intel

PRODUCT GUIDE

1986

About Our Cover:
The design on our front cover abstractly portrays Intel products: boards, software and systems, as leading the way through superior products and unmatched support to the new horizons of the technological explosion. The design engineer will find better answers to systems development with Intel products not only because of Intel's product reliability and performance but also because the best technological support is available from Intel.

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*MULTIBUS is a patented Intel bus.

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

Intel Corporation
Literature Distribution
Mail Stop SC6-59
3065 Bowers Avenue
Santa Clara, CA 95051

10/25/85

Table of Contents

ALPHA/NUMERIC INDEX

This is not an all-inclusive part number listing of all Intel products but merely an index to those products mentioned in this Guide. Dash numbers, military, and EXPRESS parts are not designated separately but are included under the generic product number.

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INTRODUCTION

Intel introduced the first microprocessor in 1971. Today, microprocessors touch all our lives from factories to fields, and from our offices to our homes. The microelectronic revolution has brought greater productivity to industry, while it spawned new markets and businesses, and contributed to higher quality products and a better life. As we approach the 1990's, microprocessors continue to trigger a worldwide information revolution. Personal computers, communications networks, and advances in software are all making the world a better place to live.

Intel, as the founder of microprocessor development, is dedicated to the use of microprocessors in all industries. We develop microprocessors, microcontrollers, memory components, boards, software, and integrated systems products. All these products are based on "Open Standards" and "Open Systems" that allow you to use our components, boards, software, or systems to meet your needs quickly and produce reliable products for your market. This Product Guide summarizes Intel's complete offering of our products and services.

HOW TO USE THIS GUIDE

Intel offers this Product Guide as a ready reference "tool" to make it easy for you to select the set of products you'll need to meet your design objectives. You won't find every performance parameter for every device here, but you will find key features, and more importantly, cross references to products required for "total solution" designs. Products are arranged in family groups and are shown in tabular form so you can find what you need fast. Footnotes will guide you to related products. An Alphanumeric Index is located on Page v to point you directly to the page where each product is listed. In the Product Highlights we've provided a few examples of how particular designs can be executed using Intel products. Military and EXPRESS program (extended reliability) components are recapped in special sections. Customer Support Services are also contained in the Guide, and include Customer Training, Consulting, and Software and Hardware Support.

WHERE TO FIND MORE INFORMATION

For complete product line data sheets, application notes, etc., refer to the appropriate Intel handbooks listed on the inside front cover of the Guide or consult the Intel Literature Guide. For additional assistance, call your local Intel Sales Office or distributor listed in the last section of this Guide.

PRODUCT HIGHLIGHTS

The application of electronics is advancing rapidly, driven by advances across all fronts of VLSI technology, system technology, and software technology.

Intel Corporation is contributing to the leading edge of technology by developing and producing products in all three areas. To address the ever-increasing diversity of applications, Intel endeavors to develop standard, compatible building blocks in VLSI, systems, and software that can be used to formulate solutions for unique applications.

The Product Highlights that follow serve not only as an introduction to over 30 of Intel's most important products, but also demonstrate the role these products play as building blocks in the solution of some of today's most important applications.

Computers Are Contributing To Nearly Every Aspect Of Business Enterprise

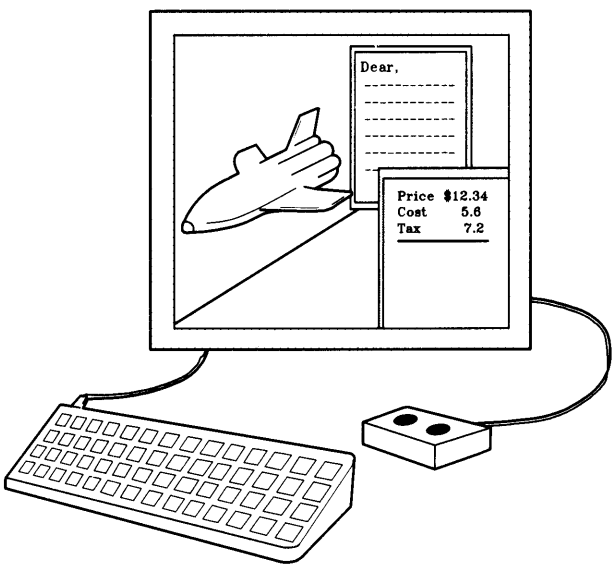
Underlying the growth in the use of personal computers is the profusion of user-friendly software written for the PC. Today a majority of desk-top PCs and portable PC products are based on the Intel 8086/8088 microprocessor architecture and supported by the largest base of compatible software for PCs.

80386 in Engineering Workstations

- Minicomputer-Level Performance
  - — 3 to 4 MIPs
  - — Floating Point Coprocessors
- Excellent UNIX‡ Machine
  - — 4 GB Segments
  - — Hardware Multitasking and Protection
  - — On-chip Paging
- Access to PC Software
  - — 8086 Compatible
- UNIX System V/386 O.S.
  - — Tailored to 386 Architecture
  - — Paged Virtual Memory
- Networking
  - — Ethernet

80386: Workhorse in the Factory

- Very High Performance
  - — On-chip Integer Math
  - — Floating Point Coprocessors
  - — Multiprocessing
- Reliability
  - — Protection
  - — CHMOS III Technology
  - — MULTIBUS® II Standard
- Real Time Operating System
  - — iRMX 286/386
- Continuity With MULTIBUS® I Standard
- Networking
  - — Manufacturing Automation Protocol



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‡UNIX is a trademark of Bell Laboratories.
†XENIX is a trademark of Microsoft Corp.
*CP/M is a trademark of Digital Research Inc.

80386 in Telecommunications

- Very High Performance
  - — Context Switch in Less Then 20 μs
  - — Multiprocessing
- Very Large Memory Addressability
  - — 4 GB Physical Space
  - — 64 TB Virtual Space
- Memory Protection
  - — Protection of O.S.
  - — Intertask Isolation
- Reliability
  - — CHMOS III Technology

80386 in Office Systems
A Natural Upgrade

- Runs 8086, 80286 Operating Systems: XENIX†, MS-DOS, PC-DOS, C-DOS . . .
- Runs Existing Applications: Lotus 1-2-3, Multimate . . .
- Choice of I/O: LAN, Graphics, Disk . . .
- 2 to 3 Times 80286 Performance

80286, 80186/80188, 8086/8088 16-Bit Microprocessor Architecture

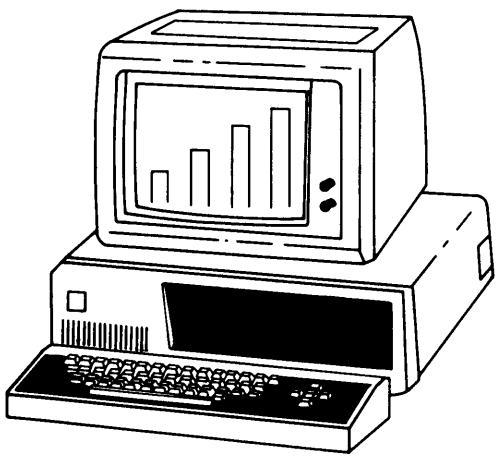
- Family of software compatible high performance processors
- Family of support peripherals for memory and communications
- Largest base of software written around the 8086 architecture
- Price performance/cost-effective growth path from the 8088 through the 80286
- Highly integrated processor with peripherals inside an 80186

The World is Witnessing Great Gains In Productivity With Human-Oriented Systems

Whether your system is a personal computer or an intelligent terminal, it must address the common issues of performance, flexibility, software and low cost. Intel has the building blocks for you. With the 80186, an entire computer design can fit on a single printed circuit board.

