Hewlett-Packard 3000 Series I and II

MANAGEMENT SUMMARY

Hewlett-Packard has enhanced its much-heralded 3000 product line with the marketing of the HP 3000 Series II Models 6 and 8 and the reintroduction of the 3000CX as the HP 3000 Series I. In making these announcements, HP has pared down and rounded out the 3000 product line to three models: the Series I on the low end, the Series II Model 6 in the middle, and the Series II Model 8 at the top.

Upward compatibility is built into the product line, through both software considerations and hardware upgrade kits, enabling any HP 3000 to be upgraded to a Series II Model 8. Specific differences between the Series I and Series II are summarized in the chart on the next page.

In reintroducing the 3000CX as the Series I, HP modified the processor with a new printed-circuit backplane and reconfigured the system in terms of both peripherals and bundled software. The Series I is roughly equivalent to the Series II Model 6 in configuration, although the improved performance of the Series I processor cannot match that of the Series II processors. The interest in the Series I will come about largely because of its $35,000 price advantage over the Series II Model 6.

The original HP 3000 was introduced in November 1971, for initial delivery in November 1972. By mid-1973, promised delivery schedules of key software elements had not been met and active marketing was suspended. In November 1973, the HP 3000 was reannounced with a modified version of the operating system. The improved HP 3000CX system was announced in November 1974, with first deliveries in the first quarter of 1975. After ▷

The HP 3000, at the top end of Hewlett-Packard's computer product line, is a multi-lingual, multiprocessing, distributed network system that features stack processing, extensive firmware-assisted software, and fault-control dynamic NMOS memory. The product line currently consists of the HP 3000 Series I (a repackaged 3000CX with new HP peripherals) and the HP 3000 Series II Models 6 and 8; all are preconfigured systems with multiple software and peripheral options.

CHARACTERISTICS

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

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, the company also manufactures more exotic instruments such as gas chromatographs, digital thermometers, network analyzers, and spectrum analyzers. Other related products include both digital and analog graphic recorders, analytic instrumentation, and medical electronic instrumentation systems. Other Hewlett-Packard Company divisions manufacture hand-held calculators and desk-top calculators.

The company has six computer product divisions, including the General Systems Division and the Data Systems Division. The former manufactures and markets the HP 3000 Series I and II general-purpose computer systems, the HP 2026 Data Entry and Communications systems, and the HP 2000 multi-terminal RJE computer systems, while the latter pro- ▶

This photo of the top-of-the-line Series II Model 8 shows the extent to which Hewlett-Packard has vertically integrated its 3000 Series product line. The interactive terminal console is an HP-manufactured 2640B, the magnetic tape drive is an HP-manufactured 7970E, and the disc drive is an HP-manufactured 7920A. This minimum Model 8 configuration is priced at $140,000.
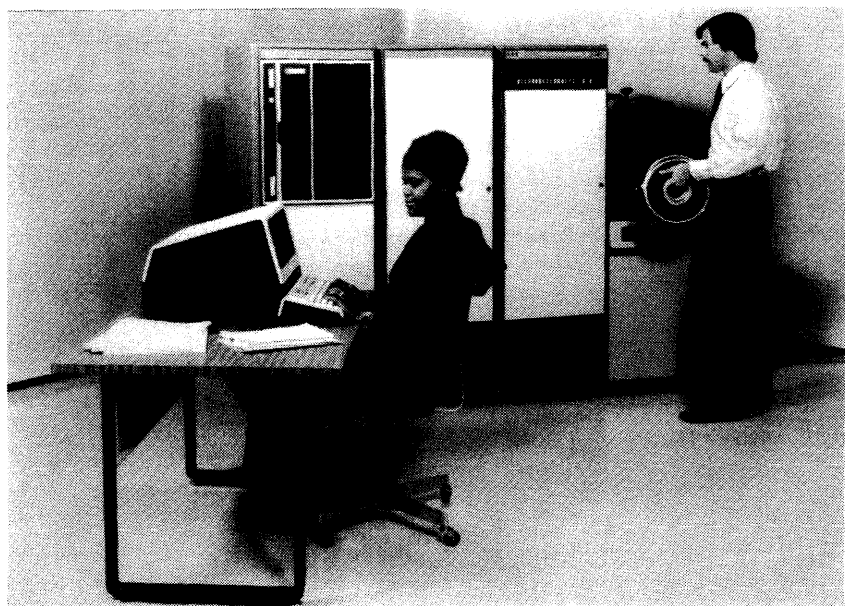
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SYSTEM DIFFERENCES

