

USER GUIDE

DSD 880x/20 880x/30

Data Systems Design

DSD 880x/20/30
WINCHESTER/FLOPPY DISK
STORAGE SYSTEM

USER GUIDE

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PREFACE

This manual describes the features, specifications, and register usage of the DSD 880 Data Storage System.

Instructions for DSD 880 installation, operation, and elementary troubleshooting are included in this manual.

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SAFETY

Operating and maintenance personnel must at all times observe sound safety practices. Do not replace components, or attempt repairs to this equipment with the power turned on. Under certain conditions, dangerous voltage potentials may exist when the power switch is in the off position, due to charges retained by capacitors. To avoid injury, always remove power cord before attempting repair procedures.

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WARNING

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulations, it has not been tested for compliance with the limits for Class A computing devices pursuant to the sub-part J or Part 15 of the FCC rules which are designed to provide reasonable protection against such interference. The operation of this equipment in a residential area is likely to cause interference. The user, at his own expense, will be required to take whatever measures may be required to correct the interference.

CAUTION

Do not operate system until you have:

- Released the lock on the winchester drive (spindle lock)
- Rotated the head lock actuator to RUN positions.

Both locks are secured in a locked position prior to shipment from the factory. See Section 3 for detailed procedures covering installation and checkout of equipment.

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1-2
1.1 General Information	1-2
1.2 System Overview	1-2
1.3 Features	1-2
1.3.1 System Architecture	1-2
1.3.2 HyperDiagnostics ^{T.M.}	1-3
1.3.3 Off-Line Backup Capability	1-3
1.3.4 Reliability	1-3
1.4 Summary	1-4
2.0 SPECIFICATIONS	2-1
2.1 General Information	2-1
2.2 DSD 880 Major Components	2-1
2.3 Recording Characteristics	2-1
2.4 Cable and Connector Requirements	2-1
2.5 Power Specifications	2-6
2.6 Physical Specifications	2-6
2.7 Environmental Requirements	2-7
2.7.1 Environmental Specifications	2-7
2.7.2 Cleanliness	2-7
3.0 INSTALLATION	3-1
3.1 General Information	3-1
3.2 Unpacking and Inspection	3-1
3.3 Power Requirements	3-1
3.4 Installing the DSD 880 Chassis	3-1
3.5 Interface Module and Cable Installation	3-5
3.5.1 LSI-11 (8836) Interface Configuration and Installation	3-5
3.5.2 LSI-11 (DSD P/N 808836) Interface Installation Procedure	3-5
3.5.3 PDP-11 (8830) Interface Jumper Configuration	3-9
3.5.4 PDP-11 (DSD P/N 808830) Interface Installation Procedure	3-9
3.6 AC Power Cord Installation	3-14
3.7 Initial Checkout and Acceptance Testing	3-14
3.8 DSD 880 Initial Program Installation	3-16
3.8.1 DSD Supplied Programs	3-16
3.8.2 Command Files	3-16
3.8.3 Use of DSDMON	3-16
3.8.4 Transfer of RT-11 to DSD 880	3-17
3.8.5 Transfer of RT-11 to the Winchester	3-19
3.8.6 Double-Sided Support Under RT-11 V3B	3-19
3.8.7 DSD Monitor Patch Program for RT-11 V3B	3-20
3.8.8 Double-Sided Floppy Support Under RT-11 V4	3-22
3.8.9 Transfer of RSX-11M to DSD 880 Winchester	3-22

TABLE OF CONTENTS (Cont)

	<u>Page</u>
3.8.10 RSX-11M Double-Sided Floppy Support	3-23
3.8.11 SYSGEN on Host System with only Floppy Drive Available	3-23
4.0 OPERATION	4-1
4.1 General Information	4-1
4.2 Power On Self-Tests	4-1
4.3 HyperDiagnostic Switch and Error Codes	4-1
4.3.1 Winchester Write Enable	4-1
4.3.2 Seven Segment Display Error Codes	4-11
4.4 Normal Operation	4-12
4.4.1 Extended Mode	4-12
4.4.2 Logical Devices	4-13
4.4.3 LSI-11 Power Up Modes	4-13
4.4.4 Bootstrap Starting Addresses	4-14
4.4.5 Bootstrap Diagnostics	4-14
4.4.6 Troubleshooting Bootstrap Failures	4-14
4.4.7 Bootstrap Program Flow Diagram	4-19
4.4.8 Bootstrap Program Listing	4-21
4.5 Off-Line Operation	4-35
4.5.1 Format Mode	4-35
4.5.2 Backup and Reload Modes	4-35
4.5.3 Backing Up the Winchester Disk onto Floppy Disks	4-37
4.5.4 Reloading the Winchester Disks from Floppy Disks	4-38
4.5.5 HyperDiagnostics Mode	4-39
5.0 BASIC PROGRAMMING INFORMATION	5-1
5.1 General Information	5-1
5.2 Operating Modes	5-1
5.2.1 Single-Sided Operation	5-1
5.2.2 Double-Sided Operation	5-1
5.2.3 Programming Interface	5-1
5.3 DSD 880 Floppy Disk Operation and Programming	5-1
5.3.1 Addressable Registers in RX02-Compatible Operation	5-2
5.3.2 Command and Status Register	5-3
5.3.3 Data Buffer Register (RX2DB)	5-5
5.3.4 Floppy Disk Controller Command Protocols	5-8
5.3.5 Diskette Formatting	5-13
5.3.6 Power Fail	5-14
5.3.7 Common Programming Mistakes	5-14
5.3.8 Interrupts	5-15
5.4 DSD 880 Winchester Disk Operation and Programming	5-15
5.4.1 Bad Track Mapping	5-15
5.4.2 Extended Mode	5-16
5.4.3 DEC Bad Block Mapping	5-17
5.4.4 Addressable Registers	5-17
5.4.5 Control Status Register	5-17

TABLE OF CONTENTS (Cont)

	<u>Page</u>
5.4.6 Bus Address Register	5-19
5.4.7 Disk Address Register	5-20
5.4.8 Multipurpose Register	5-22
5.4.9 Winchester Controller Commands	5-25
6.0 BASIC CIRCUIT DESCRIPTION	6-1
6.1 General Information	6-1
6.2 DSD 8836 Interface Board	6-1
6.3 DSD 8830 Interface Board	6-3
6.4 DSD 880 Controller/Formatter Board	6-4
6.5 DSD 8833 HyperDiagnostic Panel	6-4
7.0 USER LEVEL MAINTENANCE	7-1
7.1 General Information	7-1
7.2 Preventive Maintenance	7-1
7.2.1 Floppy Disk Drive Preventive Maintenance	7-1
7.2.2 Winchester Drive Preventive Maintenance	7-3
7.2.3 Power Supply Preventive Maintenance	7-3
7.3 Troubleshooting and Fault Isolation	7-5
7.4 Use of DSD 880 HyperDiagnostics	7-6
7.4.1 HyperDiagnostic Operation	7-7
7.4.2 Error Reporting During HyperDiagnostics	7-7
7.4.3 Winchester Write Enable	7-9
7.5 HyperDiagnostic MODE Descriptions	7-9
7.5.1 Floppy Disk Format Routines (MODE 1)	7-9
7.5.2 System Tests (MODE 2)	7-9
7.5.3 Controller Tests (MODE 3)	7-10
7.5.4 Floppy Disk Alignment Routines (MODE 4)	7-11
7.5.5 Read/Write Tests (MODE 5)	7-12
7.5.6 Reconfiguration of Floppy Drive	7-13
7.6 DSD 880 Error Code Interpretation	7-14
7.7 Subsystem Replacement	7-25
7.8 Maintenance Assistance	7-25

APPENDICES

Appendix A - Diskette Directories	A-1
Appendix B - Command Files Listings	B-1
Appendix C - Floppy Disk Exerciser (FLPEXR) User's Manual	C-1
Appendix D - Fixed Disk Exerciser (RLEXR) User's Manual	D-1
Appendix E - Winchester Direct Access Diagnostic (WINEXR) User's Manual	E-1
Appendix F - Program Backup Files Version RSX-1.0	F-1
Appendix G - Program Backup Files Version RT-1.0	G-1

TABLE OF CONTENTS (Cont)

TABLES

<u>Table No.</u>	<u>Description</u>	<u>Page</u>
1-1	DSD 880 System Configurations	1-2
2-1	DSD 880 Major Components	2-1
2-2	DSD 880 Drive Specifications	2-2
2-3	LSI-11 Interface Board Specifications	2-4
2-3	PDP-11 Interface Board Specifications	2-5
3-1	Rack Installation Hardware	3-2
3-2	DSD 8836 Interface Jumper Settings	3-7
3-3	PDP-11 Interface Jumper Settings	3-11
3-4	8830 Interrupt Priority Settings	3-12
3-5	8830 Jumper Configurations	3-12
4-1	HyperDiagnostic Panel Indicators	4-2
4-2	HyperDiagnostic Panel Mode and Class Options	4-5
4-3	Error Codes	4-11
4-4	DSD 880 Interface Bootstrap Program Starting Addresses and Device Addresses	4-14
4-5	Program Halt Locations	4-15
4-6	Program Loops	4-18
4-7	Bootstrap Program Listing	4-21
5-1	Error Register Codes for RX2ES	5-12
5-2	Diskette Format Codes	5-14
7-1	Single-Sided Floppy Drive Preventive Maintenance	7-1
7-2	Double-Sided Drive Preventive Maintenance	7-3
7-3	Preliminary Troubleshooting Guide	7-5
7-4	Definitive Error Codes	7-8

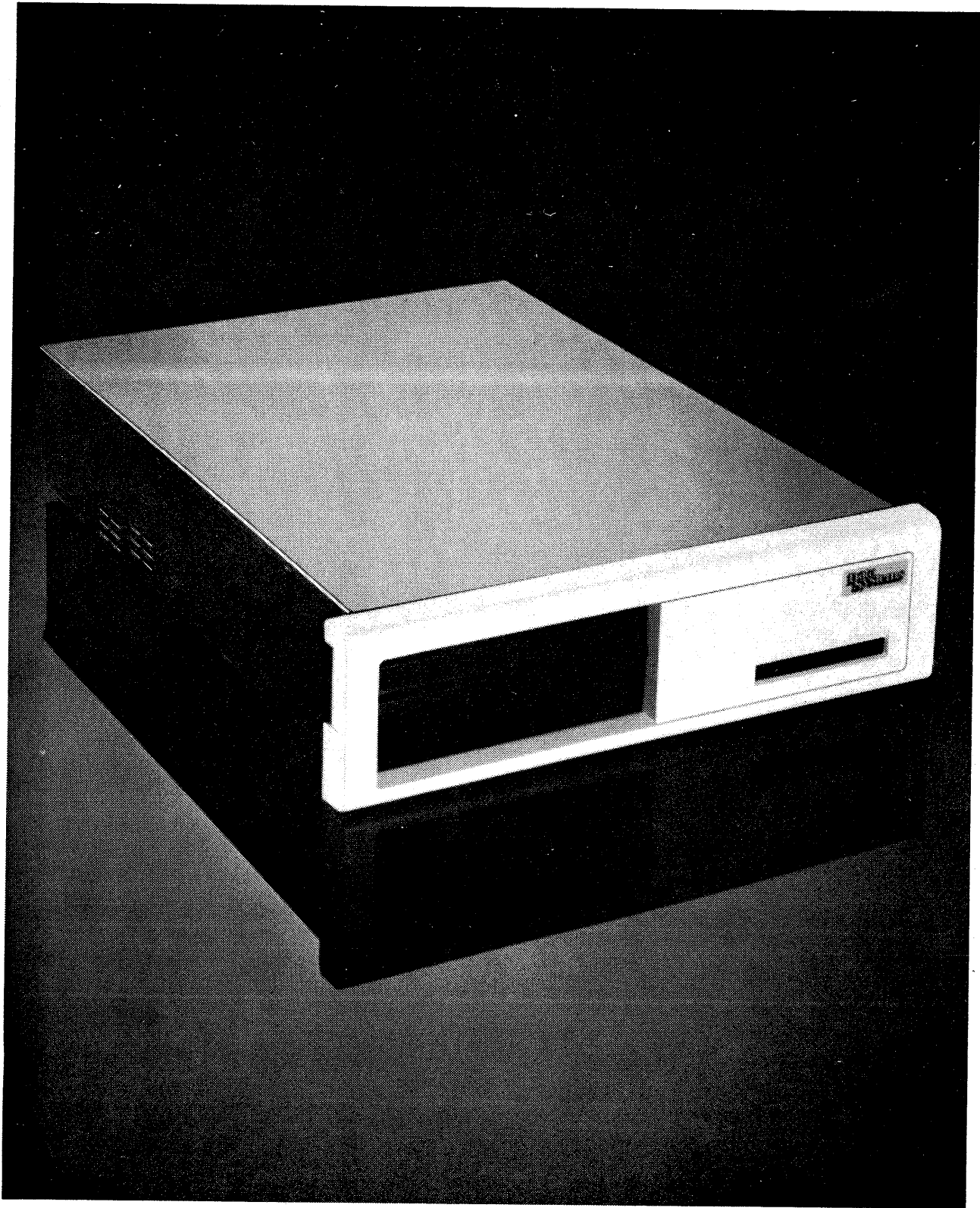
FIGURES

<u>Figure No.</u>	<u>Description</u>	<u>Page</u>
3-1	Winchester Spindle and Head Lock Access	3-3
3-2	Installing Chassis Slides	3-4
3-3	DSD 8836 (LSI-11) Interface Card	3-6
3-4	Option Priority in LSI-11 Backplanes	3-8
3-5	DSD 8830 (PDP-11) Interface Card	3-10
3-6	Typical Unibus Hex Backplane	3-13
4-1	DSD 880 HyperDiagnostic Panel	4-2
4-2	Proper Orientation of Diskette for Insertion	4-12
4-3	Bootstrap Flow Diagram	4-20
5-1	Command and Status Register	5-3
5-2	System Error and Status Register Bit Format	5-6
5-3	Control Status Register Format	5-17
5-4	Bus Address Register Format	5-20
5-5	Disk Address Register Format During a Seek Command	5-20
5-6	Disk Address Register Format for a Read or Write Command	5-21
5-7	Disk Address Register Format for a Get Status Command	5-22

TABLE OF CONTENTS (Cont)

FIGURES

<u>Figure No.</u>	<u>Description</u>	<u>Page</u>
5-8	Multipurpose Register Format for a Get Status Command	5-23
5-9	Multipurpose Register Format for a Read Header Command	5-24
5-10	Multipurpose Register Format for a Read/Write Data Command	5-24
6-1	DSD 880 Block Diagram	6-2
6-2	DSD 8841 Controller/Formatter Board	6-5
6-3	DSD 8833 HyperDiagnostic Panel	6-6
7-1	Removal and Replacement of Head Load Button	7-2
7-2	Location of R3, +5 Vdc Trim Pot	7-4



TP 100/81

Data Systems Design 880

1.0 INTRODUCTION

1.1 General Information

This manual provides user information for the DSD 880x/20/30 data storage system. Coverage provided includes: features, specifications, installation, operation, elementary programming, and user level troubleshooting.

1.2 System Overview

The DSD 880 is a compact data storage system combining the advantages of the winchester disk system and the floppy disk system. Designed for use with computers manufactured by Digital Equipment Corporation (DEC), the DSD 880 provides the large capacity, rapid data access, and reliability of winchester disk technology and the low cost versatility of the floppy disk in a compact, system oriented package.

1.3 Features

1.3.1 System Architecture

The DSD 880 uses a unique system architecture to achieve the economy and performance available by the combination of winchester and floppy disk technologies. The winchester is configured to be compatible with a high performance disk system (the DEC RL02) while the double-sided floppy disk emulates a floppy disk system (the DEC RX02). The DSD 880 is fully hardware, software, and interface compatible with DEC computers. The system provides up to 32.2 Mbyte of on-line storage (31.2 Mbyte fixed and 1 Mbyte removable). DSD 880 system configurations are listed in Table 1-1.

Table 1-1. DSD 880 System Configurations

System Type	Winchester Capacity	Emulation	Computers
DSD 880x/20	20.8 Mbyte	2 RL02s 1 RX02*	LSI-11/xx PDP-11/xx
DSD 880x/30	31.2 Mbyte	3 RL02s 1 RX02*	LSI-11/xx PDP-11/xx

*DSD 880s can be configured with:

- Single-sided floppy
- Double-sided floppy
- No floppy

The DSD 880 is implemented with a controller/formatter that is common to both drives. A single computer interface simplifies system integration. A bit-slice processor on this interface arbitrates device requests and queues pending instructions. Each disk drive responds to a different device address, interrupt priority, and interrupt vector.

The DSD 880 controller uses a bit-slice processor which switches roles between the RL and RX emulations. A single phase-lock-loop data separator operates at two clock frequencies to accommodate the different data rates of the two drives.

Although the controller emulates two devices, it does not do so simultaneously. The computer interface arbitrates RL02 and RX02 command transfers between the controller and the CPU bus. In addition to command arbitration, the interface also performs the following functions:

1. Emulation of RL02 and RX02 command and status registers.
2. Control of data transfers between the CPU and disk controller, including Direct Memory Access (DMA) transfers.
3. Contains the DSD bootstrap load program.

1.3.2 HyperDiagnostics

With the development and introduction of highly sophisticated computer peripherals comes the need to consider new methods of testing and servicing this equipment. DSD has pursued the philosophy of designing extensive self-testing and diagnostic capabilities into its products. Since our disk memory systems are controlled by microcomputers, self-diagnostic features become a natural extension of the product design. DSD's unique HyperDiagnostics provide the operator or service person with a library of user-selectable diagnostic routines and displays indicating system or error information. These HyperDiagnostics permit system diagnosis, floppy disk formatting, winchester backup and floppy drive alignment in a stand alone configuration without tying up a company's expensive computer or test equipment resources. Subsystem faults are easily isolated to allow for quick servicing. The DSD 880 HyperDiagnostics are initiated from a display panel located behind the removable front bezel. The panel is easily accessed by qualified personnel, but is concealed in normal operation.

1.3.3 Off-Line Backup Capability

The use of a common disk controller not only achieves a more economical design, it allows additional interaction between the two disk drives. The DSD 880 controller provides stand alone winchester backup and loading, independent of the CPU. This assures that data will not be lost or destroyed in the event of a computer system failure. Backup and loading are initiated from a unique HyperDiagnostic panel built into the system. The contents of each RL02 unit may be dumped onto floppy disks. When a floppy disk is full, the system pauses and instructs the operator to insert the next disk. Reloading is simple and automatic. Each flexible disk is coded with the corresponding RL02 track addresses so that it may be inserted in any order, without record keeping. The floppy disks may be single- or double-sided, and single- or double-density. Data can also be transferred from one DSD 880 to another using off-line backup capability.

1.3.4 Reliability

Winchester technology offers the potential for much greater reliability than flexible disk drives. Since the overall system reliability will be limited to that of its weakest component, new innovations are called for to enhance system reliability.

The system reliability is increased by automatically shutting off power to the floppy disk drive when it is not in use. This will save wear on media, bearing, belts, and pulleys. Since the floppy disk will be used primarily for winchester backup and loading, the mean time between failures (MTBF) of the floppy disk drive, and hence of the overall system, will be significantly increased.

1.4 Summary

Disk memory systems combining winchesters and floppy disks are opening new application possibilities for small computer systems. Their functionality and performance rival that of large disk systems costing several times as much. When considering a winchester-based disk memory system, the user should look beyond the usual considerations of capacity and backup, and should examine the functionality and capability of the entire system.

Data Systems Design has been an industry leader in the design and manufacture of DEC-compatible disk systems since 1975. The DSD 880 is a unique, hybrid design which offers a combination of price, features, and performance unavailable from any DEC product. Some of these features are summarized below:

- Cost effective data storage and retrieval
- Large capacity data storage
- Rapid data access
- Simplified system integration
- RL02 and RX02 emulation
- Off-line backup capability
- Exclusive DSD HyperDiagnostics
- Compact size

2.0 SPECIFICATIONS

2.1 General Information

This section provides specifications and operational requirements for the Data Systems Design 880 Data Storage System.

Specifications include data storage capacities, recording characteristics, and data transfer rates. Also provided is a listing of the major components that comprise the DSD 880 system. Physical dimensions are provided.

Requirements include those for interface cabling and connectors, and power requirements. Operating temperature range and other environmental considerations are given.

2.2 DSD 880 Major Components

Table 2-1 provides a listing of the major components that comprise the DSD 880 Data Storage System.

Table 2-1. DSD 880 Major Components

<u>Component</u>	<u>Part Number</u>
Main Chassis	700006-01
Winchester Disk Drive	Q2030-20 Mb
	Q2040-30 Mb
Flexible Disk Drive	SA850/800
Controller/Formatter Card (8841)	808841-01
PDP 11 Interface Card (8830)	808830-01
LSI-11 Interface Card (8836)	808836-01
Diagnostic Panel (8833)	808833-01
Power Supply Assembly 115 Volt	900230-01
Power Supply Assembly 230 Volt	900230-02

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QUANTOM

2.3 Recording Characteristics

Data is recorded on the winchester using the modified frequency modulation technique (MFM).

Data is recorded on the floppy in single-density using the industry standard IBM 3740 format double frequency (FM) code, as well as the double-density DEC RX02 format using the DEC-modified MFM technique. Product specifications are given in Tables 2-2, 2-3, and 2-4.

2.4 Cable and Connector Requirements

The DSD 880 is furnished with all internal cables installed and configured for proper operation. A 10-foot long, 26-pin interface cable is supplied for connecting the DSD 880 main chassis to the DSD 8836 or 8830 computer interface card which is installed in the backplane of the host computer.

Table 2-2. DSD 880 Drive Specifications

	Winchester Drive		Floppy Drive			
	Q2030	Q2040	Single-Sided Mode		Double-Sided Mode	
<u>GENERAL:</u>						
Emulates Modifications to DEC Operating Software	2 RL02s	3 RL02s	RX02		'Extended RX02'	
Diskettes used	None	None	None		See Section 5	
	—	—	Single-Sided		Single- and Double-Sided	
			Single-Density	Double-Density	Single- and Double-Density	Double-Density
Formatted Capacity	20.8 Mbytes	31.2 Mbytes	256 Kbytes	512 Kbytes	up to 512 Kbytes	up to 1 Mbyte
<u>DATA ORGANIZATION:</u>						
Recording format	—		IBM 3740	DEC RX02	IBM 3740	DEC RX02
Recording technique	MFM		Double Frequency	DEC Modified MFM	Double-Frequency	DEC Modified MFM
Bytes/Sector	256		128	256	128	256
Data Integrity	Header CRC/Data CRC		Header CRC/Data CRC			
Bad Track Management	Spare Track Assignment is User Transparent					

Table 2-2. DSD 880 Drive Specifications (Cont)

	Winchester Drive	Floppy Drive
<u>SPEEDS:</u>		
Access Times:		
Average	60 msec	174 msec
Maximum	100 msec	410 msec
Track-to-Track	15 msec	18 msec
Head Load Time	—	50 msec
Head Switching Time	20 microsecs	100 microsecs
Start/Stop Time	30 seconds for drive to attain operating speed and complete initialization sequence following power on	2 seconds for diskette rotational speed stabilization
Nominal Rotational Speed	3000 RPM	360 RPM \pm 2%
Average Latency	10 msec	83 msec
Data Transfer Rate:		
Within a track	4.34 Mbytes/sec	20 Kbytes/sec
across entire disk	204 Kbytes/sec	18 Kbytes/sec
burst rate	143.8 Kbytes/sec	4 microsec/word plus
	30 microsecs/8 words plus	DMA Overhead
	DMA overhead	
Data Transfer Length	5.1K words in normal mode 64K words in extended mode	—

Table 2-3. LSI-11 Interface Board Specifications

LSI-11 Interface	Winchester Drive	Floppy Drive
Device Address: Standard (as shipped) Alternate*	774400 774410, 774420, 774370	777170 777160, 777150, 777140
Hardware Bootstrap Start Address: Standard (as shipped) Alternate*	773000 771000, 766000	773000 771000, 766000
Interrupt Vector: Standard (as shipped) Alternate*	160 150, 210, 400	264 274, 270, 254
Backplane Requirement:	One dual wide Q-bus slot in <u>any</u> Q-bus backplane	

*Jumper Selectable

Table 2-4. PDP-11 Interface Board Specifications

PDP-11 Interface	Winchester Drive	Floppy Drive
Device Address: Standard (as shipped) Alternate (in word increments of 10 octal)	RLCS = 774400 760000-777770	RXCS = 777170 760000-777770
Bootstrap Base Address: Standard (as shipped) Alternate (in word increments of 1000 octal)	771000 760000-777000	771000 760000-777000
Interrupt Vector: Standard (as shipped) Alternate (in word increments of 4 octal)	160 000-774	264 000-774
Backplane Requirement:	One quad-wide Small Peripheral Controller (SPC) slot in any Unibus backplane	

2.5 Power Specifications

Input Voltage	100 Vac or 120 Vac + 10%	
	220 Vac or 240 Vac \pm 10%	
	50 Hz \pm 1 Hz	
	60 Hz \pm 1 Hz	
Chassis Current (maximum)	120V/60Hz	220V/50Hz
Busy	6A	3A
Starting Current	28A Max @ 115 Vac	
	14A Max @ 230 Vac	
Heat Dissipation (BTU/hr)	<u>Normal</u>	<u>Maximum</u>
Chassis	1055	1175
Fuse Ratings (all Slo - Blo)	<u>Main</u>	<u>Winchester</u>
	4A @ 120 Vac	2A @ 120 Vac
	2A @ 220 Vac	1A @ 220 Vac

INTERFACE

	<u>LSI-11</u>	<u>PDP-11</u>
	<u>(Q-Bus)</u>	<u>(Unibus)</u>
Current Consumption (+5V)		
Nominal	2.5A	2.8
Maximum	3A	3.3
Heat Dissipation (BTU/hr)		
Nominal		43
Maximum		52

2.6 Physical Specifications

CHASSIS

Size	Chassis	5.25"H X 17.6"W X 23.74"D	
	Shipping Carton	12.5"H X 24.5"W X 30.0"D	(13.3 cm X 44.7 cm X 76.2 cm)
Weight	Chassis	56.6 lb	(25.7 Kg)
	System Packed for Shipping	80 lb	(36.3 Kg)
Mounting	Rack Slides	Fits in standard DEC rack	

2.7 Environmental Requirements

All disk systems manufactured by Data Systems Design perform efficiently in a normal computer room environment. Temperature, humidity, and cleanliness are three environmental considerations that can affect the reliability of diskette use.

2.7.1. Environmental Specifications

TEMPERATURE

Operating	Chassis	41°F to 104°F (5°C to 40°C)
	Diskettes	50°F to 120°F (10°C to 51°C)
	Diskette Maximum Rate of Change	(15°/hr)
Non-Operating	Chassis	-40°F to 150°F (-40°C to 66°C)
	Diskettes	-40°F to 120°F (-40°C to 51°C)

HUMIDITY

Chassis	10% to 78% (non-condensing)
Diskettes	8% to 80% (With a maximum wet bulb temperature of 78°F (25.5°C))

ALTITUDE

Chassis (operating)	6000 feet maximum
---------------------	-------------------

2.7.2 Cleanliness

Cleanliness is important wherever diskettes are to be stored, handled, and used. Store the diskettes in areas free of dust and corrosive chemicals. The storage area should also be free of strong magnetic fields which might damage the recorded data. When handling a diskette, never touch the exposed magnetic media.

If the DSD 880 is operated in an environment which has a high concentration of abrasive airborne particles, the useful life of the diskettes will be reduced and the data error rate increased.

3.0 INSTALLATION

3.1 General Information

This chapter provides information on unpacking and inspection, installation, configuration, and initial check out of your DSD 880 Data Storage System.

3.2 Unpacking and Inspection

When your DSD 880 shipment arrives, inspect the shipping container immediately for evidence of mishandling during transit. If the container is damaged, request that the carrier's agent be present when the package is opened.

Compare the packing list attached to the shipping container against your purchase order to verify that the shipment is correct.

Unpack the shipping container and inspect each item for external damage such as broken controls and connectors, dented corners, bent panels, scratches, and loose components.

If any damage is evident, notify Data Systems Design Customer Service immediately.

Retain the shipping container and packing material for examination in the settlement of claims, or for future use. Retain the cardboard shipping disk which is installed in the flexible disk drive.

3.3 Power Requirements

The DSD 880 is available in configurations for nominal line voltages of either 120 or 240 Vac. The line frequency must be within 1 Hz (cycles per second) of either 50 or 60 Hz.

NOTE

The voltage and frequency configuration of the DSD 880 cannot be field modified.

3.4 Installing the DSD 880 Chassis

The DSD 880 chassis must be installed within 10 feet of the interface module's location to accommodate the length of the interconnecting cable. If the computer system operator will be changing diskettes often, it may be convenient to install the chassis close to the console terminal.

The DSD 880 may be either mounted in a standard 19-inch rack or placed on a table top. The rack installation hardware consists of the items listed in Table 3-1.

Table 3-1. Rack Installation Hardware

<u>Quantity</u>	<u>Item</u>
1	Chassis Slide, Left
1	Chassis Slide, Right
2	Slide Mtg. Bracket, Rear
12	Screw, 10-32 X 1/2" Phillips Pan Hd.
4	Screw, 8-32 X 3/8" Flat Hd. 100"
2	Screw, 8-32 X 1/4" Phillips Pan Hd.
10	Nut, #10 Retainer
4	Hex Nut, 10-32
12	Washer, #10 Flat
4	Washer, #10 Star, External Tooth
2	Washer, #8 Star, External Tooth
2	Captive Screw, 10-32 X 5/8"

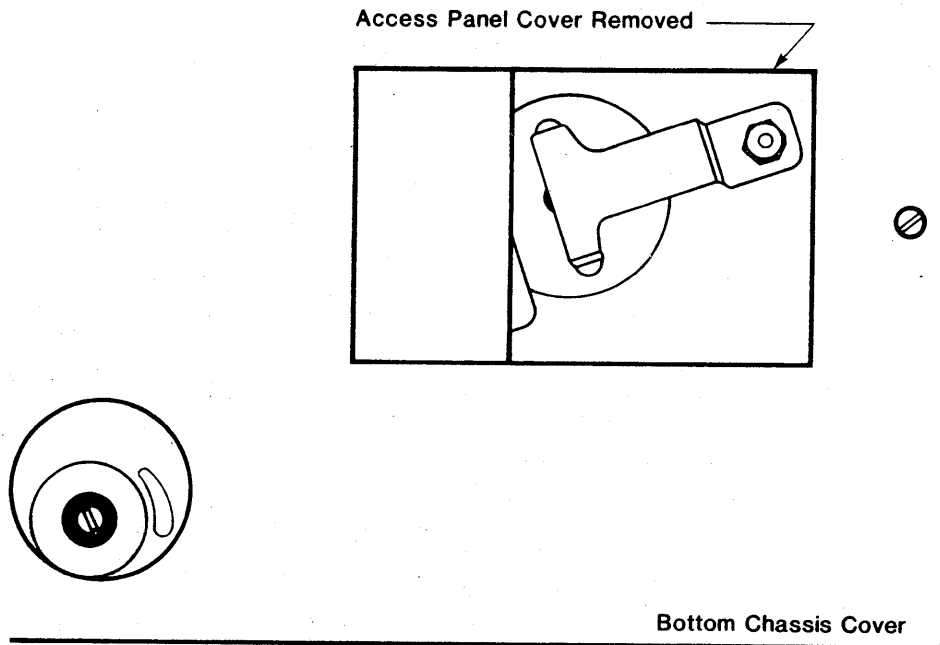
The DSD 880 chassis should be mounted in such a way that the air flow behind the fan is unrestricted. The temperature of the air entering the chassis should not exceed 104°F (40°C).

NOTE

The winchester drive furnished with the DSD 880x/20/30 system is shipped with a "spindle lock" and a "head lock" mechanism which are in the locked position to prevent damage during transit. These locks must be removed prior to installation and operation. The drive motor can be damaged if power is applied while the locks are engaged. To prepare for operation, proceed as follows:

1. Stand chassis on side and remove spindle lock access panel in bottom cover. See Figure 3-1.
2. Loosen 11/32" Hex Nut on spindle lock.
3. Rotate locking clip away from the pulley. Do NOT rotate pulley.
4. Tighten 11/32" Hex Nut.
5. Unlock head lock by rotating actuator counter clock wise as far as it will go (approximately one-half turn). Do NOT force.

Reverse this procedure to prepare drive for shipment.



TP 228/81

Figure 3-1. Winchester Spindle and Head Lock Access

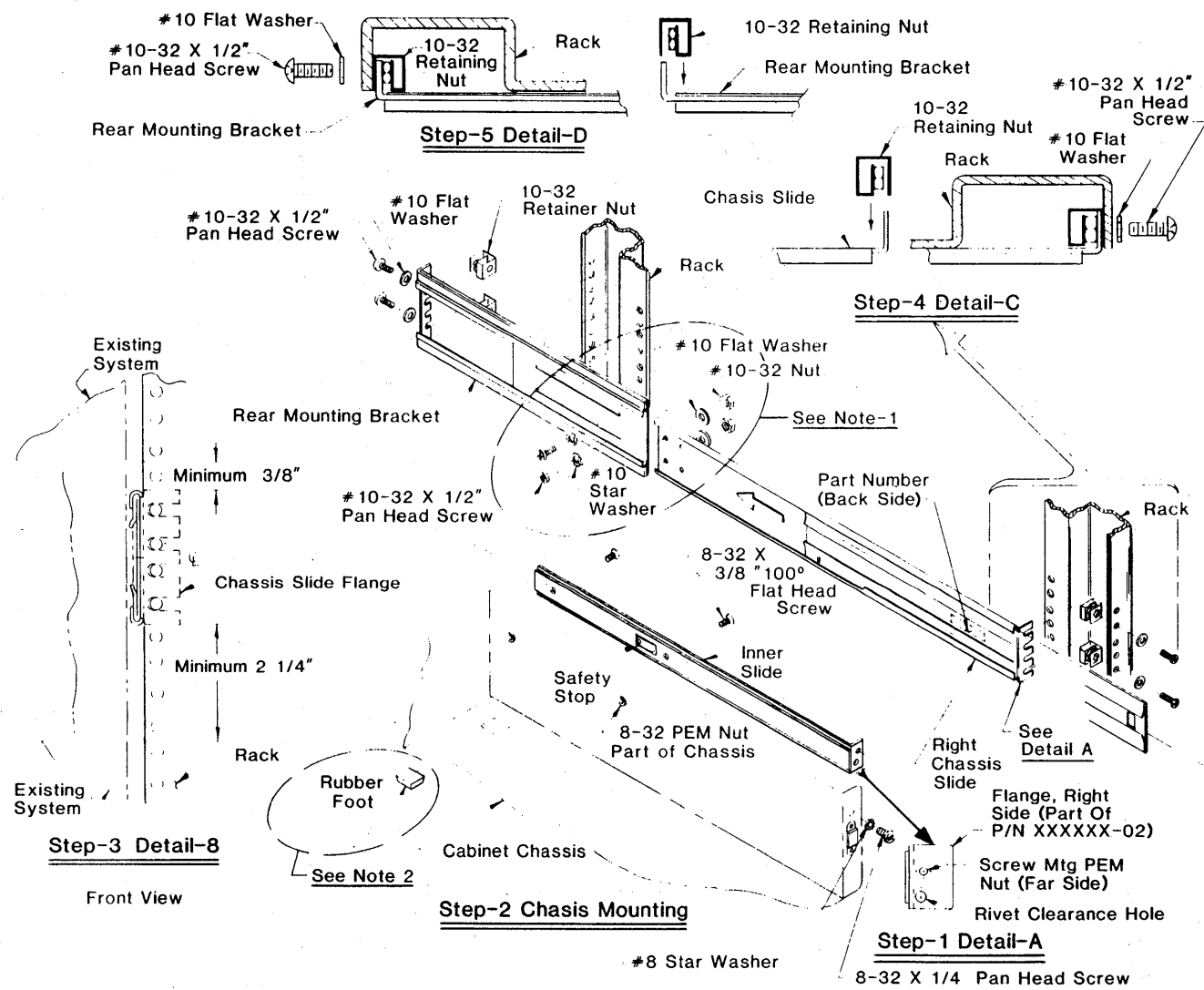
NOTE

If the DSD 880 is to be rack mounted, the user should ascertain that the 8841 controller card is configured to meet the desired operating parameters before rack installation is made. The DSD 880 is shipped properly configured for the disk drives furnished with the system, and with the flexible disk drive automatic power on/off option selected.

The following procedure should be used to mount the DSD 880 in the standard 19-inch instrumentation rack:

- 1) Attach the chassis slides to the rack using the hardware supplied. Note that the left and right rear extender brackets are not interchangeable. Figure 3-2 illustrates the correct relationship of the rack mounting components.
- 2) Insert the DSD 880 into the chassis slides and push the unit into the rack.
- 3) Remove the front bezel from the DSD 880 and install the retaining screws.
- 4) Replace the bezel by locating the guide pin and pressing firmly until the retaining mechanism engages firmly.

3-4



ASSEMBLY INSTRUCTIONS

- STEP-1.** Unpack your chassis slide kit and identify the right and left chassis slide by the stamped part no: Left is P/N XXXXXX-01, Right is P/N XXXXXX-02. (See detail-A.)
2. After identifying the right and left chassis slides (see chassis mounting), remove the inner slides by fully extending the slides and then releasing the safety stop. Assemble the inner slides to chassis using the fasteners shown.
 3. To position the chassis slides, use the recommended dimensions (see detail-B). The positioning is contingent upon mounting your new system underneath or above the existing system. Align the flange of the chassis slide with the two nearest mounting holes of the rack.
 4. After determining which two holes/slots will be used, slide the retaining nuts into the appropriate slots on the mounting flange of the chassis slides (see detail-C). Fasten the chassis slides to the rack using the fasteners shown.
 5. Slide the rear mounting bracket over the chassis slide until the flange meets the back of the rack. Align the bracket with the two nearest mounting holes on the rack. It is important to keep the slide and rear bracket level.
- NOTE-1.** For the extra long racks, additional hardware has been supplied for stiffening the assy.
2. Remove rubber feet from system before installing into rack.

NOTE: The rear has the same slot spacing relative to the center of the chassis slide. Slide the retainer nuts into the appropriate mounting slots, re-align the bracket to the holes and fasten with the hardware shown. (See detail-D)

Figure 3-2. Installing Chassis Slides

3.5 Interface Module and Cable Installation

3.5.1 LSI-11 (8836) Interface Configuration and Installation

CAUTION

Ensure that system power is off before installing the interface module and cable, or before changing the interface switch positions.

The DSD 880 LSI-11 interface card is a dual-wide card, labeled P/N 808836. The DSD 8836 is shown in Figure 3-3.

The following features can be selected through jumpers on the LSI-11 interface card. Refer to Table 3-2.

- | | |
|---------------------------------|----------------------------------|
| 1. RL Device Register Addresses | 5. RL Interrupt Vector Addresses |
| 2. RX Device Register Addresses | 6. RX Interrupt Vector Addresses |
| 3. Bootstrap Base Addresses | 7. DMA Burst Length |
| 4. Bootstrap Enable/Disable | 8. RL Interrupt Priority Level |

3.5.2 LSI-11 (DSD P/N 808836) Interface Installation Procedure

The following procedure describes how to install the LSI-11 interface module:

1. VERIFY LINE POWER IS OFF.
2. Plug one end of the interface cable into the interface module so that pin 1 (the striped side) is closest to the edge of the board. Note that the position of the clipped pin on the module connector matches the position of the plugged hole on the cable connector.
3. Plug the opposite end of the interface cable into the keyed connector mounted on the rear panel of the chassis. Note that the position of the clipped pin on the module connector matches the position of the plugged hole on the cable connector.

Now you are ready to plug the module into the lowest numbered available Q-bus slot.

NOTE

No open Q-Bus slots are allowed between the processor and the DSD 8836 interface module. Since this module uses both interrupts and Direct Memory Access (DMA), a break in either of the grant propagation chains will prevent the interface module from obtaining control of the Q-Bus. Figure 3-4 shows how Q-Bus slots are numbered on the standard backplanes available from DEC. Some Q-Bus interface cards (e.g., serial interfaces and memory) do not pass the DMA grant signal. Ensure that the DMA signal is reaching the LSI-11 interface (8836).

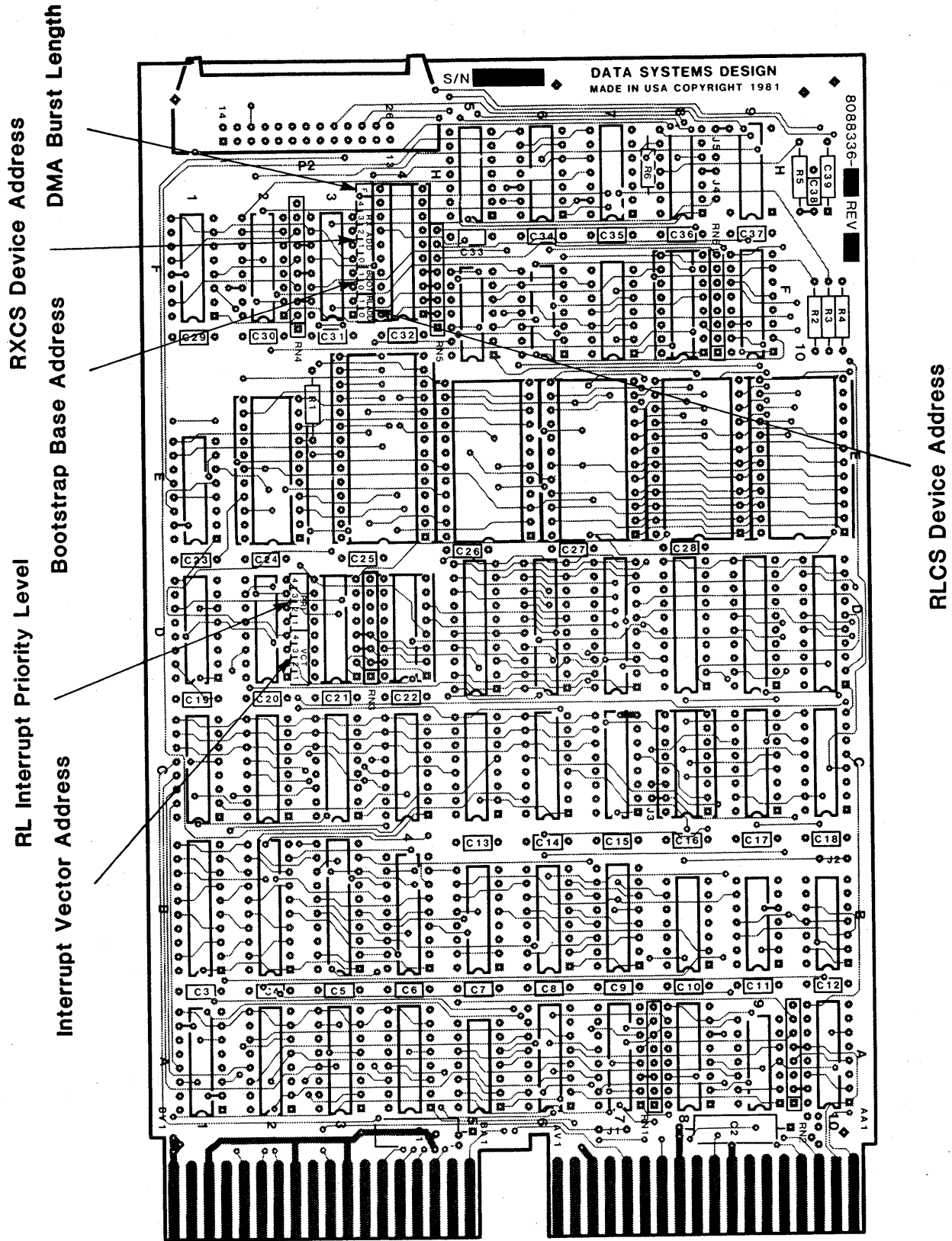


Figure 3-3. DSD 8836 (LSI-11) Interface Card

TP 229/81

Table 3-2. DSD 8836 Interface Jumper Settings
 (Refer to Figure 3-3 for jumper locations)

F	RX ADD	BOOT	RL ADD
4 3 2 1 0	1 0	1 0	1 0
			0 0
			0 S
			S 0
			S S
		0 0	
		S 0	
		0 S	
		S S	
	S 0 0 0 0		
	0 S 0 0 0		
	0 0 S 0 0		
	0 0 0 S 0		
	0 0 0 0 S		
0			
S			
S	0 0 0 S 0	S S	S S

IC Position F4
 Shown as shipped

RLCS Device Address
 774410
 774420
 774370
 774400 (Standard)

Bootstrap Base Address
 166000
 171000
 Disable Bootstrap
 173000 (Standard)

RXCS Device Address
 177150
 177140
 177160
 177170 (Standard)
 Disable RX

DMA Burst Length
 Two word burst
 (3-way interleaving)
 Eight word burst
 (supports 2-way
 interleaving)

As shipped by DSD

PRI	VCT
4 3 2 1	4 3 2 1
	0 0
	S 0
	0 S
	S S
S S S 0	
S S 0 S	
S 0 S S	
0 S S S	
S S S 0	S S S S

IC Position D3
 Shown as shipped

RL Interrupt Vector Address
 150
 330
 320
 160 (Standard)

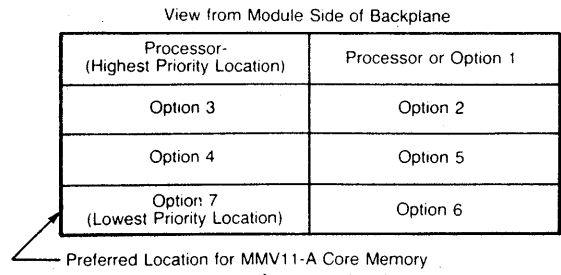
RX Interrupt Vector Address
 274
 254
 270
 264 (Standard)

RL Interrupt Priority Level
 7 (Standard)
 6
 5 Required on LSI-11/23
 with RSTS or UNIX
 4

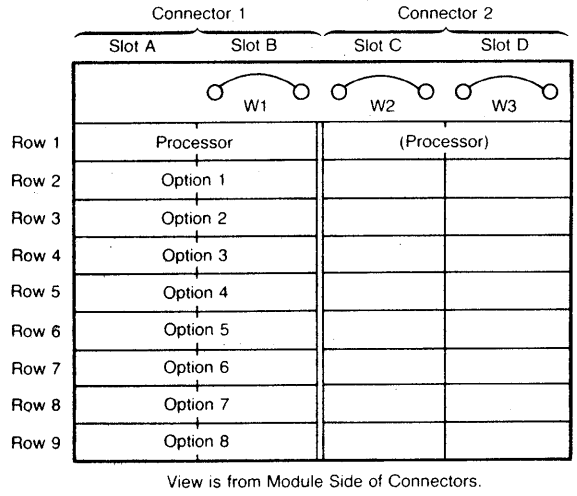
RX Interrupt Priority Level
 (Fixed at 5)

As shipped by DSD

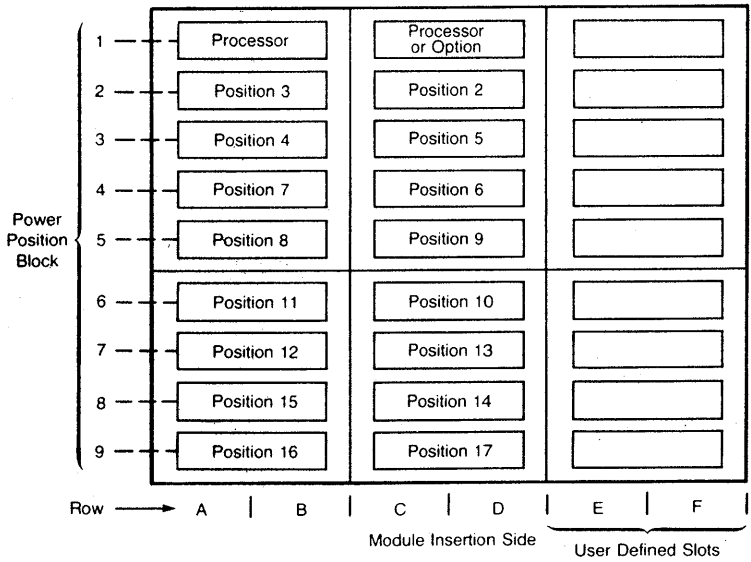
S = Short
 0 = Open



DEC Backplane H9270



DEC Backplane H9273-A



DEC Backplane DDVII-8

TP 231/81

Figure 3-4. Option Priority in LSI-11 Backplanes

3.5.3 PDP-11 (8830) Interface Jumper Configuration

The DSD 880 PDP-11 interface card is a quad-wide card, labelled P/N 808830. The DSD 8830 is shown in Figure 3-5.