80186 Highly Integrated 16-Bit Microprocessor

- The 80186/188 has integrated all the standard system peripherals (processor, interrupt controller, timers, chip selects and DMA) all onto one chip
- Add memory and optional storage device (e.g., floppy) and you have a complete system



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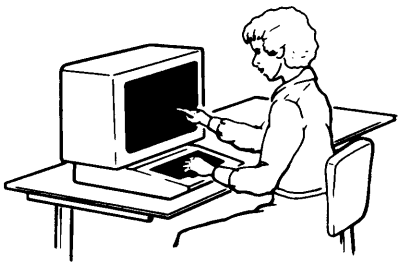
82586 LAN Coprocessor

- Local area network (LAN) controller so all computers in a given area can talk and transfer data to each other
- Intelligent processor which transfers messages to and from other computers on the network without main processor attention
- Allows connection to an Ethernet LAN to transfer data at 10 Million bits per second



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OpenNET™ Product Family

- Supports Ethernet (IEEE 802.3) and MAP (IEEE 802.4) networks
- Hardware and software modules to implement all seven layers of the ISO OSI model
- Provides interoperation among multiple operating systems, i.e., iRMX, XENIX, PC-DOS and MS-DOS
- Based on industry-wide network standards
- Networking solutions available at module and box levels

82730 Text and Graphics Coprocessor

- High quality text processor with advanced features like super and subscripting
- Supports multiple windows with smooth scrolling options in each window
- Multiple fonts, or character sets that can be simultaneously used by the user

27512, 27513 512K Bit EPROMs

- 27512—64K x 8, 27513—4 x 16K x 8 (Page Addressed)
- 64K bytes of storage for application software, which is available at the touch of a button to the user
- Standard 28-pin socket site that can be upgraded to higher density EPROMs in the near future

82588 Single-Chip LAN Controller

- LAN controller optimized for 1-2 Mbps CSMA/CD networks
- Highly integrated, including encodes/decodes, collision detection, end transmit clock functions
- Supports IBM PC Net and STARLAN(IEEE 802.3 1BASE5)

82C08 CHMOS DRAM Controller

- Draws less current than any other DRAM control solution and has a power-down mode for battery back-up
- Saves more board space than any other DRAM control solution. One chip requiring no glue provides all functions necessary for DRAM control

82716 Video Storage and Display Device

- Highly integrated, low cost graphics controller
- Graphics and character modes simultaneously displayed
- Built-in DRAM control and all video logic including color palette and D/A converters
- Extremely low chip count graphics
- Up to 640 x 512 resolution, 20 MHz dot rate

Powerful Sophisticated Graphics Capability Is Available For Both Business And Engineering Applications

Engineering work stations and sophisticated business systems are offering more graphics capability to meet the needs for visual interaction with complex objects and concepts.

80286 Advanced 16-Bit Microprocessor

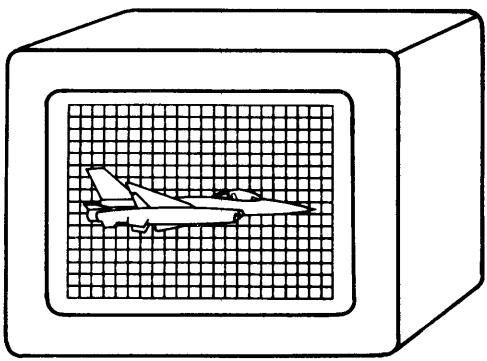
- The first fully integrated processor with high performance and on-chip virtual memory and memory management
- Designed to handle the multitasking environment in multiuser graphics systems
- Integrated layers of hardware security to protect data and software from corruption or unauthorized access
- The highest performance industry standard 16-bit micro on the market today, upward compatible with all 8086/8088 software
- Extensive family of coprocessors and peripherals to configure a system to special needs

80287 Numeric Coprocessor

- High-speed floating-point math coprocessor that adds horsepower to the 80286 instruction set
- IEEE floating point standard implementation
- Up to 100x performance of software routines
- Accuracy extended to 80 bits

82786 Graphics Display Controller

- Sophisticated graphics display and bit map graphics capability
- Off-loads host processor from doing screen updating
- Accepts high level commands from CPU to draw, move, or zoom objects



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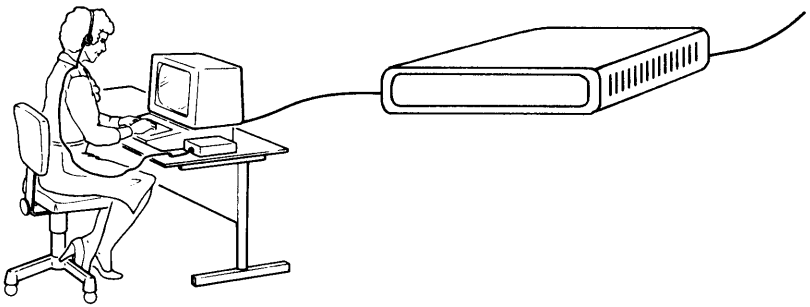
Office Systems Are Serving The Needs Of Multiple Users And Linking Them Into Networks

A family of Intel Open Systems supports the need for multiuser and networked system solutions. The networking of computers allows the sharing of expensive peripherals like printers, and large disks.

XENIX* 286 R3.0 Operating System

- Licensed version of UNIX** Operating System with commercial extensions
- Many industry standard horizontal and vertical application packages available
- Supports sophisticated multiuser, multitasking capability with all the UNIX software tools
- Uses the on-chip memory management of the 80286 and Intel engineered file system enhancements to achieve unsurpassed XENIX multiuser performance.



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System 310AP Supermicro System

- 80286-based supermicro system with XENIX 286 operating system
- Two to sixteen users for office applications
- Built with standard boards, peripherals, and software
- Expandable with other boards and application software to customize your application

iDIS™ Database Information System

- Links personal computers to mainframe database
- Provides controlled access to mainframe database
- Also a stand-alone computer with spread sheet, word processing, database, and menu and forms development packages

iATC Advanced Telecommunications Components

- Integrated services digital networks transceivers supporting transmission protocol requirements
- Voice conversion devices

*XENIX is a trademark of Microsoft Corp.
**UNIX is a trademark of Bell Laboratories.

Factory Systems Are Delivering Improved Productivity And Product Quality

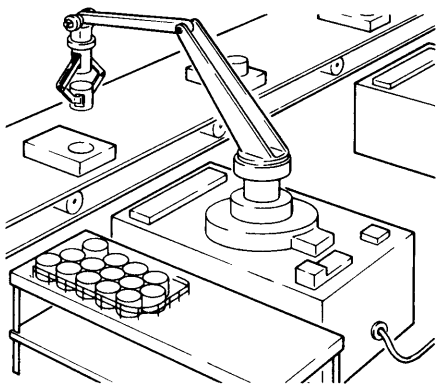
Intel's systems and components support a comprehensive automation strategy, allowing industrial control functions to reach from the central system level all the way to the most remote microcontroller.

BITBUS™ Microcontroller Interconnect

- Facilitates intelligent distributed control of industrial machines
- Makes possible simple, high performance communications among Distributed Control Modules and associated MULTIBUS® systems
- Based on Intel's 8044 Microcontroller, which includes a high speed SDLC controller
- Supports iRMX Operating Systems
- iDCX Distributed Control Executive for Intel 8051 & 8096 Microcontrollers.

iRMX™ Operating System

- Real-time, multitasking operating system for fast response to machine inputs
- Ideal for interrupt driven multitasking factory control systems
- Supports high level language and standard software driver interfaces for all Intel boards
- Highly configurable to add custom user devices or other vendors speciality boards
- Can be configured for any 8086/88, 80186/188, or 80286 board or component or System 3XX design



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System 310AP Supermicro System

- 80286 based supermicro system made from standard Intel boards and standard industry peripherals
- Supports iRMX 86 and iRMX 286 operating system for real-time factory applications
- Allows for easy integration of other boards to interface with other factory equipment

iSBC® 254 Bubble Memory MULTIBUS® Board

- Non-volatile storage with bubble memory is ideal for rugged environments such as factories
- Bubble memory eliminates need for batteries, enhances reliability and up time
- Bubble memory look like floppy disk replacements to the software operating system

MCS®-96 Advanced 16-Bit Microcontrollers

- The first 16-bit microcontroller with on-chip power and precision for industrial applications
- Sensors and actuators interfaced easily to on-chip A/D inputs, pulse width modulated outputs, and digital I/O channels
- Simple communication between MCS-96 devices and higher level microprocessors over standard serial communication lines

NVRAM And E²PROMs

- Critical local data parameters storage for power fail situations

GXM 186/78A Graphics Subsystem

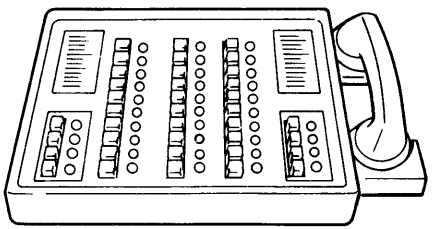
- Efficient "Human Interface" through 16 color graphics
- Expansion for any MULTIBUS® system or as a standalone host CPU
- XENIX and iRMX operating system support as standard, as is iVDI graphics firmware

OpenNET™ MAP Solution

- iSXM 554 Communications Engine provides MAP networking capabilities for MULTIBUS® based systems
- Conforms to Industry standards MAP and IEEE 802.4 t0Mbps Broadband Token Bus
- Implements a complete seven layer solution for MAP 2.1 running Intel's iNA 961 Transport/Internetwork and MAP-NET software.

