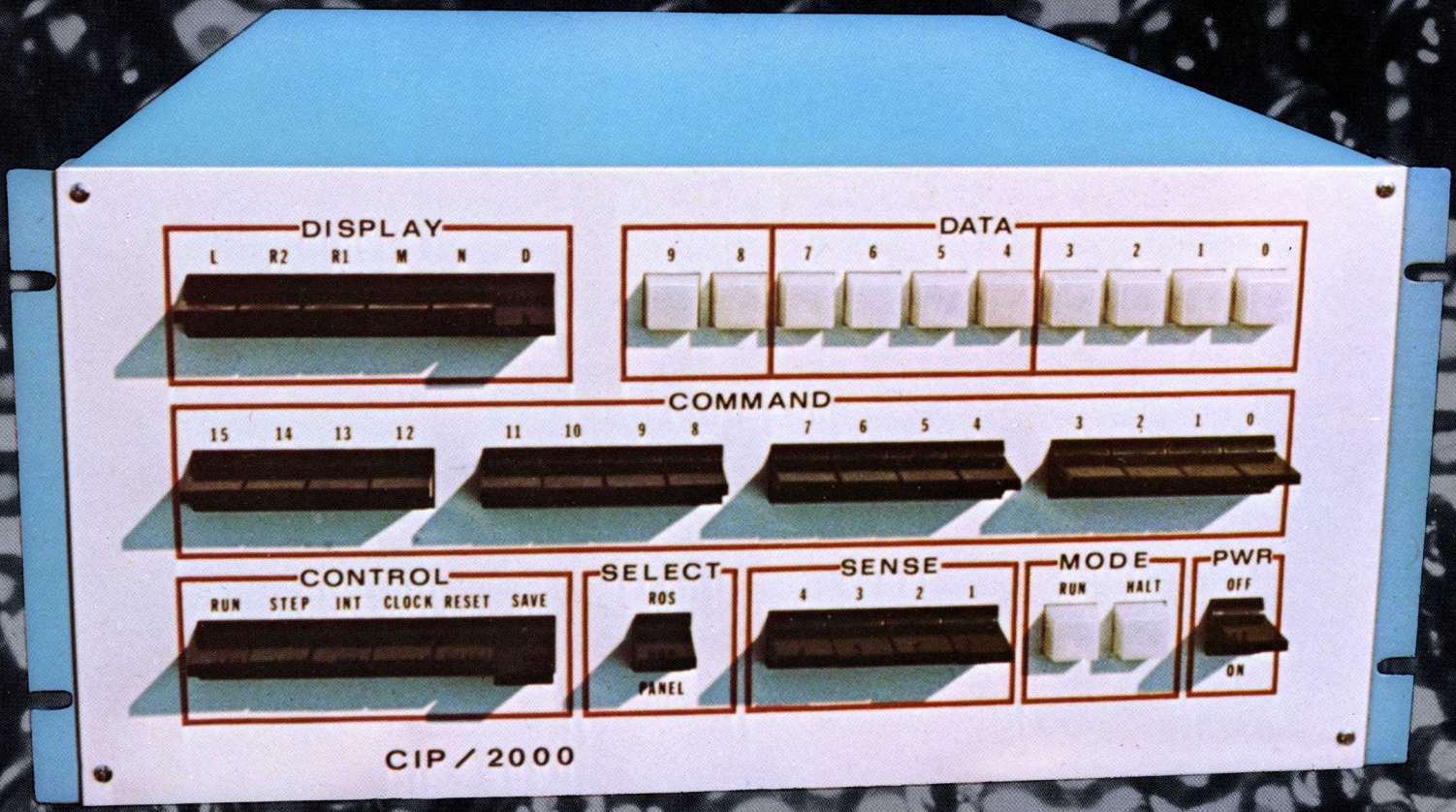
CINCINNATI

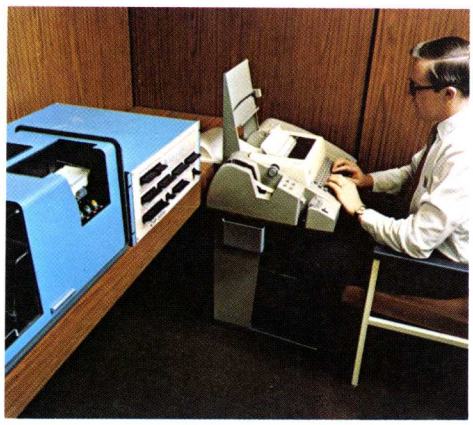
CIP/2000-CIP/2100

DEDICATED AND GENERAL PURPOSE DIGITAL COMPUTERS



CINCINNATI™

CIP/2000-CIP/2100



CIP/2000 with card reader and teletype.

FAST, POWERFUL SMALL COMPUTERS FROM A DEPENDABLE NEW SOURCE

Although The Cincinnati Milling Machine Co. is new in the field, we enter the computer area with a well-established manufacturing capacity, complete with engineering and programming talent pools, world-wide service and training networks, and one of the fastest small computers available.

Our new mini, the CIP/2000, can save OEM users considerable cost because all but the essential hardware needed for dedicated applications has been stripped away. Sophistication and performance have not been sacrificed, however, due to unique architecture and our microprogramming techniques. Microprograms can be executed by a firmware package (hardwired read-only memory boards) in the heart of the processor.

One firmware package transforms the basic CIP/2000 processor into the CIP/2100—a microprogrammed, software-programmable, macro-level, general-purpose computer.

Both units are produced by The Cincinnati Milling Machine Co., the world's largest machine tool builder and a major manufacturer of numerical and other electronic automation controls for more than 15 years. They are built in a completely new 200,000 square-foot plant designed especially to produce the most advanced forms of electronic control systems. Every precaution has been taken to assure that your CIP/2000 or CIP/2100 computers are built to the highest standards of quality and will achieve the highest possible levels of performance and reliability. This is especially important in dedicated OEM systems applications and for assured performance in unattended installations.

