Part Number 2120-0147

MODEL DU686

DISK CONTROLLER

REVISION F

INSTALLATION AND OPERATION MANUAL

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SECTION 1

DESCRIPTION

This manual describes the installation and operation of Distributed Logic Corporation (DILOG) Model DU686 Disk Controller. The controller interfaces up to four ESDI, 5-1/4-inch Winchester disk drives to DEC* VAX or PDP-11 Unibus based computer systems. Transfer rates of the system are up to 15 MHz.

The controller is software compatible with DU drivers, MSCP, in MUMPS, VMS, RT-11, RSTS/E, and RSX-11 operating systems. The controller is programmable by the host software driver to transfer from 1 to 8 words per DMA request.

Figure 1-1 is a simplified diagram of a disk system.

CHARACTERISTICS

Characteristics of the controller are as follows:

- Data Buffer

  The controller contains a 28-sector FIFO data buffer to support a 1 to 1 sector interleave and reduce software-generated latencies between the Unibus and disk drive.

- Command Buffering

  The controller contains a command queue buffer capable of storing up to 16 commands. The buffer stores all commands received by the controller and queues the command for proper order of execution on each drive.

- Elevator Seek Ordering Algorithm

  The controller uses an elevator seek ordering algorithm to determine the execution order for commands in the command buffer. This algorithm reduces drive seek latencies.

- Overlapped Seeks

  The controller supports overlapped seeks for up to four (4) drives and will start a transfer on the drive whose seek completes first. This feature reduces multiple drive seek latencies.

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* DEC PDP-11, VAX, RT-11, MSCP, and DU Driver are registered trademarks of Digital Equipment Corporation.

UNIVERSAL FORMATTING is a trademark of Distributed Logic Corporation.

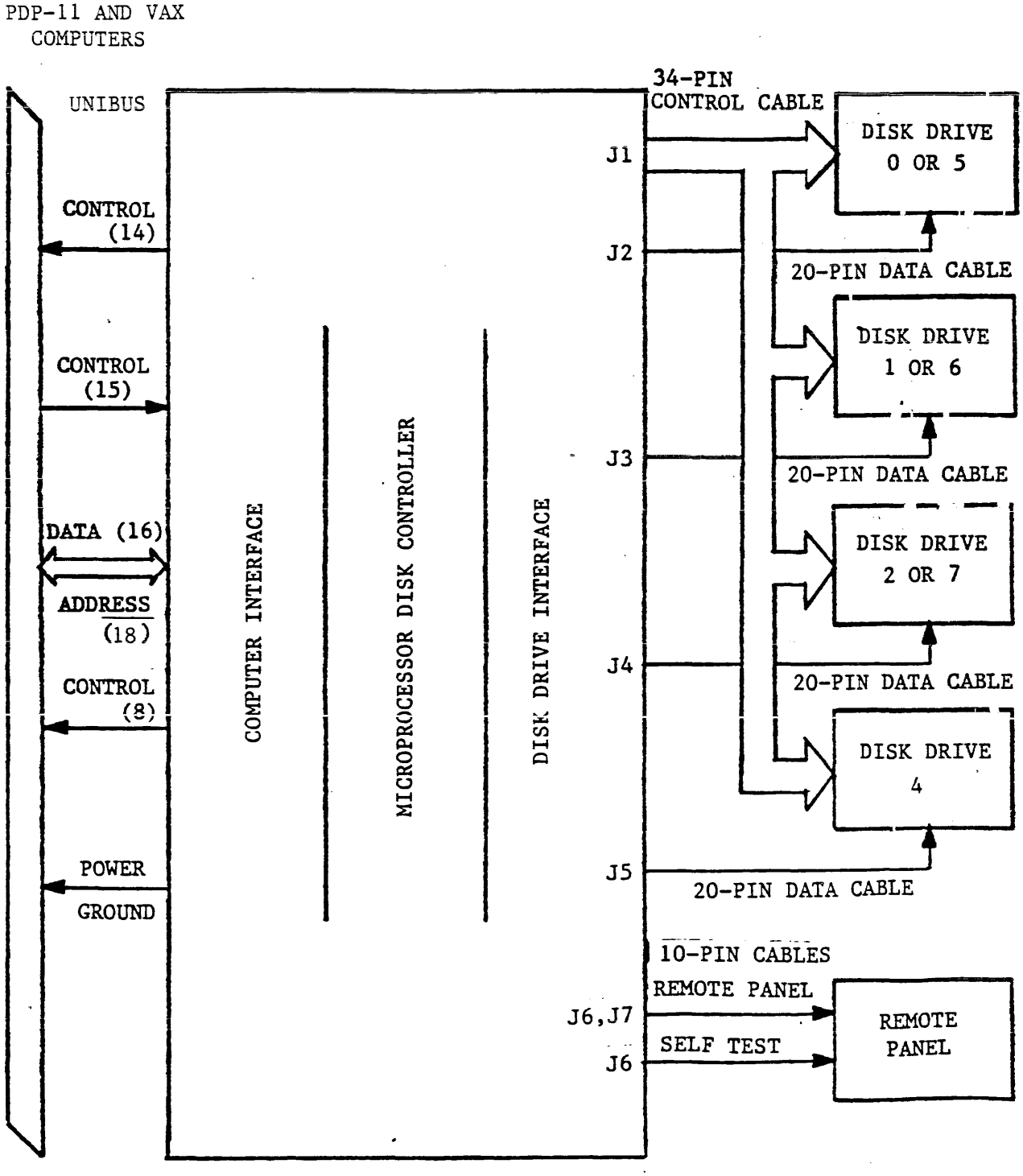

Figure 1-1. Disk System, Simplified

CHARACTERISTICS (Continued)

. Parameter Passing Commands

With these ESDI commands, drive parameters are no longer stored in programmable components on the controller or recorded on the surface of the drive(s) attached to the controller. The drive(s) now communicates configuration information to the controller every time power is applied to the system.

. Inhibit DMA Increment

The controller contains the ability to move blocks of data in or out of a specific memory of I/O address location. This function is software selectable for applications that require both incremental and non-incremental applications to run concurrently on the same controller.

. Onboard Formatting

The controller onboard formatter is accessible through the system processor to provide interactive terminal access to the controller. The formatter is menu driven and also provides controller and drive test options.

. Media Flaw Compensation

The following functions compensate for media defects:

FIRST, at format time one sector per track is reserved as an alternate. DILOG'S UNIVERSAL FORMATTING system has the ability to reassign reserved sectors for defective sectors. Also at format time the controller has the ability to read the manufacturer's defect map (if recorded per ESDI specification) and replace the sectors found bad by the drive manufacturer.

SECOND, if an error is encountered after the drive is formatted the controller will try to reread the sector with ECC disabled.

THIRD, if the error still exists, ECC is used to recover the data. This enhanced 32-bit ECC polynomial is capable of correcting one error per sector that is 11 bits or less in length. Error packets are generated by the controller every time an error recovery operation is performed.

FOURTH, if the error still exists, reassignment of defective sectors is accomplished through a dynamic replacement scheme controlled by the host software.

. Hardware Bootstrap

The controller contains an onboard bootstrap support for RP02, RL01/02, RM03, RM05, RM80, RK06/07, RX02, TS11, TSV05, TM11 and DU driver devices. Onboard jumpers allow selectable bootstrap addresses, in addition to enabling/disabling the bootstrap. When the bootstrap is disabled, the controller will boot from the standard DEC module.

- Automatic Self Test

  The controller is supplied with an automatic self test function that is initiated each time power is applied. The controller performs additional tests each time it is brought online. A green card-edge LED is lit and remains lit after each successful completion. Should self test fail, the controller isolates the disk drive from the system and the LED is extinguished.

- Remote Panel Interface

  Two interface connectors are supplied for remote panels. The panels are user-supplied. Each panel contains four LEDs and four switches for drive selection and write protection. Error codes are also displayed on one of the remote panels.

- Unibus Interface

  Commands, data and status transfers between the controller and the computer are executed via the parallel I/O bus of the computer. Data transfers are direct to memory via the DMA facility of the bus; commands and status are under programmed I/O. Controller/Unibus interface lines are listed in Table 1-1.

- Disk Drives Supported

  The controller is compatible with disk drives from the following manufacturers. Contact the factory for additional drive support.