	HP 3000 Series I	HP 3000 Series II
Memory type	Core	MOS
Memory size, bytes	128K	128K to 512K
Memory checking	Parity	Fault control
Floating-point precision	48-bit	64-bit
Firmware instructions	192	209
Total hardware registers	33	38
Program-accessible registers	16	20
I/O chassis slots standard	5	10, 23 (Model 8)
I/O chassis slots optional	10	—
Power fail restart	Manual	Automatic
Multiplexer channel speed	880K bytes	990K bytes
Device controllers/multiplexer channel	14	16
Selector channel/data bus speed	1.9M bytes	2.86M bytes
Operating system	MPE-C	MPE-II
IMAGE/QUERY:		
No. of data extents	16	32
Data set cross volume boundary?	No	Yes
Index sequential access method	Index/3000	KSAM/3000
No. of keys	1	1 + 15 alternate
Concurrent user update/inquiry	No	Yes
Open files per program	96	255
Number of file extents	16	32
File cross volume boundary?	No	On extent boundary
APL language	No	Yes
Spoolfile size	Unlimited	32 config. extents
Terminal type recognition	User-specified	Automatic
No. of printers and controllers	2	4
Punch card units:		
Read	175 cpm	200 cpm
Punch/interpret	27 to 40 cpm	45 to 75 cpm
No. of async. terminal controllers	1	4
Number of terminals	16	63 + console

the introduction of the HP 3000 Series II in June 1976, active marketing of the 3000CX was suspended until its recent reintroduction as the HP 3000 Series I.

The HP 3000 Series II, as announced in June 1976, consisted of Models 5, 7, and 9. These models were actively marketed until the present Models 6 and 8 were introduced in August 1977. Models 6 and 8 differ from the earlier Models 5, 7, and 9 mainly in disc capacity and bundled software; they differ from each other in I/O capacity, with 10 slots on the Model 6 and 23 on the Model 8.

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

Basically, the HP 3000 Series I and II computers are multiprogramming, multilingual machines that use a moving-head disc unit to provide a maximum swapping area of 8.2 million bytes of virtual storage. Spooling

duces and markets the HP 1000 general-purpose computer systems, the HP 21MX minicomputers, and measurement control and computational systems. The other computer product divisions manufacture interactive CRT terminals (Data Terminals Division); line printers, magnetic tape drives, and hard-copy terminals (Boise Division); data collection devices (Grenoble Division); and disc drives (Disc Memory Division). A seventh division, the Computer Service Division, performs maintenance on HP computers.

Hewlett-Packard products are sold by 135 sales offices in 37 countries, and are manufactured in facilities in the U.S., United Kingdom, Germany, France, Japan, and Malaysia. The company employs about 31,000 persons worldwide.

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

DATA ANNOUNCED: HP 3000 Series I—May 1977; HP 3000 Series II—May 1976 for the no-longer-marketed Models 5, 7, and 9; August 1977 for Models 6 and 8.

DATE OF FIRST DELIVERY: HP 3000 Series I—April 1977; HP 3000 Series II—June 1976.

