MOSTEK®

MD SERIES MICROCOMPUTER MODULES

Operations Manual

DYNAMIC RAM MODULE MDX-DRAM

OPERATION MANUAL
For
MDX-DRAM

Publication Number 79624

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

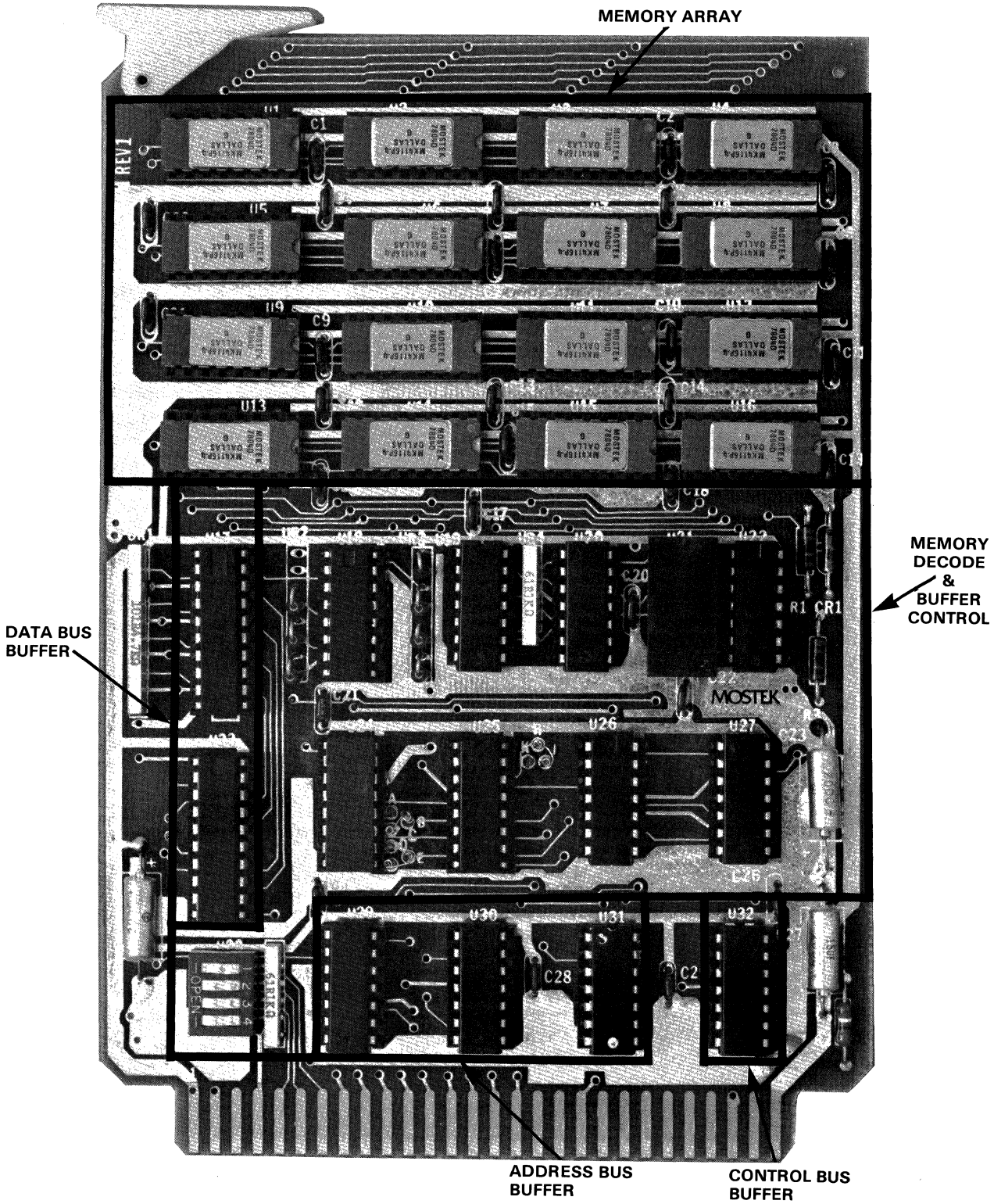
SECTION I

GENERAL INFORMATION

1.1. GENERAL DESCRIPTION

1.1.1 The MDX-DRAM is designed to be a RAM memory expansion board for the Mostek MD SERIES of Z80-based microcomputers. It is available in three memory capacities: 8K bytes (MDX-DRAM8), 16K bytes (MDX-DRAM16), and 32K bytes (MDX-DRAM32). Additionally, the MDX-DRAM16 and the MDX-DRAM32 are available in a 4MHz version. Thus, the designer can choose from the various options to add-on dynamic RAM memory to satisfy his system requirements.

FIGURE 1-1 BOARD PHOTO WITH OVERLAYS



1.3. ELECTRICAL SPECIFICATIONS

WORD SIZE

8 bits

MEMORY SIZE

MDX-DRAM8 - 8,192 bytes

MDX-DRAM16 - 16,384 bytes

MDX-DRAM32 - 32,768 bytes

ACCESS TIMES

	SYSTEM CLOCK	MEMORY ACCESS TIMES	MEMORY CYCLE TIMES
MDX-DRAM	2.5 MHz	350ns max.	465ns min.
MDX-DRAM-4	4.0 MHz	200ns max.	325ns min.

ADDRESS SELECTION

Selection of 8K, 16K, or 32K contiguous memory blocks to reside on any 4K boundary, i.e, 0000_H, 1000_H, 2000_H, 3000_H ... etc.

STD BUS INTERFACE

Inputs — One 74LS load max.

Outputs — I_{OH} = -3mA min. at 2.4 volts

I_{OL} = 24mA min. at 0.5 volts

SYSTEM CLOCK

	Min	Max
MDX-DRAM	1.25MHz	2.5MHz
MDX-DRAM-4	1.25MHz	4.0MHz

POWER SUPPLY REQUIREMENTS

+5V ± 5% at 0.6A max.

+12V ± 5% at 0.25A max.

-12V ± 5% at 0.03A max.

OPERATING TEMPERATURE

0° to 60°C

1.4. MECHANICAL SPECIFICATIONS

CARD DIMENSIONS

4.5 in. (11.43cm) high by 6.50 in. (16.51cm) long

0.48 in. (1.22cm) maximum profile thickness

0.062 in. (0.16cm) printed-circuit-board thickness

CONNECTORS

FUNCTION	CONFIGURATION	MATING CONNECTOR
STD BUS	56-pin dual 0.125-in. centers	Printed Circuit Viking 3VH28/1CE5 Wire wrap Viking 3VH28/1CND5 Solder Lug Viking 3VH28/1CN5

TABLE 1-1
STD-Z80 BUS PIN-OUT AND DESCRIPTION

BUS PIN	MNEMONIC	DESCRIPTION
1	+5V	+5Vdc system power
2	+5V	+5Vdc system power
3	GND	Ground - System signal ground and DC return
4	GND	Ground - System signal ground and DC return
5	-5V	-5Vdc system power
6	-5V	-5Vdc system power
7	D3	
8	D7	
9	D2	Data Bus (Tri-state, input/output
10	D6	active high). D_0-D7 constitute an
11	D1	8-bit bidirectional data bus. The data
12	D5	bus is used for data exchange with
13	D0	memory and I/O devices.
14	D4	
15	A7	
16	A15	
17	A6	Address Bus (Tri-state, output, active
18	A14	high).
19	A5	A_0-A_{15} make up a 16-bit address bus.
20	A13	The address but provides the address for
21	A4	

TABLE 1-1 (CONT.)

