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iSBC® 386AT USER'S GUIDE

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REV.	REVISION HISTORY	DATE
-001	Original Issue. Documents product number PBA 149422-003 to -009.	11/86
-002	Revision documents product number PBA 451213.	04/87

CAUTION

This board generates and uses energy of about the same frequency as radio and TV broadcasts. Installed incorrectly, it may interfere with reception of radio and TV broadcasts.

The board has been verified to be within energy emission limits for Class B computing devices as defined in the FCC Rules, Part 15, Subpart J. Installed correctly, it probably will not interfere with your radio or TV. However, we do not guarantee the absence of interference.

Peripherals (computer input/output devices, terminals, printers, etc.) attached to this board must be certified to comply with the Class B limits. Operation with non-certified peripherals is likely to result in interference with radio and TV reception. NOTE: shielded, grounded cables must be used.

You might find the following booklet helpful:

"How to Identify and Resolve Radio-TV Interference Problems"

You can order the booklet from the U.S. Government Printing Office, Washington, DC 20402. Ask for stock number 004-000-00345-4.

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CHAPTER 1
INTRODUCTION

The iSBC® 386AT board is a high-performance system board that provides the primary elements for building advanced personal computers. The board is functionally compatible with the system board in the IBM AT. However, it contains an 80386 microprocessor, 32-bit access to data, and other features that give it over twice the performance of an 8MHz IBM AT.

NOTE

This manual describes boards that have a product number PBA451213. If your board has a product number PBA149422–003 to –009, please read the section in this chapter called "Revision Differences." If your board does not have one of these numbers, contact your sales representative for documentation.

FEATURES

Major features of the iSBC 386AT board include:

- Intel 16MHz 80386 central processor and support circuits
- Socket for the Intel 80387 math coprocessor or iSBC® MATH (SBCMATH) module
- ROM BIOS compatible with the IBM AT BIOS
- RAM memory (Sixteen 64Kx4 chips for a total of 512K bytes of conventional memory on the system board)
- Keyboard interface compatible with IBM AT
- Keylock interface
- Real-time clock with battery-backed CMOS memory
- Sixteen interrupts
- Seven Direct Memory Access (DMA) channels
- One configurable IBM-compatible serial RS-232 communications port
- One configurable Centronics-compatible parallel printer port
- Expansion bus interface
  - --two 8-bit slots exclusively for PC-compatible expansion boards
  - --four 16-bit slots for both AT- and PC-compatible boards
  - --two expansion slots for high-speed, 32-bit RAM expansion boards (or for PC-compatible expansion boards)
- Speaker drive

Table 1-1 compares the features of the iSBC 386AT board with those of the IBM AT and XT system boards.

Table 1-1. Comparison of System Board Functions

Functions	386AT	PC-AT	PC-XT
Processor	80386	80286	8088
Math coprocessor	80387/80287 [1]	80287	8087
Maximum RAM on board	512 KB	512 KB	256 KB
ROM	128 KB	128 KB	48 KB
DMA Channels	7	7	4
TImer/Counter	3	3	3
Interrupt levels	16	16	8
Keyboard interface	8742	8042	8255
Speaker driver	yes	yes	yes
Expansion slots	8 (4 with 16-bit)	8 (6 with 16-bit)	8 (all 8-bit)
Serial interface	Standard	option board	option board
Clock/calendar	Standard	Standard	option board
Parallel printer port	Standard	option board	option board
CPU/Memory bus	32 bit	16 bit	8 bit

[1]The 386AT uses an optional 80387 or 10 MHz 80287 math module.

HOW TO USE THIS MANUAL

This manual is intended for the original equipment manufacturer (OEM) who plans to build computer systems based on the iSBC 386AT board. It describes the major features of the board, lists the pin-out specifications for all the connectors on the board, provides instructions for installing and configuring the board, and describes the system and setup software available with the board. The OEM can use this information when designing the system interfaces. Relevant information can also be included in the OEM's end-user documentation.

Revision Differences

A board numbered PBA149422-003 to -009 differs from PBA451213, the standard board discussed in this manual, in these ways:

PBA 451213 (this manual)

- Can use either an 80387 or its own SBCMATH module
- Has no stake pins numbered 4, 5, or 6; requires M146818AP for real-time clock

PBA 149422 (-003 and up)

- Can use an SBCMATH module; cannot use an 80387
- A jumper on stake pins 4 to 5 selects M146818AP for the real-time clock chip; jumper 5 to 6 selects M146818P.
- Power connector J14 has the same pinout as J14 on PBA451213. However, the connector is turned 180 degrees.

CAUTION

If you use J14 on PBA149422, do not use Figure 4–3, "Power Connector Pins." Use Figure 1–1. If the key is broken and the power connector installed incorrectly, the power connector will deliver +5V to the ground plane of the board and damage components on the board.

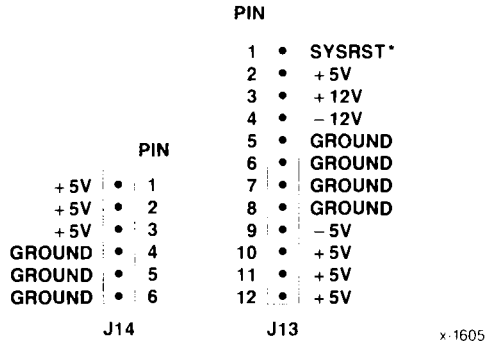

Figure 1-1. Installing J13 and J14 on PBA149422 Boards

Organization

The manual has the following chapters and appendixes:

Chapter 1. Introduction -- Introduction to the board, list of differences between revisions, and description of the organization of the manual.

Chapter 2. Features of the iSBC 386AT Board -- High-level descriptions of the major items on the board, including the pin-out specifications for all of the connectors.

Chapter 3. Configuring the iSBC 386 AT Board -- Descriptions of all the jumper settings on the board.

Chapter 4. Installation -- Recommendations for building a system based on the iSBC 386AT board, plus instructions for installing the math coprocessor and the 32-bit memory boards.

Chapter 5. SETUP Program -- Description of the SETUP program that can store system configuration information in the CMOS memory of the real-time clock chip.

Chapter 6. Power-On Self Test -- Brief description of the power-on self test and list of the screen messages and audible tones that can occur when error conditions are present.

Chapter 7. BIOS Information -- Table of BIOS interrupts and the functions they perform.

Appendix A. Specifications -- Table of board specifications.

Appendix B. Jumpers -- Table of jumper settings.

Appendix C. Tested Software and Hardware-- Table of tested software and hardware.

Appendix D. Related Publications -- List of publications that might be of interest to the reader of this manual.

Appendix E. Service Information -- How to get boards repaired.

Symbols and Terms

The following symbols and terms are used in this manual:

*	Indicates an active low signal, such as IOCHECK*.
<>	Indicates special keys on the keyboard. For example, <Enter> indicates the Enter key.
H	Denotes hexadecimal numbers. All addresses are listed in hexadecimal notation.
Cautions	indicate potential for software or hardware damage.
Notes	simply emphasize information.
Default	is the configuration of the board when shipped from the factory. Default usually refers to the factory setting of jumpers on the stake pins.

CHAPTER 2
FEATURES OF THE iSBC® 386AT BOARD

This chapter briefly describes each of the major features of the iSBC 386AT board. It covers the following topics:

- 80386 processor
- Math coprocessor socket
- Timers
- Memory
- Expansion slots
- I/O address map
- Interrupt controllers
- DMA controllers
- Real-time clock with battery backup
- Keylock interface
- Speaker interface
- Serial communications port
- Parallel printer port
- Power connectors
- Keyboard connector
- Keyclick volume

Figure 2-1 shows the layout of the board with callouts identifying most of these items. Figure 2-2 is a functional diagram of the board.

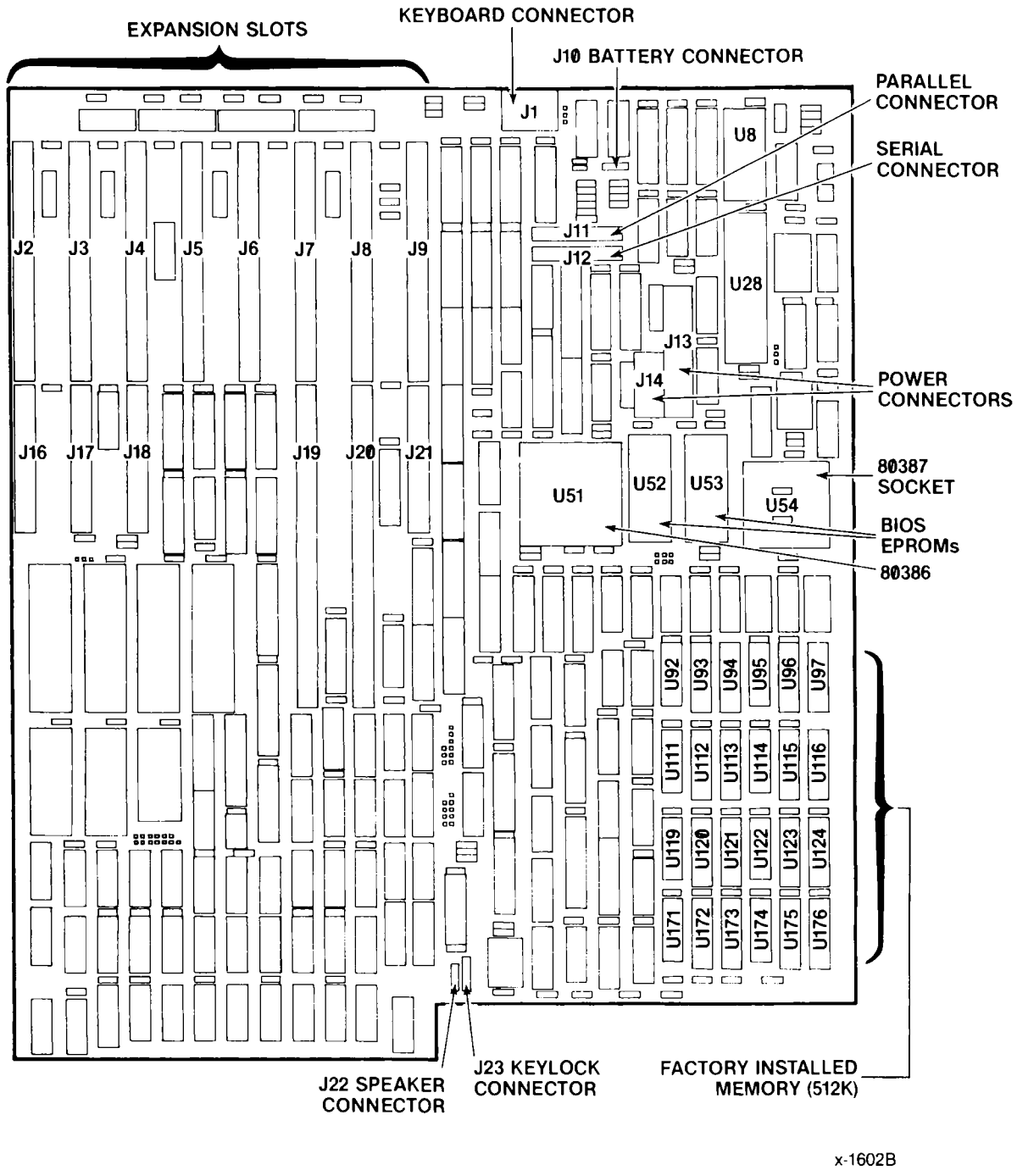

Figure 2-1. Layout of the iSBC® 386AT Board

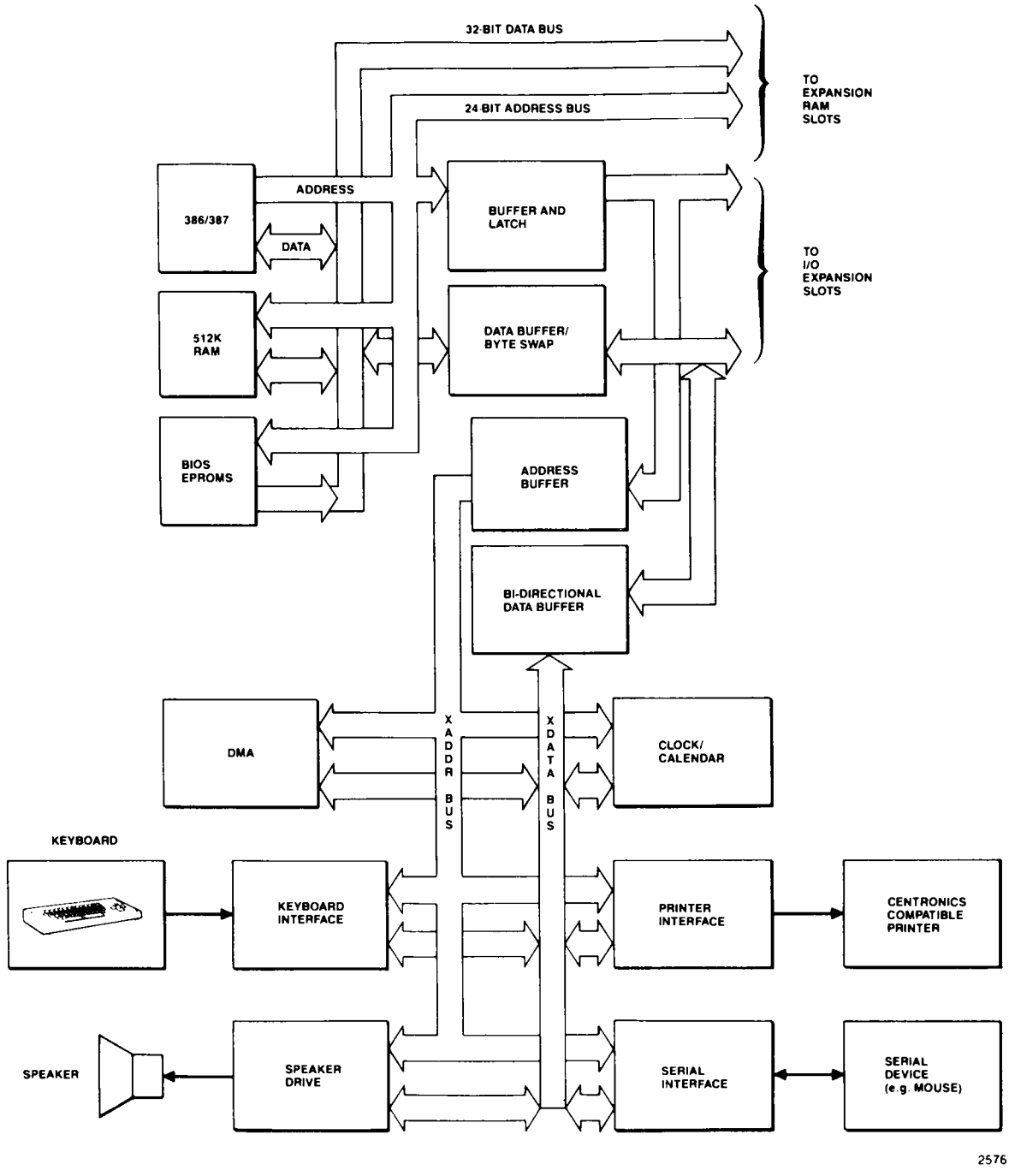

Figure 2-2. Functional Diagram of the iSBC® 386AT Board

80386 MICROPROCESSOR

The central processing unit of the iSBC 386AT board is the Intel 80386 microprocessor, a high-performance, 32-bit microprocessor that is upward compatible with Intel's 8088, 8086, and 80286 processors. Included in the extra features offered by the 80386 are the following:

- 32 data lines, enabling it to access 32 bits of data in a single instruction.
- 32 address lines, with a physical address space of 2^{32} bytes (4 gigabytes) in protected mode and a virtual address space of 2^{46} bytes (64 terabytes). Address lines 0-23 and 31 are connected on the iSBC 386AT board, limiting the actual physical address space to 16M bytes.
- Virtual 8086 mode addressing that permits concurrent execution of multiple applications written specifically for the 8088 or 8086.
- Paged memory support that permits memory to be mapped anywhere in the 16M-byte address space recognized by the iSBC 386AT board.