Control Data Corporation	Micropolis
Fujitsu	NEC
Hitachi	Priam
Maxtor	Siemens

Table 1-1. Controller/UNIBUS Interface Lines

BUS PIN	MNEMONIC	DESCRIPTION
CA1	NPG INH	Non-Processor Grant In—Generated by the processor in response to NPR whenever the processor is not using the bus. NPG is daisy-chained through the devices connected to the bus and is received and regenerated by each device until it reaches the requested device.
CB1	NPG OUTH	Non-Processor Grant Out
CC1	PAL	Parity Bit A
CD2	D15L	Data Line Bit 15—These 16 lines DXXL. are used to transfer data and register control/status information to and from the controller.
CE2	D14L	Data Line Bit 14
CF2	D13L	Data Line Bit 13
CH1	D11L	Data Line Bit 11
CH2	D12L	Data Line Bit 12
CJ2	D10L	Data Line Bit 10
CK2	D09L	Data Line Bit 9
CL2	D08L	Data Line Bit 8
CM2	D07L	Data Line Bit 7
CN1	DCLOL	DC Power Low
CN2	D04L	Data Line Bit 4
CP2	D05L	Data Line Bit 5
CR2	D01L	Data Line Bit 1
CS1	PBL	Bus Parity Bit B
CS2	D00L	Data Line Bit 0
CT2	D03L	Data Line Bit 3
CU2	D02L	Data Line Bit 2
CV1	ACLOL	AC Power Low
CV2	D06L	Data Line Bit 6
DD2	BR7L	Bus Request 7—One of these lines BRXL. will be asserted by the controller to request control of the bus for the purpose of transferring data.
DE2	BR6L	Bus Request 6
DF2	BR5L	Bus Request 5
DH2	BR4L	Bus Request 4
DK2	BGI7H	Bus Grant Bit 7 In—These daisy-chained Bus Grant lines are asserted by the processor after completing the instruction in progress. Issued in response to the corresponding Bus Request line, the Bus Grant will be generated by each device until it reaches the requested device.
DL1	INITL	INITIALIZE—This signal is asserted by the processor to initialize or clear all devices connected to the bus.
DL2	BGO7H	Bus Grant Bit 7 Out
DM2	BGI6H	Bus Grant Bit 6 In
DN2	BGO6H	Bus Grant Bit 6 Out
DP2	BGI5H	Bus Grant Bit 5 In
DR2	BGO5H	Bus Grant Bit 5 Out
DS2	BGI4H	Bus Grant Bit 4 In
DT2	BGO4H	Bus Grant Bit 4 Out

Table 1-1. Controller/UNIBUS Interface Lines (Continued)

BUS PIN	MNEMONIC	DESCRIPTION
EC1	A12L	Address Bit 12—These lines are the 18-bit address bus over which memory and peripheral register address information is communicated. Address information is placed on the bus by the bus master device and received and decoded by the selected slave device. The master device then either receives input data from, or outputs data to the addressed slave device (memory) over the data bus lines.
ED1	A17L	Address Bit 17
ED2	A15L	Address Bit 15
EE1	MSYNL	Master Sync—This control signal is issued by the master device to indicate that Address and Control information is present on the bus.
EE2	A16L	Address Bit 16
EF1	A02L	Address Bit 2
EH1	A01L	Address Bit 1
EH2	A00L	Address Bit 0
EJ1	SSYNL	Slave Sync—This control signal is issued by the slave device in response to the signals (MSYN or INTR) generated by the master device.
EK1	A14L	Address Bit 14
EK2	A13L	Address Bit 13
EL1	A11L	Address Bit 11
EN2	A08L	Address Bit 8
EP1	A10L	Address Bit 10
EP2	A07L	Address Bit 7
ER1	A09L	Address Bit 9
EU1	A06L	Address Bit 6
EU2	A04L	Address Bit 4
EV1	A05L	Address Bit 5
EV2	A03L	Address Bit 3
EJ2	C0L	Control Bit Zero—These two control lines are coded by the master device to describe the type of transfer: C1 C0 OPERATION 0 0 DATI—Data In (to master) 1 0 DATO—Data Out (from master) 1 1 DATOB—Data Out, Byte (from master)
EF2	C1L	Control Bit One
FD1	BBSYL	Bus Busy—This signal is asserted by the bus master to indicate the bus is in use. When BBSY goes false, control of the bus is passed to the new bus master.
FJ1	NPRL	Non-Processor Request—This signal is asserted by the controller to request control of the bus for the purpose of transferring data directly to or from memory.
FM1	INTRL	Interrupt Request—The controller asserts this signal after becoming bus master to indicate that the desired interrupt Vector information is present on the bus.
FT2	SACKL	Selection Acknowledge—This signal is asserted by the controller in response to the processor's NPG or Bus Grant signal, indicating that control of the bus will pass to the controller when the current bus master completes its operation.

Disk Interface

The controller interfaces up to four disk drives through 34- and 20-pin cables. If more than one drive is used, the 34-pin control cable is daisy-chained. The 20-pin cables are connected separately from the controller to each drive. Table 1-2 lists the 34-pin interface signals, and Table 1-3 lists the 20-pin interface signals.

Table 1-2. Control Cable J1 - Controller to Drive

Signal Name	Signal Pin	Ground Pin	Source
- Head Select 2^3	2	1	Controller
- Head Select 2^2	4	3	Controller
- Write Gate	6	5	Controller
- Configuration Status Data	8	7	Drive
- Transfer Acknowledge	10	9	Drive
- Attention	12	11	Drive
- Head Select 2^0	14	13	Controller
- Sector	16	15	Drive
- Head Select 2^1	18	17	Controller
- Index	20	19	Drive
- Ready	22	21	Drive
- Transfer Request	24	23	Controller
- Drive Select 1	26	25	Controller
- Drive Select 2	28	27	Controller
- Drive Select 3	30	29	Controller
- Read Gate	32	31	Controller
- Command Data	34	33	Controller

Table 1-3. Data Cables J2, J3, J4, J5 - Controller to Drive

Signal Name	Signal Pin	Ground Pin	Source
- Drive Selected	1		Drive
- Sector	2		NOT USED
- Command Complete	3		Drive
- Address Mark Enable	4		Controller
- Reserved	5	6	
+/- Write Clock	7/8		Controller
- Reserved	9		
+/- Read/Reference Clock	10/11	12	Drive
+/- NRZ Write Data	13/14	15/16	Controller
+/- DR Data	17/18	19	Drive
- Index	20		Drive

Figure 1-2 shows the interface for the customer-supplied remote panels. There are two panels; one connects from J6 and one from J7. The switches and LED connections depend on which drives are connected to J2, J3, J4 and J5. Error codes are displayed from J6 connectors. These codes are listed in Section 2.

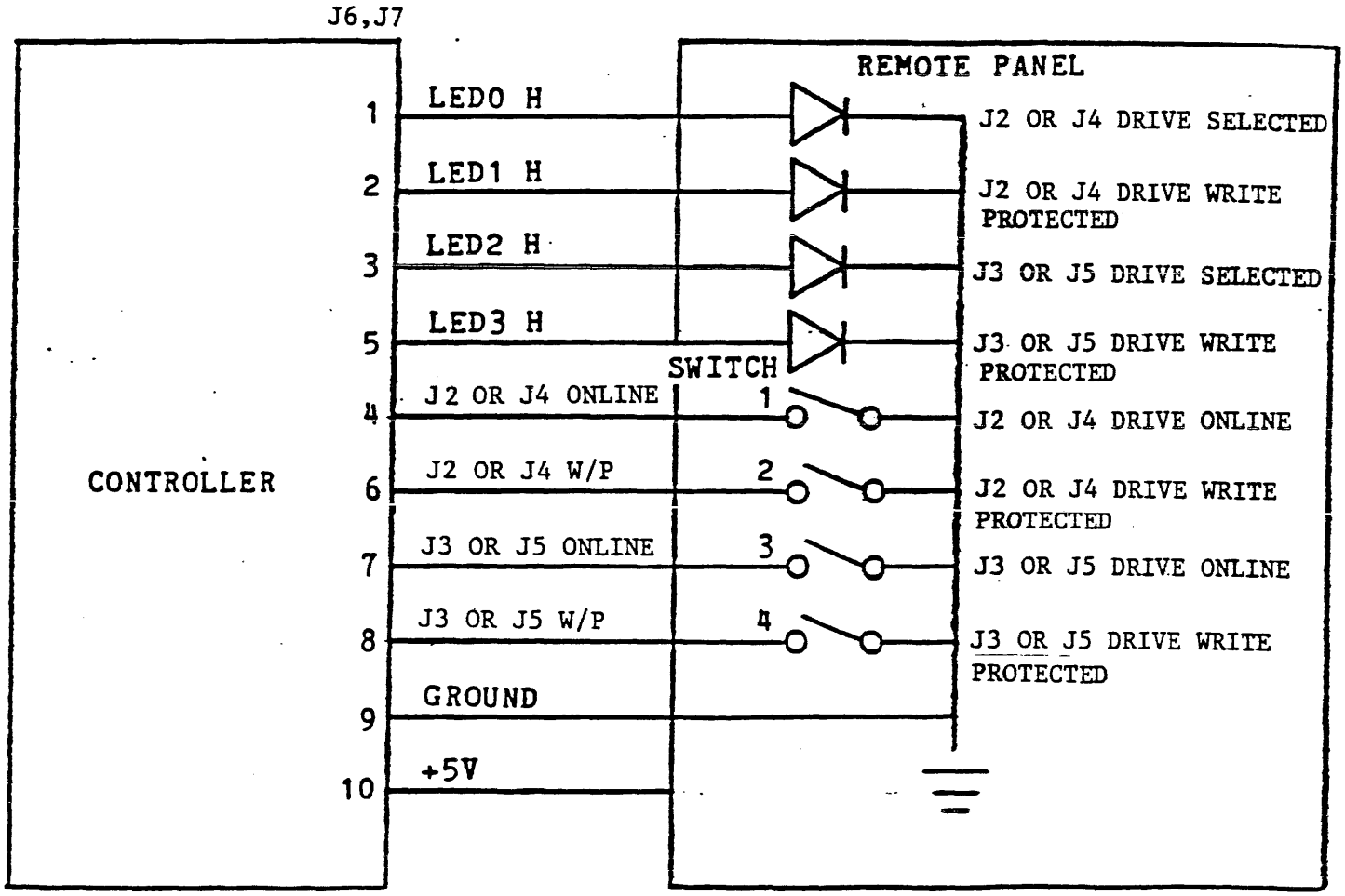

Figure 1-2. Remote Panel Interface

CONTROLLER SPECIFICATIONS *

MECHANICAL

The controller is completely contained on a quad-height module 26.4 cm (10.44 in.) wide by 22.8 cm (8.88 in.) deep and plugs into one standard Unibus SPC quad-height slot.

