CDU-710 SINGLE-ENDED

CDU-712 SINGLE-ENDED/DIFFERENTIAL

INTELLIGENT

UNIBUS SCSI HOST ADAPTER

CMD TECHNOLOGY INC.

CDU-710 SINGLE-ENDED

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UNIBUS SCSI HOST ADAPTER

CMD TECHNOLOGY, INC.

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CDU-710 Rev 2.4
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FCC WARNING

This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the technical 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 Federal Communications Commission (FCC) Rules, which are designed to provide reasonable protection against such interference when operating 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

LIST OF FIGURES

LIST OF TABLES

3

CHAPTER 1   INTRODUCTION

CDU-710 , CDU-712 UNIBUS SCSI MSCP/TMSCP DISK/TAPE CONTROLLER

The CDU-710 is an intelligent quad-wide Unibus SCSI host adapter which is fully compatible with the DEC Mass Storage Control Protocol (MSCP) and the DEC Tape Mass Storage Control Protocol (TMSCP).

The CDU-710 can be used with the PDP-11/84, PDP-11/70, PDP-11/44, PDP 11/34, PDP 11/24, VAX 11/730, VAX 11/750, VAX 11/780, VAX 8250, VAX 8350, VAX 8550, VAX 8600, VAX 8800 and other DEC computers with a UNIBUS. It supports RSX, RSTS, VMS, UNIX, ULTRIX, DSM-11, and other operating systems which use the DU/MU drivers.

The CDU-710 supports 16K bytes data buffer, command queuing, standard SCSI bus arbitration, disconnect and reconnect, and all required SCSI commands. Up to seven single-ended SCSI target devices (magnetic disk and tape) can be connected to CDU-710 with SCSI bus data transfer rate up to 2M bytes per second.

The CDU-710 supports a variety of SCSI devices including magnetic disk, magnetic tape and optical disk drives. The CDU-710/M is the SCSI host adapter that supports disk drives only. The CDU-710/T is the SCSI host adapter that supports tape drives only. The CDU-710/TM supports both disk and tape drives, etc.

The CDU-710/M has an on-board utility for users to configure and format drives, scan bad blocks and replace them automatically. The logical unit number offset is stored in an on-board non-volatile RAM (NOVRAM).

The CDU-710 comes standard with an installation manual, and one year warranty.

The CDU-712 consists of CDU-710 and on-board differential SCSI drivers and receivers. Users can select either single-ended mode or differential mode. Please refer to section 3.1.2 for details.

CHAPTER 2   CDU-710,CDU-712 SPECIFICATIONS

2.1   UNIBUS CONTROLLER SPECIFICATIONS:

Emulation   DISK: MSCP   (DU driver)
             TAPE: TMSCP   (MU driver, same as TK50 and TU81)

CSR Address:
CDU-710/M (Disk only)   772150, 760334, 760354, 760374,
IC P70011B   760340, 760344, 760350, 760360

CDU-710/T (Tape only)   774500, 760404, 760444, 760504,
IC P70012B (U102)   760544, 760410, 760450, 760454

IC P70012C (U102)   Support 30 CSR, please see Appendix D

CDU-710/TM   772150, 760334, 760354   (Disk)
(Disk and Tape)   774500, 760404, 760444   (Tape)
IC P70013A

Interrupt Vector: Software Programmable
Command Queuing: 16 commands
Data Buffer Capacity: 16K bytes data buffer
Bootstrap: Auto bootstrap or utility bootstrap
Formatting: On-board format and bad block replacement
Software Supported: All standard DEC operating systems
                         that use the DU/MU driver

Peripheral Interface: Small Computer System Interface (SCSI)

Devices Supported: Up to 7 SCSI devices
                         CDU-710/T 7 Tape Dives
                         CDU-710/M 7 Disk Drives
                         CDU-710/TM 4 Disk and 3 Tape Drives

System Performance: Support disconnect/reconnect
SCSI Transfer Rate: 2MB/sec (maximun).
SCSI Bus Parity: Odd parity
SCSI Driver/receiver: CDU-710 supports Single-ended
                         CDU-712 supports Single-ended/Differential
SCSI Cable Length: CDU-710 up to 6 meters (Single-ended)
                         CDU-712 up to 25 meters (Differential)

Operating Temperature: 5 C to 50 C
Relative Humidity: 10% to 90%, Non-condensing
Power Requirement: +5V DC, 2.8A

5

CHAPTER 3   INSTALLATION

3.1   CDU-710 Jumper Settings

3.1.1   CSR Address Selection

The CDU-710 has jumpers to select different CSR addresses. Select the desired address by installing the jumper plugs. The standard address for the CDU-710/M is 772150. The standard address for the CDU-710/T is 774500.

A new IC P70012C has been installed at location U102 of the CDU-710/T to support 30 tape CSR addresses. Only 8 CSR jumper settings are shown in the following table. Please refer to Appendix D for the other 22 CSR jumper settings.

CSR Address		W11	W15	W12	W13	W14
Standard:	17774500	2-3 IN	1-2 IN	1-2 IN	1-2 IN	2-3 IN
Second:	17760404	2-3 IN	1-2 IN	2-3 IN	1-2 IN	2-3 IN
Third:	17760444	2-3 IN	1-2 IN	1-2 IN	2-3 IN	2-3 IN
Forth:	17760504	2-3 IN	1-2 IN	2-3 IN	2-3 IN	2-3 IN
Fifth:	17760544	2-3 IN	1-2 IN	1-2 IN	1-2 IN	1-2 IN
Sixth:	17760410	2-3 IN	1-2 IN	2-3 IN	1-2 IN	1-2 IN
Seventh:	17760450	2-3 IN	1-2 IN	1-2 IN	2-3 IN	1-2 IN
Eighth:	17760454	2-3 IN	1-2 IN	2-3 IN	2-3 IN	1-2 IN

The old IC P70012B at location U102 of the CDU-710/T only supports 8 CSR addresses. The CSR jumper settings are the same as those shown in the above table.

The CSR jumper setting for the CDU-710/M (Disk only) with IC P70011B at U102:

CSR Address		W12	W13	W14
Standard:	17772150	1-2 IN	1-2 IN	2-3 IN
Second:	17760334	2-3 IN	1-2 IN	2-3 IN
Third:	17760354	1-2 IN	2-3 IN	2-3 IN
Forth:	17760374	2-3 IN	2-3 IN	2-3 IN
Fifth:	17760340	1-2 IN	1-2 IN	1-2 IN
Sixth:	17760344	2-3 IN	1-2 IN	1-2 IN
Seventh:	17760350	1-2 IN	2-3 IN	1-2 IN
Eighth:	17760360	2-3 IN	2-3 IN	1-2 IN

The CSR jumper setting for the CDU-710/TM (Disk and Tape) with IC P70013A at U102:

```
        Tape  CSR Address       W12       W13
        ---------------------   ----------------
        Standard:   17774500    1-2 IN    1-2 IN
        Second:     17760404    2-3 IN    1-2 IN
        Third:      17760444    1-2 IN    2-3 IN
        Disable Tape            2-3 IN    2-3 IN

        Disk  CSR Address       W14       W15
        ---------------------   ----------------
        Standard:   17772150    1-2 IN    1-2 IN
        Second:     17760334    2-3 IN    1-2 IN
        Third:      17760354    1-2 IN    2-3 IN
        Disable Disk            2-3 IN    2-3 IN
```

If users require other CSR addresses than listed, please cousult CMD Technology.

3.1.2 Single-ended or Differential Mode Selection

When a jumper shunt is installed in W2 pin 2-3 location, single-ended SCSI drivers and receivers are enabled. When a jumper shunt is installed in W2 pin 1-2 location, the differential drivers and receivers are enabled.

The CDU-710 comes with single-ended SCSI drivers and receivers and a jumper shunt installed in W2 pin 2-3 location. The connector J3 is used for single-ended SCSI.

The CDU-712 comes with both single-ended and differential SCSI drivers and receivers. A jumper shunt is installed in W2 pin 2-3 location, i.e. single-ended mode is selected. The connector J2 is used for differential SCSI. Users who want to use CDU-712 in differential mode need to install a jumper shunt in W2 pin 1-2 location , disconnect the single-ended target devices from the connector J3 and connect the differential target devices to the connector J2 of the CDU-712. Whem power is applied to the CDU-712, the corresponding green LED right next to the selected SCSI connector will be on. Please refer to section 3.1.8 for LED indications and Figure 1 for SCSI connectors.

