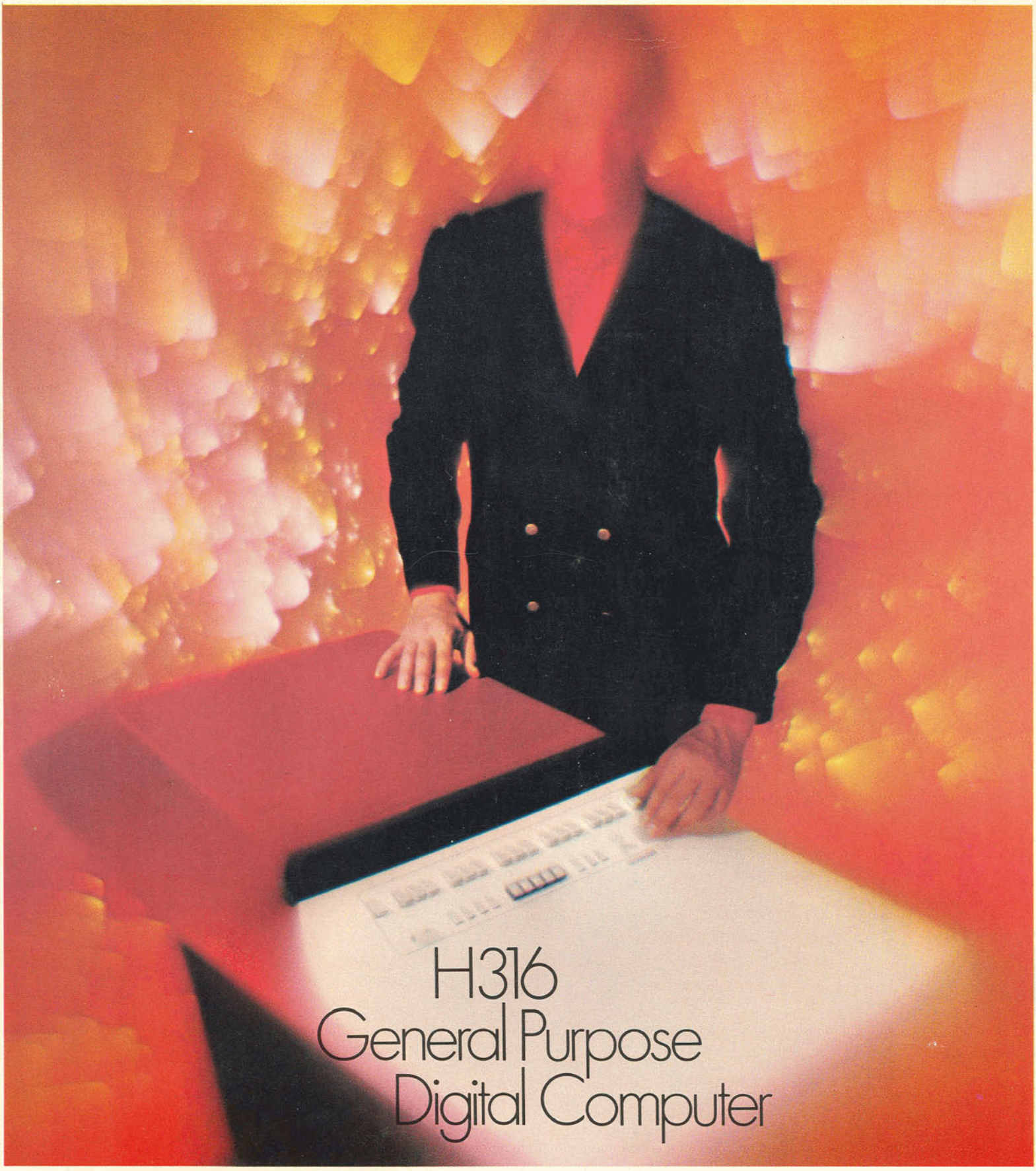


H316 General Purpose Digital Computer

Honeywell

H316 - First under - $10,000 16-bit machine from a major computer manufacturer

For less than $10,000 you can have the Honeywell 316 general-purpose computer working for you on your real-time control, acquisition, or communications system. Although it is small, this machine is a full-fledged member of the Honeywell Series 16 family (116, 316, 416, and 516) of computer systems. And with the H316, you have the backup of a major computer company, which means:

- You get your machines when you need them
- You can receive one or hundreds to meet your systems needs
- You have the support of thousands of Honeywell people all over the world
- You can order from a full line of peripherals proven reliable in tens of thousands of operations

The H316 is a full-scale digital computer with 72 commands, 1.6 μs memory cycle time, and memory size of 4K expandable to 16K. It is logically identical to the DDP-516 – same organization, same instructions, same interface characteristics – resulting in more than 500 programs you know will work, peripherals and options you can count on, and 16-bit experience that's bound to benefit you. And when you're ready to grow into larger Series 16 systems, you can do so without costly reprogramming.

You may choose any of the three styles: table-top; rack-mountable, in a standard 19-inch RETMA rack; and pedestal, with desk-height controls, writing table convenience, and futuristic styling.

The H316 delivers so much at such a low cost that it is the optimum computer for a multitude of applications. Typical ones include: control systems in many industrial and military/aerospace fields, research and scientific data acquisition, hybrid operations in conjunction with analog computers, data storage and retrieval, and communications systems.

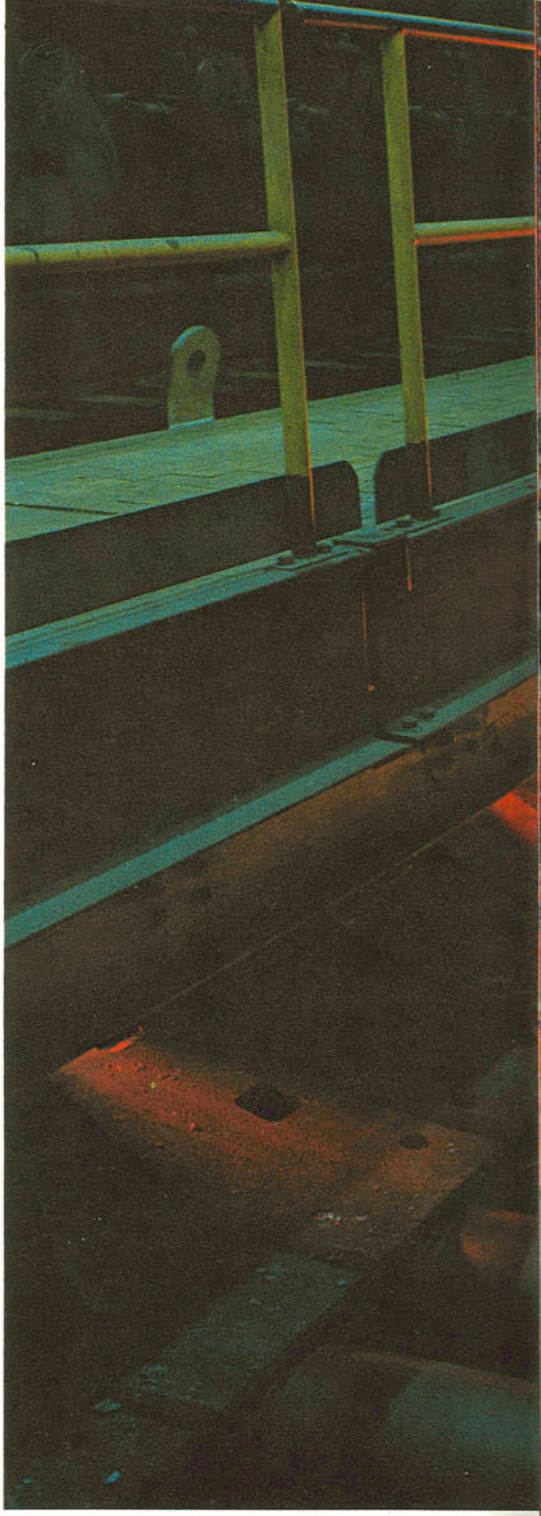
As a matter of fact, in applications where real-time performance characteristics are the major criteria, you will find Honeywell Series 16 computer systems in more than a thousand installations.