BUS PIN	MNEMONIC	DESCRIPTION
22 23 24 25 26 27 28 29 30	A12 A3 A11 A2 A10 A1 A9 A0 A8	memory (up to 65K bytes) data exchanges and for I/O device data exchanges. I/O addressing uses the lower 8 address bits to allow the user to directly select up to 256 input or 256 output ports. A_0 is the least significant address bit. During refresh time, the lower 7 bits contain a valid refresh address for dynamic memories in the system.
31	$\overline{WR}$	Memory Write (Tri-state, output, active low). $\overline{WR}$ indicates that the CPU data bus holds valid data to be stored in the addressed memory or I/O device.
32	$\overline{RD}$	Memory Read (Tri-state, output, active low). $\overline{RD}$ indicates that the CPU wants to read data from memory or an I/O device. The addressed I/O device or memory should use this signal to gate data onto the CPU data bus.
33	$\overline{IORQ}$	Input/Output Request (Tri-state, output, active low). The $\overline{IORQ}$ signal indicates that the lower half of the address bus holds a valid I/O address for an I/O read or write operation. An $\overline{IORQ}$ signal is also generated with an $\overline{M1}$ signal when an interrupt is being acknowledged to indicate that an interrupt response vector can be placed on the data bus. Interrupt Acknowledge operations occur during $\overline{M1}$ time, while I/O operations never occur during $\overline{M1}$ time.

TABLE 1-1 (CONT.)

BUS PIN	MNEMONIC	DESCRIPTION
34	$\overline{\text{MEMRQ}}$	Memory Request (Tri-State output, active low). The $\overline{\text{MEMRQ}}$ signal indicates that the address bus holds a valid address for a memory read or memory write operation.
35	$\overline{\text{IOEXP}}$	I/O expansion, not used on Mostek MDX cards.
36	$\overline{\text{MEMEX}}$	Memory expansion, not used on Mostek MDX cards.
37	$\overline{\text{REFRESH}}$	REFRESH (Tri-state, output, active low). REFRESH indicates that the lower 7 bits of the address bus contain a refresh address for dynamic memories and the $\overline{\text{MEMRQ}}$ signal should be used to perform a refresh cycle for all dynamic RAMs in the system. During the refresh cycle A7 is a logic zero and the upper 8 bits of the address bus contains the I register.
38	$\overline{\text{DEBUG}}$	$\overline{\text{DEBUG}}$ (Input) used in conjunction with DDT-80 operating system and the MDX Single Step card for implementing a hardware single step. When pulled low, the $\overline{\text{DEBUG}}$ line will set a latch that will force the upper three address lines to a logic 1. To reset this latch, an I/O operation must be performed.

TABLE 1-1 (CONT.)

BUS PIN	MNEMONICS	DESCRIPTION
39	$\overline{M1}$	Machine Cycle One (Tri-state, output, active low) $\overline{M1}$ indicates that the current machine cycle is in the opcode fetch cycle of an instruction. Note that during the execution of 2-byte op-codes, M1 will be generated as each op code is fetched. These two-byte op-codes always begin with a CBH, DDH, EDH, or FDH. $\overline{M1}$ also occurs with $\overline{IORQ}$ to indicate an interrupt acknowledge cycle.
40	STATUS Ø	Not used in Mostek MDX Cards.
41	$\overline{BUSAK}$	Bus Acknowledge (Output, active low). Bus Acknowledge is used to indicate to the requesting device that the CPU address bus, data bus, and control bus signals have been set to their high impedance state and the external device can now control the bus.
42	$\overline{BUSRQ}$	Bus Request (Input, active low). The $\overline{BUSRQ}$ signal is used to request the CPU address bus, data bus, and control signal bus to go to a high impedance state so that other devices can control those buses. When $\overline{BUSRQ}$ is activated, the CPU will set these buses to a high impedance state as soon as the current CPU machine cycle is terminated, and the Bus Acknowledge ($\overline{BUSAK}$) signal is activated.

TABLE 1-1 (CONT.)

BUS PIN	MNEMONIC	DESCRIPTION
43	$\overline{\text{INTAK}}$	Interrupt Acknowledge (Tri-state output, active low). The $\overline{\text{INTAK}}$ signal indicates that an interrupt acknowledge cycle is in progress, and the interrupting device should place its response vector on the data bus.
44	$\overline{\text{INTRQ}}$	Interrupt Request (Input, active low). The Interrupt Request Signal is generated by I/O devices. A request will be honored at the end of the current instruction if the internal software controlled interrupt enable flip-flop (IFF) is enabled and if the $\overline{\text{BUSRQ}}$ signal is not active. When the CPU accepts the interrupt, an acknow-acknowledge signal (IORQ during an M1) is sent out at the beginning of the next instruction cycle.
45	$\overline{\text{WAITRQ}}$	WAIT REQUEST (Input, active low). Wait request indicates to the CPU that addressed memory or I/O devices are not ready for a data transfer. The CPU continues to enter wait states for as long as this signal is active. This signal allows memory or I/O devices of any speed to be synchronized to the CPU.

TABLE 1-1 (CONT.)

BUS PIN	MNEMONICS	DESCRIPTION
46	$\overline{\text{NMIRQ}}$	Non-Maskable Interrupt Request (Input, negative edge triggered). The Non-Maskable Interrupt request has a higher priority than $\overline{\text{INTRQ}}$ and is always recognized at the end of the current instruction, independent of the status of the interrupt enable flip-flop. $\overline{\text{NMIRQ}}$ automatically forces the CPU to restart to location 0066_H. The program counter is automatically saved in the external stack so that the user can return to the program that was interrupted. Note that continuous $\overline{\text{WAIT}}$ cycle can prevent the current instruction from ending, and that a $\overline{\text{BUSRQ}}$ will override a $\overline{\text{NMIRQ}}$.
47	$\overline{\text{SYSRESET}}$	System Reset (Output, active low). The System Reset line indicates that a reset has been generated from either an external reset or the power-on reset circuit. The system reset will occur only once per reset request and will be approximately 2 microseconds in duration. The system reset will also force the CPU program counter to zero, disable interrupts, set the I register to 00_H, set the R register to 00_H and set Interrupt Mode 0.

TABLE 1-1 (CONT.)

