

# Hewlett-Packard 3000 Series

## MANAGEMENT SUMMARY

Hewlett-Packard enhanced its already sophisticated 3000 Series considerably 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 allowed the reduction of nine Series III CPU boards to two printed circuit boards in the new processor. HP chose the Series 33 name 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 HP 3000 Series III, with four times the main memory capacity of the old Series II, utilizes 16K RAM chips, making possible a memory cost reduction of almost 50 percent.

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 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 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 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; two general-purpose I/O channels; two asynchronous data communications controllers; an operating system (MPE-III) with virtual

The top end of Hewlett-Packard's product line, the HP 3000 Series, has been realigned again with the introduction of the Series 30. The silicon-on-sapphire (SOS) Series 30 is priced less than the existing Series 33 and Series III and includes fewer communications and I/O facilities. The HP 3000 line now consists of the Series 30, the Series 33, and the Series III. Prices for basic processor units range from \$28,525 to \$60,545.

**MAIN MEMORY:** 256K bytes to 2 megabytes.

**DISK CAPACITY:** 20 to 960 megabytes.

**WORKSTATIONS:** Up to 31 on the 30 and 33, 63 on the III.

**PRINTERS:** 180 cps to 1,000 lpm.

**OTHER I/O:** Magnetic tape, punched card, paper tape, factory data collection terminals.

## CHARACTERISTICS

**MANUFACTURER:** Hewlett-Packard Company, Computer Systems Division, 19447 Pruneridge Avenue, Cupertino, California 95014. Telephone (408) 725-8111.

Hewlett-Packard is 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, HP also manufactures more exotic instruments such as gas chromatographs, digital



*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.*

## Hewlett-Packard 3000 Series

### CHARACTERISTICS OF THE HP 3000 SERIES SYSTEMS

	HP 3000 Series 30	HP 3000 Series 33	HP 3000 Series III
Memory type	MOS	MOS	MOS
Memory size, bytes	256K to 1 million	256K to 1 million	256K to 2 million
Memory checking	Fault control	Fault control	Fault control
Floating-point precision	64-bit	64-bit	64-bit
Firmware instructions	214	214	209
Total hardware registers	—	—	38
Program-accessible registers	—	—	20
I/O chassis slots standard	8	6	10
I/O chassis slots optional	0	7	13
Power fail restart	Automatic	Automatic	Automatic
Multiplexer channel speed	1M bytes/sec	1M bytes/sec	990K bytes/sec
Device controllers/multiplexer channel	8	8	16
Selector channel/data bus speed	1M bytes/sec	1M 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	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	2	4
Punch card units:			
Read	—	—	200 cpm
Punch/interpret	—	—	45 to 75 cpm
No. of async. terminal controllers	8	8	4
Maximum number of terminals	31	31	63
Optimum number of terminals	10-15	10-15	30-45

▷ memory capabilities, I/O spooling, hardware data stacks, and separation of data and program code (for user program sharing); and a 20-megabyte disk unit.

Smallest and most recent of the current HP 3000 computers, the Series 30 provides a central processor with 256K bytes of error-correcting semiconductor memory, a one-megabyte flexible disk, four asynchronous terminal ports, a system/maintenance console, a 20-megabyte disk system, and eight powered I/O expansion slots. Up to two communications lines can be added, with each line replacing four terminal ports. Like the HP 3000 Series 33, the Series 30 incorporates a self-test feature and remote system verification program (RSVP) to improve the speed with which on-site services may be performed and to provide the capability to control the system from an authorized remote console over a dial-up line. The Series 30 is a full-function HP 3000, capable ▷

▷ thermometers, network analyzers, and spectrum analyzers. Related products include both digital and analog graphic recorders, analytic instrumentation systems, and medical electronic instrumentation systems. Other Hewlett-Packard products are hand-held and desk-top calculators, both programmable and nonprogrammable.

The Computer Groups organization includes the Computer Systems Division, which is responsible for the HP 3000; the General Systems Division, responsible for the HP 250 small business computer; the Boise Division, which is responsible for printers and tape drives; the Data Terminals Division, which is responsible for display terminals, graphics terminals, and remote consoles for the HP 250 and consoles for the 3000 Series 30; the Data Systems Division, responsible for the HP 1000 line; the Desktop Computer Division, which is responsible for the HP 9800 family; the Vancouver Division, responsible for dot-matrix printers and printing terminals; the Disc Memory Division, responsible for disk drives; the Information Systems Division, which handles CIS/3000, DSG/3000, IMAGE/QUERY/3000, and SIS/3000; the Business Computer Group; the Computer Support Division; and the Grenoble (France) Division. ▶

## Hewlett-Packard 3000 Series

### PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
<b>MAGNETIC TAPE EQUIPMENT</b>	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 30 or 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
<b>PRINTERS</b>		
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	Hewlett-Packard
2631B	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, used as remote spooled printer with RS-232-C interface	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	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	Dataproducts 2260
2619A/2619A-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; 1000/750 lpm	Dataprinter
<b>PUNCHED CARD EQUIPMENT</b>		
30106A	Reader, 80-column; 1000-card input hopper and output stacker; reads by column; 600 cpm (not Series 30 or 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 30 or 33)	Decision Data 8000 Series
<b>PAPER TAPE EQUIPMENT</b>		
30104A	Reader, 8-level, 1-inch tape, rack-mounted or cabinet option; 500 cps (not Series 30 or 33)	Hewlett-Packard
30105A	Punch, 5 to 8-level, 11/16 to 1-inch tape, rack-mounted or cabinet option; 75 cps (not Series 30 or 33)	Facit-Addo 4070
<b>TERMINALS</b>		
2621A/2621P	Interactive Display Terminal; 48-line memory, character mode, underline, 128-character set, 9600 bps; 2621P includes 120-cps thermal printer Printing Terminal; 180 cps, automatic bidirectional printing, underline and display function modes, 16-channel computed VFU, EIA RS-232-C interface without modem control	Hewlett-Packard
2635B		Hewlett-Packard
	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-232-C interface compatible with Bell 103A or 202 type modems; full or half duplex asynchronous transmission at 110 to 2400 bps.	
2640B	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.	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 30 or 33)	Hewlett-Packard
2645A	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

## Hewlett-Packard 3000 Series

▷ of batch operation, program development, data entry, and data communications. Like all HP 3000 systems, the Series 30 uses the MPE-III operating system, so applications written on any system will run on any other without reprogramming, recompiling, or relinking. The Series 30 can execute programs written in COBOL, BASIC, FORTRAN, RPG, and SPL, HP's own high-level systems programming language. All of these languages may also be used for program development.

The Series III provides a central processor with a 256K-byte fault-control memory, expandable to two megabytes; a 50-megabyte moving-head disk unit; a 1600-bpi magnetic tape unit; a system console; and a 16-port asynchronous terminal controller. HP says that a full-blown Series III can serve as the hub of a distributed systems network.