The most modern and sophisticated mass-production manufacturing techniques assure prompt delivery in volume quantities, and we have an outstanding reputation for servicing what we produce. The CIP/2000 and CIP/2100 offer the highest possible levels of value and performance for your small computer applications.

DESIGN HIGHLIGHTS

CIP/2000

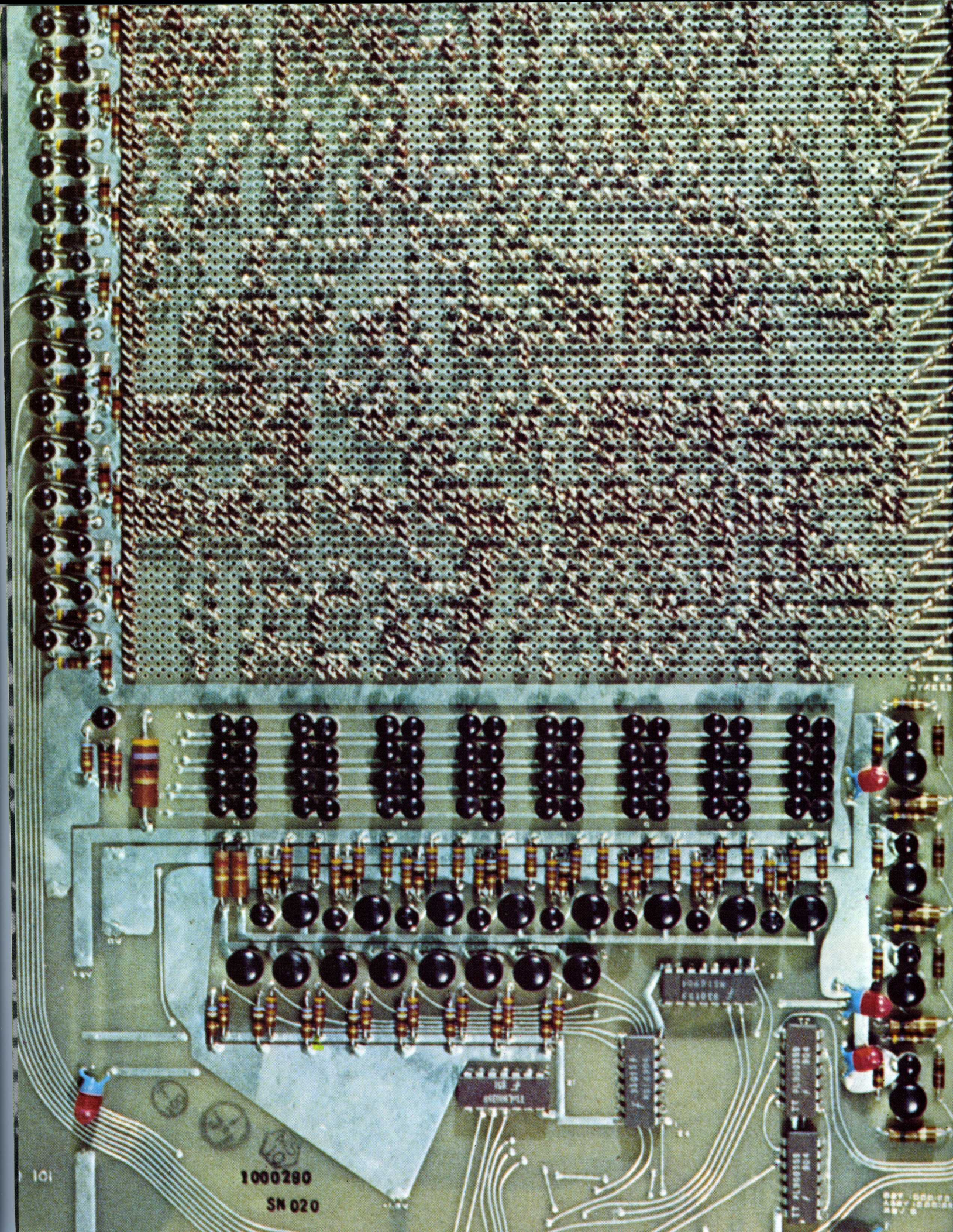
- Memory addressing to 32K.
- 4096-byte memory modules.
- 16,384 bytes of memory in basic cabinet.
- 1.1-microsec full-cycle memory speed.
- 8 or 9-bit memory bytes: extra bits for memory parity and special applications.
- 15 general-purpose 8-bit file registers.
- Up to 1024 words of read only memory, in 256-word modules.
- 220-nanosec microcommand execution time.
- Seven I/O transfer modes.
- 16 basic commands.
- TTL integrated circuitry.
- Operating temperature range 0°C to 50°C.
- Cabinet dimensions 8-3/4" high, 19" wide, 23" deep.
- Power 115/230 vac, 50-60 Hz.

OPTIONAL FEATURES

- Direct memory access.
- Memory parity
- Real-time clock.
- Memory protect.
- Power fail automatic shutdown, and automatic restart.

CIP/2100—ADDITIONAL FEATURES

- Variable-length instructions.
- 16-bit accumulator, extended accumulator, and index register.
- Eight memory referencing address modes.
- Multiply and divide.
- Variable 8, 16, 24, and 32-bit operations.
- Programmed, buffered concurrent, and DMA input/output transfers.
- Software includes Two-pass Assembler and Teletype Operating System.
- Bootstrap loader in nonvolatile read-only memory.
- Up to 64 priority interrupts, expandable in groups of 8.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CINCINNATI

CIP/2000-CIP/2100

FIRMWARE— THE KEY TO RELIABILITY, FLEXIBILITY, HIGH-SPEED PERFORMANCE AND LOW COST

Cincinnati achieves reliability and internal flexibility by the use of *firmware*—the untouched middle ground between *hard*ware and *soft* ware. A programmable high-speed control element can act as an inner processor to the computer itself. In effect, firmware behaves like programmable hardware.

