

**TECHNICAL MANUAL**

**ORGANIZATIONAL MAINTENANCE MANUAL  
DATA DISPLAY GROUP  
EQUIPMENT MAINTENANCE**

**EXPANDED TROUBLESHOOTING  
(LOGIC DIAGRAM THEORY)**

**GUIDED MISSILE AIR DEFENSE SYSTEM  
AN/TSQ-73**

**ORGANIZATIONAL MAINTENANCE MANUAL  
 DATA DISPLAY GROUP  
 EQUIPMENT MAINTENANCE  
 EXPANDED TROUBLESHOOTING  
 (LOGIC DIAGRAM THEORY)**

**GUIDED MISSILE AIR DEFENSE SYSTEM  
 AN/TSQ-73**

**REPORTING OF ERRORS**

You can help improve this publication. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, U.S. Army Missile Command, ATTN: DRSMI-SNPM, Redstone Arsenal, AL 35898. A reply will be furnished to you.

**TABLE OF CONTENTS**

		<i>Page</i>	
	LIST OF ILLUSTRATIONS .....		iii
	LIST OF TABLES .....		iv
CHAPTER 6	DATA DISPLAY GROUP EXPANDED TROUBLESHOOTING .....		6-1
		<i>Paragraph</i>	
SECTION I.	INTRODUCTION		
	Scope .....	6-1	6-1
	Expanded. Troubleshooting Concept.....	6-2	6-1
	Troubleshooting Aids .....	6-3	6-1
	Physical Description.....	6-4	6-1
SECTION II.	OVERALL THEORY OF OPERATION		
	Overall Function Description .....	6-5	6-9
	Logic Theory Presentation .....	6-6	6-9
	Circuit Card and Key Signal Lookup Tables .....	6-7	6-9
SECTION III.	DETAILED DESCRIPTIONS		
	Input Register Logic Detailed Description.....	6-8	6-104
	Fault Status Byte Logic Detailed Description.....	6-9	6-104
	Data Detection Logic Detailed Description .....	6-10	6-109
	Input Pulse Detection Logic Detailed Description .....	6-11	6-109
	Buffer Output Pulse Detection Logic Detailed Description .....	6-12	6-110
	Detailed Description Parity Check and Loop/Interrupt Byte Logic .....	6-13	6-120

**TABLE OF CONTENTS**  
**-Continued-**

	<i>Paragraph</i>	<i>Page</i>
SECTION III. DETAILED DESCRIPTIONS		
Input Counter Logic Detailed Description .....	6-14	6-120
State Gate Tree Logic Detailed Description.....	6-15	6-129
Refresh Memory-Entry Logic Detailed Description .....	6-16	6-130
Memory Storage Detailed Description .....	6-17	6-130
Memory 8-Way Multiplexer Detailed Description .....	6-18	6-140
Memory Output Multiplexer Detailed Description.....	6-19	6-140
Display Character Generator Detailed Description.....	6-20	6-140
Display Scan Register Detailed Description.....	6-21	6-140
Output Display 12-Way Clock Demultiplexer Detailed Description .....	6-22	6-140
Output Display Brightness Control Logic Detailed Description .....	6-23	6-152
FU Readout Register and Data Driver Detailed Description.....	6-24	6-152
Time-of-Day Logic Detailed Descriptions .....	6-25	6-157
Display Timing .....	6-26	6-162
LED Module Detailed Description.....	6-27	6-170
Clocking/Master Reset Detailed Description.....	6-28	6-170
SECTION IV. POWER DISTRIBUTION		
Data Display Group Power Distribution .....	6-29	6-186

