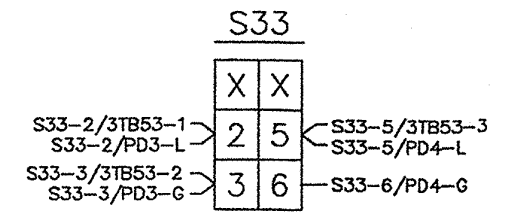
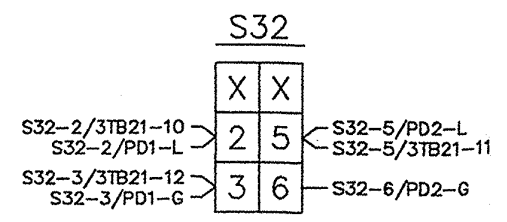
REAR VIEW (TOP)
PANEL-"R1" UNIT-2



REAR VIEW (TOP)
PANEL-"G1" UNIT-1

NOTE:
DDG 52-54 ONLY

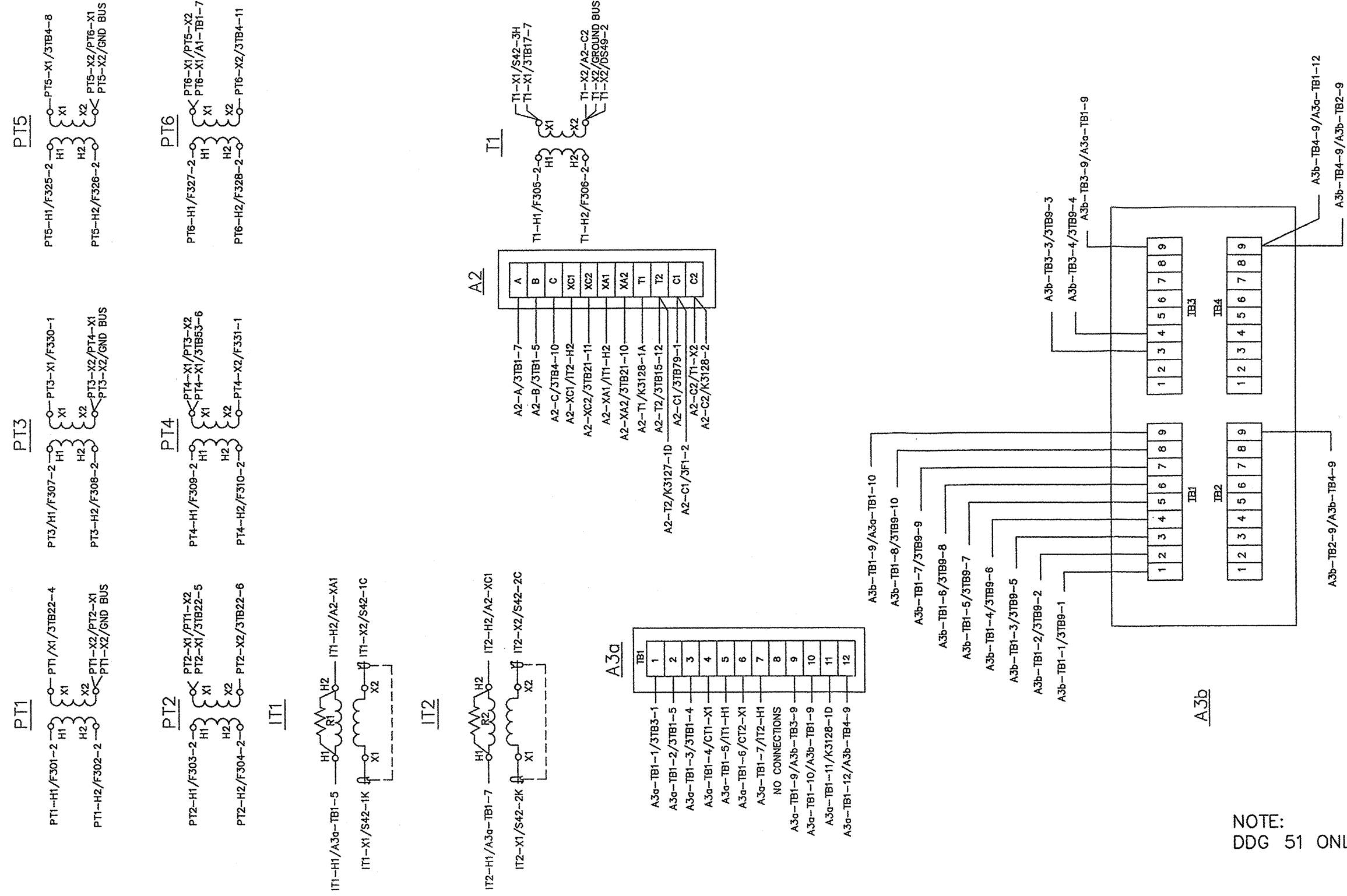
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 14 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE
PANEL-"L" UNIT-2

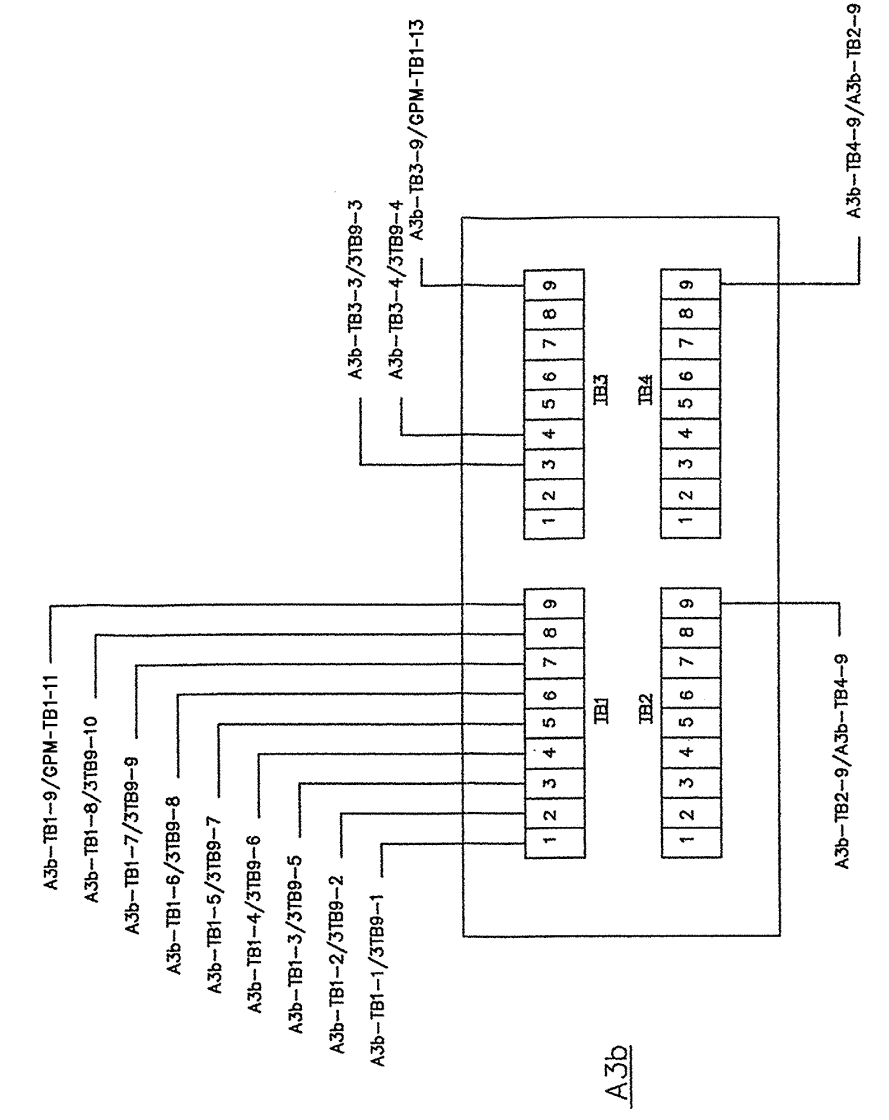
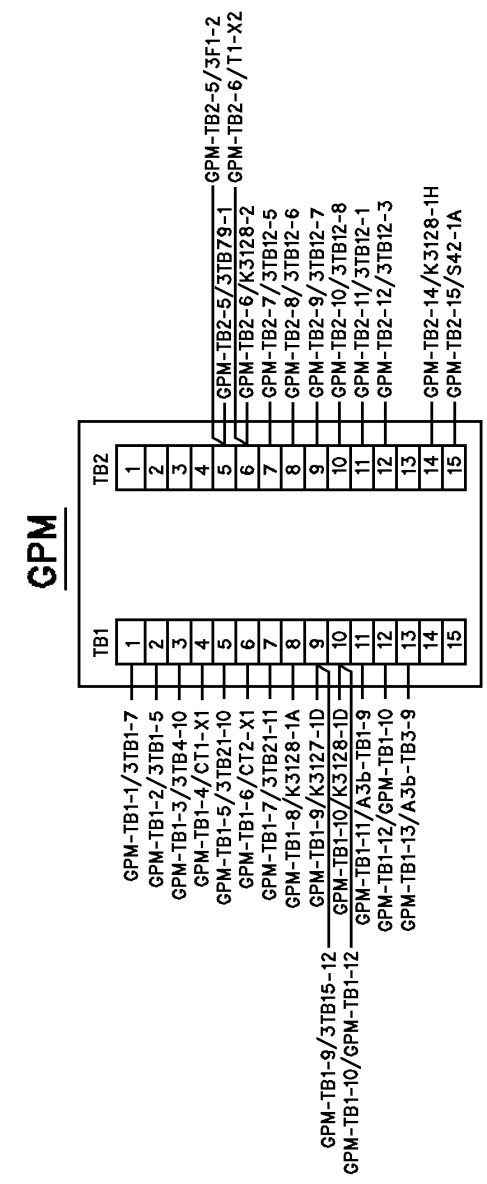
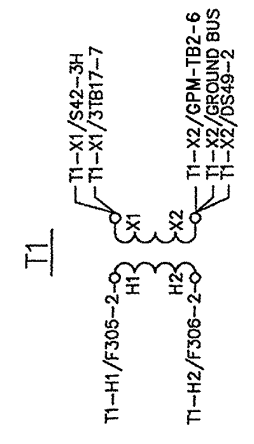
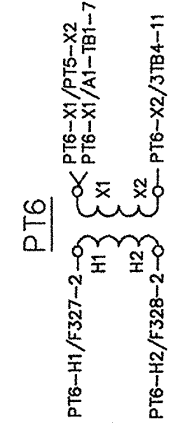
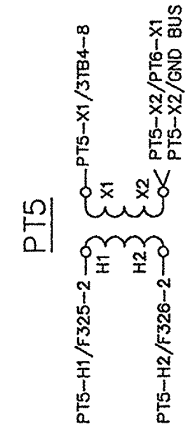
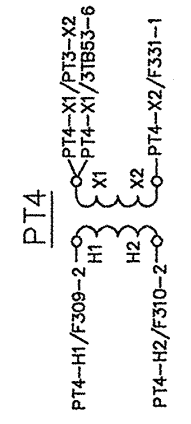
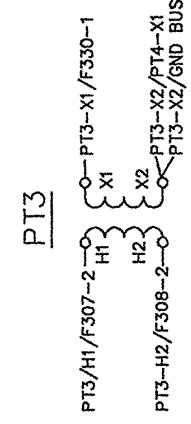
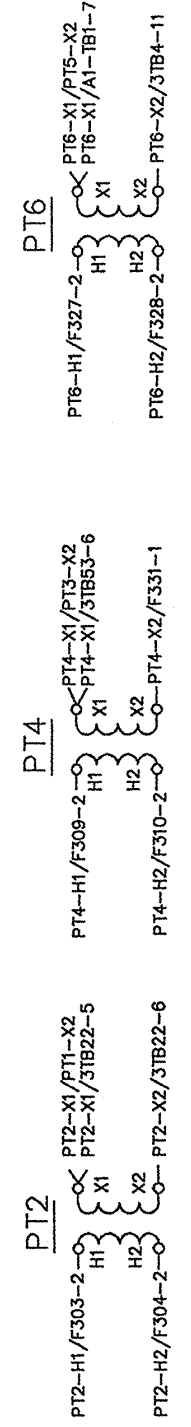
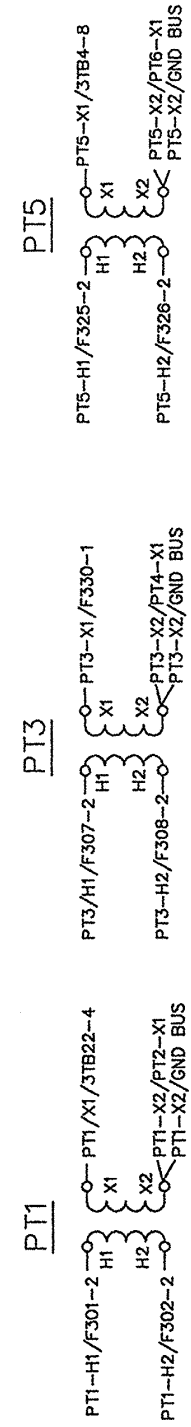
NOTE:
DDG 51 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 15 of 19)



NOTE:
DDG 51 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 16 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



NOTE:
DDG 51 ONLY

FRONT VIEW
PANEL-"M1" UNIT-2

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 16 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

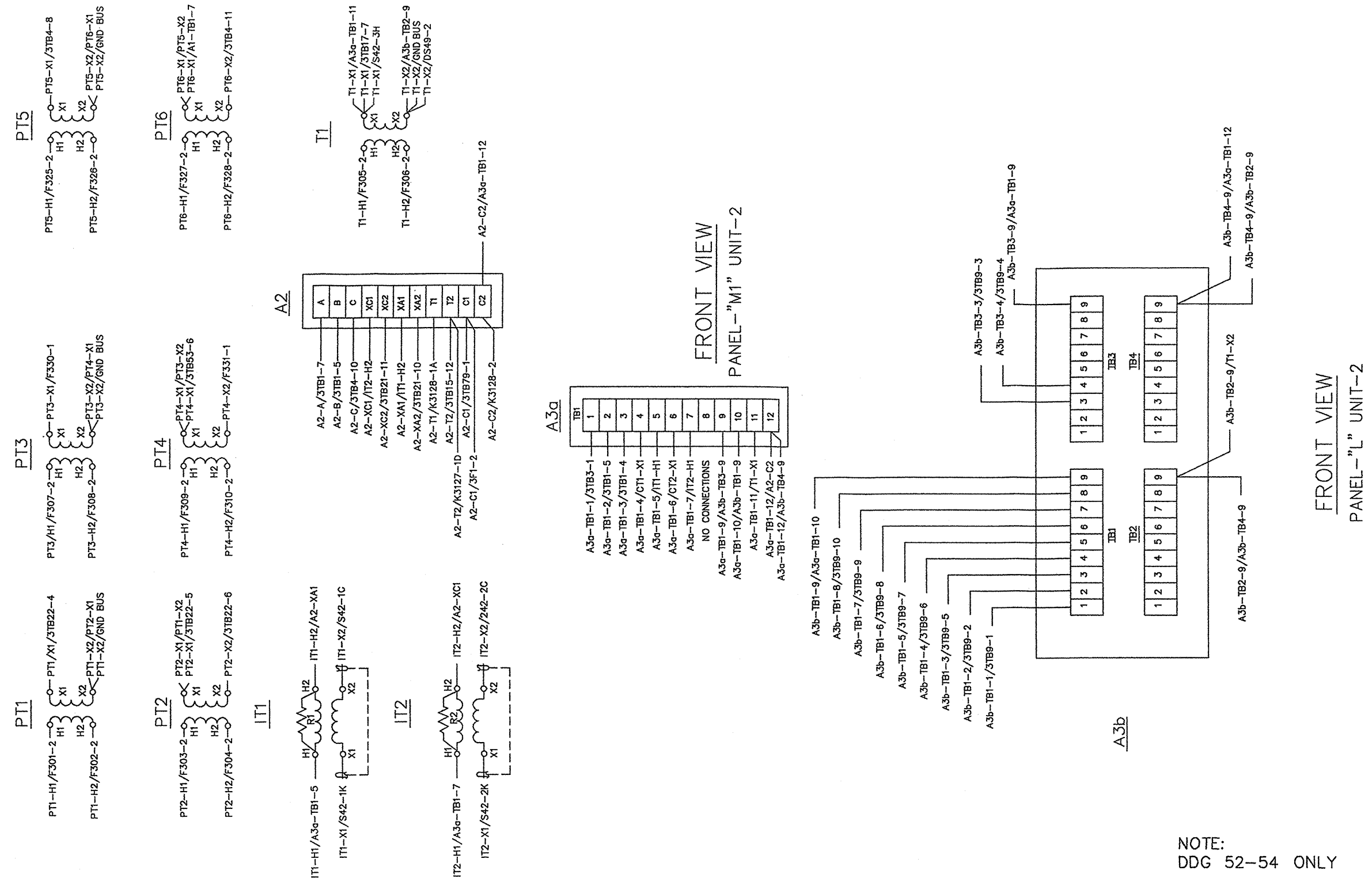
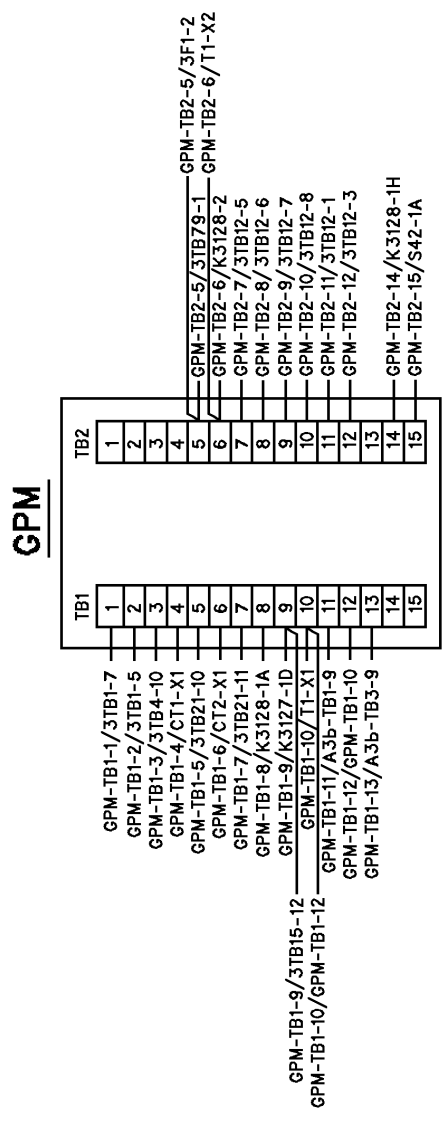
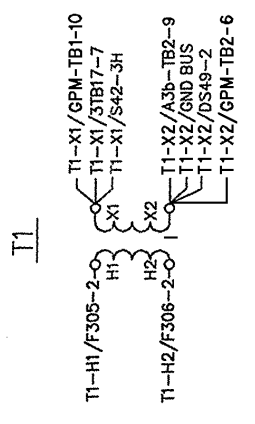
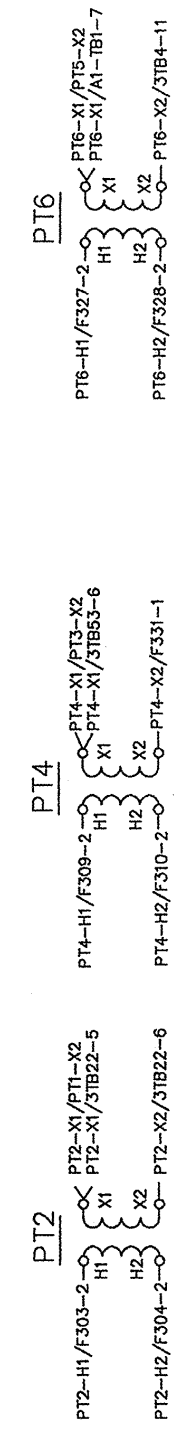
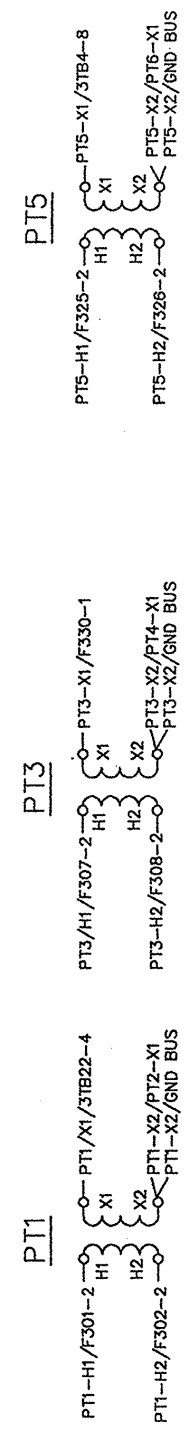
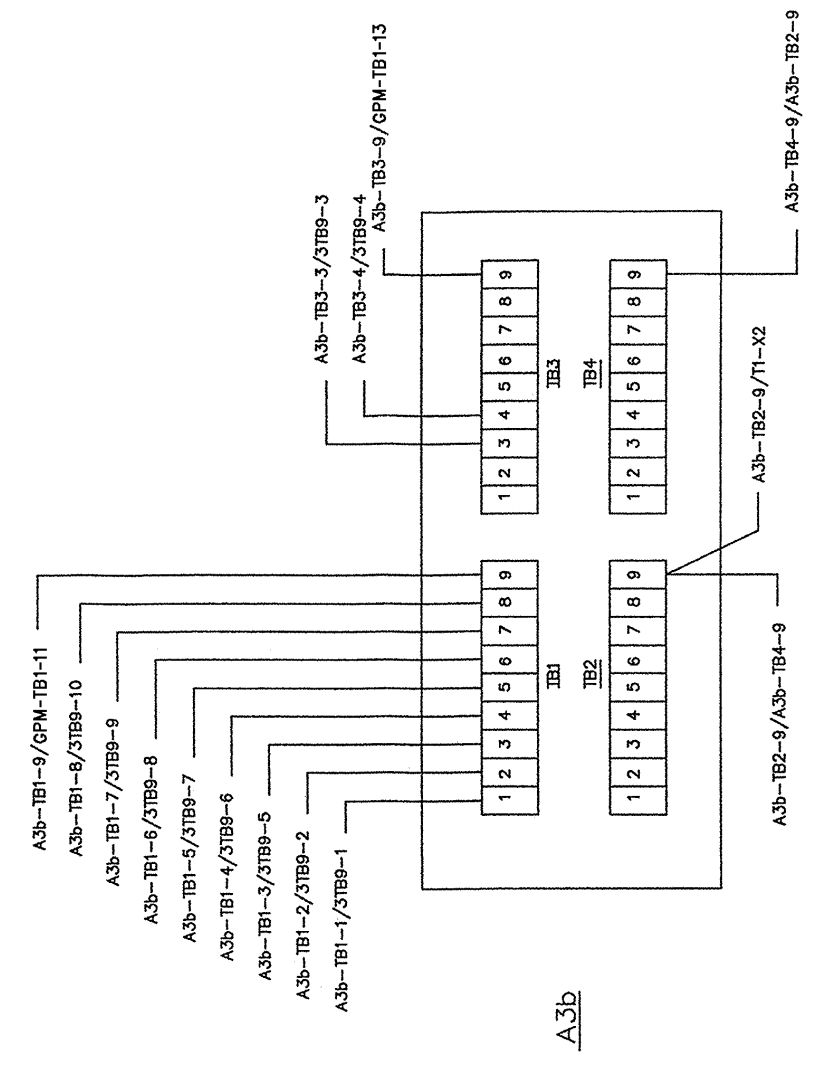


Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 16 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



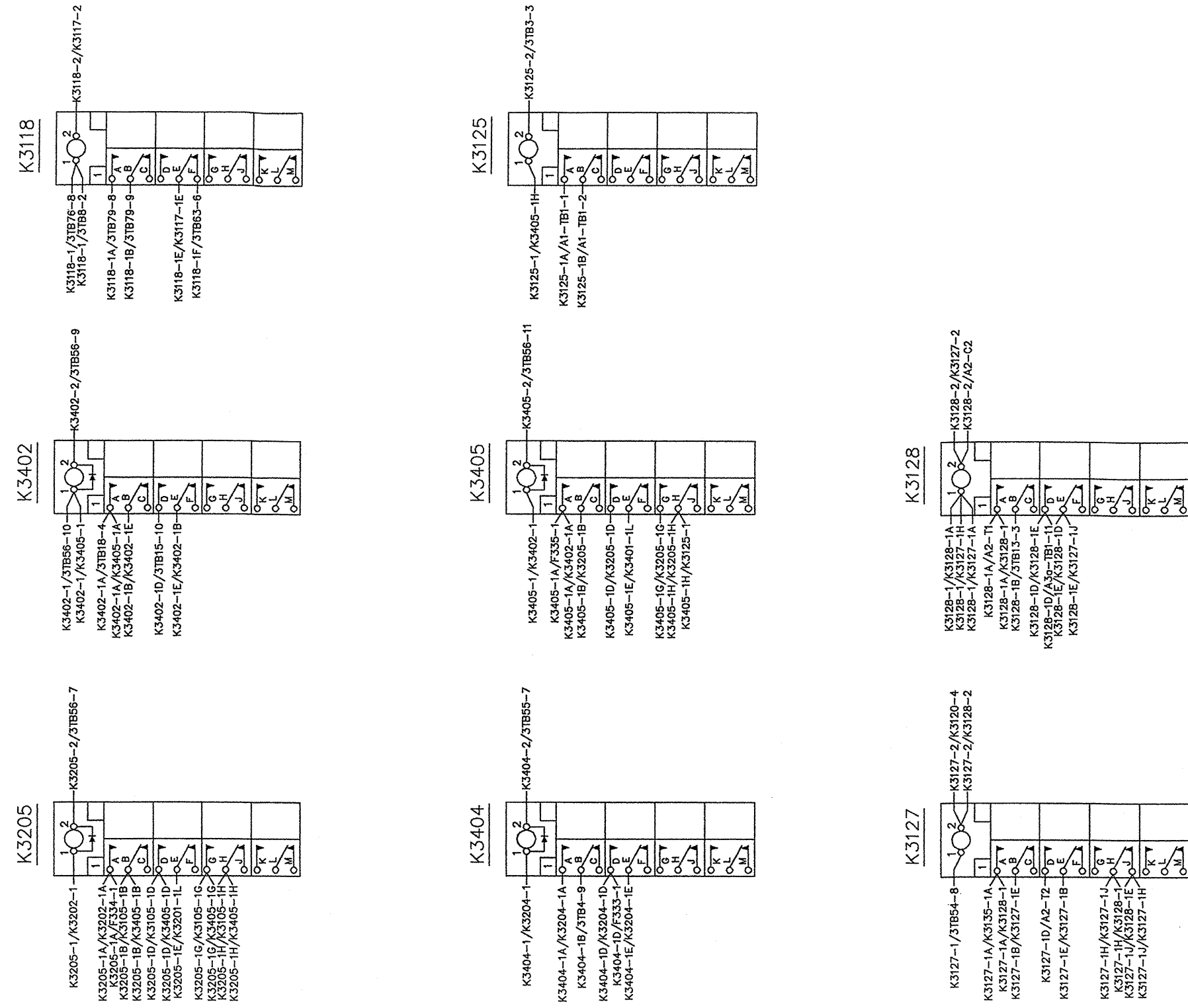
FRONT VIEW
PANEL-"M1" UNIT-2



NOTE:
DDG 52-54 ONLY

FRONT VIEW
PANEL-"L" UNIT-2

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 16 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)

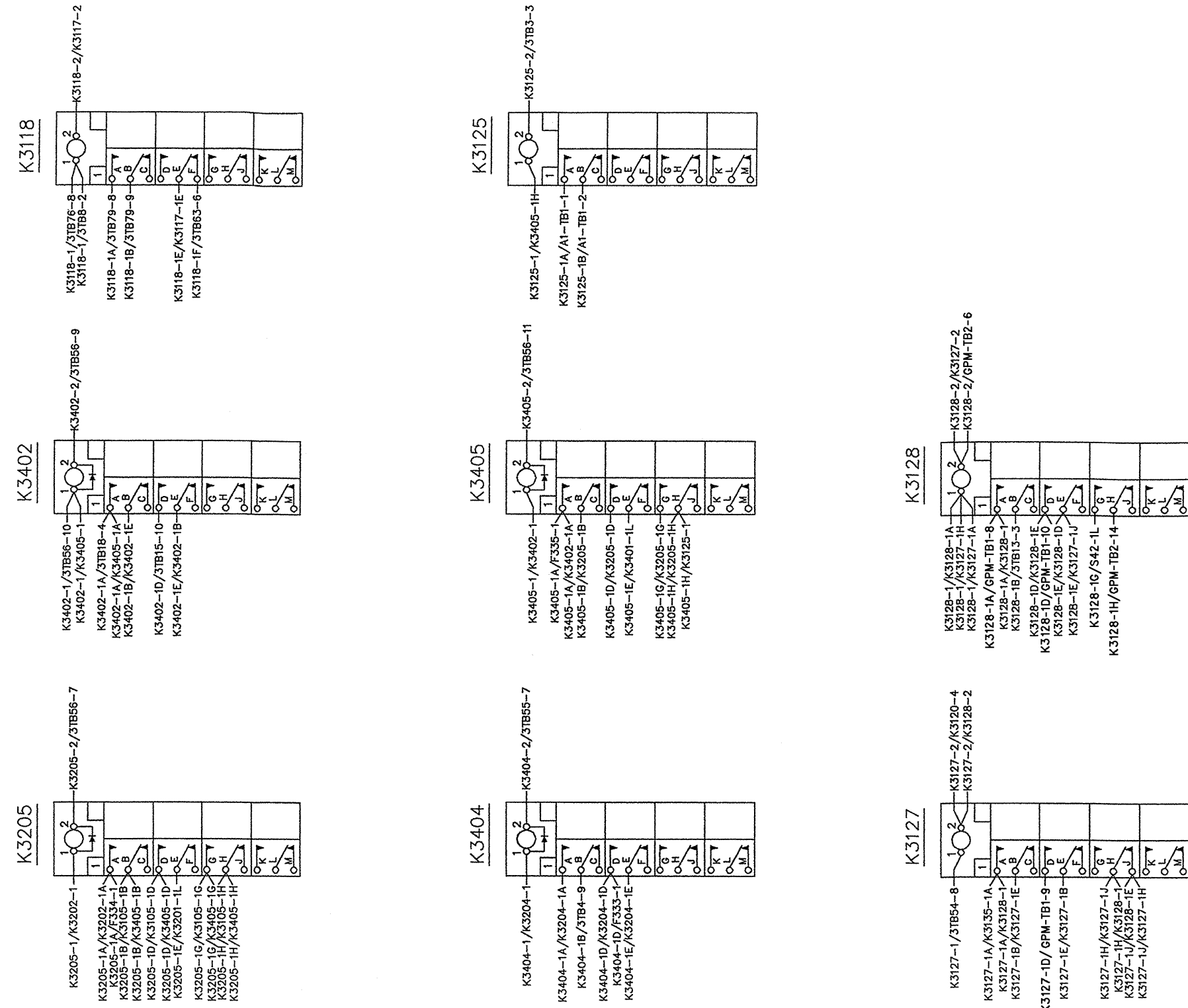


FRONT VIEW LEFT HAND SIDE

PANEL-"N" UNIT-2

NOTE:
DDG 51 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 17 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

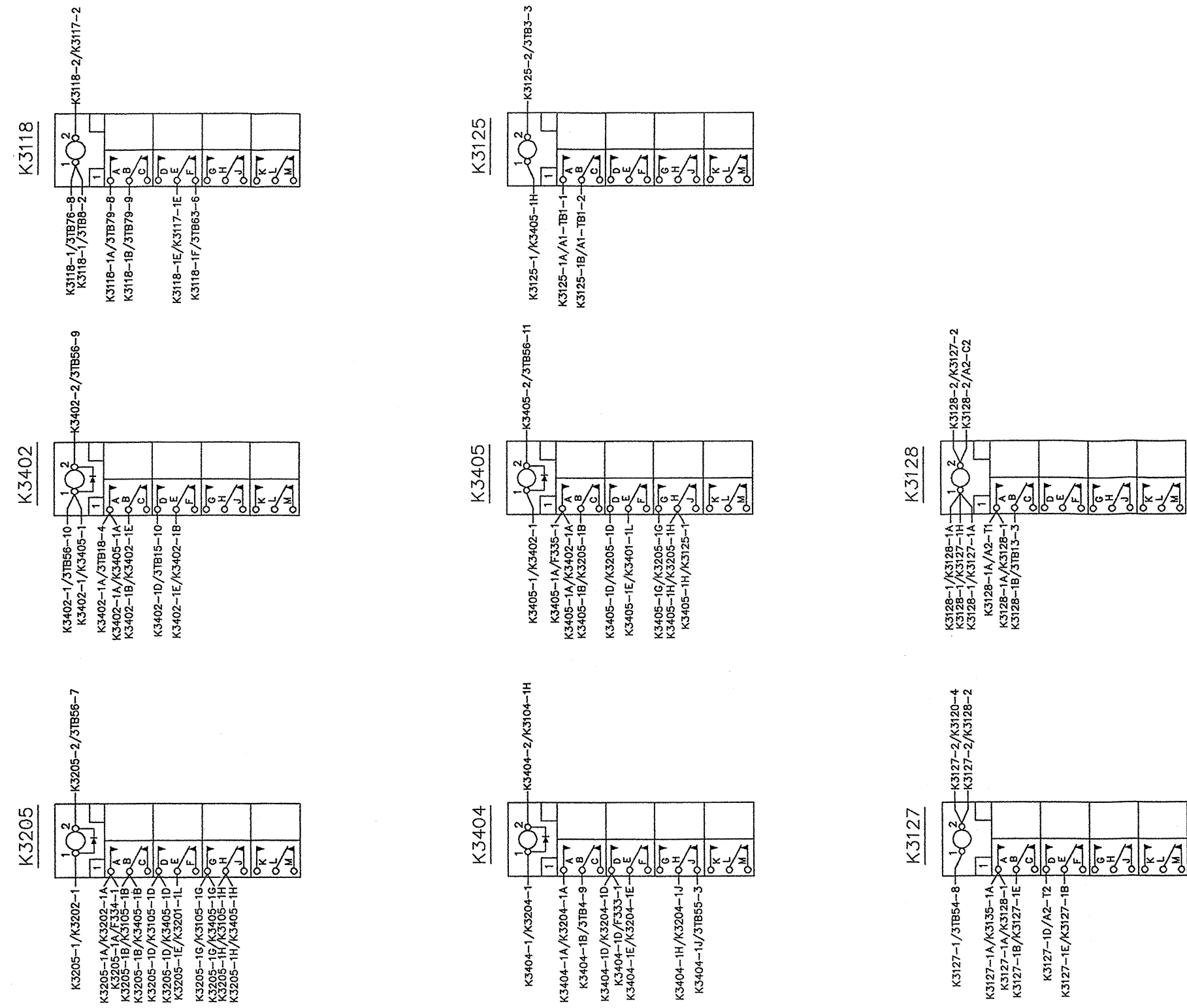


FRONT VIEW LEFT HAND SIDE

PANEL-"N" UNIT-2

NOTE:
DDG 51 ONLY

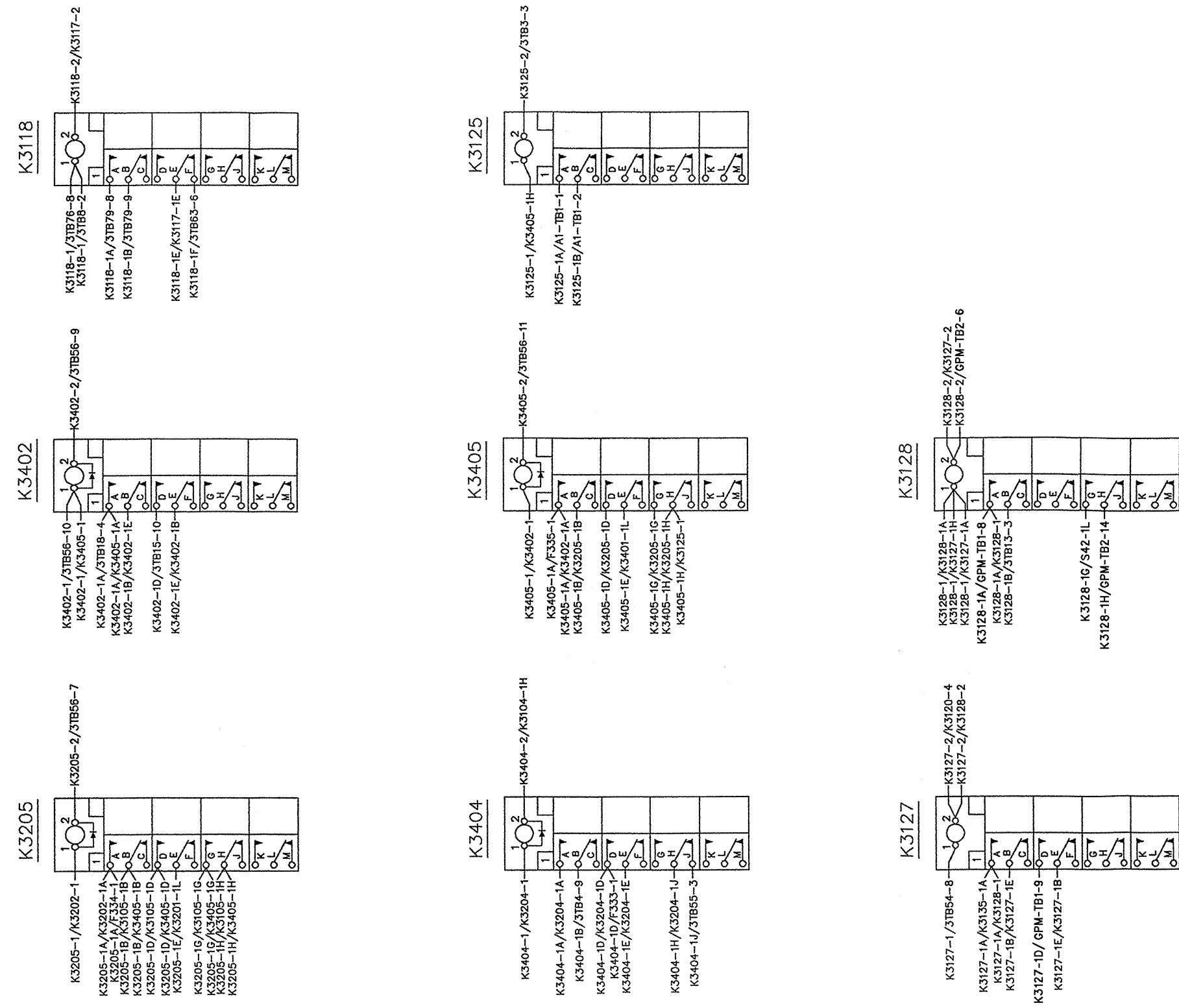
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 17 of 19)
(For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE
PANEL-"N" UNIT-2

NOTE:
DDG 52-54 ONLY

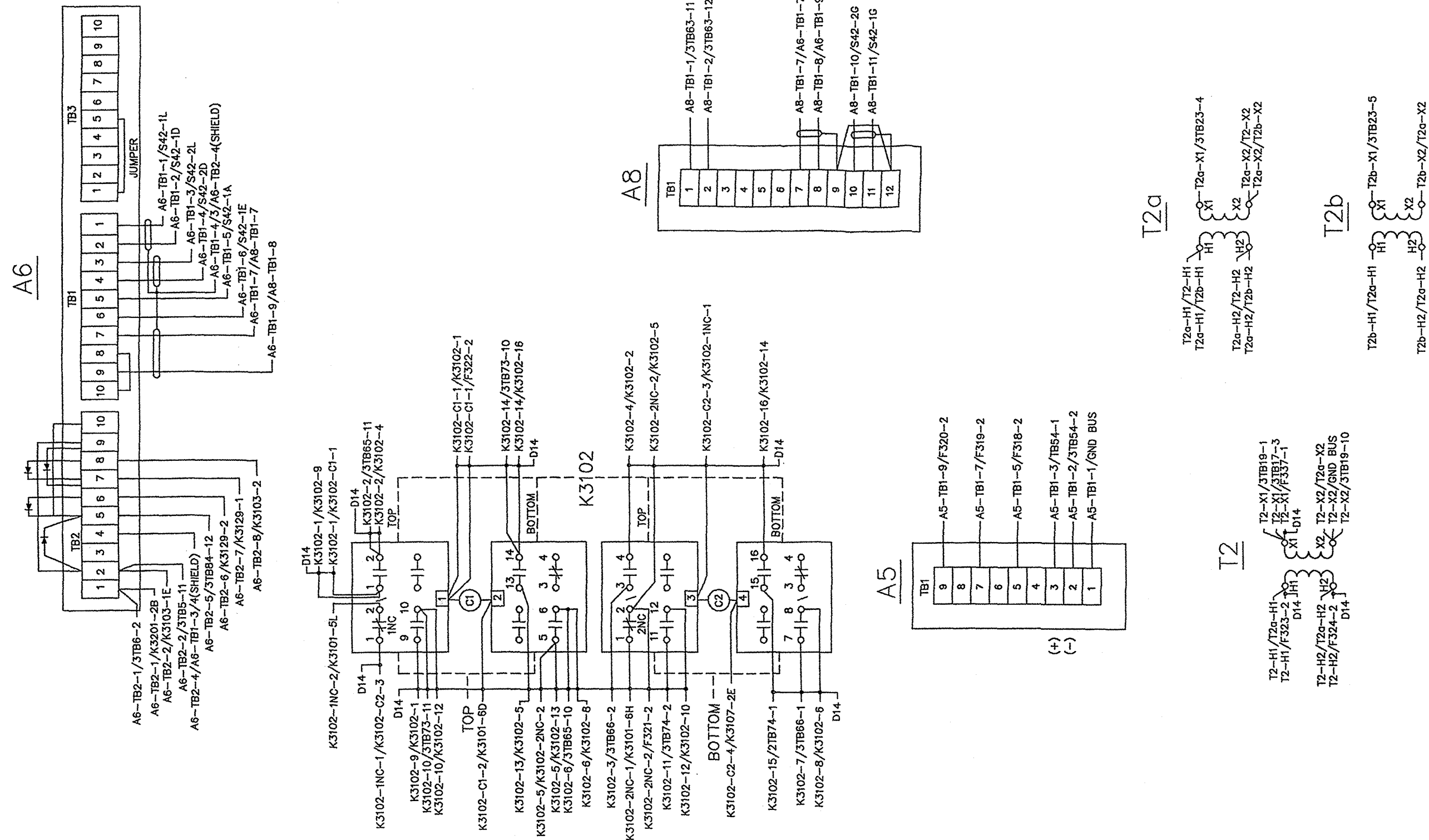
Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 17 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW LEFT HAND SIDE
 PANEL-"N" UNIT-2

NOTE:
 DDG 52-54 ONLY

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 17 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)



FRONT VIEW
PANEL "C2" UNIT-1

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 18 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)

