

**OPERATIONS
MANUAL**

**EXPANDORAM II
EXPANDABLE RANDOM ACCESS MEMORY**

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**REVISION C
MARCH 1981**

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SECTION I

1-0 INTRODUCTION

The EXPANDORAM II board provides a low cost means for expanding Random Access Memory capability for computers utilizing the S-100 bus structure.

The EXPANDORAM II is optimized for operation with SD Systems' SBC-100/200. The EXPANDORAM II uses the Z-80 refresh signal and will operate at 4 MHz if sufficiently fast rams are used.

1-1 GENERAL DESCRIPTION

The EXPANDORAM II board is a high performance dynamic RAM board using state-of-the-art MOS dynamic memory devices. The EXPANDORAM II may be configured to have a memory capacity of 16K, 32K, 48K, or 64K bytes of memory using the MK 4116 (16,384X1 MOS dynamic RAM) or 64K, 128K, 192K, or 256K bytes of memory using the MK4164 (65,536X1 MOS dynamic RAM) memories. Other notable features of the EXPANDORAM II board include:

- (1) Phantom output disable or manual switch selectable output disable.
- (2) Typical power dissipation of 5 watts
- (3) 4 MHz operation
- (4) Port Addressable board select for multi-user system
- (5) With 4164's, 4-64K banks are available

1-2 PHYSICAL

The EXPANDORAM II board is implemented on a single 5.25" x 10.0" x 0.65" Printed Circuit board. The board requires three DC voltages at levels of +7V to +10V, +14V to +18V, and -14V to -18V. The EXPANDORAM II board is interfaced to the system by connector J-1. Table 1-1 lists the overall specifications for the EXPANDORAM II board.

TABLE 1-1
SPECIFICATIONS

Memory Capacity	Up to 65,536 bytes (16K RAM) Up to 262,144 bytes (64K RAM)
Memory Access	200 ns max.
Memory Cycle	375 ns min.
Interface Levels	TTL Compatible
Power (2 us memory cycle)	+7V to +10V @ 400mA (max) +14V to +2-V @ 200mA (max) -14V to -20V @ 30mA (max)
Physical Dimensions	5.25" x 10.0" x .65"
Operating Temperature	0 degree C to 50 degree C

TABLE 1-2
CONNECTOR J1 PIN OUT
FOR 32K/64K EXPANDORAM II

PIN #	SIGNAL NAME	DIRECTION	DESCRIPTION
1,51	+8V to 10V		Power
2	+14V to 20V		Power
52	-14V to -20V		Power
25	Ø1	Input	Phase 1 clock
27	P WAIT	Input	Wait
79,80,81, 31,30,29, 82,83	A0-A7	Input	Address bus bits 0-7
84,34,37, 87,33,85, 86,32	A8-A15	Input	Address bus bits 8-15
36,35,88, 89,38,39, 40,90	D0-0 to D0-7	Input	Data bus in
95,94,41, 42,91,92, 35,43	DI-0 to DI-7	Output	Data bus out
44	SMI	Input	Machine cycle one
47	MEMR	Input	Memory read
66	RFSH	Input	Refresh (Z80 CPU card)
68	MEMW	Input	Memory write
72	PRDY	Output	Ready
78	PDBIN	Input	Data bus in
100,50	GROUND		
45	SOUT	Input	Port Output
99	POC	Input	Power on Clear
67	PHANTOM	Input	Phantom Disable

SECTION 2

2-0 FUNCTIONAL DESCRIPTION

The major functions of the EXPANDORAM II board are shown in figure 2-1. The following functions make up the memory interface: memory array, memory decode and control, address multiplexer, and data buffer.

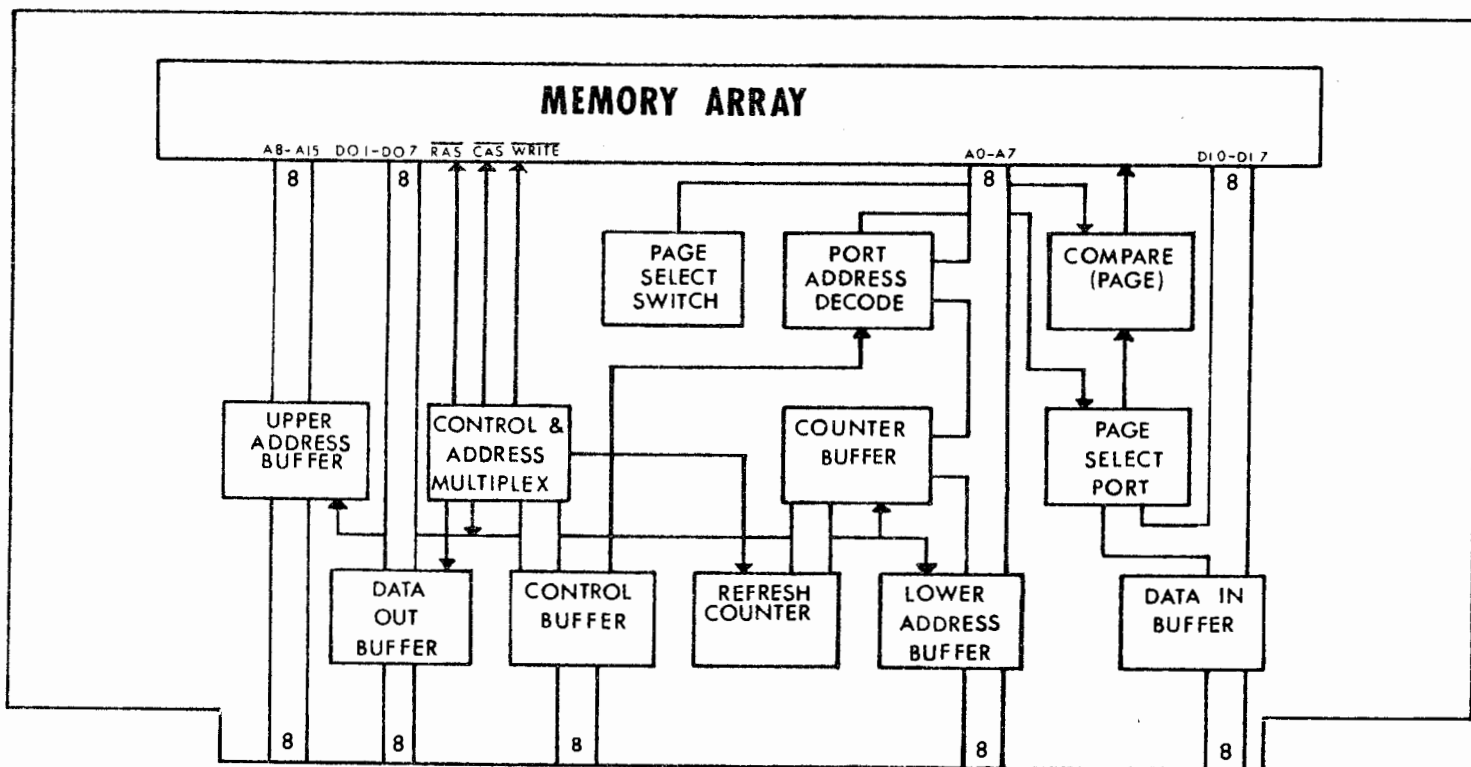
Memory Array - The memory array consists of up to 32 (16K or 64K) dynamic random access memory elements. Each 16K has a 16,384 x 1 bit capacity, while the 64K has a 65,536 x 1 bit capacity. The 32 (16K or 64K) RAMS are organized into four banks of eight RAMS each. The eight RAMS each contribute one bit to an addressable location. The total storage capacity of the EXPANDORAM II is 64,536 or 262,144 bytes, depending on the type of memory device used (16K or 64K).