By using this flexible technique for inner control as a basic building block, it is routinely possible to design machines for many different or special purposes. In data concentration applications, for instance, special instruction sets are hardwired in to speed I/O control and data handling; in teletype communications concentration, a minimum of peripheral hardware is required because firmware can be set up to process serial bit data.

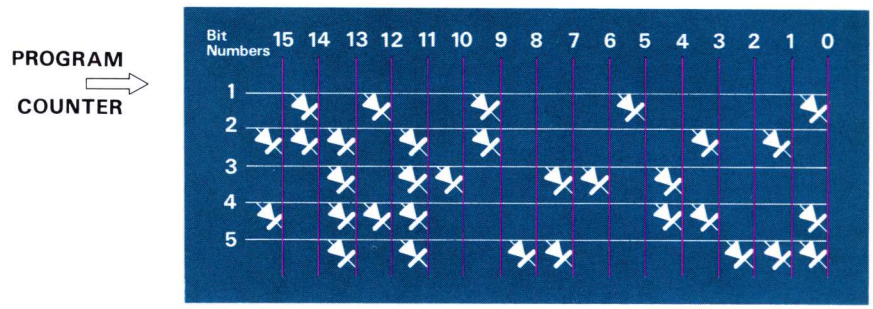
Microprogramming, the internal programming technique implemented by firmware, handles the functions that would otherwise have to be done by software or special-purpose logic. There are two advantages to microprogramming: speed and program reliability. As the internal clock institutes cycles every 220 nanosec, microprogrammed functions can enhance programs by execution factors of 5-10 times. Program reliability is ensured because each bit is represented by a discrete hardwired diode.

Designing a Read-Only Memory (ROM) board, to perform some special firmware function, is easy. First, the required program is written in assembly language. Then it is run through the Cross Assembler program to produce a map of the desired diode arrangement.

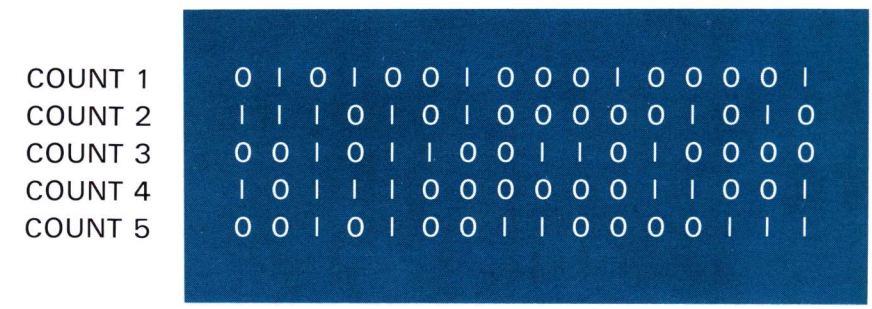
Since firmware is so easy to create, modifying the inner functions of the computer for some special purpose is a relatively simple process also. For an OEM application, special-purpose firmware instructions can be combined with the standard software instruction set. For even more "custom" OEM applications, entire algorithms can be microprogrammed into the CIP/2000 computer.

Here is exactly how microprograms are written in firmware. Each ROM board has space for 256 16-bit instruction words. Operation can best be described by referring to a representation of a small segment of the board.

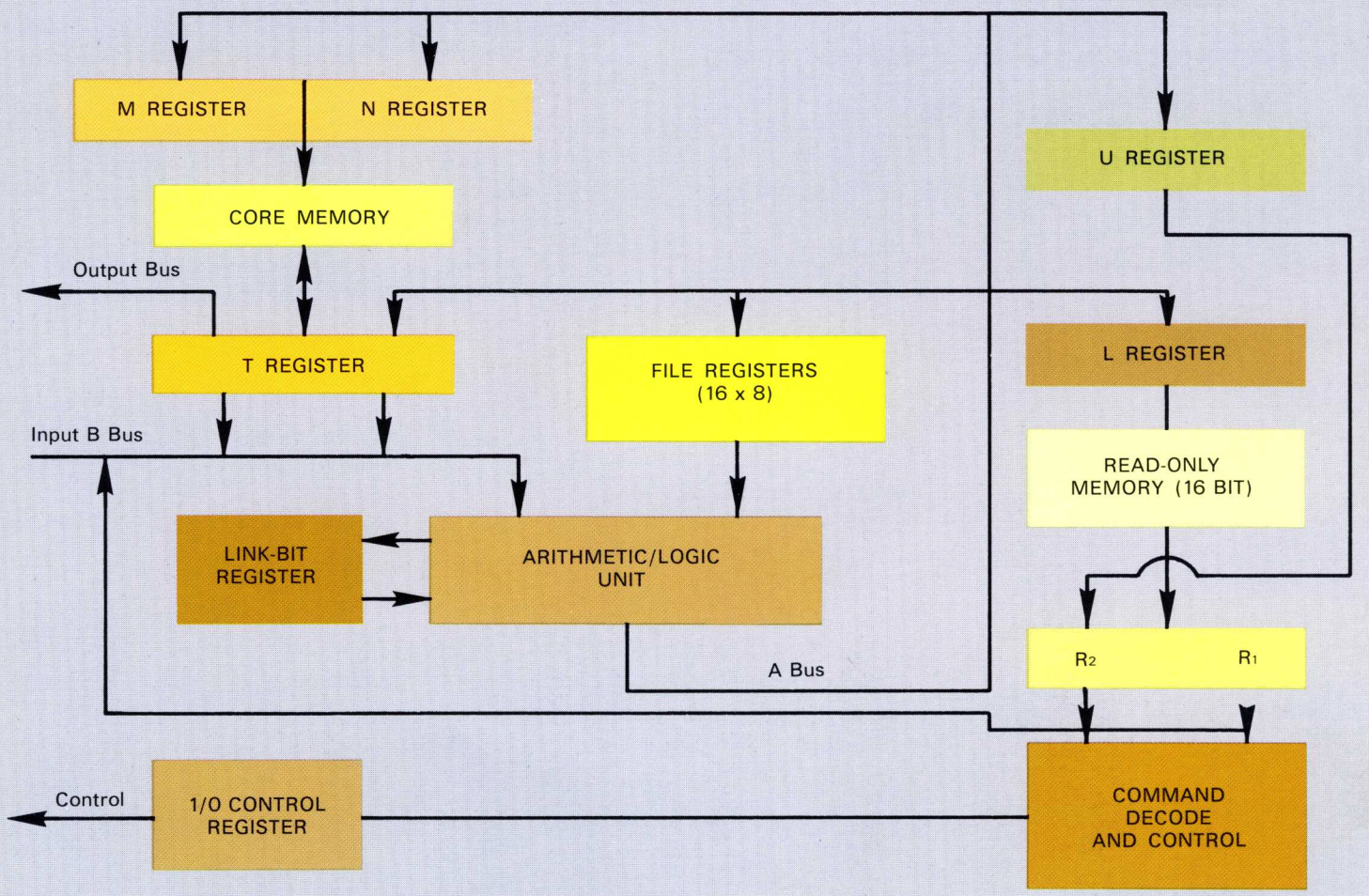
The horizontal lines represent conductor tracks on the upper side of the board; the vertical red lines are tracks on the under side of the board.