Normally, the power on/off protection selection is jumpered to match the SCSI mode selected. Please refer to section 3.1.10.

3.1.3 SCSI Host Adapter (Initiator) ID Selection

Each device (Initiator or Target) on the SCSI bus requires an unique SCSI Identification address (0-7). SCSI ID 7 has the highest priority on the bus. SCSI ID 0 has the lowest priority on the bus. The SCSI Host Adapter of CDU-710 is factory configured to SCSI ID 7. To alter the Host Adapter SCSI ID, users need to change jumper setting of SW1-3, SW1-4 and SW1-5.

SW1-5	SW1-4	SW1-3	Initiator ID	
ON	ON	ON	7	Highest priority
ON	ON	OFF	6	
ON	OFF	ON	5	
ON	OFF	OFF	4	
OFF	ON	ON	3	
OFF	ON	OFF	2	
OFF	OFF	ON	1	
OFF	OFF	OFF	0	lowest priority

Note: Do not have more than one device on the SCSI bus with the same SCSI ID. The CDU-710 should always have a higher priority than the drives on the SCSI bus.

3.1.4 SCSI Target ID Selection

Each SCSI device on (Initator or Target) on the SCSI bus requires an unique SCSI ID. Since the CDU-710 SCSI host adapter requires the highest priority, it is configured to SCSI ID 7. The SCSI ID of the target devices should be set from SCSI ID 0 to 6.

The CDU-710/T supports 7 tape drives. The SCSI ID of the tape drives should be configured as such:

CDU-710/T Tape Drive	SCSI ID	VMS device name
First Tape	0	MUA0
Second Tape	1	MUA1
Third Tape	2	MUA2
Forth Tape	3	MUA3
Fifth Tape	4	MUA4
Sixth Tape	5	MUA5
Seventh Tape	6	MUA6

The CDU-710/M supports 7 disk drives.   The SCSI ID of the   disk
drives should be configured as such:

CDU-710/M	Disk Drive	SCSI ID	VMS device name
	First Disk	0	DUA0
	Second Disk	1	DUA1
	Third Disk	2	DUA2
	Forth Disk	3	DUA3
	Fifth Disk	4	DUA4
	Sixth Disk	5	DUA5
	Seventh Disk	6	DUA6
		7	PUA0 (CDU-710/M)

The CDU-710/TM supports 4 disk drives and 3 tape drives.   The
SCSI ID of the disk and tape drives should be configured as such:

CDU-710/TM		SCSI ID	VMS device name
Disk:	First Disk	0	DUA0
	Second Disk	1	DUA1
	Third Disk	2	DUA2
	Forth Disk	3	DUA3
Tape:	First Tape	4	MUA0
	Second Tape	5	MUA1
	Third Tape	6	MUA2
		7	PUA0/PTA0 (CDU-710/TM)

When connecting more than one device to the CDU-710, be sure that
the SCSI Bus is terminated correctly. (see section of SCSI Bus
termination.)

9

3.1.5   SCSI Terminator Power Option

The CDU-710 supplies terminator power to the TERMPWR pin (pin 26) of single-ended SCSI connector (J3) through a diode, a fuse and jumper block W3 for external SCSI drives. In order to prevent accidental grounding or misconnection of terminator power, no jumper shunt is installed in W3 location. To use this option, users should add a jumper shunt in W3 location. Please make sure that the pin 1 mark of SCSI cable matches with the pin 1 mark of SCSI device's connector before turning on the system power.

W3	OUT	Single-ended SCSI terminator power disabled
W3	IN	Single-ended SCSI terminator power enabled

The CDU-712 supplies terminator power to the TERMPWR pins (pin 25 and pin 26) of differential SCSI connector (J2) through a diode, a fuse and jumper block W1 for external SCSI drives. In order to prevent accidental grounding or misconnection of terminator power, no jumper shunt is installed in W1 location. To use this option, users should add a jumper shunt in W1 location. Please make sure that the pin 1 mark of SCSI cable matches with the pin 1 mark of SCSI device's connector before turning on the system power.

W1	OUT	Differential SCSI terminator power disabled
W1	IN	Differential SCSI terminator power enabled

Please note that when the Exabyte tape drive is connected to the CDU-710 or CDU-712, the terminator power option needs to be enabled.

3.1.6   Tape Mode Select

The CDU-710/T will support ANSI variable mode tape format and fixed block mode format. The advantage of ANSI mode is media interchangeable. Tapes written by the CDU-710/T in ANSI variable mode tape format can be read by the SCSI host adapter of other computer systems that follow the ANSI format.

SW1-1	SW1-2	TAPE FORMAT SELECT
OFF	OFF	Fixed Block Mode
ON	OFF	ANSI Variable Mode but can read tapes written in Fixed Block Mode
ON	ON	ANSI Variable Mode

10

```
Configuration Chart:          SW1-1     SW1-2

     EXABYTE Drive            ON        ON
     GigaTrend DAT            ON        ON
     Fujitsu 1/2 inch         ON        ON
     Wangtek 1/4 inch         OFF       OFF
     Archive 1/4 inch         OFF       OFF
     Tandberg 1/4 inch        OFF       OFF
     Caliper 1/4 inch         OFF       OFF
```

Note: 1/4 inch tape streaming tape drives which does not support variable mode will be written in fix block mode even if the switch is is set to ANSI variable mode.

3.1.7   Tape Fast Search Option

When set to the Tape Fast Search mode, the controller will enable high speed forward and reverse filemark search. VMS may use this mode if the user does not attempt a standalone boot or run other programs that require the controller to keep track of the number of data records between filemarks. In VMS standalone boot application, this option need to be disabled. For the ISM-11 operating system, SW1-6 need to be set to ON position.


```
     SW1-6   OFF    Disable Tape Fast Search
             ON     Enable Tape Fast Search
```

3.1.8   LED Indicators

The CDU-710 has three LED's in the front of the board. The LED's are labeled DS2, DS3 and DS4.

LED	COLOR	INDICATIONS
DS2	Green	Single-ended SCSI mode selected.
DS3	Red	Error condition occured.
DS4	Green	Power up OK and activity indicator. On power up, this LED is turned on when the CDU-710 suceeds in the self-diagnostic testing. The LED blinks to show controller activity.

The CDU-712 has four LED's in the front of the board. The LED's
are labeled DS1, DS2, DS3 and DS4.

LED   COLOR   INDICATIONS

DS1   Green   Differential SCSI mode selected.

DS2   Green   Single-ended SCSI mode selected.

DS3   Red   Error condition occured.

DS4   Green   Power up OK and activity indicator.   On power up,
                   this LED is turned on when the CDU-712 succeeds
                   in the self-diagnostic testing. The LED blinks to
                   show controller activity.

3.1.9   Auto-Boot Enable Selection

For PDP-11 disk users only, the CDU-710 may be set to provide an
auto-bootstrap at 771000 or 773000 on power up or whenever the
"Boot" switch is pressed. The auto-bootstrap may be enabled by
installing a jumper shunt in jumper block W5 pin 2 and pin 3.

          W5   2-3 IN   Auto-Boot enabled
                    1-2 IN   Auto-Boot disabled

          W11   2-3 IN   Bootstrap address = 771000
                    1-2 IN   Bootstrap address = 773000

If enabled, the bootstrap ROM at 771000 (or 773000) on the CDU-
710 will load the boot block to memory.   The boot program then
bootstraps the operating system. Please make sure that there is
no existing boot ROM at that address selected by W11. The
controller will only auto-boot DU0: at CSR 772150. To boot other
devices use Utility boot. (see section on Utility Boot)

3.1.10   Power On/Off Protection

Circuits are added (from hardware revision B and up) to protect
the SCSI bus from glitching when user turns on or off the power
of the CDU-710 or CDU-712. This feature can be very useful when
the CDU-710/712 is used in the multiple host (initiator)
configuration. User can turns off the power of one SCSI host,
while the other host is accessing the shared SCSI devices. To
enable the protection circuit of the single-ended SCSI port, a
jumper shunt need to be installed in W18 pin 2-3. To enable the
protection circuit of the differential SCSI port, a jumper shunt
need to be installed in W18 pin 1-2.