The following features can be selected through jumpers on the PDP-11 interface card. Refer to Tables 3-3, 3-4, and 3-5.

1. RL Device Register Addresses
2. RX Device Register Addresses
3. Bootstrap Base Address
4. Bootstrap Disable
5. RL Disable
6. RX Disable
7. RL Interrupt Priority Level

3.5.4 PDP-11 (DSD P/N 808830) Interface Installation Procedure

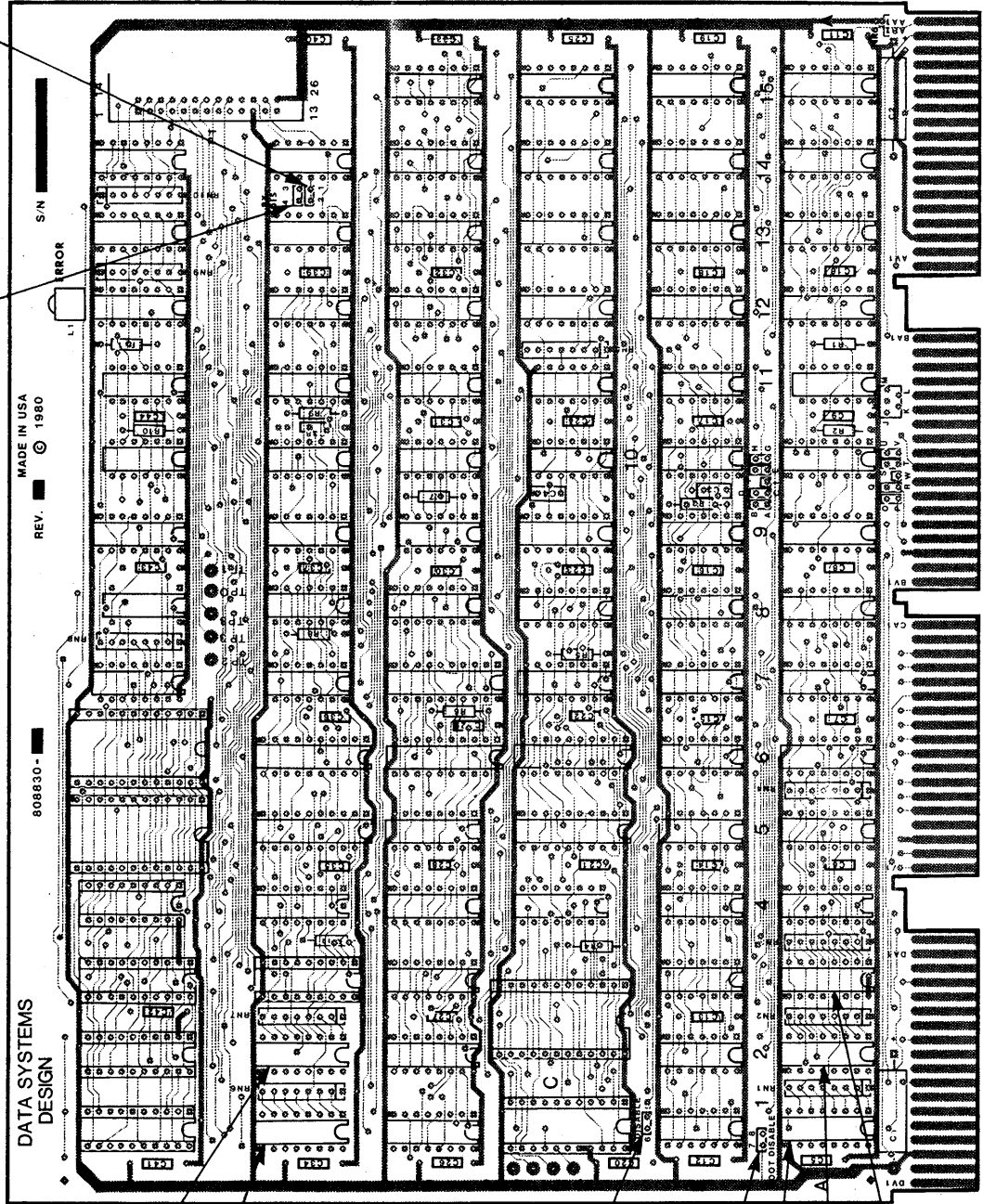
The following procedure describes how to install the PDP-11 module.

1. VERIFY LINE POWER IS OFF.
2. Check that the jumpers on the interface module are configured correctly.
3. Plug one end of the interface cable into the interface module so that pin 1 (striped side) is closest to the module handle.
4. Confirm that the position of the clipped pin on the module connector matches the position of the plugged hole on the cable connector.
5. Plug the module into a convenient Small Peripheral Controller (SPC) slot using connectors C, D, E, and F.
6. Verify that there are no open SPC slots between the DSD 8830 interface and the processor. Each slot between the 8830 interface and the processor must be occupied by either an interface board or a bus grant continuity card. Bus grant continuity cards plug into connector D of an SPC slot. See Figure 3-6. The DSD 880 system will not operate with open SPC slots between the interface and the processor.
7. Insure there is no backplane jumper or foil trace between backplane pins CA1 and CB1 of the SPC slot selected for the DSD 8830 interface board. SPC slots are not wired for DMA devices. The Non-Processor Grant (NPG) bypass jumper must be removed for DMA devices such as the 8830 interface to operate.

If the 8830 interface board is removed from the backplane, a jumper wire connecting pins CA1 and CB1 must be reinstalled to provide NPG continuity to devices along the chain. A bus grant continuity card will not replace this jumper.

RXCS
Bit 02

RX
Disable



2E 1E
Switch Location

1A 2A 3A
Switch Location

RL Disable

Boot Disable

TP 230/81

Figure 3-5. DSD 8830 (PDP-11) Interface Card

Table 3-4. 8830 Interrupt Priority Settings

Connections	Standard*	Alternate		
	Priority 5	Priority 4	Priority 6	Priority 7
N to J	Open	Short	Open	Open
N to K	Short	Open	Open	Open
N to L	Open	Open	Short	Open
N to M	Open	Open	Open	Short
O to P	Short	Open	Short	Short
Q to R	Open	Short	Short	Short
S to T	Short	Short	Open	Short
U to V	Short	Short	Short	Open
W to P	Open	Short	Open	Open
W to R	Short	Open	Open	Open
W to T	Open	Open	Short	Open
W to V	Open	Open	Open	Short
A to B	Short	Open	Short	Short
C to D	Open	Short	Short	Short
E to F	Short	Short	Open	Short
G to H	Short	Short	Short	Open
I to A	Open	Short	Open	Open
I to C	Short	Open	Open	Open
I to E	Open	Open	Short	Open
I to G	Open	Open	Open	Short

*8830s are shipped fabricated to priority 5.

Use at any other priority requires the following:

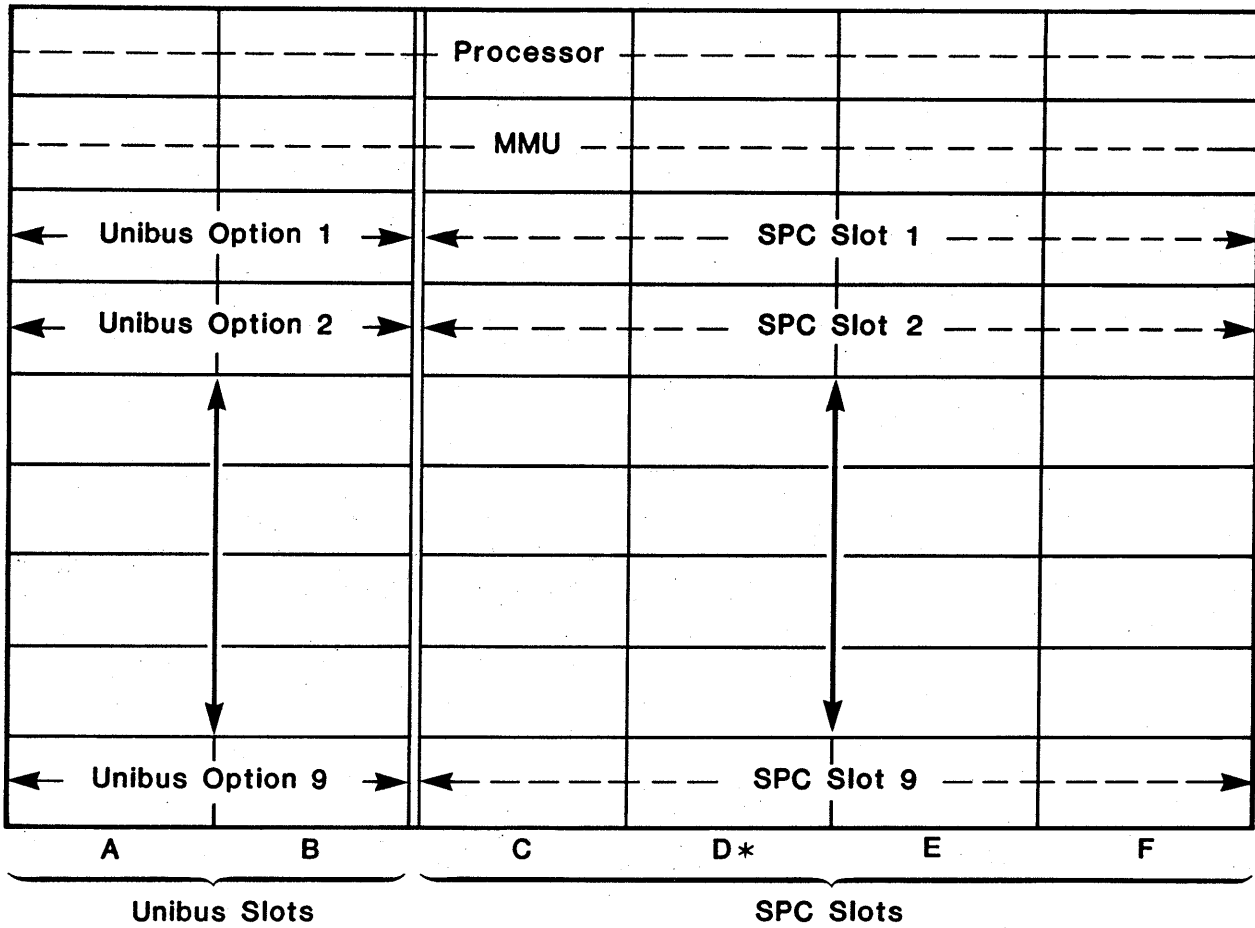
1. Cut required connections open.
2. Insert 0.025" square wire-wrap pins at appropriate connection points.
3. Wire wrap required connection closed.

Table 3-5. 8830 Jumper Configurations

8830 jumpers are shipped configured for a standard configuration where RX, RL, and BOOT are enabled and RXCS address bit is fixed at D.

Jumper		Function	In	Out	Shipped
Number	Location				
1-2	13E	RXCS address bit 2	0	Don't Care	In
3-4	13E	RX Disable	Disable	Enable	Out
5-6	1C	RL Disable	Disable	Enable	Out
7-8	1B	BOOT Disable	Disable	Enable	Out

Front



* Install Bus Continuity Cards in Slot D.

TP 232/81

Figure 3-6. Typical Unibus Hex Backplane

3.6 AC Power Cord Installation

To install the ac power cord:

1. Ensure that the DSD 880 power on/off switch is in the off position.
2. Plug the female end of the power cord into the connector on the back of the DSD 880 chassis.
3. Plug the male end of the power cord into an ac power receptacle that provides the proper ac input voltage for the DSD 880 (90 to 130V rms, on domestic models, or 198 to 250V rms on international models configured for the higher voltage.)

3.7 Initial Checkout and Acceptance Testing

After installation of the DSD 880, an initial power-up and testing sequence should be completed prior to placing the system into regular service. Be sure the winchester spindle lock and head lock have been removed prior to operation. DSD recommends the following procedure be followed:

NOTE

Prior to applying power and performing acceptance testing, the operator should be familiar with the normal operating procedures of Section 4 and the use of DSD HyperDiagnostics tests in Section 7 of this manual.

1. Remove the DSD 880 front bezel by grasping the bezel and pulling forward. Removal of the front bezel will allow access to the HyperDiagnostics panel.
2. Assure either that power is applied to the host computer, or that the interface cable is not connected.
3. Apply power to the DSD 880 using the power on/off switch on the rear panel of the chassis.
4. Insert a blank, write enabled, floppy disk into the floppy disk drive.

NOTE

Any data present on the floppy disk used in the following sequence of tests will be destroyed during the tests.

5. Perform the DSD 880 HyperDiagnostic Switch and Light test using the procedure that follows:
 - A. Place the floppy and winchester write protect switches in the off position, select MODE = 3, CLASS = 0 and depress the EXECUTE pushbutton. Verify that 30 is displayed by the seven segment displays.
 - B. Observe the fault, winchester ready, floppy fault, winchester fault, and floppy write protect indicators. Verify that each illuminates and extinguishes independently of the other indicators before proceeding.
 - C. Rotate the MODE switch through positions zero through seven, verify that the switch position is displayed by the left digit of the seven segment displays.
 - D. Rotate the CLASS switch through positions zero through seven, verify that the switch position is displayed by the right digit of the seven segment displays.
 - E. Place the floppy write protect switch in the on position, verify that the floppy write protect and floppy fault indicators illuminate, and that the value 88 is flashing in the seven segment displays.
 - F. Place the floppy write protect switch in the off position and the winchester write protect switch in the on position. Verify that the winchester write protect and winchester fault indicators illuminate, and that the value 99 is flashing in the seven segment displays.
 - G. Place the winchester write protect switch in the off position.
6. If no malfunctions are detected during the 880 switch and light test, perform the DSD 880 HyperDiagnostic sequential scan floppy disk (50) and sequential scan fixed disk (54) tests as given in Section 7 of this manual.

If no errors are detected during the sequential scan floppy disk (50) test cycle, the DSD 880 will halt with 00 displayed in the seven segment display. The sequential scan fixed disk (54) test runs until halted. If an error is detected during any portion of the test sequence, the DSD 880 will halt with an error code flashing in the seven sector display. For an explanation of each of the tests and for the meanings of any error codes displayed refer to Section 7 of this manual.

7. Select the desired normal operating MODE and CLASS (see Table 4-2), then depress the EXECUTE pushbutton momentarily. The selected MODE and CLASS will be displayed while the EXECUTE pushbutton is depressed. Upon release of the EXECUTE pushbutton, verify that the code 00 is displayed, indicating that both the floppy and winchester drives were successfully initialized.
8. Reconnect the interface cable and apply power to the host computer if necessary.

3.8 DSD 880 Initial Program Installation

This section provides a description of the DSD supplied software available and guidance in the integration of the DSD 880 into the user's operating system.

3.8.1 DSD Supplied Programs

The winchester bad track information has been coded on track 0 of the disk by DSD. The DEC RL bad sector map is supported by the DSD 880 system and shows no bad sectors. A floppy diskette which contains the DSD supplied programs and command files is shipped with each system. Several of these programs are also shipped on the winchester as an aid in initial testing of the DSD 880. Appendix A contains a directory listing of these devices/diskettes.

At this point further testing may be desired prior to loading the operating system. If required, the programs listed below may be used:

- DSDMON - A bootable diagnostic monitor that allows the user to select one of the diagnostic programs for execution. See paragraph 3.8.3.
- FLPEXR - A stand alone diagnostic/utility program for operations on the floppy drive. See Appendix C.
- RLEXR - A stand alone diagnostic program for operations on the winchester drive in RL emulation mode. See Appendix D.
- WINEXR - A stand alone diagnostic/utility program for operations on the winchester drive in direct access mode and for disk formatting and bad track mapping. See Appendix E.

3.8.2 Command Files

Command files are supplied for the main operations necessary to utilize the extended features of the DSD 880 and to assist the user in the initial loading of the operating system onto the DSD 880. A full listing of each command file is contained in Appendix B of this manual. Usage of each command file is described in the appropriate section of the manual.

Command files are also provided to facilitate backup and restores of the DSD 880 winchester. These command files should be considered as representative only; individual users should tailor the commands to their particular needs.

3.8.3 Use of DSDMON

DSDMON is the DSD diagnostic monitor program that allows the user to select which diagnostic program is to be executed from the distribution diskette. It is a secondary bootstrap program that loads RT-11 format files into memory and initiates execution of that program. Although DSDMON accesses files through an RT-11 type format, RT-11 is not required to run DSDMON.

To initiate a program, boot the diskette through the hardware bootstrap procedures outlined in Section 4. The program will output on the console:

DSD DIAGNOSTIC MONITOR PROGRAM VXX

DSDMON>

The program to be initiated is specified by typing:

R filename <CR>

DSDMON assumes an extension type of .SAV. If the file is not found on the diskette, DSDMON will output:

FILE NOT FOUND

If the file is found on the diskette, it will be brought into memory and execution begun. DSDMON also supports the following commands:

- T filename<CR> - Types the specified file contents on the console terminal
- H <CR> - Types a Help file on the console terminal
- R filename<CR> - Load and Run specified program
- L filename<CR> - Load specified file then return control to DSDMON

DSD supplied diagnostics are configured such that, if they are invoked from an RT-11 system, control can be returned to RT-11. If a diagnostic program is invoked from DSDMON, control can be returned to DSDMON. Type <CTRL C>. The diagnostic program will then ask "RETURN TO RT-11?" Type Y (yes)<CR>. Control will return to DSDMON so that another diagnostic program can be invoked.

3.8.4 Transfer of RT-11 to DSD 880

A. Transfer of RT-11 V3B to the 880 winchester:

1. Procure a DY (RX02) bootable RT-11 distribution diskette with a DL monitor (DLMNSJ.SYS or DLMNFB.SYS) and handler (DL.SYS) on it.
2. Boot this diskette and prepare to copy all files onto the 880 winchester.

NOTE

The 880 winchester as shipped contains an RT-11 type directory and all the DIAGNOSTIC DISKETTE files. These may be retained by skipping the following step.

INIT DL0:/NOQ<CR>

If INIT comes back with, "BAD BLOCK IN SYSTEM AREA" or "DIAGNOSTIC DISK PACK", run WINEXR command, "RL BAD SECTOR".

3. Copy all the RT-11 files on the distribution disk onto the 880 winchester.

```
COPY/SYS DY0:*. * DL0:<CR>
```

4. If the bootable RT-11 V3B distribution diskette does not contain a DL monitor, then it must be copied from one of the other distribution diskettes (#2 or #3).

This can be done most easily if another device is available to use as a system device. If only the DSD 880 is available, then proceed as follows:

- a) .SET USR NOSWAP <CR>

```
.R DIR <CR>
```

*

Remove the bootable system disk.

Write protect the floppy drive using the front panel switch. Insert the other distribution disks one at a time and type:

```
*DY0:/B/E <CR>
```

Determine the disk containing DLMNSJ.SYS and note the starting block number and length.

Example:

```
DLMNSJ.SYS 64 150
```

Where 64 is the length and 150 is the starting block number.

Remove the distribution disk containing DLMNSJ.SYS.

Reinsert the bootable disk first booted on.

Unprotect the floppy drive using the front panel switch.

Type: <CTRL C>

```
.LOA DL:<CR>
```

```
.R DUP <CR>
```

```
*DL0:DLMNSJ.SYS=/C:4000:64<CR>
```

```
*DL0:A=DY0:/I: (starting read block):(starting read block and length  
of file):(starting write block)=4000/W
```

For example, with the starting block and length given in the directory example:

```
*DL0:DLMNSJ.SYS/I:150:214:4000/W<CR>
```

The system will ask "CONTINUE?"

Remove the bootable system disk and insert the diskette containing DLMNSJ.SYS found above.

Type: Y <CR>

The system will copy the blocks specified on the 880 winchester and type: "INSERT SYSTEM DISK, ARE YOU READY?"

Remove the other distribution diskettes and insert the bootable system diskette.

Type: Y <CR>

There should now be a copy of the DL monitor (DLMNSJ.SYS) on DL0.

5. Make the 880 winchester hardware bootable:

COPY/BOOT DL0:DLMNSJ.SYS DL0:<CR>

or

COPY/BOOT DL0:DLMNFB.SYS DL0:<CR>

3.8.5 Transfer of RT-11 V4 to the 880 Winchester

1. Boot the bootable distribution diskette in DY0:.
2. Prepare to copy the RT-11 V4 distribution diskette contents onto the winchester.

NOTE

The DSD 880 winchester is shipped with a copy of the DSD diagnostic disk on the winchester.

These contents may be retained by skipping the following step:

Type: INIT DL0:/NOQ<CR>

3. Copy all files from the floppy to the 880 winchester.

.COPY/SYS DY0:*. * DL0:<CR>

4. Bind the device monitor to the DL handler to make it bootable.

.COPY/BOOT DL0:RT11SJ DL0:<CR>

5. Bootstrap the RT-11 on the 880 winchester.

.BOOT DL0:<CR>

3.8.6 Double-Sided Support Under RT-11 V3B

Double-sided support under RT-11 V3B may be activated by one of two methods. DSD supplies a software device handler which is equivalent to the DEC device handler with appropriate flags and conditionals enabled for double-sided support. This handler may be assembled into the RT-11 DY monitor (FB or SJ) by following the system generation procedure as supported by DEC. Alternately, to save the effort required to perform a SYSGEN, DSD supplies a command file which will automatically patch the RT-11 V3B monitor to activate the two-sided features.

If the user elects to perform a SYSGEN, the DSD handler DYDSD.MAC (found on the DSD diagnostic diskette) must first be renamed to DY.MAC and substituted for the

MACRO-11 source file, DY.MAC provided by DEC. The DSD handler, containing double-sided support may then be installed into the RT-11 monitor by following the procedure described in the RT-11 System Generation Manual supplied by DEC.

Note that the actual monitors (DYMNSJ.SYS or DYMNFB.SYS) must reside on side 0 in order to boot initially.

DOUBLE-SIDED SUPPORT UNDER RT-11 V3B

A. Nonsystem for side 1.

The file DYDSD.SYS on the diagnostic disk is an RT-11 V3B handler compatible with the distribution kit monitors, that can be copied over to the winchester for use.

1. Boot RT-11 V3B on the 880 winchester.
2. Insert the diagnostic disk into DY0:.
3. Copy the RTV3B DY handler over to the winchester.

```
.COPY DY0:DYDSD.*/SYS DL0:DY.*<CR>
```

4. Reboot the DL monitor.

```
.BOOT DL0:<CR>
```

This installs the double-sided handler.

3.8.7 DSD Monitor Patch Program For RT-11 V3B

The monitor patch program takes a DYMNSJ or DYMNFB monitor from the DEC RT-11 V3B system distribution and replaces the DY handler currently in the distribution monitor with a double-sided DY handler. The new monitor has the same characteristics as the original monitor, such as batch support, 60 Hz line time clock, all handlers supported by the distribution monitor, and no error logging.

The monitor patch program would be used under the following conditions:

1. The distribution RT-11 V3B monitor provided by DEC is sufficient for the user's normal applications, except for not having double-sided support.
2. The user does not wish to perform a System Generation.
3. The user has not changed the normal distribution monitor with customized patches, relating to the the user's system.

If these conditions are not met, a System Generation may be required.

The DYMNSJ or DYMNFB monitor may be generated from the first or second release of RT-11 V3B. The distribution DYMNSJ or DYMNFB monitor that will be modified can be found on the following distribution diskette:

First DX KIT release of RT-11 V3B	<u>Disk Label No.</u>	<u>Dated</u>
DYMNSJ.SYS	AS-5781B-BC	11-Mar-78
DYMNFB.SYS	AS-5781B-BC	11-Mar-78
Second DX KIT release of RT-11 V3B	<u>Disk Label No.</u>	<u>Dated</u>
DYMNSJ.SYS	AS-5783C-BC	27-Mar-79
DYMNFB.SYS	AS-5783C-BC	27-Mar-79

or either DY KIT release may be used.

To use the DSD monitor patch procedure on the DSD 880:

1. Boot RT-11 V3B on the 880 winchester. Note that the default device DK: should be the system device floppy.
2. Copy the desired DY monitors from the DEC floppy distribution kit onto the 880 winchester (DYMNSJ.SYS and DYMNFB.SYS).
3. Copy the PAT files from the DSD diagnostic diskette onto the winchester.

Insert the diagnostic diskette and type:

```

.@DY0:PATSET<CR>

```

4. Put a blank diskette in DY0: and set to double density. Note: The DEC format program only supports the standard device addresses. Use DSDFMT if an alternate address is to be used.

```

.R FORMAT
*<CTRL C>

```

5. Determine which double-sided monitor is to be generated. Type:

```

.@PATSJ<CR>

```

to put a single job monitor on DY0:, or type:

```

.@PATFB<CR>

```

to put a foreground/background monitor on DY0:.

Note: Both steps 4 and 5 should be repeated if both double-sided monitors are to be created.

This procedure will copy a minimal system over to the floppy in DY0;; patch the monitor and then boot that monitor. This diskette then contains the selected RT-11 V3B monitor with double-sided support and should be used as a master for generating other double-sided bootable diskettes.

NOTE

RT-11 V3B will not boot a floppy with the selected monitor on the second side.

3.8.8 Double-Sided Floppy Support Under RT-11 V4

A command documentation file DYV4DS.DOC is provided which applies the difference to the DEC distribution DY.MAC given in DYV4DS.DIF.

To update the RT-11 V4 DY handler:

1. Boot up RT-11 on the 880 winchester.
2. Copy DY.MAC from the DEC distribution kit onto the winchester.
3. Copy DYV4DS.* from the DSD diagnostic disk onto the winchester.
4. Type @DYV4DS.DOC.

An updated DY.SYS and an updated handler source DYV4DS.MAC will be generated. This handler includes full double-sided support and allows booting with the system files on side one.

3.8.9 Transfer of RSX-11M to DSD 880 Winchester

In order to bring up RSX-11M on the DSD 880, a host machine capable of reading the DEC distribution kit is required. There are several methods of transfer from this machine/disk onto the DSD 880:

1. SYSGEN with DSD 880 attached as an RL02 to the host machine.
2. SYSGEN with floppy drive and RL02 attached to the host machine.
3. SYSGEN on host system with only floppy drive available as an intermediary device.

The remainder of this section describes these methods in more detail.

SYSGEN with DSD 880 attached as an RL02 to the host machine

This is the most convenient method in that standard SYSGEN procedures can be followed for generating a target system.

SYSGEN with floppy drive and RL02 attached to host machine

Perform a SYSGEN with the RL02 as the target device. Set the directory to the middle (default case) or beginning of the volume. After performing the software boot, change the device size in the new monitor before doing the SAV/WB. Alternatively, use DSC for the final expansion to the final device size as above. The RSX system image can be transferred to the DSD 880 using either of the methods described below.

3.8.10 RSX-11M Double-Sided Floppy Support

RSX-11M, as distributed, has almost all the support needed for RX03 type floppy systems. There are, however, some glitches which are detailed below and in command file RSX11M.DOC.

1. BUG in extended memory cross field transfers. This is documented in the June 1980 SOFTWARE DISPATCH. The correction is also contained in the file RSX11M.DOC on the DSD distribution diskette.
2. BUG in track/sector calculation algorithm in 11,10 DYDRV.MAC and 12,10 SAVSPC.MAC used in 1,20 or 1,24 SAV.OLB. This causes a hard error return from the handler whenever block numbers (double-density, double-sided) greater than 1664 are accessed. A fix for the handler is included in file RSX11M.DOC on the DSD distribution diskette. If the SAV.OLB is not rebuilt prior to SYSGEN, any tasks that SAV accesses when saving the RSX-11M system image must reside below block 1663. If not, it will be impossible to make a floppy bootable RSX-11M system image.

3.8.11 SYSGEN on Host System with only Floppy Drive Available

This method requires generating a floppy diskette containing a RSX-11M system which is then booted using the DSD 880 floppy drive to produce an operational floppy based RSX-11M nucleus. The DSD 880 winchester drive is then setup from this nucleus and booted. The floppy can then be used to transfer the remaining files onto the winchester.

This procedure is most easily done in one SYSGEN if both floppy drive and RL02 handlers are set as loadable. This allows the final usable RSX11M.SYS images to be brought up by simply interchanging the LOA DL: and LOA DY: commands to VMR.

NOTE

The handler for the physical volume to be VMR'd upon must be the first file structured handler to be loaded. If not, when tasks are to be installed, the message

INSTALL DEVICE NOT LBO:

will be output independent of any assignment command.

This procedure requires either a double-sided, double-density diskette on the DSD 880, or two single-sided, double-density diskette/drives.

The following are the minimum complement of files required for DL volume initialization: (602. blocks total)

RSX11M.SYS	258. blocks
FCPMD1.TASK	62.
COT.TSK	24.
INI.TSK	34.
BAD.TSK	50.
UFD.TSK	7.
MOU.TSK	24.
MCR.TSK	28.
LOA.TSK	29.
PIP.TSK	69.
DYDRV.TSK	5.
DYDRV.STB	1.
DLDRV.TSK	4.
DLDRV.STB.	1.

The following files are required for the VMR phase and can be copied over individually as necessary.

RSX11M.STB	11. blocks
RSX11M.TSK	130.
LDR.TSK	5.
TTDRV.TSK	18.
TTDRV.STB	5.
SAV.TSK	65.
BOO.TSK	22.
INS.TSK	27.
VMR.TSK	142.
IND.TSK	101.

Appendix A contains a directory listing of a double-sided, double-density floppy diskette that includes all files needed for both booting from the DY: and the final VMR of the DSD 880 winchester.

Once the DL volume is initialized and UFDs have been created, additional files can be transferred from the floppy to the winchester as necessary. Appendix B contains a command files to perform this transfer (DLRSX.CMD, DYRSX.CMD).

When the files are transferred onto the winchester, install VMR and IND; perform the final VMR phase. Appendix B contains command files to setup and perform the VMR (DLSYSV.CMD, DYSYSV.CMD).

After the VMR is complete, the system image can be booted and run.

4.0 OPERATION

4.1 General Information

This section provides information on the operation of the DSD 880 Data Storage System. Included are operating parameters, mode/class selection, system initialization, bootstrapping, diskette formatting, and backup operation.

4.2 Power On Self-Tests

When power is applied to the DSD 880, the controller automatically performs four self-tests:

1. Arithmetic Logic Unit (ALU) and Serializer/Deserializer (SERDES) hardware tests
2. Internal RAM memory test
3. Cyclic Redundancy Check (CRC) logic test
4. Phase-Lock-Loop (PLL) test

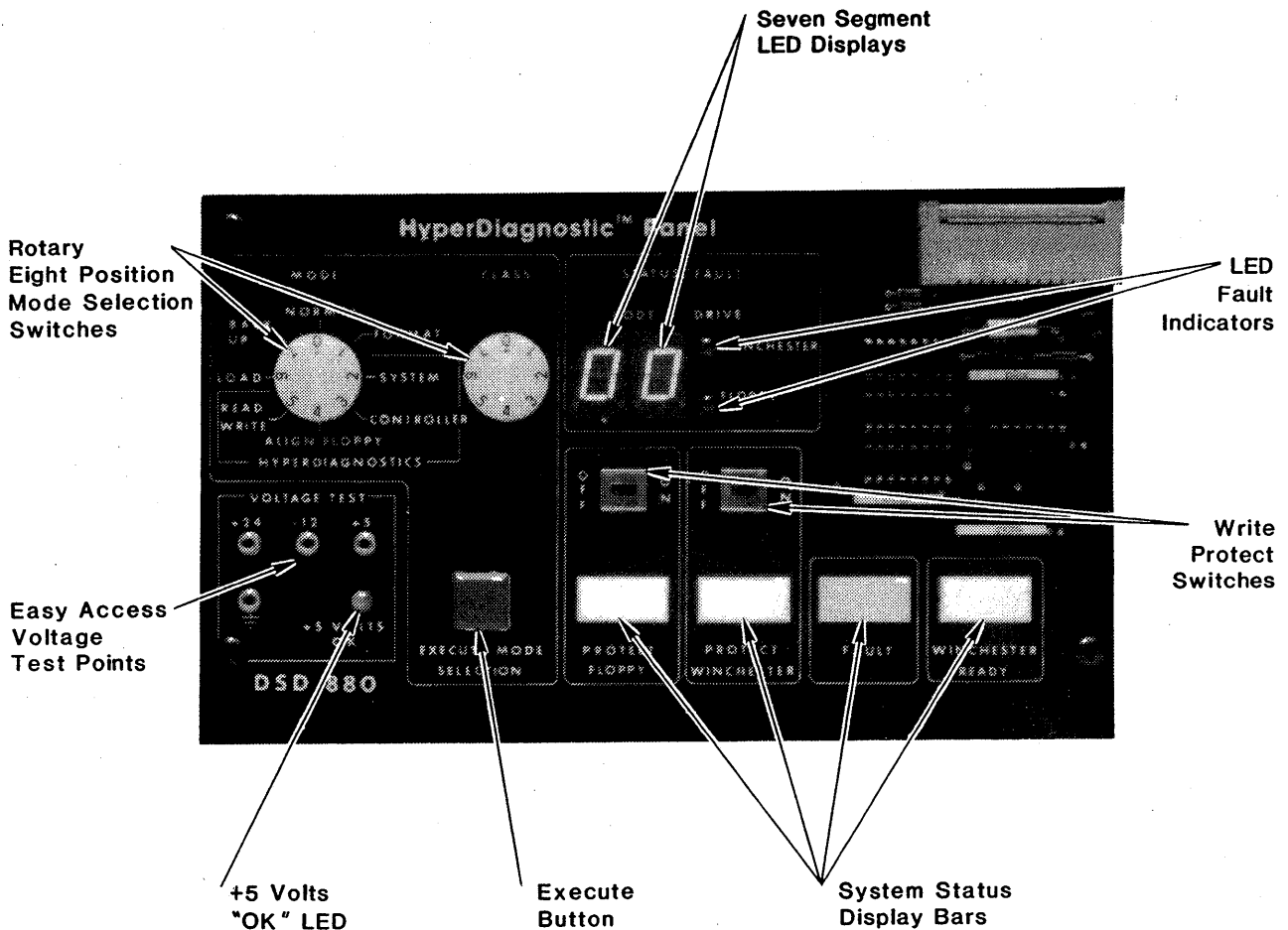
If any of these tests fail, an error code identifying the failure will be displayed on the HyperDiagnostic panel. If the tests are successfully passed, both the floppy and winchester drives will be initialized. Note that the winchester drive takes approximately 30 seconds to complete the initialization sequence.

4.3 HyperDiagnostic Switch Settings and Error Codes

Selection of the MODE and CLASS of operation is made on the HyperDiagnostic panel. To gain access to the HyperDiagnostic panel, remove the front bezel by grasping the bezel on each side and pulling forward. Figure 4-1 shows the HyperDiagnostic control panel switches and indicators and their location and function. Table 4-1 provides a summary of the indicators on the HyperDiagnostic panel and their purpose. Table 4-2 provides a summary of the MODE and CLASS switch settings on the HyperDiagnostic panel.

4.3.1 Winchester Write Enable

HyperDiagnostics that include a winchester disk sequential write operation must be write enabled prior to initiating the test. Write enable is accomplished by selecting CLASS 7 of the appropriate MODE (2 or 5), then depressing the EXECUTE pushbutton. The selected MODE will then be write enabled and will remain so until a new MODE is selected. Note that the winchester read/write HyperDiagnostics destroy data on the winchester disk.



TP 104/81

Figure 4-1. DSD 880 HyperDiagnostic Panel

Table 4-1. HyperDiagnostic Panel Indicators

<u>Indicator</u>	<u>Purpose</u>
Floppy Activity LED: (Located on the floppy disk drive front bezel)	This indicator illuminates whenever the head of the floppy disk drive is loaded. If the drive has a door lock mechanism, the door will be locked when the head is loaded.
Winchester Drive Ready LED: (Visible without removal of front bezel)	This indicator has several modes of operation. <ol style="list-style-type: none"> a. The indicator will flash for approximately 30 seconds after power is applied to the DSD 880.

Table 4-1. HyperDiagnostic Panel Indicators (Cont)

<u>Indicator</u>	<u>Purpose</u>
	<ul style="list-style-type: none">b. Approximately 30 seconds after power is applied to the unit the indicator will be illuminated if the bad track map has been read successfully, indicating that the drive is fully operational.c. Each time the winchester drive is accessed via a read or write command the indicator will flicker, indicating that the drive is busy (not ready).d. If a drive fault occurs which causes the winchester disk drive to be inoperative, the indicator will be extinguished until the fault is cleared.
Floppy Write Protect LED: (Visible without removal of front bezel)	This indicator is illuminated whenever the floppy disk drive is write protected, either by the write protect switch on the front panel, or by the presence of a write protected floppy disk.
Winchester Drive Write Protect LED: (Visible without removal of front bezel)	This indicator is illuminated whenever the winchester disk drive is write protected by the write protect switch on the front panel.
Fault LED: (Visible without removal of front bezel)	This indicator flashes for approximately one minute after an error occurs during the execution of a command. After approximately one minute, the indicator will cease flashing and illuminate steadily until the current error is cleared. If another error occurs before the original error is cleared, the indicator light will again flash for approximately one minute from the occurrence of that error. The indicator will be immediately extinguished by a bus initialize from the host processor.
Floppy Error LED:	This indicator flashes whenever the error being displayed by the seven segment displays occurs on the floppy disk drive.
Winchester Error LED:	This indicator flashes whenever the error being displayed by the seven segment displays occurs on the winchester disk drive.

Table 4-1. HyperDiagnostic Panel Indicators (Cont)

<u>Indicator</u>	<u>Purpose</u>
Seven Segment Error Displays 2:	<p>These indicators flash the definitive error code for the most recent error. The error is flashed from the time the error occurs until approximately one minute after the error is cleared. A bus initialize from the host processor will immediately clear all errors.</p> <p>When there are no errors present, the code 00 will be displayed.</p>
NOTE	
<p>During HyperDiagnostics tests, the selected test code will be displayed until either the test completes without error (00 displayed), or an error occurs (definitive error code flashing).</p> <p>If errors exist on both winchester and floppy drives, the seven segment error displays will indicate the most recent error, and the appropriate floppy or winchester error LED will flash. The other (earlier) error LED will be on continuously. If the most recent error is cleared, the seven segment error displays will begin to flash the error for the other drive.</p>	
5 Volts OK LED:	<p>This indicator will be illuminated when the output voltage of the main 5 volt power supply of the DSD 880 is within specification.</p>

Table 4-2. HyperDiagnostic Panel Mode and Class Options

<u>Switch Settings</u>		<u>Descriptions</u>
<u>Mode</u>	<u>Class</u>	
0	0	No logical unit is write protected. The winchester drive emulates two RL02s (880x/20) or three RL02s (880x/30).
0	1	Logical unit 0 (DL0) is write protected.
0	2	Logical unit 1 (DL1) is write protected.
0	3	Logical unit 0 (DL0) and logical unit 1 (DL1) are write protected.
0	4	Logical unit 2 (DL2) is write protected.
0	5	Logical unit 0 (DL0) and logical unit 2 (DL2) are write protected.
0	6	Logical unit 1 (DL1) and logical unit 2 (DL2) are write protected.
0	7	DIRECT ACCESS MODE - allows access to each physical track on winchester drive for maintenance purposes. This mode is used during WINEXR diagnostic tests. MODE 1 contains floppy disk FORMAT routines. See Section 7 for details.
1	0	FORMAT DOUBLE-DENSITY - formats entire floppy disk in DEC double-density.
1	1	FORMAT SINGLE-DENSITY - formats entire floppy disk in DEC/IBM single-density.
1	2	SET MEDIA DOUBLE-DENSITY - sets the floppy media to double-density.
1	3	SET MEDIA SINGLE-DENSITY - sets the floppy media to single-density.
1	4	SET MEDIA DOUBLE-DENSITY AND SCAN - writes all data feeds in DEC double-density format, then scans the disk looking for errors.
1	5	SET MEDIA SINGLE-DENSITY AND SCAN - writes all data fields in DEC/IBM single-density format, then scans the disk looking for errors.

Table 4-2. HyperDiagnostic Panel Mode and Class Options (Cont)

<u>Switch Settings</u>		<u>Descriptions</u>
<u>Mode</u>	<u>Class</u>	
		MODE 2 contains SYSTEM tests. See Section 7 for details.
2	0	FLOPPY DISK EXERCISER WITH WRITE FORMAT - runs the following sequence of HyperDiagnostics tests on the floppy drive only: <ul style="list-style-type: none"> a. Hardware Self-Tests b. Single-Density Write Format c. Sequential Scan All Sectors d. Butterfly Read Headers e. Sequential Write/Read All Sectors f. Set Media Double-Density g. Sequential Scan All Sectors h. Butterfly Read Headers i. Sequential Write/Read All Sectors j. Set Media Single-Density
2	1	FLOPPY DISK EXERCISER WITHOUT WRITE FORMAT - runs the same sequence of tests as the floppy disk exerciser described previously with the exception of the single-density write format.
2	2	FIXED DISK EXERCISER - runs the following sequence of HyperDiagnostics tests on the fixed disk drive only: <ul style="list-style-type: none"> a. Hardware Self-Tests b. Sequential Scan All Sectors c. Butterfly Seek Test d. Sequential Write/Read All Sectors
2	3	GENERAL EXERCISER WITH FLOPPY DISK WRITE FORMAT - runs the floppy disk general exerciser, then runs the fixed disk exerciser tests.
2	4	SINGLE PASS GENERAL EXERCISER WITH FLOPPY WRITE FORMAT - runs a single pass of the floppy and fixed disk exercisers.
2	5	SINGLE PASS GENERAL EXERCISER WITHOUT FLOPPY WRITE FORMAT - runs a single pass of the floppy and fixed disk exercisers without formatting the floppy disk.

Table 4-2. HyperDiagnostic Panel Mode and Class Options (Cont)

<u>Switch Settings</u>		<u>Descriptions</u>
<u>Mode</u>	<u>Class</u>	
2	6	GENERAL EXERCISER WITHOUT FLOPPY WRITE FORMAT AND FIXED READ/WRITE TESTS - runs the floppy disk general exerciser without formatting the floppy disk, then runs the fixed disk exerciser without executing the sequential write/read tests.
2	7	FIXED DISK EXERCISER WRITE ENABLE - permits sequential write operations on the winchester disk. (For tests 2, 3, 4, and 5.) MODE 3 contains CONTROLLER tests. See Section 7 for details.
3	0	CONTROLLER SWITCH AND INDICATOR TEST - tests the various controller switches and indicators.
3	1	GENERAL CONTROLLER HARDWARE TEST - runs the following controller hardware diagnostics: a. ALU and SERDES Tests b. Memory Test c. CRC Logic Test d. PLL Test
3	2	ALU AND SERDES TESTS - tests the operation of the ALU and SERDES circuitry.
3	3	MEMORY TEST - tests the operation of the RAM buffer.
3	4	CRC LOGIC TEST - tests the operation of the CRC logic.
3	5	PLL TEST - tests the operation of the phase-locked-loop.
3	6	MICROCODE VERSION - displays the controller microcode version number.
3	7	Not defined.

Table 4-2. HyperDiagnostic Panel Mode and Class Options (Cont)

<u>Switch Settings</u>		<u>Descriptions</u>
<u>Mode</u>	<u>Class</u>	
		MODE 4 Floppy disk alignment routines. See Section 7 for details.
		NOTE
		The following floppy disk drive alignment tests can be run without media in the floppy drive.
4	0	FLOPPY DISK TRACK 00 DETECTOR ADJUSTMENT - loads floppy head and repeatedly seeks between track 00 and 01 every 100 ms.
4	1	FLOPPY DISK SEEK TRACK 01 AND LOAD HEAD - seeks floppy head to track 01 and loads it.
4	2	FLOPPY DISK SEEK TRACK 02 AND LOAD HEAD - seeks floppy head to track 02 and loads it.
4	3	FLOPPY DISK SEEK TRACK 38 AND LOAD HEAD - seeks floppy head to track 38 and loads it.
4	4	FLOPPY DISK SEEK TRACK 76 AND LOAD HEAD - seeks floppy head to track 76 and loads it.
4	5	FLOPPY DISK HEAD LOAD TIMING ADJUSTMENT - seeks floppy head to track 00 then alternately loads and unloads head every 100 ms.

NOTE

All tests in MODE 4 are intended for use with procedures contained in the appropriate SA800/850 maintenance manuals.

Table 4-2. HyperDiagnostic Panel Mode and Class Options (Cont)

<u>Switch Settings</u>		<u>Descriptions</u>
<u>Mode</u>	<u>Class</u>	
		<u>MODE 5</u> Read/Write tests. See Section 7 for details.
5	0	SINGLE PASS SEQUENTIAL SCAN FLOPPY DISK - scans entire floppy disk for CRC errors and valid disk headers only once.
5	1	BUTTERFLY SEEK TEST FLOPPY DISK DRIVE - steps head of floppy disk drive using butterfly pattern then seeks track 00.
NOTE		
This test can be run without media in the floppy drive.		
5	2	BUTTERFLY READ HEADERS ON FLOPPY DISK - steps head of floppy disk drive using butterfly pattern checking for correct disk headers.
5	3	SEQUENTIAL WRITE/READ FLOPPY DISK - sequentially writes then reads the entire floppy disk checking for data or header errors.
5	4	SEQUENTIAL SCAN FIXED DISK - scans entire fixed disk for CRC errors and valid disk headers.
5	5	BUTTERFLY SEEK TEST ON FIXED DISK - steps head of fixed disk drive using butterfly pattern.
5	6	SEQUENTIAL WRITE/READ FIXED DISK - sequentially writes then reads the entire winchester disk.
5	7	FIXED DISK WRITE ENABLE - permits sequential write operation on the winchester disk. (For test 6.)

Table 4-2. HyperDiagnostic Panel Mode and Class Options (Cont)

<u>Switch Settings</u>		<u>Descriptions</u>																
<u>Mode</u>	<u>Class</u>																	
6	0	Reload logical unit 0 from floppy without verify.																
6	1	Reload logical unit 0 with verify.																
6	2	Reload logical unit 1 without verify.																
6	3	Reload logical unit 1 with verify.																
6	4	Reload logical unit 2 without verify.																
6	5	Reload logical unit 2 with verify.																
6	6	Not defined.																
6	7	Not defined.																
7	0	Backup logical unit 0 onto floppy without verify.																
7	1	Backup logical unit 0 with verify.																
7	2	Backup logical unit 1 without verify.																
7	3	Backup logical unit 1 with verify.																
7	4	Backup logical unit 2 without verify.																
7	5	Backup logical unit 2 with verify.																
7	6	Not defined.																
7	7	Sets floppy-type flag on bad track map for maintenance only. See below:																
		1. Enter 77 and press EXECUTE.																
		2. System will ask for confirmation by displaying 47.																
		3. Enter 22 for confirmation and press EXECUTE.																
		4. Enter:																
		<table border="0"> <thead> <tr> <th><u>Mode</u></th> <th><u>Class</u></th> <th>=</th> <th></th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>=</td> <td>No Floppy</td> </tr> <tr> <td>0</td> <td>1</td> <td>=</td> <td>SA800 (Single-Sided)</td> </tr> <tr> <td>0</td> <td>2</td> <td>=</td> <td>SA850 (Double-Sided)</td> </tr> </tbody> </table>	<u>Mode</u>	<u>Class</u>	=		0	0	=	No Floppy	0	1	=	SA800 (Single-Sided)	0	2	=	SA850 (Double-Sided)
<u>Mode</u>	<u>Class</u>	=																
0	0	=	No Floppy															
0	1	=	SA800 (Single-Sided)															
0	2	=	SA850 (Double-Sided)															

and press EXECUTE.