The 80386 runs at a clock speed of 16MHz in the iSBC 386AT board, resulting in system clock cycles of 62.5 ns. This gives the system board over twice the performance of an 8MHz IBM AT. However, for those applications that require slower operation (such as installing some copy-protected software), the iSBC 386AT board offers a "deturbo" mode that enables the board to simulate the performance of a 8MHz IBM AT. The deturbo mode is enabled and disabled from the keyboard with the following key sequences:

Key Sequence	Description
Ctrl-Alt-1	Holding down the **Ctrl** and **Alt** keys and pressing **1** on the numeric keypad places the board in deturbo mode (emulating the performance of an 8MHz AT).
Ctrl-Alt-2	Holding down the **Ctrl** and **Alt** keys and pressing **2** on the numeric keypad places the board in turbo mode (resuming full processor speed).

After every system (power-on) reset, the deturbo logic is reset, causing the system board to run at full processor speed. A software reset does not change the processor speed.

The deturbo mode does not affect the clock rate at which the 80386 executes instructions, nor does it affect the clock rate of the math coprocessor. Rather, it inserts processor hold states between each instruction, causing an effective processor speed of 8MHz.

When a speaker is connected to the system board, an audible tone occurs when you change the processor mode. Pressing Ctrl-Alt-1 (for deturbo mode) emits a low-pitched tone. Pressing Ctrl-Alt-2 (for full speed) emits a high-pitched tone.

CPU speed can also be set programmatically. Figure 2-3 lists the assembly language code needed to place the board in deturbo mode. Figure 2-4 shows the code to return the board to 16MHz operation.

```
;
; slow -- put iSBC 386AT into DETURBO mode (simulated 8MHz)
;
code    segment public
assume cs:code,ds:code
        org     100h
start:  jmp     begin
msg     db      'iSBC 386AT in DETURBO mode','$'
begin:  mov     ax,cs           ;set up ds
        mov     ds,ax
        mov     ax,0eaH
        out     64H,ax
        mov     dx,offset msg   ;address of deturbo message
        mov     ah,09h          ;display string function request
        int     21h             ;call DOS
done:   mov     ah,4ch          ;terminate process funct request
        int     21h             ;call DOS
code    ends
end     start                   ;start is the entry point
```

Figure 2-3. Programmatically Setting Deturbo Mode

```
;
; fast -- put iSBC 386AT into TURBO mode (16MHz)
;
code    segment public
assume cs:code,ds:code
        org     100h
start:  jmp     begin
msg     db      'iSBC 386AT in TURBO mode','$'
begin:  mov     ax,cs           ;set up ds
        mov     ds,ax
        mov     ax,0e5H
        out     64H,ax
        mov     dx,offset msg   ;address of turbo message
        mov     ah,09h          ;display string function request
        int     21h             ;call DOS
done:   mov     ah,4ch          ;terminate process funct request
        int     21h             ;call DOS
code    ends
end     start                   ;start is the entry point
```

Figure 2-4. Programmatically Setting Turbo Mode

MATH COPROCESSOR SOCKET

The math coprocessor socket is a 68-pin PGA (pin grid array) socket that can contain either an 80387 math coprocessor or an 80287-based SBCMATH module. The SBCMATH module is a small board containing an 80287 and support circuitry. The SBCMATH module physically adapts the 40-pin 80287, enabling it to plug into the 68-pin 80387 socket.

When an 80387 is plugged into the socket, it uses the CPU clock as its clock source and operates synchronously with the 80386. Therefore, it also operates at 16MHz. When the SBCMATH module is inserted, the 80287 operates at 10MHz, asynchronously to the 80386.

CAUTION Before inserting an 80387 in the board, read the instructions in Chapter 4. If the chip is inserted incorrectly, the chip and the system will be damaged.

TIMERS

An on-board 8254A chip provides three programmable timers, each with the same timing frequency of 1.19MHz. The timers are used for the following operations:

Timer	Function
0	The output of this timer is tied to interrupt request 0 (IRQ 0).
1	This timer is used to trigger memory refresh cycles. The BIOS loads this timer with a value of 012H to set the RAM refresh period.
2	This timer provides the speaker tone. Application programs can load different counts into this timer to generate various sound frequencies.

MEMORY

The iSBC 386AT board contains 512K bytes of RAM for system access and 64K bytes of ROM that contains the BIOS. It also contains two 32-bit expansion slots for extended memory boards. Figure 2-5 shows the memory map.

System Board RAM

The system board contains 512K bytes of RAM that the processor can access a full 32 bits at a time. Sixteen 64Kx4 chips are used for memory access, and eight 64Kx1 chips are used for the parity bits (with one parity bit for each byte of data). All of the RAM chips have 120ns access times.

The system board RAM is arranged into two 256K byte banks of memory. The memory addresses alternate between the banks (the first 32 bits of memory are in bank 0, the next 32 bits are in bank 1, the next 32 bits in bank 0, etc.). With this two-bank arrangement, the memory chips in one bank can recharge while the CPU accesses memory from the other bank. By overlapping the recharge of one bank with access in another, the CPU requires only one wait state to access memory in alternating banks. This would be the normal case for sequential memory accesses.

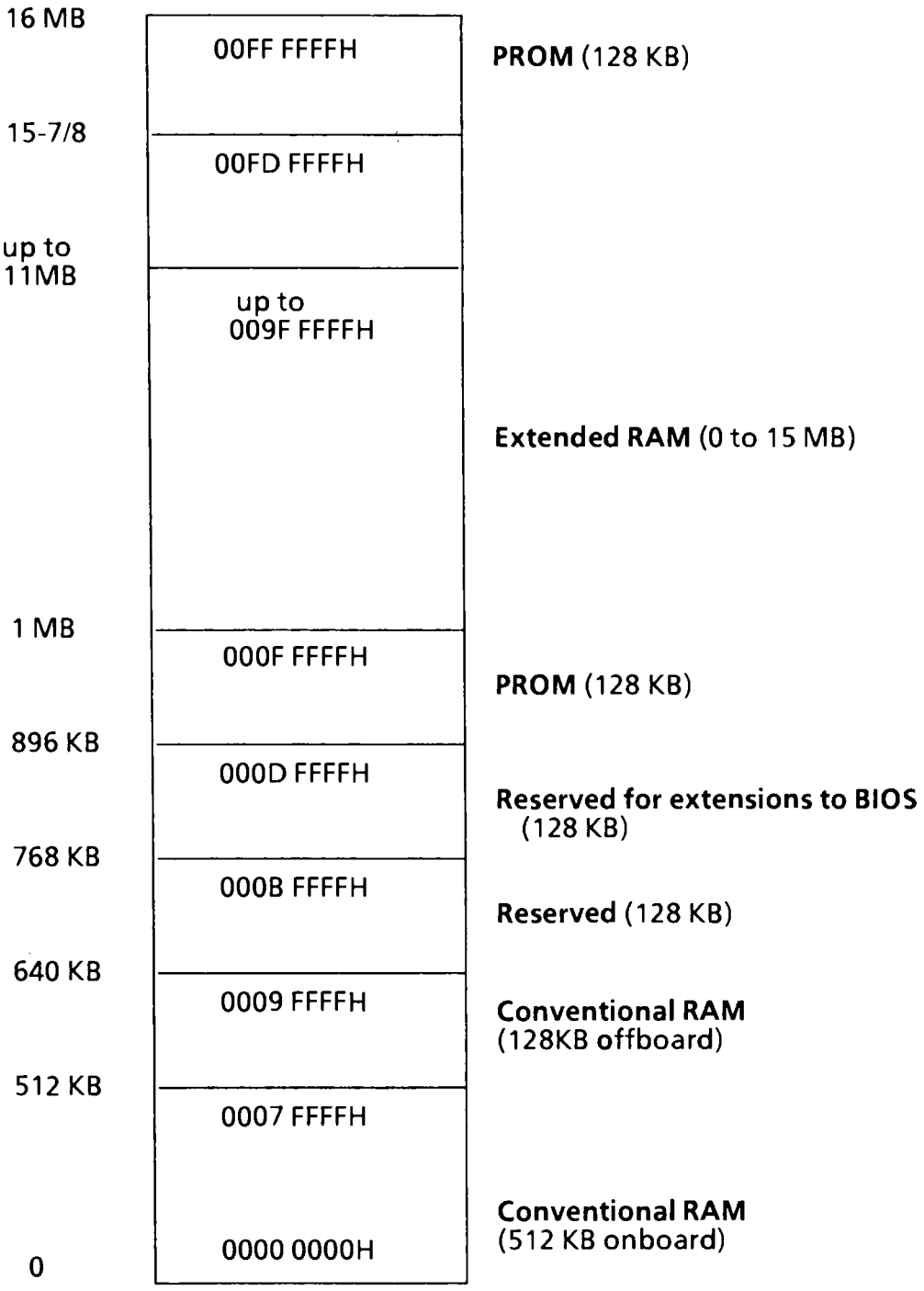

Figure 2-5. Memory Map

If the CPU makes consecutive memory accesses to the same bank, it must wait for the RAM to recharge. This performance penalty is approximately 2 wait states (125 ns).

Table 2-1 shows the access times for 32-bit read and write operations using the RAM on the system board. The table shows the times for both busy and nonbusy banks of memory. A busy bank is one to which the CPU has made consecutive accesses. When alternating between banks, the memory is nonbusy. For comparison, the table also lists the ROM access times and the access times for boards plugged into the 8-bit (PC-compatible) and 16-bit (AT-compatible) slots.

Table 2-1. System Board Memory Access Times

Operation	CPU Clock Cycles (16MHz)	Time (ns)
32-bit read of system board RAM		
Read from nonbusy bank	3	187.5
Read from busy bank	5	312.5
32-bit write of system board RAM		
Write to nonbusy bank	4	250
Write to busy bank	6	373.75
32-bit ROM read (two 16-bit accesses)	12	747.5
8-bit read/write of expansion slot		
8-bit (PC-compatible) slot	13[1]	812.5
16-bit (AT-compatible) slot	8[1]	500
16-bit read/write of expansion slot		
8-bit (PC-compatible) slot	25[1]	1562.5
16-bit (AT-compatible) slot	8[1]	500
32-bit read/write of expansion slot		
8-bit (PC-compatible) slot	50[1]	3125
16-bit (AT-compatible) slot	16[1]	1000

[1] Depending on the previous cycle, this access might take one additional clock cycle (62.5 ns).

32—bit Memory Boards

Two of the expansion slots on the iSBC 386AT board are 32-bit slots that can contain 32-bit memory boards. The iSBC 386AT board can recognize as much as 15M bytes of extended memory (starting at address 100000H and going to address 0FFFFFFH). Intel provides the iSBC® 386MEM020 and iSBC® 386MEM080 memory boards for these slots. Each MEM020 board contains 2M bytes of RAM and uses 256Kx1 chips. Each MEM080 board contains 8M bytes of RAM and uses 1Mx1 chips. On both boards, there is a parity bit for each byte of data.

Like the memory on the system board, the RAM on these boards is arranged into two banks of alternating addresses (see Figure 2-6). Thus the CPU can access the memory on these boards 32 bits at a time with only one wait state when accessing alternate banks. The access times for memory on the boards are the same as for the memory on the system board. Table 2-1 lists the times.

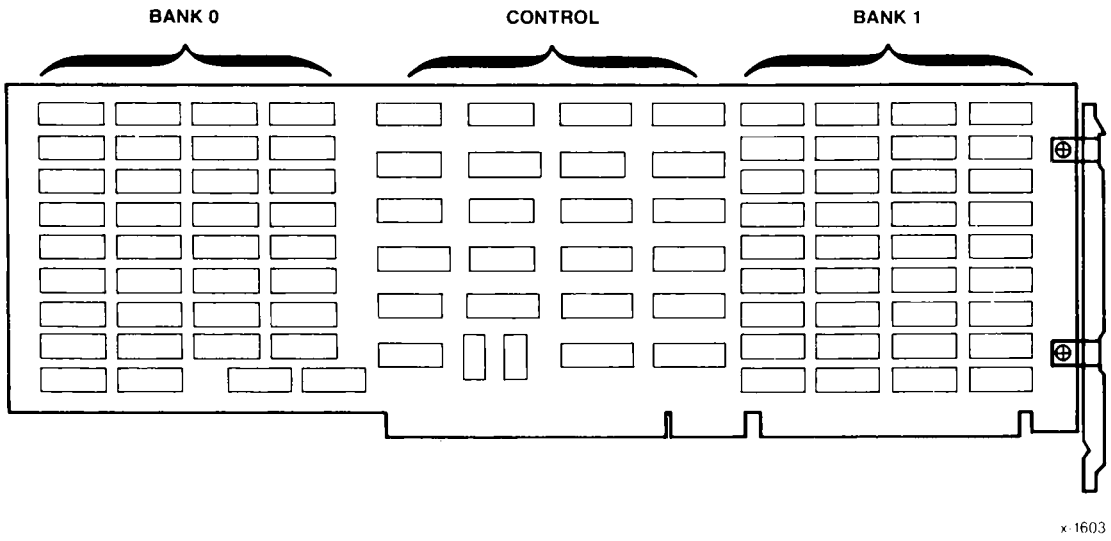

Figure 2-6. 32-Bit Memory Board

The jumpers on the system board are set at the factory to assume that two MEM020 boards will be used. If your system has a different configuration, you must change the memory jumpers on the system board. You can configure the system board for 0, 2, 4 or 10 megabytes on the 32-bit boards. The MEM080 board is shipped with a replacement PAL for U59; use the replacement if your system has 8 or 16 megabytes on the 32-bit boards. Refer to Chapter 3 for information on configuring the system board.

Memory to Fill 640 KB

To get the total 640K byte conventional memory recognized by DOS, you need to add 128K byte of offboard memory to supplement the 512K byte onboard. You can do this in one of two ways: with software, now on the market, that assigns 128K bytes from a 32-bit board to this area, or with a memory card such as an Intel AboveBoard in one of the AT-compatible 16-bit slots.

Extended and Expanded Memory

Sections of memory on the 32-bit boards or the 16-bit AboveBoard can be assigned as conventional, expanded, or extended. **Conventional** memory fills the 128K byte area from 512 to 640K bytes. **Expanded** memory is memory that adheres to the LIM (Lotus-Intel-Microsoft) specification, giving DOS applications a window in which to access more memory than the 640K bytes addressable in real mode. **Extended** memory is memory whose addresses begin at 1M byte and continue up to 16M byte. Extended memory can be accessed only when the processor is in protected mode.