Chief competitors for 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 multi-programming, multilingual machines that use a moving-head disk 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.

On all models, users have the option of selecting other peripherals, including paper tape units, punched card units, and printers ranging in speed from 180 cps to 1,000 lpm. Also available is an asynchronous interface to handle remote job entry.

The Series 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. Software for the Series 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). All language processors are optional and separately priced.

The full complement of language processors available includes SPL, FORTRAN, COBOL, RPG, BASIC, and APL (Series III only). Other software includes HP's data base management system (IMAGE/3000 plus QUERY/3000), a terminal- and batch-oriented system with direct interfaces to COBOL, RPG, FORTRAN, and SPL and ▷

▶ Hewlett-Packard products are sold by 135 sales offices and serviced by 160 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, with about 14,100 involved worldwide in computational products.

MODELS: HP 3000 Series 30; HP 3000 Series 33; HP 3000 Series III.

DATE ANNOUNCED: HP 3000 Series 30, October 1979; HP 3000 Series 33, October 1978; HP 3000 Series III, June 1977.

DATE OF FIRST DELIVERY: HP 3000 Series 30, October 1979; HP 3000 Series 33, January 1979; HP 3000 Series III, July 1978.

NUMBER INSTALLED TO DATE: All HP 3000 models, 75,000 as of August 1980.

### 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 64-bit (4-word) operands with signed 9-bit exponent and 55-bit positive fraction in the Series III. 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 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.

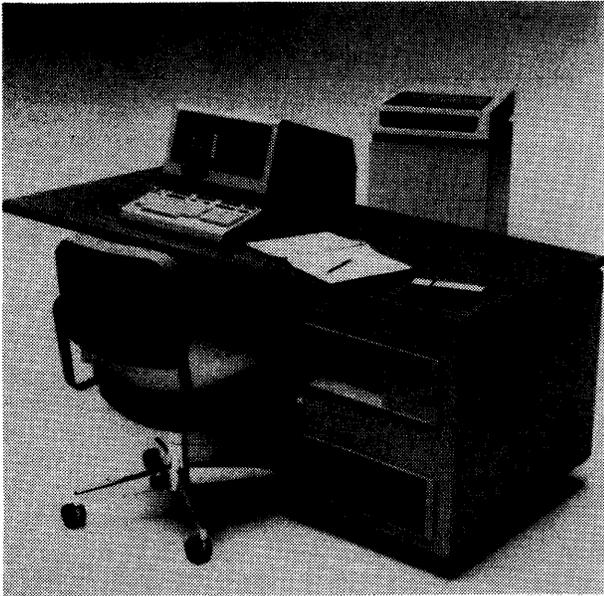
Machine instructions for the Series 30 and 33 are the same as those for the Series III except for the I/O instructions.

**INTERNAL CODE:** ASCII.

### MAIN STORAGE

**STORAGE TYPE:** MOS utilizing 16K-bit RAM's. ▶

## Hewlett-Packard 3000 Series



*This picture of HP's 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 disk unit. The 50-megabyte system disk stands behind the desk. All Series 33 software is compatible with the larger HP 3000 Series III systems running under MPE-III.*

▶ 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.

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.)

The Fundamental Operating Software is standard on all HP 3000 models and includes the operating system, EDIT/3000, FCOPY/3000, SORT-MERGE/3000, IMAGE/3000, QUERY/3000, KSAM/3000, and HP V/3000.

Hewlett-Packard stresses flexible concurrent, multi-lingual environments where terminal-oriented transaction processing applications are likely to be combined with background batch business processing. The Series 30 and 33 can be configured to handle up to 31 terminals, and the 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 all HP 3000 ▶

▶ **CYCLE TIME:** For the Series 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 30 and 33 have 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 30 and 33 capacity ranges from 256K to 1 million bytes. The Series III capacity ranges from 256K to 2 million bytes. Increment size on the Series III is 262,144 bytes. The Series 30 and 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 22 bits by appending five 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 disk file for later access by the HP customer engineer.

**STORAGE PROTECTION:** Upper and lower address boundaries, provided by certain registers, define the limits of authorized program access in main memory. The micro-program 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 eleven 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 III, 38 specific-purpose registers, 20 of which are user-accessible. The Series 30 and 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 III battery backup for the MOS memory is 45 to 90 minutes, depending on memory size. The Series 30 and 33 range is 30 minutes to 4 hours.

The Series 30 and 33 processor is based on Hewlett-Packard's complementary metal-oxide-semiconductor/silicon-on-sapphire (CMOS/SOS) process, developed as an ▶

## Hewlett-Packard 3000 Series

► systems. All models can also be configured with HP's Distributed System/3000 software, enabling multiple HP 1000, HP 2026, and/or HP 3000 computers to be interconnected in a distributed processing network. RJE is supported on all 3000 systems, and IML is available on the III.

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 1979. Customer Support Service (CSS) is HP's standard software support product and provides the highest level of ongoing support available from Hewlett-Packard. It includes the delivery of and the right to use software updates and applicable firmware updates, reference manual updates, an HP systems engineer assigned to the customer's account, phone-in consulting service, on-site systems engineering assistance, software status bulletin, software problem reporting, and the quarterly HP 3000 Communicator. Software Subscription Service (SSS) includes all of the above except assignment of an HP systems engineer, phone-in consulting service, and on-site systems engineering assistance. CSS and SSS are normally purchased for twelve-month periods, billable quarterly or yearly in advance as desired. The minimum purchase for each is three months.

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 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

Eighty-nine users with a total of 112 installed HP 3000 systems responded to Datapro's 1980 survey of mini-computer and small business computer users. Main memory capacity listed was from 256K bytes to two ►

► LSI circuit technology. 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 30 and 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 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 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 III) 32-bit words. At present, HP utilizes 4K (Series III) or 7K (Series 30 and 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 III. For the Series 30 and 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 III, 20 of which are accessible to the programmer, and 27 on the Series 30 and 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 30 and 33, 4 in the Series III); the stack pointer group (7 in the Series 30 and 33, 8 in the Series III); 4 registers in the top-of-stack group; and registers named Index, Status, and the Series 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 III only). ►

## Hewlett-Packard 3000 Series

➤ megabytes. Virtually all of the systems had at least one magnetic tape drive with five drives on a Series III being the maximum. The average number of workstations was seventeen per system.

The systems had been in use for periods ranging from three months to sixty-four months, and the average was slightly under seventeen months. Sixty-three of the users had purchased their systems; twenty-two were leasing; and the balance were renting.

