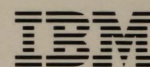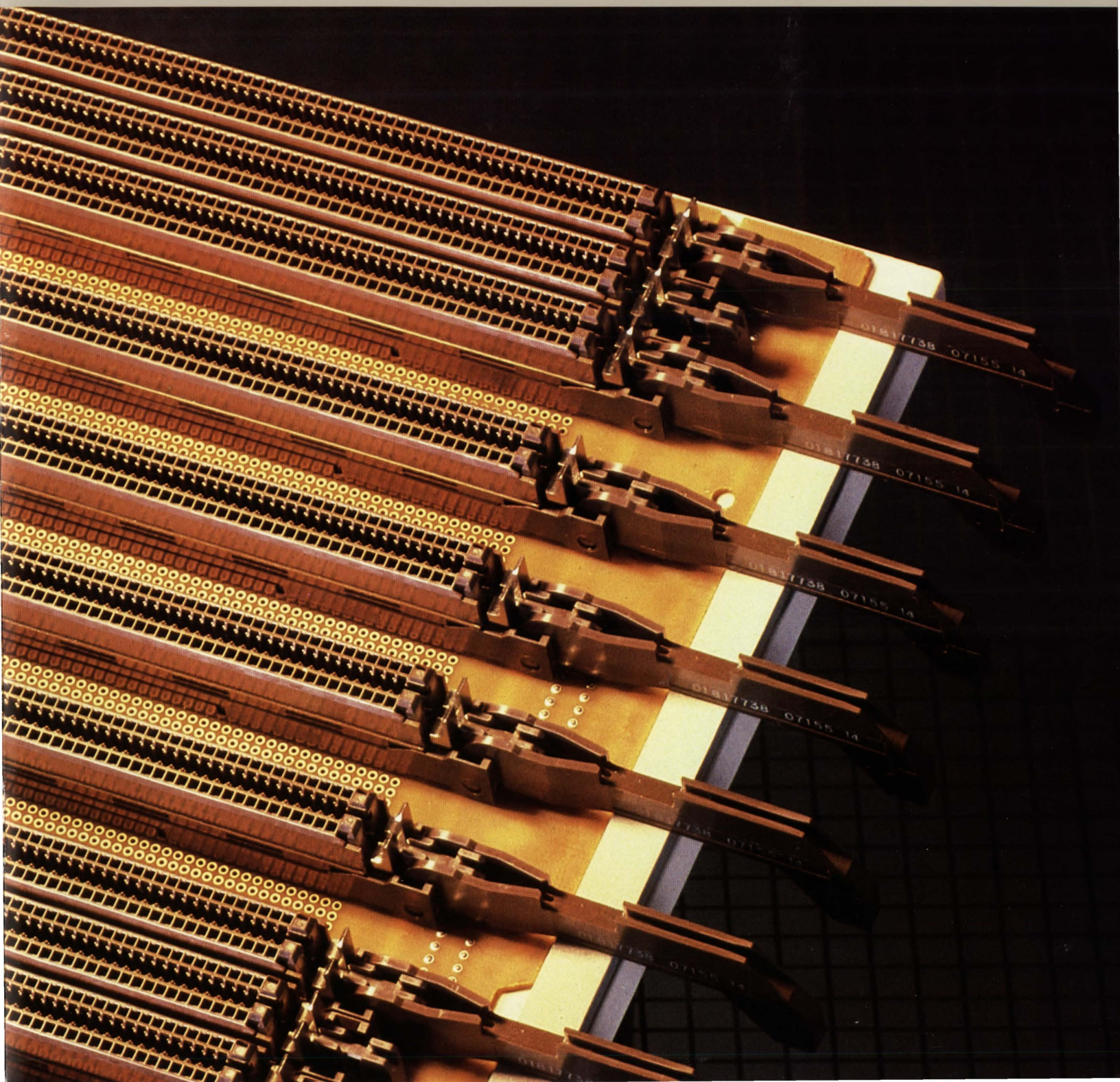# The IBM 9370 Information System

Technology Changes the Shape of Computing

IBM

Cover design derived from
IBM-developed planar
board showing the Zero
Insertion Force (ZIF)
card connectors.

What's new in IBM 370 Systems?

Introducing the IBM 9370 Information System...

A new member in the IBM System/370 product line...

In a new "supermini" package with full-function 370 capability...

Complete with new input/output devices, and a new way to attach I/O devices...

Priced for the departmental budget

For the first time, the power, function, reliability and versatility of full-sized IBM 370 systems are available to the smallest work groups...in easy to install, compact and affordable packages. The new IBM 9370 systems represent a *fully integrated* hardware and software solution for your computing needs...interactive or batch, commercial or compute-intensive, co-operative or standalone. These new systems were engineered with *you* in mind.

The IBM 9370 systems continue the proud heritage of IBM technological leadership, and are the result of extensive investment in research and development. IBM engineers' bold innovations, using advanced technology and state-of-the-art concepts in design, have produced the most compact, full-function 370 processor IBM has offered to date.

The IBM 9370 package brings you mainframe performance in a supermini package. Its small "footprint," air cooling, single phase power and quiet operation allow you to put computing power where you need it...in your workplace. Better still, this new IBM computer can connect to almost any interface, network, or protocol.

Suited for nearly any application, it can support the specialized devices and numerous workstations of today's offices, engineering/scientific laboratories and academic/industrial environments. It is an excellent solution, offering low-priced entry into 370 computing, for small work groups and departments.

For these same reasons, it is an excellent organizational solution as well. Its broad-ranging connectivity allows diverse 9370 systems to be connected within a local area network and to co-exist among other IBM or non-IBM systems. This gives you new options for distributed data processing and horizontal growth across your enterprise. At the same time, its 370 compatibility affords you expansive growth within the IBM 9370 family and up through the System/370 product line.

The flexibility you have waited for is here in a new modular system design. The IBM 9370 system, with new technology, packaging, and I/O, is a complete computing package. Turn the pages of this brochure to see why we believe the 9370 family will become the industry standard for work-group computing and your next departmental system.

9370

4381

3090
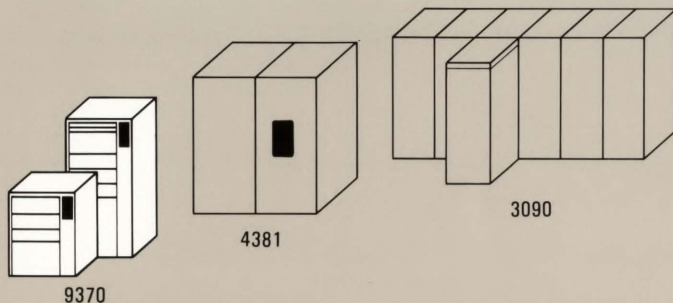
IBM 9370
Design

Engineered with you in mind

This diagram of the IBM 9370 processor shows how multiple I/O subsystem controllers (formerly standalone units with their own power supplies and cooling) are integrated into the processor's logical and physical design. This is an important element in the economy of its size and cost. The I/O controllers, consisting of I/O processors and I/O adapters pass data between an extensive variety of I/O devices and processor memory via the system's internal I/O bus (data path). This design provides a full-function 370 system with unparalleled attachment flexibility and impressive I/O data rates that is not only quiet and compact but economical to own and operate.

The goal was to offer IBM System/370 computing in a "departmental package" and thereby complete the 370 continuum between personal computers and the large host system. The challenge: to fit a computer room full of equipment in the approximate size of a file cabinet, manageable by office staff personnel, at a price within the range of other office equipment. How? A highly efficient design.

Each aspect of this new IBM 9370 family has been intensively designed from the ground up using sophisticated IBM computer-controlled design tools. Its totally new engineering pedigree is evidenced by the processor's use of advanced electronic technology and state-of-the-art concepts in power, cooling, and especially packaging.

Designers achieved the modular package by organizing system functions into functional units—common building blocks that contain the instruction processor, main memory, and even I/O subsystem controllers within the processor package. Memory and logic cards fit into slots in the processor unit, which itself fits into an industry standard rack enclosure along with DASD (Direct Access Storage Devices) and tape devices.

