

**StacPac Systems
DEC-Compatible Version
Technical Reference Manual**

**Floppy Disk Module
and 4140-03 Controller**

Models DS-100, DS-105, DSD 4140-03

Copyright (c) 1983

All rights reserved. No part of this book may
be reproduced in any form or by any means
without prior written permission of Qualogy, Inc.,
formerly Data Systems Design, Inc.

Printed in USA.

WARRANTY

Data Systems Design products are warranted against defects in materials and workmanship. For DSD products sold in the U.S.A., this warranty applies for ninety (90) days from date of shipment. For products sold outside the U.S.A., contact your DSD distributor for warranty terms.

DSD will, at its option, either repair or replace either equipment or components which prove to be defective during the warranty period. This warranty includes labor, parts, and surface travel costs of system modules or components.

Freight charges for other than surface travel or for complete systems returned for repair are not included in this warranty. Equipment returned to DSD for repair must be shipped freight prepaid and accompanied by a Material Return Authorization number issued by DSD Customer Service.

Repairs necessitated by shipping damage, misuse of the equipment, or by hardware, software, or interfacing not provided by DSD are not covered by this warranty.

No other warranty is expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. DSD shall not be liable for consequential damages and/or loss of data.

PREFACE

Data Systems Design, Inc. (DSD) manufactures a comprehensive line of mass storage peripherals under the StacPac trademark. These products are compatible with Digital Equipment Corporation (DEC) equipment.

This Technical Reference Manual provides information for the following DEC-compatible StacPac configurations:

- Floppy Disk Module Model DS-100
- Floppy Disk Module Model DS-105
- Floppy Disk Controller Interface Board (DSD 4140-03)

This manual contains:

- Features, specifications, and register usage of the storage subsystems, including DSD 4140-03 Floppy Disk Controller board information.
- Instructions for system installation, operation, and elementary troubleshooting.

The material in this manual is subject to change without notice. The manufacturer assumes no responsibility for any errors, which may appear in this manual.

Please note that DEC, LSI-11, LSI-11/2, LSI-11/21, LSI-11/23, LSI-11/23-Plus, Q-Bus, and RX02 are registered trademarks of Digital Equipment Corporation.

SAFETY

Operating and maintenance personnel must always 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, because of charges retained on capacitors. To avoid injury, always remove power before attempting repair procedures.

Data Systems Design, Inc. will accept no responsibility for injury or damage sustained as a result of operation or maintenance of this equipment with the covers removed and the power applied.

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. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Table of Contents

1.	INTRODUCTION	1-1
1.1	General Information	1-1
1.2	Subsystem Overview	1-1
1.3	The Storage Device	1-2
1.4	The Controller Interface	1-4
1.5	Feature Summary	1-5
2.	SPECIFICATIONS	2-1
2.1	General Information	2-1
2.2	Diskette Specifications	2-1
2.3	Recording Characteristics	2-3
2.4	Performance Specifications	2-3
2.5	Cable and Connector Requirements	2-4
2.6	Power Requirements	2-8
2.7	Environmental Requirements	2-8
2.8	Physical Specifications	2-9
3.	FUNCTIONAL DESCRIPTION	3-1
3.1	General Information	3-1
3.2	Disk Controller Functions	3-1
3.2.1	Processor Group	3-1
3.2.2	LSI-11 Interface Group	3-4
3.2.3	Disk Drive Interface Group	3-5
3.3	Circuit Operation	3-5
3.3.1	Reporting Status	3-6
3.3.2	Reading Data	3-6
3.3.3	Writing Data	3-6
3.3.4	Bootstrapping	3-7
3.3.5	Transferring Data via DMA	3-7
3.3.6	Handling Interrupts	3-7
3.4	Disk Drives	3-8
3.4.1	Read/Write and Control Electronics	3-8
3.4.2	Diskette Drive Mechanism	3-8
3.4.3	Positioning Mechanism	3-9
3.4.4	Read/Write Heads	3-9

List of Figures

Figure 1-1. Subsystem Block Diagram	1-3
Figure 2-1. DS-100/105 Diskettes	2-2
Figure 2-2. Interface Cable and Connectors	2-5
Figure 2-3. Card Edge Pin Designations (Component Side)	2-6
Figure 3-1. DSD 4140-03 Major Circuits	3-2
Figure 3-2. DSD 4140-03 Block Diagram	3-3
Figure 4-1. Module Controls and Indicators	4-3
Figure 4-2. Module Rear View	4-5
Figure 4-3. Module Cabling	4-7
Figure 4-4. DSD 4140-03 Jumper Locations	4-8
Figure 4-5. Controller Board Mounting Key	4-12
Figure 4-6. Module Interlocks	4-17
Figure 4-7. New Module Configuration	4-19
Figure 4-8. Daisy Chained Modules	4-20
Figure 5-1. Write Protecting the Diskette	5-4
Figure 5-2. Loading the Diskette	5-5
Figure 6-1. Command and Status (RX2CS) Register Format	6-2
Figure 6-2. Data Buffer (RX2DB) Register Format	6-5
Figure 6-3. Track Address (RX2TA) Register Format	6-5
Figure 6-4. Sector Address (RX2SA) Register Format	6-6
Figure 6-5. Word Count (RX2WC) Register Format	6-7
Figure 6-6. Error and Status (RX2ES) Register Format	6-8
Figure 7-1. Fuse Location	7-4
Figure 7-2. Module, Exploded View	7-6
Figure 7-3. Power Supply Adjustments	7-7
Figure 7-4. Power-Modification Jumpers	7-11

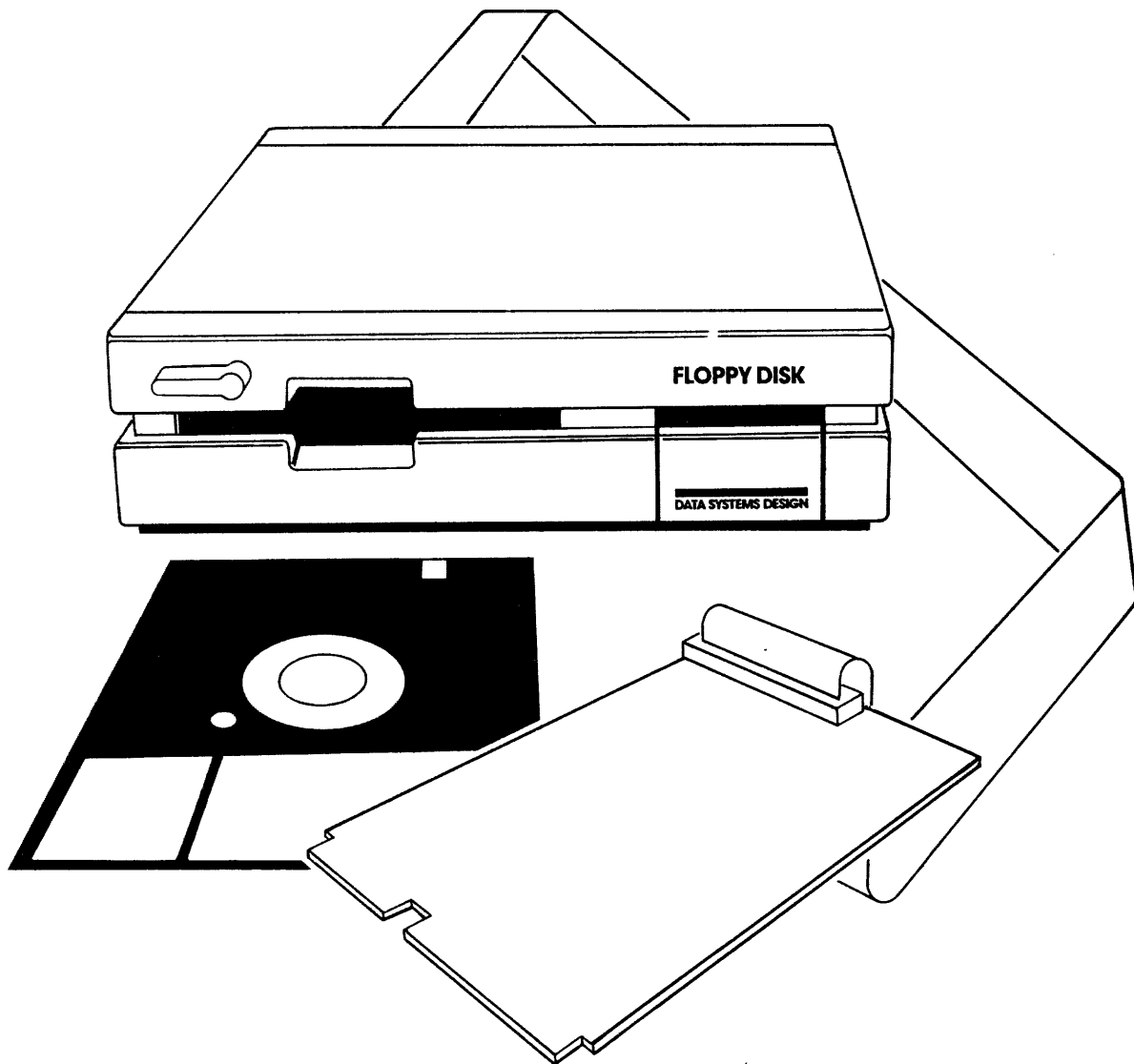
List of Tables

Table 2-1. Diskette Storage Capacities	2-2
Table 2-2. Recording Characteristics	2-3
Table 2-3. Performance Specifications	2-4
Table 2-4. Cable and Connector Requirements	2-5
Table 2-5. Interface Cable Pin Assignments	2-6
Table 2-6. Card Edge Pin Assignments	2-7
Table 2-7. Power Requirements	2-8
Table 2-8. Environmental Requirements	2-9
Table 2-9. Physical Specifications	2-10
Table 4-1. Controls and Indicators	4-2
Table 4-2. DSD 4140-03 Configuration as Shipped	4-8
Table 4-3. RM (Remapping) Jumper Functions	4-9
Table 4-4. Bootstrap Starting Address Selection	4-10
Table 5-1. Write Sector Command for FORMAT Program	5-2
Table 5-2. Special Write Sector Addresses for FORMAT Program	5-3
Table 6-1. Command and Status (RX2CS) Register Bit Assignments	6-3
Table 6-2. RX2CS Function Selection	6-4
Table 6-3. Error and Status (RX2ES) Bit Assignments	6-9
Table 6-4. Definitive Error Codes	6-13
Table 7-1. Quick Troubleshooting Chart	7-3

Table of Contents (continued)

4.	INSTALLATION	4-1
4.1	General Information	4-1
4.2	Unpacking and Inspection	4-1
4.3	Controls and Indicators	4-2
4.4	Power Configuration	4-3
4.5	Installation Procedures	4-4
4.5.1	Module Cabling	4-4
4.5.2	Jumper Configuration	4-6
4.5.3	Controller Board Mounting	4-10
4.5.4	System Power-Up	4-11
4.5.5	Acceptance Testing	4-14
4.6	Daisy Chaining Floppy Disk Modules	4-16
4.6.1	Installing Module Interlocks	4-16
4.6.2	Modifying New Module	4-18
4.6.3	Stacking Modules	4-18
5.	OPERATION	5-1
5.1	General Information	5-1
5.2	Diskette Handling	5-1
5.3	Formatting The Diskette	5-2
5.4	Write Protecting the Diskette	5-4
5.5	Diskette Loading	5-4
6.	CONTROLLER REGISTERS, FUNCTION AND FORMAT	6-1
6.1	General Information	6-1
6.2	Command and Status (RX2CS) Register	6-2
6.3	Data (RX2DB) Register	6-5
6.3.1	Data Buffer (RX2DB) Register	6-5
6.3.2	Track Address (RX2TA) Register	6-5
6.3.3	Sector Address (RX2SA) Register	6-6
6.3.4	Word Count (RX2WC) Register	6-7
6.3.5	Bus Address (RX2BA) Register	6-7
6.3.6	Error and Status (RX2ES) Register	6-8
6.4	Device Functions	6-8
6.5	Fill Buffer	6-10
6.6	Empty Buffer	6-10
6.7	Write Sector	6-10
6.8	Read Sector	6-11
6.9	Set Media Density	6-11
6.10	Read Status	6-12
6.11	Write Deleted Sector	6-12
6.12	Read Extended Status	6-12

7.	MAINTENANCE	7-1
7.1	General Information	7-1
	OPERATOR MAINTENANCE	7-1
7.2	Proper Ventilation	7-1
7.3	Cleaning the Module	7-2
7.4	Quick Troubleshooting Chart	7-2
	SERVICE MAINTENANCE	7-5
7.5	Preventive Maintenance	7-5
7.6	Corrective Maintenance Philosophy	7-7
7.7	Diagnostic Aids	7-8
7.8	Troubleshooting Guidelines	7-8
7.9	Replacement Procedures	7-9
7.10	Module Power Reconfiguration	7-10
7.11	Maintenance Assistance	7-11



TP 346/83

Typical DS-100/105 Subsystem

Data Systems Design

DEC-Compatible Products

1 INTRODUCTION

1.1. General Information

Data Systems Design, Inc. manufactures a comprehensive line of StacPac peripherals.

This manual provides user and reference information for the following DEC-compatible StacPac (DS) units:

- Floppy Disk Module (DS-100)
- Floppy Disk Module (DS-105)
- Floppy Disk Controller Board (DSD 4140-03)

The DS-100 contains a half-height, single-sided floppy disk drive. This drive uses single-sided flexible diskettes.

The DS-105 contains a half-height, double-sided floppy disk drive. This drive can use single- or double-sided flexible diskettes.

The DSD 4140-03 Floppy Disk Controller board is available with both modules. This board permits either module to operate as a peripheral storage subsystem with the DEC LSI-11 computer product line.

For brevity, this manual refers to both module/controller combinations as DS-100/105 subsystems.*

1.2. Subsystem Overview

The DS-100/105 are compact, double-density, floppy disk memory subsystems for use with LSI-11, LSI-11/2, LSI-11/21, LSI-11/23, and LSI-11/23-Plus computers.

* Ordering Information: When ordering the DS-100 module/controller combination, please specify DS-101; when ordering the DS-105 combination, DS-106.

A typical subsystem consists of a storage module and a controller interface board. A second module may be daisy chained to the first for providing added data storage capacity.

In single-sided mode, the DS-100/105 are media, software, and diagnostic compatible with the DEC RX02. Because these subsystems can read and write RX01-compatible diskettes, they provide an excellent, low cost, upgrade path for users of the older single-density subsystems.

All data block transfers are performed using direct memory access (DMA) over a full 18-bit address. The DS-100/105 provide an interrupt structure that is fully LSI-11/23 compatible.

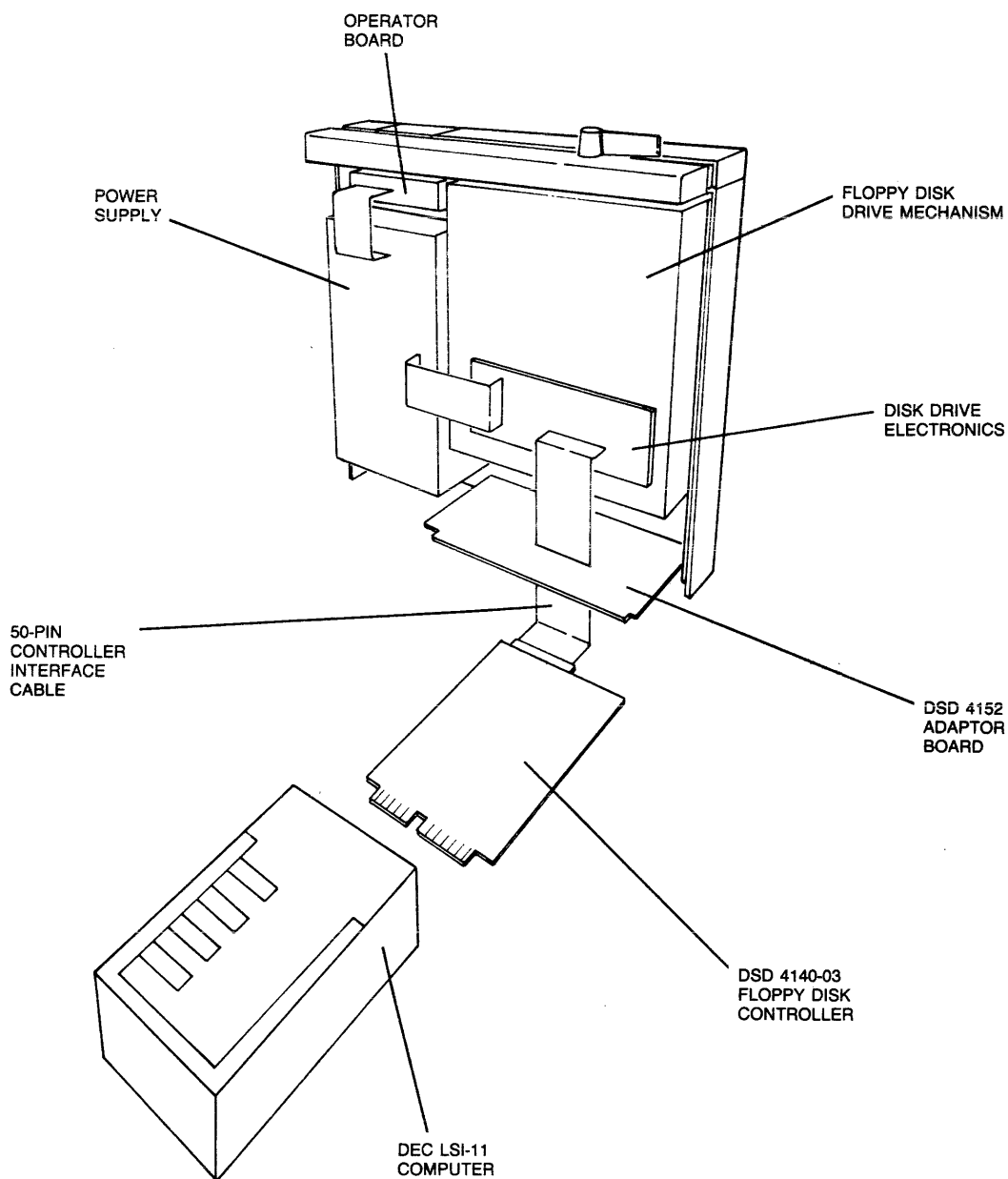
The interface/controller board (DSD 4140) is available separately for those customers who wish to use their own floppy disk drives in custom systems. The board is available as an -01 version for supporting standard-height ac drives, or as an -03 version for supporting half-height (slimline) dc drives.

