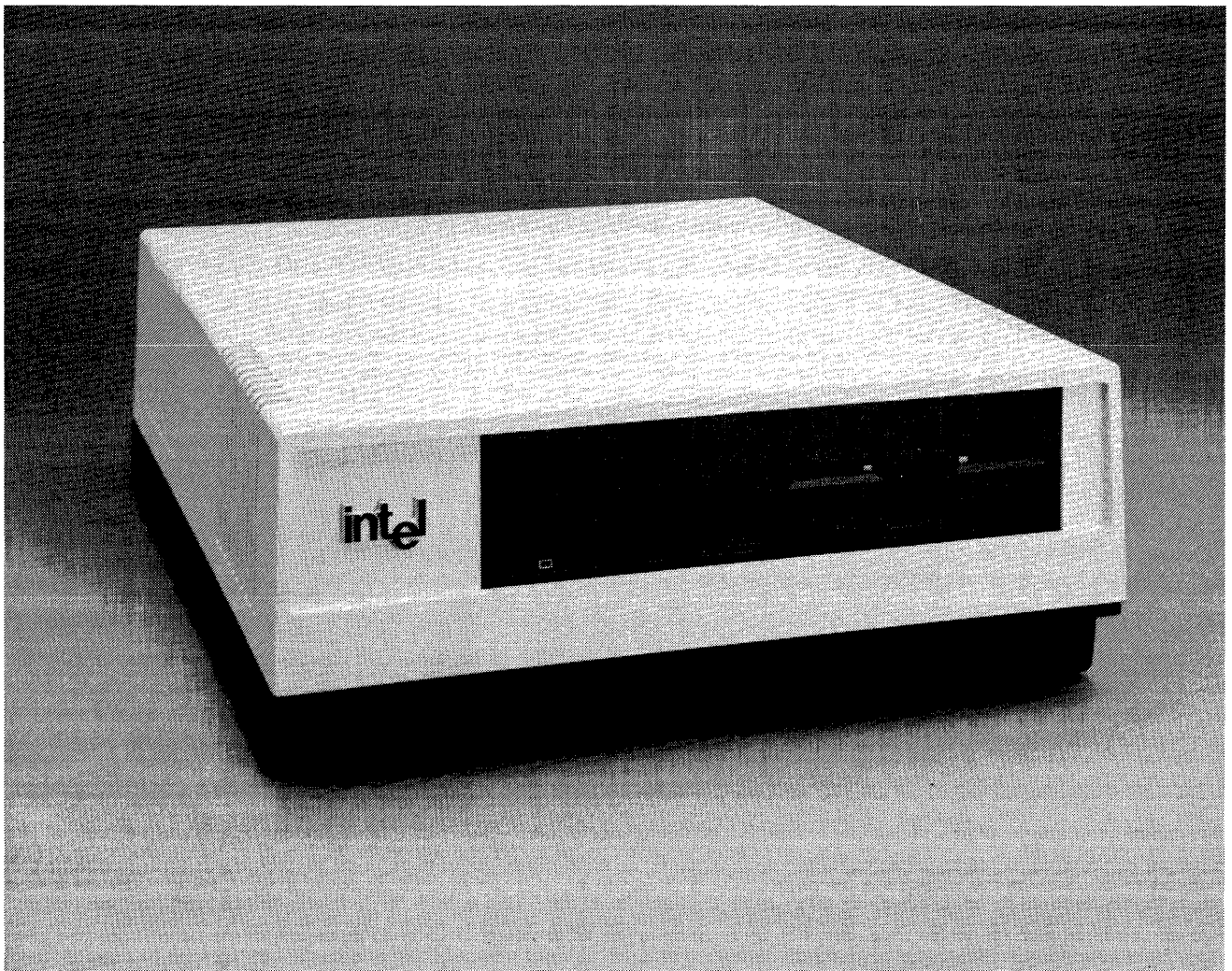




INTRODUCTION TO THE SYSTEM 310 MICROCOMPUTER



INTRODUCTION TO THE SYSTEM 310 MICROCOMPUTER

Order Number: 173202-001

Additional copies of this manual or other Intel literature may be obtained from:

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

The information in this document is subject to change without notice.

Intel Corporation makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Intel Corporation assumes no responsibility for any errors that may appear in this document. Intel Corporation makes no commitment to update or to keep current the information contained in this document.

Intel Corporation assumes no responsibility for the use of any circuitry other than circuitry embodied in an Intel product. No other circuit patent licenses are implied.

Intel software products are copyrighted by and shall remain the property of Intel Corporation. Use, duplication or disclosure is subject to restrictions stated in Intel's software license, or as defined in ASPR 7-104.9 (a) (9).

No part of this document may be copied or reproduced in any form or by any means without prior written consent of Intel Corporation.

Intel Corporation makes no warranty for the use of its products and assumes no responsibility for any errors which may appear in this document nor does it make a commitment to update the information contained herein.

Intel retains the right to make changes to these specifications at any time, without notice.

Contact your local sales office to obtain the latest specifications before placing your order.

The following are trademarks of Intel Corporation and its affiliates and may be used only to identify Intel products:

| | | | |
|--------------------|--|-----------------|---------------|
| BITBUS | iLBX | iPDS | Plug-A-Bubble |
| COMMputer | i _m | iRMX | PROMPT |
| CREDIT | iMMX | iSBC | Promware |
| Data Pipeline | Insite | iSBX | QUEX |
| Genius | int _e l | iSDM | QUEST |
| Δ | Int _e lBOS | iSXM | Ripplemode |
| l | Intelelevision | Library Manager | RMX/80 |
| i | int _e l _i gent Identifier | Megachassis | RUPI |
| I ² ICE | int _e l _i gent Programming | MICROMAINFRAME | Seamless |
| ICE | Intellec | MULTIBUS | SOLO |
| iCS | Intellink | MULTICHANNEL | SYSTEM 2000 |
| iDBP | iOSP | MULTIMODULE | UPI |
| iDIS | | | |

MDS is an ordering code only and is not used as a product name or trademark. MDS® is a registered trademark of Mohawk Data Sciences Corporation.

MULTIBUS is a patented Intel bus.

© 1983, Intel Corporation

Printed in USA/0058/1K/1084/WCP
OEM Systems

| REV. | REVISION HISTORY | DATE |
|------|------------------|-------|
| -001 | Original issue | 10/83 |

CAUTION

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A Computing Device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.



This manual provides an overview of the System 310 Microcomputer, which combines Intel's board products, peripherals, the iRMX™ or XENIX* operating system, high-level languages, and debugging and diagnostic tools in a compact, single-chassis package. Refer to the table of contents for a list of the specific items contained in this manual.

This manual is divided into four chapters.

Chapter 1 System Overview

This chapter provides a brief overview of the System 310 hardware, software, and system specifications.

Chapter 2 Hardware Overview

This chapter describes the hardware modules available for use in the System 310 and the physical characteristics of the system.

Chapter 3 Software Overview

This chapter describes the iRMX and XENIX operating systems.

Chapter 4 System Monitor and Diagnostics

This chapter describes the diagnostic software available with the System 310.

For a list of related System 310 manuals, refer to the *System 310 Publications Guide*, Order Number 173441.

* XENIX is a trademark of Microsoft Corporation.



SERVICE INFORMATION

United States customers may obtain service and repair assistance by contacting the Intel Product Service Center in Phoenix, Arizona. Customers outside the United States should contact their sales source (Intel Sales Office or Authorized Distributor) for service information.

Before calling the Product Service Center you should have the following information:

- The date you received the product.
- The complete part number (including the dash number) of the product. This number is usually silk-screened onto printed circuit boards and stamped on the label of other products.
- The serial number of the product. This is usually silk-screened onto printed circuit boards and stamped on the label of other products.
- Your shipping and billing addresses.
- A purchase order number for billing purposes if your Intel product warranty has expired.
- Extended warranty agreement information, if applicable.

SERVICE AND REPAIR ASSISTANCE

Use the following telephone numbers to contact the Intel Product Service Marketing Administration group:

| Regional Telephone Numbers | | TWX Numbers |
|----------------------------|----------------|--------------|
| Western Region | (602) 869-4951 | 910-951-1330 |
| Midwestern Region | (602) 869-4392 | 910-951-0687 |
| Eastern Region | (602) 869-4045 | |
| International | (602) 869-4391 | |

Always contact the Intel Product Service Marketing Administration group before returning a product to Intel for repair. When you make the request you will be given a repair authorization number, shipping instructions, and other information that will help Intel provide you with fast, efficient service.

If you are returning a product because of damage sustained during shipment or if the product is out of warranty, a purchase order is required before Intel can initiate repair.

Use the original factory packaging material in preparing a product for shipment to the repair center. If that material is not available, ensure the product is adequately protected by wrapping it in cushioning material before enclosing it in a heavy-duty corrugated shipping carton. All cartons should be labeled "FRAGILE" to ensure careful handling. If a printed circuit board is being returned, a material such as Air Cap TH-240, manufactured by the Sealed Air Corporation of Hawthorne, New Jersey, should be used to give adequate cushioning.

