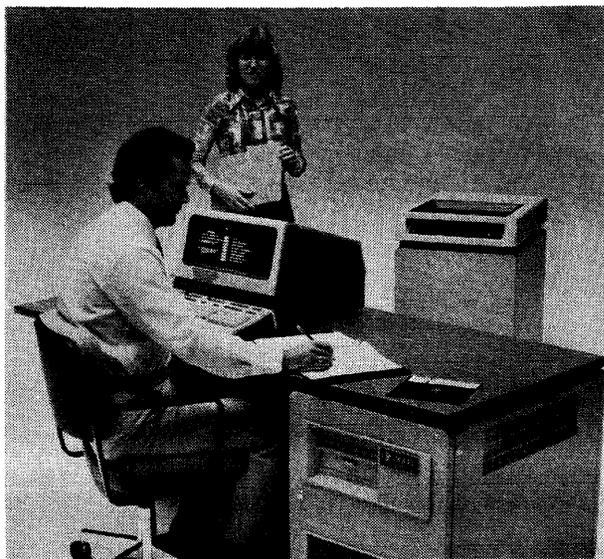


Hewlett-Packard 3000 Series



This picture of HP's new 3000 Series 33, based on silicon-on-sapphire technology, clearly shows the compactness resulting from the SOS/CMOS circuits. The desk contains the CPU, 256K bytes of fault-control memory, seven terminal ports, two general I/O channels, and a 250K-byte floppy disc unit. The 50-megabyte system disc stands behind the desk. All Series 33 software is compatible with the larger HP 3000 Series II and III systems running under MPE III.

MANAGEMENT SUMMARY

Hewlett-Packard has considerably enhanced its already sophisticated 3000 line by replacing the Series I processor with the Series 33, based on a silicon-on-sapphire (SOS/CMOS) large-scale integration process. The use of the SOS metal-gate technology has allowed the reduction of nine Series III CPU boards to two printed circuit boards in the new processor. HP states that the Series 33 name was chosen to reflect both compatibility with the established MPE III operating system and the beginning of a new series of HP 3000's employing a new CPU technology and I/O structure. The future may hold downward as well as upward expansion of this new series.

The new HP 3000 Series III, with four times the main memory capacity of the Series II, utilizes 16K RAM chips, making possible a memory cost reduction of almost 50 percent.

Upward compatibility is built into the HP 3000 product line, through both software considerations and hardware upgrade kits, enabling any HP 3000 Series II to be upgraded to a Series III. Specific differences between the Series 33, II, and III are summarized in the chart on the next page.

The Series 33 offers several advantages over the earlier Series I. One Series 33 controller handles up to eight 128K-byte main memory boards, eight times the now-replaced Series I's top capacity. The Series 33 Inter-Module Bus (IMB) transfers data between the CPU, main memory, and peripherals at twice the speed of the

The top end of Hewlett-Packard's product line, the HP 3000 Series, has been realigned again, this time with the introduction of the Series 33 to replace the Series I. The Series 33 utilizes a three-chip SOS/CMOS CPU, totaling less than one square inch, to replace components that formerly occupied 700 square inches of printed circuit boards. The Series 33 also features new lower-cost peripherals and self-test capabilities. The larger Series II, Models 6 and 8, and the new Series III, which features expanded memory and throughput capacities, complete the current HP 3000 line.

CHARACTERISTICS

MANUFACTURER: Hewlett-Packard Company, General Systems Division, 5303 Stevens Creek Blvd., Santa Clara, California 95050. Telephone (408) 249-7020.

Hewlett-Packard has seven computer product divisions, including the General Systems Division and the Data Systems Division. The former manufactures and markets the HP 300 Series general-purpose computer systems and the HP 2026 Data Entry and Communications systems, while the latter produces and markets the HP 1000 general-purpose computer systems, the HP 21MX minicomputers, and measurement control and computational systems. The Fort Collins Division, recently transferred from HP's Calculator Group, produces computational business systems, the HP 250 and peripheral equipment. Other computer product divisions manufacture interactive CRT terminals (Data Terminals Division); line printers, magnetic tape drives, and hard-copy terminals (Boise Division); data collection devices (Grenoble Division); and disc drives (Disc Memory Division). An eighth division, the Computer Service Division, performs maintenance on HP computers.

The company is also one of the foremost manufacturers of sophisticated laboratory test equipment and specialized process control instrumentation. In addition to conventional laboratory equipment such as signal generators, oscilloscopes, and voltmeters, the company also manufactures more exotic instruments such as gas chromatographs, digital thermometers, network analyzers, and spectrum analyzers. Other related products include both digital and analog graphic recorders, analytic instrumentation, and medical electronic instrumentation systems. Other Hewlett-Packard Company divisions manufacture hand-held calculators and desk-top calculators.

Hewlett-Packard products are sold by 135 sales offices in 37 countries, and are manufactured in facilities in the U.S., United Kingdom, Germany, France, Japan, and Malaysia. The company employs about 40,000 persons worldwide.

MODELS: HP 3000 Series 33; HP 3000 Series II Models 6 and 8; HP 3000 Series III.

DATE ANNOUNCED: HP 3000 Series II, May 1976; Series III, August 1977; Series 33, October 1978.

DATE OF FIRST DELIVERY: HP 3000 Series II, June 1976; Series III, August 1978; Series 33, January 1979.

Hewlett-Packard 3000 Series

CHARACTERISTICS OF THE HP 3000 SERIES SYSTEMS

	HP 3000 Series 33	HP 3000 Series II	HP 3000 Series III
Memory type	MOS	MOS	MOS
Memory size, bytes	256K to 1 million	256K to 512K	256K to 2 million
Memory checking	Fault control	Fault control	Fault control
Floating-point precision	64-bit	64-bit	64-bit
Firmware instructions	214	209	209
Total hardware registers	—	38	38
Program-accessible registers	—	20	20
I/O chassis slots standard	6	10, 23 (Model 8)	10
I/O chassis slots optional	7	—	13
Power fail restart	Automatic	Automatic	Automatic
Multiplexer channel speed	1M bytes/sec	990K bytes/sec	990K bytes/sec
Device controllers/multiplexer channel	8	16	16
Selector channel/data bus speed	1M bytes/sec	2.86M bytes/sec	2.86M bytes/sec
Operating system	MPE III	MPE III	MPE III
IMAGE/QUERY:			
No. of data extents	32	32	32
Data set cross volume boundary?	Yes	Yes	Yes
Index sequential access method			
No. of keys	1 + 15 alternate	1 + 15 alternate	1 + 15 alternate
Concurrent user update/inquiry	Yes	Yes	Yes
Open files per program	255	255	255
Number of file extents	32	32	32
File cross volume boundary?	On extent boundary	On extent boundary	On extent boundary
Languages	COBOL, RPG, FORTRAN, BASIC, SPL	COBOL, RPG, FORTRAN, BASIC, SPL, APL	COBOL, RPG, FORTRAN, BASIC, SPL, APL
Spoolfile size	32 config. extents	32 config. extents	32 config. extents
Terminal type recognition	Automatic	Automatic	Automatic
No. of printers and controllers	2	4	4
Punch card units:			
Read	—	200 cpm	200 cpm
Punch/interpret	—	45 to 75 cpm	45 to 75 cpm
No. of async. terminal controllers	8	4	4
Maximum number of terminals	31	63	63
Recommended number of terminals	15-20	15-20	30-45

➤ Series I central data bus. The Series 33 also has faster cycle and access times, and the reduction in the CPU size results in higher reliability, lower cost, and more compact packaging.

The original HP 3000 was introduced in November 1971, for initial delivery in November 1972. By mid-1973, promised delivery schedules of key software elements had not been met and active marketing was suspended. In November 1973, the HP 3000 was reannounced with a modified version of the operating system. The improved HP 3000CX system was announced in November 1974, with first deliveries in the first quarter of 1975. After the introduction of the HP 3000 Series II in June 1976, active marketing of the 3000CX was suspended until its reintroduction as the HP 3000 Series I in May 1977.

The HP 3000 Series II, as announced in June 1976, consisted of Models 5, 7, and 9. These models were

➤ **NUMBER INSTALLED TO DATE:** Approximately 2,000 HP 3000 systems have been installed since the product line was announced in November 1971.

DATA FORMATS

BASIC UNIT: 16-bit word or eight-bit byte.

FIXED-POINT OPERANDS: 16-bit operands can be used by logical or fixed-point arithmetic instructions to represent unsigned 16-bit integers from 0 to 65,535 or signed 15-bit integers from -32,768 to +32,767. Double-integer fixed-point formats provide 32 bits for representation of values from -2 billion to +2 billion. Bit 0 of the most significant word is the sign bit. Logical operands are represented in positive integer format, while fixed-point operands are represented in two's-complement format. Also provided is 28-digit packed decimal arithmetic in hardware.

FLOATING-POINT OPERANDS: Single-precision 32-bit (2-word) operands with signed 9-bit exponent and 22-bit positive fraction. Extended-precision 48-bit operands with a signed 9-bit exponent and 38-bit positive fraction in the