Telecommunications Capability Is The Key to Keeping In Touch With The Modern World, Whether You Tie Into A Worldwide Network Or You Just Need To Phone Home

Digital PABXs and their closely associated feature phones are experiencing rapid advances in capabilities in an increasingly competitive environment. Intel is continuing its contribution to this evolution of digital communications.



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80C51 CMOS Advanced 8-Bit Microcontroller

- Powerful 8-bit industry standard microcontroller in a low power chip with on-chip serial port, chip selects, and powerful software instructions to manipulate every bit
- Up to 24 I/O lines for interfacing with buttons, switches, and other external devices
- Customize 80C51 via the iCEL Design System

2817A 16K Bit E²PROM

- Stores the entire dialing repertoire and remembers the status of every feature in a non-volatile E²PROM
- Can be remotely updated with the latest toll rates
- Eliminates the need for batteries or maintenance, uses a 5V only supply
- System configuration parameters can be stored so on power up the system configures itself

2914 Combo Codec/Filter Family

- Reduced cost and improved line card density with the standard combo codec/filter
- Exceeds D3 and CCITT transmission specifications in the u/law and A/law versions

27C256 CHMOS 32K x 8 EPROM

- Low active power requirements with fast access time for power sensitive communication equipment

iATC Product Family

- Modular building blocks for advanced telecommunication systems (exchanges terminal equipment)
- Comprehensive solutions for ISDN (Integrated Services Digital Network)

And Intel has the support you need to get your product to market on time, on budget, and on your performance target.

Intel offers proven development tools on a selection of industry standard systems

Development Tools

- High-level languages are optimized around each architecture for maximum performance
- Debuggers feature symbolic debugging to automate otherwise tedious operations
- I²ICE, TargetSCOPE 186, and PSCOPE debuggers offer a full range of software and hardware debugging capabilities for 8086, 8088, 80186, 80188, and 80286 microprocessors
- Emulators debug 8096, 8042, 8044, 8049, and 8051 microcontrollers thoroughly and transparently
- EPROM programming and EPLD development tools help put the design into hardware
- Program management tools bring control into software version management and system generation.

Networks

- Intel NDS II and OpenNET networks link tools hosted on Intel development systems with tools hosted on other industry-standard systems
- Networks are based on the high-performance Ethernet local area network standard
- NDS II provides Intel's development systems with Program Management Tools, electronic mail, load sharing, print spooling, protected file management, and over 300MB of mass storage

Development Workstations

- The Intellec Series IV development system is the most complete microprocessor development tools host available
- Series IV supports the full capability of Intel development products, including languages, debuggers, and network-based tools
- The iPDS Personal Development System supports 8051 and 8044 languages, debugging, and EPROM programming on a portable system

Product Service Provides Maintenance Services

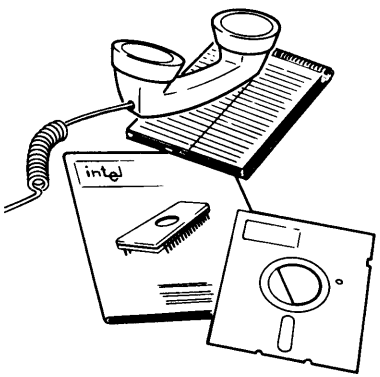
- Supports board and system level products
- Capability includes warranty, field, contract services as well as installation

Software Support Services

- Software updates, technical reports, software library
- Hotline phone support and consulting available

Customer Training Courses

- Workshops on component, systems, and software products
- Available at Intel Training Centers and at customer sites



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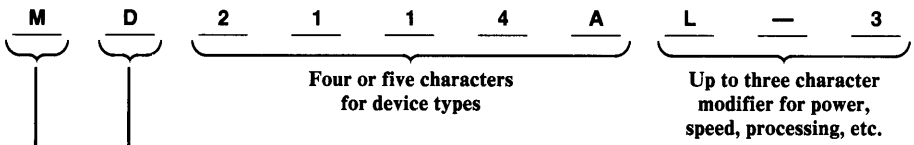
PRODUCT IDENTIFICATION CODE

Semiconductor components are identified as follows:



Package Type

A — Ceramic, Pin Grid Array
B — Hermetic Package, Type B
C — Hermetic Package, Type C (Ceramic)
D — Hermetic Package, Type D (Cerdip)
L — Laminated Plastic
N — Plastic Leaded Chip Carrier (PLCC)
P — Plastic Package
R — Hermetic, Leadless Chip Carrier (LCC)
V — Plastic Leaded Chip Carrier
X — Unpackaged Device

M — Indicates Military Operating Temperature Range

I — Indicates Industrial Grade

J — Indicates a JAN qualified devec, but is for internal identification purposes only. All JAN devices must be ordered by M38510 part number (Example: M38510/42001 BQB), and will be marked in accordance with MIL-M-38510 specifications.

L — Indicates extended operating temperature range (−40°C to −85°C) Express product with 168 ± 8 hrs. dynamic burn-in.

Q — Indicates commercial temperature range (0°C to −70°C) Express product with 168 ± 8 hrs. dynamic burn-in.

T — Indicates extended temperature range (−40°C to −85°C) Express product without burn-in.

Examples:

D2147H-1	High Speed 4096 x 1-Bit Static RAM (35ns, 180/30 mA), hermetic package Type D.
C8080A2	8080A Microprocessor with 1.5 s cycle time, hermetic package Type C, commercial temperature range.
MD8080A/B	8080A Microprocessor, hermetic package Type D, military temperature range, MIL-STD-883 Level C processing.*

*On Military temperature devices, C suffix indicates MIL-STD-883 Level C processing.

CUSTOMER SUPPORT

CUSTOMER SUPPORT

Customer Support is Intel's complete support service that provides Intel customers with Hardware support, Software support and Customer Training.

After a customer purchases any system hardware or software product, service and support become major factors in determining whether that product will continue to meet a customer's expectations. Such support requires an international support organization and a breadth of programs to meet a variety of customer needs. As you might expect, Intel's customer support is quite extensive. It includes factory repair services and worldwide field service offices providing hardware repair services, software support services and customer training classes.

Hardware Support Service provides maintenance on Intel-supportable products at the board and system level. Both field and factory services are offered. Services include several types of field maintenance agreements, installation and warranty services, hourly contracted services (factory return for repair) and specially negotiated support agreements for OEMs, system integrators and large volume end-users having unique service requirements.

Software Support Service provides maintenance on software packages via software support contracts which include subscription services, information phone support, and updates. Consulting services can be arranged for on-site assistance at the customer's location for both short-term and long-term need. For complex products such as NDS II or I^2ICE, orientation/installation packages are available for training at the customer site. Additional software programming is available through a membership in Insite Users' Library, where customer-submitted programs are catalogued and made available for a minimum fee to members.

Customer Training provides workshops at customer sites and Intel's facilities.

HARDWARE SUPPORT SERVICES

Today, it's essential to have dependable data processing and information storage equipment. To ensure trouble-free performance, every Intel product is engineered and manufactured to exacting standards. But sometimes, even the finest components can malfunction. It's then that Intel Hardware Support Service delivers fast, economical, quality hardware maintenance and service support to keep vital projects on schedule.

Intel is committed to providing an international service support package through a wide variety of service offerings available from Intel Hardware Support. See Table 1 for list of services.

SOFTWARE SUPPORT SERVICES

Intel's Software Support Service is a comprehensive range of post sales support programs for your software and systems purchased from Intel. Its objectives are to maximize your system's performance and minimize unnecessary downtime for greater productivity. These services are provided for all Intel developed and most Intel marketed third-party software.

System Support Services include software support contracts, orientation/installation packages, consulting services, and Insite™ Users' Program Library.