BUS PIN	MNEMONICS	DESCRIPTION
48	$\overline{\text{PBRESET}}$	Push Button Reset (Input, active low). The Push Button Reset will generate a debounced system reset.
49	$\overline{\text{CLOCK}}$	Processor Clock (Output, active low). Single phase system clock.
50	$\overline{\text{CNTRL}}$	Auxiliary Timing
51	PCO	Priority Chain Output (Output, active high). This signal is used to form a priority interrupt daisy chain when more than one interrupt driven device is being used. A high level on this pin indicates that no other devices of higher priority are being serviced by a CPU interrupt service routine.
52	PCI	Priority Chain In (Input, active high). This signal is used to form a priority interrupt daisy chain when more than one interrupt driven device is being used. A high level on this pin indicates that no other devices of higher priority are being serviced by a CPU interrupt service routine.

TABLE 1-1 (CONT.)

BUS PIN	MNEMONICS	DESCRIPTION
53	AUX GND	Auxiliary Ground (Bussed)
54	AUX GND	Auxiliary Ground (Bussed)
55	+12V	+12Vdc system power
56	-12V	-12Vdc system power

NOTES:

(1) The references to input and output of a given signal is made with respect to the CPU module.

(2) The following CPU signals have pull-up resisters: $\overline{WR}$, $\overline{RD}$, $\overline{IROQ}$, $\overline{MEMRQ}$, $\overline{REFRESH}$, $\overline{DEBUG}$, $\overline{M1}$, $\overline{BUSRQ}$, $\overline{INTAK}$, $\overline{INTRQ}$, $\overline{WAITRQ}$, $\overline{NMIRQ}$, $\overline{SYSRESET}$, $\overline{PBRESET}$, $\overline{CLOCK}$, $\overline{PCI}$.

1.5. STD-Z80 BUS ELECTRICAL SPECIFICATIONS.

Bus Receivers

Logical Low: 0.8V max. at -0.36 mA

Logical High: 2.0V min. at 20 microamperes

Bus Drivers

Logical Low: 0.5V at 24 mA

Logical High: 2.4V at -3 mA

Off-State Output Current (tri-state): ±100 microamp

Recommended Bus Drivers and Receivers

Bus Drivers - 74LS240, 74LS241, 74LS373, 74LS374, 74LS244

Bus Receivers - 74LS240, 74LS241, 74LS244

Bus Transceivers - 74LS245, 74LS242, 74LS243

SECTION II

FUNCTIONAL DESCRIPTION

2.1. INTRODUCTION.

2.1.1 The MDX-DRAM block diagram shown in Figure 2-1 provides a low-cost way to expand RAM for the MDX system. The major functions of the MDX-DRAM are shown in Figure 2-1 and will be explained below.

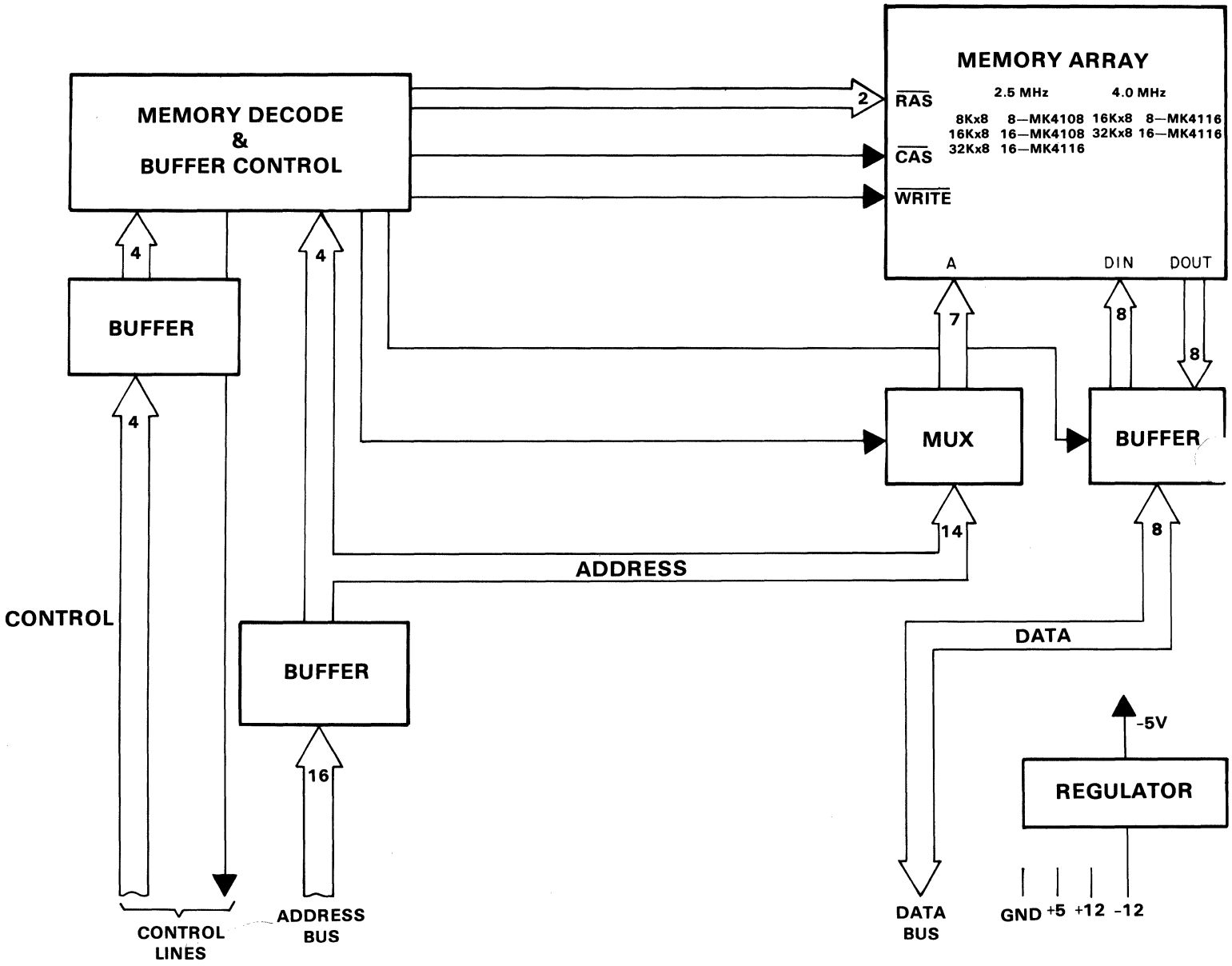
2.2. MEMORY ARRAY. The memory array consists of up to 16 MK4108 or MK4116 Dynamic Memories. The 16 RAMs are organized into two banks of eight RAMs each. The eight RAMs of each bank contribute one byte to an addressable location. The total storage capacity of the MDX-DRAM is 32,768 bytes.

2.3. MEMORY DECODE AND CONTROL. The memory decode and control section is responsible for generating the necessary timing signals of the memory array, mux, and data buffer. Timing within the memory decode and control section is generated by a TTL buffered delay line.

2.4. ADDRESS MULTIPLEXER (MUX). The address multiplexer is responsible for taking the address bits from the address buffers and converting them into a row and column address for the memory array. The address multiplexer is controlled by the memory decode and control section.

2.5. DATA BUFFER. The data buffer isolates the memory array from the data bus and is controlled by the memory decode and control section.