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE EQUIPMENT	All HP magnetic tape units accept 10½-inch reels, read and record on IBM/ANSI-compatible tape, contain read-after-write features, and can be configured with up to 4 drives	
7970B	9-track, 800 bpi, NRZI, 45 ips; 7970B-304 or -305 is the 1st drive, 7970B-300 or -302 the 2nd, 3rd or 4th drive; 36 KBS (not Series 33)	Hewlett-Packard
7970E	9-track, 1600 bpi; PE, 45 ips; 7970E-304 or -305 is the 1st drive, 7970E-300 or -302 the 2nd to 4th master drive, 7970E-301 or -303 the 2nd to 4th slave drive; 72 KBS	Hewlett-Packard
PRINTERS		
2608A	Comb matrix, 5 x 7 dot matrix (5 x 9 for lower case in 128-char. set), 132 positions, 64/129-character sets, 10 characters per inch, 6 or 8 lines per inch, 4 to 14.9-inch paper, 8-channel VFU; 400/340 lpm (Series 33 only)	Hewlett-Packard
2631A	Dot matrix, 7 x 9, 136 positions, 128-character set, 10 characters per inch, 6 or 8 lines per inch, 1.2 to 15.75-inch paper, 8-channel VFU, 180 cps (Series 33 only)	Hewlett-Packard
2613A/2613A-001	Drum, 136 positions, 64/96-character sets, 10 characters per inch, 6 or 8 lines per inch, 4 to 16.8-inch paper, 12-channel VFU, OCR-B character font available; 300/240 lpm (not Series 33)	Dataproducts 2230
2617A/2617A-001	Drum, 132 positions, 64/96-character sets, 10 characters per inch, 6 or 8 lines per inch, 4 to 16.8-inch paper, 12-channel VFU, OCR-B character font available; 600/436 lpm (not Series 33)	Dataproducts 2260
2618A/2618A-001	Drum, 132 positions, 64/96-character sets, 10 characters per inch, OCR-B character font available, 6 or 8 lines per inch, 4 to 19-inch paper, 12-channel VFU; 1250 lpm (not Series 33)	Dataproducts 2470
PUNCHED CARD EQUIPMENT		
30106A	Reader, 80-column; 1000-card input hopper and output stacker; reads by column; 600 cpm (not Series 33)	Documation M600L
30119A	Reader/Punch/Interpreter, 80-column; 600 & 400-card input hoppers; two 400-card output stackers; off-line data recorder opt; 200/45 to 75 cpm (not Series 33)	Decision Data 8000 Series
PAPER TAPE EQUIPMENT		
30104a	Reader, 8-level, 1-inch tape, rack-mounted or cabinet option; 500 cps (not Series 33)	HP
30105A	Punch, 5 to 8-level, 11/16 to 1-inch tape, rack-mounted or cabinet option; 75 cps (not Series 33)	Facit-Addo 4070
TERMINALS		
	All terminals listed below have a commonality of features, including 1920-character display, 24 lines by 80 characters, 5 by 10 matrix generated in 9 by 15 cell, 64- or 128-Roman character sets, detachable ASCII keyboard with 10-key numeric pad, cursor tab, page control, inverse video, block or character mode operation and RS-232C interface compatible with Bell 103A or 202 type modems; full or half duplex asynchronous transmission at 110 to 2400 bps.	
2640	Interactive Display Terminal (console); 1K-byte memory expandable to 8K bytes; 2 option slots, optional blinking, half-bright and underline display enhancements, and optional mathematical symbol, character line drawing, and large character sets. (For other versions of the 2640, see Report M11-472-201)	Hewlett-Packard
2641A	APL Display Station; 5 option slots, display enhancements standard (see 2640B), 4K-byte memory expandable to 12K bytes, 8 user-defined soft keys, 128-character APL set and 64-character APL overstrike set, off-line data preparation and editing, optional dual miniature 10-ips, 800-bpi, 110K-byte cartridge tape drives, and optional special character sets (not Series 33)	Hewlett-Packard
2645	Interactive Display Terminal; 7 option slots, 4K-byte memory expandable to 12K bytes, 8 user-defined soft keys, optional display enhancements (see 2640B), off-line data preparation and editing, optional cartridge tape drives (see 2641A), and optional special character sets (see 2640B)	Hewlett-Packard
2647A	Graphics Terminal; 9 user-defined soft keys, 6K-byte memory, 16K RAM's for 360 x 720-dot resolution graphic display and pan and zoom graphics, automatic plotting, graphics text composition	Hewlett-Packard
2648A	Graphics Terminal; 4 option slots and specifications of 2645A except 9 user-defined soft keys, 8K-byte memory expandable to 12K bytes; 16K RAM's for 360 x 720-dot resolution graphic display and pan and zoom graphics; separate or simultaneous alpha and graphic viewing, rubber band line, automatic plotting, graphics text composition	Hewlett-Packard

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▷ actively marketed until the present Models 6 and 8 were introduced in August 1977. Models 6 and 8 differ from the earlier Models 5, 7, and 9 mainly in disc capacity and bundled software; they differ from each other in I/O capacity, with 10 slots on the Model 6 and 23 on the Model 8.

Chief competitors for the HP 3000 computers include the DEC PDP-11/70, the Burroughs B 1800, the Univac 90/30, the Data General Eclipse systems, the Honeywell Series 60 Model 6/43, and the IBM System/34.

Basically, the HP 3000 Series computers are multiprogramming, multilingual machines that use a moving-head disc unit to provide a maximum swapping area of 8.2 million bytes of virtual storage. The hardware data stack architecture allows code compression through elimination of operands in many instructions, provides temporary storage of intermediate values so that they need not be saved, and allocates local storage only upon entry of a procedure. Several CPU registers are available to store the contents of the top of the stack; improving execution time. Spooling is a standard feature, enabling more efficient use of peripherals.

The HP 3000 Series 33 provides a central processor with a 256-byte, 860-nanosecond MOS main memory; a 32-bit LSI bipolar ROM-based microprocessor; an instruction set consisting of 214 firmware-coded instructions; a 16-level external interrupt priority system; 2 general-purpose I/O channels; two asynchronous data communications controllers; an operating system (MPE III) with virtual memory capabilities, I/O spooling, hardware data stacks, and separation of data and program code (for user program sharing); and a 20-megabyte disc unit. The Series 33 comes with partially unbundled software including MPE III, a compiler library, FCOPY/3000, EDIT/3000, and SORT/3000; language processors are separately priced except for HP's ALGOL-like SPL.

The smallest of the two current models in the Series II line, the Model 6, provides a central processor with a 128K-byte fault-control memory, expandable to 512K bytes; a 50-megabyte disc drive; a 1600-bpi magnetic tape unit; a system console; and a 16-port asynchronous terminal controller.

The Series II Model 8 provides a central processor with a 320K-byte fault-control memory, expandable to 512K bytes; a 50-megabyte moving-head disc unit; a 1600-bpi magnetic tape unit; a system console; over twice the I/O capacity of the Model 6; and a 16-port asynchronous terminal controller. The expanded I/O capacity of the Model 8 is particularly valuable for data communications.

The Series III differs from the Series II Model 8 only in that its maximum main memory capacity is 2 megabytes. HP states that the Series III has twice the throughput capability of the Series II, and that a full-blown Series III can serve as a hub for a distributed systems network.

▶ Series I. Extended-precision 64-bit (4-word) operands with signed 9-bit exponent and 55-bit positive fraction in the Series II. In both single- and extended-precision formats, the exponent can range between -256 and +255, while an assumed "one" is placed to the left of the binary point in the fraction. (The "one" is disregarded for floating-point zero.) All floating-point numbers are by definition normalized. The binary point is assumed to be between the exponent and fraction. Bit 0 of the first word is the sign bit; the exponent in bits 1 through 9 is biased by +256.

INSTRUCTIONS: The HP-3000 Series II and III have an unusually rich and varied complement of instructions; all, except the stack operation instructions, are one-word types with 23 distinct formats for 13 different instruction groups. The 65 stack instructions can be packed two per word. In general, each instruction has a number of basic fields. Invariably, the first field is always four bits long and is used to define a specific operation code (for memory reference or loop control instructions) or one of four sub-opcode groups. All sub-opcode type instructions have an operation code extension field whose length and position in the instruction vary depending upon which of the four sub-opcode groups is specified. In some cases, a third operation code field (mini-opcode or special opcode) is used to extend the basic operation code. The rest of the 16-bit instruction is used for a variety of functions (count fields, bit positions, index specification, immediate operand, etc.) and is called the argument.

Machine instructions for the Series 33 are the same as those for the Series II and III except for the I/O instructions.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: In the HP 3000 Series II, dynamic NMOS, requiring 700 nanoseconds every 62 microseconds for memory refresh. In the HP 3000 Series 33 and III, MOS utilizing 16K-bit RAM's. The Series 33 requires 860 nanoseconds every 62 microseconds for memory refresh.

CYCLE TIME: For the Series II and III, 700 nanoseconds for a 16-bit fetch, with a write access time of 700 nanoseconds and read access time of 350 nanoseconds. The Series 33 has a cycle time of 860 nanoseconds for a 16-bit fetch, with a write access time of 860 nanoseconds and a read access time of 430 nanoseconds.

CAPACITY: The HP 3000 Series 33 capacity ranges from 262,144K to 1 million bytes. The HP 3000 Series II Model 6 extends from 262,144 to 524,288 bytes, while Model 8 may be expanded from the minimum of 327,680 bytes to 524,288 bytes. The Series III capacity ranges from 256K to 2 million bytes. Increment size on the Series II is 65,536 bytes, and on the Series III it is 262,144 bytes. The Series 33 can be expanded in 131,072-byte blocks. The replaced Series I can be upgraded to a Series II or Series III.

CHECKING: Fault-Control Memory is used in all current models. The system is composed of modules, each of which is made up of a memory and control logging board (MCL), fault correction array boards (FCA), and up to four 64K-byte memory array boards. The MCL, beside controlling memory module operation and interfacing it to the system, contains 256K bits of MOS for fault logging. The FCA boards expand each word of memory to either 21 bits (Series II) or 22 bits (Series 33 and III) by appending 5 check bits. The check bits, called a Hamming code, and a special HP algorithm enable the system to automatically detect and correct a single-bit error and detect up to 30 percent of the multi-bit errors. The FCA boards also interface the fault-logging RAM (random-access memory) to the 3000 Series I/O system. The operating system, MPE-III, periodically purges this RAM and stores it in a disc file for later access by the HP customer engineer.

▷



This large HP 3000 Series III system includes a one-megabyte fault-control memory, two 7925 120-megabyte disk drives, a 7970E 1600-bpi tape drive, a 2617 600-lpm printer, a 2640B console, and two additional 2645A terminals. All of the peripheral equipment is manufactured by Hewlett-Packard.

▷ On all models, users have the option of selecting other peripherals, including paper tape units, punched card units, and printers ranging in speed from 200 to 1250 lpm. Also available is an asynchronous interface to handle remote job entry.

The Series II and III central processors feature MOS main memory with a cycle time of 700 nanoseconds for a 16-bit fetch, a 32-bit bipolar ROM-based microprocessor, a microprogrammed instruction set consisting of 209 firmware-coded instructions, firmware-assisted software, a 16-level external interrupt priority system, and facilities for handling up to 16 peripheral device controllers. The bundled software for the Series II and III includes an operating system (MPE-III) with virtual memory capabilities, I/O spooling, hardware stacks, and separation of data and program code (for user program sharing). Other bundled software includes the same programs listed above for Series 33. All language processors except SPL are optional and separately priced.

The full complement of language processors available includes SPL, FORTRAN, COBOL, RPG, BASIC, and APL (Series II and III only). Other unbundled software includes DBM/3000, as HP now calls its data base management system (IMAGE/3000 plus QUERY/3000), a terminal- and batch-oriented system with direct interfaces to COBOL, RPG II, FORTRAN, and SPL and a programmable interface to BASIC. IMAGE/3000 compares favorably to larger, more powerful DBMS's currently available on medium and large-scale systems, except for more limited data capacities. Its companion package, QUERY/3000, provides a language to facilitate quick locating, reporting, and updating of data values within an IMAGE/3000 data base.

▶ **STORAGE PROTECTION:** Upper and lower address boundaries, provided by certain registers, define the limits of authorized program access in main memory. The microprogram routinely checks for bounds violation during execution (overlapped with operand fetch), and generates an interrupt if an unauthorized memory access attempt is made. Bounds violations may be classified under program transfer or reference, data reference, and stack overflow or underflow.

RESERVED STORAGE: The first 11 main memory locations are reserved for global system pointers used in the firmware implementation of virtual memory and variable-length program segmentation. Following this is a device reference table containing a set of four-word entries (one per device, maximum 125 entries) containing device interrupt vectors and the identity of the drivers for each device.

CENTRAL PROCESSOR

GENERAL: The HP 3000 Series processors are complex systems that include a firmware-implemented instruction set; firmware-implemented repetitive functions such as subroutine linkage, string processing, and buffer transfers; firmware-assisted software; bus control clock; and crystal clock dedicated to process execution measurements.