Although most of the memory on the 32-bit boards is for extended memory, several software packages now on the market can assign part of the 32-bit boards to conventional and expanded memory. The software for the expanded memory emulates the LIM specification.

The Intel AboveBoard uses switch settings to assign memory to the conventional, expanded, and extended areas.

System ROM

The system board contains 64K bytes of ROM that comprise the system BIOS. This memory resides at the upper 64K bytes of address space in the first megabyte and is also mapped to the upper 64K bytes of the 16M byte space when the processor switches into protected mode. In protected mode, the BIOS can be accessed at either location.

The CPU accesses ROM through a local I/O bus 16 bits at a time. The system board will function correctly with ROM devices that have 250 ns access times or shorter. Table 2-1 lists the time and the number of processor clock cycles required to access the ROM.

The BIOS supplied with the iSBC 386AT board is compatible with the BIOS in the IBM AT, as long as programs that access the BIOS use software interrupts (as listed in Appendix B) and do not specify absolute memory locations. Programs that refer to absolute locations in the IBM AT BIOS will not function correctly when running on the iSBC 386AT board.

Unlike the IBM AT, the iSBC 386AT ROM does not contain code for the BASIC interpreter. Therefore, the IBM BASIC and BASICA interpreters will not run on this system board. Instead, users should acquire Microsoft's GW-BASIC interpreter for use in systems based on the iSBC 386AT board.

EXPANSION SLOTS

Expansion slots in IBM PC, XT, and AT computers and PC-compatibles have evolved in size, giving greater performance by expanding the number of bits of the data and address that can be accessed and sent through the bus. The PC and XT slots provide 8 data bits and 20 address bits. The AT slots provide 16 data bits and 24 address bits. The iSBC 386AT board contains both of these types of slots. In addition, it expands the bus further by supplying two slots with 32 data bits and 24 address bits. It contains eight expansion slots of the following types:

- Two 8-bit slots for use exclusively by PC-compatible expansion boards
- Four 16-bit slots for use by both AT-compatible and PC-compatible expansion boards
- Two 32-bit slots for use by both Intel 32-bit memory expansion boards and by PC-compatible expansion boards.

The two 8-bit slots can handle any expansion boards that work in the IBM PC or XT, including "drop cards" -- those boards that gain extra surface area by dropping down immediately after the 8-bit connector. The drop cards will not work in any 16-bit or 32-bit slot, because the longer slots interfere with the dropped portion of the boards.

The 16-bit and 32-bit slots will accept other kinds of 8-bit PC-compatible boards, but the 32-bit slots will not work with the 16-bit AT boards. The 32-bit slots are keyed to prevent 16-bit AT boards from being inserted.

CAUTION Even if these keys are removed, do not insert a 16–bit AT board in a 32–bit slot. It could damage the 80386.

Figure 2-7 identifies the slot locations on the iSBC 386AT board. Table 2-2 lists the type of slot and the number of bits it addresses.

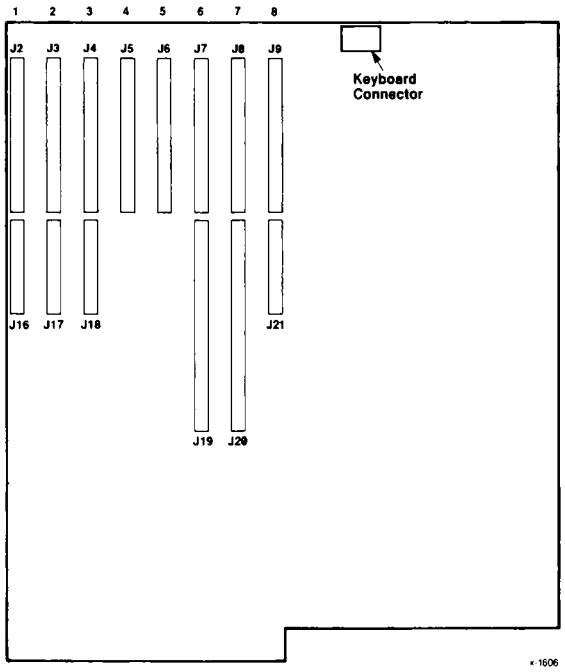

Figure 2-7. Expansion Slot Locations

Table 2-2. Expansion Slot Types

Slot #	Data Bits	Address Bits	Type
1 (J2/J16)	16	24	AT/PC (no drop cards)
2 (J3/J17)	16	24	AT/PC (no drop cards)
3 (J4/J18)	16	24	AT/PC (no drop cards)
4 (J5)	8	20	PC (including drop cards)
5 (J6)	8	20	PC (including drop cards)
6 (J7/J19)	32	24	32-bit/PC (no drop cards)
7 (J8/J20)	32	24	32-bit/PC (no drop cards)
8 (J9/J21)	16	24	AT/PC (no drop cards)

8-Bit Expansion Slots

J2 through J9 are the IBM PC- and PC XT-compatible 62-pin expansion slots. This 62-pin interface carries addresses to 1M byte and allows 8-bit data transfers. When 8-bit expansion cards occupy the slots, the slots run with 8MHz bus cycles. Slots J7 and J8 also combine with slot extensions J19 and J20 to form the 32-bit slots. When Intel MEM020 or MEM080 memory cards occupy the 32-bit slots, those slots run with 16MHz bus cycles. Table 2-1 lists the access times for these slots. Table 2-3 lists the pins for the 8-bit slots.

Table 2-3. Pin-Out Specification for 8-Bit Expansion Slot

I/O	SIGNAL	PIN #	B#	A#	PIN #	SIGNAL	I/O
-	GND	1	B1	A1	2	IOCHCK*	I
O	RSTDEV	3	B2	A2	4	D7	I/O
-	+5V	5	B3	A3	6	D6	I/O
I	IRQ9	7	B4	A4	8	D5	I/O
-	-5V	9	B5	A5	10	D4	I/O
I	DRQ2	11	B6	A6	12	D3	I/O
-	-12V	13	B7	A7	14	D2	I/O
I	SRDY*	15	B8	A8	16	D1	I/O
-	+12V	17	B9	A9	18	D0	I/O
-	GND	19	B10	A10	20	IOCHRDY	I
O	MEMW*	21	B11	A11	22	AEN	O
O	MEMR*	23	B12	A12	24	A19	I/O
O	IOWC*	25	B13	A13	26	A18	I/O
O	IORC*	27	B14	A14	28	A17	I/O
O	DACK3*	29	B15	A15	30	A16	I/O
I	DRQ3	31	B16	A16	32	A15	I/O
O	DACK1*	33	B17	A17	34	A14	I/O
I	DRQ1	35	B18	A18	36	A13	I/O
I/O	MEMREF*	37	B19	A19	38	A12	I/O
O	SYSCLK	39	B20	A20	40	A11	I/O
I	IRQ7	41	B21	A21	42	A10	I/O
I	IRQ6	43	B22	A22	44	A9	I/O
I	IRQ5	45	B23	A23	46	A8	I/O
I	IRQ4	47	B24	A24	48	A7	I/O
I	IRQ3	49	B25	A25	50	A6	I/O
O	DACK2*	51	B26	A26	52	A5	I/O
O	TC	53	B27	A27	54	A4	I/O
O	BUSALE	55	B28	A28	56	A3	I/O
-	+5V	57	B29	A29	58	A2	I/O
O	840SC	59	B30	A30	60	A1	I/O
-	GND	61	B31	A31	62	A0	I/O

16—Bit Expansion Slots

J16, J17, J18, and J21 are extensions to the 62-pin PC-compatible slots that increase addressability to 16M bytes and enable 16-bit data transfers. These 32-pin slots extend in-line with the PC slots to form 16-bit slots that are compatible with those available on the PC AT. The pin-out specification for this slot extension is given in Table 2-4. The 16-bit expansion slots operate with 8MHz bus cycles. Table 2-1 lists the access times for these slots.

Table 2-4. Pin-Out Specification for 16-Bit Expansion Slot Extension

I/O	SIGNAL	PIN #	D#	C#	PIN #	SIGNAL	I/O
I	FMEM*	1	D1	C1	2	IOBHE*	I/O
I	FIO*	3	D2	C2	4	P2A23	I/O
I	IRQ10	5	D3	C3	6	P2A22	I/O
I	IRQ11	7	D4	C4	8	P2A21	I/O
I	IRQ12	9	D5	C5	10	P2A20	I/O
I	IRQ15	11	D6	C6	12	P2A19	I/O
I	IRQ14	13	D7	C7	14	P2A18	I/O
O	DCCK0*	15	D8	C8	16	P2A17	I/O
I	DRQ0	17	D9	C9	18	MRDC*	I/O
O	DACK5*	19	D10	C10	20	MWTC*	I/O
I	DRQ5	21	D11	C11	22	D8	I/O
O	DACK6*	23	D12	C12	24	D9	I/O
I	DRQ6	25	D13	C13	26	D10	I/O
O	DACK7*	27	D14	C14	28	D11	I/O
I	DRQ7	29	D15	C15	30	D12	I/O
-	+5V	31	D16	C16	32	D13	I/O
I	SECMAST*	33	D17	C17	34	D14	I/O
-	GND	35	D18	C18	36	D15	I/O

High–Speed 32–Bit RAM Expansion Slots

Slots J7/J19 and J8/J20 are 86-pin slots available for high-speed, 32-bit RAM expansion cards. The Intel MEM020 and MEM080 memory boards fit in these slots. The slots operate at 16MHz, the same timing as the system board RAM. See Table 2-1 for the access times. Table 2-5 lists the pin-out specification for these slots.

Table 2-5. Pin-Out Specification for 32-Bit RAM Expansion Slot

I/O	SIGNAL	PIN #	PIN #	SIGNAL	I/O
O	CPUA3	1	2	EXPD0	I/O
O	CPUA4	3	4	EXPD1	I/O
O	CPUA5	5	6	EXPD2	I/O
-	GND	7	8	EXPD3	I/O
O	CPUA6	9	10	EXPD4	I/O
O	CPUA7	11	12	EXPD5	I/O
O	RA11	13	14	EXPD6	I/O
O	CPUA12	15	16	EXPD7	I/O
O	CPUA13	17	18	+5V	-
-	GND	19	20	EXPD8	I/O
O	CPUA14	21	22	EXPD9	I/O
O	CPUA15	23	24	EXPD10	I/O
O	CPUA16	25	26	EXPD11	I/O
O	CPUA17	27	28	EXPD12	I/O
O	CPUA18	29	30	EXPD13	I/O
-	+5V	31	32	EXPD14	I/O
O	CPUA19	33	34	EXPD15	I/O
O	CPUA20	35	36	NC	-
O	RA8	37	38	EXPD16	I/O
O	RA9	39	40	EXPD17	I/O
O	RA10	41	42	EXPD18	I/O

(continued)

Table 2-5. Pin-Out Specification for 32-Bit RAM Expansion Slot (continued)

I/O	SIGNAL	PIN #	PIN #	SIGNAL	I/O
-	GND	43	44	EXPD19	I/O
O	CPUA21	45	46	EXPD20	I/O
O	PI0_7	47	48	EXPD21	I/O
I	PO0_7	49	50	EXPD22	I/O
O	PI8_15	51	52	EXPD23	I/O
I	PO8_15	53	54	EXPD24	I/O
-	GND	55	56	EXPD25	I/O
O	PI16_23	57	58	EXPD26	I/O
I	PO16_23	59	60	EXPD27	I/O
O	PI24_31	61	62	EXPD28	I/O
I	PO24_31	62	63	EXPD29	I/O
O	CPUA22	64	65	EXPD30	I/O
-	GND	67	68	EXPD31	I/O
O	CPUA23	69	70	+5V	-
-	NC	71	72	LA19B0	O
-	NC	73	74	LA21B0	O
O	SLEB0*	75	76	LA19B1	O
O	SLEB1*	77	78	LA21B1	O
-	GND	79	80	WE_0	O
O	RMSEL0*	81	82	WE_1	O
O	RMSEL1*	83	84	WE_2	O
O	MEMREF	85	86	WE_3	O

Slots J7/J19 and J8/J20 can also contain standard 8-bit PC boards. However, if you insert one 62-pin PC-compatible card and one 2M byte 86-pin memory card in these two slots, you must place the memory card in slot J7/J19 and rejumper the system board accordingly.

For example, suppose all the slots on the iSBC 386AT board are filled except for slots J7/J19 and J8/J20. In addition, suppose you still need to insert a MEM020 board and a video adapter board into your computer. In this situation, you must insert the MEM020 board into slot J7/J19 and the video adapter board into slot J8/J20. Then you must jumper the iSBC 386AT board to specify that only one 2M-byte memory board is present. Chapter 3 describes the jumper settings.

I/O ADDRESS MAP

The 80386 CPU communicates with other devices via I/O ports. Table 2-6 lists the I/O port addresses used in the iSBC 386AT board. Table 2-7 lists the uses of the bits of I/O port 61H.

Table 2-6. I/O Address Map

Address (Hex)	Device
00-1F	DMA Controller--(Direct Memory Access) (8237A-5) (8-bit devices)
20-3F	Master PIC--Programmable Interrupt Controller (8259A)
40-5F	Timer/Counter (8254)
60, 64	Keyboard Controller (8742)
61	On-board Testing Registers
70,71	Clock/Calendar (MC146818AP) and NMI Mask
78	Reserved
80-9F	DMA Page Register (74LS612)
A0-BF	SlavePIC--Programmable Interrupt Controller (8259A)
C0-DF	DMA Controller--(Direct Memory Access) (8237A-5) (16-bit devices)
F0	Clear the Busy signal of the Math Coprocessor
F1	Math Reset
F8-FF	Math Coprocessor
278-27F	On-board printer port, if used as Port 2
2F8-2FF	On-board serial port, if used as Port 2
378-37F	On-board printer port, if used as Port 1
3F8-3FF	On-board serial port, if used as Port 1

Table 2-7. Bits in I/O Address 61H

Bit	Use	Read		Write	
		Bit = 0	Bit = 1	Bit = 0	Bit = 1
0	Speaker frequency	off	enabled	off	enabled
1	Speaker tone	off	enabled	off	enabled
2	DRAM Parity Test	off	enabled	off	enabled
3	I/O Channel Test (off-board parity)	off	enabled	off	enabled
4	Refresh cycle	not in process	in process	RESERVED	RESERVED
5	Speaker drive	off	on	RESERVED	RESERVED
6	I/O Channel Error (off-board parity)	no error detected	detected	RESERVED	RESERVED
7	DRAM Parity Error	no error detected	detected	RESERVED	RESERVED

INTERRUPT CONTROLLERS

The system board contains two 8259A Programmable Interrupt Controllers (PICs) that handle the hardware interrupts to the CPU. Table 2-8 lists the interrupt lines, their priorities, and the devices to which the interrupts are connected. If the interrupt line is accessible via an expansion slot, the table lists the signal and the type of slot containing the signal. An 8-bit slot is a 62-pin, PC-compatible slot. A 16-bit slot is an AT-compatible, 36-pin extension to the PC slot.