Software Support Contracts

Contracts provide updates, subscription service (including product specific trouble shooting guides); *COMMENTS* Magazine and technical information phone service—all for a fixed monthly fee. Contracts are available in two levels

Table 1. Hardware Support Offerings

Service	Highlights
Standard Hardware Maintenance Agreement	• Full level service covering parts, labor, preventative maintenance and engineering change installations at the customer site. • Customer selects hours of coverage. • Applies to standard Intel products.
Carry-in Maintenance Agreement	• Economical • Same services as standard contract, but the customer delivers the equipment to an Intel facility.
Per Call Services	• Purchase labor and materials on an as-needed basis for installations, repairs, preventative maintenance, and other services.
Factory Services Factory Direct Return Authorization Service (DRA) Factory Return Replacement Authorization Service (RRA)	 • Economical 30-day turnaround • Applies to board level products in all areas and system customers in non-serviceable areas. • Expedited service 48-hour turnaround • Applies to currently manufactured board level products in minimal quantities.
Installation and Warranty	• Installation is included on many Intel system products. Hardware support installs, services and verifies correct operation before turning the system over to the customer. • Warranty service is provided either via factory returns or at the customer site, depending on the warranty associated with that particular product.
Open Systems Support	• Individually tailored contracts to meet unique equipment configurations and customer support needs. • Can include support for non-Intel products as part of the total support agreement. • Provides the international service capabilities on Intel's Hardware support organization to the end-user customer of System Integrators and OEMs.

Not all services provided for all product lines. Contact your local Intel service office for more specific information on the right service to meet your needs.

of support: Standard Service-updates, subscription, and TIPS; Basic Service-updates and subscription. Contracts are sold in environments which represent software product grouping of the most commonly used software in a given environment (i.e., Series III/IV environment, VAX environment, iRMX environment).

Orientation/Installation Support Packages

Support Packages are available to provide an additional level of support for complex systems. This service provides you with software installation, system generation and orientation to make you and your Intel system fully productive as soon as possible.

Consulting Service

Consulting Service provides customized support for board and component level customers. Consulting Service provides a wide range of support—from system designs to solving difficult development problems to complete project management and project implementation.

Insite™ User's Program Library

Insite User's Program Library provides user-supplied and non-licensed software products and modules for a nominal fee. A wide variety of products is available to be used on or in conjunction with Intel hardware, software and system products.

Software Support Service is Intel's commitment to provide the customer with consistent, high-quality, post-sales software support. It is our way of delivering guaranteed support on which you can rely. To tailor a full service software support program that addresses your specific needs, contact your local Intel sales or service office for more information.

CUSTOMER TRAINING

Intel offers intensive training workshops on a wide range of microcomputer products and database management products. The workshops are held at Intel Training Centers across the United States, as well as in Europe and Japan, or at customer sites upon request. The workshops range in length from three to nine days and feature "hands-on" laboratory exercises.

Workshop Attendees

The microcomputer workshops are designed primarily for design engineers who need to become familiar with Intel products. Engineering managers, those who are evaluating products, field service engineers, technical writers, and other service personnel who want to get an in-depth look at the architecture and systems also attend.

Training Center Locations

Please call the nearest Training Center for our complete workshops catalog (Order No. 980100) or write/call the Intel Literature Department to order a copy.

Boston	(617) 692-1000	Stockholm	(468) 734-01-00
Chicago	(312) 310-5700	Milan	39-2-82-44-071
San Francisco	(415) 940-7800	Tokyo	03-437-6611
Washington, D.C.	(301) 474-2878	Osaka (Call Tokyo)	03-437-6611
Israel	(972) 349-491-099	Benelux (Rotterdam)	(10) 21.23.77
London	(0793) 696-000	Copenhagen	(1) 198-033
Munich	(089) 5389-1	Hong Kong	5-215311/7
Paris	(01) 687-22-21		

Table 2. Customer Training Courses

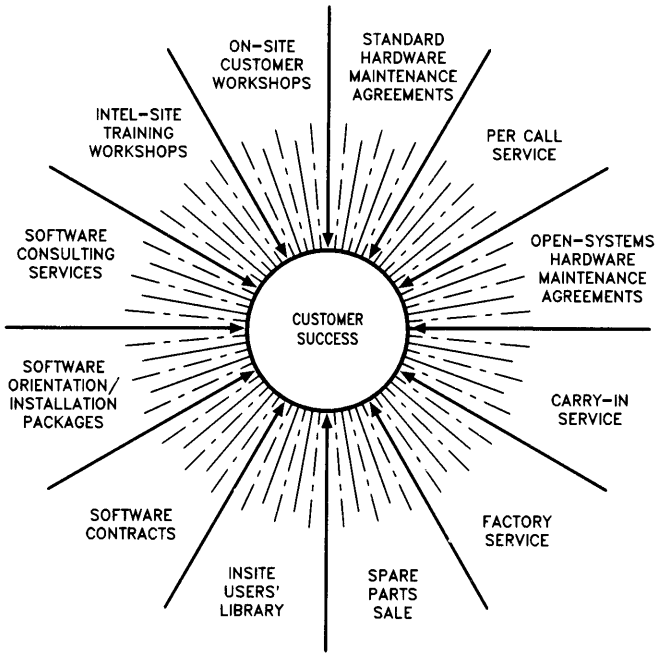
Course Title	Description
INTRODUCTORY:	
Self Study Introduction to Microprocessors	Contains an 8085-based kit, audio cassettes, workbook, and manuals.
Introduction to Microprocessors	Covers fundamental computer concepts using the SDK-85 design kit.
MICROCONTROLLERS:	
MCS®-51 Microcontrollers	Architecture, assembly language programming, in-circuit emulation, and communication chips.
MCS®-96 16-Bit Microcontrollers	Architecture, assembler, linkage software, peripherals and single board emulator.
MICROPROCESSORS:	
MCS®-80/85 Microprocessors	Architecture, assembly language programming, system design, interfacing, and in-circuit emulation.
iAPX Based Architecture Microprocessors	ASM 86, 88, 186-systems design, debugging tools, multiple-module programming.
80186, 80188 Microprocessors	Large-system programming, 8086, 8088, 80186 family of products; utilities, high-level language interfacing, 8087, 8089 coprocessors.
286 Microprocessor	Architecture, operating modes, 286 protection model.
DATA COMMUNICATIONS: (Including Ethernet)	Introduction to data communication fundamentals including protocols, packet switching, plus network topologies and ISO model layered architecture. Presentation of local area networks (LAN's) with concentration on Ethernet. Single-chip and single-board computer (iSBC™) solutions for data communication implementations are discussed. "Hands-on" laboratories covering asynchronous and synchronous communications.
MICROCOMPUTER PROGRAMMING & OPERATING SYSTEM WORKSHOPS:	
"C" Programming	Design, implement and debug "C" software. Interface "C" to XENIX* environment.
PL/M Programming	Design, implement and debug structured applications software. Use PSCOPE debugging tool.
PL/M-iRMX™ 51 Operating System	Techniques to design and implement software using the PL/M langauge for the 8051/44 family. PL/M applications using ICE-51. Introduction to real-time multi-tasking executive principles and implementation. Concurrency of tasks, asynchronous events, priority scheduling, interrupts and intertask communication are discussed.
iRMX™ 86/286 Operating System	Two week workshop introduction to iRMX 86 real-time multi-tasking executive principles and implementation. Techniques needed to design and implement software using the PL/M language for the 8086/88 family of microprocessors. Concurrency of tasks, asynchronous events, priority scheduling, resource sharing, interrupts and inter-task communication. Inter-device communication using the features of iMMX-800 MULTIBUS® message exchange software in the iRMX 86 environment.

Table 2. Customer Training Courses (Continued)

Course Title	Description
iRMX™ Application & Debug	Exercises iRMX technique in an intensive (80%) lab-based workshop. iRMX device drivers, application design and testing tools.
XENIX* Operating System	XENIX positioning and features. XENIX editors, file system, shell programming, concurrent programming vs. sequential programming.
NDS-II/SERIES IV	Perform file maintenance routines, design & use command. Perform system maintenance operations and install software on NDS-II/Series IV. Describe iNDX operating system components, create and manage small PMT database. Design optimal system configuration and file structure.
Database Information System (iDIS™)	Overview of decision assist tools, file management, database management. Maintaining and customizing the iDIS menu/form systems. System administration, remote host communications.
"LAN" SYSTEMS IMPLEMENTATION	Reviews ISO OSI (Open System Interconnection) reference model. Teaches iNA-960 transport, external data link, and network management function commands. Provides "hands-on" laboratory in which iNA-960 is configured into an iRMX 86 environment and basic DS-8073 compatible transport level message exchanges are accomplished. Covers O.S. independent iNA-960 interface for component-based applications. Student keeps iNA-960 cookbook documentation (which could save 3 to 5 man-weeks of ramp-up time.
I^2 ICE USERS	Covers use of I^2 ICE to debug hardware and software prototypes. Offers hands-on experience with I^2 ICE. Covers emulation commands, trace data collection and display, and the display and modification of the prototype system.

