

**2000 SERIES INDUSTRIAL COMPUTERS**

User Manual

January 1988

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## 1. GENERAL DESCRIPTION

### 1.1 Introduction

The 2000 series of industrial computers are suited to a wide variety of applications where durability, and ruggedness are required from a powerful IBM PC XT/AT compatible computer system. Factory automation, machine control, process control and data acquisition systems are only a few of these applications.

Because the computers are completely IBM XT or AT compatible, they take advantage of hundreds of application software packages, translators, and operating systems. Hundreds, possibly thousands of compatible plug in cards ranging from sophisticated graphics cards to thermocouple sensors cards are also available.

This manual can be used in conjunction with the 2001A, 2003A and 2004A AT computers for configuration reference, setup and operating information, maintenance procedures, and specifications.

### 1.2 Computer Specifications

Each of the computers have the following features in common:

- IBM PC/AT Compatibility
- Shock mounted disk drives (in most configurations)
- Passive backplane (5,8 bit and 5,16 bit slots)
- Vertically removable CPU card for maintenance
- 150 Watt power supply

In addition, the 2001 computer is designed to be mounted in a 19" RETMA rack. It features positive pressure, filtered airflow, a separate compartment for circuit cards, and up to three shock mounted disk drives.

The 2003 computer is a smaller benchtop or wall mounted computer for more specialized applications. It typically has a hard disk and/or one floppy disk. .

A portable, self contained floppy disk drive is sometimes used with this computer when it is installed in industrial environments not suitable for floppy diskettes.

The 2004 computer features NEMA 4 packaging and electronics contained in a sealed compartment cooled by a unique moving air heat exchanger.

### 1.3 B286 Specifications

The B286 CPU is a high performance IBM AT compatible 6 layer CPU card featuring the following:

- Up to 1 Megabyte of parity checked DRAM memory
- Switchable clock: 6 and 8 or optional 6 and 10 MHz
- On-board battery supports real time clock
- 80287 Co-processor socket
- Proprietary Bios with built-in "setup" program
- External reset switch and speaker jack

Rather than mount horizontally in the the bottom of the computer, (as with a typical motherboard computer) the B286 plugs into a passive horizontal motherboard. If replacement is required, the board can be removed and replaced as easily as any expansion card. There is no need to disconnect any cables or remove any other boards.

## 2. CONFIGURATION AND INSTALLATION

This section describes rack mounting of the 2001 computer, cabling, and expansion module installation and removal.

### 2.1 Rack Mounting

The 2001 computer and CRT display models 1003R, 1004R, and 1005R are designed to be mounted in a 19-inch RETMA rack with ChassisTrak 300-S-120 slides. Equivalent slides from other manufacturers that have matching hole spacing and alignment may also be used.

The steps for attaching slides to the displays and the computer are the same. Mounting hardware is supplied with the slides.

#### CAUTION

DO NOT attempt to mount the computer or display by attaching these units from the front panel only.

#### SLIDE MOUNTING INSTRUCTIONS

1. Two slides are required for each chassis, one on each side. Separate each slide into two parts.
2. Select the slide parts that have a hole pattern matching the threaded holes on the computer. Using screws provided, attach a slide to right and left sides of the computer chassis (5 screws on each side, the spring loaded stop mounts to the rear of the computer).
3. Attach the second part of the slides to the 19-inch rack. Position the slides on the left and right sides of the rack and screw each end of the slide into the rack.
4. Insert the computer into the rack by mating the computer slides with the rack slides. Make sure that the computer is level and properly aligned when it slides onto the rack.
5. Push the computer completely onto the rack. Secure the computer front panel into the rack using 4 screws (8 screws on monitors).
6. Repeat this procedure to rack mount the CRT display.

## 2.2 Cable Connections

Before connecting the computer to a power source, connect the CRT display and keyboard to the computer. If the computer is to be rack mounted, refer to the slide and rack mounting instructions before connecting cables.

### 2.2.1 Power Connections and Operating Voltages

The 2001A rack mountable computer is capable of powering two devices plugged into two external AC receptacles on the rear. The combined current handling capability of the two receptacles is approximately 6 amps. The total current drawn by a fully loaded unit including the computer with a full set of circuit cards and 6 amps on external devices is 10 amps.

The 2003A and 2004A computers are self contained and draw approximately 4 amps of current when fully configured.

The 2000 Series Computers can be modified at the factory to operate using 220-volt AC power or various DC power voltages. The following considerations apply with this modification: 1)the fan is replaced to operate properly with the selected input power selected; 2)fuses are replaced; 3)the power supply is jumper selected for 220 volts or replaced with the correct DC modules.

It should be noted that special considerations may be necessary to select CRT monitors for non standard power situations.

### 2.2.2 Keyboard Connections

Both the AT and XT keyboard five-pin connectors are identical for all 2000 Series computers. The XT keyboard is specifically designed for the XT computer and does not operate properly with an AT model. However, a jumper modification inside the AT keyboard allows it to be downward compatible and to operate as an XT keyboard. Identification part numbers are placed on the underside of each keyboard.

On the 2001A computer, the keyboard connector is at the lower left corner of the front panel. For applications which require it, a rear mounted keyboard connector is available as an option.

On the 2003 computer, the keyboard connector is at the lower right corner at the back of the computer.

### 2.2.3 CRT Display Connections

On the 2001A computer the CRT display power cable can be plugged into the computer auxiliary power outlet. The signal cable connects the Crt to the video card connector at the back of the computer.

When connected to the auxiliary outlet, power is supplied to the CRT display as soon as the computer is powered-up.

The 2003A computer does not have auxiliary power outlets. Therefore, the display power cable should be plugged into a local outlet. The display signal cable connects to the video card connector at the back of the computer.

### 2.2.4 External Speaker Jack

An external speaker jack is standard on the AT computer and optional on the XT computer. The speaker jack, provides the capability for audio output to an external alarm or public address system. The speaker jack is located on the CPU card at the back of the computer.

## 2.3 Installing Modular Options

The 2000a Series Computer design provides for easy access to add or upgrade the system. Each computer is slightly different. The steps to access cards for each computer are described in the following paragraphs.

#### NOTE

All captive nuts used in the 2000 Series Computers are self-locking. Extra effort may be required to loosen or tighten the screws during installation.

### 2.3.1 Accessing Cards in the 2001 Computer

1. Power-down the computer.
2. Remove the 3 screws from the hinged access panel on top. Remove the hinged access panel (note the position of the access panel hinge tabs) and place the screws and the panel in a convenient place.
3. Unscrew and remove the hold-down clamp that fits across the circuit boards.
4. To install circuit cards, refer to the specific instructions for the card to be installed (see Section 4). In addition, read any installation instructions that come with the option purchased.



### 2.3.2 Accessing Circuit Cards in the 2003 Computer

1. Power-down the computer.
2. Remove the 4 screws on each side of the top cover. Remove the top cover and place the screws and the cover in a convenient place.
3. Unscrew and remove the hold-down clamp that fits across the circuit boards.
4. To install circuit cards, refer to the specific instructions for the card to be installed (see Section 4). In addition, read any installation instructions that come with the option purchased.

### 2.3.3 Accessing Circuit Cards in the 2004 Computer

1. Power-down the Computer.
2. Open the outer door.
3. Unscrew the two thumb screws at the top of the inside chassis.
4. Insure adequate service loop is available for all cables and then swing out (down) the inner chassis.
5. Unscrew and remove the hold-down clamp that fits across the circuit cards.
6. To install circuit cards, refer to the specific instructions for the card to be installed (see Section 4). In addition, read any installation instructions that come with the option purchased.

### 2.3.4 Expansion Slot Configuration

The 2000 Series AT computer has five 8-bit and five 16-bit expansion slots. Viewing the back of the computer, from right to left, expansion slots 1, 2, 3, 9, and 10 are the 8-bits and slots 4, 5, 6, 7, and 8 are 16-bits.

Each 8-bit slot has one 62-pin connector providing 8 data bits and 20 address lines. This configuration is equivalent to an address space of 1M byte that is 8 bits wide.

Each 16-bit slot has two connectors. A 62-pin connector contains the lower 8 data bits and lower 20 address lines. A 36-pin connector contains the upper 8 data bits and upper 4 address lines. The combined bus con-

figuration has a capacity of 16M bytes of address space that is 16 bits wide.

The 2000 Series XT configuration has ten 8-bit expansion slots. Each slot has a 62 pin connector that provides 8 data bits and 20 address lines.

The AT 16-bit expansion cards are slightly (0.6 inches) taller than the XT 8-bit expansion cards. To provide for a hold down clamp that can accommodate the different height boards, the AT cards are grouped together near the center of the expansion slots

### 2.3.5 Option Compatibility

Modular options are added by means of expansion cards that plug into the computer bus (expansion slots). This bus is designed to be both electrically and mechanically compatible with the equivalent International Business Machine computer models.

On the 2000 Series AT (6MHz clock speed) and XT models, the bus timing is identical to the IBM equivalent. The AT computers, operating at 8 or 10 MHz, have faster bus transfer rates and may not be compatible with all expansion cards.

Although XT 8-bit expansion cards may work electronically in the AT 16-bit slots, the XT cards may not be physically compatible because the AT has the additional 36 pin connector. In addition, the AT 16-bit cards are not designed to work in 8-bit slots. Expansion card compatibility may also vary, depending on the manufacturer.