Table 2-8. Interrupt Lines

Interrupt Level	Source	Destination
NMI	Parity error	80386 NMI input
0	Timer Channel 0	Master PIC, Interrupt 0
1	Keyboard Controller	Master PIC, Interrupt 1
2	Slave PIC	Master PIC, Interrupt 2
3	P1 Connector, IRQ3	Master PIC, Interrupt 3
4	P1 Connector, IRQ4	Master PIC, Interrupt 4
5	P1 Connector, IRQ5	Master PIC, Interrupt 5
6	P1 Connector, IRQ6	Master PIC, Interrupt 6
7	P1 Connector, IRQ7	Master PIC, Interrupt 7
8	Clock/Calendar	Slave PIC, Interrupt 0
9	P1 Connector, IRQ9	Slave PIC, Interrupt 1
10	P2 Connector, IRQ10	Slave PIC, Interrupt 2
11	P2 Connector, IRQ11	Slave PIC, Interrupt 3
12	P2 Connector, IRQ12	Slave PIC, Interrupt 4
13	Math coprocessor busy signal (NPXBSY*)	Slave PIC, Interrupt 5
14	P2 Connector, IRQ14	Slave PIC, Interrupt 6
15	P2 Connector, IRQ15	Slave PIC, Interrupt 7

DMA CONTROLLERS

The system board contains two 8237A-5 DMA (direct memory access) controllers for byte and word DMA. These controllers operate at 4MHz (the CPU clock divided by four), yielding a DMA clock cycle of 250ns. All DMA transfer cycles consume 1250 ns (approximately 5 DMA clocks). In addition, with a 16MHz CPU clock, 375ns are spent acquiring control and 500ns relinquishing control of the expansion bus.

Table 2-9 lists the DMA channels and the corresponding signals on the PC and AT expansion slots where these channels can be accessed.

Table 2-9. DMA Channels

Channel		Device
DMA Controller U56 (Byte Transfers)	DMA Controller U57 (Word Transfers)	
0		P2 Connector, DRQ0
1		P1 Connector, DRQ1
2		P1 Connector, DRQ2
3		P1 Connector, DRQ3
	4	DMA Controller U56 into U57
	5	P2 Connector, DRQ5
	6	P2 Connector, DRQ6
	7	P2 Connector, DRQ7

REAL–TIME CLOCK

The system board contains an MC146818AP real-time clock component that maintains date and time information in addition to storing configuration information about the computer system.

Because the real-time clock uses CMOS technology, it consumes very little power and can be maintained for long periods of time with inexpensive batteries. (Batteries are not provided with the iSBC 386AT board.)

The real-time clock chip contains 14 bytes of clock and control registers. In addition, it contains 50 bytes of general purpose RAM. This general purpose RAM is used to store configuration information entered via the SETUP program (see Chapter 5). When battery-backed power is provided for the device, it maintains date, time, and configuration information even after the computer system is turned off.

J10 is a battery connector that enables you to provide battery-backed power for the real-time clock chip. The battery connector is a 1x4 header whose pin assignments are shown in Table 2-10.

The real-time clock chip requires a 6V, 1-ampere-hour lithium battery, which will last approximately two years with normal use.

Table 2-10. Battery Connector Pin-Out Specification

SIGNAL/FUNCTION	J10 PIN #
Battery (plus)	1
Key (pin removed)	2
Ground (minus)	3
Ground (minus)	4

KEYLOCK INTERFACE

Connector J23 provides the interface that enables you to connect an electrical interlock, such as a key-activated switch, to lock out the keyboard. The keylock connector is a 1x5 header whose pin assignments are shown in Table 2-11.

Table 2-11. Keylock Connector Pin-Out Specification

SIGNAL/FUNCTION	J23 PIN #
Power for LED power-on light	1
Key (pin removed)	2
Ground	3
Keylock	4
Ground	5

SPEAKER INTERFACE

Connector J22 provides an interface that enables you to connect a speaker for audible tone generation. The connector is a 1x4 header whose pin assignments are shown in Table 2-12.

Table 2-12. Speaker Connector Pin-Out Specification

SIGNAL/FUNCTION	J22 PIN #
SPKOUT Speaker Drive Out	1
Key (pin missing)	2
Ground	3
+5V	4

SERIAL COMMUNICATIONS PORT

Connector J12 on the 386AT board is a 2x13 (26-pin) header that provides the serial communication channel. This connector can map to either a DB25 (PC style) RS-232 connector or a DB9 (AT style) connector according to the pin-out specification listed in Table 2-13.

Table 2-13. Integral Serial Port Connector Pin-Out Specification

J12 PIN #	DB9 PIN #	DB25 PIN #	SIGNAL/FUNCTION
1	1	-	DCD Carrier Detect
2	6	6	DSR Data Set Ready
3	2	3	RXD Receive Data
4	7	4	RTS Request to Send
5	3	2	TXD Transmit Data
6	8	5	CTS Clear to Send
7	4	20	DTR Data Terminal Ready
8	9	22	RI Ring Indicator
9	5	7	Ground
24	-	25	MGTEST Mfg. Test
23	-	-	Key (pin missing)

PARALLEL PRINTER PORT

Connector J11 on the 386AT board is a 2x13 (26-pin) header that provides the integral parallel printer port. You can use a cable to carry this port off the system board and onto a standard DB25 connector using the IBM PC parallel printer pin-out standard. The typical mating connector on a Centronics-type printer is a 36-pin ribbon cable. The interface is TTL compatible. The pin-out specification for this connector is shown in Table 2-14.

Table 2-14. Integral Printer Port Connector Pin-out Specification

J11 PIN #	DB25 PIN #	36-PIN RIBBON CABLE PIN #	SIGNAL/FUNCTION
1	1	1	STROBE*
3	2	2	PRTD0 Data Bit 0
5	3	3	PRTD1 Data Bit 1
7	4	4	PRTD2 Data Bit 2
9	5	5	PRTD3 Data Bit 3
11	6	6	PRTD4 Data Bit 4
13	7	7	PRTD5 Data Bit 5
15	8	8	PRTD6 Data Bit 6
17	9	9	PRTD7 Data Bit 7
19	10	10	ACK* Acknowledge
21	11	11	BUSY
23	12	12	PE Paper End
25	13	13	SLCT Select
2	14	14	AUTOFDXT* Auto Feed
4	15	32	ERROR*
6	16	31	INIT* Initializing Printer
8	17	36	SLCTIN* Select Input
10,12,14, 16,18,22,24	18-25	19-30,33	Ground
-	-	17	Chassis ground
20	-	-	Key (pin missing)
26	-	-	No connection

POWER CONNECTORS

J13 and J14, the power connectors, are 12- and 6-pin connectors, respectively, that supply power to the system board and to the eight expansion slots. Each pin has a 7-amp current-carrying capacity. J13, the primary power connector, can carry a maximum of 28 amps at 5 volts. If additional power is required, up to 21 amps can be fed through J14. Chapter 4 discusses how to install the power connectors. Table 2-15 lists the power consumption of the iSBC 386AT board. Table 2-16 estimates the current requirements of an example system based on an iSBC 386AT board.

Table 2-15. Power Consumption of System Board

Voltage and Tolerance	Nominal Current	Watts
+5 v +/- 5%	5.2 A	26.00
+12 v +/- 10%	0.06A	0.72
-12 v +/- 10%	0.08A	0.96
TOTAL		27.68

Table 2-16. System Current Requirements

Use	+ 5v	+ 12v	-12v	-5v
Baseboard	5.2	0.06 (EIA)	0.08 (EIA)	--
8 Expansion slots	14.0	0.24 (EIA)	0.32 (EIA)	--
Flexible disk drive	0.8	1.0	--	--
Hard disk drive	2.0	2.1 (4.2 peak)	--	--
Streaming tape drive	4.0	1.8 (5.0 peak)	--	--
Unspecified	--	0.3	0.6	0.1
TOTAL AMPS 32.6	26.0	5.5 (10.5 peak)	1.0	0.1
TOTAL WATTS 206.5 W	130 W	66 W	12 W	0.5 W

Note: All values in table are in amps, unless specified.
Older option boards may require -5volts.

KEYBOARD CONNECTOR

J1, the keyboard connector, is a 5-pin DIN connector for the five signal pins of keyboards that are compatible with the IBM AT keyboard. The pin assignments are shown in Table 2-17. The cable shield contacts the case of J1, which is connected to the ground planes of the board with pins 6 and 7. Signal ground (pin 4) also connects to the ground planes of the board.

The RST* pin is jumper configurable on the system board. In one setting, this pin sends a reset pulse to the keyboard when a system reset occurs. In the other setting (the default configuration), the pin is electrically disconnected. Refer to Chapter 3 for the jumper settings.

The BIOS supports two kinds of keyboards: those that are compatible with the original IBM AT keyboard and those that are compatible with IBM's 101-key enhanced keyboard. Programs that have difficulty running with IBM's enhanced keyboard will have the same difficulties when running on the iSBC 386AT board.

Table 2-17. Keyboard Connector Pin-Out Specification

SIGNAL/FUNCTION	J1 PIN #
KEYCLK (clock)	1
KEYDAT (data)	2
RST*	3
Ground	4
+5V	5
Cable shield (connector case)	6,7

The pin numbers of the keyboard connector are as follows:

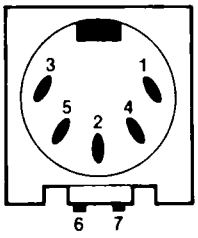

Figure 2-8. Keyboard Connector

KEYCLICK VOLUME

Whenever you press a key, the 386AT system board emits a clicking sound to give audio feedback for systems whose keyboards give little audio or tactile feedback themselves. This keyclick feature has eight volume levels that can be changed in a circular fashion. Holding down the **Ctrl** and **Alt** keys and pressing + on the numeric keypad increases the volume to the next highest level:

Ctrl-Alt-+ (on keypad)

When the volme is at the highest level, pressing the key sequence again changes to the least audible setting (not audible). At power-up, the volume is set to the second level.

CHAPTER 3
intel® CONFIGURING THE iSBC® 386AT BOARD

The 386AT board has several jumper blocks that are used to set the configuration of the board. The following configuration options can be selected:

- Monitor type
- Memory configuration
- ROM size
- Serial communications port
- Parallel printer port
- Printer acknowledge signal
- Keyboard reset
- Math coprocessor
- Real-time clock

This chapter describes how to set the various configuration options.

JUMPER LOCATIONS

Figure 3-1 shows the locations of all the jumper blocks on the 386AT board. Some pin numbers shown in this figure are silk-screened on the board so that the pins can be located easily. This chapter refers to the individual pins by these numbers. Appendix B summarizes all the options.

Setting board options involves placing the jumpers on the designated pins or sometimes removing a jumper altogether. The following sections describe the configuration options that can be set. An asterisk (*) marks the default jumper.

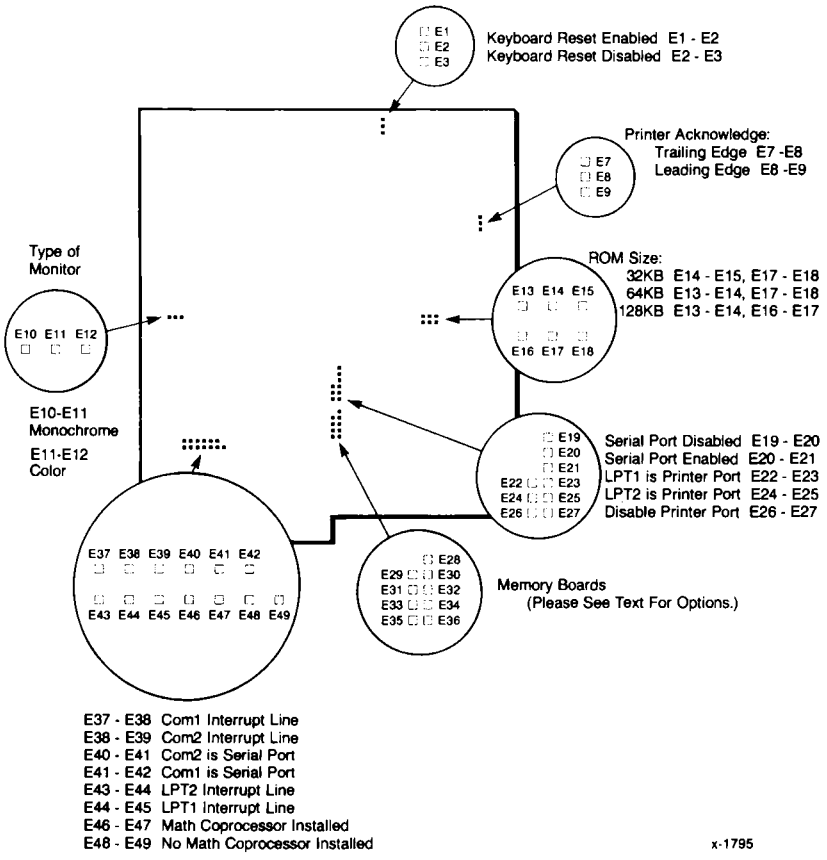

Figure 3-1. 386AT Jumper Locations

MONITOR TYPE

Jumper pins E10 through E12 should be set depending on whether you will be using a color or monochrome monitor. The options are:

Display	Install Jumper
color	E11-E12*
monochrome	E10-E11

The factory setting is E11-E12 for the color monitor. If your monitor is a monochrome, change the jumper to E10-E11.

MEMORY CONFIGURATION SELECTION

Jumper pins E28 through E36 identify the amount of memory installed. If you install 16-bit memory cards, such as the Intel AboveBoard, to fill conventional memory to its 640K limit or to add expanded memory, you do not need to change any jumpers on the iSBC 386AT board.

Figure 3-2 shows the jumpers for 512K byte and 2, 4, and 10 M bytes.

* default setting

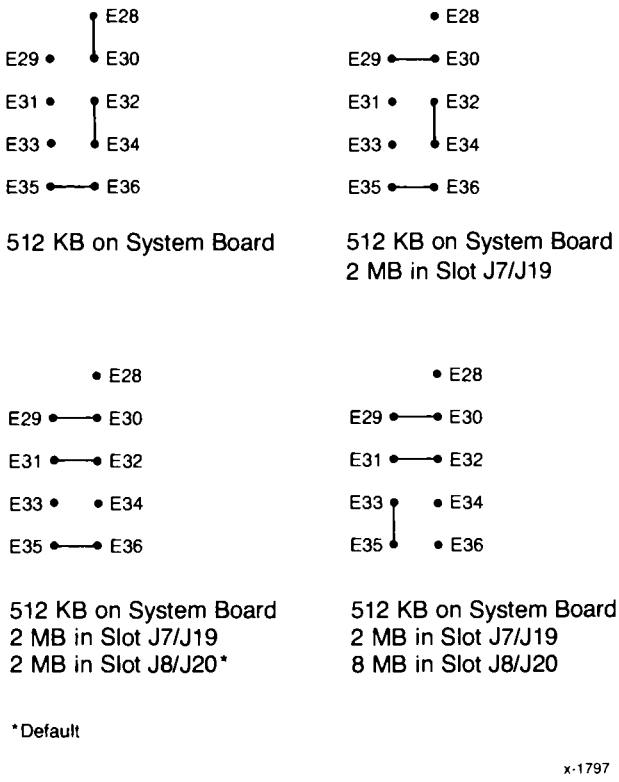

Figure 3-2. Jumper Options for Standard Board (512 KB, 2 MB, 4 MB, 10 MB)

The factory setting has 512K byte of memory on the system board and 2M bytes of extended memory in each of the 32-bit slots (slots J7/J19 and J8/J20). This option assumes that two of Intel's MEM020 memory boards are installed. If you have fewer 32-bit memory boards installed, or a different amount of memory on the boards, change the jumpers to match the memory installed.