BASE ADDRESSES

8 choices, switch selectable:

IP-772150	IP-760334	IP-760340	IP-760344
SA-772152	SA-760336	SA-760342	IP-760346
IP-760354	IP-760360	IP-760374	IP-760400
SA-760356	SA-760362	SA-760376	SA-760402

INTERRUPT VECTOR ADDRESS

Programmable by software.

PRIORITY LEVEL

BR5 in etch; BR4, BR6, and BR7 by jumpers.

DMA BURST SIZE

Preprogrammed for 4-word transfers.

DISK TRANSFER RATES

Up to 15 MHz per second.

DISK DRIVE I/O

One 34-pin flat ribbon cable and four 20-pin flat ribbon cables (one for each drive).

POWER

+5 volts at 2.5 amps.

ENVIRONMENT

Operating temperature 50 degrees F. (10 degrees C.) to 104 degrees F. (40 degrees C.); Humidity 10-90% non-condensing.

SHIPPING WEIGHT

5 pounds, including documentation and cables.

MTTR

Less than 0.5 hours.

* SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

SECTION 2

INSTALLATION

The padded shipping carton contains the controller board, a 34-pin control cable to the drive, and if specified on the sales order, four optional 20-pin data cables to the drives. Inspect the controller board and its components and the cables for damage.

NOTE

> If damage to the board, components on the board, or cables is noted, do not install. Immediately inform the carrier and DILOG.

Figure 2-1 shows the locations of the switch and jumpers.

Table 2-1 describes the switch and jumper settings. Some jumper connections may be etched or cut on the board and are referred to in the table as installed or removed.

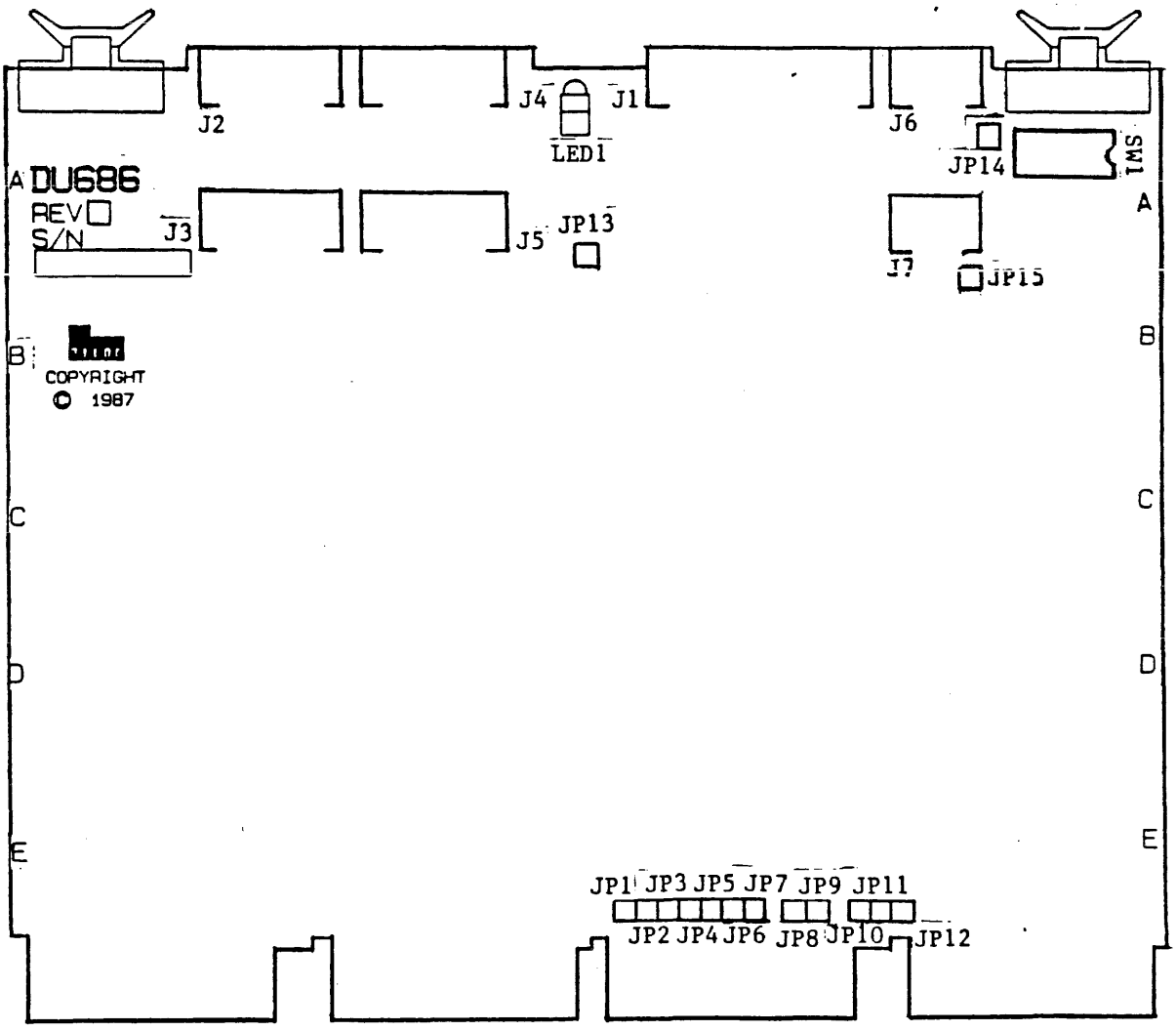

Figure 2-1. Controller Configuration

Table 2-1. Switch and Jumper Setting

Switch SW1
Slave Address Select (IP/SA Register)

SW1-1	SW1-2	SW1-3		ADDRESS SELECT
OFF	OFF	OFF	=	772150
ON	OFF	OFF	=	760334
OFF	ON	OFF	=	760340
ON	ON	OFF	=	760344
OFF	OFF	ON	=	760354
ON	OFF	ON	=	760360
OFF	ON	ON	=	760374
ON	ON	ON	=	760400

Switch SW1-4 - MUST BE OFF

Switch SW1-5 - MUST BE OFF

Switch SW1-6 - MUST BE OFF

Switch SW1-7

EXTENDED DWELL TIME

ON = Extends the dwell time between DMA bursts (12.8 usec) if pending interrupt requests
OFF = Normal dwell time between DMA bursts

Switch SW1-8

PARITY ENABLE

ON = Checks and reports parity to host
OFF = Parity disabled

Jumpers JP1 through JP12 - FACTORY SET

Jumper JP13 - Installed (Factory Etch)

When removed, indicates a future hardware revision.

Jumper JP14/JP15 - Removed (Factory Set)

These jumpers may be installed for +5V Remote Panel power.

PRE-INSTALLATION CHECKS

Before the controller is installed, it may be necessary to check the operating system for device addresses. The drives are designated DUX except in VAX/VMS where they are designated DUAX. The "X" represents drive number and drives may be any number from 0 to 6. The numbering of drives is described in Section 3 under Main Menu, Select Drive.

NOTE

The ESDI drive numbering system is 1-7; the DEC numbering system is 0-6. Consult the drive manufacturer's documentation for selecting the ESDI configuration of the drive. The controller on-board formatting program lists both numbers; for example, "ESDI DRIVE 01 (DU00) SELECTED."

1. From the operating system, determine and select the address of the controller to be installed. Available addresses are listed in Table 2-1. Examples of controller names for the first controller for some operating systems are as follows:

OPERATING SYSTEM	CONTROLLER
RSTS/E	RU1
RSX-11M-PLUS	DUA
RT-11	Port0
VAX/VMS	DUA

2. Determine and select the drive name. The first drive may be DU0, except for VAX/VMS, which is DUA0. Set the switches and jumpers in the controller and drive for the selected addresses.

3. Remove power from the system and install the controller as described below.

RECOMMENDED DRIVE SETUP

The switches and jumpers on the disk drive need not be set up to accommodate the controller. The controller interrogates the drive for the status and configuration and selects the optimum format. However, where there are choices for selecting drive options (for example, hard/soft sectoring), for the most efficient use of the system, DILOG recommends the following:

OPTION	RECOMMENDATION/REQUIREMENT
Hard/Soft Sector	Hard Sector - The controller can accept both, but hard sectoring is the most efficient use of drive capacity.
Motor Control Enable/ Disable	Enabled - With motor control enabled, the controller can sequence the drive, requiring less power consumption.
Drive Cabling From J2, J3, J4, and J5	No recommendation - J2, J3, J4 and J5 cables may be connected to any drive. The remote panel connections depend on the J2, J3, J4 and J5 connections.

Step or Serial Mode	SERIAL MODE REQUIRED - Few drives offer a step mode option, but these must be set for serial mode. (With the step mode, the controller must know where the head is and where the next Seek must go. With the serial mode, a single command causes a Seek to a given track.)

INSTALLATION

To install the controller module, proceed as follows:

CAUTION

Remove DC power from computer chassis before inserting or removing controller module.

Damage to the backplane assembly and the controller module will occur if the controller module is plugged in backwards!

1. Select the backplane Small Peripheral Controller (SPC) location into which the controller is to be inserted. SPC locations are connectors C, D, E, and F of a UNIBUS backplane assembly.