The DS-100/105 combine a compact, but powerful set of components (see Figure 1-1). As the figure shows, each subsystem consists of the following devices:

- Disk Drive: A Shugart Associates' half-height, single-sided (DS-100) or double-sided (DS-105), eight-inch drive capable of storing a maximum of 512 Kbytes or 1024 Kbytes of data. It features low-wear heads, fast-access time, and rapid-start dc motor.
- Power Supply: A highly efficient supply with line filter and 90 watts of switching power providing all dc power requirements of the modular unit.
- Adapter Board: A DSD 4152 board used for interfacing the module with the 4140-03 board, connecting internal components, providing drive terminations and selection jumpers, and for supporting status display logic circuits.
- Controller Interface: A DSD 4140-03 board capable of interfacing two floppy drives while fully emulating DEC LSI-11 host software.

1.3. The Storage Device

The floppy disk memory system is an electro-mechanical device that stores information and transfers data between the host computer and the floppy disk (flexible diskette).



TP 347 83

Figure 1-1. Subsystem Block Diagram

The diskette is a mylar disc coated with magnetic material. It is 7.8 inches in diameter and 0.005 inches thick. It is permanently housed in an eight-inch square flexible jacket. When inserted into the disk drive, it rotates inside the jacket at 360 rpm.

In single-density format, the diskette can store up to 256,256 bytes of data on each side--and up to 1,025,024 bytes of data on each double-density, double-sided diskette.

The floppy disk storage device is ideal for applications that require low cost, medium speed, random access data storage. It costs less than large rigid disk subsystems, and provides faster access times than magnetic tapes. Because diskettes can be quickly exchanged, an unlimited amount of data is readily accessible.

There are two types of eight-inch floppy disk drives. Each type is available in single-sided or double-sided versions. The older type is the standard-height drive, with dimensions of 4.62 inches by 8.55 inches by 12.00 inches.

The newer type of floppy drive, the so-called half-height or slimline drive has dimensions of 2.31 inches by 8.55 inches by 12.00 inches. The DS-100/105 subsystems use half-height (slimline) floppy disk drives.

The major functional difference between these two types of drives is that half-height drives use a dc motor that shuts down when the drive is not being used. The motor requires time to start up when the drive is selected. This time delay is handled by the microcode in the 4140-03 controller.

1.4. The Controller Interface

The DSD 4140-03 is designed to control the single-sided or double-sided floppy disk data storage for the LSI-11, LSI-11/2, or LSI-11/23 computer system.

The DSD 4140-03 controls the floppy disk memory device through use of a specially programmed processor. The intelligence of the device resides in the microcode of this card, which functions as controller, formatter, interface, and bootstrap card.

As controller, the DSD 4140-03 executes commands sent from the computer and controls the operation of one or two floppy disk drives.

As formatter, the DSD 4140-03 can format diskettes in IBM 3740 single-density format or DEC RX02 double-density format.

As interface, the DSD 4140-03 accepts commands from a computer and transfers data between the computer and the floppy disk.

As bootstrap, the DSD 4140-03 can automatically load the operating system into main memory and verify proper system operation.

The DSD 4140-03, combined with single-sided or double-sided disk drives, power supply, and interface cables comprise a powerful, reliable, cost effective floppy disk subsystem.

When incorporated into a floppy disk memory system that uses single-sided diskettes, the DSD 4140-03 is completely compatible in media and software with the DEC RX02, and can fully use diagnostics written for the RX02.

In addition, the DSD 4140-03 performs on-board diagnostics, formats diskettes, and controls double-sided disk drives. It provides a microcoded bootstrap and LSI-11/23 compatible position-independent interrupt acknowledgement.

To save space, the DSD 4140-03 control electronics are located on a single, half-quad sized controller card. The 4140-03 offers a programmable array of six pairs of wirewrap pins. By installing the appropriate jumpers, the customer can use double-sided drives, remap drives, choose alternate device addresses, and check for pending high priority interrupts.

1.5. Feature Summary

- Single-Sided or Double-Sided Disk Drive Control
- Single-Density or Double-Density Data Storage
- Double-Density Write Precompensation
- LSI-11/23 Compatible, Position-Independent Interrupt Acknowledgment
- Extended (18 Bit) Main Memory Addressing
- Direct Memory Access (DMA) Data Transfer
- Automatic Self-Testing
- On-Board Diagnostics
- Phase-Lock Loop (PLL) Data Separation
- Emulates RX02 Operation
- DEC Media, Software and Diagnostic Compatible
- Integral Bootstrap

- Supports DSD Diskette Utility Package (FLPEXR)
- Operates with One or Two Floppy Disk Modules
- Two Half-Height, Eight-Inch Floppy Disk Modules are Available: Single-Sided (DS-100) or Double-Sided (DS-105).
- Single-Sided Drive for Up to 0.5 Mbyte of Formatted Storage Capacity
- Double-Sided Drive for Up to 1.0 Mbyte of Formatted Storage Capacity
- Attractive Modular Packaging Design
- Low Profile 3.25-Inch Cabinet
- Status Panel
- Compact 14-Inch by 16.25-Inch Footprint
- Quiet Operation
- Simple Cabling Design
- Module-to-Module Interlock
- Lightweight

[^]

2 SPECIFICATIONS

2.1. General Information

This chapter provides specifications and operational requirements for DS-100/105 subsystems.

Specifications include diskette storage capacities, recording characteristics, and data transfer rates.

Requirements include those for interface cable and connectors, and power. Operating temperature ranges and other environmental requirements are also listed.

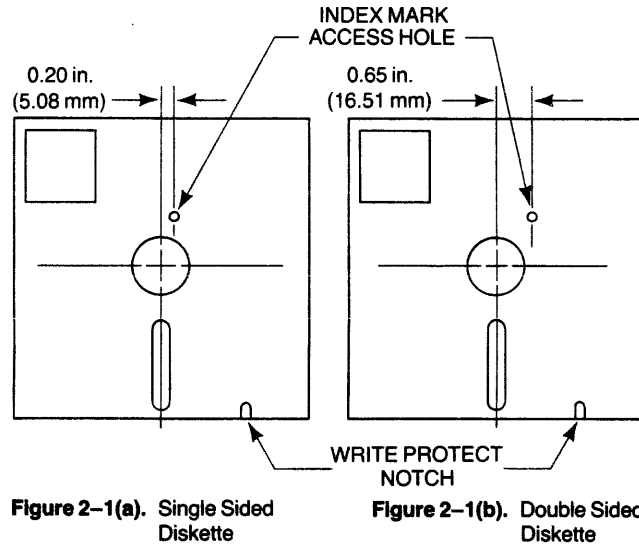
2.2. Diskette Specifications

The DSD 4140-03 controls either single-sided or double-sided drives. DS-100 provides a single-sided disk drive; DS-105 a double-sided drive. The diskettes used by these drives are shown in Figure 2-1.

The diskettes must be soft sectored. When rotated a full revolution inside their jackets, soft sectored diskettes have but one hole that can be seen through the envelope index mark access hole.

Before use, diskettes must be formatted by the industry standard (26 sectors per track, 77 tracks per side). Chapter 5.0 explains how to do this operation.

The required capacities of blank (unformatted) diskettes and their storage capacities, after formatting, are given in Table 2-1.



TP 285/82

Figure 2-1. DS-100/105 Diskettes

Table 2-1. Diskette Storage Capacities

	Single-Density	Double-Density
Single-Sided:		
Required Capacity	400 Kbytes	800 Kbytes
Formatted Capacity	250 Kbytes	500 Kbytes
Bytes per Sector	128	256
Sectors per Track	26	26
Tracks per Diskette	77	77
Double-Sided:		
Required Capacity	800 Kbytes	1,600 Kbytes
Formatted Capacity	500 Kbytes	1,000 Kbytes
Bytes per Sector	128	256
Sectors per Track	26	26
Tracks per Diskette	154	154

2.3. Recording Characteristics

The DS-100/105 controller interface board (DSD 4140-03) permits single-density data storage in IBM 3740 format--the current industry standard. Data are recorded using the double frequency (FM) code.

The DSD 4140-03 can also store double-density data in a format compatible with DEC RX02 operation. This format writes single-density headers followed by double-density data. The data are recorded using the DEC-modified modified frequency modulation (MFM) technique.

These recording characteristics are presented in Table 2-2.

Table 2-2. Recording Characteristics

	Single-Density	Double-Density
Data Format	IBM 3740	DEC RX02
Recording Technique	Double-Frequency (FM)	DEC-Modified MFM

2.4. Performance Specifications

The DS-100/105 performance specifications are given in Table 2-3.

Real throughput is the average rate of data transfer the customer may expect during sustained system operation. Note that DEC software uses two-way sector interleaving with seven sector track-to-track skew.

The DMA transfer rate--the direct transfer rate between floppy disk memory device and LSI-11 main memory--is also listed.

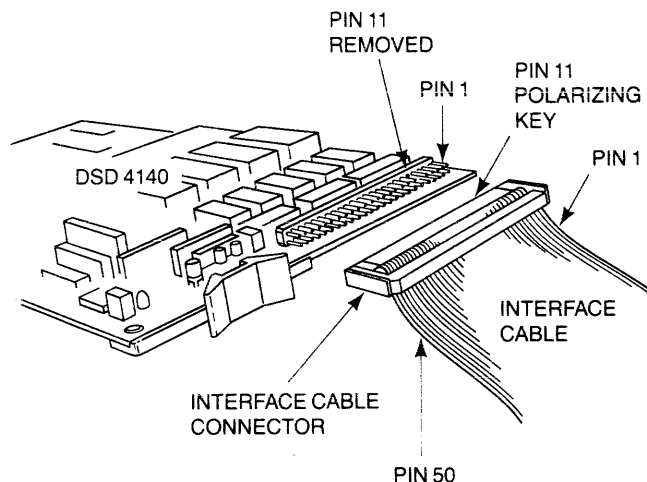
Table 2-3. Performance Specifications

Controller Interface Board		
DMA Transfer Rate		43,000 words per second
Real Throughput	Within Track	20 Kbytes per second two-way interleave
	Across Diskette	18 Kbytes per second two-way interleave seven sector skew
Floppy Disk Module		
StacPac Subsystem:	Module Drive:	Drive Model:
DS-100	Single-Sided	Shugart SA810
DS-105	Double-Sided	Shugart SA860
Diskette Rotation		360 rpm \pm 2%
Access Times:		
Track-to-Track		3 msec
Settle Time		13 msec
One Track Seek and Settle		16 msec
Motor Start Time		165 msec
Average (includes Settle)		89 msec

2.5. Cable and Connector Requirements

The DSD 4140-03 and the Floppy Disk module are connected with a 50-pin interface cable. For lengths up to 12 feet, flat ribbon cable is used. For lengths ranging from 12 feet to 20 feet, twisted pair ribbon cable is used. The length of the cable should not exceed 20 feet.

The interface cable and connectors are shown in Figure 2-2. Cable and connector requirements are listed in Table 2-4. Requirements for the programmable jumper array (see Chapter 4) are also given.



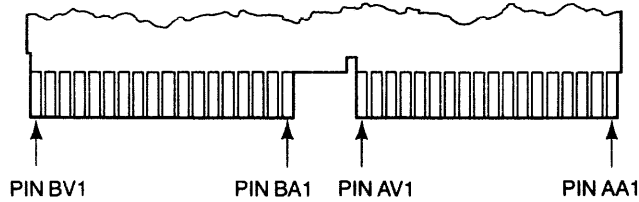
TP 348 83

Figure 2-2. Interface Cable and Connectors

Table 2-4. Cable and Connector Requirements

Interface Cable	Flat ribbon cable 3M 3365/50, or equivalent (up to 12 feet in length)
	Twisted pair ribbon cable, or equivalent (12 feet to 20 feet maximum length)
Interface Cable Connector	3M 3425-3000, or equivalent 3M 3435-0000 polarizing key in pin 11
DSD 4140-03 Connector	SAE CHD6950W1R or equivalent
Programmable Jumper Array	0.025-inch square wirewrap pin Wirewrapped to fit pin

Table 2-5 lists interface cable pin assignments. Table 2-6 lists DSD 4140-03 card edge pin assignments. Card edge pin designations are shown in Figure 2-3.



TP 349/83

Figure 2-3. Card Edge Pin Designations (Component Side)

Table 2-5. Interface Cable Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
1	GND	26	Drive Select 1
2	Track >43	27	GND
3	GND	28	Drive Select 2
4	Not Used	29	GND
5	GND	30	Not Used
6	Not Used	31	GND
7	GND	32	Not Used
8	Not Used	33	GND
9	GND	34	Direction Select
10	Two Sided	35	GND
11	Key	36	Step
12	Not Used	37	GND
13	GND	38	Write Data
14	Side Select	39	GND
15	GND	40	Write Gate
16	Not Used	41	GND
17	GND	42	Track 00
18	Head Load	43	GND
19	GND	44	Write Protect
20	Index	45	GND
21	GND	46	Read Data
22	Ready	47	GND
23	GND	48	Not Used
24	Not Used	49	GND
25	GND	50	Not Used

Table 2-6. Card Edge Pin Assignments

Component Side		Solder Side	
Pin Number	Signal Name	Pin Number	Signal Name
AA1	BIRQ5L	AA2	+5
AB1	BIRQ6L	AB2	Not Used
AC1	BDAL16L	AC2	GND
AD1	BDAL17L	AE2	BDOUTL
AF1	Not Used	AF2	BRPLYL
AH1	Not Used	AH2	BDINL
AJ1	GND	AJ2	BSYNCL
AK1	MSPAREA	AK2	BWTBTL
AL1	MSPAREA	AL2	BIRQ4L
AM1	GND	AM2	BIAK1L
AN1	BDMRL	AN2	BIAK0L
AP1	BHALTL	AP2	BBS7L
AR1	Not Used	AR2	BDMGIL
AS1	Not Used	AS2	BDMG0L
AT1	GND	AT2	BINITL
AU1	Not Used	AU2	BDAL0L
AV1	Not Used	AV2	BDAL1L
BA1	Not Used	BA2	+5
BB1	Not Used	BB2	Not Used
BC1	Not Used	BC2	GND
BD1	Not Used	BD2	+12
BE1	Not Used	BE2	BDAL2L
BF1	Not Used	BF2	BDAL3L
BH1	Not Used	BH2	BDAL4L
BJ1	GND	BJ2	BDAL5L
BK1	MSPAREB	BK2	BDAL6L
BL1	MSPAREB	BL2	BDAL7L
BM1	GND	BM2	BDAL8L
BN1	BSACKL	BN2	BDAL9L
BP1	BIRQ7	BP2	BDAL10L
BR1	Not Used	BR2	BDAL11L
BS1	Not Used	BS2	BDAL12L
BT1	GND	BT2	BDAL13L
BU1	Not Used	BU2	BDAL14L
BV1	+5	BV2	BDAL15L

2.6. Power Requirements

The DSD 4140-03 operates on nominal +5 volt dc backplane voltage. The phase-lock loop data separator requires +12 volt dc backplane voltage.

The minimum voltage required to operate the DSD 4140-03 is +4.80 volts dc. The recommended operating voltage is +5.1 volts dc, measured at the LSI-11 backplane.

Make sure that the total dc power requirements do not overload the LSI-11 computer power supply, and that there is enough ac power for the floppy disk memory device, computer, and other equipment.

DS-100/105 power requirements are given in Table 2-7.

Table 2-7. Power Requirements

Controller Interface Board		
+5 Vdc	2.70 Amps (nominal)	3.70 Amps (maximum)
+12 Vdc	0.06 Amps (nominal)	0.09 Amps (maximum)
Floppy Disk Module		
Input Voltage:	Line Frequency:	
90 to 132 Vac (Domestic)	47 Hz to 63 Hz	
180 to 253 Vac (International)	47 Hz to 63 Hz	
Power Consumption:		
Starting Surge: 160 watts (less than 20 seconds)		
Average Power: 139 watts		

2.7. Environmental Requirements

Table 2-8 lists DS-100/105 environmental requirements. These requirements include operating temperature ranges, non-operating (shipping and storage) temperature ranges, and humidity ranges. Heat dissipation ranges are also given.

Table 2-8. Environmental Requirements

Controller Interface Board	
Operating Temperature: 32 F to 122 F (Ambient) (0 C to 50 C)	Non-Operating Temperature: -40 F to 150 F (Ambient) (-40 C to 66 C)
Humidity: 10% to 95% (Non-Condensating)	Heat Dissipation: 45 BTU per hour (Nominal)
Floppy Disk Module	
Operating Temperature: 41 F to 104 F (Ambient) (5 C to 40 C)	Non-Operating Temperature: -40 F to 151 F (Ambient) (-40 C to 66 C)
Operating Altitude: 8,000 feet (maximum)	Non-Operating Altitude: 30,000 feet (maximum)
Humidity: 8% to 80% (Non-Condensing)	Heat Dissipation: 120 BTU per hour (Busy) 51 BTU per hour (Idle)

2.8. Physical Specifications

The DS-100/105 physical specifications are listed in Table 2-9.

Table 2-9. Physical Specifications

Controller Interface Board				
Length:	Width:	Component Height:		
8.94 inches	5.19 inches	Ø.35 inch maximum		
(22.7 cm)	(13.2 cm)	(Ø.89 cm)		
Floppy Disk Module				
Height:	Width:	Depth:	Weight:	Shipping Weight:
3.25 in.	14.0 in.	16.25 in.	18 lbs	26 lbs
(8.26 cm)	(35.6 cm)	(41.3 cm)	(40 Kg)	(58 Kg)

[^]

3 FUNCTIONAL DESCRIPTION

3.1. General Information

This chapter provides a functional description of the DS-100/105 subsystems. Emphasis is given to the DSD 4140-03 Floppy Disk Controller board, which provides interface and functional control for all storage subsystem operations.