If you want to use two 8M byte memory boards or one 8M byte board without a 2M byte board, you need to change the jumpers and replace one PAL device. The 8M byte boards ship with the PAL device and instructions for changing it. Figure 3-3 shows the jumper settings for this option.

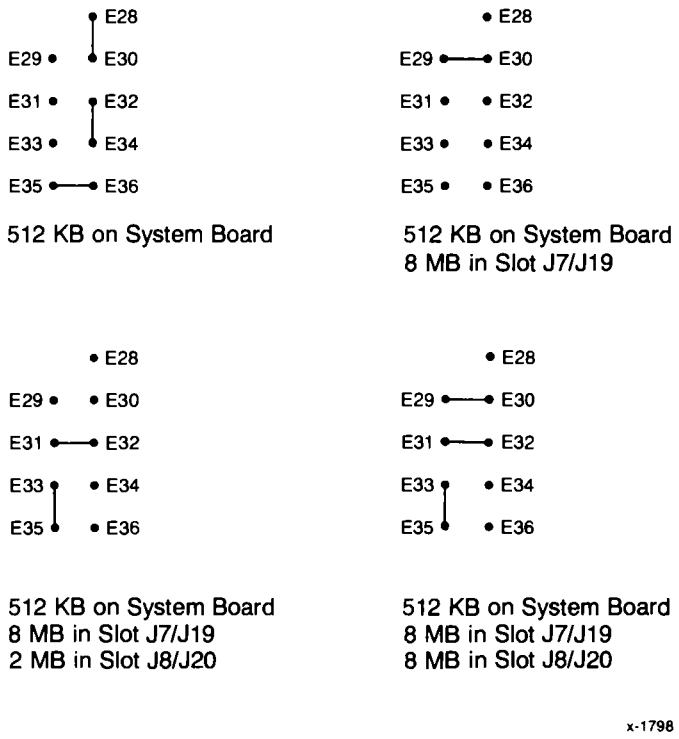

Figure 3-3. Jumper Options for 16 MB RAM Option (512 KB, 8 MB, 10 MB, 16 MB)

ROM SIZE SELECTION

Jumper pins E13 through E18 identify the size of ROMs used. Figure 3-4 shows the jumper settings for the three options.

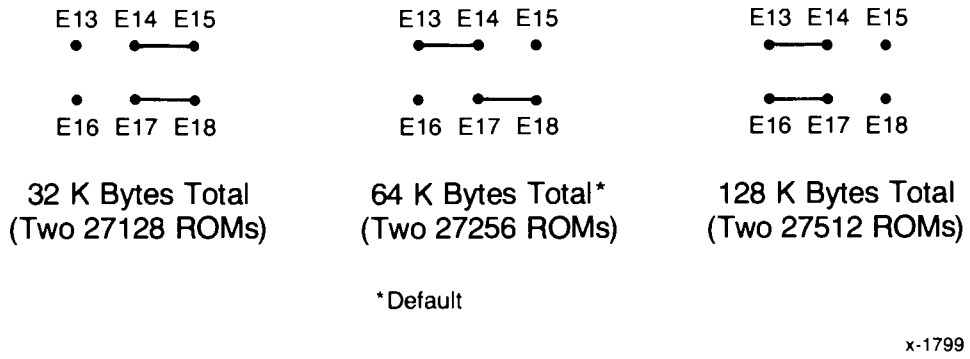

Figure 3-4. Jumpers for ROM

SERIAL COMMUNICATIONS PORT SELECTION

Selecting the serial communications port on the 386AT board involves three sets of jumpers: one set to select the port number, one set to enable or disable the port, and one set to select the interrupt request (IRQ) line used with the port.

Jumper pins E40 through E42 select the port number. The serial port can be configured as either COM1 or COM2.

Option	Install Jumper
Select COM1	E41-E42*
Select COM2	E40-E41

Jumper pins E19 through E21 enable or disable the serial port, regardless of the one selected.

Option	Install Jumper
Disable serial port	E19-E20
Enable serial port	E20-E21*

Pins E37 through E39 select the interrupt request line. This setting must correspond to the serial communications port you chose.

IRQ Line	Install Jumper
IRQ4 (COM1)	E37-E38*
IRQ3 (COM2)	E38-E39

The factory setting is COM1 enabled (E41-E42, E20-E21, and E37-E38). If you want to select COM2 or disable the serial port, set the jumpers accordingly.

* default setting

PARALLEL PRINTER PORT SELECTION

Selecting the parallel printer port involves two sets of jumper blocks, one to select the port and one to select the interrupt request (IRQ) line used with the port. Jumper pins E22 through E27 select the port. Jumper pins E43 through E45 select the interrupt request line.

Jumper pins E22 through E25 select the number of the 386AT board's parallel printer port and enable the port. Jumper pins E26 and E27 disable the port. The parallel port can be configured as either LPT1 or LPT2.

CAUTION Only one of the following three jumper settings is permitted. Installing jumpers in more than one position could damage the system board.

Option	Install Jumper
Select LPT1	E22-E23
Select LPT2	E24-E25*
Disable printer port	E26-E27

The factory setting is LPT2 (E24-E25). Move the jumper as indicated to select LPT1 or to disable the printer port.

Jumper pins E43 through E45 select the interrupt request line that will be used with the printer port. This jumper setting must correspond to the parallel printer port you chose.

IRQ Line	Install Jumper
IRQ7 (LPT1)	E44-E45
IRQ5 (LPT2)	E43-E44*

The factory setting is IRQ5 (E43-E44). If you selected printer port LPT1, move the jumper to E44-E45 to select IRQ7.

* default setting

PRINTER ACKNOWLEDGE SIGNAL

Jumper pins E7 through E9 select whether the leading or trailing edge of the printer acknowledge signal is used to trigger the interrupt line selected above.

Option	Install Jumper
Leading edge of the acknowledge	E8-E9
Trailing edge of the acknowledge	E7-E8*

The factory setting is to use the trailing edge of the acknowledge signal (E7-E8). Check your printer instructions to determine which acknowledge signal is needed. If necessary, move the jumper to E8-E9 to select the leading edge.

KEYBOARD RESET

Jumper pins E1 through E3 select whether the system sends a reset signal (RST* signal) to the keyboard when a system reset occurs. Enabling the keyboard reset might be necessary for keyboards that are not compatible with the IBM AT keyboard. The options are:

Option	Install Jumper
Keyboard reset enabled	E1-E2
Keyboard reset disabled	E2-E3*

The factory setting is E2-E3 to disable the keyboard reset. To enable the keyboard reset signal, move the jumper to E1-E2.

* default setting

MATH COPROCESSOR

Jumper pins E46 through E49 select whether you have a math coprocessor installed on the 386AT board. The math coprocessor can be either an 80387 math coprocessor or an SBCMATH module. The SBCMATH module is a special circuit board that contains an 80287 math coprocessor, circuitry that enables the 80287 to emulate the 80387, and pins that allow the board to plug into the 80387 socket.

CAUTION Before inserting an 80387 in the board, read the instructions in Chapter 4. If the chip is inserted incorrectly, the chip and the system will be damaged.

CAUTION Only one of the following two jumper settings is permitted. Installing jumpers in both positions could damage the system board.

Option	Install Jumper
Math coprocessor installed	E46-E47
Math coprocessor not installed	E48-E49*

The factory setting is E48-E49, indicating that the coprocessor is not installed. If you install a math coprocessor on the 386AT board, remove the jumper from E48-E49 and move it to E46-E47.

* default setting

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CHAPTER 4
INSTALLATION

This chapter describes the equipment you need to create a working system around the iSBC 386AT board. It also describes how to install Intel's memory boards (2M byte MEM020 and 8M byte MEM080) into the 32-bit expansion slots and how to install the math coprocessor.

BUILDING A SYSTEM

To build a system based on the iSBC 386AT board, you must obtain the following equipment:

- A chassis to hold all the system components. The iSBC 386AT board measures 12.0 inches by 13.8 inches (304.8 by 350.5 mm), so a chassis similar in size to the one used with the IBM AT is appropriate. The holes for mounting the iSBC 386AT board to the chassis are in the same locations as on the IBM AT system board.

- A multi-voltage power supply similar to the one used in the IBM AT. Appendix A shows the pin-out of the power supply connectors. Because of the high-performance and high-capacity equipment that is expected to be used in the system, Intel recommends that you use at least a 185 watt supply for a minimum system.

- A 6V battery to sustain the clock/calendar chip. Chapter 2 lists the pin-out for the battery connector.

- An 8 ohm speaker to provide sound capabilities for your system. The pin-out for the speaker connector is listed in Chapter 2.

- A cable from the system board's serial communication port to an IBM-compatible DB25 or DB9 male connector. The pin-out for the serial port is listed in Chapter 2.

- A cable from the system board's parallel printer port to an IBM-compatible DB25 female connector. The pin-out for the parallel port is listed in Chapter 2.

- A fixed disk/diskette controller.

- At least one diskette drive (360K or 1.2M).
- A fixed disk, if needed. Refer to Chapter 5 for a list of the drive types that the BIOS supports.
- Cables between the fixed disk/diskette controller and the drives.
- A video controller and corresponding monitor.
- An AT-compatible keyboard. A PC- or XT-compatible keyboard will not work with this board.
- Additional memory, if necessary. The iSBC 386AT board contains 512K bytes of RAM as standard equipment. To fill conventional memory to its 640K maximum, use a 32-bit memory board (MEM020 or MEM080) or a 16-bit memory board such as the Intel AboveBoard. Use the remaining memory on the add-in board(s) for expanded or extended memory, as described in Chapter 2. The next section in this chapter describes how to install the 32-bit boards.
- A math coprocessor, if needed. The iSBC 386AT board has a socket for an 80387 coprocessor, but you can use Intel's 80287-based SBCMATH module. A later section in this chapter describes how to install the math coprocessor and the SBCMATH module.
- MS-DOS version 3.10 or later, or PC-DOS version 3.10 or later.

INSTALLING INTEL MEMORY BOARDS

The 80386 processor can access memory 32 bits at a time. To enable 32-bit memory accesses, the iSBC 386AT board provides a full 32-bit data path for the 512K bytes of on-board memory. In addition, it provides two expansion slots that also supply data 32 bits at a time to the processor. The 32-bit expansion slots are slots J7/J19 and J8/J20.

To take advantage of the 32-bit data path, you must install Intel's 2M-byte MEM020 or 8M-byte MEM080 memory boards in these slots. If you install only one 32-bit memory board, you must place it in slot J7/J19. If you install two boards, place them in slots J7/J19 and J8/J20.

There are no switches or jumpers to set on the memory boards. However, you need to set jumpers E28 through E36 on the iSBC 386AT board to identify the amount of 32-bit memory in your system. These settings are listed in Chapter 3.

The memory addresses of these boards are set automatically depending on the slots in which the boards are inserted. The memory board in slot J7/J19 automatically starts the extended memory at 1M (100000H). If two memory boards are installed, the memory on the second board (slot J8/J20) is located immediately after the memory on the first.

CAUTION Use the replacement PAL shipped with the MEM080 board only in a system that has 8M or 16M byte of RAM.

INSTALLING THE MATH COPROCESSOR

Socket U54 on the iSBC 386AT board is available for inserting a math coprocessor chip. This socket can contain either an 80387 chip or Intel's 80287-based SBCMATH module. The SBCMATH module contains an 80287 mounted on a special card with a connector that fits into the 80387 socket.

If you install either of the math coprocessors, you must set jumpers E46 through E49 on the iSBC 386AT board to indicate that a math coprocessor is present. The jumper positions are as follows:

Option	Jumper
Math coprocessor installed	E46-E47
Math coprocessor not installed	E48-E49*

The factory setting is E48-E49, indicating that the coprocessor is not installed. When you install either math coprocessor, remove the jumper from E48-E49 and move it to E46-E47.

CAUTION Installing jumpers in both positions could damage the system board. Ensure that a jumper is on E46–E47 or on E48–E49, not on both.

Installing the 80387 Math Coprocessor

To install an 80387 math coprocessor, align the chip with socket U54, and make sure that pin 1 of the math coprocessor chip corresponds to pin 1 of the socket. Pin 1 of socket U54 is labeled. Pin 1 of the 80387 is designated with a dot on the corner of the chip or with the corner of the chip cut off. Then press the 80387 into socket U54. Figure 4-1 shows the location of pin 1 for the 80386 and for the 80387.

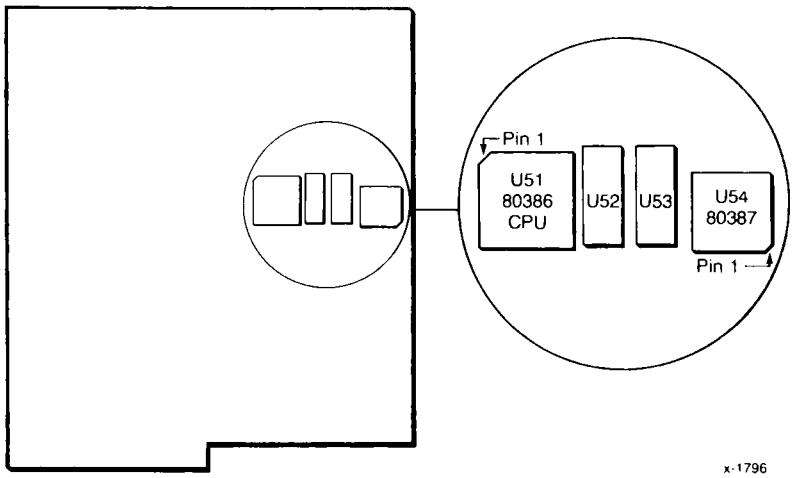

Figure 4-1. Location of Pin 1 on the 80387

CAUTION

If the 80387 is not installed correctly, the 80387 and the system will be damaged. Note that the 80387 and 80386 have different orientations.

Installing the SBCMATH Module

The SBCMATH module contains an 80287 math coprocessor and has pins designed to fit into the 80387 socket U54. To install the SBCMATH module, first align the module as shown in Figure 4-2. In the correct alignment, the long edge of the SBCMATH module is closest to the edge of the iSBC 386AT board and parallel to it. In this alignment, pin 1 of the 80287 chip corresponds to pin 1 of socket U54.

Once the SBCMATH module is aligned, install the stress-relief standoffs and press the SBCMATH module into socket U54.

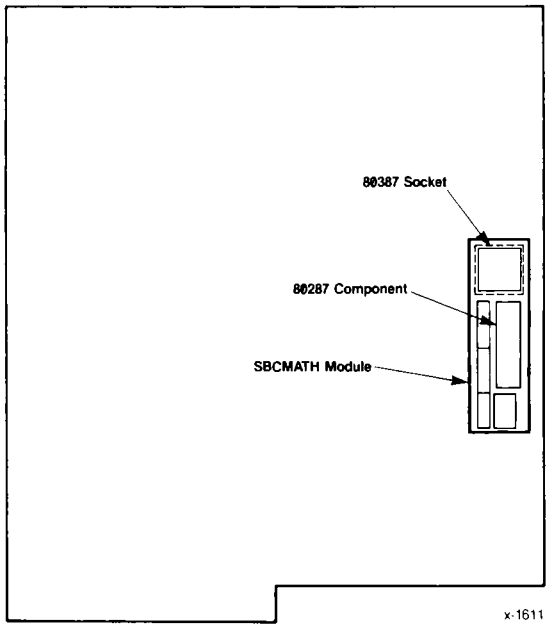

Figure 4-2. Installing the SBCMATH Module

INSTALLING THE POWER CONNECTORS

Figure 4-3 shows the pin assignments, keys (protrusions), and standard wire colors for power connectors J13 and J14.