The IBM 9370 processor's physical characteristics, including air-cooling, together with its unique architecture make it a system that is easy to adapt to both your environment and your computing needs. It is a powerful IBM System/370 data processing system that supports many users and applications in the office, commercial, industrial, and engineering/scientific environments. Through a selection of software (application programs and operating systems) and hardware (physical devices, including the processor and I/O) you can shape a system to *your* particular requirements.
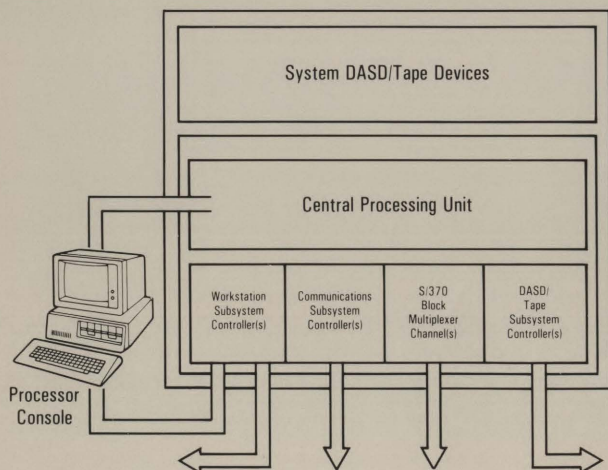
Operating system choices—to accommodate application programs, manage data and resources, schedule jobs, and provide networking support—include:

- Virtual Machine/Integrated System (VM/IS) or Virtual Machine/System Product (VM/SP)
- Interactive Executive for System/370 (IX/370), an IBM UNIX® implementation
- Virtual Storage Extended/System Package (VSE/SP)
- Multiple Virtual Storage/System Product, Version 1 (MVS/370)

Hardware choices include:

- Four models of 9370 processors—Model 20, 40, 60, and 90—with different performance capabilities, memory and I/O capacities
- I/O subsystem controllers for:
  - DASD and tape devices
  - Workstations
  - Communications, including teleprocessing, ASCII, and local area networks
  - System/370 channel I/O devices
- Two separate, rack-mounted I/O card units for the 9370 Model 90 processor
- Two rack-mounted, high-performance DASD
- A rack-mounted tape device
- To house the above, two rack enclosure sizes

This impressive list of options illustrates the flexibility of configuring an IBM 9370 system to satisfy a variety of customers' requirements. You can select from several pre-configured systems defined by IBM or define a customized system *(from several thousand possible configurations)* for your special needs. In either case, the choice is yours. And, of course, a wide range of other IBM devices (controllers, adapters, and I/O devices such as, printers and displays) can be added to complete your computing requirements.

System DASD/Tape Devices

Central Processing Unit

Workstation Subsystem Controller(s) | Communications Subsystem Controller(s) | S/370 Block Multiplexer Channel(s) | DASD/Tape Subsystem Controller(s)

Processor Console

To I/O Devices, other Systems, Networks, and System DASD/Tape Devices

IBM 9370 Package

Modular design for complete flexibility

The newest IBM family delivers performance, function and quality that is a tradition in IBM 370 systems. The new processors, built to Electronic Industries Association (EIA) standards, fit in the lower portion of an IBM 9309 rack enclosure. A large 9370 system, including I/O devices, may span multiple racks. The rack enclosure is available in two models:

- Model 1 - 1.0 meter (3 feet 3 inches) high; 19 EIA units*

- Model 2 - 1.6 meters (5 feet 3 inches) high; 32 EIA units

The IBM 9309 rack enclosure, while deceptively simple in appearance, incorporates many advanced design features. *Monocoque construction* (a one-piece shell with no frame) assures rigidity and simplicity while helping meet IBM noise limit specifications. The enclosures reduce floor space, contain all system components, and provide power for the devices. The front is open for the installation of electronic equipment, and the rear is instantly accessible by a door which may be removed when installation access requires it.

The new compact and affordable IBM 9370 system package truly changes the shape of 370 computing.

*One EIA unit equals 1.75 inches (44.45 mm).

3.

Extensive development effort went into designing a power control compartment to fit within the rack enclosure and provide a single point of control for the system. A single switch on the front (upper right) of the rack containing the processor unit turns on all modular components in the rack or in a multiple rack system. The power control unit contains the fusing and circuit breakers to safeguard the system.

The power control unit follows the correct power-on sequence for all the interconnected components and controls start-up to eliminate power surges. It can also detect certain power failure conditions, trigger actions to save data and power-down one or multiple racks in an emergency.

A rack-mountable System/370 Channel Power Control feature is also available with IBM 9370 processors. In conjunction with the processor's power control unit, it functions automatically to power-on System/370 control units sequentially from the processor.
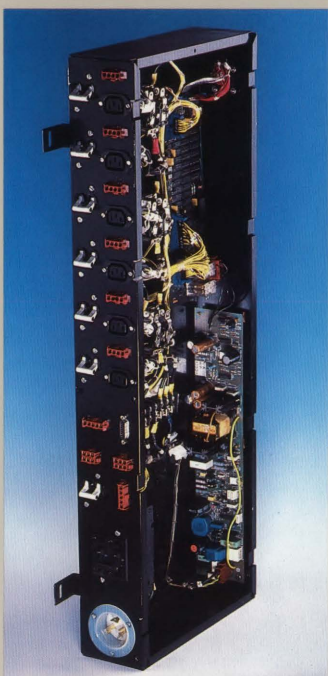
The IBM 9347 Tape Unit is available within the 9370 system package. The device is a streaming tape, 0.5 inches (12.5mm) wide, used for loading and offloading DASD volumes, and includes an integrated device function controller.

The IBM 9347 mounts in the upper portion of the rack enclosure. It protrudes slightly to facilitate air intake from the bottom of the unit to accommodate automatic tape threading. The tape device pulls out for easy access.

The 1589 Magnetic Tape Subsystem satisfies more demanding tape processing applications using 9 track, 0.5 inch tape reels at 1600 and 6250 BPI (Bits Per Inch) densities.

Rack mounted, utilizing 16 EIA units of enclosure space, this unit and its integrated control attaches to the S/370 channel. The 1589 Magnetic Tape Subsystem is manufactured by TELEX®.

Two high-performance (fixed disk, fixed-block record format) DASDs are available within the 9370 system package. The IBM 9335 controller and drive units (824 MB capacity) are shown in the system configuration below. The other is the IBM 9332 DASD (368 MB capacity) with integrated controller.

The DASD units can be positioned anywhere within the rack enclosure. For safety reasons, heavier components, like the processor unit, are positioned in the lower portion. A non-tip "foot" at the base of the rack keeps it in a safe, upright position when a drawer in the top, containing a DASD or tape unit, is pulled out.

IBM 9370 Processors

Your System/370 link between personal computers and IBM large systems

This multi-member processor family covers a range of memory sizes, I/O capacities, and performance. IBM 9370 processors include:

- System/370 instruction set
- Battery powered time-of-day clock and calendar
- Capability for automated operations—such as, remote and timed power-on, programmed power-off, auto-restart—secured through a system keylock
- Separate processor console for system operations, which can also be used as a 3270 workstation
- Enhanced RAS (reliability, availability, serviceability) and Problem Analysis Facility

A task-oriented system library and online help facility simplify, for novice and experienced users, system-related tasks including planning and installation which can be performed by the customer. System support information, including labels, operator panels, and machine-readable information is available in several national languages.

IBM 9370 Model 20 Processor

Shown here in a 1.0 meter rack enclosure *(only 3 feet, 3 inches high)* is a system package including a tape unit, DASD, *and* a full-function 9370 Model 20 processor. Its 7.8 square feet of floor space is 33% that of its IBM equivalent, a 4361-3 system including DASD and tape units. Highlights of this *entry level* processor are:

- 14 inches (356 mm) high
- 110 or 220 volt operation
- From 4 to 16 MB of main memory
- One internal I/O bus (Up to 4 I/O controllers)

IBM 9370 Models 40 and 60 Processors

Shown below in its typical housing, a 1.6 meter rack enclosure (5 feet, 3 inches high) is a system package including a tape unit, IBM 9332 DASD, *and* full-function 9370 Model 60 processor. A Model 40 is also available. The Model 60 offers approximately twice the performance of the Model 40. Highlights of this *intermediate level* processor are:

- 8 or 16 MB of main memory
- Four internal I/O buses (Up to 16 I/O controllers)
- High-performance floating point accelerator
- Model 40 to Model 60 field conversion
- Field conversion to Model 90

IBM 9370 Model 90 Processor

A system package including a Model 90 processor, I/O card units, and DASD, typically spans multiple 1.6 meter rack enclosures. Highlights of 9370 family's *most powerful* processor, the Model 90, are:

- Air-cooled Thermal Conduction Module (TCM) technology
- 8 or 16 MB of main memory
- 8-byte (64-bit) wide processor/memory data path
- Six internal I/O buses (Up to 16 I/O controllers)
- High-performance floating point facility

7.