12

Note that dark square mark in the diagram indicates pin 1.

Differential SCSI connector

Single-ended SCSI connector
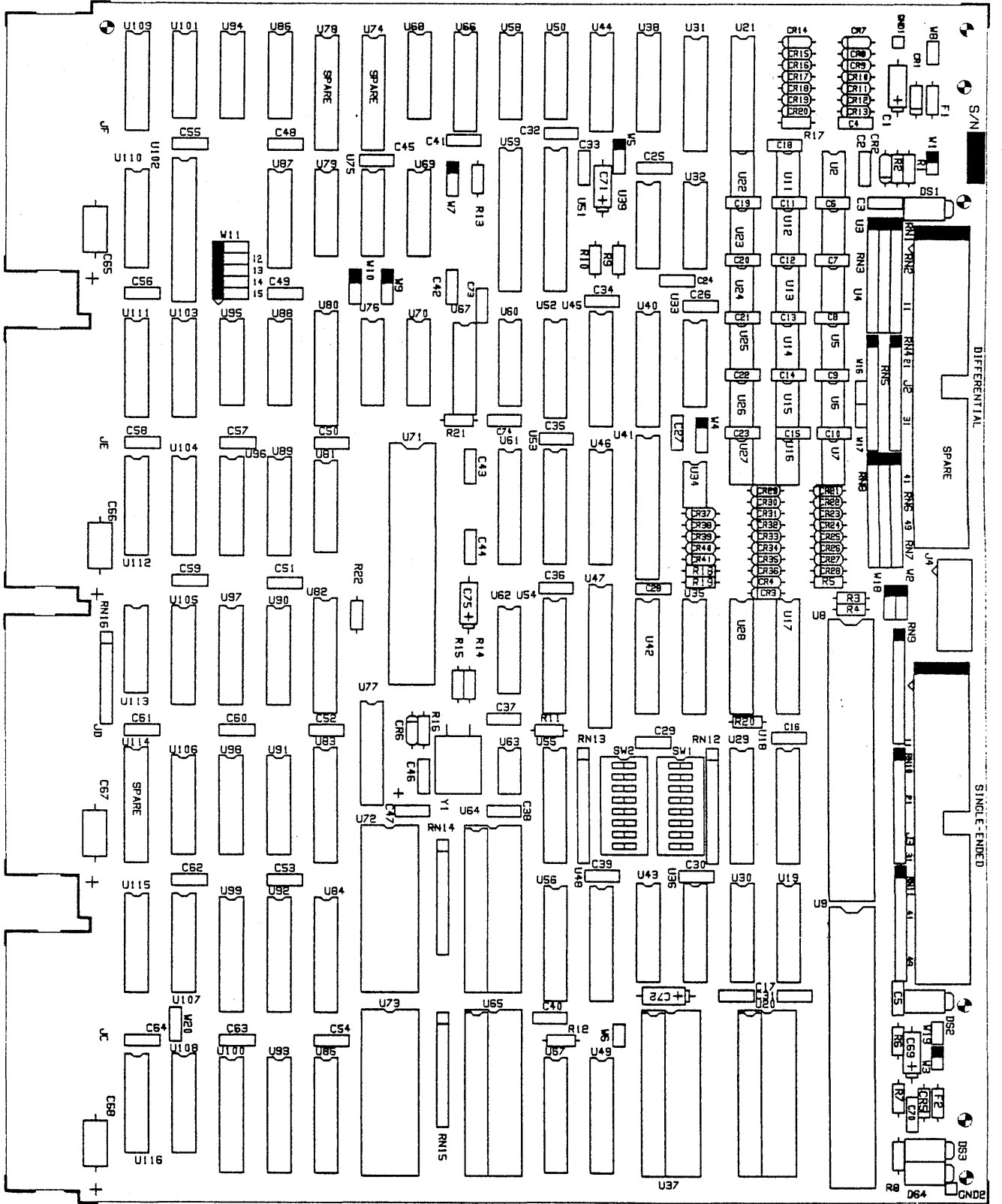
Figure 1   Jumper block location diagram Rev. A

Table 1   Jumper Setting on the CDU-710

SW1-1	SW1-2	TAPE RECORDING MODE SELECT
OFF	OFF	Fixed Block Mode
ON	OFF	ANSI variable mode (Can read tapes written in Fixed Block Mode)
ON	ON	ANSI variable mode

SW1-6	OFF	Normal operation (F)
	ON	Tape Fast Search enabled
SW1-7	OFF	Reserved (F)
SW1-8	OFF	Reserved (F)

SW1-5	SW1-4	SW1-3	Initiator ID	
ON	ON	ON	7	CDU-710 (F)
ON	ON	OFF	6	
ON	OFF	ON	5	
ON	OFF	OFF	4	
OFF	ON	ON	3	
OFF	ON	OFF	2	
OFF	OFF	ON	1	
OFF	OFF	OFF	0	

SW2	OFF	All Reserved (F)

W1	OUT	Differential SCSI terminator power disabled(F)
W1	IN	Differential SCSI terminator power enabled

W2	1-2 IN	Differential SCSI mode selected
W2	2-3 IN	Single-ended SCSI mode selected (F)

W3	OUT	Single-ended SCSI terminator power disabled(F)
W3	IN	Single-ended SCSI terminator power enabled

W4	1-2 IN	Reserved (F)

W6,W8,W16,W17,W19,W20 Reserved (F)

W7	1-2 IN	4 uS dwell time between DMA (F Disk only)
	2-3 IN	2 uS dwell time between DMA (F Tape, /TM)

W10	W9	
2-3 IN	2-3 IN	1 word per DMA burst (F Tape, /TM)
2-3 IN	1-2 IN	2 words per DMA burst
1-2 IN	1-2 IN	4 words per DMA burst (F Disk only)

14

```
------------------------------------------------------------------
FOR CDU-710/T
     W5         1-2 IN        Reserved (F)
------------------------------------------------------------------
FOR CDU-710/M, CDU-710/TM
     W5         2-3 IN        Auto-Boot Enabled
                1-2 IN        Auto-Boot Disabled (F)

     W11        2-3 IN        Bootstrap address = 771000 (F)
                1-2 IN        Bootstrap address = 773000
------------------------------------------------------------------
```
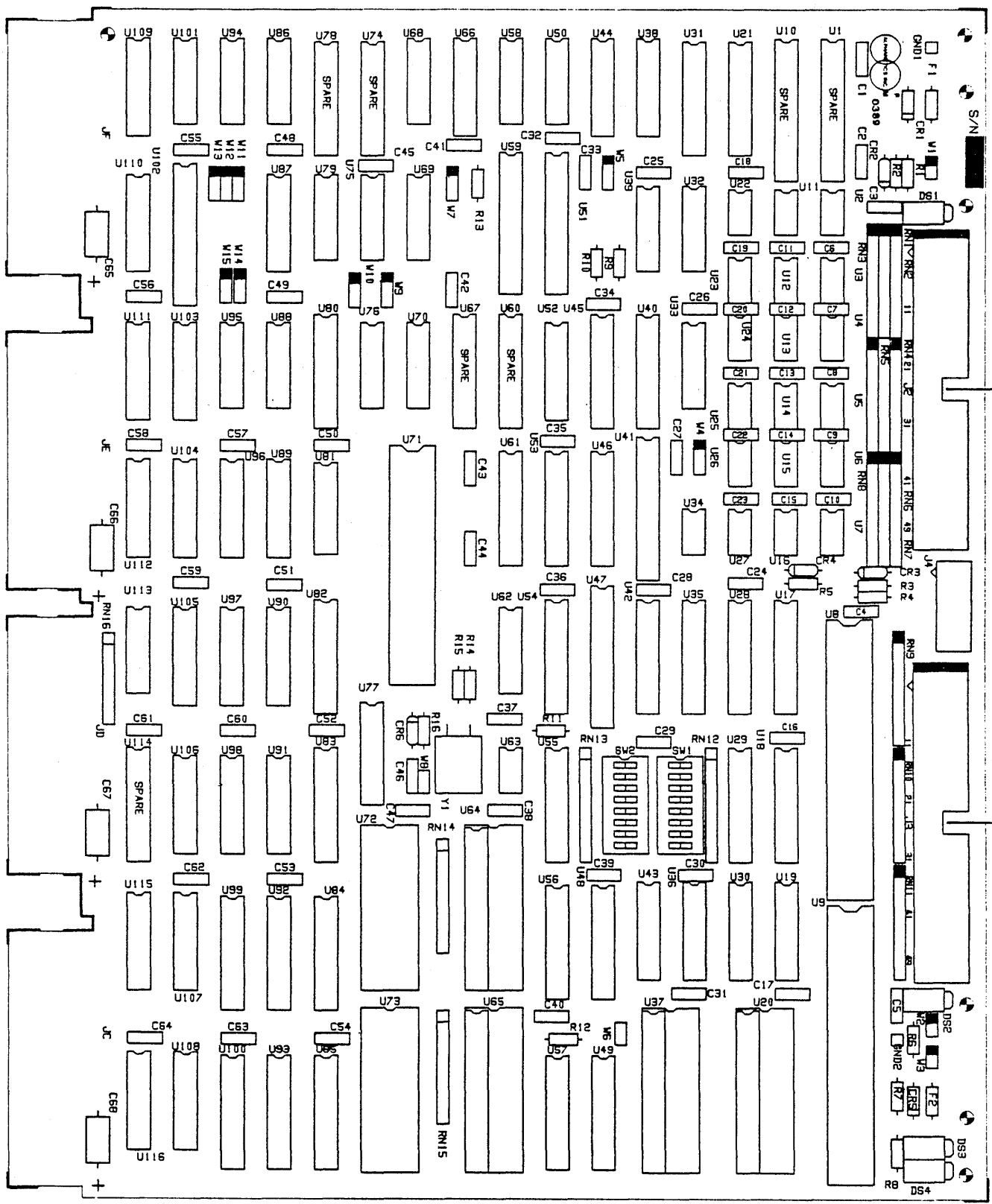CDU-710/T Tape Only with IC P70012C at U102:
Please refer to Appendix D for the other 22 CSR jumper settings.