The hardware processors consist of an arithmetic-logic unit, shifting network, and, on the Series II and III, 38 specific-purpose registers, 20 of which are user-accessible. The Series 33 CPU contains 27 registers, with 13 available to users. Since the system architecture is based on code segments and data segments (data stacks), most of the CPU registers are used for defining segment limits and operating elements.

Auto restart after power failure is standard. The Series II and III battery backup for the MOS memory is 45 to 90 minutes, depending on memory size. The Series 33 range is 30 minutes to 4 hours.

The Series 33 processor is based on Hewlett-Packard's complementary metal-oxide-semiconductor/silicon-on-sapphire (CMOS/SOS) process, developed as an LSI circuit tech- ▶

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➤ The close parallels between the FORTRAN and BASIC languages used on the smaller HP 1000 Series computers and their counterparts of the HP 3000 systems make it possible for users with these smaller systems to upgrade easily. (Even though conversion will be required, the standard portions of the languages will be unchanged, and only the discrepancies in language extensions and data format expressions will need to be resolved.)

Hewlett-Packard stresses flexible concurrent, multilingual environments where terminal-oriented transaction processing applications are likely to be combined with background batch business processing. The Series 33 and Series II Model 6 can be configured to handle up to 31 terminals; and the Series II Model 8 and Series III can handle up to 63 terminals. Terminals can be opened as files or used for program development with equal facility. Emulation of the IBM 2780/3780 batch terminals is available on the Series II and III systems. All Series II and III models can also be configured with HP's Distributed System/3000 software, enabling multiple HP 1000, HP 2026, and/or HP 3000 Series II computers to be interconnected in a distributed processing network.

At present, the 3000 Series systems are available only in packaged configurations. Purchase prices range from \$70,000 for a minimum Series 33 configuration to over \$200,000 for a large Series III system. HP will upgrade any of the older 3000, 3000CX, or 3000 Series I processors to a 192K-byte Series II Model 6 for \$52,500, or to a 320K-byte Model 8 for \$77,500. Memory is expandable on both in 64K-byte increments at \$3,700 each.

Customer services for the HP 3000 Series are extensive. They include pre-installation site planning, installation, several levels of training given both at users' sites and at HP, several levels of on-site hardware and software service, user program consultation both on-site and via toll-free telephone, reference manual updates, information newsletters, an active users' group, and a comprehensive software support policy announced in August 1977. The software support policy offers the HP 3000 user a statement of the mail, telephone, and on-site services a customer may expect; software initial-payment discounts of up to 70 percent for both volume end users and OEM's; a prepaid 12-month plan for users who don't wish to contract for the standard 48-month period; and 5-year support for discontinued software.

The HP 3000 systems are being marketed to five general classes of prospective users: small manufacturers with sales in the 10 to 100 million dollar range; medium-scale manufacturers in the 100 to 250 million dollar range; *Fortune* 500 or 1000 companies that wish to decentralize and have several applications in each location; educational institutions on both the college/university and secondary school levels; and OEM accounts and system houses with capabilities for applications software development. About 10 percent of the 3000 Series systems being sold at present go to educational institutions. The main thrust of HP's marketing effort is toward ➤

➤ nology. Both N-channel and P-channel MOS field-effect transistors are present on the same substrate. The technology uses metal-gate transistors. All of the instructions and some of the MPE operating system are microcoded. The Series 33 CPU is modular in design, utilizing an inter-module bus (IMB), a bus interface controller (BIC), and one or more general I/O channels.

The Series II and III system design also emphasizes a modular structure, with the CPU, I/O processor (IOP), and its Module Control Unit (MCU) connected via a high-speed central data bus to other system modules such as the fault-control memory module. The MCU is shared by the CPU and IOP. The I/O processor executes I/O programs in parallel with CPU operations.

All these CPU's are divided into the instruction decoder, firmware storage and control, and hardware processor. The Series II and III CPU is microprocessor-controlled and uses a pipeline technique. It receives an instruction word from memory and translates it into a microprogram starting address. As this instruction word is being executed, another is received.

Program code and data are maintained in strictly separate domains and cannot be intermixed except for "immediate" type data present in program instructions. This design was chosen so that all program code would be protected from alteration, thus permitting the development of re-entrant programs for multi-thread operation.

Firmware-assisted software includes the interrupt handler, cold-start loader, power-failure data-saving routines, automatic restart routines, and front panel-initiated diagnostics. The basic microprogramming architecture is asynchronous and designed to facilitate a multiprogrammed, variable-length, code-segmentation, virtual-memory mode of operation with extensive stack processing.

CONTROL STORAGE: Bipolar ROM (read-only memory) consisting of 14,000 (Series 33) or 10,240 (Series II and III) 32-bit words. At present, HP utilizes 4K (Series II and III) or 7K (Series 33) words of this space. Control storage is not directly accessible to the end user; it has a cycle time of 55 nanoseconds and an average instruction execution time of 175 nanoseconds on the Series II and III. For the Series 33, the cycle time is 90 nanoseconds, with instruction execution times of 270 to 630 nanoseconds.

REGISTERS: There are 38 hardware registers on the Series II and III, 20 of which are accessible to the programmer, and 27 on the Series 33, 13 of which are accessible to the programmer. Those dedicated to system use are mostly 16-bit registers. These include the current and next instruction registers; nine registers for scratchpad, flag, and interrupt purposes; two I/O registers; three memory address and data registers; and two firmware address registers.

Registers accessible to the programmer include the code segment pointer group (3 in the Series 33, 4 in the Series II and III); the stack pointer group (7 in the Series 33, 8 in the Series II and III); 4 registers in the top-of-stack group; and registers named Index, Status, and the Series II and III Program Clock and switch register. All registers are 16 bits in length except the bank registers and the Program Clock register.

The code segment group consists of the Program Base register (PB), which defines the program base of the code segment being executed; the Program Counter (P), which contains the 16-bit absolute address of the instruction being executed; the Program Limit register (PL), which defines the limit of the code segment being executed; and the Program Bank register (PB-Bank), which defines the bank of 64K words where the code segment resides (Series II and III only). ➤

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▷ distributed processing applications instead of the older batch processing market.

Maintenance is handled through 53 HP offices in the U.S., 9 in Canada, 18 in Central and South America, and 103 in Europe, Africa, Asia, and Australia. Both on-call and scheduled services are available. The basic monthly maintenance contract provides for typical four-hour response times within a 100-mile radius of a major metropolitan area. Prime-time coverage is provided Monday through Friday from 8 a.m. to 5 p.m.

USER REACTION

Twenty-two users with a total of 33 installed HP 3000 systems responded to Datapro's 1979 survey of mini-computer and small business computer users. Main memory capacities for these systems ranged from 128K to 2048K bytes, and mass storage capacities from 56 to 820 million bytes. The average number of interactive terminals supported was 14 per system. All of these users reported at least one magnetic tape unit in their configurations, and the maximum was four.

All of the systems were using the MPE III operating system, and COBOL, BASIC, FORTRAN, SPL, and RPG were the most frequently used languages. All but one user reported business data processing as a principal application, and data base management, data communications, and scientific/engineering computing were also listed by some of the users.

These systems had been installed for periods ranging from 3 months to over 40 months, with an average installation life of 15 months. Two-thirds of these users had purchased their systems outright, while the remaining systems were acquired via a lease/purchase agreement or a third-party lease.

Twenty-two users reported that applications programs were being written by in-house personnel. Two users reported using the manufacturer's program packages, two were using proprietary software packages, and four users had employed a contract programming house to develop their application programs.

The table below summarizes the ratings given by these HP 3000 users.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	15	7	0	0	3.7
Reliability of mainframe	21	1	0	0	4.0
Reliability of peripherals	14	7	0	0	3.7
Maintenance service:					
Responsiveness	5	14	1	0	3.2
Effectiveness	10	7	3	0	3.4
Technical support	6	7	6	0	3.0
Manufacturer's software:					
Operating system	12	8	2	0	3.5
Compilers and assemblers	9	9	4	0	3.2
Application programs	6	6	1	1	3.2
Ease of programming	11	9	1	0	3.5
Ease of conversion	10	6	1	1	3.4
Overall satisfaction	12	10	0	0	3.6

*Weighted Average on a scale of 4.0 for Excellent.

▶ The stack pointer group is divided into the data segment group and the stack pointers. The data segment group includes the Data Base register (DB), used to define the data base of the current user's stack; the Q register, utilized to define the current stack master in the current data segment; the Data Limit register (DL), where the data limit of the current data segment is defined; and the Data Base Bank register, which contains the location of the bank in which the stack or split stacks reside. The stack pointers include the SM register, which defines the number of top-of-stack elements that are in CPU Stack registers; the Z register, whose function is to define the stack limit of the current user's stack; and the Stack Bank register (S-Bank), used to define the 64K word bank in which the stack resides (Series II and III only).

The Status register (STA) indicates the current status of the computer hardware, including whether the system is in user or privileged mode. The Program Clock register (PCLK) is a counter loaded and read by software. The Switch register (SWCH) is a 16-bit register representing front panel switches used for bootstrapping and fault diagnosis.

ADDRESSING: Only privileged instructions may use absolute addressing. All other addressing is performed using one of the six allowable relative techniques. Two techniques apply to code, while four apply to data. Except for privileged instructions (including I/O), all word addressing is indirect, indexed, or indirect indexed relative to the P-register (plus or minus), the Q-register (plus or minus), the DB-register (plus only), or the S-register, a logical addition of the contents of the SM and SR registers (minus only). Indirect addressing and indexing are both provided, individually or in combination. Up to 65K words (addresses) can be referenced by a memory reference instruction. For byte addressing, the left half of each word can be addressed, permitting a memory byte reference instruction to address up to 32K bytes. Byte addressing is direct, direct-indexed, indirect, and indirect-indexed relative to the DB register (plus only).

Double-word indexing is provided for two memory address instructions that automatically cause the index register contents to be incremented by two during development of the effective address.

INSTRUCTION REPERTOIRE: In total there are 214 machine instructions in the HP 3000 Series 33 and 209 in the Series II and III, consisting of: 65 stack instructions, 16 memory address instructions, 13 branch instructions, 4 loop control instructions, 6 single-word shift instructions, 6 double-word shift instructions, 3 triple-word shift instructions, 2 quadruple shift instructions, 1 field instruction, 6 bit instructions, 10 I/O and interrupt instructions (15 on the Series 33), 15 immediate instructions, 17 program control and special instructions, 7 register control instructions, 6 extended-precision floating-point instructions, 8 privileged memory reference instructions, 12 packed decimal instructions, and 12 move instructions. Approximately 19 percent of the instructions are privileged.

INSTRUCTION TIMINGS: The following HP 3000 Series II and III instruction times are for full-word (16-bit) fixed-point operands and for single-precision (32-bit) floating-point operands, in microseconds. HP has not released instruction timing data for the Series 33 processor to date.