## LIST OF ILLUSTRATIONS

<i>Figure</i>	<i>Title</i>	<i>Page</i>
6-1.	Data Display Group (DDG) .....	6-2
6-2.	DDG Front Panel Assembly .....	6-3
6-3.	DDG Card Cage/Array Assembly .....	6-4
6-4.	DDG Cabinet Connector Cabling .....	6-5
6-5.	DDG Cable Set.....	6-6
6-6.	DDG Circuit Card Location.....	6-7
6-7.	Data Display Group Overall Block Diagram .....	6-10
6-8.	Input Register Block Diagram .....	6-105
6-9.	Fault/Status Byte Logic .....	6-107
6-10.	Data Detection Block Diagram .....	6-113
6-11.	Input Pulse Detection Block Diagram .....	6-115
6-12.	Input Pulse Detection Timing Diagram .....	6-119
6-13.	Output Pulse Detection Block Diagram .....	6-121
6-14.	Parity Check/Interrupt Byte Block Diagram .....	6-123
6-15.	Input Counter Block Diagram .....	6-127
6-16.	Simplified Block Diagram State Gate Tree.....	6-129
6-17.	State Gate Tree Block Diagram .....	6-131
6-18.	Memory Entry Block Diagram .....	6-141
6-19.	Memory Storage Block Diagram .....	6-149
6-20.	Memory 8 Way Multiplexer Block Diagram .....	6-151
6-21.	Memory 8-Way Multiplexer Timing Diagram .....	6-153
6-22.	Memory Output Multiplexer Block Diagram .....	6-155
6-23.	ROM Input/Output Scheme.....	6-157
6-24.	Display Character Generator Block Diagram.....	6-163
6-25.	Display Scan Register Functional Block Diagram.....	6-165
6-26.	Clock Demultiplexer Block Diagram.....	6-171
6-27.	Output Display Brightness Control Block Diagram.....	6-173
6-28.	FU Readout/Data Drivers Block Diagram.....	6-175
6-29.	Time-of-Day Logic Block Diagram .....	6-177
6-30.	Display Timing Block Diagram .....	6-179
6-31.	Display Timing Diagram.....	6-183
6-32.	MOD-27 Diagram.....	6-185
6-33.	LED Module.....	6-187
6-34.	LED Module Panel.....	6-189
6-35.	LED R/H and L/H Modules Block Diagram .....	6-191
6-36.	Clock and Master Reset Block Diagram .....	6-193
6-37.	Clock and Master Reset Timing Diagram .....	6-195
6-38.	Power Distribution Block Diagram .....	6-197
FO-1.	Input Register Logic Diagram.....	
FO-2.	Fault/Status Byte Logic Diagram.....	
FO-3.	Data Detection Logic Diagram .....	
FO-4.	Input Pulse Detection Logic Diagram .....	
FO-5.	Output Pulse Detection Logic Diagram .....	
FO-6.	Parity Check/Interrupt Byte Logic Diagram.....	
FO-7.	Input Counter Logic Diagram .....	
FO-8.	State Gate Tree Logic Diagram .....	
FO-9.	Memory Entry Logic Diagram.....	
FO-10.	Memory Storage Logic Diagram.....	
FO-11.	Memory 8-Way Multiplexer Logic Diagram .....	
FO-12.	Memory Output Multiplexer Logic Diagram .....	
FO-13.	Display Character Generator Logic Diagram .....	
FO-14.	Display Scan Register Logic Diagram .....	

**LIST OF ILLUSTRATIONS**  
**-Continued-**

<i>Figure</i>	<i>Title</i>	<i>Page</i>
FO-15.	Clock Demultiplexer Logic Diagram .....	
FO-16.	Display Brightness Control Logic Diagram .....	
FO-17.	FU Readout Registers/Data Drivers Logic Diagram.....	
FO-18.	Time of Day Logic Diagram .....	
FO-19.	Display Timing Logic Diagram .....	
FO-20.	Pullups and Grounds Logic Diagram .....	
FO-21.	L/H LED Modules Logic Diagram .....	
FO-22.	R/H LED Modules Logic Diagram.....	
FO-23.	Clock/Master Reset Logic Diagram .....	
FO-24.	Control Panel Assembly.....	
FO-25.	Power Distribution Wiring Diagram .....	
FO-26.	DDG/IOX Interface Wiring Diagram .....	

**LIST OF TABLES**

<i>Table</i>	<i>Title</i>	<i>Page</i>
6-1.	Left-Hand Assembly Card Location Index .....	6-11
6-2.	Right-Hand Assembly Card Location Index .....	6-13
6-3.	Left-Hand Assembly Key Signal Lookup .....	6-16
6-4.	Right-Hand Assembly Key Signal Lookup .....	6-55
6-5.	Command Functions.....	6-104
6-6.	Fault and Indicator Status Bytes .....	6-111
6-7.	State Sequence .....	6-139
6-8.	ROM I/O Bit.....	6-158
6-9.	ASCII Character Code .....	6-158
6-10.	LED Bit Pattern.....	6-159
6-11.	Refresh Memory Organization .....	6-185

## CHAPTER 6

## DATA DISPLAY GROUP EXPANDED TROUBLESHOOTING

## Section I. INTRODUCTION

**6-1. Scope.** This manual is volume four of TM 9-1430-655-20-4 of the Display Equipment Maintenance for Guided Missile Air Defense System AN/TSQ-73 and provides supplemental expanded troubleshooting information. This manual is published for the use and guidance of advanced personnel responsible for repair of the display console beyond the scope of organizational maintenance covered in the basic TM 9-1430-655-20 series of technical manuals.