FIGURE 2-1 MDX-DRAM BLOCK DIAGRAM



SECTION III

UTILIZATION

3.1. INTRODUCTION.

3.1.1 This section will describe the various jumper options and switch settings for the MDX-DRAM.

3.2. MEMORY DEVICE SELECTION JUMPERS

3.2.1 Table 3-1 shows how jumpers A-K are configured for the different MDX-DRAM boards.

TABLE 3-1
JUMPER CONFIGURATIONS

BOARD	JUMPERS
MDX-DRAM8	A to B H to K
MDX-DRAM16	B to C H to J
MDX-DRAM16-4	B to C H to J
MDX-DRAM16-8	A to B D to E H to K
MDX-DRAM32	B to C E to F H to J
MDX-DRAM32-4	B to C E to F H to J

3.3. MEMORY DECODING.

3.3.1 Memory Decoding for the MDX-DRAM is on 4K boundaries i.e. 0000_H, 1000_H 2000_H, etc. The starting address for the MDX-DRAM is selected by a four-position DIP switch located in U28. Table 3.2 shows the switch setting for U28 versus starting address.

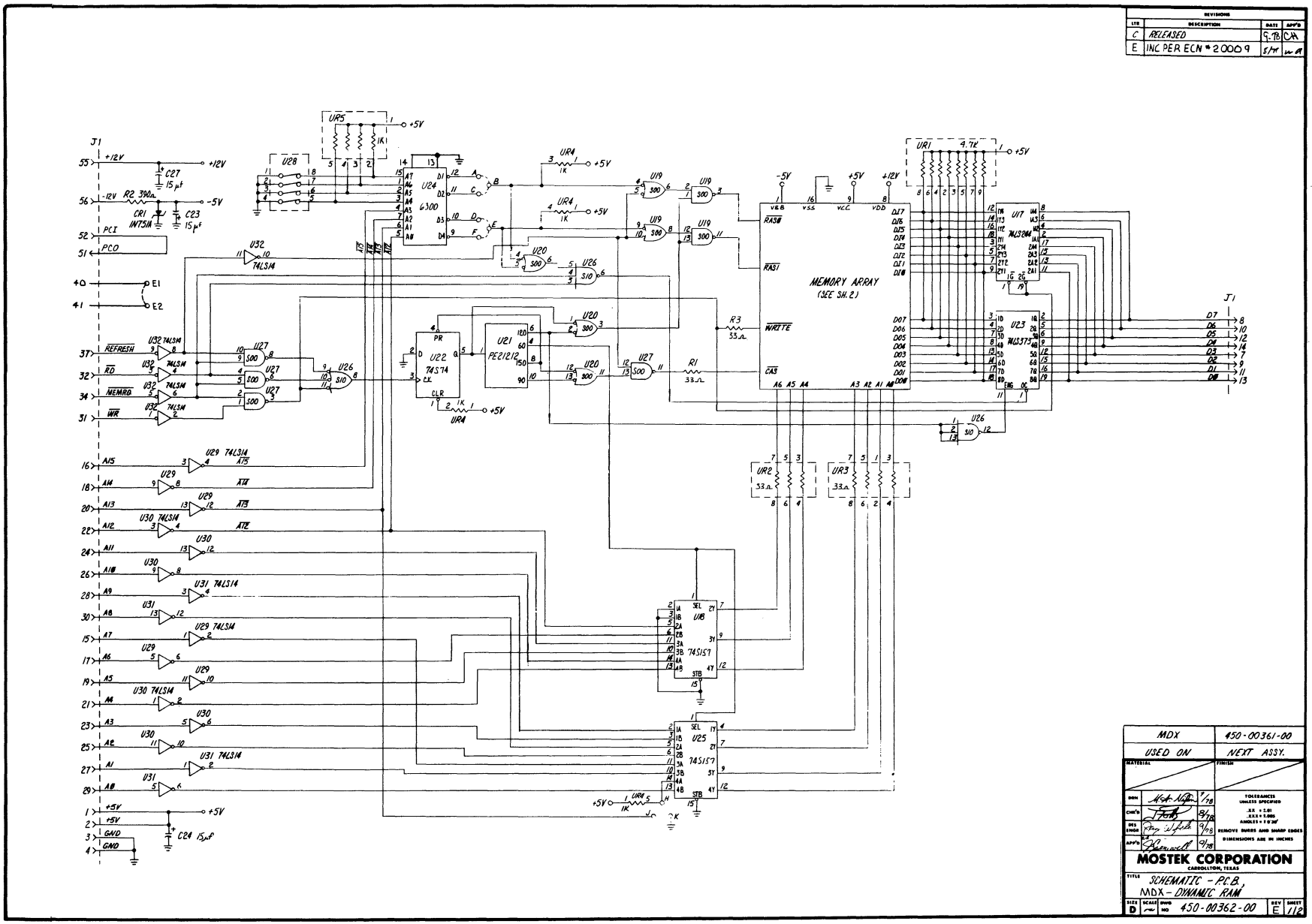
NOTE: The address select switch only sets the starting address for the memory board. If for example, an MDX-DRAM32 board is positioned to start at $F000_H$, the remaining 28K of memory will "roll over" at 0000_H and continue up to $6FFF_H$.

TABLE 3-2
MEMORY DECODING

STARTING ADDRESS	U28 SWITCH POSITION			
	1	2	3	4
0000	0	0	0	0
1000	0	0	0	1
2000	0	0	1	0
3000	0	0	1	1
4000	0	1	0	0
5000	0	1	0	1
6000	0	1	1	0
7000	0	1	1	1
8000	1	0	0	0
9000	1	0	0	1
A000	1	0	1	0
B000	1	0	1	1
C000	1	1	0	0
D000	1	1	0	1
E000	1	1	1	0
F000	1	1	1	1
0=CLOSED	1=OPEN			