	Series II and III	
	Fixed Point	Floating Point
Load/Store	1.6/1.9	2.6/3.0
Add/Subtract	0.55	8.2 avg./8.4 avg.
Multiply/Divide	5.25/6.125	15.2/19.4
Compare and Branch	3.3	3.7

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▷ These users were obviously well satisfied with virtually all aspects of their HP 3000 systems. Their comments were mixed, ranging from "Good OS, good data base system, extensive software" to "Data base system too expensive, software reliability poor." The one comment that seemed to best sum up the feelings expressed by most of these users was "Reliable and easy to use."

The HP 3000 Series has been a very successful product line for Hewlett-Packard, and as long as the company continues to provide the quality of tools and support that it has supplied to date, it should continue to be successful. If the new Series 33 is as good as HP believes it to be, the competitive strength of the 3000 line will increase, and we will certainly see more of the SOS technology in other HP products. □

▶ **INTERRUPTS:** The interrupt system provides for up to 125 external interrupts. There are 16 levels of interrupt masking, and each device is initially assigned to one of the 16 levels to fix priorities and permit masking under software control. Under microprogram control, context switching for an interrupt is performed in an average time of 21 microseconds (minimum 18; maximum 24.5). The interrupt routines operate on a common Interrupt Control Stack to permit nesting of interrupt routines for multiple interrupts; context switching time is reduced by about two microseconds should nested interrupts occur. Twenty-one internal interrupts for user errors, system violations, hardware faults, and power fail/restart are also provided, plus 14 traps for arithmetic errors and illegal use of instructions or privileged mode.

The priority assigned to external devices is determined by the device's logical proximity to the I/O processor (IOP) on the interrupt poll line. Masking is permissible through the 16-bit mask word, which will enable or disable an interrupt request according to the bit pattern of the word.

PHYSICAL SPECIFICATIONS: The Series 33 flexible disc drive and system cabinet are housed in a desk. The Series II and III processors use cabinets 64.5 inches high, 21 inches wide, and 33 inches deep. The Series II Model 6 and Series III require two system cabinets, while the Series III Model 8 requires three for its standard configuration.

The HP 3000 Series 33 can operate at a temperature between 59 and 95 degrees F., and the Series II and III can operate at a temperature between 60 and 85 degrees F. with a relative humidity tolerance of 50 (30 for the Series 33) to 80 percent, noncondensing. The Series II Model 6, with standard configuration including a 7920A Disc Drive, outputs 16,683 BTU's of heat per hour. The Series II Model 8 in standard configuration outputs 17,683 BTU's per hour. Weight of the Series II Model 6 in standard configuration is 1169 pounds, while the Series II Model 8 in standard configuration weighs 1389 pounds. The weights of the Series 33 and Series III are 1039 and 1169 pounds, respectively.

Power requirements for the HP 3000 Series models are as follows: Series 33-200/240 VAC, single phase, 50 or 60 Hz; Series II and III—120/208 VAC, 3-phase, 50 or 60 Hz. Air conditioning requirements for the Series II and III will exceed the average office installation by about two tons. A raised floor is not required, but is recommended for the Series II and III.

INPUT/OUTPUT CONTROL

The most significant differences between the various HP 3000 Series models are in the area of I/O control. The Series 33 I/O

processing is based on a general I/O channel (GIC), with its own microcoded logic, and a slower bit-serial Asynchronous Data Communications Controller (ADCC). The Series II and III utilize an I/O processor, selector channels, and multiplexer channels.

The Series 33 I/O control hardware consists of general I/O channels, and interface bus (IB), and device controllers. Eight ports are provided per terminal controller, with up to four terminal controllers per system, three general I/O channels, and type 103 and 2025 modem support. Two types of channels are available on the Inter-Module Bus (IMB): GIC and Asynchronous Data Communications Controller (ADCC). The GIC connects the CPU, via the IMB, with peripheral devices connected to the interface bus. The IB consists of 8 data lines and 8 control lines. The ADCC provides a bit-serial interface between the CPU and terminals. The GIC includes a direct memory access facility for direct high-speed data transfer, while the ADCC transfers one character at a time.

The maximum peripheral transfer rate through a Series 33 IB is approximately 1 megabyte per second, with an aggregate transfer rate through the IMB of about 4 megabytes per second.

I/O PROCESSOR: The Series II and III IOP operates in parallel with the CPU, and communicates with the CPU as well as other system modules over a high-speed central data bus. The CPU and IOP, although independent, share a common module address. Conflicts are resolved by the IOP's higher priority. Data can be transferred directly to or from memory over the central data bus (via a high-speed selector channel) or multiplexed via the IOP. Up to five system modules (CPU, IOP, selector channel, and two memory controller units) can be attached to the central data bus. Up to 16 I/O device controllers can be connected to the Series II and III. I/O devices can be connected to the system via the IOP bus, the multiplexer channel, and the selector channel. Each of the modules in the system can operate independently at its own speed when not operating over the central bus.

The selector channel can transfer data at a maximum rate of 2.86 megabytes per second on the Series II and III. The IOP bus has a maximum transmission rate of 952K bytes per second on the Series II and III. The channel can accommodate one controller at present. The aggregate selector channel data rate cannot exceed the central data bus maximum data rate of 2.86 megabytes per second on the Series II and III.

The Series II and III multiplexer channel can support up to 16 device controllers with an aggregate data rate of 1.038 (input) and 0.952 (output) megabytes per second. Data from the multiplexer channel is passed through the IOP for transfer to memory via the central data bus.

In addition to the multiplexer and selector modes of I/O data transfer, a direct I/O mode permits the CPU to transfer data, status, or control information directly to/from IOP-connected devices and the top of the user program data stack. Four privileged I/O instructions are included to handle these one-word direct data transfers to/from the top of a stack in memory.

SIMULTANEOUS OPERATION: In addition to the Series II and III overlapped operations between the CPU and IOP, and the basically asynchronous nature of the architecture, a "microcode pipeline" and concurrent operation of the memory modules are also implemented on the HP 3000 Series.

CONFIGURATION RULES

As is true with most minicomputers, the complement of peripheral equipment for the HP 3000 systems is restricted ▶

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► only by the number of slots available in the CPU chassis or its extensions, by software restrictions, by controller limitations, and by marketing considerations.

The Series 33 comes with two 128K memory boards connected through their memory control unit to the intermodule bus. Two general I/O channels are standard; they are connected to the IMB, allowing for one disc controller with up to eight 120-megabyte disk drives (one 20-megabyte drive is standard), a floppy disc unit, and one or two line printers. Supplied as standard on the IMB are two asynchronous data communications controllers. The two ADCC's control the system console and up to 7 other terminals. An additional general I/O channel for up to four magnetic tape drives and a total of eight ADCC's, each capable of supporting four terminals, are available.

The Series II Model 6 comes with two 64K-byte memory increments, and additional increments are allowable. The memory increments are connected through a memory control unit to the central data bus. One port controller and selector channel are standard; they are connected to the central data bus, allowing for up to eight 50- or 120-megabyte disc drives (one is standard). Supplied as standard on the IOP bus are an ATC and a magnetic tape controller (MTC) with one 1600-bpi tape drive. The ATC controls the system console and up to 15 other terminals. Standard support for 103-type or 103/202-type modems is included. The MTC controls up to four magnetic tape drives, either 800 or 1600 bpi. The drives may be intermixed on the same controller. Up to 10 slots are available for connection of additional peripherals.

The Series II Model 8 comes with five 64K-byte memory increments, with three additional memory increments allowable; while the standard Series III has one 256K-byte module, with seven additional increments available. All other aspects of the models are the same as those of the Model 6 with the following exceptions: the Model 8 and Series III have up to 23 slots available for additional peripherals, and up to 3 additional ATC's for up to 16 terminals each may be attached.

The following peripherals are supported by the Series 33: up to four 1600-bpi magnetic tape drives, one or two line printers and controllers, and asynchronous data communications controllers.

Series II and III peripherals include a plotter interface, an additional ATC for up to 16 terminals, ATC support for 103-type modems, ATC support for 103/202-type modems, an additional controller for up to four 800- and/or 1600-bpi tape drives (2 slots), up to four line printers and controllers, up to two hard-wired serial interfaces, up to seven synchronous single-line controllers, up to two 600-cpm card readers and controllers, a card reader/punch rated at 200/45 to 75 cpm with controller, a 500-cps paper tape reader with controller, and a 75-cps paper tape punch with controller.

The MPE II operating system on the Series II and III will support the following terminals in addition to HP's own 2620, 2630, and 2640 series: Teletype Model 33, 35, or 37 ASR teleprinters, Execuport 300 Data Communications Transceiver Terminals, HP 2600A Keyboard Display Terminals, Memorex 1240 Communications Terminals, and HP 2615A Terminals.

On the Series 33, MPE supports HP's 2620, 2630, and 2640 series terminals.

MASS STORAGE

7920A DISC PACK DRIVE: The 7920A is a 50-megabyte drive employing a five-platter disc pack of the IBM 3330 type. Three of the five platters are actually used, with five surfaces for data and the sixth for servo use. The remaining two platters are for protection, with one located on top of the

pack and the other on the bottom. The add-on drive is the 7920S, available singly or in packages.

The 30229 controller can control up to eight 7906/7920/7925 drives in any combination. The controller is a microprocessor-based, microprogrammed unit that incorporates integral error detection, marginal data recovery, and rotational position sensing, and can view the discs in cylinder mode. The controller chains commands operating on multiple sectors (even if a head switch or new seek is required) without interrupting the CPU, retries commands that have failed, automatically selects alternate tracks, and follows data protection procedures.

Integral error detection is implemented using a special seven-word error detection code appended to each sector. Under this scheme, one burst of erroneous data up to 32 bits long can be detected and corrected in each sector. Erroneous data blocks between 32 and 48 bits long can be detected but not corrected. Actual correction occurs in the controller buffer. Error detection logic in the disc controller computes a three-word mask that is Excluded-ORed with the incorrect data to form the correct version.

Data is recorded at 4680 bpi on 815 tracks per surface, using 256-byte sectors and 48 sectors (12,288 bytes) per track. Track density is 384 tracks per inch. Spare tracks are not included in the rated drive capacity of 50,073,600 bytes; 8 spare tracks per surface are provided. Track-to-track, average, and across-all-tracks head positioning times are 5, 25, and 45 milliseconds, respectively. The drive has a rotational speed of 3600 rpm with an average rotational delay of 8.3 milliseconds. The data transfer rate is 937,500 bytes per second. The 7920A drive is manufactured by Hewlett-Packard.

7925A DISC PACK DRIVE: The 7925A has essentially the same design as the 7920A except that it is a 120-megabyte drive with 7 platters, 9 functional surfaces, 64 sectors per track, and 16,348 bytes per track. The rotational speed is 2700 rpm and the average rotational delay is 11.1 milliseconds.