**6-2. Expanded Troubleshooting Concept.** Expanded troubleshooting is required when use of the existing fault isolation procedures in the basic manuals fail to isolate and correct a malfunction. It is assumed that expanded troubleshooting will be performed by personnel fully trained and experienced in the AN/TSQ-73 system and its mission. Expanded troubleshooting covered in this manual is based on the use of existing onsite equipment (tapes, tools, test equipment, spare parts, and publications). Isolation of malfunctions is based on the fault analysis of normal system operating conditions and the use of built-in M & D software programs.

**6-3. Troubleshooting Aids.** This manual contains functional logic diagrams to enhance troubleshooting and fault isolation capabilities. The functional logic diagrams and the associated circuit descriptions are intended to be self contained and minimize the requirements for additional troubleshooting aids. Power distribution diagrams, cabling diagrams, and front-panel schematic diagrams are also supplied.

*a. Input/Output Tables.* Input and output tables are provided, as applicable, for each figure and sheet to enable easy access to signals referenced to other diagrams.

*b. Input/Output Symbols.* Symbols used on diagrams to indicate input and output signals include the following: A Indicates input from another figure:

▲ Indicates input from another figure.

△ Indicates input from same figure.

■ Indicates output to another figure.

□ Indicates output to same figure.

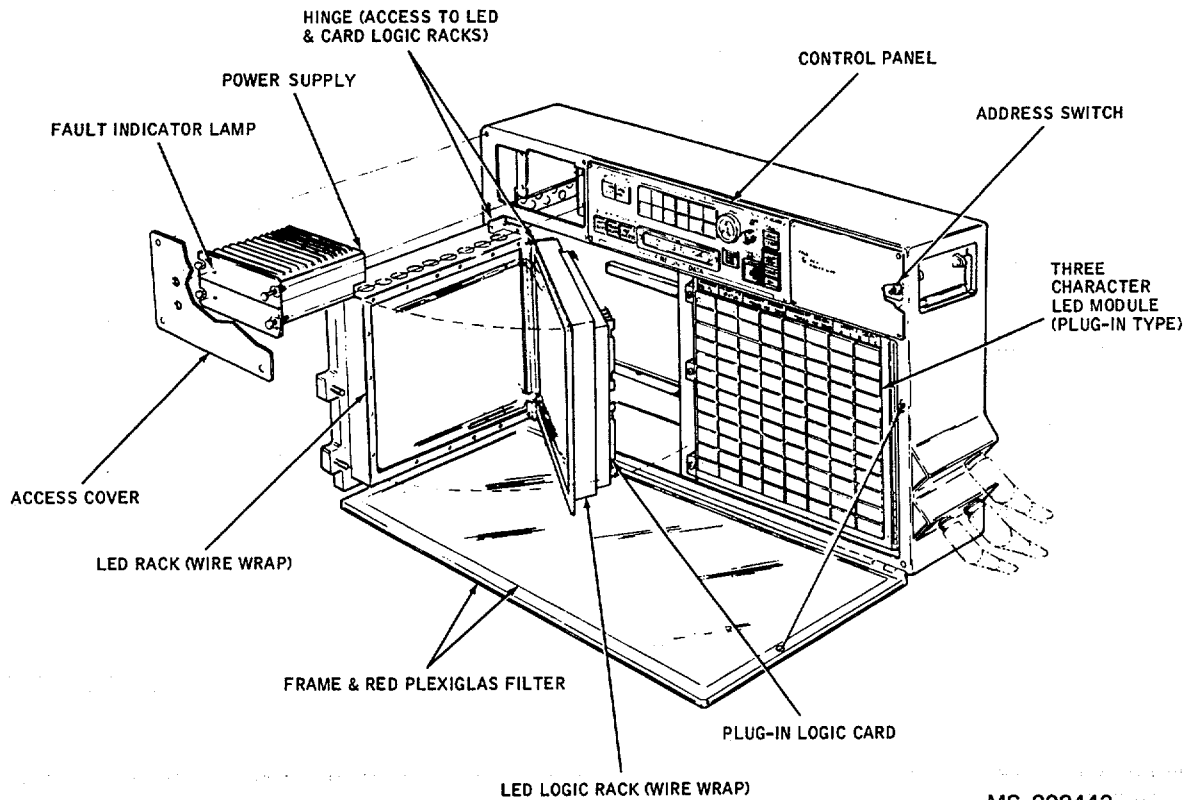
▣ Indicates output to same and another figure.