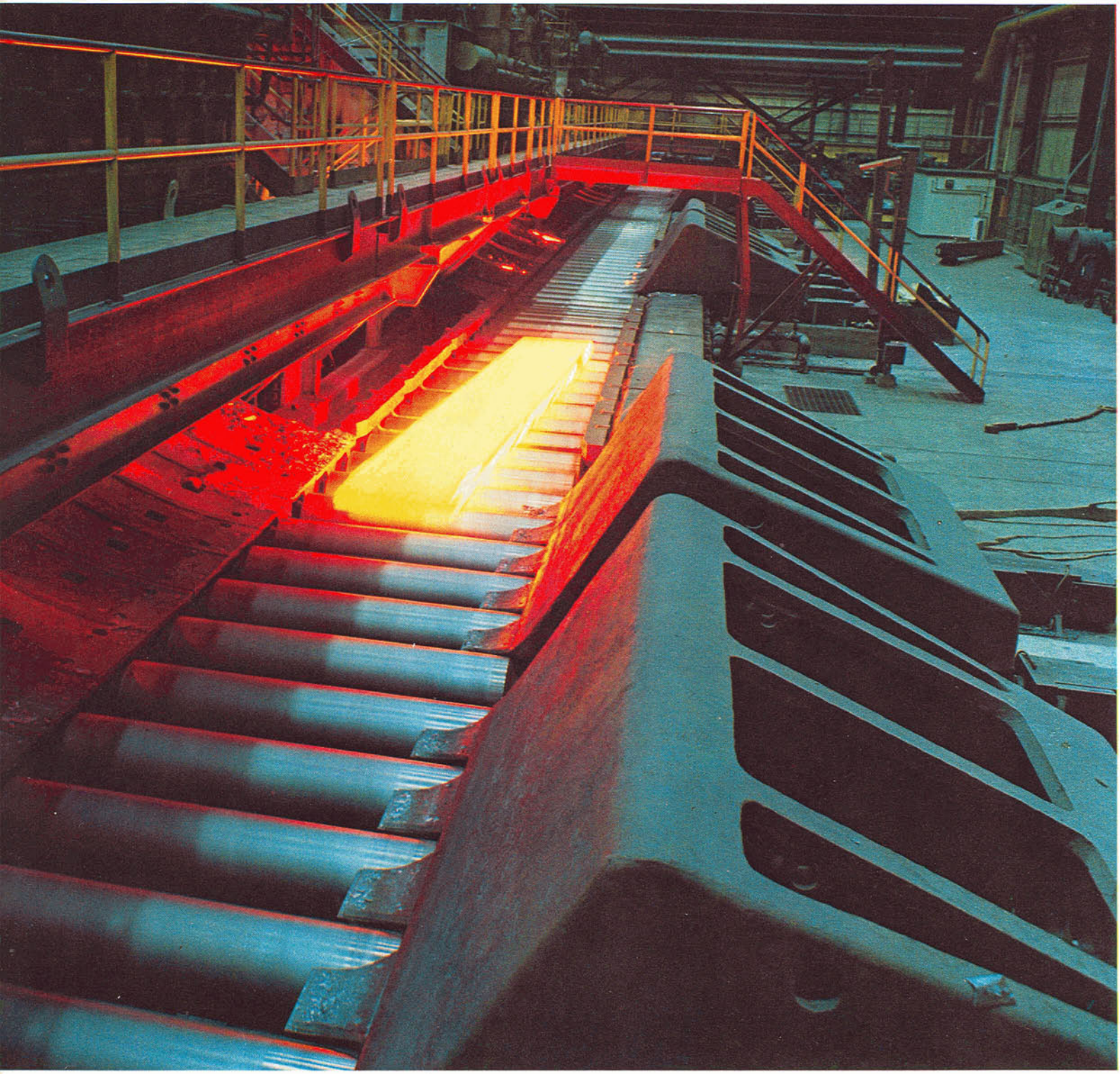
Communications Systems using the H316 for data concentration, message storage, queuing, and transmission can save you many thousands of dollars monthly while serving up to 64 remote terminals at higher speeds and with lower cost than can be gained with direct lines. Instead of using individual Teletype grade circuits (110 bits per second) from each remote terminal to the computer interface, the distance between the remote location and the central computer area is covered by two full duplex voice grade lines (2400 bits per second) serving the communications processor and computer interface.

With the H316 as the processor, your communications gain the flexibility and speed offered by a computer system. Many functions can be completed close to the remote terminals, eliminating possible difficulties which might be encountered through interference on low-speed transmission lines. The communications processor can also be used for monitoring and error checking.

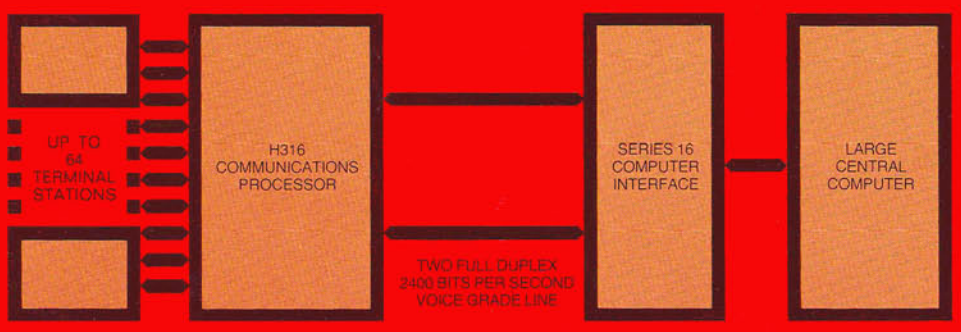
Industrial Control Systems allow you to exercise various levels of control over a wide variety of industrial processes. Levels can range from simple scan, log, and alarm functions to completely automated plants. Newest Honeywell contribution is the H1603 Real-Time Control System. A standard hardware/software package combining the H316 and a Real-Time Interface (RTI) unit, this system can come in a compact, single 24-inch cabinet or can be expanded modularly to handle up to 2048 analog and 4096 digital inputs (or digital I/O). The RTI supplies the computer with measurement signals from sensors located throughout the process; the computer reads these measurements and records and/or displays the necessary values; and it sends control signals through the RTI to operating devices in accordance with the computer program. An executive program is also supplied.