4.3.2 Seven Segment Display Error Codes

Error codes displayed on HyperDiagnostic panel are listed in Table 4-3.

Table 4-3. Error Codes

These errors are flashed on the HyperDiagnostic panel when the indicated error occurs. See Section 7 for more detailed error code interpretation.

<u>CODE Displayed</u>	<u>Description</u>
00	No errors - operation complete (HyperDiagnostics only)
01	Drive failed to home on initialize
02	Nonexistent drive
03	Track 00 found while stepping in on initialize
04	Invalid RX02 track address
05	Track 00 found before desired track while stepping
06	Seek timeout while stepping (RL02 only)
07	Requested sector not found in 2 revolutions
10	Write protect violation
11	Not defined
12	No preamble found
13	Preamble found but no address mark within window
14	CRC error on what appeared to be a header
15	Address in header did not match desired track
16	Too many tries for an ID address mark
17	Data address mark not found in allotted time
20	CRC error on data field
21	Write gate error (RL02 only)
22	VCO failure during read operation (RL02 only)
23	Invalid word count specified
24	Media density did not match desired density (RX02 only)
25	Invalid key for set media density or format command (RX02 only)
26	Indeterminate media density (RX02 only)
27	Write format failure
30	Data compare error (RL02 and read/write HyperDiagnostics)
31	Invalid bad track map detected during INIT (RL02 only)
32	Bad track map checksum did not match stored value
33	Not defined
34	Not defined
35	Nonexistent memory (NXM) error during DMA transfer
36	Drive not ready (door open, speed error, absent media)
37	Low ac power caused abort of write activity
40	Invalid disk used for reload (RL02 reload only)
41	Multiple reload disk versions used (RL02 reload only)
42	Invalid class selected (HyperDiagnostics only)
43	Invalid winchester disk address
44	Winchester disk word count overflow
45	Deleted data mark encountered on reload floppy (RL02 reload only)
46	Reserved for DSD use only
47	Confirmation of intent to reconfigure floppy (see paragraph 7.5.6)
51	Memory test failure
52	CRC test failure
53	PLL test failure

4.4 Normal Operation

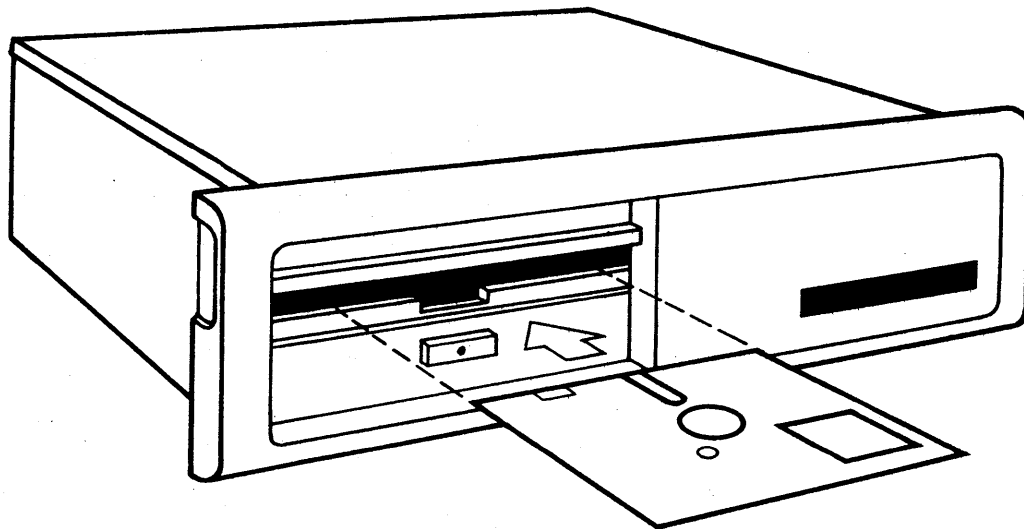
The DSD 880x/20/30 system can be booted from either the floppy or the winchester. If booting from the floppy, insert the diskette into the floppy disk drive. See Figure 4-2 for diskette orientation for insertion. Close the drive door. Select mode of operation that matches the operating system parameters (refer to Table 4-2 for HyperDiagnostic Panel Mode and Class Options).

CAUTION

If the DSD 880 is not in Mode 0 at the time a Bus Init is generated by the host processor, the DSD 880 controller will terminate any HyperDiagnostic test in progress, force the mode and class to 0, and initialize (home) the floppy and winchester disk drives.

4.4.1 Extended Mode

Extended (EXT) mode operation may be enabled if implied seek or multiple track transfer capability is required. To enable EXT mode of operation, remove top cover of the chassis and insert the jumper supplied with the accessory kit into the pins labeled EXT on the 8841 controller board (board location 1H). Note that the extended mode is not supported by standard DEC operating systems. It is recommended that only experienced software personnel utilize this mode of operation.



TP 240/81

Figure 4-2. Proper Orientation of Diskette for Insertion

4.4.2 Logical Devices

A hardware bootstrap is built into the DSD 880 LSI-11 and PDP-11 interfaces, eliminating the need to buy an additional DEC card to perform the bootstrap operation.

The bootstrap supplied with the DSD 880 system permits the user to boot from a logical unit of either the RX or RL device as follows:

<u>DSD 880 Model</u>	<u>Valid Logical Units</u>
x/20	RX02 DY0 RL02 DL0: and DL1:
x/30	RX02 RL02 DL0: DL1: and DL2:

The DSD 880 bootstrap program consists of three or four procedures, depending on the device to be booted:

Determines the selected bootstrap device (RL or RX).

Sizes memory, then checks memory for failing data or address bits.

RL BOOT - Reads Block 0 from the specified RL logical unit, then starts at location 0.

RX BOOT - Performs fill-empty test on DSD880 RX02 device which verifies operation of available DMA address lines and RX02 sector buffer.

RX BOOT - Reads Block 0 from the specified logical unit, then starts at location 0.

4.4.3 LSI-11 Power Up Modes

For LSI-11 systems, the 880 system can be bootstrapped in two of the four power up modes. In power up mode 1, the LSI-11 processor enters console ODT immediately on power up. The user may select the bootstrap device by entering the appropriate starting address at the console. For example, if the standard bootstrap base address is used, bootstrapping on the winchester may be initiated by entering 773000G. Entering 773020G initiates bootstrap on the floppy disk.

In power up mode 2, the LSI-11 program counter is automatically set at 773000 on power up. Hence, the system automatically attempts to boot on the winchester. If the winchester is not bootable, the system loops at 773116 to 773256. The user may force bootstrapping on the floppy disk by striking the BREAK key on the console, or flipping the halt switch and then booting as described above. After initialization, the DSD 880 hardware bootstrap automatically verifies operation of the interface, controller, and host processor memory. Upon successful completion of these tests, the program will prompt for the desired logical unit by printing the character D on the console. The operator may then enter the valid logical unit number for which system bootstrap is desired. If no entry is made within ten seconds, the bootstrap will default to logical unit 0.

4.4.4 Bootstrap Starting Addresses

Table 4-4 shows bootstrap program start and device addresses.

Table 4-4. DSD 880 Interface Bootstrap Program Starting Addresses and Device Addresses

Bootstrap Offset	Standard Bootstrap Address		Bootstrap Device	Device Address
	PDP-11	LSI-11		
+ 0	771000	773000	Winchester	774400 Standard
+ 10	771010	773010	Winchester	774410
+ 20	771020	773020	Floppy	777170 Standard
+ 30	771030	773030	Floppy	777150
+ 36	771036	773036	*User Defined	

*See start addresses in Table 4-6 for procedures.

4.4.5 Bootstrap Diagnostics

The bootstrap program has built in diagnostic routines. Because of limited code space in the bootstrap program, error reports are made through the use of halts and loops in the program.

Processor Halts - The processor run indicator will be extinguished on PDP-11 and LSI-11 front panels.

On processors with ODT and a console terminal, there will be an ODT prompt on the console.

Program Loops - The processor run indicator will be illuminated on PDP-11 and LSI-11 front panels.

Program loops can be halted by typing break on the console terminal, if ODT is available, and halt on break is enabled. On PDP-11s without ODT, enter control halt from the front panel.

4.4.6 Troubleshooting Bootstrap Failures

If the program is stuck in a loop (i.e., not halted though not booted after approximately 30 seconds), manually halt the program via the console or front panel. Note the address at which the program halts and any error reported by the DSD 880 front panel. Tables 4-5 and 4-6 provide a listing of bootstrap halt and program loop locations, the possible cause of the halt, and procedure for solving the problem. If you are unable to manually halt the program, or a PDP-11 bus error occurs:

- Verify the DSD 880 interface jumper configuration.
- Verify the backplane jumpers for DMA and interrupt grants. (PDP-11 only)
- Verify correct installation of the DSD 880 interface in the backplane.

Table 4-5. Program Halt Locations
(Halt location offset from bootstrap base address)

<u>Location</u>	<u>Description</u>
XXX002	Fault: Bootstrap does not respond
	Possible cause: DSD 880 bootstrap not enabled Bootstrap starting address incorrectly configured Defective DSD 880 interface Memory address range extends into bootstrap area Processor halt switch is in HALT position
	Troubleshooting: Verify configuration of DSD 880 interface jumpers Verify ability to access bootstrap starting address without error (should contain 12737) Verify halt switch is in RUN position
XXX246	Fault: RL device reported error following read sector operation
	Possible cause: Unable to read sector from RL Defective DSD 880 controller Defective winchester disk drive Invalid RL logical unit specified as boot device
	Troubleshooting: Verify integrity of DSD 880 winchester bad track map Replace DSD 880 controller PCB assembly Replace winchester disk drive assembly Reboot using correct logical unit
XXX300	Fault: Processor memory error at location R4 (contents of memory did not equal value of R4)
	Possible cause: Defective host processor memory Defective host processor Refresh for dynamic memory board defective
	Troubleshooting: Verify ability to access failing memory location Verify dynamic memory refresh (deposit 125252, wait two minutes, verify contents unchanged) Use DEC memory diagnostics to verify failure Replace failing memory module
XXX324	Fault: Processor memory error (at location -2, R4, Read R0 expected 0)
	Possible cause: Defective host processor memory Defective host processor Refresh for dynamic memory board defective
	Troubleshooting: Verify ability to access failing memory location Verify dynamic memory refresh (deposit 125252, wait two minutes, verify contents unchanged) Use DEC memory diagnostics to verify failure Replace failing memory module

Table 4-5. Program Halt Locations (Cont)
 (Halt location offset from bootstrap base address)

<u>Location</u>	<u>Description</u>
XXX374	<p>Fault: Processor memory error (if R5=Boot Base address + 116, R6=5002)</p> <p>Fill-Empty error (if R5=Boot Base address + 622, R6=5000)</p> <p>Possible cause: KD11-F processor is being used to refresh external RAM Defective host processor memory Defective DSD 880 controller if fill-empty error</p> <p>Troubleshooting: If KD11-F uses REV-11 or on-board memory refresh Use DEC memory diagnostics to verify failure Replace failing memory module Replace DSD 880 controller PCB assembly</p>
XXX476	<p>Fault: Error flag in RXCS set following initialize</p> <p>Possible cause: Interface cable not properly installed AC power to DSD 880 chassis not turned on Unable to read sector from floppy disk DSD 880 controller failed initialize test sequence Defective DSD 880 controller</p> <p>Troubleshooting: Verify installation of DSD 880 interface cable Verify ac power to DSD 880 chassis Verify controller passes initialize test sequence Verify that floppy drive is properly configured for operating voltage and frequency Replace floppy disk media Replace DSD 880 controller PCB assembly</p>
XXX524	<p>Fault: RXCS does not latch appropriate bits (5460)</p> <p>Possible cause: Interface defective</p> <p>Troubleshooting: Replace interface PCB assembly</p>

Table 4-5. Program Halt Locations (Cont)
 (Halt location offset from bootstrap base address)

<u>Location</u>	<u>Description</u>
XXX424	<p>Fault: RX02 device reported error following READ SECTOR operation (definitive error code at memory location 0)</p> <p>Possible cause: Disk not inserted in floppy drive Floppy disk door open Double-sided floppy disk in single-sided drive Defective floppy disk media Incorrectly configured floppy disk drive (ac voltage and frequency) Defective floppy disk drive Defective DSD 880 controller Incorrect logical unit specified as boot address</p> <p>Troubleshooting: Verify installation of floppy disk media in drive Replace floppy disk media Verify drive configuration Replace floppy disk drive Replace DSD 880 controller PCB assembly Reboot using RX logical unit 0</p>

Table 4-6. Program Loops
 (Program loop addresses offset from bootstrap base address)

<u>Location</u>	<u>Description</u>
XXX146-152	<p>Fault: RL controller not ready following bus initialize</p> <p>Possible cause: Interface cable not properly installed DSD 880 controller failed initialization test sequence AC power to DSD 880 chassis not turned on</p> <p>Troubleshooting: Verify installation of DSD 880 interface cable Verify ac power to DSD 880 chassis Verify controller passes initialization test sequence Replace DSD 880 controller PCB assembly</p>
XXX150	<p>Fault: Interface does not respond to RLCS address</p> <p>Possible cause: Incorrectly configured RL device address jumpers Incorrectly specified bootstrap starting address Defective interface</p> <p>Troubleshooting: Verify interface jumper configuration Verify interface response at expected device addresses Replace interface PCB assembly</p>

Table 4-6. Program Loops
(Program loop addresses offset from bootstrap base address)

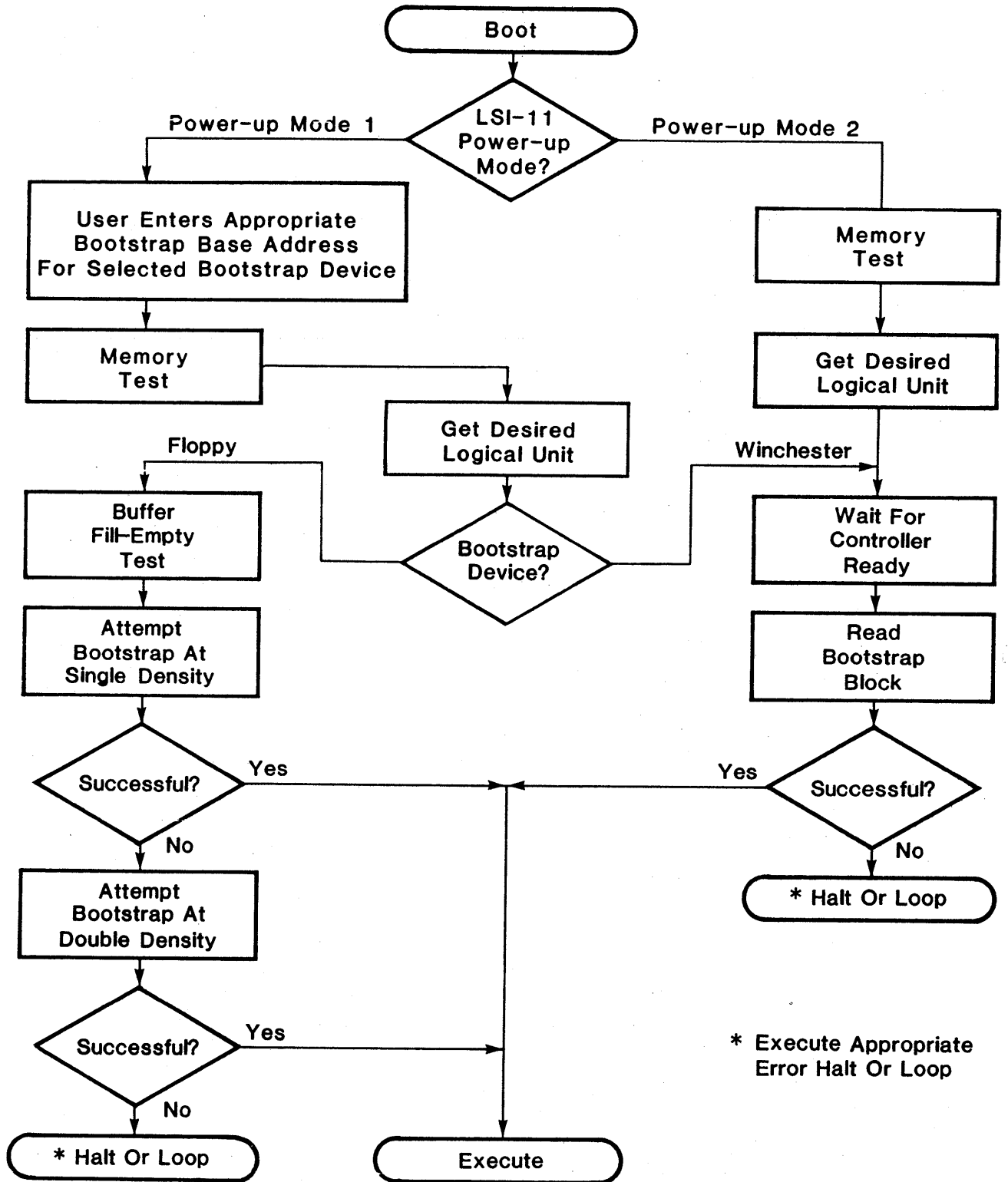
<u>Location</u>	<u>Description</u>
XXX166-170	Fault: RL controller not ready following get status command Possible cause: Defective DSD 880 controller Defective interface Troubleshooting: Replace DSD 880 controller PCB assembly Replace interface PBC assembly
XXX212-214	Fault: RL controller not ready following seek command Possible cause: Defective DSD 880 controller Defective interface Troubleshooting: Replace DSD 880 controller PCB assembly Replace interface PBC assembly
XXX236-240	Fault: RL controller not ready following read sector command Possible cause: Defective DSD 880 controller Defective interface Troubleshooting: Replace DSD 880 controller PCB assembly Replace interface PBC assembly
XXX416-420	Fault: Transfer request error during read definitive error status command Possible Causes: Defective interface Defective DSD 880 controller Troubleshooting: Replace interface PCB assembly Replace DDS 880 controller PCB assembly
XXX470	Fault: Interface does not respond to RXCS address Possible cause: Incorrectly configured RX device address jumpers Incorrectly specified bootstrap starting address Defective interface Troubleshooting: Verify interface jumper configuration Verify interface response at expected device address Replace interface PCB assembly

Table 4-6. Program Loops
(Program loop addresses offset from bootstrap base address)

<u>Location</u>		<u>Description</u>
XXX534-536 XXX544-546	Fault:	Transfer request error during RX02 fill buffer test
	Possible cause:	Defective interface Defective DSD 880 controller
	Troubleshooting:	Replace interface PCB assembly Replace DSD 880 controller PCB assembly
XXX566-570 XXX576-600	Fault:	Transfer request error during RX02 empty buffer test
	Possible cause:	Defective interface Defective DSD 880 controller
	Troubleshooting:	Replace interface PCB assembly Replace DSD 880 controller PCB assembly
XXX652-654 XXX660-662	Fault:	Transfer request error during RX02 read sector command
	Possible cause:	Defective interface Defective DSD 880 controller
	Troubleshooting:	Replace interface PCB assembly Replace DSD 880 controller PCB assembly
XXX730-732 XXX736-740	Fault:	Transfer request error during RX02 empty buffer command
	Possible cause:	Defective interface Defective DSD 880 controller
	Troubleshooting:	Replace interface PCB assembly Replace DSD 880 controller PCB assembly
XXX770-774	Fault:	Done flag or transfer request error during RX02 command
	Possible cause:	Defective interface Defective DSD 880 controller
	Troubleshooting:	Replace interface PCB assembly Replace DSD 880 controller PCB assembly

4.4.7 Bootstrap Program Flow Diagram

Figure 4-3 illustrates the bootstrap sequence of operations.



TP 233/81

Figure 4-3. Bootstrap Flow Diagram

4.4.8 Bootstrap Program Listing

Table 4-7 contains a listing of the bootstrap program.

Table 4-7. DSD Bootstrap Program Listing

DSD 880/x/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26
TABLE OF CONTENTS

1-	8	LSI-11 VERSION
3-	214	RL COMPATIBLE BOOT

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26 PAGE 1

```

1                                     TITLE DSD 880-TAURUS BOOTSTRAP PROM
2                                     ; BOT88T.MAC    8-JUL-81

.SBTTL LSI-11 VERSION
BOOTSTRAP FOR DSD880 FLOPPY / WINCHESTER DISK CONTROLLER
BOOTS EITHER SINGLE OR DOUBLE DENSITY FLOPPIES
** NOTE ON BOOTING WHILE REAL TIME CLOCK IS ENABLED. **
THIS BOOT CAN BE STARTED WITH A RUNNING REAL TIME CLOCK IN 2 WAYS.
1) BY SETTING THE PSW AHEAD OF TIME TO DISABLE INTERRUPTS BY TYPING
   "$S/ 340<CR>" AND "R7/ 773000<CR>" AND HITTING "P".
1) (LSI-11 /2 ONLY) BY ENSURING THAT THE STACK IS POINTING TO
   NON-EXISTANT MEMORY THUS FORCING A DOUBLE BUS ERROR ON ANY
   INTERRUPT AND BY TYPING
   "773000G" AND TYPING "P" IF HALTS OCCUR DUE TO ATTEMPTED INTERRUPTS.

THE BOOTSTRAP PROCEEDS IN 4 STEPS
1) SELECT DEVICE    DETERMINES DEVICE TO BE BOOTED
2) RAM TEST        CHECKS ALL AVAILABLE MEMORY FOR STUCK BITS
                   ON BOTH DATA AND ADDRESS LINES. <0-30K>
                   DOES BOTH DATA = ADDRESS AND PATTERN TESTS
                   1) CLEARS MEMORY TO 0'S AND SIZES MEMORY
                   2) LOADS MEMORY = ADDRESS AND CHECKS
                   3) LOADS MEMORY = ADDRESS COMPLEMENT, CHECKS
                   4) LOADS MEMORY WITH THE REPEATING PATTERN OF
                     131617, 154707, 166343, 173161, 175470
CHECK FOR UNIT 0 OVERRIDE FROM KEYBOARD
3-WINCHESTER READ IN BLOCK 0, START AT LOC 0
3-DY FILL-EMPTY    CHECKS DSD880 - PROCESSOR DATA PATH FOR
                   SYNTAX AND DATA ERRORS. ALSO INSURE'S ALL
                   AVAILABLE ADDRESS LINES TOGGLE UNDER DMA.
                   CHECKS FILL-EMPTY WITH BUFFERS AT 774,
                   17700, 37676, 77704, 137700 IF MEMORY EXISTS.
4-DY BOOTSTRAP    READS IN BLOCK 0 FROM DISKETTE IN CORRECT
                   DENSITY AND STARTS AT LOC 0

ERROR HALTS OR HANG UP LOOPS (ADDRESSES RELATIVE TO BOOT BASE ADDR)
146-52 LOOP    RL CONTROLLER NOT READY
150 HANG       RL CONTROLLER NOT RESPONDING AT ADDRESS
166-170, 212-214, 236-240    RL TYPE CONTROLLER HUNG
246 HALT       ERROR DURING READ BLOCK 0
300 HALT       MEMORY ERROR AT LOC (R4), CONTENTS SHOULD EQUAL ADDRESS
324 HALT       MEMORY ERROR AT -2(R4), EXPECT 0, CONTENTS=ADDRESS COMPLEMENTED
374 HALT       1) FILL-EMPTY ERROR IF R5=BOOT+622
                 2) MEMORY ERR IF R5=BOOT+116
424 HALT       ERROR ON FLOPPY. DEFINITIVE STATUS AT LOC 0 IN MEMORY
470 LOOP       DY DEVICE ADDRESS SELECTED FOR BOOTING DOESN'T RESPOND
500 HALT       ERROR FLAG IN RXCS SET AFTER INIT
524 HALT       RXCS OR RXDB INTERFACE REGISTER STUCK BIT PROBLEM
                 NOTE CONTENTS OF RXCS, RXDB <5460,1420>,<*,173767>
534-536, 544-546    TRANSFER REQUEST HANGUP (FILL BUFFER)
566-570, 576-600    TRANSFER REQUEST HANGUP (EMPTY BUFFER)

652-654, 660-662    TRANSFER REQUEST HANGUP (DY-READ-BOOTSTRAP)
730-732, 740-742    TRANSFER REQUEST HANGUP (DY-EMPTY-BOOTSTRAP)
770-774 LOOP    DSD880 FLAG WAIT ROUTINE HANGUP

START ADDRESSES

```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP FROM MACRO M1113 05-OCT-81 19:26 PAGE 1-1
LSI-11 VERSION

```

; BOOT+0 (TYPICALLY 173000) BOOTS RL DEVICE WITH RLCS AT 174400
; BOOT+10 (TYPICALLY 173010) BOOTS RL DEVICE WITH RLCS AT 174410
; BOOT+20 (TYPICALLY 173020) BOOTS DY DEVICE WITH RXCS AT 177170
; BOOT+30 (TYPICALLY 173030) BOOTS DY DEVICE WITH RXCS AT 177150
; BOOT+36 (TYPICALLY 173036) GENERAL DEVICE ENTRANCE - USER
; SET'S LOCATION 0 = DESIRED RLCS OR RXCS
; NOTE: THE BIT OF VALUE 1000 MUST BE SET FOR RX BOOTING
; IF REAL TIME CLOCK MUST BE LEFT ON THEN SET
; *S/ 340<CR> AND R7/ 173040<CR> AND PROCEED

; A "BOOT" ON AN 11/04 OR 11/34 PRINTS R0, R4, SP, R7 ON THE TERMINAL.
; IF AN ERROR HALT OCCURS AT BOOT+774 WHILE BOOTING THEN
; BOOTING AGAIN ON AN 11/04 OR /34 PRINTS OUT THE FOLLOWING.
; R0 = CURRENT DRIVE # BEING BOOTED FROM.
; R4 = LOAD ADDRESS WHERE ERROR OCCURRED
; SP = DEFINITIVE STATUS OF ERROR
; R7 = ERROR HALT ADDR+2

; NOTE - A HALT OR HANGUP OCCURRING BETWEEN 742-746 THAT WILL NOT
; RESPOND TO BREAK OR HALT IS GENERALLY DUE TO LACK OF DMA GRANT
; CONTINUITY ON THE BUS. USER SHOULD PUT DSD880 INTERFACE CARD
; CLOSER TO THE PROCESSOR AND ENSURE GRANT CONTINUITY.

; DSD880 - RX02 REGISTER SYNTAX DEFS
RXCS= 177170
; ERR INI XM XM X02 ?? SID DEN TRG IEN DON UN1 FUN FUN FUN GO
; ; 100000 ; ERR ERROR FLAG
; ; 40000 ; INI LOAD INTO RXCS TO INITIALIZE
; ; 30000 ; XM EXTENDED MEMORY SELECT BITS
; ; 4000 ; X02 = 1 FOR RX02 MODE SYNTAX
; ; 400 ; DEN SET = 1 FOR DOUBLE DENSITY
; ; 200 ; TRG TRANSFER REQUEST - DATA TO/FROM RXDB
; ; 16 ; FUN FUNCTION <0-7> - SET "GO" TO EXEC

RXDB=RXCS+2 ; RXES ERROR BIT LAYOUT
; NXM WCV SID DRV DRV DEL DSK DEN ACL INT SID CRC
; QVF #1 #1 RDY DAT DEN ERR LOW DON RDY ERR

; REGISTER USAGE IN BOOTRX SECTION
XCS= %1 ; R1 POINTER TO RXCS
XDB= %2 ; R2 POINTER TO RXDB
; R3 READ COMMAND VAL WITH DENSITY BIT
LDP= %4 ; R4 LOAD POINTER
SCT= %5 ; R5 CURRENT SECTOR # (1, 3, 5, 7)
; (SP) WORD COUNT FOR CURRENT DENSITY

TKS= 177560 ; CONSOLE STATUS REGISTER DEFS FOR GETTING UNIT #
TKB= TKS+2
TPS= TKB+2
TPB= TPS+2

```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP FROM MACRO M1113 05-OCT-81 19:26 PAGE 2
LSI-11 VERSION

```

; RLO1 / RLO2 COMPATIBLE HARDWARE DEFS.
RLCS= 174400 ; RL COMMAND STATUS REGISTER
; ERR DE NXM DLT DCRC OPI DS1 DSO CRDY IE A17 A16 F2 F1 FO DRDY
; HNF HCRC OPI
; RD RD RD RD RD RD R/W R/W R/W R/W R/W R/W RW RW RW RD
; 15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00
;
; FUNCTIONS 0 0 0 00 NOOP
; 0 0 1 02 WRITE CHECK
; 0 1 0 04 GET STATUS
; 0 1 1 06 SEEK
; 1 0 0 10 READ HEADER
; 1 0 1 12 WRITE DATA
; 1 1 0 14 READ DATA
; 1 1 1 16 READ DATA - NO HEADER CHECK
;
; RLBA = 174402 - BUS ADDRESS REGISTER
; RLBA = 2 ; OFFSET
;
; RLDA= 174404 - DISK ADDRESS REGISTER (SEEK)
; RLDA= 4
; DF3 DF7 DF6 DF5 DF4 DF3 DF2 DF1 DF0 000 000 HS 000 DIR 000 001
; DF7 - DF0 CYLINDER DIFFERENCE TO SEEK
; HS SET = LOWER SIDE, CLEAR = UPPER
; DIR SET = SEEK INWARDS TOWARD SPINDLE
; CLR = SEEK OUTWARDS
;
; RLDA= 174404 - DISK ADDRESS DURING READ/WRITE DATA COMMANDS
; CAB CA7 CA6 CA5 CA4 CA3 CA2 CA1 CA0 HS SA5 SA4 SA3 SA2 SA1 SA0
;
; - DISK ADDRESS DURING GET STATUS COMMAND
; 000 000 000 000 000 000 000 000 000 000 000 000 RST 000 000 000
;
; RLMP= 174406 - MULTI-PURPOSE REGISTER
; RLMP= 6
; WDE HCE WLK SKTD SPE WGE VC DSE 000 HS CO HO BH ST2 ST1 ST0
;
157 ; START HERE FOR RLO1 TYPE BOOT - @ 174400
158 000000 012737 BOTW00: MOV #RLCS, @#0 ; DO RL BOOT ON POWER UP
; 174400
; 000000
159 000006 000413 BR BOTENT
160
161 000010 012737 BOTW10: MOV #RLCS+10, @#0 ; DO ALTERNATIVE RL BOOT
; 174410
; 000000
162 000016 000407 BR BOTENT
163
164 000020 012737 BOT170: MOV #177170, @#0 ; DO STANDARD FLOPPY BOOT
; 177170
; 000000
165 000026 000403 BR BOTENT
166
167 000030 012737 BOT150: MOV #177150, @#0 ; DO ALTERNATIVE FLOPPY BOOT
; 177150
; 000000

```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/1/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26 PAGE 2-1
LSI-11 VERSION

```

168
169 000036 011706 BOTENT: MOV      (PC), SP      ; SET STACK TO 12700
170 000040 012700      MOV      #340, R0      ; LOCK OUT LINE TIME CLOCK
      000340
172 000044 106400      MTPS   R0      ; BY SETTING TO PRIORITY 7.
173 000046 000240      NOP      ; SO SAME SIZE IN PDP-11 VERSION
174      ; ABOVE 2 WORDS BECOME
175      ; MOV R0, @#177776
179
180 000050 004467      JSR     R4, MEMHGH ; GET POINTER TO TRAP ROUTINE
      000010
181
182      ; TRAP PROCESSOR FOR NON-EXISTANT MEMORY TIMEOUT
183      ; SETS CARRY AND RETURNS ON NON-EXISTANT MEMORY TRAP
184
185 000054 012766 TRAP4: MOV      #341, 2(SP) ; SETS CARRY ON TRAP TO 4
      000341
      000002
186 000062 000002      RTI      ; ALSO SETS CURRENT PRIORITY HIGH
187
188
189      ; NOW TEST FROM 10 TO TOP OF AVAILABLE CONTIGUOUS MEMORY
190      ; INIT VECTORS AND SET LOW TEST LIMIT TO 10
191 000064 012701 MEMHGH: MOV      #4, R1      ; SET LOW MEM POINTER
      000004
192 000070 010421      MOV     R4, (R1)+      ; LOAD TRAP VECTOR
193 000072 010021      MOV     R0, (R1)+      ; LOAD TRAP PSW VALUE = 340
194 000074 010102      MOV     R1, R2      ; INIT TO LOW MEMORY = 10
195
196      ; FIND TOP OF AVAILABLE MEMORY
197 000076 005022 2*:   CLR      (R2)+      ; FIND TOP OF MEMORY
198 000100 103403      BCS     4*           ; CARRY SET BY TRAP TO 4
199 000102 020227      CMP     R2, #160000 ; AT END OF PDP-11 ADDR SPACE?
      160000
200 000106 103773      BLD     2*           ;
201 000110 005042 4*:   CLR      -(R2)      ; SET POINTER TO LAST LOCATION+2
202 000112 004567      JSR     R5, MEMCHK    ; TEST TO TOP OF MEMORY
      000144
203
204 000116 005000 CHKDEV: CLR      R0      ; INIT UNIT # FOR LATER
205 000120 011001      MOV     (R0), R1      ; GET R*CS POINTER
206 000122 105737      TSTB   @#TKS         ; HAS A UNIT # BEEN TYPED
      177560
207 000126 100004      BPL     10*          ; NO - DEFAULT TO 0
208 000130 013700      MOV     @#TKB, R0     ; ELSE USE LOW 2 BITS AS UNIT #
      177562
209
210 000134 042700      MOV     R0, @#TPB    ; ECHOE CHAR IF TYPED
      177774
      BIC     #^C3, R0   ; CLEAR ALL BUT UNIT BITS
211 000140 032701 10$:  BIT      #1000, R1    ; RX02 OR RLO1 DEVICE?
      001000
212 000144 001130      BNE     RXFLEM        ; BOOT VIA RX02 MODE IF 1000 BIT SET IN R*CS

```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26 PAGE 3
 RL COMPATIBLE BOOT

```

214          .SBTTL RL COMPATIBLE BOOT
215          ; BOOT USING RLO1 PROTOCOL (UNOTE 063)
216          ; DISPATCH WITH R0 = UNIT #, R1 = RLCS
217
218 000146 105711 BOOTRL: TSTB   (XCS)          ; CHECK CONTROLLER READY
219 000150 103777          BCS          ; HANG IF NO BUS RESPONSE TO DEVICE
220 000152 100375          BPL   BOOTRL     ; ELSE WAIT FOR CONTROLLER RDY
221 000154 012761          MOV    #13, .RLDA(XCS) ; DO RESET CONTROLLER ON GET STATUS
      000013
      000004
222 000162 012711          MOV    #4, (XCS)      ; RLCS - LOAD GET STATUS FUNCTION
      000004
223 000166 105711          TSTB   (XCS)      ; WAIT FOR CONTROLLER READY
224 000170 100376          BPL    -2
225 000172 012761          MOV    #177601, .RLDA(XCS) ; SET MAXIMAL LENGTH SEEK OUTWARDS
      177601
      000004
226 000200 012703          MOV    #6*400, R3      ; SEEK COMMAND
      003000
227 000204 050003          BIS    R0, R3          ; WITH UNIT BITS
228 000206 000303          SWAB   R3          ; BACK TO UN UN CR IE DF DF FN FN FN GO
229 000210 010311          MOV    R3, (XCS)      ; LOAD RLO1 SEEK COMMAND
230 000212 105711          TSTB   (XCS)      ; RLCS - WAIT FOR CONTROLLER READY
231 000214 100376          BPL    -2
232 000216 012761          MOV    #-400, .RLMP(R1) ; RLWC - SET WORDCOUNT FOR 1 BLOCK
      177400
      000006
233 000224 005061          CLR    .RLDA(R1)      ; LOAD A ZERO INTO DISK ADDRESS REG
      000004
234 000230 062703          ADD    #6, R3        ; MAKE SEEK INTO A READ COMMAND
      000006
235 000234 010311          MOV    R3, (XCS)      ; ISSUE READ FUNCTION
236 000236 105711          TSTB   (XCS)      ; CONTROLLER READY?
237 000240 100376          BPL    -2
238
239 000242 005711          CHKNOP: TST (XCS)      ; ERROR?
240 000244 100001          BPL    +4
241 000246 000000          HALT
242 000250 023727          CMP    @#0, #240     ; LOC 0 MUST BE NOP
      000000
      000240
243 000256 001317          BNE   CHKDEV        ; CHECK IF DIFFERENT UNIT #
244 000260 005007          CLR    PC           ; DISPATCH TO LOC 0.
  
```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP FROM MACRO M1113 05-OCT-81 19:26 PAGE 4
 RL COMPATIBLE BOOT

```

246          ; ROUTINE TO TEST MEMORY FROM C(R1) = LOW LIMIT
247          ; TO C(R2) = UPPER LIMIT BEYOND TEST
248          ; IF ERROR FOUND HALTS WITH R4 POINTING TO ERROR LOC. OR 2 BEYOND.
249          ; RO = UNIT # (UNCHANGED)
250
251 000262 010104 MEMCHK: MOV     R1, R4          ; GET STARTING ADDRESS
252 000264 010403 2*:   MOV     R4, R3          ; KILL Z FLAG <MOV R4, (R4)>
253 000266 010324      MOV     R3, (R4)+        ; LOAD CONTENTS = ADDRESS
254 000270 020402      CMP     R4, R2          ; AT END OF TEST?
255 000272 103774      BLO     2*
256 000274 024404 CHKADP: CMP     -(R4), R4      ; CHECK BACK DOWN TO START ADDR
257 000276 001401      BEQ     NCKADP
258 000300 000000      HALT
259 000302 020401 NCKADP: CMP     R4, R1          ; STUCK BIT IN DATA OR ADDRESS!!
260 000304 101373      BHI     CHKADP          ; CONTINUE TILL AT START ADDR
261
262 000306 005124 SETCOM: COM     (R4)+        ; MAKE LOC = ADDR COMPLEMENT
263 000310 020402      CMP     R4, R2          ; AT END OF TEST?
264 000312 103775      BLO     SETCOM
265
266 000314 010104      MOV     R1, R4          ; START AT BEGINNING
267 000316 060414 CHKCOM: ADD     R4, (R4)      ; SHOULD BE ALL 1'S
268 000320 005224      INC     (R4)+        ; DATA SHOULD = ALL ZERES
269 000322 001401      BEQ     NCKCOM
270 000324 000000      HALT
271 000326 020402 NCKCOM: CMP     R4, R2          ; STUCK DATA BIT IF NO HALT AT +156
272 000330 103772      BLO     CHKCOM
273
274 000332 012737      MOV     #'D, @#TPB      ; PRINT A "D" AS PROMPT
275          000104
276          177566
277          ; SET UP TO LEAVE A PATTERN OF 1 011 001 110 001 111 B ROTATED
278          ; RIGHT INTO 4 SUCCESSIVE WORDS
279          ; USED AS MEM BACKGROUND AND FILL-EMPTY DATA.
280
281 000340 010104      MOV     R1, R4          ; SET INITIAL ADDRESS
282 000342 012703 SETPAT: MOV     #131617, R3      ; SET INITIAL PATTERN
283          131617
284 000346 020402 4*:   CMP     R4, R2          ; END OF ADDRESS RANGE?
285 000350 103004      BHIS   CHKPAT          ; GO CHECK DATA IF AT END
286 000352 010324      MOV     R3, (R4)+        ; CARRY SET BY CMP INSTRUCTION.
287 000354 006203      ASR     R3              ; ROTATE AND LOAD AGAIN
288 000356 103773      BCS     4*
289 000360 000770      BR      SETPAT
290
291 000362 010104 CHKPAT: MOV     R1, R4          ; SET INITIAL ADDRESS
292 000364 012703 CHKPTL: MOV     #131617, R3
293          131617
294 000370 020324 3*:   CMP     R3, (R4)+        ; DATA OK?
295 000372 001401      BEQ     4*
296 000374 000000      HALT
297 000376 020402 4*:   CMP     R4, R2          ; PATTERN SENSITIVITY ERROR
298 000400 103003      BHIS   MEMEXT          ; AT END OF ADDRESS RANGE?
299 000402 006203      ASR     R3              ; YES - EXIT
300 000404 103771      BCS     3*              ; CARRY SET BY CMP INSTRUCTION
301 000406 000766      BR      CHKPTL
302 000410 000205 MEMEXT: RTS     R5

```


Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26 PAGE 5
 RL COMPATIBLE BOOT

```

300          ; DEFNST - DISPLAY RX02 DEFINITIVE STATUS STARTING AT LOC 0
301          ; PROCEDE WILL REPLY
302
303 000412 012711 DEFNST: MOV      #17, (XCS)      ; DO DEFINITIVE ERROR STATUS
          000017
304 000416 105711 DEFNWT: TSTB   (XCS)          ; WAIT FOR TRREG OR DONE
305 000420 100376          BPL   DEFNWT         ; WAIT FOR TRANSFER REQUEST
306 000422 005012          CLR   (XDB)         ; STATUS UPWARDS FROM LOAD ADDR
307 000424 000000          HALT                    ; DEFINITIVE STATUS AT LOC 0
308          ; BR      CHKDEV      ; ACCEPT UNIT AGAIN ON PROCEDE
309
310
311          ; FILL EMPTY TEST - DONE AT MULTIPLE BUFFER ADDRESSES IN ORDER
312          ; TO TOGGLE ALL ADDRESS BITS IN SYSTEM MEMORY
313 000426 004567 RXFLEM: JSR    R5, FILEMP      ; DO FILL-EMPTY BUFFER TEST
          000016
314 000432 000034          10+<5*4>          ; START FILL AT BEGINNING OF
315 000434 017700          10+<5*1624.>      ; PATTERN REPETITION LEFT BY RAM TEST
316 000436 037676          10+<5*3262.>      ; DO DMA TEST ACROSS ALL ADDRESS BITS
317 000440 077704          10+<5*6540.>      ; THAT CAN BE SET IN AVAILABLE MEMORY
318 000442 000000          0          ; ADDRESS TERMINATOR
319 000444 007          .BYTE 7, 27      ; COMMAND SET BITS FOR UNIT 0, 1, 2, 3
          000445 027
320 000446 047          .BYTE 47, 67      ; PROTECT AGAINST HIGH UNITS
          000447 067
321
322          ; NOTE - FILEMP DOES NOT RETURN BUT FLOWS THROUGH INTO BOOTRX
323
324          ; FILL - EMPTY BUFFER TEST
325
326 000450 012504 FILEMP: MOV      (R5)+, R4      ; GET BUFFER ADDRESS
327 000452 001464          BEQ    BOOTRX      ; GO BOOT UNIT IN R0
328 000454 005764          TST    404(R4)     ; DOES MEMORY EXIST?
          000404
329 000460 103773          BCS    FILEMP      ; NO - STEP TO END OF LIST
330 000462 010102          MOV    XCS, XDB    ; INIT FOR RXDB
331 000464 004767          CALL   WTFLAG     ; WAIT FOR DONE FLAG UP
          000300
332 000470 103777          BCS    .          ; LOOP IF NO BUS RESPONSE
333 000472 005711          TST    (R1)      ; RX02 ERROR SET?
334 000474 100001          BPL    +4          ; HALT IF ERROR
335 000476 000000          HALT                    ; INTERFACE SETUP ERROR
336
337          ; DSD880 - RX02 INTERFACE LATCHED BIT TEST
338
339 000500 012722          MOV    #1420, (XDB)+ ; LOAD INTO RXCS
          001420
340 000504 022711          CMP    #5460, (XCS)     ; DID THEY LATCH OK?
          005460
341 000510 001005          BNE    RXHALT     ; LATCHED BIT COMPARE ERROR
342          ; CMP    #1420, (XDB)     ; LATCHED OK IN RXDB?
343          ; BNE    RXHALT     ; NO - BAD INTERFACE.
344
345 000512 012712 RXDBTS: MOV    #173767, (XDB) ; CHECK RXDB LATCH
          173767
346 000516 022712          CMP    #173767, (XDB) ; DID THEY LATCH
          173767

```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26 PAGE 5-1
 RL COMPATIBLE BOOT

```

347 000522 001401      BEQ   RXFIEM      ; DO FILL-EMPTY DATA TEST
348 000524 000000  RXHALT:  HALT      ; HALT IF INCORRECT BIT LATCHUP
349
350 000526 010102  RXFIEM:  MOV   XCS, XDB      ; SET UP RXDB POINTER
351 000530 012722      MOV   #401, (XDB)+      ; DO FILL COMMAND
352 000534 105711      TSTB  (XCS)      ; WAIT FOR TRREG
353 000536 100376      BPL   -2          ;
354 000540 012712      MOV   #200, (XDB)      ; WORDCOUNT (=200)
355 000544 105711      TSTB  (XCS)      ; WAIT FOR TRREG
356 000546 100376      BPL   -2          ;
357 000550 010412      MOV   R4, (XDB)      ; BUFFER ADDR
358 000552 004767      CALL  WTFLAG      ; WAIT FOR DONE OR TRREG
359 000554 000212
360
361                ; NOW EMPTY SECTOR BUFFER AND CHECK DATA VALIDITY
362 000556 022424  EMPBFT:  CMP   (R4)+, (R4)+      ; BUMP EMPTY BUFFER ADDR
363 000560 012711      MOV   #403, (XCS)      ; DO EMPTY BUFFER COMMAND
364 000564 010403      MOV   R4, R3      ; SAVE BUFFER START ADDRESS
365 000566 105711      TSTB  (XCS)      ; WAIT FOR TRREG
366 000570 100376      BPL   -2          ;
367 000572 012712      MOV   #200, (XDB)      ; LOAD WORD COUNT
368 000576 105711      TSTB  (XCS)      ; WAIT FOR TRREG
369 000600 100376      BPL   -2          ;
370 000602 010412      MOV   R4, (XDB)      ; AND FILL BUFFER ADDR+2
371 000604 004767      CALL  WTFLAG      ; WAIT FOR ERROR, DONE OR TRREG
372 000606 000160
373
374 000610 010402  CHKEMP:  MOV   R4, R2      ; SET UP UPPER CHECK LIMIT
375 000612 062702      ADD   #400, R2      ; SET R2 = END ADDR TO CHECK
376 000616 004367      JBR   R5, CHKPTL      ; DO DATA CHECK
377 000622 000712      BR    FILEMP      ; DO NEXT FILL-EMPTY
  
```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/x/20/30 BOOTSTRAP FROM MACRO M1113 05-OCT-81 19:26 PAGE 6
 RL COMPATIBLE BOOT

```

379           ; BOOT THE DEVICE IN R1, REGISTERS USED AS INDICATED BELOW
380           ; R0 LOGICAL UNIT #
381           000001 XCS= %1 ; R1 POINTER TO RXCS
382           000002 XDB= %2 ; R2 POINTER TO RXDB
383           ; R3 READ COMMAND VALUE WITH DENSITY BIT
384           000004 LDP= %4 ; R4 LOAD POINTER
385           000005 SCT= %5 ; R5 CURRENT SECTOR # (1, 3, 5, 7)
386           ; (SP) WORD COUNT FOR CURRENT DENSITY
387
388 000624 060005 BOOTRX: ADD R0, R5 ; PTR TO READ UNIT N COMMAND
389 000626 111503 MOV R5, R3 ; GET COMMAND FOR UNIT
390 000630 005004 CLR LDP ; INIT LOAD ADDRESS POINTER
391 000632 012746 MOV #100, -(SP) ; SET LOW DENSITY WORDCOUNT
392 000636 012705 MOV #1, SCT ; INIT SECTOR TO READ
393 000001
394 000642 004767 RDLP: CALL WTFLAG ; WAIT FOR DONE FLAG SET?
395 000644 010102 MOV XCS, XDB ; COPY RXCS POINTER
396 000650 010322 MOV R3, (XDB)+ ; LOAD READ COMMAND AND BUMP XDB TO RXDB
397 000652 105711 TSTB (XCS) ; WAIT FOR TRREG
398 000654 100376 BPL -2
399 000656 010512 MOV SCT, (XDB) ; LOAD SECTOR
400 000660 105711 TSTB (XCS)
401 000662 100376 BPL -2
402 000664 012712 MOV #1, (XDB) ; LOAD TRACK
403 000670 000001
404 000670 004767 CALL WTFLAG ; WAIT FOR DONE
405 000674 005711 TST (XCS) ; CLUDGE SINCE DEC RX02 SETS ERROR
406 000676 100010 BPL EMPBUF ; EMPTY IF NO ERROR
407 000700 032712 BIT #20, (XDB) ; IS ERROR A DENSITY ERROR?
408 000704 001642 BEG DEFNST ; NO- DO DEFINITIVE STATUS
409 000706 052703 BIS #400, R3 ; SET COMMAND TO DOUBLE DENSITY
410 000712 012716 MOV #200, (SP) ; SET TO D. D. WORD COUNT
411 000716 000751 BR RDLP ; AND TRY READING AGAIN
412
413 000720 010346 EMPBUF: MOV R3, -(SP) ; GET COMMAND COPY
414 000722 042716 BIC #4, (SP) ; MAKE INTO AN EMPTY BUFFER COMMAND
415 000726 012611 MOV (SP)+, (XCS) ; AND EXECUTE
416 000730 105711 TSTB (XCS) ; WAIT FOR FIRST TRREG
417 000732 100376 BPL -2
418 000734 011612 MOV (SP), (XDB) ; LOAD THE WORD COUNT
419 000736 105711 TSTB (XCS)
420 000740 100376 BPL -2
421 000742 010412 MOV LDP, (XDB) ; AND XFER ADDRESS
422 000744 004767 CALL WTFLAG ; WAIT FOR DONE OR TRREG
423 000750 061604 ADD (SP), LDP ; BUMP LOAD ADDRESS FOR NEXT SECT
424 000752 061604 ADD (SP), LDP ; ADD ACTUAL BYTE COUNT
425 000754 122525 CMPB (SCT)+, (SCT)+ ; BUMP SECTOR # BY 2