All of the users reported MPE as their operating system, and COBOL, FORTRAN, RPG, BASIC, SPL, and APL (listed in descending order) were the programming languages in use. All of the fifty-five users who were employing data base management listed IMAGE as their software. Accounting, reported by fifty-nine users, was overwhelmingly the leading application, followed, at a respectful distance, by payroll and personnel, manufacturing, transaction processing, word processing, distributed processing, service bureau work, engineering and science, education, banking and finance, government, insurance, retail, medical and health, construction, and transportation. Software development and time-sharing were also listed as applications. Seventy-eight users reported that in-house personnel had written applications programs; forty-one had used proprietary software packages; twenty-four had turned to contract programming houses; and twenty were using "ready-made" programs from the vendor.

Thirty-eight users reported plans to obtain additional proprietary software from other suppliers, while twenty-four expected to secure additional software from HP. Thirty were going to increase their data communications facilities; twenty reported plans to increase distributed processing capabilities; and fifteen were planning to add to their word processing capabilities. Eighty-four had no plans to replace their equipment within the year, but two expected to do so with equipment from a different manufacturer.

The following table summarizes the ratings given by these HP 3000 users:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	63	22	0	1	3.7
Reliability of mainframe	62	22	2	0	3.7
Reliability of peripherals	38	43	4	1	3.4
Maintenance service:					
Responsiveness	29	44	12	1	3.2
Effectiveness	32	39	14	1	3.2
Technical support:					
Trouble-shooting	24	43	17	2	3.0
Education	26	42	14	2	3.1
Documentation	25	44	13	3	3.1
Manufacturer's software:					
Operating system	60	24	0	1	3.7
Compilers and assemblers	38	38	7	1	3.3
Applications programs	11	34	8	1	3.0
Ease of programming	42	36	5	1	3.4
Ease of conversion	30	41	4	2	3.3
Overall satisfaction	49	34	1	1	3.5

\*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 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 30 and 33 and 209 in the Series III, consisting of 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 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 30 and 33 processor to date.

	Series 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

## Hewlett-Packard 3000 Series

▷ Seventy users praised the ease with which the equipment could be expanded or reconfigured, and the data base users were unanimous in saying that the data base language is efficient and effective. The systems' response time pleased fifty of the users, and the other advantages which were reported included programming costs being kept down by productivity aids, the compatibility of programs and data carried over from other systems, the systems' power efficiency, early delivery or installation of equipment, the compatibility of terminals and peripherals carried over from other systems, early delivery of software, and lower costs than had been expected.

The leading problem which had been encountered, a proposed system that turned out to be too small, was reported by twelve users. Seven said that their equipment had been delivered or installed late; six felt that the final costs exceeded their expectations; and six claimed that their systems required excessive power. Other problems, reported by from one to four users, were late delivery of software, failure by the vendor to supply promised software or support, incompatibility of software or peripherals carried over from other systems, and difficulty in keeping up with enhancements or changes to software or hardware.

Additional comments which users wrote on their surveys were "HP is a first-class vendor to work with," "The HP 3000 is an excellent machine . . . just hasn't got any weak spots," "For the money, the HP 3000 is an excellent computer," and "HP is superb!"

Eighty-five of the users would recommend their HP 3000 systems to other users; two would not; and two other users did not answer that question on the survey form. □

▶ **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 30 and 33 flexible disk drive and system cabinet are housed in a desk. The Series III processors use cabinets 64.5 inches high, 21 inches wide, and 33 inches deep. The Series III requires two system cabinets.

The HP 3000 Series models can operate at a temperature range between 55 and 95 degrees F., with a relative humidity tolerance of 30 percent (40 for the Series III) to 80 percent, noncondensing. The Series 30 with a 7906M disk drive, a system cabinet, and a 2649E system/maintenance console outputs 4,650 BTU's of heat per hour. A Series 33 with the same disk drive and system/maintenance console outputs 7,310 BTU's per hour. A Series III with a 7920M disk drive, a system bay, a 2621A CRT console, and a 7970E magnetic tape drive outputs 15,100 BTU's per hour. The same three systems weigh 570 pounds, 1,030 pounds, and 1,210 pounds, respectively.

Power requirements for the Series 30 are 100 or 120 (220 or 240) VAC, +4%, -10% single-phase, 50 or 60 Hz, ±0.5 Hz; for the Series 33 and III, 200/210/220/230/240 VAC, +4%, -10% single-phase, 50 or 60 Hz, ±0.5 Hz.

### INPUT/OUTPUT CONTROL

The most significant differences between the various HP 3000 Series models are in the area of I/O control. The Series 30 and 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 III utilizes an I/O processor, selector channels, and multiplexer channels.

The Series 30 and 33 I/O control hardware consists of general I/O channels, an 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 202S 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 eight data lines and eight 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 30 and 33 IB is approximately one megabyte per second, with an aggregate transfer rate through the IMB of about four megabytes per second.

**I/O PROCESSOR:** The Series 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 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 III. The IOP bus has a maximum transmission rate of 952K bytes per second on the Series 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 III.

The Series III multiplexer channel can support up to sixteen device controllers with an aggregate data rate of 1.038 (input) and 0.952 (output) megabytes per second. Data ▶

## Hewlett-Packard 3000 Series

► 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 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 HP 3000 systems is restricted 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 30 and 33 come 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 disk controller with up to eight 120-megabyte disk drives (one 20-megabyte drive is standard), a floppy disk unit, and one or two line printers. Supplied as standard on the IMB is one asynchronous data communications controller. The ADCC controls the system console and up to three 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 following peripherals are supported by the Series 30 and 33: up to four 1600-bpi magnetic tape drives, one or two line printers and controllers, and asynchronous data communications controllers.

Series 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 seven Intelligent Network Processors, 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 operating system on the Series 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 30 and 33, MPE supports HP's, 262x, 263x, and 264x series terminals and the 2675A.

**WORKSTATIONS:** The optimum number of terminals for concurrent use on the Series 30 and 33 is from ten to fifteen; the maximum is thirty-one. On a Series III, the optimum number is from thirty to forty-five, and the maximum is sixty-three.

**MASS STORAGE:** The 13037C controller can interface a maximum of eight disk drives in any combination, allowing for expansion to 960 megabytes of disk storage.

**MAGNETIC TAPE UNITS:** The Series 30 and 33 can support only 1600-bpi drives, a maximum of four. The Series III can support 800- or 1600-bpi drives. An additional controller increases the Series III's capacity to eight drives.

**PRINTERS:** The Series 30 and 33 can be configured with up to two printers and controllers; the Series III will support a maximum of four.

### MASS STORAGE

**7920M DISK PACK DRIVE:** The 7920M is a 50-megabyte drive employing a five-platter disk 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.

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 7920M drive is manufactured by Hewlett-Packard.

**7925M DISK PACK DRIVE:** The 7925M has essentially the same design as the 7920M 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.

**7906M DISK CARTRIDGE DRIVE:** The 7906M is a 19.6-megabyte drive with 9.8 megabytes of fixed disk 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 disk 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.

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 disks 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 disk controller computes a three-word mask that is Exclusive ORed with the incorrect data to form the correct version.

