EXPANDORAM™

OPERATIONS MANUAL

EXPANDABLE RAM Printed Circuit Board

SD Systems

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 satisfactorily return it prepaid to SD Systems and it will, at our option, be repaired or 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.

This warranty is made in lieu of all other warranties expressed or implied.

SD7140012

INDEX

INTRODUCTION

The SD SALES EXPANDORAM ™ board provides a low cost means for expanding Random Access Memory capability for computers utilizing the S-100 bus structure. The SD SALES EXPANDORAM ™ will interface directly to the following computers: IMSAI, ALTAIR A, ALTAIR B, SOL-8, CROMEMCO, and the SD SALES Z80 CPU card. Poly-88 Computers must have the Poly modifications to put the SM1 and P WAIT Lines (Buss pins 44 and 27 respectively) on the buss.

GENERAL DESCRIPTION

The SD SALES EXPANDORAM ™ board is a high performance dynamic RAM board using state-of-the-art MOS dynamic memory devices from MOSTEK CORPORATION. The SD SALES EXPANDORAM may be configured to have a memory capacity of 8K, 16K, 24K, or 32K bytes of memory using the MK 4115 (8,192x1 MOS dynamic RAM) or 16K, 32K, 48K, or 64K bytes of memory using the MK 4116 (16,384x1 MOS dynamic RAM) memories. An eight position DIP Switch is provided for positioning memory on any 8K or 16K boundary. Other notable features of the SD SALES EXPANDORAM ™ ,board include:

> (1) Bank selectable write protect.
>
> (2) Phantom output disable or
>   manual switch selectable output disable.
>
> (3) Typical power dissipation of 5 watts.

PHYSICAL

The SD SALES EXPANDORAM ™ 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 DC. The SD SALES EXPANDORAM ™ board is interfaced
to the system by connector J-1.

SPECIFICATIONS

Table 1-1 lists the overall specifications for the SD SALES
EXPANDORAM board. Table 1-2 lists the pin usages of connector
J-1 for the EXPANDORAM ™.

TABLE 1-1

SPECIFICATIONS

Memory Capacity	Up to 32,768 bytes (MK 4115) Up tq 65,536 bytes (MK 4116)
Memory Access	375 ns max.
Memory Cycle	500 ns min.
Interface Levels	TTL Compatible
Power	+7V to +10V @ 400 mA (max) +14V to +20V @ 200 mA (max) 2 us memory cycle -14V to -20V@ 30 mA (max)
Physical Dimensions	5.25" x 10.0" x .65"
Operating Temperature	0 degree C to 50 degree C
	(Poly-88 users should make provision for external cooling to ensure proper operation.)

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

PIN #	SIGNAL NAME	DIRECTION	DESCRIPTION
1,51	+8V to 10V	---------	Power
2	+14V to 20V	---------	Power
24	∅2	Input	Phase 2 clock
25	∅1	Input	Phase 1 clock
26	PHOLDA	Input	Hold acknowledge
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	A-8,A-15 etc.	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, 91,92,93,43	DI-0 to DI-7	Output	Data bus out
44	SM1	Input	Machine cycle one
47	SMEMR	Input	Memory read
66	RFSH	Input	Refresh (Z80 CPU card)
68	MWRT	Input	Memory write
72	PRDY	Output	Ready
75	RESET	Input	Reset
76	PSYNC	Input	Sync
78	PDBIN	Input	Data bus in
100,50	GROUND	--------	-----------
48	HALTA	Input	Halt Acknowledge

FUNCTIONAL DESCRIPTION

The major functions of the SD SALES EXPANDORAM ™ 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 MK 4115 or MK 4116 dynamic random access memory elements. Each MK 4115 has an 8,192 x 1 bit capacity, while the MK 4116 has a 16,384 x 1 bit capacity. The 32 MK 4115 or MK 4116 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 SD SALES EXPANDORAM ™ is 32,768 or 65,536 bytes, depending on the type of memory device that is used (8K or 16K).

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.

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.
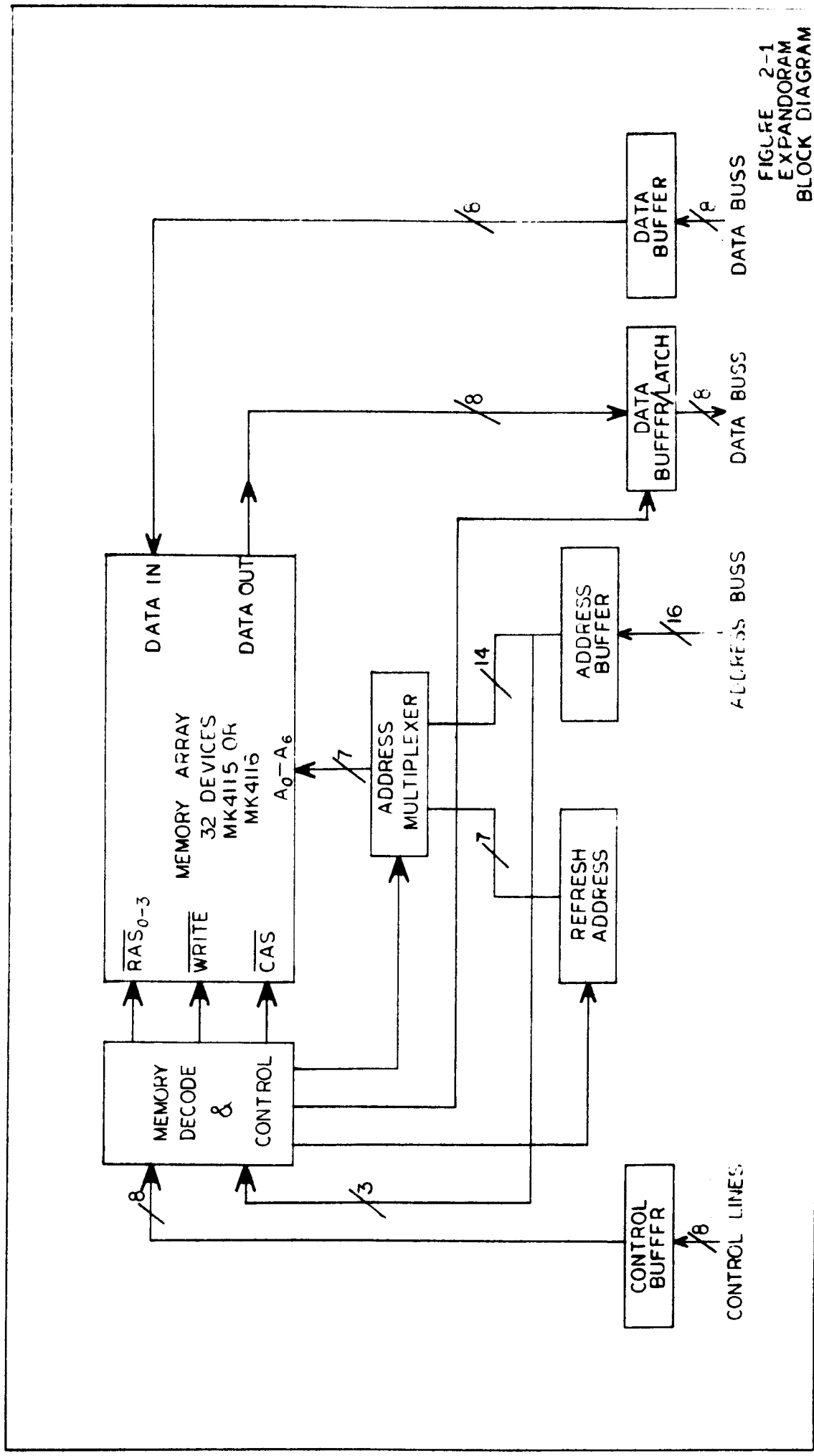
FIGURE 2-1
EXPANDORAM
BLOCK DIAGRAM

-5-

CONSTRUCTION

The SD SALES 32K EXPANDORAM ™ 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 either: (1) find an experienced person to help you assembly and checkout the board or (2) return the board to SD SALES and have the board assembled and tested for a nominal fee.

Table 3-1 shows the parts list for the SD SALES EXPANDORAM ™ board while Table 3-2 shows the parts lists broken down into the shipping packets. Double check all parts against the parts list. If any differences are noted, please call SD SALES at 1-800-527-3460 (TOLL FREE.)

NOTE: General construction information, Assembly diagram and Schematic diagram can be found in Section V.

Assembly Procedure

(1) Install the IC sockets in their proper locations. NOTE: No sockets for DIP switches, U1, U2.