*c. Equipment Interface.* The troubleshooting diagrams may reference inputs and outputs interfacing between other pieces of equipment. When a notation shows that external equipment is involved, it is assumed that the user will refer to the applicable troubleshooting information provided for that equipment.

*d. Logic Symbols.* Logic symbols depend on card types. For discrete circuit cards containing conventional integrated circuits, conventional logic symbols are used. These symbols are used independently, with card locations and card pin numbers notated with the symbol. For analog circuits, circuit card details are provided only to a functional level.

**6-4. Physical Description (fig. 6-1).** The Data Display Group (DDG) is a freestanding assembly comprising a cabinet with two power supplies, and a front panel assembly, two card cage/array assemblies, a blower fan, miscellaneous minor components, and associated cabling and connectors. Two DDG's (units 1A7 and 1A17) are usually installed in the AN/TSQ-73 system shelter. In the Group configuration, both are used; in the Battalion configuration, only unit 1A7 is used. Provisions are made for installing either DDG, or both, in a remote position external to the system shelter. Refer to TM 9-1430655-20-1 for cabling diagrams depicting the various DDG installations.

*a. Cabinet Assembly.* The DDG cabinet assembly is an electromechanical enclosure that houses a control panel assembly, two power supplies, and two card cage/array assemblies. Mechanically, the cabinet contains a cooling system, two hinged doors, and mounting provisions for mechanical components.



**Figure 6-1. Data Display Group (DDG)**

(1) *Front Panel Assembly (fig. 6-2).* The front panel assembly contains the control panel assembly and the status board section. The control panel assembly is mounted in the upper section of the cabinet. With the use of lamps and audible alarms, the panel provides fault indicators, operational status, and the state of alert information. The status board section houses the LED displays, which provide fire unit information and status.

(2) *Card Cage/Array Assembly (fig 6-3).* The card cage/array assemblies include the left-hand (A2) and right-hand (A3) assemblies. They are mounted in the lower front of the cabinet. Hinges on the outside permit easy access to the printed circuit cards and backplane wiring.