Hewlett-Packard 3000 Series I and II

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE EQUIPMENT	All HP magnetic tape units accept 10½-inch reels, read and record on IBM/ANSI-compatible tape, contain read-after-write features, and can be configured with up to 4 drives	
7970B	9-track, 800 bpi, NRZI, 45 ips; 7970B-304 or -305 is the 1st drive, 7970B-300 or -302 the 2nd, 3rd or 4th drive; 36 KBS	Hewlett-Packard
7970E	9-track, 1600 bpi; PE, 45 ips; 7970E-304 or -305 is the 1st drive, 7970E-300 or -302 the 2nd to 4th master drive, 7970E-301 or -303 the 2nd to 4th slave drive; 72 KBS	Hewlett-Packard
PRINTERS		
2607A/2607A-001	Comb matrix, 5 x 7 dot matrix (5 x 9 for lower case in 128-char. set), 132 positions, 64/128-character sets, 10 characters per inch, 6 or 8 lines per inch, 4 to 14.9-inch paper, 8-channel VFU; 200/165 lpm	HP, under license from Tally
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
2618A/2618A-001	Drum, 132 positions, 64/96-character sets, 10 characters per inch, OCR-B character font available, 6 or 8 lines per inch, 4 to 19-inch paper, 12-channel VFU; 1250 lpm	Dataproducts 2470
PUNCHED CARD EQUIPMENT		
30106A	Reader, 80-column; 1000-card input hopper and output stacker; reads by column; 600 cpm	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 (Series II) 175/27 to 40 cpm (Series 1)	Decision Data 8000 Series
PAPER TAPE EQUIPMENT		
30104a	Reader, 8-level, 1-inch tape, rack-mounted or cabinet option; 500 cps	HP
30105A	Punch, 5 to 8-level, 11/16 to 1-inch tape, rack-mounted or cabinet option; 75 cps	Facit-Addo 4070
TERMINALS	All terminals listed below have a commonality of features, including 1920-character display, 24 lines by 80 characters, 5 by 10 matrix generated in 9 by 15 cell, 64- or 128-Roman character sets, detachable ASCII keyboard with 10-key numeric pad, cursor, tab, page control, inverse video, block or character mode operation and RS-232C interface compatible with Bell 103A or 202 type modems; full or half duplex asynchronous transmission at 110 to 2400 bps	
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. (For other versions of the 2640, see Report M11-472-201)	Hewlett-Packard
2641A	APL Display Station; 5 option slots, display enhancements standard (see 2640B), 4K-byte memory expandable to 12K bytes, 8 user-defined soft keys, 128-character APL set and 64-character APL overstrike set, off-line data preparation and editing, optional dual miniature 10-ips, 800-bpi, 110K-byte cartridge tape drives, and optional special character sets (see 2640B)	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
2648A	Graphics Terminal; 4 option slots and specifications of 2645A except 9 user-defined soft keys, 8K-byte memory expandable to 12K bytes; 16K RAM's for 360 x 720-dot resolution graphic display and pan and zoom graphics; separate or simultaneous alpha and graphic viewing, rubber band line, automatic plotting, graphics text composition	Hewlett-Packard

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◁ is a standard feature, enabling more efficient use of peripherals.

The HP 3000 Series I provides a central processor with a 128K-byte, 1-microsecond core main memory; a 32-bit LSI bipolar ROM-based microprocessor; an instruction set consisting of 192 instructions; a 16-level external interrupt priority system; facilities for handling up to 14 peripheral device controllers; an operating system (MPE/C) with virtual memory capabilities, I/O spooling, hardware stacks, and separation of data and program code (for user program sharing); a 16-port asynchronous terminal controller; a multiplexer channel with 14-device capacity; a 50-megabyte disc unit, and a 1600-bpi magnetic tape unit. The Series I comes with basic software including MPE/C, a compiler library, TRACE/3000, FCOPY/3000, EDIT/3000, and SORT/3000, but language processors are separately priced except for HP's ALGOL-like SPL.

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

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

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

The Series II central processor features 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 instructions, firmware-assisted software, a 16-level external interrupt priority system, and facilities for handling up to 16 peripheral device controllers. The bundled software for the Series II includes an operating system (MPE-II) with virtual memory capabilities, I/O spooling, hardware stacks, and separation of data and program code (for user program sharing). Other bundled software includes the same programs listed above for Series I. All language processors except SPL are optional.