APPENDIX A

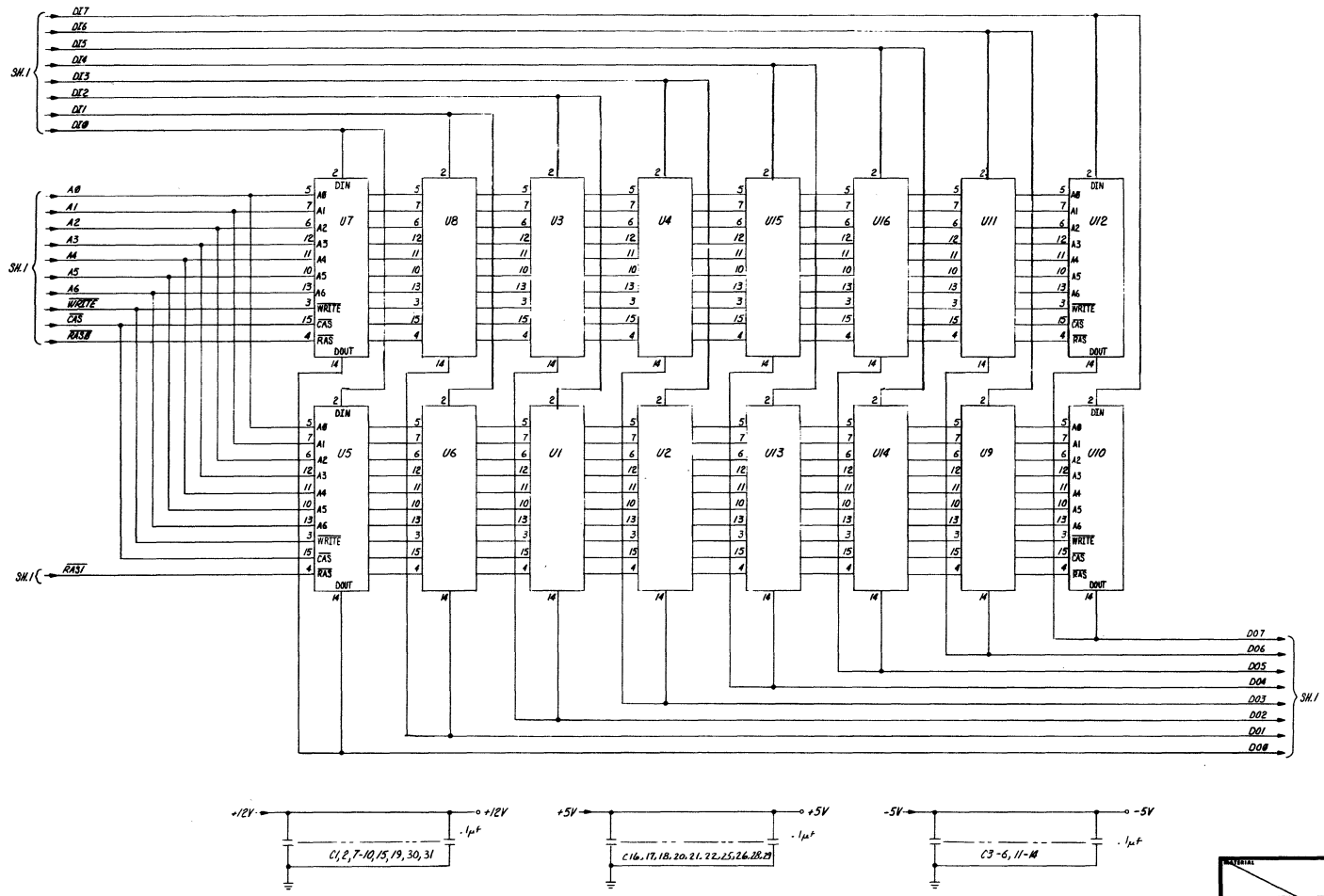
SCHEMATICS


REVISIONS
LTR DESCRIPTION DATE APP'D
C RELEASED 9-78 CM
E INC PER ECN # 20009 5/79 WA
MEMORY ARRAY (SEE SH. 2)
MDX 450-00361-00
USED ON NEXT ASSY.
MOSTEK CORPORATION
CARROLLTON, TEXAS
SCHEMATIC - P.C.B.
MDX - DYNAMIC RAM
450-00362-00
SIZE D SCALE ~ DWG NO 450-00362-00 REV E SHEET 1/2

SCHEMATIC

SCHEMATIC (CONT.)

REVISIONS			
LTR	DESCRIPTION	DATE	APP'D
C		C-78	CM
E	INC PER ECN # 20009		



MEMORY DECOUPLING

MATERIAL	FINISH
DRN	TOLERANCES UNLESS SPECIFIED .XX ± 0.05 .XXX ± 0.005 ANGLES ± 0°30' REMOVE BURRS AND SHARP EDGES DIMENSIONS ARE IN INCHES
CHK'D	
DES ENGR	
APP'D	