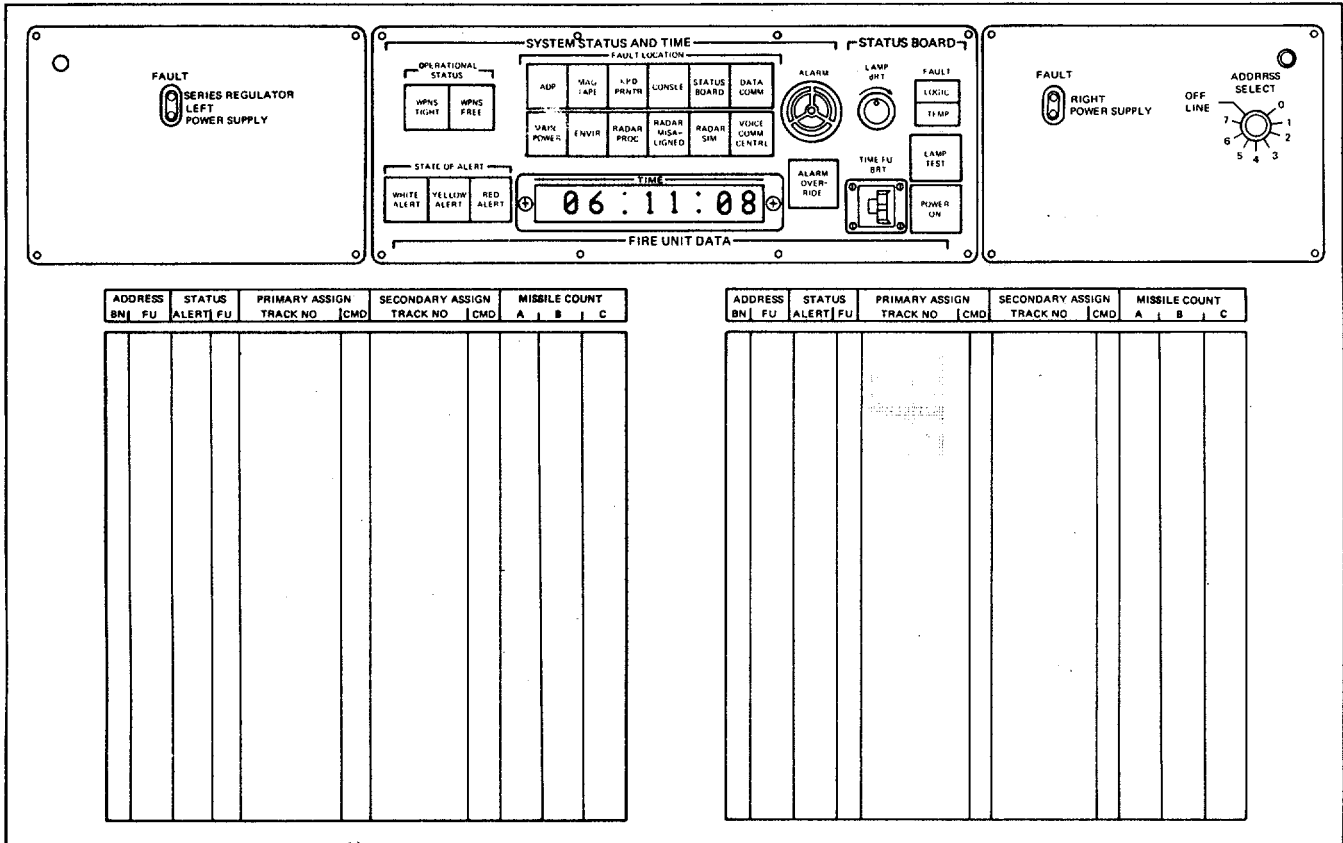
(3) *Cooling System.* Cooling within the cabinet is accomplished by air circulation from an internally mounted blower fan which draws in filtered air for distribution to the electronic components.

(4) *Cabinet Cable Set (fig. 6-4 and 6-5).* The cabinet cable set includes wiring harnesses, and cable assemblies W291 thru W294. The cable set provides electrical interconnections between internal electronic components, and external interface. The interface connectors are located on the right side of the cabinet.

(5) *Power Supplies.* The power supplies are mounted in the upper left (PS1) and upper right (PS2) sections of the data display cabinet. Each power supply is provided with a fault indicator.

(6) *Series Regulator.* The series regulator (A4), an electronic component assembly located in the center rear of the cabinet, provides voltage regulation for the output of PS1.

*b. Circuit Card Location.* The circuit cards in the data display group are mounted inside the card cage/array, right-hand and left-hand sides. Refer to figure 6-6 for individual circuit card locations.