IBM 9370 System Reveals a New World of Computing

Intensive engineering details you may never see

This rear-view of an IBM 9370 Model 60 system package, including DASD, reveals new engineering features that deliver System/370 processing power in a compact, quiet and simple-to-manage system for your current and future data processing needs.
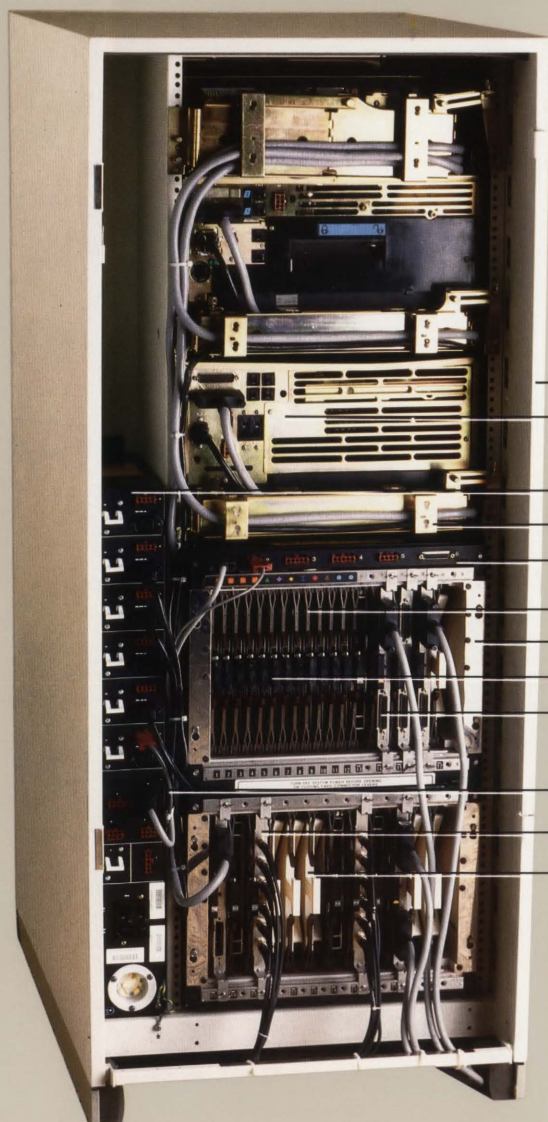
A. Rack enclosure
B. I/O units (DASD)

C. Power Control Compartment
D. Retracting cable management arms
E. Processor unit
F. Zero Insertion Force connectors
G. Card enclosure
H. Memory and logic cards
I. I/O card with connectors for external device cables
J. High reliability cabling
K. I/O card with coaxial cables connected
L. Air flow cards

CHIP MODULE CARD

CARD ENCLOSURE

TCM

PROCESSOR UNIT
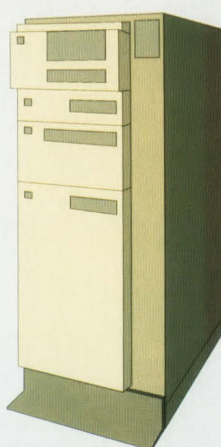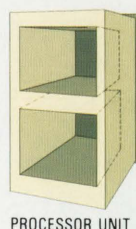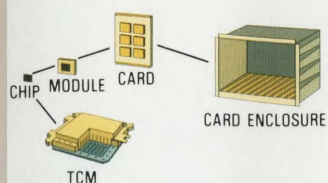
IBM 9370 SYSTEM

Memory and logic chips for the 9370 Models 20, 40, and 60 are mounted on modules which are, in turn, mounted on cards. Logic chips for the 9370 Model 90 are mounted on the multilayer substrate of an air-cooled TCM. Memory, I/O controller, and processor logic cards fit into slots in a card enclosure; the 9370 Model 90 TCM resides in a similar unit. One or two of these units fit into a frame which includes cables, cooling units, and power supplies to complete the processor unit. The processor unit is rack-mountable, designed to share space in the IBM 9309 rack along with other rack-mountable equipment.

| IBM 9370 Processor Units	Model 20 (9373)	Model 40 (9375)	Model 60 (9375)	Model 90 (9377)
Processor Memory (MB)	4, 8, 16	8, 16		
Logic Chips	> 4,000 circuits			704 circuits
Packaging	Single-chip modules, on cards, between boards (new card-on-board package)			Air-cooled, Thermal Conduction Module
I/O facilities:				
Internal I/O buses	1	4		6
I/O controller slots (for I/O Processor and Adapter card combinations)	7	17		10-54 (see note)
I/O subsystem controllers, total:	4	16		
Number of each type:				
•DASD/Tape	2	4		12
•Workstation	2	6		12
•Communications - Telecommunications - ASCII - IBM Token-Ring - IEEE 802.3 LAN (local area network)	2	4		12
•System/370 Channel	1	2		12
Height: EIA units (equivalent)	8 (14"/356mm)	16 (28"/711mm)		
Operating Environment:				
Temperature	10° - 40.6° C 50° - 105° F			10° - 32.2° C 50° - 90° F
Humidity	8 - 80%			
Wet Bulb	26.7° C 80° F			22.8° C 73° F
Line Voltage	100-127 200-240	200-240		
Heat Dissipation (watts)	500	1800		1900
Cooling; air flow (cubic feet p/minute)	220	600		600
Sound Level (Bels)* 50Hz 60Hz	6.2 6.2	6.7 6.5		6.8 6.6
Operating Systems Support	VM/IS - VM/SP IX/370 VSE/SP			
			MVS/SP	

Note: The 9370 Model 90 processor uses separate I/O card units for I/O controller cards. There are two different types of I/O card units available which connect with the processor unit via I/O adapters. Refer to the physical installation planning manual for system level acoustics and environmental specifications.

*Processors in an IBM 9309 rack
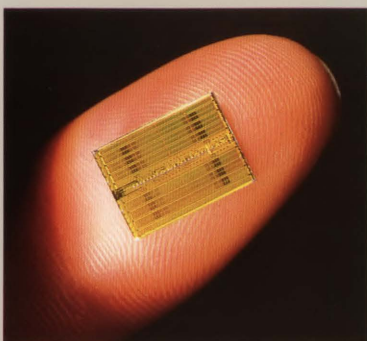
The capacity of the densest IBM memory chip (one megabit) is actually more than one million bits (1,048,576 binary Os and 1s)—enough to store approximately 100 pages of double-spaced type-written text.

This specially developed high-speed bipolar memory array chip supports the simultaneous switching of 36 data output signals in 16 billionths of a second making it the densest and fastest IBM bipolar RAM (random access memory) chip in an air-cooled implementation.
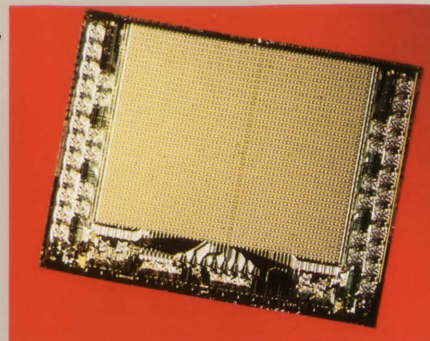

IBM 9370
Chip Technology

*The densest IBM memory and logic chips*

The ongoing IBM commitment to product excellence is manifested in the new technology that goes into the 9370 processors.