When using an AT-compatible power supply, plug both of the power supply's connectors into J13. Pins 1 through 6 of one connector (the one that supplies +12V, -12V, SYSRST*, and +5V) should match pins 1 through 6 of J13. Pins 1 through 6 of the other connector (the one that supplies +5V, -5V and ground) should match pins 7 through 12 of J13.

Some power supplies have a third plug with three 5V pins and three ground pins. Pin 1 of this third power plug should match pin 1 of J14, which is marked on the board.

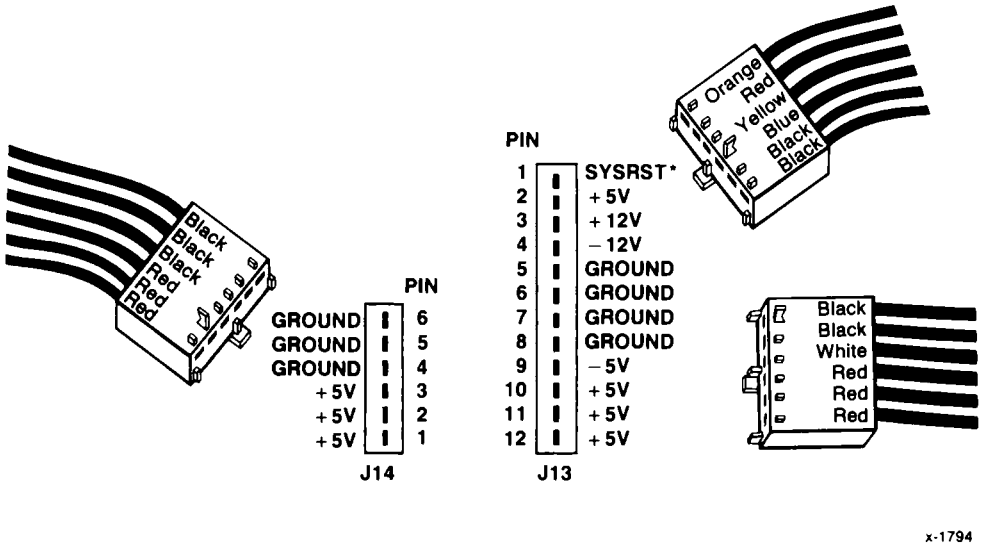

Figure 4-3. Power Connector Pins

CAUTION For the 5 volt supply to the system and adapter boards, do not exceed 28 amps on J13 or 41 amps when using both J13 and J14. Each power supply pin can handle a maximum of 7 amps.

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CHAPTER 5
SETUP PROGRAM

With the iSBC 386AT product, the OEM receives a diskette containing the file SETUP.COM. This file is a program that stores system configuration information in the battery-backed memory of the real-time clock chip. The configuration information takes effect when you restart the system.

The following information is stored in the real-time clock/CMOS chip and can be set with the SETUP program:

- Date and time
- Number and capacity of diskette drives
- Number and type of fixed disks
- Amount of base memory
- Amount of expansion (extended) memory
- Type of primary video adapter

You should run the SETUP program when you configure a system for the first time, when you change the battery, and whenever you change any of the items listed above. If you don't run SETUP the first time you use the system, you will get an invalid configuration message. If you press F1 after getting this message, the system boots with information for a minimum default system and may not see all the installed memory.

This section provides step-by-step instructions for using the SETUP program to configure the iSBC 386AT-based system.

PREPARING THE SYSTEM TO RUN SETUP

The SETUP program runs under the control of DOS. Therefore, you must load DOS before invoking SETUP. Refer to the DOS manual for instructions on loading DOS.

RUNNING THE SETUP PROGRAM

The SETUP program performs the following operations:

- Displays date, time, and a series of screens that list current values for system options.
- Allows you to accept current values or enter different values for time, date, and system options.
- Instructs you to re-boot the system so that the settings take effect.

When you turn on the system before you have run SETUP the first time, the BIOS (Basic Input/Output System) sends a message that the configuration information is not valid, and requests that SETUP be run. Thereafter when the system is booted, it verifies the information you entered previously and issues a message if the data does not agree with actual system options.

CAUTION It is essential to configure your system with the correct fixed disk drive type because the system cannot independently verify the fixed disk drive type. Specifying an incorrect drive type could damage the disk.

To run SETUP, load DOS, insert the SETUP diskette in drive A, and type:

`A:SETUP` (and press <**Enter**>)

The following screen appears:

```
Phoenix Technologies Ltd.
Configuration Setup Program  Ver x.y
(c) Copyright 198x

This program is used to store system
configuration information into battery
backed memory in your computer.  It is
necessary to run this program when
any memory, disk drives, or monitors
are added or removed from your system,
or to set the battery maintained time
or date.

Press <enter> to continue ...
```

Setting the Date and Time

Press <**Enter**>. SETUP displays the date and time as shown in the next screen:

```
The battery maintained date is:

00/00/1900

The battery maintained time is:

00:00:51

Are these correct?
[Y or N]
```

If the date and time are correct, type **Y** and press <**Enter**> to indicate yes. SETUP displays current settings for all system options as described in the "Setting the Current Option" section of this chapter.

If the time or date is incorrect, type **N** and press <**Enter**> to indicate no. SETUP displays the following message:

```
The battery maintained date is:

00/00/1900

If this date is not correct, type
the correct date using numbers
separated by slashes.

For example type        05/21/1985 <enter>
meaning May 21, 1985.

?
```

Enter the correct date in the month/day/year format (mm/dd/yy or mm-dd-yy). SETUP then prompts you to enter the correct time in the hour:minute:second format (hh:mm:ss). It is not necessary to enter the seconds.

Setting the Current Options

When the date and time information has been entered correctly, SETUP displays the current option settings as in the following example:

```
The following information is required
for correct operation of your computer.

The current settings of your options:

Diskette Drive A:          is       1.2M
Diskette Drive B:          is       360K
Fixed Disk Drive C:        is       Type 7
Fixed Disk Drive D:        is       NOT INSTALLED
System Base Memory         is       512K
Extended Memory            is       0K
Prime Video Adapter        is       EGA
Math Coprocessor           is       80387

Are these options correct
(Reply Y or N then <enter>)

?
```

If the information is correct, type **Y** and press <**Enter**>. Then turn to the "Rebooting the System" section of this chapter for further information.

If the current option settings are not correct, type **N** and press <**Enter**>. Then continue with the "SETUP Option Screens" section.

SETUP Option Screens

If your system is not configured as indicated in the current options screen, SETUP displays the first in a series of screens that list current setting choices for each option. At each option, SETUP asks:

```
Is this correct (Y or N).
```

To change any setting, type **N** and press <**Enter**>. SETUP prompts for the necessary information. If you type **Y** and press <**Enter**>, SETUP continues with the next screen.

Diskette Drive Types

The first option screen asks for information on diskette drive types as follows:

```
Your diskette drive types are set to

Diskette Drive A:   is   1.2M
Diskette Drive B:   is   360K

Are these drive types correct  (Y or N)
?
```

Type **Y** and press <**Enter**> to accept the current information. Type **N** and press <**Enter**> to change the drive types. If you type **N**, SETUP displays the following prompts:

```
What type is diskette drive A:

          0 if this drive is not installed
          1 if capacity is 360 kilobytes
          2 if capacity is 1.2 megabytes
          3 if capacity is 720 kilobytes
          4 if capacity is 1.44 megabytes

(0,1,2,3 or 4) ?
```

Respond to the prompt with the correct type number and press <**Enter**>. SETUP then repeats the prompt for drive B. Diskette types 1 and 2 are 5.25-inch diskette drives; types 3 and 4 are 3.5-inch drives.

Fixed Disk Drive Types

After you correct the diskette settings as necessary, SETUP displays the following screen:

```
Your fixed disk types are set to

Fixed Disk Drive C: is   TYPE 7
Fixed Disk Drive D: is   NOT INSTALLED

Are these drive types correct  (Y or N)
?
```

If listed information is correct, type **Y** and press <**Enter**> to accept it. Type **N** and press <**Enter**> to enter different fixed drive type information. In this case, SETUP issues the following prompts:

```
How many fixed disk drives are installed
in your system ?
(0, 1, or 2) ?
```

Enter the number of fixed disk drives in your system and press <**Enter**>.

Next, SETUP requests the information for the first drive, as follows:

```
What type is fixed drive C:

 (Enter drive type indicated by label
  affixed to drive)
For a list of disk types supported by
your computer enter a ? at prompt


(1 to 47 or ?)?
```

If you know the drive type associated with drive C, type that number and press <**Enter**>. Table 5-1 lists the drive types for some drives that work with the system board. Consult your vendor's reference manual and Table 5-2 to confirm these values.

Table 5-1. Types for Example Fixed Disks

VENDOR	MODEL (MB)	SIZE	TYPE
Fujitsu	M223SAS	20	13
Fujitsu	B03B-4695	20	13
Fujitsu	MKF3FB	86.5	37
Maxtor	XT1140	140	9
Rodine	203E	90	3
Seagate	ST225	20	2
Seagate	ST4038	33	8
Toshiba	MKM0353E	86	37
Quantum	Q540	40	7

If you do not know the drive type, type **?** and press <**Enter**>. SETUP will display a list of drive types and the specifications associated with each drive type. By comparing this display with the specifications in your disk drive's hardware reference manual, you will be able to pick the correct drive type. Table 5-2 lists the drive type specifications you will see.

Table 5-2. Fixed Disk Types

TYPE	CYLIN-DERS	HEADS	PRE-COMP	LAND ZONE	SEC-TORS	SIZE MEGS
1	306	4	128	305	17	10.1
2	615	4	300	615	17	20.4
3	615	6	300	615	17	30.6
4	940	8	512	940	17	62.4
5	940	6	512	940	17	46.8
6	615	4	-1	615	17	20.4

(continued)

Table 5-2. Fixed Disk Types (continued)

TYPE	CYLIN-DERS	HEADS	PRE-COMP	LAND ZONE	SEC-TORS	SIZE MEGS
7	462	8	256	511	17	30.6
8	733	5	-1	733	17	30.4
9	900	15	-1	901	17	112.0
10	820	3	-1	820	17	20.4
11	855	5	-1	855	17	35.4
12	855	7	-1	855	17	49.6
13	306	8	128	319	17	20.3
14	733	7	-1	733	17	42.5
16	612	4	0	663	17	20.3
17	977	5	300	977	17	40.5
18	977	7	-1	977	17	56.7
19	1024	7	512	1023	17	59.5
20	733	5	300	732	17	30.4
21	733	7	300	732	17	42.5
22	733	5	300	733	17	30.4
23	306	4	0	336	17	10.1
25	615	4	0	615	17	20.4
26	1024	4	-1	1023	17	34.0
27	1024	5	-1	1023	17	42.5
28	1024	8	-1	1023	17	68.0
29	512	8	256	512	17	34.0
30*	615	2	615	615	17	10.2
35	1024	9	1024	1024	17	76.5
36	1024	5	512	1024	17	42.5
37	830	10	-1	830	17	68.8
38	823	10	256	824	17	68.3
39	615	4	128	664	17	20.4
40	615	8	128	664	17	40.8
41	917	15	-1	918	17	114.1
42	1023	15	-1	1024	17	127.3
43	823	10	512	823	17	68.3
44	820	6	-1	820	17	40.8
45	1024	8	-1	1024	17	68.0
46	925	9	-1	925	17	69.1
47**	699	7	256	700	17	40.6

* This type is available only on BIOS versions 3.06 or later.

** On BIOS versions earlier than 3.06, this type is:

47	1024	5	-1	1024	17	42.5

The column headings in Table 5-2 are the same column headings you will see when SETUP displays the drive type information. These headings have the following meanings:

TYPE	The drive type number that you must enter to specify the type of fixed disk you have.
CYLINDERS	The number of cylinders in the drive.
HEADS	The number of heads in the drive
PRECOMP	The number of the cylinder at which the drive begins performing write precompensation. A value of 0 means precomp will start at 0; a value of -1 means precomp will not happen.
LAND ZONE	The number of the cylinder used for the head landing zone.
SECTORS	The number of sectors per track.
SIZE MEGS	The size of the formatted drive in megabytes.

You can use the SETUP drive-type list in two ways:

- If your fixed drive has a label that specifies a type code (1-47), use the list to confirm that SETUP supports your drive.
- If your fixed drive does not specify a type code, use the information on the list and your drive specifications to identify the drive type.

For example, you can verify that your drive is a type 7 if it has the following parameters:

Cylinders	462
Heads	8
Precompensation Cylinder	256
Landing Zone	511
Sectors per track	17
Size (in megabytes)	30.6

NOTE If the list does not include your fixed–disk type, you can still use SETUP to set system options, but you won't be able to use the full capacity of the fixed disk. In this case, choose the disk type that most closely matches the specifications for your fixed disk, making sure that the number of cylinders, number of heads, and disk capacity are less than or equal to your disk's values. Of course, picking a disk type for a smaller disk means that your disk will have a smaller usable capacity.

After you compare the SETUP display with the specifications for your fixed disk, enter the correct drive type and press <**Enter**>. The SETUP program then requests the same information for any other fixed disks in your system.

Base Memory

After you enter the fixed disk information, SETUP displays a screen similar to the following one:

```
Base memory is that memory positioned
so as to be available to MS-DOS programs.

System Base Memory is  512K

Is this correct  (Y or N) ?
```

As the display mentions, base memory is the amount of memory available to DOS. Base memory is sometimes called conventional memory. It is limited to a maximum of 640K bytes.

If the listed amount of base memory is correct, type **Y** and press <**Enter**>.

If your system contains a different amount of base memory, type **N** and press <**Enter**>. SETUP then issues the following prompt:

```
What is the total size of the base
memory installed in your system in K
   (Standard configurations are
    256, 512, or 640)
?
```

In response, enter the base memory size and press <**Enter**>.

Extended Memory

After you correct the base memory information if necessary, SETUP displays the following information concerning extended memory:

```
Extended memory is positioned at
a high address and available to MS-DOS
only for special functions.

Extended Memory is  OK

Is this correct  (Y or N) ?
```

When using the term *extended memory*, the SETUP program is referring to memory whose address range begins at 1 megabyte. Figure 5-1 illustrates the locations of extended memory, conventional (or base) memory, and expanded memory.

If the information listed on the screen is correct, type **Y** and press <**Enter**>.

If your system contains a different amount of extended memory than listed, type **N** and press <**Enter**>. The SETUP program prompts for the size, as follows:

```
What is the total size of the extended
memory installed in your system in K
   (Standard configurations are
    512, 1024, ... )
?
```

In response, enter the correct memory size.

NOTE Some memory expansion cards add memory in increments of 256K bytes. SETUP is NOT restricted to incremental sizes and accepts any memory size.