The computer reads a set of machine instruction words out of ROM by sequentially sending pulses along the horizontal lines. When the program counter sends a pulse along the line 1, for instance, the diode at intersection 14 will indicate a logic "one" at bit position 14, and also a bit will be indicated at positions 12, 9, 5, and 0. Exactly 220 nanosec later, the program counter sends a pulse along line 2, to generate the 16-bit instruction word below, labeled "count 2."

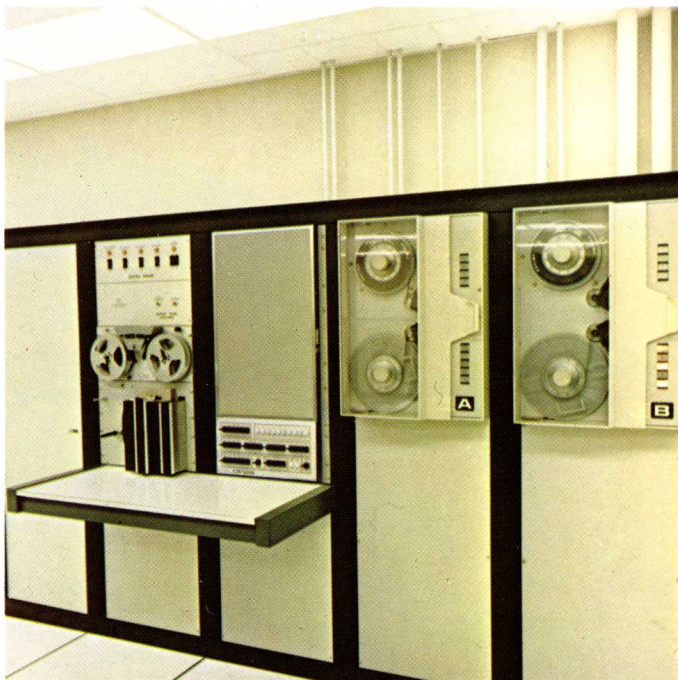


And so on down the line, just as fast as the program counter can be gated, words are read out of ROM.



CIP/2000 with CRT/KB terminal.

CIP/2000 as peripheral controller.



CINCINNATI

CIP/2000

HOW IT WORKS

The CIP/2000 is a bus-organized machine built around a file of 15 programmable registers and employing microprogrammed control. The machine executes 16 basic commands, 16 bits in length, of one of two formats. Microprograms are placed in a Read-Only Memory board made up of discrete diodes, and thereafter are a part of the machine's hardware. The commands read out of the ROM control all aspects of the operation of the basic machine and are executed in a single machine-clock cycle.

The 8-bit arithmetic/logic unit performs all manipulation of data including: addition, logical AND, logical OR, logical exclusive OR, and 1-bit left and right shifts. The output of this logic network is the A-bus, which is the input to the file and other machine registers. All byte data movement is performed over this bus. The output of the file is one of the inputs to the arithmetic/logic unit; the other is the B bus. Inputs to this bus are determined by the command, its options, and the I/O mode. Bus inputs are the true output of the T register, the complement output of the T register, the Input bus, and the 8-bit literal contained in some micro commands.

STRUCTURED FOR EFFICIENCY

The CIP/2000 provides a rare combination of high speed, flexible microprogramming capability, reliability, and low cost which make it the ideal solution to a wide variety of dedicated volume OEM applications where fast, system-oriented operations are required.

Extremely fast execution speed permits time-sharing of processor logic to minimize input/output interface hardware. The fixed nature of the diode arrangement provides a high degree of operating reliability in adverse environments and, while nonvolatile in nature, it can be modified with comparative ease if necessary. Printed circuit (ROM) modules contain up to 256 16-bit words per board, with a maximum capacity of 1024 words.

While the ROM will be adequate for many applications, high-speed core memory is available when variable data or parameters must be stored. Full-cycle time of the core memory is 1.1 microsec and it can also be operated in a half-cycle mode by the microprogrammed control unit at a 660-nanosec cycle time.

The basic data word length is an 8-bit byte. The memory itself can be 8 or 9-bits to provide storage of parity, flag, or special bits. The core memory is available in 4,096-byte increments up to 32,768 bytes. A Direct Memory Access option permits the core memory to be accessed directly instead of under direction of the control unit.

The input/output section has two 8-bit unidirectional paths for transfer of data in and out under control of microcommands in ROM. Control output lines are turned on and off by the microprogram to direct operations in the external devices. Control and status input lines from external devices are tested by the microprogram to determine branching to appropriate micro subroutines for the input/output functions being performed. Microprogram control simplifies most I/O interface requirements, is less expensive than hardware control, and can completely eliminate the need for I/O software subroutines.