Address and ship only to the address specified by Intel Product Service Marketing Administration group personnel.



| CHAPTER 1 | PAGE |
|---|-------------|
| SYSTEM OVERVIEW | |
| Open System Support | 1-1 |
| Processors | 1-1 |
| Operating Systems | 1-1 |
| Disk Drives | 1-2 |
| Chassis | 1-2 |
| Diagnostics | 1-2 |
| Example System 310 Configurations | 1-2 |
| Specifications | 1-4 |
| CHAPTER 2 | |
| HARDWARE OVERVIEW | |
| Block Diagram Description | 2-1 |
| MULTIBUS Interface | 2-1 |
| iLBX Local Bus Extension | 2-2 |
| Processor Boards | 2-3 |
| iSBC 86/30 Single Board Computer | 2-3 |
| iSBC 286/10 Single Board Computer | 2-3 |
| System Memory | 2-4 |
| Disk Drive Controllers | 2-4 |
| Other Boards | 2-5 |
| Physical Features | 2-5 |
| Operating Positions | 2-5 |
| Cardcage | 2-7 |
| Back Panel | 2-8 |
| CHAPTER 3 | |
| SOFTWARE OVERVIEW | |
| The iRMX Operating System | 3-1 |
| Multitasking | 3-1 |
| Priority-Based Scheduling | 3-1 |
| Interrupt-Driven Processing | 3-2 |
| Device-Independent I/O | 3-2 |
| Object-Oriented Architecture | 3-2 |
| Configurability | 3-2 |
| Interactive Configuration Utility | 3-4 |
| Language Translators | 3-4 |
| Utilities | 3-5 |
| The Preconfigured iRMX Operating System | 3-5 |
| Memory Requirements of the iRMX Operating System | 3-6 |
| The XENIX Operating System | 3-6 |
| XENIX Structure | 3-6 |
| Command Language | 3-7 |
| File-Handling Facilities | 3-8 |

| | |
|---|------|
| The C Programming Language | 3-9 |
| Utilities | 3-9 |
| Editors | 3-9 |
| Text Processors | 3-9 |
| Software Development Tools | 3-10 |
| Communications Utilities | 3-10 |
| Storage Requirements of the XENIX Operating System | 3-10 |
| Special Hardware for XENIX Operating System Users | 3-10 |

CHAPTER 4

SYSTEM MONITOR AND DIAGNOSTICS

| | |
|---|-----|
| iSDM 86 and iSDM 286 Monitor Programs | 4-1 |
| SCT 86/300 and SCT 286/300 System Confidence Tests | 4-1 |
| System Analysis Test (SAT) | 4-1 |
| System Diagnostic Tests (SDTs) | 4-2 |

TABLES

| TABLE | TITLE | PAGE |
|--------------|--|-------------|
| 3-1 | XENIX Software Tools and Utilities | 3-7 |

FIGURES

| FIGURE | TITLE | PAGE |
|---------------|--|-------------|
| 1-1 | Example System 310 Configurations | 1-3 |
| 2-1 | Block Diagram of System 310 | 2-2 |
| 2-2 | Operating Positions for the System 310 | 2-6 |
| 2-3 | Cardcage | 2-7 |
| 2-4 | Back Panel | 2-8 |
| 3-1 | iRMX Layers | 3-3 |
| 3-2 | XENIX Layers | 3-8 |



The System 310 (shown on the front cover of this manual) is a versatile, stand-alone microcomputer system, designed to provide low-cost 16-bit computing power and Open System versatility for original equipment manufacturer (OEM) applications. It offers a selection of operating systems, processors, and mass storage devices. The industry-standard MULTIBUS® system bus (IEEE-796) and extra board slots allow hardware to be easily added to the system to support specific applications.

OPEN SYSTEM SUPPORT

The design of the System 310 exemplifies Intel's Open System concept of allowing OEMs to add value to the system in any of the following three ways:

- Adding the most recent as well as future generations of VLSI microcomputers
- Taking advantage of industry-standard hardware and software, both from Intel and independent vendors
- Integrating OEM-designed hardware and software into the system at any level (system, board, or component)

To support this Open System concept, Intel offers the following hardware and software modules for use in the System 310.

PROCESSORS

Two processor boards are offered for use with the System 310: the iSBC® 86/30 processor board, based on the Intel 8086 microprocessor; and the iSBC 286/10 processor board, based on the Intel 80286 microprocessor. For increased processing power, you can add an 8087 or an 80287 floating-point math coprocessor to the iSBC 86/30 or the iSBC 286/10 boards, respectively.

OPERATING SYSTEMS

Intel offers a choice of two industry-standard operating systems for use with the System 310: Intel's iRMX™ Operating System and Microsoft's XENIX* Operating System. Both of these operating

* XENIX is a trademark of Microsoft Corporation.

systems are powerful vehicles for developing and supporting applications programs or for running off-the-shelf iRMX- or XENIX-compatible programs.

DISK DRIVES

The System 310 chassis provides space for two 5¼-inch disk drives. These spaces can be filled with one or two double-sided, double-density diskette drives or a combination of a diskette drive and a Winchester hard disk drive.

CHASSIS

The attractive, low-profile chassis for the System 310 is 17 inches wide, 6½ inches high, and 20 inches deep, and weighs 40 pounds. It contains a power supply, cooling fans, and a seven-slot cardcage.

DIAGNOSTICS

A monitor program and a set of diagnostic programs, located in PROMs, are included with the System 310. These programs provide start-up diagnostics for verifying that the system is operating correctly. An additional set of diagnostic programs, some provided on a diskette and some with the operating system, can be used for troubleshooting and fault isolation.

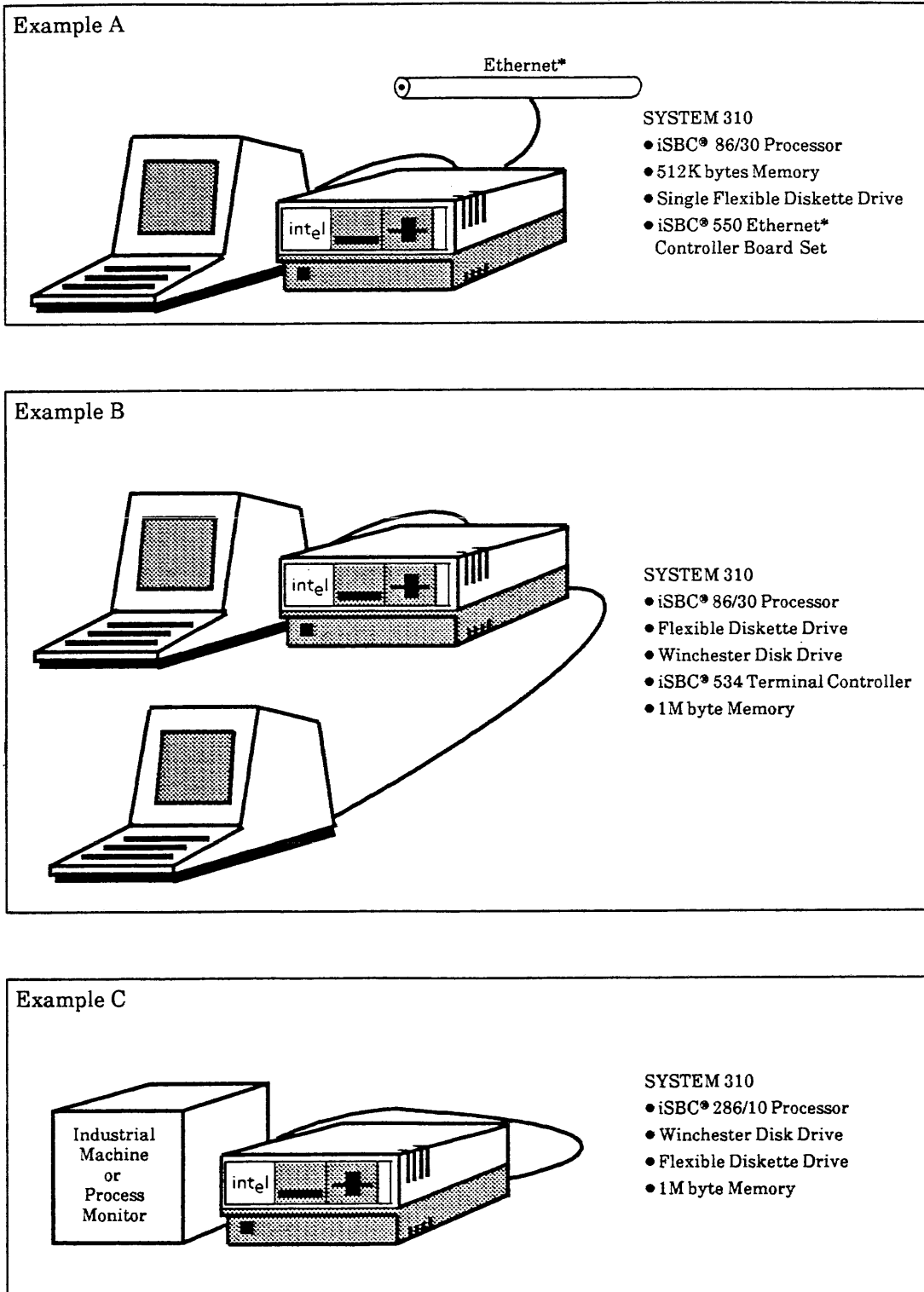
EXAMPLE SYSTEM 310 CONFIGURATIONS

Figure 1-1 shows three examples of System 310 applications. Example A shows a single-user system with an iSBC 86/30 processor board, 512K bytes of memory, and a single, flexible diskette drive. With the addition of an iSBC 550 Ethernet* controller (two-board set), this system can be used as part of a distributed network system.