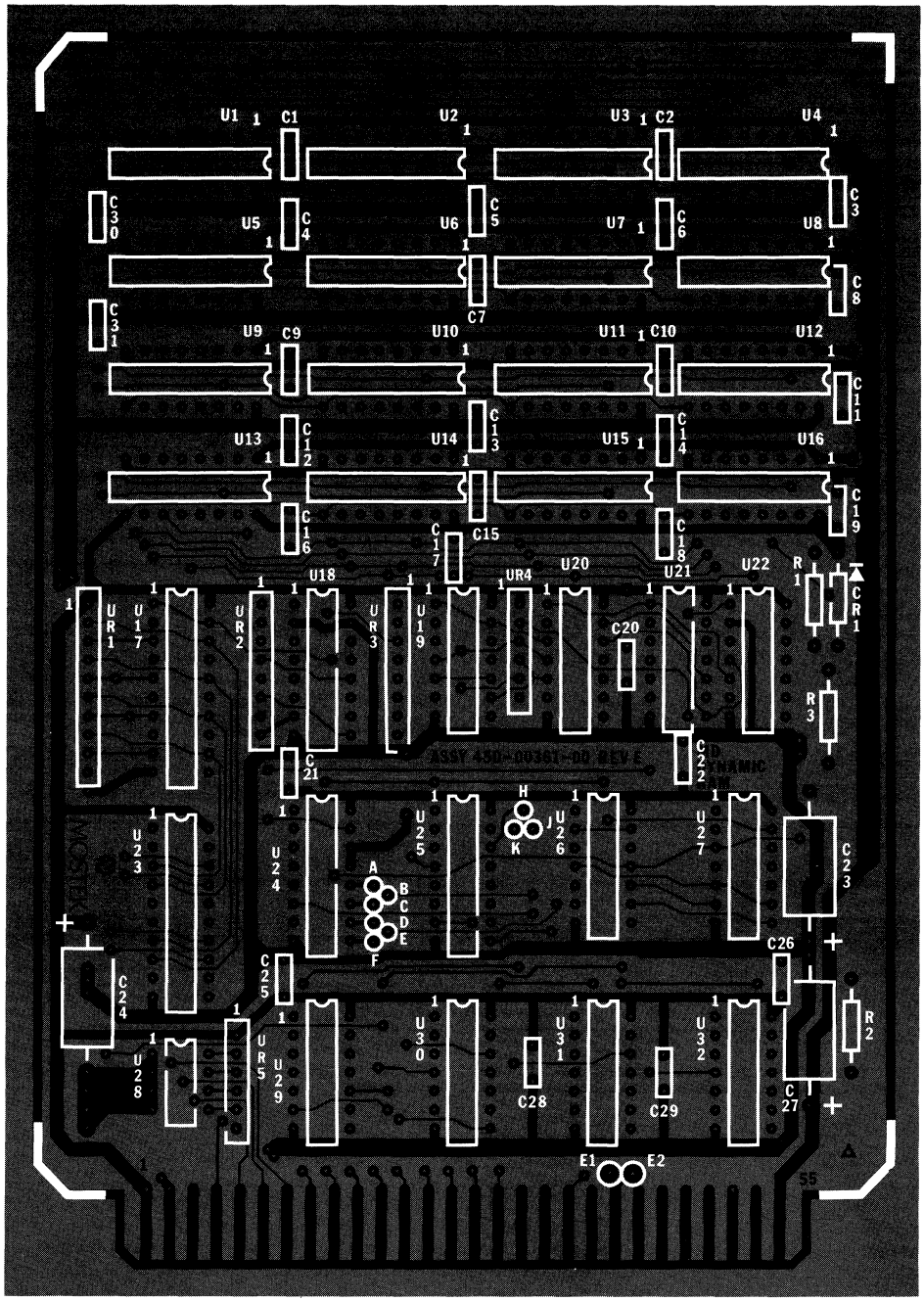
MOSTEK CORPORATION
CARROLLTON, TEXAS

TITLE: SCHEMATIC - P.C.B., MDX - DYNAMIC RAM

SIZE	SCALE	DWG NO	REV	SHEET
D	~	450-00362-00	E	2/2

APPENDIX B
PARTS PLACEMENT DIAGRAM
PARTS LISTS

PARTS PLACEMENT DIAGRAM



MDX-DRAM8 PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USED ON
0000000		PARTS LIST DRAM-8		7775
0000000		ASSY 450-00361-10 REV E1	MD RAM	7775
0000000		SCH 450-00362-00 REV E	MD RAM	7775
4610113	1	FAB 450-00360-10 REV E	MD RAM	7775
4150111	28	CAPACITOR .1UF	C1-22,25,26,28,29,30,31	7775
4150140	3	CAPACITOR 15UF	C23,24,27	7775
4480047	1	DIODE 1N751	CR1	7775
4210383	11	HEADER STRIP PINS	EA-J,E1,E2	7775
4470037	2	RESISTOR 33 OHMS	R1,3	7775
4470063	1	RESISTOR 390 OHMS	R2	7775
4313507	1	IC, 74LS244	U17	7775
4313264	2	IC, 74S157	U18,25	7775
4313284	3	IC, 74S00	U19,20,27	7775
4313574	1	IC DELAY LINE 150NS	U21	7775
4313266	1	IC, 74S74	U22	7775
4313544	1	IC, 74LS373	U23	7775
4313579	1	IC MK6268 (MMI6300)	U24	7775
4313329	1	IC, 74S10	U26	7775
4640006	1	SWITCH DIP 4 POS	U28	7775
4313291	4	IC, 74LS14	U29,30,31,32	7775
4313511	8	IC MK4108-40	U3,4,7,8,11,12,15,16	7775
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	7775
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	7775
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	7775
4620017	17	SOCKET 16 PIN	X1-16,X24	7775
4280155	1	EJECTOR	Z	7775
5025266	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	7775
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	7775
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	7775
MK79624	1	MDX-DRAM OPPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	7775
MK79728	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	7775
MK79815	1	FACTORY NOTICES	Z:SHIPPED NOT ASSEMBLED	7775

ACCEPTABLE IC SUBSTITUTION

MK4108-40 (P/N 4313511) MAY BE REPLACED BY MK4108-30 OR MK4108-20

MDX-DRAM16-8 PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USED ON
0000000		PARTS LIST DRAM16-8		77751
0000000		ASSY 450-00361-11 REV E1	MD RAM	77751
0000000		SCH 450-00362-00 REV E	MD RAM	77751
4610113	1	FAB 450-00360-10 REV E	MD RAM	77751
4150111	28	CAPACITOR .1UF	C1-22,25,26,28,29,30,31	77751
4150140	3	CAPACITOR 15UF	C23,24,27	77751
4480047	1	DIODE 1N751	CR1	77751
4210383	11	HEADER STRIP PINS	EA-J,E1,E2	77751
4470037	2	RESISTOR 33 OHMS	R1,3	77751
4470063	1	RESISTOR 390 OHMS	R2	77751
4313511	16	IC MK4108-40	U1-16	77751
4313507	1	IC, 74LS244	U17	77751
4313264	2	IC, 74S157	U18,25	77751
4313284	3	IC, 74S00	U19,20,27	77751
4313574	1	IC DELAY LINE 150NS	U21	77751
4313266	1	IC, 74S74	U22	77751
4313544	1	IC, 74LS373	U23	77751
4313579	1	IC MK6268 (MMI6300)	U24	77751
4313329	1	IC, 74S10	U26	77751
4640006	1	SWITCH DIP 4 POS	U28	77751
4313291	4	IC, 74LS14	U29,30,31,32	77751
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	77751
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	77751
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	77751
4620017	17	SOCKET 16 PIN	X1-16,X24	77751
4280155	1	EJECTOR	Z	77751
5025266	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	77751
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	77751
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	77751
MK79624	1	MDX-DRAM OPPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	77751
MK79728	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	77751
MK79815	1	FACTORY NOTICES	Z:SHIPPED NOT ASSEMBLED	77751

ACCEPTABLE IC SUBSTITUTION

MK4108-40 (P/N 4313511) MAY BE REPLACED BY MK4108-30 OR MK4108-20

MDX-DRAM16 PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USE ON
0000000		PARTS LIST DRAM16		777
0000000		ASSY 450-00361-12 REV E1	MD RAM	777
0000000		SCH 450-00362-00 REV E	MD RAM	777
4610113	1	FAB 450-00360-10 REV E	MD RAM	777
4150111	28	CAPACITOR .1UF	C1-22,25,26,28,29,30,31	777
4150140	3	CAPACITOR 15UF	C23,24,27	777
4480047	1	DIODE 1N751	CR1	777
4210383	11	HEADER STRIP PINS	EA-J,E1,E2	777
4470037	2	RESISTOR 33 OHMS	R1,3	777
4470063	1	RESISTOR 390 OHMS	R2	777
4313507	1	IC, 74LS244	U17	777
4313264	2	IC, 74S157	U18,25	777
4313284	3	IC, 74S00	U19,20,27	777
4313574	1	IC DELAY LINE 150NS	U21	777
4313266	1	IC, 74S74	U22	777
4313544	1	IC, 74LS373	U23	777
4313579	1	IC MK6268 (MMI6300)	U24	777
4313329	1	IC, 74S10	U26	777
4640006	1	SWITCH DIP 4 POS	U28	777
4313291	4	IC, 74LS14	U29,30,31,32	777
4313439	8	IC MK4116-4	U3,4,7,8,11,12,15,16	777
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	777
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	777
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	777
4620017	17	SOCKET 16 PIN	X1-16,X24	777
4280155	1	EJECTOR	Z	777
5025266	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	777
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	777
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	777
MK79624	1	MDX-DRAM OPPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	777
MK79728	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	777
MK79815	1	FACTORY NOTICES	Z:SHIPPED NOT ASSEMBLED	777