The full complement of language processors available includes SPL, FORTRAN, COBOL, RPG, BASIC, and ▷

▶ NUMBER INSTALLED TO DATE: Approximately 1200 HP 3000 systems have been installed since the product line was announced in November 1971.

DATA FORMATS

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

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

FLOATING-POINT OPERANDS: Single-precision 32-bit (2-word) operands with signed 9-bit exponent and 22-bit positive fraction. Extended-precision 48-bit operands with a signed 9-bit exponent and 38-bit positive fraction in the Series I. Extended-precision 64-bit (4-word) operands with signed 9-bit exponent and 55-bit positive fraction in the Series II. In both single- and extended-precision formats, the exponent can range between -256 and +255, while an assumed "one" is placed to the left of the binary point in the fraction. (The "one" is disregarded for floating-point zero.) All floating-point numbers are by definition normalized. The binary point is assumed to be between the exponent and fraction. Bit 0 of the first word is the sign bit; the exponent in bits 1 through 9 is biased by +256.

INSTRUCTIONS: The HP-3000 Series I and II 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.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: In the HP 3000 Series II, dynamic NMOS, requiring 700 nanoseconds every 62 microseconds for memory refresh. In the HP 3000 Series I, magnetic core.

CYCLE TIME: For the Series II, 700 nanoseconds for a 16-bit fetch, with a write access time of 700 nanoseconds and a read access time of 350 nanoseconds. The Series I has a cycle time of 1 microsecond and an access time of 500 nanoseconds for a 16-bit fetch.

CAPACITY: The HP 3000 Series I capacity is fixed at 131,072 bytes. The HP 3000 Series II Model 6 extends from 131,072 to 524,288 bytes, while Model 8 may be expanded from the minimum of 327,680 bytes to 524,288 bytes. Increment size on the Series II is 65,536 bytes. The HP 3000CX can be brought up to current Series I memory standards through the use of 32,768-byte core memory ▶

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▷ APL (Series II only). Other unbundled software includes IMAGE/3000, as HP calls its data base management system, a terminal- and batch-oriented system with direct interfaces to COBOL, RPG II, FORTRAN, and SPL and a programmable interface to BASIC. IMAGE compares favorably to larger, more powerful DBMS's currently available on medium and large-scale systems, except for more limited data capacities. A 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 21MX computers and their counterparts on the HP 3000 systems make it possible for users with these smaller systems to upgrade easily. (Even though conversion will be required, the standard portions of the languages will be unchanged, and only the discrepancies in language extensions and data format expressions will need to be resolved.)

Hewlett-Packard stresses flexible concurrent, multilingual environments where terminal-oriented scientific/ engineering problem solving is likely to be combined with background batch business processing. The Series II Model 6 can be configured to handle up to 31 terminals; the Model 8, up to 63 terminals; and the Series I, up to 16 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 models. All Series II models can also be configured with HP's Distributed System/3000 software, enabling multiple HP 1000, HP 2026, and/or HP 3000 Series II computers to be interconnected in a distributed processing network.

At present, the Series I and II systems are available only in packaged configurations. Purchase prices range from $75,000 for a minimum Series I configuration to $140,000 for the top-of-the-line Model 8. HP will upgrade any 3000, 3000CX, or 3000 Series I to a 192K-byte Series II Model 6 for $52,500, or to a 320K-byte Model 8 for $77,500. Memory is expandable on both in 64K-byte increments at $3,700 each.

Customer services for the HP 3000 Series I and II 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 of 1977. The new software support policy offers the HP 3000 user a statement of the mail, telephone, and on-site services a customer may expect; software initial-payment discounts of up to 70 percent for both volume end users and OEM's; a prepaid 12-month plan for users who don't wish to contract for the standard 48-month period; and 5-year support for discontinued software. ▷

▶ increments. Further HP 3000 Series I expansion can be accomplished through upgrade products to Series II.

CHECKING: Standard parity bit per 16-bit word is set with each write operation and checked with each read on the Series I.