7906S DISC CARTRIDGE DRIVE: The 7906S is a 19.6-megabyte drive with 9.8 megabytes of fixed disc and 4.8 megabytes of removable cartridge storage. It can be configured on the same controller as the 7920 and 7925 drives. Data is recorded on 800 tracks per cartridge or disc using 48 256-byte sectors per track. Track-to-track, average, and across-all-tracks head positioning times are 5, 25, and 45 milliseconds, respectively. The rotational speed and delay and the data transfer rate are also the same as those for the 7920 and 7925.

INPUT/OUTPUT UNITS

Refer to the Peripherals/Terminals table.

HP is also an OEM peripherals supplier, and its OEM products are covered behind the Peripherals tab (section M13). HP can also provide a vast array of instrumentation, data acquisition, process control, numerical control, and analog/digital I/O equipment. Interfaces include the HP-IB, Hewlett-Packard's implementation of IEEE Standard 488-1975.

COMMUNICATIONS CONTROL

30018A ASYNCHRONOUS DATA COMMUNICATIONS CONTROLLER (ADCC): The 30018A interfaces terminals to the Series 33 via the inter-module bus. Up to 31 terminals plus the system console can be connected through

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► type 103 (full-duplex) or 2025 (half-duplex) modems. ADCC boards contain four ports for connection to devices through RS-232C data communications lines. Data transmission rates of up to 2400 bps are supported, with parity generation and checking and automatic answering and brake detection.

30032B ASYNCHRONOUS TERMINAL CONTROLLER (ATC): The 3002B is designed to interface user terminals to the HP 3000 Series II and III via the IOP bus. Up to 64 terminals (including the system console) can be interfaced on the Series II and III. Terminals can be hard-wired or connected through type 103A3, 113B, 202C, 202S, and 202T modems. Series II and III terminals interfaced through the ATC can be configured to the multiprogramming executive (MPE III) as data entry terminals, under user program control, or as log-on terminals, accessing all the capabilities of the HP 3000 Series. Terminals on HP 3000 Series systems normally operate in character mode, except when accessed via VIEW/3000 when block mode is employed. Users who wish to access terminals in block mode directly (i.e., without using VIEW/3000) must provide their own detection and correction facilities for transmission errors by calling operating system routines. Speeds of 110, 150, 300, 600, 1200, and 2400 bps are implemented. The 30032B is connected via a 16-bit parallel interface.

30055A SYNCHRONOUS SINGLE LINE CONTROLLER: This is the hardware portion of HP's 2780/3780 emulator subsystem; it provides all IBM 2780 and 3780 capabilities, including Bisync protocol compatibility, plus 22 optional capabilities available from batch and interactive terminals under MPE III. The controller uses half- or full-duplex operation over public telephone or leased lines to allow the HP 3000 systems to be linked via modems to other computers in an HP Distributed Systems Network. The HP 30055A offers compatibility with EIA RS-232C, CCITT V.24, and Bell type 201, 208, or 209 modems. The 30055A has program-selectable parity (none, even, odd), program-selectable special character recognition, and program-selectable synchronous character. Two-character buffering is standard. The 30055A operates at speeds up to 9600 bps. Software for the 30055A is provided separately.

30360A HARD-WIRED SERIAL INTERFACE: Provides the hardware for an HP 3000 Series link via coaxial cable to other computers in an HP Distributed Systems Network for high-speed asynchronous, point-to-point data transfers. A transfer rate of up to 2.5 megabytes per second is offered over distances of up to 1000 feet, with half that speed at 2000 feet. The 30360A includes four software-selectable channels; programmable error detection; call-back or line monitoring timer; automatic hardware transmission of an acknowledge word (handshaking) without program interruption; and CRC generation, transmission, and processing. The CRC uses a 15th-degree polynomial. A pair of 75-ohm coaxial cables function as a unidirectional pair of transmission lines for fast turnaround. The cable is optically isolated at the receiving end, enabling long-distance transmission with a low probability of errors due to common-mode noise or ground-level shifting.

SOFTWARE

OPERATING SYSTEM: The *Multiprogramming Executive III (MPE III)* operating system is an enhanced general-purpose version of the Multiprogramming Executive/Communication (MPE/C) operating system originally used on the HP 3000CX. It provides concurrent processing for multiprogrammed batch, time-sharing, and transaction processing. MPE III is composed of a command interpreter, file management system, input/output system, virtual memory manager, segmenter, loader, job session scheduler, process dispatcher, user trap manager, spooling facility, disc space manager, utility intrinsics, initiator, configurator, system console manager, power fail/auto restart, private volumes facility, serial disc interface, tape labels facility, accounting

facility, and logging facility. Support is provided for FORTRAN, ANSI COBOL, BASIC, RPG II, SPL, a program file edit subsystem (EDIT/3000), an interactive diagnostics generator (SLEUTH), a generalized sort and merge (SORT/3000), a compiler library, and general utilities. In addition, MPE III adds a backup/restore facility, APL (Series II and III only), and support for hard-copy microprocessor diagnostics.

Under virtual memory allocation, each program can be segmented into as many as 63 segments. Each code segment can be up to 32K bytes in length, and each data segment up to 64K bytes. The principle of memory allocation dictates that only the essential segments be in memory at any particular time. Program execution for a particular user (called a process by HP) then proceeds until additional segments are needed. The operating system remembers all segments brought into memory under a concept called segment trapping. The goal is to keep as much as possible of a program's working set—the code, data, and system data segments used most recently—in memory. This is accomplished by the use of an HP-developed algorithm called the segment trap frequency algorithm. The algorithm remembers the frequency of use of each segment of each working set and overlays only the least-used segment of low-priority work set.

Features that have been redesigned or added to MPE III include a local compression algorithm, memory allocation manager, and program dispatcher. The local compression algorithm functions to keep user segments tight together by executing large block moves within memory whenever necessary so that the need for frequent overlays is reduced. The memory allocation manager uses the segment trap frequency and local compression algorithms to optimize system throughput as much as possible. The program dispatcher schedules processes for execution by using an algorithm which handles three concurrently existing queues, the new crystal process clock, and instruction set enhancements for privileged operations. HP states that this dispatcher is three times faster than the one used on the retired 3000 Series I under MPE/C.

Other improvements to MPE III include file control intrinsics that allow terminals to be opened as files; files that can cross physical volumes; better HP 2640 Series terminal interfaces; up to 32 file extents (MPE-C has 16); the ability to restore files to a previous volume; magnetic tape buffers of up to 32K bytes; and a power fail/auto restart that does not require human intervention.

Under MPE III, all I/O is handled by the file system; thus, programs are essentially device-independent. The IOP allows for file manipulation without extensive JCL. In any access mode, whether sequential or direct, security is maintained for users, groups, accounts, and individual files.

Information such as CPU time, connect time, and disc file space is kept by user, group, and account. A Report command allows extraction of this information.

Other features of MPE III include utilization of the machine's hardware-implemented stack architecture, recursive/re-entrant code, spooling from both terminal and batch devices, and remote processing via terminals.

Recommended disc space allocation for MPE III, the subsystems, and virtual memory is somewhat over 4 million bytes. MPE III is disc-resident, with about 2 percent (approximately 80K bytes) resident in memory at any one time.

LANGUAGES: All of the HP 3000 computers are multi-lingual systems that support five programming languages plus a data base management system. In addition, Series II and III support APL. All implemented languages have the ability

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► to call a subroutine written in another language. Of equal importance is the facility provided by the file system for all languages to utilize a common file structure, therefore providing uniform access to disc and tape.

SPL/3000 is the Systems Programming Language for the HP 3000 Series. It is ALGOL-like, but is machine-dependent (direct register references, bit extraction, etc.). It supports one-dimensional arrays and CALL's from any other language available to the system. SPL is free-form in structure and includes other features such as recursive procedures, high-level statements with unlimited nesting, and arithmetic and logical expressions. A debugging aid, TRACE/3000, is provided. HP states that MPE III and all compilers are written in SPL.

FORTRAN/3000 is based on American National Standard FORTRAN, X3.9-1966, and is a full implementation of that standard. As a programming aid, TRACE/3000 may be used for debugging.

Described below are some of the FORTRAN language extensions implemented by HP. Source programs may be written in a free-field as well as in a fixed-field format. Symbolic names may consist of up to 15 characters instead of the usual 6. Character type data may be used to facilitate string manipulation. Up to 99 files may be used during execution of a FORTRAN program. Arrays may have up to 255 dimensions instead of the standard 3. A label may be used as an actual argument in a CALL statement to allow alternative return points following execution of the subroutine referenced by CALL. Support is provided for user-written error handling routines called in trap conditions, and a parameter statement is available for giving constants symbolic names. Seven data types can be processed: integer, double integer, logical, real, double precision, complex, and character. Subroutines and functions may have secondary entry points. A built-in cross-reference facility is available as a compile-time option. Undefined variables are detected at compute time, and generic functions are recognized.

RPG/3000 is compatible to a high degree with RPG and RPG II as developed by IBM. Language extensions implemented by HP include parameters for external subroutine calls, an interface to the data base management system, three methods for run-time error options, a cross-reference error option, EBCDIC/ASCII automatic translation, input/output terminal files, and no requirements for calculation indicator repetition for duplicate conditioning indicators. Data can be processed in binary, packed and unpacked decimal, unpacked decimal with leading or trailing sign, and alphanumeric formats. RPG/3000 also provides automatic 2K- to 8K- byte program segmentation for a virtually unlimited-size RPG program.

BASIC/3000 is implemented as an interpreter and a compiler. The interpreter offers an effective way to debug programs interactively, while the compiler yields more efficient code with average program execution speeds 10 to 30 times faster for CPU-bound programs and one to four times faster for I/O-bound programs. Four numeric data types are possible: real, integer, complex, and extended precision.

BASIC/3000 also provides the following HP extensions. Mixed-mode arithmetic and program chaining with common storage are provided, along with a built-in debugging system. External routine calls, strings and string arrays, and multiple-line statements and functions are all permitted. Picture output formats can be implemented, and the programmer can use timed input by way of the ENTER statement. Both direct and sequential access to files are allowed. File creation and purging are under program control, while file security is user-definable with passwords.

Minimum requirement for SPL/3000, FORTRAN/3000, RPG/3000, and BASIC/3000 is any 3000 Series system with the minimum equipment configuration.

APL/3000 is patterned after IBM APLSV (A Programming Language—Shared Variables) and contains all its extensions plus enhancements developed by Hewlett-Packard. These HP extensions include APLGOL, a structured language extension to APL; a text editor; virtual workspaces; batch as well as interactive operation; MPE file facility; and extended control and debugging system functions.

APLGOL uses ALGOL-like keywords in conjunction with APL expressions to describe the control flow within a given function. Currently, APLGOL contains 11 commands including ASSERT, FOREVER DO, and IF THEN ELSE.

The editor available with APL/3000 is described by Hewlett-Packard as "very friendly" and usable in both calculator and edit modes. At present 21 edit commands are included in the text editor. Among these are BRIEF, CURSOR, MATRIX, UNDO, and VERBOSE.

A firmware-assisted virtual memory scheme is employed in APL/3000. This scheme results in large workspaces being made available to the user, constrained only by the amount of on-line storage. The use of files as extensions of workspaces is thus unnecessary.