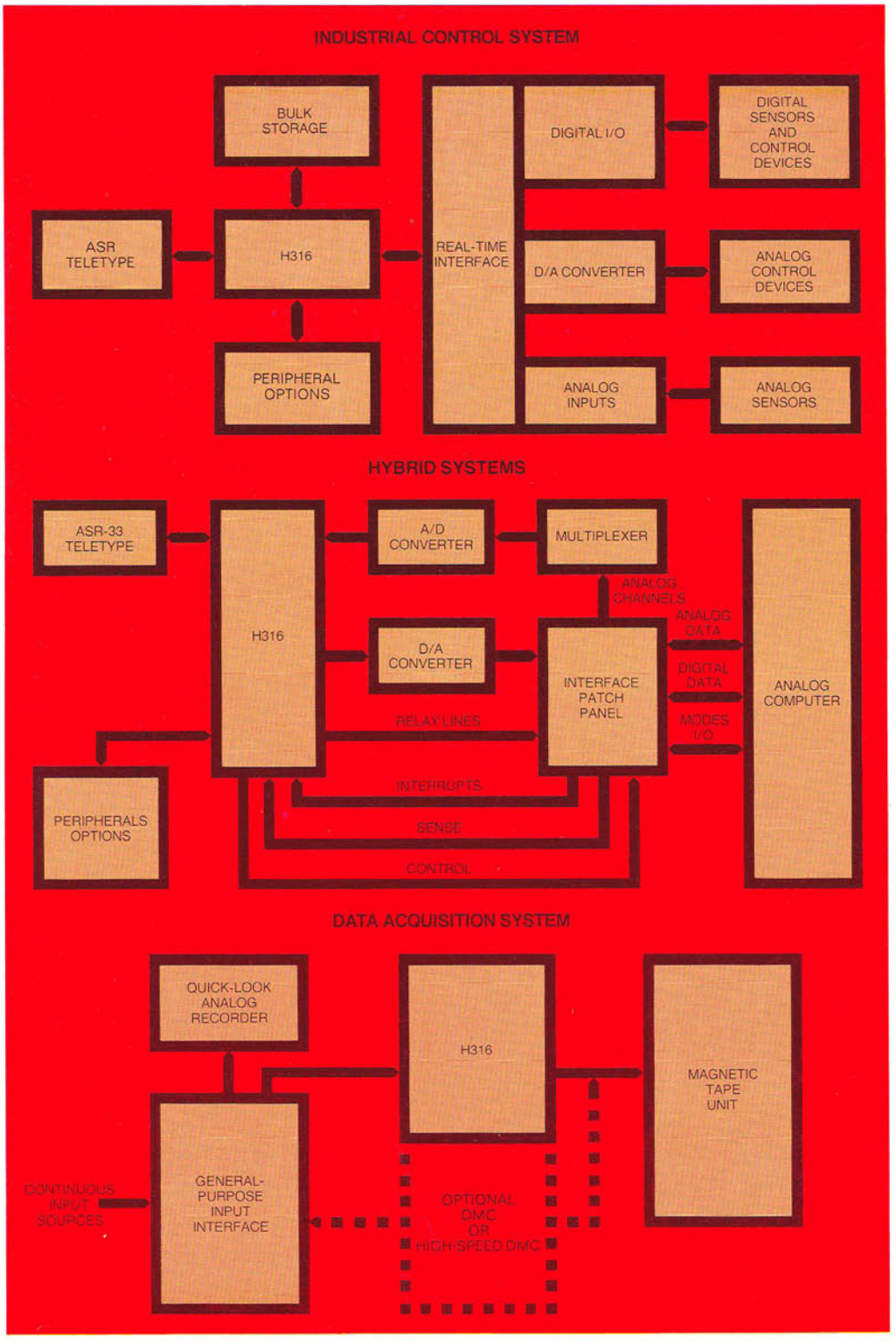
Wide variety of applications





COMMUNICATIONS SYSTEMS





Hybrid Control Systems combine the advantages of both digital and analog computers. The Honeywell Hybrid Expansion Package for the EAI TR-48 permits the H316 to serve as the digital subsystem and enables the operator to control the operation of the analog subsystem via the ASR-33 Teletype. The H316 digitizes and stores the data from the analog computer, or displays the analog and digital data on peripheral options such as printers or CRT displays.

Signals from the analog computer are scanned under digital control by a high-speed multiplexer and an analog-to-digital converter. Digital outputs from the H316 are sent via channel-dedicated digital-to-analog converters to the analog computer. The interface patch panel, supplied as part of the expansion package, buffers the signals between the computers and synchronizes operation.

Data Acquisition Systems continuously access high-speed data sources to record and store the data for later processing. Input and output are under control of the Direct Multiplex Control (DMC) or High-Speed DMC options for simultaneous I/O. The data, formatted by the computer, go through a tape controller and are recorded on magnetic tape.

The H316 provides high performance and simple, direct operation characteristics. Operator controls have been engineered for flexibility and are augmented by extensive information display.

The standard control panel contains binary displays in octal representation, run status displays, and all operator controls. By depressing the appropriate select switch, the operator can display contents of the A register, B register, program counter, and memory information register as well as internal counters and flip-flop status.

Registers may be cleared and/or altered from the control panel, and any word in memory can be manually displayed or modified. Control panel functions include operation mode selectors (memory access, single instruction, continuous run), program control sense switches, and a power failure interrupt inhibit switch.

In addition to the control panel, the H316 utilizes a teletypewriter keyboard unit with paper tape reader and punch. When used in conjunction with software checkout functions, this I/O medium is the primary control for breakpointing programs, changing memory contents, displaying memory, and related operations. Other uses include off-line preparation, duplication, or listing of program tapes.

Protection against loss of information as a result of ac power failure is provided causing the memory to automatically shut down. In addition, power failure causes an interrupt permitting storage of register contents in the memory before it shuts off.

Operation

The basic H316 chassis, occupying only about three cubic feet behind the control panel, can contain all the easily accessible, modular components to make up a complete powerful computer. The central processor, located in the left front quarter, is pre-wired for the addition of a high-speed arithmetic unit, teletypewriter interface, and real-time clock. The space in the lower right front quarter can accept a Direct Multiplex Control, a High-Speed DMC, or other options.

The upper rear section can contain the basic 4K memory, one to three additional 4K memory units (for a maximum of 16K), and two to five options to occupy the six spaces available. The power supply occupies the bottom section of the chassis.

If additional options are desired, up to 12 more can be located in an expansion chassis which is similar to a basic H316 without a control panel. The modules are all cable-connected to facilitate the customizing of each system.

INTERNAL ORGANIZATION

A Register (A) – is the primary arithmetic and logic register.

B Register (B) – is the secondary arithmetic register. It is used with the A register to hold arithmetic operands which exceed one word in length.

C Bit Overflow Indicator (C) – indicates overflow on arithmetic instructions. This flip-flop is also used in shift instructions.

OP Control Key – causes the states of key-controlled flip-flops to be displayed.

M Register (M) – is the memory information register.

Program Counter (P) – contains the location of the next instruction to be performed. Its content is incremented by one each time an instruction is performed; it may also be modified at other times during the execution of certain commands.

Index Register (X) – is used for address modification. It can be accessed by any memory reference instruction.

Y Register (Y) – is the memory address register.

The registers and program counter use 16 bits; the C indicator uses one bit. The A, B, OP, P/Y, and M registers can be displayed and manually controlled from the control panel; in addition, the X register can be displayed or modified by accessing memory address Zero.