Fault-Control Memory is used in all Series II 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 21 bits by appending 5 check bits. The check bits, called a Hamming code, and a special HP algorithm enable the system to automatically detect and correct a single-bit error and detect up to 30 percent of the multi-bit errors. The FCA boards also interface the fault-logging RAM (random-access memory) to the Series II I/O system. The operating system, MPE-II, periodically purges this RAM and stores it in a disc 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 microprogram routinely checks for bounds violation during execution (overlapped with operand fetch), and generates an interrupt if an unauthorized memory access attempt is made. Bounds violations may be classified under program transfer or reference, data reference, and stack overflow or underflow.

RESERVED STORAGE: The first 11 main memory locations are reserved for global system pointers used in the firmware implementation of virtual memory and variable-length program segmentation. In the Series I, an additional word is reserved for an interrupt counter and cold-load (bootstrap) register values. 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 I and II 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.

Auto restart after power failure is available only on the Series II; restart on the Series I is manual. The Series II is also distinctive in its use of noninterleaved but concurrently operating fault-control memory modules in groups of four (256K bytes). Battery backup for MOS memory is 60 to 90 minutes, depending on memory size.

The Series I processor is actually an HP 3000CX with a new printed-circuit CPU backplane. The processor, in conjunction with new peripherals configured with the system, improves the performance of the 3000CX by 10 to 50 percent, according to HP.

The Series I and II system design emphasizes a modular structure, with the CPU, I/O processor (IOP), and its Module Control Unit (MCU) connected via a high-speed ▶

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The HP 3000 Series I is being marketed primarily to businesses that are considering upgrading from batch processing, small colleges, divisions of large companies, and systems houses.

The Series II is 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. Between 10 and 20 percent of the Series II 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 typcial 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

Detailed below are the responses to Datapro's 1977 survey of minicomputer users from 22 HP 3000 users with a total of 25 installed HP 3000CX and HP 3000 Series II systems. The smallest system included in the survey was a FORTRAN-programmed 3000CX that included 128K bytes of memory, the MPE-C operating system, 96 megabytes of on-line disc storage, one magnetic tape drive, and 8 interactive terminals. This system had been installed for 36 months. The largest system was a 3000 Series II Model 8 programmed in APL, BASIC, COBOL, FORTRAN, and SPL, which had been installed for two months. This machine included 512K bytes of memory, 200 megabytes of on-line disc storage, one magnetic tape drive, and 32 interactive terminals.

Of the 22 users, 20 had purchased their systems and the other 2 were on third-party leases. COBOL and FORTRAN were the most popular languages, with BASIC in third place. COBOL was employed by 20 users, FORTRAN by 19, and BASIC by 15. Programming was primarily an in-house function, with HP-written programs being used by only two of the respondents, proprietary software by six, and contract programs by four users. Data communications was a prime application for only 6 of the respondents, whereas 18 of the users reported using their systems for business data processing, 14 for program development, 13 for data base management, and 10 for scientific/engineering applications.

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.

The CPU is divided into the instruction decoder, firmware storage and control, and hardware processor, 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 on the Series II 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 2048 (Series I) or 10,240 (Series II) 32-bit words. At present, HP utilizes 4K 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.

REGISTERS: There are 38 hardware registers on the Series II, 33 of which are accessible to the programmer, and 20 on the Series I, 16 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 (eight on the Series I); 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 I, 4 in the Series II); the stack pointer group (6 in the Series I, 8 in the Series II); 4 registers in the top-of-stack group; and registers named Index, Status, Switch, and the Series II Program Clock register. All registers are 16 bits in length except the bank registers and the Program Clock register.

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

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 (Series II only). The stack pointers include the SM register, which defines the number of top-of-stack elements that are in CPU Stack registers; the Z register, whose function is to define the stack limit of the current user's stack; and the Stack Bank register (S-Bank), used to define the 64K word bank in which the stack resides (Series II only).