APL/3000 requires, as a minimum, an HP 3000 Series II or III with 256K bytes of memory, or, for multilingual operation, 384K bytes of memory. Operation with 14 or more terminals requires 512K bytes of memory. The maximum recommended number of simultaneous users is 16.

COBOL/3000 is based on American National Standard COBOL, X3.23-1968, and includes these modules, all at high levels: Nucleus, Table Handling, Sequential Access, Random Access, Sort, Segmentation, and Library. At present, the Report Writer is not implemented.

Language extensions implemented by HP include interprogram communication, packed decimal (COMPUTATIONAL-3), note lines, current date in the form of MM/DD/YY, time of day in the form of HHMMSS, THEN optional, multiple REDEFINES of a given location, Unary+, Go to MORE-LABELS EXIT, synchronized for index data items, and forms message for special forms.

COBOL/3000 requires an HP 3000 Series system with at least 192K bytes of memory.

ACCESS METHODS: HP supports four access methods on each of the HP 3000 systems: direct, sequential, chained, and index sequential.

Index sequential on the HP 3000 Series is known as the Keyed Sequential Access Method (KSAM/3000). The eight-command utility can access records either by the primary key or one of up to 15 alternate keys up to 255 bytes in length. The variable-length records can be retrieved by generic key, and the primary field is updatable. KSAM/3000 can be accessed concurrently from RPG, COBOL, FORTRAN, BASIC, and SPL by multiple inquiry and update stations.

COMMUNICATIONS SOFTWARE: Software support for communications is available through the 30130E RJE 3000 (2780/3780 Emulation Subsystems), MRJE (Multileaving RJE), MTS 3000 (Multipoint Terminal Software), and the Distributed System/3000 (DS/3000).

In the 2780/3780 *Emulation Subsystems*, the supplied software supports all significant IBM 2780/3780 capabilities on point-to-point lines at speeds up to 9600 bps, plus most

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► optional capabilities such as EBCDIC and ASCII transparency, short-record truncation, and multi-record transmission. The package does not support the 2780 6-bit Transcode or the 3780 capabilities for reverse interrupt and conversational mode. Optional capabilities include blank compression, short record truncation, horizontal tabulation, 2780/3780 vertical format control, multirecord transmission, and print/punch component select.

The *Multileaving Remote Job Entry (MRJE)* software provides access to any remote host system utilizing HASP II or JES2 for multiple HP 3000 batch users.

The *Multipoint Terminal Software (MTS/3000)* permits half-duplex data transmission over a single communications line between an HP 3000 system and up to 32 multiplexed terminals. In both interactive and page modes, data can be entered, edited, and transmitted at up to 9600 bps.

Distributed System/3000 is a communications facility that makes it possible to interconnect HP 3000 Series computer systems in distributed processing networks. The DS/3000 software allows multiple interactive or batch users of a 3000 Series to communicate concurrently with a remote 3000 Series system in a full multiprogramming environment. According to HP, network operation with DS/3000 makes remote processing as easy as processing on a local 3000. The only special programming that is needed to interact with a remote processor is placement of a single word in some commands.

In a network of HP 3000's, any computer can at any time interchange information simultaneously with as many as seven others. Any number of 3000's can be interconnected via DS/3000 as long as no single system needs to interchange information at the same time with more than seven others. HP 3000 networks are also capable of communicating with larger systems via IBM 3780 emulation and through MRJE to host systems using HASP II or JES2.

Although multiple users can share the same communications line, one user can command exclusive use of the line when necessary for increased volume of data transfer. A variety of processes can be in progress at the same time, including local and remote batch operations, local and remote transaction processing, interactive problem solving, remote job entry, and inter-system program-to-program communication. One HP 3000 can store, modify, or retrieve data in IMAGE/3000 data bases in other 3000's in the network. The HP file copier can be used to copy whole files from one system to another.

HP states that when existing 3000 Series computers are networked with DS/3000, the user's investment in application software will be protected. Similarly, DS/3000 has been implemented with a "layered" architecture, with the intent that user-created software shall not be affected by future changes that may occur in communications link protocols or in electrical interfaces. A network accounting structure and file security measures provide protection against unauthorized use, and multi-level security schemes can be implemented.

DS/3000 offers remote command processing, remote file access, program-to-program communications through the use of nine intrinsics, virtual terminal capability (terminals physically connected to one system operate logically as if they were connected to another), simultaneous local and remote processing, remote data base access, inter-system data transfer, bidirectional interleaving of applications from either end of the communications line, and peripheral sharing.

HP has also implemented distributed system software on the HP 1000 and the HP 2026, thus allowing these systems to

become a part of an intercomputer communications network. For example, an HP 2026 system supports up to 16 interactive terminals, which can also function as terminals to any HP 3000 in the network.

Using a coaxial cable, line speeds of up to 2.5 million bits per second can be achieved. Using common-carrier facilities, which may be either switched or leased lines, data can be transferred at up to 9600 bits per second, depending upon line conditioning and choice of modem.

IMAGE/3000: The data base management system for the HP 3000 Series is oriented toward general-purpose data base management and operates in both terminal and batch environments.

IMAGE consists of three parts: a data base definition subsystem (DBDS), a data base management subsystem (DBMS), and a data base utility subsystem (DBUS). Typically, a data base manager would use DBDS to define the data base and DBUS to create and maintain the data base. The applications programmer, in writing his programs in RPG II, COBOL, FORTRAN, or SPL, would use the data base management language (DBML), which operates on the data base using DBMS.

IMAGE uses a network data structure as its data base organization. Data entry selection is made utilizing one of four access methods: serial, chained, directed, and calculated.

In *serial access*, IMAGE starts at the most recently accessed storage location for the data set and looks at all adjacent records sequentially until the desired entry (if it exists) is found. In *chained access*, entries have a common search item (key) value and are linked together through pointers to form a chain. Access is then merely retrieval of the next item in the current chain. In *directed access*, the calling program specifies the record address of the data entry where the requested data items should be located. In *calculated access*, master entries are retrieved by calculating an address based on a key.

In the chained access technique, pointers link one data set item to another. They are normally paired, where one pointer refers to the previous entry in a chain and the other pointer refers to the next entry in a chain. The last member of a chain contains a zero forward pointer. To add a new member in a chain, therefore, means only to change the forward pointer value. Up to 16 different pointer pairs can be maintained for each data item; this permits each data item to be a member of 16 different chains or access paths.

Security is provided at the data base, data set, and data item levels using a class type scheme with 63 levels. The scheme is such that a user with a level 10 security does not have access to level 9 data.

Eight different access modes are available for IMAGE users. Multiple users may access a data base concurrently. Restructuring of the data base is accomplished by using DBUS. The restructuring can be through a changed data item or data set name, changed security provisions, changed data set relationships, and increased data set capacities. Inverted data sets are not supported.

Limiting parameters for IMAGE/3000 include the following. In each data base there can be a maximum of 255 data item names and 99 data sets; a single set cannot exceed the capacity of a disc drive. There may be up to 16 characters per item or data set name. In each data entry there may be up to 127 data items. The maximum size of a data entry is 4094 bytes. A maximum of 16 keys per detail data set and 16 detail data sets per master data set is permitted. Each chain may have up to 65,535 entries. There may be 6 characters per data base name, 8 characters per password, and 8,388,607 entries per data base. ►

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► Additional enhancements to IMAGE for the HP 3000 Series include 32 data extents; the capability for data sets to cross volume boundaries; DBFIND and DBGET without locking in access modes 1 and 5; the intrinsic DBEXPLAIN, which explains the result of a CALL; and the intrinsic DBERROR, which supplies an English-language message to an error code. The number of data extents is a constraint of the file system, not IMAGE.

QUERY/3000: Uses such commands as FIND, REPORT, and UPDATE to locate, report, and update data values in an IMAGE/3000 data base. Reporting of retrieved data can be formatted to include page titles, column headings, group subtotals, etc., if desired. All security provisions invoked through IMAGE are adhered to in QUERY. A command file can be utilized to store complex or often-used command sets on disc. For display purposes, nine data types may be converted and error-checked.

For the HP 3000 Series, QUERY/3000 has been enhanced with computational power for crossfooting. Ten registers have been implemented for this purpose, using GROUP and TOTAL. For more information on IMAGE and QUERY, see Report M12-472-101.

VIEW 3000: A data entry software package to facilitate the implementation of interactive data entry, with or without a high-level language interface. Four facilities are included: forms design, source data entry, data formatting, and program interface. Forms can be defined using fill-in-the-blanks menus and function keys. Simple data edits are included and can be enhanced by the use of a free-form field definition language. The data entry facility allows on-line entry and modification of data. The reformatting capability changes input formats to accommodate existing programs. VIEW is callable from RPG, COBOL, BASIC, FORTRAN, and SPL.

APPLICATIONS AIDS: *The Scientific Library* is a collection of routines that perform the most often-used scientific functions. The routines may be utilized by all implemented languages except RPG.

MFG/3000, the Manufacturing Systems package, manages materials planning and control functions of a manufacturing operation. Three modules are included: engineering data control, inventory and order status, and materials requirements planning.

SIS/3000, the Student Information System, consists of an integrated data school district data base and maintenance modules, a Family Information Facility (FIF), a Mark Reporting Subsystem (MRS), and an Attendance Accounting Subsystem (AAS). SIS requires SORT/3000, SPL/3000, EDIT/3000, IMAGE/3000, and COBOL/3000.

UTILITIES: Four major elements are available. *Store/Restore* is for the backup and restoration of key programs and data. *EDIT/3000* is the HP text editor used to create, manipulate, and store files of upper and lower case alphanumeric characters in the form of lines, strings, or individual characters. *SORT/3000* can sort and merge. *FCOPY/3000* performs all file copying tasks; it operates only through the MPE file system.

PRICING

POLICY: The HP 3000 Series systems are available on a purchase or lease basis. Individual models are offered at a packaged price (processor, required peripherals, and selected software), with extensive separately priced peripheral and software options. The list of bundled software for the 3000 Series includes MPE III, SPL/3000, EDIT/3000, SORT/3000, FCOPY/3000, and the compiler library.

All language, data entry, data management, and data communications software products can also be purchased separately. See the Software Prices at the end of this report.

Standard lease rates can be calculated as percentages of the list (purchase) price payable per month for terms from three to five years in accordance with the following table:

Term, months	Percent of List Price per Month
36	3.42
60	2.33

The leases are noncancellable, but a special provision is available that permits cancellation on nine months' notice for an additional premium of 1.25 percent of the list price per month.

A purchase option provision is available throughout the duration of a lease; a substantial portion of the lease payments can be applied to the purchase price.

Most peripherals are also available for operation at 230 VAC, 50 Hertz. The option appears in the price list, however, only if there is a charge for the feature. Users may specify this feature as option 015.