(2) Install the resistors as follows:

    ( )   R1 510 OHM ¼W (Green, Brown, Brown)

    ( )   R2 4.1K OHM 1/8W 1% Metal Film

    ( )   R3 8.6K OHM 1/8W 1% Metal Film

( ) R4   33 OHM ¼W   (Orange, Orange, Black)

( ) R5, R6 3.3K OHM ¼W (Orange, Orange, Red)

( ) R7   470 OHM ½W   (Yellow, Violet, Brown)

( ) R8   1K OHM ¼W   (Brown, Black, Red)

( ) R9   200 OHM ¼W   (Red, Black, Brown)
( ) R10 470 OHM ¼W   (Yellow, Violet, Brown)
( ) Resister packs: RP1 3K OHM 6 pin SIP
                        RP2-RP5 3K OHM 10 pin SIP
        NOTE: Pin 1 of the SIP's 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

( ) CR1 1N71   ( ) CR2 1N914/1N4148

(4) Install the capacitors as follows:

( ) C1,C10,C13,C18,C19,C22 10 MF Tantalum (Note proper
                                                 polarity)

( ) C3,C7,C71 100 pf mica

( ) C6, C14 200 pf mica

( ) C2, C4, C5, C8, C9, C11, C12, C15, C16, C17, C20, C21
     C23-C70 .1MF ceramic

(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.

( ) VR1 +5V 7805/LM 390-05

( ) 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
( ) E1,E2,E3, E10-E30   be set up for only one type of micro-
                                 processor. The wire wrap pins are for
                                 those that will be reconfiguring the
                                 board frequently.

(7) Install DIP switches.
     ( ) U1 Observe the proper position of the PC Board
            (The ON side should be toward the top of the board)
     ( ) U2
(8) Install Transistor
     ( ) Q1 1N2222   -7-

(9) Double check all solder connections for cold solder joints, unsoldered connections, or shorted connections.

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.

( )	U3	74LS00	( )	U16	74LS157
( )	U4	74LS93	( )	U17	74157
( )	U5	74LS221	( )	U19	74LS14
( )	U6	74LS21	( )	U20	74LS75
( )	U7	741S138	( )	U21	74LS157
( )	U8	74LS00	( )	U22	74157
( )	U9	74LS32	( )	U23	74 S373
( )	U10	74LS27	( )	U24	74LS14
( )	U11	74LS93	( )	U25	74LS14
( )	U12	DELAY LINE	( )	U26	74LS14
( )	U13	7400	( )	U27	74LS14

```
( )   U14    7425              ( )   U28    74LS244

( )   U15    74LS93

*( )  U32,U36,U40,U44,U48,U52,U56,U60   (Bank 0)

( )   U31,U35,U39,U43,U47,U51,U55,U58   (Bank 1)

( )   U30,U34,U38,U42,U46,U50,U54,U58   (Bank 2)

( )   U29,U33,U37,U41,U45,U49,U53,U57   (Bank 3)
```

*NOTE: If less than 32K 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™ 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 WRITE PROTECT 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 ™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 insetions into the socket. If this does not bring any further results, call SD SALES at 1-800-527-3460 for

further advise on trouble shooting the board.

(9) If the read/write test is successful, verify that memory on the EXPANDORAM ^{TM}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 checkout of the board by loading the memory test that is shown in Appendix D. 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 IV

UTILIZATION

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

MK 4115-40, MK 4115-41 or MK 4116 DEVICE SELECTION JUMPERS

Two types of MK 4115's can be used with the 32K EXPANDORAM™,
whereas one type of MK 4116 is used for the 64K board. Table
4-1 shows which jumpers should be connected for the 32K board
using the two types of MK 4115's. Table 4-2 shows the jumpers
for the 64K board using the MK 4116.

TABLE 4-1

Jumpers for MK 4115-40 or -41 Selection

DEVICE	JUMPERS	
MK 4115-40	E16 to E17	Connected
MK 4115-41	E16 to E17	Open ✓

NOTE: For the 32K RAM board using the MK 4115, all RAM's for
the board must be all MK 4115-40's or MK 4115-41's. The 40's
and the 41's CANNOT BE MIXED! Therefore, if additional RAMS are
ordered, the same type must be ordered, either -40's or 41's!

TABLE 4-2

Jumpers for MK 4116 64K Configuration

DEVICE	JUMPERS			
MK 4116	E15	to	E16	Connected
	E16	to	E17	Open
	E4	to	E5	Break etch line
	E6	to	E7	Break etch line
	E8	to	E9	Break etch line
	E5	to	E6	Connected
	E7	to	E8	Connected
	E9	to	E18	Connected

NOTE: If a 64K Board is to be reconfigured for the MK 4115, then the three broken etch lines must be reinstalled, and jumpers connected as shown in Table 4-1.

ADDRESSING SWITCH

Figure 4-3 shows the switch positions for address selection of the 32K board populated with MK 4115's.

TOP OF BOARD

```
on  ┌─┬─┬─┬─┬─┬─┬─┬─┐
    │1│2│3│4│5│6│7│8│
off └─┴─┴─┴─┴─┴─┴─┴─┘
                      └─E000-FFFF  (Bank-3)
                     └──C000-DFFF  (Bank-2)
                    └───A000-BFFF  (Bank-1)
                   └────8000-9FFF  (Bank-0)
                  └─────6000-7FFF  (Bank-3)
                 └──────4000-5FFF  (Bank-2)
                └───────2000-3FFF  (Bank-1)
               └────────0   -FFFF  (Bank-0)
```
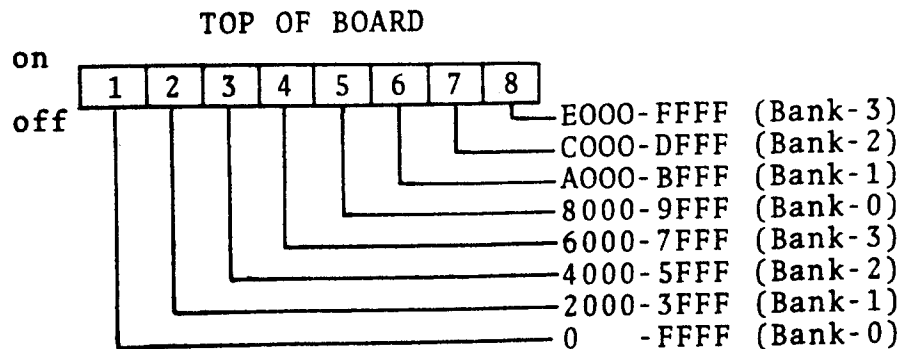
Figure 4-3

Figure 4-4 shows the address switch positions for the 64K board populated with MK 4116's.

```
                     |Not used  set 5-8 to off position
         on          ┌──────────┐
                   ┌─┬─┬─┬─┬─┬─┬─┬─┐
                   │1│2│3│4│5│6│7│8│
         off       └─┴─┴─┴─┴─┴─┴─┴─┘
                               │ │ │ └── C000-FFFF (Bank 3)
                               │ │ └──── 8000-BFFF (Bank 2)
                               │ └────── 4000-7FFF (Bank 1)
                               └──────── 0   -3FFF (Bank 0)
```
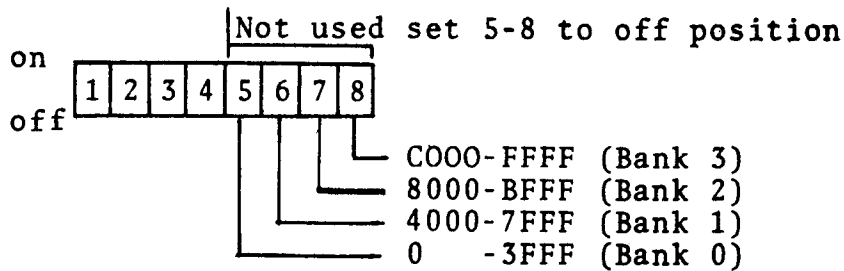
Figure 4-4

BANK SELECTABLE WRITE PROTECT SWITCH

Figure 4-5 shows the positions for the bank selectable write protect switch.

```
         on           Used for optional output disable
                   ┌─┬─┬─┬─┬─┐
                   │1│2│3│4│5│
         off       └─┴─┴─┴─┴─┘
                     │ │ │ │    off= protected
                     │ │ │ │    on = unprotected
                     │ │ │ └──── Bank 0
                     │ │ └────── Bank 1
                     │ └──────── Bank 2
                     └────────── Bank 3
```
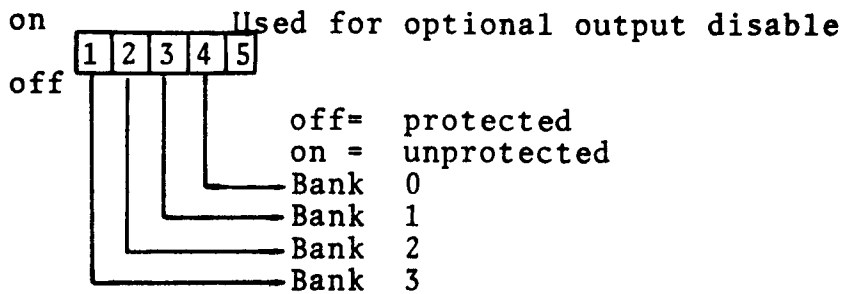
Figure 4-5

CPU CARD SELECTION

TABLE 4-6 shows the jumpering for the selection of either an 8080 CPU card, a Z80 CPU card, or 8085 CPU card.