W11	W15	W12	W13	W14	CSR Address of PDP-11	
2-3 IN	1-2 IN	1-2 IN	1-2 IN	2-3 IN	Standard CSR:	17774500 (F)
2-3 IN	1-2 IN	2-3 IN	1-2 IN	2-3 IN	Second CSR:	17760404
2-3 IN	1-2 IN	1-2 IN	2-3 IN	2-3 IN	Third CSR:	17760444
2-3 IN	1-2 IN	2-3 IN	2-3 IN	2-3 IN	Forth CSR:	17760504
2-3 IN	1-2 IN	1-2 IN	1-2 IN	1-2 IN	Fifth CSR:	17760544
2-3 IN	1-2 IN	2-3 IN	1-2 IN	1-2 IN	Sixth CSR:	17760410
2-3 IN	1-2 IN	1-2 IN	2-3 IN	1-2 IN	Seventh CSR:	17760450
2-3 IN	1-2 IN	2-3 IN	2-3 IN	1-2 IN	Eighth CSR:	17760454

The old IC P70012B at location U102 of the CDU-710/T only
supports 8 CSR addresses. The jumper settings are the same as
those shown above.
```
------------------------------------------------------------------
```
CDU-710/M Disk only with IC P70011B at U102:

W12	W13	W14	CSR Address	
1-2 IN	1-2 IN	2-3 IN	Standard CSR:	17772150 (F)
2-3 IN	1-2 IN	2-3 IN	Second CSR:	17760334
1-2 IN	2-3 IN	2-3 IN	Third CSR:	17760354
2-3 IN	2-3 IN	2-3 IN	Forth CSR:	17760374
1-2 IN	1-2 IN	1-2 IN	Fifth CSR:	17760340
2-3 IN	1-2 IN	1-2 IN	Sixth CSR:	17760344
1-2 IN	2-3 IN	1-2 IN	Seventh CSR:	17760350
2-3 IN	2-3 IN	1-2 IN	Eighth CSR:	17760360

```
     W15        1-2 IN        Reserved
------------------------------------------------------------------
```

```
------------------------------------------------------------------------
CDU-710/TM Tape and Disk with IC P70013A at U102:

     W12        W13              CSR Address

     1-2 IN     1-2 IN           Tape Standard CSR:     17774500  (F)
     2-3 IN     1-2 IN           Tape Second CSR:       17760404
     1-2 IN     2-3 IN           Tape Third CSR:        17760444
     2-3 IN     2-3 IN           Disable Tape

     W14        W15              CSR Address

     1-2 IN     1-2 IN           Disk Standard CSR:     17772150  (F)
     2-3 IN     1-2 IN           Disk Second CSR:       17760334
     1-2 IN     2-3 IN           Disk Third CSR:        17760354
     2-3 IN     2-3 IN           Disable Disk
------------------------------------------------------------------------
     W18      1-2 IN             Enable Differential SCSI multiple host
                                 protection circuit
     W18      2-3 IN             Enable Single-ended SCSI multiple host
                                 protection circuit (F)
------------------------------------------------------------------------



Note:   (F) means factory setting.
Note:   J4 connector is used for in house diagnostic only.
```

3.2 CDU-710 Mounting Slot Selection

The CDU-710 can be installed in any priority on the standard PDP-11 Unibus SPC backplane. The CDU-710 is a DMA device and requires the Nonprocessor Grant (NPG) jumper on the SPC card slot in which the controller is being installed be removed. It is recommended that the CDU-710 be placed in front of other devices on the Unibus except when there is an Ethernet controller which should go first.

The CDU-710 should be inserted into C, D, E, F sockets of a Unibus slot.

3.2.1 NPG Non-Processor Grant Signal

The NPG signal jumper is located at pins CA1 to CB1 on the Unibus backplane. Figure 2 is a DD11-DK nine-slot backplane seen from the rear.

To locate the NPG jumper do the following:

From the rear of the backplane locate the card slot in which the board is to be installed. Note: Each card slot is 4 pins wide.

Locate the C socket and then locate the pins CA1 and CB1. Remove the jumper wire between the two pins.

Figure 2.   WIRE WRAP SIDE OF BACKPLANE

17
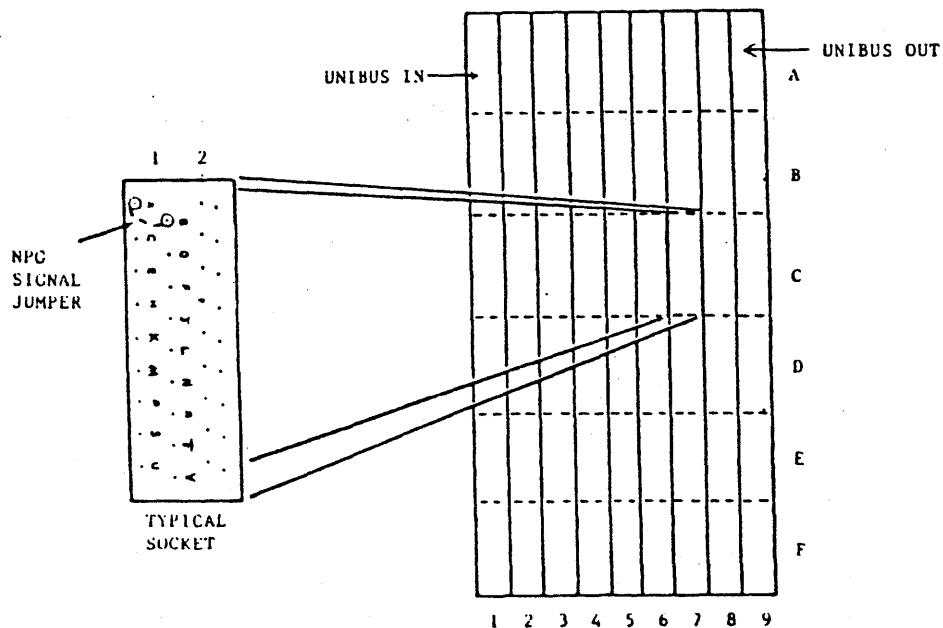
3.3 DMA Burst Length and Dwell Time

The Busrt Length determines how many words the CDU-710 transfers by DMA during each NPR. The Dwell time is the time the CDU-710 waits before it requests for another NPR.