### INPUT/OUTPUT UNITS

Refer to the Peripherals/Terminals table. ►

## Hewlett-Packard 3000 Series

- ▶ 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.

### COMMUNICATIONS CONTROL

**30018A ASYNCHRONOUS DATA COMMUNICATIONS CONTROLLER (ADCC):** The 30018A interfaces terminals to the Series 30 and 33 via the inter-module bus. Up to 31 terminals plus the system console can be connected through type 103 (full-duplex) or 202S (half-duplex) modems. ADCC boards contain four ports for connection to devices through RS-232-C data communications lines. Data transmission rates of up to 9600 bps are supported, with parity generation and checking and automatic answering and brake detection. Over modems, the maximum data transmission rate is 1200 bps.

**30032B ASYNCHRONOUS TERMINAL CONTROLLER (ATC):** the 30032B is designed to interface user terminals to the HP 3000 Series III via the IOP bus. Up to 64 terminals (including the system console) can be interfaced on the Series III. Terminals can be hard-wired or connected through type 103A3, 113B, 202C, 202S, and 202T modems. Series 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 V/3000 when block mode is employed. Users who wish to access terminals in block mode directly (i.e., without using V/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-232-C, 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. On the Series III, SSLC supports 2780/3780 emulation, RJE/3000, MRJE/3000, MTS/3000, and DS/3000.

**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.

**30010A/30020A INTELLIGENT NETWORK PROCESSOR:** Allows HP 3000 computers to be linked to other computers in an HP Distributed System Network, performs character handling, and provides buffer storage. The INP uses an HP silicon-on-sapphire (SOS) microprocessor and can be used with DS/3000, RJE/3000, and IML/3000 communications subsystems. IBM Binary Synchronous Communications (bisync or BSC) protocol is used. Data rates up to 19,200 bps using modems or up to 56,000 bps hardwired or with CCITT V.35 standard interface are supported. The INP requires a single Series 30 or 33 I/O slot (30020A) or two I/O slots for Series III (30010A) and is compatible with the following modems: HP 32210T and 37220T, Bell 201C, 208A, 208B, and 209A. On a Series III, the combined total of INP's and SSLC's cannot exceed seven.

### 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, disk space manager, utility intrinsic, initiator, configurator, system console manager, power fail/auto restart, private volumes facility, serial disk 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 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 a 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. ▶

## Hewlett-Packard 3000 Series

► 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 disk 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/reentrant code, spooling from both terminal and batch devices, and remote processing via terminals.

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

**LANGUAGES:** All of the HP 3000 computers are multilingual systems that support five programming languages plus a data base management system. In addition, Series III supports APL. All implemented languages have the ability 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 disk 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 fifteen characters instead of the usual six. 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 three. 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 eleven 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 twenty-one 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 III with 256K bytes of memory, or, for multilingual operation, 384K bytes of memory. Operation with fourteen or more terminals requires 512K bytes of memory. The maximum recommended number of simultaneous users is sixteen.

*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. ►

## Hewlett-Packard 3000 Series

► 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.

COBOL II/3000 is the primary commercial language for the HP 3000's. COBOL II/3000 conforms to the Level-2 implementation (except the RERUN option for I/O) of nine of the twelve modules defined by the ANSI COBOL X3.23-1974 specifications. The nine modules, all implemented at the highest level, are Nucleus, Table Handling, Sequential I/O, Relative I/O, Indexed I/O, SORT-MERGE, Segmentation, Library, and Inter-program Communication.

Language extensions implemented by HP include micro-coded instructions, pre-processor function (provides statements which allow the programmer to equate a particular section of code or a file to an identifier), program debugging aids, access to subprograms (written in COBOL, COBOL II, FORTRAN, and SPL), access to all MPE System Intrinsic, ACCEPT FREE option (allows a free format for low-volume data entry), file locking capability, special registers, packed decimal, and multiple entry points to subprograms. COBOL II provides access to both sequential MPE and indexed sequential (KSAM) files through the use of ANSI Standard COBOL Input and Output operations as well as access to V/3000, HP's data entry product, and to IMAGE/3000, HP's data base management package, through the use of procedure libraries.

COBOL II/3000 requires an HP 3000 system with 256K bytes of memory and the current version of the MPE-III operating system. KSAM/3000 is included for all systems shipped as of August 1, 1979.

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 fifteen 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 (Multi-leaving RJE), MTS/3000 (Multipoint Terminal Software), IML/3000 (Interactive Mainframe Link for 3270 cluster controller emulation), 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 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, JES 2, JES 3, or ASP 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 multi-dropped terminals. In both interactive and page modes, data can be entered, edited, and transmitted at up to 9600 bps.

*IML/3000 Interactive Mainframe Link/3000 (3270 Emulator Software)* allows interactive communication between HP 3000 systems and IBM 360, 370, 303X, or 4300 host mainframe computers or plug-compatible host mainframes using IBM operating software. With IML/3000 software, the HP 3000 appears to the host mainframe as a remote IBM 3271, 3274, or 3276 bisync (BSC) cluster control unit. IML/3000 allows user-written application programs in high-level languages on the HP 3000 to communicate interactively with teleprocessing applications such as CICS and IMS DB/DC applications using standard access methods on the host mainframe. IML/3000 requires an Intelligent Network Processor hardware interface for the HP 3000.

*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 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

## Hewlett-Packard 3000 Series

► 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, thus allowing these systems to become a part of an intercomputer communications network. For example, an HP 1000 system supports up to sixteen 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. The Hewlett-Packard 37220T, a synchronous modem, transmits data over four-wire point-to-point leased telephone circuits at 9600 bps and features RS-232-C and CCITT V.24/V.20 data interface. The 37210T, also a synchronous modem, transmits at 4800 bps and is designed for point-to-point and multidrop operation. The 37230A Short Haul Modem provides synchronous transmission of data at rates of 2.4K, 4.8K, 9.6K, and 19.2K bps over short distances (from four to twenty-two miles) and is designed for half-duplex, full-duplex, and multidrop operation over local circuits.

**DATA BASE MANAGEMENT SYSTEM: 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 sixteen different pointer pairs can be maintained for each data item; this permits each data item to be a member of sixteen 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 disk drive. There may be up to sixteen 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 sixteen keys per detail data set and sixteen detail data sets per master data set is permitted. Each chain may have up to 65,535 entries. There may be six characters per data base name, eight characters per password, and 8,388,607 entries per data base.

Additional enhancements to IMAGE for the HP 3000 Series include thirty-two 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 disk. 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.

**HP V/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 accommodating existing programs. V/3000 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.

**Materials Management/3000** is a user-customizable, interactive system for managing the materials planning and control function of a manufacturing operation. It consists of ten application software modules: master production scheduling, rough cut resource planning, parts and bills of material, routings and workcenters, material issues and receipts, inventory balance management, work order control, purchase order tracking, material requirements planning, and standard product costing.