3.2. Disk Controller Functions

The major circuits of the DSD 4140-03 comprise three primary circuit groups. Each group has specific functions that enable the floppy disk memory device to store and retrieve data.

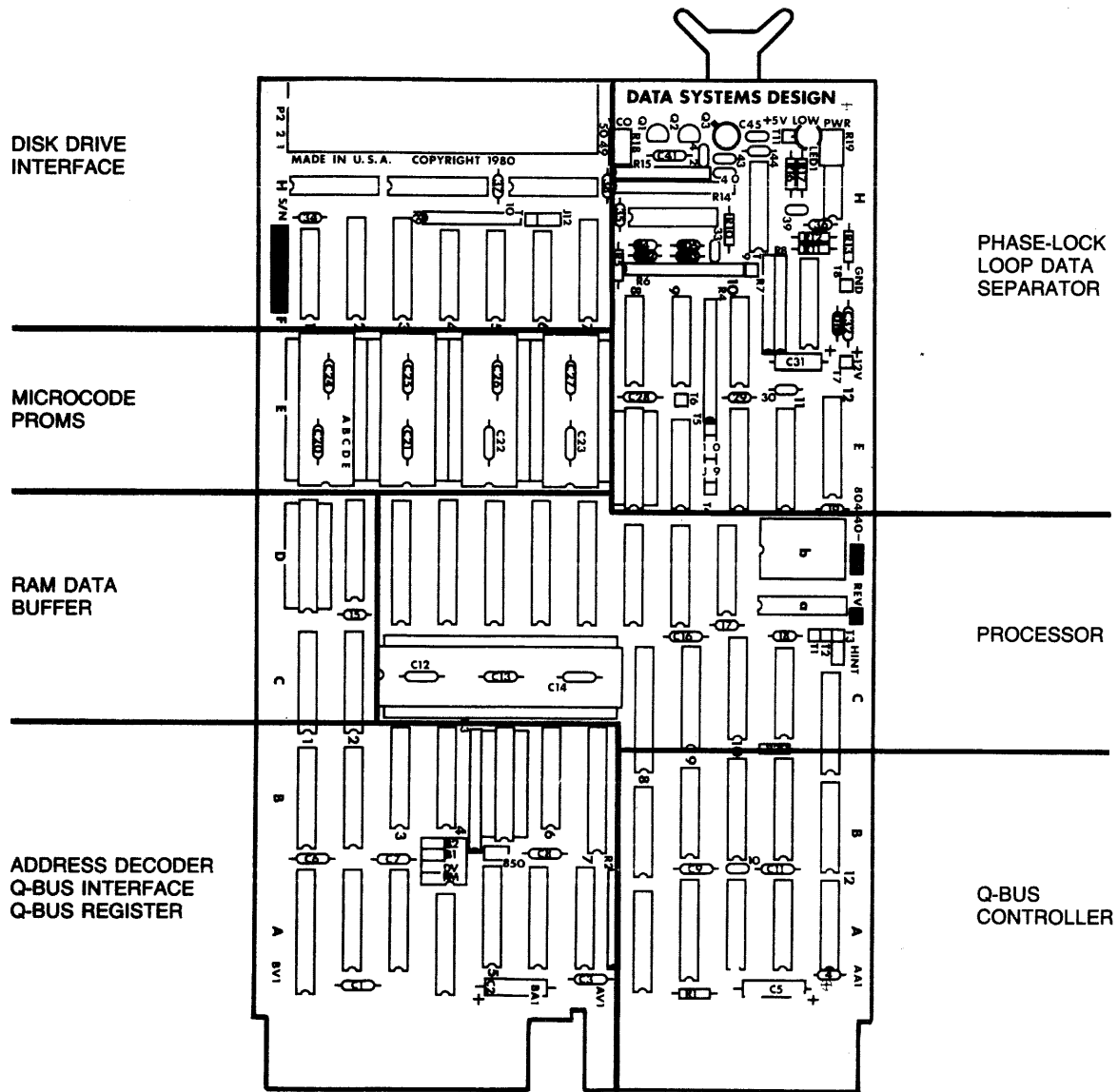
- Processor Group
- LSI-11 (Q-Bus) Interface Group
- Disk Drive Interface Group

The processor group, LSI-11 interface group, and disk drive interface group each consists of several major circuits. The locations of these DSD 4140-03 circuits are shown in Figure 3-1.

The DSD 4140-03 reports LSI-11 and disk drive status, read and writes data, performs bootstrapping and DMA transfers, and handles interrupts. Figure 3-2 shows how the DSD 4140-03 communicates the addresses, signals, and data needed to do these operations.

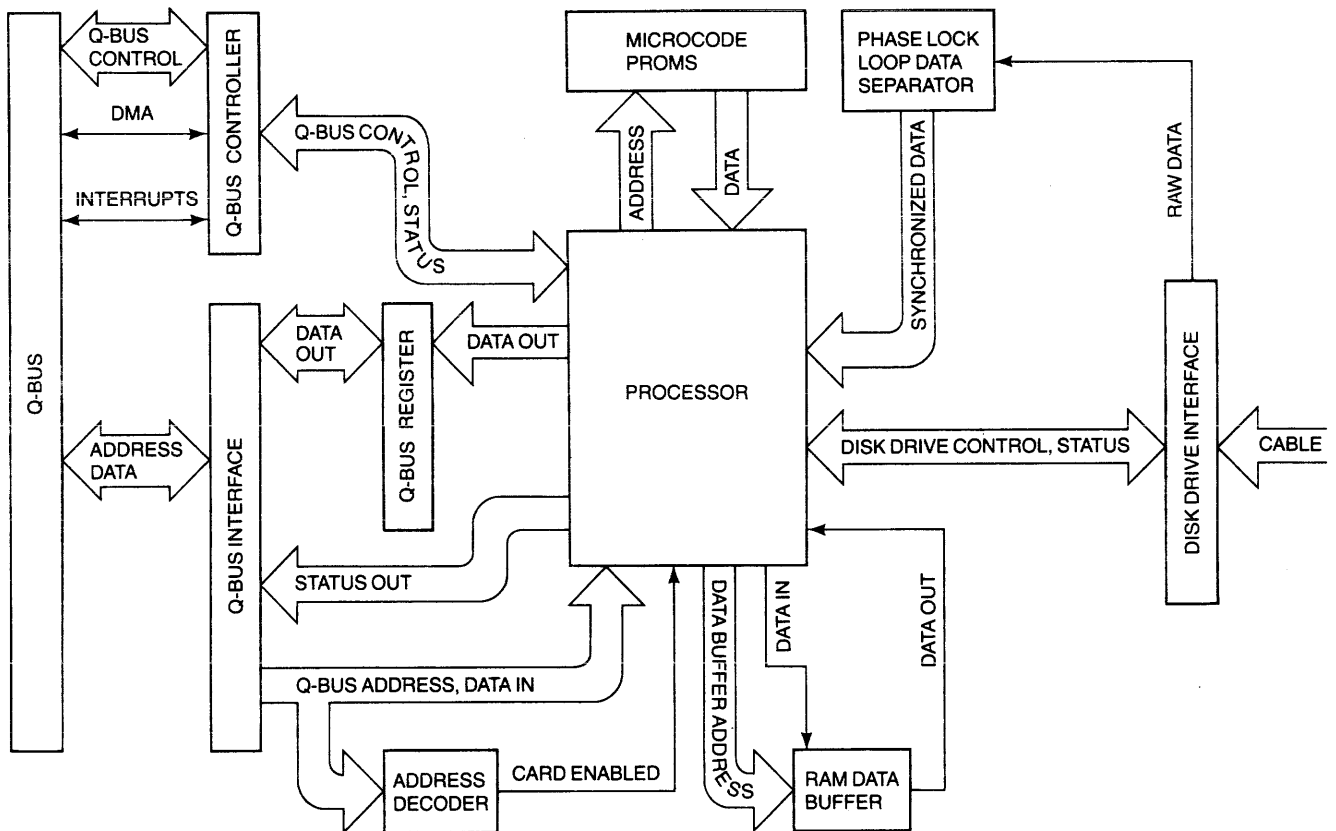
3.2.1. Processor Group

The processor is the heart of the DSD 4140-03. Its bit-slice pipelined architecture results in fast LSI-11 response time and improved throughput. Use of this single, centralized processor also simplifies troubleshooting.



TP 350.83

Figure 3-1. DSD 4140-03 Major Circuits



TP 351 83

Figure 3-2. DSD 4140-03 Block Diagram

The processor monitors the floppy disk subsystem, accepts commands from the LSI-11 Q-Bus interface, and controls drive operations.

Executing six million instructions per second, the processor reads and writes data, formats diskettes, runs diagnostic tests, and performs bootstrapping and DMA data transfers.

The random access memory (RAM) data buffer and microcode programmable read only memory (PROMs) are associated with the processor.

RAM Data Buffer

The data buffer stores and transmits data. It can buffer a full 256-byte data sector at one time. The data buffer also stores various internal variables.

Microcode PROMS

The microcode PROMs store instructions--up to 2,048 16-bit words--for use by the processor.

3.2.2. LSI-11 Interface Group

The LSI-11 interface group controls communication between the computer and the DSD 4140-03. It consists of the address decoder, Q-Bus interface, Q-Bus controller, and Q-Bus register.

Address Decoder

The address decoder identifies the addresses to which LSI-11 commands and data are sent, and notifies the processor when the LSI-11 is addressing it.

Q-Bus Interface

The Q-Bus interface buffers LSI-11 commands and data, and holds them for the processor. It passes disk drive status information and data to the LSI-11.

Q-Bus Controller

The Q-Bus controller directs DMA transfers, handles interrupts, and informs the processor of Q-Bus operations in progress.

Q-Bus Register

The Q-Bus register holds data, addresses, and other information during their transfer from the processor to the Q-Bus interface.

3.2.3. Disk Drive Interface Group

The disk drive interface group permits communication between the disk drives and the DSD 4140-03. It consists of the disk drive interface circuits and the PLL data separator.

Disk Drive Interface

The disk drive interface circuit directs disk drive status information to the processor, and diskette data to the phase lock loop data separator. It also passes control signals from the processor to the disk drives.

Phase-Lock Loop Data Separator

The phase-lock loop data separator decodes the raw data stream from the diskette, separating the data from the clock information. It then synchronizes the data stream to the processor timing.

3.3. Circuit Operation

The DSD 4140-03 stores and retrieves data by executing commands sent from the LSI-11 computer via the processor device registers. These DSD 4140-03 device registers are described in Chapter 6.

Each DSD 4140-03 operation is initiated by loading a command and required data into either the processor RX2Cs register address, or the RX2DB register address. The selected register address is identified by the address decoder. The command and data are buffered by the interface and transferred to the processor.

When each DSD 4140-03 operation is completed, the Done Status bit (bit 5) of the RX2CS register is set to 1 to show this. The contents of the RX2ES register address are then available to the Q-Bus interface, and to the LSI-11 computer.

3.3.1. Reporting Status

The DSD 4140-03 regularly makes disk drive and processor status information available to the LSI-11 computer.

Disk drive status information is sent to the disk drive interface and read by the processor. When requested, the processor sends this information to the Q-Bus register, which transfers it to the LSI-11 via the Q-Bus.

The RX2ES register reports drive status at the conclusion of each DSD 4140-03 operation. Processor status can be displayed by the RX2CS register at any time.

3.3.2. Reading Data

Data read from the diskette are first sent to the phase-lock loop data separator.

The PLL quickly locks onto the raw data stream and transform it to conform to the processor timing. The PLL then modifies its operation to maintain a steady, reliable data stream. This data stream is interpreted by the processor and stored in the RAM data buffer.

The phase lock loop data separator tolerates variations in diskette rate of spin, and the shifting of data bits that is characteristic of higher recording densities.

The PLL is factory-adjusted for a wide range of conditions, including temperature and voltage fluctuations.

3.3.3. Writing Data

Data stored in the RAM data buffer are written onto the diskette under the direct control of the processor.

The processor transfers these data from the RAM data buffer to the disk drive interface and disk drives. To detect inaccurate data, the processor calculates an error code word (CRC) and attaches it to the end of each data block. The processor establishes the amount of (double-density) write compensation needed for accurate high-density recording.

3.3.4. Bootstrapping

Bootstrapping transfers the operating program from diskette to LSI-11 main memory. This occurs when the address decoder receives an instruction fetch from the bootstrap starting address.

The flexible disk memory device may bootstrap automatically, under microprogram control. This is a function of the LSI-11 computer. You should refer to the computer documentation for the jumper configuration that allows best automatic bootstrapping on power-up.

3.3.5. Transferring Data via DMA

All data transfers between the RAM data buffer and LSI-11 main memory are performed by DMA. DMA maximizes data transfer speed and frees the LSI-11 computer for other tasks.

DMA data transfers can be initiated by a FILL BUFFER, EMPTY BUFFER, or READ EXTENDED STATUS command (explained in Chapter 6.0). These transfers are directed by the Q-Bus controller.

The Q-Bus controller notifies the LSI-11 computer that the Q-Bus is needed for a DMA transfer. When the LSI-11 computer informs the Q-Bus controller that the Q-Bus is available, data are transferred directly between the RAM data buffer addresses and the LSI-11 main memory addresses supplied by the processor.

If LSI-11 main memory does not respond to the Q-bus controller request within ten microseconds, the operation is halted and an error is reported.

The Q-Bus controller notifies the LSI-11 computer when the DMA data transfer is completed.

3.3.6. Handling Interrupts

Interrupts are initiated by the Q-Bus controller at the completion of the command in progress, when Interrupt Enabled (bit 6) of the RX2CS register is set to 1.

The Q-Bus Controller requests an interrupt from the LSI-11 computer. After the LSI-11 acknowledges the Q-Bus controller request, the DSD 4140-03 verifies the absence of pending higher priority interrupts. This conforms with the multiple level interrupt protocol recommended by DEC for systems such as the LSI-11/23.

If there are no pending higher priority interrupts, the Q-Bus controller request is granted. The DSD 4140-03 then provides an interrupt vector address to the LSI-11 computer. This address directs the LSI-11 computer to the service routine to be performed.

After executing the service routine, the LSI-11 computer returns to the program that was interrupted.

3.4. Disk Drives

The disk drives contained in the DS-100/105 subsystems rotate the diskette media within its jacket, position the read/write mechanism to the desired position, control the recording and playback of information on the diskette, and provide various status indicators such as whether the diskette is write-protected, or if the index hole is sensed.

The drives consist of the read/write and control electronics, the drive mechanism, the positioning mechanism, and the read/write head assembly.

3.4.1. Read/Write and Control Electronics

Most of the circuitry required to do the drive read/write and control functions are mounted on a single attached printed circuit board. Circuits used to buffer the interface signals from the DSD 4140-03 controller board are contained on the DSD 4152 board at the rear of the storage module.

The DSD 4152 board is used for interfacing the module with the DSD 4140-03 board, connecting the module internal assemblies, providing internal terminations and drive selection jumpers, and for supporting status panel logic circuits.

3.4.2. Diskette Drive Mechanism

When a diskette is inserted into the drive and the control knob is closed, the controller may cause the drive head(s) to be activated and positioned onto the desired track. If the diskette is absent, the head-positioning mechanism is not activated.

When accessed by the controller, the drive dc motor is started and it rotates the spindle, under phase-lock loop control, at exactly 360 rpm. A contracting tapered clamp on the spindle provides precision media positioning and clamping to ensure accurate data interchange.

When the control lever is released, a disk ejector unclamps the diskette and forces it out of the drive, within the operator's reach.

3.4.3. Positioning Mechanism

The read/write assembly is accurately positioned by a helical cam mechanism attached to the head carriage assembly. Precise track location is obtained as the mechanism is rotated by a stepping motor, in discrete increments.

3.4.4. Read/Write Heads

The StacPac model DS-100 uses one read/write head; model DS-105 uses two. Each head is a single-element read/write device with straddle erase elements for providing erased areas between data tracks. Thus, normal interchange tolerances between media and drives do not degrade signal-to-noise ratios, ensuring diskette interchangeability.

The read/write head(s) are mounted on a carriage located on a precision carriage ways. The diskette is held in a plane perpendicular to the read/write head(s) by a platen located on the base casting. This precise registration assures perfect compliance with the read/write head(s). The read/write head is in direct contact with the diskette.

The head surfaces are designed to obtain maximum signal transfer with the magnetic surface of the diskette with minimum head/diskette wear owing to the low mass suspension mechanism.

[^]

4 INSTALLATION

4.1. General Information

This chapter provides information on unpacking and inspection, controls and indicators, and installation and acceptance testing of your StacPac DS-100/105 subsystems. It also provides special installation instructions for adding a second floppy drive module to the subsystem.

The DS-100/105 subsystems are fully tested before shipping. Unless there is physical damage from shipment, either subsystem can be installed and made operational in a short period of time without any special procedures other than those recommended here.

4.2. Unpacking and Inspection

When your StacPac subsystem 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 container is opened.

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

Carefully examine all the packing materials to ensure that you have received a complete shipment. Small items, such as cables, foot clips, documents, etc., may be wrapped separately and placed in special compartments within the container.

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 damage is evident, notify the carrier and DSD Customer Service immediately. Retain the shipping container and packing material for examination during the settlement of claims or for future use.

Before installation, take a few minutes to examine the next section and become familiar with the module controls, indicators, and their functions.

4.3. Controls and Indicators

The controls and indicators provided with the DS-100 and the DS-105 subsystems are identical. The controls and indicators are located on the front bezel of each subsystem module. The only control not accessible from the front bezel is the power switch, which is a rocker arm switch located at the rear of the module.

The DS-100/105 module controls and indicators consists of a Status panel and a Disk Control lever. The Status panel is located on the upper right side of the front bezel and becomes visible when the module is powered-up.