Processor clock speed differences may also effect expansion card compatibility. The 2000 Series, AT, 80286 processor operates at a much faster speed (6, 8, or 10 MHz) than the XT model 8088 processor speed (4.77 MHz). To accommodate this speed difference, the B286 card contains a programmable wait state generator which inserts additional time in the bus transfer cycles. Refer to the module section for a detailed description of this feature. For most plug in modules, the additional wait states are all that is required for compatibility. If a speed problem is suspected, contact the manufacturer of the plug in circuit card regarding operation at the higher bus speeds.

### 3. OPERATION

This section describes the operation of the computer, including a description of the BIOS and SETUP firmware contained on the B286 CPU.

#### 3.1 Firmware Operation

The B286 board contains approximately 32k of firmware in two 32K x 8 EPROMS. This firmware performs power-on computer checks, sets up the computer hardware, and contains the internal setup routines for configuration.

The computer can be restarted using three methods:

1. Cycle the ON/OFF power switch to the ON position.
2. Reboot the computer - Press and hold the CTRL and ALT keys and then press the DELETE key.
3. Press the RESET pushbutton - the computer stops processing activities and reboots. This method is only recommended as a "last resort" because loss of data can result if a program is in process.

The BIOS performs internal diagnostics to check the current configuration against the configuration information recorded in CMOS memory during Setup. If inconsistencies exist, BIOS error messages are displayed. Some of these errors can be quickly corrected by checking the Setup information. More technical errors require the assistance of trained TMI technical personnel. Some of the elements tested during BIOS diagnostics include the following:

- Processor CPU chip
- DMA controllers
- Floppy disk drive controllers
- Hard disk drive controller
- Hard disk drive configuration
- Real time clock chip
- Interrupt controller chip
- Keyboard
- Time-of-day clock (CMOS RAM)
- Video controllers
- RAM memory
- BIOS ROM (check sum used for validity)

Although BIOS power-up diagnostics are not comprehensive, the few seconds that the BIOS routine requires are very effective in identifying problems. For in depth diagnostics that are more comprehensive and require more time, the International Business

Machines Advanced Diagnostics program for the AT can be used.

### 3.1.1 BIOS Startup Routine

The BIOS is a collection of driver and initialization software stored in ROM on the CPU board. The BIOS is designed to be totally compatible with software written for the IBM personal computers. The I/O drivers are invoked through the software interrupt structure of the 80286 processor.

The largest portion of the BIOS software program, (approximately 4K bytes), is devoted to computer startup. During this procedure, the memory and I/O ports are tested and initialized. If everything goes well and no errors are discovered, an operating system is loaded and executed from the disk or other mass storage device. The BIOS startup routine is as follows:

1. The 80286 executes a jump instruction to the BIOS start point.
2. The CPU flags are tested. The 80286 processor register set is tested. If either of these tests fails, the CPU halts.
3. Video controllers are stabilized.
4. The following tests are performed. If a failure occurs during any one of these tests, the CPU halts.
  5. The shutdown byte in CMOS RAM is tested for reliability.
  6. The 8254 timer is tested.
  7. DMA controllers are tested.
  8. DMA page registers are tested.
9. DMA controllers are initialized.
10. Memory refresh is tested. If a failure occurs, the CPU halts.
11. Bus A20 line is disabled.

12. The first 64K bytes of memory are tested. If failure occurs, the following error message is displayed:

0000:xxxx yyyy #201

Where: x = Failing Address  
y = Failing Data

13. The stack is set up.
14. The interrupt controllers are initialized.
15. All interrupt vectors are set to the temporary interrupt handler.
16. Software interrupt vectors are initialized.
17. The 8042 keyboard peripheral interface chip is tested.
18. CMOS memory is tested.
19. Base memory size is determined.
20. Video controllers are tested against the CMOS configuration.
21. Video card BIOS ROMs are initialized.
22. Video cards are tested. If the video card tested does not agree with the #1 switch setting on the CPU card, an audible beep is heard (one long and two short beeps).
23. Hardware interrupt vectors are initialized.
24. Default power-up processor speed is selected.
25. The monitor screen is cleared and the TMI logo is displayed with the following message:

The TMI INDUSTRIAL COMPUTER BIOS  
Self-Test in Progress, Please Wait

26. Keyboard is tested.

27. Floppy disk drives are tested. If an error occurs one of the following messages is displayed:

Floppy seek error . .  
Press F1 to Continue.

Floppy reset error . .  
Press F1 to Continue.

Note

If a floppy disk error occurs, the Setup Utility is invoked automatically. The floppy disk drive configuration data on the Setup screen should be checked. If the configuration is accurate, refer to Section 3 on Troubleshooting.

28. Printer and RS232 timeouts are set
29. The type floppy disk drive is determined.
30. Base addresses for RS232 cards are determined.
31. Base addresses for the printer card are determined.
32. BIOS tests for the existence of the 80287 numeric coprocessor.
33. Memory test is performed on the video card. If an error occurs, the following message is displayed:

Memory Test Failure  
Address = xxxx, Data = yyyy  
Continue? (Y/N)

Where: x = address  
y = failing bit pattern

Note

If Y is entered to continue the BIOS will try to down-size the memory and continue the power-up sequence. If an error exists, it is recommended that the user rectify the problem, since unreliable operation may occur otherwise.

34. The monitor screen is cleared and the TMI logo is displayed. The following message is displayed:

The TMI INDUSTRIAL COMPUTER BIOS  
Self-Test in Progress, Please Wait

35. The base memory size and clock speed are written to the screen as follows:

Base memory size is \_\_\_\_ K, Clock speed is xxxx MHz.

36. Expansion memory size is determined, and if greater than zero, is written to the screen as follows:

Expansion memory size is \_\_\_\_\_ K

37. Base memory is tested. If an error occurs, the following message is displayed:

```
Memory Test Failure
Address = xxxx, Data = yyyy
Continue? (Y/N)
```

Where:     x = address  
           y = failing bit

Note

If Y is entered to continue the BIOS will try to down-size the memory and continue the power-up sequence. If an error exists, it is recommended that the user rectify the problem, since unreliable operation may occur otherwise.

38. Expansion memory is tested. If an error occurs, the following message is displayed:

Address = \_\_\_\_\_, Should Be = \_\_\_\_\_ H, Is \_\_\_\_\_ H

39. Hard disk is initialized.

40. Expansion card BIOS ROMs are initialized.

41. Keyboard and timer interrupts are enabled.

42. BIOS ROM checksums are calculated. If an error occurs, the following message is displayed:

ROM Checksum error.

43. BIOS Report Sequence. In steps 44 through 48, the computer displays a message for each error that occurred during power-up:

44. Hard disk errors; one of the following messages may be displayed:

Hard disk controller  
Hard disk failure on Drive 0  
Hard disk failure on drive 1

45. Memory size comparison errors; the following message is displayed:

Invalid memory size configuration

46. CMOS equipment configuration error; the following message is displayed:

Invalid CMOS equipment configuration.

47. CMOS checksum error; the following message is displayed:

CMOS checksum is bad.

48. Bad Battery; the following message is displayed:

Bad battery flag set in CMOS.

49. If any of the errors (44 through 48) occur, the Setup Utility is invoked automatically. The configuration data on the Setup screen should be checked for accuracy. If the configuration is accurate, press F1 to continue.

50. BIOS Report Sequence. In steps 51 through 54, the computer displays a message for each error that occurred during power-up. Each message is displayed for 5 seconds and then messages are cleared.

51. Keyboard error - the following message is displayed:

Keyboard error or keyboard not present.

52. Type Monitor doesn't agree with switch setting on video card - one of the following messages may be displayed:

Display switch set for color adapter  
Display switch set for monochrome adapter

53. Video card horizontal sync output not present - the following message is displayed:



Status error from display adapter.

54. Video output not present - the following message may be displayed:

No video signal from display adapter.

55. If any of the errors (51 through 54) occur, the Setup Utility is invoked automatically. The configuration data on the Setup screen should be checked for accuracy. If the configuration is accurate, press F1 to continue.

56. If the CPU card switch for Loop Diagnostics is set, the BIOS startup routine repeats, otherwise, the following steps are performed.

57. Operating system is loaded, the following message is displayed:

Loading Operating System

58. BIOS checks for valid ROM at address E000:0000, and if valid ROM exists, the program jumps to that address. If not, the nonmaskable interrupts are armed.

59. The Operating system is actually loaded from the disk and control is transferred to the operating system.

### 3.1.2 Setup Utility

The Setup Utility is used to set the computer time, date and configuration data. Setup is made up of two screens (pages). The first screen records computer configuration information. The second screen initiates a Parking Utility used to prepare the disk drives for shipping.

The Setup Utility resides in ROM; the configuration information resides in CMOS RAM. Each time the computer is powered-up, the BIOS performs computer diagnostics and checks the configuration information stored in memory against the actual configuration being tested. If inconsistencies are discovered, BIOS error messages are displayed. The following steps describe how to use the Setup Utility:

1. To access the Setup Utility, press the CTRL and ALT keys at the same time and then press the S key. Page 1 of the Setup Utility is displayed.

2. Use the up and down arrows to select the desired field. Use the plus (+) and minus (-) keys on the keypad to scroll through possible choices.