Maintenance is separately priced and offered through 53 U.S. offices, 9 Canadian offices, and 121 international offices. The standard Basic Monthly Maintenance Charge (BMMC) contract includes preventive maintenance calls and goes into effect after the 90-day warranty period. The basic monthly contract calls for four-hour response time within a 100-mile radius of a major metropolitan area. Coverage is provided Monday through Friday, 8 a.m. to 5 p.m. Extended coverage is available in most locations (see below). The contract also covers service on distributed systems, service on reproducible non-critical problems, and service on non-reproducible system failures.

In the table below, the rates for extended maintenance coverage can be obtained by multiplying the figure shown by the Basic Monthly Maintenance Charge shown on the price list.

Hours of Coverage	Five-Day Service	Seven-Day Service	Typical Response
8 to 5 (8 hrs.)*	BMMC	1.1	4 hrs.
8 to 9 (12 hrs.)	1.1	1.2	4 hrs.
8 to 12 (16 hrs.)	1.25	1.3	4 hrs.
8 to 8 (24 hrs.)	1.3	1.35	4 hrs.

*Occasional extra service is billable at a \$20 surcharge.

The present software support policy for the HP 3000, which became effective on August 1, 1977, contains the following provisions:

- Statement of the mail, telephone, and on-site services a customer may expect.
- Software initial payment discounts of up to 70 percent for both volume end users (VEU's) and OEM's.
- A prepaid plan for those who don't wish to contract for a 48-month period as required under the new standard plan.
- Yearly support contract after the initial 48-month period.
- Support for discontinued software.

Services that accompany software purchased under the support policy include phone-in consulting with an HP ►

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► systems engineer (with an advertised four-hour response time) within a 100-mile radius of the HP sales office, software updates every 3 months, reference manual updates, software status bulletins every two weeks, and installation of software at the customer site. The phone-in consulting service may also be used for customer application bugs and interpretation of HP documentation. Software bulletins and updates also offer an avenue for interpretation of HP documentation.

The following table lists the software discount schedule for VEU's and OEM's.

Number of HP 3000's Purchased	Percent Discount
1	0
2-3	20
4-5	30
6-10	40
11-15	50
16-20	60
21-25	65
26 & up	70

Discounts apply to both the initial payment and the monthly fee, and are dependent on how multiple-site support is defined. For a single systems manager in charge of multiple sites, the discount schedule applies to both the initial payment and the monthly fee. For one customer with multiple sites, each with its own systems manager, the discount schedule applies only to the initial payment. Greater discounts will go into effect if the customer increases the number of systems contracted for purchase.

The prepaid plan provides a full year of software support. In addition, the terms of this plan provide immediate title to a copy of the software object code, installation, and documentation. Both the prepaid plan and the 48-month standard plan provide the same 90-day software warranty. Billing for the standard plan is quarterly.

Three support options are offered at the end of the initial prepaid-plan contract period:

- Full software support contracted on a yearly basis at the same rate as under the 48-month plan.
- A software subscription service, which provides bimonthly status bulletins, the latest updates and revisions to software purchased for the specific site, and an automatic supply of user manual updates pertinent to the system.
- Self support, where the customer's programmers assume responsibility for software maintenance and HP software consulting is on a time-and-material basis.

Hewlett-Packard also indicates that if a software product is discontinued from sale, support will continue for an additional five-year period. Thereafter, support will be provided on an as-available and time-and-material basis.

On-site consulting services by HP systems engineers are available at \$500 per day in areas including system operation, system management, system security, application design, system optimization, data base usage, language utilization, and customer software problem resolution. HP estimates one day as the typical time span for the systems engineer's stay in all areas except the last one, where the stay is generally one to three days.

For system discount purposes, each of the 3000 Series systems counts as four functional units, and upgrades generally count as two. The following table shows the end-user and OEM discount schedules.

Functional Units	End-User Schedule	OEM Schedule
1-4	0%	5%
5-7	4	9
8-14	7	12
15-24	10	15
25-34	13	18
35-49	15	20
50-74	17	22
75-99	19	24
100-149	20	25
150-199	22	27
200-249	23	28

Data Base Management and other user training courses are offered at the HP Training Center for \$500 per day and at the customer's site for \$575 to \$1000 per day. Both hands-on and classroom experience are included. Current course offerings include: HP 3000 Comprehensive Introduction, on-site or at HP, five days; HP 3000 System Management and Operation, on-site or at HP, four days; HP 3000 IMAGE, on-site or at HP, five days; HP 3000 Special Capabilities, five days at HP; HP 3000 SPL File System Introduction, five days at HP; IBM System/3 to HP Conversion, two days on-site; HP 3000CX or Series I to HP 3000 Series II Conversion, one day on-site; VIEW/3000, two days on-site or at HP, KSAM, two days on-site; and DS/3000, three days on-site. HP 3000 COBOL and HP 3000 BASIC are available as self-study courses at \$325 each.

HP makes available, in advance of 3000 Series system shipments, a set of \$175 reference manuals for the standard software, priced at \$175 for all available HP software.

The HP General Systems Users Group provides information interchange. The fee for membership is \$200 per year.

EQUIPMENT: Since the HP 3000 computers are sold only as packaged systems, the reader is referred to the equipment price list that follows for details on configurations and pricing.■

EQUIPMENT PRICES

PACKAGED SYSTEMS

32412A

HP 3000 Series 33 Computer System; includes 256K bytes of memory, 20-megabyte 7906 disc, 1-megabyte 7902 flexible disc, system console/maintenance console, 8-port asynchronous data communications controller, 103 and 202S modem capability, 2 general I/O channels, remote diagnostic capability, system desk mainframe, MPE III operating system, initial payment for Fundamental Operating Software (SPL, EDIT, FCOPY, SORT, Compiler Library); 48 additional monthly software fee payments required.

Purchase Price	Monthly Maint.
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\$ 70,000	\$410
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EQUIPMENT PRICES

PACKAGED SYSTEMS (Continued)		Purchase Price	Monthly Maint.
002	Prepaid purchase option of HP 3000 Fundamental Operating Software (SPL, EDIT, FCOPY, SORT)	2,250	0
120	Replace 20-megabyte 7906 disc with 50-megabyte 7920 disc	3,000	-1
125	Replace 20-megabyte 7906 disc with 120-megabyte 7925 disc	7,000	6
The HP 300 Series II Computer Systems, Models 6 and 8, include a 50-megabyte disc, 1600-bpi mag tape unit, 2640B Console, 16-port asynchronous terminal controller, 103 modem capability, MPE III operating system, initial payment for Fundamental Operating Software (SPL, EDIT, FCOPY, SORT, Compiler Library); 48 additional monthly software fee payments required.			
32416A	HP 3000 Series II Model 6 Computer System with 256K bytes of memory, 3 system cabinets, and table	99,000	664
002	Prepaid purchase option of Fundamental Operating Software	2,250	0
015	230-V, 50-Hz single-phase operation; isolation transformer not supplied	-2,100	0
050	Delete isolation transformer	-2,100	0
110	Add 202S-type modem control to asynchronous terminal controller	1,240	6
125	Replace 50-megabyte 7920 disc with 120-megabyte 7925 disc	4,000	8
130	Replace 1600-bpi mag tape unit with 800-bpi mag tape unit	-2,115	-9
502	Expand memory to 320K bytes	7,600	78
503	Expand memory to 384K bytes	11,300	99
504	Expand memory to 448K bytes	15,000	120
505	Expand memory to 512K bytes	18,700	141
32418A	HP 3000 Series Model 8 Computer System with 320K bytes of memory, 3 system cabinets, and table	121,600	765
002	Prepaid purchase option of Fundamental Operating Software	2,250	0
015	230-V, 50-Hz single-phase operation; isolation transformer not supplied	-2,100	0
050	Delete isolation transformer	-2,100	0
110	Add 202S-type modem control to asynchronous terminal controller	1,240	6
125	Replace 50-megabyte 7920 disc with 120-megabyte 7925 disc	4,000	8
130	Replace 1600-bpi mag tape unit with 800-bpi mag tape unit	2,115	-9
135	Replace 2640B system console with 2635A system console	850	13
503	Expand memory to 384K bytes	3,700	21
504	Expand memory to 448K bytes	7,400	42
505	Expand memory to 512K bytes	11,100	63
32421A	HP 3000 Series III Computer System; includes 256K bytes of memory, 50-megabyte disc, 1600-bpi mag tape units 2640B console, 16-port asynchronous terminal controller, 2 system cabinets and table, capacity for 32 asynchronous terminal ports, MPE III operating system, initial payment for Fundamental Operating Software (SPL, EDIT, FCOPY, SORT, Compiler Library); 48 additional monthly software fee payments required.	115,000	682
002	Prepaid purchase option of Fundamental Operating Software	2,250	0
015	230-V, 50-Hz single-phase operation; isolation transformer not supplied	-2,100	0
050	Delete isolation transformer	-2,100	0
110	Add 202S-type modem control to asynchronous terminal controller	1,240	6
125	Replace 7920 50-megabyte disc with 7925 120-megabyte disc	4,000	8
130	Replace 1600-bpi mag tape unit with 800-bpi mag tape unit	2,115	-9
135	Replace 2640B CRT console with 2635A 180-cps dot matrix printing terminal	850	13
200	Additional I/O cabinet; adds 13 I/O slots and capacity for an additional 32 asynchronous terminal ports	10,000	21
505	Expand memory to 512K bytes	8,000	38
506	Expand memory to 768K bytes	16,000	76
507	Expand memory to 1024K bytes	24,000	114
509	Expand memory to 1536K bytes	44,000	237
511	Expand memory to 2048K bytes	60,000	313

INPUT/OUTPUT EXPANSION FEATURES

30416A	Series 33 Expansion Kit for 7 additional I/O slots; includes a second card cage, cooling unit, and power supply	7,500	20
30079A	General I/O Channel for mag tape drive support for Series 33	1,800	10
30030B	High-Speed Selector Channel for Series II; for 30229A Disc Controller only	3,600	38
30408A-002	I/O Expansion Kit for Series III; adds one cabinet with 13 I/O slots and capacity for an additional 32 asynchronous terminal ports	15,000	*

SYSTEM UPGRADES

30408A	Upgrade for HP 3000 Series III Model 5, 6, or 7 to a system similar to a Series II Model 8; upgrade consists of a memory expansion kit to accommodate up to 512K bytes, the addition of a third cabinet for I/O expansion of 13 I/O slots, space for 32 additional terminal ports, and one 64K-byte board	40,000	*
002	Delete memory expansion kit and 64K-byte memory board (adds I/O expansion only; required for Model 6 systems with 320K bytes or more)	-10,000	*
30417A	Upgrade for HP 3000 Series II to a Series III with 512K bytes of MOS memory; system may be expanded to 2 megabytes of MOS memory.	40,000	*

*The monthly maintenance charge should be recalculated on the basis of a new system.