Figure 4-7 shows the optional jumpers for connecting the PHANTOM
OUTPUT disable control to J1-67 or the manual switch output disable
control.   (Position 5 of write protect switch.)

TYPE OF OUTPUT DISABLE   JUMPERS

     Phantom J1-67   E2 to E3 Connected, E1 to E2 Open

✓ Manual Switch   E1 to E2 Connected, E2 to E3 Open

     None   E1 to E2 to E3 Open

Figure 4-7

NOTE : The PHANTOM OUTPUT disable and the MANUAL switch output
disable cannot be enabled at the same time. If the MANUAL switch
output disable is selected; Position 5 of the WRITE PROTECT switch
will control the function with ON = DISABLE OUTPUT and OFF = ENABLE
OUTPUT
DMA (Does not apply for 8085 CPU Card)
Figure 4-8 shows the jumper options for enabling/disabling DMA.

                DMA   JUMPERS

FOR 8080 and   Disabled   E13 to E14 Connected
Z80 CPU CARDS
  ONLY!   Enabled   E13 to E14 Open ✓

Figure 4-8

NOTE   DMA to and from the EXPANDORAM   is limited to 1 ms or less
due to the refreshing requirement of the dynamic memories. It is
important to note that the board will not execute refresh cycles
during a DMA, if the DMA jumpers are installed. If DMA is disabled,
then when a DMA cycle is acknowledged, the board will execute its
automatic refresh cycle to retain memory during DMA cycles to and
from other memory boards.

A DMA read cycle will be triggered when the following logical equation is true:

$$DMA\ READ = MEMR \cdot SYNC \cdot \overline{\emptyset 2}$$

A DMA write cycle will be triggered with the following condition:

$$DMA\ WRITE = MEMW$$

ECN-1   It has come to our attention that several of the existing Z-80 CPU boards may not generate PSYNC during a MEMR instruction. The following modification to the EXPANDORAM Kit is necessary to allow compatability with these units:
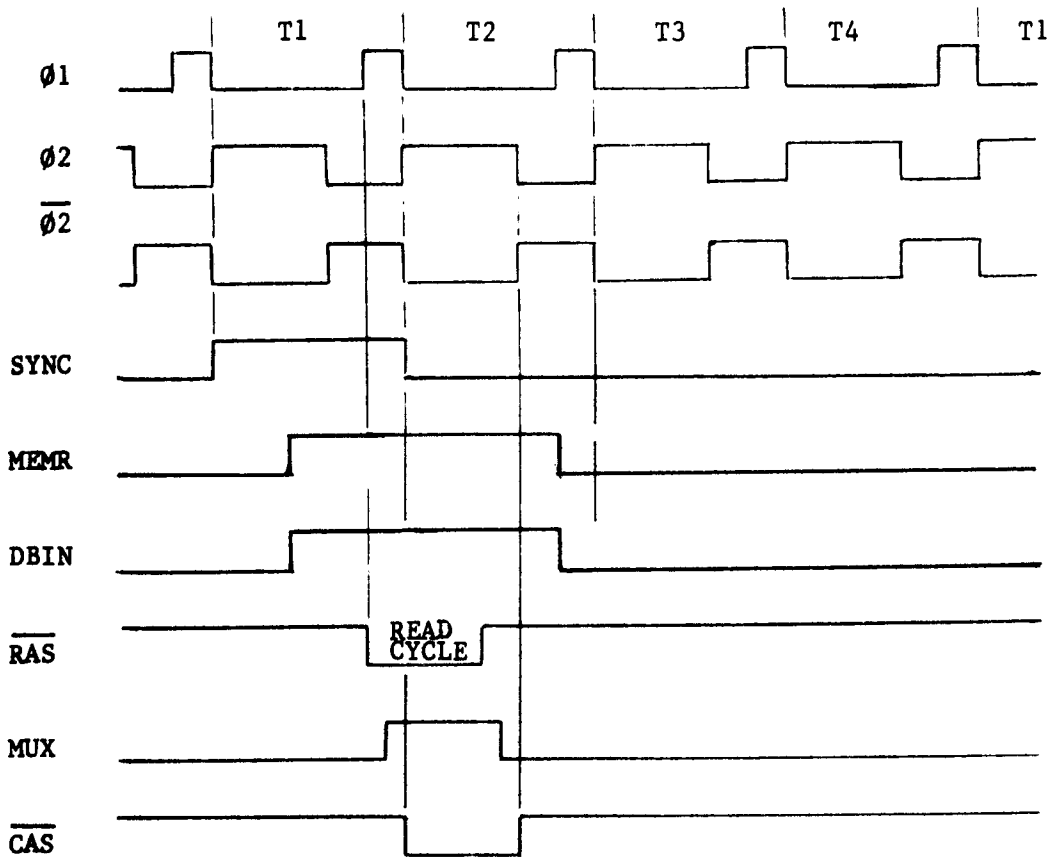
Remove IC 19 (74LS14) from its socket and bend pins 8 and 10 up. Replace chip in its socket. On the foil side of the board jumper pins 8 and 10 of the IC 19 socket to pin 7.

CPU BOARD	JUMPERS CONNECTED
8080	E10 to E11
	E20 to E21
	E22 to E23
	E25 to E26
	E28 to E30
Z-80	E11 to E12 ✓
	E20 to E21 ✓
	E22 to E23 ✓
	E25 to E26 ✓
	E28 to E30 ✓
8085	E10 to E11
	E13 to E14
	E19 to E20
	E22 to E24
	E26 to E27
	E28 to E29

TABLE 4-6
CPU CARD SELECTION
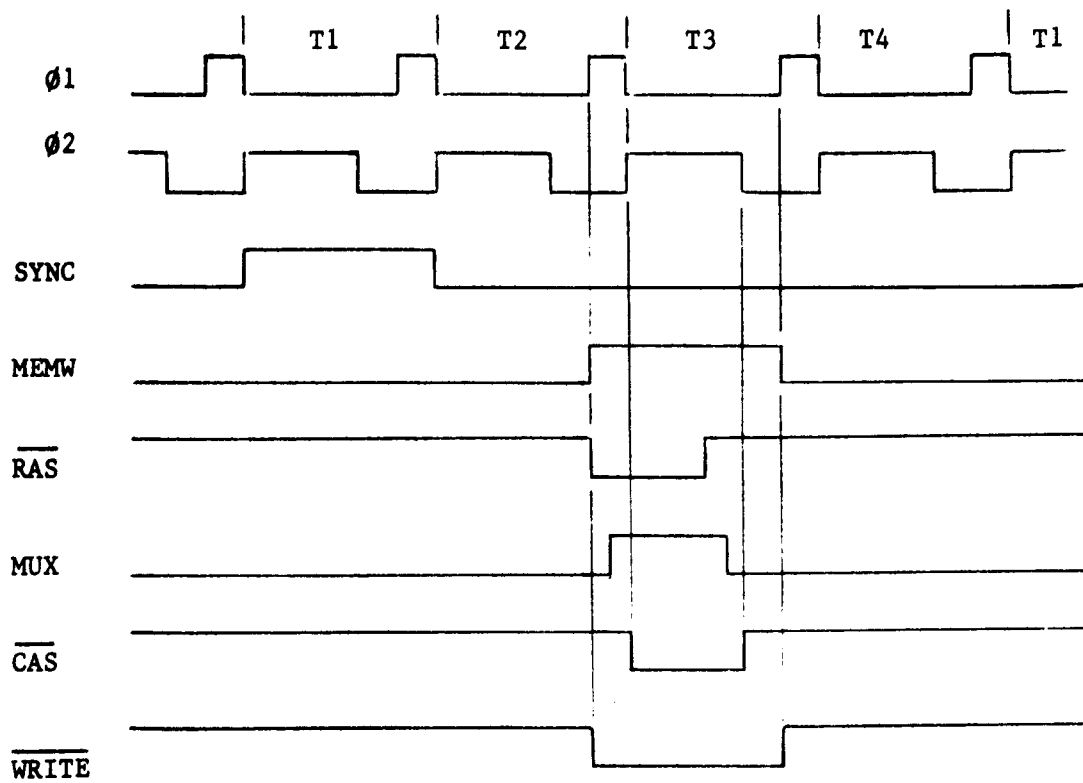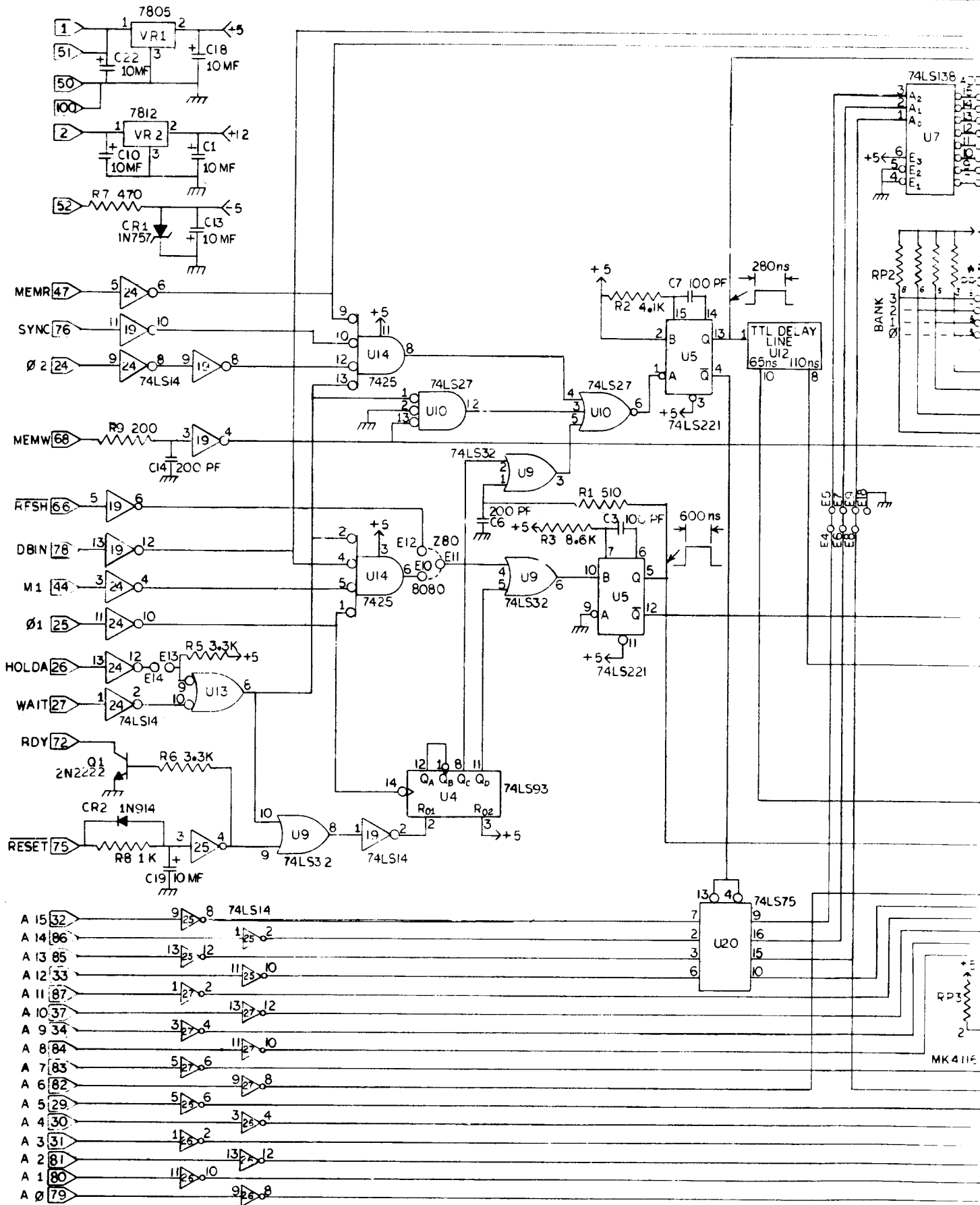
Memory Write Cycle   (Z80 & 8080 CPU's)

