

**OPERATIONS MANUAL**

# **ExpandoRAM II**



## LIMITED WARRANTY

This unit is warranted for a period of ninety (90) days from the date of purchase to be free from material or workmanship defects. Should the product fail to perform to specifications returned and repaired to SD Systems and it will, at our option, be replaced free of charge, provided the unit is received during the warranty period. This warranty is invalid if product has been misused or modified. Warranty is limited to replacement of defective parts and no responsibility is assumed for damage to other equipment.

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OPERATIONS  
MANUAL

EXPANDORAM II  
EXPANDABLE RANDOM ACCESS MEMORY

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JULY 1979

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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 +18V @ 200mA (max) -14V to -18V @ 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	$\phi$ 1	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, 43,43	DI-0 to DI-7	Output	Data bus out
44	SM1	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).

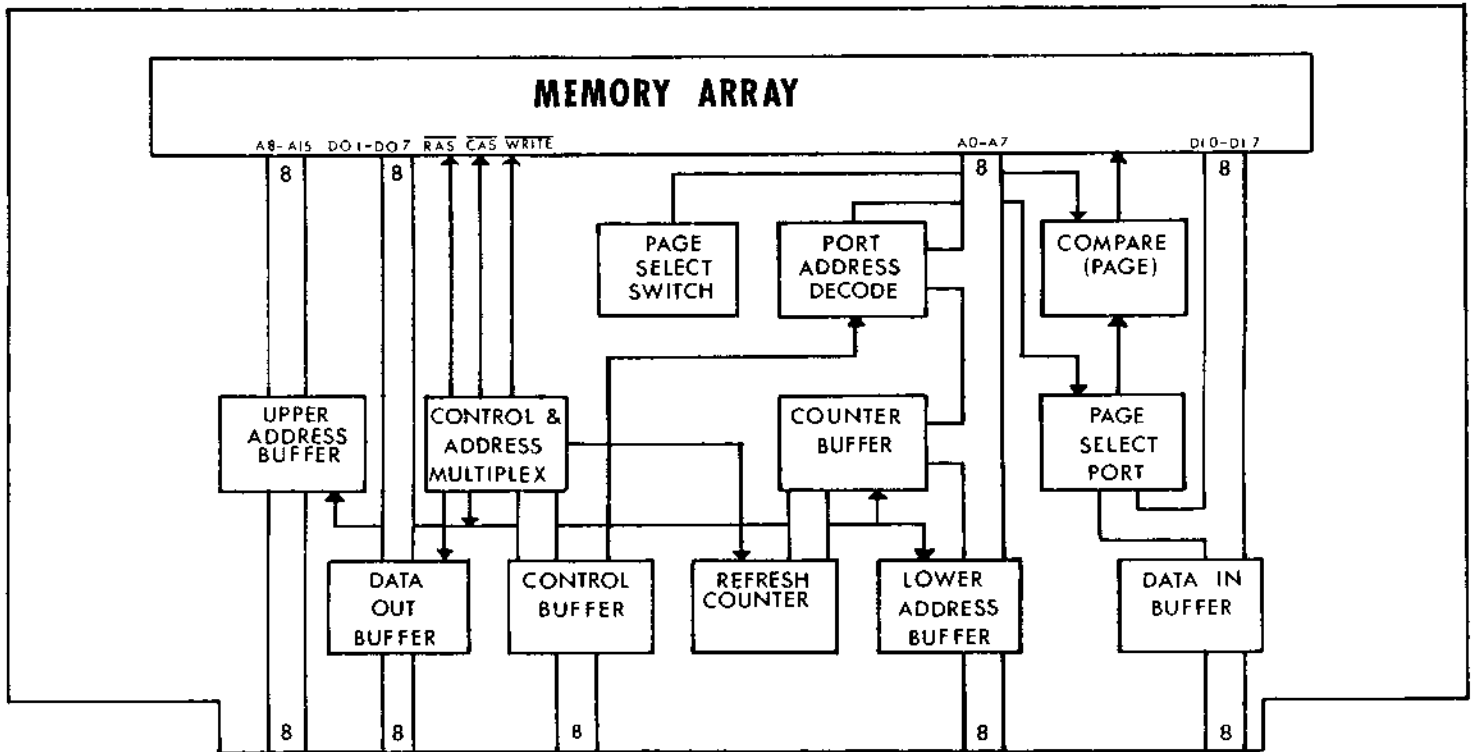
**Memory Decode and Control** - The memory decode and control section is responsible for generating the timing signals for the memory array, address multiplexer, and data buffer. Timing within the memory decode and control section is generated by a TTL compatible delay line. An 82S130 PROM is used to select the proper banks according to the address lines, board select switches, and the board select latch. Two versions of this prom are available. **Version 1** is for use with memory swapping applications. **Version 2** is to allow the board to work in a standard manner.