W10	W9	
2-3 IN	2-3 IN	1 word per NPR
2-3 IN	1-2 IN	2 words per NPR
1-2 IN	1-2 IN	4 words per NPR
W7	1-2 IN	4 micro second dwell time
	2-3 IN	2 micro second dwell time

Factory Settings:
  CDU-710/T, CDU-710/TM   1 word per NPR, 2 micro second dwell time
  CDU-710/M, 4 words per NPR, 4 micro second dwell time

IMPORTANT: If the CDU-710 is installed in a VAX BI Unibus (VAX 8350, 8750, etc) the setting must be 1 word per NPR and 2 micro second dwell time.   Data compare errors will occur on the VAX BI Unibus if the throughput is set to more than the BI Unibus adapter can handle.   On the PDP-11 and Non-BI VAX (VAX-730, 750, 780, and others) Unibus the user may set the controller to 4 words per NPR and 4 micro second Dwell time.

3.4   SCSI Bus Cabling and Termination

3.4.1   Single-Ended

The CDU-710 provides a 50-pin connector (J3), to interface with external single-ended SCSI devices.

When the CDU-710 and the external SCSI drives are installed in the same cabinet which meets EMI/RFI shielding requirements, a 50-conductor flat cable or 25-signal twisted-pair cable can be used for connecting the CDU-710 (J3) and the external SCSI drives When the CDU-710 and the external SCSI drives are installed in seperated cabinets, the shielded SCSI cable should be used to meet FCC requirements.

Note that a minimum conductor size of 28 AWG shall be employed to minimize noise effects and ensure proper distribution of optional terminator power. The maximum cable length is 6.0 meters or 20 feet in single ended mode.

The SCSI bus signals should be terminated with 220 ohms to +5 volts and 330 ohms to ground at each end of the cable. The CDU-710 provides on-board removable terminators (RN9,RN10,RN11), which are next to the connector J3. Therefore, the CDU-710 can be installed in any position of the SCSI cable. If the CDU-710 is installed at either end of SCSI cable, the on-board SCSI bus terminators should remain on the board. Otherwise, the on-board SCSI bus terminators should be removed.

3.4.2   Differential

The CDU-712 provides an additional 50-pin connector (J2), to interface with external differential SCSI devices.

When the CDU-712 and the external SCSI drives are installed in the same cabinet which meets EMI/RFI shielding requirements, a 50-conductor flat cable or 25-signal twisted-pair cable can be used for connecting the CDU-712 (J2) and the external SCSI drives When the CDU-712 and the external SCSI drives are installed in seperated cabinets, the shielded SCSI cable should be used to meet FCC requirements.

Note that the twisted pair cable is strongly recommended. Without twisted pairs, even at slow data transfer rates and very short distances, crosstalk between adjacent signals causes spurious pulses with differential signals. Cables should consist of conductors of 26AWG or 28AWG. The two wires of a pair should be connected to the same signal, one to the positive and the other to the negative signal. The maximum cable length is 25 meters or 82 feet in differential mode.

19

Every differential SCSI bus signal pair should be terminated with 330 ohms connected between the negative signal and +5 volts , 330 ohms connected between the positive signal and ground, and 150 ohms connected between the positive and the negative signal at each end of the SCSI cable. The CDU-712 provides on-board removable terminators (RN1,RN2,RN3,RN4,RN5,RN6,RN7,RN8) which are next to the connector J2. Therefore, the CDU-712 can be installed in any position of the SCSI cable. If the CDU-712 is installed at either end of SCSI cable, the on-board SCSI bus terminators should remain on the board. Otherwise, the on-board SCSI bus terminators should be removed.

CHAPTER 4   ON-BOARD UTILITY

4.1   Disk Utility for the CDU-710/M, CDU-710/TM

The CMD Technology Utility Program provides a convenient means of formatting and configuring the drive and configuring the logical unit number offset.   The utility program can be started by means of an ODT command. For Example:

PDP-11/24 SYSTEMS

    1.   Hit the Boot Switch.

    2.   Halt the processor.

    3.   17772152/004400 123456 <CR>   ;DEPOSIT 123456 TO
                                          ; CSR BASE ADDRESS + 2

    4.   17772152/001000 100 <CR>   ;DEPOSIT 100 TO
                                          ; CSR BASE ADDRESS + 2

    5.   5000G   ;5000 and a G
                                          ;The Utility program
                                          ;will begin executing.

Note that the address shown in step 3 is equal to the CSR address selected by jumper W12, W13 and W14 plus 2.

PDP-11/34 SYSTEMS

    1.   Enter ODT mode

    2.   From the terminal type   ; DEPOSIT 123456 TO
         L 772152   <CR>   ; CSR BASE ADDRESS + 2
         D 123456   <CR>

    3.   L 772152   <CR>   ; DEPOSIT 100 TO
         D 100   <CR>   ; CSR BASE ADDRESS + 2

    4.   L 5000   <CR>   ; 5000 and a S
         S   <CR>   ; The Utility program
                                          ; will begin executing.

For the CDU-710/M, the utility will display:

CMD TECHNOLOGY UTILITY PROGRAM
COPYRIGHT 1987, CMD TECHNOLOGY, INC.

```
     SELECT CSR ADDRESS
     1 = 772150                    ;The user will then
     2 = 760334                    ;select the number which
     3 = 760354                    ;matches with the CSR
     4 = 760374                    ;address selected by
     5 = 760340                    ;jumpers W12, W13, W14
     6 = 760344
     7 = 760350
     8 = 760360

     WHICH CSR #
```

For the CDU-710/TM, the utility will display:

CMD TECHNOLOGY UTILITY PROGRAM
COPYRIGHT 1987, CMD TECHNOLOGY, INC.

```
     SELECT CSR ADDRESS
     1 = 772150                    ;The user will then
     2 = 760334                    ;select the number which
     3 = 760354                    ;matches with the CSR
     4 = 774500  (TAPE)            ;address selected by
     5 = 760404  (TAPE)            ;jumpers W12,W13,W14,W15
     6 = 760444  (TAPE)

     WHICH CSR #
```

4.1.1   Configure LUN Offset

LUN Offset: For LSI-11 systems,   each MSCP drive   requires   a different Logical   Unit   Number.   If there are   no   other   MSCP controllers   in   the   system,   then the LUN offset   number   is   0 (Drive   0 will be LUN 0,   and Drive 1 will be LUN   1).   If   there exists   another MSCP controller with 4 LUN units (0 to 3),   then the   LUN offset should be 4.   In this case Drive 0 will be LUN   4 and Drive 1 will be LUN 5.   Normally, when the CDU-710 is used in VMS   operating   system,   the LUN Offset should remain as   factory setting (LUN=0).

The operator   now has 6   options to choose from. To specify or to check   the configuration of a drive,   the operator types in a   2. If   at   any time the operator types in a ctrl C,   the command   is aborted and the utility program returns to the main menu.   If the operator   types in <CR> with no value,   then the parameters   will remain unchange.

In order to store any changes permanently, the user must give the correct password. The password is CMD.

MAIN MENU

        1 = BOOT DRIVE
        2 = CONFIGURE LUN OFFSET
        3 = FORMAT DRIVE
        4 = QUALIFY DRIVE
        5 = MANUAL REPLACE BAD SECTORS
        6 = READ, WRITE AND VERIFY TEST

SELECT OPTION :   2

PRESENT LUN OFFSET = 0, ENTER NEW VALUE:
SAVE NEW CONFIGURATION (Y or N)?   Y
ENTER PASSWORD: CMD

COMPLETE.

4.1.2   Format Drive

Formatting a drive will rewrite all the sectors on the drive. In this option, the CDU-710 issues Format Unit Command to the selected SCSI disk drive and requests it to map out the defects on the Manufacture Defect List (MDL). It is recommended to use qualify drive option after formatting the drive. In order to format or qualify the drive, the correct password is needed. The password is CMD.

        1 = BOOT DRIVE
        2 = CONFIGURE LUN OFFSET
        3 = FORMAT DRIVE
        4 = QUALIFY DRIVE
        5 = MANUAL REPLACE BAD SECTORS
        6 = READ, WRITE AND VERIFY TEST

SELECT OPTION :   3

ENTER DRIVE NUMBER <0 TO 6> :   0

*** WILL DESTROY DATA ON DRIVE 0, ARE YOU SURE?   Y

ENTER PASSWORD: CMD

WAIT.....