ACCEPTABLE IC SUBSTITUTION

MK4116-4 (P/N 4313439) MAY BE REPLACED BY MK4116-3, MK4116-2, OR MK4116-1

MDX-DRAM32 PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USED ON
0000000		PARTS LIST DRAM32		77752
0000000		ASSY 450-00361-14 REV E1	MD RAM	77752
0000000		SCH 450-00362-00 REV E	MD RAM	77752
4610113	1	FAB 450-00360-10 REV F	MD RAM	77752
4150111	28	CAPACITOR .1UF	C1-22,25,26,28,29,30,31	77752
4150140	3	CAPACITOR 15UF	C23,24,27	77752
4480047	1	DIODE 1N751	CR1	77752
4210383	11	HEADER STRIP PINS	EA-J,E1,E2	77752
4470037	2	RESISTOR 33 OHMS	R1,3	77752
4470063	1	RESISTOR 390 OHMS	R2	77752
4313439	16	IC MK4116-4	U1-16	77752
4313507	1	IC, 74LS244	U17	77752
4313264	2	IC, 74S157	U18,25	77752
4313284	3	IC, 74S00	U19,20,27	77752
4313574	1	IC DELAY LINE 150NS	U21	77752
4313266	1	IC, 74S74	U22	77752
4313544	1	IC, 74LS373	U23	77752
4313579	1	IC MK6268 (MMI6300)	U24	77752
4313329	1	IC, 74S10	U26	77752
4640006	1	SWITCH DIP 4 POS	U28	77752
4313291	4	IC, 74LS14	U29,30,31,32	77752
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	77752
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	77752
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	77752
4620017	17	SOCKET 16 PIN	X1-16,X24	77752
4280155	1	EJECTOR	Z	77752
5025265	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	77752
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	77752
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	77752
MK79624	1	MDX-DRAM OPPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	77752
MK79726	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	77752
MK79815	1	FACTORY NOTICES	Z:SHIPPED NOT ASSEMBLED	77752

ACCEPTABLE IC SUBSTITUTION

MK4116-4 (P/N 4313439) MAY BE REPLACED BY MK4116-3, MK4116-2, OR MK4116-1

MDX-DRAM16-4 PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USED ON
0000000		PARTS LIST DRAM16-4		77754
0000000		ASSY 450-00361-13 REV E1	MD RAM	77754
0000000		SCH 450-00362-00 REV E	MD RAM	77754
4610113	1	FAB 450-00360-10 REV E	MD RAM	77754
4150111	28	CAPACITOR .1UF	C1-22,25,26,28,29,30,31	77754
4150140	3	CAPACITOR 15UF	C23,24,27	77754
4480047	1	DIODE 1N751	CR1	77754
4210383	11	HEADER STRIP PINS	EA-J,E1,E2	77754
4470037	2	RESISTOR 33 OHMS	R1,3	77754
4470063	1	RESISTOR 390 OHMS	R2	77754
4313507	1	IC, 74LS244	U17	77754
4313264	2	IC, 74S157	U18,25	77754
4313284	3	IC, 74S00	U19,20,27	77754
4313744	1	IC DELAY LINE 100NS	U21	77754
4313266	1	IC, 74S74	U22	77754
4313544	1	IC, 74LS373	U23	77754
4313579	1	IC MK6268 (MMI6300)	U24	77754
4313329	1	IC, 74S10	U26	77754
4640006	1	SWITCH DIP 4 POS	U28	77754
4313291	4	IC, 74LS14	U29,30,31,32	77754
4313392	8	IC MK4116-2	U3,4,7,8,11,12,15,16	77754
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	77754
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	77754
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	77754
4620017	17	SOCKET 16 PIN	X1-16,X24	77754
4280155	1	EJECTOR	Z	77754
5025266	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	77754
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	77754
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	77754
MK79624	1	MDX-DRAM OPPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	77754
MK79728	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	77754
MK79815	1	FACTORY NOTICES	Z:SHIPPED NOT ASSEMBLED	77754

ACCEPTABLE IC SUBSTITUTION

MK4116-2 (P/N 4313392) MAY BE REPLACED BY MK4116-1

MDX-DRAM32-4 PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USED ON
0000000		PARTS LIST DRAM32-4		77752-4
0000000		ASSY 450-00361-15 REV E1	MD RAM	77752-4
0000000		SCH 450-00362-00 REV E	MD RAM	77752-4
4610113	1	FAB 450-00360-10 REV E	MD RAM	77752-4
4150111	28	CAPACITOR .1UF	C1-22,25,26,28,29,30,31	77752-4
4150140	3	CAPACITOR 15UF	C23,24,27	77752-4
4480047	1	DIODE 1N751	CR1	77752-4
4210383	11	HEADER STRIP PINS	EA-J,E1,E2	77752-4
4470037	2	RESISTOR 33 OHMS	R1,3	77752-4
4470063	1	RESISTOR 390 OHMS	R2	77752-4
4313392	16	IC MK4116-2	U1-16	77752-4
4313507	1	IC, 74LS244	U17	77752-4
4313264	2	IC, 74S157	U18,25	77752-4
4313284	3	IC, 74S00	U19,20,27	77752-4
4313744	1	IC DELAY LINE 100NS	U21	77752-4
4313266	1	IC, 74S74	U22	77752-4
4313544	1	IC, 74LS373	U23	77752-4
4313579	1	IC MK6268 (MMI6300)	U24	77752-4
4313329	1	IC, 74S10	U26	77752-4
4640006	1	SWITCH DIP 4 POS	U28	77752-4
4313291	4	IC, 74LS14	U29,30,31,32	77752-4
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	77752-4
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	77752-4
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	77752-4
4520017	17	SOCKET 16 PIN	X1-16,X24	77752-4
4280155	1	EJECTOR	Z	77752-4
5025266	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	77752-4
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	77752-4
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	77752-4
MK79624	1	MDX-DRAM OPPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	77752-4
MK79728	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	77752-4
MK79815	1	FACTORY NOTICES	Z:SHIPPED NOT ASSEMBLED	77752-4

ACCEPTABLE IC SUBSTITUTION

MK4116-2 (P/N 4313392) MAY BE REPLACED BY MK4116-1

MOSTEK®

1215 W. Crosby Rd. • Carrollton, Texas 75006 • 214/323-6000
In Europe, Contact: MOSTEK Brussels
150 Chaussee de la Hulpe, B1170, Belgium;
Telephone: 660.69.24

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MDX-DRAM32A
ERRATA
TO
MDX-DRAM OPERATIONS MANUAL
MK79624

NOVEMBER 1980

MK79976

MDX-DRAM32A

MK77761

ERRATA

The following need to be corrected as shown on the next pages:

1. LIST OF TABLES page iii
2. Paragraph 1.1.1 page 1-1
3. Paragraph 1.3 page 1-3
4. Paragraph 3.2 (including Table 3-1 page 3-1. Notice that there is a new paragraph 3.2.2 to be added.
5. MDX-DRAM32 PARTS LIST, to be replaced by MDX-DRAM32A PARTS LIST
6. MDX-DRAM32-4 PARTS LIST, to be replaced by MDX-DRAM32A-4 PARTS LIST

LIST OF TABLES

1.1.1 The MDX-DRAM is designed to be a RAM memory expansion board for the MOSTEK MD SERIES of Z-80 based microcomputers. It is available in three memory capacities: 8K bytes (MDX-DRAM8), 16K bytes (MDX-DRAM), and 32K bytes (MDX-DRAM32A). Additionally, the MDX-DRAM16 and the MDX-DRAM32A are available in a 4MHz version. More over, the MDX-DRAM32A can be configured such that its memory elements occupying the addresses from E000H through EFFFH are unaddressable (see paragraph 3.2.2 for the use of this feature). Thus, the designer can choose from the various options to add-on dynamic RAM memory to satisfy his system requirements.