The System 310 shown in Example B contains an iSBC 86/30 processor, 512K bytes of memory, a flexible diskette drive, a Winchester disk drive, and an iSXM™ 534 terminal controller board. This System 310 configuration can support up to four terminals.

The system shown in Example C contains an iSBC 286/10 board with an 80287 numeric coprocessor, 1M byte of memory, a flexible diskette drive, and a Winchester disk drive. This system is configured for a process control environment.

* Ethernet is a trademark of Xerox Corporation.



*Ethernet is a trademark of Xerox Corporation.

Figure 1-1. Example System 310 Configurations

F-0052

SPECIFICATIONS

The System 310 has the following characteristics and options.

PROCESSOR

Boards

iSBC 86/30 Single Board Computer--Includes 8086 processor operating at 5 or 8 MHz (jumper-selected); two iSBX™ connectors for installation of MULTIMODULE™ boards; 24 programmable parallel I/O lines; one serial port; two programmable timers; nine interrupt levels; 32K bytes of ROM (monitor and start-up diagnostics); and 128K bytes of RAM.

iSBC 286/10 Single Board Computer--Includes 80286 processor, operating at 6 MHz; two iSBX connectors for installation of MULTIMODULE boards; Centronics*-compatible parallel interface; two serial ports; three programmable timers; and 16 interrupt levels.

iSBC 337 Numeric Data Processor MULTIMODULE Board--Installed on the 8086 socket on the iSBC 86/30 board, and provides both 8086 and 8087 processors for enhanced numeric processing capability. (The 80287 numeric coprocessor chip, which performs the same function, can be installed directly on the iSBC 286/10 board.)

Word Sizes

8-, 16-, or 32-bit instructions; 8- or 16-bit data words.

Instruction Cycle Time

8086 microprocessor--400 ns for the fastest executable instructions, when the instruction is in the queue; 1.2 μ s for fastest executable instructions, when instruction is not in the queue.

80286 microprocessor--333 ns for the fastest executable instructions, when the instruction is in the queue; 500 ns for fastest executable instructions, when instruction is not in the queue.

Interrupts

iSBC 86/30 board--an eight-level, maskable, nested-priority interrupt network, and one nonmaskable interrupt.

iSBC 286/10 board--16 vectored requests, using two Intel 8259As and the 80286's NMI line.

*Centronics is a trademark of Centronics Data Computer Corporation.

MEMORY**Boards**

iSBC 012B RAM Board--Provides 512K bytes of dynamic RAM on a standard MULTIBUS™ board.

iSBC 056A RAM Board--Provides 256K bytes of dynamic RAM on a standard MULTIBUS board.

iSBC 012C RAM Board--Provides 512K bytes of dynamic RAM and Error Checking and Correction (ECC) circuitry on a standard MULTIBUS board.

iSBC 056C RAM Board--Provides 256K bytes of dynamic RAM and Error Checking and Correction (ECC) circuitry on a standard MULTIBUS board.

iSBC 012CX RAM Board--Provides 512K bytes of dynamic RAM and Error Checking and Correction (ECC) circuitry on a standard MULTIBUS board. Also includes an iLBX™ Local Bus Extension interface and connector for use with the iSBC 86/30 board.

iSBC 056CX RAM Board--Provides 256K bytes of dynamic RAM and Error Checking and Correction (ECC) circuitry on a standard MULTIBUS board. Also includes an iLBX Local Bus Extension interface and connector for use with the iSBC 286/10 board.

iSBC 304 RAM MULTIMODULE Board--Provides 128K bytes of dynamic RAM on a MULTIMODULE board that fastens to the iSBC 86/30 board.

ROM

32K bytes of ROM on the iSBC 86/30 board; 64K bytes of ROM on the iSBC 286/10 board.

DISK STORAGE**Boards**

iSBC 215G Generic Winchester Controller Board--Uses 8089 I/O processor for both direct memory access (DMA) and user-programmable I/O modes. Includes on-board diagnostic firmware, Error Checking and Correction (ECC) circuitry, full-sector buffering, and 1M-byte addressing. Controls up to four drives.

iSBC 218A Flexible Diskette Controller Board--Attaches to the iSBX connector of an iSBC 215G, iSBC 86/30, or iSBC 286/10 board. Transfer rate for double-density diskettes is 62.5K bytes per second. Head load time is programmable from 4 to 508 ms; unload time is programmable from 32 to 480 ms.

INTERFACES**Serial**

EIA Standard RS-232C signals provided for 9600 baud (asynchronous) or 150 to 19.2 kbaud (synchronous); programmable baud rates and serial formats.

Parallel

Parallel I/O port configured for Centronics-compatible printer interface.

CHASSIS AC POWER REQUIREMENTS**Domestic Systems**

5.8 A @ 90 to 132 VAC, 60Hz \pm 5%, single-phase. Maximum total power consumption 367 watts.

European Systems

2.6 A @ 180 to 264 VAC, 50Hz \pm 5%, single-phase. Maximum total power consumption 367 watts.

Japanese Systems

5.8 A @ 90 to 132 VAC, 50 Hz \pm 5%, single-phase. Maximum total power consumption 367 watts.

ENVIRONMENTAL REQUIREMENTS**Operating**

Temperature--10° C to 35° C ambient (with flexible diskettes); -34° C to 60° C (without flexible diskettes).

Relative Humidity--20% to 80% noncondensing. The humidity/temperature combination cannot exceed 26° C wet bulb.

Altitude--Sea level to 8000 feet.

Nonoperating

Temperature--15° C to 60° C ambient.

Relative Humidity--5% to 95% noncondensing.

Altitude--Sea level to 40,000 feet.

PHYSICAL CHARACTERISTICS

Width--17 in. (43.18 cm).

Height--6.5 in. (16.51 cm).

Depth--20 in. (51.80 cm).

Weight--40 pounds (18.16 kg).



This chapter describes the hardware available with the System 310. Both a block diagram and a physical description are provided.

BLOCK DIAGRAM DESCRIPTION

As shown in Figure 2-1, the System 310 provides a processor board, a memory expansion board, and a disk controller board. (For a minimum configuration of the System 310 with an iSBC 86/10 processor board, the memory and a flexible diskette controller board are both contained on the processor board.) The System 310 has seven slots in the cardcage, allowing additional MULTIBUS-compatible boards such as terminal controllers, memory, and OEM-designed boards to be added to the system. In addition, the iSBC 286/10 Single Board Computer provides an iLBX Local Bus Extension that allows the processor to access off-board memory as though it were physically located on the board.

MULTIBUS® INTERFACE

The Intel MULTIBUS interface (IEEE-796 standard) is a versatile bus structure for intrasystem communication and for transmission of 8- and 16-bit information among the various hardware modules of a system. It allows memory and I/O data transfers, direct memory accesses, and generation of interrupts. It also supports multiple-processor configurations.

The MULTIBUS interface supports two independent address spaces: memory and I/O. During memory cycles, the bus allows direct addressing of up to 16 megabytes using 24-bit addressing. During I/O bus cycles, the bus allows addressing of up to 64K I/O ports using 16-bit addressing. Both memory and I/O cycles can support 8-bit or 16-bit data transfers.

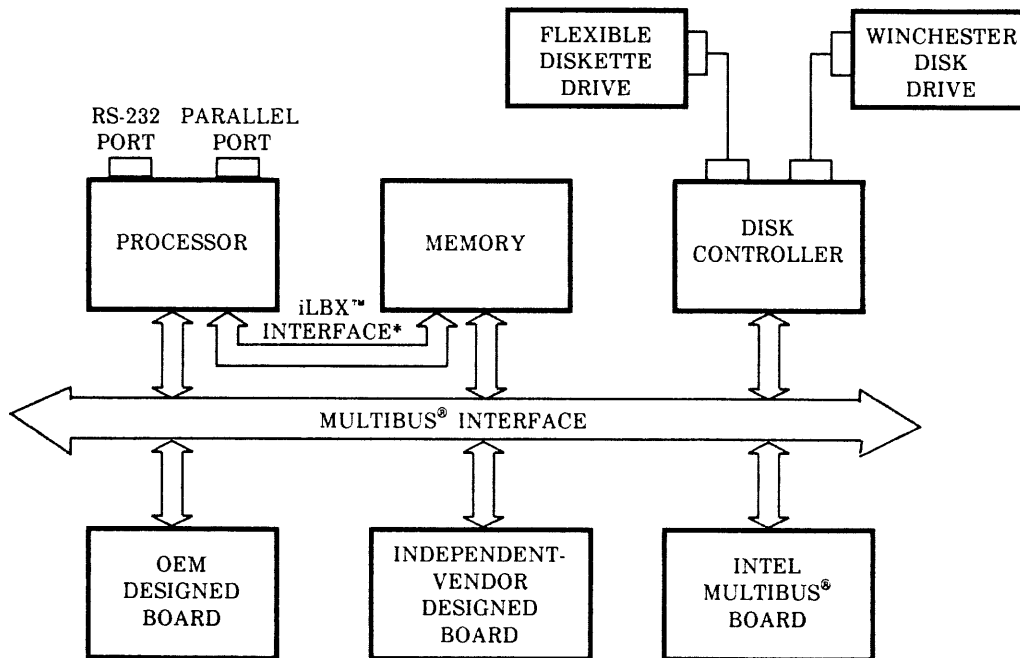
The bus structure is built upon the master-slave concept, where the master device in the system takes control of the bus and sends out an address to a slave device. The slave device, upon decoding its own address, acts upon the command provided by the master. This handshake (master-slave relationship) between the master and slave devices allows modules of different speeds to be interfaced via the bus. It also allows data rates of up to five million transfers per second (bytes or words) to take place across the bus.