Time	Sets the computer real time clock (24 hour format)
Date	Sets the computer date (mm/dd/yyyy)
Floppy Disk Drive A:	Drive capacity: High Capacity (1.2M bytes), Double Sided (360K bytes), 3.5-inch (720K bytes) drive.
Floppy Disk Drive B:	Drive capacity: Double Sided (360K bytes), High Capacity (1.2M bytes), 3.5-inch (720K bytes) drive.
Hard Disk Drive C:	Drive type (Range 1 to 15, see table) or not installed
Hard Disk Drive D:	Drive type (Range 1 to 15, see table) or not installed
Monitor Type	Monochrome, 40 Column Color, 80 Column Color, EGA or other
Base memory size	Range from 128K to 640K bytes in 128K increments
Expansion memory size	Range from 0M to 15M bytes in 128K increments
Power-up Processor	Options are: 6, 8, or 10MHz

3. After modifications are made, press F1 to restart the computer from power-up.

Setup Utility (Page 1)

Texas Microsystems Inc.  
B286 Setup Utility Version x.x

Use the up and down arrow to select de-  
sired field. Use the plus (+) and minus  
(-) keys on the keypad to scroll through  
possible choices.

Time (24 hour format) . . . . . 09:50:56  
Date . . . . . 07/06/1986  
Floppy Disk Drive A: . . High Cap. (1.2M)  
Floppy Disk Drive B: Double Sided (360K)  
Hard Disk Drive C: . . . . . Type 1  
Hard Disk Drive D: . . . . . Not Installed  
Monitor Type . . . . . Monochrome  
Base memory size . . . . . 512K  
Expansion memory size . . . . . 512K  
Power-up processor speed . . . . . 8MHz

Type F10 to go to SETUP page 2

Type F1 to restart computer from power-up

Note: F2 may be used to continue. This may cause  
unexpected results. See user manual for  
details.

Notes on Using Setup Utility Function keys:

1. Press F1 to restart the computer, simulating a power-up. When Setup information is changed, the computer should be restarted from power-up, so that BIOS can read the new data stored in memory.
2. Press F10 to prepare the disk drives for shipment. (Refer to the Packing for Shipment instructions later in this section.)
3. Press F2 to continue. This function can be used as follows:

The Setup Utility can be selected to view the existing computer configuration information. As long as no changes are made, BIOS diagnostics are not affected. Under these conditions, pressing F2 allows the computer to continue and operate normally.

If configuration information is changed and the computer is not restarted from power-up (F1), BIOS diagnostics are not updated. Under these conditions, pressing F2 allows the computer to

continue. However, operating inconsistencies can result that may cause the computer to abort. (Refer to the BIOS Startup Routine and Error Messages discussed previously in this section.)

Supported fixed disk configurations:

Type	Cyls.	Hds.	Size (M Bytes)
1	306	4	10
2	615	4	20
3	615	6	30
4	940	8	60
5	940	6	45
6	615	4	20 (no precomp)
7	462	8	30
8	733	5	30
9	900	15	110
10	820	3	20
11	855	5	35
12	1024	5	40
13	306	8	20
14	1024	8	70

### 3.1.3 Changing Processor Clock Speed

The 2000 Series AT configuration has a 80286 processor and operates at clock speeds of 6 or 8 and 6 or 10 MHz. The following two methods can be used to modify the processor clock speed.

1. Use the Setup Utility (page 1) to modify the power-up processor speed field.
2. Use a quick key method that can be used any time. Press and hold the CTRL and ALT keys at the same time, then type the desired speed:

6 = 6 MHz  
8 = 8 MHz  
1 = 10 MHz

### 3.1.4 Continuous Loop Diagnostics

The BIOS diagnostics can be executed in a continuous loop program by simply changing one of the switch settings on the CPU card. Continuous Loop Diagnostics are used at the factory to test all equipment before shipment. This procedure can also be used for confidence testing if computer integrity is in question. Refer to the the B286 section of the MODULES chapter on how to setup for loop diagnostics.

### 3.2 Preparing the Hard Disk Drive

Computer Initialization refers to the procedures used to power-up the computer for the first time and to load the disk operating system. The 2000 Series Computers are designed to accommodate several operating systems; however, the procedures described in the following paragraphs are valid for International Business Machines PC/DOS or Microsoft's MS/DOS versions 2.0 or later.

Before the hard disk can be used, it must be prepared to accept data. This initial one-time format preparation is done in three steps. The first step is a low level format which is completed at the factory, the second step partitions the disk, and the third step formats the disk.

The low level format erases all data from the disk and writes the sector information for each sector throughout the disk. A map of bad tracks is compiled for use by the operating system.

Partitioning writes the partition sector on sector 1 of track 0. This sector tells the operating system how much of the hard disk is available, and where it is. Several partitions may exist on one disk.

The upper level format is operating system dependant. Bootstrap code and file allocation information is written to the disk and if the partition is to be "bootable", the operating system is also copied from floppy during this format procedure.

#### CAUTION

When the hard disk is formatted for the first time, the disk is blank and spaces are created to accept data. However, any time the hard disk or floppy disk is reformatted, all data recorded on the disk/diskette is ERASED. Use the format procedure carefully.

#### 3.2.1 Partitioning the Hard Disk

##### Note

The following procedure assumes that DOS is loaded and the DOS diskette is in drive A.

1. The A-prompt is displayed. Type: "fdisk" next to the A-prompt and press the ENTER key.

2. The following set of options are displayed:

- 1 Create DOS Partition
- 2 Change Active Partition
- 3 Delete DOS Partition
- 4 Display Partition Information

Enter Choice [1]

3. Option 1 is preselected. To create the DOS partition, press ENTER. To select a different option, type the number and press ENTER.

4. The following message is displayed:

"Do you want to use the entire fixed disk for DOS (Y/N) ?

5. Answer Yes by pressing ENTER. The following messages are displayed, where xxx is 305 for a 10M byte hard drive and 611 for a 20M byte drive.

"Total fixed disk space is xxx cyls."

"The current active partition is 1"

6. Return to the A-prompt by pressing the Esc key twice. The hard disk is partitioned. Continue with the next phase: formatting the hard disk.

### 3.2.2 Formatting the Hard Disk

1. To format the hard disk, type: "format c: /s/v" after the A-prompt and press the ENTER key.

The format command: "format c: /s/v" is used to format drive C. The /s indicates that DOS system files are to be copied to the hard disk. DOS system files make it possible to automatically access the operating system from the hard disk. The /v causes the computer to prompt for a volume label after the disk is formatted.

2. The computer displays a warning message to be sure that the hard disk (C:) is to be formatted. If Y (yes) is typed, followed by ENTER, the formatting process begins. If N (no) is typed, followed by ENTER, the computer returns to the A-prompt.

#### CAUTION

When the hard disk is formatted for the first time, the disk is blank and spaces are created to accept data. However, any the hard disk or floppy disk is re\_

formatted, any data that was recorded on the disk/diskette is ERASED. Use the format procedure carefully.

3. Type: Y to format the hard disk. During this process, the following message is displayed:

"Formatting . . ."

4. The formatting process takes about 3 minutes. A message is displayed indicating that formatting is completed and showing the amount of available disk space.
5. Type in the desired volume label (11 characters). This label is be noted each time the drive C directory is displayed. Enter the label to be used and press ENTER.

The hard disk is ready to accept data. Because DOS system files reside on the hard disk the computer can now be started from drive C.

### 3.3 Floppy Disk Drives

Three types of floppy disk drives are available as options with the 2000 Series AT computers.

The 1.2M byte high capacity drive stores data on 5.25-inch high capacity diskettes.

The 360K byte drive is a double sided drive and stores data on 5-1/4 inch double sided, double denaity diskettes.

The 720K byte drive is designed for 3.5-inch diskettes and requires DOS versions 3.2 or greater. This drive is compatible with the International Business Machines Laptop computer.

#### 3.3.1 Compatibility Guidelines

Floppy diskette and disk drive capacities must be compatible or reading and writing data can be distorted and, in some cases, not possible. Diskettes can either be single sided, double sided, or high capacity and each has a different storage capability:

Single Sided diskette	160/180K bytes
Double Sided diskette	320/360K bytes
High Capacity diskette	1.2M bytes -AT only

1. The 1.2M byte high capacity floppy disk drive requires high capacity or diskettes for

formatting, reading and writing data. However, this high capacity drive can read 360K byte floppy diskettes.

2. The 320/360K byte floppy disk drive requires double sided, double density diskettes for formatting, reading, and writing data. The high capacity diskettes cannot be read or written in the 360K byte disk drive.
3. The 720K byte floppy disk drive requires double sided 3.5-inch cartridge diskettes for formatting, reading, and writing data.

Note

It is unlikely that damage or loss of data will result when the computer is powered-up with diskettes installed. However, it is considered good practice to remove the diskettes before the computer is powered-up or down.

### 3.4 BASIC Interpreter

An interpreter is computer software that translates and executes each program instruction one at a time. In contrast, a compiler translates all source program instructions creating an object program that is executed. The GWBASIC interpreter translates and executes programs written in BASIC.

It is important to note that the BASIC or BASICA interpreters available from International Business Machines, require firmware found only on the IBM personal computers. The BASIC interpreters available from IBM will not operate on the 2000 Series AT and XT models. However, the GWBASIC interpreter available from Texas Microsystems is totally compatible with the 2000 Series Industrial Computers.

Accidental use of BASIC or BASICA will result in the message:

Incorrect BASIC version.

to be displayed and the operating system reloaded.



## 4. MAINTENANCE

### 4.1 Fuses

2001 Computer	3 amp, 3AG fuse (computer) 10 amp, 3AG fuse (2 line)
2003 Computer	3 amp, 3AG fuse (computer)
2004 Computer	3 amp, 3AG fuse (computer)

### 4.2 Fan Filters

It is recommended that the fan filter be cleaned at least once every 6 months, depending on the computer work environment. If the work area is very dusty, the fan filter should be cleaned more often, as needed.