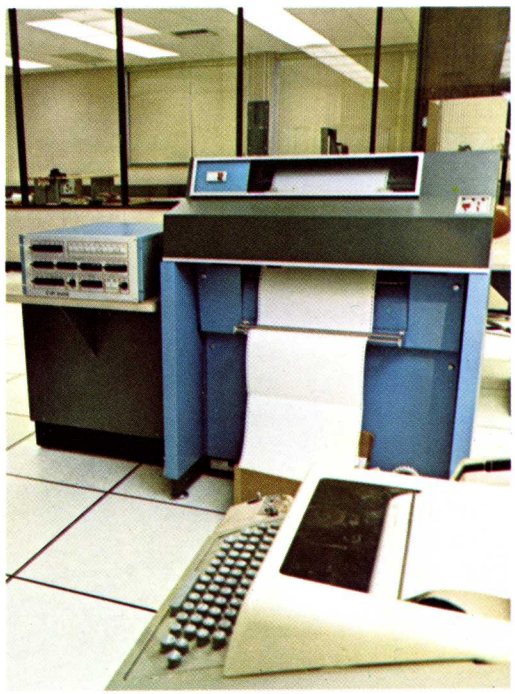
An important feature of the CIP/2000 is its ease of adaptation to changing demands. The addition of more problem-oriented functions in the ROM through a simple change or modification of the ROM circuit boards can create a dramatic gain in system capacity and throughput performance.


DISPLAY
DATA
COMMAND
CONTROL
SELECT
CIP/3600

CINCINNATI

CIP/2100

CIP/2000 with line printer.



STRUCTURED FOR FLEXIBLE POWER

MICROPROGRAMMED—SOFTWARE PROGRAMMABLE FOR GENERAL PURPOSE APPLICATIONS

The CIP/2100 is an expanded version of the basic CIP/2000 hardware, microprogrammed to convert it into a software-programmable, macro-level, general-purpose computer. It provides ample capacity for larger programs than are possible with the CIP/2000, along with a greater degree of program flexibility and ease of programming. Programs are stored in the core memory and are interpreted by the microprogram in the ROM.

Problem-oriented macro-level instructions may be added to enhance performance and throughput by adding special subroutines to the standard firmware in the ROM. This retains its flexibility as a software programmable computer but also permits the high speed of the basic CIP/2000 to be employed on job-oriented tasks.

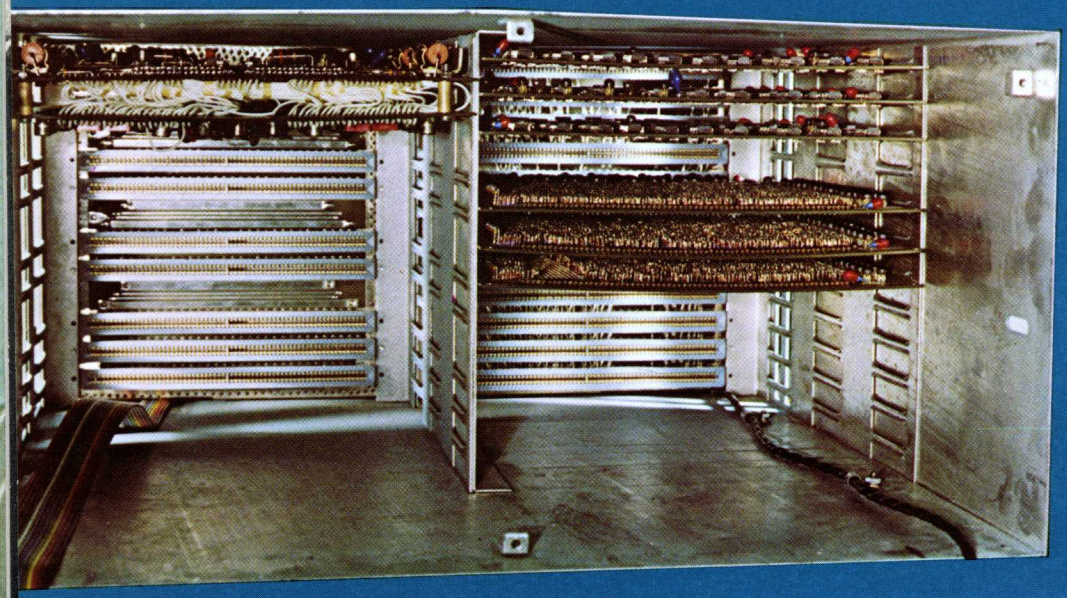
Important increases in speed can also be attained by the addition of problem-oriented macros to the basic instruction set. Multiple precision arithmetic and complex macros which replace entire software subroutines in core memory can be several times faster than software subroutines and yet require only a small fraction of core memory allocation.

The CIP/2100 has a more powerful set of instructions than do other general-purpose machines in the same class because optimum operand manipulation, shift control, etc. can readily be obtained by implementation of variable-word-length instruction and data formats under microprogram control.

The basic elements of the CIP/2100 include the operational registers, core memory, interrupt system, input/output system and control console. A number of different processor and peripheral equipment options are available to meet a broad range of system requirements.

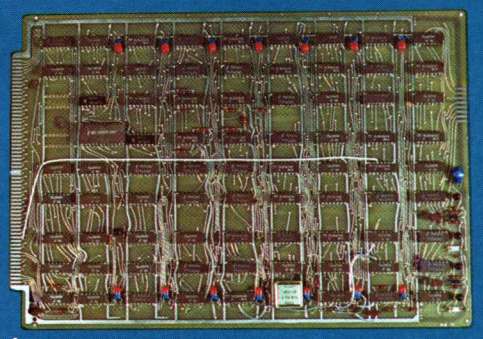
Salient characteristics of the CIP/2100 include:

- Variable length instructions.
- 16-bit accumulator, extended accumulator, and index register.
- Eight memory referencing address modes.
- Multiply and divide.
- Variable 8, 16, 24, and 32-bit operations.
- Programmed, buffered concurrent, and DMA input/output transfers.
- Software includes Two-Pass Assembler and Teletype Operating System.
- Bootstrap loader in ROM.
- Up to 64 priority interrupts, expandable in groups of 8.