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

### 3-1 ASSEMBLY PROCEDURE

✓(1) Install the IC sockets in their proper locations. NOTE: No sockets for U2 or DIP switch S3.

(2) Install 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~~<sup>22K</sup> 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 Diodes CR1, and CR2 with the banded end as shown on the PC board.

✓(N) CR1 1N751

✓(N) CR2 1N914/1N4148

(4) Install the capacitors as follows:

✓(N) C1,C5,C8,C12,C14, C16 10MF Tantalum (Note Polarity)

(N) C2,C4,C6,C7,C9,C10,C13,C17-64 .1MF MICA

(N) C15,C3 200PF MICA

(5) Install the two voltage regulators with the heat sink, 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 PC board.

(N) VR1 +5V 7805/LM 340-5

✓(N) VR2 +12V 7812/LM 340-12

✓(6) Install the wire wrap pins. NOTE: It is not necessary to install the wire wrap pins if the board is to be set up for only one type of microprocessor. The wire wrap pins are for those who will be reconfiguring the board frequently.

(7) Install DIP switches.

✓(N) S3 Observe the proper position of the PC Board  
(The ON side should be toward the top of the board)

(8) 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

( ) U2 Delay Line

( ) U15 33 Ohm DIP

( ) U3 74LS10

( ) U16 74LS162

( ) U4 74LS20

( ) U17 74LS00

( ) U5 74LS00

( ) U18 74LS14

( ) U6 74LS74

( ) U19 74LS30

( ) U7 74LS02

( ) U20 74LS373

( ) U8 82S130

( ) U21 74LS74

( ) U9 74LS393

( ) U22 74LS14

( ) U10 74LS00

( ) U23 74LS244

( ) U11 74LS368

( ) U24 74LS244

( ) U12 74LS14

( ) U25 74LS244

( ) U13 74LS174

( ) U26 - 57 - RAMS

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

\*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 RAM (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
- B. Cut etch between E4 and E5
- C. Cut etch between E6 and E8
- D. Connect E2 to 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. One is for use with 16K RAMS and the other for use with 64K RAMS. There are also proms for use with a multi-user system.

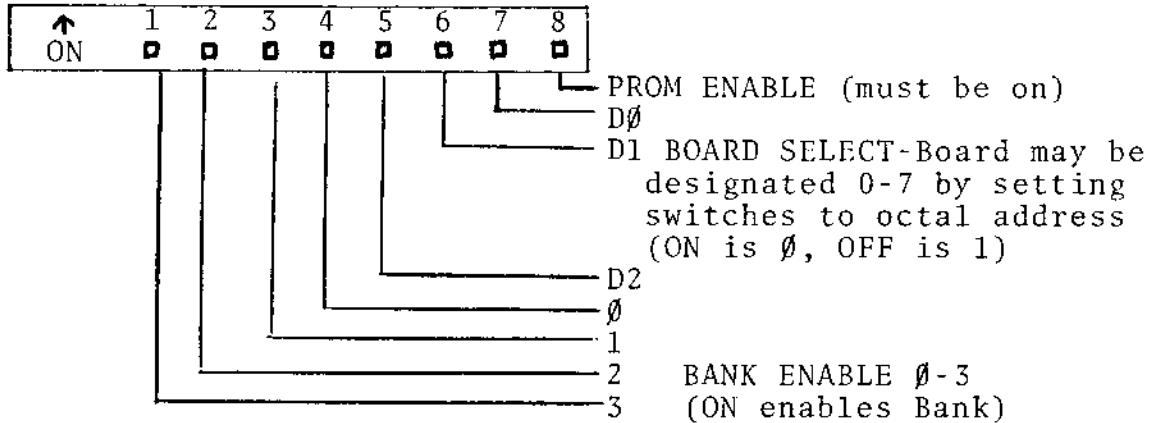
### 4-3 SWITCH SETTINGS

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



### 4-3 SWITCH SETTINGS

Port FF is used to select the Memory page (64K) to be accessed by the CPU. Up to 8 pages (0-7) may be in a system simultaneously, by using either 8 Expandoram II boards populated with 16K RAMS or 2 Expandoram II boards populated with 64K RAMS. The pages are accessed by outputting the page number to port FF.