Memory Read Cycle   (Z80 & 8080 CPU's)

BANK 0 BANK 1 BANK 2 BANK 3

BIT 0 1 2 3 4 5 6 7
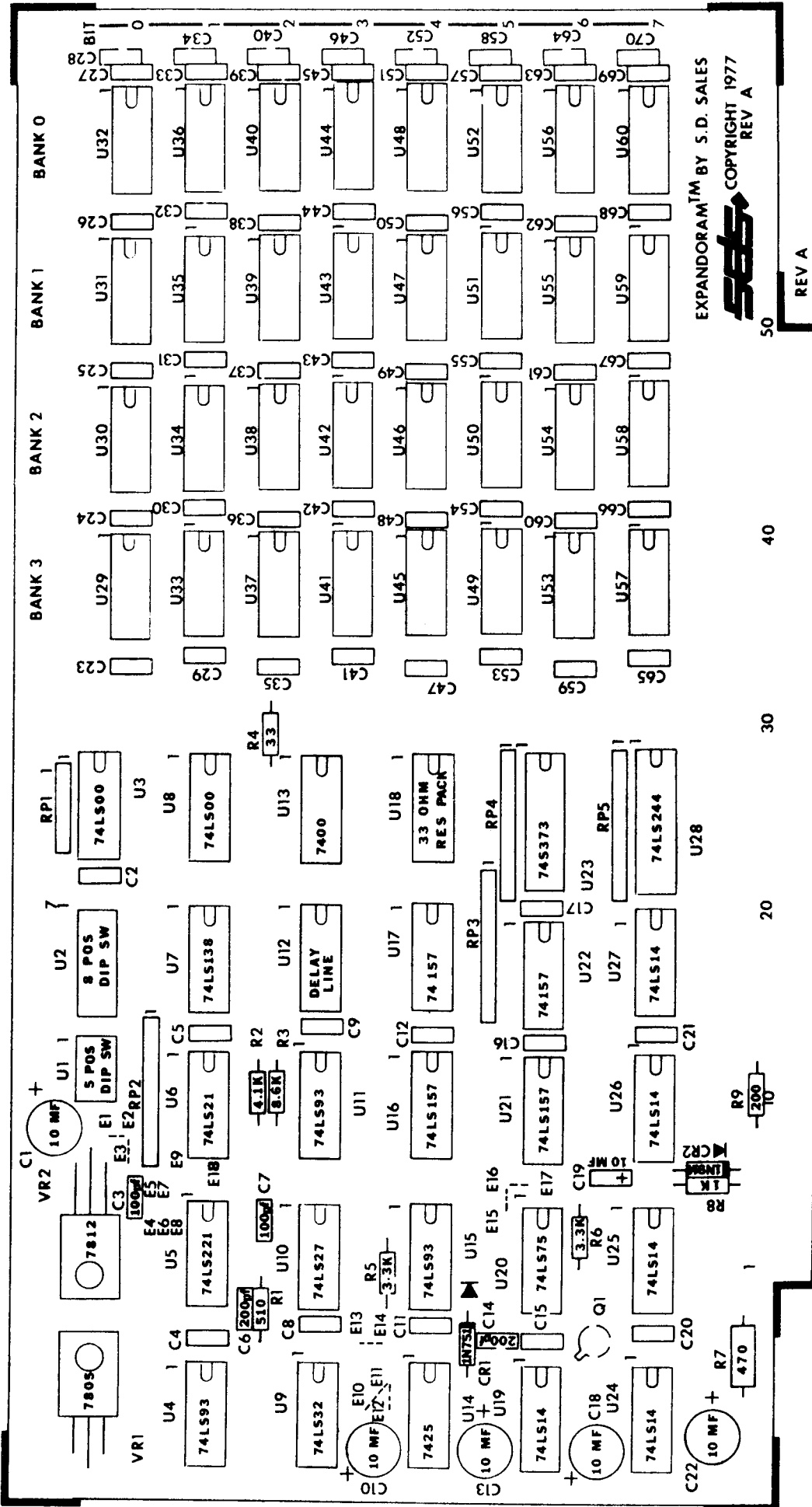
EXPANDORAM™ BY S.D. SALES
COPYRIGHT 1977
REV A

REV A

7805
VR1
+5
C22 10MF
C18 10MF

7812
VR2
+12
C10 10MF
C1 10MF

R7 470
CR1 1N757
C13 10MF

MEMR [47] 5 24 6
SYNC [76] 11 19 10
Ø2 [24] 9 24 8 9 19 8
74LS14

+5
U14
12
13 U14 8
7425

74LS27
1 2 13 U10 12
74LS27
3 5 U10 6

MEMW [68] R9 200 3 19 4
C14 200 PF

RFSH [66] 5 19 6
DBIN [78] 13 19 12
M1 [44] 3 24 4
Ø1 [25] 11 24 10

+5
2 4 5 1 U14 7425
6 E10
E12 Z80 E11
8080

HOLDA [26] 13 24 12 E13 R5 3.3K +5
WAIT [27] 1 24 2 E14 9 10 U13 6
74LS14

RDY [72]
Q1 2N2222 R6 3.3K
CR2 1N914
RESET [75] 3 25 4
R8 1K C19 10MF
9 U9 8 1 19 2
74LS32 74LS14

74LS32
1 2 U9 3
R1 510
200 PF C6 +5
R3 8.6K C3 100 PF
600 ns
4 5 U9 6
74LS32

+5 C7 100 PF 280ns
R2 4.1K
15 2 B U5 Q 13
1 A Q 14
+5 3
74LS221

TTL DELAY LINE U12
65ns 110ns
10 8

7 6 B U5 Q 5
10 B U5 Q
9 A Q 12
+5 11
74LS221

74LS138
3 A2
2 A1
1 A0
U7
+5 6 E3
5 E2
4 E1

RP2
BANK Ø-3

E5
E4 E6 E7

12 10 8 11
QA QB QC QD
14 U4 74LS93
R01 R02
3 +5

13 4 74LS75
7 9
2 16
3 U20 15
6 10

RP3
MK4116

A 15 [32] 9 25 8 74LS14
A 14 [86] 1 25 2
A 13 [85] 13 25 12
A 12 [33] 11 25 10
A 11 [87] 1 27 2
A 10 [37] 13 27 12
A 9 [34] 3 27 4
A 8 [84] 11 27 10
A 7 [83] 5 27 6
A 6 [82] 9 27 8
A 5 [29] 5 25 6
A 4 [30] 3 25 4
A 3 [31] 1 26 2
A 2 [81] 13 25 12
A 1 [80] 11 26 10
A Ø [79] 9 26 8