Memory Decode and Control - The memory decode and control section is responsible for generating the timing signals for the memory array, address multiplexer, and data buffer. Timing within the memory decode and control section is generated by a TTL compatible delay line. An 82S130 PROM is used to select the proper banks according to the address lines, board select switches, and the board select latch. (See Section 4 for more details on Proms).

Address Multiplexer - The address multiplexer is responsible for taking the address bits from the address bus buffers and multiplexing the proper row and column address into the memory array under control of the memory decode and control section.

Data Buffers - The data buffers, controlled by the memory decode and control section, isolate the memory array from the data bus.

Port FF Board Select - The port FF board select decodes port FF and latches the output data on the board.



EXPANDORAM II BLOCK DIAGRAM

Figure 2-1

SECTION 3

3-0 CONSTRUCTION

The EXPANDORAM II board kit is intended for those persons who have had some prior experience with kit building and digital electronics. If you do not fall into this category, it is highly recommended that you find an experienced person to help you assemble and check out the board.

Appendix E shows the parts list for the EXPANDORAM II board. Double check all parts against the parts list.

3-1 ASSEMBLY PROCEDURE

(1) Install and solder the IC sockets in their proper locations as follows:

- () 14-Pin - U1,U3-U7,U9,U10,U12,U17-U19,U21,U22,U58
- () 16-Pin - U8,U11,U13,U15,U16,U26-U57
- () 20-Pin - U14,U20,U23-U25

NOTE: No sockets for U2 or DIP switch S3.

(2) Install and solder the resistors as follows:

- () R1, R4 33 Ohm (Orange, Orange, Black)
- () R2, R6, R8 1K Ohm (Brown, Black, Red)
- () R3 3.3K Ohm (Orange, Orange, Red)
- () R5 150 Ohm (Brown, Green, Brown)
- () R7 10K Ohm (Brown, Black, Orange)
- () R9 470 Ohm (Yellow, Violet, Brown)
- () R10 200 Ohm (Red, Black, Brown)
- () Resistor packs: RP1 3, 4, 5 10 Pin SIP - 3.3K
RP2 6 Pin SIP - 3.3K

NOTE: Pin 1 of each SIP is designated by a notch or a dot on one end of the package.

- (3) Install and solder diodes CR1, and CR2 with the banded end as shown on the PC board.
- () CR1 1N751
 - () CR2 1N914 or 1N4148
- (4) Install and solder the capacitors as follows:
- () C1,C5,C8,C12,C14,C16 10MF Tantalum (Note Polarity)
 - () C2,C4,C6,C7,C9,C10,C13,C17-64 .1MF MICA
 - () C15,C3 200PF MICA
- (5) Install and solder the two voltage regulators with the heatsink, using the 6-32 hardware supplies. NOTE: There are two types of voltage regulators, a +5V and a +12V. Be sure that the regulators are installed as shown on the Assembly Drawing.
- () VR1 +5V 7805 or LM 340T-5
 - () VR2 +12V 7812 or LM 340T-12
- (6) Install two PCB ejectors using pins (See Assembly Drawing).
- (7) Install and solder DIP switch.
- () S3 Observe the proper position of the PC board (the ON side should be toward the top of the board).
- (8) Install and solder the delay line (U2) observing the location of pin 1
- () U2 (DDU-4-5250 or PE21214 or TTLDL250)
- (9) Double check all solder connections for cold solder joints, unsoldered connections, or shorted connections.

3-2 CHECK OUT PROCEDURE

- (1) Install the board in the computer and measure the output of the

+5V and +12V regulators, VR1 and Vr2,

() VR1 = 5 volts

() VR2 = 12 volts

(2) Measure the power supply voltages in the memory array. (Any of the memory array IC sockets can be used.)

() Pin 1 U29 = -5V

() Pin 8 U29 = +12V

() Pin 9 U29 = +5V

NOTE: DO NOT PROCEED WITH BOARD CHECK-OUT UNTIL ALL POWER SUPPLY VOLTAGES ARE CORRECT. The TTL logic and MOS memories can be permanently damaged if improper voltages are applied.

(3) Install the IC's in their sockets observing the Pin 1 designation on each socket on the PC board.