Another important feature of the bus is the ability to connect multiple master modules for multiple-processor configurations. The bus provides control signals for connecting multiple masters in either

a serial or parallel priority fashion. With either of these arrangements, more than one master may share bus resources.

iLBX™ LOCAL BUS EXTENSION

The iLBX Local Bus Extension is a specialized electrical and mechanical interfacing protocol, operating within the overall MULTIBUS interfacing system. It provides a path to local memory that is physically off-board, without loss of execution speed due to MULTIBUS interface overhead. It also allows direct access to a much larger memory space than is generally available with single board computers. The iLBX bus is currently available only with the iSBC 286/10, iSBC 012CX, and iSBC 056CX boards.



*Available only on iSBC® 286/10, iSBC® 012CX, and iSBC® 056CX boards.

Figure 2-1. Block Diagram of System 310

F-0060

PROCESSOR BOARDS

The processor boards offered for use in the System 310 provide you with the state of the art in 16-bit computing machines. You have a choice of the industry-standard 8086 microprocessor or the advanced, high-performance 80286 microprocessor. Both processors support multiuser, multiprocessor, and multitasking systems. Their large address space, numeric data processing options, and comprehensive instruction set also provide powerful support for number crunching and process control applications.

While a single processor board provides ample computing power for most System 310 applications, you can also add additional processor boards to the system for increased computing power through parallel processing.

iSBC® 86/30 Single Board Computer

The iSBC 86/30 Single Board Computer is a complete computer system on a single board. It provides an 8086 processor, system clock, 128K bytes of RAM, four monitor and diagnostics PROMs, I/O ports and drivers, interfaces and connectors for serial and parallel communications, priority interrupt logic, and programmable timers.

The 8086 microprocessor provides the System 310 with superior data processing speed and efficiency. It can be run at 5 MHz or 8 MHz (jumper selectable). It can directly address up to 1M byte of memory. Its versatile instruction set supports a wide variety of applications and enhances throughput with such features as binary or decimal arithmetic, and multiply and divide instructions.

By adding an iSBC 337 MULTIMODULE Numeric Data Processor to the iSBC 86/30 board, you can greatly increase the numeric processing capability of the System 310. The iSBC 337 board contains an 8087 numeric data processor, which supports floating-point arithmetic and adds over 60 mathematical instructions to the 8086 instruction set.

Two iSBX connectors on the iSBC 86/30 board allow you to add functions to the board such as a flexible diskette controller.

iSBC® 286/10 Single Board Computer

The iSBC 286/10 Single Board Computer incorporates the enhanced processing capabilities of the 80286 microprocessor and the iLBX bus extension. It provides a system clock, four monitor and diagnostics PROMs, I/O ports and drivers, interfaces and connectors for two serial communications ports and one parallel communications port, priority interrupt logic, and programmable timers.

The 80286 microprocessor represents the state of the art in 16-bit microcomputers. It provides enhanced multiuser and multitasking

capabilities such as built-in memory protection that supports operating system and task isolation, and program and data privacy within tasks. It can address up to 16 megabytes of physical address space and up to 1 gigabyte per task of virtual address space.

The 80286 processor is upwardly compatible with the 8086 and 8088 processors; however, it runs 8086 and 8088 code at substantially higher speeds than is possible with an 8086 and 8088 processor. The 80286 instruction set is a superset of the 8086 and 8088 instruction set.

The numeric processing capability of the iSBC 286/10 board can be enhanced with an optional 80287 numeric processor, which is plugged into a socket on the iSBC 286/10 board. The 80287 extends the 80286 microprocessor's instruction set and supports additional data types, including the ability to perform floating-point arithmetic. The clock rates of the 80286 and the 80287 processors are independent. On the iSBC 286/10 board, the 80286 operates at a 6 MHz clock rate; the 80287 clock rate is jumper selectable for either 4 or 8 MHz.

Like the iSBC 86/30 board, the iSBC 286/10 also provides two iSBX connectors, which allow you to add functions to the board such as a flexible diskette controller.

SYSTEM MEMORY

As described above, system memory (RAM) can be located both on the processor board (iSBC 86/10 board only) and on separate memory boards installed on the MULTIBUS interface.

The iSBC 86/30 provides 128K bytes of on-board memory; 128K bytes of memory can be added to the board by means of an iSBC 304 RAM MULTIMODULE board. The iSBC 86/30 board can also access system memory through the MULTIBUS interface. The iSBC 056A RAM board, which is installed in a MULTIBUS slot, provides 256K bytes of RAM; the iSBC 012B RAM board provides 512K bytes of RAM.

As configured for the System 310, the iSBC 286/10 board does not have any on-board system memory. Instead, it accesses off-board memory either through the MULTIBUS interface or through its iLBX interface. The iSBC 056CX 256K RAM and the iSBC 012CX 512K RAM boards, which are installed in MULTIBUS slots, both provide iLBX bus connectors to allow the iSBC 286/10 board to access them directly.

DISK DRIVE CONTROLLERS

Two disk drive controller boards are offered for use with the System 310: the iSBC 215G Generic Winchester Disk Controller board and the iSBX 218A Flexible Disk Controller board.

The iSBC 215G board fits in a MULTIBUS slot. It also requires an iSBC 213A Data Separator board and a scrambler board, which are included with any System 310 that is equipped with a Winchester disk drive. The iSBC 215G can control up to four Winchester disk drives. If a System 310 is configured with multiple Winchester drives, they will normally be contained in one or more separate chassis.

The iSBX 218A board can be installed in an iSBX connector on the processor board or on the iSBC 215G board. It can control up to four flexible diskette drives; however, its use will generally be limited to one or two diskette drives mounted in the System 310 chassis.

NOTE

When the iSBX 218A board is mounted on the iSBC 86/30 or iSBC 286/10 board, you cannot perform DMA data transfers to the flexible diskette drives.

OTHER BOARDS

Intel offers a variety of other boards in the iSBC, iSBX, and iSXM family to perform specific processing or I/O functions. For example, the iSBC 534 Four Channel Communications Controller Board and the iSBC 544 Intelligent Communications Controller Board provide interfaces for up to four terminals, modems, and other serial I/O devices. These boards are also available in iSXM versions, which have been preconfigured for use with the XENIX operating system. Boards are also available for graphics and Ethernet communications.

PHYSICAL FEATURES

Physically, the System 310 consists of a compact chassis, power supply, fans, cardcage, back panel, one or two disk drives, reset and interrupt switches and lights, and a top cover.

OPERATING POSITIONS

The System 310 can be operated on a desk or table top, or mounted vertically (by means of a floor stand) beside or under a desk or workbench. It can also be mounted in a rack. Figure 2-2 shows examples of the different positions in which the System 310 can be operated.