Schematic, 32K RAM (Sheet 1), No. D2A005-002, SD Sales Company, P.O. Box 28810 • Dallas, Texas 75228. REV A

PHANTOM DISABLE

67
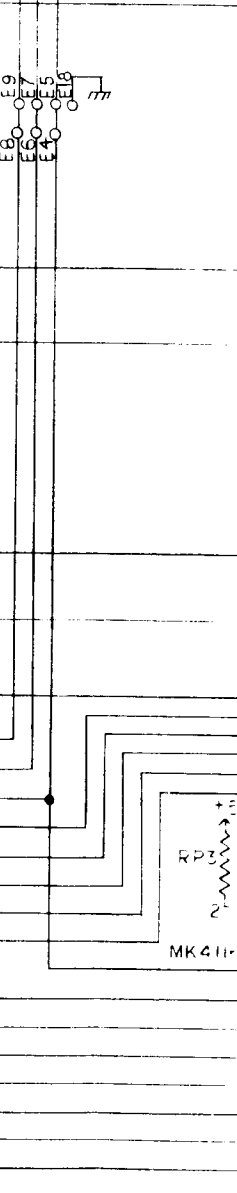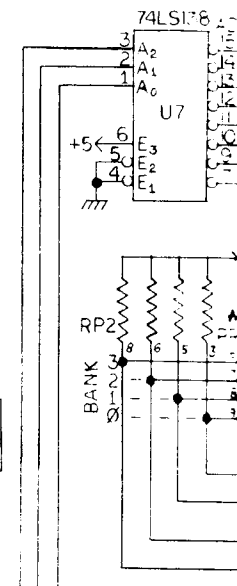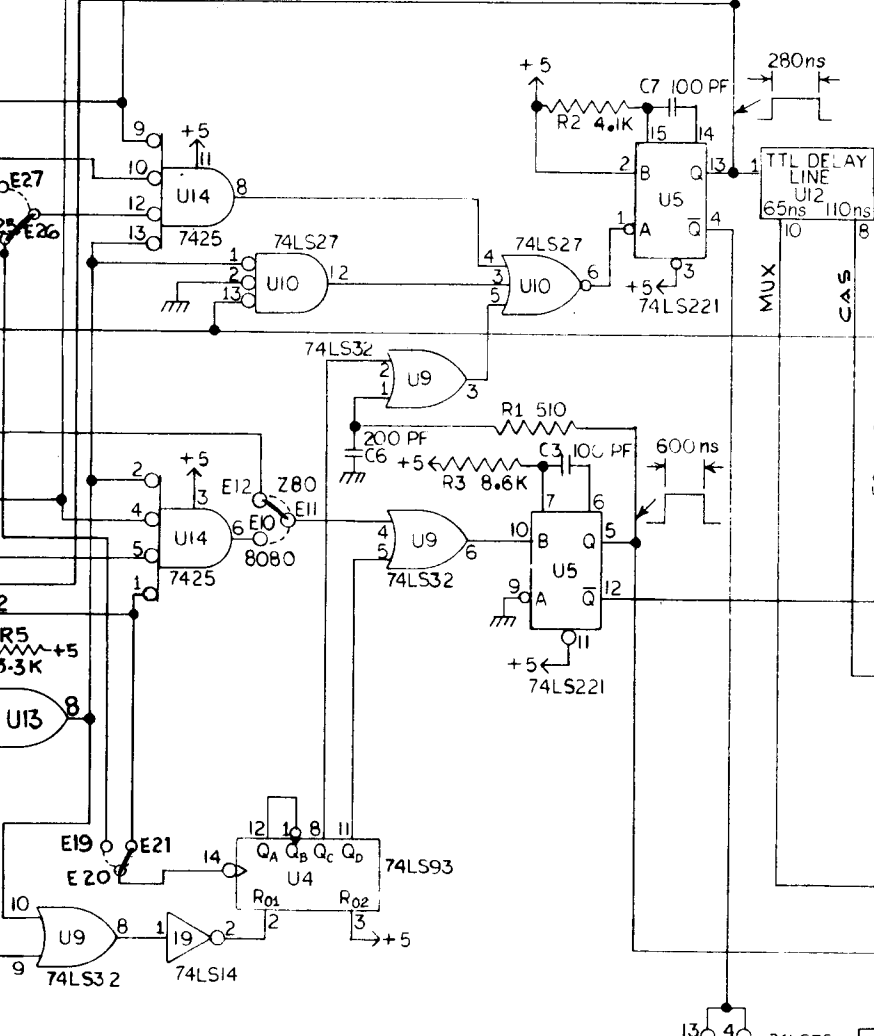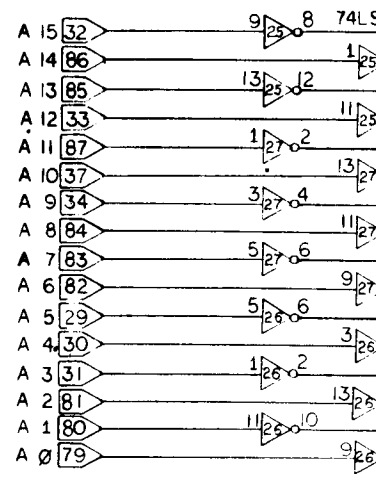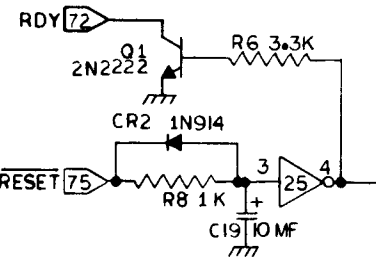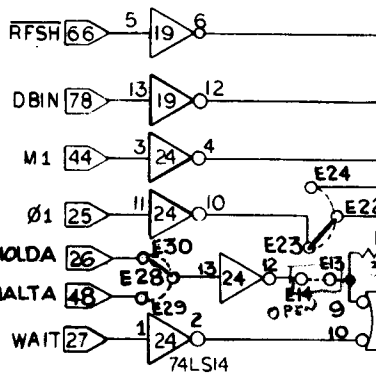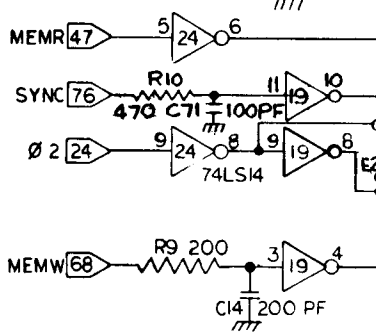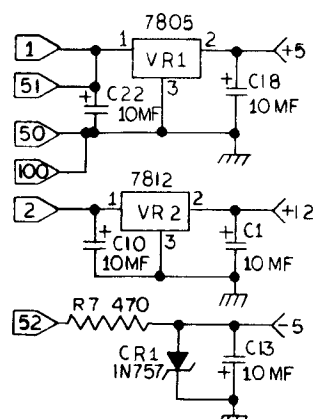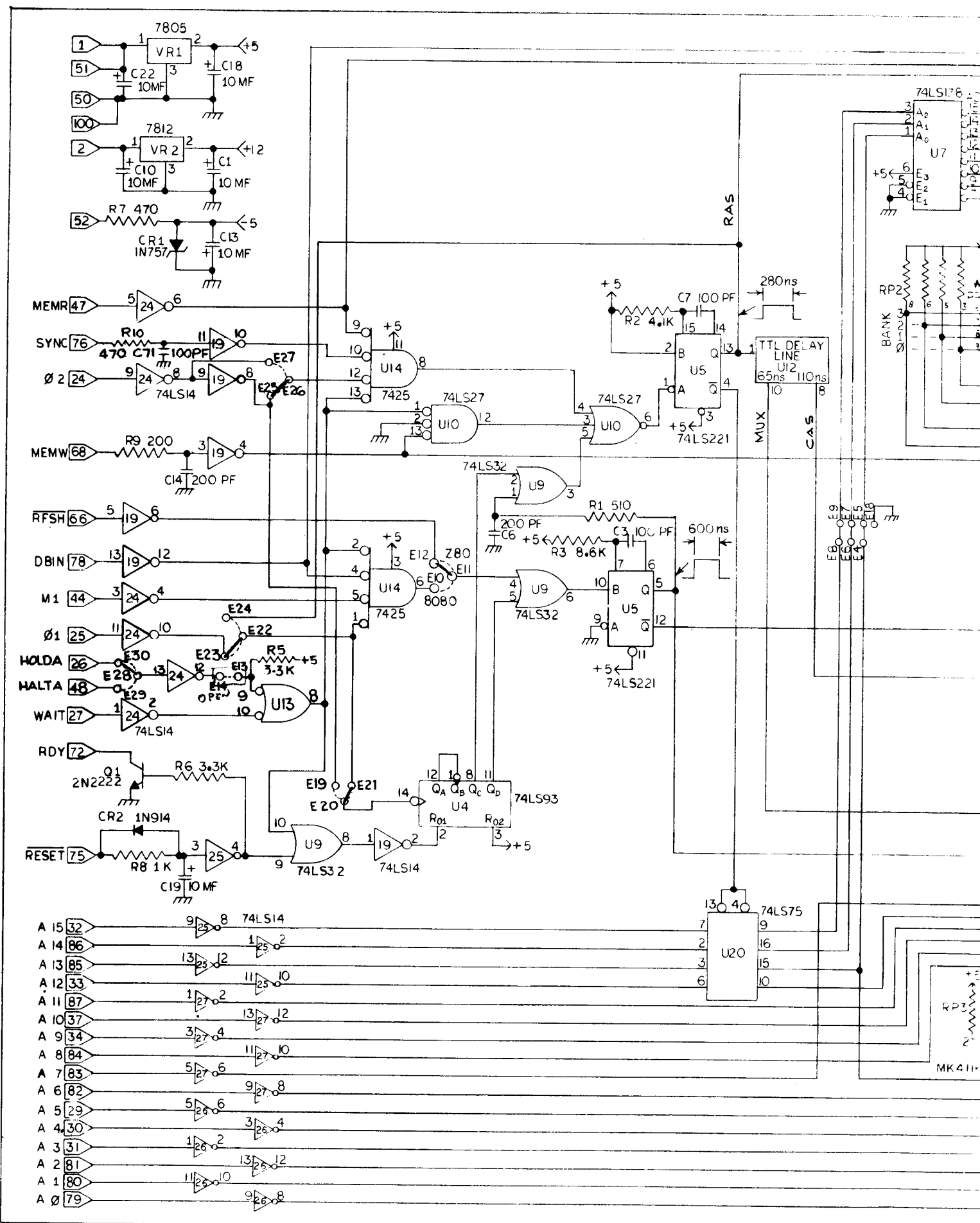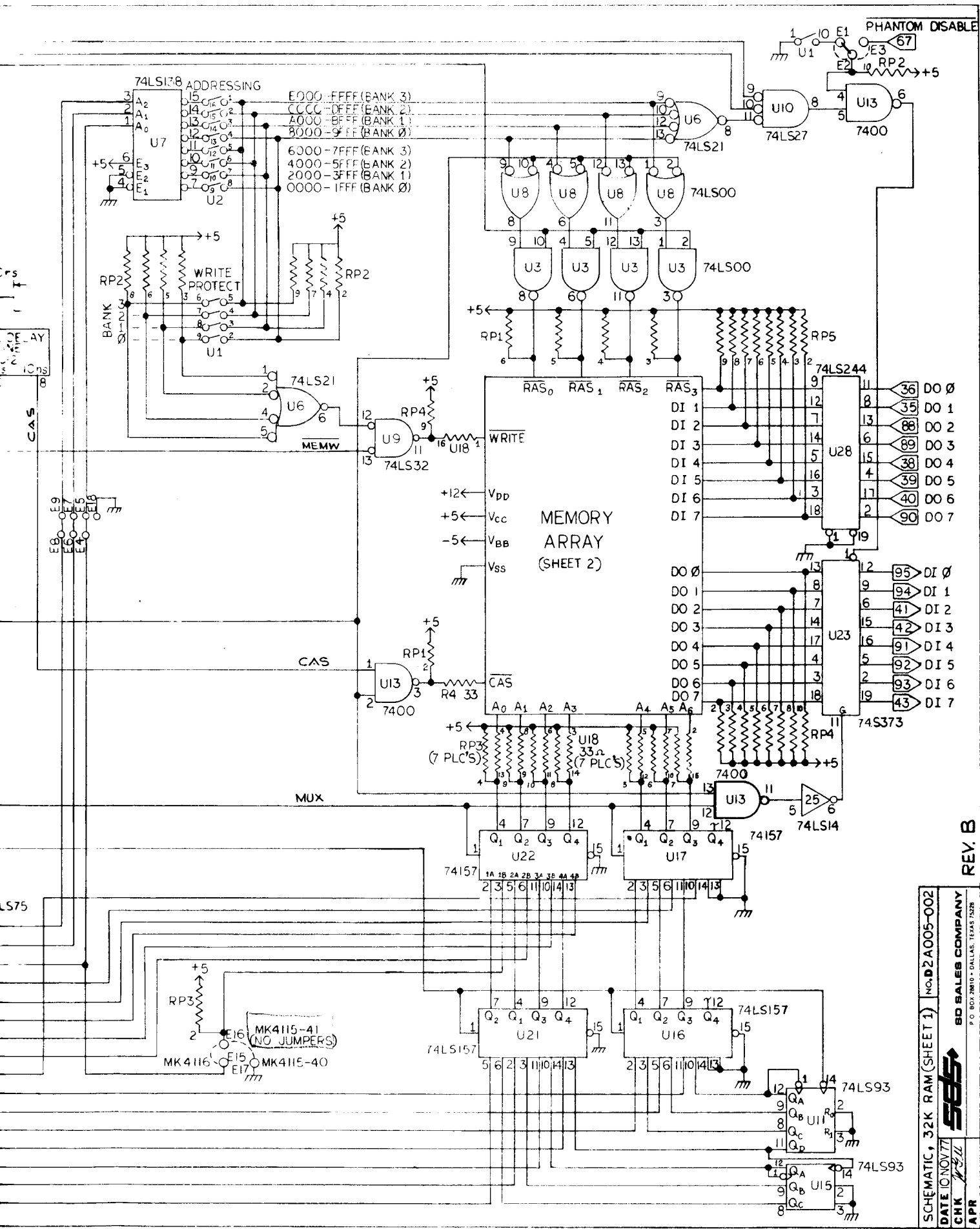
74LS138 ADDRESSING