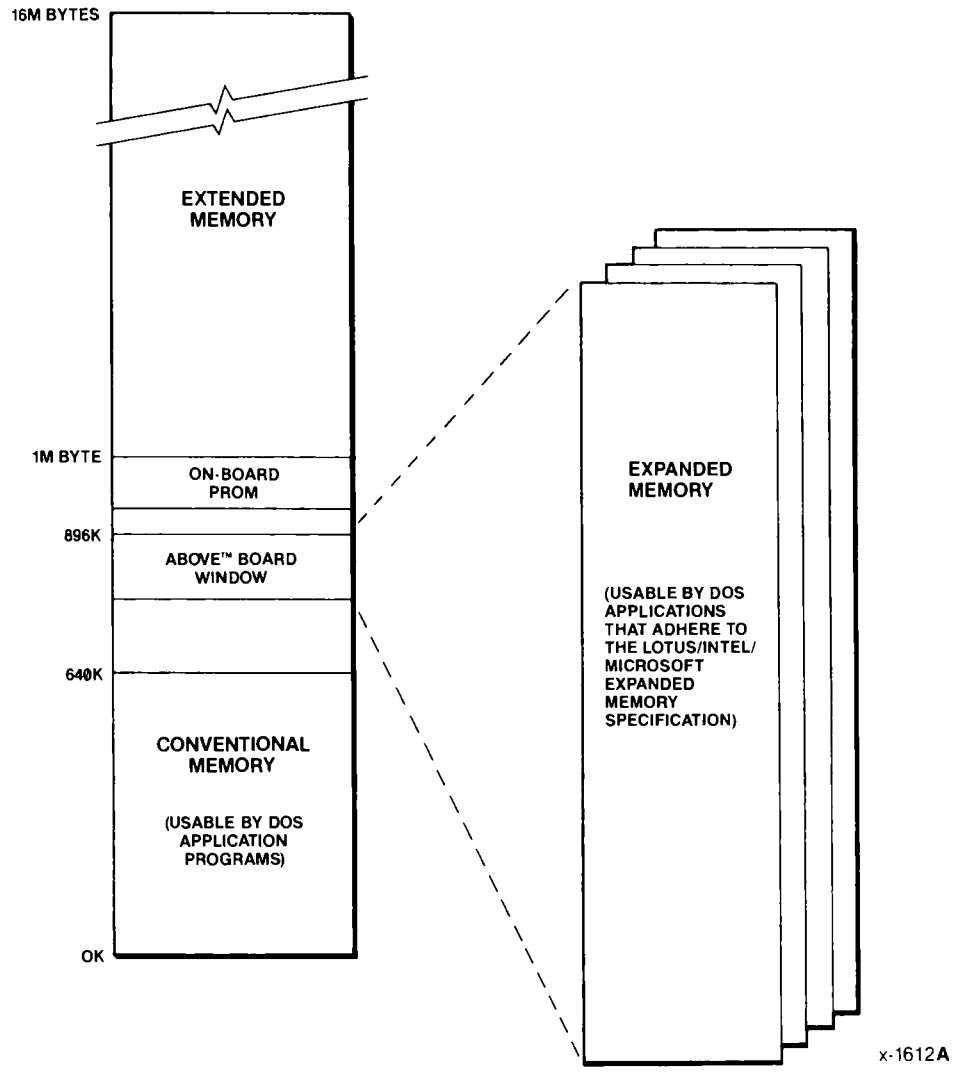

Figure 5-1. Memory Map

Primary Video Adapter

Next, SETUP displays the following information concerning video adapters:

```
The primary display is used by the
system following boot.  If more than
one video adapter is installed in your
system you must select one as primary.
If you have an EGA installed, the EGA
option must be selected even if another
adapter is to be used as primary.
See your installation manual for details
of option switch settings that might
also be needed.

Prime Video Adapter is  EGA

Is this correct  (Y or N) ?
```

If the listed video adapter is correct for your system, type **Y** and press <**Enter**>.

If your system's primary video adapter is not the type indicated in the this screen, type **N** and press <**Enter**>. This causes SETUP to display the following information:

```
Use the number code to indicate the
primary display adapter

     0     EGA
     1     Color graphic (40 columns)
     2     Color graphic (80 columns)
     3     Monochrome
```

In response, enter the number that corresponds to your primary video adapter and press <**Enter**>.

NOTE If your system has an EGA monitor, answer with 0 (EGA), even if another adapter is the primary one. This enables the SETUP program to configure the EGA properly.

Rebooting the System

After you have modified the option settings as necessary, SETUP displays the settings you have entered for all options, and asks if these options are correct. If there are any errors in the option settings, type **N** and press <**Enter**>. This causes SETUP to take you through each option screen again.

If the option settings are correct, type **Y** and press <**Enter**>. SETUP then prompts you to reboot the system as follows:

```
Your system must now be rebooted.
Insert DOS disk and Press <enter>
```

Remove the SETUP diskette, insert the DOS diskette in drive A, and press <**Enter**>. The new configuration settings take effect upon booting.

SETUP ERROR MESSAGES

The SETUP program can report the following error messages. These messages can also appear when you boot the system.

MESSAGE:
```
ERRORS FOUND-
DISK X: FAILED INITIALIZATION
```

Explanation: SETUP reports that the fixed-disk configuration information is incorrect.

Action: Rerun SETUP and enter correct fixed-disk information.

MESSAGE:
```
ERRORS FOUND-
INCORRECT CONFIGURATION INFO
MEMORY SIZE MISCOMPARE
```

Explanation: SETUP reports that the size of base or expansion (extended) memory does not agree with configuration information.

Action: Rerun SETUP and enter correct memory size.

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CHAPTER 6
POWER–ON SELF TEST

The Power-On Self Test (POST) is a diagnostic test that resides in the ROM-BIOS and runs automatically whenever you turn on or reset your system. The POST checks the processor, the memory, and the peripheral devices connected to the computer (keyboard, monitor, disk drives, and others).

POST OPERATION

Each time you turn on the system unit, the POST performs the following operations:

1. Blinks the keyboard status lights on and off.

2. Displays the following message on the screen:

```
Phoenix 80386 ROM BIOS Version x.yy
Copyright (c) 1985,1986 Phoenix Technologies Ltd
All Rights Reserved
```

3. Tests system memory, displaying the amount of memory tested as the test progresses. The POST takes from 3 to 15 seconds to complete, depending on the amount of resident memory.

4. Tests the other devices in the system.

5. If the POST completes successfully, it begins the boot process. If the POST detects an error, it sounds two beeps and displays a message on the monitor or it sounds three sets of beeps. The following sections list the errors that can occur.

POST ERROR MESSAGES

If the Power-On Self Test (POST) can display an error message on the monitor screen, it will beep the speaker twice as the message appears. However, when an error occurs before the monitor is initialized, the POST cannot display messages on the screen. Therefore, the POST will send out a series of beeps instead.

The next two sections discuss the screen messages and beep codes.

Screen Messages

The POST may display one of the following messages during a normal test or when it encounters a non-fatal system-board failure or an off-board failure.

The Messages are in alphabetical order; the User Action suggests the reason for the message or something for the user to do. The items in ***italics*** are variable items that will differ from message to message.

Message: *Hex–value*k Base Memory, *hex–value*k Extended

User Action: Indication of the amount of memory that has been tested. No action required.

Message: Decreasing available memory

User Action: This message immediately follows any memory error message, informing you that memory chips are failing. Check that each memory chip is installed correctly. If you have a memory board with socketed chips, press each chip to ensure it is seated well. If the message repeats, contact your service representative.

Message: Diskette drive 0 seek failure

User Action: Check that Drive A is present and the diskette is inserted properly. If they are, then Drive A may have failed.

Message:	Diskette drive 1 seek failure
User Action:	Check that Drive B is present and the diskette is inserted properly. If they are, then Drive B may have failed.
Message:	Diskette subsystem failed
User Action:	The diskette adapter (controller board) has failed. Check the cable connections and reseat the adapter.
Message:	Diskette read failure – strike F1 to retry boot.
User Action:	Replace the diskette and try again. Clean the drive heads.
Message:	Display adapter failed; using alternate
User Action:	Check to ensure that the monitor type jumpers are set correctly.
Message:	Gate A20 failure
User Action:	The system cannot switch into protected mode. Check the system board.
Message:	Hard disk configuration error
User Action:	Run the SETUP utility

Message: Hard disk controller failure

User Action: Check both ends of the controller's cables, and reseat the hard disk controller. If the message recurs, replace the hard disk controller.

Message: Hard disk failure

User Action: Check the system configuration and drive type, and rerun the SETUP program. Check both ends of the controller's cable, and reseat the hard disk controller.

Message: Hard disk read failure –
strike F1 to retry boot

User Action: Check the system configuration and drive type, and rerun the SETUP program. Check both ends of the controller's cables, and reseat the hard disk controller.

Message: Invalid configuration information – please run SETUP program

User Action: Check the system configuration and drive type, and rerun the SETUP program.

Message: Keyboard clock line failure

User Action: Check the keyboard connection. If connection is good, the keyboard may have failed.

Message: Keyboard controller failure

User Action: Check the keyboard controller.

Message: Keyboard data line failure

User Action: Check the keyboard connection. If the connection is good, the keyboard may have failed.

Message: Keyboard is locked – please unlock

User Action: Unlock the keyboard and try again.

Message: Keyboard stuck key failure

User Action: One of the keys is pressed. Release it and try again.

Message: Memory address line failure at *hex–value*, read *hex–value* expecting *hex–value*

User Action: The memory chip circuitry has failed. Contact your service representative.

Message: Memory data line failure at *hex–value–hex–value*

User Action: One of the memory chips or associated circuitry has failed. Contact your service representative.

Message: Memory high address line failure at *hex–value–hex–value*

User Action: The memory chip circuitry has failed. Contact your service representative.

Message: Memory odd/even logic failure at *hex–value–hex–value*

User Action: The memory chip circuitry has failed. Contact your service representative.

Message: Memory parity failure at *hex–value–hex–value*

User Action: One of the parity or data memory chips has failed. Contact your service representative.

Message: Memory test terminated by keystroke

User Action: A key was pressed during the memory test. Reboot the system to rerun to the POST.

Message: Memory write/read failure at *hex–value*, read *hex–value* expecting *hex–value*

User Action: One of the memory chips has failed. Contact your service representative.

Message: No boot device available –
strike F1 to retry boot

User Action: Make sure that the diskette drive A contains a DOS system diskette and that the door to the drive is closed. Or, make sure the hard drive contains DOS. It could be a problem with the disk controller board or the keyboard interface.

Message: No boot sector on hard disk –
strike F1 to retry boot

User Action: The hard disk is not formatted as a system disk. Format the disk with the /S option.

Message: No timer tick interrupt

User Action: The timer chip on the system board may have failed. Contact your service representative.

Message: Not a boot diskette –
strike F1 to retry boot

User Action: Replace the diskette with a DOS system diskette and try again.

Message: *hex–value* Optional ROM bad Checksum = *hex–value*

User Action: A peripheral card contains a defective ROM. Replace the ROM or the peripheral card.

Message: Phoenix 80386 ROM BIOS Version *x.yy*
Copyright (c) 1985, 1986 Phoenix Technologies Ltd
All Rights Reserved

User Action: Informational. No action required.

Message: Shutdown failure

User Action: The keyboard controller or its associated logic has failed. Check the keyboard controller.

Message: Strike the F1 key to continue

User Action: Follow the instructions to continue.

Message: Time–of–day clock stopped

User Action: The battery is probably dead. Replace the battery and run SETUP.

Message: Time–of–day not set –
Please run SETUP program

User Action: ROM BIOS startup program reports that date and time information was to set in the real-time clock. Run SETUP and configure the system

Message: Timer chip counter 2 failed

User Action: The timer chip on the system board may have failed. Contact your service representative.

Message: Timer or Interrupt Controller Bad

User Action: The timer chip or the interrupt controller on the system board may have failed. Contact your service representative.

System Board Errors

If the POST finds an error and cannot display a message on the monitor, the POST issues a series of beeps to indicate the error.

For example, a failure of bit 3 in the first 64K of RAM is indicated by a 2-1-4 beep code (a burst of two beeps, a single beep, and a burst of four beeps). In addition, the POST writes a value to I/O port 80H to enable debugging tools to identify the area of failure.

Tables 6-1 and 6-2 list the beep codes and I/O port values that the POST generates when it encounters error conditions. Table 6-1 lists fatal errors (those that halt the system). Table 6-2 lists the non-fatal errors (those that aren't serious enough to halt the system). Both tables list other conditions that have no beep codes.

One beep code is not listed in Tables 6-1 or 6-2: a long beep followed by 1 or more short beeps indicates a video adapter failure.

No beep code is sounded if a test is aborted while in progress.

Table 6-1. Beep Codes for Fatal Errors and I/O Port Contents for Errors and Status

Beep Code	Description of Error	Contents of I/O Port 80H
none	80386 register test in progress	01H
1-1-3	Real-time clock write/read failure	02H
1-1-4	ROM BIOS checksum failure	03H
1-2-1	Programmable Interval Timer failure	04H
1-2-2	DMA initialization failure	05H
1-2-3	DMA page register write/read failure	06H
1-3-1	RAM refresh verification failure	08H
none	1st 64K RAM test in progress	09H
1-3-3	1st 64K RAM chip or data line failure multi-bit	0AH
1-3-4	1st 64K RAM odd/even logic failure	0BH
1-4-1	Address line failure 1st 64K RAM	0CH
1-4-2	Parity failure 1st 64K RAM	0DH
2-1-1	Bit 0 1st 64K RAM failure	10H
2-1-2	Bit 1 1st 64K RAM failure	11H
2-1-3	Bit 2 1st 64K RAM failure	12H
2-1-4	Bit 3 1st 64K RAM failure	13H
2-2-1	Bit 4 1st 64K RAM failure	14H
2-2-2	Bit 5 1st 64K RAM failure	15H
2-2-3	Bit 6 1st 64K RAM failure	16H
2-2-4	Bit 7 1st 64K RAM failure	17H
2-3-1	Bit 8 1st 64K RAM failure	18H
2-3-2	Bit 9 1st 64K RAM failure	19H
2-3-3	Bit A 1st 64K RAM failure	1AH
2-3-4	Bit B 1st 64K RAM failure	1BH
2-4-1	Bit C 1st 64K RAM failure	1CH
2-4-2	Bit D 1st 64K RAM failure	1DH
2-4-3	Bit E 1st 64K RAM failure	1EH
2-4-4	Bit F 1st 64K RAM failure	1FH
3-1-1	Slave DMA register failure	20H
3-1-2	Master DMA register failure	21H
3-1-3	Master interrupt mask register failure	22H
3-1-4	Slave interrupt mask register failure	23H
none	Interrupt vector loading in progress	25H
3-2-4	Keyboard controller test failure	27H
none	Real-time clock power failure and checksum calculation in progress	28H

Table 6-2. Beep Codes for Non-Fatal Errors and I/O Port Contents for Errors and Status

Beep Code	Description of Error	Contents of I/O Port 80H
none	Real-time clock configuration validation in progress	29H
3-3-4	Screen memory test failure	2BH
3-4-1	Screen initialization failure	2CH
3-4-2	Screen retrace test failure	2DH
none	Search for video ROM in progress	2EH
none	Screen believed operable	30H
none	Screen believed running with video ROM	30H
none	Monochrome display believed operable	31H
none	Color display (40 column) believed operable	32H
none	Color display (80 column) believed operable	33H

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CHAPTER 7
BIOS INFORMATION

The BIOS is available in ROM on the iSBC 386AT board and provides input/output functions that are compatible with those provided in the BIOS of the IBM AT. The programming interface to the BIOS is summarized in Table 7-1.