COMPLETE.

4.1.3   Qualify Drive

The qualify program will write different patterns into the drive
and then verify the pattern.   If there is any bad sector, the
sector will be automatically replaced.

To ensure a defect free drive, the qualify program should be run
at least 10 passes.

        1 = BOOT DRIVE
        2 = CONFIGURE LUN OFFSET
        3 = FORMAT DRIVE
        4 = QUALIFY DRIVE
        5 = MANUAL REPLACE BAD SECTORS
        6 = READ, WRITE AND VERIFY TEST

SELECT OPTION :   4

ENTER PASSWORD: CMD

QUALIFY DRIVE # <0 TO 6>:   0
*** WILL DESTROY DATA ON THIS DRIVE, ARE YOU SURE?

QUALIFY LOOP 1

TO ABORT, ENTER ^C (CONTROL C).

4.1.4   Manual Replace Bad Sectors

This program allows user to replace bad sectors found in the
future.

        1 = BOOT DRIVE
        2 = CONFIGURE LUN OFFSET
        3 = FORMAT DRIVE
        4 = QUALIFY DRIVE
        5 = MANUAL REPLACE BAD SECTORS
        6 = READ, WRITE AND VERIFY TEST

SELECT OPTION :   5

ENTER PASSWORD: CMD

ENTER DRIVE NUMBER <0 TO 6>:   0

REPLACE LOGICAL BLOCK NUMBER ?   XXXXXX

REPLACE LOGICAL BLOCK XXXXXX. ARE YOU SURE ?   Y

--REPLACED--

4.1.5   Read, Write and Verify Test

This option allows user to test the integrity of the controller
board, drive cable and disk drive. The program will generate
random data patterns for testing.

        1 = BOOT DRIVE
        2 = CONFIGURE LUN OFFSET
        3 = FORMAT DRIVE
        4 = QUALIFY DRIVE
        5 = MANUAL REPLACE BAD SECTORS
        6 = READ, WRITE AND VERIFY TEST

SELECT OPTION :   6

RANDOM READ WRITE TEST
DO YOU WANT READ ONLY ? <Y OR N>

ENTER PASSWORD: CMD

DRIVE NUMBER <0 TO 6>:   0
*** WILL DESTROY DATA ON THIS DRIVE, ARE YOU SURE?

TEST FROM BLOCK # <0-XXXXX> ?

TO BLOCK # <XXXXX-YYYYY> ?

TESTING STARTED. TYPE CTRL-C TO ABORT.

4.1.6   Utility Bootstrap

To bootstrap the operating system on drive 0 to 6, just select
option 1 from MAIN MENU.

        1 = BOOT DRIVE
        2 = CONFIGURE LUN OFFSET
        3 = FORMAT DRIVE
        4 = QUALIFY DRIVE
        5 = MANUAL REPLACE BAD SECTORS
        6 = READ, WRITE AND VERIFY TEST

SELECT OPTION :   1

BOOT DRIVE NUMBER <0 TO 6>   0

BOOT DU0. ARE YOU SURE ?   Y

WAIT ...

25

4.2 Tape Utility for the CDU-710/T, CDU-710/TM

The utility program can be started by means of an ODT command.

For Example:

PDP-11/24 SYSTEMS

1. Hit the Boot Switch.

2. Halt the processor.

3. 17774502/004700 123456 <CR>   ;DEPOSIT 123456 TO
   ; CSR BASE ADDRESS + 2

4. 17774502/001000 100 <CR>   ;DEPOSIT 100 TO
   ; CSR BASE ADDRESS + 2

5. 5000G   ;5000 and a G
   ;The Utility program
   ;will begin executing.

Note that the address shown in step 3 is equal to the CSR address selected by jumper W12, W13, and W14 plus 2.

PDP-11/34 SYSTEMS

1. Enter ODT mode

2. From the terminal type   ; DEPOSIT 123456 TO
   L 774502   <CR>   ; CSR BASE ADDRESS + 2
   D 123456   <CR>

3. L 774502   <CR>   ; DEPOSIT 100 TO
   D 100   <CR>   ; CSR BASE ADDRESS + 2

4. L 5000   <CR>   ; 5000 and a S
   S   <CR>   ; The Utility program
   ; will begin executing.

For the CDU-710/T, the utility will display:

CMD TECHNOLOGY UTILITY PROGRAM
COPYRIGHT 1987, CMD TECHNOLOGY, INC.

```
    SELECT CSR ADDRESS
    1 = 774500                          ;The user will then
    2 = 760404                          ;select the number which
    3 = 760444                          ;matches with the CSR
    4 = 760504                          ;address selected by
    5 = 760544                          ;jumpers W12,W13,W14
    6 = 760410
    7 = 760450
    8 = 760454

    WHICH CSR #
```

For the CDU-710/TM, the utility will display:

CMD TECHNOLOGY UTILITY PROGRAM
COPYRIGHT 1987, CMD TECHNOLOGY, INC.

```
    SELECT CSR ADDRESS
    1 = 772150                          ;The user will then
    2 = 760334                          ;select the number which
    3 = 760354                          ;matches with the CSR
    4 = 774500 (TAPE)                   ;address selected by
    5 = 760404 (TAPE)                   ;jumpers W12,W13,W14,W15
    6 = 760444 (TAPE)

    WHICH CSR #
```


4.2.1   Configure Tape LUN Offset

LUN Offset: For PDP-11 only, TMSCP requires that each TMSCP drive has a different Logical Unit Number. If there are no other TMSCP controllers in your system, then the LUN offset number is 0 (Drive 0 will be LUN 0, and Drive 1 will be LUN 1). If there exists another TMSCP controller with 4 LUN units (0 to 3), then the LUN offset should be 4. In this case Tape Drive 0 will be LUN 4 and Tape Drive 1 will be LUN 5.

The operator now has 1 option to choose from. To configure the LUN offset, the operator types in a 1. If at any time the operator types in a ctrl C, the command is aborted and the utility program returns to the main menu. If the operator types in <CR> with no value, then the parameters will remain unchange.

In order to store any changes permanently, the user must give the correct password. The password is CMD.

27

```
MAIN MENU

     1 = CONFIGURE LUN OFFSET

SELECT OPTION :   1

PRESENT LUN OFFSET = 0, ENTER NEW VALUE:
SAVE NEW CONFIGURATION (Y or N)?    Y
ENTER PASSWORD: CMD

COMPLETE.
```

4.3   ODT Utility

When the CDU-710/M is used in VAX-11/730, 750 , 780 systems, the ODT utility is required to format or qualify a disk drive.

The addresses of IP and SA registers of CDU-710/M for VAX-11/730 and VAX-11/750 are listed in the following table.

OCTAL ADDRESS	HEX ADDRESS
772150	FFF468
772152	FFF46A
760334	FFE0DC
760336	FFE0DE
760354	FFE0EC
760356	FFE0EE
760374	FFE0FC
760376	FFE0FE
760340	FFE0E0
760342	FFE0E2
760344	FFE0E4
760346	FFE0E6
760350	FFE0E8
760352	FFE0EA
760360	FFE0F0
760362	FFE0F2

The addresses of IP and SA registers of CDU-710/M for VAX-11/780 are listed in the following table.

OCTAL ADDRESS	HEX ADDRESS FOR UBA 1	HEX ADDRESS FOR UBA 2	HEX ADDRESS FOR UBA 3	HEX ADDRESS FOR UBA 4
772150	2013F468	2017F468	201BF468	201FF468
772152	2013F46A	2017F46A	201BF46A	201FF46A
760334	2013E0DC	2017E0DC	201BE0DC	201FE0DC
760336	2013E0DE	2017E0DE	201BE0DE	201FE0DE
760354	2013E0EC	2017E0EC	201BE0EC	201FE0EC
760356	2013E0EE	2017E0EE	201BE0EE	201FE0EE
760374	2013E0FC	2017E0FC	201BE0FC	201FE0FC
760376	2013E0FE	2017E0FE	201BE0FE	201FE0FE
760340	2013E0E0	2017E0E0	201BE0E0	201FE0E0
760342	2013E0E2	2017E0E2	201BE0E2	201FE0E2
760340	2013E0E4	2017E0E4	201BE0E4	201FE0E4
760342	2013E0E6	2017E0E6	201BE0E6	201FE0E6
760350	2013E0E8	2017E0E8	201BE0E8	201FE0E8
760352	2013E0EA	2017E0EA	201BE0EA	201FE0EA
760350	2013E0F0	2017E0F0	201BE0F0	201FE0F0
760352	2013E0F2	2017E0F2	201BE0F2	201FE0F2

On a VAX-11/730 or VAX-11/750, please follow the example to specify LUN offset, verify LUN offset, format a drive, or qualify a drive. In this example, first CSR address is assumed.