2. To use the DMA (NPR) facility required with the controller, the backplane wiring of the SPC slot must be modified. The modification is as follows:

   Remove the wire on the connector C between A1 and B1 of the slot into which the controller is to be plugged. This allows the nonprocessor grant priority line to be carried through the controller. If the controller is removed, replace this wire.

   Note that any connector rows which do not have a card installed, must have a bus grant jumper card installed in the D slot to continue the bus grants to other devices in the UNIBUS.

   On older PDP-11 backplanes, the following additional wiring changes may be necessary if slot 1 AU1 is directly connected to slot 4 AU1 of the system unit into which the controller is to be installed.

   A. Remove wire between 1 AU1 and 4 AU1.

   B. At the controller slot, connect 1 AU1 to CA1 and 4 AU1 to CB1.

   Additional consideration of the slot into which the controller is to be plugged is required. The interrupt request and NPR request levels are selected by the position of the controller on the backplane bus. Remember that devices closest to the processor have highest priority.

   When selecting the backplane slot, NPR request priority should be considered first, then priority of interrupt requests.

3. Perform this step if the remote panel switch/indicators are to be connected. Connect the cables from J6 and J7 on the controller to the remote panels (not supplied by DILOG). Refer to Figure 1-2 for pinouts and descriptions.

4. Install J1 and J2 into the connectors on the controller and J3, J4 and J5, if four drives are used. Ensure pin 1 on each cable is matched with the triangle on each connector as indicated on Figure 2-1.

5. Ensure the controller is oriented with the components facing row one, the processor, and gently press both handles until the module connectors are firmly seated in the backplane.

6. Connect J1 to the drive or drives if daisy-chained. Ensure the terminator is installed in the last drive. Connect the J2, J3, J4 and J5 cables to the appropriate drive as described in Section 3 under Drive Select.

7. Refer to the disk drive manual for operating instructions, and apply power to the drive(s) and the computer.

8. Power up the system. If the green LED lights, self test passed. If the green LED does not light, self test failed. If the remote panels (J6 and J7) are used, the remote panel LEDs will display the self test error code on J6 only. (See Table 2-2 for self test error code definitions.) If the green LED does not light, perform the following steps:

   A. Power down the system.

   B. Remove all drive cables.

   C. Power up the system.

   D. If the green LED lights, the cabling is probably wrong. Install the cables into the proper connector.

9. The system is now ready to operate. Format the disks as described in Section 3.

Table 2-2. Test in Error--Remote Panel

Self test is entered upon initialization (Reset or Write IP Register). If self test fails, an error code is displayed on the Remote Panel LEDs (J6 only) and self test LED is off. Upon self test failure, report status to DILOG Customer Service.

LED3 J3 or J5 Drive Write Protected	LED2 J3 or J5 Drive Selected	LED1 J2 or J4 Drive Write Protected	LED0 J2 or J4 Drive Selected	DESCRIPTION
0	0	0	1	Test Drive Status A Register
0	0	1	0	Test Drive Status B Register
0	0	1	1	Test Controller Status Register (Remote Write Protect)
0	1	0	0	Request QBIC Status Register and Test Status Bits
0	1	0	1	Test QBIC DMA LSB Byte Count Register
0	1	1	0	Test QBIC DMA MSB Byte Count Register
0	1	1	1	Test QBIC DMA MSB Byte Count Register
1	0	0	0	Clear QBIC DMA Byte Count Register
1	0	0	1	Test QBIC DMA Control Register (Enable Zero Fill)
1	0	1	0	Test Z80 Working RAM Address Test (only on power up)
1	0	1	1	Test Z80 Working RAM Pattern (5AH) (only on power up)

Table 2-2. Test in Error--Remote Panel
(Continued)

LED3 J3 or J5 Drive Write Protected	LED2 J3 or J5 Drive Selected	LED1 J2 or J4 Drive Write Protected	LED0 J2 or J4 Drive Selected	DESCRIPTION
1	1	0	0	Test Z80 Working RAM Pattern (A5H) (only on power up)
1	1	0	1	Test Disk Data RAM Address/Pattern (only on power up) First 8K
1	1	1	0	Test Disk Data RAM Address/Pattern (only on power up) Second 8K
1	1	1	1	Zero Fill Data RAM and test for zeros (16K) (only on power up)

SECTION 3

OPERATION -- FORMAT, DIAGNOSTICS, AND ERROR LOGGING

The operation of the controller includes interrogating the drive, formatting the disc, running diagnostics, and checking the disk subsystem error log. Interrogating the ESDI drive is simply determining the drive parameters for formatting.

The method for establishing communications with the formatting program is the DILOG Boot procedure. This method is described below. Diagnostic procedures and error log messages are listed at the end of this section.

COMMUNICATION WITH CRT OR HARD COPY CONSOLE

If using the optional Dilog Format Paddle Card, the system console must be set up as follows:

- 9600
- 8 bit
- no parity
- 1 stop bit

If the system console is attached directly to the host, the setup is as follows:

- 9600, 4800, 2400, 1200
- 8 bit
- no parity
- 1 stop bit

DILOG PDP-11 BOOTSTRAP PROCEDURE

The controller not only supports standard DEC devices, but also allows the use of the onboard formatter. When DU is used, the standard DEC emulation is called. When FT is used, the onboard formatter is enabled for use through the system console.

The following assumes the system is in ODT mode. Note that the bootstrap can be used under processor Power Up Mode 2 conditions. Refer to the appropriate DEC manual for a discussion of the Power Up modes. Further note that the disc drive does not need to be READY to enter the bootstrap.

Reset the system by pressing RESET (Break) or enter the following (characters underlined are output by the system; characters not underlined are input by the operator):

@ <IP>/0

@ <SA>/77777

@ 2000G

The values for the IP and SA addresses and switch settings are as follows:

SW1-1	SW1-2	SW1-3		IP	SA
OFF	OFF	OFF	=	772150	772152
ON	OFF	OFF	=	760334	760336
OFF	ON	OFF	=	760340	760342
ON	ON	OFF	=	760344	760346
OFF	OFF	ON	=	760354	760356
ON	OFF	ON	=	760360	760362
OFF	ON	ON	=	760374	760376
ON	ON	ON	=	760400	760402

* Enter one of the following: DM0, DP0, DL0, DR0, MS0, MT0, DY0, DU, or FT <CR>.

Definitions are as follows:

DM = RK06/07 Disc
DP = RP02/03 Disc
DL = RL01/02 Disc
DR = RM03/05/80
MS = TS11 Tape
MT = Tape
MU = (TMSCP) Tape
DY = RX02 Floppy Disc
DU = DU emulation (see below)
FT = Enable onboard formatter through system console

Booting can be executed from logical units other than "0" shown above by entering the desired logical unit number, i.e., 1, 2, 3, ... or 7.

VAX-11/730 COMMUNICATIONS PROCEDURE

1. On the VAX-11/730, press the Restart switch.

2. Enter the code below. (Underlined values are outputs to the terminal.) The values of the IP and SA registers are listed in Table 3-1.

   >>> D/P/L F26804 80000001 <CR>

   >>> D/P/W <IP> 0 <CR>

   >>> D/P/W <SA> 3FFF <CR>

   >>> D/G F 200 <CR>

   >>> C <CR>

VAX-11/750 COMMUNICATIONS PROCEDURE

1. On the VAX-11/750, press the Restart switch.

2. Enter the code below. (Underlined values are outputs to the terminal.) The values of the IP and SA registers are listed in Table 3-1.

   >>> D/P/L F30804 80000001 <CR>

   If the controller is plugged into the second Unibus adapter in the VAX-11/750, enter the following line; otherwise, omit this entry and proceed to the next entry:

   >>> D/P/L F32804 80000001 <CR>

   >>> D/P/W <IP> 0 <CR>

   >>> D/P/W <SA> 3FFF <CR>

If the controller is plugged into the second Unibus adapter in the VAX-11/750, enter the following line; otherwise, omit this entry and proceed to the last two entries.

```
>>> D/P/L 230 F80000 <CR>

>>> D/G F 200 <CR>

>>> C <CR>
```

Table 3-1. VAX-11/750 IP/SA Addresses

Switch SW1			IP (Octal)	First Unibus Adapter <IP> IP Hex Address Entered	First Unibus Adapter <SA> SA Hex Address Entered
SW1-1	SW1-2	SW1-3			
OFF	OFF	OFF	772150	FFF468	FFF46A
ON	OFF	OFF	760334	FFE0DC	FFE0DE
OFF	ON	OFF	760340	FFE0E0	FFE0E2
ON	ON	OFF	760344	FFE0E4	FFE0E6
OFF	OFF	ON	760354	FFE0EC	FFE0EE
ON	OFF	ON	760360	FFE0F0	FFE0F2
OFF	ON	ON	760374	FFE0FC	FFE0FE
ON	ON	ON	760400	FFE100	FFE102
				Second Unibus Adapter	
SW1-1	SW1-2	SW1-3			
OFF	OFF	OFF	772150	FBF468	FBF46A
ON	OFF	OFF	760334	FBE0DC	FBE0DE
OFF	ON	OFF	760340	FBE0E0	FBE0E2
ON	ON	OFF	760344	FBE0E4	FBE0E6
OFF	OFF	ON	760354	FBE0EC	FBE0EE
ON	OFF	ON	760360	FBE0F0	FBE0F2
OFF	ON	ON	760374	FBE0FC	FBE0FE
ON	ON	ON	760400	FBE100	FBE102

VAX 11/780 COMMUNICATIONS PROCEDURE

1. On the VAX-11/780, press the Restart switch.

2. Enter the code below. (Underlined values are outputs to the terminal.) The values of the IP and SA registers are listed in Table 3-2.