One megabit (million-bit) memory chips used in these new processors are, for example, four times denser than previous memory chips used in IBM 370 intermediate systems. To pack this much memory on a chip, circuit lines can be only 1.2 microns wide—or about a fiftieth of the width of a human hair. Similarly, very high speed bipolar chips used for central processor logic in the Model 20, 40, and 60 processors, contain over 4,000 circuits per chip, a six times improvement in circuit density over previous logic chips used in IBM 370 inter-mediate systems. Central processor perform-ance is enhanced by two specially designed high-performance, multiport, random access
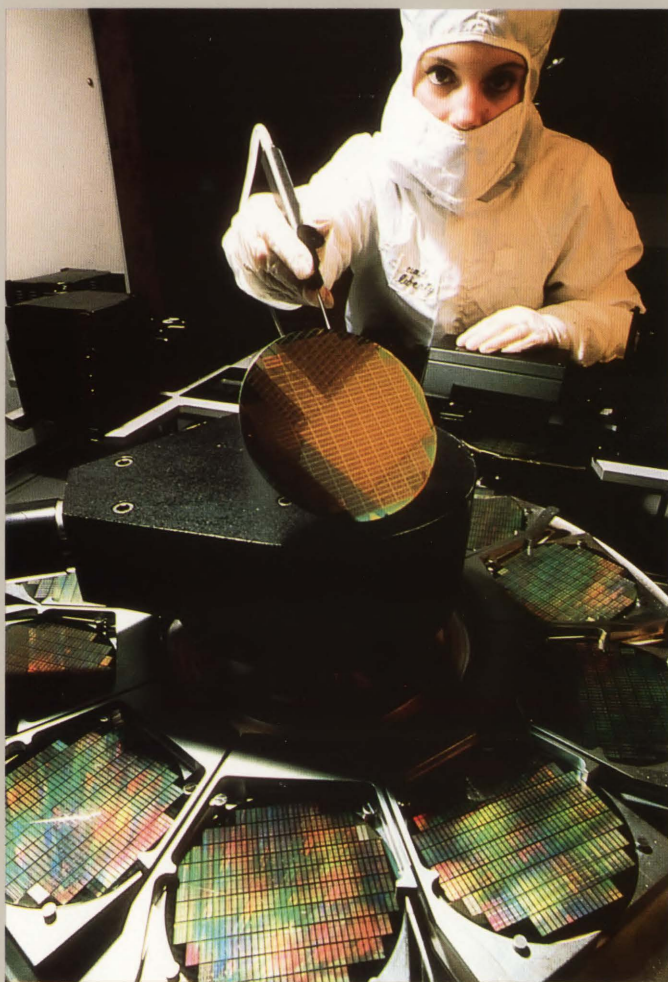
Clean room techniques are critical to the yield and reliability of IBM semi-conductor chips. In this computer-controlled IBM process, high energy ions are precisely implanted in the silicon wafers to carefully tailor their electrical characteristics for superior reliability and performance.
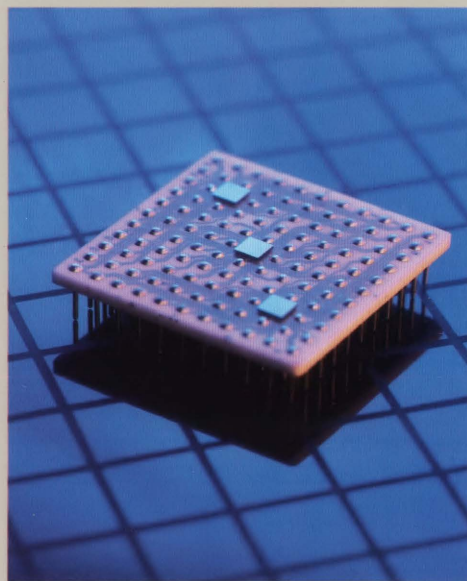

This custom-designed line driver/receiver module, used on the System/370 Channel card, can com-municate with I/O devices at 3 million bytes (the equivalent of eight double density PC diskettes) per second.
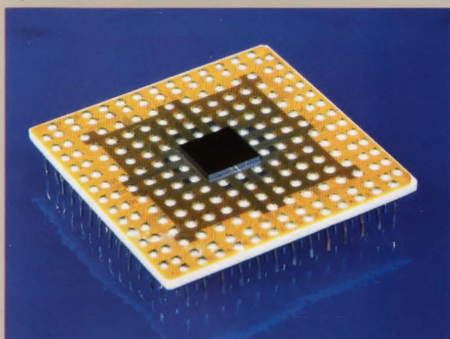
In this IBM-designed and fabricated module, two layers of circuitry are separated by a layer of polyimide dielectric and connected by electronic conduits, called vias. This technique allows for high performance and greater packaging density in less space.

This densest IBM high-speed bipolar logic chip has over ten times the available circuitry of earlier IBM bipolar logic chips, and is the first to use four levels, or layers, of metal to interconnect various electronic components on a chip.
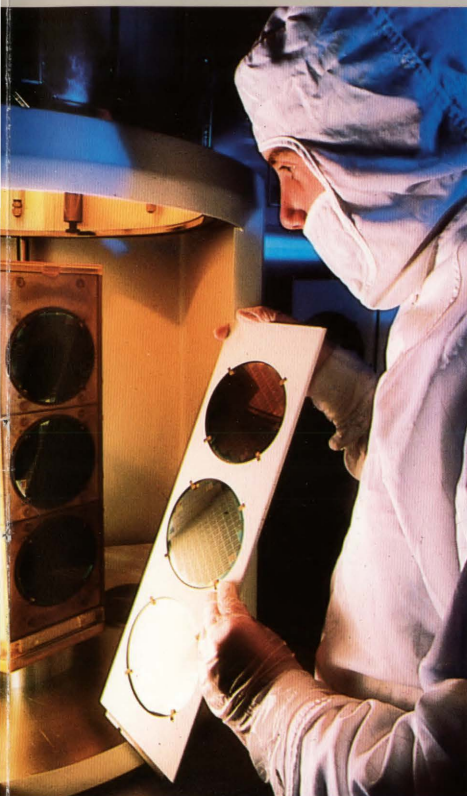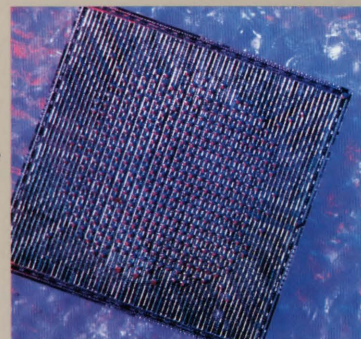
memories included on these logic chips. Many micro-instruction operations are performed in *one machine cycle (less than one hundred billionths of a second).*

Floating point calculations in the 9370 Model 20, 40, and 60 processors are handled in hardware by special "accelerator" cards. The high performance of the respective cards is based on the densest of IBM bipolar custom logic chips with over 9,000 circuits and gate-array logic chips with over 7,500 circuits. These chips handle half-, full-, *and* extended-precision floating point instructions.

High-performance chips are joined to the metallic surface of multi-layer modules with solder pads using the special controlled collapse chip connection (C4) process developed by IBM. Removing heat from such high-performance chips is an important reliability consideration. Thermal enhancement grease, between the chip and module cap, improve the dissipation of heat away from the chip by 50%.

New high-speed bipolar RAM chips have also been developed for use in the 9370 Model 40 and 60 processors' translation lookaside buffers and cache directories. These IBM chips are among the densest and fastest array chips available anywhere, and are capable of storing or retrieving the equivalent of *seven standard collegiate dictionaries every second.*

Memory wafers containing million-bit chips are loaded into a reactive ion etch tool where streams of ions are used to etch the fine geometries needed to build the microscopic features on the chip.

Product development engineers compare a test substrate to its design plot.
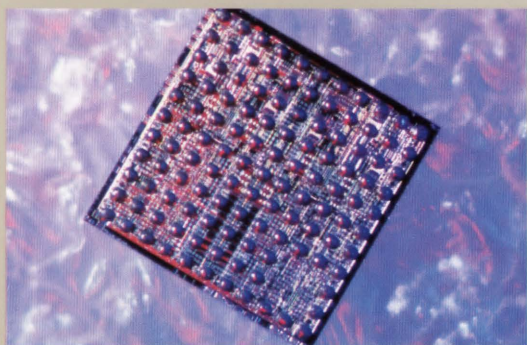
Significant in a system where packaging space is at a premium, new line driver/receiver chips, with higher accuracy and a simplified power requirement of 5 volts, are packaged on a *single* line driver/receiver module.
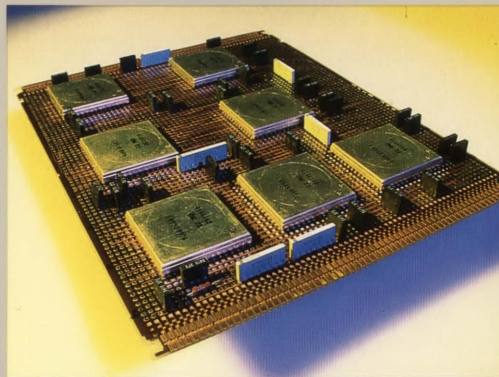
The 9370 Model 40 and 60 processors attain their remarkable compute-intensive performance through accelerated floating point calculations. For this, the "accelerator" card uses the densest of IBM bipolar logic chips (with over 7500 circuits), making it the processor's densest logic card using over 40,000 circuits.

IBM 9370
Packaging: Cards

Advanced technology for big system performance in a small package

The next level of packaging in the IBM 9370 processor is composed of dense logic and memory cards (made up of IBM-developed memory and logic chips). High-density logic chips and special-purpose microprocessor chips allow functions to be performed at the card level that previously took up almost a room full of equipment.