4.3.1 Specify LUN Offset

```
>>> D/W/P   FFF468   0          ;WRITE IP ANY VALUE
>>> D/W/P   FFF46A   A72E       ;WRITE SA, ADDRESS=CSR+2
>>> D * 22                      ;WRITE SA WITH COMMAND
>>> D * 0                       ;WRITE LUN OFFSET VALUE
```

4.3.2 Verify LUN Offset

```
>>> D/W/P   FFF468   0          ;WRITE IP ANY VALUE
>>> D/W/P   FFF46A   A72E       ;WRITE SA, ADDRESS=CSR+2
>>> D * 23                      ;WRITE SA WITH COMMAND
>>> E *                         ;DISPLAY LUN OFFSET VALUE
```

4.3.3 Format a Drive

```
>>> D/W/P    FFF468    0              ;WRITE IP ANY VALUE
>>> D/W/P    FFF46A    A72E           ;WRITE SA, ADDRESS=CSR+2
>>> D * 20                           ;WRITE SA WITH COMMAND
>>> D * 0                            ;SELECT DRIVE 0
>>> D * 0                            ;DRIVE SERIAL NUMBER
>>> E *                              ;VALUE=20000, FORMATTING
                                     ;VALUE=0,FORMAT COMPLETE
```

4.3.4 Qualify a Drive

```
>>> D/W/P    FFF468    0              ;WRITE IP ANY VALUE
>>> D/W/P    FFF46A    A72E           ;WRITE SA, ADDRESS=CSR+2
>>> D * 21                           ;WRITE SA WITH COMMAND
>>> D * 0                            ;SELECT DRIVE 0
>>> E *                              ;SHOW CURRENT QUALIFY
                                     ;LOOP COUNT
```

On a VAX-11/780, please follow the example to specify LUN offset,
verify LUN offset, format a drive, or qualify a drive. In this
example, first CSR address of UBA 1 is assumed.

4.3.5 Specify LUN Offset

```
>>> D/W/P    2013F468    0            ;WRITE IP ANY VALUE
>>> D/W/P    2013F46A    A72E         ;WRITE SA, ADDRESS=CSR+2
>>> D * 22                           ;WRITE SA WITH COMMAND
>>> D * 0                            ;WRITE LUN OFFSET VALUE
```

4.3.6 Verify LUN Offset

```
>>> D/W/P    2013F468    0            ;WRITE IP ANY VALUE
>>> D/W/P    2013F46A    A72E         ;WRITE SA, ADDRESS=CSR+2
>>> D * 23                           ;WRITE SA WITH COMMAND
>>> E *                              ;DISPLAY LUN OFFSET VALUE
```

4.3.7 Format a Drive

```
>>> D/W/P    2013F468    0              ;WRITE IP ANY VALUE
>>> D/W/P    2013F46A    A72E           ;WRITE SA, ADDRESS=CSR+2
>>> D * 20                              ;WRITE SA WITH COMMAND
>>> D * 0                               ;SELECT DRIVE 0
>>> D * 0                               ;DRIVE SERIAL NUMBER
>>> E *                                 ;VALUE=20000, FORMATTING
                                        ;VALUE=0,FORMAT COMPLETE
```


4.3.8 Qualify a Drive

```
>>> D/W/P    2013F468    0              ;WRITE IP ANY VALUE
>>> D/W/P    2013F46A    A72E           ;WRITE SA, ADDRESS=CSR+2
>>> D * 21                              ;WRITE SA WITH COMMAND
>>> D * 0                               ;SELECT DRIVE 0
>>> E *                                 ;SHOW CURRENT QUALIFY
                                        ;LOOP COUNT
```

CHAPTER 5   SCSI INFORMATION

5.1   SCSI DEFINITIONS:

Connect: The function that occurs when an initiator selects a target to start an operation.

Disconnect: The function that occurs when a target release control of the SCSI bus, allowing it to go to the BUS FREE phase.

Initiator: An SCSI device (usually a host system) that requests an operation to be performed by another SCSI device.

LUN: Logic Unit Number

Peripheral device: A peripheral that can be attatched to an SCSI device (e.g., magnetic disk, magnetic tape, or optical disk).

Reconnect: The function that occurs when a target selects an initiator to continue an operation after a disconnect.

SCSI address: The octal representation of the unique address (0-7) assigned to an SCSI device. This address would normally be assigned and set in the SCSI device during system installation.

SCSI ID: The bit-significant representation of the SCSI address refering to one of the signal lines DB(7-0).

SCSI device: A host computer adapter or a peripheral controller or an intelligent peripheral that can be attatched to the SCSI bus.

Target: An SCSI device that performs an operation requested by an initiator.

5.2   SCSI Commands

SCSI commands used by CDU-710/M or CDU-710/TM for MSCP emulation
are listed in the following table.

Code	Command Name
00h	Test Unit Ready
01h	Rezero Unit
03h	Request Sense
04h	Format Unit (1)
07h	Reassign Block
08h	Read
0Ah	Write
0Bh	Seek
12h	Inquiry
15h	Mode Select
1Ah	Mode Sense
1Bh	Start Stop Unit
25h	Read Capacity
28h	Extended Read
2Ah	Extended Write
2Bh	Extended Seek (2)
3Eh	Read Long (3)
3Fh	Write Long(3)

(1) The Format Unit command is used by the on-board utility only.
(2) These commands are used only when the disk drive capacity is
    greater than 1 Giga bytes.
(3) These commands are used if the drives support them.

SCSI commands used by CDU-710/T or CDU-710/TM   for   TMSCP
emulation are listed as follows:

Code	Command Name
00h	Test Unit Ready
01h	Rewind
03h	Request Sense
08h	Read
0Ah	Write
10h	Write Filemark
11h	Space
12h	Inquiry
15h	Mode Select
19h	Erase
1Ah	Mode Sense
1Bh	Load/Unload

5.3 SCSI Status

The SCSI status codes used by CDU-710 are listed as follows:

Code	Status Name
00h	Good
02h	Check Condition
08h	Busy

5.4 SCSI Messages

The SCSI Messages used by CDU-710 are listed as follows:

Code	Message Name
00h	Command Complete
01h	Extended Message
02h	Save Data Pointer
03h	Restore Pointer
04h	Disconnect
05h	Initiator Detected Error
07h	Message Reject
08h	No Operation
09h	Message Parity Error
80-FFh	Identify

5.5   SCSI Single-Ended Signals

Pin assignment of the CDU-710 Single-ended SCSI Cable Connector (J3):

Signal	Pin Number
-DB(0)	2
-DB(1)	4
-DB(2)	6
-DB(3)	8
-DB(4)	10
-DB(5)	12
-DB(6)	14
-DB(7)	16
-DB(P)	18
GROUND	20
GROUND	22
GROUND	24
TERMPWR	26
GROUND	28
GROUND	30
-ATN	32
GROUND	34
-BSY	36
-ACK	38
-RST	40
-MSG	42
-SEL	44
-C/D	46
-REQ	48
-I/O	50

NOTE: All odd pins except pin 25 are connected to ground. Pin 25 is left open. The minus sign next to the signal indicates active low.