*XENIX is a trademark of Microsoft Corp.

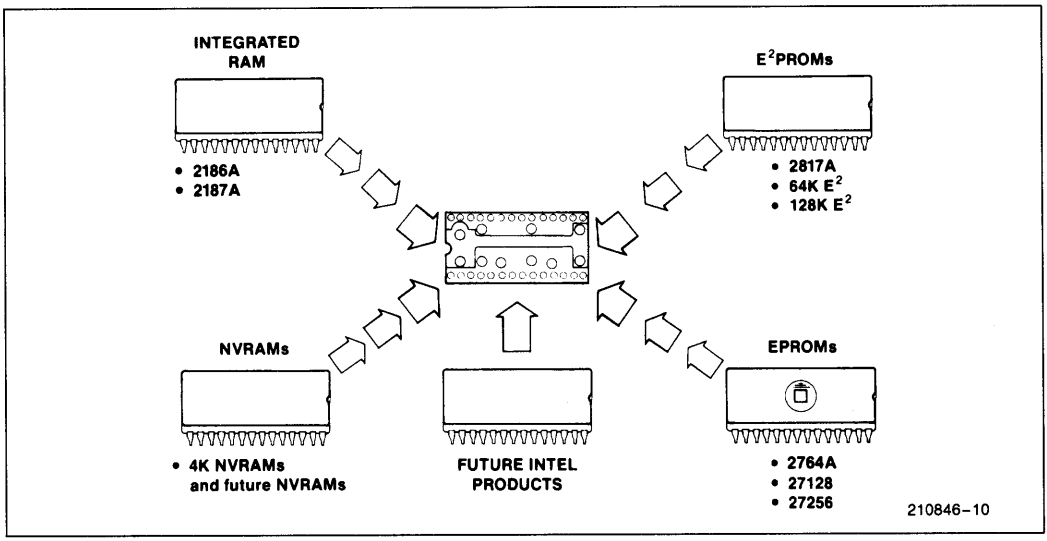
FULL RANGE OF SUPPORT SERVICES



210846-9

MEMORY COMPONENTS

Intel supplies a broad line of memory products to meet your application needs. To fit the needs of smaller microprocessor based systems, the byte-wide family of memories offer flexibility and upgradeability that tailors the memory to the exact requirements of the application.



Byte-Wide Family (JEDEC-Approved Universal Socket)

RAMs

Intel offers a wide range of RAMs, fabricated with Intel's production-proven HMOS technology and the latest CHMOS IIE technology for high system performance and reliability. Ranging from the traditional high speed Static RAMs to the innovative iRAM, each is optimized to best satisfy system design objectives. From microprocessor memory to mainframe memory, Intel RAMs form an integral part of the system solution from Intel.

EPROMS

An EPROM, or erasable, programmable read only memory, is a non-volatile memory component for program storage and prototyping applications. Intel offers a wide range of EPROM densities from 16K to 512K bits which use Intel's JEDEC-approved pin sites, allowing easy upgrade. EPROMs are available in either cerdip or windowless plastic packages. The plastic packaged EPROMs are one-time programmable and ideal for high-volume production environments. Intel's 27512 and 27513 EPROMs are based on the HMOS II-E technology, which scales down cell size and offers advanced product specifications such as improved performance and power dissipation. An important feature is the two-line control which eliminates bus contention in microprocessor systems. Access times are compatible with high performance microprocessor systems. Intel is also moving EPROMs into low power, high performance applications with its CHMOS IIE technology. The popular 2764 and 27256 are now available as a 27C64 and 27C256 respectively. Latched versions for high integration solutions with microcontrollers are also available.

Intel EPROMs feature the int$_e$ligent Programming™ Algorithm, which ensures faster and more reliable programming. Recently with Intel's plastic packaged EPROMs a new Quick-Pulse Programing™ Algorithm was introduced cutting programming time down to seconds.

Intel is committed to the rapidly advancing Surface Mount Technology. Intel's growing line of Plastic Leaded Chip Carriers (PLCC) packages includes the 27128A and 27C64 EPROMs.

Table 3. RAMs

	HMOS* Static RAMs					CHMOS* Static RAMs		Integrated RAMs	
Part Number	**2114A**	**2115/ 2125A**	**2147H**	**2148H**	**2149H**	**51C67**	**51C68**	**2186A**	**2187A**
Size (Bits)	4K	1K	4K	4K	4K	16K	16K	64K	64K
Organization	1K x 4	1K x 1	4K x 1	1K x 4	1K x 1	16K x 1	4K x 4	8K x 8	8K x 8
# of Pins	18	16	18	18	18	20	20	28	28
Read Access (ns)	100–250	45–70	35–70	45–70	45–70	30–35	30–35	250–300	250–300
Maximum Current dis (mA) (Operating/ Standby)	40–70	75–125	140–180/ 10–30	125–180/ 20–30	125–180	60–55/5 60–80/5–10	60–80/5–10	70/20	70/20
Express Available	Yes	Yes	Yes	Yes	Yes	—	—	No	No
Military Available	Yes	No	Yes	Yes	No	Yes	Yes	No	No
Failure Rate/ 1000 Hrs. @ 55° (60% UCL)	0.007%	0.017%	0.009%	0.009%	0.009%	TBD	TBD	0.03%	0.03%
Reliability Data Literature #	—	—	RR-26	RR-26	RR-26	—	—	RR-37 ER-08	RR-37 ER-08

*CHMOS and HMOS are patented processes of Intel Corporation.

E²PROMS

As part of its non-volatile memory family, Intel produces a family of electrically erasable programmable read-only-memories (E²PROMs). These devices embody all of the functional benefits of EPROMs plus the added features of in-circuit erasability and programmability.

E²PROMs are furnished in JEDEC-approved DIP and chip carrier packages for commercial and military applications. These devices are characterized by their fast read times, high reliability, and long term data retention. Extended temperature and burn-in (EXPRESS Program) versions are also available.

Typical uses for E²PROMs include changeable system parameters, soft keys in terminals, user-configuration tables, remote firmware updates, and error logs. Intel E²PROMs offer the functionality of the 2817A and 2864A for complete ease-of-design and mobility to higher E²PROM densities.

NVRAMS

The Intel 2004 Non-Volatile Random Access Memory (NVRAM) is a 4K device organized in a 512 X 8, byte-wide architecture. The 2001 is a 1K device organized 128 X 8. They provide the real-time read/write functions of a static RAM together with the reliable non-volatile storage capability of an E²PROM. Internally the NVRAM consists of a high speed static RAM array backed up, bit-for-bit, by an E²PROM array for non-volatile storage. The transfer of memory data between the static RAM and the E²PROM array occurs in parallel for fast storage and recall as well as minimal system support. The RAM operating characteristics of the NVRAM provides high speed microprocessor performance with unlimited endurance.

In the non-volatile storage mode, data retention is specified at over 10 years for each STORE operation. Over 10,000 STORE operations can be performed reliably. The 2004 NVRAM is furnished in the JEDEC-approved 28-pin byte wide universal package, while the 2001 NVRAM is furnished in an 18-pin, 300 mil package with its address and data lines multiplexed for direct interface to microcontrollers and microprocessors.