```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 980/x/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26 PAGE 6-1
RL COMPATIBLE BOOT

```
426 000756 020427      CMP      LDP, #1000      ; FINISHED LOADING?
      001000
427 000762 002727      BLT      RDLP          ; READ NEXT SECTOR
428
429 000764 000167      JMP      CHKNOP        ; CHECK LOC 0 = NOP AND DISPATCH
      177252
430
431
432      ; WAIT FOR FLOPPY FLAGS, DONE, ERROR, TRREG
433
434 000770 032711  WTFLAG: BIT      #240, (XCS) ; WAIT FOR DONE OR TRREG
      000240
435 000774 001775      BEG      WTFLAG        ; CAN'T TEST RX02 ERROR HERE
436 000776 000207      RETURN
437
438 001000      BOTLST:
440
441      000020'      .END      BOT170
```

Table 4-7. DSD Bootstrap Program Listing (Cont)

DSD 880/1/20/30 BOOTSTRAP PROM MACRO M1113 05-OCT-81 19:26 PAGE 6-2
 SYMBOL TABLE

BOOTRL	000146R	002 DEFNWT	000416R	002 RXFLEM	000426R	002
BOOTRX	000624R	002 EMPBFT	000556R	002 RXHALT	000524R	002
BOTENT	000036R	002 EMPBUF	000720R	002 SCT	=%000005	
BOTLST	001000R	002 FILEMP	000450R	002 SETCOM	000306R	002
BOTW00	000000R	002 LDP	=%000004	SETPAT	000342R	002
BOTW10	000010R	002 MEMCHK	000262R	002 TKB	= 177562	
BOT150	000030R	002 MEMEXT	000410R	002 TKS	= 177560	
BOT170	000020R	002 MEMHGH	000064R	002 TPB	= 177566	
CHKADP	000274R	002 NCKADP	000302R	002 TPS	= 177564	
CHKCOM	000316R	002 NCKCOM	000326R	002 TRAP4	000054R	002
CHKDEV	000116R	002 RDLP	000642R	002 WTFLAG	000770R	002
CHKEMP	000610R	002 RLCS	= 174400	XCS	=%000001	
CHKNOP	000242R	002 RXCS	= 177170	XDB	=%000002	
CHKPAT	000362R	002 RXDB	= 177172	.RLBA	= 000002	
CHKPTL	000364R	002 RXDBTS	000512R	002 .RLDA	= 000004	
DEFNST	000412R	002 RXFIEM	000526R	002 .RLMP	= 000006	

ABS. 000000 000
 000000 001
 BOOT 001000 002
 ERRORS DETECTED: 0

VIRTUAL MEMORY USED: 331 WORDS (2 PAGES)
 DYNAMIC MEMORY: 2822 WORDS (10 PAGES)
 ELAPSED TIME: 00:00:12
 ,BOTSBT/CR=BOTSBT

Table 4-7. DSD Bootstrap Program Listing (Cont)

SYMBOL CROSS REFERENCE		PAGE 1				
SYMBOL	VALUE	REFERENCES		CREF		
B00TRL	000146 R	#3-218	3-220			
B00TRX	000624 R	5-327	#6-388			
B0TENT	000036 R	2-159	2-162	2-165	#2-169	
B3TLST	001000 RG	#6-438	6-439			
B0TW00	000000 R	#2-158	6-439			
B0TW10	000010 R	#2-161				
B0T150	000030 R	#2-167				
B0T170	000020 R	#2-164	6-441			
CHKADP	000274 R	#4-256	4-260			
CHKCOM	000316 R	#4-267	4-272			
CHKDEV	000116 R	#2-204	3-243			
CHKEMP	000610 R	#5-374				
CHKNOP	000242 R	#3-239	6-429			
CHKPAT	000362 R	4-282	#4-288			
CHKPTL	000364 R	#4-289	4-297	5-376		
DEFNST	000412 R	#5-303	6-408			
DEFNWT	000416 R	#5-304	5-305			
EMPBFT	000556 R	#5-362				
EMPBUF	000720 R	6-406	#6-413			
FILEMP	000450 R	5-313	#5-326	5-329	5-377	
LDP	=%000004	#1-106	#6-384	*6-390	6-421	*6-423
		*6-424	6-426			
MEMCHK	000262 R	2-202	#4-251			
MEMEXT	000410 R	4-294	#4-298			
MEMHGH	000064 R	2-180	#2-191			
NCKADP	000302 R	4-257	#4-259			
NCKCOM	000326 R	4-269	#4-271			
RDLP	000642 R	#6-394	6-411	6-427		
RLCS	= 174400	#2-116	2-158	2-161		
RXCS	= 177170	#1-88	1-98			
RXDB	= 177172	#1-98				
RXDBTS	000512 R	#5-345				
RXFIEH	000526 R	5-347	#5-350			
RXFLEM	000426 R	2-212	#5-313			
RXHALT	000524 R	5-341	#5-348			
SCT	=%000005	#1-107	#6-385	*6-392	6-399	*6-425
		*6-425				
SETCOM	000306 R	#4-262	4-264			
SETPAT	000342 R	#4-280	4-286			
TKB	= 177562	#1-111	1-112	2-208		
TKS	= 177560	#1-110	1-111	2-206		
TPB	= 177566	#1-113	*4-274			
TPS	= 177564	#1-112	1-113			
TRAP4	000054 R	#2-185				
WTFLAG	000770 R	5-331	5-358	5-372	6-394	6-403
		6-422	#6-434	6-435		
XCS	=%000001	#1-103	3-218	3-221	3-222	3-223
		3-225	3-229	3-230	3-235	3-236
		3-239	5-303	5-304	5-330	5-340
		5-350	5-352	5-355	5-364	5-366
		5-369	#6-381	6-395	6-397	6-400
		6-404	6-415	6-416	6-419	6-434

Table 4-7. DSD Bootstrap Program Listing (Cont)

BOTBBT CREATED BY MACRO ON 5-OCT-81 AT 19:26 PAGE 2

SYMBOL CROSS REFERENCE

CREF

SYMBOL	VALUE	REFERENCES				
XDB	= %000002	#1-104 5-306 *5-330 *5-339 5-345				
		5-346 *5-350 *5-351 5-354 5-357				
		5-368 5-371 *6-382 *6-395 *6-396				
		6-399 6-402 6-407 6-418 6-421				
\$PDP11	= *****	1-8 1-9 2-171				
.RLBA	= 000002	#2-132				
.RLDA	= 000004	#2-135 *3-221 *3-225 *3-233				
.RLMP	= 000006	*2-149 *3-232				

4.5 Off-Line Operation

Off-line operation is accomplished through the use of the controls on the HyperDiagnostic panel. These off-line operations are useful for:

- Formatting disks
- Backup and reloading
- Acceptance testing
- Fault isolation without a computer

CAUTION

To ensure operating system integrity, no attempt to access the DSD 880 from the host computer should be made while using the DSD 880 off-line capabilities.

If the DSD 880 is not in mode 0 at the time a bus initialize is generated by the host processor, the DSD 880 controller will terminate any HyperDiagnostic test in progress, force the mode and class to 0, and then initialize (home) the floppy and winchester drives.

Performance of a DSD 880 off-line function is achieved by first ensuring no DSD 880 computer controlled operation is taking place, selecting the desired function on the mode and class switches on the DSD 880 control panel, and pushing the EXECUTE pushbutton once. At the completion of the selected operation, return the mode and class switches to the desired normal operating mode and push the EXECUTE pushbutton once to return to normal computer controlled operation. Mode and class options are provided in Table 4-2.

4.5.1 Format Mode

The format mode (mode 1, class 0) is used to format the entire floppy disk in DEC double-density format or (mode 1, class 1) to format the entire floppy disk in DEC/IBM single-density format.

4.5.2 Backup and Reload Modes

The DSD 880 Data Storage System provides the user with the facility to transfer data between the nonremovable winchester disk and floppy disks without the intervention of a host processor. The resulting backup floppy disks are physical images of the RL02 unit and may be used to regenerate the disk data on the original or any other DSD 880 disk.

Data integrity may be verified by selecting a backup or a reload routine which includes a verify pass. The verify routine will be executed following the reload or backup routine and compares the data on the backup floppy to the data on the winchester. If data does not compare, a 30 error will be reported and the verify routine will terminate. If a 30 error occurs, another diskette may be installed to continue the backup operation where it left off.

Backup

It is recommended that prior to starting a back up routine the floppy disks to be used are initialized to the desired density using the appropriate format operation (see paragraph 4.5.1).

Since the backup routine cannot determine the extent of valid data on the winchester disk, it is designed to copy the entire RL02 logical unit onto the backup floppy disks. Each time a backup is initiated, a unique version number is recorded on the backup floppy disks along with the disk number.

The entire RL02 unit should be backed up, regardless of the actual amount of disk space used. Therefore, continue the backup process until the code 00 is displayed by the seven segment displays.

A complete RL02 backup requires the following quantities of floppy disks:

Double-Density, Double-Sided	- 11
Double-Density, Single-Sided	- 22
Single-Density, Double-Sided	- 22
Single-Density, Single-Sided	- 44

Partial backups can be accomplished by terminating the backup operation before all diskettes have been used. Trial and error should be used to determine how many diskettes to use for partial backups.

If an unrecoverable floppy disk errors occurs during the backup, try another disk. The backup routine will restart at the beginning of the floppy disk on which the failure occurred.

The error recovery abilities of the backup routine are limited. Therefore, it is highly recommended that the backup process be done regularly. It is not possible to backup a winchester disk with hard read errors. However, if the winchester disk has soft header or data CRC errors, the backup routine will retry 16 times before declaring the sector's data invalid.

If the backup routine retries 16 times and is unsuccessful in reading a winchester sector with CRC errors, it will flag the floppy data with a deleted data mark and continue to the next sector. In this manner, it is possible to successfully backup a winchester disk with hard CRC errors; however, the data for that sector stored on the backup floppy disk may be invalid.

The backup routine takes bad tracks into account. Therefore, it is possible to transfer images between winchester disk drives with different bad track maps.

Reload

The reload routine does not keep track of how many backup disks have been reloaded onto the winchester. For this reason, it is necessary that the operator conscientiously reload the entire complement of backup floppy disks. Record keeping will be aided by the display of the backup disk number on the seven segment indicators.

Since each backup disk is uniquely identified as to backup version number, it is not possible to intermix the disks of backups which were done at different times.

The reload routine is limited in its error recovery abilities. If a hard read or write error is encountered, the routine will terminate.

CRC error on the floppy or winchester disks will be retried 16 times before the reload routine aborts.

If a deleted data mark is detected on the backup floppy disk in the course of reloading, a 45 error will be displayed by the seven segment indicators. The user should be aware that one or more winchester sectors were unrecoverable at the time of the backup. The reload proceeds to completion.

4.5.3 Backing Up the Winchester Disk onto Floppy Disks

There are six possible backup classes which may be selected on the DSD 880.

<u>Mode</u>	<u>Class</u>	<u>Description</u>
7	0	Backup logical unit 0 without verify
7	1	Backup logical unit 0 with verify
7	2	Backup logical unit 1 without verify
7	3	Backup logical unit 1 with verify
7	4	Backup logical unit 2 without verify
7	5	Backup logical unit 2 with verify

Select the appropriate backup class and set the MODE and CLASS switches accordingly, insert a floppy disk into the floppy drive, close the door, and momentarily depress the EXECUTE pushbutton.

The seven segment displays will echo the switch setting for as long as the EXECUTE pushbutton is depressed.

When the EXECUTE pushbutton is released, the controller will display the current floppy disk volume number (starting from 1), lock the door of the floppy drive, and write a unique disk identifier on track 00 of the floppy disk. The disk identifier contains the disk volume number, backup version number, starting RLO2 address of the data, and number of sectors of winchester data contained on the floppy.

The controller will then copy the appropriate winchester data onto the floppy from the winchester.

When the operation is complete, the controller will unlock the door of the floppy drive. When the door of the floppy drive is opened, the controller will increment the disk volume number being displayed.

Repeat the preceding steps until the seven segment display again displays 00 indicating that the winchester drive has been successfully backed up.

Select the desired operating mode of the DSD 880, set the switches accordingly, and momentarily depress the EXECUTE pushbutton. The seven segment display will indicate the selected MODE and CLASS until the pushbutton is released and execution begins.

Error Reporting During Backup

1. If a hard error occurs on the floppy drive while the controller is writing to the floppy disk, the operation will terminate. To continue backup, remove the bad disk from the floppy drive and replace it with a new one, then close the door and momentarily depress the EXECUTE pushbutton again. The controller will attempt to recopy the data onto the new disk and continue where it left off.
2. If hard errors occur while copying the floppy, the operator may insert a new disk into the drive and continue as above, or reformat the diskette using one of the reformat operations and begin the entire backup operation again.
3. If unrecoverable CRC errors occur on the winchester drive during the backup procedure, the controller will write deleted data marks on the floppy for the length of the unrecoverable error code on the seven segment displays. The controller will continue writing deleted data on the floppy until recoverable winchester data is found or the floppy is full.

4.5.4 Reloading the Winchester Disk from Floppy Disks

There are six possible classes which may be selected on the DSD 880.

<u>Mode</u>	<u>Class</u>	<u>Description</u>
6	0	Reload logical unit 0 without verify
6	1	Reload logical unit 0 with verify
6	2	Reload logical unit 1 without verify
6	3	Reload logical unit 1 with verify
6	4	Reload logical unit 2 without verify
6	5	Reload logical unit 2 with verify

1. Insert the first disk to be reloaded into the floppy disk drive and close the drive door.
2. Start the reload program by selecting the desired MODE and CLASS, and momentarily depressing the EXECUTE pushbutton.
3. The seven segment displays will echo the switch setting for as long as the EXECUTE pushbutton is depressed.
4. When the EXECUTE pushbutton is released, the controller will lock the door of the floppy drive and read the disk identifier. If the identifier is valid, the controller will display the disk volume number in the seven segment displays and proceed to copy the contents of the floppy disk onto the winchester disk.
5. When the controller has successfully copied the contents of the floppy onto the winchester, it will unlock the door of the floppy drive and display 00 on the seven segment displays.
6. Repeat steps one and two until all the floppy disks have been reloaded.

Select the desired operating mode of the DSD 880, set the switches accordingly, and momentarily depress the EXECUTE pushbutton. The seven segment displays will indicate the selected MODE and CLASS until the pushbutton is released and execution begins.

Error Reporting During Reload

1. If a hard error occurs during reading the floppy, the same disk may be retried by depressing the EXECUTE pushbutton again. If the error occurs again, the disk may be skipped entirely by removing it and inserting the next disk to be reloaded before depressing the EXECUTE pushbutton.
2. If a disk with an invalid disk identifier is detected, the controller will report an error. The invalid disk must be removed and a valid disk inserted before depressing the EXECUTE pushbutton.
3. If a hard error occurs while the controller is writing to the winchester, the controller will report an error and terminate the reload procedure.
4. An error is indicated by flashing the appropriate error code in the seven segment displays and illuminating the fault and appropriate drive error indicators.
5. If a deleted data mark is detected on the floppy disk during the reload operation, the reload routine will report a deleted data error and continue to copy the questionable data onto the winchester disk.

4.5.5 HyperDiagnostics Mode

The DSD 880 HyperDiagnostics may be used to verify system integrity, troubleshooting and fault isolation. An expanded description of the HyperDiagnostics and their use is provided in Section 7 of this manual.

5.0 BASIC PROGRAMMING INFORMATION

5.1 General Information

This chapter provides basic programming and register usage information for the DSD 880 System.

5.2 Operating Modes

The DSD 880 has three operating modes: normal, extended, and direct access. The floppy disk drive of the 880 emulates a DEC RX02 with double-sided capability in standard or extended mode. The 880 winchester disk drive emulates a DEC RL02 in standard mode and provides RL02 operation with spiral read/write/write check (implied seek) capability in extended mode. Refer to paragraph 4.4.1 for enabling extended mode. The RX02 and RL02 emulations in standard mode are fully hardware and software compatible with DEC operating systems.

The direct access mode is intended for use as a diagnostic aid only. The direct access mode provides additional features not available on the DEC RX02 or RL02. The HyperDiagnostics are microcode routines for stand alone self-testing and detailed disk system status reporting.

5.2.1 Single-Sided Operation

The floppy disk drive in the DSD 880 operates as a single-sided disk drive, with single-sided diskettes, and provides a true emulation of the DEC RX02.

5.2.2 Double-Sided Operation

The DSD 880 floppy disk drive is configured for double-sided operation either through standard system options, or by using the DSD supplied patches.

5.2.3 Programming Interface

The system interface for the DSD 880 varies according to both the host computer type and the operational mode for which the system is configured. The DSD 880 operating characteristics are embedded in the DSD 880 controller.

5.3 DSD 880 Floppy Disk Operation and Programming

Data are transferred to and from the diskette in fixed-length blocks called sectors. A sector contains 64, 16-bit words when using single-density diskettes, and 128, 16-bit words when using double-density diskettes.

The programmer can direct the DSD 880 controller to perform several tasks. Each of these tasks facilitates the storage and retrieval of information on a diskette.

For example, two operations are needed to move a sector of data from main memory to a particular sector on a diskette. The first operation, a fill buffer, moves the data from computer main memory to a RAM buffer internal to the disk controller. The second operation, write sector, positions the read/write head of the flexible disk drive over the specified portion of the diskette and writes the data from the controller sector buffer onto the diskette.

The handler communicates the task requirements to the DSD 880 controller through two physical peripheral device registers which are addressable as though they are in computer memory. The control and status register is normally located at address 777170 octal. The data buffer register is normally located at address 777172 octal.

There are a total of seven logical registers described in this section. These registers represent such information as data, controller status, track addresses, and sector addresses. The handler always reads and writes logical registers through the data buffer register, which is a physical register.

Writing a specific bit pattern to the control and status register initiates a task. Each task is associated with a specific protocol, a set of rules which determines the parameters, or data the computer should pass through the data buffer register during the execution of a task.

For example, operations which move the read/write head in the disk drive require a track address and a sector address. The protocol for these functions is as follows:

1. The command is written to the control and status register.
2. The sector address is written to the data buffer register when the controller requests it.
3. The track address is written to the data buffer register when the controller requests it.

Programmed input/output is used to transfer parameters, but direct memory access (DMA) is used to transfer data between the controller and main memory.

5.3.1 Addressable Registers in RX02-Compatible Operation

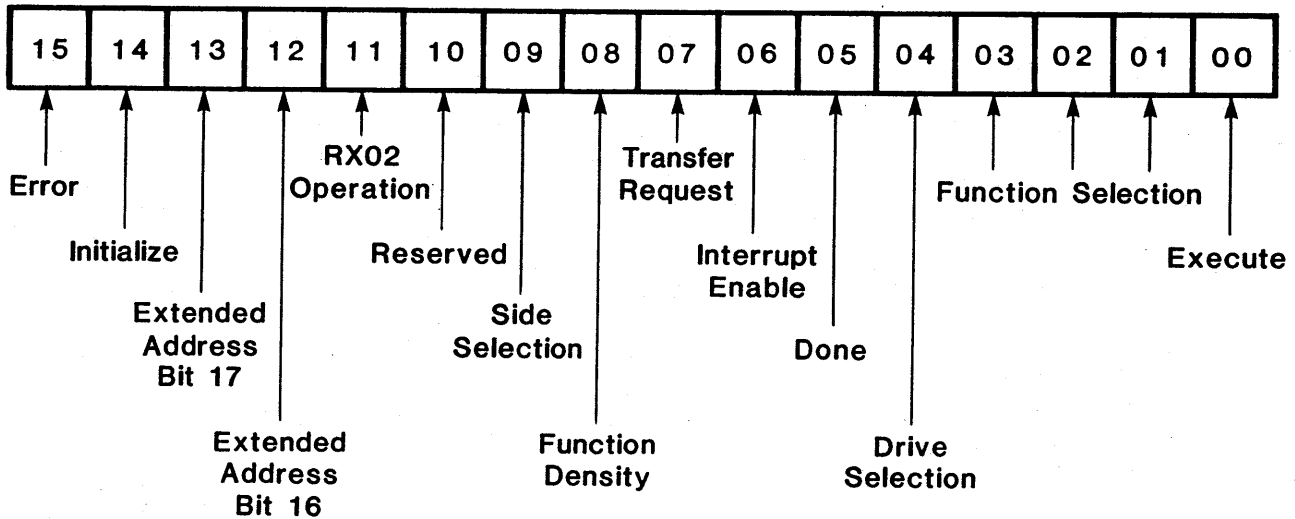
Programs communicate with the DSD 880 through two physical registers, the command and status register (RX2CS), and the data buffer register (RX2DB).

The peripheral device registers reside in the top 4K-words memory address space in DEC-11 computers. The registers are addressed as memory, and any instruction that operates on a memory location can operate on a peripheral device register in the same way, except that certain bits may indicate read only or write only.

Note that the data buffer register, a physical register acts as a multiple-use logical register as explained under Data Buffer Register (RX2DB). (See paragraph 5.3.3.)

5.3.2 Command and Status Register

This register is normally at location 777170 (octal) in the memory address space. The bits of this physical register control the DSD 880 floppy disk. The format for this register is shown in Figure 5-1. The RX2CS register also provides the user program with status information and error indications.



TP 107/81

Figure 5-1. Command and Status Register

BIT 15 - ER - Error

This read-only bit is set by the RX02 to indicate that an error has occurred during an attempt to execute a command. It is cleared by the initialize bit (bit 14) hardware bus initialize or by issuing a new command.

BIT 14 - IN - Initialize the DSD 880 floppy disk system

The DONE flag is reset. The controller resets some internal variables and executes the self-test microcode. The disk floppy drive goes to the home position (track 0).

If the controller is operating in the normal mode, and the drive is ready, it reads track 1 sector 1 of the diskette in drive 0. Attempting the read sector operation sets the initialize done bit in the command and status register. Bit 14 is a write-only bit.

BIT 13 - A17 - Extended address bit 17

This write-only bit is asserted on Unibus or Q-Bus address line 17 (A17) when the DSD 880 transfers data by DMA. An initialize bit clears this bit. A17 toggles if A01 through A16 are all ones and the bus address register increments.

BIT 12 - A16 - Extended address bit 16

This write-only bit is asserted on Unibus or Q-Bus address line 16 (A16) when the DSD 880 transfers data by DMA. An initialize bit clears this bit. A16 toggles if A01 through A15 are all ones and the bus address register increments.

BIT 11 - RX02 system identification

The software normally uses this read-only bit to differentiate RX01 systems from RX02 systems. The DSD 880 always sets this bit.

BIT 10 - XX - Reserved for possible future use

BIT 9 - HS - Head select

This read/write bit selects side 0 or side 1 (lower head or upper head). It is set to select side 1, and cleared to select side 0.

BIT 8 - DEN - Density of function

This read/write bit specifies the density for the function encoded in bits 1, 2, and 3. This bit specifies high density when it is set.

NOTE

Even though the fill buffer and empty buffer functions do not use magnetic media, a valid density bit is required for the controller to evaluate the validity of the word count parameter.

BIT 7 - TR - Transfer request flag

This read-only bit indicates to the program that the data buffer register is empty and needs loading, or is loaded and needs emptying.

BIT 6 - IE - Interrupt enable

This read/write bit, when set, allows an interrupt to be generated whenever the done flag is set.

BIT 5 - DN - Done flag

This read-only bit indicates the completion of an operation. The bit works in conjunction with the interrupt enable (IE) bit to generate interrupts.

BIT 4 - UNI - Unit select

This read/write bit selects floppy drive 0 or drive 1. In the DSD 880, the floppy drive selected is always drive 0. Drive selection occurs only if a drive-related function is executed.

BITS 3 through 1 - F2, F1, F0 - Function select

The binary encoding of these write-only bits selects the function to be performed by the DSD 880 system as indicated below:

<u>F2</u>	<u>F1</u>	<u>F0</u>	<u>Command Specified</u>	<u>Octal Function Code</u>
0	0	0	Fill Buffer	0
0	0	1	Empty Buffer	1
0	1	0	Write Sector	2
0	1	1	Read Sector	3
1	0	0	Set Media Density	4
1	0	1	Read Status	5
1	1	0	Write Deleted Data Sector	6
1	1	1	Read Error Code	7

BIT 0 - EX - Function execute

This bit controls the execution of the function encoded in bits 1 through 3 of this register. This is a write-only bit.

5.3.3 Data Buffer Register (RX2DB)

The RX2DB data buffer register provides the communication link between the host processor and the DSD 880 system. The register transfers data to and from the controller data buffer. The logical register information passing through the register depends on a predetermined protocol.

If the DSD 880 is not executing a command, the RX2DB can be modified without risk of adverse effects. However, during the execution of an instruction, the RX2DB register provides or accepts information (according to the RX2DB protocol) whenever the transfer request flag is set.

CAUTION

Data may be lost if an incorrect protocol is followed.

The following descriptions explain the various logical register formats of the physical data register (RX2DB).

Disk Track Address Register (RX2TA at 777172) - During commands such as write sector and read sector, which require a track number (or a cylinder number) during double-sided operation, the number is written into the physical RX2DB register. Track or cylinder numbers from 0 to 76 (decimal) are valid.

Disk Sector Address Register (RX2SA at 777172) - During commands such as write sector and read sector, which require a sector address, the address is written into the

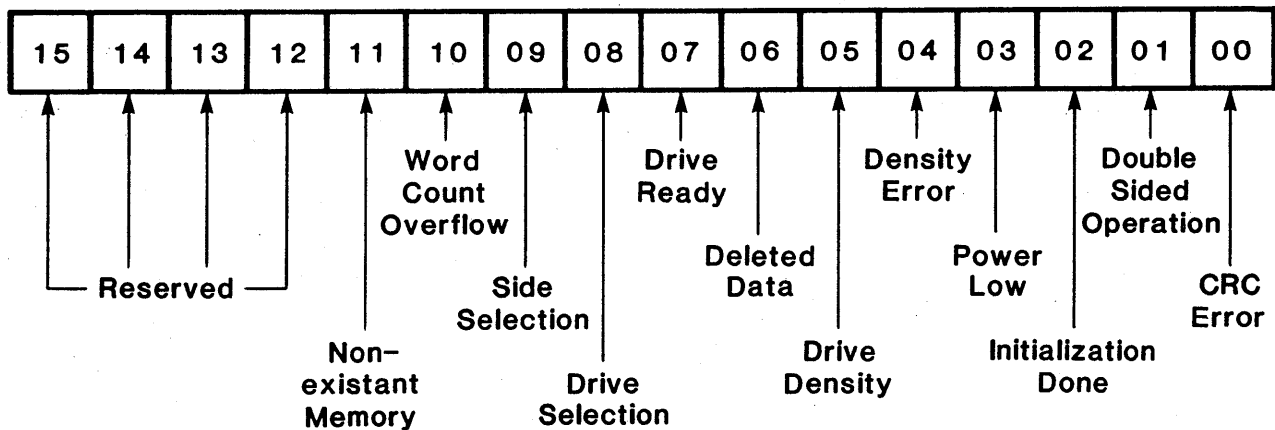
physical RX2DB register. Sectors addresses from 1 to 26 (decimal) are valid. Bits 6 and 7 of RX2SA are masked to zero.

Word Count Register (RX2WC at 777172) - The word count register specifies the number of words for DMA transfer between the controller sector buffer and main memory. For a double-density sector, the maximum word count is 128 (decimal), or 256 bytes. For single-density sector, the maximum word count is 64 (decimal), or 128 bytes. In each case, the programmer loads the actual word count, not the two's complement of the word count, into the word count register.

Bus Address Register (RX2BA at 777172) - This register specifies the bus address for the data transfer during a DMA operation. It increments by two following each data transfer.

The bus address register is write-only. It should always be loaded with the starting memory address of a data buffer at the appropriate time during the fill buffer, empty buffer, or read extended status operations.

System Error and Status Register (RX2ES) - The RX2ES register is another logical register implemented using the physical RX2DB register. It provides error and status information about the drive specified by bit 4 of the (physical) RX2CS register. At the completion of a command, the controller places the contents of the RX2ES register into a data buffer register (RX2DB = 777172) so the host processor can check the status and error results of the most recent operation. When the controller completes an operation that does not select a drive (e.g., fill buffer, empty buffer), the RX2ES unit select and drive density bits remain unmodified. All the other RX2ES bits are cleared at the initiation of each new function. See Figure 5-2 for the format of this register.



TP 108/81

Figure 5-2. System Error and Status Register Bit Format

BITS 15 through 12 - Not used

BIT 11 - NXM - Nonexistent memory error

This bit sets if, during a DMA cycle, the interface does not receive a bus reply when it tries to write or read a word to or from memory. Usually no bus reply means that the

address in the RX2BA or the extended address bits in the RX2CS are invalid. The operation terminates and error and done bits are set. To recover from this error condition, generate either a bus or a programmed initialize.

BIT 10 - WC OVFL - Word count overflow

This bit sets if the word count specified during a fill or empty buffer command is too large for the sector size indicated by the density bit. At a word count overflow, the operation terminates, and the error and done bits are set.

BIT 9 - HD SEL - Head selected

This bit indicates the read/write head selected during the most recent read or write operation. It sets to indicate the upper head, and clears to indicate the lower head.

BIT 8 - UNIT SEL - Unit selected

This bit indicates the disk drive head selected during the most recent read or write operation. It sets to indicate drive 1 and clears to indicate drive 0.

BIT 7 - DRV READY - Drive ready

This bit, when set, indicates that the selected disk drive has a diskette correctly installed and up to speed. The drive ready bit is valid immediately following the read status function. This bit is also valid for drive 0 immediately following an initialization. (See Bit 1, SD1 RDY)

BIT 6 - DD - Deleted data

This bit indicates that a deleted data address mark was found during the most recent read sector operation, or that the most recently executed command was write deleted data sector.

BIT 5 - DRV DEN - Drive density

This bit indicates the density of the diskette in the drive indicated by bit 8. Bit 5 is updated during a read or write sector operation.

BIT 4 - DEN ERR - Density error

This bit indicates that during a read sector, write sector, write deleted data sector, or read status operation the diskette density and the density indicated by the density bit of the RX2CS do not match. Any operation terminates, and the error and done bits are set.

BIT 3 - PWR LOW - Power low

This bit indicates a power failure in the controller/drive subsystem. It also sets if the interface cable disconnects. Any operation terminates, and error and done bits are set.

BIT 2 - ID - Initialize done

This bit indicates that the controller/drive has completed an initialization sequence. This sequence may be initiated by a power failure, a bus or a programmed initialize.

BIT 1 - SD1 RDY - Side 1 ready

Bit 1 and bit 7 are both set when a double-sided diskette is correctly installed and up to speed. When bit 7 is set but bit 1 is clear, a single-sided diskette is installed and up to speed. A single-sided diskette is restricted to side 0 functions only.

BIT 0 - CRC - Cyclic redundancy check error

This bit indicates that a cyclic redundancy check error was detected during the most recent Read Sector operation. The operation terminates, and the error and done bits are set.

5.3.4 Floppy Disk Controller Command Protocols

The following sections describe the protocol for each command that can be sent to the controller. Failure to adhere to the correct protocol results in lost or incorrect data.

Function Code 0 - Fill Sector Buffer Command

The fill sector buffer command fills a storage buffer in the DSD 880 with 128 or 256, eight-bit bytes of data from computer memory. To write the data to the diskette or transfer it back to memory, use other functions.

When the fill sector buffer command is given, the DSD 880 responds by clearing the done flag (RX2CS bit 5). The controller then requests a word count by setting the transfer request flag. The program should respond by writing a valid RX2WC (word count) into the RX2DB. When the controller again asserts transfer request, the program should respond by writing a valid starting memory address (RX2BA) into the RX2DB.

Loading RX2BA clears transfer request, and it remains clear for the duration of the fill sector buffer. The data bytes transfer directly from memory to the controller sector buffer. The done flag sets when the word count is decremented to zero and the controller has zero-filled the remainder of the sector buffer (if necessary). Also, if interrupts are enabled (RX2CS bit 6 is set) when the done flag sets, an interrupt request occurs. The contents of the RX2ES register are left in the RX2DB at the completion of the operation.

NOTE

Bit 4 of the RX2CS does not affect this function because no disk drives are selected. The density bit, RX2CS bit 8, must be set correctly because the controller uses this bit in evaluating the validity of the word count.

Function Code 1 - Empty Sector Buffer Command

The empty sector buffer command transfers the contents of the floppy sector buffer to main memory. The sector buffer is loaded from a previous fill sector buffer or read sector command.

The controller responds to an empty sector buffer command by clearing the done flag (RX2CS bit 5). The controller then sets the transfer request flag (RX2CS bit 7) to request the contents of the word count register. The program should respond by loading a valid word count into the data buffer register.

When transfer request is asserted again, the program responds by loading the starting memory address into the data buffer register. The controller then clears the transfer request flag which remains clear for the rest of the operation.

The data in the sector buffer is transferred to memory one word at a time, decrementing the contents of the word count register at each transfer, until the word count becomes zero. When the data transfer is completed, the controller places the contents of RX2ES into the data buffer register and sets the done flag. If the interrupt enable bit is set, setting the done flag initiates an interrupt request.

The information above, which applies to the fill buffer command, applies equally to the empty sector buffer command. Note that the empty buffer operation does not modify the contents of the sector buffer.

Function Code 2 - Write Sector Command - (Bit 9 selects side 0/side 1)

The write sector command transfers the contents of the sector buffer to a specified track and sector of the diskette.

When the write sector command is given, the controller clears the logical RX2ES register and the done flag.

Next, the transfer request flag (RX2CS register bit 7) is set to request the sector address (RX2SA) from the CPU. When the sector address is received, the transfer request flag is removed. The transfer request flag is then set to request the desired track address (RX2TA) from the CPU. When the track address is written to the RX2TA, the transfer request flag is cleared.

After the track address is received, the controller makes the selected drive seek the desired track. Transfer request is left reset for the remainder of the operation. The heads are loaded against the media and positioned over the specified track. If the controller does not know the density and format of the media, it reads a random sector on the target track to determine the density.

If the media density does not agree with the command density (RX2CS bit 8), the operation terminates and bit 4 of the RX2ES register indicates a density error. If the densities agree, the controller checks the track address and looks for the specified sector address. If the correct track and sector are found, the controller writes either 128 bytes of single-density data or 256 bytes of double-density data from the sector buffer to the diskette. Two CRC bytes are written immediately after the data.

If the controller finds an invalid track address, the extended status error code is set to 40. If the contents of RX2TA does not match the track address from the header, the extended status error code is set to 150. If the specified sector cannot be found within the two diskette revolutions, the extended status error code is set to 70. Either of these error conditions or a density error terminates the operation. The error flag (RX2CS bit 15) and the done flag (RX2CS bit 5) are asserted when the function terminates due to an

error condition. As with the error free termination, an interrupt request is generated if the interrupt enable bit is set when the done flag becomes true. The extended error status can only be read by the read extended status command (17g).

NOTE

The contents of the sector buffer are not modified by the write sector function. If the contents of the sector buffer are modified as a result of a power failure or the initialize command, users must be sure that valid data are written back into the sector buffer. This is especially true before executing the write sector command. If a sector number of 154 or 155 is written to the RX2SA, the write sector function turns into a write format track function.

Function Code 3 - Read Sector Command (Bit 9 selects side 0 or side 1)

The read sector command locates a specified track and sector of a diskette and transfers the contents of the data filed into the sector buffer in the controller.

The controller clears the logical RX2ES register and the DONE flag when the read sector command is given. Next, the transfer request flag sets (RX2CS bit 7) to request a sector address. The program responds by writing the desired sector address (RX2SA) into the data buffer register, RX2DB (at 177172 typically), which clears the transfer request. After receiving the sector address, the transfer request flag is again set to request the track address. The program responds by writing the desired track address into the RX2TA (at 177172, typically). When the RX2TA is received, the transfer request flag is again cleared.

After receiving the track address, the controller causes the selected drive to seek the desired track. Transfer request is left reset for the remainder of the operation.

The controller loads the heads against the media and determines the density of the media if the density is unknown. If the diskette density does not agree with the command density (RX2CS bit 8), an error is reported and the operation terminates. If the densities agree, the controller looks for the specified sector. When the correct sector is located, the controller looks for the appropriate data or deleted data address mark.

If a data address mark is found, the controller transfers the next 128 bytes (single-density) or 256 bytes (double-density) into the sector buffer followed by the two CRC bytes. An error free read is indicated if the address mark, data bytes, and two CRC bytes produce a zero residue when passed sequentially throughout the CRC checker hardware circuits. As soon as the data are available in the buffer, the controller terminates the operation by writing the contents of RX2ES to the data buffer register and setting the done flag. An interrupt request is generated if the interrupt enable bit is set when done becomes true.

If a deleted data address mark is detected, the controller sets the deleted data flag. This flag appears in the error/status register (as RX2ES bit 6). If a CRC error is detected, the controller sets RX2ES bit 0 and the error flag (RX2CS bit 15). Seek errors and missing-sector errors are reported as in the write sector command.

Function Code 4 - Set Media Density Command

This command initializes an entire DEC-formatted diskette to a specified density. When the set media density command is executed, the controller attempts to write zeroes in every field on the diskette. Bit 8 of the RX2CS determines the recording density and the type of data address mark to be written in each data field. No sector headers are written when the set media density command is executed.

When the set media density command is received, the controller clears the done flag. Next, the controller sets the transfer request flag. The program responds by writing a key byte into the physical register RX2DB. If the key byte is an ASCII I (111 in octal), the set media density function is executed. If the key byte written into the RX2DB is not an I, the done and error flags are set and the operation terminates. The extended error status register is then loaded with 250 to indicate an invalid key byte. The purpose of the key byte is to make accidental erasure of the data on a diskette difficult.

As soon as the safety character I is received, the controller moves the heads to track 0. When sector 1 is found, the controller starts writing. If bit 8 of the RX2CS is a 0, a single-density data address mark and 128 FM-format zeroes are written. If bit 8 of the RX2CS is a 1, a double-density data address mark and 256 DEC-MFM-format zeroes are written. After writing all 26 sectors on the track 0, the controller seeks track 1, track 2, etc., writing all 26 sectors on each track. If the disk is double-sided, the second is done automatically. The write continues until either every sector has been written through track 76: sector 26 or a bad header is found. The error and done flags are set if the operation terminates due to a bad header.

The set media density command requires approximately 27 seconds for a single-sided disk, and 54 seconds for a double-sided disk, depending on the sector interleave. Never interrupt the set media density command before it is completed. If the function does not terminate normally, an illegal diskette with data address marks of both densities may be created. In this case, completely rewrite the diskette. If the set media density command is incomplete due to an unreadable header, use the track format procedure to rewrite the incorrect header information.

Function Code 5 - Read Status Command

The read status command determines the current status of the drive selected by RX2CS bit 4. The information returned consists of the drive readiness status and the density of the diskette currently in the drive.

Issuing the read status command clears the done flag. The controller checks that the door of the selected drive is closed, a diskette is inserted, and the diskette is up to speed. Diskette speed is determined by measuring the amount of time between successive index pulses. Because this measurement takes an average of 250 milliseconds, excessive use of the read status function causes reduced throughput. If the drive is ready, the controller sets bit 7 (drive ready) of the RX2ES, then loads the heads and reads the first sector it finds. If the disk is double-sided, bit 1 of the RX2ES is set to 1.

If a double-density address mark is detected, bit 5 (drive density) of the RX2ES is set. If a single-density mark is found, bit 5 is cleared. The controller terminates the function by shifting the contents of the RX2ES to the RX2DB and setting the done flag. An interrupt request is generated if the interrupt enable bit, RX2CS bit 6, is set when done becomes true.

Function Code 6 - Write Deleted Data Sector Command

This command performs the same task as the write sector command, except that it writes a deleted data address mark just before the data field. The standard write sector command writes a regular data address mark. Reading a sector written with a deleted data address mark sets bit 6 of the logical RX2ES register.

The density bit associated with this function (RX2CS bit 8) determines whether a single- or double-density deleted data address mark is written.

Function Code 7 - Read Extended Status Command

The read extended status command retrieves information from several internal controller registers, including the error register, as shown below. These registers are transferred to memory using DMA. As soon as the command is loaded into the RX2CS, the done flag clears. The controller then asserts the transfer request flag.

The program then loads a starting memory address into the RX2DB. The controller transfers four words directly to memory. When the words are in memory, the controller asserts done, generating an interrupt request if interrupts are enabled.

The words transferred to memory are as follows:

Word 1	:	BITS	0 - 7	Error Code (See Table 5-1)
	:	BITS	8 - 15	Word Count Register
Word 2	:	BITS	0 - 7	Current Track Address of Drive 0
	:	BITS	8 - 15	All 0s
Word 3	:	BITS	0 - 7	Target Track of Current Disk Access
	:	BITS	8 - 15	Target Sector of Current Disk Access
Word 4	:	BIT	0	Density of Read Error Register Command
	:	BITS	1, 2, 3	Unused
	:	BIT	4	Drive Density of Drive 0
	:	BIT	5	Head Load Bit
	:	BIT	6	0
	:	BIT	7	0
	:	BITS	8 - 15	Track Address of Selected Drive

Table 5-1. Error Register Codes for RX2ES
(Function Code 7)

<u>Octal Code</u>	<u>Description</u>
000	No errors
010	Drive failed to home on initialize
020	Nonexistent drive

Table 5-1. Error Register Codes for RX2ES (Cont)
(Function Code 7)

<u>Octal Code</u>	<u>Description</u>
030	Track 00 found while stepping in on initialize
040	Invalid RX02 track address
050	Track 00 found before desired track while stepping in
070	Requested sector not found in 2 revolutions
100	Write protect violation
120	No preamble found
130	Preamble found but no address mark within window
140	CRC error on what appeared to be a header
150	Address in header did not match desired track
160	Too many tries for an ID address mark
170	Data address mark not found in allotted time
200	CRC error on data field
240	Media density did not match desired density (RX02 only)
250	Wrong key in set media density command
260	Indeterminate media density (RX02 only)
270	Write format failure
350	Nonexistent memory error during DMA
360	Drive not ready (door open, speed error, absent media)
370	Low ac power caused abort of write activity

5.3.5 Diskette Formatting

When configured for RX02 operation, the DSD 880 can format diskettes in the two formats shown in Table 5-2. The entire diskette is formatted.

NOTE

The DEC RX02 does not support the command protocol described below. It is a special feature which is unique to the DSD 880.

1. The program issues the write sector function code (010) to the controller using the command and status register. The density bit (bit 9) is ignored. The side bit is also ignored.
2. The controller then clears the done flag and sets the transfer request flag (bit 7 RX2CS).
3. The user must then write an octal value corresponding to the desired format into the data buffer (RX2DB). The controller sets transfer request flag again. The user then writes 0 into RX2DB. Table 5-2 lists the available formats. When the operation is completed, the controller sets the done flag. An interrupt occurs if bit 6 (interrupt enable) is set prior to the format command.

Table 5-2. Diskette Format Codes

ID Code	Description	Density	# Sectors/ Track	Track #
154g	Format the entire disk with FM-coded single-density. Both sides of a double-sided diskette are formatted.	Single	26	0 to 76
155g	Format the entire disk with DEC-modified MFM, double-density. Both sides of a double-sided disk are formatted.	Double	26	0 to 76

5.3.6 Power Fail

When a power failure occurs, or dc power to the DSD 880 is interrupted, the controller gradually drains the filter capacitors and stops executing microcode. The done and error bits set in the RX2CS and the power low bit sets in the RX2DB to signal to the program that the controller/drive subsystem has lost power.

When power is restored, the DSD 880 controller initiates the following sequence:

1. Clears done.
2. Executes the hardware self-tests.
3. Positions drive to track 00.
4. Clears RX2ES of all active error bits.
5. Reads sector one, track one of the floppy disk into the floppy buffer, if the drive is ready, and leaves floppy head at track one.
6. Sets bit 2 of RX2ES (initialize done).
7. Updates bits 7 (drive ready) and 5 (drive density) of RX2ES according to the status of drive 0.

At the end of this sequence, the controller sets RX2CS bit 5 (the done flag).

5.3.7 Common Programming Mistakes

Use the following descriptions of common programming mistakes and hints to avoid data loss and/or error conditions.

1. Sending an illegal track or sector address to the controller. Note that the valid sectors are one through 26 (decimal), and the valid tracks are 0 through 76 (decimal).

2. Providing an incorrect word count for the length of a variable length sector/density set in the fill or empty command.
3. Underestimating the duration of the read status command. The read status command requires up to two revolutions of the disk to complete. To avoid excessive delays, use this command only when necessary.
4. Not checking the initialize done bit following a read or write operation. A short power outage will set the done flag without any error indication. After reading or writing, check the initialize done (RX2ES bit 2) for an indication of power failure.
5. Decoding the drive select bit during fill buffer and empty buffer operations. The drive select bit, RX2CS bit 4, may not be decoded by the controller during fill buffer and empty buffer functions.
6. Using a one-sector interleave. Use a two-sector interleave (sectors 1, 3, 5, etc.) for optimal data transfer rate.
7. Using the incorrect type of diskette. For both single-density and double-density recording, use only a 26 sector per track diskette. Do not use a hard sectored disk (multiple sector/index holes).
8. Typically a fill buffer command precedes a write sector command. Similarly, a read sector command precedes an empty buffer command.

5.3.8 Interrupts

The interface module requests an interrupt whenever the interrupt enable and done flag bits of the RX2CS both become set. The standard interrupt vector address is location 264 octal.

5.4 DSD 880 Winchester Disk Operation and Programming

The DSD 880 winchester disk drive has two operating modes. In the normal mode, the drive emulates a single DEC RL02 with a formatted capacity of 10.4 megabytes. Refer to paragraph 4.4.1 for extended mode operation.

5.4.1 Bad Track Mapping

The winchester drive used in the DSD 880 provides 512 cylinders, with six/eight tracks per cylinder and 32 sectors per track. Each sector contains 256 bytes, so the total capacity of the winchester drive is 98,304/131,072 sectors or 25,165,824/33,544,432 bytes.

The current state of the art in the production of winchester recording media is such that it is not possible to guarantee a flawless recording surface; it is expected that there will be a certain number of defects on the disk. The locations of these defects are recorded at the factory in a bad-track map, located on physical cylinder 0 of the winchester drive. The DSD 880 controller automatically reads this bad track map when

power is first applied, and subsequent accesses of the winchester disk are adjusted automatically by the controller to avoid the flawed areas. Twelve tracks per head, or 96 tracks in all, are reserved as spares.

It is possible to add entries to the bad track map, by use of a special diagnostic program (WINEXR) supplied by DSD. Its use is described in Appendix E of this manual. The winchester disk should be backed up onto floppy disks prior to use of the WINEXR program. A hard-copy record is made at the factory of the data entered into the bad track map. This record is stored in an envelope on the front of the winchester drive, just behind the HyperDiagnostic panel. Changes to the bad track map should be noted on the record.