INTERNAL ORGANIZATION

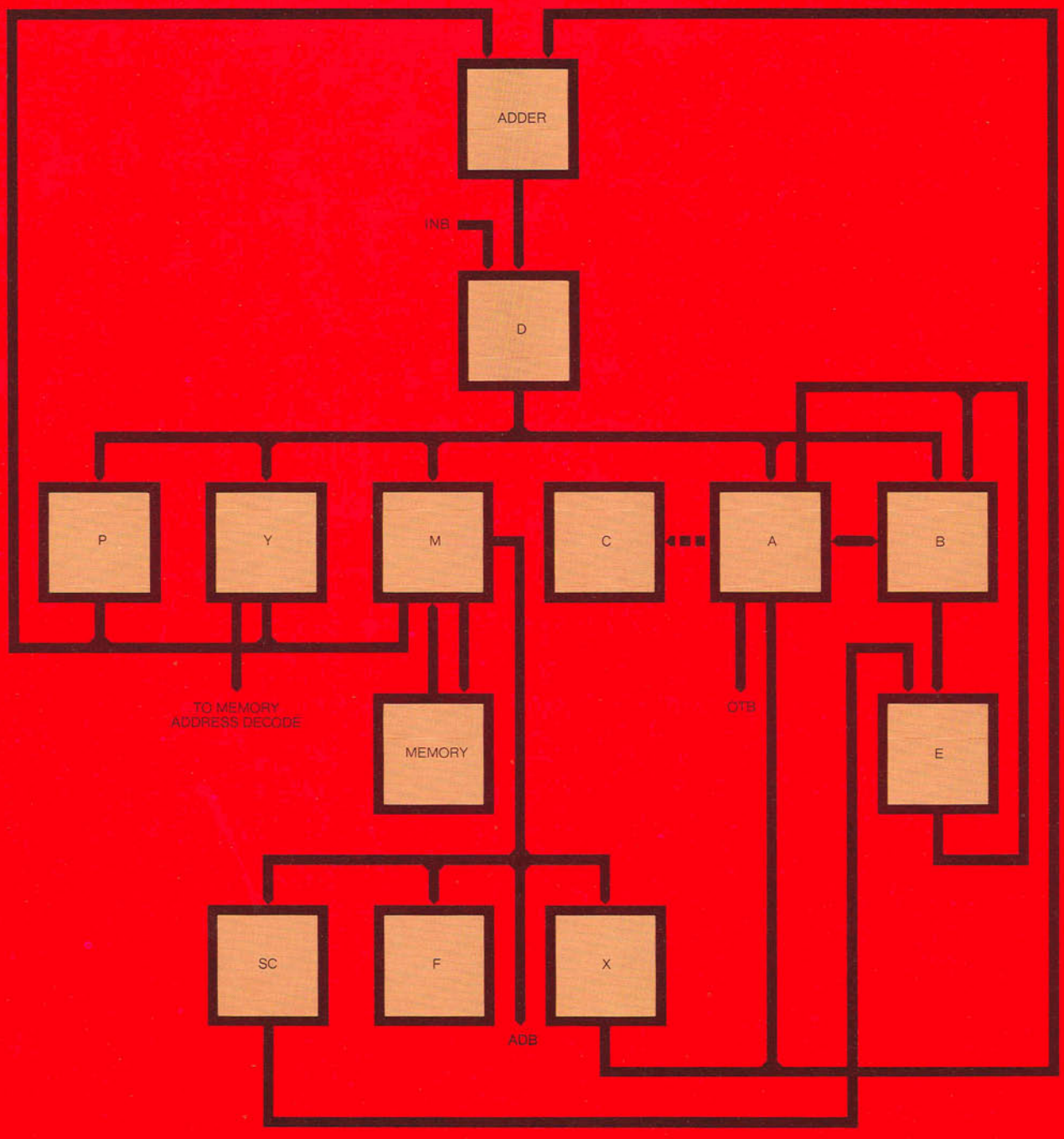


FIGURE 1 INSTRUCTIONAL FORMAT – MEMORY REFERENCE INSTRUCTION

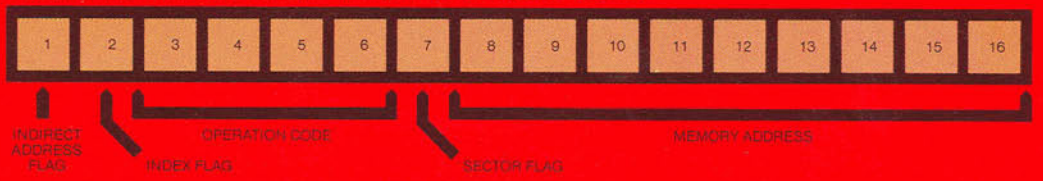


FIGURE 2 INDIRECT ADDRESS FORMAT (STANDARD)

FIGURE 3 DATA FORMAT – SINGLE PRECISION

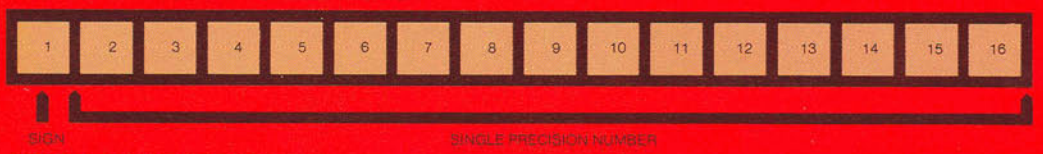


FIGURE 4 DOUBLE PRECISION

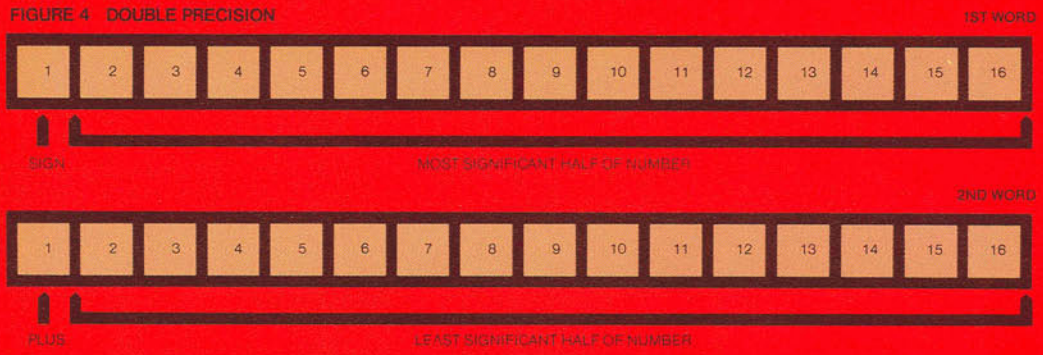


FIGURE 5 FLOATING-POINT SINGLE-PRECISION DATA

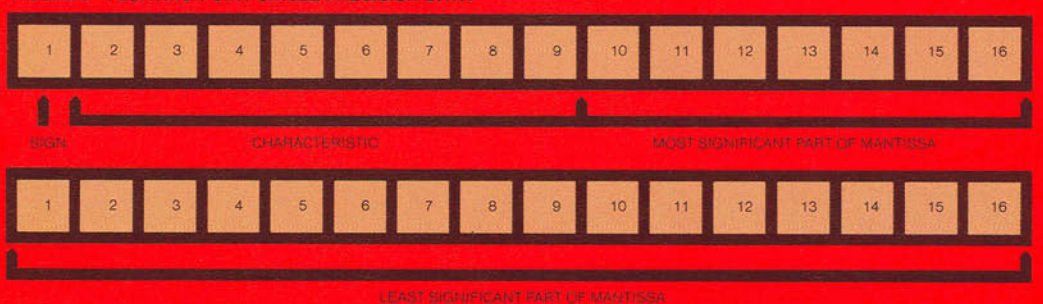


FIGURE 6 FLOATING-POINT DOUBLE-PRECISION DATA

FIGURE 7 INSTRUCTION FORMAT – INPUT/OUTPUT INSTRUCTION

Formats

INPUT OUTPUT CAPABILITIES

The basic H316 I/O system contains an I/O bus to transfer full words in and out of the computers, and lines to provide timing signals and commands to peripheral devices. Each peripheral device connected to the bus has its own buffer and control logic. This permits a high degree of flexibility in using multiple devices concurrently and in handling them through priority interrupts.

Since the H316 is part of the Series 16 family, all of the related peripherals and interfaces are available to it including:

- Analog and discrete I/O
- Disc files
- Drums
- Displays
- Magnetic tapes
- Card I/O
- Paper tape I/O
- Line printers
- Communications interfaces
- Teletypewriters
- Logging typewriters
- Special-purpose devices

Devices are addressed by the six least significant bits in an I/O instruction. These, plus four function bits, are transmitted over the ten ADB (address bus) lines to the device for decoding. For extreme flexibility in real-time applications, the basic I/O instructions have the ability to test the status of a device and skip it if not ready. Therefore, the H316 is not required to hold off, waiting for a ready signal.

Single Word Transfer is the basic I/O mode of the standard computer. Under program control, the transfers can be made at a rate of up to 75 kHz. Words from an external device can be read into the A register utilizing INA instructions. Before each input, the programmer has the option of clearing or not clearing the A register, so characters can be packed into words as part of a basic input routine. Full words can be transferred from the A register to an output device using OTA instructions.

Single Word Transfer With Interrupt eliminates the frequent testing of a device for readiness and substitutes an interrupt procedure to augment the basic I/O mode. The device ready signal initiates an interrupt causing the I/O functions to be performed, then the program continues normally.

Direct Multiplex Control (DMC) permits data transfer between peripheral devices and memory concurrent with computation. In this mode, the starting location to which the information block is to be transferred, and the final location for the block transfer, are set up under program control. The data transfers are initiated by the program, then the transfers occur independent of program control until the specified block of memory is filled. The maximum DMC transfer rate with the H316 is 156 kHz.

High-Speed DMC doubles the standard DMC transfer rate. This option and the standard DMC can be installed in the H316 utilizing off-the-shelf Honeywell μ-PAC logic modules.

Other Desirable Options include a high-speed arithmetic package and a real-time clock which permits the H316 to track real-time through a memory location.

INSTRUCTION FORMAT AND ADDRESSING MODES

Sector Addressing – For addressing purposes, memory is divided into 512-word sectors of which 1024 words are directly addressable.

As shown in Fig. 1, the Flag (F), Tag (T), and Sector (S) bits of a memory reference instruction determine the addressing mode:

F	T	S	
0	0	0	Direct to base sector
0	0	1	Direct to current sector
0	1	0	Direct to base sector, indexed
0	1	1	Direct to current sector, indexed
1	0	0	Indirect through base sector
1	0	1	Indirect through current sector
1	1	0	Indirect through base sector, pre-indexed
1	1	1	Indirect through current sector, pre-indexed

Indirect Addressing – Multilevel, to 16K core, can be pre- or post-indexed. Adds 1.6 μs per level to instruction execution time. When indirect addressing is required, the effective address is assumed to be in the location specified by the address portion of the instruction and the selected sector address (see Fig. 2). However, if this location also calls for indirect addressing, another cycle is initiated. The chain can continue indefinitely for all instructions which permit indirect addressing.

Indexing – When the index bit is set, the contents of the index register are added to the effective address of the instruction to produce a new effective address. If indexing is specified in a given instruction, it occurs before any indirect addressing; if specified in an indirect address, it occurs before any further indirect addressing. No additional time is required for instruction when indexing.

DATA FORMATS

Fixed Point – Data are represented in two's complement form, with the sign in the most significant bit position followed by 15 magnitude bits. Single-precision fixed-point values thus range from –32,768 to + 32,767 (Fig. 3). While this is adequate for most applications, the H316 offers both hardware and software double-precision capabilities for users who require 30-bit accuracy (Fig. 4). Typical double-precision times:

Add (hardware) 4.8 μs
Add (subroutine) 44.8 μs

All arithmetic operations in the H316 automatically keep track of the sign. Overflow results in the setting of the C bit indicator.