The cards fit side by side in a card enclosure. Four- and eight-megabyte memory cards and processor logic cards which average 23,000 circuits represent some of the densest packaging in intermediate level systems. This packaging density keeps circuits close to each other for fast operation and minimizes space...a key design consideration for the processors right from the beginning.
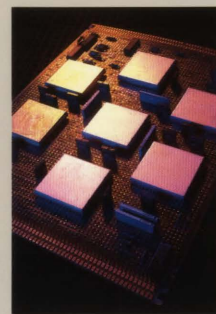
Processor functions for the 9370 Models 20, 40 and 60 are implemented on 5 or 6 (for the Model 60) logic cards totaling approximately 150,000 circuits. An IBM bipolar logic chip with over 4,000 circuits is the mainstay of implementation in these processors. Four of the seven single-chip logic modules on this card, responsible for instruction processing, represent the processor's arithmetic logic unit.
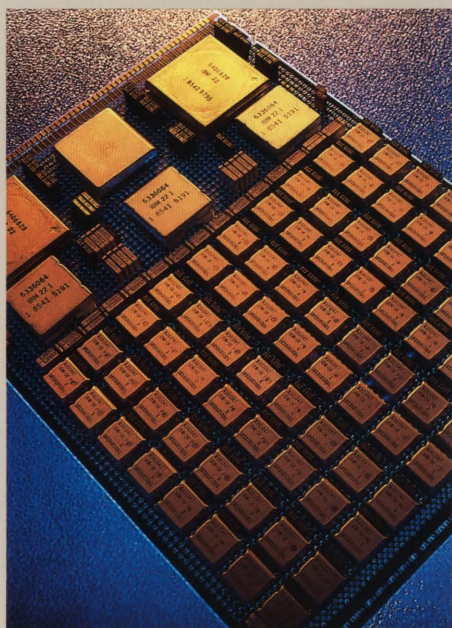

Eight megabytes of memory are packaged on a single card that measures approximately 9 inches (23 cm) high by 7 inches (18 cm) wide. Each one of the 80 small modules contains an IBM one-megabit memory chip.

CARD ASSEMBLY

STANDARD CARD COVER

I/O CARD COVER

ACTIVE TAILGATE

I/O SUPPORT BRACKET
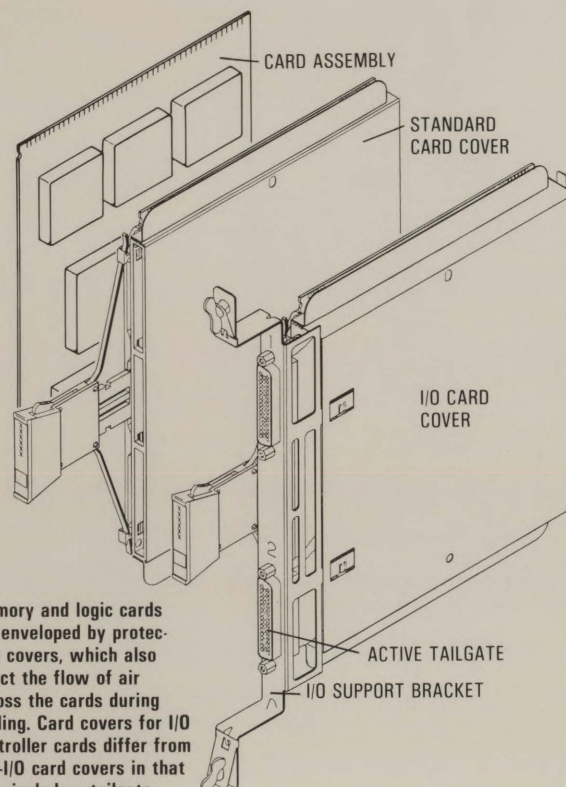
Memory and logic cards are enveloped by protective covers, which also direct the flow of air across the cards during cooling. Card covers for I/O controller cards differ from non-I/O card covers in that they include a tailgate assembly and support brackets to accommodate direct attachment of external device cables.

The planar board is populated with ZIF connectors according to the type and number of cards it must accommodate.

ZIF CONNECTOR

CARD ENTRY SLOT

ACTUATION LEVER (OPEN)
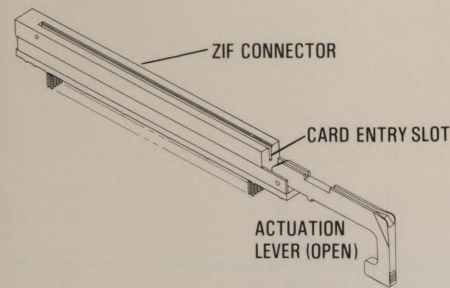
IBM 9370 Packaging: Boards

A new generation of card-on-board packaging

The bread-box sized card enclosure in IBM 9370 processors represents state of the art technology in card-on-board packaging. Two boards, called planars, at the top and bottom of the assembly, firmly hold dense memory and logic cards mounted between them. A one-piece, self-supporting frame supports and accurately locates the two opposing planars and provides a mounting surface for fastening the package to the system frame.
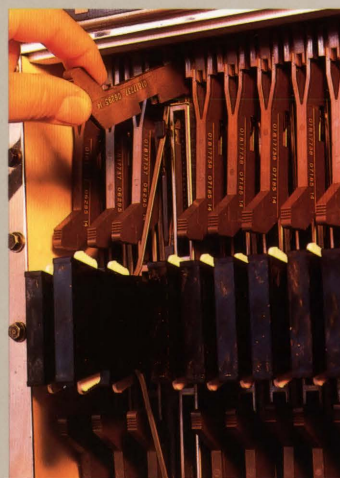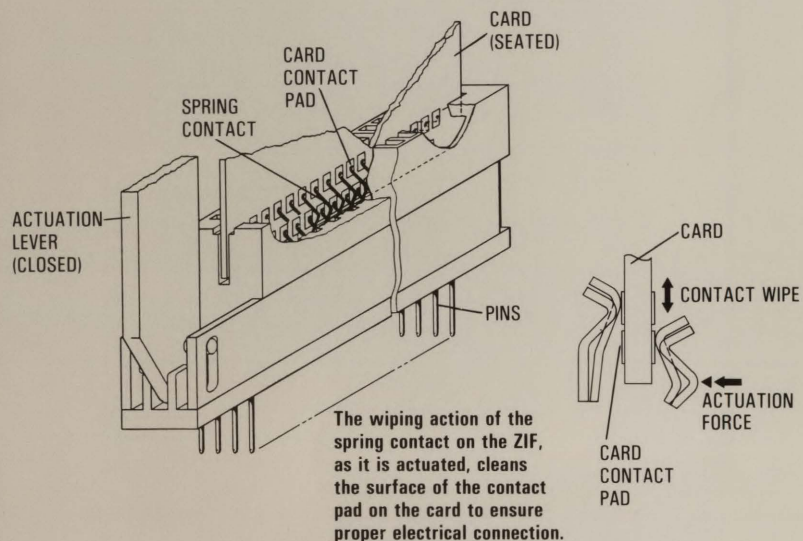
Gold-plated I/O tabs on opposite ends of the cards connect the two planars through Zero Insertion Force (ZIF) connectors. The ZIF connector pins protrude through the backs of the two planars to accept signal cable connectors.

The 9370 processors' card enclosures feature:

- Up to 17 card positions per unit
- 258 card contact pads with a special wipe and contact force design for added reliability
- Convenient signal and power connections
- Positive retention of cards, cables, and power connections
- Improved signal distribution due to shorter cable lengths
- Special card cover for component protection and better air cooling
- Active tailgate for direct connection of external device cables

Careful attention is given to every aspect of assembly.

CARD (SEATED)

CARD CONTACT PAD

SPRING CONTACT

ACTUATION LEVER (CLOSED)

PINS

The wiping action of the spring contact on the ZIF, as it is actuated, cleans the surface of the contact pad on the card to ensure proper electrical connection.