   >>> I <CR>

   >>> D/P/L 20006804 80000001 <CR>

   If the controller is plugged into a second, third, or fourth Unibus adapter in the VAX-11/780, enter the following; otherwise, proceed to the next entry:

   Second UB: >>> D/P/L 20008804 80000001 <CR>
   Third UB: >>> D/P/L 2000A804 80000001 <CR>
   Fourth UB: >>> D/P/L 2000C804 80000001 <CR>

   >>> D/P/W <IP> 0 <CR>

   >>> D/P/W <SA> 3FFF <CR>

   If one Unibus adapter is used, enter the first line of code. If more than one are used, enter the appropriate code as follows:

   First UB: >>> D/P/L 227 20100000 <CR>
   Second UB: >>> D/P/L 227 20140000 <CR>
   Third UB: >>> D/P/L 227 20180000 <CR>
   Fourth UB: >>> D/P/L 227 201C0000 <CR>

   >>> D/G F 200 <CR>

   >>> C <CR>

Table 3-2. VAX-11/780 IP/SA Addresses

Switch SW1			IP (Octal)	First Unibus Adapter <IP> IP Hex Address Entered	First Unibus Adapter <SA> SA Hex Address Entered
SW1-1	SW1-2	SW1-3			
OFF	OFF	OFF	772150	2013F468	2013F46A
ON	OFF	OFF	760334	2013E0DC	2013E0DE
OFF	ON	OFF	760340	2013E0E0	2013E0E2
ON	ON	OFF	760344	2013E0E4	2013E0E6
OFF	OFF	ON	760354	2013E0EC	2013E0EE
ON	OFF	ON	760360	2013E0F0	2013E0F2
OFF	ON	ON	760374	2013E0FC	2013E0FE
ON	ON	ON	760400	2013E100	2013E102
				Second Unibus Adapter	
SW1-1	SW1-2	SW1-3			
OFF	OFF	OFF	772150	2017F468	2017F46A
ON	OFF	OFF	760334	2017E0DC	2017E0DE
OFF	ON	OFF	760340	2017E0E0	2017E0E2
ON	ON	OFF	760344	2017E0E4	2017E0E6
OFF	OFF	ON	760354	2017E0EC	2017E0EE
ON	OFF	ON	760360	2017E0F0	2017E0F2
OFF	ON	ON	760374	2017E0FC	2017E0FE
ON	ON	ON	760400	2017E100	2017E102
				Third Unibus Adapter	
SW1-1	SW1-2	SW1-3			
OFF	OFF	OFF	772150	201BF468	201BF46A
ON	OFF	OFF	760334	201BE0DC	201BE0DE
OFF	ON	OFF	760340	201BE0E0	201BE0E2
ON	ON	OFF	760344	201BE0E4	201BE0E6
OFF	OFF	ON	760354	201BE0EC	201BE0EE
ON	OFF	ON	760360	201BE0F0	201BE0F2
OFF	ON	ON	760374	201BE0FC	201BE0FE
ON	ON	ON	760400	201BE100	201BE102
				Fourth Unibus Adapter	
SW1-1	SW1-2	SW1-3			
OFF	OFF	OFF	772150	201FF468	201FF46A
ON	OFF	OFF	760334	201FE0DC	201FF0DE
OFF	ON	OFF	760340	201FE0E0	201FE0E2
ON	ON	OFF	760344	201FE0E4	201FE0E6
OFF	OFF	ON	760354	201FE0EC	201FE0EE
ON	OFF	ON	760360	201FE0F0	201FE0F2
OFF	ON	ON	760374	201FE0FC	201FE0FE
ON	ON	ON	760400	201FE100	201FE102

FORMATTING PROGRAM

After communication is established, the program is ready to format the disk.

NOTE

> Inputs or outputs to or from the program may be in either decimal or Hexadecimal. In the upper right hand corner of the screen after the header, either "DECIMAL" or "HEX" will be shown. To change values, use the CONTROL and B keys. When these keys are pressed an audible alarm will sound, and outputs will toggle immediately. Exceptions are listed below:

The following outputs are fixed, and will not change:

- SA/IP Registers - Always Octal
- Firmware Version - Always Decimal
- Date - Always Decimal
- Drive Capacity and Transfer Rate - Always Decimal
- Correction Pattern and Vector - Always Hexadecimal

The first display of the program will be:

```
NO DRIVE SELECTED

ARE YOU USING A (P)RINTER OR (C)RT?
```

If a CRT is used, the program will display rolling cylinder addresses. If a printer is used, the addresses will not be printed unless an error is detected. If an address is needed when a printer is used, use the CONTROL and P keys and the address will be printed.

Each display on the screen will list the program name, the version, and the controller model, followed by either "NO DRIVE SELECTED" or "DRIVE 0 (or 1) SELECTED." The main formatter menu will appear next. The logo is shown in the first example, below, but is omitted in the subsequent examples after the Main Formatter Menu. The ESDI convention of numbering drives is 1-7; the DU driver convention is 0-6.

MAIN MENU

```
-------------------------------------------------------
 DILOG On Board Disk Formatter      IP/SA Address = 772150
 Version: A-B-C     Model DU686
-------------------------------------------------------
    ESDI DRIVE 01 (DU00) SELECTED                    DECIMAL

 Main Formatter Menu
--------------------
1 - SELECT DRIVE 01  [OR 05]        7 - SELECT DRIVE 03  [OR 07]
2 - SELECT DRIVE 02  [OR 06]        8 - SELECT DRIVE 04
3 - DISPLAY DRIVE CONFIGURATION
4 - FORMAT DRIVE
5 - READ DRIVE DATA
6 - WRITE DATA TO DRIVE
9 - MEMORY - DMA TEST
E - PRINT ERROR LOG                 R - REPLACE BAD BLOCKS
T - READ/WRITE RANDOM SECTORS TEST  W - WR/RD/COMPARE DRIVE
                                        DATA
Enter a Selection:
```

The first letter (A) of the version number represents the hardware revision number, the second letter (B) represents the formatter version number, and the third letter (C) represents the DU emulation revision. The IP/SA and boot addresses are read from the switch settings. The address shown above is the IP register. Add 2 for the SA register (772152). Items 1, 2, 7, and 8, SELECT DRIVE, will be the number of the drive as wired on the drive; for example, if the second drive is selected (jumpered) as 6 on the drive, the display will be 06. A drive may be assigned the numbers 1 or 5 but not both; that is, if 1 is assigned, 5 may not be assigned. The same applies for 2 or 6 and 7 or 8. If the drives are assigned the same number or if the two least significant binary bits are the same, the program will prompt as follows:

```
ERROR - BOTH DRIVES HAVE THE SAME UNIT NUMBER
RESET THE UNIT NUMBERS AND PRESS RETURN TO RESTART
```

or

```
ERROR - DRIVE UNIT NUMBERS MUST HAVE UNIQUE LEAST SIGNIFI-
CANT BITS
RESET THE UNIT NUMBER AND PRESS RETURN TO RESTART
```

DMA MEMORY TEST

The onboard formatting program will size and test the memory. If a CRT is used, the size number in Kbytes will change continually until the total memory size is displayed. The following is an example:

Select Item 9 on the menu, and after the logo, a display similar to the following example will appear:

```
MEMORY SIZE (KBYTES) = 0512

***  ***  ***   CAUTION   ***  ***  ***
 This test MODIFIES DEC MEMORY!!! If
 the host is running and you continue,
 you will CRASH the OS!!!
*** *** *** *** *** *** *** *** *** ***

1 - Continue

<ANY OTHER KEY> - Abort, return to Main Menu

Enter a Selection: 1

CHECKING DMA - PLEASE WAIT

CHECKING DMA AT (KBYTES) = 0512

DMA IS OPERATIONAL OVER THE ENTIRE MEMORY RANGE

Press RETURN to continue
```

NOTE

If a printer is used, the memory size will be displayed when the test is completed. The line "CHECKING DMA AT (KBYTES)" will be displayed only when a CRT is used.

If there is a failure, the program will give one of two reasons and display the address where DMA failed:

```
DMA TEST FAILED DUE TO DATA MISCOMPARE AT DEC ADDRESS =
                                                    XXXXXX

DMA TEST FAILED DUE TO NONEXISTENT MEMORY AT DEC ADDRESS =
                                                    XXXXXX
```

SELECT DRIVE

Before Items 3 through 6 are selected, a drive must be selected by selecting Items 1, 2, 7 or 8. If drive 1 is selected, the Main Menu will appear with a message similar to the following example:

```
ESDI DRIVE 01 (DU00) SELECTED
```

If a drive is selected, but the drive is not powered up, the message will be similar to the following:

```
1 - SELECT DRIVE NULL
```

When the drive is selected and powered up, the message will be:

```
1 - SELECT DRIVE 01
```

After a drive is selected, it must spin up. If the drive does not spin up within the program time-out period (approximately 45 seconds), the program will display the following error message:

```
DRIVE SETUP ERROR

Press RETURN to continue
```

When the Main Menu reappears, the message will again be:

```
NO DRIVE SELECTED
```

NOTE

Selecting a drive will clear the formatter's internal error log (see the "R" menu entry).