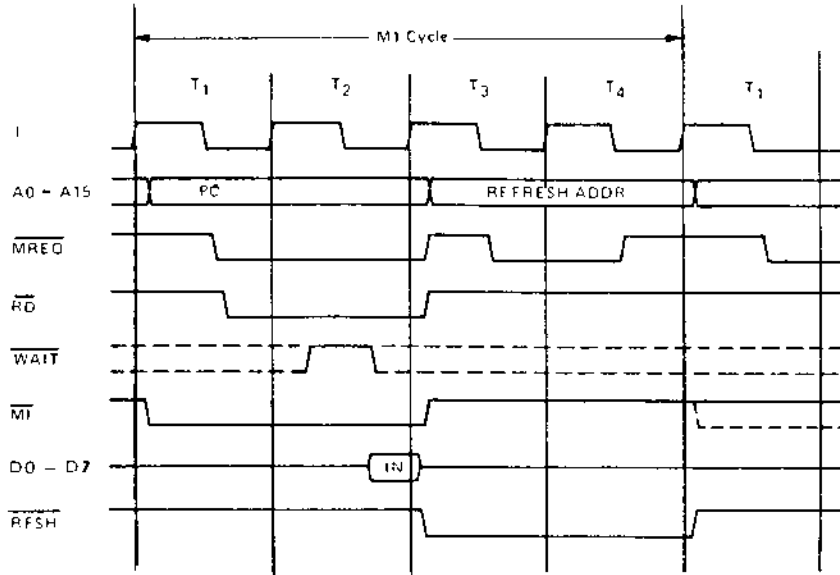
APPENDIX A  
MEMORY DIAGNOSTIC SOFTWARE LISTING

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
			VALUE OF EPAGE
		0020	;
		0021	; 4K '10'H
		0022	; 8K '20'H
		0023	; 16K '40'H
		0024	; 32K '80'H
		0025	; 48K 'CO'H
		0026	; 64K 'FF'H
		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
>0000		0036	; ORG 0000H
0000	0600	0037	; LD B,0 ;CLEAR B PATRN MODIFIER
		0038	;LOAD UP MEMORY
0002	212F00	0039	LOOP: LD HL,START ;GET STARTING ADDR
0005	7D	0040	FILL: LD A,L ;LOW BYTE TO ACCN
0006	AC	0041	XOR H ;XOR WITH HIGH BYTE
0007	A8	0042	XOR B ;XOR WITH PATTERN
0008	77	0043	LD (HL),A ;STORE IN ADDR
0009	23	0044	INC HL ;INCREMENT ADDR
000A	7C	0045	LD A,H ;LOAD HIGH BYTE OF ADDR
000B	FE10	0046	CP EPAGE ;COMPARE WITH STOP ADDR
000D	C20500	0047	JP NZ,FILL ;NOT DONE,GO BACK
		0048	;READ AND CHECK TEST DATA
0010	212F00	0049	LD HL,START ;GET START ADDR
0013	7D	0050	TEST; LD A,L ;LOAD LOW BYTE
0014	AC	0051	XOR H ;XOR WITH HIGH BYTE
0015	AB	0052	XOR B ;XOR WITH MODIFIER
0016	BE	0053	CP (HL) ;COMPARE WITH MEMORY LOC
0017	C225000	0054	JP NZ,EXIT ;ERROR EXIT
001A	23	0055	INC HL ;UPDATE MEMORY ADDR
001B	7C	0056	LD A,H ;LOAD HIGH BYTE
001C	FE10	0057	CP EPAGE ;COMPARE WITH STOP ADDR
001E	C21300	0058	JP NZ,TEST ;LOOP BACK
0021	04	0059	INC B ;UPDATE MODIFIER
0022	C30200	0060	JP LOOP ;RST WITH NEW MODIFIER