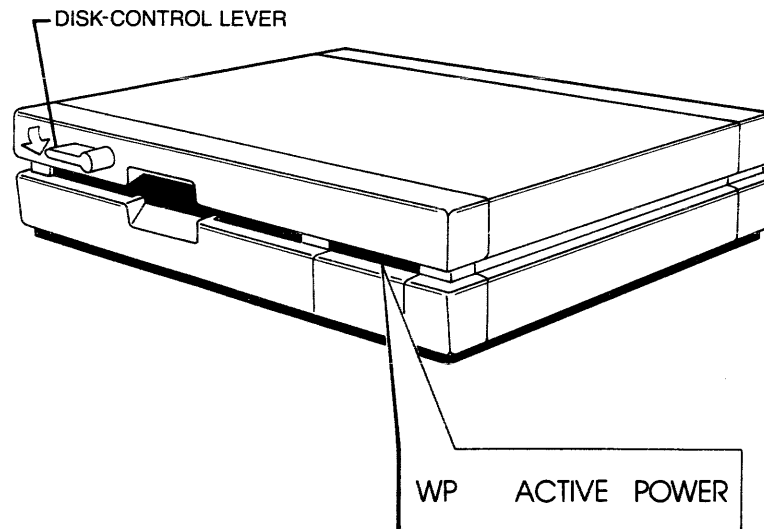
The Status panel gives drive activity and disk write-protect indications. It also provides module power on/off and system fault indications.

The Disk Control lever is located on the upper left side of the front bezel. This lever permits the user to lock the diskette after insertion and to eject it after an operation is complete.

The module controls and indicators are shown in Figure 4-1, their functions described in Table 4-1.

Table 4-1. Controls and Indicators

Control or Indicator	Function
POWER	Lights to show module is powered-up.
ACTIVE	Lights to show floppy drive is active.
WP (Write-Protected)	When drive is active, lights to show diskette is write-protected.
Disk Control Lever	After diskette is inserted, setting counterclockwise (to six o'clock) locks diskette in place and makes it accessible to the controller. Setting clockwise (to nine o'clock) ejects diskette.



TP 352/83

Figure 4-1. Module Controls and Indicators

4.4. Power Configuration

Your system is factory-configured to accept the line voltage and frequency of your power lines. Before you begin the installation, inspect the model and serial number tag located at the rear of the system module. This tag identifies the power requirements of the unit. If you need to modify the unit, refer to Chapter 7 for instructions.

CAUTION:

Ensure line power is off. Do not restore or apply power to computer or DSD systems until specifically instructed.

4.5. Installation Procedures

The DS-100/105 installation consists of these procedures:

- Module Cabling
- Jumper Configuration
- Controller Board Mounting
- System Power-Up
- Acceptance Testing

If you use the standard cable supplied with the DS-100/105, the module must be installed within ten feet of the controller interface board.

The module may be set on a desk or table top. (See Chapter 2 for physical specifications.) Ensure there is enough space behind the module to permit unrestricted air flow. The temperature of the air entering the module should not exceed 104 degrees Fahrenheit (40 degrees Celsius).

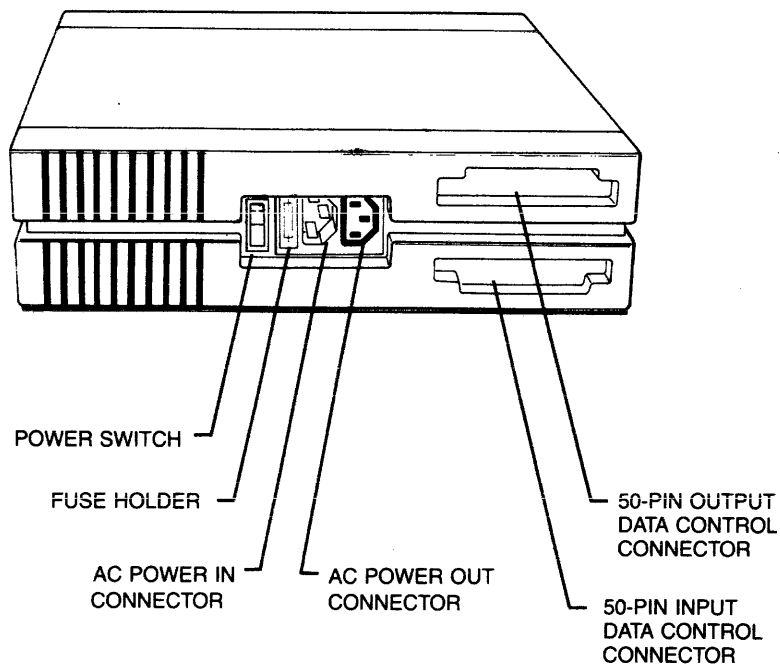
4.5.1. Module Cabling

The module has two 50-pin rear bezel connectors protected by cable clamps (see Figure 4-2). The bottom connector is used for interfacing the unit with the DSD 4140-03 board.

The top connector is used for adding a second floppy drive to your DS-100/105 subsystem. This is also known as daisy chaining. Daisy chaining a second module to the first requires some reconfiguration of the new module and additional cabling.

If you need to add a second floppy drive module to your system, refer to Section 4.6 for special installation instructions. The remaining procedures assume your DS-100/105 subsystem is equipped with only one floppy drive module.

The module is connected to the DSD 4140-03 board with one flat ribbon cable, shielded to prevent radio-frequency (R-F) emissions. This cable is included with your equipment.



TP 474/83

Figure 4-2. Module Rear View

To cable the module, refer to Figure 4-3 and proceed as follows:

- (1) Remove protective cable clamp from rear bezel bottom connector and set it aside.
- (2) Set controller board on flat surface, component side up, as the figure shows.
- (3) Obtain interface cable. Note the cable has a black jacket that covers its shield. On one connector end, the jacket is notched on both sides. This is the end that connects to the Floppy Module rear bezel.
- (4) Inspect the connector on notched end of cable and observe a triangular marking etched on one side. This marking identifies pin 1. (See Detail in Figure 4-3.)
- (5) Go to the rear of module and inspect bottom connector. Note marking on bezel identifying pin 1.
- (6) Insert notched end of interface cable into module connector. Ensure that pin 1 of cable matches pin 1 of rear bezel connector.

- (7) Insert other end of interface cable into 4140-03 board P2 connector. Ensure that pin 1 of cable matches pin 1 of 4140-03 P2 as the figure shows. Note that pin 11 of the connector has been removed to accommodate an interface cable key. If necessary, refer to Chapter 2.0 for interface requirements, connector pin numbers, and signal names.
- (8) Reinstall protective cable clamp removed in Step 1. Tighten the clamp with both retaining screws to ensure proper grounding of the cable shield to the rear panel. This is important to prevent R-F emissions from the cable. The Floppy Disk module is properly cabled.

4.5.2. Jumper Configuration

The DSD 4140-03 provides an array of six wire-wrap jumpers that the customer may install. This array can configure the DSD 4140-03 to the customer's requirements.

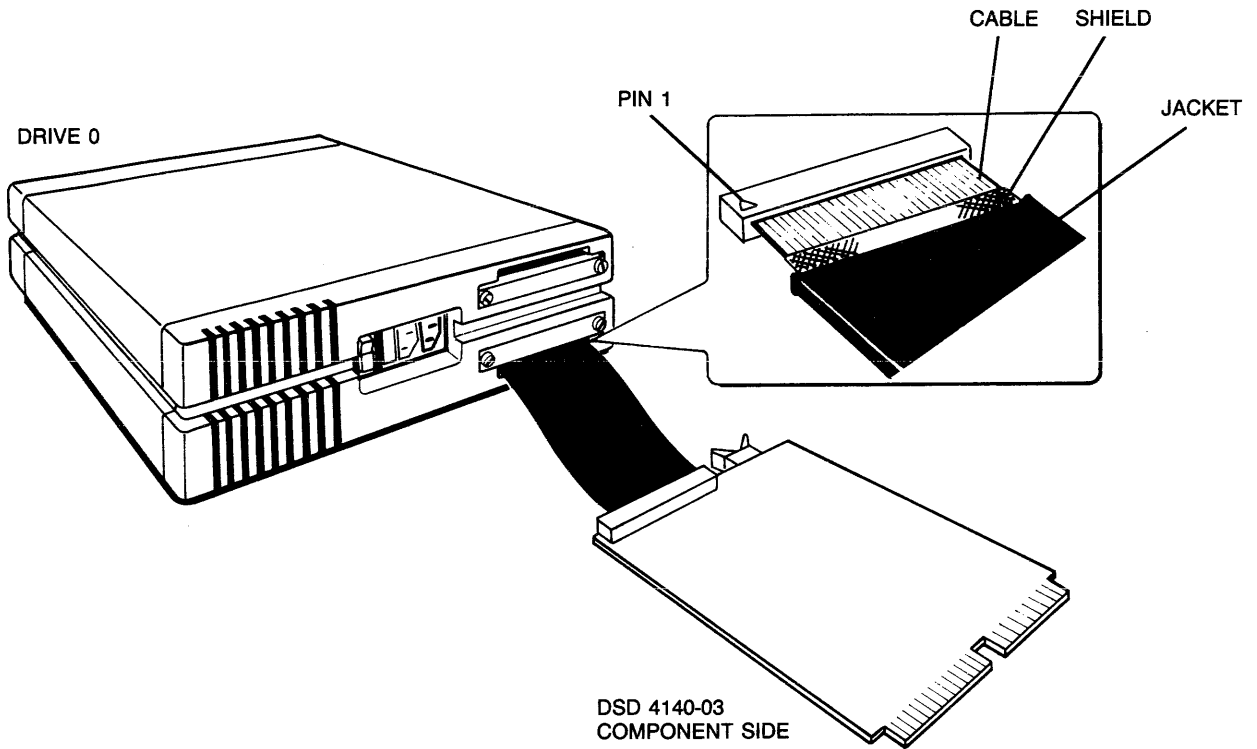
The location of the jumper array is shown in Figure 4-4, and its function identified in Table 4-2.

As the table shows, the DSD 4140-03 is shipped with all jumpers, except Jumper 850, open (not installed). If Jumper 850 is open, it must be installed for proper DS-100/105 operation.

In addition the DSD 4140-03 is equipped with some wire-wrap jumpers which are for factory testing only. Of these, only jumper J12 is shipped in the closed (installed) position.

CAUTION:

Removal of Jumper J12 will cause loss of diskette data.



TP 354/83

Figure 4-3. Module Cabling

Double-Sided Drive Selection

The double-sided drive selection is handled automatically by the 4140-03. The 850 jumper must be installed for a three-millisecond step rate. (See Table 4-2.)

Drive Remapping

The RM jumper performs the functions shown in Table 4-3.

Table 4-3. RM (Remapping) Jumper Functions

Configuration	Drive Configuration	Drive Addressing
Open	Drive 0	As Drive 0
Open	Drive 1	As Drive 1
Closed	Drive 0	As Drive 1
Closed	Drive 1	As Drive 0

Device Address/Vector Selection

If jumper DV is open, the device (RX2CS) address is 777170; the interrupt vector 264.

If jumper DV is closed, the device (RX2CS) address is 777150; the interrupt vector 270.

Bootstrap Starting Address Selection

As Table 4-4 shows, jumpers B1 and B2 can select three different bootstrap starting addresses. The bootstrap is disabled if both jumpers are closed. This should be done if another bootstrap device, such as a DEC BDV-11, or a DSD 8240 Winchester/Tape controller is in use.

Table 4-4. Bootstrap Starting Address Selection

Jumper B1	Jumper B2	Starting Address
Open	Open	773000
Open	Closed	775000
Closed	Open	771000
Closed	Closed	Disabled

Interrupt Verification

If jumper HINT (J5) is open, the DSD 4140-03 must be used with a single-level interrupt computer system only.

If jumper HINT (J5) is closed, the DSD 4140 may be used with multiple level interrupt computer systems, such as the LSI-11/23. The DSD 4140-03 verifies the absence of higher priority interrupts before accepting an interrupt acknowledgement. This conforms with the multiple level interrupt protocol recommended by Digital Equipment Corporation.

4.5.3. Controller Board Mounting

The DSD 4140 Flexible Disk Controller plugs into one LSI-11 Q-Bus location. The board can also be installed in a StacPac Processor module. If you purchased this module, refer to the Technical Reference Document provided with the unit for instructions.

To install the controller board in a LSI-11 backplane, follow the procedure provided below:

- (1) Ensure the DSD 4140-03 array of six wire-wrap jumpers is correctly configured, as previously explained.
- (2) Refer to your DEC Microcomputer Handbook Series and determine floppy disk subsystem priority, desired power-up mode, and proper controller board location in the LSI-11 backplane. Ensure that DMA continuity and controller board interrupt continuity are maintained.

- (3) Position the board so its mounting key is facing the LSI-11 backplane. The board is inserted with the same component solder side orientation as the LSI-11 computer card already inserted in the chassis. The controller board mounting key is shown in Figure 4-5.
- (4) Insert the DSD 4140-03 board into the Q-Bus location inside the LSI-11 card cage. Make sure the board is properly seated in the Q-Bus backplane, and the board components are not in contact with adjacent cards. If necessary refer to Chapter 2 for board edge pin designations, pin numbers, and signal names.

CAUTION:

Upside-down insertion will cause severe and permanent damage to the DSD 4140-03 board.

4.5.4. System Power-Up

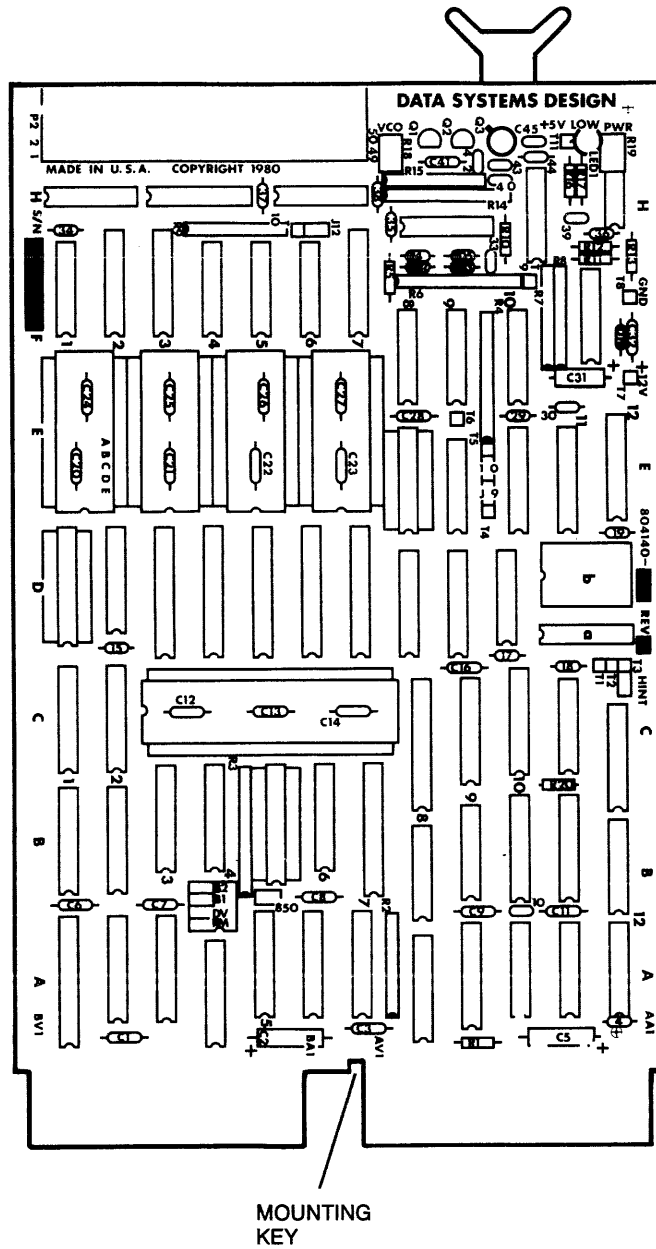
The DS-100/105 subsystem can operate only when ac power is applied to the Floppy Disk module and the 4140-03 controller. The controller is powered via the LSI-11 computer.

The module should be power up first, especially if automatic bootstrapping on power-up is desired. The LSI-11 may be powered-up or powered-down without fear of writing on any diskettes that may be loaded.

The LSI-11 supplies nominal +5 volt dc power to the DSD 4140-03. The recommended DSD 4140-03 operating voltage is +5.1.

NOTE:

The DSD 4140-03 is equipped with a power low indicator. If the dc voltage from the LSI-11 does not rise above +4.80 volts, the indicator will remain on and no disk drive operations will be allowed.



TP 356/83

Figure 4-5. Controller Board Mounting Key

Initialization

There are four ways to start the floppy disk subsystem. When the nominal dc power supplied by the LSI-11 rises above +4.80 volts, the controller automatically initializes the disk drive.

The disk drives can be initialized at any time with the INIT switch on the LSI-11 front panel.

The disk drives can also be initialized by pulsing the Q-Bus BINIT L line, or by loading 40000 (octal) into the RX2CS register address.

The initialization sequence is provided below. If equipped with only one disk drive module, disregard references to drive 1.

- (1) The controller executes self-testing diagnostics on its internal circuitry. These diagnostics require about 100 milliseconds.
- (2) Drive 1 seeks to track 0. Then, drive 0 seeks to track 0.
- (3) When diskettes are properly loaded, the controller reads track 1, sector 1 of drive 0 into the data buffer.
- (4) Drive 0 is released.

During the initialization sequence, the ACTIVE indicator on the modules blinks once; first on drive 1, then on drive 0.

Bootstrapping

The DSD 4140-03 can bootstrap the floppy disk memory subsystem only when a bootable diskette is properly loaded in drive 0.

The bootstrap program may be initiated from three different LSI-11 main memory locations. As explained before, two wire-wrap jumpers are used to select the bootstrap starting address:

- (1) As initialization begins, the controller places a Jump-to-Self instruction (000777) into the bootstrap starting address.
- (2) Following initialization, the controller verifies the LSI-11 is attempting to execute the bootstrap program.
- (3) As bootstrapping begins, 1,024 bytes of data (from the first two or four sectors of the diskette, beginning with track 1, sector 1) are transferred to the lowest LSI-11 main memory address via DMA. Sectors transferred depends on the diskette density.