The bad track map and spare tracks are not available for user data storage. The bad track map configuration is as follows:

- Sector 0 of cylinder 0 holds backup information
- Sector 1 of cylinder 1 holds the headers for the bad track map
- Sectors 2 to 31 of cylinder 0 (heads 0 through 7) hold the bad track map and option flags.

Option flags are:

Nibble 504: Winchester Type:
0001- /8
0011- /20
0100- /30

Nibble 506: Floppy Type
0- No Floppy
1- SA800 (Single-Sided)
2- SA850 (Double-Sided)

Nibble 507: 2 or 3 Way Flag
0 = 3-Way
1 = 2-Way

Nibbles 508 through 511 contain the bad track map checksum.

5.4.2 Extended Mode

Extended mode also provides a spiral read/write/write check capability. The DEC RL02 requires that a seek command be issued to position the heads, followed by a read, write, or write check command to do the data transfer. The read, write, or write check command must specify the same cylinder and head set up by the seek command. If the word count exceeds the capacity of a single track, an error will result. In extended mode, the DSD 880 will seek to the specified cylinder and head on receipt of a read, write, or write check command, and will seek again if the word count exceeds the capacity of a single track; it is actually not necessary to use seek commands at all. DEC software does not support this feature, but it may be useful when special handlers are being planned. Refer to paragraph 4.4.1 for enabling extended mode.

5.4.3 DEC Bad Block Map

DEC provides a method of flagging bad blocks (one block is two sectors) in the RL02 by providing a list of bad blocks on the last track of the disk pack, (cylinder 777 octal, head 1 for the RL02). This technique is fully supported by the DSD 880 since the bad block maps are present on the winchester disk and the correction for bad blocks is handled by DEC software. The DSD WINEXR diagnostic which updates the bad track map also writes valid bad block data into the appropriate sectors.

DEC provides utility programs to add entries into the bad block area. These may be used with the DSD 880. The bad block data will be saved on floppy disks during a backup operation, and will be restored during the reload operation. This should be taken into consideration if the backup and reload functions are used to transfer a disk image between different DSD 880s.

5.4.4 Addressable Registers

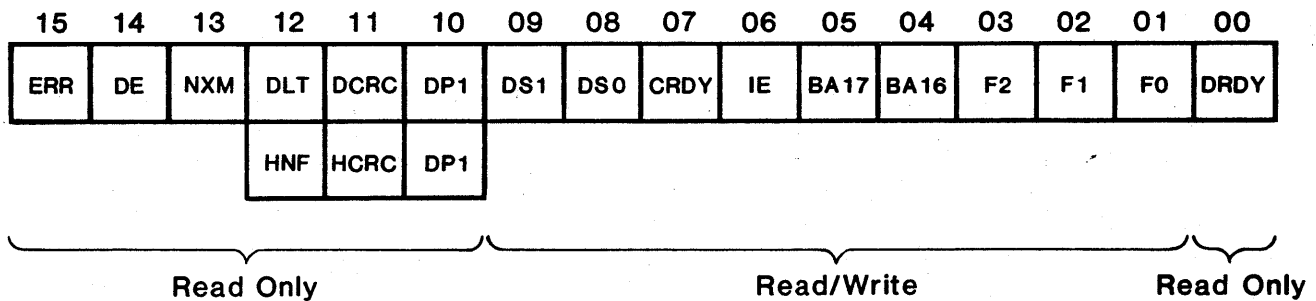
The DSD 880 winchester disk drive (RL02 emulation) provides the following four types of physical, addressable registers:

- Control Status Register
- Bus Address Register
- Disk Address Register
- Multipurpose Register

These registers are described below.

5.4.5 Control Status Register

The 16-bit control status (CS) register has a base address of 774400. As shown in Figure 5-3, bits 1 through 9 and read/write bits (bit 0 and 10 through 15) are read-only.



TP 234/81

Figure 5-3. Control Status Register Format

A bus initialize sets bits 7 and 0 (continuously) and clears bits 1 through 6 and 8 through 13.

The start of each controller command clears the error indicating bits (10 through 13). The completion of each controller command sets bit 7. Note that the detection of an error during command execution also sets bit 7. The function of the control status register bits is detailed below.

BIT 15 - ER - Composite error

When set, this bit indicates that at least one of the error detection bits (bits 10 through 14) is set. Note that if an error occurs when the interrupt enable bit (bit 6) is set, the current operation terminates and interrupt occurs.

BIT 14 - DE - Drive error

This bit is set if a winchester drive related error occurs. The execution of a get status command identifies the source of the drive error. Clear this bit by correcting the drive error or by executing the get status command with bits 3, 0, and 1 of the data address register set.

BIT 13 - NXM - Nonexistent memory

During a DMA data transfer, bit 13 set specifies that no memory response was received with 10 to 20 μ s.

BIT 12 - DLT/HNF - Data late or header not found

The function of this bit is explained as follows:

<u>OPI (Operation Incomplete)</u> <u>(bit 10)</u>	<u>DLT/HNF</u> <u>(bit 12)</u>	<u>Indication</u>
Set	Set	Header not found; controller search for the correct read or write sector exceeded the 200 milliseconds timeout limit.

BIT 11 - DCRC/HCRC - Data or header cyclic redundancy check (DCRC or HCRC)

This bit indicates data and header cyclic redundancy check errors as follows:

<u>OPI (Operation Incomplete)</u> <u>(bit 10)</u>	<u>DCRC/HCRC</u> <u>(bit 11)</u>	<u>Indication</u>
Cleared	Set	Data CRC error
Set	Set	Header CRC error

NOTE

On a write check command, DCRC/HCRC set and OPI clear indicates that the CRC error is a write check error.

BIT 10 - OPI - Operation incomplete

OPI sets when an error occurs which prevents transfer of data.

BITS 8, 9 - DS0, DS1 - Drive select

These bits specify which drive communicates with the controller. Note that the DSD 880x/20 supplies DL0 and DL1, the 880x/30 supplies DL0, DL1, and DL2.

BIT 7 - CRDY - Controller ready

The software clears this bit to initiate the execution of the command in bits 1 through 3. When this bit is set, the controller is ready to accept another command.

BIT 6 - IE - Interrupt enable

When this bit is set (by software), the controller will interrupt the processor at the normal or error caused termination of a command.

BITS 4, 5 - BA16, BA17 - Bus address extension

These bits function as the two-high order address bits of the bus address register, but are read and written as bits in the control status register.

BITS 1, 2, 3 - F2, F1, F0 - Function

These bits specify the command to be executed according to the following:

<u>F2</u>	<u>F1</u>	<u>F0</u>	<u>Command Specified</u>	<u>Octal Code</u>
0	0	0	NOP (clear errors)	0
0	0	1	Write Check	1
0	1	0	Get Status	2
0	1	1	Seek	3
1	0	0	Read Header	4
1	0	1	Write Data	5
1	1	0	Read Data	6
1	1	1	Read Data Without Header Check	7

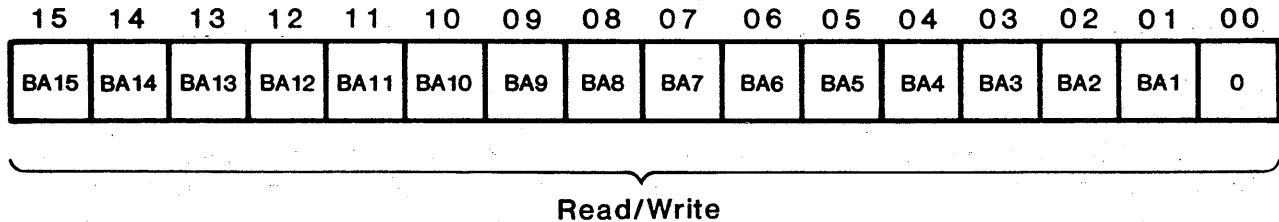
BIT 0 - DRDY - Drive ready

When bit 0 is set, the drive is ready to receive a command.

5.4.6 Bus Address Register

The 16-bit bus address (BA) register has a base address of 774402. The BA register (Figure 5-4) specifies the memory location for the data transfer of a normal read or write operation. At the transfer of each word between the disk drive and the processor bus, the BA register contents increment by two. The BA register may be read only when bit 7 (CRDY) of the CS register is set.

Bit 0 in the BA register is always zero. All 16 bits are read/write bits. To clear the register, execute a bus initialize or load the register with zeroes. Note that the BA register expands to an 18-bit register with bits 4 and 5 of the control status register becoming BA16 and BA17.



TP 110/81

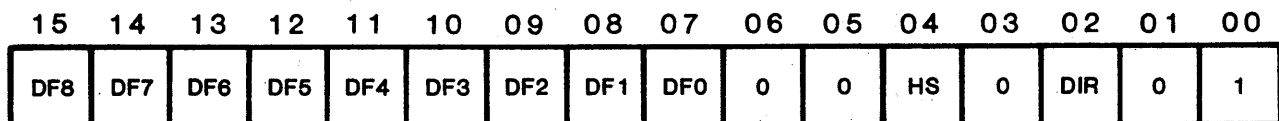
Figure 5-4. Bus Address Register Format

5.4.7 Disk Address Register

The 16-bit disk address (DA) register, at address 774404, is a three function register. The function depends upon the current command as explained below. The DA register may be read only when bit 7 (CRDY) of the CS register is set.

1. Disk Address Register for a Seek Command

During a seek operation, the DA register provides the drive with the head direction, head select, and cylinder address difference as shown in Figure 5-5 and described below:



TP 235/81

Figure 5-5. Disk Address Register Format During a Seek Command

BITS 7 through 15

These bits provide the cylinder address difference, which is the number of cylinders the heads must move for the seek.

BITS 5, 6 - Reserved

BIT 4 - HS - Head Select

This bit specifies upper (HS clear) or lower (HS set) head (and disk surface) for the seek operation.

BIT 3 - Must be 0

BIT 2 - DIR - Direction for the seek operation

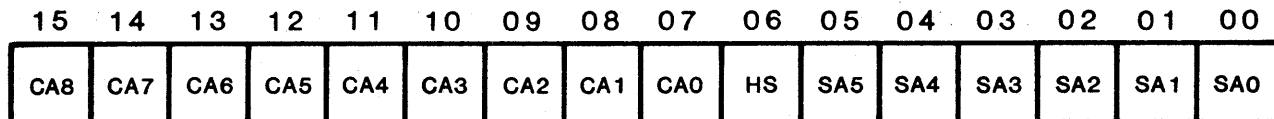
Bit 2 set specifies head movement toward the spindle. The head movement is away from the spindle if bit 2 is clear.

BIT 1 - Must be 0

BIT 0 - Must be 1

2. Disk Address Register for a Read or Write Command

For a read or write operation, the DA register initially contains the address of the first sector for the read or write. The contents of the register increment by one with each sector transfer. Figure 5-6 shows the DA register format for standard mode operation. The contents are described below.



TP 236/81

Figure 5-6. Disk Address Register Format for a Read or Write Command

SA0 through SA5 - Sector address for one of the 40 sectors on the track. (Valid sectors are 0 through 39).

HS - Head select specifies the head (disk surface) for the read or write; upper (clear) or lower (set).

CA0 through CA8 - Cylinder address of one of the 512 cylinders. CA8 is used for extended mode only.

3. Data Address Register for a Get Status Command

The contents of the DA register for a get status command are shown in Figure 5-7 and explained in the following.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
X	X	X	X	X	X	X	X	0	0	0	0	RST	0	GS	1

TP 113/81

Figure 5-7. Disk Address Register Format for a Get Status Command

BITS 8 through 15 - Not used

BITS 4 through 7 - Must be 0

BIT 3 - RST - Reset

When the bit is set, the drive first clears the error bits, then sends the status word to the controller.

BIT 2 - Must be 0

BIT 1 - GS - Get status

This bit must be a 1 to request the status word from the drive and to direct the drive to ignore bits 8 through 15. As soon as the get status command is completed, the controller multipurpose register (described below) is loaded with the drive status word.

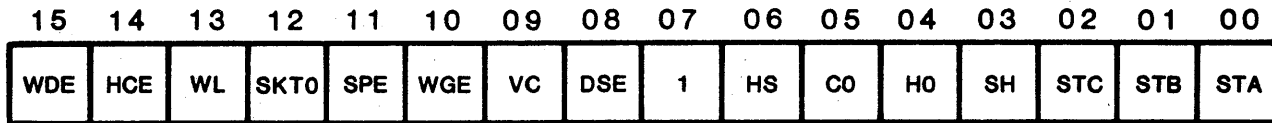
BIT 0 - Must be a 1

5.4.8 Multipurpose Register

The 16-bit multipurpose (MP) register, like the disk address register, is a triple-function register. The function depends on the command used.

1. Multipurpose Register for a Get Status Command

When a status word is returned to the controller following execution of a get status command, the MP register contents are as pictured in Figure 5-8 and explained below. The MP register may be read only when bit 7 (CRDY) of the CS register is set.



TP 237/81

Figure 5-8. Multipurpose Register Format for a Get Status Command

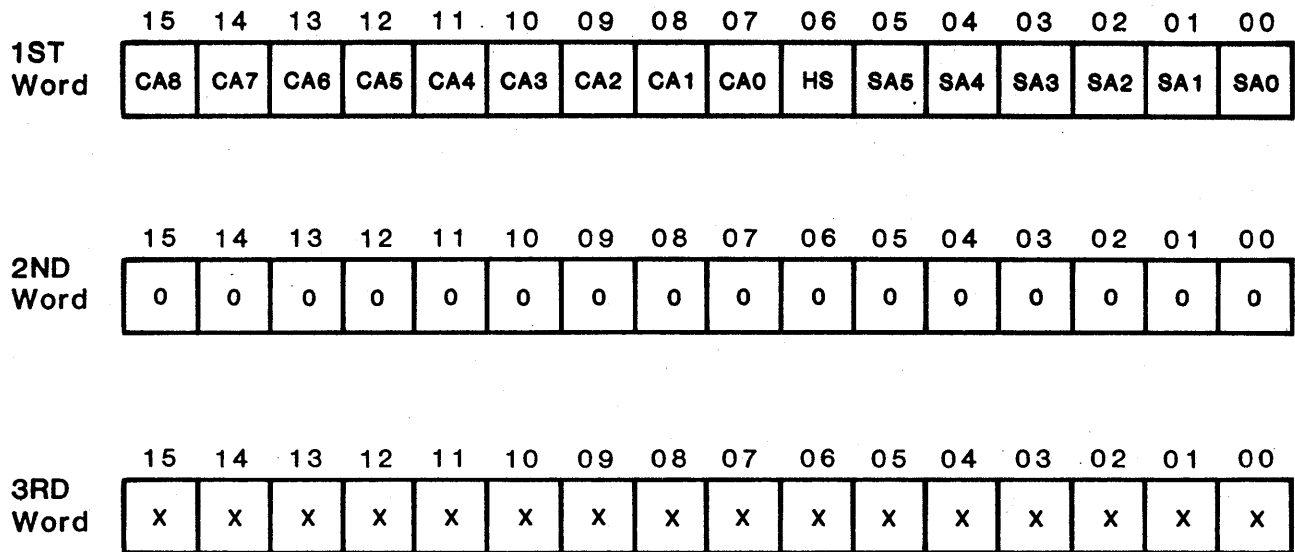
- BIT 15 Always 0
- BIT 14 Head Current Error - write current was detected in the heads when the write gate was not asserted
- BIT 13 Write Lock - winchester drive is write protected
- BIT 12 Seek Timeout - winchester drive did not complete a seek in the allotted time
- BIT 11 Speed Error - winchester drive not ready
- BIT 10 Write Gate Error - set when write fault is set in winchester drive
- BIT 9 Always 0
- BIT 8 Drive Select Error - attempt was made to select a nonexistent drive
- BIT 7 Always 1
- BIT 6 Head Select - this bit specifies the head currently selected (0 or 1)
- BIT 5 Always 0
- BIT 4 Heads Out - always 1
- BIT 3 Always 1
- BITS 0 - 2 STA, STB, and STC - States A, B, and C

These bits define the current state of the winchester drive as follows:

<u>C</u>	<u>B</u>	<u>A</u>	<u>State Specified</u>
0	0	0	Load
1	0	0	Seek
1	0	1	Lock On

2. Multipurpose Register During a Read Header Command

Execution of a read header command loads three words into the MP register. The first word contains the sector address, head select, and cylinder address information. The second word is all zeroes; the third word contains the header CRC data. Figure 5-9 shows the format for each word. The MP register may be read only when bit 7 (CRDY) of the CS register is set.



TP 115/81

Figure 5-9. Multipurpose Register Format for a Read Header Command

3. Multipurpose Register for a Read/Write Data Command

The multipurpose register acts as a word counter when the drive is reading or writing data. Initially, the MP register is loaded with the two's complement of the number of words to be transferred. Word counter overflow normally terminates the read or write operation. Figure 5-10 shows the MP register during a read/write data command in both standard and extended operating modes. The largest valid word count for the normal mode is 5120 words. The longest valid word count for the extended mode (where a spiral read/write is allowed) is 65536 words.

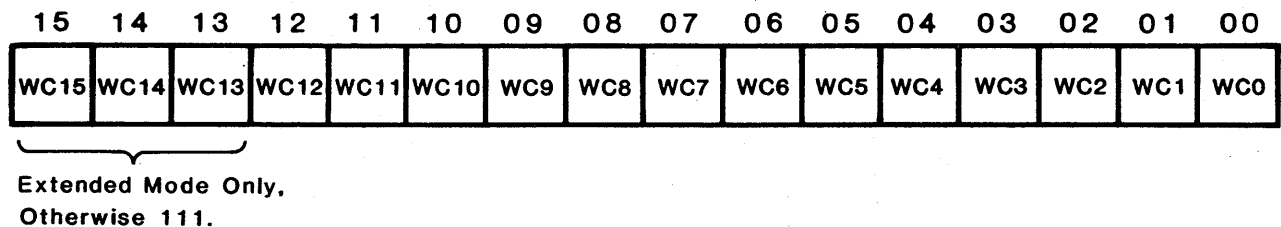


Figure 5-10. Multipurpose Register Format for a Read/Write Data Command

5.4.9 Winchester Controller Commands

The winchester disk drive commands to the controller are specified by bits 1, 2 and 3 of the CS register.

Function Code 0 - NOP

The drive clears errors (except for a drive error in the CS register), sets the CRDY bit in the CS register, and causes an interrupt if interrupts are enabled (IE is set).

Function Code 1 - Write Check Command

Write check command verifies that data were accurately written on the disk in the following manner. The write command writes a block of data from the data buffer in main memory onto the disk. Then the write check reads that block of data from the disk and serially compares it with the original data in the data buffer. Note that this comparison occurs in the controller which requires a source data transfer from memory into the controller data buffer.

Before executing the write check command, initialize the BA, MP (word count), and DA registers as follows:

Register	Contents
Bus Address	Address of first data block in main memory
Multipurpose (Word Count)	Length of the data block
Disk Address	Starting disk address location

Immediately, the DMA transfer of data from the main memory data buffer to the controller begins. The logical RL02 disk address is mapped onto a physical winchester disk address and header address words, read from the disk, are compared to the starting physical address.

As soon as the starting address is found, the controller is monitored until it contains a complete sector. If there are no header cyclic redundancy check (HCRC) errors, the data (1 to 5,120 words in normal mode, 65,536 words in extended mode) are then read from the disk and compared to the data in the controller's data buffer. An error in this comparison, or in the data cyclic redundancy check, sets the DCRC bit in the CS register.

Function Code 2 - Get Status Command

Upon execution of the get status command, the drive sends the drive status word to the controller if the get status bit (bit 1) in the DA register is set. The get status command loads the drive status word into the MP register. The controller sets CRDY and causes an interrupt, if interrupts are enabled (IE set). Note that if bit 3 (RST, the reset bit) of the DA register is set, the drive first clears the error bits then sends the status word.

If the get status bit in the DA register is clear, the get status command is undefined and an error is repeated.

Function Code 3 - Seek Command

On execution of a seek command DA0 will be set and DA1 cleared in the DA register. On receiving the seek information, the controller will set CRDY and enable interrupts if IE is set. The seek information includes the head direction, head select, and cylinder address difference. When the drive receives the seek information from the controller, it seeks and/or selects a new read/write head. DA0 must be set and DA1 clear for a seek command; any other combinations are undefined, and an error is repeated.

If the size of the cylinder address difference would move the heads beyond permissible limits (inside the innermost track or beyond track 0), the head stops at the limit track. A maximum length seek out may therefore be used as restore command.

Function Code 4 - Read Header Command

This command finds the current location on the disk as follows. If CRDY is clear, a Read Header command causes the controller to read the current disk location into the MP register. The controller then sets CRDY and, if interrupts are enabled (IE is set), causes an interrupt. To obtain the two header words, the software can then read the MP register contents for the current cylinder, head, or sector location of the drive and can then calculate the cylinder address difference for a seek operation.

The HCRC word enters the silo behind the two header words, to be available from the MP register for diagnostic use.

Function Code 5 - Write Data Command

This command moves the head to the correct location and writes the required data as follows. If CRDY is clear, a Write Data command causes the controller to map the logical RL02 disk address onto a physical winchester disk address. It then reads and compares successive header words with the physical DA register until an address match is found. Then the HCRC occurs and, if there is no HCRC error, the data specified by the BA register are written into the sector. If the data does not fill the sector, zeroes are written in the remaining locations.

If the amount of data requires any additional sectors, the sector address in the DA increments when the current sector is full, then the write continues in the next sector. Completion of the data transfer sets CRDY and, if interrupts are enabled (IE is set), causes an interrupt.

Function Code 6 - Read Data Command

This command moves the head to the correct location and reads the required data as follows. If CRDY is clear, the read data command causes the controller to map the logical RL02 disk address onto a physical winchester disk address and read and compare successive header words with the required DA word in the DA register until a match occurs. If there are no HCRC errors, the data in the sector are read into the location specified by the contents of the BA register. A DCRC occurs. If there are no errors, the contents of the DS increment by one. If the word count (the contents of the MP) register overflows, CRDY sets. If interrupts are enabled (IE is set), an interrupt occurs. If the MP register does not overflow, the read continues with the next sector.

Function Code 7 - Read Data Without Header Check Command

If CRDY is clear, a read data without header check command reads the data from the next sector to the location specified by the contents of the BA register. The DCRC occurs at the end of the sector. Then, if the word count (in the MP register) has not overflowed, the read continues at the next sector. The word count overflow sets CRDY and, if interrupts are enabled, an interrupt occurs.

Note that the header is not compared or checked for cyclic redundancy errors with this command. The read data without header check command is normally used by issuing read header commands until the sector prior to the desired sector is found, then issuing the read data without header check command.

6.0 BASIC CIRCUIT DESCRIPTION

6.1 General Information

This chapter provides a basic, block diagram level description of the DSD 880 circuitry.

6.2 DSD 8836 Interface Board

The DSD 8836 is the interface between the DSD 880 System and the DEC LSI-11 processor. The DSD 8836 interface board performs several functions, the primary ones being:

- Emulation of RX02 and RL02 control and status registers.
- Control of the data transfer between the DSD 880 interface bus and the LSI-11 Q-bus.
- Containing the user selectable RL02 and RX02 bootstrap program.
- Arbitrates RL02 and RX02 command transfers between the DSD 880 controller and the LSI-11 processor.

The unique capability of the DSD 880 to emulate both a RL02 and a RX02 in a single cost effective package is due in part to the ability of the interface to arbitrate between RL02 and RX02 commands.

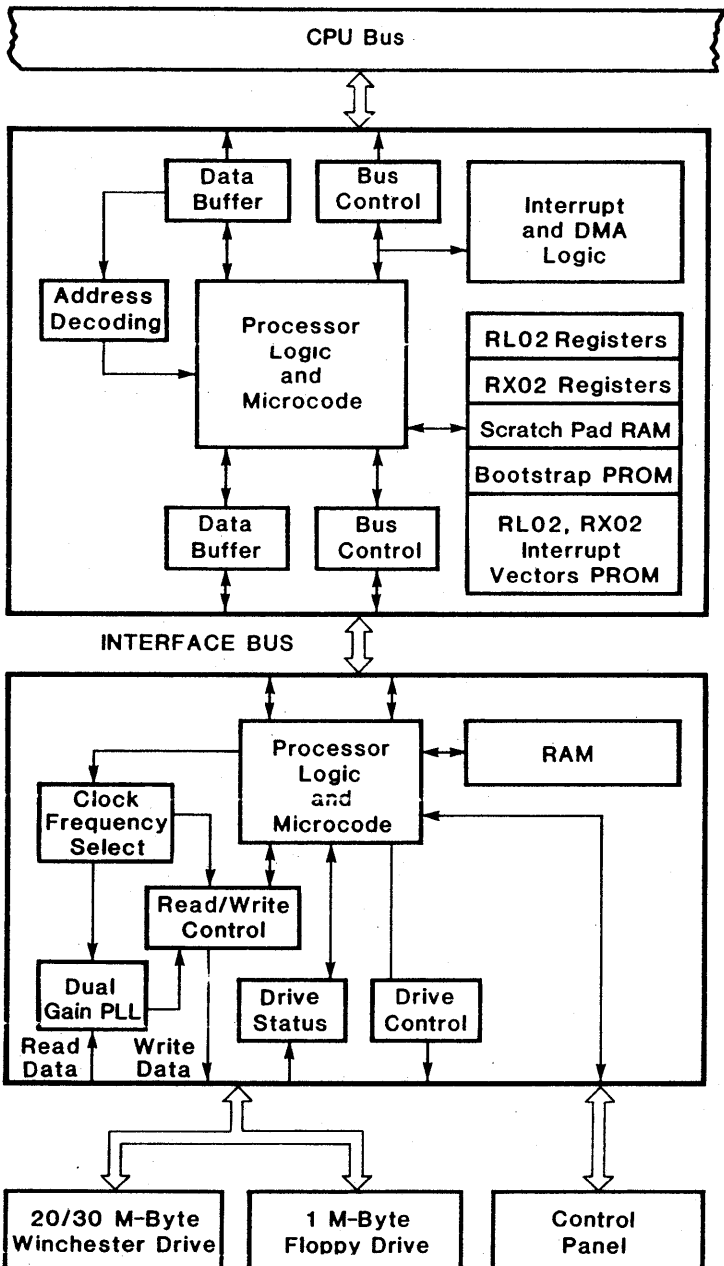
Although the DSD 880 system controller emulates both RL02 and RX02 operations; it cannot do so simultaneously. In order to maintain system compatibility and resolve device conflicts, the DSD 8836 interface arbitrates command transfers in the following manner.

Assume that, initially, neither the RL02 or RX02 is executing a command and a command is received by the interface for the RX02 device. The command will immediately be sent to the DSD 880 controller for execution and the done bit in the RX2CS will be cleared. If a command is received for the RL02 device before the RX02 command has completed execution, the interface will accept the command, place it in a one level queue for transfer to the controller, and clear the controller ready bit in the CSR. At this point, both devices will appear busy.

When the RX02 device completes execution, the interface will set the done bit in the RX2CS register and immediately send the queued RL02 command to the controller for execution. If a new command is received for the RX02 device before the RL02 command completes execution, it will be placed in the one level queue and the done bit will be cleared.

When the controller completes execution of the RL02 command the interface will set the controller ready bit in the CSR. If a command is in the queue for the RX02 device, it will be executed. Otherwise, both devices will be ready to accept new commands.

The DSD 8836 interface has been implemented using bipolar technology in order to provide the desired fast LSI-11 response time and DMA throughput. Refer to the block diagram and the DSD 880 shown in Figure 6-1. Note the logic of the interface can be divided into 3 major subsections; Processor and associated logic, LSI-11 Q-Bus interface, and DSD 880 I-Bus interface.



CPU INTERFACE

- Emulates RL02 and RX02 command and status registers
- Arbitrates RL02 and RX02 command transfers between DSD880 controller and CPU
- Controls data transfer between DSD 880 controller and CPU
- Contains user selectable RL02 and RX02 bootstrap programs
- Contains DMA and interrupt logic

DSD 880 CONTROLLER/FORMATTER

- Directly emulates RL02 and RX02 hardware and software operations
- Controls data transfer to and from disk drives
 - Encoding decoding
 - Formatting
 - Implied seeks
 - Multiple sector transfers
 - Bad track remapping
- Executes self diagnostics

CONTROL PANEL

- Selection display
 - Diskette formatting
 - Backup loading
 - Fault indication
 - Write protection
 - System diagnostics

TP 239/81

Figure 6-1. DSD 880 Block Diagram

The processor subsection forms the intelligent heart of the interface. It consists of the processor logic (ALU, sequencer, etc.), the microcode PROM, and the RAM data buffer. The processor subsection controls data and command transfer between the LSI-11 Q-Bus and the DSD 880 controller I-Bus, implements the device registers, and performs RL02 and RX02 command queing. Note that the command and status registers for the RL02 and RX02 devices are implemented in software using the RAM data buffer rather than as discrete hardware registers.

The LSI-11 Q-Bus interface subsection consists of the device address decoder, the interrupt logic, Q-Bus register, and Q-Bus buffers. This subsection controls the transfer of data between the processor subsection and LSI-11 Q-Bus. The address decoder recognizes jumper selectable RX02 and RL02 device and bootstrap addresses. The Q-Bus register stores data, and address and status information while it is being transferred to the LSI-11 processor via the Q-Bus. The interrupt request logic and interrupt vector PROM control the interrupt of the LSI-11 processor by the processor subsection. The desired interrupt vector and level are jumper selectable.

The DSD 880 I-Bus interface subsection consists of the I-Bus register, I-Bus controller, and I-Bus buffers. This subsection controls the transfer of data between the processor subsection and the DSD 880 controller I-Bus. The I-Bus register allows the transfer of data between the controller and interface to be as rapid as possible without exceeding the capability of either. The I-Bus controller coordinates the transfer of data into and out of the I-Bus register while the I-Bus buffers match the I-Bus cable to the logic requirements of the I-Bus interface.

The LSI-11 interface has the capability of displaying its microcode level through the use of ODT. To access the LSI-11 interface module microcode level, the user must simulate an ac low condition. To accomplish this, turn off the power to the DSD 880 chassis, or disconnect the interface cable from the chassis. Using ODT, examine the RL02 multipurpose register (RLMPR) typically located at 174406. The last four bits reflect the microcode version number. Example: @ 174406/xxxx V.

6.3 DSD 8830 Interface Board

The DSD 8830 interface board is available for those customers utilizing the DSD 880 Data Storage System with the DEC PDP-11 processor. The DSD 8830 controls data transfer between the PDP-11 Unibus and the DSD 880 interface bus.

The 8830 can emulate both RX02 and RL02 device registers according to DEC standards. Since the 880 controller can only operate on one device at a time, the 8830 arbitrates between sending the latest RL or RX command. The bootstrap eliminates the need for a DEC bootstrap board. Finally, five switch packs allow the user to select any of the possible boot addresses, device register addresses, or vector addresses.

Basically, the 8830 is a simple bit slice or nibble machine. A straight forward micro-instruction set can be derived since the ALU A input is designated for straight 128X4 RAM nibbles. The ALU B input is selected through the ALU MUX, the ALU F output is latched into the RAM (A0 register) and/or buffer register A. The 2911 based micro-instruction sequencer allows JMP-, JSR-, and RTS-type branches. A high 880 to Unibus throughput rate during DMA is enhanced by the two 16-bit data buffer registers A and B which can be parallel loaded, or nibble shifted, in a way that allows the 880 to read or write data through register B while the rest of the 8830 operates through register A.

6.4 DSD 880 Controller/Formatter Board

The processor logic, which is the heart of the DSD 880 controller, is made up of 2901 bit slice logic circuitry. It performs the following basic functions:

- Handles the I-Bus protocol between the interface and the controller.
- Executes DEC compatible RL02 and RX02 command sets.
- Executes seek, head load, read, write, and other disk drive related functions.
- Handles data flow to and from the interface and the read/write circuitry.
- Provides format control.
- Controls the diagnostic front panel.
- Executes HyperDiagnostics.

The phase-lock-loop circuitry consists of dual front-end phase comparators with their associated low pass filters and a common voltage controlled oscillator. The use of a dual gain approach provides extended margins of acquisition and tracking range. It is used to:

- Discriminate preamble for winchester data.
- Reconstruct clock and data margins from raw data.

A sophisticated clock system is used to synchronize the processor logic with the read/write format control circuitry. The system uses three clock sources:

- A 6 Mhz crystal for floppy write and system housekeeping functions.
- A 17.36 Mhz crystal for floppy read, winchester write, and other critical timing functions.
- A VCO for floppy and winchester read.

The heart of the read/write format control circuitry is a 82S100 FPLA. The circuitry is used to:

- Encode and decode FM and DEC-modified MFM formats for the floppy disk.
- Encode and decode MFM format for the winchester disk.
- Check the CRC of header and data fields.
- Provide proper precompensation for both the floppy and winchester drives.

The DSD 8841 is shown in Figure 6-2.

6.5 DSD 8833 HyperDiagnostic Panel

The DSD 8833 HyperDiagnostic panel shown in Figure 6-3 provides user access to controller functions and status indicators. These functions include:

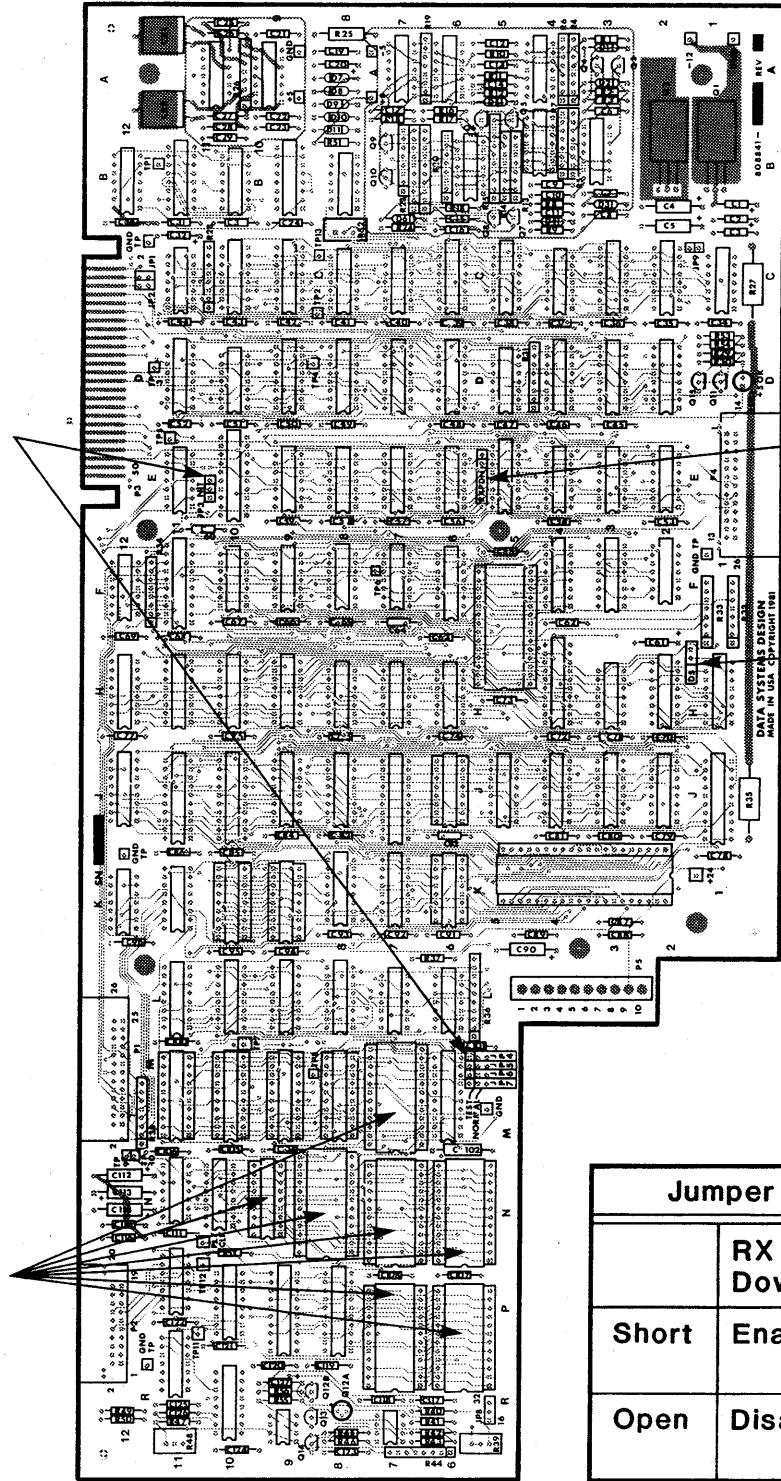
- System mode selection.
- Backup and load operations.
- Diskette formatting.
- Write protection for both the floppy and winchester drives.
- HyperDiagnostic test selection.
- Fault and status indication.

Service Only
DO NOT
REMOVE

Floppy Disk
Power Down
Option

Normal /
Extended
Mode Select

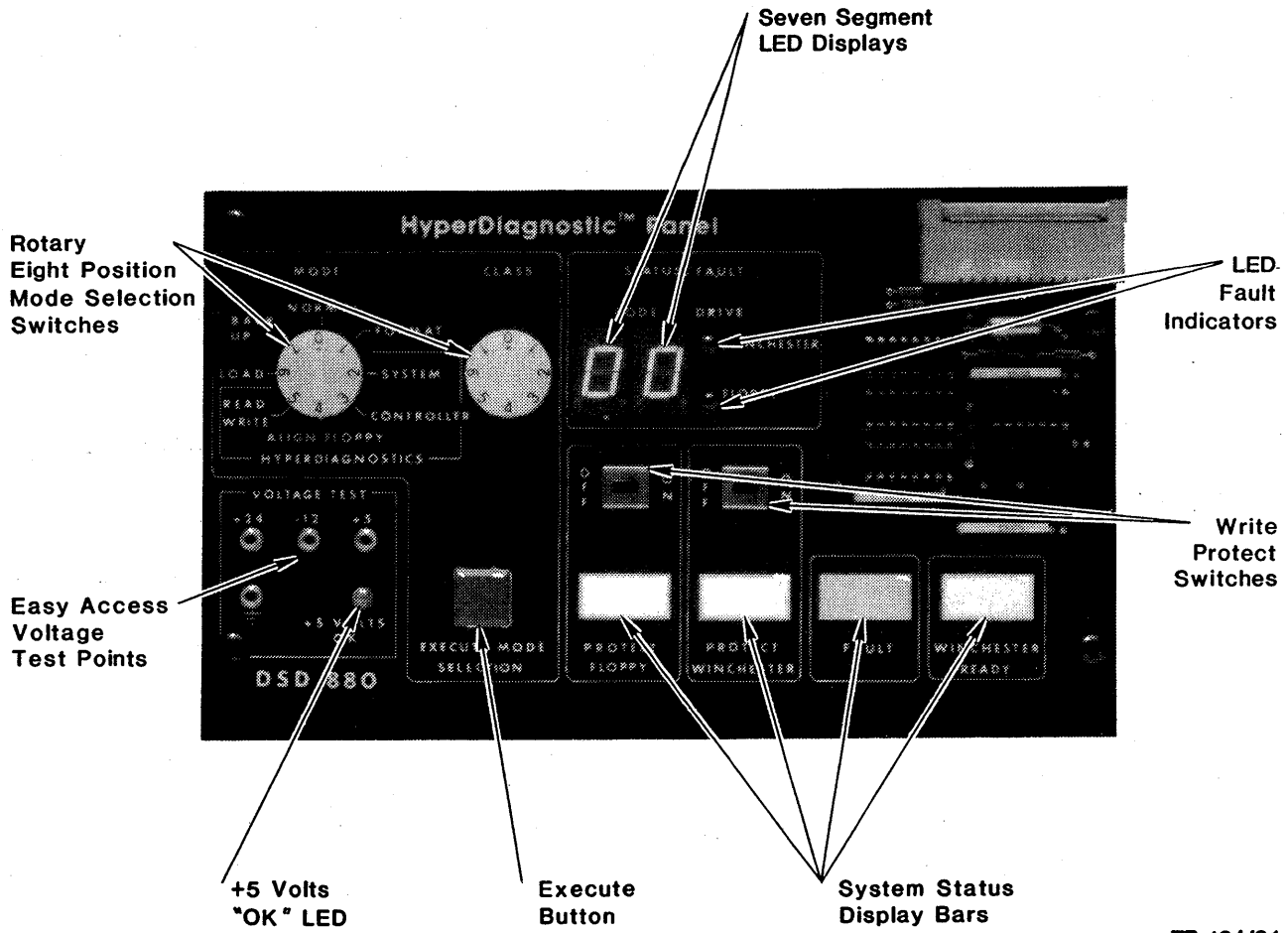
Microcode
PROMS



Jumper Configuration		
	RX Power Down	Normal/Extended
Short	Enabled	Extend Mode
Open	Disabled	Normal Mode

TP 238/81

Figure 6-2. DSD 8841 Controller/Formatter Board



TP 104/81

Figure 6-3. DSD 8833 HyperDiagnostic Panel

7.0 USER LEVEL MAINTENANCE

7.1 General Information

This section provides information on the maintenance of the DSD 880 Data Storage System. The first part discusses the routine procedures required to maintain the equipment at its peak efficiency. The second part provides basic troubleshooting and fault isolation techniques to be utilized in quickly locating the portion of the system causing a problem.

7.2 Preventive Maintenance

The DSD 880 is designed to minimize the amount of periodic maintenance required. The prime factor in maintaining electronic equipment is ensuring that it is operated within its design parameters and specified environmental limits. (See Section 2.) Cleanliness should be considered as part of the environmental requirement.

During any routine or scheduled maintenance, the first step should always be a visual inspection. Check for corrosion, dirt, and undue wear on moving parts. Check all connector assemblies for proper and firm installation.

7.2.1 Floppy Disk Drive Preventive Maintenance

Preventive maintenance schedules for the floppy disk drives furnished with the DSD 880 system are provided in Tables 7-1 and 7-2. The maintenance intervals specified are considered minimum for normal usage and may be changed to more frequent intervals as determined by the user. Any maintenance or adjustments beyond those specified should be attempted only by qualified technicians using procedures outlined in the service manual for the drive.

1. SA800 Single-Sided Drive:

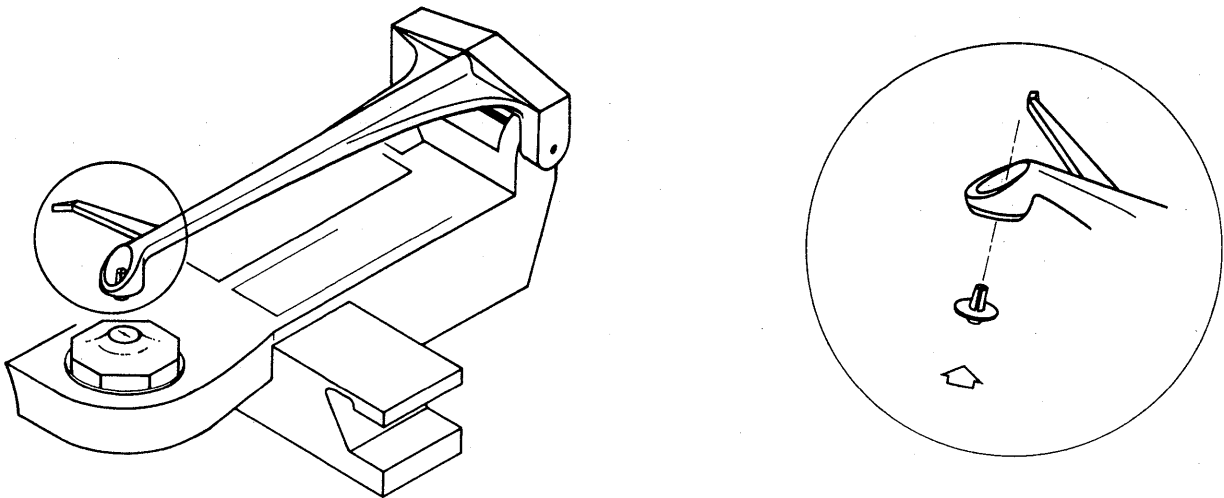
Table 7-1. Single-Sided Floppy Drive Preventive Maintenance

Unit	Frequency (Months)	Action	Observe
Read/Write Heads	6	Clean read/write head ONLY IF NECESSARY	Oxide build up
Read/Write Load Head Button	6 *	Replace as necessary	Color; bright red = OK, pink = replace
Stepper Motor and Lead Screw	6	Clean off all oil, dust, and dirt	Inspect for nicks and burrs
Belt	6		Inspect for frayed or weakened areas
Base	6	Clean base	Inspect for loose screws, connectors, and switches

*Assumes normal usage

A. Read/write head load button removal and replacement procedure:

- To remove the old button, hold the arm out away from the head, squeeze the locking tabs together with a pair of needle nose pliers and press forward.
- To install the new load button, press the button into the arm from the head side; it will snap into place. See Figure 7-1.



TP 242/81

Figure 7-1. Removal and Replacement of Head Load Button

CAUTION

To prevent damage to the torsion spring, the load arm should never be opened over 90° from the carriage assembly, or while at track 00.

B. Single-sided drive cleaning procedure:

Single-sided heads can be cleaned using a clean cotton swab and a solution of at least 90% isopropol alcohol. Take care that none of the solution gets on the head load pad.

2. SA850 Double-Sided Drive:

Table 7-2. Double-Sided Drive Preventive Maintenance

Unit	Frequency (Months)	Action	Observe
Read/Write Heads	6	Clean read/write head ONLY IF NECESSARY	Oxide build up
Actuator Band	6	Clean off all oil, dust, and dirt	
Belt	6	Replace if damaged	Inspect for frayed or weakened areas
Base	6	Clean base	Inspect for loose screws, connectors, and switches

A. Double-sided drive cleaning procedure:

Use the approved head cleaning diskette, Innovative Computer Products P/N 2024, or DSD P/N 530010 for the SA850 double-sided drive. The cleaning kit comes with diskettes, fluid, and full instructions for use. Use of any other head cleaning diskette may damage the drive head and void the warranty.

CAUTION

A perforated tab is removed from the diskette for use in cleaning double-sided drives. Use of this same diskette for cleaning heads in single-sided drives will cause damage to the heads.

7.2.2 Winchester Drive Preventive Maintenance

The winchester drives used with the DSD 880 systems require no preventive maintenance.

7.2.3 Power Supply Preventive Maintenance

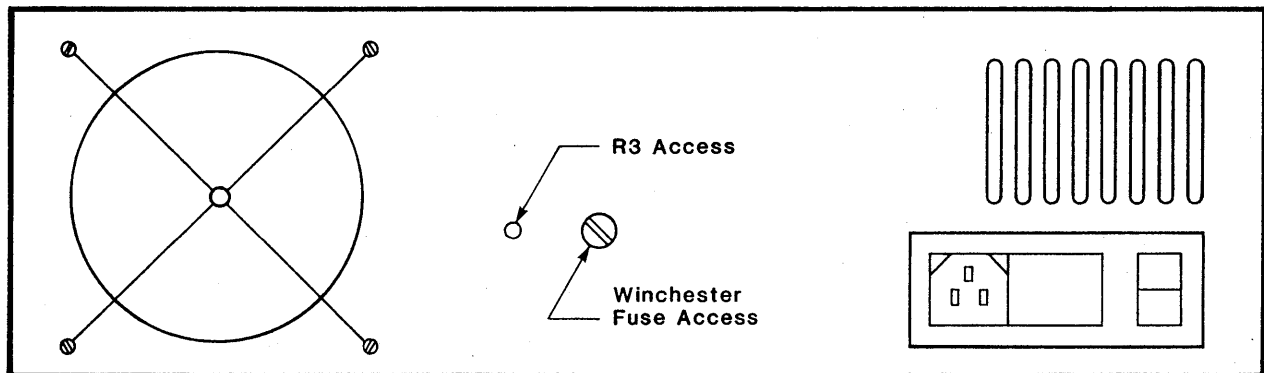
Preventive maintenance of the DSD 880 power supply consists of checking the dc voltages at test jacks provided on the HyperDiagnostic panel. A digital voltmeter is required to check these voltages. This routine should be performed at six month intervals. Proceed as follows:

1. Turn off the power to the DSD 880 chassis and remove the front bezel to gain access to the HyperDiagnostic panel.
2. Set range and function controls on the voltmeter to read +5 V dc.