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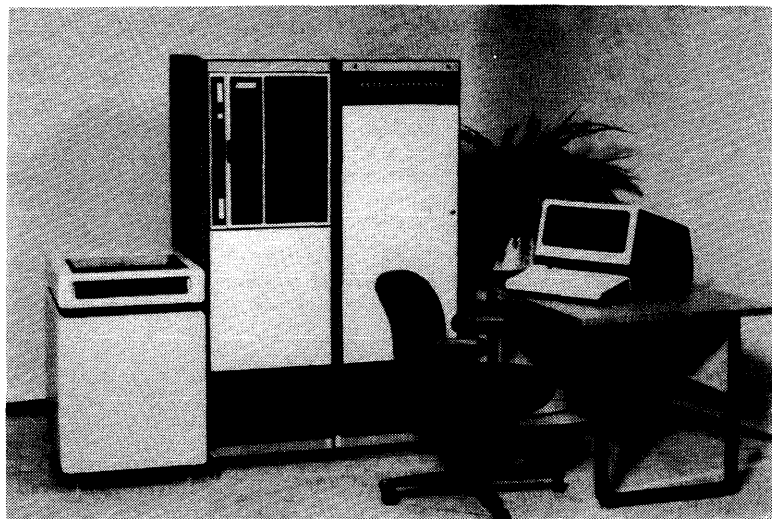
By integrating a new CPU backplane, card cages, and peripherals with previously employed mainframe parts such as the processor and core memory boards returned to HP by 3000CX users who have upgraded to the Series II, HP has created its entry-level 3000 Series I system. Pictured here is a minimum-configuration Series I including central processor, 16-port asynchronous terminal controller, 50-megabyte disc drive, 1600-bpi tape drive, and 2640B CRT terminal acting as a system console.

▷ The table below shows how the users rated the HP 3000CX and HP 3000 Series II product lines. The weighted average user ratings earned by the same systems in Datapro's 1976 minicomputer user survey are also shown for comparative purposes.

	Excellent	Good	Fair	Poor	1977 WA*	1976 WA*
Ease of operation	13	3	1	0	3.8	3.6
Reliability of mainframe	16	4	0	1	3.7	3.5
Reliability of peripherals	10	9	2	0	3.4	3.6
Maintenance service:						
Responsiveness	2	13	5	1	2.8	3.5
Effectiveness	3	12	5	1	2.8	3.5
Technical support	1	14	4	2	2.7	3.4
Manufacturer's software:						
Operating system	16	6	0	0	3.7	3.4
Compilers and assemblers	11	9	2	0	3.8	3.5
Ease of programming	15	6	1	0	3.6	3.6
Ease of conversion	10	7	3	0	3.4	3.0
Overall satisfaction	13	8	1	0	3.5	3.6

*Weighted Average on a scale of 4.0 for Excellent.

A review of the user ratings makes it clear that Hewlett-Packard has achieved success in developing and improving its top-of-the-line computer family. A comparison of the weighted average user ratings for the last two Datapro surveys shows improvement in five of the rating categories and slippage in five others. The most significant improvements were in software and ease of conversion, while the largest drops were in maintenance service and technical support. Although the 1977 ratings in the latter categories were close to the overall averages for the minicomputer industry, we hope that HP will strive to restore its maintenance and support functions to the above-par levels of the past.

Overall satisfaction, the most significant single indicator of user reaction to a computer system, received an average user rating of 3.5—a level that was exceeded or equaled by only a few other systems in Datapro's 1977 survey. If the latest product announcements are as well received as those made during the past few years, Hewlett-Packard can look forward to continued success with the HP 3000 line.□

▶ 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 209 machine instructions in the HP 3000 Series II and 192 in the Series I consisting of: 65 stack instructions, 16 memory address instructions, 13 branch instructions, 4 loop control instructions, 6 single-word shift instructions, 6 double-word shift instructions, 3 triple-word shift instructions, 1 field instruction, 10 I/O and interrupt instructions, 15 (11 on Series I) immediate instructions, 17 (12 on Series I) program control and special instructions, 7 (5 on Series I) register control instructions, 6 extended-precision floating-point instructions, 8 privileged memory reference instructions, 12 (10 on Series I) packed decimal instructions, and 12 (8 on Series I) move instructions. Approximately 19 percent of the instructions are privileged.