Floating Point – Used in conjunction with numerous floating-point routines in the program library, floating-point capabilities include both single- and double-precision accuracies. Convenient and fast, these routines offer the flexibility of either 7- or 12-digit precision for number ranges of $10^{\pm 38}$ (Fig. 5, 6).

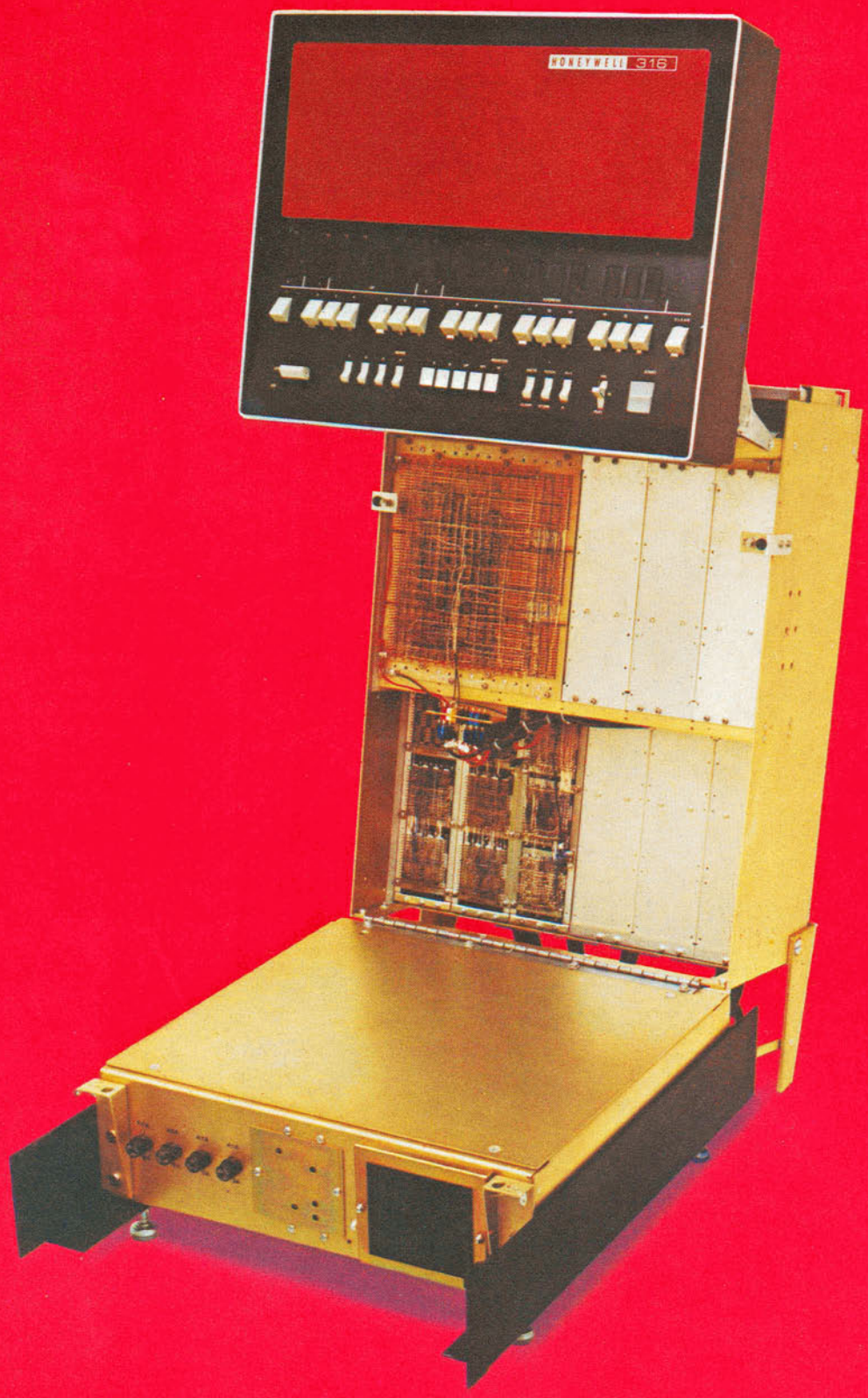
Input/Output – In Figure 7, bits 1 through 6 specify the particular I/O instruction; bits 11 through 16, which device is being addressed. Bits 7 through 10 define the function to be performed by the instruction.

INSTRUCTION	MNEMONIC	EXECUTION TIME (μs)
Load and Store		
Load A	LDA	3.2
Load Index	LDX	4.8
Interchange Memory and A	IMA	4.8
Interchange A and B	IAB	1.6
Clear A	CRA	1.6
Store A	STA	3.2
Store Index	STX	3.2
Arithmetic		
Add	ADD	3.2
Subtract	SUB	3.2
Increment, Replace and Skip	IRS	4.8
Add One to A	AOA	1.6
Control		
Set A Sign Plus	SSP	1.6
Set A Sign Minus	SSM	1.6
Set Mask	SMK	3.2
Complement A	CMA	1.6
Copy Sign and Set Sign Plus	CSA	1.6
Add C to A	ACA	1.6
Set C Bit	SCB	1.6
Reset C Bit	RCB	1.6
Halt	HLT	1.6
No Operation	NOP	1.6
Enable Program Interrupt	ENB	1.6
Inhibit Program Interrupt	INH	1.6
Two's Complement A	TCA	2.4
Complement A Sign	CHS	1.6
Input/Output		
Output Control Pulse	OCP	3.2
Skip if Ready Line Set	SKS	3.2
Input to A	INA	3.2
Input Keys	INK	1.6
Output from A	OTA	3.2
Output Keys	OTK	3.2
Byte Manipulation		
Interchange Characters in A	ICA	1.6
Interchange and Clear Left Half of A	ICL	1.6
Interchange and Clear Right Half of A	ICR	1.6
Clear A, Left Half	CAL	1.6
Clear A, Right Half	CAR	1.6
Logical		
AND to A	ANA	3.2
Exclusive OR to A	ERA	3.2

INSTRUCTION	MNEMONIC	EXECUTION TIME (μs)
Shift		
Logical Left Shift	LGL	1.6 + .8N
Logical Right Shift	LGR	1.6 + .8N
Logical Left Rotate	ALR	1.6 + .8N
Logical Right Rotate	ARR	1.6 + .8N
Arithmetic Left Shift	ALS	1.6 + .8N
Arithmetic Right Shift	ARS	1.6 + .8N
Long Left Logical Shift	LLL	1.6 + .8N
Long Right Logical Shift	LRL	1.6 + .8N
Long Left Rotate	LLR	1.6 + .8N
Long Right Rotate	LRR	1.6 + .8N
Long Arithmetic Left Shift	LLS	1.6 + .8N
Long Arithmetic Right Shift	LRS	1.6 + .8N
Transfer Control		
Unconditional Jump	JMP	1.6
Jump and Store Location	JST	4.8
Compare	CAS	4.8
Unconditional Skip	SKP	1.6
Skip if A Sign Plus	SPL	1.6
Skip if A Sign Minus	SMI	1.6
Skip if A Zero	SZE	1.6
Skip if A Not Zero	SNZ	1.6
Skip if (A_{16}) is Zero	SLZ	1.6
Skip if (A_{16}) is One	SLN	1.6
Skip if C Bit Set	SSC	1.6
Skip if C Bit Reset	SRC	1.6
Skip if Sense Switch #1 Set	SS1	1.6
Skip if Sense Switch #2 Set	SS2	1.6
Skip if Sense Switch #3 Set	SS3	1.6
Skip if Sense Switch #4 Set	SS4	1.6
Skip if Sense Switch #1 Reset	SR1	1.6
Skip if Sense Switch #2 Reset	SR2	1.6
Skip if Sense Switch #3 Reset	SR3	1.6
Skip if Sense Switch #4 Reset	SR4	1.6
Skip if No Sense Switch Set	SSR	1.6
Skip if Any Sense Switch Set	SSS	1.6

N = Number of Shifts

Instruction Repertoire


HONEYWELL 316

MORE THAN 500 FIELD-PROVEN SOFTWARE PACKAGES

Because the H316 is logically identical with other Series 16 computers, more than 500 field-proven packages can be operated without modification, including hundreds of applications programs. Some H316 programs are:

FORTRAN IV – This compiler is available as standard software for the H316. FORTRAN IV is a one-pass compiler that operates in a minimum system consisting of a H316 with 8192 words of core memory. It provides all the power and flexibility of FORTRAN as defined by the USA Standards Institute, and features the use of type statements, external statements, block data, double-precision, complex, and logical constants. From a programmer's point of view, it can be said that FORTRAN IV retains all of the ease of programming and the clarity of FORTRAN II while adding the advantages of generality and flexibility.