3. Connect meter to the +5 and ground test jacks on the HyperDiagnostic panel. Observe meter polarity.
4. Turn on chassis power and verify meter reading of +5 Vdc \pm 0.1 Vdc.
 - A. If reading is not within tolerance, adjust R3 trim pot on rear panel of main chassis to bring the voltage within specification. See Figure 7-2.

CAUTION

The ac fuse for the winchester drive is located on the rear panel adjacent to trim pot R3. Use extreme caution during adjustment of R3 to avoid the inadvertent release of the fuse with the power on. Inadvertent release of the winchester drive ac fuse will cause damage to the drive and void warranty.



TP 220/81

Figure 7-2. Location of R3, +5 Vdc Trim Pot

5. Disconnect the meter from the +5 test jack, and connect it in turn to measure the +24 Vdc and -12 Vdc voltages. These checks are made after the +5 Vdc is verified within tolerance.
 - A. Verify +24 Vdc \pm 3 Vdc (+21 to +27 Vdc) meter reading.
 - B. Verify -12 Vdc. A reading of from -8 to -18 Vdc is acceptable.
6. Disconnect meter and reinstall the front bezel covering the HyperDiagnostic panel.

NOTE

If difficulties arise during the performance of any of the preventive maintenance routines contact your Customer Service Representative for assistance.

7.3 Troubleshooting and Fault Isolation

The following list of diagnostic tools should be used to assist in the isolation of faults in the system.

1. Built in self-tests.
2. Error lights and indicators on the HyperDiagnostic panel.
3. Power supply test points on the HyperDiagnostic panel.
4. Internal controller registers indicating the status of the RX and RL devices. Refer to Section 5 for instructions on recovering register data.
5. Halts and loops in the bootstrap program.
6. HyperDiagnostic routines.
7. FLPEXR, RLEXR, and WINEXR diagnostic programs.
8. DEC diagnostics.
9. DSD Customer Service.

Table 7-3 is furnished for initial, user level, fault isolation on the DSD 880. This guide should be used as a preliminary check list prior to any extensive maintenance procedures.

Table 7-3. Preliminary Troubleshooting Guide

<u>Trouble Indication</u>	<u>Possible Cause</u>
DSD 880 floppy disk and/or winchester disk will not operate	<ul style="list-style-type: none">● Power switch not turned on● Power cord is disconnected● Interface cable improperly installed● Fuse blown● Overheated condition
Floppy disk drive activity lights do not light. Disk drives do not initialize	<ul style="list-style-type: none">● Power supply failure● Floppy disk drive door open● Diskette improperly loaded into floppy disk drive
Floppy disk drive activity light remains lit at all times	<ul style="list-style-type: none">● Defective or empty drive● Defective controller● Attempted boot on blank diskette
Disk drive will not initialize	<ul style="list-style-type: none">● Defective interface, power supply, controller, or drive. Halt switch on computer is set to on

Table 7-3. Preliminary Troubleshooting Guide (Cont)

<u>Trouble Indication</u>	<u>Possible Cause</u>
Bootstrapping cannot be performed	<ul style="list-style-type: none">● Interface cable improperly installed● Interface cable improperly installed at computer backplane● Defective interface● Halt switch on computer front panel is set to on● Possible drive malfunction● Bus grant continuity broken● DMA grant jumper not removed● DMA grant chain broken● Diskette not bootable

7.4 Use of DSD 880 HyperDiagnostics

The DSD 880 provides diagnostic aid in the form of the built-in, microcoded, HyperDiagnostic mode of operation. Added diagnostic assistance is available through use the DSD RLEXR, FLPEXR, and WINEXR programs.

If the preliminary troubleshooting guide, Table 7-3, fails to locate the cause of the system malfunction, the built-in diagnostic capabilities of the DSD 880 should be used to isolate the fault to a replaceable subsystem (interface card, controller board, floppy disk drive, winchester disk drive, interface cable, or power supply).

The DSD 880 Data Storage System provides the user with extensive built-in self test features, HyperDiagnostics, which permit testing of the system without requiring the use of a computer. The HyperDiagnostics are a series of routines in microcode which self-test the 8841 controller and exercise both the floppy and winchester disk drives. The tests are initiated and monitored from the HyperDiagnostic panel, located behind the front bezel.

The following MODES may be selected:

- 0 Normal and direct access modes, and selection of write protected RL logical units.
- 1 Floppy disk format routines, used to format the floppy disk in single or double density, with or without rewriting headers, or scan verification.
- 2 General exerciser tests of the floppy disk, the winchester disk, or both; used to verify proper system operation.
- 3 Controller hardware tests, which do not exercise the drives.
- 4 Floppy disk alignment routines.
- 5 Individual tests of the floppy and winchester drives; used mostly for troubleshooting.
- 6 Reload winchester disk from backup floppy disks.
- 7 Backup winchester disk data onto floppy disks. Selects floppy option flag.

CAUTION

Any test that causes data to be written on the winchester disk can cause loss of data that are on the disk prior to testing.

7.4.1 HyperDiagnostic Operation

DSD 880 HyperDiagnostics are initiated by selecting the appropriate MODE and CLASS switch settings and momentarily depressing the EXECUTE pushbutton. The selected MODE and CLASS is echoed by the seven segment displays while the EXECUTE pushbutton is depressed.

If a floppy disk is required for the HyperDiagnostic, it must be inserted prior to initiating the test. Otherwise, a drive error (36) will be reported. Likewise, if the HyperDiagnostic includes a write operation, the appropriate drive(s) must be write enabled. Otherwise, a write protect error (10) will be reported.

Most HyperDiagnostics display the selected CLASS and MODE while the test is running. If the test fails, the appropriate error code and fault indicators will be flashing. If the selected HyperDiagnostics is a single pass test, the code 00 will be displayed upon successful completion. If the HyperDiagnostic selected is repetitive, the code 00 will be displayed for one second between each pass.

Most HyperDiagnostics can be terminated at any time by selecting the new HyperDiagnostic test code and depressing the EXECUTE pushbutton. The floppy disk format HyperDiagnostics cannot be terminated via the EXECUTE pushbutton and must be allowed to complete before selecting a new test.

Since the HyperDiagnostics are controlled by microcode, the microprocessor in the DSD 880 must be at least partially functioning before any tests can be run. HyperDiagnostics do not perform any tests on the interface board or on the I-Bus cable. It is not necessary to have the I-Bus cable connected while running HyperDiagnostics. In most cases it is better to disconnect the I-Bus cable to prevent computer system activity from affecting test results. In particular, bus initialize from the computer will always abort HyperDiagnostics.

7.4.2 Error Reporting During HyperDiagnostics

Errors are indicated by displaying the appropriate error code in the seven segment displays and illuminating the composite and appropriate drive fault indicators located on the HyperDiagnostic panel. Table 7-4 lists the DSD 880 definitive error codes. Paragraph 7-6 provides an expanded definition of the error codes.

Errors other than header or data CRC (14 or 20) errors will cause the HyperDiagnostics routine to terminate immediately upon their occurrence. Each occurrence of the CRC error is logged and a running total kept. The HyperDiagnostic will terminate when a total of 16 (decimal) CRC errors have occurred since the HyperDiagnostic was initiated.

Table 7-4. Definitive Error Codes

These errors are flashed on the HyperDiagnostic panel when the indicated error occurs:

<u>CODE</u> <u>Displayed</u>	<u>Description</u>
00	No errors - operation complete (HyperDiagnostics only)
01	Drive failed to home on initialize
02	Nonexistent drive
03	Track 00 found while stepping in on initialize
04	Invalid RX02 track address
05	Track 00 found before desired track while stepping
06	Seek timeout while stepping (RL02 only)
07	Requested sector not found in two revolutions
10	Write protect violation
11	Not defined
12	No preamble found
13	Preamble found but no address mark within window
14	CRC error on what appeared to be a header
15	Address in header did not match desired track
16	Too many tries for an ID address mark
17	Data address mark not found in allotted time
20	CRC error on data field
21	Write gate error (RL02 only)
22	VCO failure during read operation (RL02 only)
23	Invalid word count specified
24	Media density did not match desired density (RX02 only)
25	Invalid key for set media density or format command (RX02 only)
26	Indeterminate media density (RX02 only)
27	Write format failure
30	Data compare error (RL02 and read/write HyperDiagnostics)
31	Invalid bad track map detected during initialization (RL02 only)
32	Bad track map checksum did not match stored value
33	Not defined
34	Not defined
35	Nonexistent memory (NXM) error during DMA transfer
36	Drive not ready (door open, speed error, absent media)
37	Low ac power caused abort of write activity
40	Invalid disk used for reload (RL02 reload only)
41	Multiple reload disk versions used (RL02 reload only)
42	Invalid class selected (HyperDiagnostics only)
43	Invalid winchester disk address
44	Winchester disk word count overflow
45	Deleted data mark encountered on reload floppy (RL02 reload only)
46	Reserved for DSD use only
47	Confirmation of intent to reconfigure floppy
51	Memory test failure
52	CRC test failure
53	PLL test failure

7.4.3 Winchester Write Enable

HyperDiagnostics which include a winchester disk sequential write operation must be write enabled prior to initiating the test. Write enable is accomplished by selecting CLASS 7 of the appropriate MODE (2 or 5), then depressing the EXECUTE pushbutton. The selected MODE will then be write enabled and will remain so until a new MODE is selected. Note that winchester read/write HyperDiagnostics destroy data on the winchester disk.

7.5 HyperDiagnostic MODE Descriptions

7.5.1 Floppy Disk Format Routines (MODE 1)

The floppy disk format routines are entered by setting the MODE switch to position 1 (FORMAT), selecting the desired CLASS, and depressing the EXECUTE pushbutton. These routines affect only the floppy disk drive; it is not possible to format the winchester drive from the HyperDiagnostic panel. The floppy write protect switch must be off, and a write enabled floppy disk must be placed in the drive. All data on the floppy disk will be lost. Either single- or double-sided disks may be used. Unlike most HyperDiagnostics, it is not possible to interrupt the operation by pressing the EXECUTE pushbutton during the test. This prevents mixed-density diskettes from being created.

The following CLASSES may be selected:

- 0 FORMAT DOUBLE-DENSITY - formats the entire floppy disk in DEC double-density format. Headers are rewritten.
- 1 FORMAT SINGLE-DENSITY - formats the entire floppy disk in DEC/IBM single-density format. Headers are rewritten.
- 2 SET MEDIA DOUBLE-DENSITY - writes all data fields in DEC double-density format, with all data bytes equal to 0. Headers are not rewritten.
- 3 SET MEDIA SINGLE-DENSITY - writes all data fields in DEC single-density format, with all data bytes equal to 0. Headers are not rewritten.
- 4 SET MEDIA DOUBLE-DENSITY AND SCAN - writes all data fields in DEC double-density format and scans the disk looking for errors.
- 5 SET MEDIA SINGLE-DENSITY AND SCAN - writes all data fields in DEC single-density format and scans the disk looking for errors.

7.5.2 System Tests (MODE 2)

The system tests are entered by setting the MODE switch to position 2 (SYSTEM), selecting the desired CLASS, and depressing the EXECUTE pushbutton. The tests are normally used to verify that the 880 system is working correctly, rather than for troubleshooting. The tests exercise the 8841 controller and one or both disk drives, but do not test the interface card or the I-Bus cable. These tests are useful for verifying system operation during incoming inspection and after site installation of the system.

The following CLASSES may be selected:

- 0 FLOPPY DISK EXERCISER WITH WRITE FORMAT - runs the following sequence of HyperDiagnostic tests on the floppy drive only:
 - a. Hardware Self-Tests
 - b. Single-Density Write Format
 - c. Sequential Scan All Sectors
 - d. Butterfly Read Headers
 - e. Sequential Write/Read All Sectors
 - f. Set Media Double-Density
 - g. Sequential Scan All Sectors
 - h. Butterfly Read Headers
 - i. Sequential Write/Read All Sectors
 - j. Set Media Double-Density
- 1 FLOPPY DISK EXERCISER WITHOUT WRITE FORMAT - runs the same sequence of tests as the floppy disk exerciser described previously with the exception of the single-density write format.
- 2 FIXED DISK EXERCISER - runs the following sequence of HyperDiagnostic tests on the fixed disk drive only:
 - a. Hardware Self-Tests
 - b. Sequential Scan All Sectors
 - c. Butterfly Seek Test
 - d. Sequential Write/Read All Sectors
- 3 GENERAL EXERCISER WITH FLOPPY DISK WRITE FORMAT - runs the floppy disk general exerciser, then runs the fixed disk exerciser tests.
- 4 SINGLE-PASS GENERAL EXERCISER WITH FLOPPY WRITE FORMAT - runs a single pass of the floppy and fixed disk exercisers.
- 5 SINGLE-PASS GENERAL EXERCISER WITHOUT FLOPPY WRITE FORMAT - runs a single pass of the floppy and fixed disk exercisers without formatting the floppy disk.
- 6 GENERAL EXERCISER WITHOUT FLOPPY WRITE FORMAT AND FIXED READ/WRITE TESTS - runs the floppy disk general exerciser without formatting the floppy disk, then runs the fixed disk exerciser without executing the sequential write/read tests.
- 7 FIXED DISK EXERCISER WRITE ENABLE - permits sequential write operations on the winchester disk. (For tests 2, 3, 4, and 5.)

7.5.3 Controller Tests (MODE 3)

The controller tests are entered by setting the MODE switch to position 3 (CONTROLLER), selecting the desired CLASS, and depressing the EXECUTE pushbutton. The tests are intended for troubleshooting the controller logic to determine if a problem is drive related.

The following CLASSES may be selected:

- 0 SWITCH AND INDICATOR TEST - tests the various controller switches and indicators on the diagnostic panel for proper operation.

Setting the floppy write protect switch to the on position will illuminate the floppy write protect and floppy fault indicators, and cause the digits 88 to flash in the seven segment displays.

Setting the winchester write protect switch to the on position will illuminate the winchester write protect and winchester fault indicators, and cause the digits 99 to flash in the seven segment displays.

If neither the floppy or winchester write protect switches are in the on position, the winchester fault, floppy fault, floppy write protect, composite fault, and winchester ready indicators will be sequentially illuminated one at a time. In addition, the position of the CLASS and MODE switches will be echoed in the seven segment displays.

- 1 GENERAL CONTROLLER HARDWARE TEST - runs the following controller hardware diagnostics:

- a. ALU and SERDES logic tests
- b. RAM memory test
- c. CRC logic test
- d. PLL logic test

This test verifies the controller hardware and is useful in localizing failure to a specific functional block.

- 2 ALU AND SERDES LOGIC TEST - tests the operation of the arithmetic logic unit and SERDES circuitry.
- 3 RAM MEMORY TEST - tests the operation of the RAM buffer memory.
- 4 CRC LOGIC TEST - tests the operation of the CRC logic.
- 5 PLL LOGIC TEST - tests the operation of the phase-locked-loop circuit.
- 6 MICROCODE VERSION - displays microcode version number.

7.5.4 Floppy Disk Alignment Routines (MODE 4)

The floppy disk alignment routines are entered by setting the MODE switch to position 4 (ALIGN FLOPPY), selecting the desired CLASS, and depressing the EXECUTE pushbutton. These routines affect only the floppy disk drive and are intended for use by qualified service personnel when an alignment disk (DYSAN part number 360-2A or DSD part number 530003) is used to adjust the drive.

The following CLASSES may be selected:

- 0 FLOPPY DISK TRACK 00 DETECTOR ADJUSTMENT - loads floppy head and repeatedly seeks between track 00 and 01 every 100 milliseconds.
- 1 FLOPPY DISK SEEK TRACK 01 AND LOAD HEAD - seeks floppy head to track 01 and loads it.
- 2 FLOPPY DISK SEEK TRACK 02 AND LOAD HEAD - seeks floppy head to track 02 and loads it.
- 3 FLOPPY DISK SEEK TRACK 38 AND LOAD HEAD - seeks floppy head to track 38 and loads it.
- 4 FLOPPY DISK SEEK TRACK 76 AND LOAD HEAD - seeks floppy head to track 76 and loads it.
- 5 FLOPPY DISK HEAD LOAD TIMING ADJUSTMENT - seeks floppy head to track 00 and alternately loads head for 100 milliseconds, and then unloads head for 200 milliseconds.

7.5.5 Read/Write Tests (MODE 5)

The read/write tests are entered by setting the MODE switch to position 5 (READ/WRITE), selecting the desired CLASS, and depressing the EXECUTE pushbutton. These routines are intended for troubleshooting of problems encountered during computer system operation, or during the system MODE HyperDiagnostics. They consist of individual read, write, scan, and seek tests on both the floppy and winchester drives. Write protect switches should be off. A disk must be inserted in the floppy disk drive if tests are being performed on that drive. Single- or double-sided floppy disks of either density may be used. Data on the affected disk will be lost if the sequential write/read test is run. The following CLASSES may be selected:

- 0 SINGLE-PASS SEQUENTIAL SCAN FLOPPY DISK - scans the entire disk for CRC errors and valid disk headers. Data on the floppy disk is not affected. This test is extremely useful, if a system disk cannot be booted, to check for errors on the disk. The test stops after one pass is made.
- 1 BUTTERFLY SEEK TEST FLOPPY DISK DRIVE - steps head of floppy disk drive using a butterfly pattern, then seeks track 00. This test is used to detect head positioning problems in the floppy disk drive. The test runs until halted.

NOTE

This test can be run without media in the floppy drive.

- 2 BUTTERFLY READ HEADERS ON FLOPPY DISK - steps head of floppy disk drive using a butterfly pattern, checking for correct disk headers. This test is similar to the butterfly seek test, except that head positioning is verified by comparing the track number in the disk header to an expected track number. The test runs until halted.

- 3 SEQUENTIAL WRITE/READ FLOPPY DISK - sequentially writes then reads the entire floppy disk checking for data or header errors. This test exercises the read/write circuitry of the controller and floppy disk drive and is useful in diagnosing problems in this area. The test runs until halted.
- 4 SEQUENTIAL SCAN FIXED DISK - scans entire fixed disk for CRC errors and valid disk headers. Data on the disk is not changed by this test. This test is useful in verifying the winchester disk media when intermittent CRC errors occur during operation. The test runs until halted.
- 5 BUTTERFLY SEEK TEST FIXED DISK - steps head of fixed disk drive using butterfly pattern, then seeks to cylinder 00 and verifies that it is there. This test is useful in detecting head positioning problems in the winchester disk drive. The test runs until halted.
- 6 SEQUENTIAL WRITE/READ FIXED DISK - sequentially writes then reads the entire winchester disk checking for data or header errors. This test exercises the read/write circuitry of the controller and winchester disk drive and is useful in diagnosing problems in this area. The test runs until halted.
- 7 FIXED DISK WRITE ENABLE - permits sequential write operations on the winchester disk. (For test 6.)

7.5.6 Reconfiguration of Floppy Drive

If the type of floppy drive must be altered, the drive-type flags must be updated in the bad track map. To modify drive-type flags, proceed as follows:

1. Set MODE and CLASS to 7-7. Press EXECUTE pushbutton.
2. System will ask for confirmation by displaying 47 in seven segment displays.
3. Set MODE and CLASS to 2-2 for confirmation and press EXECUTE pushbutton.
4. Enter drive type by setting:

<u>MODE</u>	<u>CLASS</u>	<u>Drive Type</u>
0	0	No Floppy
0	1	SA800
1	2	SA850

and press EXECUTE pushbutton.

7.6 DSD 880 Error Code Interpretation

This section details the error codes reported by the DSD 880 controller, their possible causes, and troubleshooting tips. Note that the error code displayed by the seven segment LED displays is the same as the octal error code reported by the RX02 read error code command with the trailing zero deleted. There is no provision for reporting winchester numeric error codes to the host processor.

Errors are indicated by displaying the error code in the seven segment displays, and illuminating the composite and appropriate drive fault indicators. Note that some errors are applicable to the winchester drive, some to the floppy drive, some to either drive, and some are non-drive related.

When operating in normal MODE, the occurrence of any error will cause the current operation to terminate and the error to be reported. When an error occurs during a HyperDiagnostic routine, it is checked to determine if it is a data or header CRC error (14 or 20). If it isn't, the current operation will terminate and the error will be reported. If the error was a CRC error, it is logged in a totalizing counter and the operation is retried. When the total number of CRC errors encountered since the start of the HyperDiagnostic reaches 16 (decimal), the HyperDiagnostic will terminate.

NOTE

Failure of the ALU or SERDES logic tests will cause the controller to cease responding to interface commands and the EXECUTE pushbutton. The composite fault indicator will be illuminated. The error code displayed by the seven segment displays will not be flashing and should be disregarded. If these logic tests fail, the ac power must be cycled to restart the controller.

If the ALU hardware test fails, the composite, winchester and floppy fault indicators will be illuminated.

If the ALU test passes and the SERDES hardware test fails, the composite fault indicator will be illuminated and the winchester and floppy fault indicators will be extinguished.

If both the ALU and SERDES hardware tests pass and the RAM, CRC, or PLL tests fail, the appropriate error code will be flashing in the seven segment displays, and the composite fault indicator will be illuminated.

Unless otherwise indicated, all errors apply to either drive

ERROR CODE = XX (X = blank seven segment displays)

NON DRIVE RELATED

Fault: Controller failed to complete hardware initialize

Possible cause: Defective +5 volt power supply
Defective front panel displays
Interface is forcing controller to initialize continuously
Interface cable may be plugged in backwards
Front panel cable disconnected

Troubleshooting: Observe +5 volts OK indicator
Measure +5 volt power supply at front panel test point
Run HyperDiagnostic switch and light test
Remove interface cable, check orientation
Check front panel cable connections

ERROR CODE = 00 (000 octal)

Fault: None, this is the normal operating condition

ERROR CODE = 01 (010 octal)

Fault: Drive failed to home on initialize

Possible cause: WINCHESTER: Winchester head retainer not removed during installation

FLOPPY: Incorrect setting of SA800/SA850 flags in bad track map

EITHER: No drive in system
Incorrect drive select jumpering
Defective +24 volt power supply
Defective drive

Troubleshooting: WINCHESTER: Remove winchester drive head retainer

FLOPPY: Reconfigure SA800/SA850 flags in bad track map

EITHER: Check head movement during initialize. If head does not move, the drive select may be incorrectly jumpered. Measure +24 volt power supply at front panel test point

ERROR CODE = 02 (020 octal)

Fault: Nonexistent drive selected
Possible cause: Software attempted to access nonexistent drive
Troubleshooting: Verify software operation

ERROR CODE = 03 (030 octal)

Fault: Track 00 found while stepping inwards (toward hub) during initialize
Possible cause: Drive head may have been out beyond track zero before initialize
Incorrect drive select jumpering
Incorrect installation of drive cable
Defective drive
Troubleshooting: Retry initialize operation
Check drive select jumpering
Check installation of drive cable

ERROR CODE = 04 (040 octal)

Fault: Invalid cylinder address
Possible cause: Software attempting to access nonexistent cylinder
Troubleshooting: Verify software

ERROR CODE = 05 (050 octal)

Fault: Track 00 found while stepping
Possible cause: Defective drive
Troubleshooting: Service drive

ERROR CODE = 06 (not reported to host processor)

Fault: WINCHESTER: Seek did not complete when expected
Possible cause: Defective winchester
Troubleshooting: Service drive

ERROR CODE = 07 (070 octal)

Fault: Requested sector not found in two revolutions

Possible cause: Desired sector header has a hard CRC error
Disk headers incorrectly formatted
Software requested nonexistent sector address

Troubleshooting: Check disk headers for validity and reformat if necessary
Verify applications software operation

ERROR CODE = 10 (100 octal)

Fault: Write protect violation (attempted to write on write protected disk)

Possible cause: WINCHESTER: Winchester disk write protected via front panel switch
Winchester disk write/read HyperDiagnostics not write enabled

FLOPPY: Floppy disk write enable tab missing or not opaque
Floppy disk write protected via front panel switch
Defective drive

Troubleshooting: WINCHESTER: Write enable winchester disk from front panel
Write enable winchester disk write/read HyperDiagnostics

FLOPPY: Install or replace floppy disk write enable tab
Write enable floppy disk from front panel
Service drive

EITHER: Check operation of front panel write protect switches via HyperDiagnostic switch and light test

ERROR CODE = 12 (120 octal)

Fault: Unable to find preamble of disk header (could not identify preamble independently of PLL).

Possible cause: WINCHESTER: Data cable reversed

FLOPPY: Floppy disk head not loaded
Incorrect installation of head load jumper

EITHER: Incorrect installation of -5 volt jumper on affected drive
Defective -12 volt power supply
Defective media

Troubleshooting: WINCHESTER: Check winchester data cable

FLOPPY: Check floppy disk head load
Check floppy disk load jumper

EITHER: Check installation of -5 volt jumper on affected drive
Measure -12 volt power supply at front panel test point
Reformat disk media

ERROR CODE = 13 (130 octal)

Fault: Preamble found but no disk ID address mark within window
(preamble continues forever)

Possible cause: Defective media

Troubleshooting: Reformat disk media

ERROR CODE = 14 (140 octal)

Fault: CRC error on what appeared to be a header (found preamble)

Possible cause: Floppy disk head load defective
Incorrect headed CRC
Defective media

Troubleshooting: Check floppy disk head load
Reformat disk headers
Run sequential write/read HyperDiagnostics to verify disk
media

ERROR CODE = 15 (150 octal)

Fault: Address in header did not match expected track (CRC code of
ID sector field was correct; track or head specified in ID field
did not match expected value)

Possible cause: FLOPPY: Incorrect setting of SA850/SA800 flags in bad track
map

EITHER: Defective drive
Incorrect disk headers

Troubleshooting: FLOPPY: Reconfigure SA850/SA800 flags in bad track map

EITHER: Check disk headers and reformat if necessary
Check head positioning by running butterfly HyperDiagnostics

ERROR CODE = 16 (160 octal)

Fault: Too many tries to find good ID address mark (found preamble)

Possible cause: Phase-locked-loop defective
Defective drive

Troubleshooting: Check read channel signal on good track or diskette
Check operation of PLL by running PLL HyperDiagnostic
Service drive

ERROR CODE = 17 (170 octal)

Fault: Data address mark not found in allotted time (correct sector ID and valid data preamble found, but no data address mark followed)

Possible cause: Incorrectly formatted media
Defective media

Troubleshooting: Check read operation on good track or diskette
Reformat disk media if necessary

ERROR CODE = 20 (200 octal)

Fault: CRC error on data field

Possible cause: Defective media
Encountering excessive radiated or conducted electrical interference

Troubleshooting: Examine media for excessive wear
Attempt to reread affected data
Replace drive

ERROR CODE = 21 (210 octal)

Fault: WINCHESTER: Write gate error

Possible cause: Winchester sensed write current in head without write gate active

Troubleshooting: Replace winchester disk drive

ERROR CODE = 22 (not reported to host processor)

Fault: WINCHESTER: VCO failed during read operation
Possible cause: Defective PLL circuit on controller (8841)
Troubleshooting: Check operation of PLL by running PLL HyperDiagnostic
Replace controller

ERROR CODE = 23 (230 octal)

Fault: Invalid word count specified
Possible cause: Software specified a word count inconsistent with sector size
(64 words for single-density, 128 words for double-density)
Troubleshooting: Verify software

ERROR CODE = 24 (240 octal)

Fault: FLOPPY: Media density did not match density of read, or
read status command.
Possible cause: Incorrect disk density specified
Disk incorrectly formatted with mixed densities
Troubleshooting: Correct specified density
Reformat disk to desired density

ERROR CODE = 25 (250 octal)

Fault: WINCHESTER: Invalid key word specified during seek, get
status, or format command
FLOPPY: Invalid key word specified for set media density, or
format command
Possible cause: Software specified invalid key word for command (111 octal
for set media density, 154 or 155 octal for format)
Troubleshooting: Verify software

ERROR CODE = 26 (260 octal)

Fault: FLOPPY: Indeterminate floppy media density (controller was
unable to determine the density of the media)

Possible cause: Incorrectly formatted diskette (may be IBM 2D)
Defective drive

Troubleshooting: Check density in a known good drive, reformat if necessary
Service drive

ERROR CODE = 27 (270 octal)

Fault: Write format failure

Possible cause: Index did not appear in allotted time during write format

Troubleshooting: Check drive spindle pulley for correct size
Replace drive

ERROR CODE = 30 (300 octal)

Fault: Data compare error (data CRC was valid but disk data did not
match sector buffer data)
Backup floppy data does not match winchester data read, or
data written

Possible cause: Defective controller

Troubleshooting: Check sector buffer by running RAM HyperDiagnostic test
Check read/write channels and media by running write/read
HyperDiagnostic

ERROR CODE = 31 (310 octal)

Fault: WINCHESTER: Invalid bad track map detected during
initialize (able to read data, but data was not a valid bad track
map)

Possible cause: Bad track map overwritten

Troubleshooting: Use DSD supplied support software to rewrite bad track map

ERROR CODE = 32 (320 octal)

Fault: WINCHESTER: Checksum of bad track map did not match
stored value

Possible cause: Defective controller

Troubleshooting: Reinitialize winchester drive
Replace controller

ERROR CODE = 35 (350 octal)

NON DRIVE RELATED

Fault: Nonexistent memory error occurred during DMA

Possible cause: Programming error (starting address and word count was inconsistent with available memory)
Defective DSD 880 interface board
Defective host processor memory

Troubleshooting: Verify software
Use DSD supplied support software to test host processor memory and DSD 880 interface board

ERROR CODE = 36 (360 octal)

Fault: Drive not ready

Possible cause: WINCHESTER: Winchester spindle lock not removed
Unable to initialize

FLOPPY: No floppy disk in drive
Floppy door open
Floppy drive not up to speed following automatic power down
Side one of single-sided floppy disk selected by software

EITHER: Drive not within speed tolerance (incorrect drive spindle pulley)
Incorrect drive select jumpering
Defective drive ready or index signals

Troubleshooting: WINCHESTER: Remove winchester spindle lock
Restore bad track map

FLOPPY: Check installation of media, close floppy drive door
Verify software selection of floppy side
Check operation of automatic power down solid state relay

EITHER: Check drive spindle pulley size
Check drive cables
Replace drive

ERROR CODE = 37 (370 octal)

Fault: Low ac (primary) power caused abort of write operation

Possible cause: Temporary loss of primary power caused controller to abort the specified write operation

Troubleshooting: Retry write operation
 Check if primary power is within specifications

ERROR CODE = 40 (not reported to host processor)

NON DRIVE RELATED

Fault: Invalid disk was used for reload
Possible cause: Invalid disk identifier was detected on a disk used for reload
Troubleshooting: Use correct reload disk

ERROR CODE = 41 (not reported to host processor)

NON DRIVE RELATED

Fault: Multiple backup disk versions detected during reload
Possible cause: Version number of disk used for reload did not match the
 version number of the first valid disk.
Troubleshooting: Use correct reload disk

ERROR CODE = 42 (not reported to host processor)

NON DRIVE RELATED

Fault: Invalid CLASS selected
Possible cause: Nonexistent HyperDiagnostic test selected
Troubleshooting: Reposition CLASS switch to correct position
 Check operation of CLASS and MODE switches by running the
 switch and indicator HyperDiagnostic

ERROR CODE = 43 (not reported to host processor)

Fault: WINCHESTER: Invalid winchester disk address (header not
 found)
Possible cause: Invalid winchester sector address specified
 Requested cylinder address was different from the current
 cylinder at which the head was positioned (implied seek)
Troubleshooting: Verify software operation
 If implied seeks are desired, extended mode must be selected

ERROR CODE = 44 (not reported to host processor)

Fault: WINCHESTER: Winchester disk word count overflow
Possible cause: Multiple sector read/write operation caused winchester cylinder address to overflow (greater than 512 cylinders)
Troubleshooting: Verify software operation

ERROR CODE = 45 (not reported to host processor)

NON DRIVE RELATED

Fault: Deleted data mark was encountered on reload floppy
Possible cause: Reload routine encountered a deleted data sector on backup floppy
Troubleshooting: None required
Note that one or more sectors on the winchester disk following the backup may have invalid data

ERROR CODE = 46 (not reported to host processor)

Fault: Reserved for DSD use only

ERROR CODE = 47 (not reported to host processor)

Fault: Confirmation of intent to reconfigure floppy

ERROR CODE = 51 (not reported to host processor)

NON DRIVE RELATED

Fault: RAM failed hardware test HyperDiagnostic
Possible cause: Defective controller
Troubleshooting: Replace controller

ERROR CODE = 52 (not reported to host processor)

NON DRIVE RELATED

Fault: CRC logic failed hardware test HyperDiagnostic
Possible cause: Malfunctioning 8841 controller
Troubleshooting: Replace controller

ERROR CODE = 53 (not reported to host processor)

NON DRIVE RELATED

Fault: PLL failed hardware test HyperDiagnostic
Possible cause: Defective 8841 controller
Troubleshooting: Replace controller

ERROR CODE = XX (XXX = undefined error code)

NON DRIVE RELATED

Fault: Defective front panel interface
Possible cause: Defective front panel interface logic
Defective front panel logic
Defective front panel cable
Troubleshooting: Check operation of front panel by running switch and indicator HyperDiagnostic
Check operation of SERDES by running ALU test Hyper-Diagnostic
Replace controller PCB assembly

7.7 Subsystem Replacement

After it has been determined that a hardware malfunction exists and the problem has been isolated to a subsystem, repair can be accomplished by replacement of the faulty subsystem. All subsystems can be replaced without the use of special tools.

Repairs to the individual subsystems should only be attempted by qualified maintenance technicians on a bench setup, or at the factory.

7.8 Maintenance Assistance

Data Systems Design maintains a fully staffed Customer Service Department. If at any time during inspection, installation, or operation you encounter a problem, contact one of the offices. Our trained staff can help you diagnose the cause of a failure, and if necessary, speed replacement parts to you. Any time you need to return a product to the factory, please contact Customer Service to obtain a Material Return Authorization Number.

NOTE

If a floppy disk drive is to be shipped, a cardboard shipping disk should be inserted into the drive prior to shipment. This prevents head damage during shipment. If the winchester drive is being shipped, install the head and spindle locks to prevent damage.

**Data Systems Design
Customer Service**

**(West Coast)
2241 Lundy Avenue
San Jose, CA 95131
(408) 946-5815**

**(East Coast)
51 Morgan Drive
Norwood, MA 02026
(617) 769-7620**

For products sold outside the United States, contact your local Data Systems Design distributor for parts and customer service assistance.

APPENDIX A
DISKETTE DIRECTORIES

DIRECTORY
16-OCT-81

DY0:

DSDMON.SYS	4.	18-SEP-81
DYDSD .MAC	31.	22-APR-81
DYDSD .SYS	3.	22-APR-81
PATCH .SAV	10.	1-FEB-80
PATSET.COM	1.	30-DEC-80
PATSJ .COM	8.	30-DEC-80
PATFB .COM	9.	30-DEC-80
PAT1 .TXT	3.	30-DEC-80
PAT2 .TXT	1.	30-DEC-80
PAT3 .TXT	1.	30-DEC-80
PATSTR.COM	1.	30-DEC-80
PATERR.TXT	1.	30-DEC-80
DYV4DS.DIF	3.	30-DEC-80
DYV4DS.DOC	5.	30-DEC-80
RSX11M.DOC	13.	21-SEP-81
DLRSX .CMD	4.	18-MAR-81
DLSYSV.CMD	3.	18-MAR-81
DYRSX .CMD	4.	18-MAR-81
DYSYSV.CMD	3.	18-MAR-81
BOT88T.MAC	30.	7-AUG-81
HELP .TXT	2.	25-SEP-81
RSXBF .DOC	10.	13-AUG-81
RSXBF .TSK	100.	12-AUG-81
RTBF .DOC	10.	13-AUG-81
RTBF .SAV	27.	11-AUG-81
DLWAIT.MAC	6.	7-APR-81
DLWAIT.SAV	2.	7-APR-81
DSDFMT.MAC	7.	30-DEC-80
DSDFMT.SAV	3.	30-DEC-80
RSXFMT.DOC	3.	21-APR-81
RSXFMT.MAC	18.	21-APR-81
RSXFMT.TSK	6.	22-APR-81
DYCOM .TSK	3.	20-APR-81
DYCOM .STB	1.	20-APR-81
FLPEXR.SAV	46.	13-JAN-81
WINEXR.SAV	65.	25-SEP-81
RLEXR .SAV	62.	1-OCT-81
RELEAS.DOC	1.	7-OCT-81
INDEX .DOC	5.	7-OCT-81
< UNUSED >	459.	

459. FREE BLOCKS

TOTAL OF 515. BLOCKS IN 39. FILES

FLX>

DIRECTORY DY0:[1,54]
30-APR-81 15:33

RSX11M.SYS;1	258.	C	07-JAN-81	21:23
RSX11M.TSK;1	130.	C	07-JAN-81	21:24
RSX11M.STB;4	11.		07-JAN-81	21:24
DYDRV.STB;6	1.		07-JAN-81	21:24
DYDRV.TSK;6	5.	C	07-JAN-81	21:24
DLDRV.STB;4	1.		07-JAN-81	21:24
DLDRV.TSK;4	4.	C	07-JAN-81	21:24
LDR.TSK;3	5.	C	07-JAN-81	21:24
TTDRV.STB;4	5.		07-JAN-81	21:24
TTDRV.TSK;4	18.	C	07-JAN-81	21:24
LPDRV.STB;5	1.		07-JAN-81	21:24
LPDRV.TSK;5	4.	C	07-JAN-81	21:24
DRDRV.STB;5	1.		07-JAN-81	21:24
DRDRV.TSK;5	5.	C	07-JAN-81	21:24
FCPMD1.TSK;3	62.	C	07-JAN-81	21:24
COT.TSK;4	24.	C	07-JAN-81	21:25
LOA.TSK;4	29.	C	07-JAN-81	21:25
MCRMU.TSK;3	28.	C	07-JAN-81	21:25
SAV.TSK;4	65.	C	07-JAN-81	21:25
SHF.TSK;3	12.	C	07-JAN-81	21:25
ACS.TSK;4	15.	C	07-JAN-81	21:25
BOO.TSK;4	22.	C	07-JAN-81	21:25
IND.TSK;4	101.	C	07-JAN-81	21:25
DMO.TSK;4	13.	C	07-JAN-81	21:26
ERF.TSK;3	4.	C	07-JAN-81	21:26
ERL.TSK;3	30.	C	07-JAN-81	21:26
INI.TSK;4	34.	C	07-JAN-81	21:26
INS.TSK;5	27.	C	07-JAN-81	21:26
MOU.TSK;4	24.	C	07-JAN-81	21:26
SYS.TSK;3	78.	C	07-JAN-81	21:26
TKN.TSK;4	16.	C	07-JAN-81	21:26
UFD.TSK;4	7.	C	07-JAN-81	21:26
UNL.TSK;4	23.	C	07-JAN-81	21:26
HEL.TSK;3	33.	C	07-JAN-81	21:27
BYE.TSK;3	6.	C	07-JAN-81	21:27
ACNT.TSK;4	57.	C	07-JAN-81	21:27
PIP.TSK;2	69.	C	07-JAN-81	21:27
TEC.TSK;1	63.	C	07-JAN-81	21:27
BAD.TSK;2	50.	C	07-JAN-81	21:27
VMR.TSK;2	142.	C	07-JAN-81	21:27
MAC.TSK;1	81.	C	07-JAN-81	21:28
DMP.TSK;2	57.	C	07-JAN-81	21:28
BRO.TSK;3	25.	C	07-JAN-81	21:28

TOTAL OF 1646./1646. BLOCKS IN 43. FILES

DIRECTORY DY0:[1,2]
30-APR-81 15:34

DLSYSVMR.CMD;2	3.		02-FEB-81	02:19
DYRSXDSK.CMD;4	4.		02-FEB-81	02:26
DLRSXDSK.CMD;2	4.		02-FEB-81	02:27
DYSYSVMR.CMD;7	3.		09-JAN-81	00:08
STARTUP.CMD;11	1.		02-FEB-81	00:59

TOTAL OF 15./23. BLOCKS IN 5. FILES

DIRECTORY DY0:[5,1]
30-APR-81 15:34

TOTAL OF 0./0. BLOCKS IN 0. FILES

GRAND TOTAL OF 1661./1669. BLOCKS IN 48. FILES IN 3. DIRECTORIES

APPENDIX B
COMMAND FILE LISTINGS

```

! COMMAND AND DOCUMENTATION FILE TO UPDATE THE DISTRIBUTION RT11-V4 HANDLER
!   DYV4DS.DOC  30-DEC-80          880 VERSION

! THIS FILE BOTH DOCUMENTS THE PROCEDURE AND CONTAINS THE COMMANDS
! REQUIRED TO MODIFY THE DEC RT11-V4 RX02 HANDLER TO SUPPORT DOUBLE
! SIDED OPERATION.
!
! SETUP FOR DUAL FLOPPY SYSTEM
! -----
!
! FIRST MAKE A COPY OF THE RX02 BOOTABLE DISTRIBUTION DISKETTE.
! THEN BOOT THIS DISK IN DY0: (LEFT HAND DRIVE)
! THEN COPY THE FILES (DYV4DS.DOC AND DYV4DS.DIF) FROM THE DSD DIAGNOSTIC DISK
! TO THE BOOTED RT-11 V4 DISKETTE IN DY0:..
!
! NOTE: THERE SHOULD BE AT LEAST 40. CONTIGUOUS FREE BLOCKS ON THIS DISK.
!       AND IT MUST CONTAIN DY.MAC, MACRO.SAV, LINK.SAV, SYSMAC.SML AND DUP.SAV
!
! SETUP FOR SINGLE FLOPPY SYSTEM (DSD880)
! -----
!
! 1)   COPY THE BOOTABLE RT-11 DISTRIBUTION DISKETTE ONTO THE WINCHESTER DRIVE
!       INSERT THE BOOTABLE RT-11 DISTRIBUTION DISKETTE INTO DY0: AND BOOT IT.
!       INIT DL0:
!       COPY /SYS DY0:*. * DL0:
!       COPY /BOOT DL0:RT11SJ DL0:
!       BOOT DL0:
! 2)   COPY DY.MAC FROM THE DRIVER SOURCE DEC DISTRIBUTION DISKETTE TO DL0:
!       COPY DY0:DY.MAC DL0:
!
! 3)   COPY THE DYV4 FILES FROM THE DSD DIAGNOSTIC DISKETTE TO DL0:
!       COPY DY0:DYV4*. * DL0:
! COMMON UPDATE PROCEDURE FOR ALL HARDWARE CONFIGURATIONS.
! -----
!
!
! THE USER SHOULD THEN TYPE THE QUOTED COMMAND TO THE MONITOR PROMPT.
! ."@DYV4DS.DOC<CR>"
!
! UPDATE THE DY.MAC SOURCE FILE USING SLP (SOURCE LANGUAGE PATCHER)
R SLP
DYV4DS.MAC,=DY.MAC,DYV4DS.DIF

!THIS PRODUCES A REVISED HANDLER SOURCE THAT WILL NOW BE ASSEMBLED
!
R MACRO
DYV4DS,=DYV4DS

!
! SAVE THE DEC STANDARD HANDLER BY RENAMING IT.
!
RENAME /SYS/NOPROTECT DY.SYS DY.SYS
RENAME /SYS DY.SYS DY.DEC
!
! GENERATE THE NEW DY.SYS HANDLER FILE
!
R LINK
DY.SYS=DYV4DS

!
! THE NEW HANDLER SHOULD BE BOUND TO A MONITOR ON THE FLOPPY USING COPY/BOOT
!   INSERT A BOOTABLE RT-11 V4 FLOPPY INTO DY0: FOR HANDLER UPDATE

COPY /SYS DY.SYS DY0:DY.SYS
COPY/BOOT DY:RT11SJ.SYS DY:
! OR FOR THE FOREGROUND/BACKGROUND MONITOR
! COPY/BOOT DY0:RT11FB.SYS DY:
BOOT DY:

```

```

! DLRSX.CMD - COMMAND FILE TO INITIALIZE AN 880-WINCHESTER WITH RSX-11 TASKS
! GENERATES A BOOTABLE RSX11M SYSTEM ON WINCHESTER AFTER FINAL VMR PHASE
! 16-MAR-81 - SETS UP READY FOR VMR SYSGEN PHASE

```

```

BAD DLO:
ALL DLO:
INI DLO:DYRSXSYS
MOU DLO:DYRSXSYS
UFD DLO:[1,54]
UFD DLO:[1,2]
SET /UIC=[1,54]
PIP DLO:RSX11M.SYS/CO/BL:494.=RSX11M.TSK
PIP DLO:RSX11M.TSK/CO=RSX11M.TSK
PIP DLO:=RSX11M.STB
PIP DLO:=DYDRV.*
PIP DLO:=DLDRV.*
PIP DLO:=LDR.*
PIP DLO:=TTDRV.*
PIP DLO:=LPDRV.*
PIP DLO:=DRDRV.*
PIP DLO:=FCFMD1.TSK
PIP DLO:=COT.TSK
PIP DLO:=LOA.TSK
PIP DLO:=MCRMU.TSK
PIP DLO:=SAV.TSK
PIP DLO:=SHF.TSK
PIP DLO:=ACS.TSK
PIP DLO:=BOO.TSK
PIP DLO:=IND.TSK
PIP DLO:=DMO.TSK
PIP DLO:=ERF.TSK
PIP DLO:=ERL.TSK
PIP DLO:=INI.TSK
PIP DLO:=INS.TSK
PIP DLO:=MOU.TSK
PIP DLO:=SYS.TSK
PIP DLO:=TKN.TSK
PIP DLO:=UFD.TSK
PIP DLO:=UNL.TSK
PIP DLO:=HEL.TSK
PIP DLO:=BYE.TSK
PIP DLO:=ACNT.TSK
!
PIP DLO:=PIP.TSK
PIP DLO:=TEC.TSK
PIP DLO:=BAD.TSK
PIP DLO:=VMR.TSK
!
SET /UIC=[1,2]
PIP DLO:=STARTUP.CMD
!
!
! SETUP TO TRANSFER COMMAND FILES
!
SET /UIC=[5,1]
UFD DLO:[5,1]
PIP DLO:=DLRSX.CMD
PIP DLO:=DYRSX.CMD
PIP DLO:=DLSYSVMR.CMD
PIP DLO:=DYSYSVMR.CMD
!
! SETUP TO TRANSFER UTILITIES
! NOTE: ADDITIONAL UTILITIES AND LIBRARIES MAY BE DESIRED
SET /UIC=[1,54]
PIP DLO:=MAC.TSK
PIP DLO:=DMP.TSK
PIP DLO:=BRO.TSK
!PIP DLO:=TKB.TSK
!PIP DLO:=CRF.TSK
!
! TRANSFER SYSLIB.OLB
!
!UFD DLO:[1,1]
:SET /UIC=[1,1]
!PIP DLO:=SYSLIB.OLB
!
!
! SECTION TO SET UP FOR FINAL VMR PHASE
! TYPE "VMR @[5,1]DYSYSVMR.CMD<CR>"
!
SET /UIC=[1,54]
INS SY0:VMR
ASN DLO:=LB0:
ASN DLO:=SY0:
ALL LB0:

```

```

! DYRSX.CMD - COMMAND FILE TO INITIALIZE A DISKETTE WITH RSX-11 TASKS
! FOR TRANSFER OVER TO DSD-880 WINCHESTER.
! REQUIRES A DOUBLE SIDED DOUBLE DENSITY DISKETTE
! GENERATES A BOOTABLE RSX11M DISKETTE AFTER FINAL VMR PHASE
! 16-MAR-81 - SETS UP READY FOR VMR SYSGEN PHASE

```

```

ALL DY0:
INI DY0:DYRSXSYS
MOU DY0:DYRSXSYS
UFD DY0:[1,54]
UFD DY0:[1,2]
SET /UIC=[1,54]
PIP DY0:RSX11M.SYS/CO/BL:258.=RSX11M.TSK
PIP DY0:RSX11M.TSK/CO=RSX11M.TSK
PIP DY0:=RSX11M.STB
PIP DY0:=DYDRV.*
PIP DY0:=DLDRV.*
PIP DY0:=LDR.*
PIP DY0:=TDRV.*
PIP DY0:=LPDRV.*
PIP DY0:=DRDRV.*
PIP DY0:=FCPMD1.TSK
PIP DY0:=COT.TSK
PIP DY0:=LOA.TSK
PIP DY0:=MCRMU.TSK
PIP DY0:=SAV.TSK
PIP DY0:=SHF.TSK
PIP DY0:=ACS.TSK
PIP DY0:=BOO.TSK
PIP DY0:=IND.TSK
PIP DY0:=DMO.TSK
PIP DY0:=ERF.TSK
PIP DY0:=ERL.TSK
PIP DY0:=INI.TSK
PIP DY0:=INS.TSK
PIP DY0:=MOU.TSK
PIP DY0:=SYS.TSK
PIP DY0:=TKN.TSK
PIP DY0:=UFD.TSK
PIP DY0:=UNL.TSK
PIP DY0:=HEL.TSK
PIP DY0:=BYE.TSK
PIP DY0:=ACNT.TSK
!
PIP DY0:=PIP.TSK
PIP DY0:=TEC.TSK
PIP DY0:=BAD.TSK
PIP DY0:=VMR.TSK
!
SET /UIC=[1,2]
PIP DY0:=STARTUP.CMD
!
!
SET /UIC=[5,1]
UFD DY0:[5,1]
PIP DY0:=DYRSX.CMD
PIP DY0:=DLRSX.CMD
PIP DY0:=DYSYSVMR.CMD
PIP DY0:=DLSYSVMR.CMD
!
SET /UIC=[1,54]
PIP DY0:=MAC.TSK
PIP DY0:=DMP.TSK
PIP DY0:=BRO.TSK
! ADDITIONAL UTILITIES MAY BE COPIED HERE
! PIP DY0:=MAC.TSK
! PIP DY0:=TKB.TSK
! PIP DY0:=CRF.TSK
!
!UFD [1,1]
!PIP DY0:[1,1]=[1,1]SYSLIB.OLB
!
! SECTION TO SET UP FOR FINAL VMR PHASE
! TYPE "VMR @[5,1]DYSYSVMR.CMD<CR>"
!
INS SY0:VMR
ASN DY0:=LB0:
ASN DY0:=SY0:
ALL LB0:

```

```

! DYSYSVMR.COMD - VMR A RSX11M SYS ON FLOPPY 8-JUN-80 - PART 2
! INDIRECT COMMAND STREAM TO VMR
SET /POOL=1000
SET /MAIN=LDRPAR*:24:TASK
INS LDR
FIX ...LDR
SET /MAIN=TTPAR*:200:TASK
LOA TT:
SET /MAIN=SYSPAR*:100:TASK
SET /MAIN=FCPPAR*:240:TASK
SET /MAIN=GEN*:*:SYS
LOA DY:
LOA DL:
INS FCPMD1      ! INSTALL FILE SYSTEM
INS COT         ! INSTALL CO DRIVER TASK
INS ACS         ! INSTALL ALLOCATE CHECKPOINT FILE
INS BOO        ! INSTALL BOOT
INS DMO        ! INSTALL DISMOUNT
INS ERF        ! INSTALL ERROR OFF
INS ERL        ! INSTALL ERROR LOGGER
INS IND        ! INSTALL INDIRECT FILE PROCESSOR
INS INI        ! INSTALL INITVOL
INS INS        ! INSTALL INSTALL
! INS PMD/PAR=GEN ! INSTALL POST-MORTEM DUMPER
INS LOA        ! INSTALL LOAD
INS MCRMU      ! INSTALL MULTI-USER MCR
INS HEL        ! INSTALL LOGIN PROCESSOR
INS BYE        ! INSTALL LOGOUT PROCESSOR
INS MOU        ! INSTALL MOUNT
INS SAV        ! INSTALL SAVE
INS SHF        ! INSTALL SHUFFLER
INS SYS        ! INSTALL SYSTEM DISPLAY PART OF MCR
INS TKN        ! INSTALL TASK TERMINATION TASK
INS UFD        ! INSTALL USER FILE DIRECTORY BUILDER
INS UNL        ! INSTALL UNLOAD
SET /UIC=[1,54]:TT0:
;
SET /POOL
;
PAR
;
TAS
;
DEV

```

```

! DLSYSVMR.COMD - VMR A RSX11M SYS ON RL01 13-FEB-81
! INDIRECT COMMAND STREAM TO VMR
SET /POOL=1000
SET /MAIN=LDRPAR*:24:TASK
INS LDR
FIX ...LDR
SET /MAIN=TTPAR*:200:TASK
LOA TT:
SET /MAIN=SYSPAR*:100:TASK
SET /MAIN=FCPPAR*:240:TASK
SET /MAIN=GEN*:*:SYS
LOA DL:
LOA DY:
LOA DR:
INS FCPMD1      ! INSTALL FILE SYSTEM
INS COT         ! INSTALL CO DRIVER TASK
INS ACS         ! INSTALL ALLOCATE CHECKPOINT FILE
INS BOO        ! INSTALL BOOT
INS DMO        ! INSTALL DISMOUNT
INS ERF        ! INSTALL ERROR OFF
INS ERL        ! INSTALL ERROR LOGGER
INS IND        ! INSTALL INDIRECT FILE PROCESSOR
INS INI        ! INSTALL INITVOL
INS INS        ! INSTALL INSTALL
INS PMD/PAR=GEN ! INSTALL POST-MORTEM DUMPER
INS LOA        ! INSTALL LOAD
INS MCRMU      ! INSTALL MULTI-USER MCR
INS HEL        ! INSTALL LOGIN PROCESSOR
INS BYE        ! INSTALL LOGOUT PROCESSOR
INS MOU        ! INSTALL MOUNT
INS SAV        ! INSTALL SAVE
INS SHF        ! INSTALL SHUFFLER
INS SYS        ! INSTALL SYSTEM DISPLAY PART OF MCR
INS TKN        ! INSTALL TASK TERMINATION TASK
INS UFD        ! INSTALL USER FILE DIRECTORY BUILDER
INS UNL        ! INSTALL UNLOAD
SET /UIC=[1,54]:TT0:
;
SET /POOL
;
PAR
;
TAS
;
DEV

```


APPENDIX C
FLPEXR USER'S MANUAL

Appendix C: FLPEXR Users Manual

INTRODUCTION
PROGRAM LOADING
PROGRAM EXIT
PROGRAM COMMANDS
PROGRAM INPUT/OUTPUT
PROGRAM STATUS AND ERROR DISPLAYS
DETAILED DESCRIPTION OF COMMANDS

- Comprehensive Tests
- Individual Tests
- Media Modification
- Program Control Values
- Program Status
- Data Utilities

INTRODUCTION

All DSD flexible disk systems with an LSI-11 or PDP-11 interface board are shipped with a diskette containing an interactive diagnostic program called FLPEXR. The manual explains the operation of this comprehensive set of tests and utility programs. This manual assumes the user is familiar with floppy diskette operations and terminology.