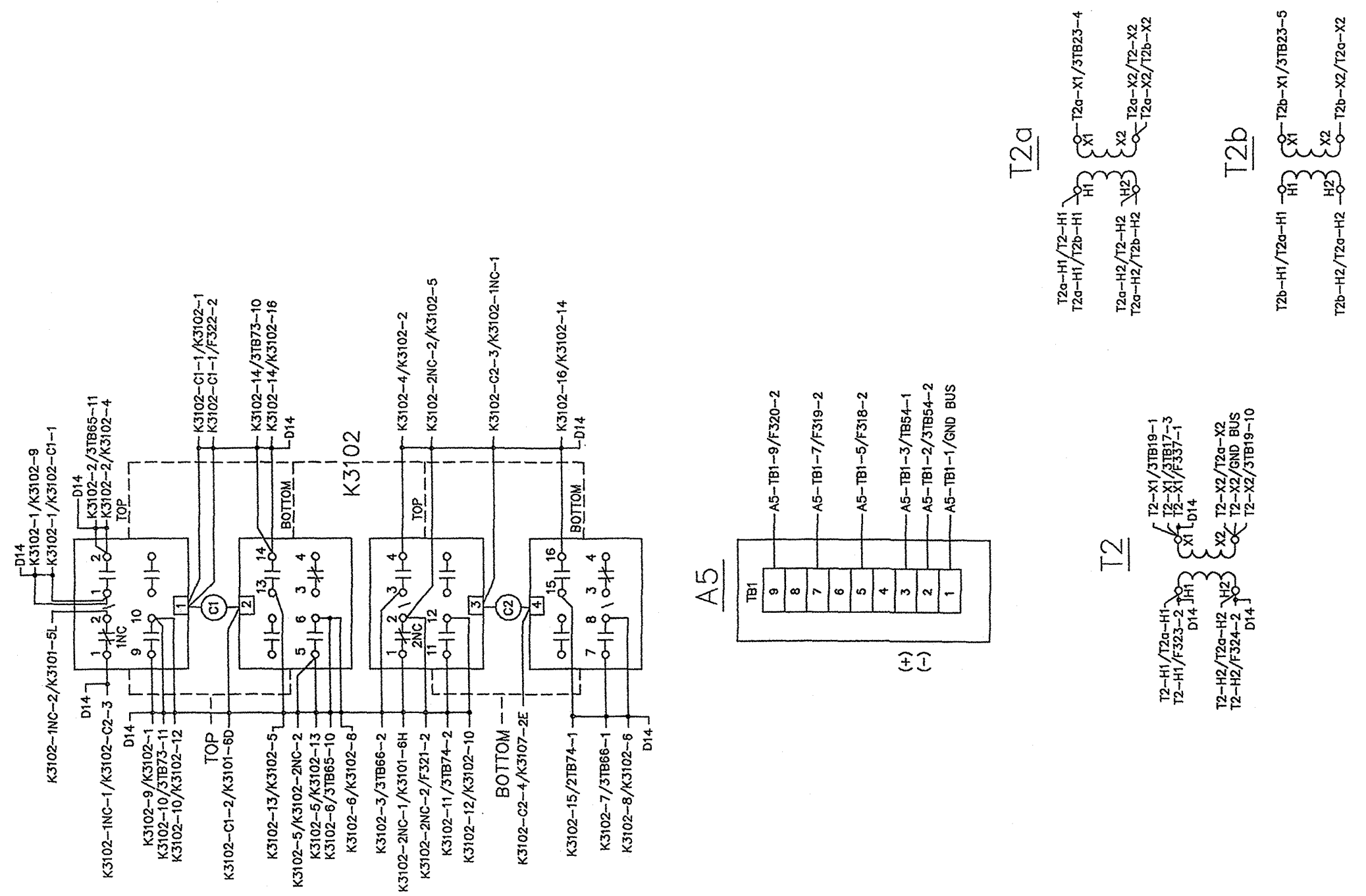


Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 18 of 19)
 (For Ships With MACHALT 320-59006 (ECP-515) Installed)

FRONT VIEW
 PANEL "C2" UNIT-1

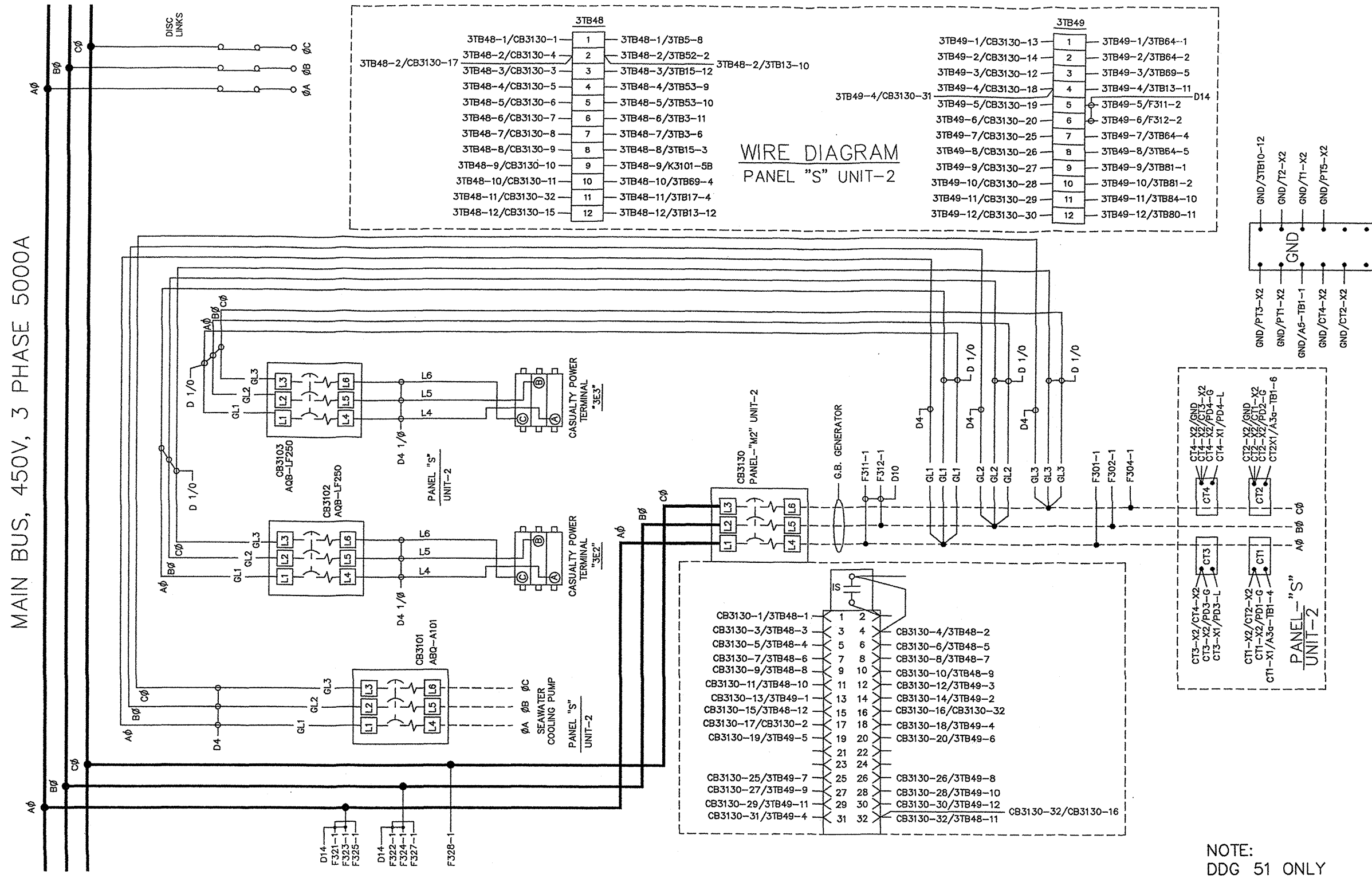
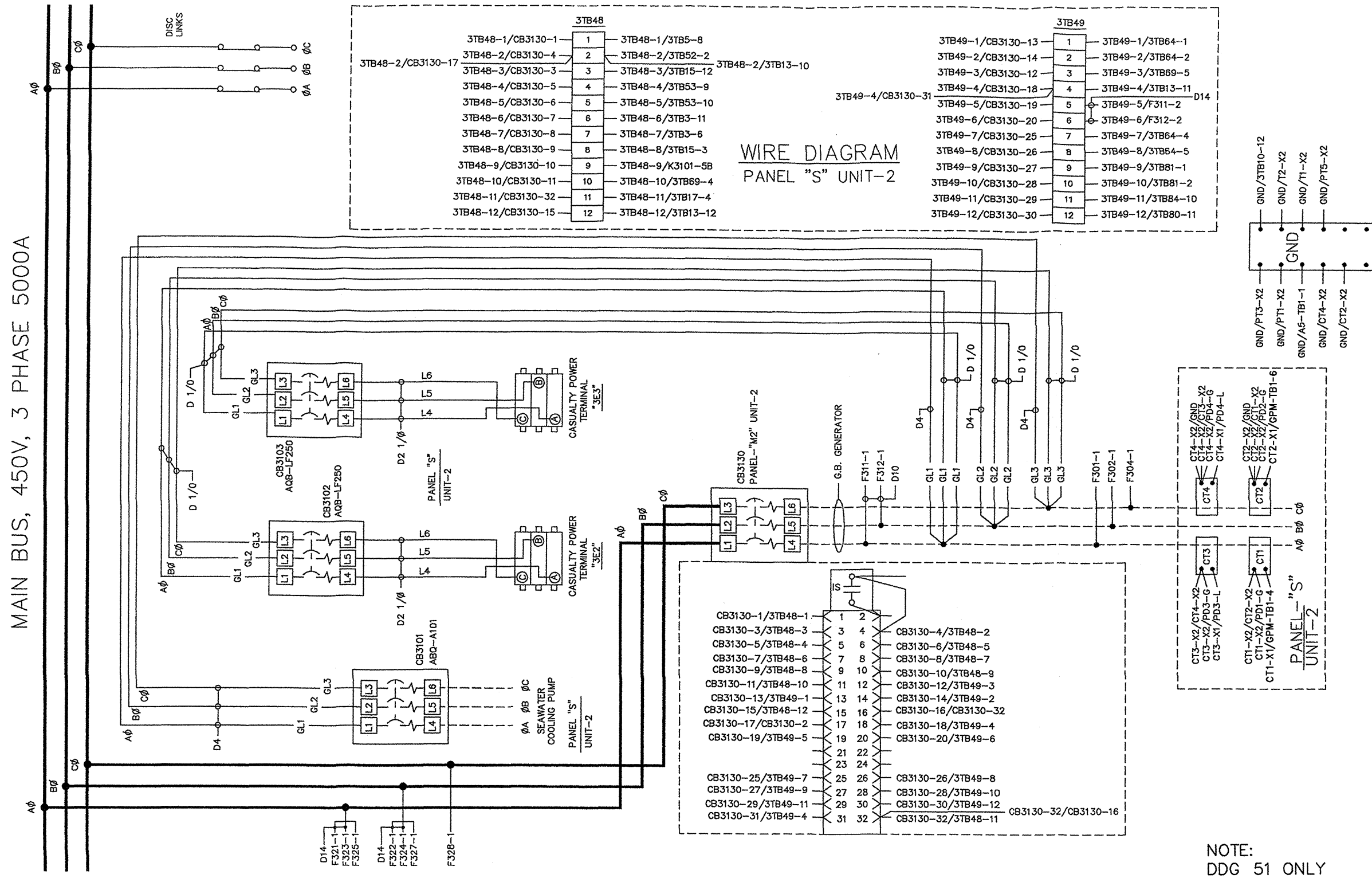


Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 19 of 19)
(For Ships Without MACHALT 320-59006 (ECP-515) Installed)



MAIN BUS, 450V, 3 PHASE 5000A

Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 19 of 19)
(For Ships With MACHALTs 320-59006 (ECP-515) and 320-42001 (ECP-597) Installed)

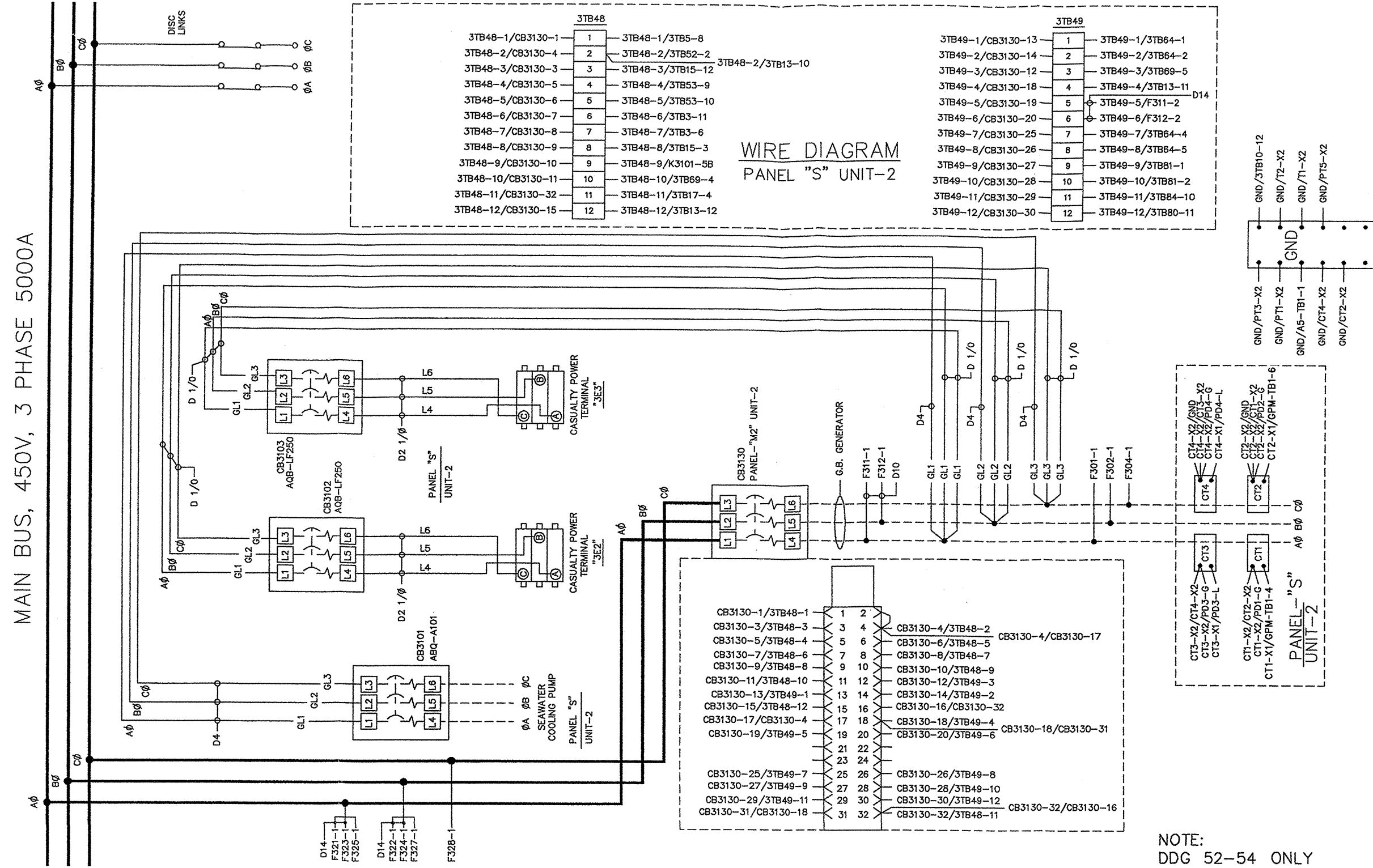


Figure 9-8. 3SG Switchboard; Wiring Diagram (Sheet 19 of 19)
(For Ships With MACHALTs 320-59006 (ECP-515) and 320-42001 (ECP-597) Installed)

PANEL A SHEET-5 (DDG 51) SHEET-5A (DDG 52-54)	PANEL B	PANEL C SHEET-6 (DDG 51) SHEET-7 (DDG 52-54)	PANEL D	PANEL E SHEET-6 (DDG 51) SHEET-7 (DDG 52-54)	PANEL F SHEET-4	PANEL G	PANEL H SHEET-6 (DDG 51) SHEET-7 (DDG 52-54)
---	---------	--	---------	--	--------------------	---------	--

UNIT-1

PANEL J SHEET-3 (DDG 51) SHEET-3A (DDG 52-54) SHEET-5 (DDG 51) SHEET-5A (DDG 52-54)	PANEL K	PANEL L	PANEL M	PANEL N SHEET-3 (DDG 51) SHEET-3A (DDG 52-54)	PANEL P	PANEL R SHEET-8 (DDG 51) SHEET-9 (DDG 52-54)	PANEL S
---	---------	---------	---------	---	---------	--	---------

UNIT-2

PANEL T SHEET 8 (DDG 51) SHEET 9 (DDG 52-54)	PANEL U	PANEL V	PANEL W	PANEL X	PANEL Y	PANEL Z	PANEL ZZ
--	---------	---------	---------	---------	---------	---------	----------

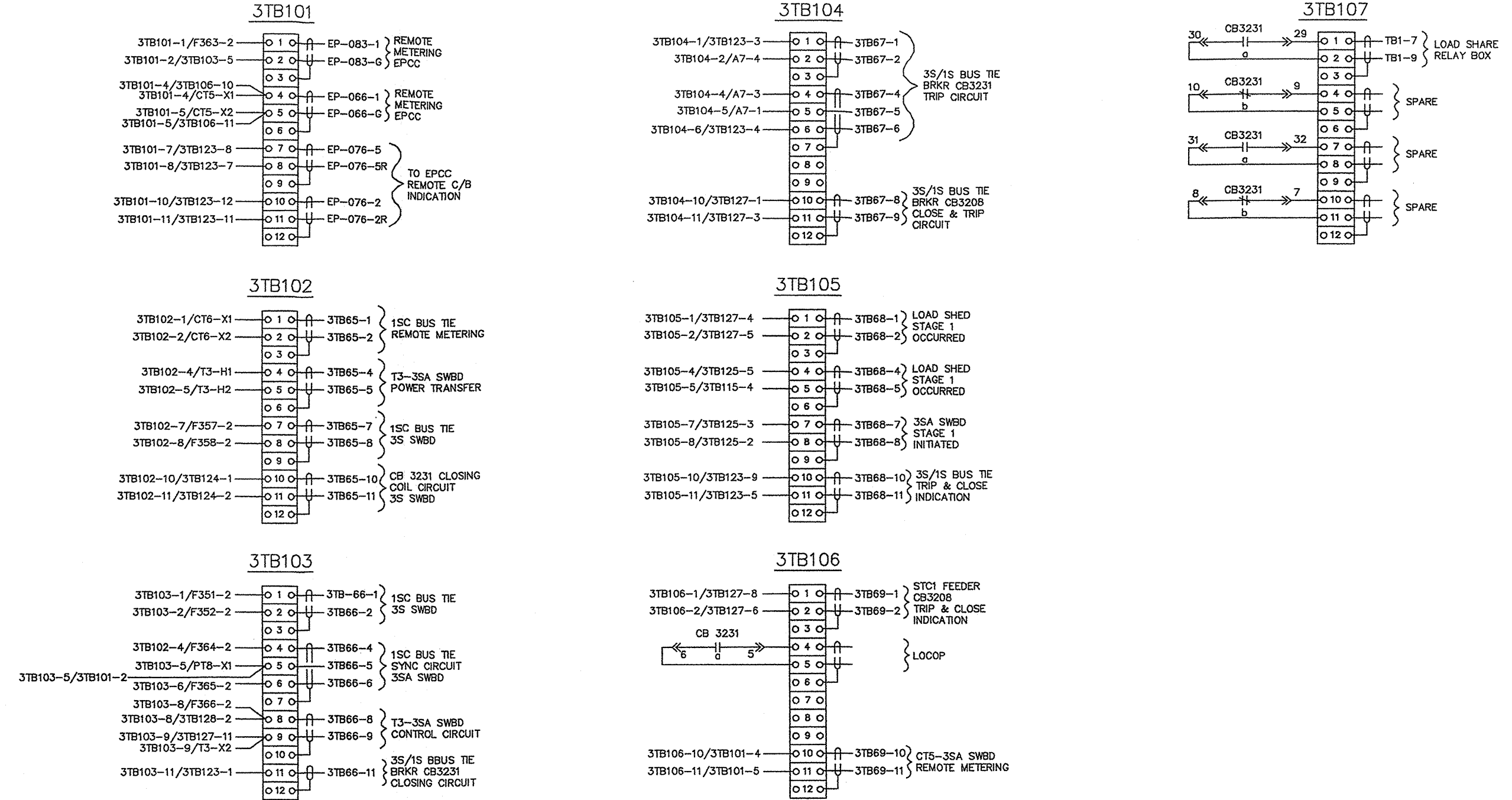
UNIT-3

H	S	ZZ
G	E R	N Z X
F	P	Y
C	L	V
B	D K	M U W
A	J	T

UNIT-1 UNIT-2 UNIT-3

TOP VIEW-PANEL LOCATION
SWITCHBOARD "3SA"

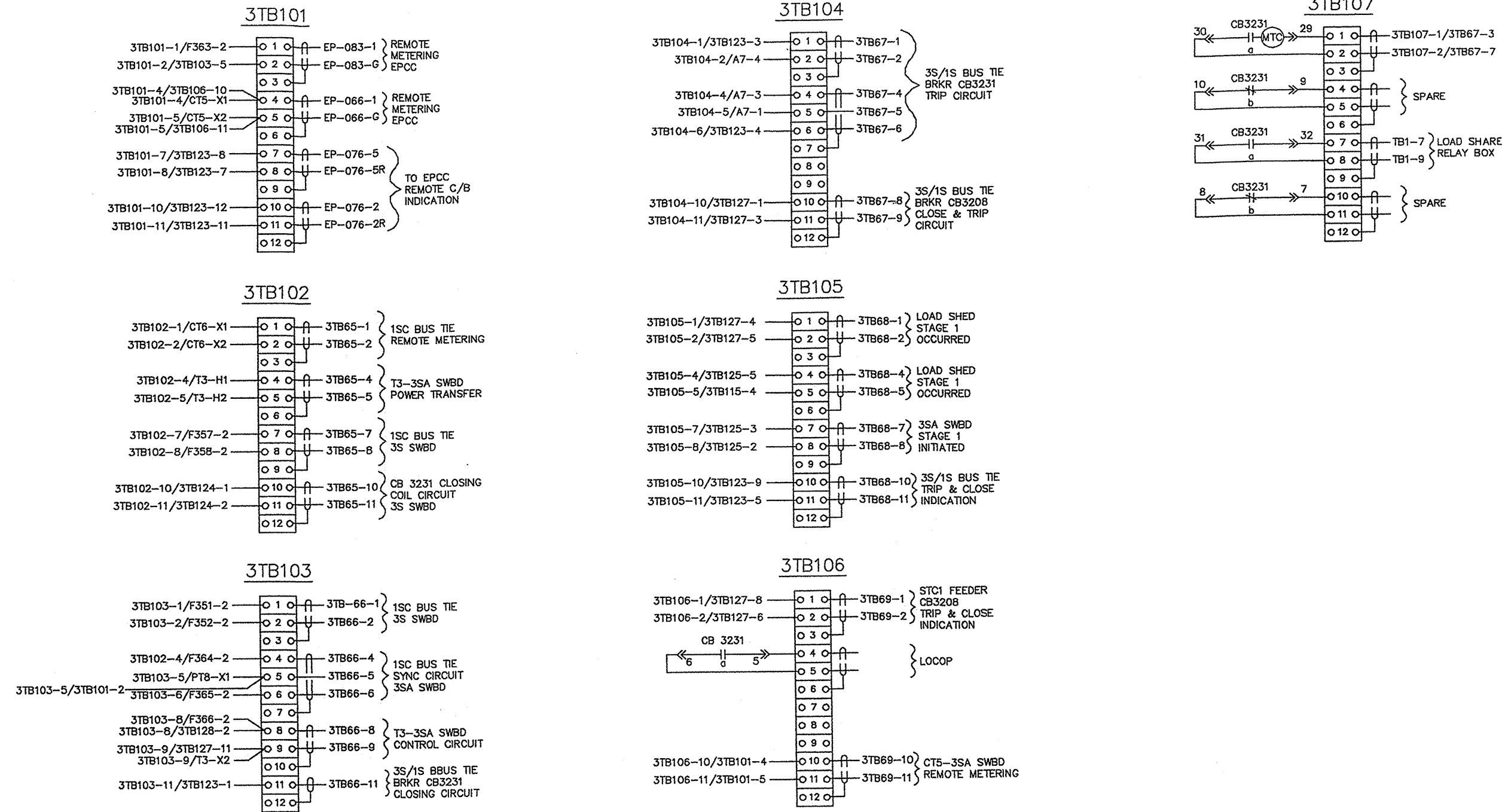
Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 1 of 7)