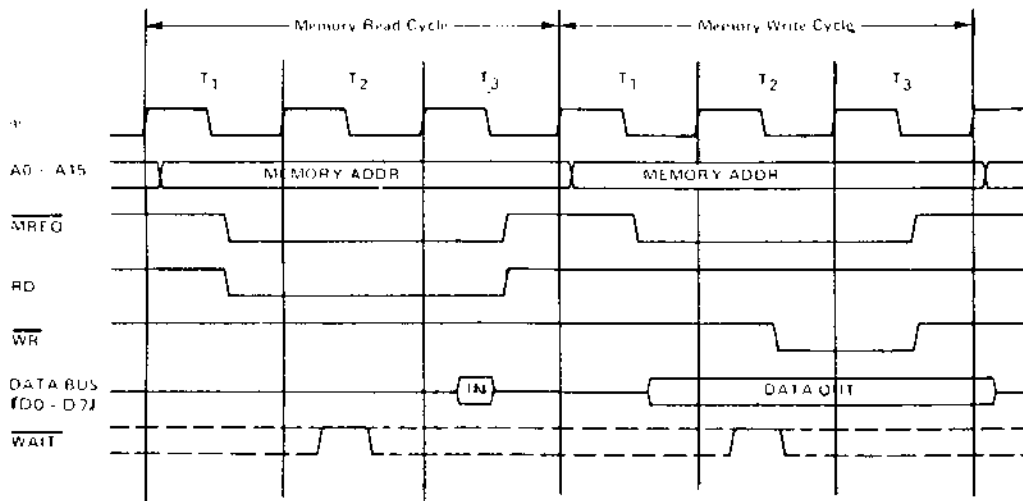
0025	222D00	0061	;ERROR EXIT		
0028	322C00	0062	EXIT	LD	(BYTE),HL ;SAVE ERROR ADDRESS
002B	76	0063		LD	(PATRN),A ;SAVE BAD PATTERN
>002C		0064		HALT	;FLAG OPERATOR
>002D		0065	PATRN:	DEFS	1
002F	2F00	0066	BYTE:	DEFS	2
0031	3100	0067	START:	DEFW	\$
>0010		0068		DEFW	\$
		0069	EPAGE:	EQU	10H ;PLACE FOR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