FLPEXR supports the full product line of floppy disk drive products and multiple drive systems with 1 through 4 drives per system. It is a standalone program, capable of being bootstrapped into the processor. It performs auto configuration of certain control parameters, determining both disk and CPU characteristics. It supports both hard copy and video display terminals with full x-on, x-off output control. In order to facilitate unattended testing, terminal output is also retained in a circular buffer autoconfigured to the full

available memory; commands are also provided to display and reset the circular buffer. Commands are also provided for diskette formatting, examination, duplication, and comparison. Test commands fully exercise system capabilities with operational parameters being user selectable through commands. The acceptance test and verify commands are suitable for both incoming quality control checks and system exercise/burn-in.

PROGRAM LOADING

FLPEXR requires a standard console device, an LSI-11 or PDP-11 computer and at least 12K words of memory. Loading FLPEXR can be accomplished by two methods. One method is to bootstrap the diagnostic diskette. This loads FLPEXR into memory automatically. The other method requires an RT-11 operating system. The FLPEXR diagnostic diskette has an RT-11 compatible directory and file space. The files on the diagnostic diskette can be accessed using standard RT-11 procedures. For example, FLPEXR can be run from an RT-11 system by typing.

```
RU DEV: FLPEXR <CR>
```

where <DEV:> might be DX0:, DX1:, DY0:, DY1: as appropriate.

On a system running other operating systems (e.g., RSX11M, IAS, RSTS, etc.), the distribution diskette must be bootstrapped into memory.

Since both bootstrap and diagnostic programs handle RX01 and RX02 protocols, FLPEXR diagnostic diskette may be used with any DEC compatible disk system.

Once the FLPEXR diagnostic program has been loaded into memory, the diagnostic diskette may be used with any DEC compatible disk system.

Once the FLPEXR diagnostic program has been loaded into memory, the diagnostic diskette should be removed from the drive so it is not erased.

Two high quality, write-enabled formatted diskettes of the same type (density and number of sides) should be installed in the FLPEXR drives before proceeding with any of the tests.

After FLPEXR is loaded into memory, a brief description is displayed on the terminal which includes a memory map, preliminary usage instructions, and a prompt for selection of device type.

The memory map indicates the ranges of the address space which responds with SSYNC (or BRPLY) when accessed by the host computer. The figure below shows the text initially output:

```

<Memory map>
Remove distribution diskette.
DSD floppy disk diagnostic with format capability.
Type 'V' to do verify/acceptance test on two drives.
  This will do a set media and short verify.
  Then go into a regular acceptance test.
Type 'H' for a list of valid commands.
Type 'FO' to format a diskette.
CTRL-C returns to mode.
CTRL-R aborts function and returns to mode.
All numeric inputs/outputs are in octal.
Insert test diskettes (both must be of same density).
Enter device type (0 to 7) or 'H' for list of types.
    
```

The device type specification is used by FLPEXR to set up internal control values that tailor the program's operation to specific DSD product capabilities. An input of 0 will select a default value that is applicable for all products. The device flag (which is the major control value set by the device type specification) can be modified during program operation by the 'SET DEVICE' command. An 'H' input in response to the device type prompt will output the list of types as shown below:

Type	Device
0	Default
1	110
2	210
3	430
4	440
5	470
6	480
7	880

Which type of device? (0 to 7):

After the device type is selected, FLPEXR will output the device flag being used, as shown below.

```

Device flag being used is: XXXX
Use set device command to modify flag
    
```

FLPEXR then outputs the name and version number of the program.

```

DSD FLPEXR VXX
    
```

FLPEXR types "<CRLF> #" when starting, and the program then attempts an INIT (initialize) instruction. When the INIT cycle is successful, the program types the prompt word: "DD COMMAND:" or "COMMAND:". This prompt string allows the operator to input a command. The "DD" indicates that the program is accessing double density diskettes. A list of all the available commands may be obtained by typing an 'H' (HELP).

PROGRAM EXIT

If FLPEXR was loaded via the bootstrap, the operating system must be rebooted.

If FLPEXR was loaded via the RT-11 operating system, direct return to the operating system may be possible. A control input of 'CRTL C' will cause FLPEXR to output "EXIT TO RT-11?". A 'Y' response will cause the return to the RT-11 monitor. Exit to the monitor may not function if:

1. There is insufficient memory available.
2. The system device is not located at 177170.
3. The system device or diskette is not available.

If the direct monitor exit is not possible, the operating system must be rebooted.

PROGRAM COMMANDS

Legal responses to "COMMAND:" are listed in Table 1, grouped by class of command. Only the characters enclosed in parenthesis need to be typed. The parenthesis should NOT be typed. When the typed string is recognized, the terminal "BELL" will sound at which time <CR> should be typed. The program will fill in the remaining characters and then proceed to execute the function.

FLPEXR also recognizes various control inputs. Table 2 lists the control input and the associated action. This input can be performed at any time, even while a test is in progress.

Table 1. FLPEXR Commands

Command	Description
Comprehensive Tests	
• (V)ERIFY	General Exerciser
• (SH)ORT VERIFY	Short Exerciser
Individual Tests	
• (FI)LL EMPTY	Fill/Empty Buffer Test
• (SEQW)/R	Sequential Write/Read Test
• (SEQ)READ	Sequential Read
• (RA)NDOM R/W	Random Read/Write
• (REA)D RANDOM	Read Random
• (SC)AN	Scan
• (SEE)K RANGE	Seek Range
Media Modification	
• (SET M)EDIA DENSITY	Set Media Density
• (FO)RMAT	Format Diskette
Program Control Values	
• (SET U)NIT	Set Unit
• (SET T)RACK	Set Track Limits
• (SEC)TOR INCREMENT	Specify Sector Inteleave
• (I)NTERRUPT	Set Interrupt Status
• (DE)NSITY LOCKUP	Lock Density to Current Density
• (SET D)EVICE	Set Device
• (H)ELP	Output List of Commands
Program Status	
• (M)AP ADDRESS	Memory and Device Map
• (ST)ATUS	Display Status Information
• (RES)ET STATUS	Change Status
• (SA)VE STATUS	Save Status on Diskette
• (DUMP C)IR BUFFER	Display Circular Output Buffer
• (REC)OVER STATUS	Retrieve
Data Utilities	
• (DUP)LICATE	Duplicate
• (CO)MPARE	Compare by Sector
• (DUMP O)CTAL	Data Dump in Octal Format
• (DUMP B)YTE	Data Dump in Byte Format
• (DUMP A)SCII	Data Dump in ASCII Format

FLPEXR has several restart addresses that can be used to restart the program if necessary. They are:

1104	—Normal start-restart address
1110	—Start address from monitor call
1114	—Start at command prompt, without performing INIT on device
1100	—Return address from ODT after CTRL D dispatch

PROGRAM INPUT/OUTPUT

All data input and output is in octal format unless otherwise specified.

The 'DEL' or 'RUB' key may be used during input to remove the previously input character. On some output devices, the cursor will be backspaced one position for each 'DEL'; on other devices, a '/' will be output followed by the characters being deleted. Normal input may be resumed at any time.

Table 2. Control Inputs

Input	Meaning	Notes
CTRL R	Aborts current test, restarts at command	
CTRL S	Freezes terminal output until another character is typed	
CTRL O	Throws away all output until another character is typed	
CTRL P	Throws away all output except errors until another character is typed	
CTRL Q	Causes output to resume	1
<LF>	Types current track and sector and status counts	4
CTRL C	Asks 'EXIT TO RT-11?' if RT-11 monitor is available. Type Y to exit. If RT-11 monitor not available, action is similar to CTRL R. If in ODT, may return control to program	
CTRL D	Causes control transfer to ODT	2,3
CTRL T	Causes control transfer to ODT with stack trace	2,3
CTRL L	Toggles extended error printout formats	
RUB or DEL	Deletes previous character in input string	

Notes:

1. Actually, any character being input will perform this function.
2. Exit to monitor and control transfer to debug may not function if there is not enough memory available or if booted from a device other than 177170.
3. Control transfer from ODT back into FLPEXR is accomplished by 'CTRL C'. If this does not work, the program may be restarted by 'XXXX'G, where XXXX is the appropriate restart address (see below).
4. This command always functions; however, for some tests, the track and sector information should be disregarded (e.g., fill-empty test).

The program fully supports X-on, X-off protocol (i.e., CTRL S, CTRL O and CTRL O) to enable output to be suspended and restarted.

Diskette data is accessed via a combined address unit #, side #, track #, and sector #. Various commands are provided to specify the limits of the address components to be used for tests. These values are set to default values when the device type is selected following initial program load.

Input is typically terminated by either a <CR> or <SP>. Validation input (e.g., Y or N) typically does not require termination.

PROGRAM STATUS AND ERROR DISPLAYS

FLPEXR types out error and status information under a wide variety of circumstances. All printouts to the console terminal are sent to a circular buffer in memory as well. The buffer size is determined by available memory. The circular buffer is useful if a hard copy console terminal is not being used and error printouts no longer on the face of the CRT screen need to be examined. The display output buffer (DUMP C) function is used to examine messages in the circular buffer. The status

C-4

variables that might appear on the console terminal are explained below:

DEV XXX	Is printed only when running multiple controllers. XXX are the last 3 octal digits of the RXCS address for the system whose error/status data is being displayed.
UN U	U represents the logical drive unit number for which the error/status data is being displayed.
TRACK = TK	Track address at time of status/error printout.
SECTOR = SC	Sector address at the time of status/error printout.
RXCS = XY	Shows the contents of the command and status register.
RXDB = XY	Shows the contents of the data buffer register. It should normally be 0 or 214 octal following an INIT.
INTERRUPT ERROR: X	If X is less than 0, this indicates that an expected interrupt failed to occur. If X is greater than 0, this indicates that more than one interrupt occurred.
#BAD = XX	This variable indicates the number of status errors detected.
#RD/WRT = XX	This variable indicates the number of sectors that were transferred error-free.
#XFERS = XX	This variable indicates the number of fill/empty command cycles that were completed successfully.
B-DATA = XX	Number of data errors where a byte or word of data did not compare with the value the program was expecting. This is different than a CRC error, which would be

counted as bad status. There can be up to 128 data errors in 1 sector.

DEFSTT = DEFINITIVE ERROR STATUS

Error code associated with the error currently being displayed. The meaning of each error code can be found in the unit users manual.

SIDE 1

Indicates an error has occurred on side 1 (second side of a diskette). Error messages not specifying side 1 relate to side 0. Single sided products display only side 0.

EXPANDED ERROR DISPLAYS

If in RX02 compatible mode, and CTRL L has been typed to select expanded error printout mode, the following additional status variables appear in the error printout:

D0@TK = TK	Track address of drive 0
D1@TK = TK	Track address of drive 1
CURTK = TK	Track address of the current selected logical unit
CSCT = SC	Sector address of the current selected logical unit
DSTT = XX	Drive status byte—each of the bits in this status byte is used to encode some information about one or both of the flexible disk drives and/or the media presently installed. The bits get decoded into words which are displayed with the other status. These words are explained below.
US0	Drive 0 is currently selected
US1	Drive 1 is currently selected
DN0L	Drive 0 currently contains a single density diskette
DN0H	Drive 0 currently contains a double density diskette
DN1L	Drive 1 currently contains a single density diskette
DN1H	Drive 1 currently contains a double density diskette
HDUP	Head on currently selected unit is up (unloaded)
HDL D	Head on currently selected unit is loaded

TRKRD = TK Track address read from a sector header. This number would only be useful following a DEFSTT = 150 error.

DEF - RXDB = XX Contents of the RXDB following a definitive error status command.

ERROR ACTIVITY CODES

A number of 2-character activity codes are displayed in the context of error printouts. The codes listed below indicate what the diagnostic was doing when the error was detected.

Activity	Code	Meaning
FILL-EMPTY	FB	Problem loading sector buffer
FILL-EMPTY	E1, E2	Sector buffer data did not check during an empty buffer operation
FILL-EMPTY	FL, EL	DMA fill or empty error to low mem. buffer
FILL-EMPTY	FD, ED	DMA fill or empty error to cir. mem. buffer
FILL-EMPTY	FH, EH	DMA fill or empty error to high mem. buffer
SEQ. WRITE	SW, CW	Problem during sequential write
SEQRD	SR	Problem during sequential read
RANDOM	RW, RC, RR	Random (write, check, read) activity when error was detected
ANY READ RETRY	XE	Empty buffer check before retrying read
DUP UTILITY	IN	Error reading the source diskette
DUP UTILITY	CW	Error checking what was just written
DELETED DATA	DW, DR	Deleted data flag failure

EXAMPLES OF ERROR OUTPUT

The following printouts are examples of what the FLPEXR diagnostic program outputs to the console under varying circumstances.

EXAMPLE 1: Operator requests status of currently selected drive during a test by typing LF.

```
UN 0 TRACK=0 SECTOR=4
BAD=0 RD/WRT=0 XFERS=0
B-DATA=0
```

EXAMPLE 2: Operator requests status of both drives using the "STATUS"

```
UN 0 BAD=0 RD/WRT=0
XFERS=0 B-DATA=0
UN 1 BAD=0 RD/WRT=0
XFERS=0 B-DATA=0
```

EXAMPLE 3: Disk was write protected.

```
Error detected on drive #1 at track
#1, sector #1
error code was 100
#BAD=1 #RD/WRT=2002
#XFERS=0 B-DATA=0
```

EXAMPLE 4: Read on drive with no disk installed.

```
Error detected on drive #0 at track
#1, sector #11
error code was 110
#BAD=3 #RD/WRT=2049
XFERS=0 B-DATA=0
```

COMPREHENSIVE TEST COMMANDS

• VERIFY—(V)ERIFY

The VERIFY test does one pass of a SHORT ACCEPTANCE TEST, on the first 7 tracks and then resets the limit variables back to the normal default values. It then induces an automatic "CTRL P" to inhibit all but error printout and initiates the long verify test. This test will run until terminated by a "CTRL R."

EXAMPLE

```
#DD COMMAND : VERIFY
SCRATCH DISKS INSTALLED? (Y, N) : Y
SET DENSITY TO (S, D) : S
ARE YOU SURE? (Y, N) : Y
VERIFY TEST NOW STARTING
SCAN CRC CHECKED WRITING READING
INTERRUPTS ENABLED
WRITING READING
```

• SHORT VERIFY—(SH)ORT VERIFY

This interactive program changes the track range used by the VERIFY TEST so that only the first 9 tracks of each selected drive are tested. This test will run until terminated by a CTRL R.

INDIVIDUAL TESTS

- SCAN—(SC)AN

The SCAN test reads all sectors on all selected drives sequentially and checks for CRC errors. It also determines media density. No direct data checking takes place in this test. Only status is checked. After all units are scanned once, the "COMMAND:" prompt is displayed on the console.

EXAMPLE

```
#COMMAND: SCAN
CRC CHECKED
#COMMAND:
```

- SEEK RANGE—(SE)EK RANGE

The SEEK RANGE function is a versatile drive test that performs all possible seeks within the operator specified track and seek length boundaries. It specifies a read on the first sector that can be read on the destination track after compensating for step and head load times. Thus it is a worst case test of the drive stepper motor and head setting. Status information will be continuously displayed during execution of this test indicating the seek length currently being used (x) and direction of seek ([^] = outward). An '!' will be output at the conclusion of each pass. This test will run continuously until terminated by a CTRL R.

EXAMPLE

```
#DD COMMAND SEEK RANGE
NOTE: ALL TIMES ARE GIVEN IN 'OCTAL'
      TENTHS OF MSEC
SEEK LENGTH ( 1 ): 3 THROUGH ( 27 )
: 7
850 SEEK TIME ( 36 ):
850 SECTOR OFFSET: ( 4 ):
COVERING TRACKS ( 1 ): THROUGH
( 114 ): [ 3 ][ ^ ][ 4 ][ ^ ][ 5 ][ 6 ]
[ ^ ][ 7 ][ ^ ] ! [ 3 ][ ^ ][ 4 ][ ^ ]...
```

- FILL-EMPTY—(FI)LL EMPTY

The FILL-EMPTY test checks the FILL BUFFER and EMPTY BUFFER controller commands. If the controller under test is configured in the RX01 compatible mode, then the test involves only programmed I/O. If the controller is configured as an RX02, the controller does FILL/EMPTIES into three different buffers so as to verify proper operation of all possible address bits. FILL/EMPTIES are done in both densities covering all possible word counts. Since this test does not manipulate the drives, the system will oper-

ate in silence. This test continues until the operator types a 'CTRL R'.

- SEQUENTIAL WRITE/READ—(SEQW)/R

The SEQUENTIAL WRITE / READ test writes pseudo-random data sequentially on all selected drives. The test then reads all the data and checks it. The message "WRITING" is typed on the console terminal when the test first starts writing. The message "READING" is typed when the test starts reading. This test continues until the operator types "CTRL R". It also performs a set media density operation if the diskette is not of the expected density.

Note

The following three tests require a SEQUENTIAL WRITE pass be done first in order to initialize the pseudo-random data. Data compare errors are reported if this is not done. FLPEXR prompts 'IS DISKETTE SEQUENTIAL WRITTEN? (Y, N)' at the start of each test. A 'Y' response will initiate the test; a 'N' response will return to the command prompt.

- SEQUENTIAL READ—(SEQ) READ

The SEQUENTIAL READ test reads the data on all selected drives sequentially and compares the data pattern against what was written. The program types "READING" at the beginning of each pass. This test continues until the operator types "CTRL R".

- RANDOM READ/WRITE—(RA)NDOM R/W

The RANDOM READ/WRITE test selects a random sector of a selected drive, then reads or writes it. It checks data when appropriate. This test continues until the operator types "CTRL R".

- READ RANDOM—(REA)D RANDOM

The READ RANDOM test reads randomly selected sectors. Data is checked following each read. This test continues until the operator types "CTRL R".

MEDIA MODIFICATION COMMANDS

- REFORMAT—(FO)RMAT

This function is used to rewrite diskette headers, as well as all the other data on a particular diskette. It also prompts for confirmation, unit, and sequential or interleaved format. Either the entire diskette (Formats 2 through 8) or just a portion of the diskette (Format 0 through 1) may be formatted. If a partial format is selected, the track range to be formatted is specified by the set track command. The sides to be formatted can also be specified.

EXAMPLE (for 480)

```

#COMMAND: FORMAT
SEQUENTIAL SECTOR FORMAT?
(Y OR N) : Y

Density                Type  Supported
                        On
DEC SD (IBM SD 2-128)  0    480
                        440
                        210
                        110
DEC DD                  1    480
                        440
DEC SD (ALL OF DISK)   2    880, 480,
                        470, 430,
                        4140
DEC DD (ALL OF DISK)   3    880, 480,
                        470, 430,
                        4140
IBM SD (92-256)        4    480
IBM SD (2-512)         5    480
IBM DD (2D-256)        6    480
IBM DD (2D-512)       7    480
IBM DD (2D-1024)      8    480
DESIRED SELECTION? (0 to 8) : 4
DO YOU WISH TO DO SIDE #0? (Y OR N) : Y
DO YOU WISH TO DO SIDE #1? (Y OR N) : Y
ARE YOU SURE? (Y OR N) : Y
# COMMAND:

```

FLPEXR is designed to support the full range of formats available throughout the product line. However, not all units are capable of writing all formats. If an inappropriate format is selected, an error message will be output. If the unit is not capable of IBM format modes, they will not be output in the selection menu.

Typically, the operator should format new diskettes by Formats 2 for single density diskettes and 3 for double density diskettes.

- SET MEDIA DENSITY (SET M) MEDIA DENSITY

This function enables the operator to initialize a diskette to single density or double density format. The function prompts for function confirmation, unit, and desired density. To select single density, respond with an "S". Type "D" to select double density.

The SET MEDIA DENSITY command is used to implement this function, therefore, no headers are rewritten. The prompt is issued when this function is complete. This function causes any status saved on track 0, sector 1 to be erased.

```

#COMMAND: SET MEDIA DENSITY
DO A SET MEDIA ON ALL DEVICES? (Y OR N) :
N
UNIT: 1: SET DENSITY TO (S,D) : S
ARE YOU SURE? (Y, N) : Y

```

PROGRAM CONTROL VALUE COMMANDS

- SET UNIT—(SET U)NIT

This command enables the operator to specify which drives are to be accessed by the various test functions. The default drives are units 0 and 1. The currently selected units are printed first. It prompts with "UNIT:", expecting a number between 0 and 3, inclusive. Unit numbers are accepted as long as they are valid. When a non-number is typed to a unit request, the units currently selected are prompted and FLPEXR returns to command prompt.

Note

- 1 If using a two drive system, then selection of units 2 and 3 is invalid and may cause an error.
 - 2 If units are selected by "SET DEVICE", they will override "SET UNIT". See the "SET DEVICE" command for more information.
-

EXAMPLE

```
"SET DEVICE" overriding "SET UNIT"
#DD COMMAND: SET UNIT
— LOADED BY SET DEVICE FLAGS
UNITS SELECTED 1
```

- SET TRACK—(SET T)RACK

This command enables the operator to specify lower and upper track limits for all other test functions. The default lower track limit is track 1 and upper track limit is track 76. The "COMMAND" prompt is issued after the entry of valid new limits. The lower limit must not exceed the upper limit.

EXAMPLE

```
"SET TRACK" used to set track range from
track 1 to track 10
#COMMAND: SET TRACK
FROM 1: THROUGH 14: 10
```

- SECTOR INCREMENT—(SEC)TOR INCREMENT

This command enables the operator to specify the sector increment value. The number is added to the present sector address to determine the next sector address in the functions that read multiple sectors on a single track. If this number were 1 and the diskette did not have an interleaved format, an entire revolution would be required to read each sector. On LSI-11 processors, the default increment value is 3. On PDP-11 processors, the default increment value is 2. The "MODE:" prompt is issued after the new value has been entered.

```
#DD COMMAND: SECTOR INCREMENT
= 3 - 2
#DD COMMAND: SECTOR INCREMENT
= 2 - 3
```

- SET INTERRUPT STATUS—(I)NTERRUPT

The SET INTERRUPT STATUS command enables the operator to test the disk system with interrupts either enabled or disabled. If interrupts are enabled, the FLPEXR ensures that an interrupt occurs whenever it is appropriate. The operator enters a D to disable interrupts and an E to enable interrupts. This function is also used in ACCEPTANCE and VERIFY to set "Interrupts Enabled" and "Interrupts Disabled".

EXAMPLE

```
#DD COMMAND: INTERRUPT
CURRENTLY INTERRUPTS ARE DISABLED
(D)
INPUT NEW STATUS (ENABLE OR
DISABLE)
(E OR D) : D
```

- DENSITY LOCKUP—(DE)NSITY LOCKUP

The "DENSITY LOCKUP" function allows the operator to lock the current disk density during the various tests. This feature is useful when testing for a problem that occurs in one density only, or when the disk density cannot be changed by a SET MEDIA DENSITY function.

EXAMPLE

```
#DD COMMAND: DENSITY LOCKUP
DENSITY IS CURRENTLY UNLOCKED
DO YOU WISH TO LOCK THE DENSITY (Y
OR N): Y
#DD COMMAND:
```

- SET DEVICE—(SET D)EVICE

This function facilitates testing controllers that are not configured at the standard device I/O address and interrupt vector. It also enables the FLPEXR test program to simultaneously exercise multiple controllers. The function protocol asks you for device address, interrupt vector, and flag word. If a space is typed, the program steps past that field, leaving it intact. Return to "COMMAND:" is by input of a "CR" (carriage return) in response to "RXCS:". The flag word is organized as follows:

15	14	13	12	11	10	09	08
				DMA	D85	DBS	DDN
07	06	05	04	03	02	01	00
US3	US2	US1	US0				

When set to a 1, the bit labeled:

DMA indicates the device should be tested as an RX02.

D85 indicates 850 timing should be used (else 800 timing).

DBS indicates that double sided operation is enabled.

DDN indicates double density operation is enabled.

US3 indicates this device contains a drive unit 3.

US2 indicates this device contains a drive unit 2.

US1 indicates this device contains a drive unit 1.

US0 indicates this device contains a drive unit 0.

US0, US1, US2, US3 do an implicit "SET UNIT" function when set. The normal flag variable for RX02 mode is 4400 (octal). The normal flag variable for RX01 is 0000 (octal). The normal flag for double sided RX02 operation is 7400 (octal).

EXAMPLE SET DEVICE

```
#COMMAND: SET DEVICE
SET THE DEVICE FLAGS FOR EACH SYS-
TEM AS FOLLOWS:
  4000: ENABLES DMA OPERATION IF
        AVAILABLE
  2000: SETS 850 TIMING (ELSE 800)
  1000: ENABLES DOUBLE SIDED OPERA-
        TION IF DOUBLE SIDED DRIVE
        AND DISK USED
  400:  ENABLE DENSITY SWITCHING IF
        RX02/440/480
  20:   ENABLE UNIT #1 ON CURRENT
        DEVICE
  10:  ENABLE UNIT #0 ON CURRENT
        DEVICE
RXCS @ 177170: INT @ 264 INTVEC = 264
FLAGS: 4400 6410
RXCS @ 0:
```

- HELP

The HELP command causes all the valid "MODE:" responses to be displayed on the console terminal. The "MODE:" prompt is typed when this function is complete.

PROGRAM STATUS COMMANDS

- MAP ADDRESS—(M)AP ADDRESS

The MAP ADDRESS command causes a memory and device address map of the system to be displayed on the console terminal. This is the same map displayed when the FLPEXR program is first loaded. In addition, the interrupt vector address associated with each disk interface is displayed. The "COMMAND:" prompt is typed when this function is complete.

EXAMPLE

```
#DD COMMAND: MAP ADDRESS
( 0 - 157776)
( 160100 - 160106)
( 165000 - 165776)
( 171000 - 171776)
( 172300 - 172316)
( 172340 - 172356)
( 172520 - 172536)
( 173000 - 173776)
( 176700 - 176746)
( 177170 - 177172)
( 177510 - 177516)
( 177546 - 177546)
( 177560 - 177616)
( 177640 - 177656)
( 177776)
DEV: 177170 INT @ 264
```

Note

This example indicates that a device is installed at location 177170 with interrupt vector at location 264.

- STATUS—(S)TATUS

The STATUS function causes all the current status information including hardware errors, data errors, and pass counts to be displayed on the console terminal. Displaying status information does not reset the status counts. The "COMMAND:" prompt is typed when this function is complete.

EXAMPLE

```
#COMMAND: STATUS
UNIT #0 #BAD = 3 #RD/WRT = 2049
#XFERS = 0 B - DATA = 0 ST = 110 # = 3
```

- RESET STATUS—(RES)ET STATUS

The RESET STATUS function first displays all the available status counts. Next, the display will ask whether all of the status counts need resetting. A "Y" will cause all of the error, pass, etc. counts to be reset to zero. The "COMMAND:" prompt is output when this function is complete.

- SAVE STATUS—(SA)VE STATUS

The SAVE STATUS command causes all the status counts associated with a particular drive to be written on track 0, sector 1 of the diskette in that drive. Only the SET MEDIA DENSITY commands over-write track 0, so the status data associated with each drive can be safely stored away. This function is used by the acceptance test so that it can survive a loss of main computer CPU memory without any loss of cumulative error data. The "COMMAND:" prompt is typed when this function is complete.

- RECOVER STATUS—(REC)OVER STATUS

The RECOVER STATUS routine performs the opposite function performed by the SAVE STATUS function. The status data stored away on track 0, sector 1 of the diskette in each drive is transferred back from the diskette to the status/counter variables in memory. The "COMMAND:" prompt is displayed when this function is complete.

- DISPLAY CIRCULAR OUTPUT BUFFER—(DUMP C)IR BUFFER

The DUMP C function is used to display the output buffer associated with all console terminal output. This function is useful on systems where the console terminal is CRT. Messages previously output can be re-examined on the console. The buffer can be cleared after it is displayed by this function.

DATA UTILITIES COMMANDS

Note

The SECTOR INCREMENT function may be used to specify sector sequencing for the duplicate and compare commands. For the dump commands, a sector increment of 1 is always assumed.

• **DUPLICATE—(DUP)PLICATE**

The DUPLICATE command enables the operator to make a duplicate copy of a diskette. The function prompts for a source drive unit number and a destination drive unit number. For each possible sector address, the function performs a READ SOURCE SECTOR, WRITE DESTINATION SECTOR, READ DESTINATION SECTOR, and COMPARE DATA.

EXAMPLE

```
#DD COMMAND: DUPLICATE
SOURCE UNIT: 0
TO DESTINATION UNIT: 1
#DD COMMAND:
```

• **COMPARE—(CO)MPARE**

The COMPARE command enables the operator to compare two diskettes starting at a specific address. The function prompts for: SOURCE UNIT, STARTING TRACK, STARTING SECTOR, NUMBER OF SECTORS, and DESTINATION UNIT. Any differences in data will be output.

• **OCTAL DUMP BY SECTORS—(DUMP O)CTAL**

This command enables the operator to cause an octal dump of specified sectors to the console terminal. The function prompts for: UNIT, STARTING TRACK, STARTING SECTOR, SIDE, and NUMBER OF SECTORS.

EXAMPLE

```
#DD MODE: DUMP OCTAL
SOURCE UNIT: 0 TRACK: 0 SECTOR: 1 #
SECTORS: 2
[DDEN DRIVE #0 AT TRACK 0, SECTOR 1,
SIDE 0]
SC = 1
```

```
0: 00037760000
20: 00000000
40: 00000000
60: 00000000
100: 00000000
120: 00000000
140: 00000000
160: 00000000
200: 00037220000
220: 00000000
240: 00000000
260: 00000000
300: 00000000
320: 00000000
340: 00000000
360: 00000000
```

[DDEN DRIVE #0 AT TRACK #0, SECTOR #2 SIDE #0]
SC = 2

```
0: 00000000
20: 00000000
40: 00000000
60: 00000000
100: 00000000
120: 00000000
140: 00000000
160: 00000000
200: 00000000
220: 00000000
240: 00000000
260: 00000000
300: 00000000
320: 00000000
340: 00000000
360: 00000000
```

• **BYTE DUMP BY SECTORS—(DUMP B)YTE**

This command enables the operator to cause an octal dump of specified sectors to the console terminal. The function prompts for: UNIT, STARTING TRACK, STARTING SECTOR, SIDE, and NUMBER OF SECTORS.

• **ASCII DUMP BY SECTORS—(DUMP A)SCII**

This utility command enables the operator to cause an ASCII dump of specified sectors to the console terminal. The function prompts for: UNIT, STARTING TRACK, STARTING SECTOR, SIDE, and NUMBER OF SECTORS.

APPENDIX D

RLEXR USER'S MANUAL

INTRODUCTION

PROGRAM LOADING

PROGRAM EXIT

PROGRAM COMMANDS

PROGRAM INPUT/OUTPUT

DETAILED DESCRIPTION OF STATUS AND ERROR DISPLAYS

- **Status Variables Displayed**
- **Error Messages and Meanings**
- **Examples of Error Output**

DETAILED DESCRIPTION OF COMMANDS

- **Comprehensive Tests**
- **Individual Tests**
- **Program Control Utilities**
- **Program Status**
- **Data Utilities**

RLEXR USER'S MANUAL

INTRODUCTION

All DSD systems having an LSI-11 or PDP-11 interface board are shipped with a diskette containing an interactive diagnostic program called RLEXR. This manual explains the operation of this comprehensive set of tests and utility programs. The manual assumes the user is familiar with DSD 880 operations and terminology.

RLEXR is designed to test and verify all functions of the DSD 880 winchester drive subsystem in normal and extended (if applicable) mode. It runs as a stand-alone program (with bootstrap) and is capable of handling multiple drives and systems. Both display console and hard copy terminals with full X-on, X-off output control are supported. To facilitate unattended operation, all terminal output is retained in a circular text buffer that is configured to use all available memory. This buffer may be displayed or reset at any time by use of a single command. Test commands fully exercise system functions while detecting and reporting any faults or bad disk areas. The acceptance tests provide total reliability testing and are suitable for both system burn-in/exercise and quality control checks.

PROGRAM LOADING

RLEXR requires a standard console device, an LSI-11 or PDP-11 computer, and at least 16K words of memory. Loading RLEXR can be accomplished by two methods. One method is to bootstrap the diagnostic diskette. This loads RLEXR into memory automatically. The other method requires an RT-11-compatible directory and file structure. The files on the diagnostic diskette can be accessed using standard RT-11 procedures. For example, RLEXR can be run from an RT-11 system by typing:

```
RU <DEV:> RLEXR <CR>
```

where<DEV:>might be DX0:, DX1:, or DY1:, as appropriate.

On a system running other operating systems (e.g., RSX-11M, IAS, PSTS, etc.), the distribution diskette must be bootstrapped into memory. Once the diagnostic diskette has been bootstrapped into memory, the following appears on the screen:

```
DSD DIAGNOSTIC MONITOR VXX
```

```
DSDMON>
```

to run the RLEXR program, type:

```
RLEXR <CR>
```

Since both bootstrap and diagnostic programs handle RX01 and RX02 protocols, RLEXR diagnostic diskettes may be used with any DEC-compatible disk system.

Once the RLEXR diagnostic program has been loaded into memory, the diagnostic diskette should be removed from the drive so it is not erased.

One high quality, write enabled formatted floppy diskette, single- or double-density, single- or double-sided, should be installed in the drive before proceeding with any of the tests.

After RLEXR is loaded into memory, a brief description is displayed on the terminal which includes a memory map and preliminary usage instructions. The memory map indicates the ranges of the address space which responds with SSYNC or BRPLY when accessed by the host computer. The following example shows the text initially output.

After you have run RLEXR by typing:

```
DSDMON> R RLEXR <CR>
```

The following text will be printed on the screen:

```
( 000000 - 157776 )  
( 171000 - 171776 )  
( 172300 - 172316 )  
( 172340 - 172356 )  
( 172516 - 172516 )  
( 173000 - 173776 )  
( 174400 - 174406 )  
( 177150 - 177152 )  
( 177170 - 177172 )  
( 177560 - 177566 )  
( 177572 - 177616 )  
( 177640 - 177656 )  
( 177776 )
```

REMOVE THE DISTRIBUTION DISKETTE

TYPE: A TO DO AN ACCEPTANCE TEST

This will do a short acceptance test followed by a full acceptance test.

TYPE: H FOR LIST OF VALID COMMANDS

CTRL C RETURNS TO COMMAND PROMPT

CTRL R ABORTS FUNCTION AND RETURNS TO COMMAND PROMPT

ALL NUMERIC INPUTS/OUTPUTS ARE IN OCTAL

INSERT ONE TEST DISKETTE PER SYSTEM

ENTER DEVICE TYPE (0, 1, 2) OR <CR> FOR LIST: <CR>

<u>Type</u>	<u>Device</u>
0	880x/8
1	880x/20
2	880x/30

ENTER DEVICE TYPE (0, 1, 2) OR CR FOR LIST: 2

Another memory map is then printed:

DSD RLEXR VXX

(000000 - 157776)
(171000 - 171776)
(172300 - 172316)
(172340 - 172356)
(172516 - 172516)
(173000 - 173776)
(174400 - 174406)
(177150 - 177152)
(177170 - 177172)
(177560 - 177566)
(177572 - 177616)
(177640 - 177656)
(177776)

FULL OR PARTIAL TESTING (F, P)? P

This option is asking whether to run the diagnostic over the entire disk, or only part of the disk. Partial testing preserves tracks 00 through 10 so that testing can be performed without wiping out the diagnostic programs.

SET CLASS SWITCH TO 0
PUSH BUTTON AND TYPE A CHARACTER

This means set the switch marked CLASS on the HyperDiagnostic panel to 0 and depress the EXECUTE pushbutton. Type any character on the keyboard to signal the program to proceed.

ENABLE HALT ON ERROR (Y, N)? N

A yes means that the program will halt on the first error encountered. No means the program will store all error messages in a circular buffer. These messages can be recovered using the DUMP C command.

COMMAND:

PROGRAM EXIT

If RLEXR was loaded via RT-11 operating system or DSDMON, direct return to the monitor may be possible. A control input of CTRL C will cause RLEXR to output, EXIT TO RT-11? A yes response will cause the return to RT-11 monitor. Exit to the monitor may not function if:

1. There is insufficient memory available.
2. The system device is not located at 177170.
3. The system device is not available.

If direct monitor exit is not possible, the operating system must be rebooted.

PROGRAM COMMANDS

Legal response to

COMMAND:

The valid responses to this prompt are listed in Table 1 and grouped by class of command. Only the characters enclosed in parenthesis need to be typed. The parenthesis should NOT be typed. When the typed string is recognized, the terminal bell will sound, at which time <CR> should be typed. The program will fill in the remaining characters and then proceed to execute the function.

RLEXR also recognizes various control character inputs. Table 2 lists the control input and the associated action. This input can be performed at any time, even while a test is in progress.

Table 1. RLEXR Commands

<u>Command</u>	<u>Description</u>
Comprehensive Tests	
● (A)CCEPTANCE	General Exerciser
● (SH)ORT ACCEPTANCE	Short Exerciser
Individual Tests	
● (INTE)RFACE TEST	Interface Test
● (INTR) TEST	Interrupt Test
● (SC)AN	Scan
● (SEE)K RANGE	Seek
● (E)XTENDED MODE TEST	Extended Mode Test
● (SEQ W)/R TEST	Sequential Write/Read Test
NOTE	
The following three tests require a sequential write pass.	
● (SEQ R)EAD	Sequential Read Test
● (RANDOM R)/W	Random Read/Write Test
● (RANDOM RE)AD	Random Read Test
Program Control Utilities	
● (SET D)EVICE	Set Device
● (SET U)NIT	Set Unit
● (SET T)RACK	Set Track
● (SET I)NTERRUPT STATUS	Set Interrupt Status
● (SET M)ODE	Set Mode

Table 1. RLEXR Commands (Cont)

<u>Command</u>	<u>Description</u>
Program Status	
● (H)ELP	Provides List of Commands
● (M)AP ADDRESS	Memory and Device Map
● (ST)ATUS	Display Status Information
● (SA)VE STATUS	Save Status on Diskette
● (RES)ET STATUS	Clear Status
● (DUMP C)IR BUFFER	Display Contents of Circular Buffer
● (REC)OVER STATUS	Retrieve Status
Data Utilities	
● (RD) WITHOUT HEADER	Read Without Header
● (DUMP S)ECTOR	Display Disk Sectors

Table 2. Control Inputs

Input	Meaning	Notes
CTRL R	Aborts current test, restarts at command	
CTRL S	Freeze terminal output until another character is typed	
CTRL O	Throws away all output until another character is typed	
CTRL P	Throws away all output, except errors, until another character is typed	
CTRL Q	Causes output to resume	1
<LF>	Types current track and sector status	2
CTRL C	Asks EXIT TO RT-11?. If RT-11 monitor is available, type Y to exit. If RT-11 monitor not available, action is similar to CTRL R. If in ODT, may return control to program	3
CTRL D	Causes control transfer to ODT	3,4
CTRL T	Causes control transfer to ODT with stack trace	3,4
RUB or DEL	Deletes previous character in input string	

NOTES

1. Actually, any character being input will perform this function.
2. This command always functions; however, for some tests, the track and sector information should be disregarded (e.g., fill empty test).
3. Exit to monitor and control transfer to debug may not function if there is not enough memory available, or if booted from a device other than a 177170.
4. Control transfer from ODT back into RLEXR is accomplished by CTRL C. If this does not work, the program may be restarted by XXXX;G, where XXXX is the appropriate restart address.

Full testing will set the lower track limit to 0. Partial testing will set it to 10 (octal). Partial testing is recommended if diagnostics or other files are already on the RL. If system file RT-11 is on the RL, the lower track limit should be set much higher. The default upper track limits are:

<u>Type</u>	<u>Device</u>	<u>Limit</u>
0	880x/8 - normal mode	376
0	880x/8 - extended mode	576
1	880x/20	776
2	880x/30	776

Selection of the next higher tracks, (377, 577, or 777) may result in the bad block map being destroyed. The bad block map may be rewritten by using the WINEXR utility program. The set mode command may only be executed by the 880x/8 (type 0) device to change modes from normal to extended mode, or from extended mode to normal mode.

RLEXR then prints the name and version number of the program, DSD RLEXR V1A. RLEXR prints <CRLF># when starting, and then attempts an initialize sequence. When the initialize instruction is successfully completed, the program prints the prompt word, # COMMAND:. This prompt allows the operator to input a command. A list of all the available commands may be obtained by typing H (help).

RLEXR has several restart addresses that can be used to restart the program if necessary. They are:

- 1104 - Normal start/restart address
- 1110 - Start address from monitor call
- 1114 - Start at command prompt without performing an initialize sequence on the device
- 1100 - Return address from ODT after CTRL D dispatch

PROGRAM INPUT/OUTPUT

All data input and output (except status counters) are in octal format, unless otherwise specified.

The DEL or RUB key may be used during input to remove the previously input character. On some output devices, the cursor will be backspaced one position for each deletion. On others, a / will be output, followed by the characters being deleted. Normal input may be resumed at any time.

The program fully supports X-on, X-off protocol (CTRL S, CTRL O and CTRL Q) to enable output to be suspended and restarted.

Disk data are accessed via a combined address of unit, side, track, and sector values. Various commands are provided to specify the limits of the address components to be used by the tests. Default values are preset following the initial program load.