DRIVE CONFIGURATION

Item 3 in the Main Menu will present the drive configuration. An example follows:

```
ESDI DRIVE 01 (DU00) SELECTED                                DECIMAL

Display Drive Configuration

DRIVE IS HARD SECTORED          DRIVE HAS MOTOR CONTROL
DATA TRANSFER RATE              <=5MHZ
NUMBER OF CYLINDERS             = 0922
NUMBER OF HEADS                 = 0009
NUMBER OF USER SECTORS/TRACK
  (NOT INCLUDING ONE SPARE)     = 0017  INTERLEAVE = 01
USER DRIVE CAPACITY (MBYTES)    = 071.8 USER RECORDS = 00141066
```

NOTE

Data Transfer Rate and Drive Capacity will always be in decimal.

The interleave factor may be specified or changed in the Format Section, Item 4, from the Main Menu.

FORMAT

To format the drive, enter Item 4 from the Main Menu, and the following will appear:

```
ESDI DRIVE 01 (DU00) SELECTED                          DECIMAL

Format Selected Drive
---------------------

***   ***   ***   CAUTION   ***   ***   ***
  If you continue, ALL data will be lost
          on the selected drive!!!
***   ***   ***   ***   ***   ***   ***   ***

     1        - Continue with format
<ANY OTHER KEY> - Abort format return to Main Menu

Enter a selection:
```

The default for the interleave prompt is 01. Interleaving is a technique of assigning successive addresses to sectors which are physically separated on the disk in order to reduce access time. A 3 to 1 interleave requires three rotations of the disk to transfer one track. The range for interleaving is from 1 to 7; that is, 1 to 1 through 7 to 1. DILOG recommends a 1 to 1 interleave as the most efficient. Any response other than 2 through 7 will result in the interleave factor being set to 01, the default value. When the disk is formatted for the first time, the program in Item 3 will indicate that the interleave factor is UNKNOWN.

CAUTION

When an interleave number is changed, the entire disk must be formatted without abort (CTRL-A) or the disk may become formatted with two different interleaves.

When the prompt CORRECT (Y/N)? appears, any response other than Y will force the prompt to repeat.

The program writes and reads two different data patterns to and from the drive. This technique precludes any possibility that a previously formatted drive will read erroneous data. If the controller is unable to read a sector, the next sector in the track is used.

To ensure the disk can be formatted, the program writes to and reads from cylinder 0, head 0, sector 0. If the disk cannot be formatted after two tries, the program will display the following message:

FORMAT ABORTED - UNABLE TO WRITE HEADERS

Pressing both the CONTROL and A keys will cause the program to stop the current step of the test and proceed to the next step. Pressing both the CONTROL and C keys will cause the program to proceed to the Main Menu.

If formatting continues, the program will write and read data and initialize the Replacement And Caching Table (RCT), but will do no re-vectoring. The addresses change as each cylinder is read from or written to.

If formatting is successful, a display similar to the following will appear:

```
          ESDI DRIVE 01 (DU00) SELECTED                    DECIMAL

     Format Selected Drive
     ---------------------

     (CTRL-A ABORTS TO NEXT STEP, CTRL-C ABORTS TO MAIN MENU)

     INTERLACE FACTOR [1]? 1 INTERLEAVE = 01 CORRECT (Y/N)? Y

     WRITING HEADERS
     CYLINDER ADDRESS XXXX

     WRITING HEADERS
     CYLINDER ADDRESS XXXX

     WRITING DATA
     CYLINDER ADDRESS XXXX

     INITIALIZING RCT TO NO DEFECT STATE

     WRITING DATA
     CYLINDER ADDRESS XXXX

     READING DATA
     CYLINDER ADDRESS XXXX

     Press RETURN to continue
```

The first WRITING HEADERS is to the host area. The second is to the RCT. The WRITING DATA is to the RCT. The last two entries, WRITING DATA and READING DATA, are to the host area.

If the remote panel is used and the WRITE PROTECT switch is ON, the following will appear:

```
     *** DRIVE IS WRITE PROTECTED ***
```

READ DRIVE

When the disk is formatted, the program will return to the Main Menu. Item 5 from the Main Menu is a further test for reading data. The following is an example:

```
          ESDI DRIVE 01 (DU00) SELECTED                    DECIMAL

     Read Drive Data
     ---------------

     (CTRL-C ABORTS TO MAIN MENU)

     CYLINDER ADDRESS XXXX

     Press RETURN to continue
```

If a printer is used, the cylinder address is given when the CONTROL and P keys are pressed.

Data errors will display the cylinder, head, sector, logical block address (LBA), type of error, and whether the error is correctable or uncorrectable. If the error is correctable, the pattern and the vector will be displayed. The following are examples of each:

```
CYL=0014 HEAD=0000 SECTOR=0013 LBA=000005545  READ DATA ERROR
                                              (UNCORRECTABLE)

CYL=0028 HEAD=0002 SECTOR=0007 LBA=000011091  READ DATA ERROR (CORRECTABLE)
                                              CORR PAT 01FA02 (10 BITS
                                                CORR) CORR
                                              VEC 0061
```

WRITE DATA

Item 6 from the Main Menu is a further test which writes zeroes to the disk. The following is an example:

```
          ESDI DRIVE 01 (DU00) SELECTED                    DECIMAL

     Write Data to Drive
     -------------------

     ***   ***   ***   CAUTION   ***   ***   ***
       If you continue, ALL data will be lost
             on the selected drive!!!
     ***   ***   ***  ***   ***  ***   ***   ***

          1       - Continue with format
     <ANY OTHER KEY> - Abort format return to Main Menu


     Write Data to Drive
     -------------------

     (CTRL-C ABORTS TO MAIN MENU)

     ENTER 16-BIT HEX DATA PATTERN [0000]:

     CYLINDER ADDRESS XXXX

     Press RETURN to continue
```

If the remote panel is used and the WRITE PROTECT switch is ON, the following will appear:

```
*** DRIVE IS WRITE PROTECTED ***
```

PRINT ERROR LOG

When E is selected from the Main Menu, the error log lists the errors from the last read operation. The error log may contain up to 150 entries, and after 150 entries, the log accepts no more. The following is an example of an error log:

```
Print Error Log
---------------

(USE CTRL-S/CTRL-Q TO START/STOP LISTING)

CYL=0014 HEAD=0000 SECTOR=0013 LBA=00005545   READ DATA ERROR (UNCORRECT-
                                              ABLE)
CYL=0028 HEAD=0002 SECTOR=0007 LBA=00011091   READ DATA ERROR (CORRECTABLE)

NUMBER OF ERRORS = 0002
```

REPLACE BAD BLOCKS

The formatter may revector a bad block to a spare. If there is a correctable error in the field, the data is revectored and the program indicates the replacement was successful. If the data is uncorrectable, an error in the spare is reported to the operating system with a flag which is FORCE ERROR SET.

Before selecting R from the main menu, select E, the Error Log, if replacement is determined from the error log; that is, blocks are replaced only if they are specified on the error log. Ensure a drive is selected, then enter R from the main menu. The following replacement menu will appear:

```
          ESDI DRIVE 02 (DU01) SELECTED                    DECIMAL

Replace Bad Blocks
------------------

D - LOAD MANUFACTURER'S DEFECT LIST INTO ERROR LOG AND REPLACE
L - REPLACE ALL ENTRIES IN ERROR LOG
M - MANUALLY REVECTOR BAD BLOCKS
S - SUMMARIZE PRESENT RCT STATE
Q - RETURN TO MAIN MENU

Enter a selection:
```

D (Subset of R, Replace Bad Blocks)

If D, Load Manufacturer's Defect List, is selected from the replacement menu, the following will appear:

```
*** *** *** WARNING *** *** ***
Revectoring is IRREVERSIBLE and can only
be undone by REFORMATTING the disk. MAKE
SURE YOU HAVE VALID DEFECT DATA BEFORE
DOING THIS OPERATION!
*** *** *** *** *** *** *** *** *** ***

ESDI DRIVE 02 (DU01) SELECTED                    DECIMAL

Replace Bad Blocks
------------------

LOADING DRIVE DEFECT LIST FOR HEAD 00
```

The program takes the defect list from the drive and lists the cylinder and the Bytes From Index (BFI). If the prompt to replace is Y, the program lists the replacement. If a spare is unusable, the program marks that spare unusable (MARKING UNUSABLE).

The ESDI specification lists four data field lengths: 256, 512, 1024, and 2048. DILOG supports only 256.

Note that the defect list is in descending order:

```
CYL = 1186      BFI = 00005212
CYL = 0521      BFI = 00004599
CYL = 0052      BFI = 00020248

HEAD 00 DEFECT LIST CONTAINS 03 ERRORS AND WAS CREATED ON
03-05-86.
```

```
CYL=1186 HEAD=0000 SECTOR=0004 LBA=00483484 DRIVE DEFECT LIST ENTRY
CYL=0521 HEAD=0000 SECTOR=0021 LBA=00212181 DRIVE DEFECT LIST ENTRY
CYL=0052 HEAD=0000 SECTOR=0034 LBA=00020842 DRIVE DEFECT LIST ENTRY

     NUMBER OF ERRORS = 03

     REPLACE (Q TO QUIT) (Y/N/Q)?
```

If the response is Y, the following will appear:

```
     REPLACING LBN 00483484 WITH RBN 00014225
     REPLACING LBN 00021061 WITH RBN 00006244

     Press RETURN to continue
```

The program then repeats the above for each head.