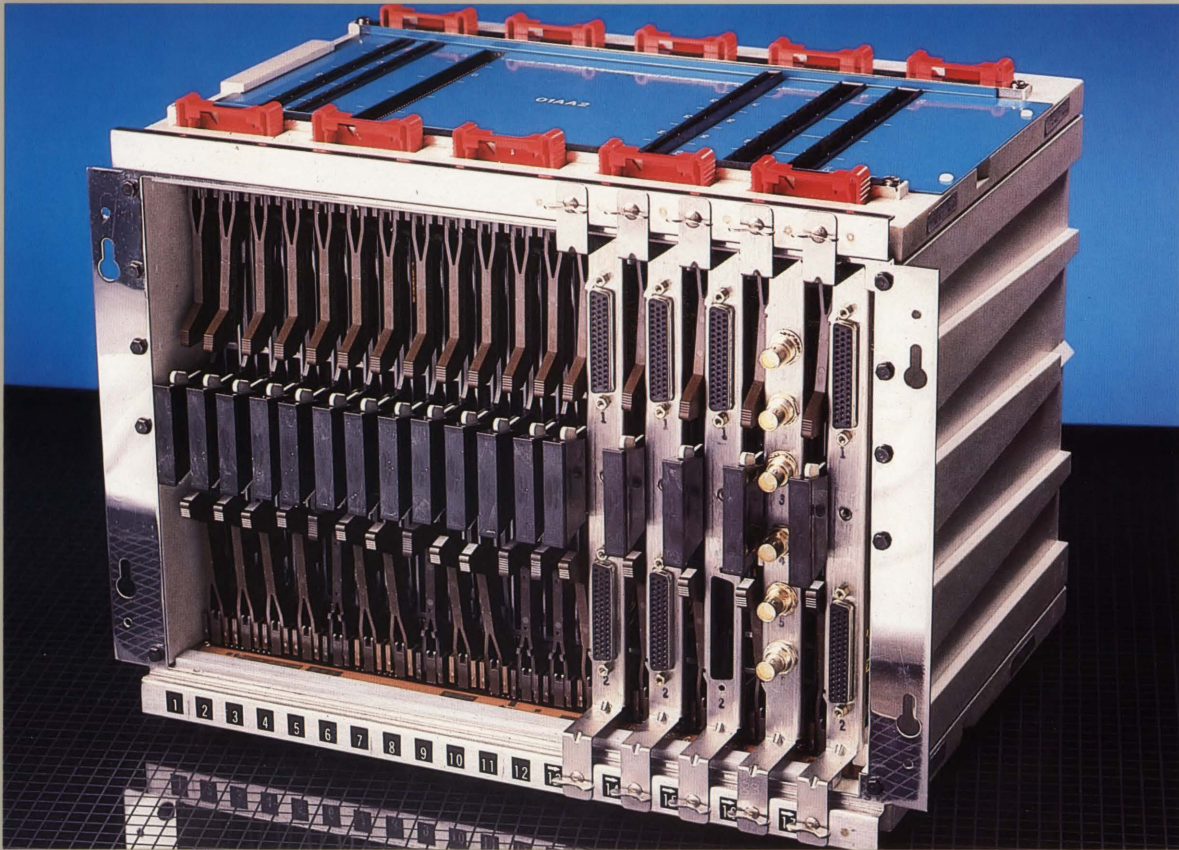CARD

CONTACT WIPE

ACTUATION FORCE

CARD CONTACT PAD

A card inserts easily into its slot. A retention spring on the card cover ensures that the card is positioned properly before the ZIF connector is actuated.

13.

High-velocity motorized impellers do "double duty" to cool processor components. First, the impellers draw air in from the front of the rack enclosure up *through* the processor's power supply units. The air, moving at 600 cubic feet per minute is then forced out through the card enclosures containing the memory, logic, and I/O cards. The impellers thus provide cooling both during air intake *and* output. This highly efficient technique, requiring fewer air movement devices, results in a smaller, simpler, quieter machine.

IBM 9370 Packaging: Card Enclosures

Common building blocks make for simplicity and flexibility

A completely new, rigid, self-supporting card enclosure allows a variety of memory, logic, and I/O cards to mount vertically between top and bottom planars. In this model, memory and logic cards are shown on the left and I/O cards are shown on the right.

Extensive development using the latest design techniques results in a highly efficient packaging concept for the IBM 9370 family which increases packaging density and reliability.

14.
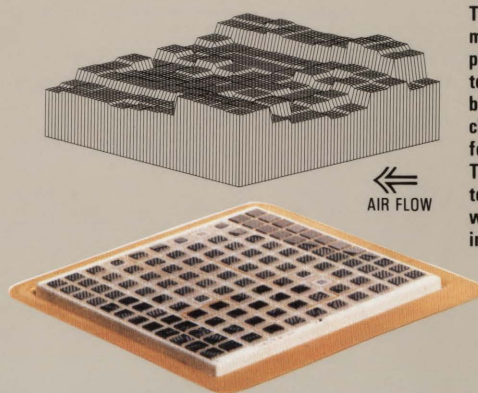
The chips on the TCM's multilayer substrate are positioned so that the hottest chips (the high-speed bipolar cache chips) are closest to the cooler air forced in by the blower. This gives an optimum temperature "landscape" which ensures proper cooling and high reliability.

AIR FLOW

# IBM 9370 Packaging: Air-cooled TCM

Another first from the combination of proven technologies

A further technological development combines the proven packaging of the IBM 4381 and the 3090 mainframes in the IBM 9370 family's high end processor. *All* of the processor logic, cache memory, and control storage for the 9370 Model 90 processor is contained on *a single, air-cooled,* Thermal Conduction Module (TCM). The high-performance 704-circuit logic chips used in this single, large-module package doubles the overall performance (in a commercial environment) of the IBM 9370 Model 90 compared to the Model 60 processor.

The TCM's multilayer substrate (33 layers of conductors) accommodates *3.2 meters (10.5 feet) of wiring per square centimeter of surface.* On the bottom surface of the substrate are 1,800 pins that supply power to the chips and route signals to and from the next level in the packaging hierarchy. Higher reliability results by imbedding the wiring, and by eliminating many feet of wiring and many cards. And, the air-cooled 9370 Model 90 fits economically into the general office and lab environments for which it was designed.
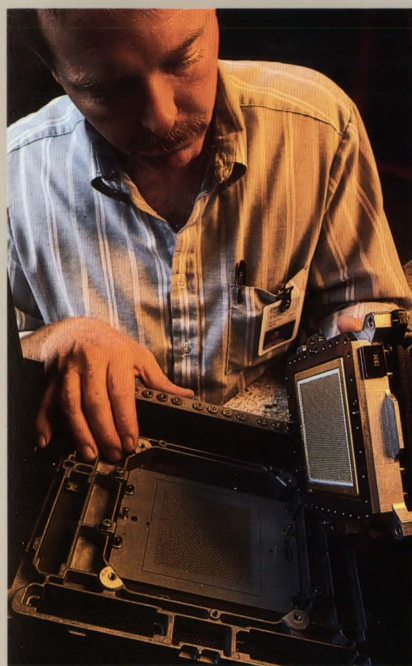
The 9370 Model 90 processor's single TCM mounts on a multilayer circuit board.

HEAT SINK
SPRING
HAT
PISTON
HELIUM FILL PORT
CHIP
SEALING RING
FLANGE
BASE PLATE
SUBSTRATE
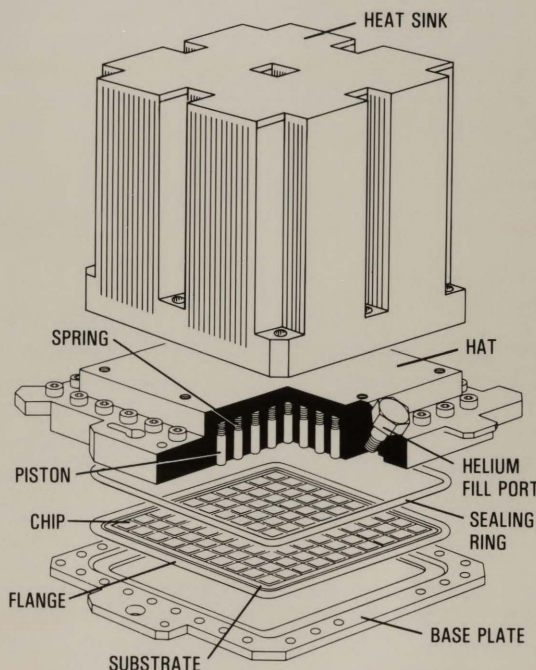
The newly developed air-cooled TCM houses the multilayer substrate and cools the 116 logic and array chips mounted on its surface. Chips are soldered to the module surface using the special IBM C4 process. All electrical interconnections are made through the multilayer ceramic which contains a total of more than 12,000 chip contact pads on the top surface. The substrate is clamped between a baseplate and a "hat" with spring-loaded metal pistons. Each piston presses against the back of a chip, conducting heat to an aluminum heatsink bolted on top of the "hat." The heatsink, in turn, gives up the heat to room-temperature air that is blown across it by a powerful fan. The rated power-handling capacity of the air-cooled TCM is 200 watts, or 40% the capacity of the highly advanced water-cooled TCM used in IBM 3090 processors.
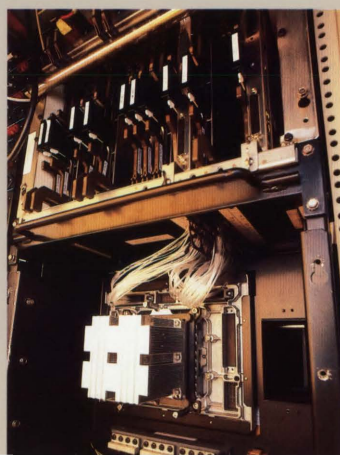
The board-mounted TCM occupies the bottom portion of the Model 90 processor unit.