Input is typically terminated by a <CR> or <SP>. Validation input (Y, N)? typically does not require termination.

DETAILED DESCRIPTION OF STATUS AND ERROR DISPLAYS

RLEXR types out error and status information under a wide variety of circumstances. All printouts to the console terminal are sent to a circular buffer in memory as well. The buffer size is determined by available memory. The circular buffer is useful if a hard copy console terminal is not being used, and the error printouts are longer than can be displayed on the CRT screen. The display output buffer function (DUMP C) is used to examine messages in the circular buffer.

Status Variables Displayed

The status variables that might appear on the console terminal are explained below:

DEV XXX	Is printed only when running multiple controllers. XXX are the six octal digits of the CS address for the system whose error/status data is being displayed.
UN U	U represents the logical drive unit number for which the error/status data are being displayed.
TRACK= TK	Track address at time of status/error printout.
SECTOR= SC	Sector address at the time of status/error printout.
SIDE 1	Indicates the status or error relates to side one (first or second side of the disk).
RLCS= XY	Shows the contents of the command and status register.
RXCS= XY	Shows the contents of the floppy control and status register.

#BAD= XX This variable indicates the number of status errors detected.

#RD/WRT= XX This variable indicates the number of read and write operations performed error free.

B-TRACK= XX This variable indicates the number of bad tracks detected.

B-DATA= XX Number of data errors where a byte or word of data did not compare with the value the program was expecting. This is different from the CRC error, which would be counted as bad status. There can be up to 128 data errors in one sector.

Error Messages and Meanings

1 * No Bus Response *

ADDRESS

17XXXX

This indicates no SSYN acknowledge to memory access within 200 milliseconds (interface test only).

2 * Status Error *

RLCS RLBA RLDA RLMP STAT

XXXX XXXX XXXX XXXX XXXX

This indicates fault or error during operation indicated in RLCS. Parameters in address registers and status should give exact nature of error (all tests).

3 * No Interrupt *

RLCS RLBA RLDA RLMP STAT

XXXX XXXX XXXX XXXX XXXX

An expected interrupt did not occur after completion of the function in RLCS (interrupt test).

4 * Read/Write Error *

ADDRESS READ EXPECTED

17XXXX XXXX XXXX

5 * Bus Reset Error *

ADDRESS READ EXPECTED

17XXXX XXXX XXXX

A bus reset instruction did not clear all expected bits in a specific register at address indicated (interface test).

6 * Time Out Error *

RLCS

XXXX

Indicates that a function was not completed within the required time.

7 * Header CRC Error *

DEVICE UNIT SECTOR SIDE TRACK EXPECTED CALCULATED

17XXXX XXXX XXXX XXXX XXXX XXXX XXXX

The CRC calculated by software did not compare to that written by hardware during a format operation (scan test).

8 * Non Consecutive Header Error *

DEVICE UNIT PREV PRES SIDE TRACK

17XXXX XXXX XXXX XXXX XXXX XXXX

Sector header information for two adjacent sectors was incorrect (scan test).

9 *Data Compare Error *

DEVICE UNIT SIDE TRACK SECTOR EXPECTED READ WORD-#

17XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX

During a sequential or random read, data read did not match that expected (written). Multiple errors may indicate a bad sector or track. Refer to WINEXR utilities program for rewriting the bad track map.

10 * Bad Track Detected *

DEVICE	UNIT	SIDE	TRACK
17XXXX	XXXX	XXXX	XXXX

Results from multiple data compare errors on the same track.

11 * Write Protect Error *

DEVICE	UNIT
17XXXX	XXXX

Drive was write protected during a write operation (sequential or random write tests).

12 * Drive Select Error *

RLCS	RLBA	RLDA	RLMP	STAT
XXXX	XXXX	XXXX	XXXX	XXXX

A nonexistent drive unit was selected (all tests).

13 * Spin Error *

DEVICE	UNIT	RLCS
17XXXX	XXXX	XXXX

Indicates the drive was not up to speed during operation in RLCS (all tests).

14 * Nonexistent Memory *

DEVICE	UNIT	RLCS	RLBA
17XXXX	XXXX	XXXX	XXXX

15 * Seek Time Out *

DEVICE	UNIT	RLCS
17XXXX	XXXX	XXXX

A seek operation did not complete in 200 milliseconds (all tests).

16 * Write Check Error *

RLCS RLBA RLDA RLMP STAT
XXXX XXXX XXXX XXXX XXXX

Data read from disk did not compare to that originally written. Usually indicates a bad block or track (sequential read/write test).

17 * Header Not Found *

DEVICE UNIT RLDA
17XXXX XXXX XXXX

Seek to sector and track in RLDA could not be completed in 200 milliseconds due to invalid or nonexistent disk address (all tests).

18 * Header CRC Error *

DEVICE UNIT RLCS RLDA
17XXXX XXXX XXXX XXXX

A CRC error was detected on the header field (scan test).

19 * Data CRC Error *

DEVICE UNIT RLCS RLBA RLDA
17XXXX XXXX XXXX XXXX XXXX

A CRC error was detected during a data transfer (scan, sequential write/read, and random write/read tests).

20 * AC Power Low *

RLCS
XXXX

AC voltage is below normal, or interface cable is not connected (all tests).

Examples of Error Output

The following are examples of the RLEXR diagnostic program outputs to the console under varying circumstances:

Example 1: Operator requests status of currently selected drive during a test by typing <LF>.

```
DRIVE #0 SIDE 0 AT TRACK 155 SECTOR 0 # BAD=0
# RD/WRT=0 B-TRACK=0 B-DATA=0
```

Example 2: Operator requests status of both drives using the status command.

```
UNIT#0 #BAD=0 #RD/WRT=0 B-TRACK=0 B-DATA=0
UNIT#1 #BAD=0 #RD/WRT=0 B-TRACK=0 B-DATA=0
```

Example 3: Disk was write protected.

* Write Protect Error *

```
DEVICE UNIT
174400 1
```

Example 4: Bad block found during read/write test.

* Data Compare Error *

DEVICE	UNIT	SIDE	TRACK	SECTOR	EXPECTED	READ	WORD #
174400	1	1	207	31	14761	14561	2

DETAILED DESCRIPTION OF COMMANDS

Comprehensive Tests:

- (A)CCEPTANCE

This test does one pass of a short acceptance test on the first seven tracks and then resets the limit variables back to the default values. It then induces an automatic CTRL P to inhibit all but error printout, and initiates the longer test. This test will run until terminated by a CTRL R.

Example: # COMMAND: A <CR>
SCRATCH DISK \bar{S} INSTALLED? (Y,N)? Y
TEST NOW STARTING
SCAN CRC CHECKED WRITING READING
INTERRUPTS ENABLED
WRITING READING

- (SH)ORT ACCEPTANCE

This interactive program changes the track range used by the acceptance test so that only the first seven tracks of each selected drive are tested. This test will run until terminated by a CTRL R.

Individual Tests:

- (INTE)RFACE TEST

Checks for response of all interface registers and issues a response error if a bus time out occurs. All read/write bits in each register are verified to be individually set and cleared without affecting other bits. A no-op or maintenance-op code is checked along with a bus reset.

- (INTR) INTERRUPT TEST

All RL op codes (except write) are executed with interrupts enabled. If an interrupt does not occur, an interrupt error message will appear. This test runs until terminated by a CTRL R.

- (SC)AN

The scan test reads all sectors on all selected drives sequentially, and checks for CRC errors. No direct data checking takes place in this test; only status is checked. After all units are scanned once, the command prompt is displayed on the console.

- (SEE)K RANGE

The seek test function is a versatile drive test that performs all possible seeks within the operator specified track and seek length boundaries. Thus, it is a worst-case test of the drive stepper motor and head setting. Status information will be continuously displayed during execution of the test indicating the seek length currently being used (x) and direction of seek (^ = outward). An ! will be printed at the conclusion of each pass. This test will run until terminated by a CTRL R.

Example: # COMMAND: SEE<CR>
 SEEK LENGTH (1): 3 THROUGH (40): 7
 COVERING TRACKS (0): 10 THROUGH (776): 40

- (SEQ W)/R TEST

The sequential write/read test writes pseudo-random data sequentially on all selected tracks. The test then reads and checks all the data. The message WRITING is typed on the console terminal when the test starts writing the data. The message READING is typed when the test starts reading the data. This test continues until the operator types CTRL R.

- (E)XTENDED MODE TEST

Checks implied seek capability of controller during large inter-track data transfers. This test will not execute if the 880x/8 device (type 0) has been selected, and if the extended test mode was selected.

NOTE

The following three tests require a sequential write pass be done first in order to initialize the pseudo-random data. If this is not done, data compare errors are reported.

- (SEQ R)EAD

This test reads the data on all selected drives sequentially, and compares the data pattern against what was written. The program types READING at the beginning of each pass. This test continues until terminated by typing a CTRL R.

- (RANDOM R)/W

This test selects a random sector of a selected drive, then reads or writes it. It checks data when appropriate. This test continues until terminated by a CTRL R.

- (RANDOM RE)AD

This test reads randomly selected sectors. Data are checked after each read. This test continues until the operator types CTRL R.

Program Control Utilities:

- (SET M)ODE

This test may be executed only on an 880x/8 device. The test allows selection of normal or extended mode of operation. Extended mode will allow access of tracks 0 through 576 (octal) and is selected in normal mode, class 1. Normal mode (normal switch, class 0) allows access to tracks 0 through 376 (octal). After setting class select switch to 0 or 1, depress EXECUTE pushbutton BEFORE typing a character. After typing a character, it prompts ENABLE HALT ON ERROR? If an error occurs, the error message will be printed followed by * HR *. This allows the LED to continue flashing the current error.

- (SET U)NIT

This comand enables the operator to specify which drives are to be accessed by the various test functions. The default drive is unit 0. The currently selected units are printed first. It prompts with UNIT:, expecting a number between 0 and 3, inclusive. Unit numbers are accepted as long as they are valid. When an invalid number is typed as a response to a unit request, the units currently selected are prompted and the program returns to a command prompt.

When set to a 1, the bit labelled:

US3 indicates this device contains a drive unit 3.
US2 indicates this device contains a drive unit 2.
US1 indicates this device contains a drive unit 1.
US0 indicates this device contains a drive unit 0.

US0, US1, US2, and US3 do an implicit set unit function when set.

Example: # COMMAND: SET D<CR>
 SET THE DEVICE FLAGS FOR EACH SYSTEM AS FOLLOWS:
 10: ENABLE UNIT 0 ON CURRENT DEVICE
 20: ENABLE UNIT 1 ON CURRENT DEVICE
 40: ENABLE UNIT 2 ON CURRENT DEVICE
 RLCS @ 174400: INT @ 160 INTVEC=160 FLAGS: 70
 RXCS @ 177170
 RLCS @ 0:

Program Status Commands:

● (H)ELP

The help command causes all valid command responses to be displayed on the console terminal. The command prompt is typed when this function is complete.

● (M)AP ADDRESS

The map address command causes a memory and device address map of the system to be displayed on the console terminal. This is the same map displayed when the RLEXR program is first loaded. In addition, the interrupt vector address associated with each disk interface is displayed. The command prompt is typed when this function is complete.

Example: # COMMAND: M<CR>

(000000 - 157776)
(160100 - 165776)
(171000 - 171776)
(172300 - 172316)
(172340 - 172356)
(172520 - 172536)
(173000 - 173776)
(176700 - 176746)
(177170 - 177172)
(177510 - 177516)
(177546 - 177546)
(177560 - 177616)
(177640 - 177656)
(177776)

DEV: 174400 INT @ 160

NOTE

The previous example indicates that a device is installed at location 177170 with interrupt vector at location 160.

- (ST)ATUS

The status command causes all the current status information, including hardware errors, data errors, and pass counts to be displayed on the console terminal. Displaying status information does not reset the status counts. The command prompt is printed when this function is complete.

Example: # COMMAND: ST<CR>
 UNIT #0 #BAD=3 #RD/WRT=2049 B-DATA=0 B-TRACK=0
 # COMMAND:

- (RES)ET STATUS

The reset status command first displays all the available status counts. Next, the display will ask whether all the status counts need resetting. A yes response will cause all of the error, pass, etc., counts to be reset to zero. The command prompt is output when this function is complete.

- (SA)VE STATUS

This command causes all the status counts associated with a particular drive to be written on track 0, sectors 1, 2, and 3 of the diskette in that system. This function is used by the acceptance test so that it can survive a loss of main computer memory, without any loss of cumulative error data. The command prompt is displayed when this function is completed.

- (REC)OVER STATUS

This command performs the opposite function performed by the save status command. The status data stored on track 0, sectors 1, 2, and 3 of the diskette in each drive is transferred back from the diskette to the status/counter variables in memory. The command prompt is displayed when the function is complete.

- (DUMP C)IR BUFFER

This command is used to display the output buffer associated with all console terminal outputs. This function is useful on systems where the console terminal is a CRT. Messages previously output can be re-examined on the display. The buffer can be cleared after it is displayed by this command.

Data Utilities Commands:

- (DUMP S)ECTOR

This command enables the operator to cause an octal, or ASCII dump, at a specified sector to the console terminal. This function prompts for unit, cylinder, sector, side, ASCII or octal format, and exit from this function.

Example:

```
# COMMAND DUMP S<CR>
ALL PARAMETERS ARE IN OCTAL
UNIT (0,2)? 2<CR>
CYLINDER (0,776)? 23<CR>
SECTOR (0,47)? 5<CR>
SIDE (0,1)? 1<CR>
DUMP IN ASCII OR OCTAL WORD FORMAT (A,0)? 0<CR>
.....
EXIT (Y,N)? Y
```

- (RD) WITHOUT HEADER

This command performs the same function as the dump sector command.

APPENDIX E

WINEXR USER'S MANUAL

INTRODUCTION

PROGRAM LOADING

PROGRAM EXIT

PROGRAM COMMANDS

PROGRAM INPUT/OUTPUT

DETAILED DESCRIPTION OF PROGRAM STATUS AND ERROR DISPLAYS

- **Status Variables Displayed**
- **Error Activity Codes**

DETAILED DESCRIPTION OF COMMANDS

- **Comprehensive Tests**
- **Individual Tests**
- **Media Modification**
- **Program Control Values**
- **Program Status**
- **Data Utilities**

CAUTION

The WINEXR utility program should only be used if the system will not pass the RLEXR program, and the entry of new bad tracks, or reformatting, is indicated.

WINEXR is a utility that allows direct access to all winchester tracks. Used improperly, it can destroy the existing bad track map, rendering the RL01 or RL02 emulation inoperative.

WINEXR USER'S MANUAL

INTRODUCTION

All DSD 880 flexible disk systems with an LSI-11 or PDP-11 interface board are shipped with a diskette containing an interactive diagnostic program called WINEXR. This manual explains the operation of this set of utility programs. The manual assumes the user is familiar with DSD 880 operations and terminology.

WINEXR supports the direct access mode of the DSD 880 and bad track map generation. It is a stand-alone program, capable of being bootstrapped into the processor. It performs auto-configuration of certain control parameters, determining both disk and CPU characteristics. It supports both hard copy and video display terminals with full X-on, X-off output control. In order to facilitate unattended testing, terminal output is also retained in a circular buffer, auto-configured to the full available memory. Commands are provided to display and reset this circular buffer. Commands are also provided for disk formatting, bad track mapping, and examination. Test commands fully exercise system capabilities with operational parameters being user selectable through commands. The acceptance test, drive test, and verify commands are suitable for both incoming quality control checks, and system exercise/burn-in.

PROGRAM LOADING

WINEXR requires a standard console device, an LSI-11 or PDP-11 computer and, at least, 16K words of memory. Loading WINEXR can be accomplished by two methods. One method is to bootstrap the diagnostic diskette. This loads DSDMEN. The other method requires an RT-11 operating system. The WINEXR diagnostic diskette has an RT-11-compatible directory and file space. The files on the diagnostic diskette can be accessed using standard RT-11 procedures. For example, WINEXR can be run from the RT-11 system by typing:

```
RU<DEV:>WINEXR<CR>
```

where<DEV:>might be DX0:, DX1:, DY0:, or DY1:, as appropriate.

On a system running other operating systems (e.g., RSX-11M, IAS, RSTS, etc.), the distribution diskette must be bootstrapped into memory.

After WINEXR is loaded into memory, a brief description is displayed on the terminal which includes a memory map and preliminary usage instructions. The memory map indicates the ranges of the address space which responds with SSYNC or BRPLY when accessed by the host computer.

This device type specification is used by WINEXR to set up internal control values that tailor the program's operation to specific DSD winchester product capabilities. A CR input, in response to a device-type prompt, will output the list of types as shown below.

<u>TYPE</u>	<u>DEVICE</u>
0	880x/8
1	880x/20
2	880x/30

Which type of device? (0, 1, or 2)

After the device type is selected, WINEXR will output the device flag being used as shown below:

```
Device flag being used is: XXXX
Use set device command to modify flag
Is unit in mode 0, class 2 or 7 ? (Y,N):
Is bad track map on disk? (Y,N):
Skip bad tracks during testing? (Y,N):
```

```
880x/8      mode 0, class 2
880x/20
880x/30     mode 0, class 7
```

WINEXR then outputs the name and version number of the program.

DSD WINEXR

WINEXR types <CRLF># when starting the program, and then attempts an initialize instruction. When the initialize cycle is successful, the program types the prompt word command. This prompt string allows the operator to input a command. A list of all the available commands may be obtained by typing an H (help).

PROGRAM EXIT

If WINEXR was loaded via the bootstrap, the operating system must be rebooted. If WINEXR was loaded via the RT-11, or DSDMON operating system, direct return to the monitor may be possible. A control input of CTRL C will cause WINEXR to output EXIT TO RT-11? A yes response will cause return to the monitor. Exit to the monitor may not function if:

1. There is insufficient memory available.
2. The system device is not located at 177170.
3. The system device, or diskette, is not available.

If direct monitor exit is not possible, the operating system must be rebooted.

PROGRAM COMMANDS

Legal responses to:

COMMAND:

The valid responses to this prompt, # COMMAND:, are listed in Table 1 and grouped by class of command. Only the characters enclosed in parenthesis need to be typed. The parenthesis should NOT be typed. When the typed string is recognized, the terminal bell will sound, at which time <CR> should be typed. The program will fill in the remaining characters and then proceed to execute the function.

Table 1. WINEXR Commands

<u>Commands</u>	<u>Description</u>
Comprehensive Tests	
● (V)ERIFY	General Exerciser
● (A)CCEPTANCE	General Exerciser
● (D)RIVE	Drive Exerciser
Individual Tests	
● (FI)LL EMPTY	Fill/Empty Buffer
● (SEQ W)/R	Sequential Write/Read
● (SEQ) READ	Sequential Read
● (RA)NDOM R/W	Random Read/Write
● (REA)D RANDOM	Read Random
● (SC)AN	Scan
● (SEE)K RANGE	Seek Range
Media Modification	
● (RE-)FORMAT RL	Reformat Disk
● (B)AD TRACK MAPPING	Entry of Bad Track Map
● (P)RINT BAD TRACK MAP	Output Bad Track Map
● (T)RANSFORM	Transform RL Address to SA Address
● (RL) BAD SECTOR	Rewrite RL Bad Sector Map
● (DISC)OVERED BAD TRACKS	Output Discovered Bad Tracks
Program Control Values	
● (SET U)NIT	Set Unit
● (SET T)RACK	Set Track Limits
● (SET S)ECTOR INCREMENT	Specify Sector Interleave
● (SET D)EVICE	Set Device
● (H)ELP	Output List of Commands
● (SET P)RINTING	Printing Control
Program Status	
● (M)AP ADDRESS	Memory and Device Map
● (ST)ATUS DISPLAY	Display Status Information
● (RES)ET STATUS	Change Status
● (SA)VE STATUS	Save Status on Diskette
● (DUMP C)IR BUFFER	Display Circular Output Buffer
● (REC)OVER STATUS	Retrieve Status
Data Utilities	
● (DUMP O)CTAL	Data Dump in Octal Format
● (DUMP B)YTE	Data Dump in Byte Format
● (DUMP A)SCII	Data Dump in ASCII Format

WINEXR also recognizes various control character inputs. Table 2 lists the control character inputs and the associated action. This input can be performed at any time, even while a test is in progress.

Table 2. Control Inputs

Input	Meaning	Notes
CTRL R	Aborts current test, restarts at command	
CTRL S	Freeze terminal output until another character is typed	
CTRL O	Throws away all output until another character is typed	
CTRL P	Throws away all output, except errors, until another character is typed	
CTRL Q	Causes output to resume	1
<LF>	Types current track and sector and status counts	2
CTRL C	Asks EXIT TO RT-11?. If RT-11 monitor is available, type Y to exit. If RT-11 monitor not available, action is similar to CTRL R. If in ODT, may return control to program	3
CTRL D	Causes control transfer to ODT	3,4
CTRL T	Causes control transfer to ODT with stack trace	3,4
RUB or DEL	Deletes previous character in input string	

NOTES

1. Actually any character being input will perform this function.
2. This command always functions; however, for some tests, the track and sector information should be disregarded (e.g., fill/empty test).
3. Exit to monitor and control transfer to debug may not function if there is not enough memory available, or if booted from a device other than a 177170.
4. Control transfer from ODT back into WINEXR is accomplished by CTRL C. If this does not work, the program may be restarted by XXXX;G, where XXXX is the appropriate restart address.

WINEXR has several restart addresses that can be used to restart the program if necessary. They are:

1104 - Normal start - Restart address

1110 - Start address from monitor call

1114 - Start at command prompt, without performing initialize on device

1100 - Return address from ODT after CTRL D dispatch

PROGRAM INPUT/OUTPUT

All data input and output are in octal format, unless otherwise specified.

The DEL or RUB key may be used during input to remove the previously input character. On some output devices, the cursor will be backspaced one position for each deletion. On other devices, a / will be output, followed by the characters being deleted. Normal input may be resumed at any time.

The program fully supports X-on, X-off protocol (CTRL S, CTRL O, and CTRL Q) to enable output to be suspended and restarted.

Disk data are accessed via a combined address of unit, head, track, and sector values. Various commands are provided to specify the limits of the address components to be used for tests. Default values are preset following the initial program load.

Input is typically terminated by either a <CR> or <SP>. Validation input (Y,N)? typically does not require termination.

DETAILED DESCRIPTION OF STATUS AND ERROR DISPLAYS

WINEXR types out error and status information under a wide variety of circumstances. All printouts to the console terminal are sent to a circular buffer in memory as well. The buffer size is determined by available memory. The circular buffer is useful if a hard copy console terminal is not being used and error printouts, no longer on the face of the CRT screen, need to be examined. The display output buffer (DUMP C) function is used to examine messages in the circular buffer. The status variables that might appear on the console terminal are explained below.

Status Variables Displayed

DEV XXX Is printed only when running multiple controllers. XXX are the three octal digits of the RXCS address for the system whose error/status data are being displayed.

UN U U represents the logical drive unit number for which the error/status data is being displayed.

TRACK= TK	Track address at time of status/error printout.
SECTOR= SC	Sector address at the time of status/error printout.
RXCS= XY	Shows the contents of the command and status register.
RXDB= XY	Shows the contents of the data buffer register.
INTERRUPT ERROR	If X is less than 0, this indicates that an expected interrupt failed to occur. If X is greater than 0, more than one interrupt occurred.
#BAD= XX	Indicates the number of status errors detected.
#RD/WRT= XX	Indicates the number of sectors that were transferred error free.
#XFERS = XX	Indicates the number of fill/empty command cycles that were completed successfully.
B - DATA= XX	Number of data errors where a byte, or word of data, did not compare with the value the program was expecting. This is more difficult than a CRC error, which would be counted as bad status. There can be up to 128 data errors in one sector.
DEFSTT= DEFINITIVE ERROR STATUS	Error code associated with the error currently being displayed. The meaning of each error code can be found in the user's manual.

Error Activity Codes

A number of two-character activity codes are displayed in the context of error printouts. The codes listed below indicate what the diagnostic was doing when the error was detected.

<u>Activity</u>	<u>Code</u>	<u>Meaning</u>
FILL/EMPTY	FB	Problem loading sector buffer
FILL/EMPTY	E1, E2	Sector buffer data did not check during an empty buffer operation
FILL/EMPTY	FL, EL	DMA fill or empty error to low memory buffer
FILL/EMPTY	FD, ED	DMA fill or empty error to center memory buffer
FILL/EMPTY	FH, EH	DMA fill or empty error to high memory buffer
SEQ WRITE	SW, CW	Problem during sequential write
SEQ	SR	Problem during sequential read

<u>Activity</u>	<u>Code</u>	<u>Meaning</u>
RA	RW,RC,RR	Random (write, check, or read) activity when error was detected
ANY READ RETRY	XE	Empty buffer check before retrying read

DETAILED DESCRIPTION OF COMMANDS

Comprehensive Test Commands:

- (V)ERIFY

The verify test does one pass of a short acceptance test on the first seven tracks, then resets the limit variables back to the normal default values. It then induces an automatic CTRL P to inhibit all but error printout, and initiates the acceptance test. This test will run until terminated by a CTRL R.

Example: #DD COMMAND: V<CR>
 VERIFY TEST NOW STARTING
 WRITING - PASS CODE= 0 READING - PASS CODE = 0 RANDOM
 RD/WRT
 READING - PASS CODE = 0
 PASS FINISHED

- (A)CCEPTANCE

This interactive program changes the track range used by the verify test so that only the first nine tracks of each selected drive are tested. This test will run until terminated by a CTRL R.

- (D)RIVE

The functions in this command are similar to the verify test except it does not do seek range functions.

Individual Tests:

- (SC)AN

The scan test reads all sectors on all selected drives sequentially, and checks for CRC errors. No direct data checking takes place in this test; only status is checked. After all units are scanned once, the command prompt is displayed on the console.

Example: # COMMAND: SC<CR>
 CRC CHECKED
 # COMMAND:

- (SEE)K RANGE

The seek range function is a versatile drive test that performs all possible seeks within the operator specified track and seek length boundaries. Thus, it is a worst-case test of the drive stepper motor and head setting. Status information will be continuously displayed during execution of this test indicating head, the seek length currently being used (x), and direction of seek (^ = outward). An ! will be output at the conclusion of each pass. This test will run until terminated by a CTRL R.

Example: #DD COMMAND: SEE<CR>
ALL TIMES ARE GIVEN IN OCTAL TENTHS OF MSEC
SEEK LENGTH (1): 3 THROUGH (27): 7
850 SEEK TIME (36):
850 SECTOR OFFSET: (4):
COVERING TRACKS (0): 1 THROUGH (114); 3 (HEAD: 0)
3 4 S 6 7 ! 3 4 ...

- (FI)LL EMPTY

The fill/empty test checks the fill buffer and empty buffer controller commands. The controller does fill/empties into three different buffers to verify proper operation of all possible address bits. Fill/empties are done to cover the drives; the system will operate in silence. This test continues until the operator types a CTRL R.

- (SEQ W)/R

The sequential write/read test writes pseudo-random data sequentially on all selected tracks. The test then reads and checks all the data. The message WRITING is typed on the console terminal when the test starts writing. The message READING is typed when the test starts reading. This test continues until the operator types CTRL R.

NOTE

The following three tests require a sequential write pass be done first to initialize the pseudo-random data. Data compare errors are reported if this is not done. WINEXR prompts IS DISKETTE SEQUENTIALLY WRITTEN? (Y,N)? at the start of each test. A yes response will initiate the test. A no response will return to the command prompt.

- (SEQ) READ

The sequential read tests reads the data on all selected drives sequentially and compares the data pattern against what was written. The program types READING at the beginning of each pass. This test continues until the operator types CTRL R.

- (RA)NDOM R/W

The random read/write test selects a random sector of a selected drive and reads or writes it. It checks data when appropriate. This test continues until the operator types CTRL R.

- (REA)D RANDOM

The read random test reads randomly selected sectors. Data are checked following each read. This test continues until the operator types CTRL R.

Media Modification Commands:

- (DISC)OVERED BAD TRACKS

This command will accumulate information for bad tracks discovered during test execution. Any discovered bad tracks should be verified by specific tests, and the bad track map updated. This data are reset each time the program is initiated.

- (RL) BAD SECTOR

This command is used to rewrite the RL bad sector data if it has become corrupted. In normal operation, the data should not be corrupted; however, diagnostic testing may have modified the data.

Example: # COMMAND: RL <CR>
WRITE RL BAD SECTOR: (Y,N)? Y
WRITING RL BAD SECTOR
RL BAD SECTOR COMPLETED
COMMAND:

- (B)AD TRACK MAPPING

This command enables the operator to input bad tracks, or update the bad track map. The input prompt is issued after the operator selects decimal or octal input. A CR will terminate input mode. The operator is allowed to do editing on new bad tracks. It also allows formatting of the disk before writing the bad track map and the RL bad sector on the disk.

```

Example: # COMMAND: B<CR>
ENTRY OF NEW BAD TRACK MAP? (Y,N)? Y
ARE YOU SURE? (Y,N)? Y
DSD 880 BAD TRACK MAP
LATEST UPDATE: 26-NOV-80
DRIVE SN: 1234567890
DATE FIRST ENTERED: 26-NOV-80
DECIMAL/OCTAL INPUT? (D,O)? O
***OCTAL INPUT***
TRACK: 1      HEAD: 1
TRACK: 2      HEAD: 2
TRACK: 101    HEAD: 3
TRACK: 202    HEAD: 2
TRACK: 303    HEAD: 3
TRACK: <CR>
ANY MORE INPUT? (Y,N)? N

```

TRACK		—HEAD	TRACK		—HEAD	TRACK		—HEAD
DECIMAL	OCTAL		DECIMAL	OCTAL		DECIMAL	OCTAL	
1	1	1	2	2	1	65	101	3
130	202	2	195	303	3			

```

EDIT INPUT? (Y,N)? Y
DECIMAL/OCTAL INPUT? (D,O)? D
***DECIMAL INPUT***
ADD (Y,N)? Y
TRACK: 10    HEAD: 1
TRACK: <CR>
ANY MORE INPUT? (Y,N)? N
DELETE? (Y,N)? Y
TRACK: 1     HEAD: 1
TRACK: <CR>
EXIT EDITING? (Y,N)? Y

```

TRACK		—HEAD	TRACK		—HEAD	TRACK		—HEAD
DECIMAL	OCTAL		DECIMAL	OCTAL		DECIMAL	OCTAL	
2	2	1	65	101	3	130	202	2
195	303	3	10	12	1			

```

EDIT INPUT? (Y,N)? N

```

TRACK		—HEAD	TRACK		—HEAD	TRACK		—HEAD
DECIMAL	OCTAL		DECIMAL	OCTAL		DECIMAL	OCTAL	
2	2	1	10	12	1	65	101	3
130	202	2	195	303	3			

```

FORMAT DISK? (Y,N)? N
FLOPPY DRIVE IN UNIT? (Y,N)? Y
SA800 FLOPPY DRIVE (DEFAULT SA850 DRIVE)? (Y,N)? Y
WRITE BAD TRACK MAP ON DISK? (Y,N)? Y
WRITING RL BAD SECTOR
BAD TRACK MAP COMPLETED

```

NOTE

Press EXECUTE pushbutton on HyperDiagnostic panel after rewrite/update of bad track map to signal the controller to read the new bad track information.

- (P)RINT BAD TRACK MAP

This command prints the existing bad track map on the CRT or printer.

```

Example: # COMMAND: P <CR>
          DSD 880 BAD TRACK MAP
          LATEST UPDATE: 16-DEC-80
          DRIVE SN: A10533
          DATE FIRST ENTERED: 16-DEC-80
          FORMAT: 2
          FLOPPY DRIVE - SA850 SYSTEM TYPE - 880x/xx

```

TRACK		—HEAD	TRACK		—HEAD	TRACK		—HEAD
DECIMAL	OCTAL		DECIMAL	OCTAL		DECIMAL	OCTAL	
8	10	3	9	11	3	10	12	3
24	30	1	24	30	2	25	31	0
25	31	1	25	31	2	26	32	0
26	32	1	26	32	2	27	33	0
27	33	2	28	34	2			

- (RE-)FORMAT RL

This command allows the user to reformat the winchester disk. The program responds with:

2-WAY OR 3-WAY INTERLEAVE ? (2,3)?

The two-way interleave provides faster throughput in most instances. Units are shipped with two-way interleave. The DMA burst length jumper on the LSI-11 interface must be in the eight-word burst mode for two-way interleaving to work on an LSI-11. The three-way interleaving could improve performance

on systems that have a lot of DMA activity, or systems with a lot of operating system overhead. The two-way interleaving is best for most DEC software systems. The program next asks:

FULL FORMAT (HEADERS AND DATA)? (Y,N)?

A yes causes the program to write the data fields as well as the header fields. This format takes longer, but writes the entire disk. A no causes the program to write headers only. This format is faster, but might cause problems for programs that attempt to read sectors which have not been written upon previously. A sequential write in RLEXR will fill in the data fields for this type of format. The program then types:

FORMAT FROM TRACK 1 THROUGH 777
ON SURFACE 0 THROUGH 7

This prompt tells the user what portions of the disk will be formatted. The set track command should be used to change these parameters. Two sections of the disk are of special interest, the hardware bad track map which resides on track 0, and the RL bad sector maps. To preserve both types of maps, reset the lower track limit to 0 using the set track command. When this parameter is 0, the program automatically saves and restores the bad track and bad sector maps if allowed to run to completion.

WARNING

If you abort the reformat operation before its completion, the bad track and bad sector information will be lost.

The program then types:

INCREMENT IS 7 SECTORS, ENTER NEW INCR:

Increment refers to the sector offset from track-to-track.

FAST FORMAT OF RLXX

This refers to your earlier choice of no to the full format question.

- (T)RANSFORM

This command is used to map cylinder, surface, and sector of the RL01/02 winchester disk drives. The computed winchester cylinder and surface are adjusted to take bad tracks into account. The bad track map is examined for bad tracks up to and including the target track. Each bad track encountered causes the target surface and cylinder to be incremented by one surface.

Example: (If no bad track)

```
Unit: 0    RL TRACK: 12    RL HEAD: 3    RL SECTOR: 4
           DA TRACK: 10    DA HEAD: 0    DA SECTOR: 34
           RL TRACK:<CR>
```

Program Control Values Commands:

- (SET U)NIT

This command enables the operator to specify which drives are to be accessed by the various test functions. The default drive is unit 2. The currently selected units are printed first. It prompts with UNIT:, expecting a number between 0 and 3, inclusive. Unit numbers are accepted as long as they are valid. When a non-number is typed to a unit request, the units currently selected are prompted and WINEXR returns to command prompt. Note that the single winchester 880 systems default to unit 2 and do not allow unit selection.

- (SET T)RACK

This command enables the operator to specify lower and upper track limits for all other test functions. The default lower track limit is 1 and the upper track limit is 377. The command prompt is issued after the entry of valid new limits. The low limit must not exceed the upper limit.

Example: Set track used to set track range from 1 to 100 on heads 1 and 2.

```
# COMMAND: SET T<CR>
FROM (0): 1 THROUGH (377): 100
HEAD FROM (0): 1 THROUGH (3): 2
```

NOTE

880x/20 maximum track is 577, maximum head is 5.

880x/30 maximum track is 777, maximum head is 7.

- (SET P)RINTING

This command enables the line printer for output device. The printer device address is LpCS = 175564, LpDB = 175566.

- (SET S)ECTOR INCREMENT

This command enables the operator to specify the sector increment value. The number is added to the present sector address to determine the next sector address in the functions that read multiple sectors on a single track. The prompt is issued after the new value has been entered.

```
Example: # COMMAND: SET S<CR>
INCREMENT IS 7 SECTORS
ENTER NEW INCR: 6
```

- (SET D)EVICE

This function facilitates testing controllers that are not configured at the standard device input/output address and interrupt vector. It also enables the WINEXR test program to simultaneously exercise multiple controllers. The

function protocol asks you for device address, interrupt vector, and flag word. If a space is typed, the program steps past the field, leaving it intact. Return to command is by input of a <CR> in response to RXCS:.

- (H)ELP

The help command causes all the valid command responses to be displayed on the console terminal. The command prompt is typed when this function is complete.

Program Status Commands:

- (M)AP ADDRESS

The map address command causes a memory and device address map of the system to be displayed on the console terminal. This is the same map displayed when the WINEXR program is first loaded. In addition, the interrupt vector address associated with each disk interface is displayed. The command prompt is typed when this function is complete.

Example: #DD COMMAND: M <CR>

```
( 000000 - 157776 )  
( 160100 - 160106 )  
( 165000 - 165776 )  
( 171000 - 171776 )  
( 172300 - 172316 )  
( 172340 - 172356 )  
( 172520 - 172536 )  
( 173000 - 173776 )  
( 176700 - 176746 )  
( 177170 - 177172 )  
( 177510 - 177516 )  
( 177546 - 177546 )  
( 177560 - 177616 )  
( 177640 - 177656 )  
( 177776 )
```

```
<DEV:> 177170 INT @ 264
```

NOTE

The previous example indicates that a device is installed at location 177170 with interrupt vector at location 264.

- (ST)ATUS DISPLAY

The status function causes all the current status information including hardware errors, data errors, and pass counts to be displayed on the console terminal.

Displaying status information does not reset the status counts. The command prompt is typed when this function is complete.

Example: # COMMAND: ST <CR>
UNIT #0 #BAD=3 #RD/WRT=2049 #XFERS=0
B-DATA=0 ST = 110 # = 3

- (RES)ET STATUS

The reset status function first displays all the available status counts. Next, the display will ask whether all of the status counts need resetting. A yes will cause all the error, pass, etc., counts to be reset to zero. The command prompt is output when this function is complete.

- (SA)VE STATUS

The save status command causes all the status counts associated with a particular drive to be written on track 0, sector 1 of the diskette in that drive. Only the set media density has command over write track 0, so the status data associated with each drive can be safely stored away. This function is used by the acceptance test. It can survive a loss of main computer CPU memory without any loss of cumulative error data. The command prompt is typed when this function is complete.

- (REC)OVER STATUS

The recover status routing performs the opposite function performed by the save status function. The status data stored away on track 0, sector 1 of the diskette in each drive is transferred back from the diskette to the status/counter variables in memory. The command prompt is displayed when this function is complete.

- (DUMP C)IR BUFFER

This command is used to display the output buffer associated with all console terminal outputs. This function is useful on systems where the console terminal is a CRT. Messages previously output can be re-examined on the console. The buffer can be cleared after it is displayed by this function.

Data Utilities Commands:

NOTE

The set sector increment function may be used to specify sector sequencing for the duplicate and compare commands. For the dump commands, a sector increment of one is always assumed.

- (DUMP O)CTAL

This command enables the operator to cause an octal dump of specified sectors to the console terminal. The function prompts for the unit, starting track, starting sector, and number of sectors.

Example: #DD MODE: DUMP O <CR>
 SOURCE UNIT: 0 TRACK 0 SECTOR: 1 # SECTORS: 2
 DDEN DRIVE #0 AT TRACK 0, SECTOR #1, SIDE 0
 SC = 1

0:	0	0	0	3776	0	0	0	0
20:	0	0	0	0	0	0	0	0
40:	0	0	0	0	0	0	0	0
60:	0	0	0	0	0	0	0	0
100:	0	0	0	0	0	0	0	0
120:	0	0	0	0	0	0	0	0
140:	0	0	0	0	0	0	0	0
160:	0	0	0	0	0	0	0	0
200:	0	0	0	3722	0	0	0	0
220:	0	0	0	0	0	0	0	0
240:	0	0	0	0	0	0	0	0
260:	0	0	0	0	0	0	0	0
300:	0	0	0	0	0	0	0	0
320:	0	0	0	0	0	0	0	0
360:	0	0	0	0	0	0	0	0

DDEN DRIVE #0 AT TRACK 0, SECTOR #2, SIDE 0
 SC = 2

0:	0	0	0	0	0	0	0	0
20:	0	0	0	0	0	0	0	0
40:	0	0	0	0	0	0	0	0
60:	0	0	0	0	0	0	0	0
100:	0	0	0	0	0	0	0	0
120:	0	0	0	0	0	0	0	0
140:	0	0	0	0	0	0	0	0
160:	0	0	0	0	0	0	0	0
200:	0	0	0	0	0	0	0	0
220:	0	0	0	0	0	0	0	0
240:	0	0	0	0	0	0	0	0
260:	0	0	0	0	0	0	0	0
300:	0	0	0	0	0	0	0	0
320:	0	0	0	0	0	0	0	0
360:	0	0	0	0	0	0	0	0

- (DUMP B)YTE

This command enables the operator to cause a binary dump of specified sectors to the console terminal. The function prompts for the unit, starting track, starting sector, and number of sectors.

- (DUMP A)SCII

This utility command enables the operator to cause an ASCII dump of specified sectors to the console terminal. The function prompts for the unit, starting track, starting sector, and number of sectors.

APPENDIX F
SOFTWARE USER'S GUIDE
For
PROGRAM BACKUP FILES
(Version RSX-1.0)

INTRODUCTION

- Purpose
- Basic Operation
- Exiting Program

REQUIREMENTS

- Machine Environment
- Input
- Output
- Execution of Indirect Command File

ERROR MESSAGES

- Warning Messages
- Errors

COPYING PROGRAM DISKETTE INTO ACCOUNT

NOTES

SOFTWARE USER'S GUIDE
For
PROGRAM BACKUP FILES
(VERSION RSX-1.0)

INTRODUCTION

Purpose:

To provide an indirect command file that copies files onto floppy diskettes. This is an alternate way of making backup file copies.

Basic Operation:

A directory listing from a file created by SRD with /FU option is taken as input to create an indirect command file. The output file created will contain commands to copy the directory listing files onto diskettes. The indirect command file is independently executed at a later time.

The files to be copied are taken from the directory listing one at a time. If files do not fit in the remaining free blocks of a diskette, they are saved in a list for another diskette.

When a diskette becomes full, it will be dismounted and another diskette mounted. Files are then copied on the mounted diskette. When all the filenames have been read from the directory listing, and the list of saved filenames is empty, the input/output files are closed.

Exiting Program:

When a prompt or colon (:) is given, and the program is waiting for a reply, the following may be entered to exit the program immediately:

- Any answer but yes to the question: DO YOU WANT TO CONTINUE?
- <CONTROL E> followed by a carriage return.
- <CONTROL E> imbedded within the valid, or accepted length of input.

REQUIREMENTS

Machine Environment:

An RSX-11M Multi-user Mapped System. INI and PIP utilities must be installed. SRD utility must be in the system, but not necessarily installed.

Input:

An input file must be created in the SRD utility with the /FU switch. Use SRD to create the input file containing a full directory listing. Invoke SRD by:

```
RUN $SRD
```

SRD command format:

```
SRD > (outfile)=(dev) (UFD) (simple-select-template)/(switches)/FU (:n)
```

For example:

```
SRD list.dir=/FU
```

or

```
SRD list.dir=/AF:01-APR-81/FU
```

Type <CONTROL Z> to exit from SRD. Default file type for the input file is DIR.

Output:

The output (indirect command file name) should be entered without the file type. The file type, .CMD, is automatically added to the end.

The indirect command files have commands which have an optional automatic initialize feature. These commands mount, copy files, and dismount the diskette.

Execution of Indirect Command File:

This command file is performed independently, at a later time by typing: @ filename. Note that it is not necessary to enter .CMD.

Before execution, all the required floppy diskettes must be checked for bad sectors and be formatted in the specified format, when executing the program. They may be initialized beforehand with the command, INI ddn:/MXF=fc, where fc is the file count of maximum number of files stored on a diskette. The /MXF switch is optional, but must be used if more, or less, files than the default amount are desired.

The default device name (for source and destination devices of copy commands) is the current system device when executing the command file.

ERROR MESSAGES

Warning Messages:

---- zero blocks file ignored:

Files listed in the input directory listing with zero blocks allocated are ignored.

---- file too large and ignored:

Files listed in the input directory listing that allocate more blocks than are available on a diskette, are ignored.

Errors:

Error 20 will occur when anything but a yes is entered to the question, ARE THE INPUT (DIRECTORY) AND OUTPUT (INDIRECT COMMAND) FILES CREATED AND USED UNDER THE RSX-11M V3.2 SYSTEM? If this error occurs, the program will crash, necessitating the restart of program from the beginning.

COPYING PROGRAM DISKETTE INTO ACCOUNT

1. Make sure that program diskette is in DY0:

2. Type:

```
>FLX DRO:=DY0:*/RT
```

Instead of DRO:, the device name of the current system device is entered.

3. Remove program diskette from DY0: and execute the program by typing:

```
>RUN RSXBF
```

NOTES

1. To check current UFD or UIC, type:

```
>SET /UIC
```

2. If the input file is not in the correct format, error messages are generated and program execution is terminated.

3. Installation name of this file is: BKF

APPENDIX G
SOFTWARE USER'S GUIDE
For
PROGRAM BACKUP FILES
(Version RT-1.0)

INTRODUCTION

- Purpose
- Basic Operation
- Exiting Program

REQUIREMENTS

- Machine Environment
- Input
- Output
- Execution of Indirect Command File

ERROR MESSAGES

- Warning Messages
- Errors

COPYING PROGRAM DISKETTE INTO ACCOUNT

NOTES

SOFTWARE USER'S GUIDE
For
PROGRAM BACKUP FILES
(VERSION RT-1.0)

INTRODUCTION

Purpose:

To provide an indirect command file that copies files onto floppy diskettes. This is an alternate way of making backup file copies.

Basic Operation:

A directory listing from a file created by the directory command with the /OUTPUT:filespec option, is taken as the input to create indirect command files.

The files to be copied are taken from the directory listing one at a time. If files do not fit in the remaining free blocks of a diskette, they are saved in a list for another diskette.

When a diskette is full, a new one is initialized and files are copied onto it. When all the filenames have been read from the directory listing, and the list of saved filenames is empty, the input and output files are closed. A maximum of 245 files are copied onto a diskette.

Exiting Program:

When a prompt or colon (:) is given, and the program is waiting for a reply, the following may be entered to exit the program immediately:

- Any answer but yes to the question: DO YOU WANT TO CONTINUE?
- <CONTROL E> followed by a carriage return.
- <CONTROL E> imbedded within the valid, or accepted length of input.

REQUIREMENTS

Machine Environment:

An RT-11 V3B and RT-11 V4.0 operating system.

Input:

An input file must be created by the DIR command with the /OUTPUT:filespec option. Using options such as /BLOCKS, /POSITION, and /FULL will result

in errors. It is important that the file be in correct format. The format of the listing must be as follows:

filename.filetype blocks date filename.filetype blocks date

Default file type for the input file is .DIR.

Output:

The output (indirect command file name) should be entered without the file type. Only one to four characters may be entered. A two-digit number will be added to the end of these characters, indicating the file number.

The file type, .COM, is automatically added to the end of the full name of each output file. For example, four files will have the following names:

FILE01.COM, FILE02.COM, FILE03.COM, FILE04.COM

One indirect command file is created for each required diskette, up to a maximum of 99 diskettes.

Execution of Indirect Command File:

Execution is performed independently at a later time by typing: @ filename. Note that it is not necessary to enter .COM.

Before execution, all the required floppy diskettes must be checked for bad sectors, and be formatted in the specified format, when executing the program.

The default device name (for source and destination devices of copy commands) is the current system device when executing the command file.

ERROR MESSAGES

Warning Messages:

---- zero blocks file ignored:

Files listed in the input directory listing with zero blocks allocated are ignored.

---- file too large and ignored:

Files listed in the input directory listing that allocate more blocks than are available on a diskette, are ignored.

Errors:

Error 10 occurs when more than 99 diskettes are needed for the full backup. Note that files already created are still good.

Error 30 occurs when anything but a yes is entered after the question, ARE THE INPUT (DIRECTORY) AND OUTPUT (INDIRECT COMMAND) FILES CREATED AND USED UNDER THE RT-11 V3B OR V4.0 SYSTEM? This error causes program to crash, necessitating restart of the program from beginning.

COPYING PROGRAM DISKETTE INTO ACCOUNT

1. Make sure that program diskette is in DY0:

2. Type:

.COPY DY0:*. * DL0:

Instead of DL0:, the device name of the current system device is entered.

3. Remove program diskette from DY0: and execute the program by typing:

.R RTBF

NOTES

If the input file is not in the correct format, error messages are generated and program execution is terminated.