() U1 74LS00

() U14 74LS244

() U3 74LS10

() U15 33 Ohm DIP

() U4 74LS20

() U16 74LS162

() U5 74LS00

() U17 74LS00

() U6 74LS74

() U18 74LS14

() U7 74LS02

() U19 74LS30

() U8 82S130

() U20 74LS373

() U9 74LS393

() U21 74LS74

() U10 74LS00

() U22 74LS14

() U11 74LS368

() U23 74LS244

() U12 74LS14

() U24 74LS244

() U13 74LS174

() U25 74LS244

() U58 74LS122

* () U26-33	(Bank 0)	RAM
* () U34-41	(Bank 1)	RAM
* () U42-49	(Bank 2)	RAM
* () U50-57	(Bank 3)	RAM

*NOTE: If less than 64K is being installed on the board then refer to Section IV under ADDRESSING SWITCH to determine in which Bank the memory should be installed.

(4) Double check all IC's for proper orientation and location.

(5) Refer to UTILIZATION SECTION for proper configuration of jumper options, and connect jumper options as required.

(6) Install board into computer and turn on power.

(7) By using front panel or monitor program, deposit data into a memory location that falls within the boundaries of the EXPANDORAM II board. Now examine the same location in which data was deposited. If the proper data is not read back, power the system down and double check the following:

(1) Check ADDRESSING DIP Switch and board Select Dip Switch for the correct settings.

(2) Check jumper options.

(8) Reinstall the board and once again try to write and read data from the EXPANDORAM II board by the use of a front panel or monitor program. If some of the data bits appear to be stuck, power down the board and examine the memory array for bent pins, or a defective

memory device. If the board does not respond in any way to write or read data, then examine the TTL IC's for bent pins or improper insertions into the socket.

(9) If the read/write test is successful, verify that memory on the EXPANDORAM II can be accessed in every bank of memory that is installed on the board.

(10) If all banks can be written to and read back properly, complete check-out of the board by loading the memory test that is shown in Appendix A. Execute the test and verify that all locations within the memory array are functional.

NOTE: When executing the memory diagnostic, it is recommended that the memory board not be on an extender card. Use of an extender card may introduce external noise into the board.

SECTION 4

4-0 UTILIZATION

This section will explain the various options for the EXPANDORAM II memory card.

4-1 16K or 64K DEVICE SELECTION JUMPERS

Two types of RAMS may be used with the EXPANDORAM II. These are the 16K RAM (4116) and the 64K (4164). The board comes in a standard configuration that uses 16K RAMS. In order to use the 64K RAMS the following cuts and connections must be made:

- A. Cut etch between E1 and E2 CUT E1-E2
- B. Cut etch between E4 and E5
- C. Cut etch between E6 and E8
- D. Connect E2 to E3 CONNECT E2-E3
- E. Connect E6 to E7

4-2 PROM INFORMATION

There are two proms available for use with the EXPANDORAM II. These proms perform memory decoding. These are for use with 32K or 48K partition multi-user systems. If the board is used in a single-user environment, either Prom will work. In addition, other Proms may be configured if the user desires.

4-3 SWITCH SETTINGS

The information for the switch settings of S3 for the EXPANDORAM II is given in figure 4-1.

Port FF is used to select the Memory page (32K or 48K) to be accessed by the CPU. Up to 10 pages (0-9) may be in a system simultaneously, by using either 6 Expandoram II boards with a 32K Prom or 8 Expandoram II board with a 48K Prom (user 0AH has 16K positioned at @ C000H). The pages are accessed by outputting the page number to port FF. See Figure 4-2 for page mapping and Prom program information.

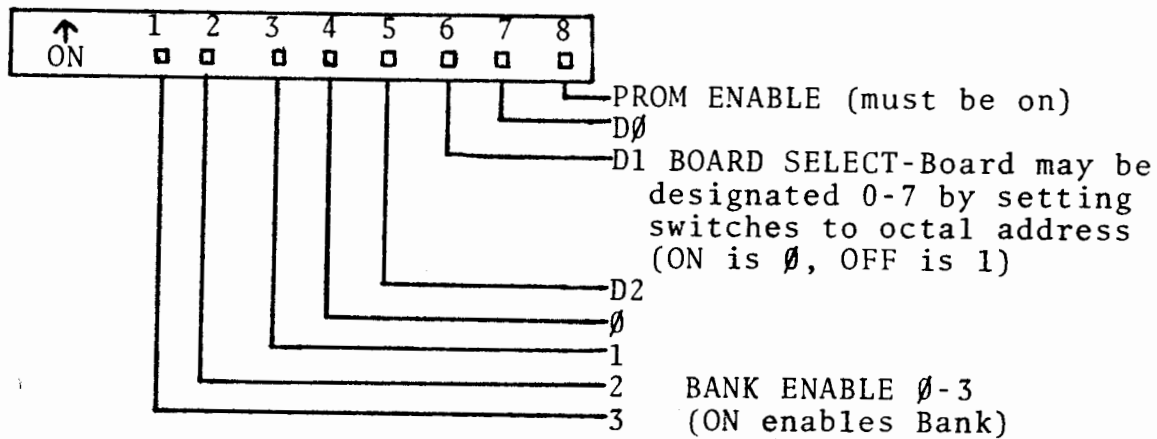


FIGURE 4-1

4-4 USING THE EXPANDORAM II IN NON-SD SYSTEMS ENVIRONMENTS

Some CPU boards supply a different phase of the system clock on pins 24 and 25. If one of these CPU boards are used with the Expandoram II, make the following change. Cut the etch on the back of the board between E22 and E23. Install a jumper between E23 and E24. Also cut the etch between E26 and E25 and install a jumper between E26 and E27. Install the phantom disable jumper between E9 and E10 if the system has other memory in conflict with the Expandoram II board. In addition, if the system is operated at

at 4 MHz, install the jumper between E14 and E15 to enable M1
Wait States.