**SIS/3000**, the Student Information System, consists of an integrated data school district data base and maintenance

## Hewlett-Packard 3000 Series

► 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-MERGE/3000 can sort and merge. FCOPY/3000 performs all file copying tasks; it operates only through the MPE file system.

Hewlett-Packard has also just released HP Decisions Support Graphics/3000, an interactive graphics software package which enables nontechnical computer users to create and save fully-annotated line graphs, horizontal and vertical bar charts, pie charts, and scattergrams. The package will run on any 3000 Series model and includes a set of high-level procedure calls that can be used by any of the computer's familiar business languages, COBOL, BASIC, FORTRAN, and HP's SPL. Access is by menu-driven, fill-in-the-blanks prompts on the CRT screen. Charts created with HP DSG/3000 can be displayed on either the 2647A or the 2648A graphics terminal, and output can be to HP digital plotters, plotter/printers, or graphics printers. An interactive option provides for multi-color graphs.

Text and Document Processor/3000, TDP/3000, is a text editing and document formatting system. Its features include text editing, document formatting, mathematical expression handling, table creation, built-in calculator, command files, form letters, automatic hyphenation, security, and MPE command execution. The only other software required is the MPE-III operating system. Certain MPE commands can be executed without exiting TDP/3000.

### PRICING

**POLICY:** The HP 3000 Series systems are available on a purchase or lease basis. Individual models are offered as a system processor unit, SPU (processor and selected software), with extensive separately priced peripheral and software options. Standard on each HP 3000 system is the Fundamental Operating Software which includes MPE-III operating system, EDIT/3000 text editor, FCOPY/3000 file copying utility, SORT-MERGE/3000, IMAGE/3000 data base management system, QUERY/3000 data base inquiry language, KSAM/3000 keyed sequential access method, HP V/3000 forms management software, and the facility to execute compiled programs without the source language compiler on the system (except programs written in APL/3000).

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:

<u>Term, months</u>	<u>Percent of List Price per Month</u>
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. Users may specify this feature as option 015.

Maintenance is separately priced and offered through fifty-three U.S. offices, nine Canadian offices, and 121 international offices. The Basic Maintenance Plan provides on-site maintenance services for HP Computer Systems products (selected by the customer) from 8 a.m. to 5 p.m. during the normal work week excluding HP holidays. Each HP product selected for coverage has a fixed Basic Monthly Maintenance Charge (BMMC) that includes travel, labor, and parts, regardless of the type or frequency of services rendered for the product. A customer can add more HP products to a Basic Plan at any time; the corresponding charges are merely added to the customer's Monthly Maintenance Agreement Service charge. The Basic Maintenance Plan provides a response time of within four hours to sites located within zones 1, 2, and 3 of a Primary Service Responsible Office. Standard coverages allow extension of the Basic Maintenance Plan to include Saturday coverage and/or to extend the hours per day to 9 p.m. Extended coverage can provide service up to seven days per week and 24 hours per day. Available hourly extensions include 8 a.m. to midnight and 8 a.m. to 8 a.m. Days per week can be selected as five, six, or seven days. Seven-day-per-week coverage includes HP holidays.

The present software support policy for the HP 3000, which became effective in August 1979, contains the following qualifications:

- An HP-trained System Manager responsible for maintaining the integrity of the system's hardware and software or a trained designated alternate must be identified as a contact for HP.
- The same level of service must be purchased for all of the HP software products which make up one computer system. Due to the interaction among software elements, service cannot be given to specific software products while omitting others.
- Additional phone-in service can be purchased as many times as desired. The name of a single authorized caller must be provided for each additional caller service purchased. Additional phone-in service cannot be purchased unless Customer Support Service (CSS) has been purchased.
- Central system CSS support of additional systems can be purchased only by customers with multiple installations. It cannot be purchased unless one of the installations has purchased Customer Support Service.
- A minimum of three months of support must be purchased.
- If twelve months of software support is ordered concurrently with the HP 3000 software, HP will provide an additional 90-day period of the services ordered at no charge.

All HP 3000 software products are discountable under Hewlett-Packard Computer Products Purchase Agreements. Software support services are not discountable. ►

## Hewlett-Packard 3000 Series

► Services that accompany software purchased under the support policy include phone-in consulting with an HP systems engineer (with an advertised four-hour response time) within a 100-mile radius of the HP sales office, software updates every three 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.

Hewlett-Packard 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 to resolve software and documentation problems which cannot be solved using the phone-in service. If the problem reported is not associated with an HP software design error or system malfunction, the on-site services are considered outside the scope of HP's software and support agreement and subject to a time and materials charge. HP is not obligated to provide any on-site services for HP software products which the customer has modified. When on-site, the SE will help the customer to identify, verify, isolate, and work around problems caused by HP software. Assistance is available weekdays, excluding HP holidays, during HP working hours, at distances not more than 100 miles from the nearest HP office designated to provide on-site SE services. Support for facilities farther away can be provided at additional cost.

For system discount purposes, each 33 and III system counts as four Functional Units, and each 30 counts as three. 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

Training courses are available at an HP Technical Center at a per student charge or on-site classes at a per class charge (for up to ten students). Additional students are accommodated at \$100.00 per student. Typical classes, length, and charges are: Programmer's Introduction, five days, \$6,500 on-site, \$625/student at Tech. Center; System Management and Operation, five days, \$6,500, \$750; MPE-III Special Capabilities, five days only at Tech. Center, \$875; HP V/3000, four days, \$5,200, \$500; IMAGE/3000, five days, \$6,500, \$625; SPL File System Introduction, five days only at Tech. Center, \$875; IML/3000 Training/Consulting Package, four days on-site, \$3,800.

HP makes available, in advance of 3000 Series system shipments, a complete set of user manuals as part of the system.

The HP 3000 Users Group provides information interchange. The fee for membership is \$200 per year.

**EQUIPMENT:** The HP 3000 computers are offered as system processor units onto which the user configures the peripherals required by his application. Prices for the three system processor units and peripherals will be found in the following Equipment Prices.■

## EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
<b>SYSTEM PROCESSOR UNITS</b>			
32430B	HP 3000 Series 30 System Processor Unit: 100 or 120V, 60 Hz, single-phase; 256K-byte fault control memory; 1.2-megabyte flexible disk; 4-port Asynchronous Data Communications Controller with type 103, 212, 202, modem support; one General I/O Channel; remote diagnostic capability; system cabinet. Fundamental Operating Software (MPE-III operating system, EDIT/3000, FCOPY/3000, SORT-MERGE/3000, IMAGE/3000, QUERY/3000, HP V/3000, KSAM/3000; and facility to execute compiled programs without the source language compiler on the system, except programs written in APL/3000). Complete user manual set.	\$28,525	\$283
32431B	Same; 220 or 240V, 50 Hz, single-phase	28,525	283
201	Add console table	425	0
212	Delete flexible disk drive and controller	-2,000	-38
32412B	HP 3000 Series 33 System Processor Unit: 220-240V, 60 Hz, single-phase; 256K-byte fault control memory; 1.2-megabyte flexible disk; 8 ports via two Asynchronous Data Communications Controllers with type 103, 212, 202, modem support; two General I/O Channels; remote diagnostic capability; system desk mainframe; isolation transformer included in desk mainframe. Fundamental Operating Software. Complete user manual set.	37,275	316
32413B	Same; 200-240V, 50 Hz, single-phase	37,275	316
212	Delete flexible disk drive and controller	-2,000	-38
32435B	HP 3000 Series III System Processor Unit: 200-240V, 60 Hz, single-phase; 256K-byte fault control memory; 16-port Asynchronous Terminal Controller with type 103, 202T, and 212, modem support; capacity for 48 asynchronous terminal ports; 30215A magnetic tape controller included in system cabinet; one system cabinet and console table; isolation transformer included in system cabinet. Fundamental Operating Software. Complete user manual set. Software on 1600-bpi magnetic tape.	60,545	409

**Hewlett-Packard 3000 Series**

**EQUIPMENT PRICES**

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>SYSTEM PROCESSOR UNITS (Continued)</b>			
008	Software on 800-bpi magnetic tape	0	N/A
015	230V/50 Hz, single-phase operation	0	0
110	Add 202S type modem control to Asynchronous Terminal Controller	1,240	3
200	Additional I/O cabinet; adds 20 I/O slots and capacity for an additional 16 asynchronous terminal ports	8,000	41
505	Memory expansion to 512K bytes	3,750	22
506	Memory expansion to 768K bytes	7,500	44
507	Memory expansion to 1,024K bytes	11,250	66
509	Memory expansion to 1,536K bytes	20,250	110
511	Memory expansion to 2,048K bytes	27,750	154
<b>INPUT/OUTPUT EXPANSION FEATURES</b>			
30416A	Series 33 expansion kit for 7 additional I/O slots; includes a second card cage, cooling unit, and power supply	7,500	21
30079A	General I/O channel for magnetic tape drive support for Series 33	1,800	12
030	Replace Series 33 cable with Series 30 cable	0	0
30235A	I/O expansion kit for Series III; adds one cabinet with 20 I/O slots and capacity for an additional 16 asynchronous terminal ports	8,000	41
<b>SYSTEM UPGRADES</b>			
30408A	Upgrade for Series III to system similar to Series II Model 8; upgrade consists of memory expansion kit to accommodate up to 512K bytes, 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	25,000	78
002	Delete memory expansion kit and 64K-byte memory board (adds I/O expansion only; required for systems with 320K bytes or more)	-10,000	-62
30417A	Upgrade for Series II to Series III with 512K bytes of MOS memory; system may be expanded to 2 megabytes of MOS memory	34,000	260
499	Credit for 128K-byte system	-3,200	-278
500	Credit for 192K-byte system	-4,800	-297
501	Credit for 256K-byte system	-6,400	-316
502	Credit for 320K-byte system	-8,000	-367
503	Credit for 384K-byte system	-9,600	-386
504	Credit for 448K-byte system	-11,200	-405
505	Credit for 512K-byte system	-12,800	-424
532	Delete selector channel replacement board	-500	-25
<b>MEMORY</b>			
30078A	Series 30 and 33 128K-byte fault control; 16K RAM semiconductor memory array; order 128K-byte arrays so that the resulting system contains 512K, 768K, or 1,024K bytes	2,500	9
30418A	1,536K-byte memory expansion kit for Series III systems with 1,024K bytes	9,000	51
001	30311A power supply (required for Series III systems)	2,500	20
30008B	256K-byte memory array for Series III	3,750	22
<b>MASS STORAGE</b>			
7906M	Master 20-megabyte cartridge disk drive, cartridge, controller, and low-profile cabinet	15,000	112
015	230V/50 Hz, single-phase operation	0	0
102	HP-IB interface and 2-meter cable	1,000	6
7906S	Add-on 20-megabyte disk drive; include drive in low-profile cabinet and cables; for use as second through eighth add-on drive	11,000	78
015	230V/50 Hz, single-phase operation	0	0
7920M	Master 50-megabyte disk drive, pack, controller, and low-profile cabinet	18,000	109
015	230V/50 Hz, single-phase operation	0	0
102	HP-IB interface and 2-meter cable	1,000	4
7920S	Add-on 50-megabyte disk drive; includes drive, cabinet, 13394A disk pack, and cables; for use as second through eighth add-on drive	14,000	75
015	230V/50 Hz, single-phase operation	0	0

## Hewlett-Packard 3000 Series

## EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>MASS STORAGE (Continued)</b>			
7925M	Master 120-megabyte disk drive, pack, controller, and low-profile cabinet	21,000	99
	015 230V/50 Hz, single-phase operation	0	0
	102 HP-IB interface and 2-meter cable	1,000	4
7925S	Add-on 120-megabyte disk drive; includes drive, cabinet, 13356A disk pack, and cables; for use as second through eighth add-on drive	17,000	65
	015 230V/50 Hz, single-phase operation	0	0
	250 30229A controller upgrade; upgrades device controller board from 13037-60004 to 13037-60024	500	0
7925T	Add-on 240-megabyte disk storage system	29,950	130
12940A	7906 disk cartridge	180	N/A
13394A	7920 disk pack	525	N/A
13356A	7925 disk pack	850	N/A
<b>MAGNETIC TAPE EQUIPMENT</b>			
7970B	800-bpi, 45-ips magnetic tape drive (option 320 or 324 must be ordered for interface to Series III)	7,350	74
	320 Option for add-on drives	2,500	3
	324 Option for first drive on a 30215A controller	2,500	3
7970E	1600-bpi, 45-ips magnetic tape drive, 9-track, phase-encoded (option 320, 321, 324, 421, or 426 must be ordered for interface)	9,500	84
	320 Option for 2nd, 3rd, and 4th master drive	2,410	3
	321 Option for 1st, 2nd, and 3rd slave drive	565	-6
	324 Option for first drive on a 30215A controller	2,410	3
	421 Specifies HP-IB slave drive	565	3
	426 Specifies HP-IB master drive	3,700	28
30215A	Magnetic tape controller; interfaces fifth through eighth; 7970B or 7970E tape drives with 300-level options to Series III	2,700	14
<b>PRINTERS</b>			
2635B	Printing terminal; 180 cps, automatic bidirectional printing, underline and display function modes, 16-channel computed VFU, EIA RS-232-C interface without modem control; for use with 103-type modems or some hard-wired applications	3,950	32
	015 230V/50 Hz, single-phase operation	0	0
	715 Add service documentation	25	N/A
26090A	Sound abatement cover for 2635B	100	0
26097A	Stand for 2635B with casters	275	0
	002 Paper catcher	50	0
2675A	Printing terminal with cartridge tape unit	5,000	27
	001 Finnish/Swedish keyboard	100	0
	002 Danish/Norwegian keyboard	100	0
	003 French keyboard	100	0
	004 German keyboard	100	0
	005 United Kingdom keyboard	100	0
	006 Spanish keyboard	100	0
	015 230V/50 Hz operation	0	0
	026 300-bps modem	450	0
	070 Delete cartridge tapes	-1,600	-7
	301 U.S. modem cable	75	0
	302 European modem cable	75	0
	302 RS-232-C cable	50	0
13269A	2675A carrying case	95	0
2631B	180-cps dot matrix printer (option 333 must be ordered)	3,600	30
	015 230V/50 Hz, single-phase operation	0	0
	333 HP-IB interface and 2-meter cable	350	0