E000 - FFFF (BANK 3)
CCCC - DEFF (BANK 2)
A000 - BFFF (BANK 1)
8000 - 9FFF (BANK Ø)
6000 - 7FFF (BANK 3)
4000 - 5FFF (BANK 2)
2000 - 3FFF (BANK 1)
0000 - 1FFF (BANK Ø)

U7
U2
+5
E3
E2
E1

74LS21
U6
U10
74LS27
U13
7400

U8 U8 U8 U8 74LS00

U3 U3 U3 U3 74LS00

WRITE PROTECT
RP2
BANK 3 2 1 Ø
U1
RP2

+5

RP1
$\overline{RAS_0}$ $\overline{RAS_1}$ $\overline{RAS_2}$ $\overline{RAS_3}$
RP5
74LS244
U28

DO Ø 36
DO 1 35
DO 2 88
DO 3 89
DO 4 38
DO 5 39
DO 6 40
DO 7 90

DI 1
DI 2
DI 3
DI 4
DI 5
DI 6
DI 7

74LS21
U6
RP4
U9
MEMW
74LS32
U18
$\overline{WRITE}$

+12 → V_{DD}
+5 → V_{CC}
-5 → V_{BB}
V_{SS}

MEMORY ARRAY
(SHEET 2)

DO Ø
DO 1
DO 2
DO 3
DO 4
DO 5
DO 6
DO 7

U23
74S373

DI Ø 95
DI 1 94
DI 2 41
DI 3 42
DI 4 91
DI 5 92
DI 6 93
DI 7 43

CAS
RP1
U13
R4 33
$\overline{CAS}$
7400

A_0 A_1 A_2 A_3 A_4 A_5 A_6
+5
RP3 (7 PLC'S)
U18 33Ω (7 PLC'S)
RP4
7400

MUX
U13
25
74LS14

Q_1 Q_2 Q_3 Q_4
U22
74157
1A 1B 2A 2B 3A 3B 4A 4B

Q_1 Q_2 Q_3 Q_4
U17
74157

LS75

+5
RP3
E16 MK4115-41 (NO JUMPERS)
MK4116 E15 MK4115-40
E17

Q_2 Q_1 Q_3 Q_4
U21
74LS157

Q_1 Q_2 Q_3 Q_4
U16
74LS157

74LS93
Q_A Q_B Q_C Q_D U11

74LS93
Q_A Q_B Q_C U15

CAS
E9 E7 E5
E6 E4

BIT 3   BIT 4   BIT 5   BIT 6   BIT 7

DO 3   DO 4   DO 5   DO 6   DO 7

U44   U48   U52   U56   U60   BANK Ø

U43   U47   U51   U55   U59   BANK 1

U42   U46   U50   U54   U58   BANK 2

U41   U45   U49   U53   U57   BANK 3

NOTE :
REFERENCE DESIGNATIONS
APPLY FOR RAM POPULATED
WITH 4115-40, 4115-41
OR 4116 IC'S.