Assembly Program (DAP-16) – DAP-16 is a symbolic language assembly program. Its purpose is to translate from programmer's symbolic language to binary coding language for the computer. Translation is optionally made in a two-pass or one-pass process. It is generally on a one-for-one basis, that is, for each source statement written by the programmer, one machine instruction is generated by DAP-16.

DAP-16 produces either relocatable or absolute object code, and the source language includes the capability of using symbolic addressing, mnemonic machine codes, double-precision operations (optional hardware required), index register instructions, and compound address expressions. In addition, DAP-16 provides octal, decimal, and ASCII literals plus a wide variety of pseudo-operations which serve to control the assembly process, define data, allocate core memory, or generate linkage to subroutines. The CALL and SUBR pseudo-operations produce FORTRAN IV compatible subroutine linkages.

An important feature of DAP-16 is the generation of an extended object code. This, in conjunction with the desectorizing loader, permits the programmer to address the computer as if the entire memory was directly addressable rather than concerning himself with sector addressing and the indirect address linkage necessary to cross from sector to sector.

Input/Output Selector (IOS) – This program is used in conjunction with major programs supplied with the IOS to establish the input/output communication link with the input/output equipment. Users with varying complements of peripheral equipment are readily accommodated by the modular design of IOS.

Desectorizing Loader – This relocatable program loads memory with octal information in absolute or relocatable format. It is capable of loading the main program and subroutines called by it or by other subroutines, and completes the transfer vector linkage between the main program and external subroutines. Also included is the capability to generate special indirect address links in sector zero based on addressing information generated by the assembly program or compiler.

DOP (Disc Operating Program) – This powerful data processing tool makes the use of mass storage devices with the H316 easy and efficient. Two versions, DOP and DOP-S, enhance the capability of the DAP-16 assembler and the FORTRAN IV compiler by permitting them to perform disc-to-disc language translations. DOP also supports the object-text loader to allow object programs as well as subroutine libraries to be disc resident or mixed among several I/O devices. The new program can store and retrieve core-image information on disc in either non-relocatable programs or data.

EXEC-16 – An executive control package provides H316 users with a multiprogramming capability for real-time programs. A scheduler and coordinator of functions in a real-time environment, Exec-16 performs scheduling, interrupt handling, core allocation, coordination of I/O devices, and general supervisory functions. Multiprogramming capability is provided through hardware interrupts; a maximum of 50 programs is allowed on the basic system. A program can be requested by another program, through the keyboard, or as the result of an elapsed time interval. All programs under executive control are started according to their priority in an executive table list. When a priority interrupt signal is received, an Exec-16 interrupt handler saves the contents of key system locations and registers so that control may be easily returned to the interrupted program.

Extensive Software

Subroutine Library – An extensive assortment of subroutines aids the programmer in performing mathematical operations and functions, conversions, and I/O operations.

Mathematical routines are available for single and double precision, fixed and floating point, and complex calculations as indicated in Table I.

Conversion routines are available for ASCII to fixed point, floating point, and complex; fixed point, floating point, and complex to ASCII; fixed point to floating point; floating point to fixed point; and complex to floating point.

DEBUG Program – A compact relocatable program which can:

- Type memory in octal
- Type corrections into memory
- Enter a breakpoint into memory and start at a specified location
- Return to breakpoint and continue with program being debugged
- Clear memory to zero within limits
- Search memory for an address within specified limits
- Start at a location and print the contents of any or all of the following when one of several dynamic options is chosen: A register, B register, index register, and C bit.

DUMP – This compact, completely modular relocatable program enables the user to obtain memory dumps in octal or mnemonic instruction format. Each function is provided in subroutine format, i.e., if the user desires only an octal memory dump, he need only carry the coding necessary to perform this function. The DUMP can communicate with any output equipment available in the system through the IOS program.

Symbolic Source Update Program (SSUP) – Facilitates the deletion, insertion, or replacement of source program statements located on paper tape, and whose output is on either paper or magnetic tape. A listing of the modified tape is optionally available as an output.

Input/Output Library – Made up of a set of subroutines for each I/O device offered with the H316. Each I/O routine permits the user to specify the data format most convenient for his application. Any necessary code conversion is handled by the I/O routine. Complete error checking and, where possible, recovery procedures are included. See Table II.

Verification and Test Programs – An extensive package of programs is provided with the H316, which includes routines for verifying the operation of the control unit, arithmetic unit, core memory, and the available I/O devices. These routines generate indicative information reflecting the operational status of the equipment being verified.

TABLE I
MATHEMATICAL LIBRARY

SUBROUTINES	COMPLEX	FIXED POINT SINGLE PRECISION	FIXED POINT DOUBLE PRECISION	FLOATING POINT SINGLE PRECISION	FLOATING POINT DOUBLE PRECISION
Square Root	■	■	■	■	■
Cos	■	■	■	■	■
Sin	■	■	■	■	■
Arc Tan		■	■	■	■
Log Base e	■	■	■	■	■
Log Base 2		■	■		
Log Base 10				■	■
Exponential	■	■	■	■	■
Add	■		■	■	■
Subtract	■		■	■	■
Multiply	■	■	■	■	■
Divide	■	■	■	■	■
Maximum Value		■		■	■
Minimum Value				■	■
Absolute Value	■	■		■	■
Remaindering		■			■
Hyperbolic Tan				■	

TABLE II
INPUT/OUTPUT LIBRARY

	ASCII	BINARY
ASR-33	■	■
ASR-35	■	■
Paper Tape Reader	■	■
Paper Tape Punch	■	■
Card Reader	■	■
Card Punch	■	■
Line Printer	■	
Magnetic Tape	▲	■
Disc File	■	■

▲ Includes conversion to and from IBM 729 series tape code.


HONEYWELL 316

CENTRAL PROCESSOR OPTIONS

High-Speed Arithmetic Package – Arithmetic capability of the H316 computer is enhanced by this option which provides hardware implementation of multiply, divide, and normalize. In addition, hardware double-precision arithmetic capability operates on a pair of words in memory and the A and B registers. The following ten instructions are added to the H316 repertoire (cycle time in μs):

MPY	8.8	Multiply
DIV	17.6	Divide
NRM	1.6 + .8N	Normalize
SCA	1.6	Shift count to A
DBL	1.6	Enter double precision
SGL	1.6	Enter single precision
DLD	4.8	Double load
DST	4.8	Double store
DAD	4.8	Double add
DSB	4.8	Double subtract

Real-Time Clock – By means of a memory location which is incremented by one each 16.67 ms, this option provides the computer with an interval timer for automatic initiation of a time-dependent process.
Incrementation can be turned on or off under program control. The real-time clock can also be used as an elapsed-time counter programmed to keep the time of day.

Priority Interrupt, Memory Increment – In addition to the standard priority interrupt system to which all peripherals and certain internal options are connected, external interrupts are available in groups of four up to a total of 48 lines. Each line can be individually enabled or disabled, and has its own cell in memory containing the address of the interrupt subroutine. As a further option, groups of four interrupt lines can be converted to memory increment lines. Here the associated location in memory is incremented by one on each interrupt request.

Many Options

Direct Multiplex Control (DMC) – This option allows data transfers on the I/O bus to be effected independent of program control. Up to 16 peripheral devices can be controlled on a priority basis. In this mode, the starting and ending locations for transferring the block of information are set up under program control. Once data transfer is initiated by the program, it occurs independent of program control until the specified block of memory has been filled.

High Speed DMC – Doubles the standard DMC transfer rate.

PERIPHERAL OPTIONS

Data Acquisition and Control Subsystem (DACS) – For the laboratory user or systems builder who requires a smaller number of inputs and outputs, the Honeywell DACS links the H316 with sensors, control elements, and special laboratory instrumentation. DACS may be as small as eight analog inputs or 16 discrete I/O points, or even a single digital-to-analog converter. By adding modules, you can expand the subsystem to 96 analog inputs and 256 digital I/O points. The fully expanded DACS occupies a 14-inch high expansion cabinet.