Table 4. EPROMs/E²PROMs/NVRAMs

	EPROMs										E²PROMs		NVRAMs	
	2732A	**2764A**	**27128A**	**27256**	**27512**	**27513**	**27C64**	**87C64**	**27C256**	**87C256**	**2817A**	**2864A**	**2004**	**2001**
Size (Bits)	32K	64K	128K	256K	512K	512K	64K	64K	256K	256K	16K	64K	4K	1K
Organization	4K x 8	8K x 8	16K x 8	32K x 8	64K x 8	4 x 16K x 8	8K x 8	8K x 8	32K x 8	32K x 8	2K x 8	8K x 8	512K x 8	128K x 8
# of Pins	24	28	28	28	28	28	28	28	28	28	28	28	28	18
Read Access (ns)	200-450	180-450	150-300	170-300	200-300	200-300	200-300	200-300	170-300	170-300	200-450	200-250	200-300	180-300
Programming Time (Typical)*	3.5 min.	1.5 min.	3 min.	6 min.	6 min.	6 min.	1 min.	—	—	—	10 ms	10-20 ms	10 ms	10 ms
Quick-Pulse Programming™ (Typ)**	—	1s	2s	4s	—	—	—	—	—	—	—	—	—	—
Current (mA)	Active 125	Active 60/75	Active 100	Active 100	Active 125	Active 125	Active 10	Active 10	Active 30	Active 30	Active 150	Active 125	Active 100	Active 100
	Standby 35	Standby 20/35	Standby 40	Standby 40	Standby 40	Standby 40	Standby 100μ	Standby 100μ	Standby 100μ	Standby 100μ	Standby 55	Standby 60	Standby 55	Standby 35
Express Available	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Q186	Yes	—	Yes	Yes
Military Available	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Q286	—	Yes	—	Yes	—
Failure Rate/1000 Hrs. @ 55°C (60% UCL)	0.005%	0.0065%	0.0152%	0.0063%	0.0063%	0.0063%	0.0063%	0.0063%	—	—	—	—	—	—
Reliability Data Literature #	RR-35C	RR-35C	RR-35C	RR-35C	—	—	RR-35C	RR-35C	—	—	ER-9	—	—	—
Plastic	Yes	Yes	Yes	Yes	Q286	Q286	—	—	—	—	—	Q286	—	—
PLCC	—	—	Yes	—	Q386	Q386	Yes	—	Yes	—	—	—	—	—
On-Chip Latch	No	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	No	Yes

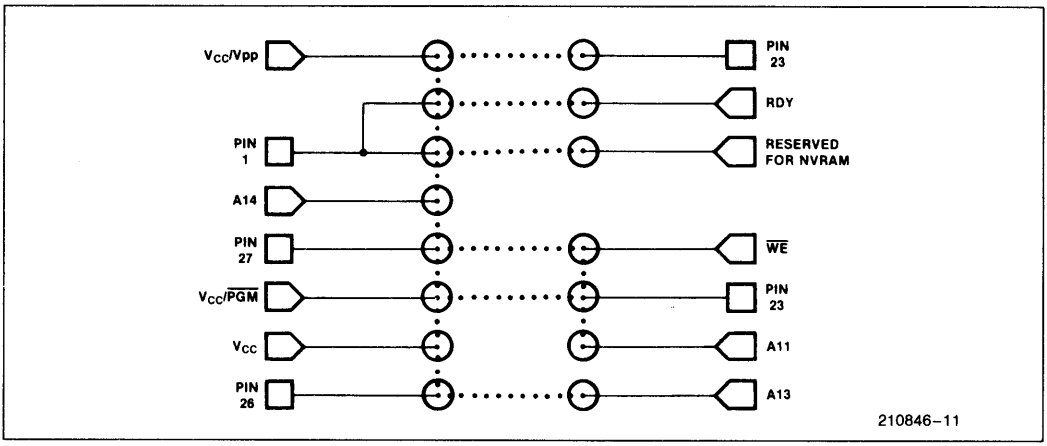
*EPROMs per device, E²PROMs per byte.

**Plastic EPROMs only, theoretical limit with no overhead on programmer.

The Universal Configurator

The Universal Configurator is a printed circuit layout for the JEDEC-approved universal socket. It takes advantage of the broad pinout compatibility of the byte-wide memories. The socket layout has been designed to accommodate devices of various product families, RAMs, EPROMs, E²PROMs, and NVRAMs.

The Universal Configurator places the necessary control signals for all product families in close proximity to traces for the few pins that differ between the families. To "design in" any Universal Site-compatible product, the system designer merely connects (using wire jumpers or by cutting existing traces) the appropriate control signals for the desired devices. The dotted lines on the Universal Configurator show where these connections are made.



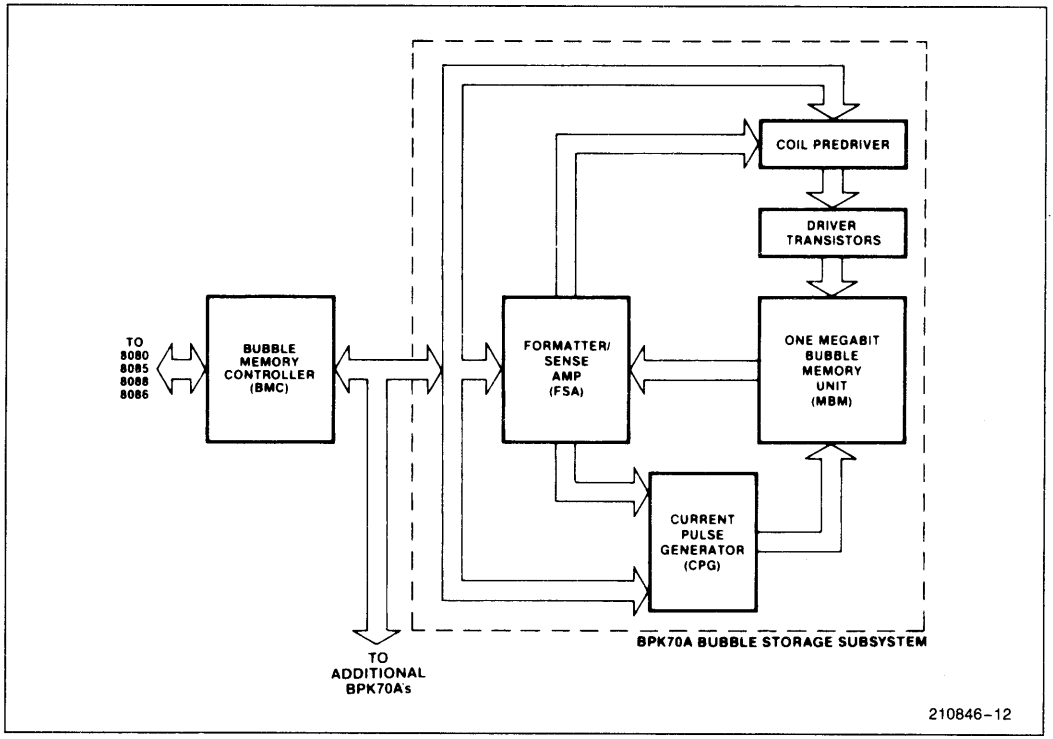
Universal Configurator for 24-Pin and 28-Pin Sites

Bubble Memory

Magnetic bubble memory is a solid state, read-write, non-volatile mass storage subsystem that features reliability, ruggedness, small size, light weight, and limited power dissipation. A magnetic bubble memory stores data in magnetic domains or "bubbles" in a thin film on a garnet chip. The Intel bubble storage subsystem includes the bubble memory chip and five support chips (formatter/sense amplifier, current pulse generator, coil pre-driver and two drive transistors) which serve to support read and write operations between the bubble and the controller. The bubble memory controller has a software command set and is the interface between the bubble storage subsystem and microprocessor bus. Interfacing with a bubble memory controller is similar to interfacing with a disk drive controller. The controller does data conversion between serial storage in the bubble and parallel data from the system bus. The controller generates all timing signals required by the bubble storage subsystem. The Intel bubble memory product line includes interchangeable component kits for production, fully assembled and tested single bubble prototyping boards, multibubble MULTIBUS® boards, multibubble MULTIMODULE® boards using both 1 megabit and 4 megabit bubble memories. A rugged, removable cassette is also available using 1 megabit bubble memory.

Table 5. Bubble Components (1 Mbit)

	Description	Power Supply	Operating Temp. 10–55° 0–75° 20–85°	Package Type	Reliability % Per 1000 Hrs./55°C	Reliability Data Literature#
7254	Coil Driver	+12V	— Yes Yes	16 Pin DIP	0.043	RR-36
7250	Coil Predriver	+12V	— Yes Yes	16 Pin DIP	0.058	RR-36
7242	1 Mbit Formatter/ Sense Amplifier	+5V, +12V	— Yes Yes	20 Pin DIP	0.027	RR-36
7230	1 Mbit Current Pulse Generator	+5V, +12V	Yes Yes Yes	22 Pin DIP	0.017	RR-36
7220	1 Mbit Controller	+5V	— Yes Yes	40 Pin DIP	0.030	RR-36
7110A	1 Mbit Bubble Memory	+12V	Yes Yes Yes	20 Pin Leaded	0.072	RR-36



Bubble Configuration 1 Mbit System

Table 6. Bubble Components (4 Mbit)