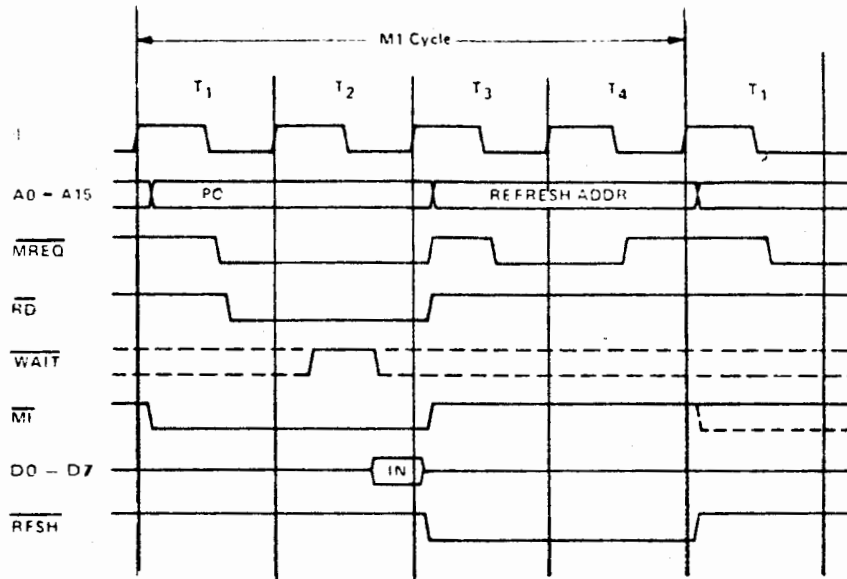
APPENDIX A
MEMORY DIAGNOSTIC SOFTWARE LISTING

ADDR	OBJECT	ST #	SOURCE STATEMENT
0001			;TRANSLATED FROM DEC 1976 INTERFACE MAGAZINE
0002			;
0003			;THIS IS A MODIFIED ADDRESS STORAGE TEST WITH
0004			;AN INCREMENTING PATTERN
0005			;
0006			;256 PASSES MUST BE EXECUTED BEFORE THE MEMORY
0007			;IS COMPLETELY TESTED
0008			;
0009			;IF AN ERROR OCCURS, THE PATTERN WILL BE STORED
0010			;AT LOCATION '002C'H AND THE ADDRESS OF THE
0011			;ERROR LOCATION WILL BE STORED AT '002D'H
0012			;AND '002E'H.
0013			;
0014			;THE CONTENTS OF LOCATIONS '000C'H AND'001D'H
0015			;SHOULD BE SELECTED ACCORDING TO THE FOLLOWING
0016			;MEMORY SIZE TESTED
0017			;
0018			;TOP OF MEMORY TO
0019			;BE TESTED
0020			;
0021			4K
0022			8K
0023			16K
0024			32K
0025			48K
0026			64K
0027			;
0028			;THE PROGRAM IS SET UP TO START TESTING AT
0029			;LOCATION '002F'H. THE STARTING ADDRESS FOR THE
0030			;TEST CAN BE MODIFIED BY CHANGING LOCATIONS
0031			;'0003'H-'0004'H AND '0011'H-'0012'H.
0032			;
0033			;TEST TIME FOR A 16K BY 8 MEMORY IS APPROX. 4 MIN
0034			;
0035			PSECT ABS
0036			ORG 0000H
0037			LD B,0 ;CLEAR B PATRN MODIFIER
0038			;LOAD UP MEMORY
0039			LOOP: LD HL,START ;GET STARTING ADDR
0040			FILL: LD A,L ;LOW BYTE TO ACCM
0041			XOR H ;XOR WITH HIGH BYTE
0042			XOR B ;XOR WITH PATTERN
0043			LD (HL),A ;STORE IN ADDR
0044			INC HL ;INCREMENT ADDR
0045			LD A,H ;LOAD HIGH BYTE OF ADDR
0046			CP EPAGE ;COMPARE WITH STOP ADDR
0047			JP NZ,FILL ;NOT DONE,GO BACK
0048			;READ AND CHECK TEST DATA
0049			LD HL,START ;GET START ADDR
0050			TEST; LD A,L ;LOAD LOW BYTE
0051			XOR H ;XOR WITH HIGH BYTE
0052			XOR B ;XOR WITH MODIFIER
0053			CP (HL) ;COMPARE WITH MEMORY LOC
0054			JP NZ,EXIT ;ERROR EXIT
0055			INC HL ;UPDATE MEMORY ADDR
0056			LD A,H ;LOAD HIGH BYTE
0057			CP EPAGE ;COMPARE WITH STOP ADDR
0058			JP NZ,TEST ;LOOP BACK
0059			INC B ;UPDATE MODIFIER
0060			JP LOOP ;RST WITH NEW MODIFIER
>0000			
0000	0500		
0002	212F00		
0005	7D		
0006	AC		
0007	A8		
0008	77		
0009	23		
000A	7C		
000B	FE10		
000D	C20500		
0010	212F00		
0013	7D		
0014	AC		
0015	AB		
0016	BE		
0017	C225000		
001A	23		
001B	7C		
001C	FE10		
001E	C21300		
0021	04		
0022	C30200		