APPENDIX B  
EXPANDORAM II TIMING DIAGRAM

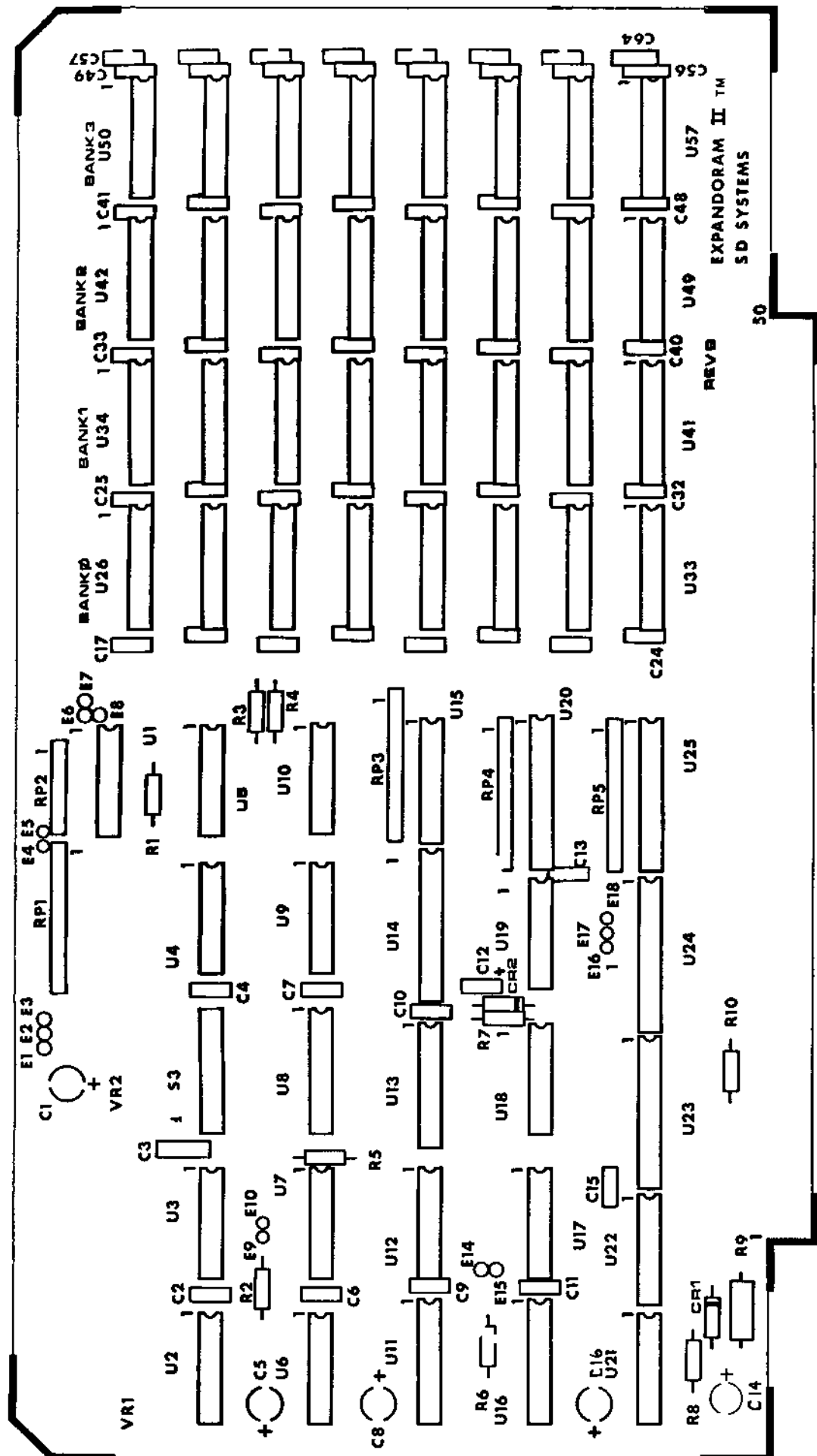
## INSTRUCTION OP CODE FETCH



## MEMORY READ OR WRITE CYCLES



APPENDIX C  
EXPANDORAM II PARTS PLACEMENT DRAWING

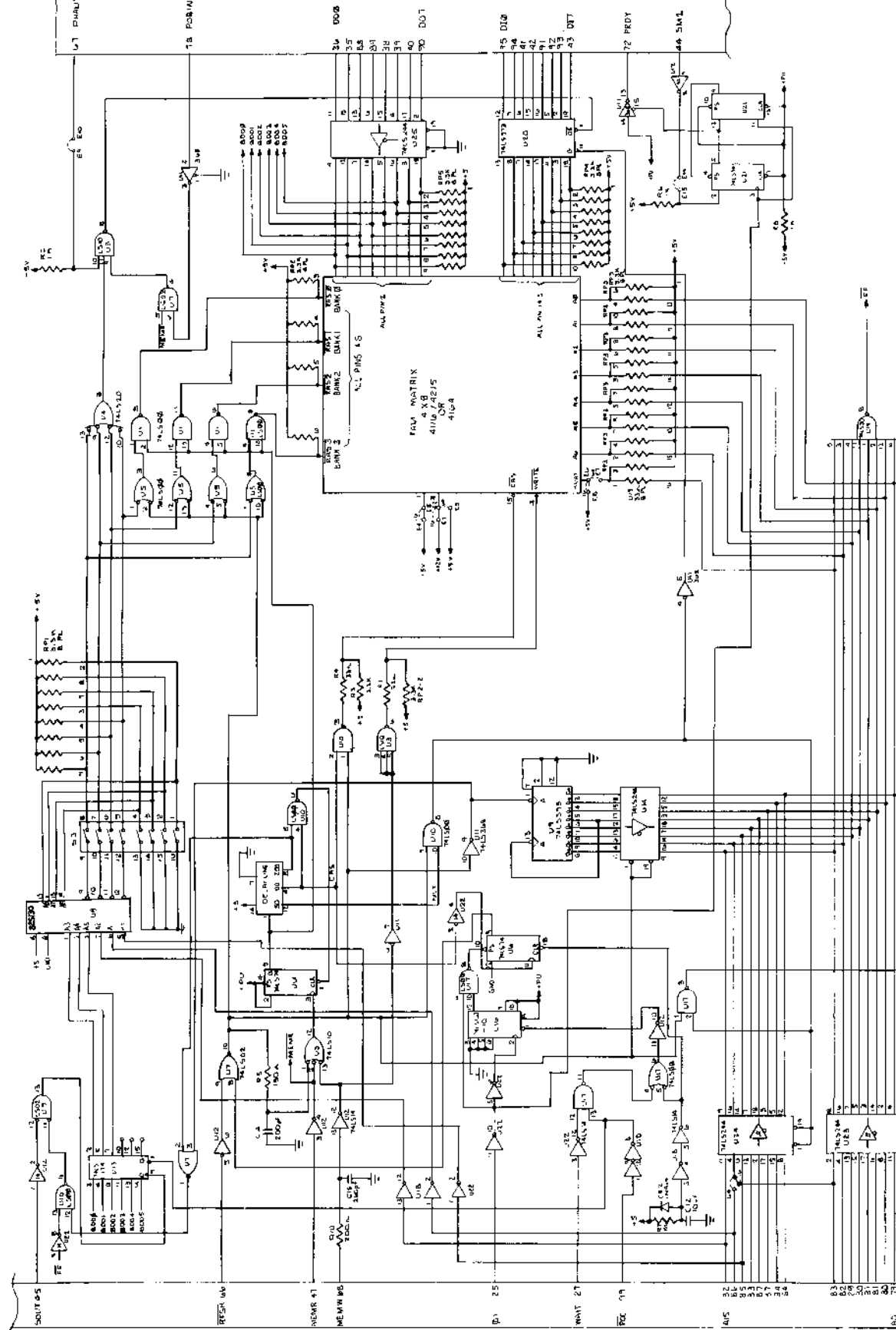


EXPANDORAM II™  
SD SYSTEMS



APPENDIX D  
EXPANDORAM II SCHEMATIC

LYR	DESCRIPTION	DATE	APR
A	ENIG PER EEN 027	10/27/71	027
B	ENIG PER EEN 036	9-17-71	036



TOLERANCES		DATE	DRAWN BY
XX	± 0.00 MM	10/27/71	...
XX	± 0.00 IN	10/27/71	...
XX	± 0.00	10/27/71	...
MATERIAL		DATE	APPROVED
		10/27/71	...

SIZE CODE IDENT	DRAWING NO.	REV
D	010061	B

SCALE	DO NOT SCALE DRAWING	SHEET	OF
D		1	1

NOTES:

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. B
Date Released:	Approved: <i>[Signature]</i>		Sheet 1 of 2

Item No	Qty	SD-P/N	Description	Unit Cost	Extension
1	1	7000012	P.C.B. Board 0100162		