Magnetic Tape – Large volume storage capability is provided by a seven-channel format magnetic tape system. Up to four magnetic tape transports of similar speed and density can be operated from one control unit. Six models provide recording densities from 200 to 800 bits per inch in either 36 ips or 80 ips tape speeds. Three program-selectable record packing modes are designed to permit communications with other computer systems using the seven-channel format.

Disc Storage – Bulk disc storage and control for the H316 system is provided by a high capacity (3.6 million words) disc store option.

The high capacity, moving head disc uses interchangeable disc packs which provide the greatest flexibility as on-line system requirements change. Packs are available with capacities up to 3.6 million words with access time of no more than 190 ms. Modular expansion of the system provides maximum storage of 14.4 million words.

Small Mass Store – The small mass store is a low-cost drum that provides fast access, moderate capacity bulk storage for the H316 computer system. It is ideal for on-line applications involving data acquisition, information retrieval, or program and test parameter storage. In addition, it can be used as a peripheral device in program generation and testing. Capacities are available to 196K words.

Paper Tape Reader/Punch – High-speed tape facilities read at 300 characters per second and punch information at 110 characters per second. This option is available as a combined reader/punch unit or as separate reader-only and punch-only units.

Priority interrupt lines permit interrupting the computer program when either reader or punch requires service, thus using less than 1% of computer time.

The punch not only provides a means of recording data blocks for later processing but also prepares program tapes for computer operation and maintenance.

Card Reader – High-speed input from either alphanumeric or binary punched cards is available upon programmed command. Operating photoelectrically at 200 cards per minute on a column-by-column basis, this card reader automatically converts alphanumeric data to six-bit BCD code.

Line Printer – The 300-line-per-minute unbuffered line printer and control for the H316 computer provides low-cost, high-speed printout of data. This shuttle printer operates under program control via a direct multiplex control. It is capable of printing any one of 64 characters in any of 120 positions. Vertical format control is by combination of OCP code and punched form tape in the printer.

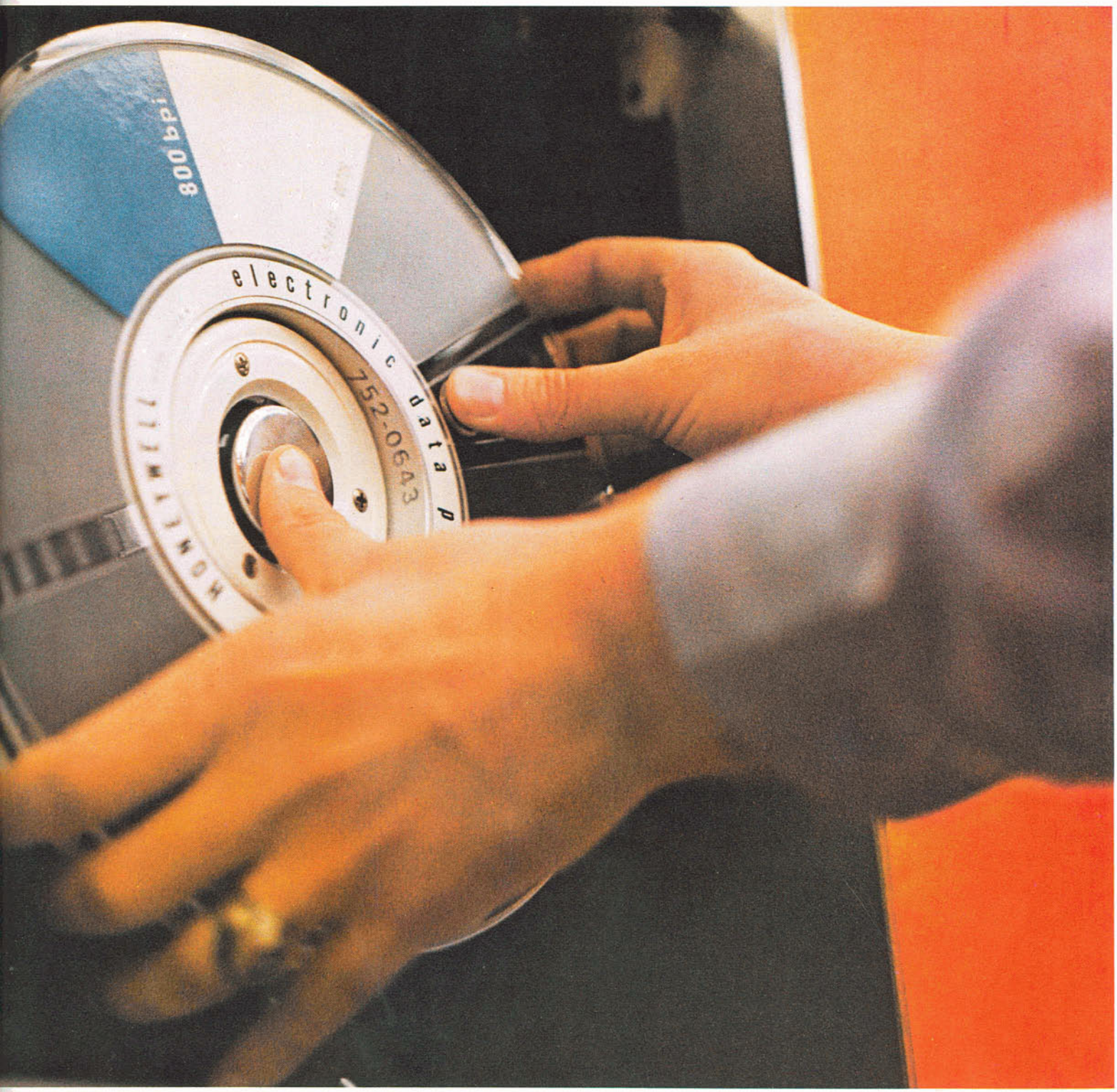
Teletypewriters – Teletypewriter options print data from, or transmit data to the computer via a keyboard at the rate of ten characters per second. Teletypewriters can also read and punch paper tape at the same speed. In the local mode, teletypewriters can be used for off-line paper tape preparation, reproduction, or listing.

Real Time Interface (RTI) – In industrial control systems, the RTI links the H316 computer with remote sensors, control elements, and display devices. This enables the computer to obtain data and to control the process efficiently at computer speed without having to wait for an I/O device. Up to 2048 analog inputs and 4096 digital inputs can be accommodated. Optional equipment associated with use of the RTI includes: Operator's Console, Alarm Printer, and Logging Typewriter.

Operator's Console – For data acquisition or direct digital control systems, the Honeywell Operator's Console provides communications with the computer through the RTI modules. This console consists of rear-projection-type devices (with 11 or 18 readouts) which provide a visual indication of requested information, and operator keyboard devices (with 24 or 54 keys) for entering information and requesting displays.

Alarm Printer – The Alarm Printer provides the capability of alarm condition printout. Printer operates at ten characters per second using data in the ASCII format in programmable red and black printout. It connects to the H316 computer through the RTI and the I/O transfer bus. The computer supplies the RTI with printer identification and the information to be printed in parallel word form. RTI selects the appropriate printer and supplies its buffer with data. The printer buffer performs the conversion from parallel to serial word by bit form consisting of 11 bits.