15.

The processor's active tailgate design allows you to add I/O devices by simply plugging them directly into the appropriate I/O controller card.

IBM 9370 Connectivity

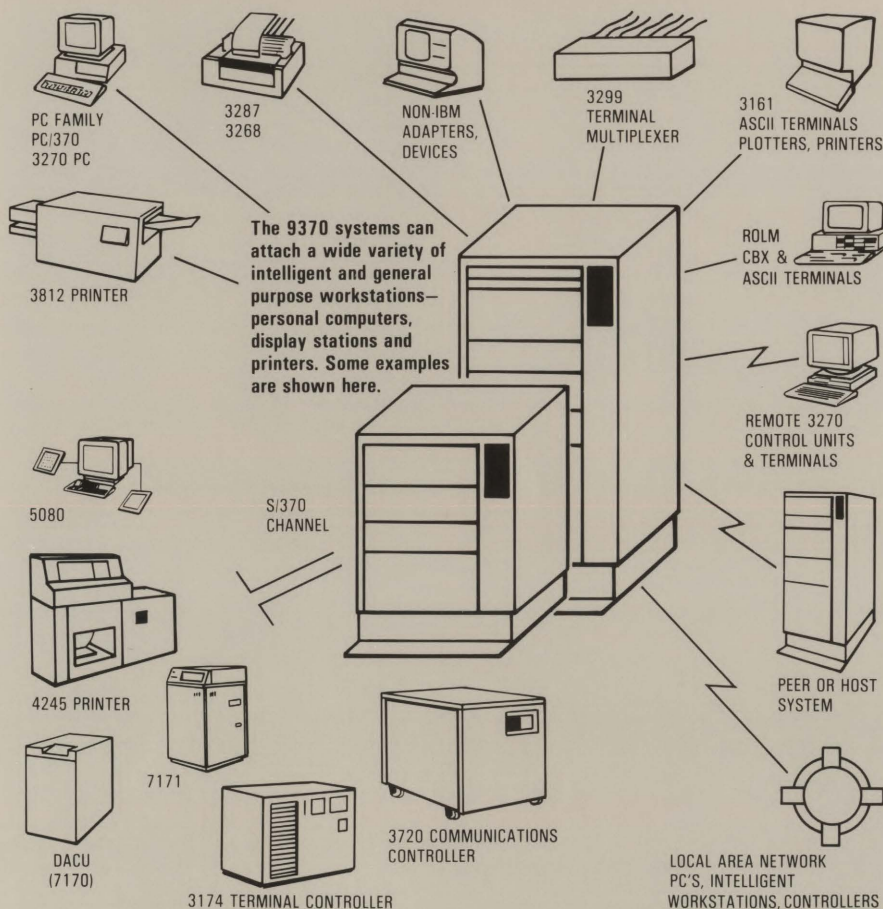*Can it attach?...*
Yes it can!

The IBM 9370 was designed from the beginning for simplicity, flexibility and growth. Its integrated I/O subsystem controllers also help reduce your total cost of computing. Necessary control functions, previously provided by stand-alone control units and associated cables, are implemented on I/O controller cards *within your 9370 system package.*

As your needs grow—new users, more workstations, additional DASD—I/O controller cards can be added to your 9370 system configuration as required. To attach devices, swing open the back door of your system, and plug cable connectors directly into corresponding I/O cards.

The 9370 processor provides extensive connectivity options. You can attach PCs and ASCII terminals (3270 protocol conversion is built in), or connect it with multiple PCs in a local area network, or link systems in a network for peer-to-peer or central site communications. The processor's integrated controllers support the following:

- DASD/Tape subsystem controller
  -Rack-mountable 9332 and 9335 DASD and 9347 tape devices
- Workstation subsystem controller
  -3270 devices, including displays, printers, graphic devices, intelligent workstations, personal computers and 3299 terminal multiplexers (fanout boxes) for more devices and greater distance
  -OEM (Original Equipment Manufacturer, non-IBM) devices, such as specialized instrumentation, via Serial OEM Interface (SOEMI) to appropriate adapter
- Communications subsystems controllers
  -Telecommunications: for networks of devices using switched and non-switched tele-communications lines (BSC, SDLC, HDLC protocols) and start/stop devices attached directly or through controllers
  -ASCII: for devices (in ASCII or 3270 mode) using asynchronous communications lines (local, switched or non-switched)
  -IBM Token-Ring (IEEE 802.5) network
  -IEEE 802.3 standard or Ethernet® local area network
- System/370 Block Multiplexer Channel
  -Control units to support the full complement of System/370 channel I/O including IBM and non-IBM DASD, tape devices, printers, etc.

Connectivity depends on hardware and software that work hand-in-hand. The IBM 9370 processor enhances co-operation between the two to access, process, and move your data as needed. You can also use Systems Network Architecture (SNA) on your system to do necessary network management tasks. So, while your 9370 processor meets the diverse needs of even remote work groups, it can serve as a vital connecting link in your organization.


PC FAMILY
PC/370
3270 PC

3287
3268

NON-IBM ADAPTERS, DEVICES

3299 TERMINAL MULTIPLEXER

3161 ASCII TERMINALS PLOTTERS, PRINTERS

3812 PRINTER

The 9370 systems can attach a wide variety of intelligent and general purpose workstations—personal computers, display stations and printers. Some examples are shown here.

ROLM CBX & ASCII TERMINALS

REMOTE 3270 CONTROL UNITS & TERMINALS

5080

S/370 CHANNEL

PEER OR HOST SYSTEM

4245 PRINTER

7171

DACU (7170)

3174 TERMINAL CONTROLLER

3720 COMMUNICATIONS CONTROLLER

LOCAL AREA NETWORK PC'S, INTELLIGENT WORKSTATIONS, CONTROLLERS

Specially installed to produce the IBM 9370 processors, this Continuous Flow Manufacturing (CFM) line significantly reduces manufacturing time.

IBM 9370 Manufacturing Excellence

Our goal: the highest quality throughout the IBM 9370

This IBM-designed stress test chamber cycles each completed processor through high and low temperature and voltage fluctuations to ensure that it will work in your environment.
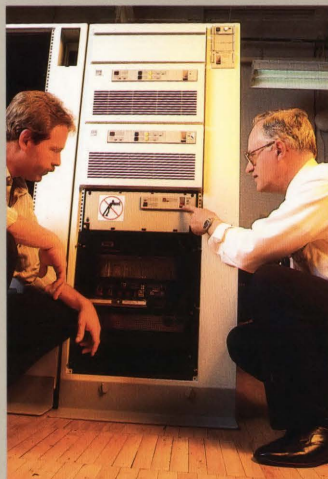
Early in the process of designing a system, IBM engineers consulted with the people who would manufacture their product. Working together, they arrived at a design for the new system that is both functional and easy to manufacture. Reducing manufacturing complexity as well as reducing manufacturing time reduces cost. A completely new manufacturing line, befitting this new computer system, has dramatically reduced both the human time and total cycle time to build a system.

Built around an advanced manufacturing concept, called Continuous Flow Manufacturing (CFM), the 9370 line incorporates a number of unique features. These include:

- Robotic carriers that deliver component parts to work stations at just the right time to move the product through the process and ensure that there is a continuous flow in the manufacturing line

- Work stations where technicians can raise or lower machines to the most comfortable working height and where they receive specific assembly instructions through a production monitoring system

- Automated test stations using IBM PC ATs to functionally test the system and an IBM computer-controlled system to monitor test data

- A specially designed stress test chamber (utilizing the high-reliability IBM 7532 Industrial Computers and the 7534 Industrial Display) that tests each completed processor using high and low temperature and voltage fluctuations

With higher productivity and faster turn-around time, the CFM line can produce a new 9370 processor in one-fifth the production time required for an IBM 4361 processor. The net result is not only a high quality, more reliable system but also lower cost to you, our customer.