L (Subset of R, Replace Bad Blocks)

If L, Replace Entries in Error Log, is entered from the menu, the following will appear:

```
     *** *** *** CAUTION *** *** ***
     This operation will REVECTOR ALL ENTRIES
     IN THE ERROR LOG.  This revectoring is
     IRREVERSIBLE and can only be undone by
     REFORMATTING the disk.  MAKE SURE YOU
     HAVE VALID ERRORS IN THE ERROR LOG BE-
     FORE DOING THIS OPERATION!
     *** *** *** *** *** *** *** *** *** ***

          1  - Continue

     <ANY OTHER KEY> - Abort, return to main menu

     Enter a selection:
```

If 1 is selected and there are no errors in the error log, the following will appear:

```
          ESDI DRIVE 02 (DU01) SELECTED                    DECIMAL

     Replace Bad Blocks
     ------------------

     Press RETURN to continue
```

An error read from Read Data, Item 5 in the main menu, will list the ECC pattern with the error. The same error as listed from the error log will omit the ECC pattern. The following is an example from Item 5, Read Data:

```
     CYL=0082 HEAD=0011 SECTOR=0002 LBA=00033424
          READ DATA ERROR (CORRECTABLE)
          CORR PAT = 084000 (6 BITS CORR)
          CORR VEC = 018C
```

NOTE

Correction Pattern and Vector are always in hexadecimal.

From the error log, the same error is listed as follows:

```
CYL=0082 HEAD=0011 SECTOR=0002 LBA=00033424
     READ DATA ERROR (CORRECTABLE)
```

When the block is replaced, the LBA (Logical Block Address) will appear as follows:

```
REPLACING LBN 008290 WITH RBN 0003D7
```

If the block replacing the LBN is also bad, the following will appear:

```
REPLACING LBN 008290 WITH RBN 0003D7
REPLACE FAILED
```

The program will then re-replace the LBN:

```
REPLACED LBN WITH BAD RBN - RE-REPLACING LBN
REPLACING LBN 008290 WITH RBN 0003D8
```

If all spares are used (which will rarely happen), the following will appear:

```
REPLACE FAILED - RCT IS FULL
```

If this condition occurs, the disk must be reformatted before any further revectoring may be done.

CAUTION

To avoid losing logical blocks, DILOG requires multiple read and replace passes (Item 5 from the Main Menu) for all soft sectored drives. Read and replace until there are no errors. The same technique should also be applied for hard sectored drives.

Q (Subset of R, Replace Bad Blocks)

If Q, Quit, is selected, the program will display the Main Menu.

M (Subset of R, Replace Bad Blocks)

If M, Manually Revector Bad Blocks, is selected from the replace menu, another menu is displayed for which the values must be entered for each defect. The program prompts for FORCE ERROR to set the flag for the operating system. The program prompts to replace and does the replacement. The following are examples:

```
*** *** *** CAUTION *** *** ***
Revectoring is IRREVERSIBLE and can only
be undone by REFORMATTING the disk. MAKE
SURE YOU HAVE VALID DEFECT DATA BEFORE
DOING THIS OPERATION.
*** *** *** *** *** *** *** *** *** ***

Replace Bad Blocks

---------------------------

Select one of the following input formats:

  B - Cylinder, Head, Bytes From Index
  S = Cylinder, Head, Sector
  L - Logical Block Number
  Q - Quit

Enter a selection:

(ENTER Q IN RESPONSE TO ANY PROMPT TO EXIT)
```

B (Subset of M, Manually Revector Bad Blocks)

If B is entered, a display similar to the following will appear:

```
CYL=1186 HEAD=0000 BFI=5212 SET FORCE ERROR (Y/N)? CORRECT (Y/N)?
```

The FORCE ERROR and CORRECT prompts and the replacement results are described below.

S (Subset of M, Manually Revector Bad Blocks)

If S is selected, a display similar to the following will appear:

```
CYL=1186 HEAD=0000 SECTOR=0004 SET FORCE ERROR (Y/N)? CORRECT
                                                      (Y/N)?
```

The prompts and replacement results are described below.

L (Subset of M, Manually Revector Bad Blocks)

If L is selected, the program will prompt for decimal or hexadecimal entries, depending on the current base (toggled by Control B). If decimal, the display will be similar to the following:

```
ENTER 4 MOST SIGNIFICANT DIGITS OF 8 DIGIT
     DECIMAL LBA VALUE - 0012

ENTER 4 LEAST SIGNIFICANT DIGITS OF 8 DIGIT
     DECIMAL LBA VALUE - 3456

LBA=00123456    SET FORCE ERROR (Y/N)?    CORRECT (Y/N)?
```

If hexadecimal, the display will be similar to the following:

```
ENTER 2 MOST SIGNIFICANT DIGITS OF 6 DIGIT HEX
     LBA VALUE - AB

ENTER 4 LEAST SIGNIFICANT DIGITS OF 6 DIGIT HEX
     LBA VALUE - CDEF

LBA=ABCDEF    SET FORCE ERROR (Y/N)?    CORRECT (Y/N)?
```

The prompts and replacement results are described below.

Q (Subset of M, Manually Revector Bad Blocks)

If Q is selected, the program will display the previous menu.

If responses to both FORCE ERROR and CORRECT prompts are Yes, a display similar to the following will appear:

```
REPLACING LBN 00483484 WITH RBN 00014225 - FORCE ERROR SET
```

If the prompt for SET FORCE ERROR is No, and CORRECT is Yes, the response will be as above without FORCE ERROR SET.

Other combinations of responses will present the Replace Menu: B, S, L, Q.

S (Subset of R, Replace Bad Blocks)

If S, Summarize Present RCT State, is selected from the replace menu, the program will list the Replacement Block Number for the Logical Block Number being replaced. The program will also specify if the Replacement Blocks is at the end of the track on which the LBN resides (primary) or on another track on which the LBN being replaced does not reside (non-primary). The program will also specify unusable RBNs. The summary will list total spares, unused spares, primary and non-primary allocated spares, and unusable spares. The following is an example:

```
          ESDI DRIVE 02 (DU01) SELECTED

     Replace Bad Blocks
     ------------------

     RBN 00000200 IS ALLOCATED (PRIMARY)     FOR LBN 00006811
     RBN 00000251 IS ALLOCATED (NON-PRIMARY) FOR LBN 00008541
     RBN 00000263 IS UNUSABLE
     RBN 00000344 IS ALLOCATED (PRIMARY)     FOR LBN 00011725

     TOTAL SPARES                    = 00014568
     UNUSED SPARES                   = 00014564
     ALLOCATED (PRIMARY) SPARES      = 00000002
     ALLOCATED (NON-PRIMARY) SPARES  = 00000001
     UNUSABLE SPARES                 = 00000001

     Press RETURN to Continue
```

READ/WRITE RANDOM SECTORS TEST

When T is entered from the Main Menu, the program either reads or writes, reads, and compares data randomly over the user portion of the drive (Host area). The pattern written corresponds to cylinder, head, and sector. The default value of NUMBER OF PASSES is infinite unless the CONTROL A or CONTROL C keys are pressed, in which case the program will return to the Main Menu. When T is entered, the following will appear:

```
Read/Write Random Sectors Test
------------------------------
(R)EAD TEST OR (W)WRITE/READ TEST [R]?
NUMBER OF PASSES [INFINITE]?
```

R - If the response is R (or any key other than W), the following will appear:

```
Read/Write Random Sectors Test
------------------------------
(CTRL-C ABORTS TO MAIN MENU)
CYLINDER ADDRESS XXXX
```

The XXXX above represents the random cylinder address displayed.

If an error occurs, the program will display the error and continue with the test. The error display will be similar to the following:

```
CYL=0014 HEAD=0000 SECTOR=0013 LBA=00005545 READ DATA ERROR UNCOR-
                                                          RECTABLE
```

W - If W, write, is selected, the following will appear:

```
Read/Write Random Sectors Test
------------------------------
(R)EAD TEST OR (W)RITE TEST [R] W

*** *** ***   CAUTION   *** *** ***
If you continue, ALL data will be lost
      on the selected drive!!!!
*** *** *** *** *** *** *** *** *** ***

1                 - continue
<ANY OTHER KEY> - abort, return to Main Menu

Enter a selection
```

The cylinder address will be displayed as in the read test, and if an error appears, it will be displayed as in the read test.

WRITE, READ, AND COMPARE DRIVE DATA

When W is entered from the main menu, the program checks the complete data path between the controller and the drive by writing and reading to and from the disk and comparing data. This option also ensures revectoring was successful. An example of the first prompt is as follows:

```
          ESDI DRIVE 01 (DU00) SELECTED                    DECIMAL

     Write, Read, and Compare Drive Data
     -----------------------------------

      *** *** *** CAUTION *** *** ***
     If you continue, ALL data will be lost
     on the selected drive!!!
     *** *** *** *** *** *** *** *** *** ***

     1               - Continue
     <ANY OTHER KEY> - Abort, Return to Main Menu

     Enter a selection:
```

The program will list the current cylinder (if a CRT is used) until a compare error occurs. An example is as follows:

```
          ESDI DRIVE 01 (DU00) SELECTED                    DECIMAL

     Write, Read, and Compare Drive Data
     -----------------------------------

     (CTRL-A ABORTS TO NEXT STEP, CTRL-C ABORTS TO MAIN MENU)


     WRITING DATA
     CYLINDER ADDRESS:  XXXX

     CYL=0082 HEAD=0011 SECTOR=0001 LBA=00033424
          WRITE, READ, COMPARE TEST ERROR
```

If the remote panel is used and the WRITE PROTECT switch is ON, the following will appear:

```
*** DRIVE IS WRITE PROTECTED ***
```

DIAGNOSTICS

Two DEC RC25 diagnostics may be used to test the controller. They are ZRCFB3, Front End Test, and ZRCDA1, Disk Exerciser.