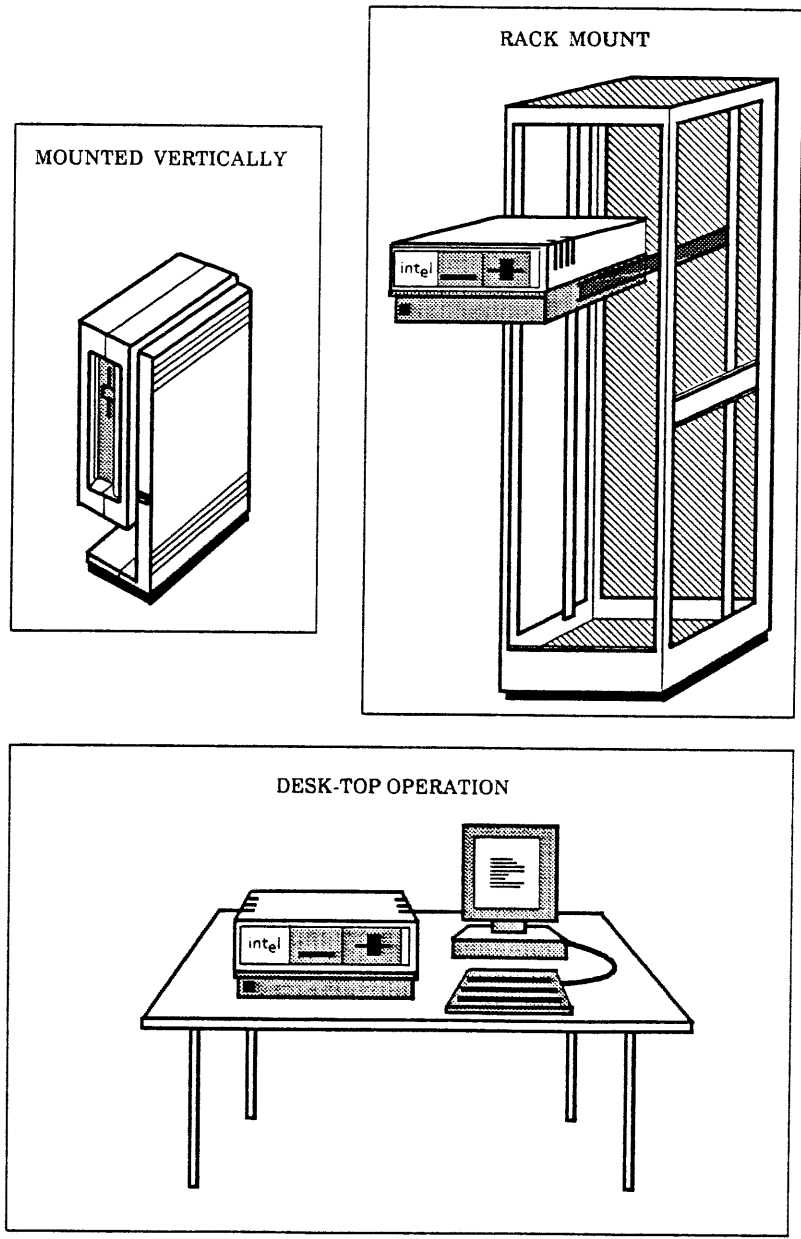


Figure 2-2. Operating Positions for the System 310

F-0042

CARDCAGE

Figure 2-3 provides a rear view of the system with the back panel removed to reveal the system cardcage. The cardcage has seven slots for iSBC MULTIBUS boards. The top and bottom slots allow room for smaller iSBC and iSBX boards to be attached to full-size iSBC MULTIBUS boards, without encroaching on the space of an adjacent slot. OEM boards built according to the Intel iSBC MULTIBUS form-factor and designed to communicate on the MULTIBUS interface can be installed in these slots.

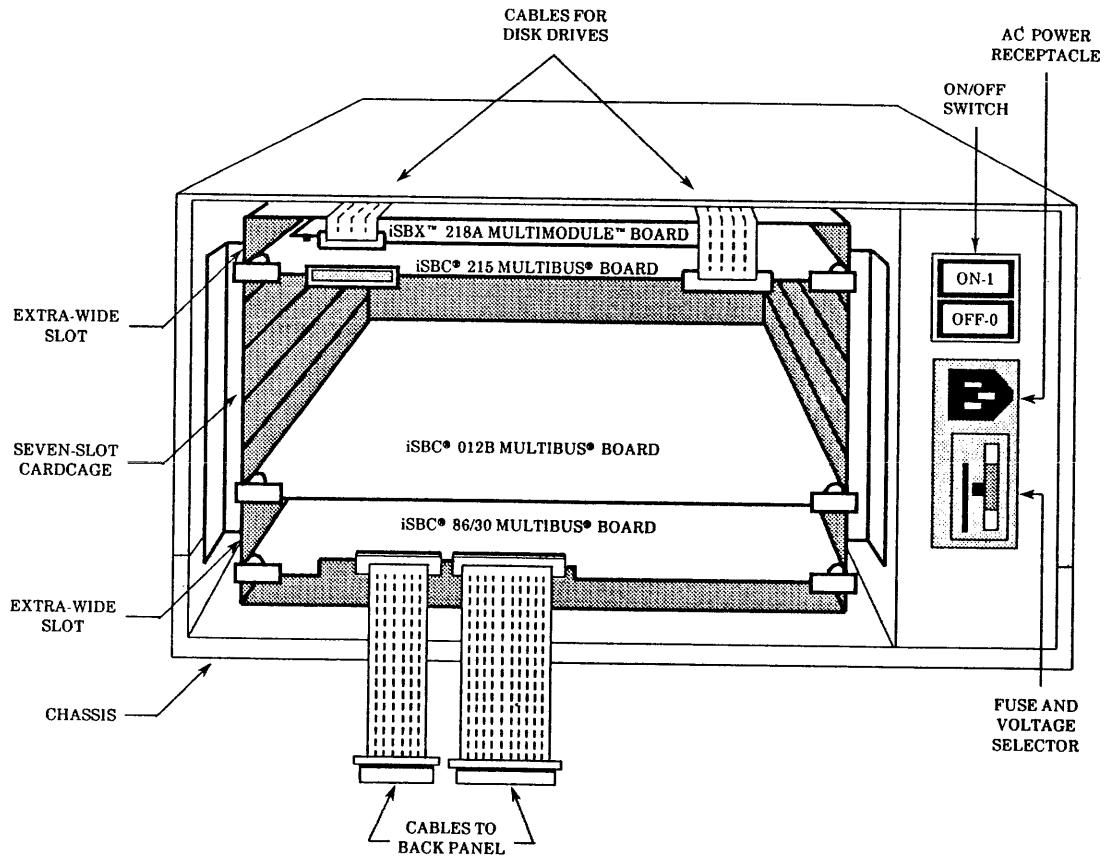
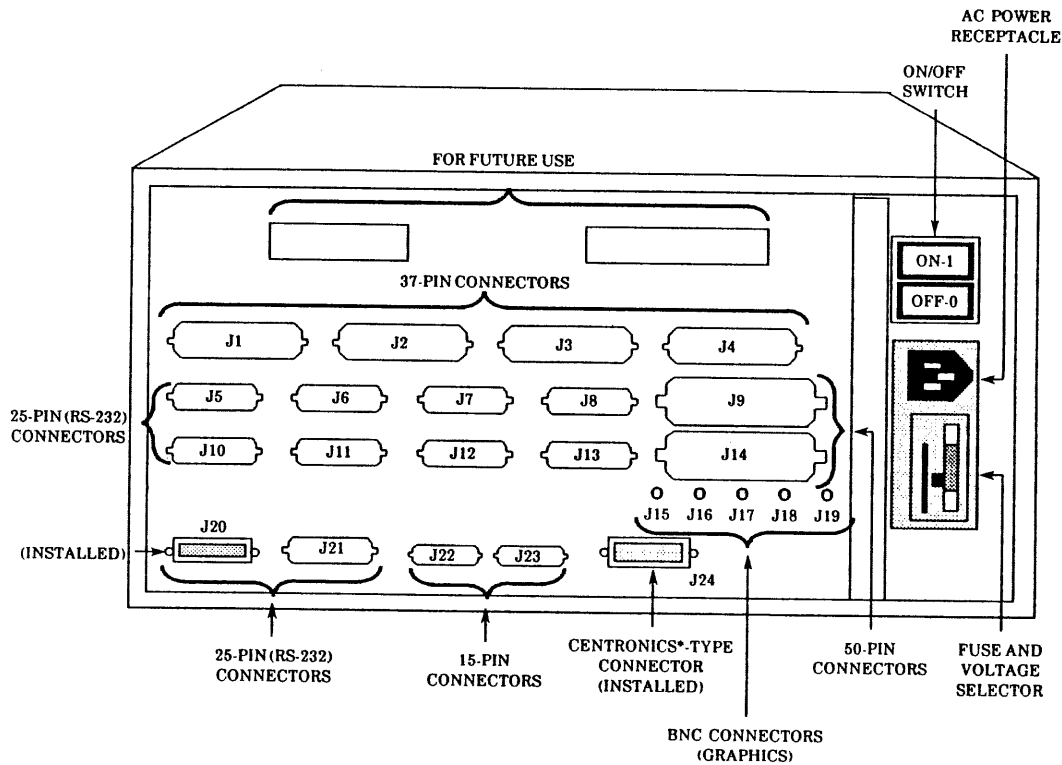


Figure 2-3. Cardcage

F-0072

BACK PANEL

Figure 2-4 shows the back panel, which is mounted at the rear of the system. The back panel provides an RS-232 connector and a Centronics-type connector, which are connected internally to the serial and parallel I/O interfaces, respectively, on the processor board. Knockouts for a variety of connector types are also provided on the back panel for installation of additional connectors.



*CENTRONICS is a trademark of Centronics Data Computer Corporation.

Figure 2-4. Back Panel

F-0074



Both the Intel iRMX Operating System and Microsoft's XENIX Operating System are available for use with the System 310. Although both of these operating systems provide a variety of powerful and versatile features, they each offer different advantages. This chapter describes the major features of each these operating systems and briefly describes the applications for which each is best suited.

THE iRMX™ OPERATING SYSTEM

The iRMX Operating System is a real-time, multitasking operating system. These qualities enable it to respond quickly to a number of different inputs, making it an excellent choice for applications involving process control or data capture and reduction.

A number of features are provided with the iRMX Operating System to streamline program execution and ensure data security, including multitasking, priority-based scheduling, interrupt-driven processing, device-independent I/O, and an object architecture. These and other features of the iRMX Operating System are described in the following sections.

The iRMX Operating System is currently available in two versions: the iRMX 86 Operating System, for use with the iSBC 86/30 Single Board Computer; and the iRMX 286R Operating System, for use with the iSBC 286/10 Single Board Computer. The iRMX 286R Operating System provides support only for the real address mode of the 80286 processor.

MULTITASKING

The iRMX Operating System permits multiple tasks to be executed concurrently. That is, tasks take turns running on a single processor. Tasks can communicate with each other through operating system calls, yet each task runs independently of the other tasks in the application.

PRIORITY-BASED SCHEDULING

Another feature of the iRMX Operating System is a priority-based, event-driven method of scheduling tasks for execution. Each task is assigned one of 256 priority levels, which it retains throughout its life. The operating system uses these priorities to schedule task execution.

INTERRUPT-DRIVEN PROCESSING

An iRMX-based application can, if desired, allow external interrupts to preempt the executing task so that appropriate software routines can respond to the interrupts. After handling an interrupt, such a routine surrenders the processor to normal task execution.