- (4) The DSD 4140 replaces the Jump-to-Self instruction with a Clear-PC (005007) instruction.
- (5) The bootstrap program is executed, and the diskette operating program is transferred to LSI-11 main memory.

Reading the bootstrap starting address at any time displays an arbitrary value, but does not execute the bootstrap program.

4.5.5. Acceptance Testing

The DSD 4140-03 can verify the operation of the floppy disk memory subsystem with diagnostic programs designed for the RX02, including those supplied by DEC.

In addition, two powerful on-board diagnostics are available to check the diskettes for errors and exercise the drive mechanism, without the use of system software. These two on-board diagnostics, called Scan Disk and Seek Test are described in detail below.

The Scan Disk Program

The Scan Disk diagnostic test checks a diskette for errors. This is done by reading every sector of the diskette and verifying the check-word read for each data block agrees with the calculated value. Scan Disk halts when an error is detected, when the system is initialized, or after every sector has been checked. If a double-sided diskette is installed, both sides are verified.

On completion, the Error bit (bit 15) of the Command and Status (RX2CS) Register is set if an error was detected, during initialization, or after every sector has been checked. If a double sided diskette is installed, both sides are verified.

On completion, the Error bit (bit 15) of the Command and Status (RX2CS) Register is set if an error was detected; if there were no errors, this Error bit will be cleared. The RX2CS register is described in in Chapter 6. Specific information regarding the cause of an error can be obtained using the Read Extended Status command, also described in Chapter 6.

The Scan Disk diagnostic can be executed for a diskette in either drive as follows:

- (1) Using on-line diagnostic techniques (ODT), load the value 11 (selecting drive 0) or 31 (selecting drive 1) into the RX2CS register address.

- (2) The controller will respond by setting the Transfer Request bit (bit 7) of the RX2CS register to one, to request a key word. This key word determines whether an on-board diagnostic or a SET MEDIA DENSITY operation (see Chapter 6) is to occur.
- (3) Load the key word for the Scan Disk diagnostic (7100) into the RX2DB register address.
- (4) The Scan Disk diagnostic program now begins. When the diagnostic program completes, the read/write head will lift and the disk drive activity light will be extinguished. This normally takes 25 seconds for a single sided-diskette or 40 seconds for a double-sided diskette.

The Seek Test Diagnostic Program

The Seek Test diagnostic program is designed to thoroughly exercise the positioning mechanism of either disk drive, by stepping between the innermost track (track 76 decimal) and every other track in a "ping-pong" fashion. Track position is verified at each excursion, thus assuring that the drive is operating properly.

The Seek Test program continues exercising the drive indefinitely unless an error is detected or the controller is initialized. For an error, the Error bit (bit 15) of the RX2CS register is set to 1. Otherwise this bit will be cleared. The RX2CS register is described in Chapter 6. Specific information regarding the cause of an error can be obtained using the Read Extended Status command, also described in Chapter 6.

The Seek Test diagnostic can be performed on either drive as follows:

- (1) Using ODT, load the value 11 (selecting drive 0) or 31 (selecting drive 1) into the RX2CS register address.
- (2) The DSD 4140-03 will respond by setting the Transfer Request bit (bit 7) of the RX2CS register to one, to request a key word. This key word determines whether an on-board diagnostic or a Set Media Density operation (See Chapter 6) is to occur.
- (3) Load the key word for the Seek Test diagnostic (7110) into the RX2DB register (see Chapter 6).
- (4) The Seek Test diagnostic program now begins on the selected drive.

4.6. Daisy Chaining Floppy Disk Modules

As previously mentioned, the DSD 4140-03 can daisy chain two DS-100 or DS-105 Floppy Disk modules, allowing customers to expand the capabilities of a StacPac floppy-based storage subsystem.

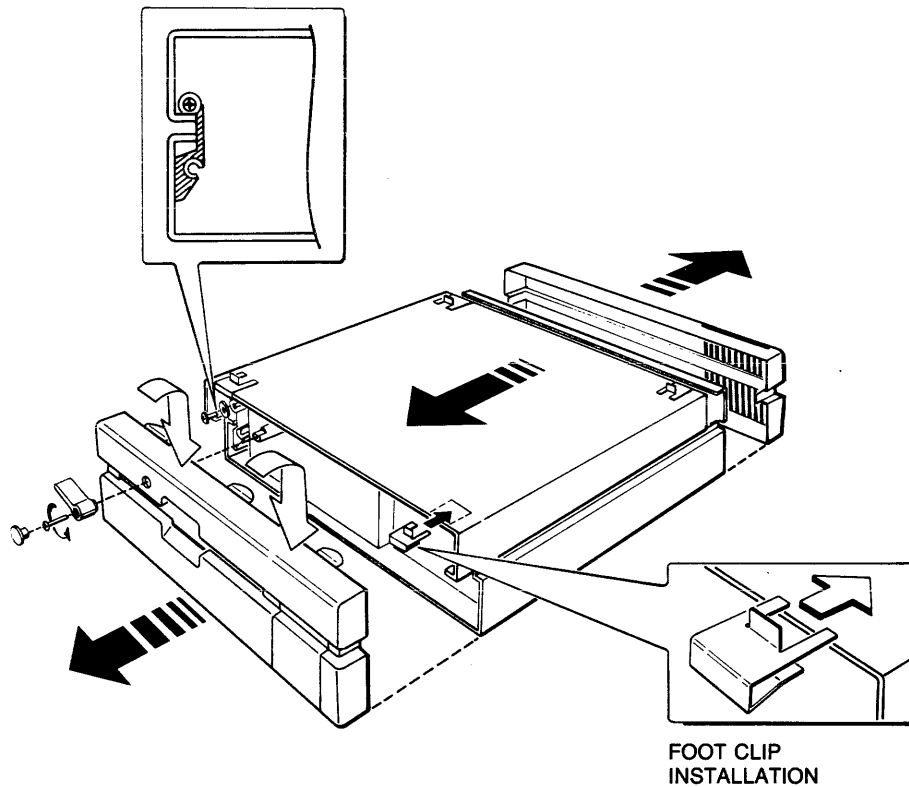
This section assumes installation of an additional module to an operating DS-100/105 subsystem. The installation consists of the following procedures:

- Installing module interlocks (foot-clips).
- Modifying new module for Drive 1 operation.
- Stacking both modules.

4.6.1. Installing Module Interlocks

Your new equipment includes a set of four module interlocks (foot-clips). These clips allow you to stack both modules securely. The foot-clips are installed on the new module as follows:

- (1) Unpack module and set on table.
- (2) Refer to Figure 4-6. Detach unit rear bezel by removing the four retaining screws. Set rear bezel aside.
- (3) Using a blade screwdriver or similar tool, remove plastic cap from Disk Control lever to expose retaining Phillip screw. Remove screw and lever.
- (4) Grasp unit front bezel by both corners and exert thumb pressure on bezel top to dislodge it from unit. Pull bezel towards you, away from unit, and remove. DO NOT STRESS CABLE.
- (5) Disconnect cable from operator board and set front bezel aside.
- (6) Note (at the front of the unit) two sets of screws and retaining washers, one at each inner side of top cover (see detail in the figure). The washers fit into chassis slots, preventing top cover from sliding forward.
- (7) Loosen one screw. Using blade screwdriver or similar tool, push upward on washer to disengage it from chassis slot. Tighten screw. Repeat operation for other screw and washer.



TP 357/83

Figure 4-6. Module Interlocks

- (8) Grasp top cover with both hands and slide it forward about one inch.
- (9) Obtain foot-clips included with new equipment. Insert clips into top cover as the figure shows.
- (10) Reposition top cover, loosen cover screws, re-align retaining washers, and tighten screws.
- (11) Reconnect operator board cable and reinstall front bezel. Reinstall Disk Control lever, tighten screw, and replace plastic cap. The module interlocks are properly installed.

NOTE:

DO NOT REINSTALL REAR BEZEL. The bezel will be reinstalled in the next subsection, after modification of the drive.

4.6.2. Modifying New Module

A Floppy Disk module is factory-configured to operate as Drive 0. To operate properly, the new module must be re-configured to operate as Drive 1. This procedure consists of removing two termination resistor packs and relocating a drive select jumper. These components are located on the DSD 4152 printed circuit board at the rear of the module.

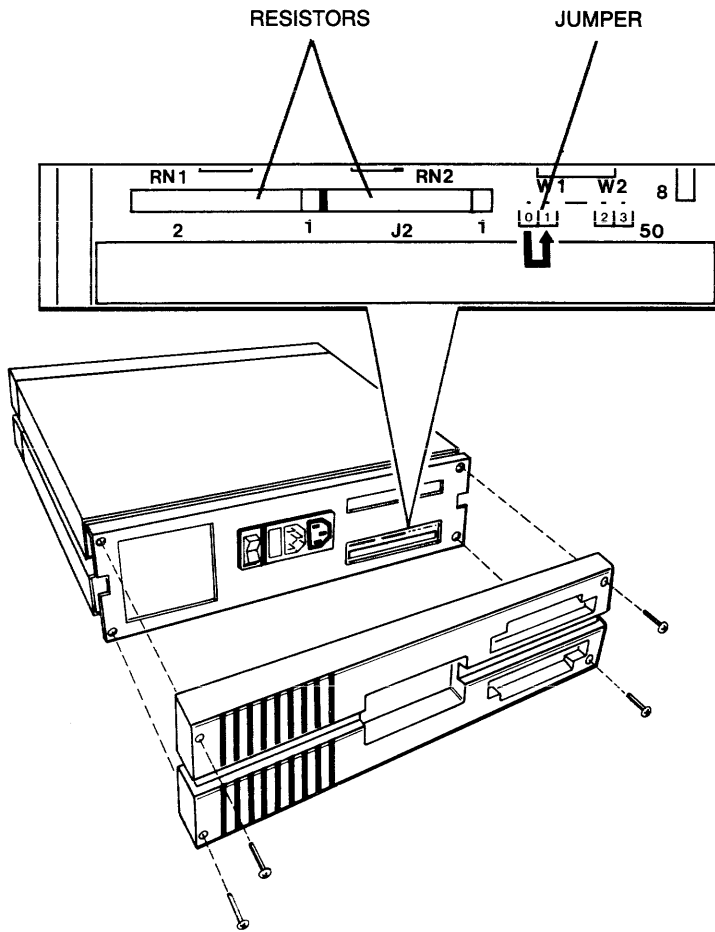
Refer to Figure 4-7 and proceed as follows:

- (1) Ensure unit rear bezel has been removed to expose resistor packs and drive select jumper on DSD 4152 board.
- (2) Using a pair of long-nose pliers or tweezers, remove both resistor packs and save for future use.
- (3) Remove drive select jumper and move it over one position to the right, as the figure shows.
- (4) Reinstall unit rear bezel with four retaining screws. Place a tag on module identifying it as Drive 1. The module is properly configured.

4.6.3. Stacking Modules

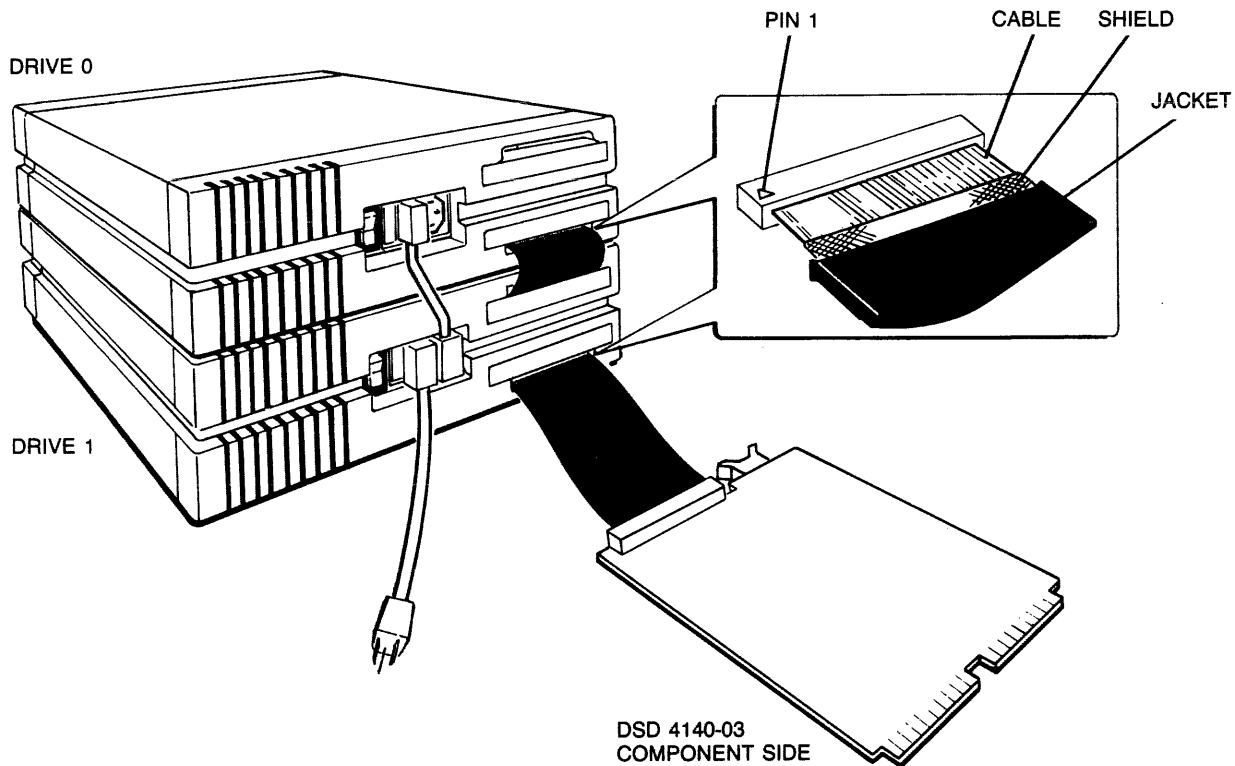
The procedure for stacking the modules consists of connecting the new module directly to the DSD 4140-03, placing the old module on top of the new one, and connecting the daisy chain cable purchased with the new unit. Refer to Figure 4-8, and proceed as follows:

- (1) Remove power from existing module and disconnect the DSD 4140-03 controller interface cable. Attach a tag to the module identifying it as Drive 0.



TP 358 83

Figure 4-7. New Module Configuration



TP 359/83

Figure 4-8. Daisy Chained Modules

- (2) Move Drive 0 from work table to a temporary location to make space for Drive 1 (new module).
- (3) Place Drive 1 on work table. Ensure the module power switch is set to 0 (off).
- (4) Remove protective cable clamps from both rear bezel connectors of Drive 1 and save for future use.
- (5) Connect controller interface cable to bottom rear connector of Drive 1. Ensure pins 1 of cable and connector correspond.
- (6) Stack Drive 0 on top of Drive 1. Ensure bottom module foot-clips are inserted into slots provided on rubber feet of top module.

- (7) Obtain daisy chain cable provided with new module and connect it as Figure 4-8 shows. Ensure correct connector-to-cable pin orientation. Both modules should be connected as Figure 4-8 shows, including ac power cables.
- (8) Reinstall all cable clamps. Both modules should look as shown in Figure 4-8.
- (9) Apply power to both modules and do the acceptance test procedures provided in this chapter. Your modules are properly daisy chained.

[^]

5 OPERATION

5.1. General Information

This chapter explains how to format and write protect diskettes for use with the DS-100/105 subsystems. Before operating either subsystem, ensure that the following operations (described in Chapter 4) are complete:

- First, ac power is applied to the floppy disk memory subsystem and the LSI-11 computer.
- Next, the disk drives are initialized (prepared for operation). The DSD 4140-03 bootstrap program can then be transferred to LSI-11 main memory.
- Finally, diskettes can be checked for errors.

5.2. Diskette Handling

The diskette recording medium is permanently stored in a protective jacket and free to rotate inside it. The interior of the jacket is lined with a wiping material to help keep the recording surface clean.

When not in use, the diskette should be kept inside its storage envelope. The following precautions are also necessary:

- Use only high-quality diskettes to ensure maximum performance and minimum wear of drive heads.
- Store diskettes away from television sets, appliances, or tools. Magnetic fields can erase or damage recorded data.
- Replace storage envelopes when they become worn, cracked, or distorted. Envelopes are designed to protect the diskettes.
- Do not write on protective jacket with lead pencil or ball-point pen. Use felt-tip pen.

- Do not smoke while handling the diskette. Heat and contamination from carelessly dropped ashes can damage the diskette.
- Do not expose the diskette to heat, sunlight, or moisture.
- Do not touch or attempt to clean diskette surface. Abrasions may cause loss of stored data.

5.3. Formatting The Diskette

The DSD 4140-03 formats diskettes in either IBM 3740 single-density or DEC RX02 double-density. These operations are done with FORMAT, a special on-board microcode program.

The FORMAT procedure reformats the entire single- or double-sided diskette. The FORMAT program can be invoked via ODT or with the Format command of the diagnostic utility FLPEXR (see Appendix).

CAUTION:

Use of this procedure will cause loss of diskette data.

The FORMAT protocol, via ODT, is as follows:

- (1) The Write Sector command, in the form specified by Table 5-1, is loaded into the RX2CS register address.

Table 5-1. Write Sector Command for FORMAT Program

Drive Selected	Command Form
0	5
1	25

- (2) The DSD 4140 clears the RX2ES register, and sets the Done bit (bit 5) of the RX2CS register to zero.

- (3) The DSD 4140-03 sets the Transfer Request bit (bit 7) of the RX2CS register to one, to request a sector address.
- (4) The special sector address, as specified by Table 5-2, is loaded into the RX2SA register (RX2DB register address).

Table 5-2. Special Write Sector Addresses for FORMAT Program

Diskette Density	Sector Address
Single	154
Double	155

- (5) The DSD 4140-03 sets the Transfer Request bit (bit 7) of the RX2CS register to one, to request a starting track address.
- (6) The starting track address, normally track 0, is loaded into the RX2TA register (RX2DB register address).
- (7) The header fields of each track of the diskette, beginning with the selected track, are written in sequential order. The data fields are written in the selected density.