Hewlett-Packard 3000 Series

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>PRINTERS (Continued)</b>			
2608A	400-lpm dot matrix printer, 128-character ASCII set (option 333 must be ordered for Series 30 or 33; option 300 for Series III); with 1 to 69 print hours/month	9,900	125
	U02 With 70 to 130 print hours/month	0	+24
	U03 With 131 to 360 print hours/month	0	+96
	001 Language option	150	0
	002 Substitution option	150	0
	015 230V/50 Hz, single-phase operation	0	0
	110 Sound cover	200	0
	300 Series II and III interface	950	0
	333 HP-IB interface and 2-meter cable	850	0
2613A	Line printer; 136 positions, 64 characters, 300-lpm; with 1 to 35 print hours/month	12,750	200
	U02 With 36 to 70 print hours/month	0	+54
	U03 With 71 to 105 print hours/month	0	+159
	001 96-character set; 240 lpm	1,850	0
	002 64-character set with OCR-B font	0	0
	003 96-character set with OCR-B font	1,850	0
	015 230V/50 Hz, single-phase operation	0	0
	300 Series II and III interface	950	0
2617A	Line printer; 136 positions, 64 characters, 600-lpm; with 1 to 50 print hours/month	17,250	219
	U02 With 51 to 100 print hours/month	0	+54
	U03 With 101 to 150 print hours/month	0	+159
	001 96-character set; 436 lpm	1,850	0
	002 64-character set with OCR-B font	0	0
	003 96-character set with OCR-B font	1,850	0
	015 230V/50 Hz, single-phase operation	0	0
	300 Series II and III interface	950	0
2619A	Line printer; 132 positions, 64 characters, 1000-lpm; with 1 to 66 print hours/month	23,000	275
	U02 With 67 to 99 print hours/month	0	+131
	U03 With 100 to 132 print hours/month	0	+295
	001 96-character set; 750 lpm	1,350	0
	002 64-character set with OCR-B font	650	0
	003 96-character set with OCR-B font	2,000	0
	015 230V/50 Hz, single-phase operation	0	0
	016 100V/50 Hz, single-phase operation	0	0
	017 230V/60 Hz, single-phase operation	0	0
	300 Series II and III interface	950	0
30209A	Line printer controller; interfaces one 2608A, 2613A, 2617A, or 2619A printer with option 300 to a Series III	1,275	5
<b>PUNCHED CARD EQUIPMENT</b>			
30106A	Card reader and controller; 600 cpm; includes 2893A card reader, controller/interface, and device diagnostic software	7,700	101
	015 230V/50 Hz, single-phase operation	0	0
30119A	Card reader/punch and controller; reads 176-200 cpm; punches 45-75 cpm; includes reader/punch, interface package, and device diagnostic software; must order option 002	17,500	210
	002 Keyboard for off-line use	2,000	0
	015 230V/50 Hz, single-phase operation	0	0
<b>PAPER TAPE EQUIPMENT</b>			
30104A	Paper tape reader and controller; 500 cps; includes tape reader, rack-mounting kit, controller/interface, and device diagnostic software	3,585	36
	003 Low-profile cabinet, 115V/60 Hz	2,000	2
	004 Low-profile cabinet, 230V/50 Hz	2,000	2
	015 230V/50 Hz, single-phase operation	0	0
30105A	Paper tape punch and controller; 75 cps; includes tape punch, controller/interface, and device diagnostic software	5,000	66
	003 Low-profile cabinet, 115V/60 Hz	2,000	2
	004 Low-profile cabinet, 230V/50 Hz	2,000	2

## Hewlett-Packard 3000 Series

## EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>TERMINALS</b>			
2621A	Interactive terminal, 115V/60 Hz	1,495	20
2621P	Interactive terminal with printer, 115V/60 Hz	2,650	34
	The following options apply to 2621A and 2621P, except as noted:		
001	Finnish/Swedish character set and keyboard	100	0
002	Danish/Norwegian character set and keyboard	100	0
003	French character set and keyboard	100	0
004	German character set and keyboard	100	0
005	United Kingdom character set and keyboard	100	0
006	Spanish character set and keyboard	100	0
013	240V/50 Hz operation, 2621A only	0	0
014	100V/60 Hz operation, 2621A only	0	0
015	220V/50 Hz operation	0	0
016	100V/50 Hz operation	0	0
2626A	Display station, 110V/60 Hz	3,950	31
001	Finnish/Swedish character set and keyboard	250	0
002	Danish/Norwegian character set and keyboard	250	0
003	French character set and keyboard	250	0
004	German character set and keyboard	250	0
005	United Kingdom character set and keyboard	250	0
006	Spanish character set and keyboard	250	0
013	240V/50 Hz operation	0	0
014	100V/60 Hz operation	0	0
015	220V/50 Hz operation	0	0
016	100V/50 Hz operation	0	0
050	Integral terminal printer	1,150	13
201	Math and large-character set (included with language options)	250	0
2640B	Display terminal; 1K- to 8K-byte memory, 64-character set	3,250	24
005	United Kingdom character set	0	0
015	230V/50 Hz operation	0	0
016	115V/50 Hz operation	0	0
2641A	APL display station for Series III; 64-character set plus 128 APL character set, 4K- to 12K-byte memory, 5 option slots	4,100	27
2645A	Display station; 4K- to 12K-byte memory, 128-character set, 7 option slots	3,500	27
015	220V/50 Hz operation	0	0
2647A	Intelligent graphics terminal; 9K-byte memory (max.), 128-character set, one option slot	8,950	70
2648A	Graphics terminal; 8K- to 12K-byte memory, 128-character set, 4 option slots	5,950	32
2649E	System/maintenance console for Series 30 or 33, includes cables	6,350	46
015	230V/50 Hz operation	0	0
	The following options apply to 2641A, 2645A, 2647A, and 2648A, except as noted:		
001	128-character set with lower case and displayable control codes; 2641A only	100	0
007	Integrated dual cartridge tapes; std. on 2647A	1,600	10
015	230V/50 Hz operation, except 2645A	0	0
016	115V/50 Hz operation, except 2645A	0	0
030	Delete standard asynchronous communications interface for multipoint applications	-160	0
031	Delete standard asynchronous communications interface to free one option slot; 2647A only	-75	0
033	Delete communications interface; add asynchronous multipoint communications capability; includes monitor mode	250	0
034	Delete communications interface; add synchronous multipoint communications capability; includes monitor mode	275	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
13234A	Additional 4K-byte terminal memory	300	0
13240A	Option slot extender; 5-slot; for 2640B only	150	0
30126A	CalComp 565 Series plotter interface	1,350	18
001	CalComp 702 Series plotter interface	0	0