5.6　　　SCSI Differential Signals

Pin assignment of the CDU-712　Differential SCSI Cable　Connector (J2):

Signal	Pin Number		Signal
SHIELD GROUND	1	2	GROUND
+DB(0)	3	4	-DB(0)
+DB(1)	5	6	-DB(1)
+DB(2)	7	8	-DB(2)
+DB(3)	9	10	-DB(3)
+DB(4)	11	12	-DB(4)
+DB(5)	13	14	-DB(5)
+DB(6)	15	16	-DB(6)
+DB(7)	17	18	-DB(7)
+DB(P)	19	20	-DB(P)
DIFFSENS	21	22	GROUND
GROUND	23	24	GROUND
TERMPWR	25	26	TERMPWR
GROUND	27	28	GROUND
+ATN	29	30	-ATN
GROUND	31	32	GROUND
+BSY	33	34	-BSY
+ACK	35	36	-ACK
+RST	37	38	-RST
+MSG	39	40	-MSG
+SEL	41	42	-SEL
+C/D	43	44	-C/D
+REQ	45	46	-REQ
+I/O	47	48	-I/O
GROUND	49	50	GROUND

NOTE:　SHIELD GROUND is optional on some cables.

Appendix B   Operating Systems Supported by CDU-710

All DEC-compatible products designed by CMD Technology, Inc. implement MSCP (Mass Storage Control Protocol)/ TMSCP (Tape Mass Storage Control Protocol). CMD supports its implementation of MSCP/TMSCP beginning with the indicated version of the following DEC operating systems.

Operating System	Version
VMS	4.0 and 5.0
Ultrix	1.2
UNIX/Berkeley	4.2
RSX-11M	4.1
RSX-11M-PLUS	3.0
RSTS/E	9.0
RT-11	5.2
DSM-11	3.3
ISM-11	3.4
TSX	x.x
VAXELN	x.x

Appendix C   SCSI Devices Supported by CDU-710

Disk drives supported by CDU-710/M,CDU-710/TM SCSI host adapter:

10/18/1989   *** indicates new qualified device.

Magnetic disk drives:

CDC	WREN-III, WREN-IV, WREN V, WREN VI SWIFT (3 1/2"), Sabre (8") ***
CITOH	YD-3042, YD-3082
CONNER PERIPHERALS	CP-340, CP-3100
FUJITSU	M2246SA, M2249SA Series
MAXTOR	XT-3000 ,XT-4000S, XT-8000S Series
HITACHI	DK515C Series
HP	97548S/D series ***
IBM	320MB, 3 1/2" ***
MICROPOLIS	1370 Series
PRIAM	Model 717, 728, 738
QUANTUM	ProDrive 40S/80S
RODIME	3085S, 5215S, 5180S
SIEMENS	Model 2200, 2300
SYQUEST	SQ555 ***
TOSHIBA	MK156FB series
EMULEX	MD21, MD23 (SCSI TO ESDI CONTROLLER)

Erasable Optical disk drives:

SONY	SMO-D501	Magneto Optical disk
RICOH	RO-5030E	Magneto Optical disk

CD ROM drives:

LMS	CM210, CM212 ***
TOSHIBA	XM3200 series ***

WORM drives:

1. with Ten X Technology Optical Convertion Unit

MAXTOR   RXT-800S, REV. J, K

LMSI   LD510, LD1200

MITSUBISHI   MW-5U1

PIONEER   DD-55001   etc.

2. with LASERDRIVE interface

LASERDRIVE   Model 800 series

Tape drives supported by CDU-710/T,CDU-710/TM SCSI host adapter:

10/18/1989   *** indicates new qualified device.

EXABYTE   EXB-8200   8mm helical scan

SONY   SDT-1000 DAT, 4mm helical scan

HP   35450A DAT, 4mm helican scan ***

GIGATREND   1200 Series DAT, 4mm helical scan

ARCHIVE   1/4 "   streaming

ASPEN   1/2 "   System 480, 3480 compatible

CALIPER   1/4 "   C150SAE streaming, series

CIPHER   1/4 "   ST150S-I streaming, series

FUJITSU   1/2 "   M2452E, 1/2" cartridge

LMS   1/2 "   Independence, 3480 compatible ***

KENNEDY   1/4 "   streaming
                    1/2 "   9 track, model 9612

TANDBERG   1/4 "   TDC3600 series

TEAC   1/4 "   streaming

WANGTEK   1/4 "   streaming

Appendix D   30 CSR Addresses Supported by IC P70012C

1. 8 CSR addresses supported by old IC P70012B at location U102:

Address	PDP-11	W11	W15	W14	W13	W12
Standard:	17774500	2-3 IN	1-2 IN	2-3 IN	1-2 IN	1-2 IN
Second:	17760404	2-3 IN	1-2 IN	2-3 IN	1-2 IN	2-3 IN
Third:	17760444	2-3 IN	1-2 IN	2-3 IN	2-3 IN	1-2 IN
Fourth:	17760504	2-3 IN	1-2 IN	2-3 IN	2-3 IN	2-3 IN
Fifth:	17760544	2-3 IN	1-2 IN	1-2 IN	1-2 IN	1-2 IN
Sixth:	17760410	2-3 IN	1-2 IN	1-2 IN	1-2 IN	2-3 IN
Seventh:	17760450	2-3 IN	1-2 IN	1-2 IN	2-3 IN	1-2 IN
Eighth:	17760454	2-3 IN	1-2 IN	1-2 IN	2-3 IN	2-3 IN

2. 30 CSR addresses supported by new IC P70012C at location U102:

Address	PDP-11	W11	W15	W14	W13	W12
1	17774500	2-3 IN	1-2 IN	2-3 IN	1-2 IN	1-2 IN
2	17760404	2-3 IN	1-2 IN	2-3 IN	1-2 IN	2-3 IN
3	17760444	2-3 IN	1-2 IN	2-3 IN	2-3 IN	1-2 IN
4	17760504	2-3 IN	1-2 IN	2-3 IN	2-3 IN	2-3 IN
5	17760544	2-3 IN	1-2 IN	1-2 IN	1-2 IN	1-2 IN
6	17760410	2-3 IN	1-2 IN	1-2 IN	1-2 IN	2-3 IN
7	17760450	2-3 IN	1-2 IN	1-2 IN	2-3 IN	1-2 IN
8	17760454	2-3 IN	1-2 IN	1-2 IN	2-3 IN	2-3 IN
9	17760414	2-3 IN	2-3 IN	2-3 IN	1-2 IN	1-2 IN
10	17760420	2-3 IN	2-3 IN	2-3 IN	1-2 IN	2-3 IN
11	17760460	2-3 IN	2-3 IN	2-3 IN	2-3 IN	1-2 IN
12	17760510	2-3 IN	2-3 IN	2-3 IN	2-3 IN	2-3 IN
13	17760514	2-3 IN	2-3 IN	1-2 IN	1-2 IN	1-2 IN
14	17760520	2-3 IN	2-3 IN	1-2 IN	1-2 IN	2-3 IN
15	17760550	2-3 IN	2-3 IN	1-2 IN	2-3 IN	1-2 IN
16	17760554	2-3 IN	2-3 IN	1-2 IN	2-3 IN	2-3 IN
17	17760560	1-2 IN	1-2 IN	2-3 IN	1-2 IN	1-2 IN
18	17760604	1-2 IN	1-2 IN	2-3 IN	1-2 IN	2-3 IN
19	17760610	1-2 IN	1-2 IN	2-3 IN	2-3 IN	1-2 IN
20	17760614	1-2 IN	1-2 IN	2-3 IN	2-3 IN	2-3 IN
21	17760620	1-2 IN	1-2 IN	1-2 IN	1-2 IN	1-2 IN
22	17760644	1-2 IN	1-2 IN	1-2 IN	1-2 IN	2-3 IN
23	17760650	1-2 IN	1-2 IN	1-2 IN	2-3 IN	1-2 IN
24	17760654	1-2 IN	1-2 IN	1-2 IN	2-3 IN	2-3 IN
25	17760660	1-2 IN	2-3 IN	2-3 IN	1-2 IN	1-2 IN
26	17760704	1-2 IN	2-3 IN	2-3 IN	1-2 IN	2-3 IN
27	17760710	1-2 IN	2-3 IN	2-3 IN	2-3 IN	1-2 IN
28	17760714	1-2 IN	2-3 IN	2-3 IN	2-3 IN	2-3 IN
29	17760744	1-2 IN	2-3 IN	1-2 IN	1-2 IN	1-2 IN
30	17760750	1-2 IN	2-3 IN	1-2 IN	1-2 IN	2-3 IN