	Description	Power Supply	Operating Temp. 10–55° 0–75° 20–85°	Package Type	Reliability % Per 1000 Hrs./55°C	Reliability Data Literature #
7264	Coil Driver	+12V	— Yes —	Discrete 3 Pin	—	—
7250	Coil Predriver	+12V	— Yes Yes	16 Pin DIP	—	—
7244/ 7245	4 Mbit Formatter/ Sense Amplifier	+5V, +12V	— Yes —	20 Pin DIP	—	—
7234	4 Mbit Current Pulse Generator	+5V, +12V	— Yes —	22 Pin DIP	—	—
7224/ 7225	4 Mbit Controller	+5V	— Yes —	40 Pin DIP	—	—
7114	4 Mbit Bubble Memory	+12V	Yes — —	20 Pin Leaded	—	—

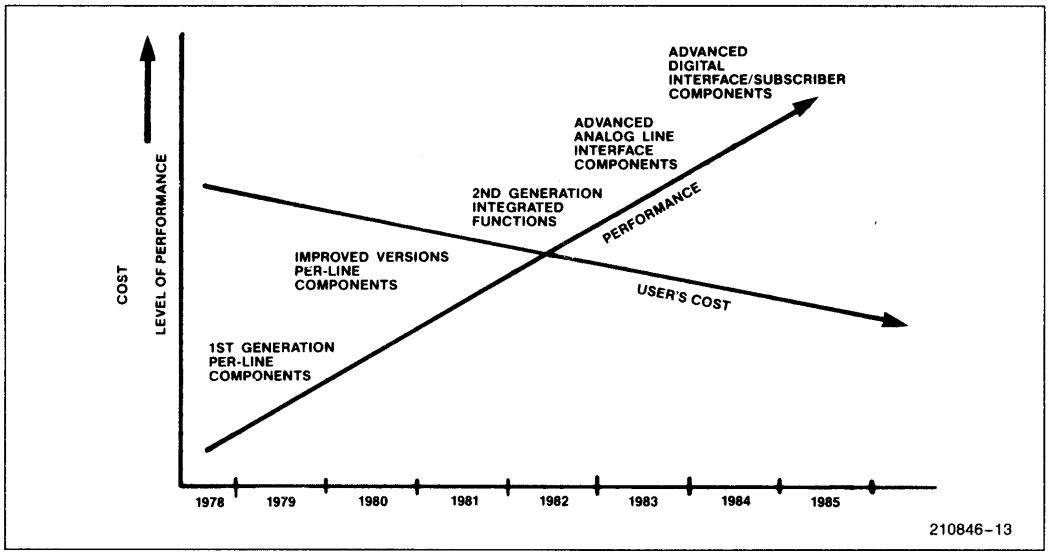
Table 7. Bubble Memory Kits‡

	BPK70A	BPK72A	BPK5V75A	BPK5V74A	BPK 74*
Description	1 Mbit Production Kit	1 Mbit Prototype Board Assembled & Tested	4 Mbit Prototype Board Assembled & Tested	4 Mbit Production Kit	4 Mbit Production Kit
Average Access Time	40 ms	40 ms	80 ms	80 ms	80 ms
Data Rate	100K bit/sec.	100K bit/sec.	200K bit/sec.	200K bit/sec.	200K bit/sec.
Power Supplies	+5V, +12V	+5V, +12V	+5V, +12V	+5V, +12V	+5V, +12V
Operating Temperature 10–55° 0–75° 20–85°	 Yes Yes Yes	 Yes Yes Yes	 Yes — —	 Yes — —	 Yes Yes —
Typical Power Consumption (W)	3.4	3.9	5.0	6.0	5.0
Reliability % Per 1000 Hrs./55°C	0.260	0.290	—	—	—
Reliability Data Literature #	RR-36	RR-36	—	—	—
Kit Content	7110A 7220 7230 7242 7250 7254 (2)	7110A 7220 7230 7242 7250 7254 (2) Literature Pre-Fabricated Printed Circuit Board	7114 7224 7234 7244 7250 7264 (8) Literature Pre-Fabricated Printed Circuit Board	7114 7224 7234 7244 7250 7264 (8) 9 TTL ICIS For Added Redundancy Capability	7114 7225 7234 7245 7250 7264 (8)

*Available 2H85.
‡See Table 39, Page 79 for Bubble Memory Boards.

TELEPHONY COMPONENTS

The Intel telecommunication product line consists of three generations of telecom voice/data conversion products; the first generation codecs and filter; the second generation combo family; and the third generation of Advanced Telecom Components (iATC). Two arrows are indicated on the chart below which illustrate Intel's philosophy of increasing performance levels while reducing user's costs, with each succeeding generation of telecom product.



Codecs/Filter/Combos

Intel's PCM Codecs, Line Filters and Combo Chips are special purpose A/D and D/A converters and filters for use in PCM Line Circuits in telephony switching and transmission systems. The wide dynamic range (78 dB) and minimal conversion time (80 μsec) also make them ideal for such other applications as voice store and forward, digital echo cancellers, secure communications systems, and satellite earth stations.

The 2910A/11A PCM Codecs and 2912A PCM Line Filter are industry standard components which have been in production for over eight years. We have shipped more than 20,000,000 Codec Filter or combo sets to date.

The new industry standard telephony line circuits are the 2913 and 2914 Codec/Filter Combo Chips. These devices have a fully differential internal architecture to improve crosstalk, idle channel noise, and power supply rejection. In addition, the transmit and receive channels are totally separate to further reduce crosstalk, and to improve performance in asynchronous operation. The charge-redistribution DAC has essentially eliminated gain tracking error. This superior transmission performance is combined with surprisingly low power dissipation through the use of our advanced HMOS-E technology; a proven technology which has supported the production of millions of 2764 EPROMs. For applications requiring especially low power levels (e.g., telephone handsets), CMOS combo chips are available.

Table 8. Performance Comparison

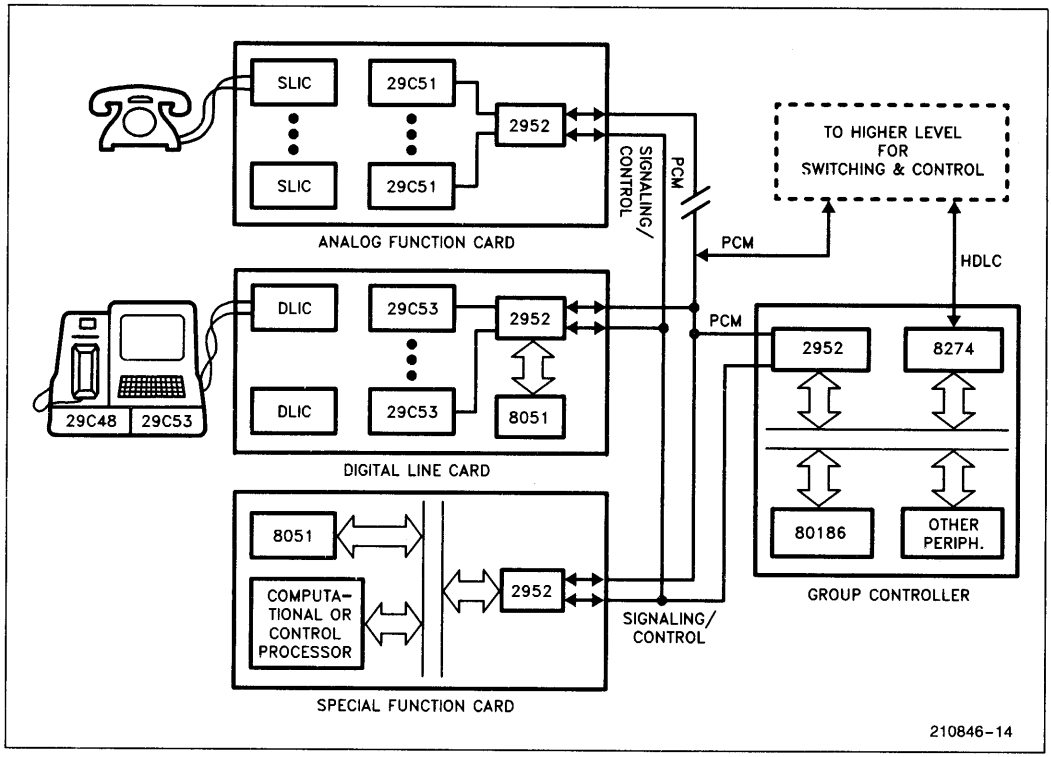
Features	2913 Codec/Filter Combo Chip	2914 Codec/Filter Combo Chip	2910A PCM Codec μ-Law	2911A PCM Codec A-Law	2912A PCM Line Filter
Fixed Data Rate Mode	1.536, 1.544, 2.048 MHz	1.536, 1.544, 2.048 MHz	1.536, 1.544, 2.048 MHz	1.536, 1.544, 2.048 MHz	Compatible
Variable Data Rate Mode	64 kHz to 2.048 MHz	64 kHz to 2.048 MHz	No	No	Compatible
μ/A-Law Select	Yes	Yes	μ-Law Only	A-Law Only	N/A
Asynchronous Operation	No	Yes	Yes	Yes	Yes
Analog Loop Back	No	Yes	No	No	No
Power Down Mode	Yes	Yes	Yes	Yes	Yes
On-Chip Timeslot Assignment	No	No	Yes	Yes	N/A
Cross Talk	−80 dB	−80 dB	−80 dB	−80 dB	−70 dB
Idle Channel Noise Transmit/Receive	15/11 dBrnc0	15/11 dBrnc0	10 dBrnc0	−78 dBm0p	6/2 dBrnc0
Power Supply Rejection	40 dB	40 dB	50 dB	50 dB	30 dB
Gain Tracking, S/D, Frequency Response	Exceeds D3/D4 & CCITT G.712	Exceeds D3/D4 & CCITT G.712	Meets D3/D4	Meets CCITT G.712	Meets D3/D4 & CCITT G.712