#### 4.2.1 2001 Computer Filter

1. Power-down the computer. The power indicator lights should be off.
2. At the back of the computer, gently pry off the plastic frame that holds the filter screens in place. Notice that the three screen components are aligned as follows:

Outer screen - vertical corrugated  
Middle screen - horizontal corrugated  
Inner screen - vertical corrugated

3. Remove the filter screens for cleaning in a mild soap and water solution.

#### CAUTION

Make sure that the filter screens are thoroughly dry before they are reinserted in place.

4. Reinsert the filter screens in order (vertical, horizontal, vertical).
5. Snap the filter frame back in place to secure the filter screens.

#### 4.2.2 2003 Computer Filter

1. Power-down the computer. The power indicator lights should be off.

2. The fan is positioned at the back of the computer. Unscrew the 4 holding screws visible on the filter frame outside the computer. Remove the fan filter and frame.
3. Unsnap the filter frame and remove the filter for cleaning in a mild soap and water solution. The fan filter is very porous. Rinse the filter well, gently squeeze out excess water, and let dry thoroughly.
4. Reinsert the filter into its frame. Align the frame so that the 4 screws can be replaced and tightened.

#### 4.3 Replacing the B286 Battery

The 2000 Series AT computer has a built-in high capacity lithium battery installed on the CPU card. This battery supports a real time clock, which retains the correct time and date, and computer parameters in memory when the computer is powered-down. This information assists BIOS in performing initialization and configuration every time the computer is powered-up.

The battery is intended to provide many years of service without replacement. However, if the computer is over 5 years old, and/or configuration or clock related inconsistencies occur, the battery may need to be replaced.

A battery replacement kit is available from Texas Microsystems. On-site installation is available with qualified technical personnel, or the CPU card may be returned to the factory for battery replacement. Contact a local TMI sales representative for information.

#### 4.4 Factory Return Goods Authorizations (RGA)

You must obtain authorization from Texas Microsystems before returning any equipment to the factory for credit or repair. When authorization is given, you will be issued a "Return Goods Authorization" number (RGA). This number must appear on all packing materials and correspondence to insure proper handling.

## 5. MODULES

### 5.1 Central Processing Units (CPUs)

Paragraphs of this section of the manual which pertain to all revision levels of the B286 CPU make no notation of revision level in their paragraph title. Those paragraphs which pertain only to specific revision levels of the B286 CPU card, designate this applicability and limitation in the paragraph title. Users should make note of the Revision Level of the CPU Card (referenced on the serial number tag). After noting the CPU card revision, users should utilize those sub-sections/paragraphs of this manual which pertain to their particular CPU revision.

#### 5.1.1 B286 (AT) CPU

#### 5.1.2 Description

The B286 is an IBM PC/AT compatible CPU board, designed for industrial applications. The PC/AT sized card plugs into a passive backplane (BP2 or BP3) and provides the central processing functions of an industrial computer.

The board contains an 80286 6Mhz (optional 8Mhz or 10Mhz) 16 bit microprocessor, optional 80287 numeric processor, 512KB or 1MB of parity checked random access memory (RAM), battery backed up clock, 50 bytes of battery backed up CMOS RAM, long life battery, 15 interrupt channels, 7 DMA channels, real-time-clock, keyboard interface microprocessor, audio generator and driver, external reset switch and 16 bit PC/AT bus interface electronics.

The board is implemented with CMOS and advanced low power shottky gate arrays for minimum power consumption. Interfaces to the board, other than the standard PC/AT bus are for keyboard and speaker connections, and an external audio jack. The PCB is implemented with 4 circuit layers, one power plane and 1 ground plane.

#### 5.1.3 Specifications

Temperature range	0° to 60°C
Relative Humidity	95% Non-condensing
Supply requirements	+5V at 2.2A typical
Battery rating	3.5V 750mAH
Power OFF battery drain	.017mA typical
Dimensions	14.5" x 6.5" x .55"
Weight	1 lb.
Skirt Protrusion	.4"
Operating Speed	6Mhz Lo / 8Mhz Hi
or	6Mhz Lo / 10Mhz Hi
On Board Memory wait States	1
Bus Memory wait States	1 (optionally 2 at Hi Speed)
8 Bit I/O Wait states	4 Lo, 6 Hi
16 Bit I/O Wait States	1 Lo, 2 Hi
Standard 80287 Clock speed	2/3 of CPU Clock speed
Optional 80287 Speed	8 Mhz and 10 Mhz options

#### 5.1.4 Installation

In addition to the instructions for installing modular options in chapter 1, the eight position keyboard cable must be installed at J3 on the bottom edge of the card. Insure that the cable extends to the bottom of the computer for proper polarity. Improper installation may result in keyboard damage.

#### 5.1.5 Configuration - Rev A - C CPU Board

There are 6 switch settings on the A through C revision of the B286 CPU boards as shown below:

<u>Switch number</u>	<u>Function</u>
1	Video Configuration on = color, off = monochrome
<u>2</u> <u>3</u>	<u>Memory Configuration</u>
on    on	256K main    Zero expansion
off   on	512K main    Zero expansion
on    off	640K main    Zero expansion
off   off	512K main    512K expansion
4	on = swap ~ with esc
5	on = continuous power on test
6	on

#### 5.1.6 Configuration - Rev D and E CPU Board

B286 Revisions D and E boards are configured in three ways:

- ° Soft-configured via CMOS setup parameters
- ° Switch settings on SW1
- ° Jumpers E1, E3 and E4

For information regarding soft configuration, refer to Chapter 3, Firmware Operation.

SW1 controls the default monitor type, the amount of RAM and ROM contained on the board plus three software readable switches used for keyboard options and the diagnostic loop feature:

#### MONITOR TYPE

SW1-1  
OPEN  
CLOSED

DEFAULT MONITOR TYPE  
MONOCHROME  
COLOR

## MEMORY CONFIGURATION

SW1-4	SW1-3	SW1-2	BASE /	EXPANDED MEMORY
OPEN	CLOSED	CLOSED	ZERO	ZERO
CLOSED	CLOSED	CLOSED	256K	ZERO
CLOSED	CLOSED	OPEN	512K	ZERO
CLOSED	OPEN	CLOSED	640K	ZERO
CLOSED	OPEN	OPEN	512K	512K (above 1Mbyte)
OPEN	OPEN	OPEN	640	384K (above 1Mbyte)

## SOFTWARE FEATURES

SW1-7	SW1-6	SW1-5	FEATURE
	CLOSED		LOOP ON POWERUP DIAGNOSTICS
		CLOSED	ALLOWS USE OF XT KEYBOARD
X			SW1-7 IS <u>NOT</u> USED (always OFF)

## ROM CONFIGURATION

SW1-8	ROM TYPE
OPEN	27128 (32K TOTAL)
CLOSED	27256 (64K TOTAL) (STANDARD)

Jumpers E1, E3 and E4 configure the on-board battery, co-processor clock rate option and wait state generator options.

FUNCTION	JUMPER SETTING
BATTERY CONNECTED	E1-1 to E1-2
80287 STANDARD CLOCK	E3-1 to E3-2 E3-6 to E3-4
80287 OPTIONAL CLOCK	E3-1 to E3-3 E3-6 to E3-5
2 WAIT STATES ON 16 BIT EXTERNAL MEMORY	E4-1 to E4-2
NO WAIT STATE GEN.	E4-5 to E4-6 (REMOVE U74)

### 5.1.6 Configuration - Rev F CPU Board

B286 Revision F boards are configured in three ways:

- ° Soft-configured via CMOS setup parameters
- ° Switch settings on SW1
- ° Jumpers E1, E3, E4, E5, E6, and E7

For information regarding soft configuration, refer to Chapter 3, Firmware Operation.

SW1 controls the default monitor type, the amount of RAM and ROM contained on the board plus three software readable switches used for keyboard options and the diagnostic loop feature:

#### MONITOR TYPE

<u>SW1-1</u>	<u>DEFAULT MONITOR TYPE</u>
OPEN	MONOCHROME
CLOSED	COLOR

#### MEMORY CONFIGURATION

<u>SW1-4</u>	<u>SW1-3</u>	<u>SW1-2</u>	<u>BASE / EXPANDED MEMORY</u>	
OPEN	CLOSED	CLOSED	ZERO	ZERO
CLOSED	CLOSED	CLOSED	256K	ZERO
CLOSED	CLOSED	OPEN	512K	ZERO
CLOSED	OPEN	CLOSED	640K	ZERO
CLOSED	OPEN	OPEN	512K	512K (above 1Mbyte)
OPEN	OPEN	OPEN	640	384K (above 1Mbyte)

#### SOFTWARE FEATURES

<u>SW1-7</u>	<u>SW1-6</u>	<u>SW1-5</u>	<u>FEATURE</u>
	CLOSED		LOOP ON POWERUP DIAGNOSTICS
		CLOSED	ALLOWS USE OF XT KEYBOARD
X			SW1-7 IS <u>NOT</u> USED (always OFF)

#### ROM CONFIGURATION

<u>SW1-8</u>	<u>ROM TYPE</u>
OPEN	27256 (64K TOTAL) (STANDARD)
CLOSED	27512 (128K TOTAL)

Jumpers E1, E3 and E4 configure the on-board battery, co-processor clock rate option and wait state generator options.