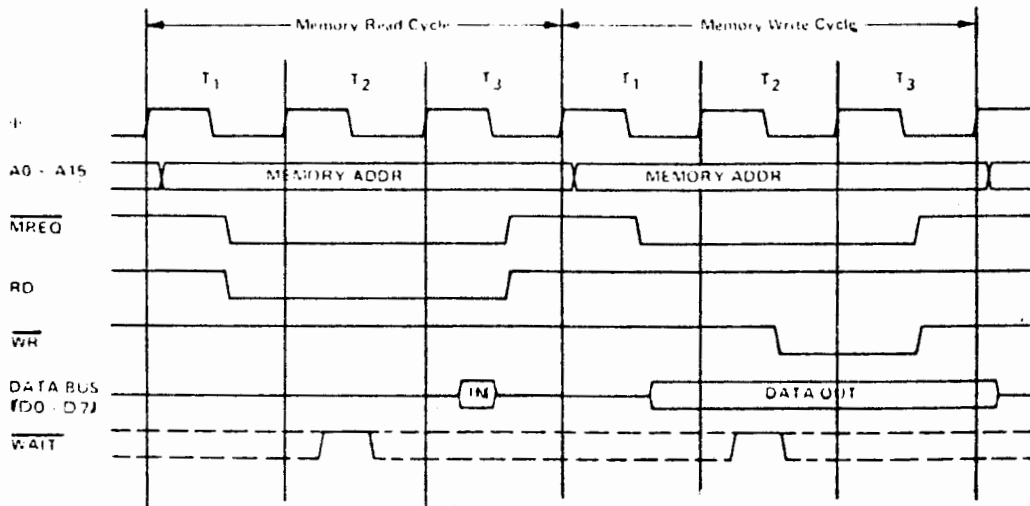
0025	222D00	0061	;ERROR EXIT		
0028	322C00	0062	EXIT LD	(BYTE),HL	;SAVE ERROR ADDRESS
002B	76	0063	LD	(PATRN),A	;SAVE BAD PATTERN
>002C		0064	HALT		;FLAG OPERATOR
>002D		0065	PATRN: DEFS	1	
002F	2F00	0066	BYTE: DEFS	2	
0031	3100	0067	START: DEFW	\$	
>0010		0068	DEFW	\$;PLACE FOR FIRST ADDR
		0069	EPAGE: EQU	10H	;SET UP FOR 4K TEST
		0070	END		

APPENDIX B
EXPANDORAM II TIMING DIAGRAM

INSTRUCTION OP CODE FETCH

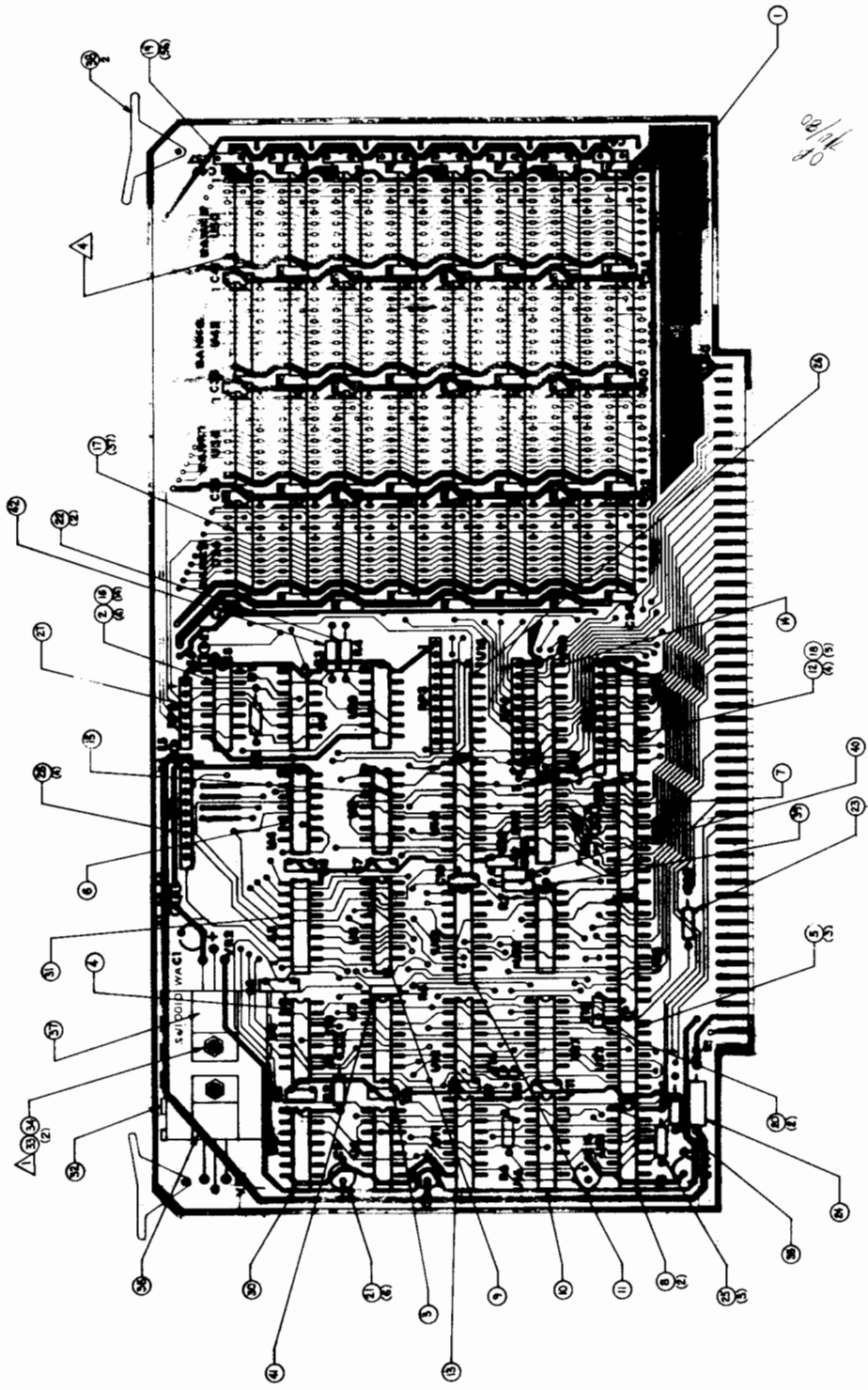


MEMORY READ OR WRITE CYCLES



APPENDIX C
EXPANDORAM II
ASSEMBLY DRAWING

REV	DESCRIPTION	DATE
A	INITIAL	12/1/60
B	INITIAL	12/1/60
C	INITIAL	12/1/60
D	INITIAL	12/1/60



SEE SEPARATE B.O.M. 0100100

DESIGNED BY	DATE	DATE
CHECKED BY	DATE	DATE
TESTED BY	DATE	DATE
APPROVED BY	DATE	DATE
PROJECT	DATE	DATE
PROJ. ENGR.	DATE	DATE
APPROVES	DATE	DATE

REFERENCE TO B.O.M. NO. 0100100
 XXX - SEE 1/2
 XXX - SEE 1/2
 XXX - SEE 1/2

PCB ASSY. EAPADODHAM II

ITERATION 1827 DRAWING NO. 0100160

REV D

SCALE 1:1

DO NOT SCALE DRAWING

FOR 64K SEE B.O.M. 0100110
 FOR 48K SEE B.O.M. 0100100
 FOR 32K SEE B.O.M. 0100100
 FOR 16K SEE B.O.M. 0100207

ASSEMBLE ALL OTHER PARTS PER PARTS LIST.