The FORMAT program proceeds, one track at a time. The program halts when the designated tracks have been reformatted, the read/write head is unloaded, and the ACTIVE indicator (on the module) is extinguished. The entire operation takes 40 seconds for a single-sided diskette, or 65 seconds for a double-sided diskette.

CAUTION:

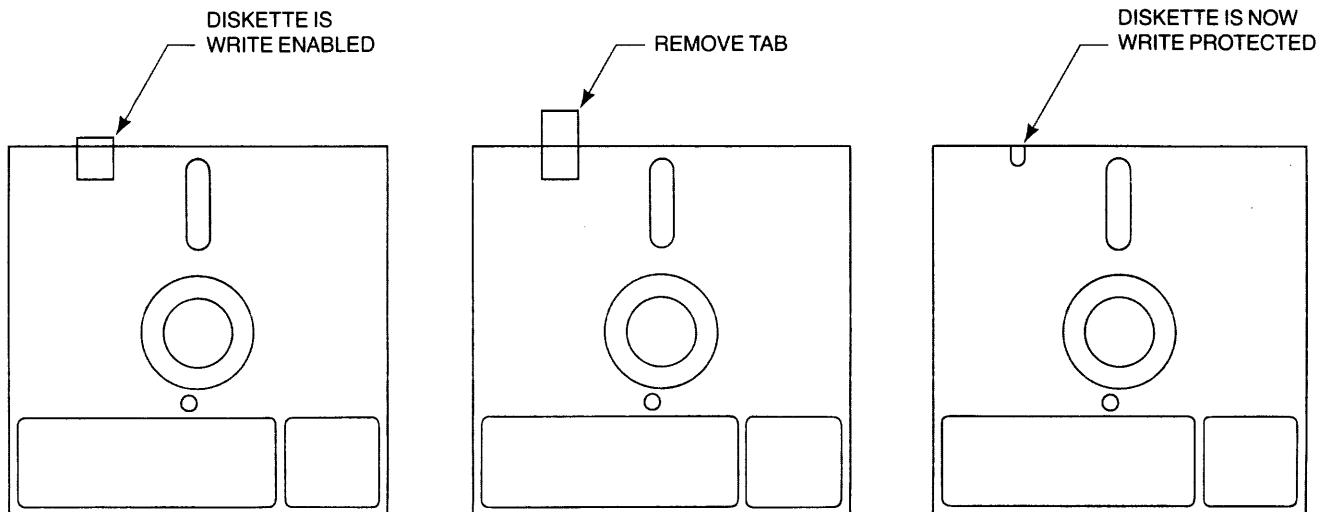
Do not disturb the controller while the format operation is in progress. An invalid format will result.

5.4. Write Protecting the Diskette

Write protecting the diskette protects the data and programs stored on it from being rewritten, deliberately or accidentally.

The diskette can be write protected only if it has a write-protect notch on its sealed jacket.

To write protect the diskette, uncover the write-protect notch. This is shown in Figure 5-1.



TP 286/82

Figure 5-1. Write Protecting the Diskette

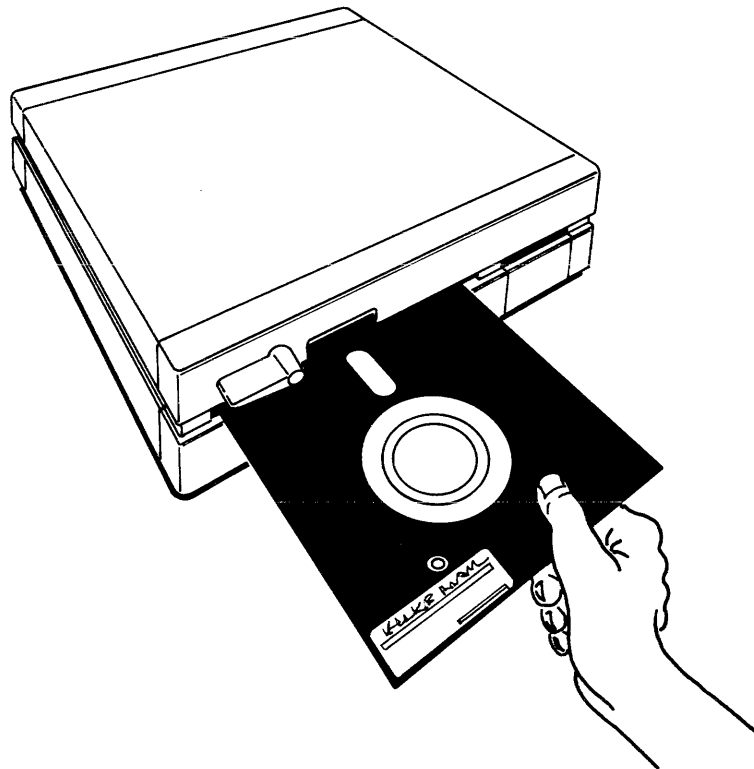
When the write-protect notch is uncovered, nothing can be written on the diskette. But when the write-protect notch is covered, by any opaque tape, writing onto the diskette is allowed.

5.5. Diskette Loading

Figure 5-2 shows the correct method of loading a diskette. To load, insert the diskette with its label facing the lever. To start the drive, rotate the lever counterclockwise downwards to six o'clock.

NOTE:

The diskette cannot be removed when the ACTIVE light is on. The activity light indicates that the door is locked and the drive is in operation. The diskette can be loaded or unloaded with the power on.



TP 360/83

Figure 5-2. Loading the Diskette

[^]

6 CONTROLLER REGISTERS, FUNCTION AND FORMAT

6.1. General Information

This chapter explains how the DS-100/105 subsystems use the device registers of the DSD 4140-03 controller to store and retrieve data from the diskette.

Proper understanding of the material contained in this chapter should enable the programmer to achieve full benefit of the capabilities built into the system.

The names and bit assignments used by the DSD 4140-03 controller are identical to those of DEC RX02. There are two primary registers:

- Command and Status (RX2CS) Register
- Data (RX2DB) Register

The DSD 4140-03 communicates with the LSI-11 computer through these two registers. The RX2CS register is normally accessed through Q-Bus address 777170.

The RX2DB register is normally accessed through Q-Bus address 777172. The address of the RX2DB register is, always, two octal digits greater than the address of the RX2CS register.

There are six additional logical registers that are accessed through the RX2DB register address:

- Data Buffer (RX2DB) Register
- Track Address (RX2TA) Register
- Sector Address (RX2SA) Register
- Word Count (RX2WC) Register
- Bus Address (RX2BA) Register
- Error and Status (RX2ES) Register

The Data register and the logical Data Buffer register are both termed RX2DB.

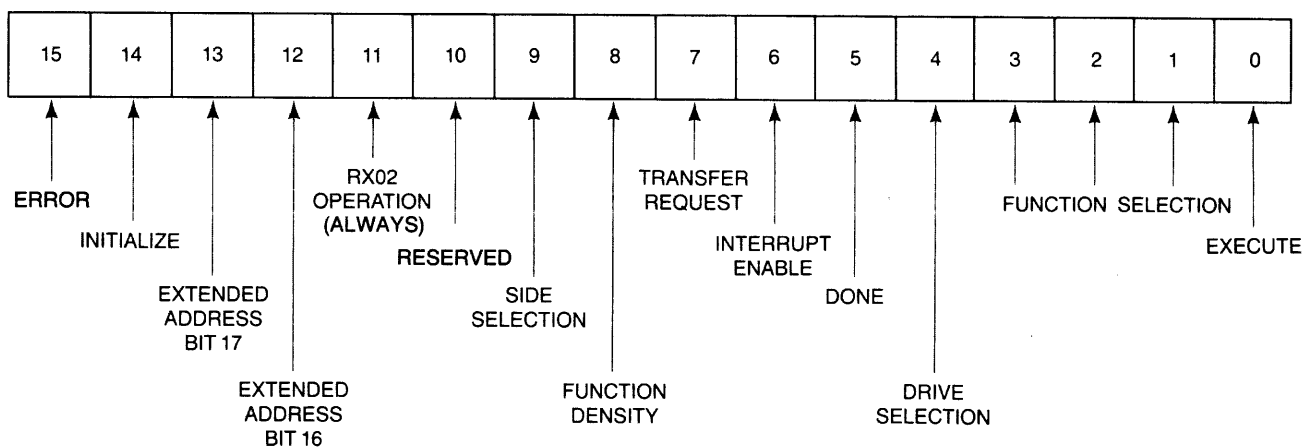
The device registers are usually accessed by loading the appropriate bits into the RX2CS register address and following the corresponding protocol. Data are then written or read via the RX2DB register address, the general purpose data path.

6.2. Command and Status (RX2CS) Register

The contents of the Command Status (RX2CS) register control the operation of the floppy disk memory system.

RX2CS provides important status information and error indications. This register also selects the disk drive function to be executed.

The format of the Command and Status (RX2CS) register is shown in Figure 6-1. Bit assignments are given in Table 6-1. Table 6-2 lists the disk drive functions selected by RX2CS.



TP 361/83

Figure 6-1. Command and Status (RX2CS) Register Format

Table 6-1. Command and Status (RX2CS) Register Bit Assignments

Number	Type	Meaning
15	Read only	Error
14	Write only	Initialize
13	Write only	Extended Address Bit 17
12	Write only	Extended Address Bit 16
11	Read only	RX02 Operation (always set)
10	RESERVED	--
9	Read Write	Side Selection
8	Read Write	Function Density
7	Read only	Transfer Request
6	Read Write	Interrupt Enable
5	Read only	Done
4	Read Write	Drive Selection
3,2,1	Write only	Function Selection
0	Write only	Execute

Bit Meaning

Bit Number:	0	1
15	--	Error detected
14	--	Begin initialization
13	0	DMA to Extended Address

(Continued on next page)

Table 6-1. Command and Status (RX2CS) Bit Assignments (Cont)

Bit Number	0	1
12	0	DMA to Extended Address
11	--	RX02 operation
10	RESERVED	--
9	Side 0 selected	Side 1 selected
8	Single-density selected	Double-density selected
7	RX2DB not ready for data transfer	RX2DB ready for data transfer
6	Interrupt disabled	Interrupt enabled
5	Operation in progress	Operation completed
4	Drive 0 selected	Drive 1 selected
3,2,1	(See Table 6.2.)	
0	Does not execute the function selected by bits 1 through 3	Executes the function selected by bits 1 through 3

Table 6-2. RX2CS Function Selection

Bit:	3	2	1	Function Selected
	0	0	0	FILL BUFFER
	0	0	1	EMPTY BUFFER
	0	1	0	WRITE SECTOR *
Setting	0	1	1	READ SECTOR
	1	0	0	SET MEDIA DENSITY **
	1	0	1	READ STATUS
	1	1	0	WRITE DELETED SECTOR
	1	1	1	READ EXTENDED STATUS

* Also used by FORMAT program. See Chapter 5.

** Also used by Scan Disk and Seek Test programs. See Chapter 4.

6.3. Data (RX2DB) Register

The contents of the Data (RX2DB) register provide the general purpose communication link between the LSI-11 computer and the floppy disk memory system.

Six different logical registers may be accessed through the RX2DB register address. The protocol of the disk drive function being executed determines which of these registers is accessed.

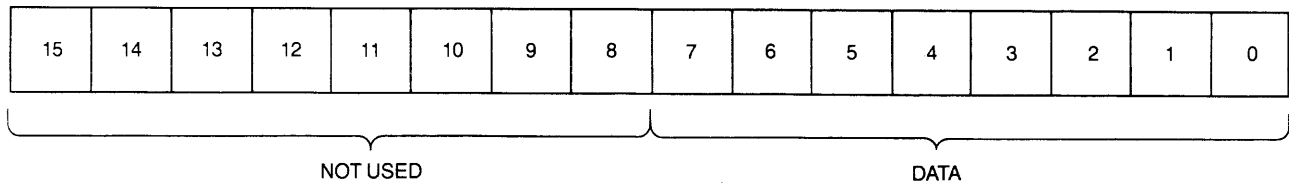
6.3.1. Data Buffer (RX2DB) Register

Bits 0 through 7 of the logical Data Buffer (RX2DB) register transfer data to and from the diskette.

The read/write RX2DB register may be accessed through the Data (RX2DB) register address. The format of the Data Buffer (RX2DB) register is shown in Figure 6-2.

6.3.2. Track Address (RX2TA) Register

Bits 0 through 7 of the logical Track Address (RX2TA) register specify the execution track of the selected function. Octal addresses 0 through 114 are valid.



TP 362-83

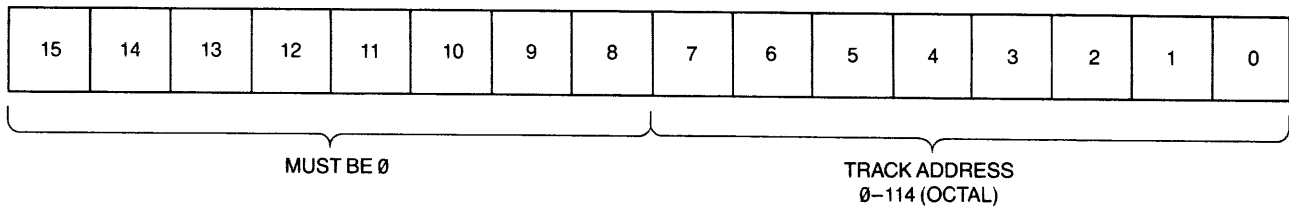
Figure 6-2. Data Buffer (RX2DB) Register Format

The write-only RX2TA register may be accessed through the RX2DB register address. The format of the RX2TA register is shown in Figure 6-3.

6.3.3. Sector Address (RX2SA) Register

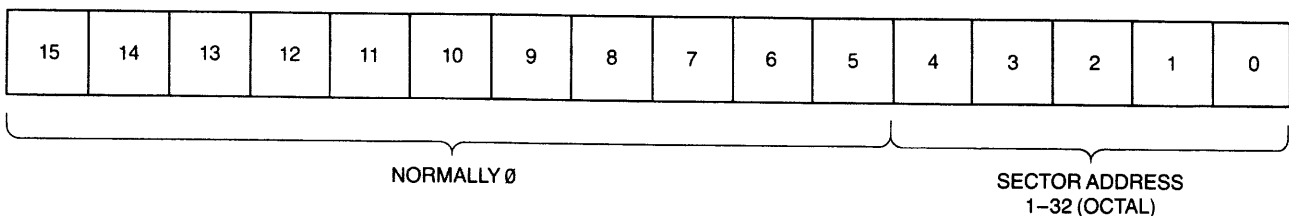
Bits 0 through 7 of the logical Sector Address (RX2SA) register specify the sector on which the selected function is to be executed. Sector addresses 1 through 32 (octal) are valid.

The write-only RX2SA register may be accessed through the RX2DB register address. The format of the Sector Address (RX2SA) register is shown in Figure 6-4.



TP 363 83

Figure 6-3. Track Address (RX2TA) Register Format



TP 364 83

Figure 6-4. Sector Address (RX2SA) Register Format

6.3.4. Word Count (RX2WC) Register

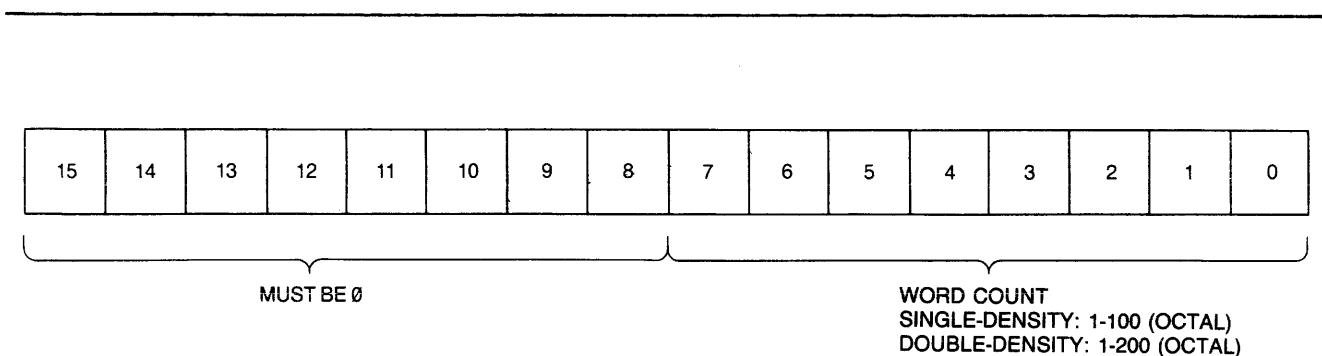
Bits 0 through 7 of the logical Word Count (RX2WC) register specify the number of words to be transferred during each DMA operation. Double-density word counts 1 through 200 (octal) are valid. For single-density, the maximum valid word count is 100 (octal).

The write-only RX2WC register may be accessed through the RX2DB register address. The format of the Word Count (RX2WC) register is shown in Figure 6-5.

6.3.5. Bus Address (RX2BA) Register

The contents of the logical Bus Address (RX2BA) register specify the lower 16 bits of the Q-Bus address to where data are transferred during each DMA operation. Bits 12 and 13 of the RX2CS register are used to specify DMA to memory extended addresses.

The write-only RX2BA register may be accessed through the RX2DB register address.



TP 365 83

Figure 6-5. Word Count (RX2WC) Register Format

6.3.6. Error and Status (RX2ES) Register

The logical Error and Status (RX2ES) register provide current status information and error indications for the selected disk drive. At the end of each command, the contents of this register are stored in the RX2DB register.