REAR VIEW LEFT HAND SIDE
 PANEL-"J" UNIT-2

NOTE:
 DDG 51 ONLY

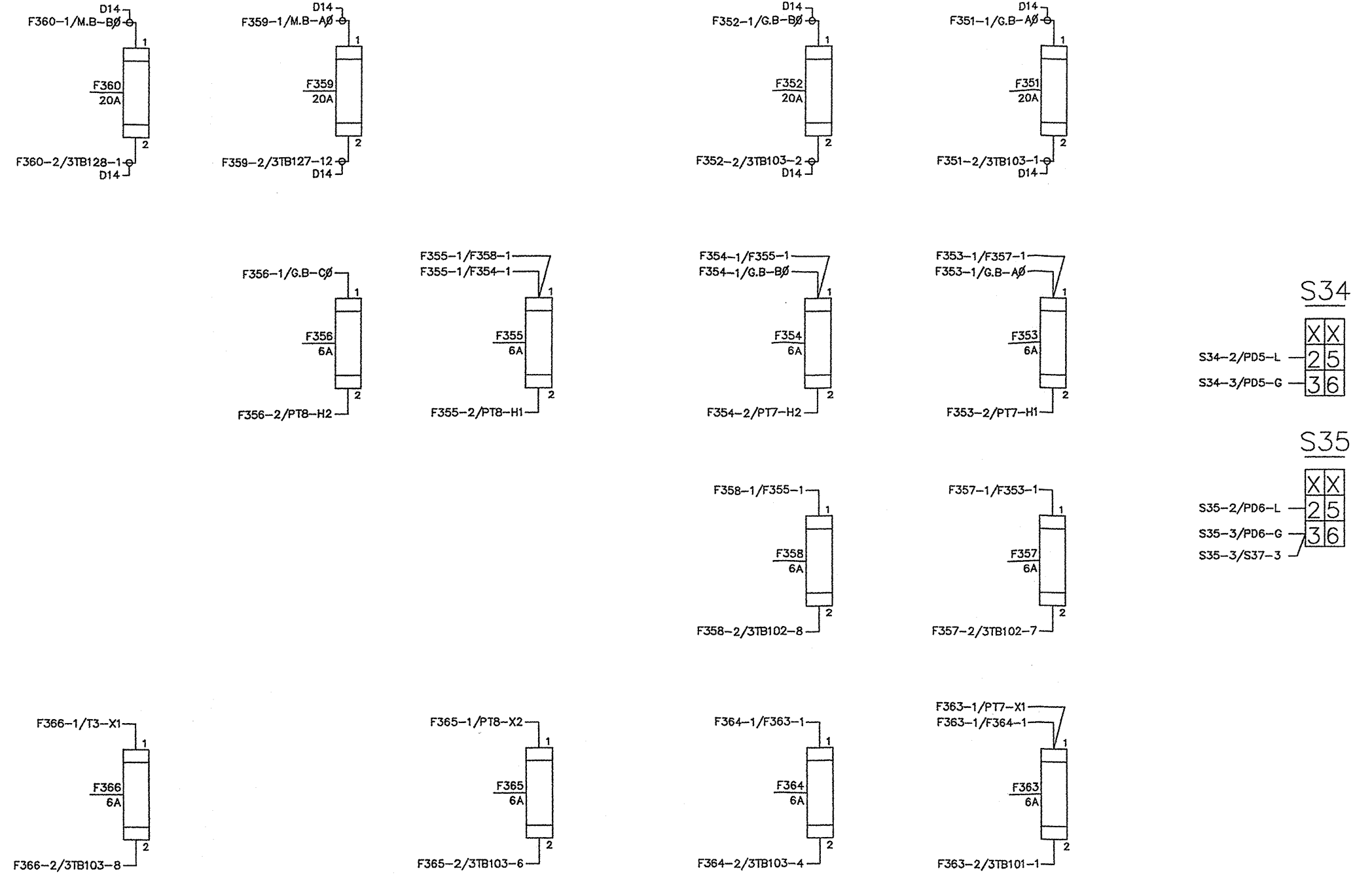
Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 3 of 7)



REAR VIEW LEFT HAND SIDE
PANEL-"J" UNIT-2

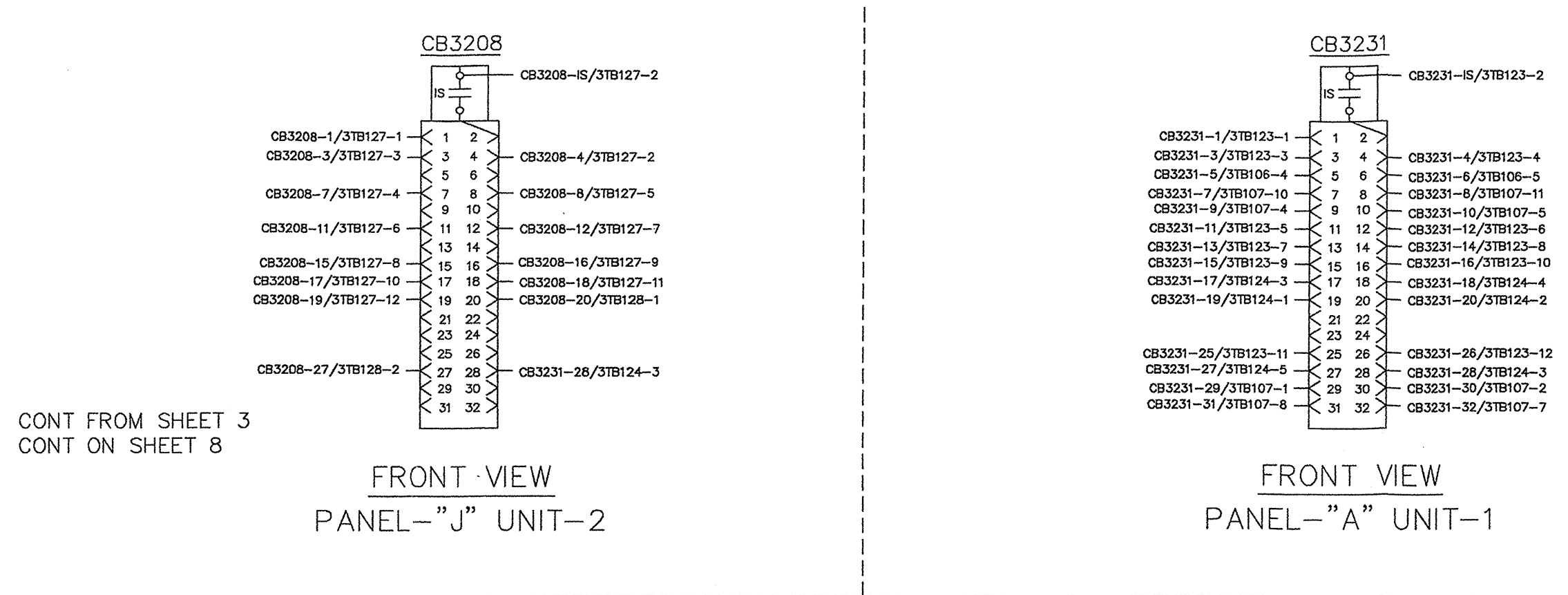
NOTE:
DDG 52-54 ONLY

Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 3 of 7)



REAR VIEW (TOP)
PANEL-"F" UNIT-1

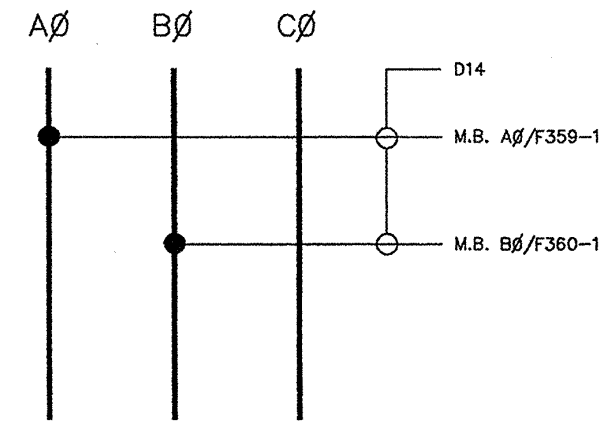
Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 4 of 7)



CONT FROM SHEET 3
CONT ON SHEET 8

FRONT VIEW
PANEL-"J" UNIT-2

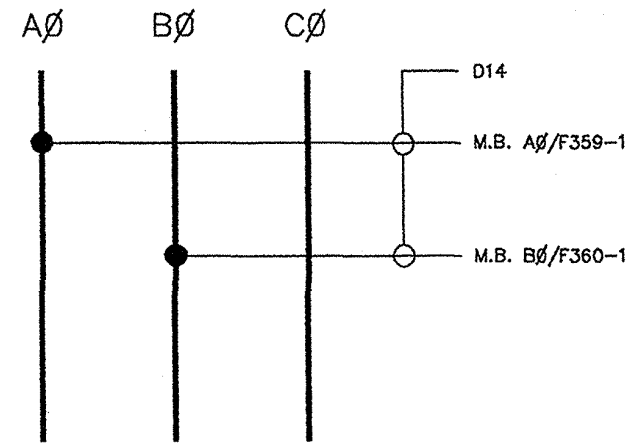
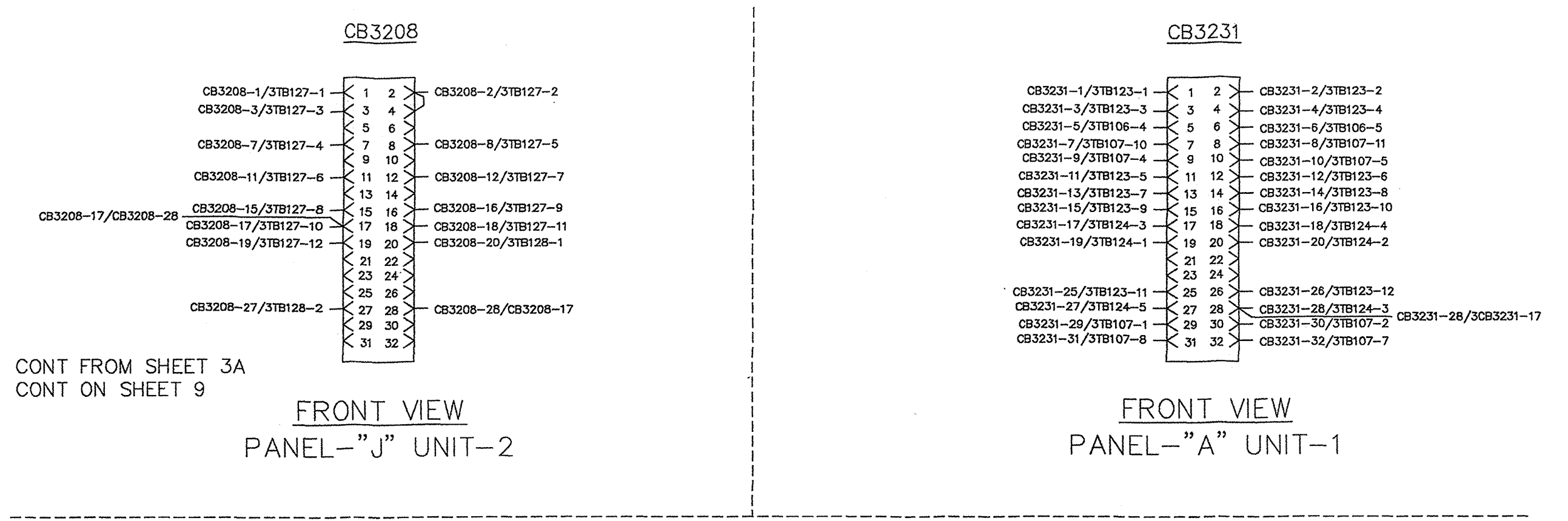
FRONT VIEW
PANEL-"A" UNIT-1



MAIN BUS

NOTE:
DDG 51 ONLY

Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 5 of 7)



MAIN BUS

NOTE:
DDG 52-54 ONLY

Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 5 of 7)

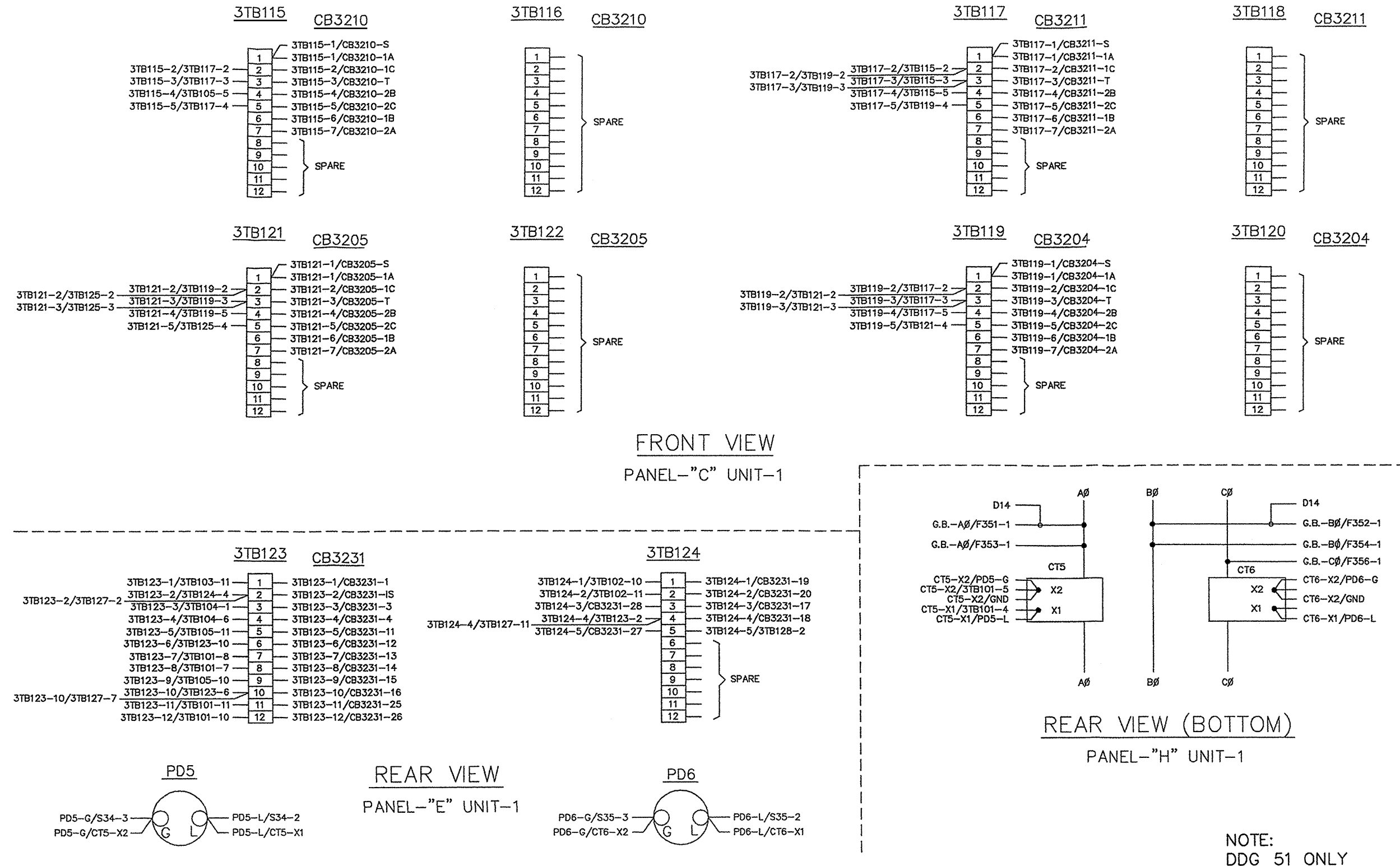


Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 6 of 7)

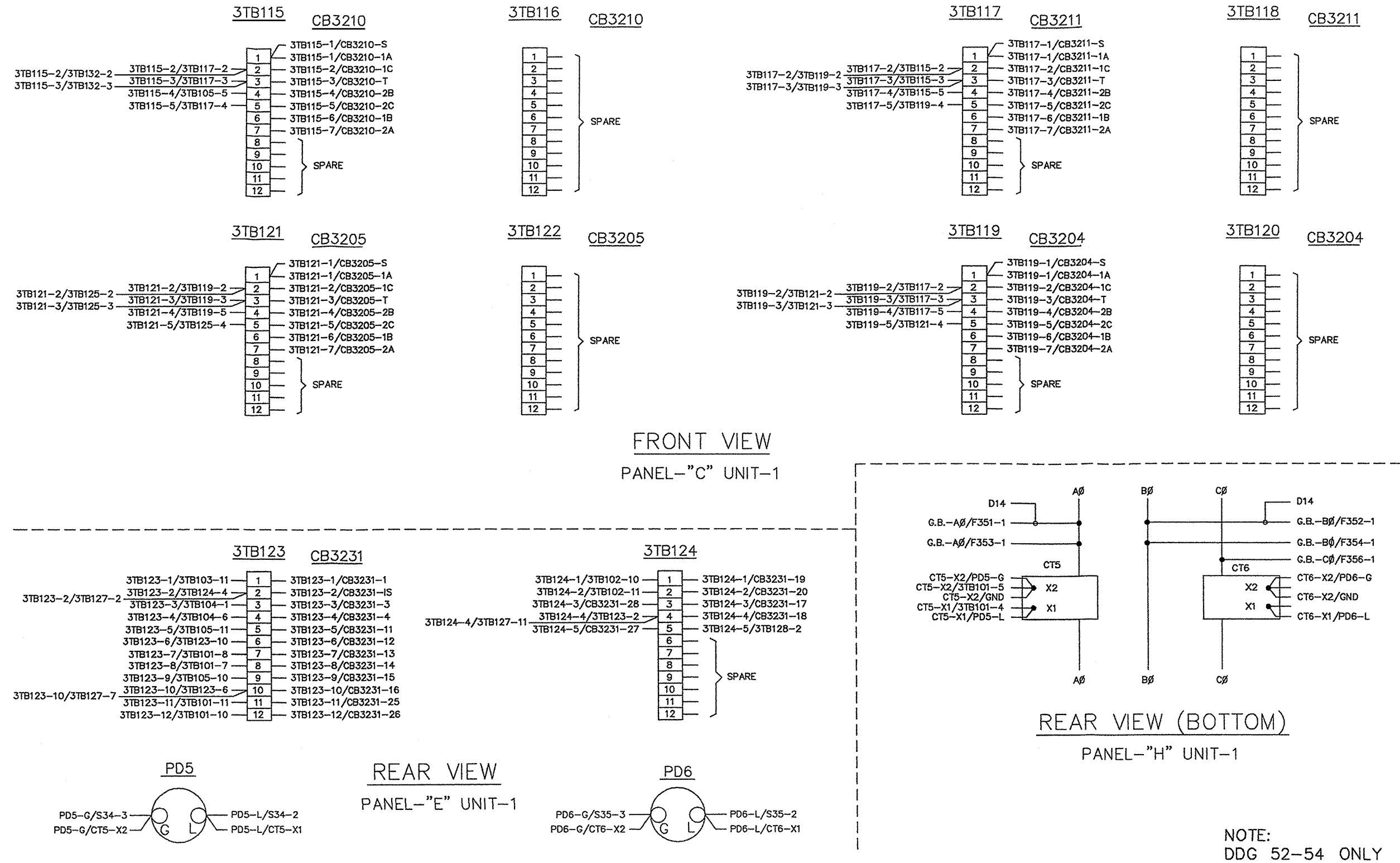
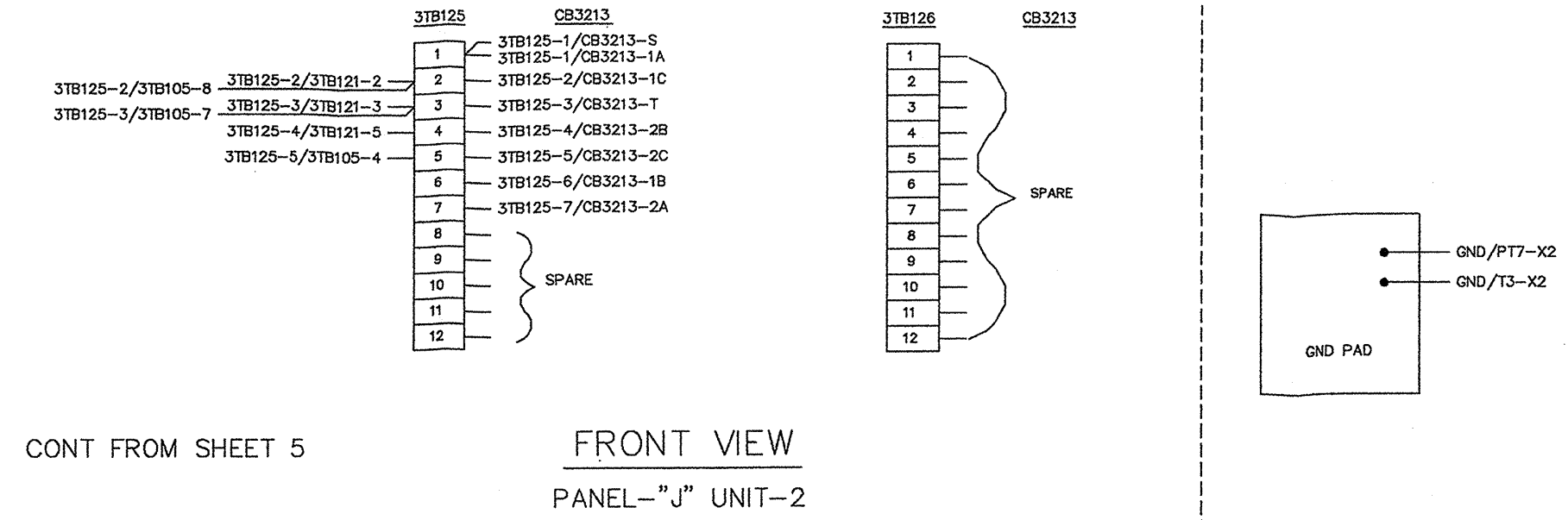
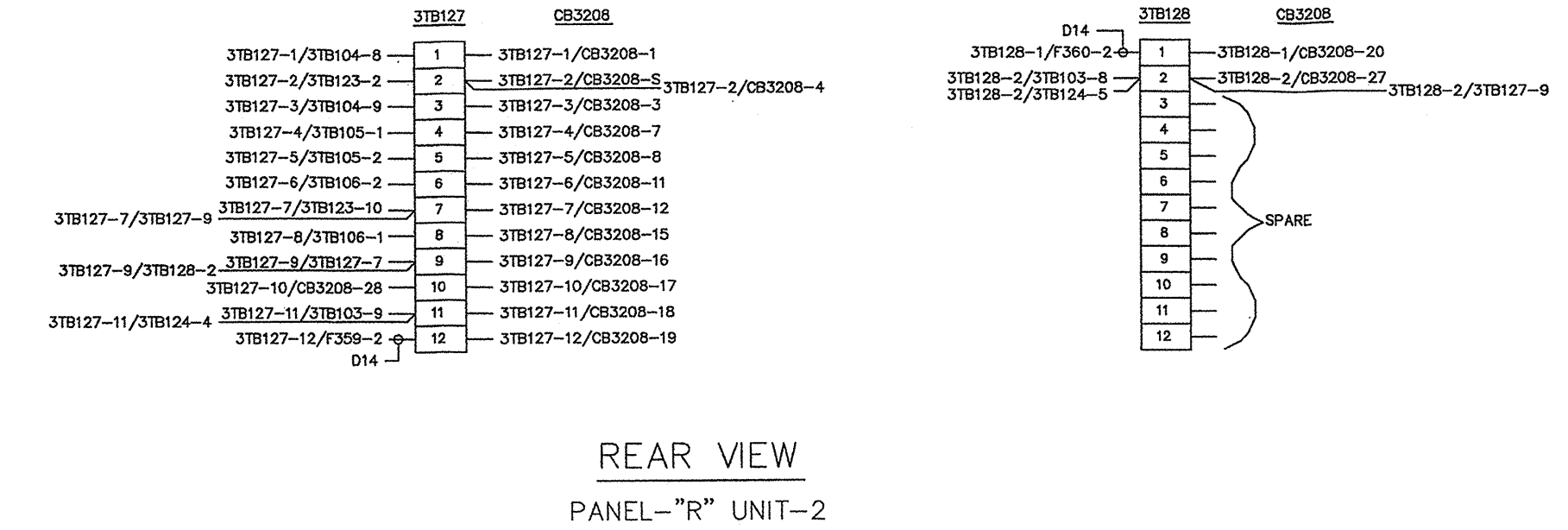


Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 6 of 7)

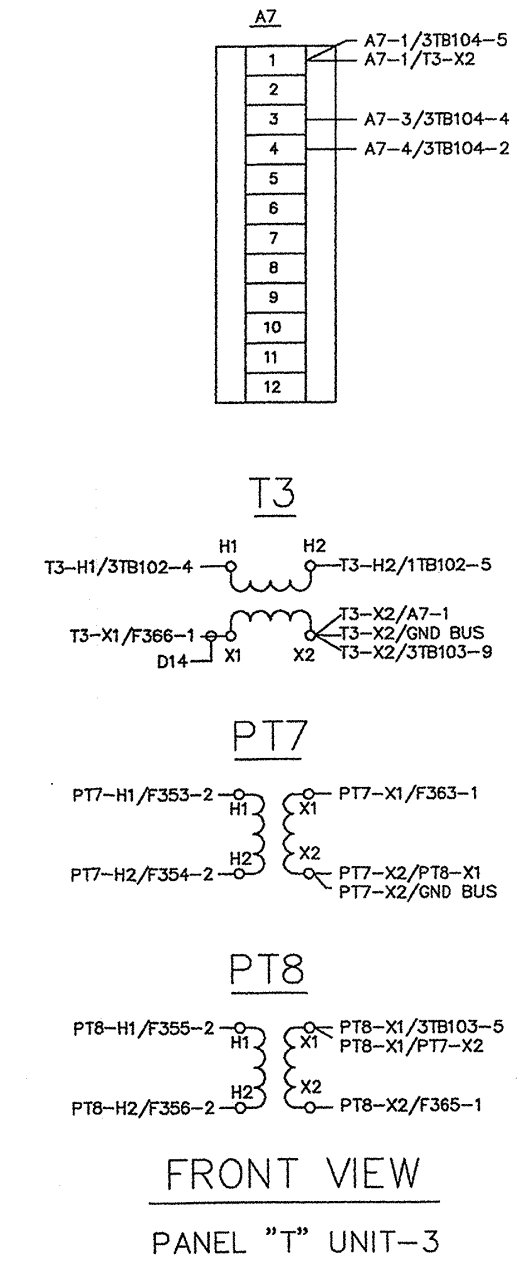


CONT FROM SHEET 5

FRONT VIEW
PANEL-"J" UNIT-2

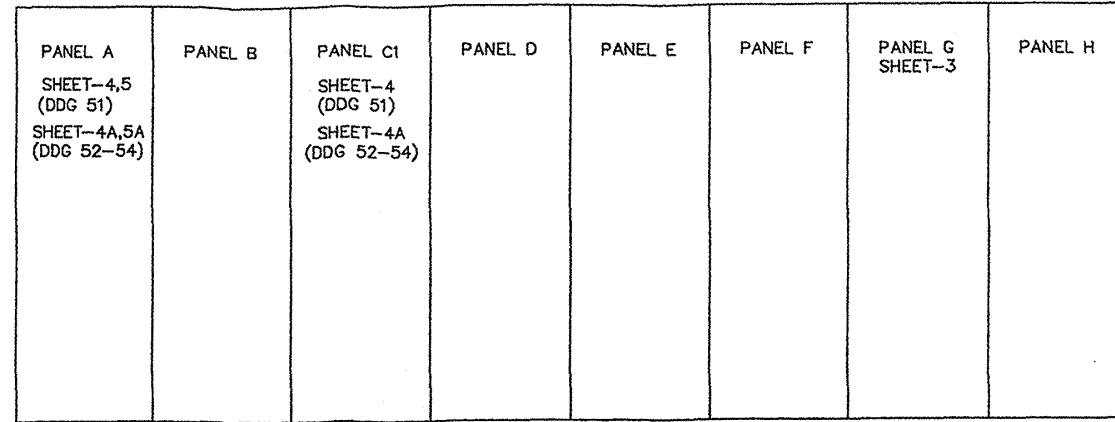


REAR VIEW
PANEL-"R" UNIT-2

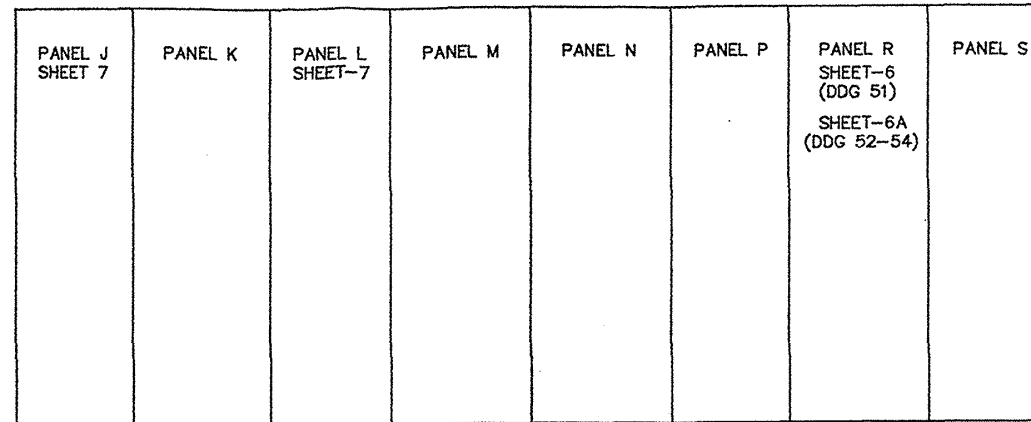


NOTE:
DDG 51 ONLY

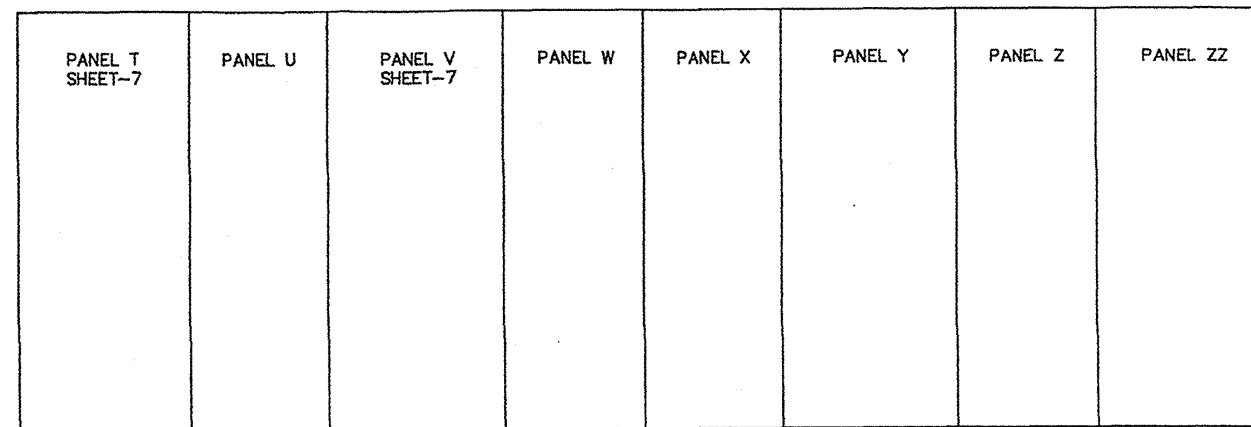
Figure 9-9. 3SA Switchboard; Wiring Diagram (Sheet 7 of 7)



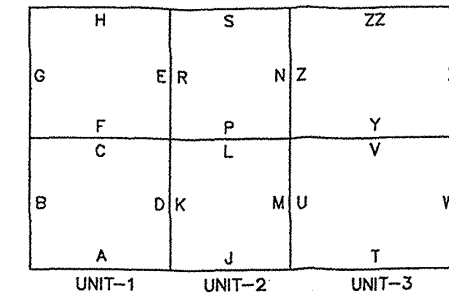
UNIT-1



UNIT-2



UNIT-3



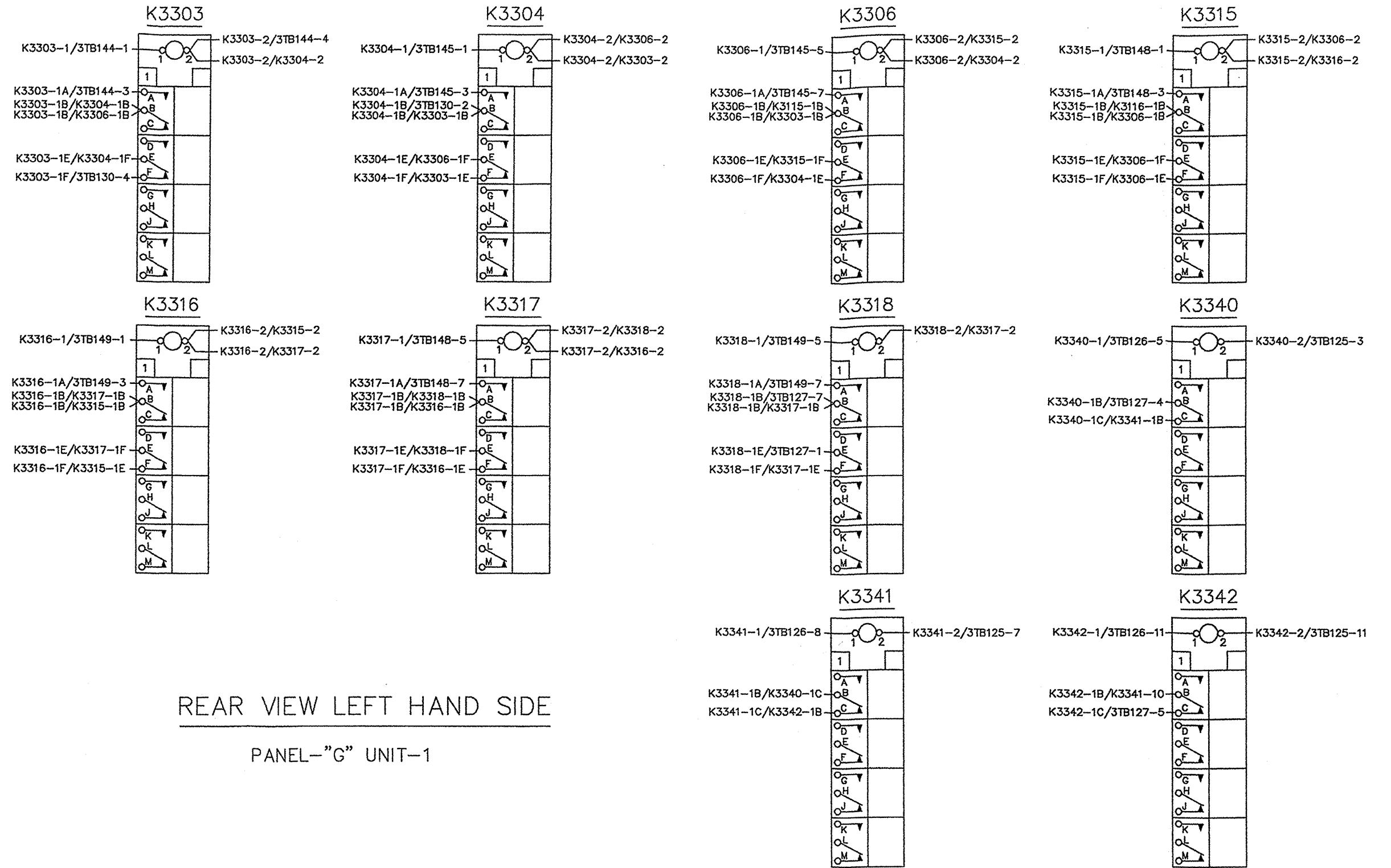
TOP VIEW-PANEL LOCATION
SWITCHBOARD "3SB"

Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 1 of 7)

COMPONENT LOCATIONS

PANEL NO														
A	CB3303-CB3304	CB3340-CB3342	DS1-DS3											
G	K3303-K3304	K3306	K3315-K3318	K3340-K3342										
J	CB3334	CB3339												
R	3TB125-3TB128	3TB143												
T	CB3315-CB3318	CB3329												
C1	3TB144	3TB145												
C2	3TB140	3TB141	3TB142											
L	3TB146	3TB147												
V	3TB148	3TB149	3TB130											

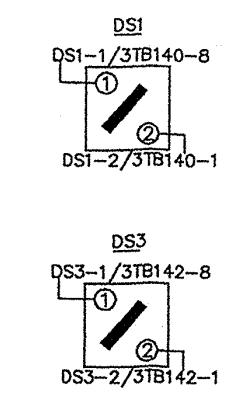
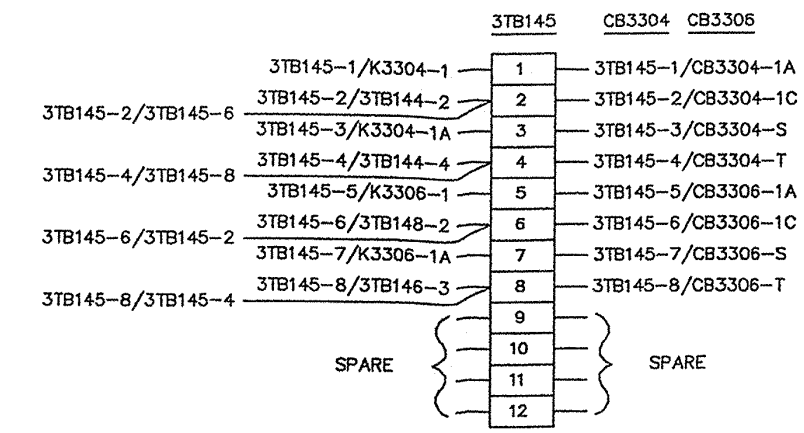
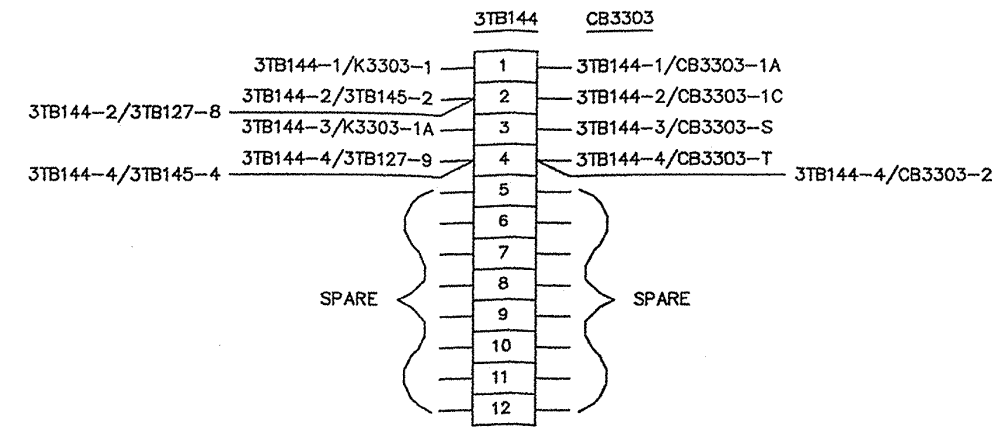
Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 2 of 7)



REAR VIEW LEFT HAND SIDE

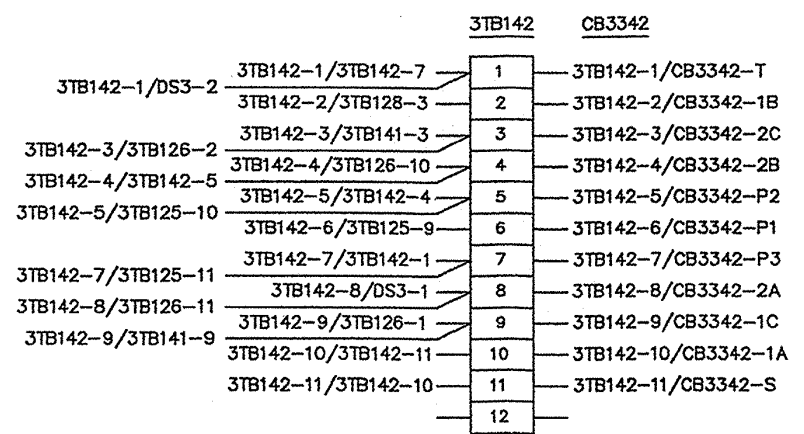
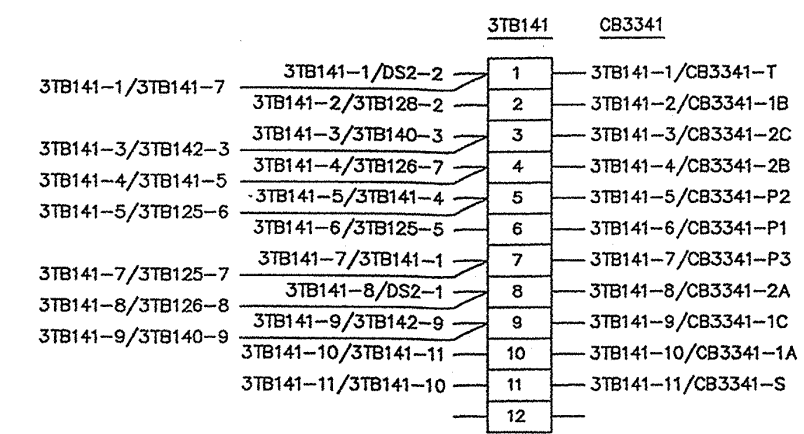
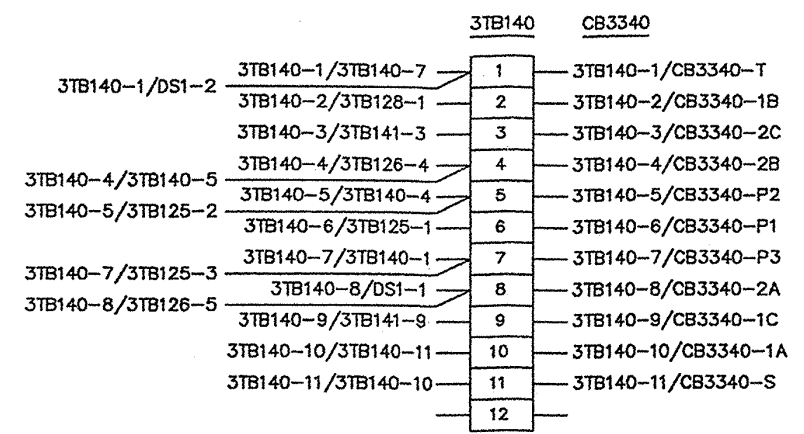
PANEL-"G" UNIT-1

Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 3 of 7)