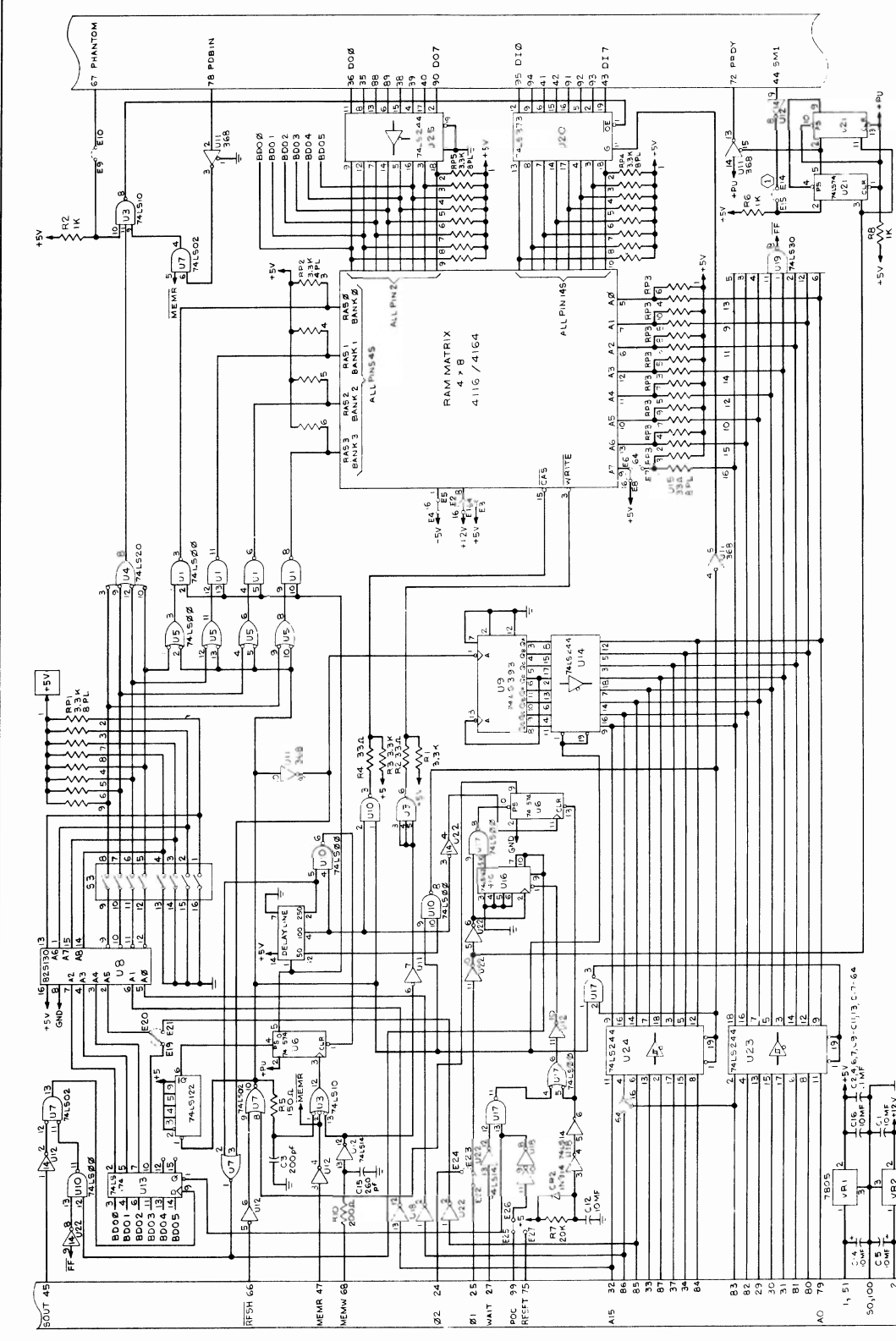
A. DEGRADE BOARD.

APPLY THERMAL COMPOUND PR. 120-6 TO VR142.

NOTES:

APPENDIX D
EXPANDORAM II SCHEMATIC

REV	DESCRIPTION	DATE	APP.
E	PER ECLM 137		



SD SYSTEMS SUNSHINE, TEXAS	
SCHEMATIC EXPANDORAM II	
DATE	REV
DESIGNER	DATE
PROJECT	DATE
APPROVED	DATE
SIZE CODE IDENT	DRAWING NO.
D	0100161
SCALE	DO NOT SCALE DRAWING
SHEET 1	OF 1

TOLERANCES	UNLESS OTHERWISE SPECIFIED
XX	± 0.005 INCHES
XXX	± 0.002 INCHES
XXXX	± 0.001 INCHES
MATERIAL	
FINISH	SD-200
USED ON	
APPLICATION	

NOTES: 1 REMOVE JUMPER FOR 100A.