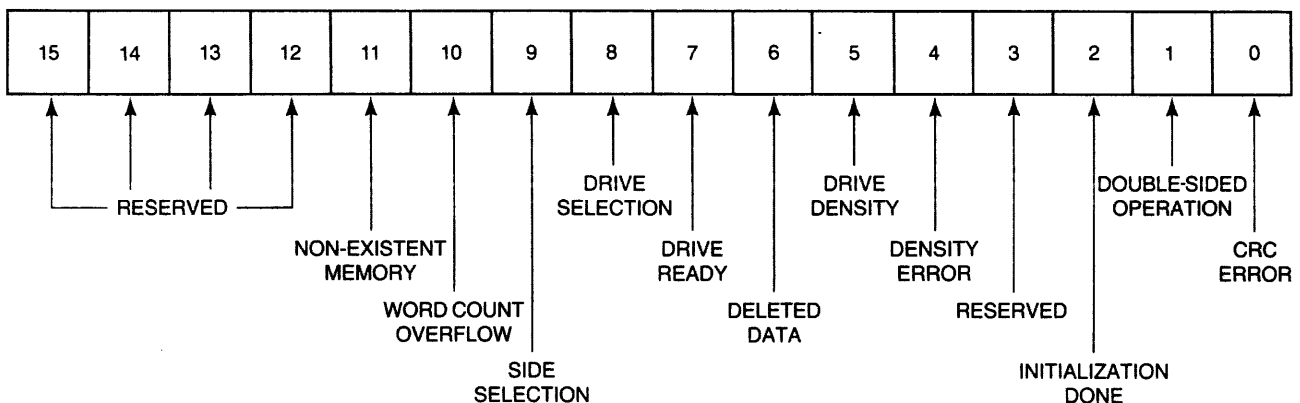
The read-only RX2ES register may be accessed through the RX2DB register address. The format of the Error and Status (RX2ES) register is shown in Figure 6-6.

6.4. Device Functions

Storage and retrieval of data is accomplished by using the eight device functions of the DSD 4140-03 controller.

Six of the eight DSD 4140-03 device functions use names and protocols identical to those used by the DEC RX02:

- FILL BUFFER
- READ SECTOR
- WRITE DELETED SECTOR
- EMPTY BUFFER
- READ STATUS
- READ EXTENDED STATUS or READ ERROR CODE



TP 366/83

Figure 6-6. Error and Status (RX2ES) Register Format

Table 6-3 Error and Status (RX2ES) Bit Assignments

Number	Name	Meaning	
		0	1
15,14, 13,12	RESERVED	--	--
11	Non-Existent Memory	--	DMA attempted into non-existent memory
10	Word Count Overflow	--	Word count too large for specified sector size
9	Side Selection	Side 0	Side 1
8	Drive Selection	Drive 0	Drive 1
7	Drive Ready	--	Selected drive ready
6	Deleted Data	--	Deleted data address mark found on previous command was WRITE DELETED SECTOR
5	Drive Density	Single- Density Diskette in drive	Double- Density Diskette in drive
4	Density Error	--	Diskette density does not match RX2CS function density bit.
3	RESERVED	--	--
2	Initialization Done	--	Initialization sequence is completed.
1	Double-Sided Operation	--	If bit 7 is set to 1, double- sided diskette is installed.
0	CRC Error	--	Inaccurate data detected by CRC

Two DSD 4140-03 device functions--WRITE SECTOR and SET MEDIA DENSITY--offer capabilities beyond those found in the DEC RX02. WRITE SECTOR can be used to format diskettes.

SET MEDIA DENSITY is executed on both sides of double-sided diskettes, and can also be used to do DSD 4140-03 on-board diagnostics.

6.5. Fill Buffer

The FILL BUFFER command transfers data from LSI-11 main memory to the data buffer of the DSD 4140-03.

The Command and Status (RX2CS) register is loaded with a FILL BUFFER command. The LSI-11 waits until the Transfer Request bit (bit 7) of the RX2CS register is asserted, and then loads the Word Count (RX2WC) register. The LSI-11 again waits for Transfer Request, and then loads the Bus Address (RX2BA) register. The data are transferred via DMA. The LSI-11 tests the Done bit (bit 5) of the RX2CS register until the bit is asserted. This signals the completion of the command.

The contents of the data buffer may then be written onto the diskette by a WRITE SECTOR command. Or, they may be returned to LSI-11 main memory by an EMPTY BUFFER command.

6.6. Empty Buffer

The EMPTY BUFFER command transfers the contents of the data buffer to LSI-11 main memory. The buffer data are in the data buffer as the result of a FILL BUFFER or a READ SECTOR command.

The Command and Status (RX2CS) register is loaded with an EMPTY BUFFER command. The Word Count (RX2WC) register is loaded after the Transfer Request bit (bit 7) of the RX2CS register is asserted. When Transfer Request is set for a second time, the Bus Address (RX2BA) register is loaded. The data are transferred via DMA. The Done bit (bit 5) of the RX2CS register signals completion of the command.

6.7. Write Sector

The WRITE SECTOR command transfers the data buffer contents to the diskette selected sector and track. The buffer data are not modified by this command.

A WRITE SECTOR command is loaded into the Command and Status (RX2CS) register. The assertion of the Transfer Request bit (bit 7) of the RX2CS register signals that the DSD 4140-03 is ready to accept a new sector in the Sector Address (RX2SA) register. After Transfer Request is asserted for the second time, the Track Address (RX2TA) register should be loaded with a new track. The data contained in the DSD 4140-03 data buffer are written onto the appropriate diskette track and sector. The Done bit (bit 5) of the RX2CS signals completion of the command.

6.8. Read Sector

The READ SECTOR command transfers data from a selected sector and track of the diskette to the DSD 4140-03 data buffer.

The LSI-11 loads a READ SECTOR command into the Command and Status (RX2CS) register. The LSI-11 waits for the Transfer Request bit (bit 7) of the RX2CS register to be asserted, and then loads the Sector Address (RX2SA) register. The LSI-11 again waits for Transfer Request, and then loads the Track Address (RX2TA) register. The DSD 4140-03 reads the appropriate diskette track and sector, leaving the data in the data buffer. The LSI-11 tests the Done bit (bit 5) of the RX2CS register to await completion of the command.

6.9. Set Media Density

The SET MEDIA DENSITY command reassigns the entire single-sided or double-sided diskette to a specified density, writes new data address marks and zeroes all data fields.

To begin the SET MEDIA DENSITY command, the LSI-11 loads the command into the Command and Status (RX2CS) register. The LSI-11 waits for the Transfer Request bit (bit 7) of the RX2CS register to be asserted, and then loads the SET MEDIA DENSITY keyword, octal 111, into the RX2DB register address.

If the Function Density bit (bit 8) of the Command and Status (RX2CS) register is set to 0, the diskette is rewritten to single-density. The diskette is rewritten to double-density if this bit is set to 1.

The SET MEDIA DENSITY operation requires about 26 seconds for completion. On completion, the Done bit (bit 5) of the RX2CS register is set.

The SET MEDIA DENSITY command can also be used to do DSD 4140-03 on-board diagnostics.

6.10. Read Status

The READ STATUS command reports the drive readiness and the density of the diskette inserted into a selected disk drive.

The LSI-11 loads a READ STATUS command into the Command and Status (RX2CS) register. The Drive Selection bit (bit 4) of the RX2CS register specifies the drive whose status is requested. When the DSD 4140 asserts the Done bit (bit 5) of the RX2CS register, the RX2DB register address contains the Error and Status (RX2ES) register. Drive readiness is reported by the Drive Ready bit (bit 7), and diskette density by the Drive Density bit (bit 5) of the RX2ES register.

6.11. Write Deleted Sector

The WRITE DELETED SECTOR command transfers the contents of the DSD 4140 data buffer to a selected sector and track of the diskette--as does the WRITE SECTOR command.

However, instead of writing a standard data address mark just before the data field, the WRITE DELETED SECTOR command writes a deleted data address mark in that location.

6.12. Read Extended Status

The READ EXTENDED STATUS command transfers the four words of "internal scratch pad memory"--used to maintain status information--to LSI-11 main memory, via DMA.

The LSI-11 begins the READ EXTENDED STATUS command by loading it into the Command and Status (RX2CS) register. The LSI-11 waits until the Transfer Request bit (bit 7) of the RX2CS register is asserted, and then loads the Bus Address (RX2BA) register. Four words of data are transferred via DMA to LSI-11 raw memory. When this transfer is complete, the Done bit (bit 5) of the RX2CS register is asserted.

Bits 0 through 7 of the first word of "internal scratch pad memory" comprise the 4140-03 definitive error codes. These codes are used to determine an error cause. The error codes are listed in Table 6-4.

Table 6-4. Definitive Error Codes

Octal Code	Code Meaning
000	No error found.
010	No drive 0 found. Or, drive 0 failed to find track 0 during initialization.
020	No drive 1 found. Or, drive 1 failed to find track 0 during initialization.
030	Track 0 unexpectedly found during initialization.
040	Controller received invalid track address.
050	Track 0 found before selected track found.
060	Error found during self-test.
070	Selected sector not found during two revolutions.
100	Attempt made to write or format write-protected diskette.
110	No read data signal found. (Or, no diskette loaded).
120	No preamble found. (Or, no diskette loaded).
130	Preamble found, but no address mark found within window.
140	CRC error found on what appeared to be header.
150	Track address in good header did not match selected track.
160	Too many attempts to find address mark.
170	Address mark not found in time allotted after preamble.

Table 6-4. Definitive Error Codes (Cont)

Octal Code	Code Meaning
200	CRC error found on data field.
230	Invalid word count selected.
240	Diskette density does not match selected function density.
250	Invalid key word selected for SET MEDIA DENSITY.
260	Diskette density can not be determined.
350	Non-existent memory location addressed during DMA transfer.
360	Drive not ready during format or bootstrap operation.

[^]

7 MAINTENANCE

7.1. General Information

Before shipment, your equipment passed many rigorous quality tests to ensure long periods of trouble-free service. However, if you suspect an equipment malfunction, follow the instructions provided in this chapter. Observe all suggested precautions to avoid equipment damage, personal injury, or both.

This chapter is divided in two parts:

- **Operator Maintenance:** Instructions are provided for the daily user of the equipment. No special technical qualifications are needed.
- **Service Maintenance:** Instructions are provided for technical users and/or qualified service personnel.

OPERATOR MAINTENANCE

7.2. Proper Ventilation

Your system is kept at an ideal operating temperature by vents located at the rear of the system modules. The circulating air is propelled by an internal fan. It is important for the modules to have enough rear space--not less than three inches--for free air flow.

Should the system become hot, turn the power off and inspect the area surrounding the modules for obstructing objects. Turn the power on again. If the problem recurs, turn the power off and contact your technical manager or DSD Customer Service for further instructions.

7.3. Cleaning the Module

The module is not completely waterproof; consequently, care should be used when cleaning the surface. Follow these instructions:

- Dust module surface frequently to keep the display panel clean.
- Turn the power off. Pour a small amount of non-abrasive mild detergent solution (such as Windex or equivalent) on a lint-free soft cloth or paper towel. DO NOT USE CLEANERS CONTAINING SOLVENTS OR ABRASIVE SUBSTANCES.
- Apply the damp cloth, or paper towel, to the module surface and rub gently until it appears clean. Allow it to dry; reapply, if necessary.

7.4. Quick Troubleshooting Chart

Generally, field equipment problems owe to minor oversights easily correctable by a few simple steps. Table 7-1 contains a chart for aiding the operator with this type of problem. The location of the Stac-Pac module fuse is shown in Figure 7-1.

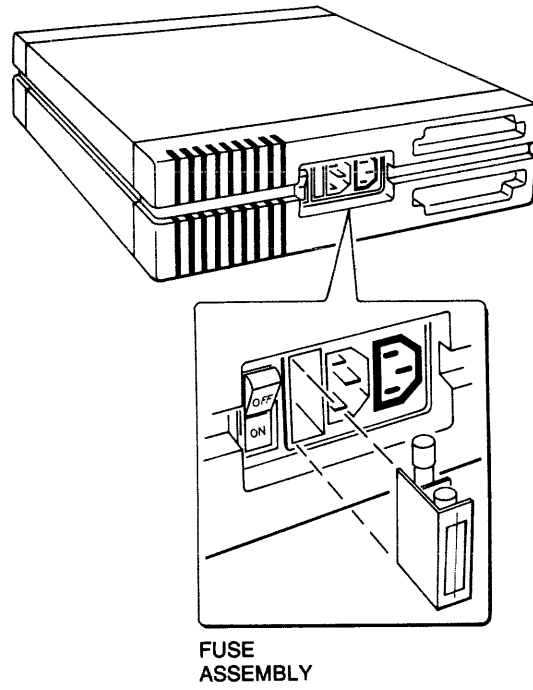
When using the chart, first look under the "Trouble Indication" column and find the signs given by your equipment most closely approximating the chart.

Second, look under the "Possible Cause" column. Examine your equipment to see if the cause of your trouble is in the chart.

If unable to correct the problem, contact the technical manager of your organization, your equipment supplier, or DSD Customer Service for further instructions.

Table 7-1. Quick Troubleshooting Chart

Trouble Indication	Possible Cause
Controller Power Low indicator remains lit	<ul style="list-style-type: none"> ● LSI-11 voltage below +4.80 volts
Disk drives inoperative	<ul style="list-style-type: none"> ● Power cord disconnected ● Interface cable loose, or installed backwards ● Blown fuse (See Figure 7-1) ● Circuit breaker open ● Drive incorrectly configured (See Chapter 4)
ACTIVE indicators off	<ul style="list-style-type: none"> ● Disk Control Lever released
Disk drives do not start	<ul style="list-style-type: none"> ● Diskette improperly loaded
Disk drives start, but one ACTIVE indicator remains on	<ul style="list-style-type: none"> ● DMA or interrupt continuity not maintained ● Interface cable installed backwards
Disk drives initialize, but bootstrapping cannot be done	<ul style="list-style-type: none"> ● Blank diskette in drive ● No bootstrap program on diskette ● Bootstrap on diskette not RX02 compatible ● Double-sided diskette loaded in single-sided disk drive ● HALT switch on LSI-11 front panel is set to ON ● Diskette data damaged ● Diskette format damaged ● Diskette worn ● Diskette-mounting hole not concentric



TP 441 83

Figure 7-1. Fuse Location

SERVICE MAINTENANCE

7.5. Preventive Maintenance

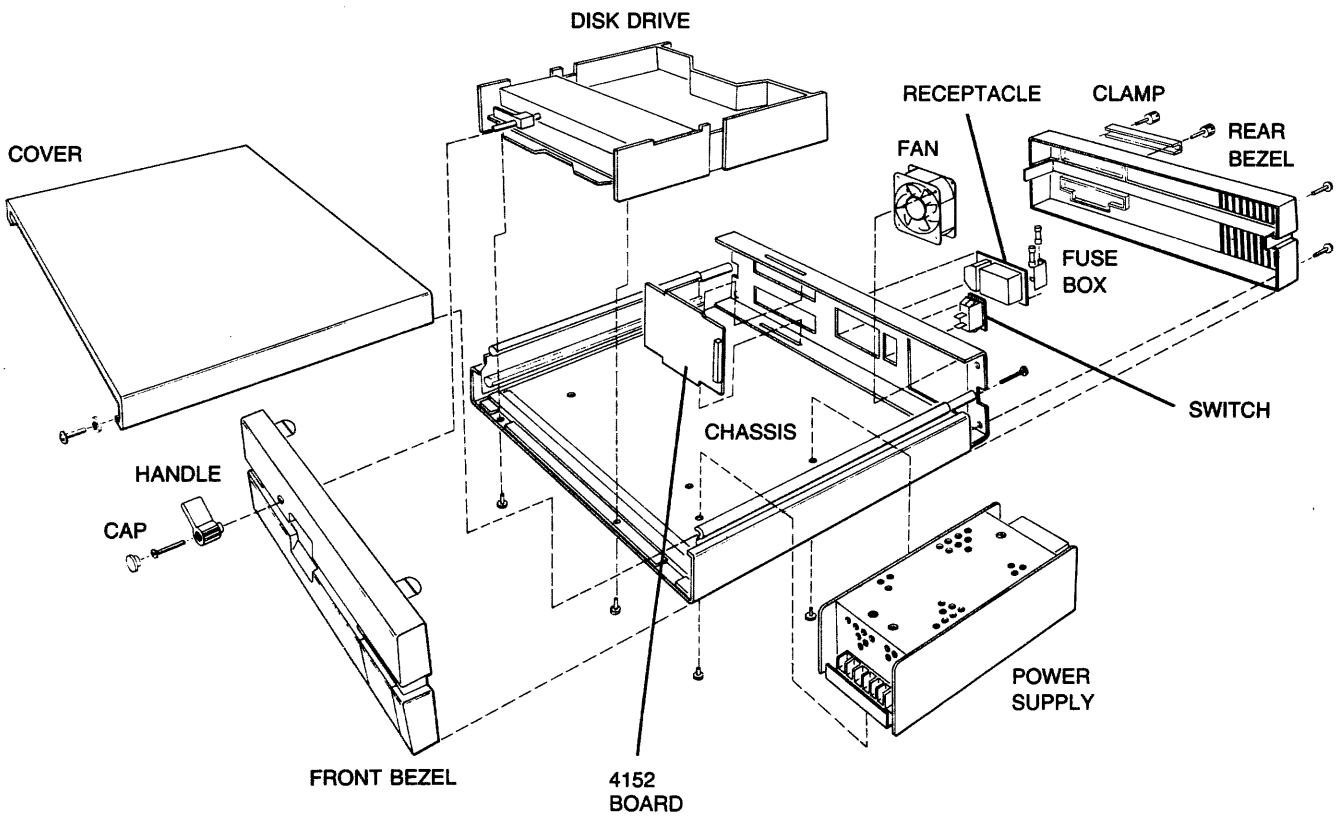
Preventive maintenance of DS-100/105 subsystems is limited to adjustments of the module power supply dc voltages. There is no preventive maintenance needed for the DSD 4140-03 Floppy Disk Controller board.

The power supply provides two dc voltages: +5 Vdc and +24 Vdc. The +5 Vdc is used for powering the drive electronics logic levels. The +24 Vdc is used for powering the dc drive motor.

These power supply voltages should be checked and adjusted, if necessary, according with the maintenance schedule recommended by your organization; but at least, once a year.

The location of the power supply and other internal parts of the module is shown in Figure 7-2. The power supply adjustment procedure is provided below.