SETUP AND SELF TEST

Install the controller as described in Section 2. Apply power to the system, and verify that the green LED lights. Install the XXDP+ diagnostic floppy in the floppy drive and boot the system. When the boot switch on the system is toggled, the LED will go out, but will light again when the controller is brought online by the diagnostic.

When booting is completed, the XXDP+ sign-on will appear:

```
XXDP-SM SMALL MONITOR VERSION 2
BOOT FROM DY0
28KW MEMORY
UNIBUS SYSTEM

RESTART ADDR: 152010
THIS IS XXDP-SM  TYPE "H" OR "H/L" FOR HELP
```

(NOTE: 28KW = 28 Kilowords)

FRONT END TEST ZRCFB3

The controller will only support tests 1-8 which must be selected by the user. These tests will bring the controller through initialization several times and do extensive checks on the DMA capability. Once the prompt "." has appeared, type the following command line to start ZRCFB3 diagnostic:

```
.R ZRCFB3
```

The system will echo the filename to let the user know that the file is being loaded.

```
.R ZRCFB3
ZRCFB3.BIN
```

When the diagnostic has been loaded, the diagnostic startup message will appear on the user's console.

```
DRSSM-F0
CZRCF-A-0
RC25 FRONT END/HOST DIAGNOSTIC
UNIT IS AZTEC RC25 PLATTER
RSTRT ADR 145676

DR>
```

The diagnostic can be started by typing the following command line:

```
DR>START/TEST:1-8<CR>
```

The above command line instructs the diagnostic supervisor to start the test but initiate only tests 1 through 8. The supervisor will then prompt the user for hardware or software changes.

```
CHANGE HW (L)  ?
```

The diagnostic must be informed of the hardware parameters of the system under test. Enter the following information.

```
CHANGE HW (L)  ? Y<CR>
```

Enter the number of controllers that are being tested.

```
# UNITS (D)  ? 1<CR>
```

The diagnostic will then prompt the user to enter the following information for the number of units that have been selected. The following is an example:

```
UNIT 0
IP ADDRESS (O)  172150  ? <CR>
VECTOR (O)  154  ? <CR>
BR LEVEL (O)  5  ? <CR>
PLATTER ADDRESS[ES] (D)  ? 0<CR>
```

The platter address is the unit number of the disk drive under test. Since the controller does not support the tests which require a disk, this question is not appropriate but must be answered to start the diagnostic. Once the hardware questions are answered, the supervisor will prompt for software changes.

```
CHANGE SW (L)  ?
```

The software question can be answered NO because the controller does not support the tests which require a disc drive.

```
CHANGE SW (L)  ? N<CR>
```

The diagnostic will print each test as it runs and will inform the user of any errors that occur.

```
TESTING UNIT #:   0     IP_REGISTER:172150      PLATTER #: 0

TEST  1  REGISTER EXISTENCE TEST
TEST  2  STEP 1 READ/WRITE POWERUP DIAGNOSTICS
TEST  3  DIAGNOSTIC WRAP TEST
TEST  4  VECTOR AND BR LEVEL TEST
TEST  5  STEP 1-3 READ/WRITE DIAGNOSTIC
TEST  6  PURGE POLL TEST
TEST  7  SMALL RING TEST
TEST  8  LARGE RING TEST
```

When the diagnostic has completed all the tests, the end of pass message will be printed and the diagnostic will be restarted.

```
DZRCF    EOP     1
         0  TOTAL ERRORS

DR>EXIT<CR>
```

DISC EXERCISER, ZRCDA1

The controller is also compatible with the multi-drive exerciser, ZRCDA1. This diagnostic will bring the controller online and issue random record numbers to the selected unit(s). This diagnostic also supports multiple controllers as well as multiple units on a single controller.

Once the XXDP prompt "." is displayed, run ZRCDA1 by typing the following command line:

```
.R ZRCDA1<CR>
```

The system will echo the filename to inform the user that the program is being loaded:

```
.R ZRCDA1
 ZRCDA1.BIN
```

Once the diagnostic is loaded, the diagnostics startup message will be displayed on the user's console:

```
DRSSM-F0
CZRCD-A-0
RC25 DISC EXERCISER
UNIT IS SINGLE RC25 PLATTER
RSTRT ADR 145676

DR>
```

Patch as follows:

	ADDRESS	IS	SHOULD BE
PATCH 1	26070	16237	12737
	26072	50	143326
PATCH 2	30644	1003	1367
PATCH 3	30704	1003	1367
PATCH 4	37522	1416	240

Start the test after the diagnostic supervisor prompt "DR>" appears.

```
DR>START<CR>
```

The supervisor will then prompt the user to change hardware or software default parameters:

```
CHANGE HW (L)  ?
```

The diagnostic must be informed of the hardware parameters of the system under test. Enter the following command line to change hardware parameters:

```
CHANGE HW (L)  ? Y<CR>
```

Enter the number of controllers or drives that are currently being tested:

```
# UNITS (D)  ? 1<CR>
```

If 2 is entered the next prompt will appear twice so that the second controller or second drive may be selected.

The diagnostic will prompt the user to enter the following information for the number of units that have been selected:

```
UNIT 0
IP ADDRESS (O) 172150  ? <CR>
VECTOR (O) 154  ? <CR>
BR LEVEL (D)  5  ? <CR>
PLATTER ADDRESS (UNIT PLUG) (D)  0  ? <CR>
ALLOW WRITES TO CUSTOMER DATA AREA ON THIS PLATTER (L)  ?  Y<CR>
** WARNING - CUSTOMER DATA AREA MAY BE OVERWRITTEN! ...
   CONFIRM (L)  ? Y<CR>
```

The platter address is the unit number of the disk drive under test. The customer data area is the host data area of the disk drive and is used to test the controller. Backup any data in the host partition, if necessary, before continuing with the diagnostic.

After the hardware questions are answered, the supervisor will prompt the user for any software changes:

```
CHANGE SW (L)  ?
```

The user can take the default software values because the drives are larger than an RC25. If the tests are being run on a contracted unit, some of the software values may have to be changed to prevent errors from occurring.

If the selected unit is fully formatted, use the default values by typing NO to the software query:

```
CHANGE SW (L)  ? N<CR>
```

To change the software default values, answer YES to the software query:

```
CHANGE SW (L)  ? Y<CR>
```

The user will then be prompted by the supervisor to input the following information:

ERROR LIMIT (0 FOR NO LIMIT) (D) 32 ? <CR>

Enter the error limit that must be reached before a unit is deselected by the diagnostic. The default value of 32 is used.

TRANSFER LIMIT IN MEGABYTES (0 FOR NO LIMIT) (D) 2 ? <CR>

Enter the number of bytes to be transferred between the controller and the diagnostic. Effectively, this selects the time required to reach an END OF PASS.

SUPPRESS PRINTING ERROR LOG MESSAGES (L) Y ? <CR>

The default value should be used unless multiple errors occur and more information is required to resolve the problem.

RUN DM EXERCISER INSTEAD OF MULTI-DRIVE SUBTEST (L) N ? <CR>

The default must always be taken because the controller does not support Diagnostic Mode (DM) of operation.

RANDOM SEEK MODE (L) Y ? <CR>

The best possible test is to seek randomly across the entire disk surface. Therefore, the default value should be used.

STARTING TRACK (D) 0 ? <CR>

The starting track number is to be entered. (Because the controller does not emulate the RC25, the questions regarding starting and ending track numbers do not apply. If the unit under test is fully formatted and is more than 40 megabytes, the diagnostic will not overflow the cylinder address.)

ENDING TRACK (D) 1641 ? <CR>

Enter the ending track number. If the unit is larger than an RC25 unit (40 megabytes), the default can be used.

READ-COMPARES PERFORMED AT THE CONTROLLER (L) Y ? <CR>

The default value is used to require the controller to compare the data read with host memory.

THE REMAINING QUESTIONS APPLY ONLY TO UNPROTECTED PLATTERS.

The user can use the default values for the remaining questions.

WRITE ONLY (L) N ? <CR>

The disk drive under test is never a write only disk; therefore, always take the default.

```
WRITE-COMPARES PERFORMED AT THE CONTROLLER (L) Y ? <CR>
```

The controller will perform write checks if the default is taken.

```
CHECK ALL WRITES AT HOST BY READING (L) N ? <CR>
```

The diagnostic will NOT issue read commands to check the data just written if the default is taken. Otherwise, the diagnostic software will perform the write check function.

```
USER DEFINED DATA PATTERN (L) N ? <CR>
```

The data pattern used in the diagnostic is worst case. To ensure prompt testing, always use the default value.

```
SELECT PREDEFINED DATA PATTERN (0 FOR SEQUENTIAL SELECTION)
(D) 0 ? <CR>
```

Always use the default value.

The test will begin after the hardware and software questions are answered.

```
INIT SUBTEST START

ABOUT TO VERIFY VECTOR 154(0) FOR DEVICE 172150(0) ...COMPLETED
```

The diagnostic will run until the transfer limit is reached. After the limit has been reached, the diagnostic will print status information about the unit under test and display the END OF PASS message:

```
CZRCD EOP      1
   0 TOTAL ERRS
```