DEVICE-INDEPENDENT I/O

For input and output operations, the iRMX Operating System offers a single set of system calls. Consequently, iRMX application code is device-independent, because tasks always use the same I/O system calls in the same way, regardless of the nature of the I/O device.

OBJECT-ORIENTED ARCHITECTURE

The iRMX Operating System has an object-oriented architecture, which means that it is composed entirely of elements called objects. Objects can be thought of as the building blocks of the iRMX Operating System. There are seven different types of objects in the operating system, some of which are tasks, jobs, mailboxes, and semaphores.

This object-oriented architecture offers a number of benefits:

- It is easy to learn and work with.
- It allows you to conveniently configure your operating system for specific needs, thus reducing the amount of memory required to run it.
- It allows you to easily add your own features to the operating system.

CONFIGURABILITY

The iRMX Operating System also provides a selection of software modules (built from objects) to perform specific operating system functions. When configuring the operating system for a specific application, you link together only the software modules needed to meet the requirements of your application. At the highest level, you select subsystems, also known as layers, of the iRMX Operating System.

Figure 3-1 depicts the layers of the iRMX Operating System as a collection of concentric, partial rings. Layers that you do not explicitly request are not included in your system. However, for every layer in a system, all layers that lie inside that layer must also

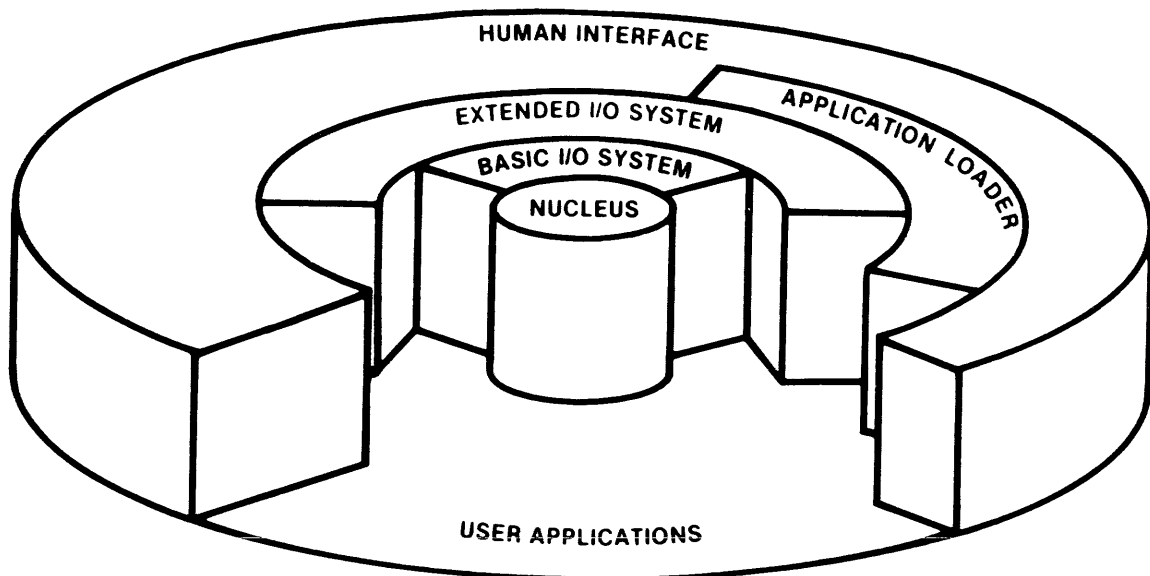


Figure 3-1. iRMX™ Layers

x-062

be included. The following paragraphs briefly describe the iRMX Operating System layers:

- | | |
|----------------------------|---|
| Nucleus | The heart of every iRMX application system. It provides management and control facilities for processor scheduling, interrupt handling, object usage, data protection, task interaction, and error handling. It also manages the allocation and reclamation of memory and other system resources. |
| Basic I/O System | Provides the calls for device-independent I/O. It supplies system drivers for several kinds of devices, as well as drivers for three different kinds of files: named files, physical files, and stream files. The Basic I/O System offers an asynchronous interface for I/O operations, letting them execute simultaneously with internal operations. |
| Extended I/O System | Provides a synchronous interface for I/O operations. It automatically performs read-ahead and write-behind buffering. It also allows tasks to use "logical" names when referring to files. |

| | |
|--------------------|--|
| Application Loader | Provides a simple mechanism for loading application code and data files from secondary storage devices into memory. It can load absolute code into fixed memory locations or relocatable code into dynamically-allocated memory locations. It can also load files containing overlays. |
| Human Interface | Supports interaction between a user and an application. It provides commands that enable the user to create, copy, rename, or delete a file; load and start an application; format or verify a secondary storage volume; back up or restore a file; read commands from a file, rather than from a terminal; and communicate with the iSDM™ 86 and iSDM 286 monitor program for debugging programs and copying files to and from an Intellec® development system. |

In addition to selecting layers of the operating system, you can select desired parts of the layers. Moreover, you can include or exclude features and system calls, and specify hardware port addresses so that your customized operating system can run on any 8086- or 8088-based system.

INTERACTIVE CONFIGURATION UTILITY

A program called the Interactive Configuration Utility (ICU), supplied as part of the iRMX Operating System, guides you through the operating system configuration process. The ICU displays a series of menus that describe the available options. You make selections from the menus to define a new configuration specification or to modify an existing one.

Because the operating system is configurable, it allows you to add support for multiple processors. The MULTIBUS Message Exchange (iMMX™ 800) software package provides the software needed for communication between processor boards via the MULTIBUS interface. Using iMMX 800, each of the system's boards can act as host to the iRMX Operating System.

You can also customize your system for communication with other System 310's, System 330A's, or System 380's on an Ethernet network.

LANGUAGE TRANSLATORS

Also included with the iRMX Operating System are translator and utility programs to assist you in developing software written in 8086 code. These programs let you compile and assemble programs (PLM86 and ASM86), link programs together (LINK86), assign absolute addresses to programs (LOC86), create libraries of programs (LIB86), and convert absolute object modules to hexadecimal format (OH86). Programs written in 8086 code can be run on the iSBC 86/30

processor or on the iSBC 286/10 processor in the real address (8086-compatible) mode.

Optional Pascal-86 and FORTRAN-86 compilers are available from Intel. Because the iRMX Operating System supports the Universal Development Interface (UDI), a wide variety of other language products, both compilers and interpreters, are available from independent software vendors for use on the iRMX Operating System.

UTILITIES

The iRMX package contains the System Debug Monitor (SDB), which is an addition to the iSDM 86 and 286 monitors. The SDB adds commands to the monitor that let you examine iRMX objects directly. If you include the SDB in your application system, you can use the SDB commands whenever you access the iSDM 86 and 286 monitors while the operating system is in place.

The operating system package also contains a sophisticated, line-oriented editing facility called ED. You can use ED to create and modify files of text; to add, insert, move, and substitute text; to read text from or write text to a file; and to perform global editing.

THE PRECONFIGURED iRMX™ OPERATING SYSTEM

When you order the iRMX Operating System with the System 310, you receive an already configured version of the operating system called the preconfigured system. The preconfigured system provides a basic operating system for you to use for general system operation. Four PROMs on the System 310 processor board (iSBC 86/30 and iSBC 286/10 boards) contain the bootstrap loader, which can be used to boot the preconfigured system.

The principal components of the preconfigured system are the following:

- The Nucleus
- The Basic I/O System, with device drivers for a terminal, an iSBC 215G Generic Winchester Controller, an iSBX 218A Flexible Diskette Controller, and a parallel printer interface
- The Extended I/O System
- The Application Loader
- The Human Interface

Also included in the preconfigured system are the SDB and ED. (The Extended I/O System, the Application Loader, and the Human Interface layers contain the UDI.)

MEMORY REQUIREMENTS OF THE iRMX™ OPERATING SYSTEM

In order to use the preconfigured system, your System 310 must have at least 384K bytes of RAM. If you write and configure your own application system, its memory requirements depend upon the layers, parts of layers, features, and system calls that you choose for your iRMX configuration.

THE XENIX* OPERATING SYSTEM

The XENIX Operating System is a superset of the well-known UNIX** Operating System. It is a time-sharing, multiuser operating system that excels in software development and computer-aided design applications. As shown in Table 3-1, the XENIX operating system includes enhancements and utilities from a variety of sources.

One of the most appealing characteristics of XENIX is that it is easy to learn and use, while providing many powerful and sophisticated features. Some of these features include a versatile command language, a hierarchical file structure, the C programming language, and a wide assortment of editing, text processing, and software development tools.

The XENIX operating system is available in two versions: the XENIX 86 operating system, for use with the iSBC 86/30 Single Board Computer; and the XENIX 286 operating system, for use with the iSBC 286/10 Single Board Computer.

XENIX* STRUCTURE

As shown in Figure 3-2, the XENIX operating system is made up of three parts. These layers are described below:

| | |
|------------------|---|
| Kernel | The kernel manages data storage, schedules tasks, and manages main memory and peripherals. |
| Shell | The shell is the human interface that interprets user-entered commands. It also allows you to execute XENIX utilities or user programs one at a time or concurrently in a series called a pipe. |
| Utility Programs | These programs perform a number of routine functions, such as compiling, editing, file maintenance, etc. |

* XENIX is a trademark of Microsoft Corporation.