2	4	7010160	74LS00 U1, U7, U5, U10		
3	1	7010162	74LS02 U7		
4	1	7010168	74LS10 U3		
5	3	7010172	74LS14 U12, U22, U18		
6	1	7010174	74LS20 U4		
7	1	7010180	74LS30 U19		
8	2	7010195	74LS74 U6, U21		
9	1	7010370	82S130 U8		
10	1	7010232	74LS162 U16		
11	1	7010241	74LS174 U13		
12	4	7010264	74LS244 U23, U24, U25, U14		
13	1	7010303	74LS368 U11		
14	1	7010304	74LS373 U20		
15	1	7010312	74LS393 U9		
16	14	7060002	14 PIN Solder-tail Dip Sockets		
17	37	7060003	16 PIN Solder-tail Dip Sockets		
18	5	7060005	20 PIN Solder-tail Dip Sockets		
19	50	7030007	.1MF Mica Capacitor C2, 4, 6, 7, 9, 10, 11, 13 17 thru 64		
20	2	7030005	200PF Mica Capacitor C15, C3		
21	10	7030009	10MF Tantalum Capacitor C1, 5, 8, 12, 14, 16		
22	2	7020037	33Ω 5% 1/4 Watt Resistor R4, R1		
23	1	7020056	200Ω 5% 1/4 Watt Res. R10		
24	1	7020065	470Ω 5% 1/4 Watt Res. R9		

NOTES