Logging Typewriter – Up to five logging typewriters can be connected to a pair of buffer modules in the RTI. They can print the same data simultaneously or different data sequentially. Each is fully buffered with respect to the computer thus allowing for efficient use of the central processor.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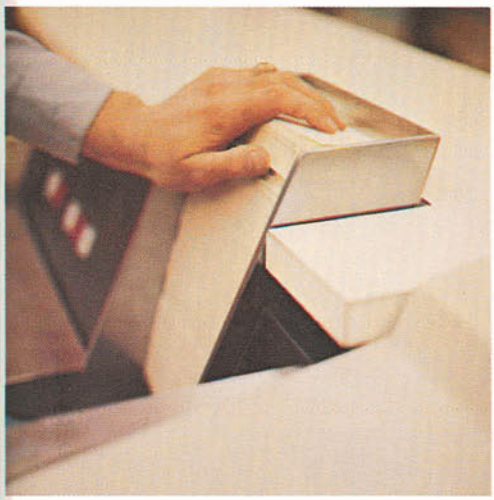
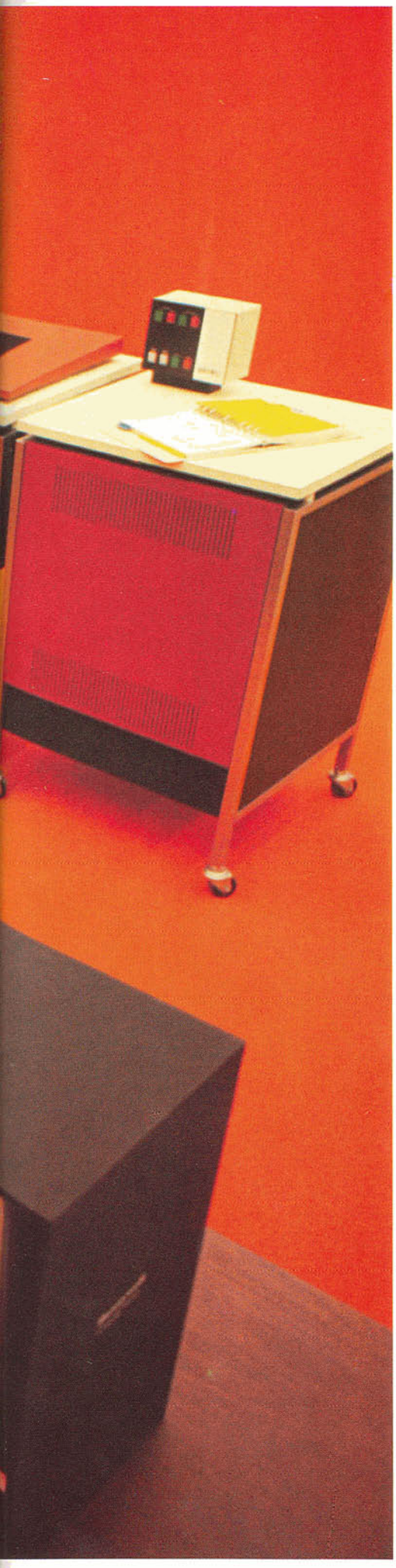




Type – Stored program, single address, binary, parallel, general purpose.

Word size – 16 bits.

Machine code – Two's complement.

Memory – Type: Four wire, coincident current, magnetic core.
Size: 4,096 words, expandable in same increments to 16,384 words.
Cycle time: 1.6 μs.
Add time: 3.2 μs.

Instruction Complement – 72.

Signal Levels – 0 volts for logical Zero; +6 volts for logical One.

Circuit Types – Monolithic integrated circuits mounted on μ-PAC and function board type of modules.

Logic Type – Diode-Transistor Logic (DTL) operating at 2 MHz. Some 5 MHz logic is also used.

Operating Frequency – The basic oscillator operates at 2.5 MHz. The 1.6 μs cycle time is divided into four 400 ns periods.

Cooling – Filtered forced air cooling front to back.

Temperature – Ambient, 0-45°C, for the computer less any I/O devices.

Humidity – 0-95% relative humidity with no condensation.

Power – 475 watts at 115 volts ac ±10%, 60 ±1 Hz, single phase. Input current, 5.5 amps.

Configuration – The basic H316 is supplied as a rack-mountable unit complete with power supply and control panel. This unit requires 14 inches of panel height in a 19-inch rack. Table-top and pedestal configurations also available.

Dimensions – 14"H x 17½"W x 24½"D. This unit can contain the central processor, 16K of memory, real-time clock, high-speed arithmetic, Teletype interface and logic for several other internal options and/or device interface.

Weight – Approximately 150 pounds.

Specifications

Honeywell's philosophy is to act as an automation partner to the systems designer and user, supplying digital computers, digital building blocks, and advanced engineering capabilities. In this partnership we support our customers in the areas of programming, hardware maintenance, training, and application engineering assistance—continuing support and flow of information before and after delivery.

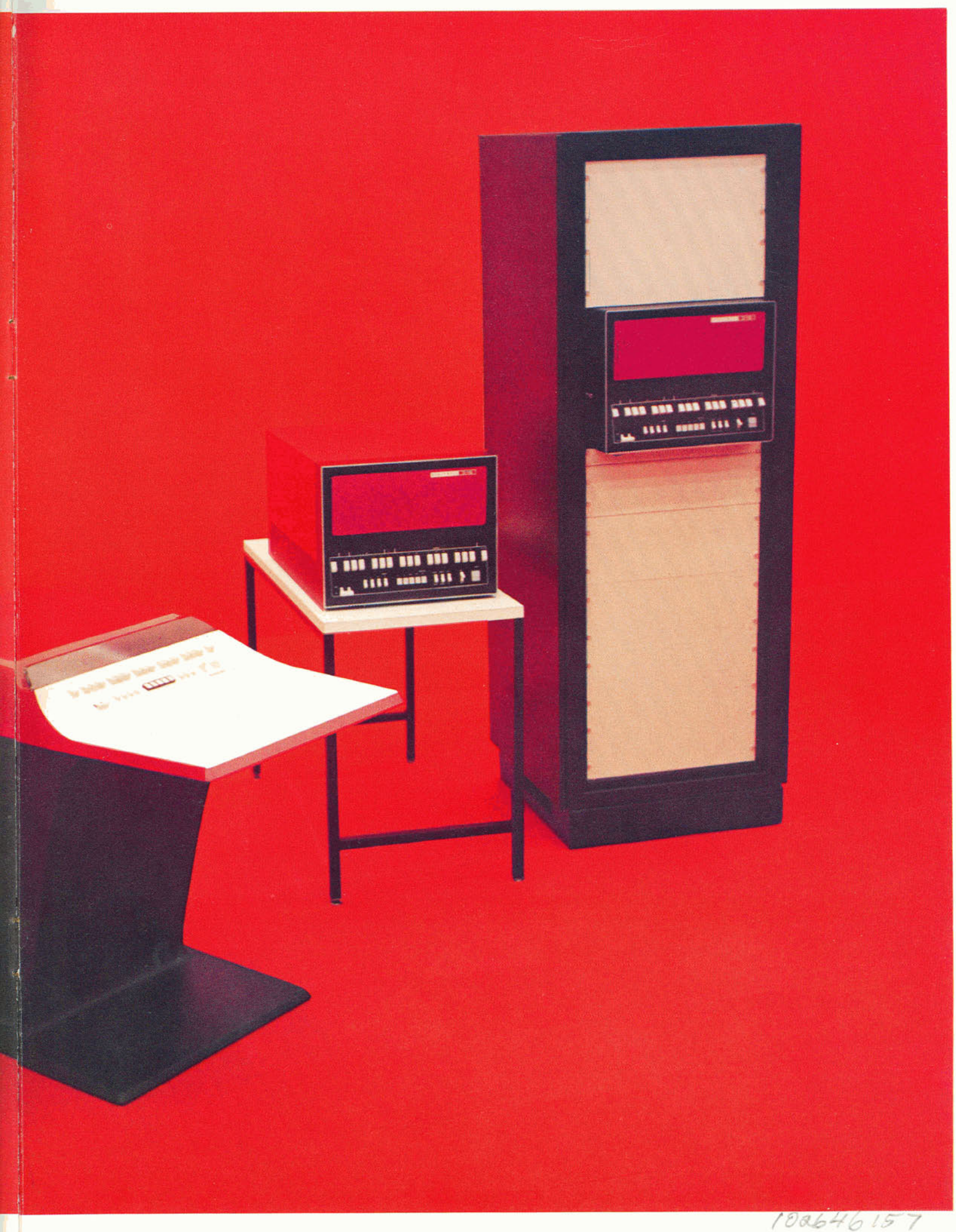
Maintenance Training Course—Instruction in operation, logic design, diagnostic procedures, diagnostic routines, and preventive maintenance is provided, at no additional cost, in a four-week course. A logistic support program for personnel with previous digital logic design knowledge is included.

Programmer Training Course—Instructions for programming in machine language, an introduction to Series 16 programming systems, and instruction in H316 operation is provided, at no additional cost, in a standard two-week course and in an accelerated one-week course.

Logistic Support Programs—From technical consultation to complete turnkey maintenance, Honeywell provides comprehensive support programs designed to guarantee optimum performance in critical customer applications. Service and parts centers are maintained in principal cities throughout the United States supported by major centers and parts depots located in Computer Control Division regional offices.

Users Group (CAP)—Actively exchanges user information and programming subroutines as developed. Membership is available to users of all Honeywell, Computer Control Division, computers at no charge.

Maintenance and Support



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