- (1) Remove power from module and disconnect controller interface cable.
- (2) Remove front and rear bezels. Also, remove module top cover.
- (3) Reapply power to module and proceed with care to prevent equipment damage or personal injury.
- (4) Refer to Figure 7-3. Obtain a digital multi-meter (DMM) and set it to a dc voltage range of 200 volts. Use a non-metallic tool when performing all adjustments.
- (5) Connect negative lead of DMM to power supply pin labeled "+12/24 V RETURN" and negative lead to pin labeled "+12/24 V." The DMM should read: +25 Vdc \pm 0.2 Vdc. If not, insert the tool into access hole provided on power supply chassis (marked R33) and adjust variable resistor for the reading of +25 Vdc. Disconnect DMM leads.
- (6) Set DMM to dc voltage range of 20 volts. Connect negative lead to pin labeled "+5 V RETURN" and positive lead to pin labeled "+5 V." The DMM should read: +5.1 Vdc \pm 0.05 Vdc. If not, adjust R53 for a reading of +5.1 Vdc. Disconnect DMM leads.



TP 368/83

Figure 7-2. Module, Exploded View

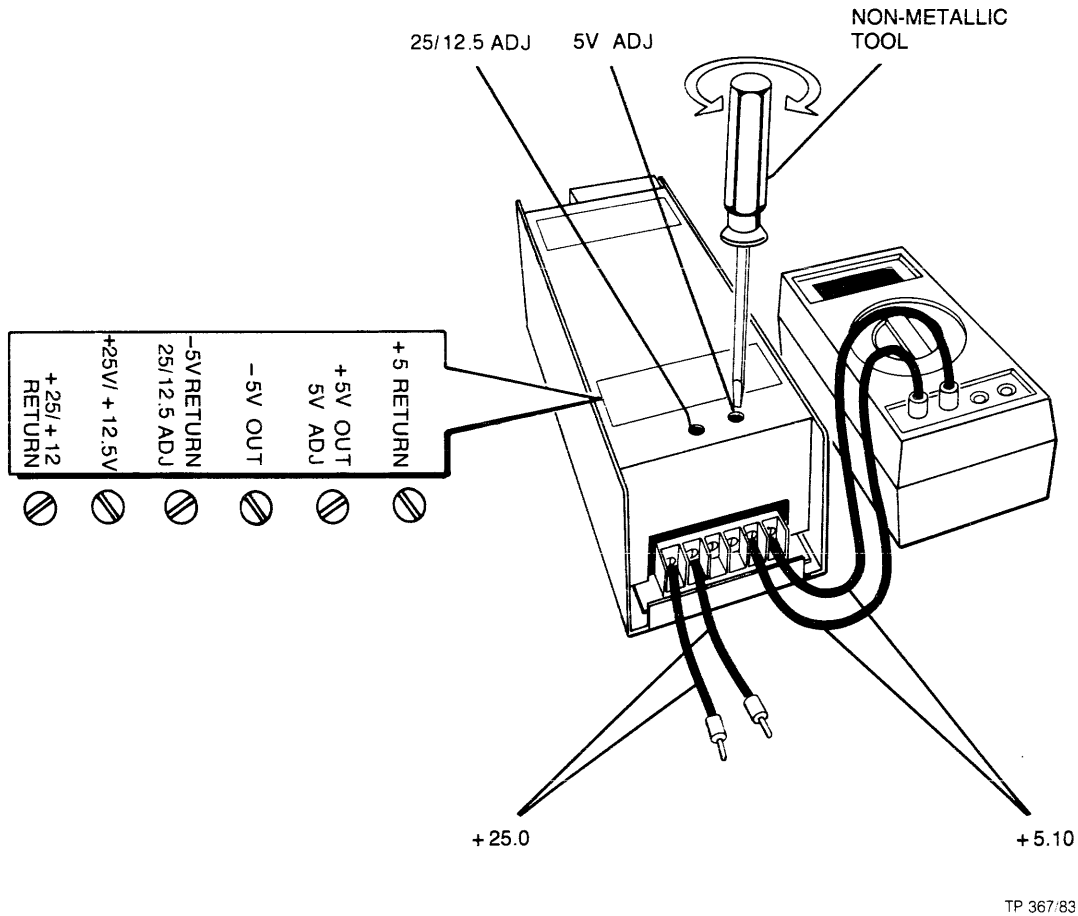


Figure 7-3. Power Supply Adjustments

- (7) Remove power from module and reassemble unit. Reconnect controller interface cable and reapply power.

7.6. Corrective Maintenance Philosophy

Corrective maintenance of the StacPac modules and controller is an easy task, because the subsystem was designed with the user in mind. The product maintenance philosophy can be summarized as follows:

- Self-tests, automatically initiated at power-up, thoroughly check for faults and provide a general and effective evaluation of the system.
- Once a problem is suspected, a comprehensive software diagnostic program distributed on diskette allows the user to quickly isolate a defective module or controller interface board.

- A telephone hot-line, staffed by fully trained technicians, provides diagnostic help with difficult problems.
- A Rapid Module Exchange policy allows the user to receive a replacement unit shortly after the faulty one is identified.

7.7. Diagnostic Aids

The DSD 4140-03 controller provides diagnostic aids as two on-board functions, called Scan Disk and Seek Test. Use of these functions is covered in Chapter 4.

Additional diagnostics are available on a special DSD software program called FLPEXR. Operating instructions for the FLPEXR are provided in the Appendix, at the end of this manual.

7.8. Troubleshooting Guidelines

Generally, methods for isolating field problems vary with the specific circumstances of the site. Since providing step-by-step troubleshooting procedures that apply to all circumstances is not feasible, this section provides general troubleshooting guidelines.

The process for troubleshooting DS-100/105 field problems is generally stated as follows:

- (1) A problem is suspected. This may result when an abnormal condition, such as a faulty power-up sequence, is reported by the user.
- (2) System cables are checked. Faulty mechanical junctures between cables and connectors will eventually lead to faulty electrical connections with consequent system degradation. Always verify cable connections first when problems are suspected.
- (3) System ventilation is checked. Electronic components operate best within ranges specified by the manufacturer. Ensure that your equipment fans are operating and the rear of the StacPac unit is at least three inches away from any obstruction.
- (4) A guess is made regarding a faulty module. Although not always accurate, experienced technicians will attempt to guess the unit at fault, and then verify their suspicions.

- (5) A diagnostic program is selected and run. Each of the programs, when properly executed, will provide enough information to verify a malfunctioning module or controller board.
- (6) The faulty unit is isolated. Once the faulty unit is isolated, contact your equipment supplier or DSD Customer Service Department for return authorization.
- (7) The faulty unit is removed from the system and the replacement unit installed. Replacement procedures are provided in the next section.
- (8) A record is made of the repair. A repair history is an invaluable tool to the technician. Always record each repair occurrence stating the symptoms, probable cause, and action taken.

7.9. Replacement Procedures

The following board and modules can be replaced by the field technician after obtaining DSD Customer Service approval:

- Floppy Disk Controller Board (DSD 4140-03)
- StacPac Floppy Disk Module (DS-100 or DS-105)

Before replacing any of the modules previously listed, follow these instructions:

- (1) Remove power from system modules and controller interface board and disconnect system cables. If the 4140-03 board is at fault, return it to the factory as instructed by Customer Service. If the faulty unit is a Floppy Disk module, proceed with the next step.
- (2) Reinstall the protective clamps over the module rear bezel connectors.
- (3) Unpack replacement unit from box.
- (4) Carefully pack faulty unit in box using material shipped with replacement unit. INCLUDE RETURN AUTHORIZATION NUMBER ON BOX.
- (5) Refer to Chapter 4, Installation. Follow appropriate procedures provided in that chapter, including acceptance tests.

NOTE:

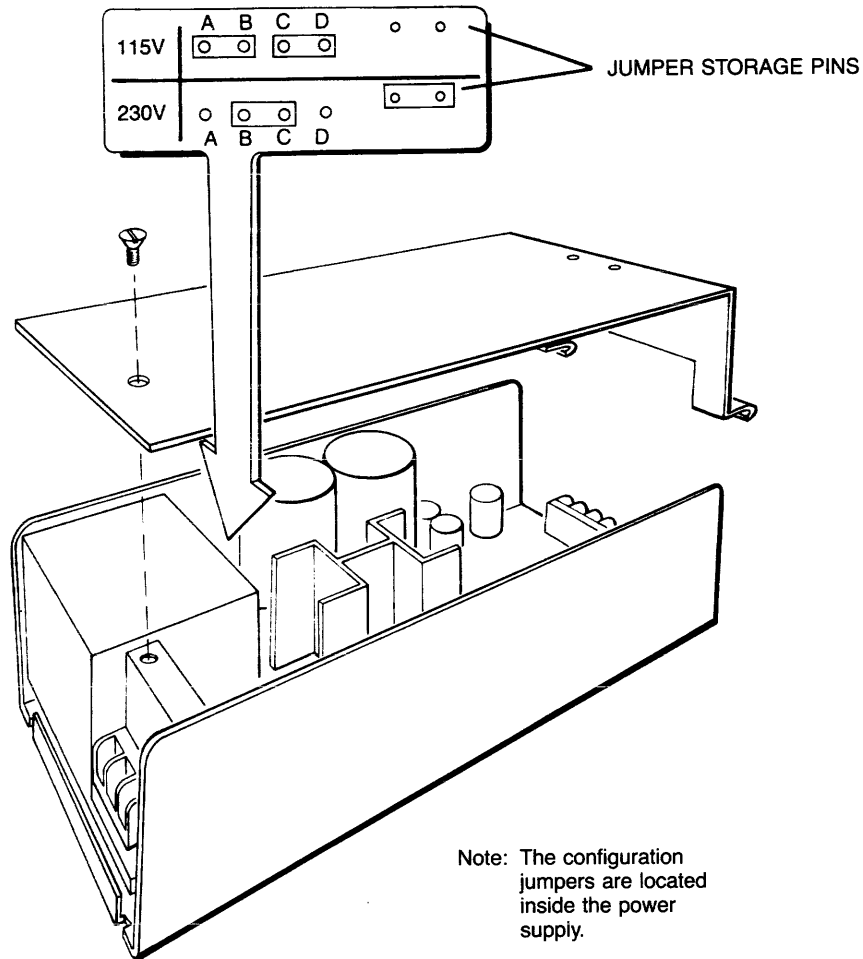
Do not attempt to replace module internal subassemblies or DSD 4140-03 components without proper training or prior approval from DSD Customer Service.

7.10. Module Power Reconfiguration

The DS-100 and DS-105 modules are configured at the factory to operate at the ac voltage provided by your local power lines.

If for any reason you need to reconfigure the module power supply to accept a different input voltage, obtain approval from DSD Customer Service and follow the instructions provided below.

- (1) Remove ac power from module and disconnect external cabling.
- (2) Refer to module exploded view (Figure 7-2) and disassemble unit.
- (3) Refer to Figure 7-4 and change jumper configuration as shown in the figure.
- (4) Reassemble unit and clearly label or otherwise mark "230-Volt Operation Only."
- (5) Reapply power to unit.
- (6) Check and, if necessary, readjust the dc power supply voltages as per Section 7.5.
- (7) Reinstall external cabling and do the acceptance test procedures provided in Chapter 4.



TP 369 83

Figure 7-4. Power-Modification Jumpers

7.11. Maintenance Assistance

Data Systems Design maintains a fully staffed Customer Service Department. If at any time during inspection, installation, or operation of the equipment you encounter a problem, contact your nearest DSD Customer Service office.

Our trained staff can help you diagnose the cause of failure, and if necessary, rush replacement parts to you. Any time you need to return a product to the factory, please contact Customer Service for a Material return Authorization Number.

Customer Service offices in the United States are listed below.
For service outside the U.S.A., contact your local distributor.

Western Region Service
2241 Lundy Avenue
San Jose, CA 95131
(408) 946-5800
TWX: 910-338-0249

Central Region
Sales and Service
5050 Quorum Drive
Suite 339
Dallas, TX 75240
(214) 980-4884

North Central Region
Sales and Service
2311 West 22nd St.
Suite 110
Oakbrook, IL 60521
(312) 920-0444

Eastern Region
Sales and Service
51 Morgan Drive
Norwood, MA 02062
(617) 769-7620
TWX: 710-336-0120

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

[^]

Appendix A: FLPEXR Program

- 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 8) or 'CR' 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. A 'CR' input in response to the device type prompt will output the list of types as shown below:

<i>Type</i>	<i>Device</i>
0	Default
1	110
2	210
3	430
4	440
5	470
6	480
7	880
8	4120

Which type of device? (0 to 8):

If device 8 is selected, the following list of drive types will be shown.

<i>Type</i>	<i>Drive</i>
0	SA460
1	T100-4
2	MP192

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 a 'CR'.

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 'CTRL 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

<i>Command</i>	<i>Description</i>
Comprehensive Tests	
• (V)ERIFY	General Exerciser
• (SH)ORT VERIFY	Short Exerciser
Individual Tests	
• (F)ILL 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
• (SA)125	Check Head Alignment
• (CL)EAN HEAD	Clean Head Utility
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)PLICATE	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

<i>Input</i>	<i>Meaning</i>	<i>Notes</i>
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

A-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)
HDLD	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.

<i>Activity</i>	<i>Code</i>	<i>Meaning</i>
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.

- SA125—(SA) 125

The SA125 test uses an SA125 alignment disk to check head alignment. This disk is recorded with correct address marks, but with data patterns offset radially in one mil steps. This test is intended for factory use only.

- CLEAN HEAD—(CL)EAN HEAD

The CLEAN HEAD utility allows the user to clean the read/write head using the FD-08 Disk Drive Head Cleaning Kit. Turn the line time clock (LTC) ON. Do not allow cleaning disk to remain in the system for more than 30 seconds. This test is intended for use only as directed by the factory.

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".

EXAMPLE (for 480)

```

#COMMAND: FORMAT
SEQUENTIAL SECTOR FORMAT?
(Y OR N) : Y
Density                Type  Supported
                        Type  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:

```

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.

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)EDIA 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
			D4120	DMA	D85	DBS	DDN
07	06	05	04	03	02	01	00
	US3	US2	US1	US0			

When set to a 1, the bit labeled:

- D4120 indicates the 4120 device is set.
- 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
SYSTEM AS FOLLOWS:
  10000: SETS FLAG FOR 4120 DEVICE
   4000: ENABLES DMA OPERATION IF
          AVAILABLE
   2000: SETS 850 (FAST) SEEKING
          TIMING (ELSE 800, SLOW)
   1000: ENABLES DOUBLE-SIDED
          OPERATION 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.

Note

This example indicates that a device is installed at location 177170 with interrupt vector at location 264.

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
```

- **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 overwrite 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)LICATE

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.

Change Notice (01)

1. SCOPE

To correct information relating to DYQ22 documentation file in cited handbook.

2. ACTION

The updated information on the attached page is highlighted by a change bar inserted in left margin.

Make pen and ink changes on corresponding page in your software handbook.

This driver will provide a combination Double-sided and Q22 driver for RSX-11M V4.0 and V4.1 Operating Systems. If only double-sided support for FLX is desired, the installation may begin at Step 9 although Qualogy recommends that the complete installation process be done for both Double-Sided/Q22 installations as well as for Double-Sided only installations.

NOTE: THE DEC DYDRV.TSK FILES IN RSX-11M V4.0 AND V4.1 DO NOT WORK IN MORE THAN AN 18 BIT ENVIRONMENT ON THE QBUS. SEE DEC u NOTE #112 OF 2/17/83 FOR DEC'S SOLUTION. ADDITIONAL INFORMATION CAN ALSO BE FOUND IN THE JANUARY AND MARCH, 1984 ISSUES OF THE RSX-11M SOFTWARE DISPATCH. THE QUALOGY DYQ22 DRIVER ALSO SOLVES THIS PROBLEM, ALTHOUGH IN A MORE GENERAL WAY. THE DYQ22 FILES MUST BE COPIED INITIALLY USING A 16- OR 18-BIT (<124KW) SYSGEN IF THESE MODIFICATIONS ARE GOING TO BE INSTALLED IN RSX-11M V 4.0 OR RSX-11M V4.1 PRIOR TO AUTOPATCH B. WITHOUT EITHER THE DEC OR THE QUALOGY DRIVER MODIFICATIONS INSTALLED, ANY FLOPPY ACCESS WILL CRASH THE SYSTEM.

- 1) The instructions and command files used in the command files and documentation use MCR format. If you are currently using DCL format, then ENTER "SET /MCR=TI:<CR>".
- 2) Check that the following exist on your RSX11M V4.n system.
 - a) UIC for accounts [1,24] and [11,34]. Enter "UFD SY0:[1,24]<CR>" and "UFD SY0:[11,34]<CR>".
 - b) EXEMC.MLB AND EXELIB.OLB are in [1,1] on LB0:.
 - c) RSXMC.MAC (with macro definitions) is in [11,10] on LB0:.
The date of RSXMC.MAC and the date of [1,54]RSX11M.TSK should correspond.
 - d) The sysgen contains loadable driver support and has been generated to include support for the DY (RX02) device. See "Guide to Writing an I/O Driver" for setting up a loadable DY SYSTBL if no support exists.
 - e) The system that this driver will be installed in has been sysgen'd for EIS support and has the appropriate CPU with EIS support. EIS support can be verified by examining the file SYSSAVED.CMD in account [200,200] and verifying the the label \$EIS has a SETT before it and not SETF. If EIS has not been sysgen'd in, a new sysgen must be performed before attempting to install this driver. If EIS support cannot be verified, then continue to install this driver. Two assembly errors will occur during the assembly phase of installation if EIS has not been sysgen'd in this system.
- 3) Log on into a privileged account.
- 4) Enter "SET /UIC=[200,200]<CR>".
- 5) Copy the Qualogy Double-Sided / Q22 driver files into this account.
 - a) Enter "FLX LB0:/RS=DY0:DYRSX.CMD/RT<CR>".
 - b) Enter "@DYRSX<CR>" to invoke the copy indirect command file

or

Enter "FLX SY0:=DY0:*/RT<CR>" to copy all of the files on this disk. Files copied to support RSX-11M are DYQ22.CMD, DYQ22.DOC, DYQ22.MAC, DYDBLD.CMD, LOADY.CMD, and UNLDY.CMD.

NOTE: If this procedure is being done for an extended memory unibus machine, such as the PDP 11/24, 11/44, or 11/70, the symbol definition Q\$\$22=1 should be commented out. This is line 31 in the file DYQ22.MAC.

QUALOGY