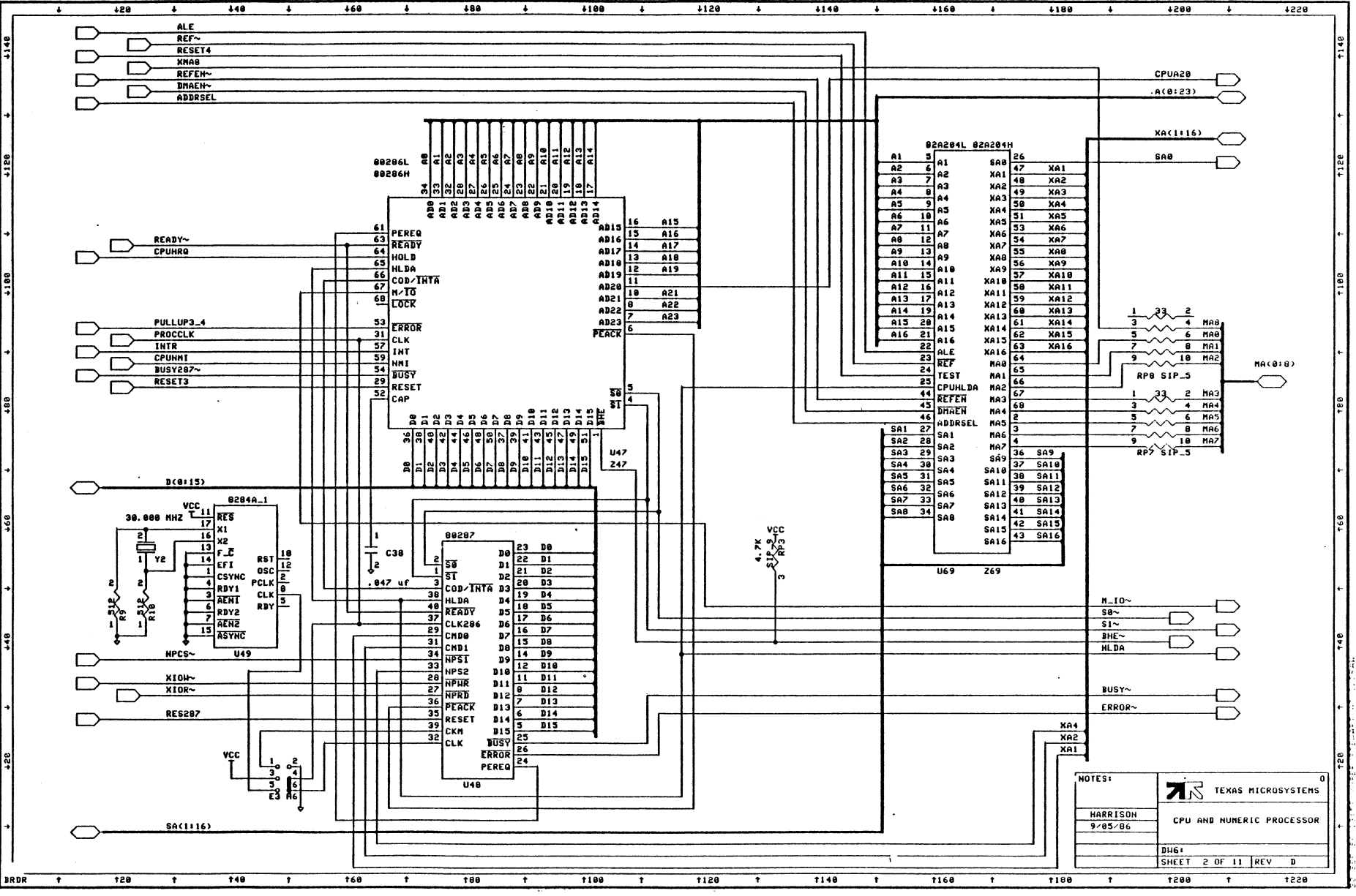
<u>FUNCTION</u>	<u>JUMPER SETTING</u>
BATTERY CONNECTED	E1-1 to E1-2
80287 STANDARD CLOCK	E3-1 to E3-2 E3-6 to E3-4
80287 OPTIONAL CLOCK	E3-1 to E3-3 E3-6 to E3-5
2 WAIT STATES ON 16 BIT EXTERNAL MEMORY NO WAIT STATE GEN.	E4-1 to E4-2 E4-5 to E4-6 (REMOVE U74)

Jumpers E5, E6 and E7 allow the user to select use of the watchdog timer feature, select for DS1231 compatibility and select for bus reset switch use. E5 is a six pin jumper, whereas, E6 and E7 are each two pin jumpers.


<u>FUNCTION</u>	<u>JUMPER SETTING</u>
WATCHDOG TIMER INSTALLED	E6-1 to E6-2 (must use DS1232 - factory configuration)
DS1231 COMPATIBILITY	E5-2 TO E5-4 No jumpers installed on E6 or E7
Bus Reset Switch Use	E5-1 to E5-2 (must use DS1232 - factory configuration)

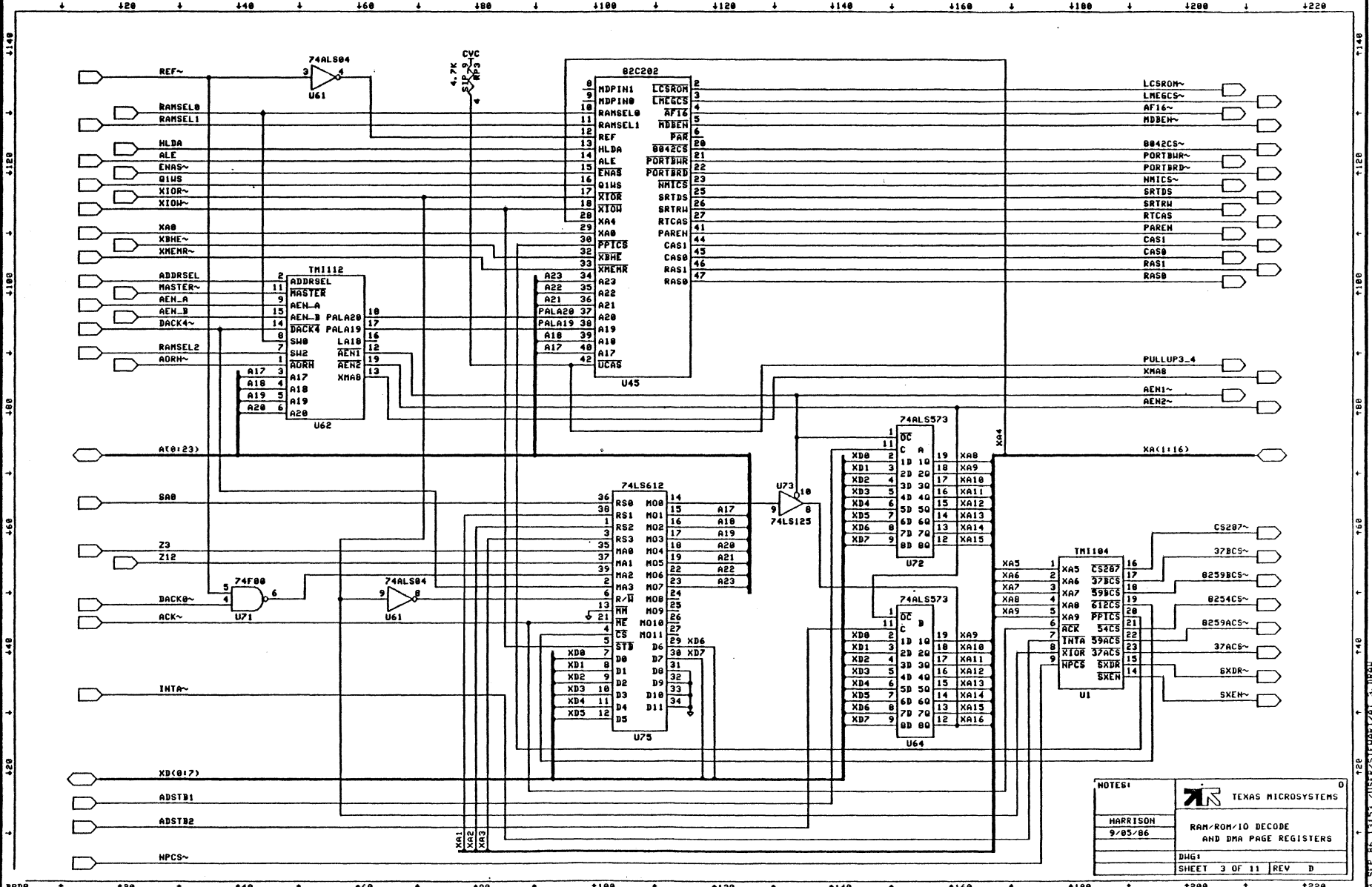







NOTES:

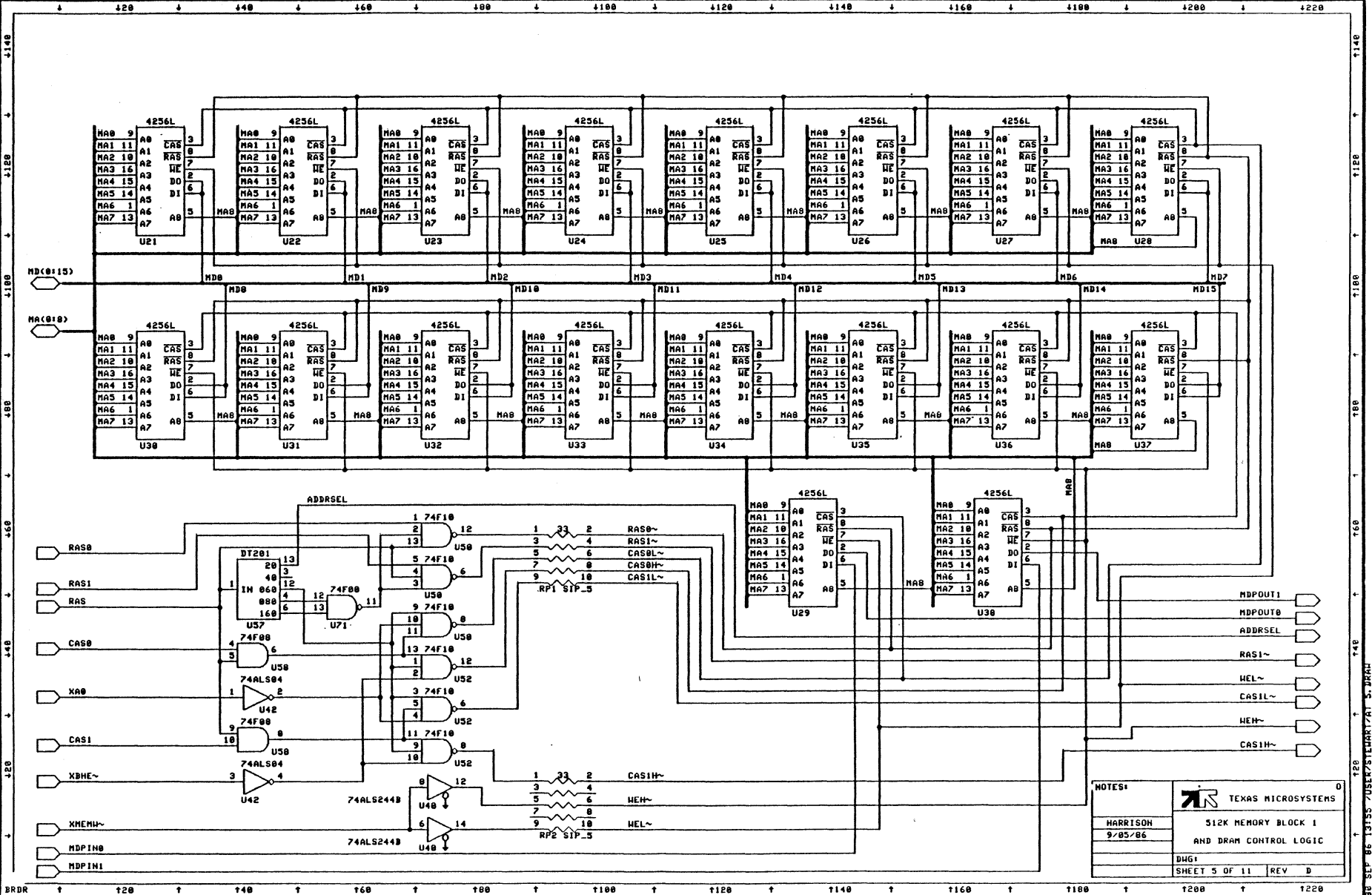
HARRISON 9/05/86	 TEXAS MICROSYSTEMS CPU AND NUMERIC PROCESSOR
DUG: SHEET 2 OF 11 REV D	




NOTES:

HARRISON 9/05/86	 TEXAS MICROSYSTEMS RAM/ROM/IO DECODE AND DMA PAGE REGISTERS
DHG1	
SHEET 3 OF 11	REV D

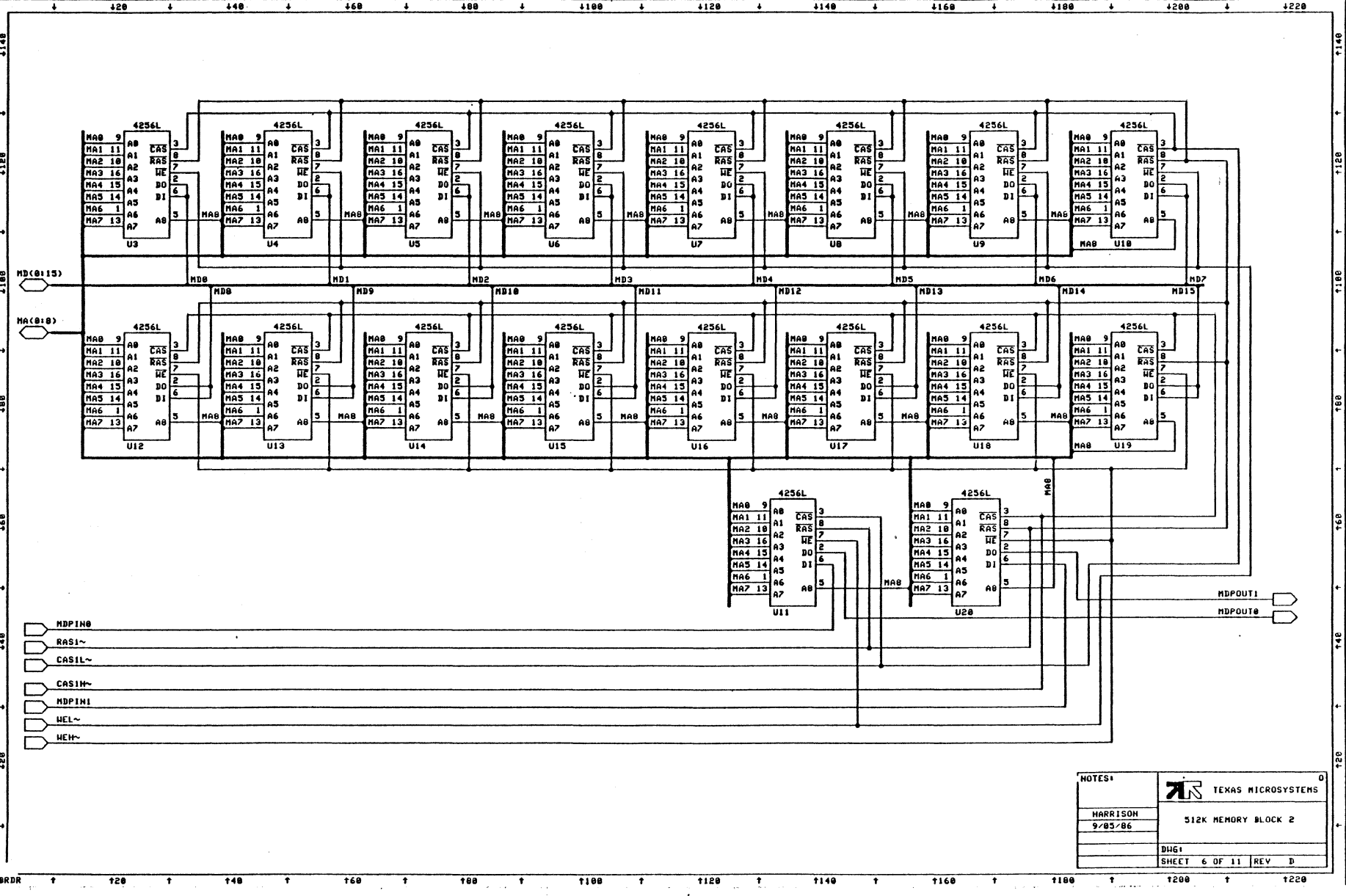




NOTES:


HARRISON 9/05/86	 TEXAS MICROSYSTEMS 512K MEMORY BLOCK 1 AND DRAM CONTROL LOGIC
DWG: SHEET 5 OF 11	

REV D

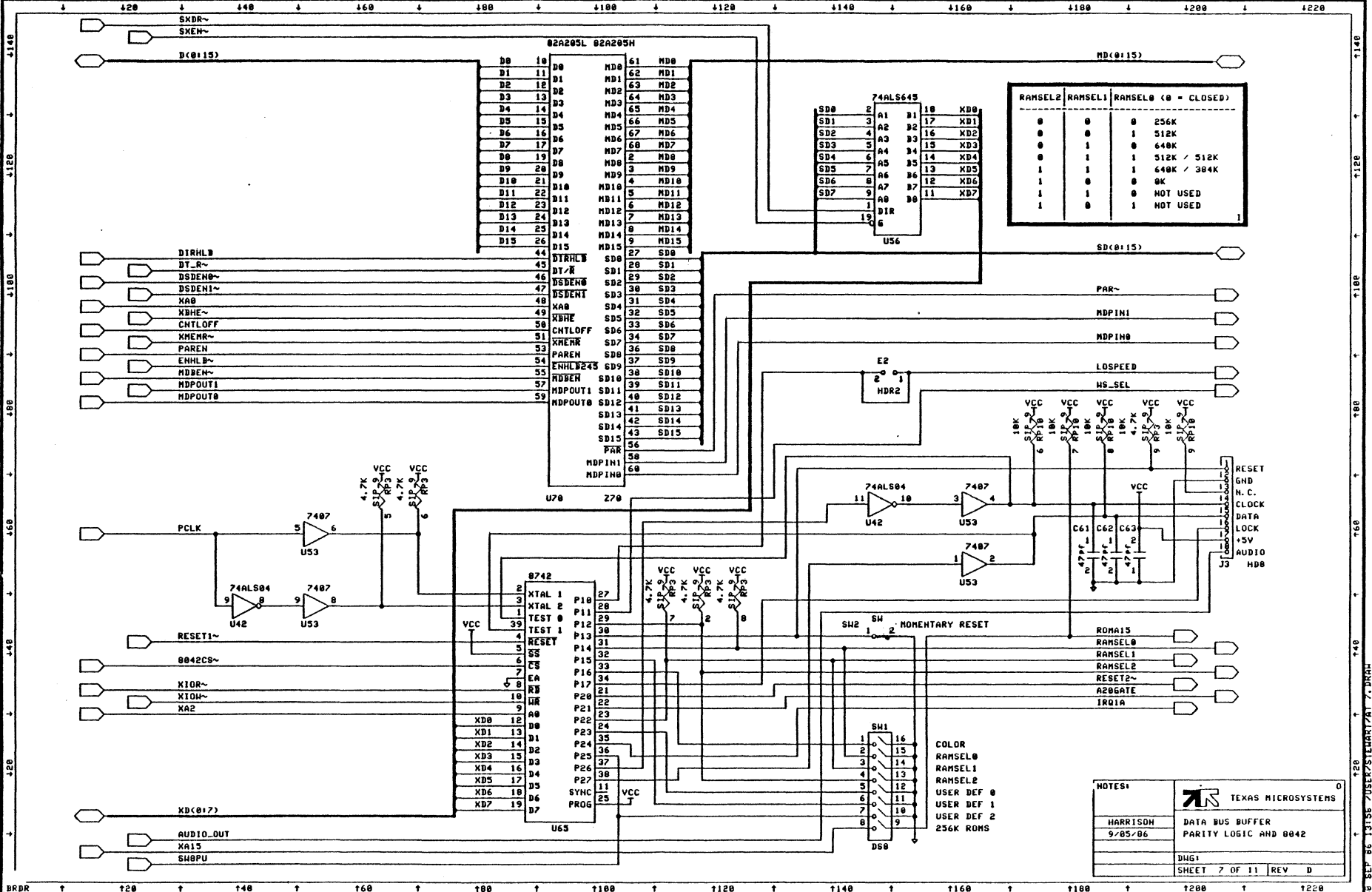


- MDPIN0
- RAS1~
- CAS1~
- CAS1H~
- MDPIM1
- MEL~
- MEH~

- MDPOUT1
- MDPOUT0

NOTES:		 TEXAS MICROSYSTEMS
HARRISON	9/85/86	
512K MEMORY BLOCK 2		
DWG:		
SHEET 6 OF 11		REV D

120 1220 1240 1260 1280 1300 1320 1340 1360 1380 1400 1420 1440 1460 1480 1500 1520 1540 1560 1580 1600 1620 1640 1660 1680 1700 1720 1740 1760 1780 1800 1820 1840 1860 1880 1900 1920 1940 1960 1980 2000 2020 2040 2060 2080 2100 2120 2140 2160 2180 2200 2220

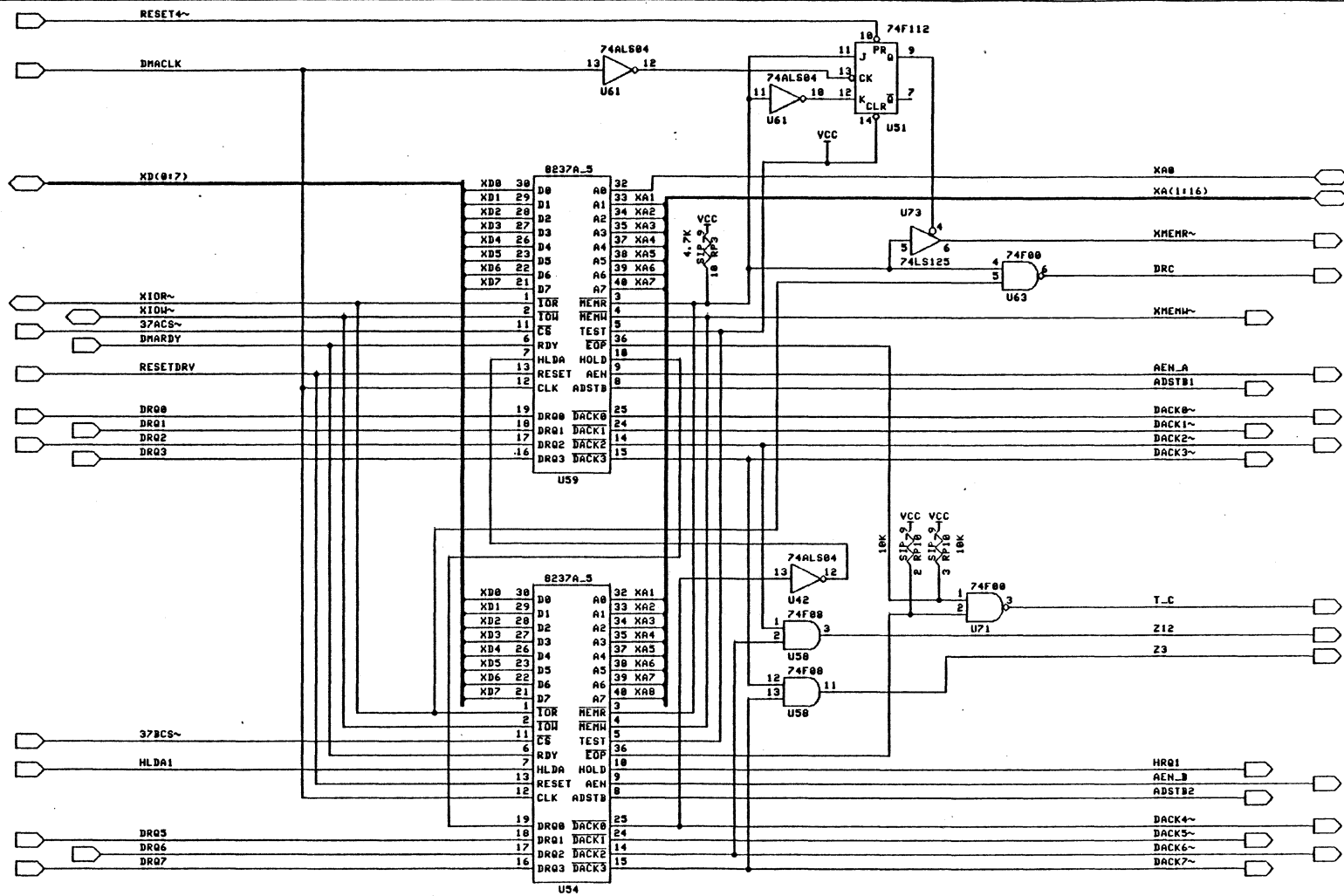


RAMSEL2	RAMSEL1	RAMSEL0 (0 = CLOSED)	
0	0	0	256K
0	0	1	512K
0	1	0	640K
0	1	1	512K / 512K
1	1	1	640K / 384K
1	0	0	9K
1	1	0	HOT USED
1	0	1	HOT USED

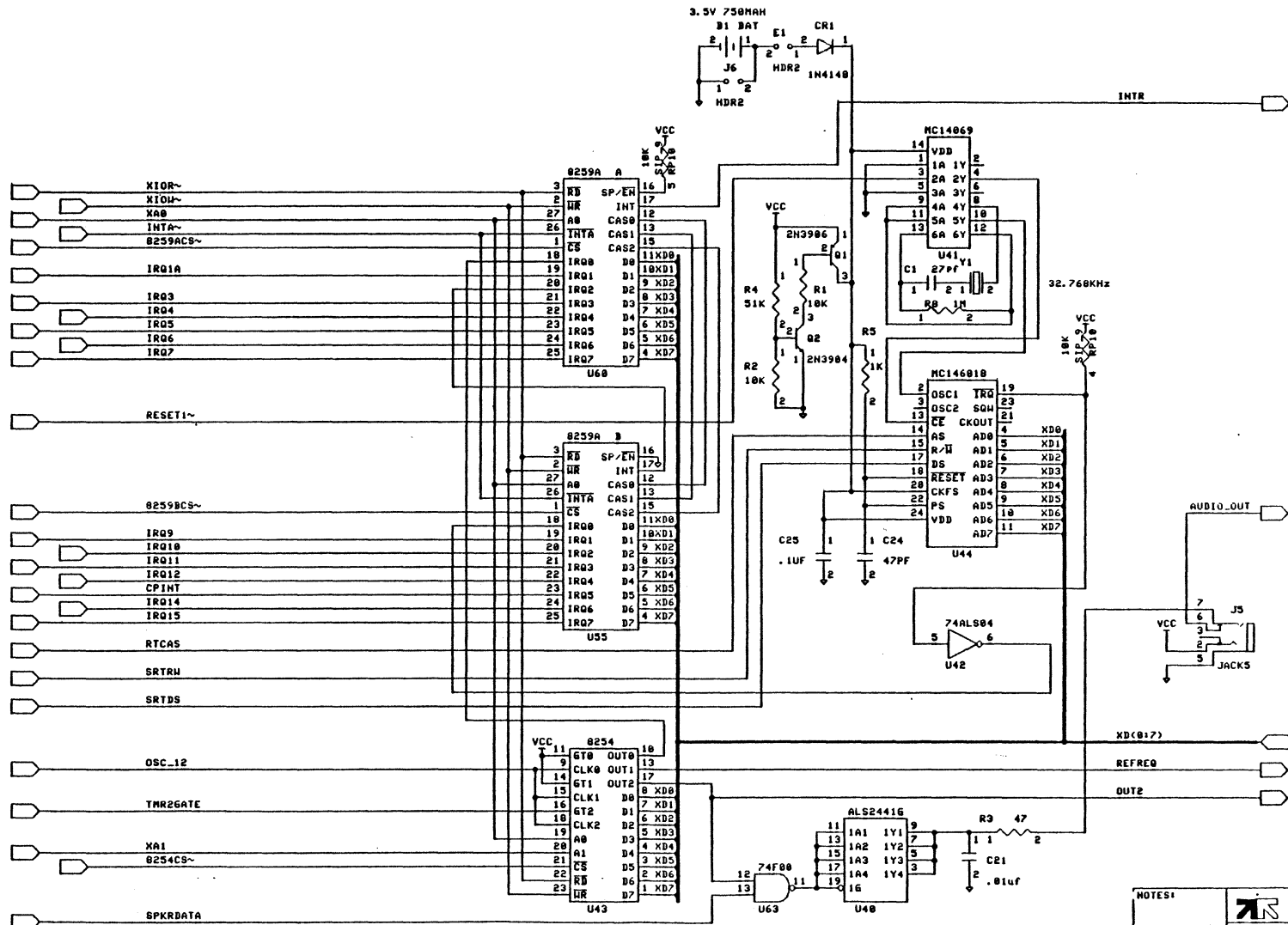
NOTES:		 TEXAS MICROSYSTEMS
HARRISON 9/85/86		
DATA BUS BUFFER PARITY LOGIC AND 8042		
DAG:		
SHEET 7 OF 11 REV D		