The modular construction of the CIP system enables its architecture to be economically "tailored" to the specific performance requirements of an application without wasteful inclusion of unnecessary capabilities. It also permits future expansions of the basic system, by simply plugging in additional capabilities, to meet changing needs quickly and at lowest possible cost. A few of the typical modular plug-in components, shown at the right, are:

1. *PROCESSOR CONTROL*
2. *INPUT/OUTPUT*
3. *PROCESSOR DATA*
4. *CORE MEMORY*
5. *CORE MEMORY (REVERSE SIDE)*



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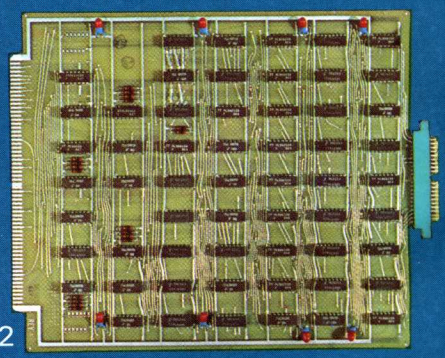

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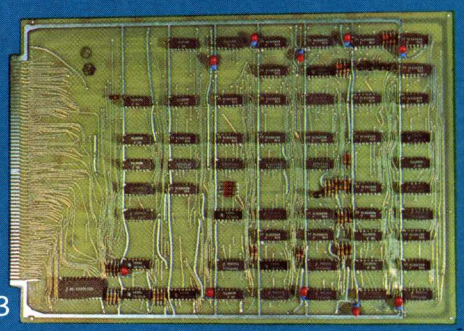

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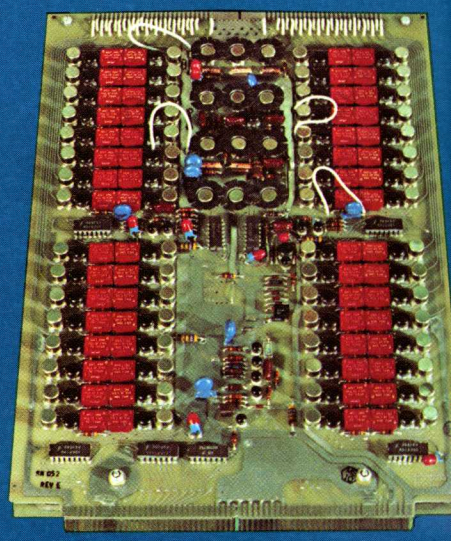

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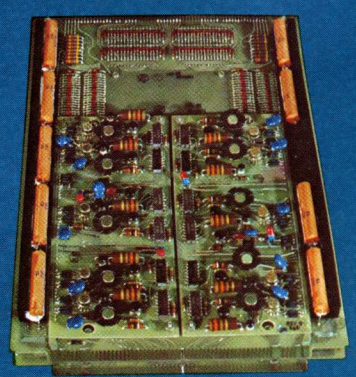


5

OPTIONAL FEATURES

An extensive list of options has been developed. For instance, an optional processor board is available which includes power fail safe, memory protection, real-time clock, and spare memory bit protection. Other optional boards are I/O Line Driver, Parallel Teletype Controller, General-purpose, Priority Interrupt, I/O Expander, Modem Controllers, Card Reader Interface and a Paper Tape Reader Interface.

SOFTWARE

Software currently available includes a Teletype Operating System, Two-Pass Assembler, Tape Editor, CIP/2000 Cross Assembler, CIP/2100 Cross Assembler, and a CIP/2000 Simulator Operating System.

SPECIFICATIONS

CIP/2000

CLOCK RATE	4.55 mHz (crystal controlled)
READ-ONLY MEMORY Speed Size	 220 nanosec per instruction 256 to 1,024 words in modules of 256 16-bit words
CORE MEMORY Speed Size	 1.1 microsec full-cycle; 0.66 microsec half-cycle Modules of 4,096 bytes (8, or 9 -bit) to maximum of 32,768 bytes.
ARITHMETIC	Parallel, binary, fixed point, one's and two's complement for negative numbers.
ADDRESSING	Firmware dependent
INPUT/ OUTPUT	8-bit parallel byte I/O bus for programmed and fully automatic concurrent transfers. Serial I/O interface for teletypes or similar devices. Direct Memory Access (DMA) channel with maximum transfer rate of 909,000 bytes per second.
INTERRUPTS	An interrupt request flag which can be tested by microcommands is available. I/O interfaces are designed for generating priority interrupts.
LOGIC	TTL logic elements including MSI types, in DIP ceramic packages. DTL circuitry for I/O interfaces.
INSTRUCTIONS	Microprogrammed to suit application; 16 basic commands.
CABINET	The processor, memory to 16K, I/O interfaces, power supply and fan are enclosed in a cabinet 8-3/4" high, 19" wide, and 23" deep. Fully expanded cabinet weighs 75 pounds.
POWER	115/230 vac, 50-60 Hz. 340 watts
ENVIRONMENT	0°-50°C (32°-122°F)
PANELS	The *system control panel* displays all registers, manual command execution, and control switches. *The basic control panel* provides only the basic control switches.
SOFTWARE	Cross Assembler written in Fortran IV to generate microprograms for the read-only store.