DOOR REAR VIEW
PANEL "A" UNIT-1

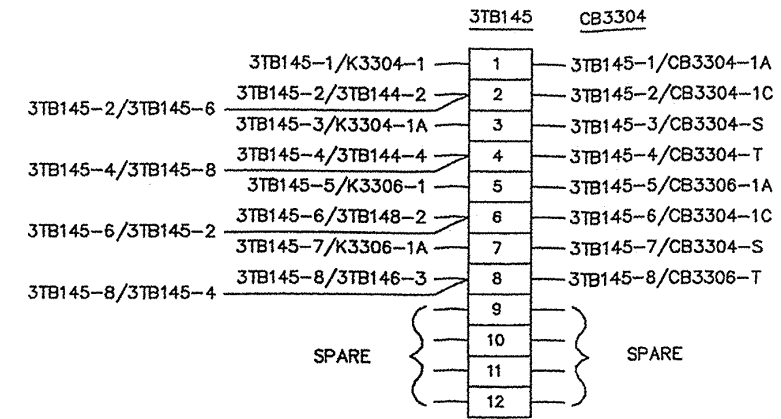
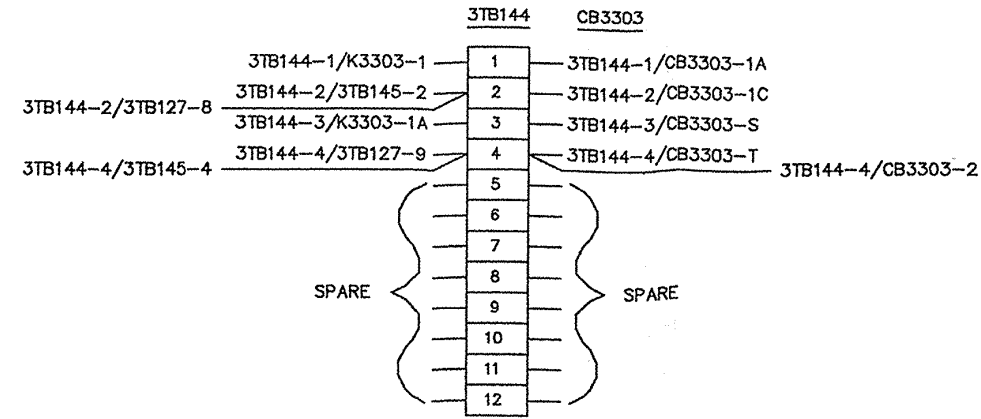
INSIDE VIEW
PANEL "C1" UNIT-1
PANEL "A" UNIT-1



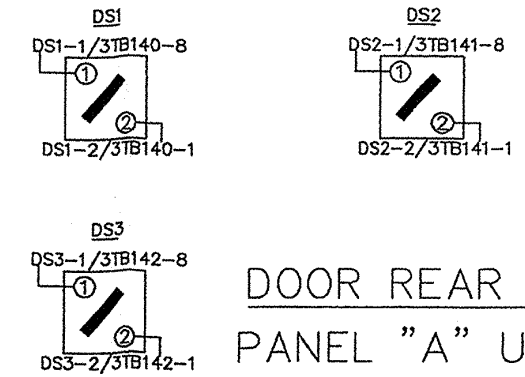
INSIDE VIEW
PANEL "C2" UNIT-1
PANEL "A" UNIT-1

NOTE:
DDG 51 ONLY

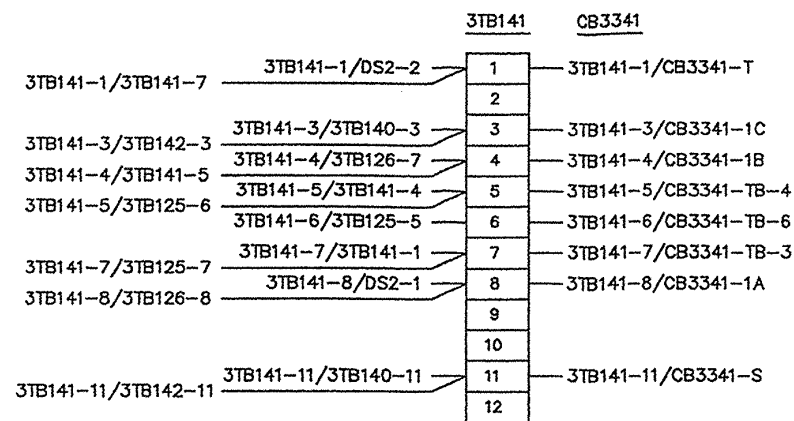
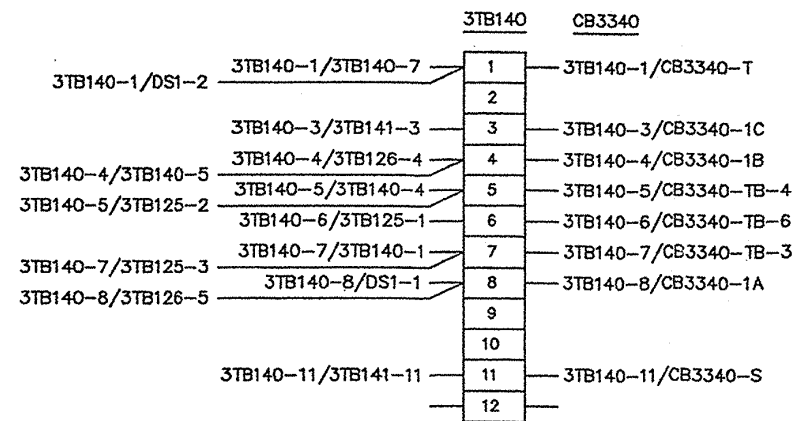
Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 4 of 7)



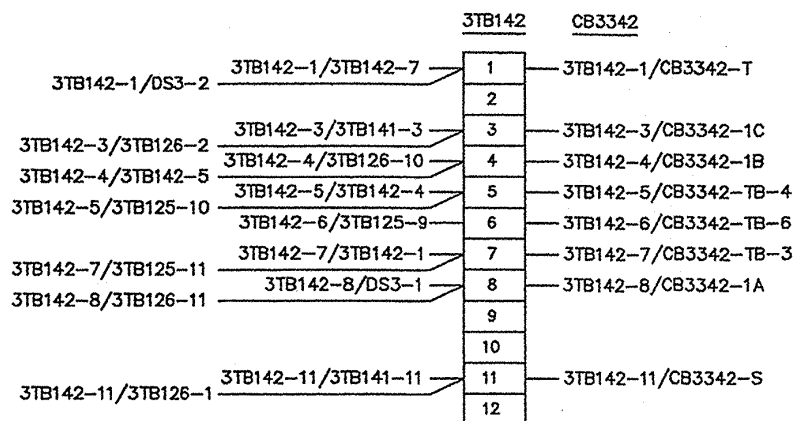
INSIDE VIEW
PANEL "C1" UNIT-1



DOOR REAR VIEW
PANEL "A" UNIT-1

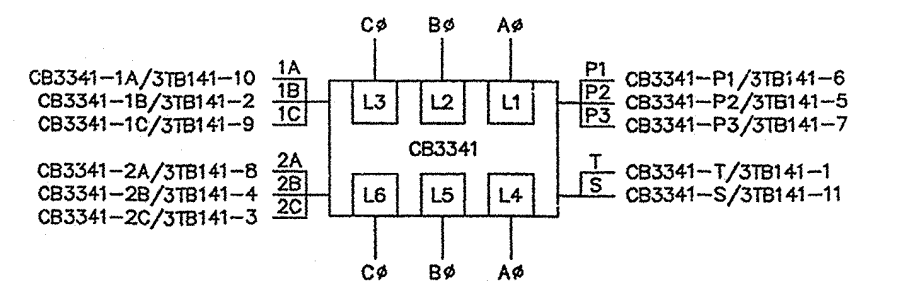
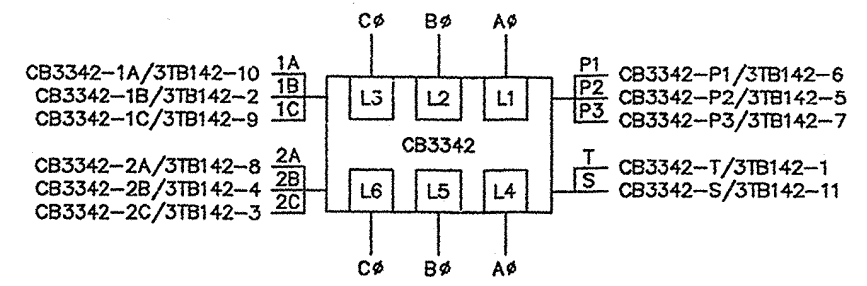
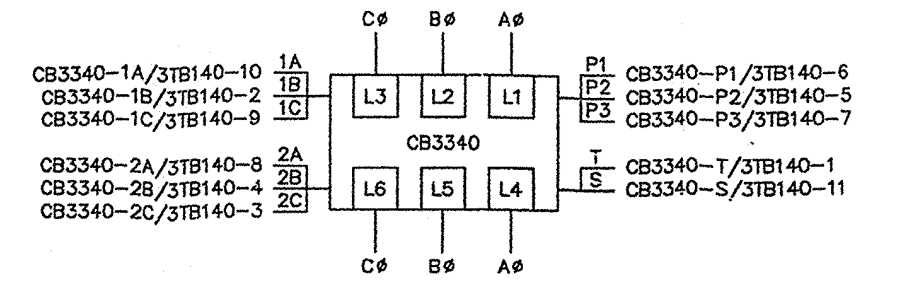


INSIDE VIEW
PANEL "C2" UNIT-1



NOTE:
DDG 52-54 ONLY

Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 4 of 7)



REAR VIEW
 PANEL--"A" UNIT-1

NOTE:
 DDG 51 ONLY

Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 5 of 7)

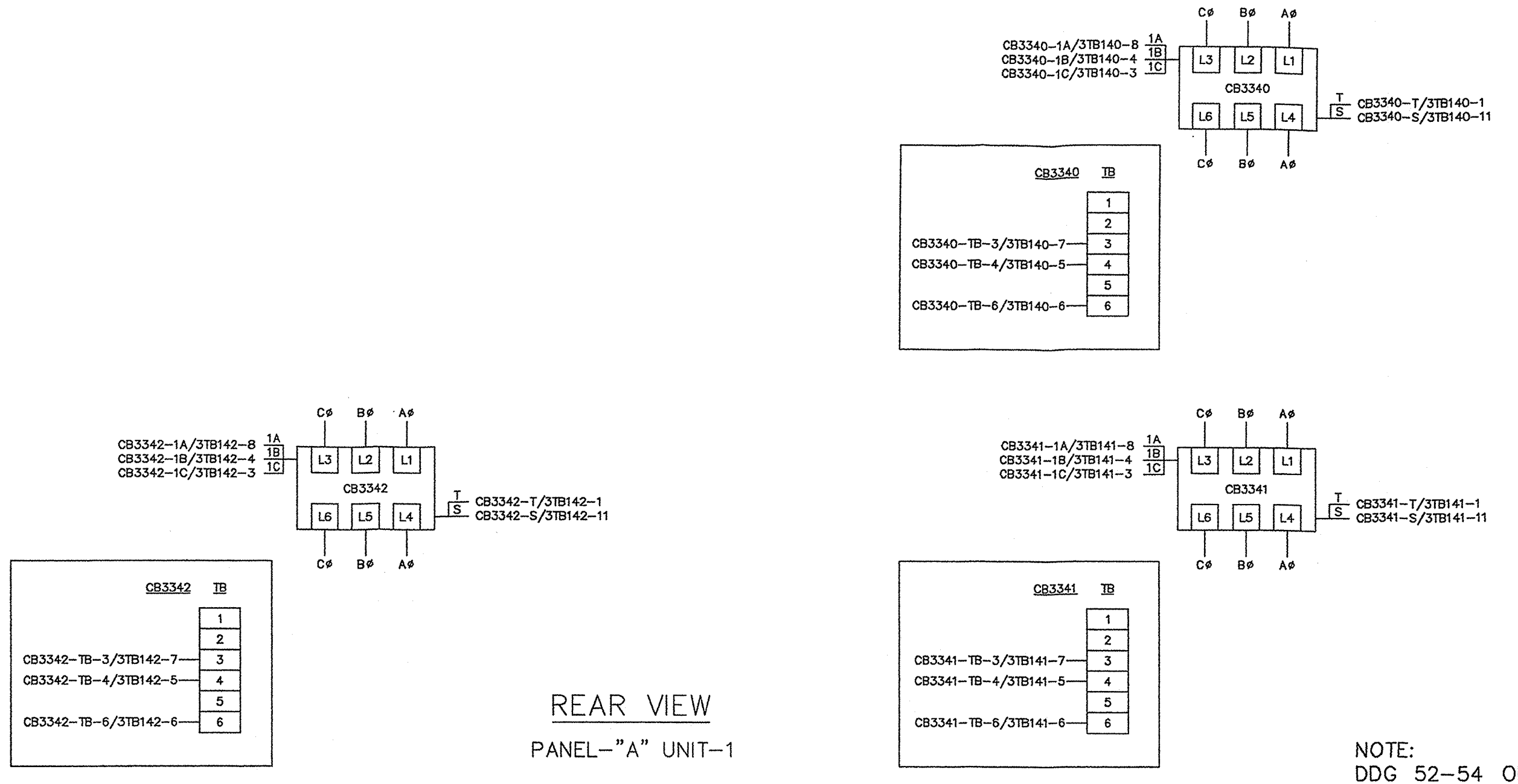
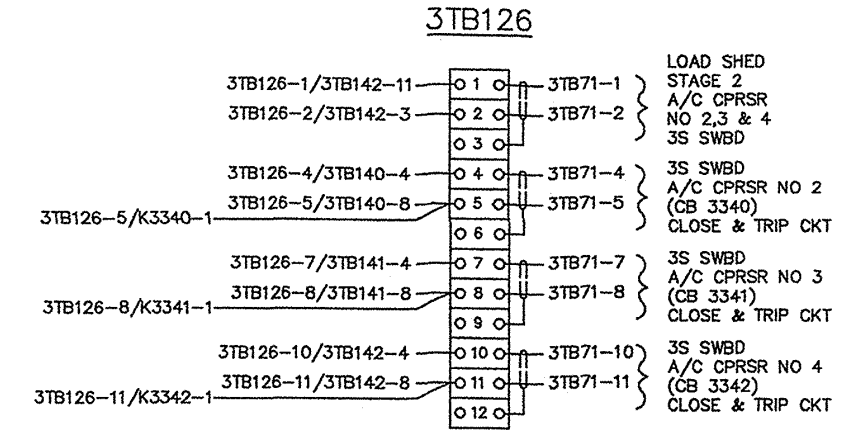
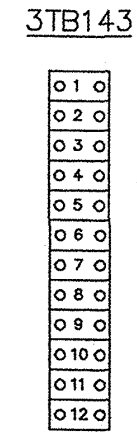
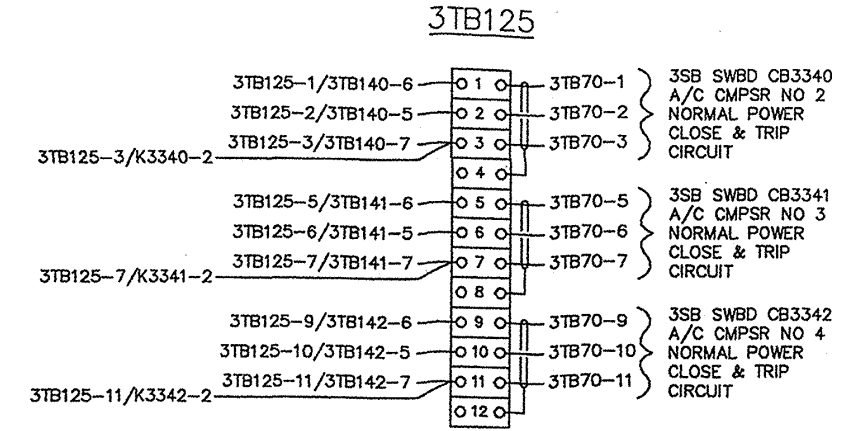
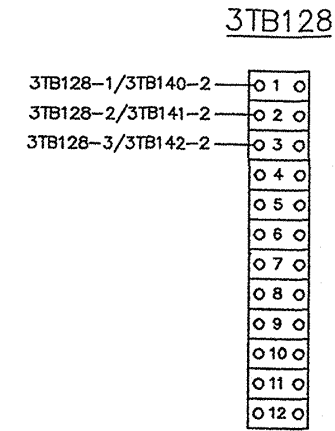
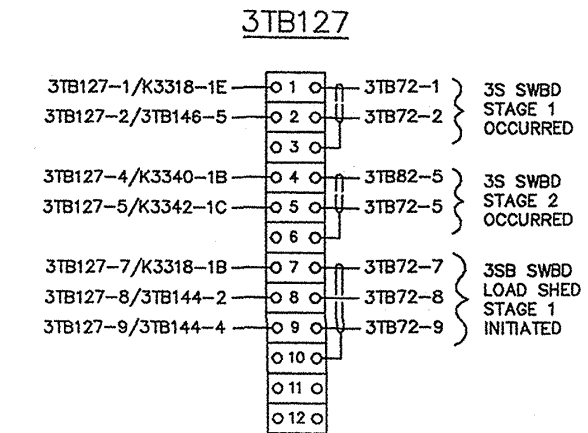


Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 5 of 7)



REAR VIEW RIGHT HAND SIDE

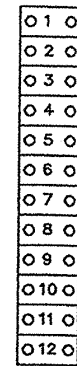
PANEL-"R" UNIT-2



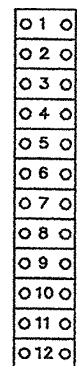
NOTE:
DDG 51 ONLY

Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 6 of 7)

3TB128

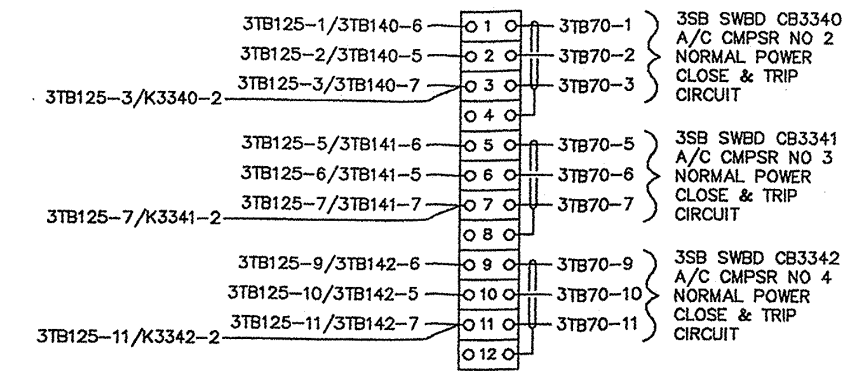


3TB143

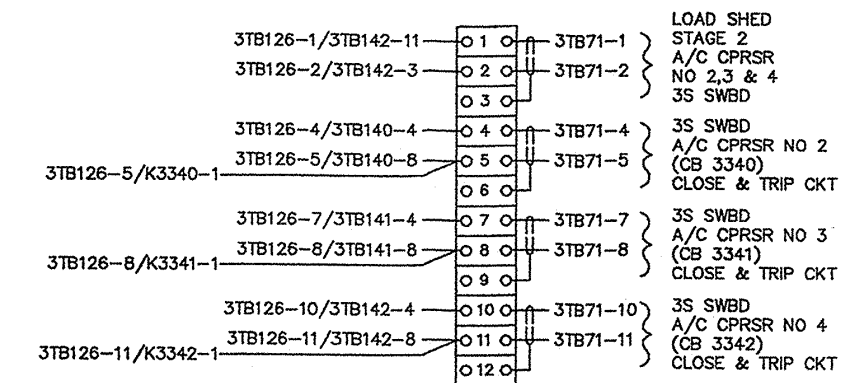


REAR VIEW RIGHT HAND SIDE
 PANEL-"R" UNIT-2

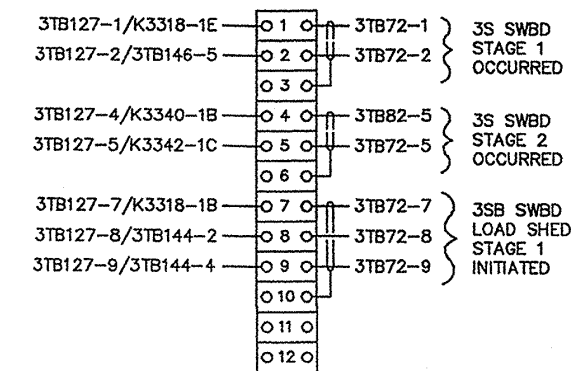
3TB125



3TB126

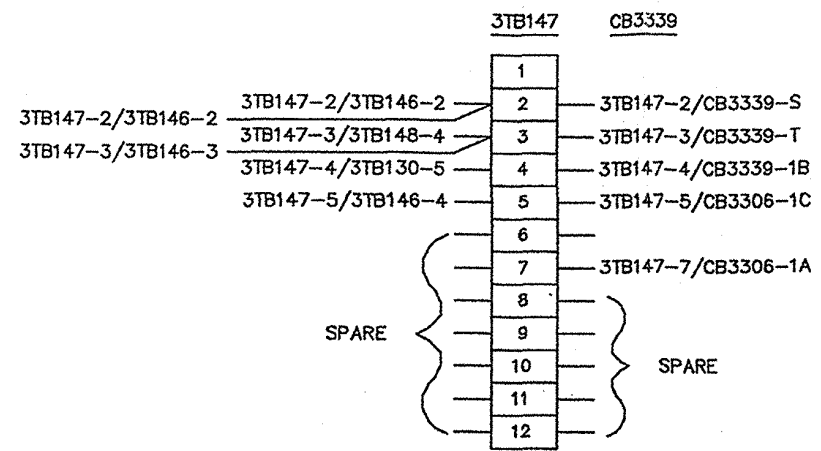
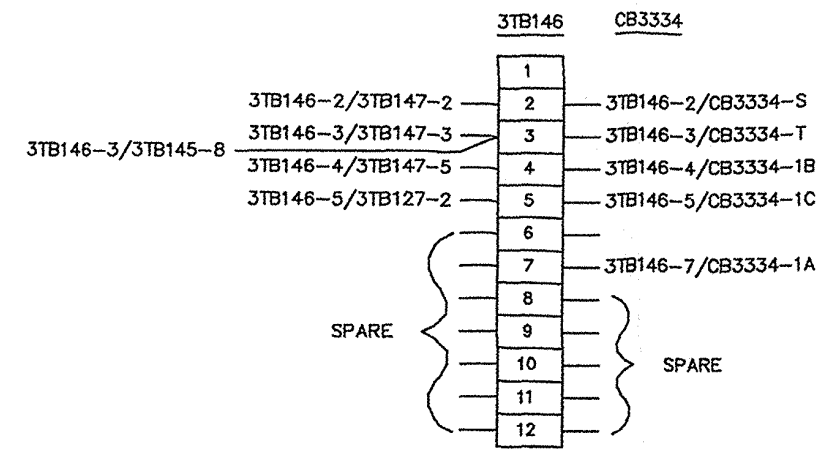