Programs that access BIOS functions directly should always do so via software interrupts and not by referring to procedure names or absolute locations. Programs that violate these restrictions are not guaranteed to run on other computers or on future versions of the iSBC 386AT BIOS.Table 7-1. BIOS Functions

Interrupt Number	Function Number	Description
02H		**Nonmaskable Interrupt**
05H		**Print Screen**
08H		**System Timer Interrupt Handler**
09H		**Keyboard Hardware Interrupt**
0EH		**Diskette Hardware Interrupt**
10H		**Video Functions**
	00H	Set video mode
	01H	Set cursor type
	02H	Set cursor position
	03H	Read current cursor position
	04H	Read light pen position
	05H	Select new video page
	06H	Scroll current page up
	07H	Scroll current page down

Table 7-1. BIOS Functions (continued)

Interrupt Number	Function Number	Description
	08H	Read character from screen
	09H	Write character and attribute
	0AH	Write character only
	0BH	Set color palette
	0CH	Write dot
	0DH	Read dot
	0EH	Teletype output function
	0FH	Return video status
	13H	Display string
11H		**Equipment Check**
12H		**Memory Size**
13H		**Diskette Functions**
	00H	Reset diskette subsystem
	01H	Read diskette status
	02H	Read sectors
	03H	Write sectors
	04H	Verify sectors
	05H	Format track
	15H	Read diskette type
	16H	Detect media change
	17H	Set diskette type for format operation
13H		**Fixed Disk Functions**
	00H	All disk reset
	01H	Return status
	02H	Read sectors
	03H	Write sectors
	04H	Verify sectors
	05H	Format track
	06H	Unused
	07H	Unused
	08H	Return drive parameters
	09H	Initialize driver parameters
	0AH	Read long
	0BH	Write long

Table 7-1. BIOS Functions (continued)

Interrupt Number	Function Number	Description
	0CH	Disk seek
	0DH	Fixed disk reset
	10H	Test drive ready
	11H	Disk recalibrate
	14H	Controller diagnostic
	15H	Return drive type
14H		**Serial Communication (RS232) Functions**
	00H	Initialize communications adapter
	01H	Send character over communications line
	02H	Receive character from communications line
	03H	Return communications port status
15H		**Extended Functions**
	80H	Device open
	81H	Device close
	82H	Program termination
	83H	Event wait
	84H	Joystick support
	85H	System Request key
	86H	Wait microseconds
	87H	Move block
	88H	Extended memory size
	89H	Set virtual mode
	90H	Device busy loop
	91H	Interrupt complete
16H		**Keyboard Functions**
	00H	Get next keyboard character
	01H	Get keyboard status
	02H	Return shift flag status
17H		**Printer Functions**
	00H	Print a character
	01H	Initialize the printer port
	02H	Read the printer status
19H		**Bootstrap Load**

Table 7-1. BIOS Functions (continued)

Interrupt Number	Function Number	Description
1AH		**Processor Clock Functions**
	00H	Read the "in RAM" system clock
	01H	Set the "in RAM" system clock
	02H	Read the time of the CMOS real-time clock
	03H	Set the time of the CMOS real-time clock
	04H	Read the date of the CMOS real-time clock
	05H	Set the date of the CMOS real-time clock
	06H	Set the alarm
	07H	Reset the alarm
1BH		**Ctrl-Break Address**
1CH		**Timer Tick**
1DH		**Video Parameter Table**
1EH		**Diskette Parameter Table**
1FH		**Graphics Character Generator**
41H, 46H		**Fixed Disk Drive Parameter Tables**
50H		**Real-Time Clock Interrupt Handler**
76H		**Fixed Disk Hardware Interrupt**

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APPENDIX A
SPECIFICATIONS

Table A-1. Specifications

CPU		80386 32-bit microprocessor
Word Size	Data Path:	8-, 16-, 32-bits
	Physical Addressing:	2^{20} bytes in Real mode, 2^{24} bytes in Protected mode
	Virtual Addressing:	2^{46} bytes
Clock Rates	Processor clock:	16 MHz
	Bus clock:	8 Mhz
Memory	EPROM:	up to 128 KB
	RAM on board:	512 KB
	Extended RAM:	0 to 15 MB on 32-bit memory board
	Expanded RAM:	on option card
Dimensions	Length and width:	12.0 by 13.8 inches (304.8 by 350.5 mm)
	Height (max. with mounted components):	0.5 inches (12.7 mm) without option cards and cables
	Thickness	0.0625 inches nominal

(continued)

Table A-1. Specifications (continued)

Weight		18 ounces (510 grams)
Environment Required	Operating Temperature	10°to 40°C
	Airflow	50 linear feet per minute across 80386
	Storage Temperature	-40° to 70°C
	Humidity	0 to 90%, noncondensing
	Altitude	0 to 10,000 feet

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APPENDIX B
JUMPERS

Table B-1 contains a complete list of the jumper options available with the iSBC 386AT board. The options indicated with an asterisk (*) are the default settings when the board is shipped from Intel.

Table B-1. Jumper Descriptions

Stake Pin Numbers	Function
E1-E2	Connects Reset line to keyboard
E2-E3 *	Disables keyboard reset
E4-E5	Pins do not exist
E5-E6	Pins do not exist
E7-E8 *	Uses trailing edge of Acknowledge signal from printer for interrupt
E8-E9	Uses leading edge of Acknowledge signal from printer for interrupt
E10-E11	Selects monochrome monitor
E11-E12 *	Selects color monitor
E13-E14 *	Selects ROM size for 27256 and 27512 ROMs
E14-E15	Selects ROM size for 27128 ROMs
E16-E17	Selects ROM size for 27512 ROMs
E17-E18 *	Selects ROM size for 27128 and 27256 ROMs

* default setting

Table B-1. Jumper Descriptions (continued)

Stake Pin Numbers	Function
E19-E20	Disables serial communications port
E20-E21 *	Enables serial communications port
E22-E23	Selects printer port 1 (LPT1)
E24-E25 *	Selects printer port 2 (LPT2)
E26-E27	Disables parallel printer port
E28 thru E36	RAM size selection; please see Chapter 3 for information.
E37-E38 *	Connects serial channel 1 interrupt to IRQ4
E38-E39	Connects serial channel 2 interrupt to IRQ3
E40-E41	Selects serial channel 2 (COM2)
E41-E42 *	Selects serial channel 1 (COM1)
E43-E44 *	Connects parallel channel 2 interrupt to IRQ5
E44-E45	Connects parallel channel 1 interrupt to IRQ7
E46-E47	A math coprocessor is installed
E48-E49 *	No math coprocessor installed

* default setting

APPENDIX C
intel® TESTED SOFTWARE AND HARDWARE

This appendix contains a list of the software and hardware products that have been verified to work with the iSBC 386AT board. This list in no way constitutes all of the programs that run on the iSBC 386AT board. Rather, it represents the products tested by Intel Corporation at the time this manual went to print.

The software and hardware listed may have specific hardware and software requirements, such as MS-DOS Version 3.x. Where possible, latest versions of applications and system software are used for testing.

CAUTION Ensure that all peripheral cards you install on the 386AT system board can run at 8 MHZ.

BUSINESS MANAGEMENT

VisiSchedule v1.01A / Visicorp
Project v2.04 / Microsoft
Total Project Manager v1.1 / Harvard Software

COMMUNICATIONS

Smartmodem 1200B Internal Modem / Hayes
Smartcom II v2.1 / Hayes
Access v1.0 / Microsoft
3278/79 Emulator v1.0 / IBM
Multimodem 224E / Multitech Systems
Forte v2.02 / Forte Data Systems

DATABASE AND FILE MANAGEMENT

dBASE III Plus v1.1 / Aston Tate
Reflex v1.1 / Borland

DISK AND TAPE SYSTEMS

WD 1002-WA2 Disk Controller / Western Digital
WD 1003-WA2 Disk Controller / Western Digital
Hard Disk and Diskette Adapter / IBM
OMTI 8620 Disk and Diskette Adapter / SMS
Intelligent SCSI Host Adapter RCP / Racet Computes
Q540 Hard Disk 40MB / Quantum
MKM0353E Hard Disk 86MB / Toshiba
ST4038 Hard Disk 33MB / Seagate
ST225 Hard Disk 20 MB / Seagate
203E Hard Disk 90MB / Rodine
XT-1140 Hard Disk 140MB / Maxtor
MKF3FB Hard Disk 86.5 MB / Fujitsu
B03B-4695 Hard Disk 20 MB / Fujitsu
M223SAS Hard Disk 20 MB / Fujitsu
B042A Hard Disk / Fujitsu
40MB Hard Disk / Atasi
5412 Hard Disk / CMI
5619 Hard Disk / CMI
20MB Hard Disk / Microscience
40MB Hard Disk / Rodine
440-TD 40MB Tape / ADIC

EDUCATIONAL, RECREATIONAL, AND TRAINING

Flight Simulator v2.12 / Microsoft
Jet / Sublogic
Sargon III / Hayden Software
Rogue / Epyx
Many Public Domain Games & Utilities

GENERAL–PURPOSE ENHANCEMENTS

AboveBoard AT / Intel
AboveBoard PS AT / Intel
SBC 386MEM020 / Intel
SBCMATH / Intel
Serial Parallel Expansion Adapter / IBM
Future Net Adapter / Future Net
Advantage Card / AST Research

GRAPHICS

AutoCad v2.52 / Autodesk
In A Vision v1.21 / Micrographx
Generic Cad / Generic Software
PC Paint v2.0 / Mouse Systems
Print Shop / Broderbund Software
Print Master v1.0 /
Pyxel Visuals v2.0 / Pyxel Applications
Fontasy v2.0 / Prosoft
Gem Draw Plus v2.0 / Digital Research
Chart v2.0 / Microsoft
Overhead Express v1.11 / BPS

INPUT DEVICES

Mouse Bus Plus v5.01 / Mouse Systems
PC Mouse v4.2 / Mouse Systems
Serial Mouse / Microsoft
Bus Mouse / Microsoft

INTEGRATED PACKAGES

Framework II / Ashton Tate
Topview v1.01 / IBM
Windows v1.03 / Microsoft
Symphony v1.2 / Lotus Development Corp.
Desqview v1.3 / Quarterdeck
Gem v1.2 / Digital Research

MONITORS AND VIDEO CARDS

Enhanced Graphics Adapter / IBM
Color Graphics Adapter / IBM
Monochrome Display Adapter / IBM
Vega / Video 7
QuadEGA+ / Quadram
Hercules Graphics Adapter / Hercules
Hercules Color Adapter / Hercules
GB-1 / NEC
Chauffeur HT / STB
Enhanced Color Display / IBM
Monochrome Display / IBM
NEC Multisync Monitor / NEC
Sony Multiscan Monitor / Sony

NETWORKS

Open Net Adapter / Ungerman & Bass
Ether Series / 3COM
Excelan TCP / IP / Excelan

OPERATING SYSTEMS

MS DOS v3.20 / Microsoft
PC DOS v3.20 / IBM
XENIX System V / Santa Cruz Operation

SPREADSHEETS

123 v2.0 / Lotus Development Corp.
SuperCalc 3 v2.1 /Sorcim
SuperCalc 4 / Computer Associates International
Multiplan / Microsoft

UTILITIES AND LANGUAGES

Norton Utilities v3.1 / Peter Norton
Fastback v5.13 / Fifth Generation Software
AT Advanced Diagnostics v2.01 / IBM
Sidekick v1.5 / Borland
Ready v1.00 / Living Videotext
Superpckwik v1.11 / Multisoft
Aedit v2.13 / Intel
CopyIIpc v3.05 / Central Point Software
Matlab v2.02 / The Math Works
Prokey v3.0 / Rosesoft
Brown Bag Recovery v3.10 / Software Resource Group
GW-BASIC v3.11 / Microsoft
C Compiler v4.0 / Microsoft Turbo
Pascal v3.0 / Borland
Macro Assembler v4.0 / Microsoft
PLINK v1.0 / Phoenix Technologies
Think Tank v2.3 / Living Videotext

WORD PROCESSORS, EDITORS, AND SPELLING CHECKERS

Volkswriter v3.0 / Lifetree
Volkswriter Deluxe v2.1 / Lifetree
Wordstar v3.31 / Micropro
Displaywrite 2 v1.0 / IBM
Displaywrite 3 v1.1 / IBM
Turbo Lightning v1.00A / Borland
Personal Editor II / IBM
Wordstar 2000 v2.0 / Micropro
Word v3.0 / Microsoft
Wordperfect v4.1 / Wordperfect
Multimate Advantage v3.60 / Multimate

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APPENDIX D
RELATED PUBLICATIONS

INTEL LITERATURE

Order Intel literature from this address:

Intel Corporation
Literature Department
3065 Bowers Avenue
Santa Clara, CA 95051

PUBLICATIONS

For more information about the components or programming of the iSBC 386AT board, refer to these publications:

Order Number	Title
210621	Literature Guide (a free, bimonthly list of available Intel publications and related books from other publishers)
231746	Introduction to the 80386 (including the 80386 Data Sheet)
231732	80386 Hardware Reference Manual
231635	386 Family Product Briefs
122275	ASM 386 Manual (detailed assembly language description)
230985	80386 Programmer's Reference Manual
231499	80386 System Software Writer's Guide
230843	Intel Microsystem Components Handbook
210941	OEM Systems Handbook

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APPENDIX E
SERVICE INFORMATION

SERVICES PROVIDED

Customer Support Service Engineering provides Return Replacement Authorization (RRA) and Direct Return Authorization (DRA) service.

- Return Replacement Authorization (RRA): Under this service, Intel will replace a defective product. Return the defective product to Intel, freight prepaid. The RRA service is not offered on all products, is subject to availability, and is available only to customers in a nonserviceable area. Intel expects to ship 90% of replacement products within 48 hours of receiving the defective product.

- Direct Return Authorization (DRA): This service provides repair work. Return the defective product to Intel, freight prepaid. Intel will repair and test the product and update the product with all mandatory Engineering Change Orders. The product serial number will not change. Normal turn-around time is four to six weeks.

WHEN YOU CALL

Contact CSO for an RRA or DRA authorization number. Please write the authorization number on the packing slip, the purchase order, and other related documents. Before calling, have the following information ready:

- Part and serial numbers of the product

- Purchase order number, for repair and shipping charges

- For warranty repair, proof of purchase showing the product was received within 90 days of the service request date. Without proof, services will be billed at the current rate.

- Your shipping and billing addresses.

- Contact name and telephone number at your site.

PACKAGING REQUIREMENTS

Before shipping, remove all user modifications. Protect the equipment from damage in transit by using these guidelines:

1. Place boards in antistatic bags and then in padded shipping bags.
2. Protect the product with padding such as flow pack or foam.
3. Write the return authorization number on the outside of the box and label the box "Fragile."

NOTE

Damage due to lack of compliance with safe return packaging could result in extra repair charges.

4. Send the product and all correspondence to the address below.

SHIPPING ADDRESS

Intel Corporation
Customer Support Marketing Administration
2402 W. Beardsley Road
Phoenix, Arizona 85027

OBTAINING DRA OR RRA SERVICE

In the United States or Canada, call:

1-8-INTEL-4-U (1-800-468-3548)

In Europe or Japan, contact your local sales office.

In other countries, contact your local distributor.

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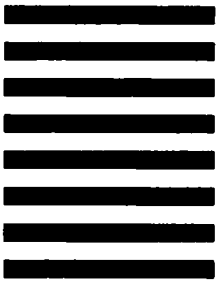

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