1.3 ELECTRICAL SPECIFICATIONS

WORD SIZE
8 bits

MEMORY SIZE
MDX-DRAM8 - 8,192 bytes
MDX-DRAM16 - 16,384 bytes
MDX-DRAM32A - 32,768 bytes

3.2 MEMORY DEVICE SELECTION JUMPERS

3.2.1 Table 3-1 shows how jumpers A-K are configured for the MDX-DRAM8 and MDX-DRAM16 boards.

TABLE 3-1
JUMPER CONFIGURATIONS
OF THE 8K AND 16K BYTES BOARDS

BOARD	JUMPERS
MDX-DRAM8	A to B
	H to K
MDX-DRAM16	B to C
	H to J
MDX-DRAM16-4	B to C
	H to J
MDX-DRAM16-8	A to B
	D to E
	H to K

3.2.2 The MDX-DRAM32A is a 32K byte board similar to the other MDX-DRAM boards, except that it has been provided with a special selection PROM (U24), which gives it the ability to be configured in two ways:

1. With 32K bytes of contiguous memory

B to C
E to F
H to J

2. With address E000H through EFFFH masked

A to B
D to E
H to J

In this way if it has a starting address which makes the addresses from E000H through EFFFH within the range of the board, these addresses will be unaccessible on the board. Thus its capacity will be reduced by 4K bytes. Otherwise all of the 32K bytes will be accessible.

This feature is necessary in case of using this board with a CPU board which has PROMs occupying these memory locations.

The MDX-DRAM32A-4 can be configured exactly like the MDX-DRAM32A.

N.B.: The jumpers A-F on the boards MDX-DRAM32A (and MDX-DRAM32A-4) are unconnected when shipped. Use the attached MINI-JUMPERS (or wire wrap straps) to configure the board in the desired way.

MDX-DRAM32A PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USED ON
		PARTS LIST MDX-DRAM32A		77761
0000000		ASSY 450-00361-20 REV A	MD RAM	77761
0000000		SCH 450-00362-00 REV F	MD RAM	77761
4610113	1	FAB 450-00360-10 REV F	MD RAM	77761
4150111	28	CAPACITOR .1 UF	C1-22,25,26,28,29,30,31	77761
4150140	3	CAPACITOR 15 UF	C23,24,27	77761
4480047	1	DIODE 1N751	CR1	77761
4280007	11	STAKE PINS	EA-J,E1,E2	77761
4470037	2	RESISTOR 33 OHMS	R1,3	77761
4470063	1	RESISTOR 390 OHMS	R2	77761
4313439	16	IC MK4116-4	U1-16	77761
4313507	1	IC, 74LS244	U17	77761
4313264	2	IC, 74S157	U18,25	77761
4313284	3	IC, 74S00	U19,20,27	77761
4313574	1	IC DELAY LINE 150NS	U21	77761
4313266	1	IC, 74S74	U22	77761
4313544	1	IC, 74LS373	U23	77761
4316011	1	IC MK6280 (MMI6300)	U24	77761
4313329	1	IC, 74S10	U26	77761
4640006	1	SWITCH DIP 4 POS	U28	77761
4313291	4	IC, 74SL14	U29,30,31,32	77761
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	77761
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	77761
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	77761
4620017	17	SOCKET 16 PIN	X1-16,X24	77761
4280155	1	EJECTOR	Z	77761
5025266	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	77761
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	77761
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	77761
MK79624	1	MDX-DRAM OPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	77761
MK79728	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	77761
MK79869	1	SERVICE CENTER POLICY	Z:SHIPPED NOT ASSEMBLED	77761
4210244	5	MINI JUMPER	Z:SHIPPED NOT ASSEMBLED	77761
5013111	1	SMALL PLASTIC BAG	Z:SHIPPED NOT ASSEMBLED	77761

ACCEPTABLE IC SUBSTITUTION

MK4116-4 (P/N 4313439) MAY BE REPLACED BY MK4116-3, MK4116-2, OR MK4116-1

MDX-DRAM32A-4 PARTS LIST

PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	USED ON
		PARTS LIST MDX-DRAM32A		77761-4
0000000		ASSY 450-00361-21 REV A	MD RAM	77761-4
0000000		SCH 450-00362-00 REV F	MD RAM	77761-4
4610113	1	FAB 450-00360-10 REV F	MD RAM	77761-4
4150111	28	CAPACITOR .1 UF	C1-22,25,26,28,29,30,31	77761-4
4150140	3	CAPACITOR 15 UF	C23,24,27	77761-4
4480047	1	DIODE 1N751	CR1	77761-4
4280007	11	STAKE PINS	EA-J,E1,E2	77761-4
4470037	2	RESISTOR 33 OHMS	R1,3	77761-4
4470063	1	RESISTOR 390 OHMS	R2	77761-4
4313439	16	IC MK4116-2	U1-16	77761-4
4313507	1	IC, 74LS244	U17	77761-4
4313264	2	IC, 74S157	U18,25	77761-4
4313284	3	IC, 74S00	U19,20,27	77761-4
4313744	1	IC DELAY LINE 100NS	U21	77761-4
4313266	1	IC, 74S74	U22	77761-4
4313544	1	IC, 74LS373	U23	77761-4
4316011	1	IC MK6280 (MMI6300)	U24	77761-4
4313329	1	IC, 74S10	U26	77761-4
4640006	1	SWITCH DIP 4 POS	U28	77761-4
4313291	4	IC, 74SL14	U29,30,31,32	77761-4
4470175	1	RESISTOR SIP 10 P. 4.7K	UR1	77761-4
4470246	2	RESISTOR SIP 8 PIN 33	UR2,3	77761-4
4470178	2	RESISTOR SIP 6 PIN 1K	UR4,5	77761-4
4620017	17	SOCKET 16 PIN	X1-16,X24	77761-4
4280155	1	EJECTOR	Z	77761-4
5025266	1	TRAVELER WIP	Z:NOTE IN HOUSE USE ONLY	77761-4
5013004	2	BAG ANTISTATIC	Z:SHIPPED NOT ASSEMBLED	77761-4
5013206	1	BOX SHIPPING	Z:SHIPPED NOT ASSEMBLED	77761-4
MK79624	1	MDX-DRAM OPS. MANUAL	Z:SHIPPED NOT ASSEMBLED	77761-4
MK79728	1	WARRANTY REGISTRATION	Z:SHIPPED NOT ASSEMBLED	77761-4
MK79869	1	SERVICE CENTER POLICY	Z:SHIPPED NOT ASSEMBLED	77761-4
4210244	5	MINI JUMPER	Z:SHIPPED NOT ASSEMBLED	77761-4
5013111	1	SMALL PLASTIC BAG	Z:SHIPPED NOT ASSEMBLED	77761-4

ACCEPTABLE IC SUBSTITUTION
MK4116-2 (P/N 4313439) MAY BE REPLACED BY MK4116-1