CIP/2100

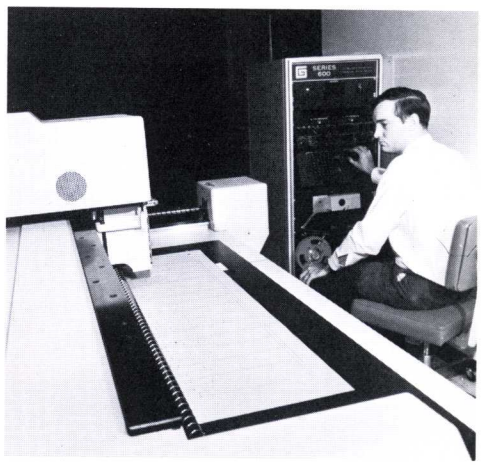
CLOCK RATE	4.55 mHz (crystal controlled)
READ-ONLY-MEMORY Speed Size	 220 nanosec per instruction 768 to 1,024 words in modules of 256 16-bit words.
CORE MEMORY Speed Size	 1.1 microsec full-cycle; 0.66 microsec half-cycle. Modules of 4,096 bytes (8, or 9-bit) to maximum of 32,768 bytes.
ARITHMETIC	Multi-precision, parallel, binary, fixed point, two's complement.
ADDRESSING	Eight modes including relative, index, indirect, and literal.
INPUT/ OUTPUT	8-bit parallel byte I/O bus for programmed and fully automatic concurrent transfers. Serial I/O interface for teletypes or similar devices. Direct Memory Access (DMA) channel with maximum transfer rate of 909,000 bytes per second.
INTERRUPTS	A priority interrupt system allows internal interrupt on power failure, real-time clock, memory parity error, and external interrupts on the byte I/O bus.
LOGIC	TTL logic elements including MSI types, in DIP ceramic packages. DTL circuitry for I/O interfaces.
REGISTERS	Six operational registers including A-accumulator, B-auxiliary accumulator, X-index, P-program counter, W-2-bit word length mode and O-1-bit overflow flag.
INSTRUCTIONS	89 standard instructions including 17 control, 16 conditional jump, 12 shifts, 8 input/output, 16 register operate, 18 memory reference, 1 multiply, and 1 divide.
CABINET	The processor, memory to 16K, I/O interfaces, power supply and fan are enclosed in a cabinet 8-3/4" high, 19" wide, and 23" deep. Fully expanded cabinet weighs 75 pounds.
POWER	115/230 vac, 50-60 Hz. 340 watts.
ENVIRONMENT	0°-50°C (32°-122°F)
PANELS	The *system control panel* displays all registers, manual command execution, and control switches. The *basic control panel* provides only the basic control switches.
SOFTWARE	Cross assembler in Fortran IV, Two-Pass Assembler, Teletype Operating System, Tape Editor, CIP/2000 Simulator.

CINCINNATI

CIP/2000-CIP/2100

Cincinnati-designed NC wiring machine.

QUALITY, PERFORMANCE AND RELIABILITY ASSURED BY ULTRA-MODERN PRODUCTION FACILITIES



NC drafting machine.

CIP/2000 and CIP/2100 computers are manufactured by the Cimtrol Division of The Cincinnati Milling Machine Co. in a completely new 200,000 square foot plant designed specifically and solely for the production of complex electronic control systems of all types.

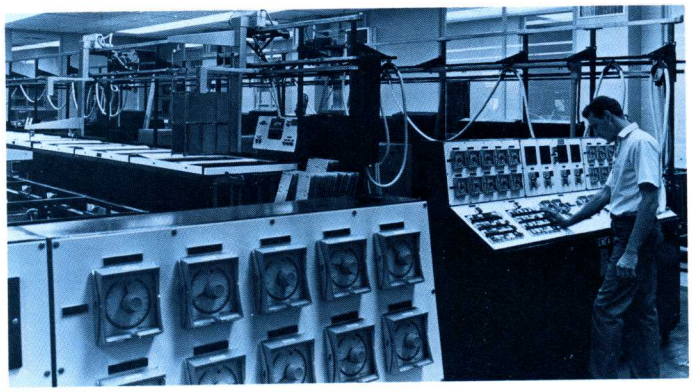
Ever since 1955 when we introduced our own proprietary numerical control systems for machine tools, we have been a major manufacturer of numerical controls and other electronic controls for all types of machine tool automation. The magnitude of our investment in this new manufacturing facility is your assurance of our continued leadership in the rapidly expanding market for computers and computer-oriented control systems. In our new plant we employ only the most advanced methods and sophisticated modern technologies to assure you of the highest levels of product

Portion of computer room.

Administrative tower of electronics plant.

CINCINNATI

CIP/2000-CIP/2100



Program controlled automatic plating lines.

••• QUALITY, PERFORMANCE AND RELIABILITY.

PC board tester with CIP/2000 control.

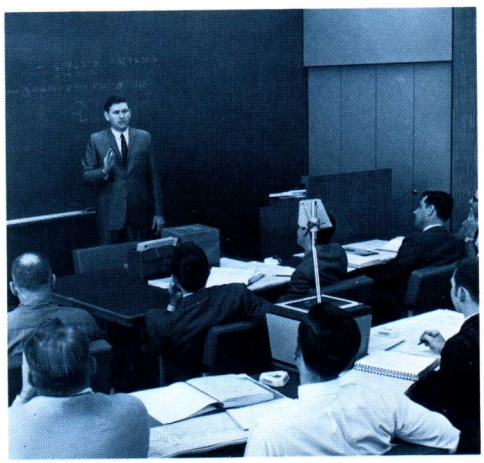
Engineering Department.

NC runoff area.