3TB127

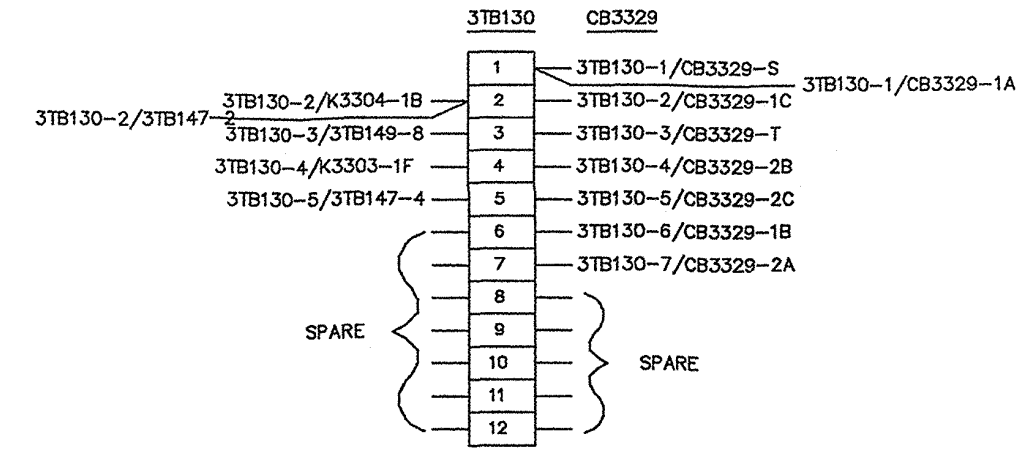
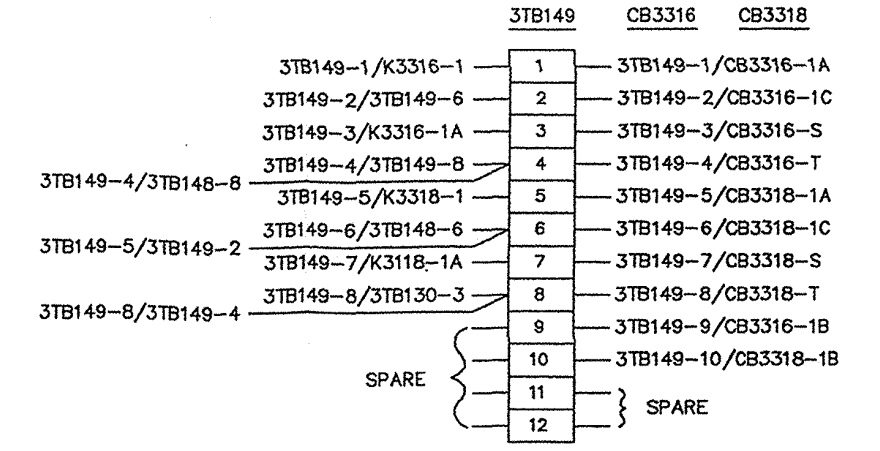
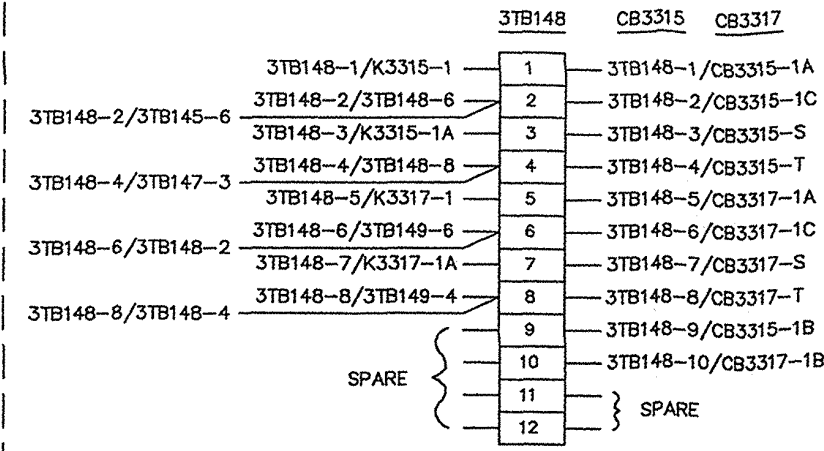


NOTE:
 DDG 52-54 ONLY

Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 6 of 7)

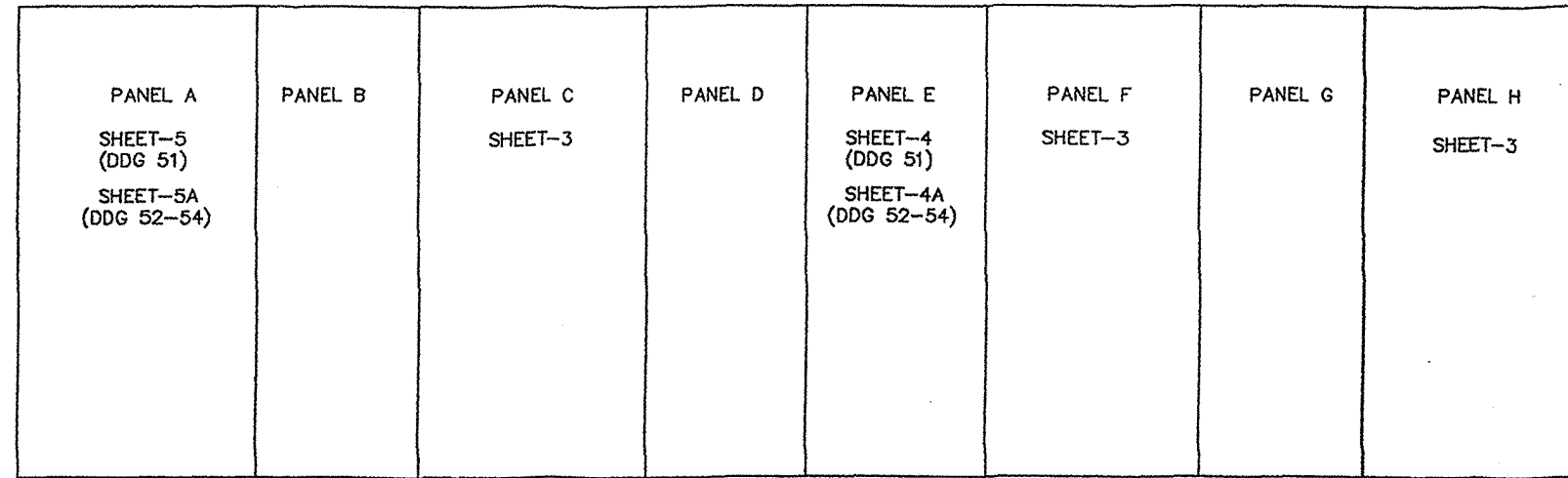


INSIDE VIEW
 PANEL "L" UNIT-2
 PANEL "J" UNIT-2

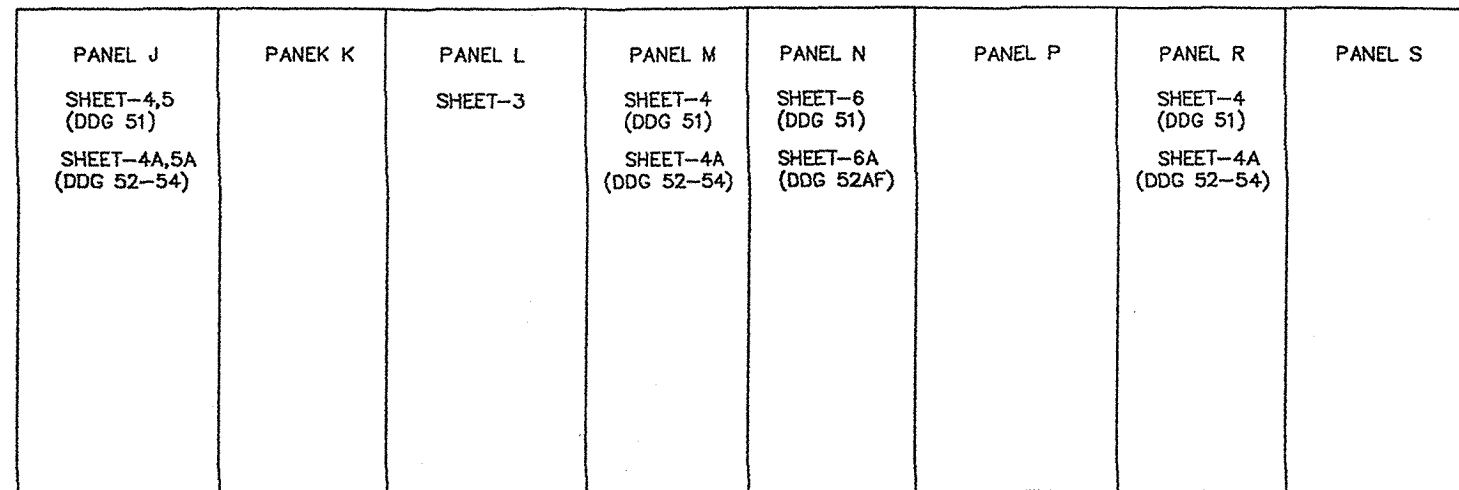


INSIDE VIEW
 PANEL "V" UNIT-3
 PANEL "T" UNIT-3

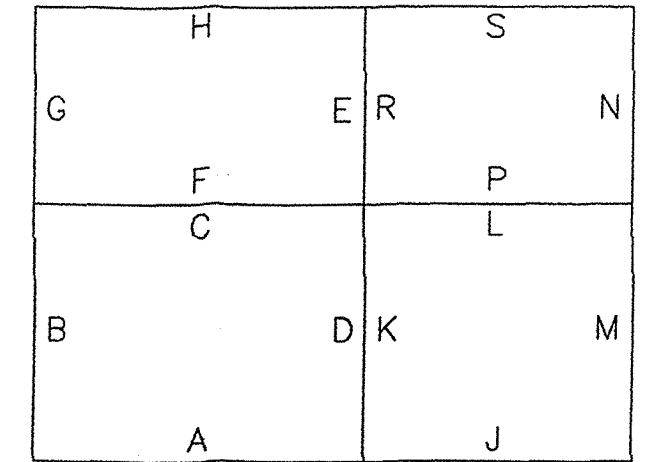
Figure 9-10. 3SB Switchboard; Wiring Diagram (Sheet 7 of 7)



UNIT-1



UNIT-2



UNIT-1 UNIT-2

TOP VIEW-PANEL LOCATION
SWITCHBOARD "3SC"

Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 1 of 6)

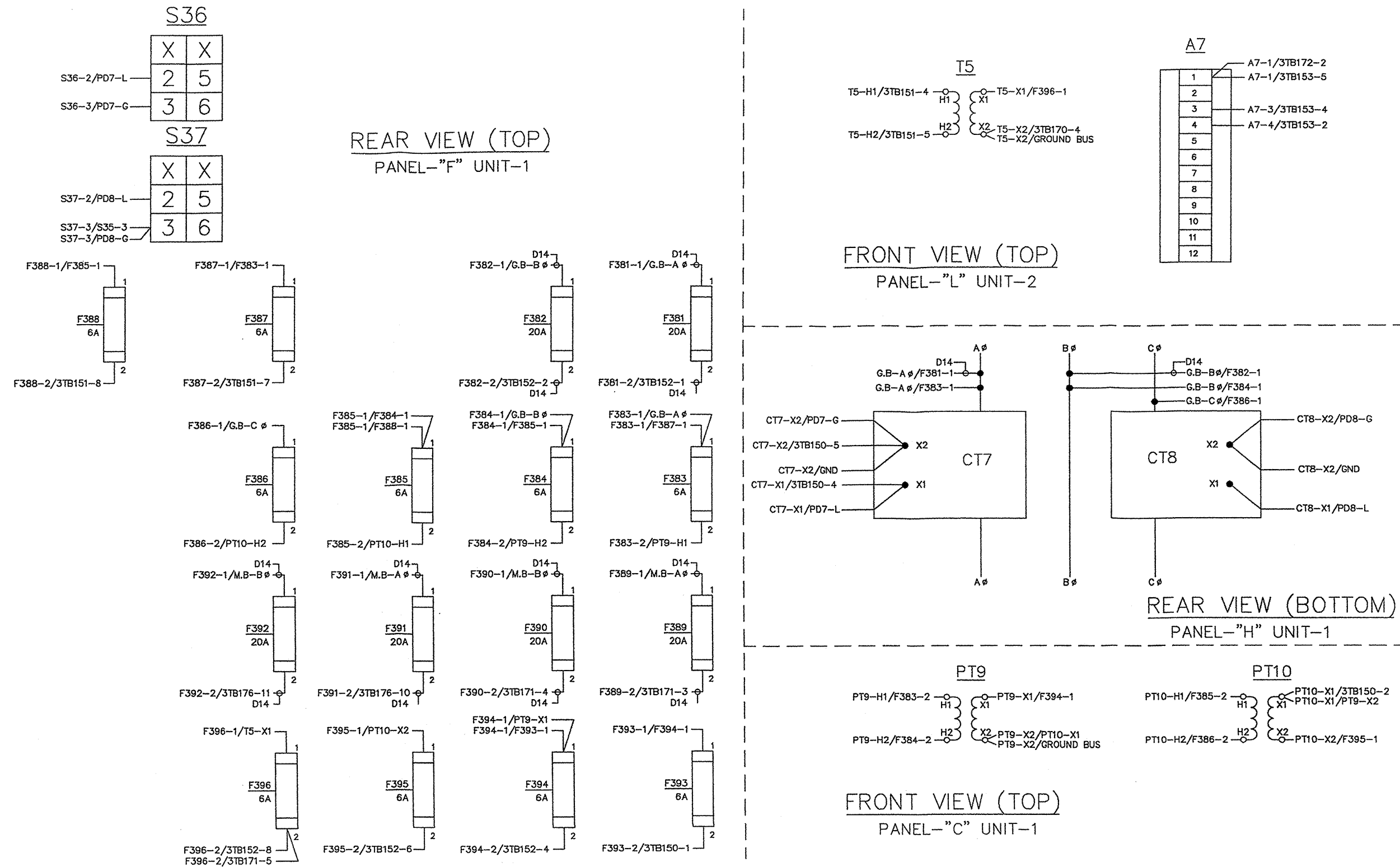
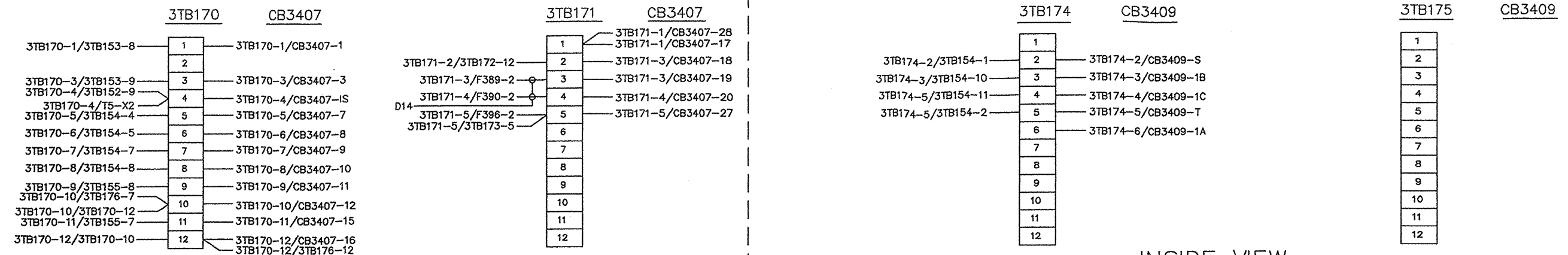
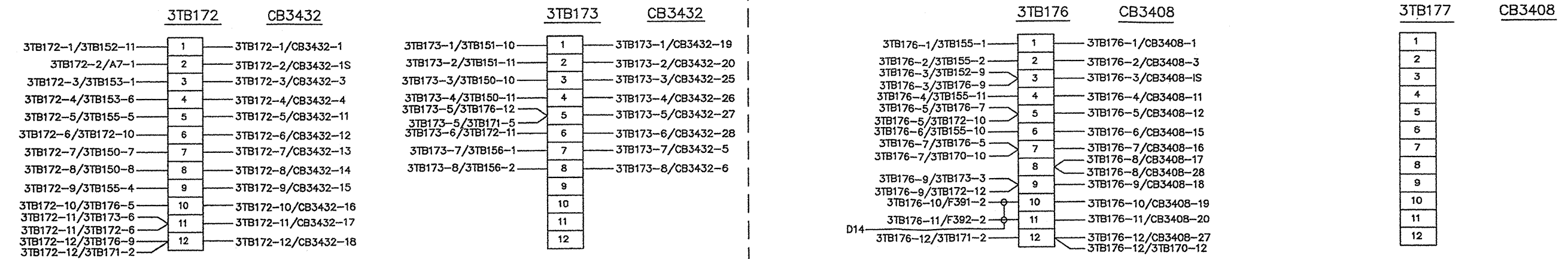


Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 3 of 6)



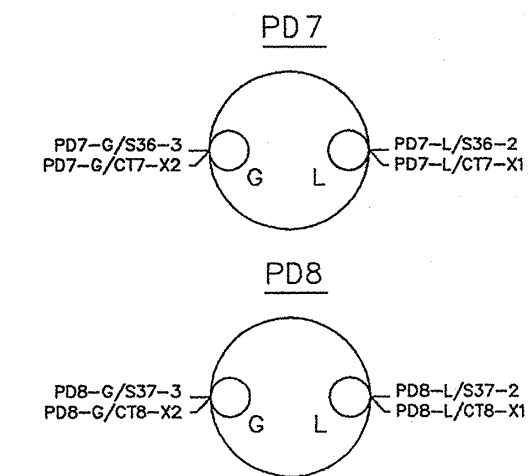
INSIDE VIEW

PANEL "M" UNIT-2
PANEL "J" UNIT-2



REAR VIEW, RIGHT SIDE

PANEL "R" UNIT-2

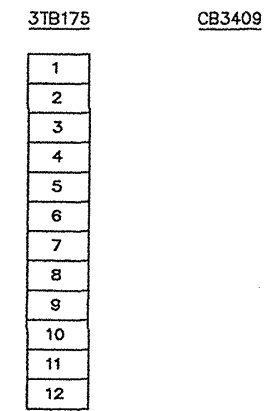
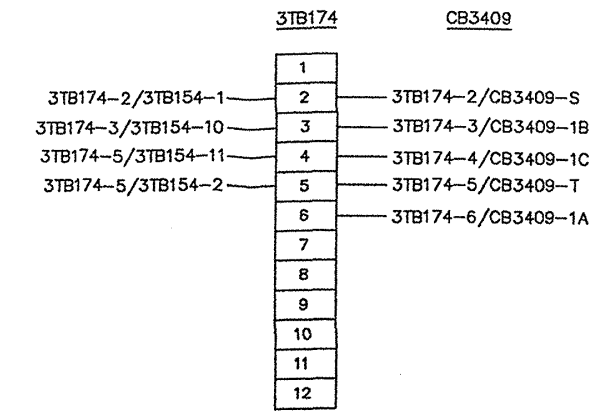
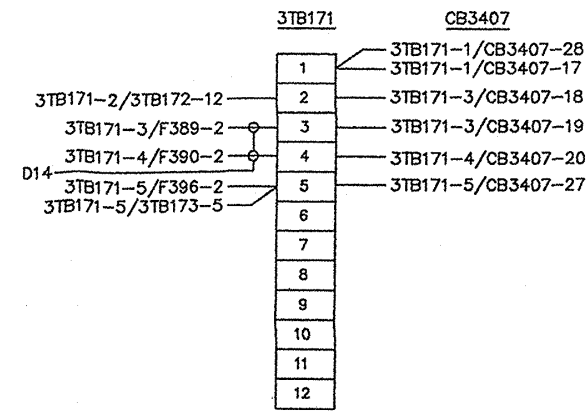
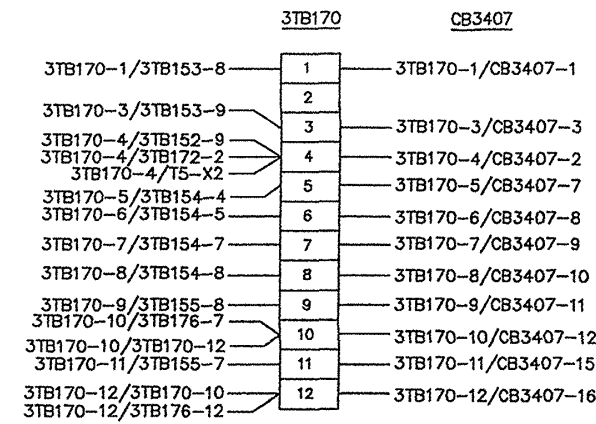


REAR VIEW, LEFT SIDE

PANEL "E" UNIT-1

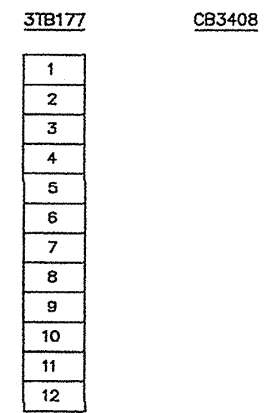
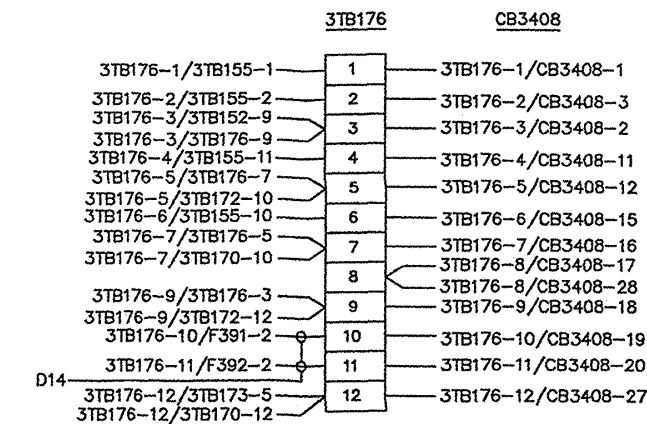
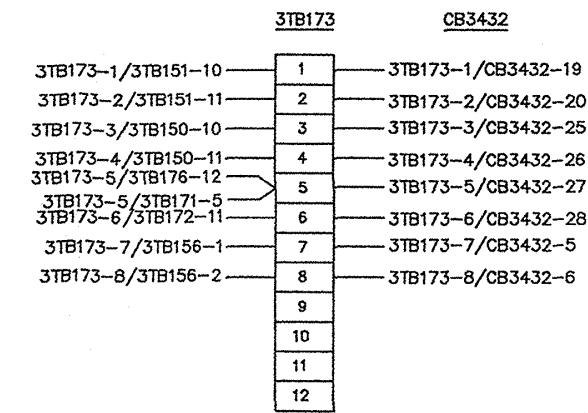
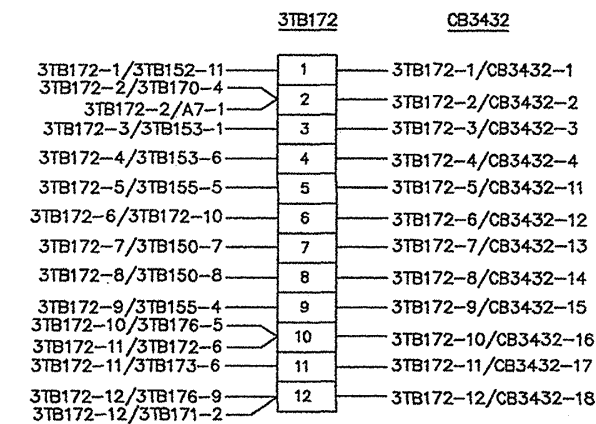
NOTE:
DDG 51 ONLY

Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 4 of 6)



INSIDE VIEW

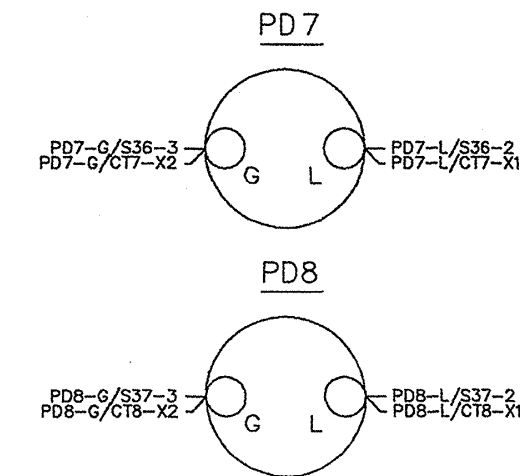
PANEL "M" UNIT-2
PANEL "J" UNIT-2



REAR VIEW, RIGHT SIDE

PANEL "R" UNIT-2

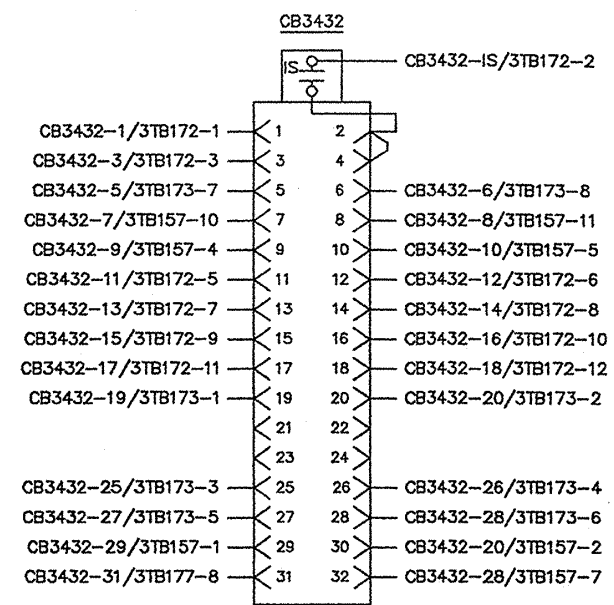
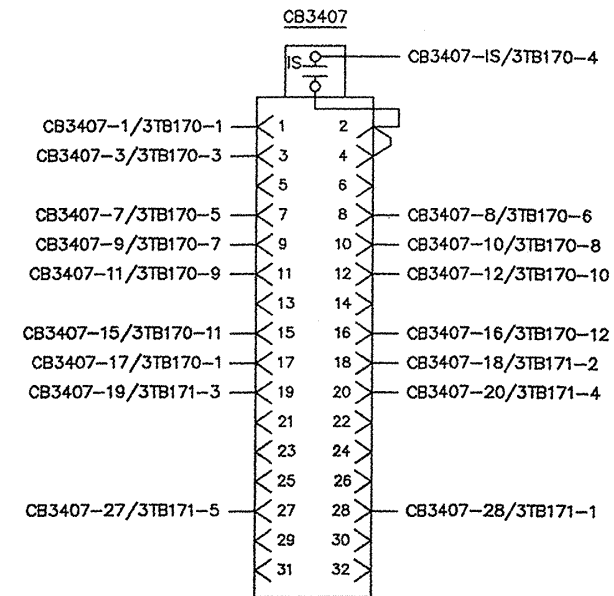
NOTE:
DDG 52-54 ONLY



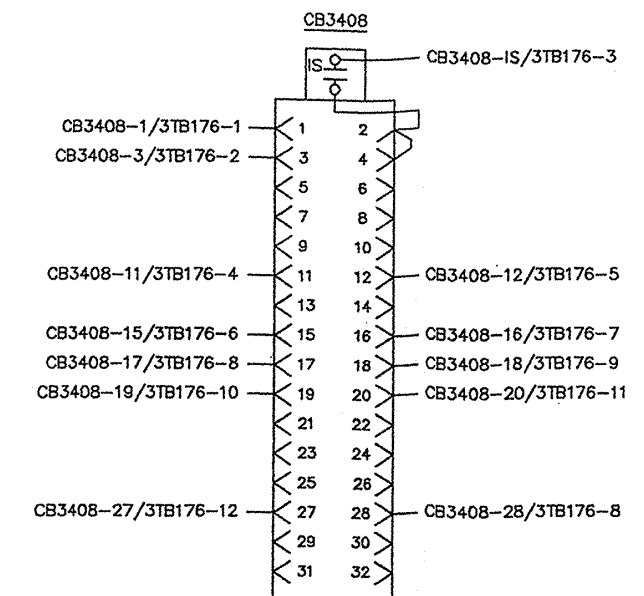
REAR VIEW, LEFT SIDE

PANEL "E" UNIT-1

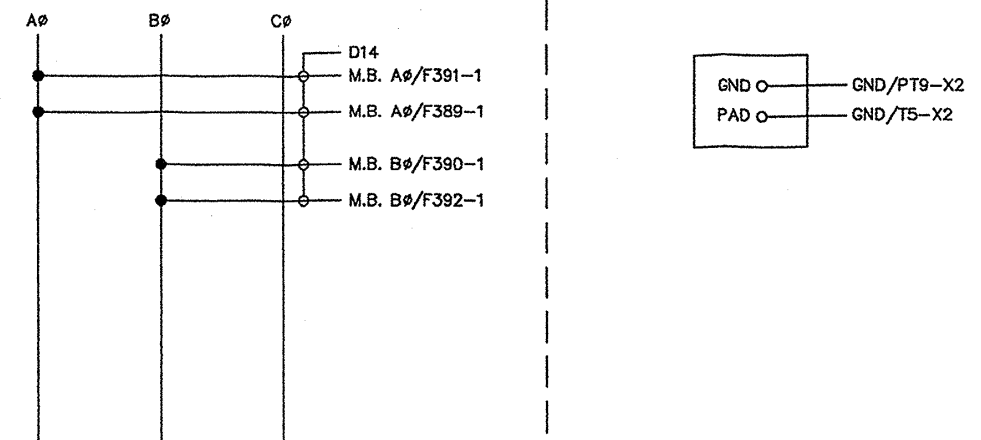
Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 4 of 6)



FRONT VIEW
PANEL "A" UNIT-1

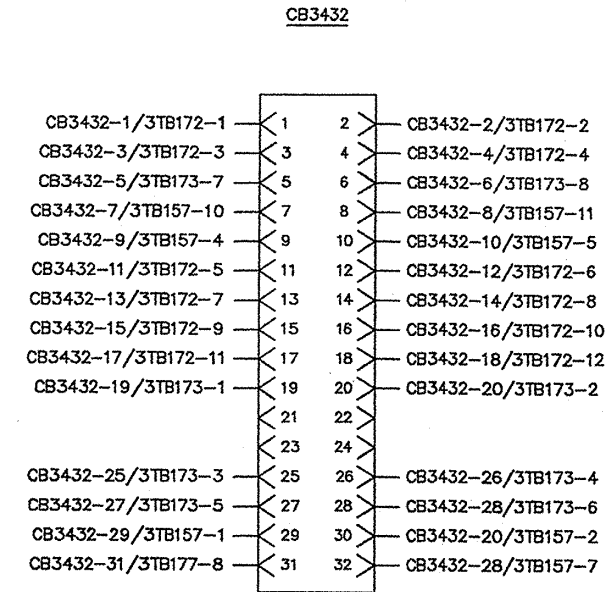
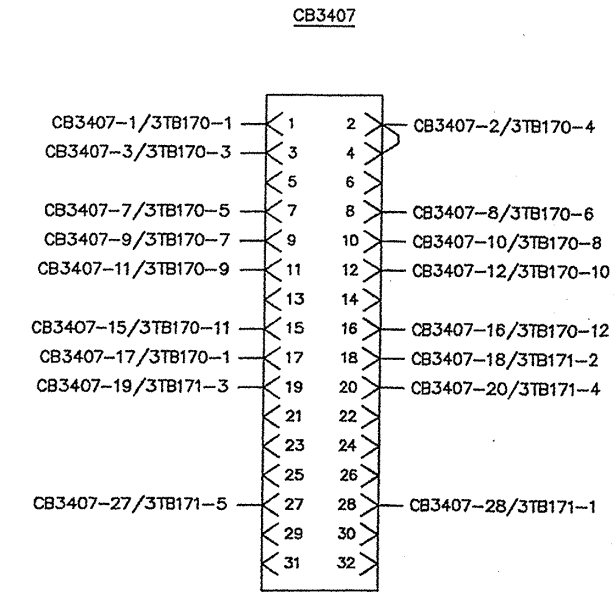


FRONT VIEW
PANEL "J" UNIT-2

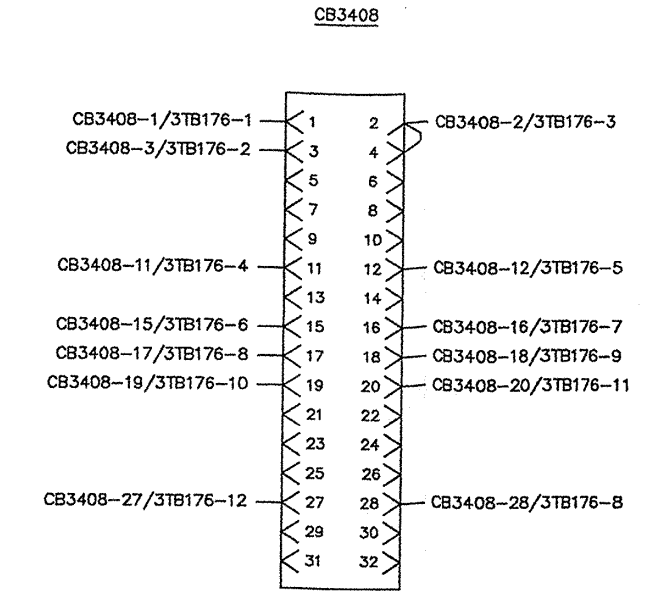


NOTE:
DDG 51 ONLY

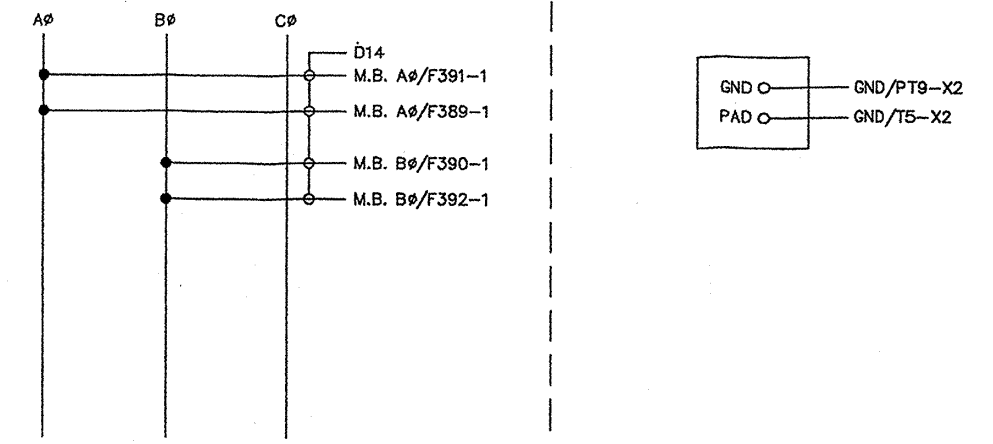
Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 5 of 6)



FRONT VIEW
PANEL "A" UNIT-1

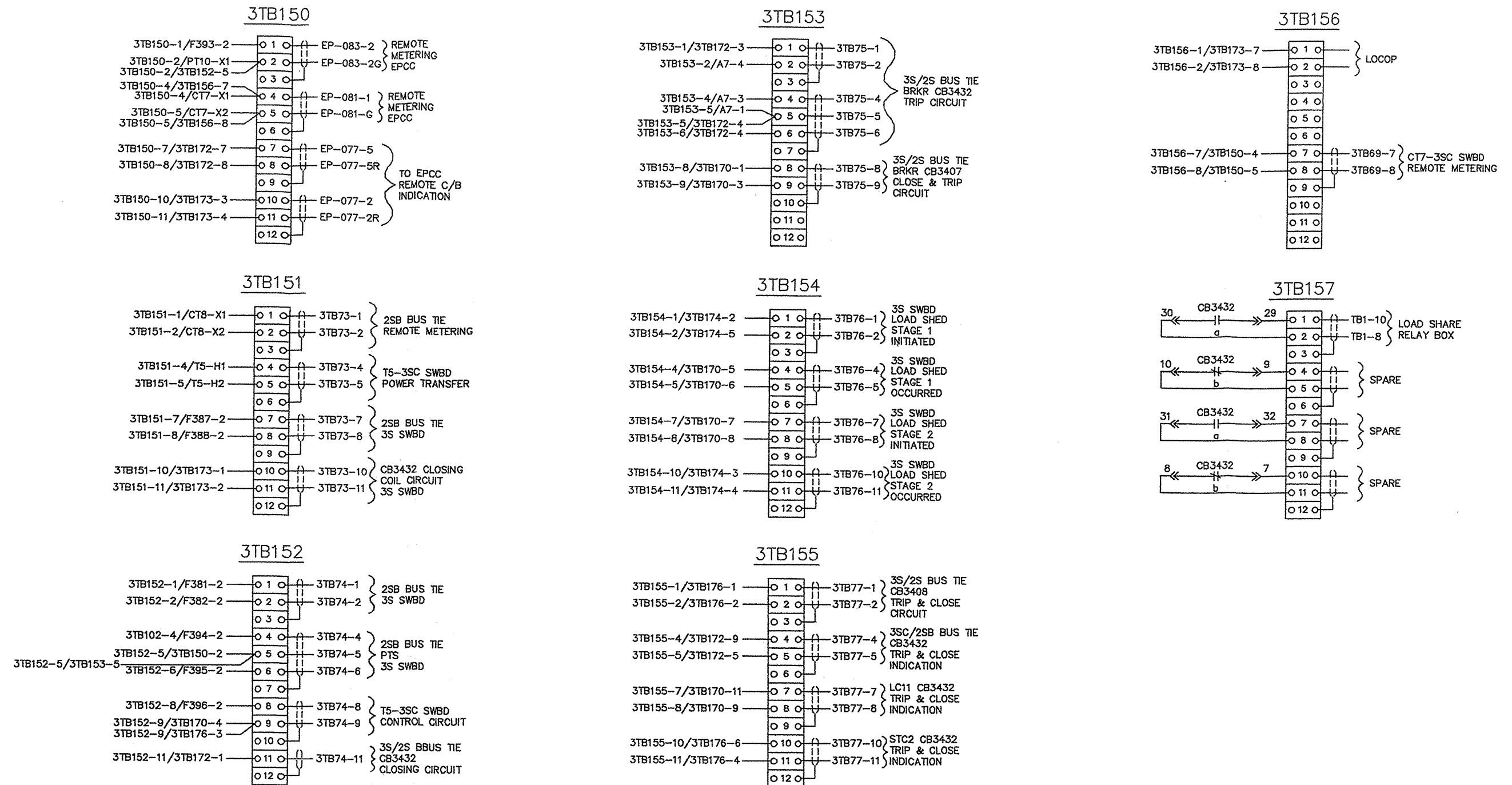


FRONT VIEW
PANEL "J" UNIT-2



NOTE:
DDG 52-54 ONLY

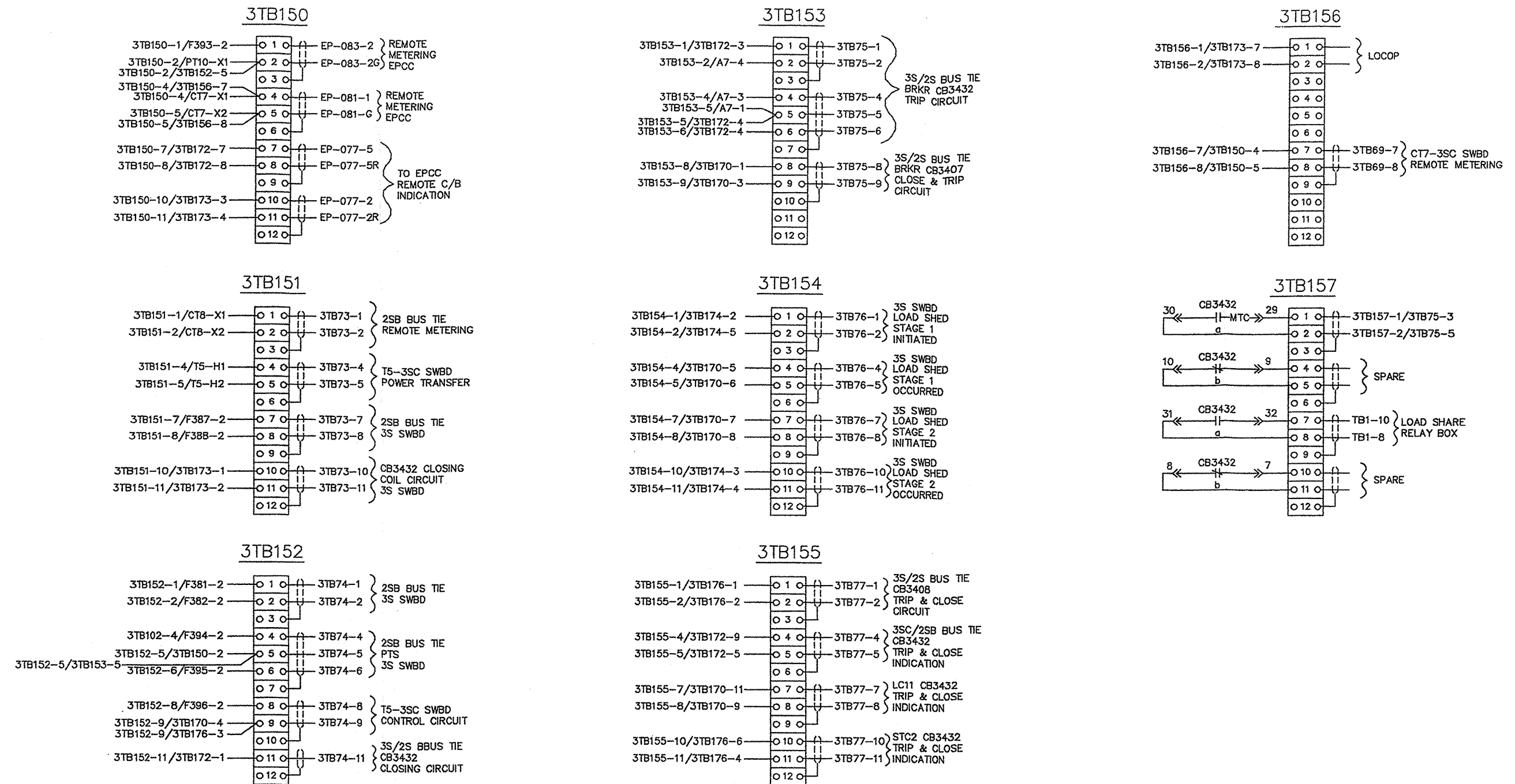
Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 5 of 6)



REAR VIEW LEFT HAND SIDE
PANEL-"N" UNIT-2

NOTE:
DDG 51 ONLY

Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 6 of 6)



REAR VIEW LEFT HAND SIDE
 PANEL-"N" UNIT-2

NOTE:
 DDG 52-54 ONLY

Figure 9-11. 3SC Switchboard; Wiring Diagram (Sheet 6 of 6)

REAR SECTION**TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)****NOTE**

Ships, training activities, supply points, depots, Naval Shipyards, and Supervisors of Shipbuilding are requested to arrange for maximum practical use and evaluation of NAVSEA technical manuals. All errors, omissions, discrepancies, and suggestions for improvement to NAVSEA technical manuals shall be forwarded to:

COMMANDER,
CODE 310 TMDER, BLDG 1388
NAVSURFWARCENDIV NSDSA
4363 MISSILE WAY
PORT HUENEME CA 93043-4307

on NAVSEA/SPAWAR Technical Manual Deficiency/Evaluation Report (TMDER), NAVSEA form 4160/1. All feedback comments shall be thoroughly investigated and originators will be advised of action resulting therefrom. One copy of NAVSEA form 4160/1 is at the end of each separately bound technical manual 8-1/2 x 11 inches or larger. Copies of NAVSEA Form 4160/1 may be requisitioned from the Naval Systems Data Support Activity Code 310 at the above address. Users are encouraged to transmit deficiency submittals via the Naval Systems Data Support Activity web site located at:

<https://nsdsa2.phdnswc.navy.mil/tmder/tmder-generate.asp?lvl=1>

Individual electronic TMs do not contain NAVSEA form 4160/1 but are linked to an electronic version on the resident CD-ROM. Therefore, we encourage the user to transmit deficiency submittals via the Naval Systems Data Support Activity web site located above.

TMDER

FOLD HERE AND TAPE SECURELY
PLEASE DO NOT STAPLE

INCLUDE COMPLETE ADDRESS

**USE PROPER
POSTAGE**

FOR OFFICE USE ONLY

COMMANDER
CODE 310 BLDG 1389
NAVSURFWARCENDIV NSDSA
4363 MISSILE WAY
PORT HUENEME, CA 93043-4307

FOLD HERE AND TAPE SECURELY
PLEASE DO NOT STAPLE