** UNIX is a trademark of Bell Laboratories.

Table 3-1. XENIX* Software Tools and Utilities

| Source | Tool or Utility |
|--------------------------------------|--|
| Bell Laboratories | UNIX V7 UUCP SCCS |
| University of California at Berkeley | VI TERMCAPS C SHELL MORE HEAD TAIL |
| Microsoft Corporation | Automatic Disk Recovery System Configuration Error Logging Floating Point Record Locking Middle Model C Semaphores |
| Independent Software Vendors | COBOL Compiler 3270 Support X 25 Support |
| Intel Corporation | 320K Byte Flexible Diskette Controller Driver 10M Byte Winchester Disk Controller Driver Diagnostics 9 Terminal Support iAPX 8087 Fast Floating Point Start/Stop Tape Support |

A number of the program development and documentation features of the XENIX Operating System are described in the following sections.

COMMAND LANGUAGE

The XENIX command language makes it possible to perform many tasks without writing a C program. For example, you can cause the output of one process to become the input of another. This feature can be used repetitively to form a chain of processes called a "pipe,"

* XENIX is a trademark of Microsoft Corporation.

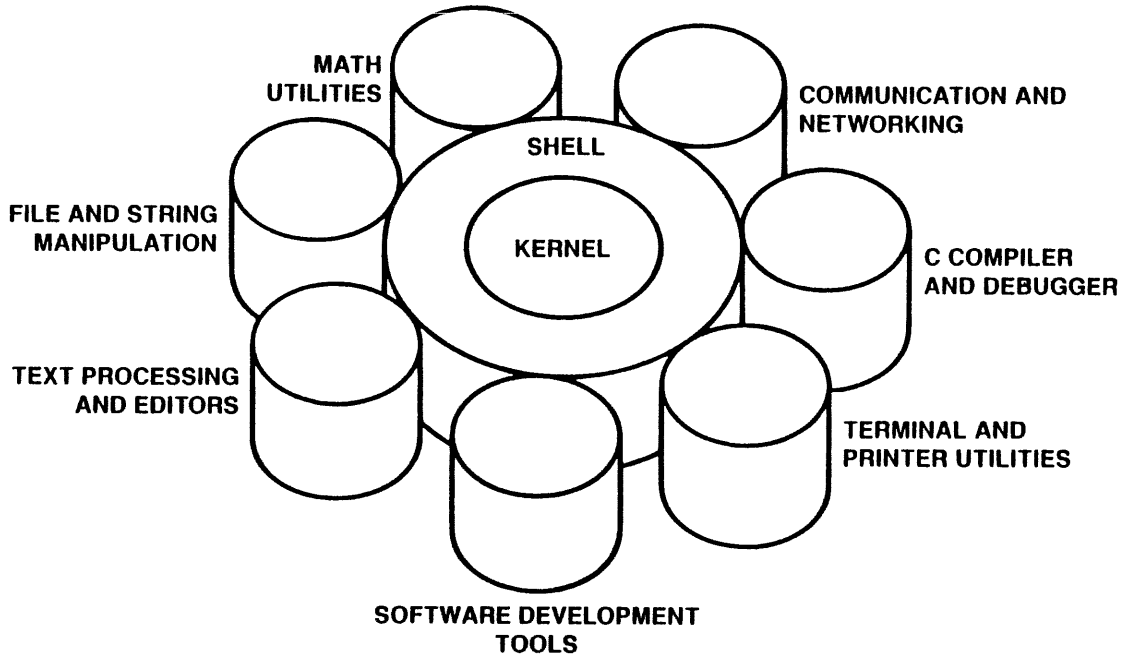


Figure 3-2. XENIX* Layers

with data flowing through the pipe. The links in a pipe can act as filters. In fact, XENIX contains a set of ready-to-use filters that perform such functions as spelling verification and sorting.

FILE-HANDLING FACILITIES

The XENIX Operating System has a comprehensive set of features for creating, accessing, moving, and processing files and directories. Some of these facilities are the following:

- Device-independent I/O operation. Each system device, including peripheral devices, memory, and directories, is treated like a file, allowing identical I/O operations for all files and I/O devices.
- A hierarchical file system for flexible organization of files and directories.

* XENIX is a trademark of Microsoft Corporation.

- Flexible file and directory naming facilities. File and directory names can be absolute or relative to any directory in the file system hierarchy.
- A complete set of file protection modes that allows the owner of a file to assign to that file any combination of read, write, and execute attributes for three different user groups. These modes can be set and changed dynamically.
- Automatic disk recovery facilities to restore data in the event of a power failure.

THE C PROGRAMMING LANGUAGE

The standard programming language for use with the XENIX operating system is C. C is a compact, structured language that combines features of both high- and low-level languages. It has a large set of powerful operators, extensive data types, facilities for handling pointers and addressing arrays, controls for structuring programs, and a substantial I/O library. Its efficiency often rivals code written in assembly language.

UTILITIES

The XENIX operating system contains an extensive set of utilities. In addition, other vendors offer many optional utilities for special-purpose applications.

Editors

Three editors, ED, VI, and SED, are included with the XENIX operating system. ED is an interactive line editor. Extensive pattern-matching capabilities allow complex global changes to be made to a program, a document, or data. VI (Visual editor) is a full-screen editor, meaning that you can edit anything you see on the screen by simply moving the cursor to the appropriate location and making the desired changes. SED is a stream editor intended for repetitive global editing functions. When using SED, you typically specify all of the changes that you want to make in a SED script. SED then makes the changes without the need for further supervision.

Text Processors

With the text processing utilities of the XENIX operating system, many types of documents can be quickly created, edited, and sent to an output device. The final output can be printed or phototypeset in a variety--or even a mixture--of type fonts. The main text formatters with the XENIX operating system are NROFF, which prepares text for output on an ASCII terminal or lineprinter, or TROFF, which prepares text for output on a phototypesetter. The

MS macro package provides a large set of command macros for use with NROFF and TROFF. Together, they can be used to produce a great variety of document characteristics.

Software Development Tools

The XENIX operating system includes several software development tools. Two of these tools, LEX and YACC, are particularly useful to compiler writers. LEX produces lexical analyzers and YACC produces parsers, both of which are important elements in structuring program input. Another useful development tool in XENIX is the Source Code Control System (SCCS). The SCCS keeps track of changes made to source code and can reconstruct previous versions of the source code at any stage in its development from these stored changes.

Communications Utilities

Several communications utilities are included in the XENIX package. MAIL enables communications from one user to one or more users of a XENIX-based system. WRITE allows two users to carry on a dialogue on a system. UUCP makes it possible for one XENIX-based system to communicate to another by means of either a modem or a direct connection.

STORAGE REQUIREMENTS OF THE XENIX* OPERATING SYSTEM

The basic version of the XENIX operating system requires 256K bytes of RAM storage. However, if you wish to customize the basic version to your own requirements, or if you plan to use the C program language, you will need 384K bytes of RAM storage.

SPECIAL HARDWARE FOR XENIX* OPERATING SYSTEM USERS

Also needed to run the XENIX operating system are the following hardware modules:

- the iSXM 101 XENIX Extension Module (not required if iSBC 286/10 board is being used)
- the iSXM 951 Terminal Communications Cable Set
- either the iSXM 534 Four-Channel Communications board or the iSXM 544 Intelligent Communications board

The iSXM 101 module consists of an iSBC 309 Memory Management MULTIMODULE board with an 8087 Numeric Data Processor on-board.

* XENIX is a trademark of Microsoft Corporation.

The iSXM 534 and 544 boards are iSBC 534 and 544 boards, respectively, that have been preconfigured for use with the XENIX operating system.

The iSXM 951 package provides four cables that connect the RS-232 connectors on the iSXM 534 or 544 board to connectors on the back panel of the System 310.



PROMs in the System 310 contain a bootstrap loader, a system confidence test, and a monitor. In addition, diagnostic programs that exercise the System 310 hardware and check it for errors are provided with the system on flexible diskettes. To use these monitor and diagnostic programs, a terminal must be connected to the RS-232 connector on the back panel of the System 310, which is in turn connected to the processor board.

iSDM™ 86 and iSDM™ 286 MONITOR PROGRAMS

The iSDM 86 and iSDM 286 Interface and Execution programs are monitors that enable you to perform basic register-, memory-, and I/O-level functions without the presence of an operating system. In particular, you can:

- Examine and modify registers and memory
- Move and compare blocks of memory
- Perform I/O via 8086 or 80286 input and output ports
- Set breakpoints in programs or single-step through code

Moreover, with minor jumpering changes to the processor board, you can use the iSDM 86 or iSDM 286 monitor to transfer files between an Intellec development system and the parallel port of the iSBC 86/30 or iSBC 286/10 board, respectively, in the System 310.

SCT 86/300 and SCT 286/300 SYSTEM CONFIDENCE TESTS

The SCT 86/300 and SCT 286/300 system confidence tests, which reside in PROM on the iSBC 86/30 and iSBC 286/10 boards, respectively, check critical elements of the System 310 operation. They are automatically invoked when you apply power to the system or when you press the front-panel RESET pushbutton.

Upon completion of the system confidence tests, program control is passed to the bootstrap loader, which loads the operating system from disk and starts it running.

SYSTEM ANALYSIS TEST (SAT)

The SAT is a means of exercising both system software and system hardware by running a program for an extended period of time. The

SAT places heavy demands on the system in an attempt to produce the kinds of errors that would occur intermittently.