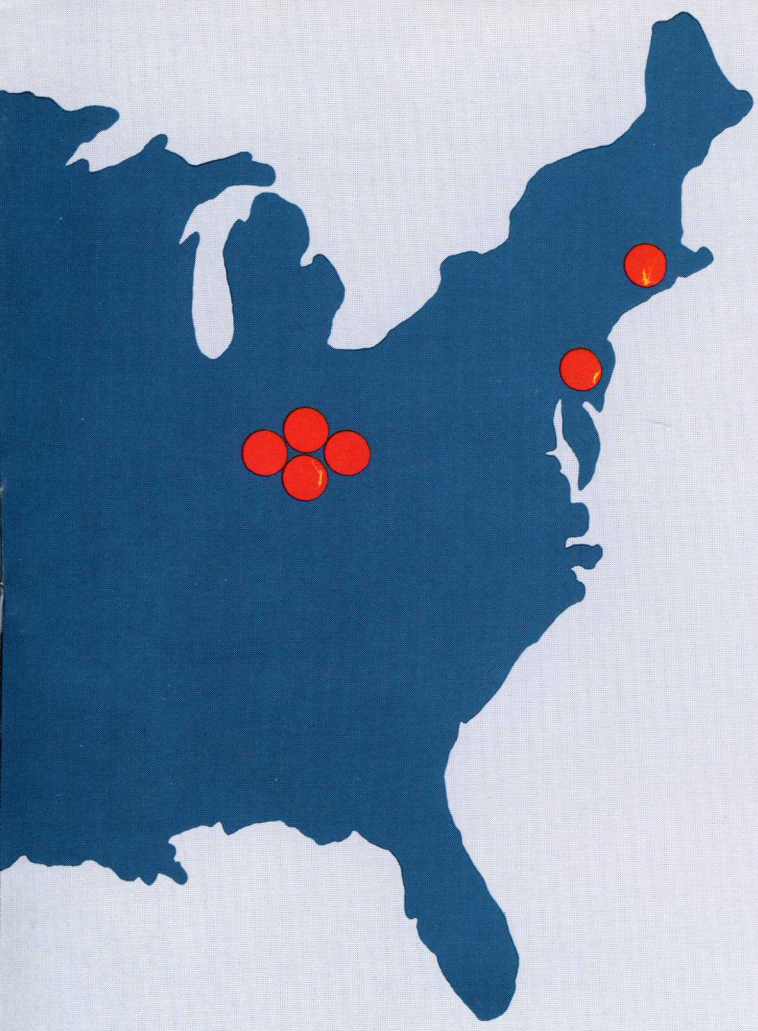
The plant is completely air conditioned. Numerically controlled drafting machines and program-controlled, automated copper, nickel, and gold-plating lines are employed in the production of printed circuit boards. Numerically controlled Cincinnati Wiring Machines speed complex wiring operations and assure the quality of these critical operations. Computer-controlled testing equipment, designed and built by the Cimtrol Division, checks critical components, assemblies, and finished computers, and an environmental test chamber permits testing at widely varying levels of temperature and humidity. Particularly sensitive production operations are performed in dust-free, temperature and humidity controlled rooms separated from the other air conditioned manufacturing areas by air locks and air showers. We have been meticulous in our attention to detail to assure the highest possible quality levels in every step of manufacture. This is an especially important consideration for system-oriented computer applications which must operate unattended, often in hostile environments.

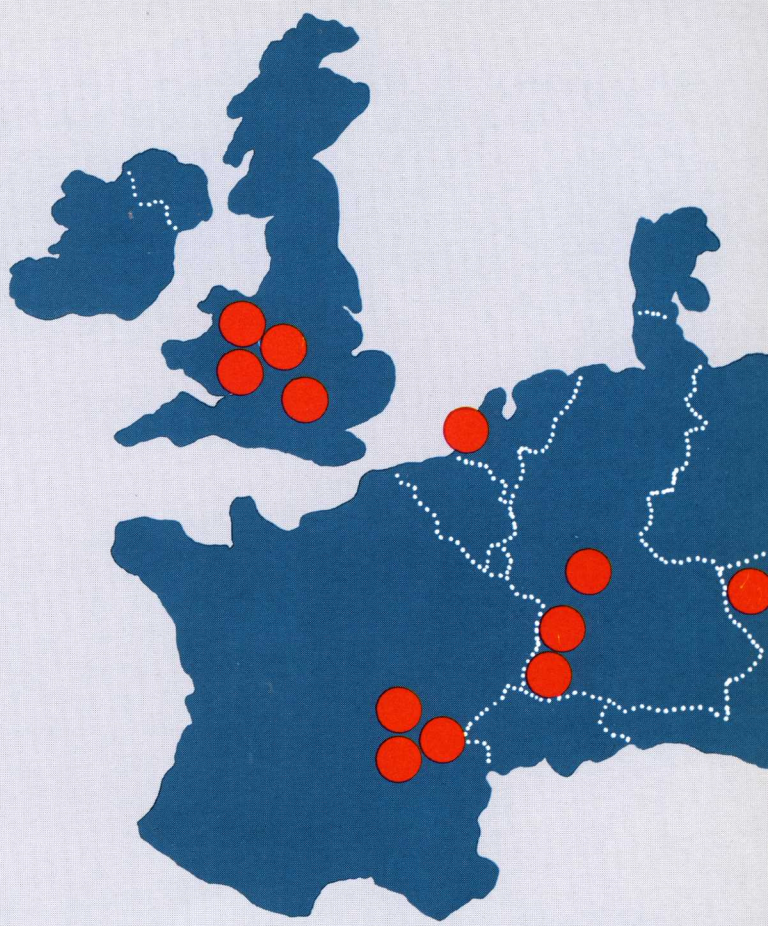
When you purchase a CIP/2000 or CIP/2100 you can be assured that you will be getting the ultimate in quality and performance. They are both production-line products, with consistent uniformity and solid dependability.

You can also be sure that we will back it up with the highest levels of customer service.



Training classroom.





ABOUT OUR COMPANY

The Cincinnati Milling Machine Company is a diversified international company with 30 modern manufacturing plants in the United States, England, The Netherlands, France, West Germany and Austria. Although we are the world's largest producer of precision machine tools, our product line has expanded over the years to include chemicals, abrasives, plastics, plastics processing equipment, process control systems . . . and now computers.

Employing more than 15,000 people, we are a technology-oriented company in which more than 1500 employees are continuously engaged in some form of research, development, and engineering. Our recent 100 million dollar expansion and capital improvements programs, of which our new electronics plant is an excellent example, have given us the most modern and effective production capabilities obtainable, with the paramount objective of providing the highest levels of product quality at the lowest possible cost.

The present scope of our worldwide operations is exemplified by our sales and service organization with 175 offices, doing business in 57 countries. After more than 85 years of successful service to our customers, you can be assured of our desire to continue this relationship to the best of our ability.

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