PARTS LIST
EXPANDORAM   SDS P/N 2A005-A01

QUANTITY	PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
CAPACITORS			
6		10MF/20Volt Min. Tant	C1,C10,C13 C18,C19,C22
2		100PF 5% Dipped MICA	C3,C7
2		200PF 5% Dipped MICA	C6,C14
60 (+5 extra for spares)		.15MF Monolythic CERAMIC	C2,C4,C5,C8, C9,C11,C12,C15, C16,C17,C20,C21 C23-C70
DIODES			
1	1N751	5V Zener	CR1
1	1N914/or1N4148	Silicon Signal	CR2
INTEGRATED CIRCUITS			
2	74LS00	Quad 2 Input NAND Gate	U3,U8
3	74LS93	4 Bit Binary Counter	U4,U11,U15
1	74LS221	Dual Monostable Multiv.	U5
1	74LS21	Dual 4 Input NAND Gate	U6
1	74LS138	3 to 8 Line Decoder	U7
1	74LS32	Quad 2 Input OR Gate	U9
1	74LS27	Triple 3 Input NOR Gate	U10
1	7400	Quad 2 Input NAND Gate	U13
1	7425	Dual 4 Input NOR Gate	U14
2	74LS157	Quad 2 to 1 Line Selector	U16,U21
2	74157	Quad 2 to 1 Line Selector	U17,U22
5	74LS14	Hex Schmitt Trig.	U19,U24,U25, U26,U27
1	74LS75	Quad 4-Bit Latch	U20
1	74S373	Octal D Latch	U23
1	74LS244	Octal Buffer	U28
AS REQUIRED	MK 4115-40/41 or MK 4116	8K x 1 Memory 16K x 1 Memory	U29-U60
1	7805	5 Volt Regulator	VR1
1	7812	12 Volt Regulator	VR2
RESISTORS			
1		510 Ohm ¼W Carbon	R1
1		4.1 K Ohm 1% 1/8W Metal Film	R2
1		8.6 K Ohm 1% 1/8W Metal Film	R3
1		33 Ohm ¼W Carbon	R4

2		3.3 K Ohm ¼W Carbon	R5,R6
1		470 Ohm ¼W Carbon	R7
1		1 K Ohm ¼W Carbon	R8
1		200 Ohm ¼W Carbon	R9
1		3K/or 3.3 K Ohm 6 Pin SIP	RP1
4		3K/or 3.3 K Ohm 10 Pin SIP	RP2-RP5
1		33 Ohm 16 Pin DIP	U18

TRANSISTORS

1	2N2222	NPN Silicon	Q1

HARDWARE

1		5 Pos. DIP Switch	U1
1		8 Pos. DIP Switch	U2
1		TTL Delay Line	U12
1		Heat Sink	
2		6-32 x ¼ Screw	
2		6-32 Nut	
16		14 Pin DIP Socket	U12
40		16 Pin DIP Socket	
2		20 Pin DIP Socket	
9		Wire Wrap Pins	
1	2A005-201	P.C. Board	
1	2A005-401	Owner's Manual	

SECTION V

SOLDERING TECHNIQUE

THE SOLDER

Use a #20 gauge resin or rosin core solder with a ratio of 63%
tin and 37% lead. A 60/40 ratio is acceptable. "Kester" and
"Ersin" are two dependable brands of solder. Acid core solders
or acid flux must not be used as they will corrode electronic
joints and will damage printed circuit boards.

THE SOLDERING IRON

Use a small, 30 watt maximum iron with a small, chisel shaped
tip. Too much heat will damage both components and boards.
Soldering guns are too hot and should not be used. Heat the iron,
wipe its tip quickly on the damp sponge, and apply a tiny
amount of solder to the tip - just enough to make it silver in
color but not so much that it will drip off. This cleaning pro-
cedure should be repeated whenever the solder of the tip of the
soldering iron begins to thicken or take on a brownish color.

REMOVAL OF MULTI-PIN SOLDERED-IN PARTS

CAUTION

If for any reason it becomes necessary to remove a soldered-in part having more than just two leads, do not try to remove the part intact. It can be done but only with great risk of damaging the printing circuit board in the process.

Hold the printed circuit board in well padded jaws of a bench vice to avoid damage.

REMOVAL OF SOLDERED-IN IC SOCKETS

Crush the plastic body with a pair of pliers to pull the pins from the body. Gently remove the pins from the top of the board with needled nosed pliers while touching the joint on the other side of the board with the tip of the iron. Do not use force. The pin will come out quite easily once the solder melts.

Clear the holes of any excess solder by rapidly inserting and removing a piece of wire while very briefly holding the soldering iron to the hole at the back of the board.

## REMOVAL OF SOLDERED-IN INTEGRATED CIRCUIT CHIPS

Cut each pin with a pair of diagonal cutters at a point between the chip and the printed circuit board which is as close to the

chip as possible so that there is enough of the pin showing above the board to be grasped by needle nosed pliers while removing as described above.

THE PROCEDURE

The entire soldering operation should take little more than two seconds per joint. The sequence is as follows:

Touch the tip of the soldering iron to the joint, as shown below, so that both the conductors to be joined are simultaneously heated sufficiently to melt the solder.
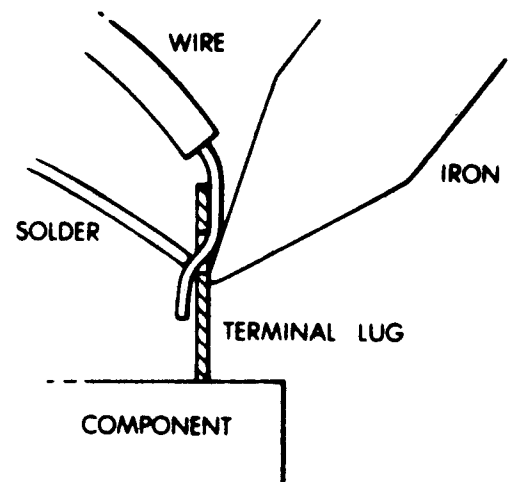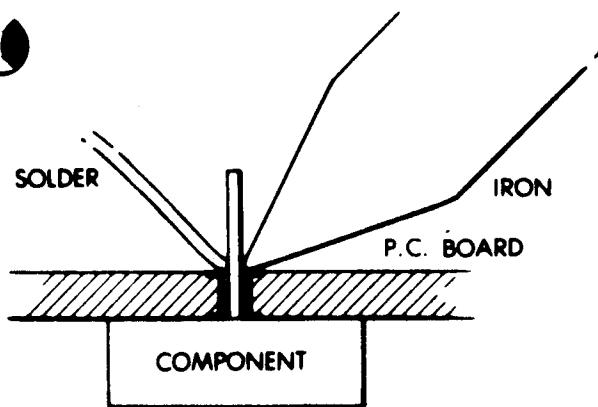
Touch the end of the solder roll to the joint, as shown above, just long enough to let no more than a 1/8" length melt into the joint. Too much solder will short circuit the bottom of the board or flow through the holes and short circuit the top of the board. The melted solder will appear wet and shiny. It will quickly flow completely around the wire and over the surface to which the wire is attached.

Remove the soldering iron as soon as both surfaces have been
completely wetted. Remember, the total time from application to
removal of the soldering iron should be only two or three sec-
onds. Removal of the soldering iron too soon will result in an
incomplete bond between the metals, but leaving the soldering
iron at the joint too long will cause heat damage to both com-
ponents and board.

ORIENTATION OF INTEGRATED CIRCUIT CHIPS

Extreme care must be taken to insure that each integrated circuit
chip is so oriented, prior to insertion in its socket, that pin
#1 is at the location so designated on the printed circuit board
or in the individual assembly instructions for the kit.

Pin #1 is, unforunately, designated in a variety of ways depend-
ing upon the integrated circuit manufacturer. Several methods
are indicated in the chart below. With the leads of the chip
pointing away from the viewer, pin #1 is in the position indicated
with respect to the various end notches or tiny circular markings
or depressions in one corner.
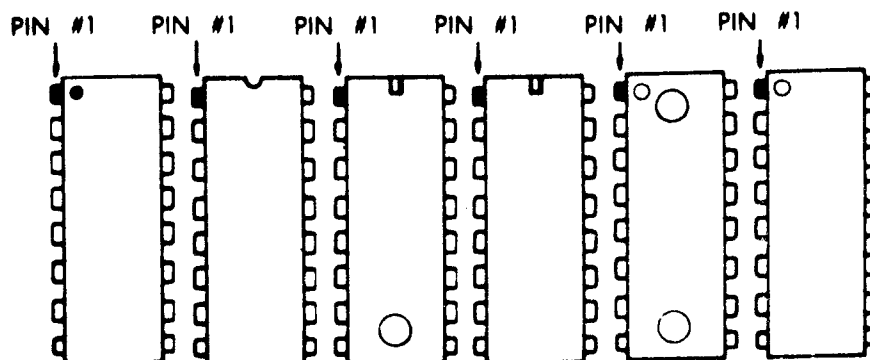
INSERTION OF INTEGRATED CIRCUIT CHIPS

Be sure all leads are straight and parallel. If not, gently straighten and align the bent pins with needle nosed pliers.