Intel's Advanced Telecom Components (iATC) architecture was conceived to insure optimum ISDN system compatibility. This means that careful consideration was given to ISDN equipment requirements on component functional partitioning. Requirements such as; application flexibility, modularity, upgrade paths, efficient interconnects, broad source of suppliers, et. al., have been factored in and are evident in the iATC architecture.

The figure on the next page shows how the iATC family addresses the requirements in switching system equipment. In this diagram, four fundamental cards are shown. They are: the analog line card, the digital line card, the special function card and the group controller card. Each of the cards interface to a common backplane through a Line Card Controller (2952). The backplane carries circuit switched voice/data and linecard/per-line control information. This interface efficiently transfers voice, data, control, and signaling/status over a three wire link consisting of a ping-pong data lead, clock, and direction signal.

The iATC component family provides modular building blocks for ISDN terminal applications. The 29C53 transceiver can be combined with an iATC-combo chip and appropriate microprocessor to tailor the solution to application needs.

The core of Intel's architecture is the Subscriber Line Datalink (SLD). This interconnect scheme allows efficient functional partitioning of the per-line components. In the switching system applications, the SLD interface would be employed between the per-line components and the LCC on analog or digital line or trunk cards, as shown. In subscriber equipment, the SLD can be converted to a serial port or used as is to add voice capability.



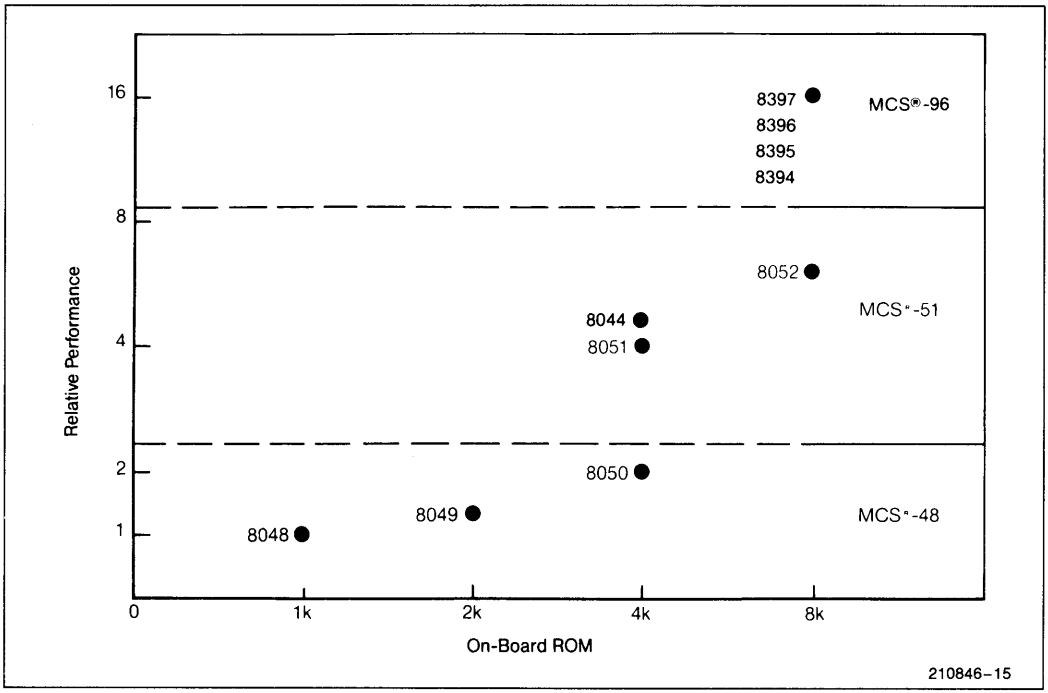
iATC Family Addressing Switching System Requirements

Table 9. iATC Advanced Telecommunication Components

Product	Description	Application	Key Features
2952	Linecard controller	Control of subscriber circuits and data routing for analog and digital linecard applications	Connects up to 16 subscriber channels with up to 128 TDM timeslots Can operate stand alone under control of HDLC channel Can act as primary station for HDLC control channel Microprocessor port for control of all functions (optional) 40 lead
29C51	High feature programmable combo	Central office and PBX linecard	Parallel 10 pin signaling interface Selectable internal and external balance networks Secondary analog channels On-chip 3 party conferencing 28 lead
29C50A	Channel A/B programmable combo	Central office and PBX linecard (sixteen subscriber), ISDN voice terminals	Parallel 7 pin signaling interface Selectable internal and external balance networks Operates on channel A or B of SLD On-chip 3 party conferencing 22 lead
29C48	Channel A/B programmable combo	Central office and PBX linecard (sixteen subscriber), ISDN voice terminals	Selectable external balance networks Operates on channel A or B of SLD External tone injection on receive signal path 18 lead
29C53	I. 430 compatible four wire transceiver	I. 430 compatible PBX linecards, terminals, terminal adaptors, network terminations	I. 430 compatible S interface Operates at either end of digital loop Bit level processing of D-channel HDLC frames 28 lead

MICROCONTROLLERS

Intel offers three basic families of single chip microcontrollers; general purpose 8-bit, advanced 8-bit, and advanced 16-bit devices. The relative range of application performance is indicated in the diagram below.



Microcontroller Performance

BASIC FAMILY CHARACTERISTICS

MCS®-48: Designed for general purpose 8-bit control applications.
- Average instruction time — 2.0 μs
- Maximum addressable code — 4 Kbytes

MCS-51: Designed for advanced 8-bit control applications.
- Typical instruction cycle time — 1.0 μs (byte operations)
- Hardware multiply and divide (4 μs — byte by byte multiply)
- Full duplex asynchronous serial port
- On-chip Boolean Processor
- Maximum addressable code — 64 Kbytes

MCS-96: Designed with 16-bit processing power for complex algorithms.
- Average instruction time — 1.25 μs (word operations)
- Hardware multiply and divide (6.5 μs — word by word multiply)
- Analog and high speed programmable digital I/O
- Full duplex asynchronous serial port
- Maximum addressable code — 64 Kbytes

GENERAL PURPOSE 8-BIT MICROCONTROLLERS

Intel's MCS-48 family of 8-bit microcontrollers has became a world standard. They are available in several versions: with on board ROM, on board EPROM, or CPU only, to better fit your specific application needs. MCS-48 products are now fabricated either on Intel's advanced HMOS II or CHMOS processes offering higher performance and reliability while consuming less power.

Table 10. General Purpose Microcontrollers

ROM Version	8048AH	8049AH 80C49-7*	8050AH
EPROM Version	8748H	8749H	—
CPU/RAM/I/O	8035AHL	8039AHL 80C39-7	8040AHL
Cycle Time	1.36 μs	1.36 μs	1.36 μs
RAM Memory (Bytes)	64	128	256
Program Memory (Bytes)	1K	2K	4K
I/O Lines	27	27	27
SYNC Mode	Yes	Yes	Yes
Timer-Counter	1	1	1
A/D	—	—	—
Interrupts	2	2	2
Program Limit	4K	4K	4K
Ext Data Limit (Bytes)	256	256	256
Development Support	See Development Systems, Page 64, and Software, Page 72.		

*Products designated with a "C" (i.e., 80C49 are CHMOS devices.