- COLOR
- RAMSEL0
- RAMSEL1
- RAMSEL2
- RAMSEL3
- USER DEF 0
- USER DEF 1
- USER DEF 2
- 256K ROMS

SEP 86 10:55 USER'S MANUAL V. 1.0



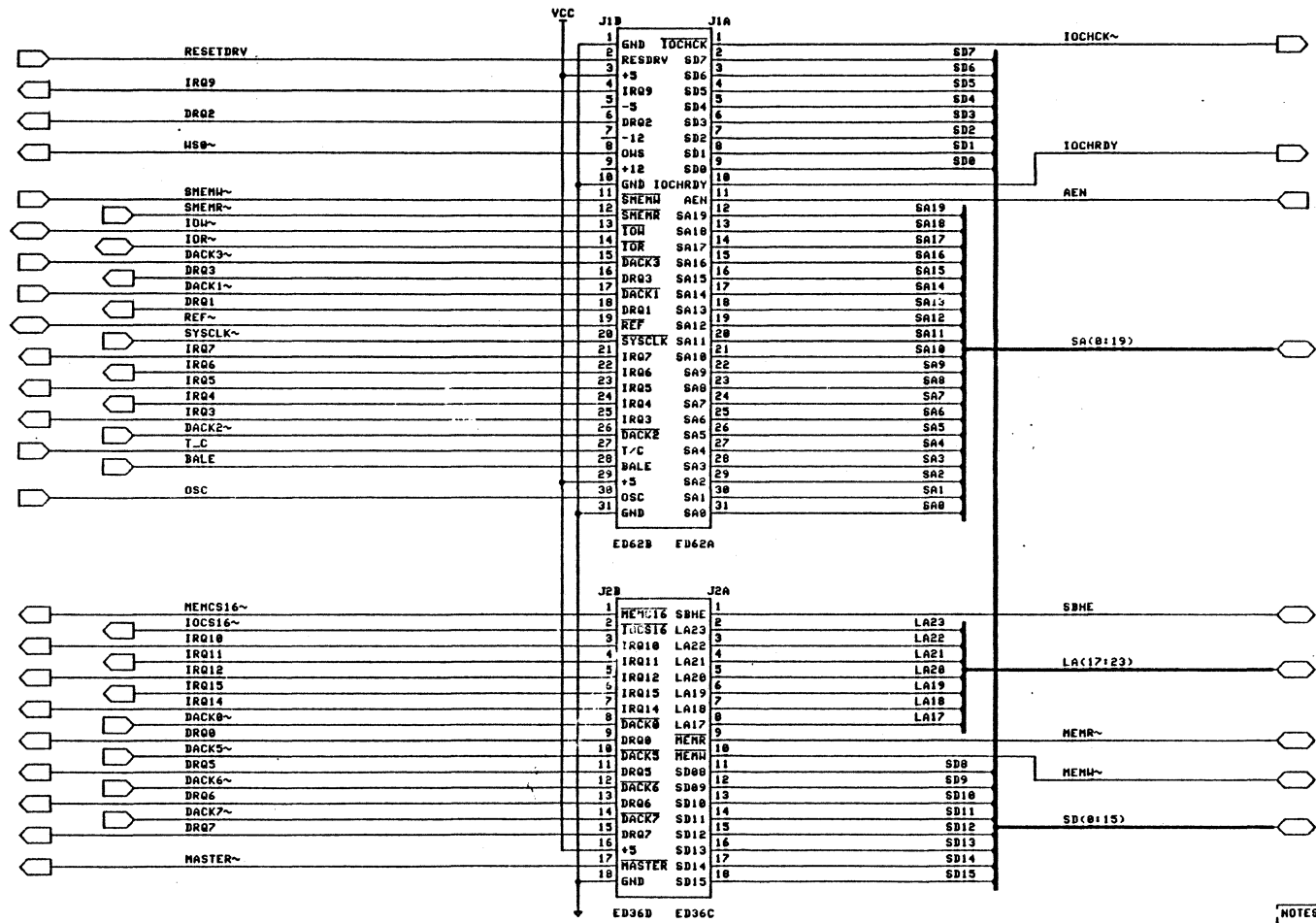
NOTES:	TEXAS MICROSYSTEMS	0
HARRISON 9/05/86		DRA CONTROLLER LOGIC
DHG1		
SHEET	OF 11	REV D



NOTES:	 <b>TEXAS MICROSYSTEMS</b>
HARRISON 9/05/86	
INTERRUPT / REAL TIME CLOCK	
DNG:	
SHEET 9 OF 11 REV D	







NOTES:

HARRISON	TEXAS MICROSYSTEMS
9/05/86	
PC BUS INTERFACE	
DWG:	
SHEET 11 OF 11 REV D	

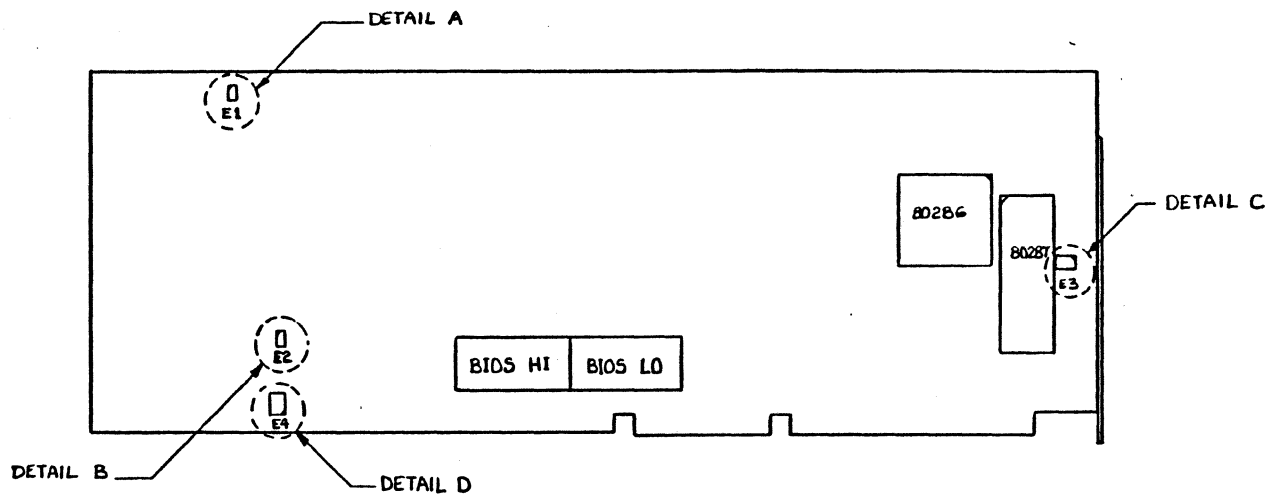
3

2

1

NOTES:

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



0	1
0	2

E1

DETAIL A

0	1
0	2

E2

DETAIL B

5	3	1
0	0	0
0	0	0
6	4	2


E3

DETAIL C

6	0	0	5
4	0	0	3
2	0	0	1

E4

DETAIL D

<b>material:</b>		TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES ± ± ±		 <b>TEXAS MICROSYSTEMS, INC.</b>		REV. X
		APPROVALS	DATE	<b>AT PROCESSOR BOARD</b> <b>REV.D - PICTORIAL</b>		
		DRAWN Bw	1/8/87			
160 D/A 200 200 000		2003 A	CHECKED	SCALE	SIZE <b>B</b>	DRAWING NO. 060-DGI-900-200-000
NEXT APPY		USED ON		DO NOT SCALE DRAWING		SHEET 1 of 1

B286 rev D and E  
 Bus Wait States

----- Low speed (6 Mhz) -----

Bus transfer type	----- Jumper setting-----		
	E4-1 to E4-2	no jumper	E4-5 to E4-6 & U74 removed
8 bit I/O	4	4	4
16 bit I/O	1	1	1
8 bit Memory	4	4	4
16 bit Memory	1	1	1

----- High speed (10 Mhz) -----

Bus transfer type	----- Jumper setting-----		
	E4-1 to E4-2	no jumper	E4-5 to E4-6 & U74 removed
8 bit I/O	6	6	4
16 bit I/O	2	2	1
8 bit Memory	6	4	4
16 bit Memory	2	1	1