## Hewlett-Packard 3000 Series

### EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>FACTORY DATA COLLECTION TERMINALS</b>			
3074A	Data link adapter; required to convert RS-232-C interface to data link interface	715	8
3075A	Desk-top data capture terminal; 15-position numeric display, protected display field, 17 user-defined prompting lights and 10 special function keys; maximum of two options per terminal from options 007, 008, 009 may be ordered	2,488	9
3076A	Wall-mounted version of 3075A	2,945	9
	The following options apply to 3075A and 3076A:		
004	Alphanumeric keyboard; includes all keys on standard numeric keyboard plus 26 alpha keys and one shift key (shift key allows alpha keys to be used as special function keys)	198	0
005	Alphanumeric display; 24-position display with 64 upper-case ASCII characters	545	0
006	5-inch CRT	936	3
007	Multifunction reader; reads punched plastic badges, 80-col. cards, and optical mark forms	936	4
008	Type V badge reader; reads nonembossed punched plastic badges with or without clip	545	4
009	Alphanumeric printer; 40-lpm thermal printing on 2.25-inch wide paper	545	4
010	Low-cost bar code reader	610	4
012	Magnetic stripe reader	655	1
013	RS-232-C interface	545	1
3077A	Time reporting terminal; large time display and Type V badge reader are standard; wall-mounted	2,945	9
001	Multifunction reader replaces Type V badge reader; reads punched plastic badges, 80-col. cards, and optical mark forms	440	0
002	Replace Type V reader with magnetic stripe reader	110	0
005	Alphanumeric display; 24-position display with 64 upper-case ASCII characters	605	4
7260A	Optical mark reader; buffered serial output data; switchable bps rate; RS-232-C compatible; up to 300 cards per minute	6,936	127
002	Select hopper	440	0
003	Encoder; allows reading of 80- and 40-col. punched cards and 40-col. marked cards without clock marks	551	0
004	Bell; audible event indicator activated under computer control	60	0
007	Wider input hopper for turnaround document	220	0
<b>COMMUNICATIONS</b>			
30018A	Asynchronous data communications controller (ADCC) — main; 4-port; includes 103, 212, and 202 type modem support and 9,600 bps communications	1,600	9
030	Replace Series 33 cable with Series 30 cable	0	0
30019A	Asynchronous data communications controller (ADCC) — extender; 4-port; includes 202S-type modem support	1,600	9
030	Replace Series 33 cable with Series 30 cable	0	0
30032B	Asynchronous terminal controller; 16-port	3,000	13
001	For 103, 202T, and 212 modems	1,240	3
002	For 202S modems	2,480	6
30441A	Asynchronous terminal controller field upgrade kit; converts std. 30032B to 30032B-001; two kits convert 30032B to 30032B-002	1,500	3
30010A	Intelligent Network Processor (INP) for Series III; provides serial interface for modem or hard-wired links; offloads data communication protocol handling from CPU	4,500	37
001	New I/O card cage backplane for systems upgraded from pre-Series II systems	375	N/A
30020A	Same as 30010A, for Series 30 and 33	4,500	38
001	HP-IB internal cable to extend to second card cage	0	0
30055A	Synchronous single line controller (SSLC); with modem cable or cable to run MTS/3000 in hard-wired asynchronous mode (option 001)	2,000	16
30360A	Hard-wired serial interface (HSI); for coaxial links; 30220A cable required for each pair of interfaces	2,300	18

## Hewlett-Packard 3000 Series

## EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>COMMUNICATIONS (Continued)</b>			
30037A	Asynchronous repeater (AR); includes adapter cable 30037-60003; converts RS-232-C signal levels to be compatible with HP terminals	900	6
015	230V operation	0	0
13260C	Asynchronous multipoint communications interface; for daisy-chained line sharing	435	0
001	Add monitor mode capability	50	0
13260D	Synchronous multipoint communications interface; for daisy-chained line sharing	450	0
001	Add monitor mode capability	50	0
37210T	4,800-bps modem	4,350	37
37220T	9,600-bps modem	6,150	40
37230A	Short-haul modem	1,020	4

## SOFTWARE PRICES

		<u>Price</u>
<b>LANGUAGES</b>		
32233A	COBOL II/3000 Compiler	\$3,000
32233R	Right to copy 32233A	1,200
32213C	COBOL/3000 Compiler	1,500
32213R	Right to copy 32213C	600
32104A	RPG/3000 Compiler	1,500
32104R	Right to copy 32104A	600
32102B	FORTRAN/3000 Compiler	1,500
32102R	Right to copy 32102B	600
32111A	BASIC/3000 Interpreter and Compiler	1,500
32111R	Right to copy 32111A	600
32105A	APL/3000 Language Subsystem	5,000
32105R	Right to copy 32105A	2,000
32100A	SPL/3000 Compiler	2,000
32100R	Right to copy 32100A	800
<b>DATA COMMUNICATIONS</b>		
32190A	DS/3000 Distributed Systems Software	3,000
32190R	Right to copy 32190A	1,200
30130E	RJE/3000 Remote Job Entry	750
30130R	Right to copy 30130E	300
32192A	MRJE/3000 Multileaving Remote Job Entry	2,000
32192R	Right to copy 32192A	800
32229A	IML/3000 Interactive Mainframe Link	3,500
32229R	Right to copy 32229A	1,400
32193A	MTS/3000 Multipoint Terminal Support	1,000
32193R	Right to copy 32193A	400
<b>MANUFACTURING APPLICATIONS</b>		
32260A	Materials Management/3000	25,000
32260R	Right to copy 32260A	5,000
<b>ADDITIONAL APPLICATIONS</b>		
32199A	Flexible Disccopy/3000	650
32199R	Right to copy 32199A	260
32205B	Scientific Library	300
32205R	Right to copy 32205B	120
32900A	SIS/3000 Student Information System	3,000
32900R	Right to copy 32900A	1,200
32902A	CIS/3000 College Information System	5,000
32902R	Right to copy 32902A	2,000
<b>INFORMATION SYSTEMS</b>		
36578A	TDP/3000 Text and Document Processor	6,000
36578R	Right to copy 36578A	3,600
32250A	DSG/3000 Decision Support Graphics	6,000
32250R	Right to copy 32250A	2,400