APPENDIX E
EXPANDORAM II PARTS LIST

SD Systems

P.O. Box 28810 • Dallas, Texas 75228 214-271-4667

BILL OF MATERIALS

Title: EXPANDORAM II		PL No. 0100160	Rev. G
Date Released:	Approved: <i>PP</i>	Sheet 2	of 4

Item no	Qty	SD-P/N	Description	Unit Cost	Extension
1	1	7000012	PRINTED CIRCUIT BOARD 0100162		
2	4	7010160	74LS00 U1, U5, U17 & U10		
3	1	7010162	74LS02 U7		
4	1	7010168	74LS10 U3		
5	3	7010172	74LS14 U12, U18 & U22		
6	1	7010174	74LS20 U4		
7	1	7010180	74LS30 U19		
8	1	7010195	74LS74 U21		
9	1	7010407	82S130 U8 (EX2-48K)		
10	1	7010232	74LS162 U16		
11	1	7010241	74LS174 U13		
12	4	7010264	74LS244 U14, U23, U24 & U25		
13	1	7010303	74LS368 U11		
14	1	7010304	74LS373 U20		
15	1	7010312	74LS393 U9		
16	15	7060002	14 PIN IC SOCKET U1, U3, U4, U5, U6, U7, U9, U10, U12, U17, U18, U19, U21, U22 & U58		
17	37	7060003	16 PIN IC SOCKET U8, U11, U13, U15, U16 & U26 THRU U57		
18	5	7060005	20 PIN IC SOCKET U14, U20, U23, U24 & U25		
19	56	7030045	.1MF CAPACITOR C2, C4, C6, C7, C9, C10, C11, C13 & C17 THRU C64		
20	2	7030043	200 PF CAPACITOR C15 & C3		
21	6	7030009	10 MF CAPACITOR C1, C5, C8, C12, C14 & C16		

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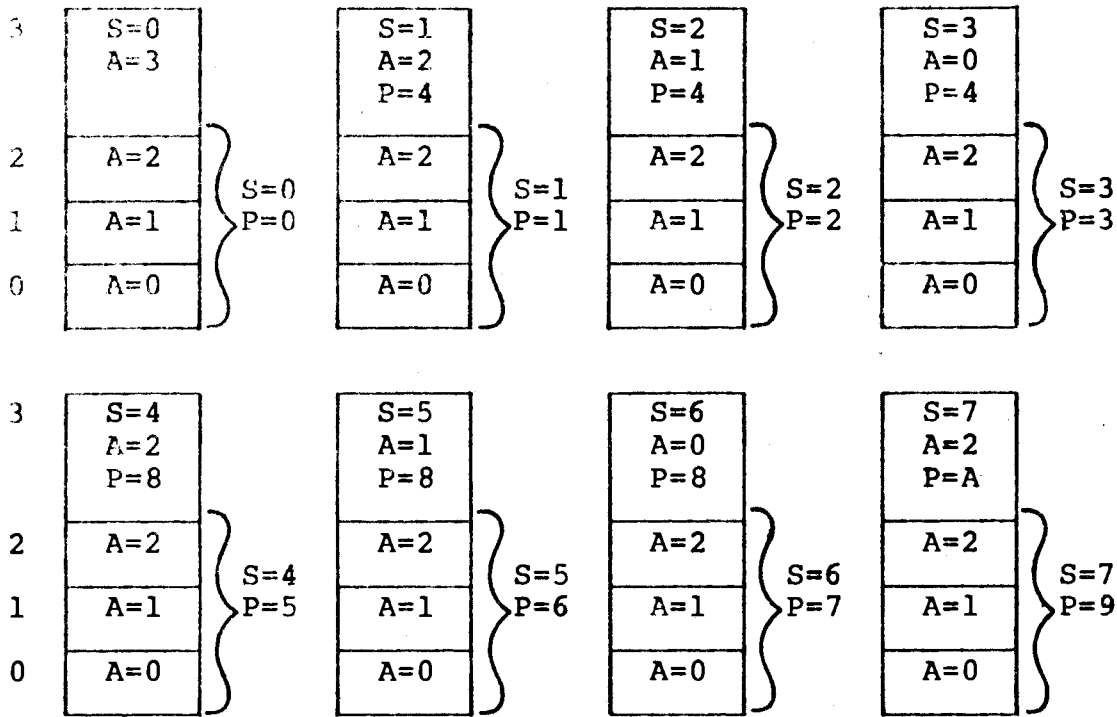
BILL OF MATERIALS

Title: EXPANDORAM II		PL No. 0100160	Rev. G
Date Released:	Approved:	Sheet 3	of 4

Item no	Qty	SD-P/N	Description	Unit Cost	Extension
22	2	7020037	33Ω 5% 1/4 WATT RESISTOR R1 & R4		
23	1	7020056	200Ω 5% 1/4 WATT RESISTOR R10		
24	1	7020065	470Ω 5% 1/4 WATT RESISTOR R9		
25	3	7020073	1KΩ 5% 1/4 WATT RESISTOR R2, R6 & R8		
26	1	7010346	33Ω 16 PIN DIP RESISTOR PACK U15		
27	1	7010344	3.3KΩ 6 PIN SIP RESISTOR PACK RP2		
28	4	7010345	3.3KΩ 10 PIN SIP RESISTOR PACK RP1, RP3, RP4 & RP5		
29	1	7010213	74LS122 U58		
30	1	7010366	DELAY LINE U2		
31	1	7050002	8 POSITION DIP SWITCH (16 PIN DIP) S3		
32	1	7130003	HEAT SINK		
33	2	7130006	6-32 x 3/8 SCREW PHILLIPS HEAD		
34	2	7130007	6-32 HEX NUT		
35	1	7040003	1N751-5V ZENER DIODE CR1		
36	1	7160001	5 VOLT REGULATOR VR1		
37	1	7160003	12 VOLT REGULATOR VR2		
38	2	7130072	PCB EJECTOR		
39	1	7020097	20KΩ 5% 1/4 WATT RESISTOR R7		
40	1	7040001	1N914 DIODE CR2		
41	1	7020053	150Ω 5% 1/4 WATT RESISTOR R5		
42	1	7020085	3.3KΩ 5% 1/4 WATT RESISTOR R3		
43	3	7170004	JUMPER STRAP		
44	2	7170018	BERG HEADER 1X2		