A system nears completion at the IBM manufacturing facility in Endicott, N.Y.
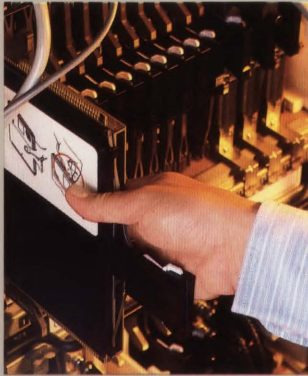
Dense packaging along with positive retention card-insertion features mean quicker upgrades with fewer failures.

IBM 9370 Reliability, Availability, Serviceability (RAS)

Your business and productivity can depend on it

Like all IBM systems, your 9370 processor has been designed with RAS in mind. First and foremost it is designed to avoid failures, but can also self-correct many types of failures. New memory cards, for example, contain error detection and correction logic formerly a function of the central processor. Processor memory includes redundant chips as back-up for continuous operation.

In the event of a disruptive failure the processor can self-diagnose, not only its own problems but problems on attached peripheral devices, and recommend immediate corrective action. The system can guide the user, step-by-step, through problem analysis routines in several national languages (through the processor console) and for certain failures identify the failing part allowing an IBM Customer Engineer to make a "first call" repair with the replacement part in hand. The common building blocks of the IBM 9370 processor are field replaceable—cards, cables, power supplies, cooling units.

Systems product assurance personnel perform a series of tests to ensure that IBM 9370 systems meet design specifications.

Through your processor console, via Remote Support Facility, you can also electronically:

- Submit a problem report to IBM for your system or *any* attached IBM I/O device
- Receive microcode updates from IBM which can be applied to your system automatically

New design tools, use of advanced technology and packaging, extensive design verification, new manufacturing techniques, and rigid test procedures all contribute to product quality. IBM engineers have used sophisticated design tools, for example, which synthesize logic to implement their functional designs. These computerized tools optimize the design's logic, and also reduce the probability of human errors.

Denser packaging, with fewer parts, fewer interconnections mean fewer failures and quicker replacements. The IBM 9370 system is, in fact, designated as a "customer setup" system. The system and its components, designed by engineers for functionality, were subjected to human factors and useability analyses. Following this feedback improvements were made to the physical design to facilitate customer handling and installation.

Testing is a continuing process, with checkpoints throughout the product development cycle to verify product design. Once the prototype product is stable, manufacture can begin. Every IBM 9370 system that is manufactured is subjected to an exhaustive series of tests before and after assembly is complete. Finally, a product stress test uses a custom-designed chamber to push *each* 9370 processor to its very limits.

Much has been done to assure the reliability, availability, and serviceability of your 9370 system. IBM does not take system RAS for granted, *so that you can.*

IBM 9370 Performance

A continuum of growth in IBM System/370 processors

Many factors of a processor's design, from the raw speed of circuit-switching on its logic chips through its capacity for handling data, have a bearing on performance. As you might expect, the IBM 9370 processor's efficiency is not only physical. Its highly efficient logical design, implemented through a combination of hardware and microcode, yields impressive performance in both commercial *and* compute-intensive applications.
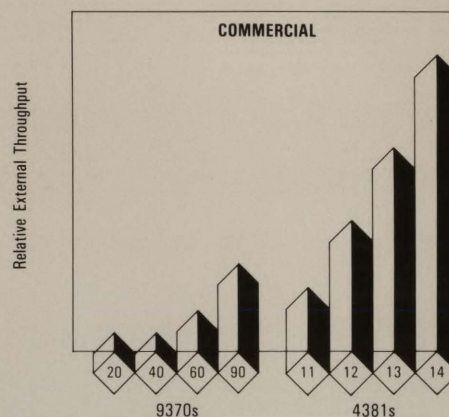
What this uncompromised performance means to you is *simplicity.* The IBM 9370 Information System offers a *single solution* to your computing needs, whether for business transactions, accounting, correspondence, engineering design, laboratory analysis, or industrial automation. And, while it serves the specialized needs of individual departments or work groups, your IBM 9370 system maintains compatibility and productivity *across* your organization. So, how ever you judge performance—throughput, millions of floating point operations, number of users, response time—IBM 9370 processors measure up. They extend the 370 continuum offered by IBM processors.

In addition to the attributes listed in the table below, 9370 processors include:
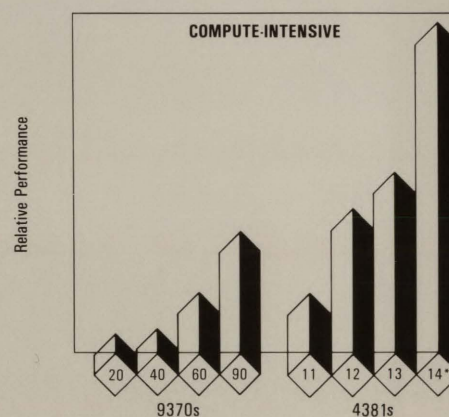
- High-capacity translation lookaside buffers
- Overlapped instruction decode/execution
- Enhancements for common mathematical and operating system functions

COMMERCIAL

Relative External Throughput

9370s: 20 40 60 90
4381s: 11 12 13 14

Data from internal measurements using IBM CICS benchmarks.

COMPUTE-INTENSIVE

Relative Performance

9370s: 20 40 60 90
4381s: 11 12 13 14*

Data from IBM measurements using the LINPACK †
(all FORTRAN) benchmark.

*Estimate (based on IBM-measured compute-intensive ratios, assuming use of dual-processor capability for 4381-14).
†A FORTRAN workload to solve dense systems of linear equations using full-precision.

COMPUTE-INTENSIVE COMPARISON

Millions of Floating Point Operations Per Second

1.25
1.00
.75
.50
.25
.00

mVAX II | VAX 8200 | DG/MV 10000 | VAX 8600 | VAX 8500 | VAX 8650 | IBM 9370s | IBM 4381s

Data from Argonne National Laboratory* (not fully verified by IBM), illustrates the performance of IBM 9370 processors and 4381 uniprocessors with comparable uniprocessors of other manufacturers —(mVAX and VAX are products of Digital Equipment Corporation; DG/MV is a product of Data General Corporation).

*"Performance of Various Computers Using Standard Linear Equations Software in a Fortran Environment," Technical Memorandum No. 23, (May 6, 1987).

IBM 9370 System	Model 20 (9373)	Model 40 (9375)	Model 60 (9375)	Model 90 (9377)
Cycle time (nanoseconds)		90		50
High-speed (cache) buffer (KB)				16
Micro-instruction (control) storage (KB)			16	8
Aggregate I/O capacity* (MB/sec), up to:	5.5	22		39
Processor/memory data path width		4-byte		8-byte
Hardware accelerators: Floating point	Add, Subtract	Add, Subtract Multiply Divide, Square Root		Add, Subtract Multiply
Microcode Assists: Operating System		VM IX/370		
			MVS	
Mathematical		Multiply/Add Mathematical Functions**		Square Root ACRITH

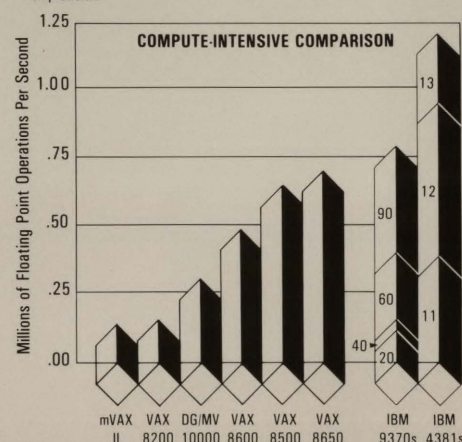*Estimated   **For use with Elementary Math Library (PRPQ P81005)

19.

IBM 9370 Summary

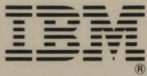## *A system that grows with you*

The IBM 9370 Information System is a harmony of advanced technology and packaging. It represents the efforts of a team of employees from IBM laboratories and plants around the world. Years of careful thought and diligent study by IBM planners and designers went into understanding your needs and data processing trends, together with the hard work of IBM engineers and developers to shape these into a fully integrated, flexible system-solution. The result is a modular design, with the computing power you need, in a package you can use wherever, however...and best of all, at a price you can afford.

If your enterprise is based in IBM System/ 370 computing, the 9370 system offers a departmental solution that can also run your existing library of 370 applications. Its open system design keeps pace with your computing needs as they change and grow. You can start with 370, stay with 370—grow within the 9370 family and beyond.

Ask your IBM marketing representative for more details about the IBM 9370 solution today.

More information about the IBM 9370 system is available in,"Introducing the IBM 9370 Information System", GA24-4030.