Hewlett-Packard 3000 Series EQUIPMENT PRICES

SYSTEM UPGRADES (Continued)		Purchase Price	Monthly Maint.
499	Credit for 128K-byte system	-3,200	—
500	Credit for 192K-byte system	-4,800	—
501	Credit for 256K-byte system	-6,400	—
502	Credit for 320K-byte system	-8,000	—
503	Credit for 384K-byte system	-9,600	—
504	Credit for 448K-byte system	-11,200	—
505	Credit for 512K-byte system	-12,800	—
532	Delete selector channel replacement board (for systems without selector channels, i.e., HP 2888 disc-based)	-500	—
533	Upgrade second selector channel (for systems with two selector channels)	1,000	—
MEMORY			
30078A	Series 33 128K-byte fault control 16K RAM semiconductor memory array; order 128K-byte arrays so that the resulting system contains 512K, 768K, or 1024K bytes	4,000	15
30008A	64K-byte MOS memory module for Series II (Models 5 and 7 memory expandable to 256K bytes; Models 6, 8, and 9 memory expandable to 512K bytes)	4,000	21
30411A	Field-installed memory expansion subsystem for Models 8 and 9; (expands memory from 256K bytes to 320K bytes (required for customers who have upgraded from an HP 3000CX to a Series II and who wish to expand memory from 256K bytes to 320K bytes)	10,000	78
30411B	Memory Expansion Kit for Series II Model 6 (allows Model 6 to accommodate up to 512K bytes of memory; includes one 64K-byte board)	10,000	70
30418A	1536K-byte Memory Expansion Kit for Series III systems; expands memory from 1024K bytes to 1536K bytes; may be expanded to 2048K bytes by ordering two 30008B 256K-byte memory array boards; (requires a Series III system with 1024K bytes of memory purchased either as a new system option or as an upgrade with a 30417A Series II upgrade kit; if a Series III has been upgraded from a Series II Model 5 or 7, a 30408A-002 I/O Expansion Kit must be obtained prior to ordering the 30418A Series III Memory Expansion Kit to permit memory expansion to or beyond 1536K bytes)	17,500	94
001	30311A power supply, (required for Series III systems)	2,500	29
30008B	256K-byte memory array for use in Series III systems	8,000	38
MASS STORAGE			
7920S	Add-on 50-megabyte Disc Drive; includes 7920 Drive in cabinet, 13394A pack, and cables; for use as second through eighth add-on drive	13,000	54
7925S	Add-on 120-megabyte Disc Drive; includes 7925 Drive in cabinet, 13356A pack, and cables	17,000	62
Series 33			
7906S	Add-on 19.6-megabyte Disc Drive; includes 7906S Drive in low-profile cabinet, and cables; for use as second through eighth add-on drive	10,000	55
12904A	7906 Disc Cartridge	180	0
Series II and III			
30229A	7920S/7925S Controller; interfaces up to eight 7920S or 7925S Disc Drives; requires a 30030B Selector channel (30030A for a pre-Series II 3000)	4,500	31
250	Field-installed 30229A Controller upgrade for 7925 disc support; (required for all 30229A shipped prior to June 1978 (approximate); upgrades device controller board from 13037-60004 to 13037-60024)	500	0
13356A	7925 Disk Pack	850	0
MAGNETIC TAPE EQUIPMENT			
7970E	1600-bpi, 45-ips Magnetic Tape Drive, 9-track, phase-encoded (Option 310, 311, 314, 421, or 426 must be ordered for interface)	8,885	70
310	Option for the 2nd, 3rd, or 4th master drive on the 30215A Controller; HP 3000 cabinet and multi-unit cable included	3,260	0
311	Option for the 2nd, 3rd, or 4th slave drive on the 30215A Controller; must be used with a master unit; HP 3000 cabinet and multi-unit cable included	1,415	0
314	Option for the first drive on the 30215A Controller; one unit must be a master; HP 3000 cabinet and 3000 interface cable included (two masters on the same controller offer greater redundancy); the slave shares the master's electronics and will not function if the master is not operative	3,260	0
Series 33			
421	Specifies HP-IB Slave drive; includes lowboy cabinet and 20-ft. cable	-105	-3
426	Specifies HP-IB Master drive; includes lowboy cabinet and HP-IB Integrated Controller; cables are not included	3,115	23

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EQUIPMENT PRICES

MAGNETIC TAPE EQUIPMENT (Continued)		Purchase Price	Monthly Maint.
Series II and III			
30215A	Magnetic Tape Controller; interfaces up to four 7970B or 7970E magnetic tape drives with 300-level options	2,700	15
7970B	800-bpi, 45-ips Magnetic Tape Drive (option 310 or 314 must be ordered for interface)	6,870	64
310	Option for Add-on drives (2nd, 3rd, and 4th drives) on 30215A Controller; HP 3000 cabinet and 20-ft. multi-unit cable included	3,160	0
314	Option for First drive on a 30215A Magnetic Tape Controller; HP 3000 cabinet and 3000 interface cable included	3,160	0
PRINTERS			
2635A	Printing Terminal; 180 cps; automatic bidirectional printing; underline & display function modes; 8-channel fixed VFU; EIA RS-232C interface without modem control; for use with 103-type modems or some hard-wired applications	3,450	31
Series 33			
2631A	180-cps Dot Matrix Printer (option 333 must be ordered; pedestal stand not included)	3,150	31
333	Series 33 option with HP-IB interface	290	0
2608A	400-lpm Dot Matrix Printer; 128-character ASCII set (Option 333 must be ordered; includes enclosed stand with casters, and basket). Monthly maint. charge allows 3 levels of monthly usage:	9,250	
	Level 1 (1 to 69 print hours)		72
	Level 2 (70 to 129 print hours)		84
	Level 3 (130 to 360 print hours)		147
110	Sound cover	150	0
333	Series 33 option with HP-IB interface	565	0
Series II and III			
30209A	Line Printer Controller; interfaces one 2613A, 2617A, or 2618A Printer with option 300 to an HP 3000 Series II or III	1,275	7
2613A	Line Printer; 136 positions, 64 characters (standard or OCR-B), 300 lpm	10,825	133
2617A	Line Printer; 136 positions, 64 characters (standard or OCR-B), 600 lpm	5,700	147
001	96-character set (standard or OCR-B)	1,675	0
300	HP-3000 interface cable, documentation, and installation	450	0
2618A	Line Printer; 132 positions, 64 characters (standard or OCR-B), 1250 lpm	35,400	150
001	96-character set (standard or OCR-B)	1,900	0
PUNCHED CARD EQUIPMENT (Series II and III)			
30106A	Card Reader and Controller; 600 cpm, includes 2893A Card Reader, controller/interface, and device diagnostic software	7,700	57
30119A	Card Reader/Punch and Controller; reads 176-200 cpm, punches 45-75 cpm; includes card reader/punch, 30219A universal interface package, and device diagnostic software	17,500	137
PAPER TAPE EQUIPMENT (Series II and III)			
30104A	Paper Tape Reader and Controller, 500 cps; includes Tape Reader, rack-mounting kit/controller interface, and device diagnostic software	3,585	26
001	Series II, III cabinet	2,500	0
30105A	Paper Tape Punch and Controller; punches 75 cps; includes Tape Punch, controller/interface, and device diagnostic software	5,000	54
001	Series II, III cabinet (required if 17 vertical inches of space not available for paper tape unit)	2,500	0
TERMINALS			
2640B	Display Terminal, 1-8K-byte memory; 64-character set	2,600	18
2645A	Display Station; 4-12K-byte memory; 128-character set; 7 option slots	3,500	20
2641A	APL Display Station for Series II and III only; 64-character set plus 128 APL character set; 4-12K-byte memory; 5 option slots	4,100	20
2647A	Intelligent Graphics Terminal; 9K-byte memory (max.); 128-character set; 1 option slot	8,300	50
2648A	Graphics Terminal; 8-12K-byte memory; 128-character set; 4 option slots	5,500	22
Options for 2645A, 2641A, 2647A, and 2648A, except as noted; cables not included:			
001	128-character set with lower case and displayable control codes; for 2640B and 2641A only	100	0
007	Integrated dual cartridge tapes (std. on 2647A)	1,600	6
013	5 mini cartridges	90	0
030	Delete standard asynchronous communications interface for multipoint applications; order 13260 product to support multipoint communications	-160	0
031	Delete standard asynchronous communications interface to free one option slot (for 2647 only)	-75	0
13234A	Additional 4K-byte memory for 2640 Series terminals	300	0
13231A	Display Enhancements: blinking, half-bright, underline, and 64-character line drawing	250	0
201	Math Symbols Alternate Character Set	100	0
203	Large Character Alternate Character Set	150	0
13240A	Option Slot Extender; 5-slot	150	0
30126A	CalComp 565 or 702 Series Plotter Interface	1,350	14

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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
COMMUNICATIONS			
Series 33			
30018A	Asynchronous Data Communications Controller (ADCC)—Main; 4-port; includes 103-type modem support	1,600	7
30019A	Asynchronous Data Communications Controller (ADCC)—Extender; 4-port; includes 202S-type modem support	1,600	7
Series II			
30441A	Asynchronous Terminal Controller Field Upgrade Kit; converts std. 30032B to 30032B-001; two kits convert 30032B to 30032B-002	1,500	6
Series II and III			
30032B	Asynchronous Terminal Controller; 16-port	3,000	15
001	For 103-type modems only	1,240	6
002	For 103- and 202S-type modems	2,480	12
300055A	Synchronous Single Line Controller (SSLC); with modem cable or cable to run MTS/3000 in hard-wired asynchronous mode (Option 001)	2,000	18
30360A	Hardwired Serial Interface (HSI); 30220A cable required for each pair of interfaces	2,300	20
30037A	Asynchronous Repeater (AR); 230-V operation; includes adapter cable 30037-60003	700	5
13260C	Asynchronous Multi-point Communications Interface; for daisy-chained line sharing	435	0
001	Add monitor code capability	50	0
13260D	Synchronous Multi-point Communications Interface; for daisy-chained line sharing	450	0
001	Add monitor mode capability	50	0

SOFTWARE PRICES

		Plan #1		Plan # 2
		<u>Initial Fee</u>	<u>Monthly Fee (48 months)</u>	<u>One-Time Payment</u>
Fundamental Operating Software; includes FCOPY, EDIT, SOFT, SPL, Comp. Lib.		\$ —	\$125	\$3,750
32213C	COBOL	1,500	100	4,500
32104A	RPG	1,500	100	4,500
32111A	BASIC	1,500	50	3,000
32102B	FORTRAN	1,500	50	3,000
32105A	APL/3000	5,000	125	8,750
32208A	KSAM	1,500	25	2,250
32235B	DBMS (IMAGE and QUERY)	3,000	125	6,750
32209A	VIEW	1,500	75	3,750
32190A	DS/3000	3,000	125	6,750
32130E	RJE/3000	750	25	1,500
32192A	MRJE/3000	2,000	75	4,250
32193A	MTS/3000	1,000	50	2,500
32205B	Scientific Library	300	25	1,050
32900A	SIS (Series II & III)	3,000	200	9,000
32902A	CIS (Series II & III)	5,000	200	11,000
32308A	EDC/3000	5,000	150	9,500
32384A	IOS/3000	5,000	150	9,500
32388A	MRP/3000	5,000	150	9,500

HP Software Subscription Service is available for monthly fees ranging from \$10 to \$60 for the above programs.