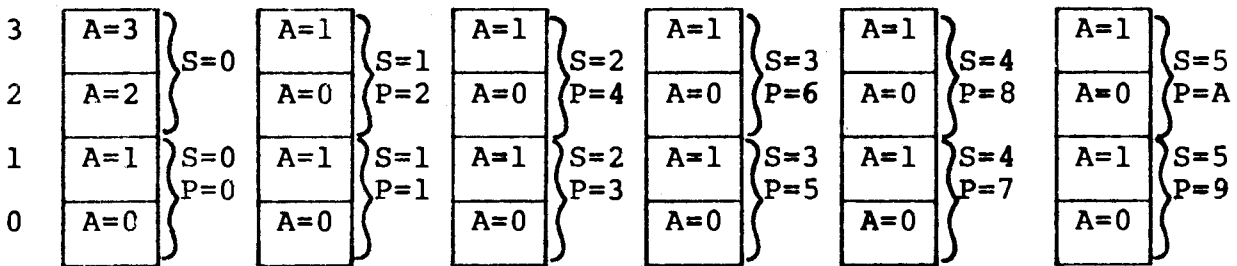
48 BOUNDARY SELECTION

BANK



32 BOUNDARY SELECTION

BANK



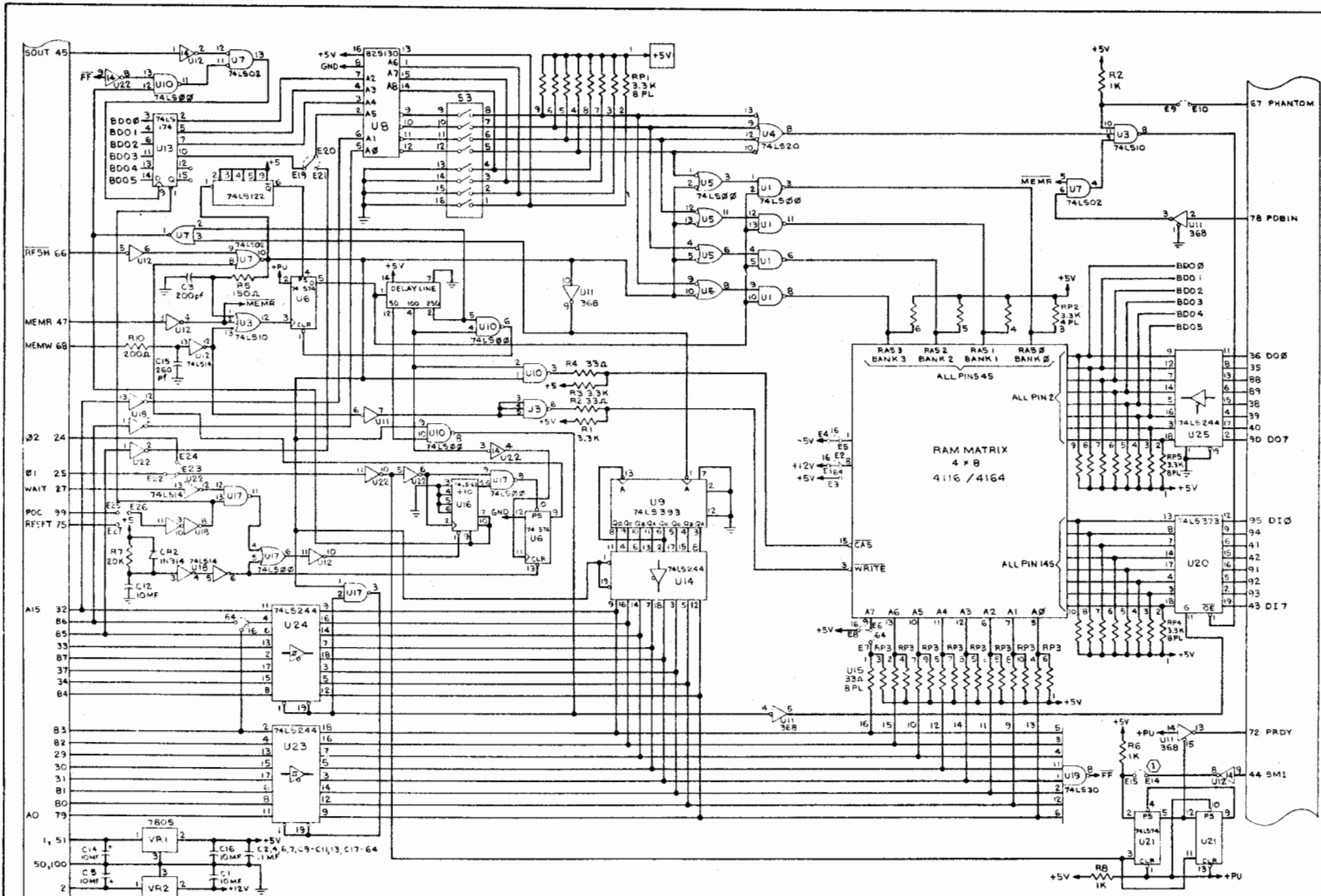
S (BD)	A8
(NBR)	A7 8 04
	A6 2
P (USER)	A5 S 03
(NBR)	A4 1
	A3 3 02
	A2 0
A (A15,A14)	A1 01
	A0

BANK SELECTED	PROM OUTPUT
3	7
2	B
1	D
0	E

NOTE: P=B,C,D,E,F IS RESERVED.

Figure 2-4. PROM Program and Page Mapping.

REVISIONS			
LTR	DESCRIPTION	DATE	APP.
E	PER ECN # 137		



NOTES: ① REMOVE JUMPER FOR 100A.

TOLERANCES .XX ± 2.000 ANGLE .XXX ± 5.010 ± 1/2 .XXXX ± 3.000		DRAWS BY D.C.G.		DATE 5-30-80		SD SYSTEMS SARLAND, TEXAS	
MATERIAL		DESIGN ENGR DATE		CHECKED BY DATE		SCHEMATIC EXPANDRAM II	
FINISH		PROJ ENGR DATE		APPROVED DATE		SIZE CODE IDENT DRAWING NO.	
NEXT ASSY USED ON		APPROVED DATE		APPROVED DATE		D 0100161	
APPLICATION		APPROVED DATE		APPROVED DATE		REV E	
						SCALE $\frac{1}{1}$ DO NOT SCALE DRAWING SHEET 1 OF 1	