SYSTEM DIAGNOSTIC TESTS (SDTs)

The SDTs are tools to help you learn more about the location of a hardware problem when you already know that the problem exists. After you have decided, perhaps with the aid of the SCT, that a particular board is defective, the appropriate SDT helps you to identify the subassembly that contains the problem.

The System 310-compatible iSBC boards for which there are currently SDTs are the following: iSBC 86/30, iSBC 286/10, iSBC 012B, iSBC 012C, iSBC 012CX, iSBC 056A, iSBC 056C, iSBC 056CX, iSBC 215G, iSBC 309, iSBC 337, iSBC 534, and iSBC 544. SDTs are also available for the iSBX 218A and iSBX 351 MULTIMODULE boards. The SDTs are furnished on a diskette.

- 012B, 012C, 012CX memory board, iSBC,
 - application of, 2-2, 2-4
 - diagnostics, 4-2
 - specification, 1-5
- 056A, 056C, 056CX memory board, iSBC,
 - application of, 2-2
 - diagnostics, 4-2
 - specification, 1-5
- 101 XENIX Extension Module, iSXM, 3-10
- 215G Generic Winchester Controller, iSBC,
 - application of, 2-4, 2-5, 3-5
 - diagnostics, 4-2
 - specification, 1-5
- 218A Flexible Diskette Controller, iSBC,
 - application of, 2-4, 2-5, 3-5
 - diagnostics, 4-2
 - specification, 1-5
- 286/10 Single Board Computer, iSBC,
 - application of, 1-2, 2-2
 - description of, 1-1, 1-2, 2-3, 2-4, 4-1
 - diagnostics, 4-2
 - on-board ROM, 1-5
 - specification, 1-4
- 304 RAM MULTIMODULE board, iSBC, 1-5
- 309 Memory Management MULTIMODULE board, iSBC,
 - description of, 3-10
 - diagnostics, 4-2
- 377 Numeric Data Processor MULTIMODULE, iSBC,
 - description of, 2-3
 - specification, 1-4
- 534 terminal controller, iSXM,
 - application of, 1-2, 3-10, 3-11
 - description of, 2-5
 - diagnostics, 4-2
- 544 terminal controller, iSXM,
 - application of, 3-10, 3-11
 - description of, 2-5
 - diagnostics, 4-2
- 550 Ethernet controller, iSBC, 1-2
- 80286 microprocessor,
 - application of, 1-1, 2-3
 - description of, 2-4
 - specification, 1-4
- 80287 Numeric Data Processor,
 - application of, 1-1, 1-2
 - description of, 2-3, 2-4
 - specification, 1-4
- 8086 microprocessor,
 - application of, 1-1, 2-3
 - description of, 2-3
 - specification, 1-4
- 8087 Numeric Data Processor,
 - application of, 1-1
 - description of, 2-3
 - specification, 1-4
- 86/30 Single Board Computer, iSBC,
 - application of, 1-2
 - description of, 1-1, 2-3, 4-1
 - diagnostics, 4-2
 - on-board RAM, 2-4
 - on-board ROM, 1-5
 - specification, 1-4
- 951 terminal communication cable set, iSXM, 3-10, 3-11
- AC power requirements. See chassis
- Back panel, 2-8
- Block diagram description, 2-1 thru 2-5
- C programming language, 3-7, 3-9, 3-10
- Cardcage, 1-2, 2-7
- Centronics-compatible printer interface. See parallel interface

- Chassis,
 - AC power requirements, 1-6
 - description of, 1-2, 2-5
 - environmental requirements, 1-6
 - physical characteristics, 1-7. *See also* back panel, cardcage, operating positions
- Diagnostics, 1-2, 4-1, 4-2
- Disk drive controllers, 2-4. *See also* 215G Generic Winchester Controller and 218A Flexible Diskette Controller
- Disk drives, 1-2. *See also* 215G Generic Winchester Controller and 218A Flexible Diskette Controller
- Disk storage, 1-5. *See also* 215G Generic Winchester Controller and 218A Flexible Diskette Controller
- ED, text editor,
 - iRMX operating system, 3-5
 - XENIX operating system, 3-9
- Environmental requirements. *See* chassis.
- Error checking and correction (ECC), 1-5
- Ethernet, 1-2, 3-4
- Example System 310 configurations, 1-2, 1-3
- Floor stand, 2-5
- FORTRAN-86, 3-5
- iLBX Local Bus Extension, 2-2
- iMMX 800 MULTIBUS Message Exchange, 3-4
- iRMX 286R Operating System, 3-1
- iRMX 86 Operating System, 3-1
- iRMX Operating System,
 - application of, 1-1, 3-1
 - configurability, 3-2
 - description of, 3-1 thru 3-6
 - device-independent I/O, 3-2
 - ED, text editor, 3-5
 - iMMX 800 MULTIBUS Message Exchange, 3-4
 - Interactive Configuration Utility (ICU), 3-4
 - interrupt-driven processing, 3-2
 - language translators, 3-4
 - layers, 3-2 thru 3-4
 - memory requirements, 3-6
 - multitasking, 3-1
 - object-oriented architecture, 3-2
 - preconfigured iRMX operating system, 3-5
 - priority-based scheduling, 3-1
 - System Debug Monitor (SDB), 3-5
 - Universal Development Interface (UDI), 3-5
 - Utilities, 3-5
- iSBX connectors, 2-3, 2-4, 2-7
- Memory,
 - required by iRMX operating system, 3-6
 - required by XENIX operating system, 3-10
 - system, 2-4
- Monitor programs, iSDM 86 and iSDM 286, 3-4, 3-5, 4-1
- MULTIBUS interface,
 - application of, 1-1, 2-7
 - description of, 2-1
- Open System, 1-1
- Operating positions, 2-5
- Operating systems, 1-1. *See also* iRMX operating system and XENIX operating system
- Parallel interface, 1-5, 2-8
- Pascal-86, 3-5
- Physical characteristics. *See* chassis
- Physical features. *See* chassis
- Processors,
 - instruction cycle time, 1-4
 - interrupts, 1-4
 - types available, 1-1
 - word sizes, 1-4. *See also* individual boards, listed by number

ROM,
 iSBC 286/10 board, 1-5
 iSBC 86/30 board, 1-5

RS-232 interface. *See* serial interface

Serial interface, 1-6, 2-8

System Analysis Test (SAT), 4-1

System Confidence Tests, SCT 86/300 and SCT 286/300, 4-1

System Diagnostic Tests (SDTs), 4-2

Universal Development Interface (UDI), 3-5

XENIX 286 Operating System, 3-6

XENIX 86 Operating System, 3-6

XENIX Operating System,
 application of, 1-1, 3-6
 C programming language, 3-7, 3-9, 3-10
 command language, 3-7
 communications utilities, 3-10
 description of, 3-6 thru 3-11
 ED, text editor, 3-9
 file handling facilities, 3-8
 kernel, 3-6
 layers, 3-6, 3-8
 LEX, 3-10
 memory requirements, 3-10
 NROFF, 3-9
 SED, 3-9
 shell, 3-6
 software development tools, 3-10
 Source Code Control System (SCCS), 3-10
 Special hardware, 3-10
 structure, 3-6
 text editors and processors, 3-9
 TROFF, 3-9
 utility programs, 3-6, 3-9
 UUCP, 3-10
 VI, 3-9
 WRITE, 3-10
 YACC, 3-10

REQUEST FOR READER'S COMMENTS

Intel's Technical Publications Departments attempt to provide publications that meet the needs of all Intel product users. This form lets you participate directly in the publication process. Your comments will help us correct and improve our publications. Please take a few minutes to respond.

Please restrict your comments to the usability, accuracy, organization, and completeness of this publication. If you have any comments on the product that this publication describes, please contact your Intel representative. If you wish to order publications, contact the Literature Department (see page ii of this manual).

1. Please describe any errors you found in this publication (include page number).

2. Does this publication cover the information you expected or required? Please make suggestions for improvement.

3. Is this the right type of publication for your needs? Is it at the right level? What other types of publications are needed?

4. Did you have any difficulty understanding descriptions or wording? Where?

5. Please rate this publication on a scale of 1 to 5 (5 being the best rating). _____

NAME _____ DATE _____

TITLE _____

COMPANY NAME/DEPARTMENT _____

ADDRESS _____

CITY _____ STATE _____ ZIP CODE _____

(COUNTRY)

Please check here if you require a written reply.

WE'D LIKE YOUR COMMENTS . . .

This document is one of a series describing Intel products. Your comments on the back of this form will help us produce better manuals. Each reply will be carefully reviewed by the responsible person. All comments and suggestions become the property of Intel Corporation.



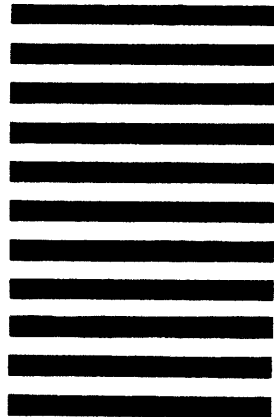
**NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES**

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 79 BEAVERTON, OR

POSTAGE WILL BE PAID BY ADDRESSEE

Intel Corporation
5200 N.E. Elam Young Pkwy.
Hillsboro, Oregon 97123

ISO-N Technical Publications





INTEL CORPORATION, 3065 Bowers Avenue, Santa Clara, California 95051 (408) **987-8080**

Printed in U.S.A.

OEM SYSTEMS