Integrated circuit chips usually come from the manufacturer with their rows of leads spread wider than the distance between rows of holes in the socket into which they are to be inserted. To slightly close the rows of pins in a uniform manner so they are aligned with the socket holes, place the chip on its side on a flat surface so that one row of pins is flat against the surface as shown below.
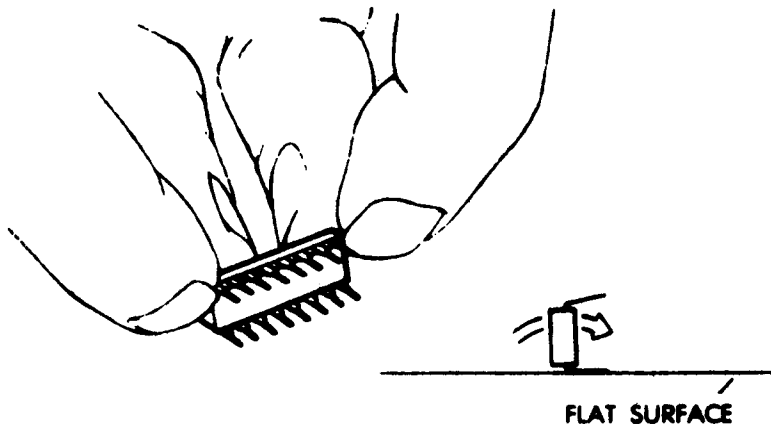
FLAT SURFACE

Holding the side of the chip firmly against the flat surface with both hands, rotate it a short distance toward its pins until it is in a full vertical position. This will put its body at a right angle to that row of pins. Place the other row of pins on the flat surface and repeat the process as above.

Partially insert all IC's with the pin #1 oriented as shown on the assembly layout which is silk screened on the front of the board. The layout symbol for IC pin #1 is designated by a white dot adjacent to the upper left hand corner of each rectangular IC chip location symbol. Recheck to insure that each pin is in its hole and has not been folded under the chip or bent outside the socket. Complete insertion evenly and firmly.

UNPLUGGING INTEGRATED CIRCUIT CHIPS

Unplugging an integrated circuit chip must be done evenly from both ends simultaneously so that the pins will not be bent during removal. Gently prying with a screwdriver a little bit at a time first at one end, then at the other is recommended. If access is possible only from one end, be sure that screwdriver is pushed as far in as possible so as to give a uniform lifting action over the full length of the chip.

POWER ON

Plug the board into your computer and check it out in accordance with the users manual proceding these assembly instruction.

Attention: Valued Customer

The attached parts list replaces the one in the manual
and should be used as a guide for assembly.

S. D. SYSTEMS

SD Systems

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

BILL OF MATERIALS

Title:				PL No.		Rev.	
EXPANDORAM, 32K				0100000		E	
Date Released:		Approved:		Sheet 1		Of 3	

Item no	Qty	SD-P/N	Description	Unit Cost	Extension
1	6	7030009	10MF,25Volt Min. Tant, C1,C10,C13,C18,C19,C22		
2	2	7030004	100PF 5% Dipped MICA, C3, C7		
3	2	7030005	200PF,5% Dipped MICA C6, C14		
4	60	7030007	.1 MFD, C2,C4,C5,C8,C9,C11,C12,C15,C16,C17,C20,		
			C21, C23-C70		
5	1	7040003	1N751 5V Zener, CR1		
6	1	7040001	1N914 or 1N4148 Silicon Signal, CR2		
7	2	7010160	74LS00, Quad 2 Input NAND Gate, U3, U8		
8	3	7010205	74LS93 4 Bit Binary Counter, U4, U11, U15		
9	1	7010259	74LS221,, Dual Monostable Multiv., U5		
10	1	7010175	74LS21, Dual 4 Input NAND Gate, U6		
11	1	7010219	74LS138, 3 to 8 Line Decoder, U7		
12	1	7010181	74LS32, Quad 2 Input OR Gate, U9		
13	1	7010178	74LS27, Triple 3 Input NOR Gate, U10		
14	1	7010001	7400, Quad 2 Input NAND Gate, U13		
15	1	7010022	7425, Dual 4 Input NOR Gate, U14		
16	2	7010228	74LS157, Quad 2 to 1 Line Selector, U16, U21		
17	2	7010093	74157, Quad 2 to 1 Line Selector, U17, U22		
18	5	7010172	74LS14, Hex Schmitt Trig., U19,U24,U25,U26,U27		
19	1	7010196	74LS75, Quad 4-Bit Latch, U20		
20	1	7010339	74S373, Octal D Latch, U23		
21	1	7010264	74LS244, Octal Buffer, U28		
22	32	7010323	MK 4115-40/41 8K X 1 Memory, U29-U60		
23	1	7160001	7805, 5 Volt Regulator VR1		

# SD Systems

PO Box 28810 • Dallas, Texas 75228   214-271-4667

BILL OF MATERIALS

Title:				PL No.		Rev.	
EXPANDORAM, 32K				0100000		E	
Date Released:		Approved:			Sheet 2		Of 3

Item no	Qty	SD-P/N	Description		Unit Cost	Extension
24	1	7160003	7812, 12 Volt Regulator, VR2		✓	
25	1	7020053	150 Ohm ¼W Carbon, R1	BROWN GREEN BROWN	✓	
26	1	7020169	4.1K Ohm 1%, 1/8W Metal R2 Film			
27	1	7020170	6.8K Ohm 1%, 1/8W Metal Film R3	BLUE GRAY RED		
28	1	7020037	33 Ohm ¼W Carbon, R4	ORANGE ORANGE BROWN	✓	
29	2	702 013	3.3K Ohm ¼W Carbon R5, R6	ORANGE ORANGE RED	✓	
30	1	7020065	470 Ohm ¼W Carbon R8 R7	YELLOW VIOLET BROWN	✓	
31	1	7020073	1K Ohm ¼W Carbon R8	BROWN BLACK RED	✓	
32	1	7020056	200 Ohm ¼W Carbon R9	RED BLACK BROWN	✓	
33	1	7020174	3.3K Ohm 6 Pin SIP, RP1			
34	4	7020175	3.3K Ohm 10 Pin SIP, RP2-RP5			
35	1	7020176	33 Ohm 16 Pin DIP, U18			
36	1	7040005	2N2222 NPN Silicon, Q1			
37	1	7050001	5 Pos. DIP Switch, U1			
38	1	7050002	8 Pos. DIP Switch, U2			
39	1	7010343	TTL Delay Line, DM355, U12			
40	1	7130003	Heat Sink 6106-13			
41	2	7130006	6-32 X 3/8 Screw PPH			
42	2	7130007	6-32 Nut			
43	16	7060002	14 Pin DIP Socket.			
44	40	7060003	16 Pin DIP Socket			
45	2	7060005	20 Pin DIP Socket			
46	9	7170001	Wire Wrap Pins			
47	1	0100002	P. C. Board			

SD Systems

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

BILL OF MATERIALS

● : EXPANDORAM, 32K	Pt No. 0100000	Rev. E
● Released:	Approved:	
		Sheet 3 Of 3

n	Qty	SD-P/N	Description	Unit Cost	Extension
	1	7020073	Resistol, 1K, ¼W, 5% R10 (Optional)		
	1	7030004	Capacitor, 100PF, 5% Dipped MICA,C71 (Optional)		

EXPANDORAM REVISION NOTICE

If you are using your Expandoram in a disc based system, with the SD SBC-100, or in a system that generates asynchronous wait states, the following modification should be made. This modification, when performed on systems utilizing a front panel, will cause loss of the DEPOSIT function.

1. Cut PC trace from U4 pin 8 to U9 pin 2.
2. Add wire jumper from pin 2 U9 to pin 7 of U9.
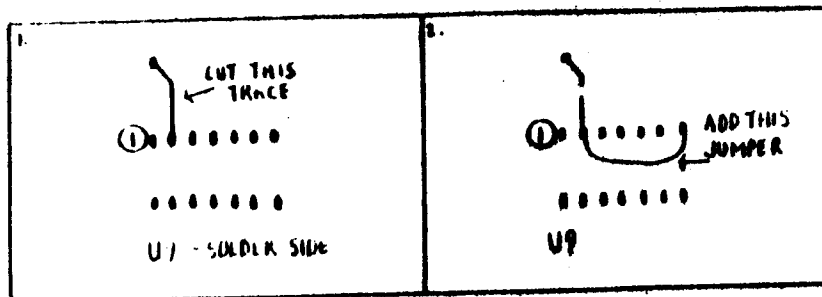
If you are using the Expandoram board with the SD SBC-100, to optimize access timing the following modification should be made.

1. Cut trace at U14 pin 12.
2. Add jumper wire from pin 12 of U14 to pin 7 of U14.