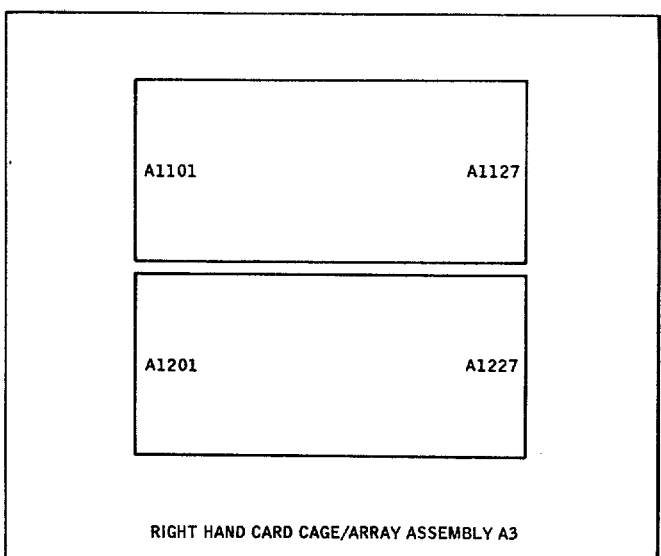
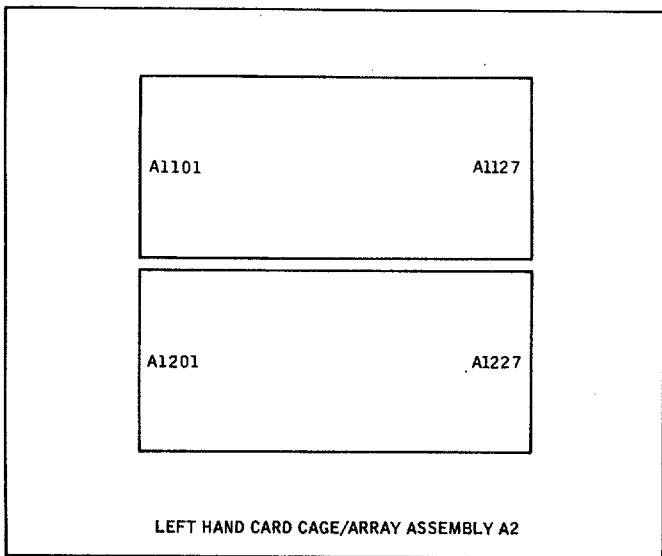
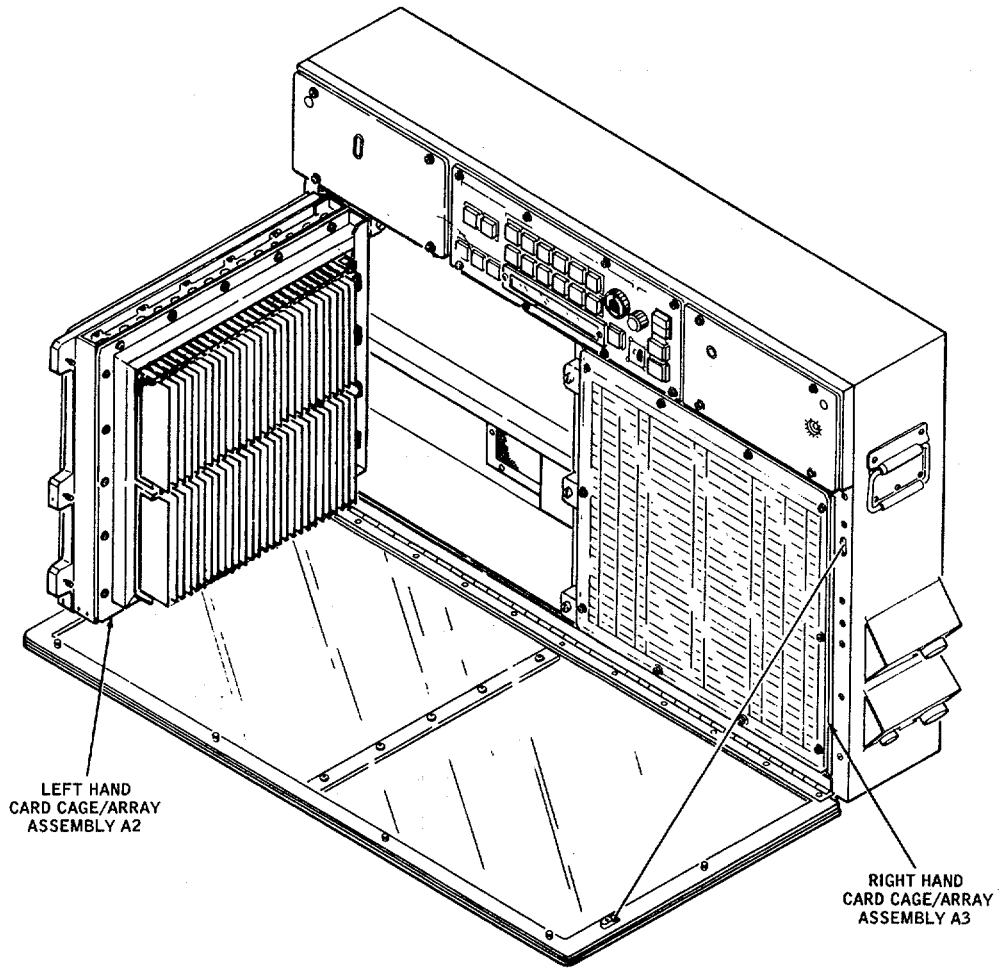


LEFT HAND SIDE

RIGHT HAND SIDE

MS 202444

Figure 6-2. DDG Front Panel Assembly



MS 202445

Figure 6-3. DDG Card Cage/Array Assembly