INSTRUCTION TIMINGS: All times are for full-word (16-bit) fixed-point operands and for single-precision (32-bit) floating-point operands, in microseconds: ▶

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Series I

	Fixed Point	Floating Point
Load/Store	2.1/2.4	3.4/3.9
Add/Subtract	0.72	10.1/10.9
Multiply/Divide	6.8	19.7
Compare and Branch	4.3	4.8

Series II

	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

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 I and II processors use cabinets 64.5 inches high, 21 inches wide, and 33 inches deep. The Series I and Series II Model 6 require two system cabinets, while the Series II Model 8 requires three for its standard configuration.

The HP 3000 Series I and II operate at a temperature between 60 and 85 (82 for the Series I) degrees F. with a relative humidity tolerance of 50 to 80 percent, non-condensing. The Series I and Series II Model 6, with standard configuration including a 7920A Disc Drive, output 4083 BTU's of heat per hour. The Series II Model 8 in standard configuration outputs 5483 BTU's per hour. Weight of the Series I or Series II Model 6 in standard configuration is 1169 pounds, while the Series II Model 8 in standard configuration weighs 1389 pounds.

Power requirements for all models are 208 volts +5 percent -10 percent, 3-phase, 60 Hz +0.5 Hz; or 230 volts +5 percent -10 percent, single phase, 50 Hz +0.5 Hz. Air conditioning requirements will exceed the average office installation by about two tons. A raised floor is not required, but is recommended.

INPUT/OUTPUT CONTROL

I/O PROCESSOR: The 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. Data is 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 14 I/O device controllers can be connected to the Series I, and 16 to the Series II Model 6 or 8. I/O devices can be connected to the system via the IOP bus, the multiplexer channel, and the selector channel. Each of the modules in the system can operate independently at its own speed when not operating over the central bus.

The selector channel can transfer data at a maximum rate of 2.86 megabytes per second on the Series II and 1.90 megabytes per second on the Series I. The IOP bus has a maximum transmission rate of 952K bytes per second on the Series II and 880K bytes per second on the Series I. The channel can accommodate one controller at present. The aggregate selector channel data rate cannot exceed the central data bus maximum data rate of 2.86 megabytes per second on the Series II and 1.9 megabytes per second on the Series I.

The Series II multiplexer channel can support up to 16 device controllers with an aggregate data rate of 1.038 (input) and 0.952 (output) megabytes per second. The Series I multiplexer channel can support up to 16 device controllers with an aggregate data rate of 0.88 (input) and 1.3 (output) megabytes per second. Data from the multiplexer channel is passed through the IOP for transfer to memory via the central data bus.

In addition to the multiplexer and selector modes of I/O data transfer, a direct I/O mode permits the CPU to transfer information directly to/from low-speed asynchronous peripheral devices without involving memory, the multiplexer, or the selector channels at rates of up to 0.88 megabytes per second on the Series I and 0.952 megabytes per second on the Series II. 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 I and II 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 II.

CONFIGURATION RULES

As is true with most minicomputers, the complement of peripheral equipment 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 I comes with two 64K-byte memory increments connected through their respective memory control units to the central data bus. One port controller and selector channel are standard; they are connected to the central data bus, allowing for one controller and up to eight 50-megabyte disc drives (one is standard). Supplied as standard on the IOP bus are an asynchronous terminal controller (ATC) and a magnetic tape controller (MTC) with one tape drive. The ATC controls the system console and up to 16 other terminals. The MTC controls up to four magnetic tape drives, either 800 or 1600 bpi. The drives may be intermixed on the same controller. Up to 15 slots are available for connection of additional peripherals.

The available Series I peripherals all require one slot except where noted. These peripherals include a plotter interface, ➤

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▶ 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 two line printers and controllers, up to two IBM 2780/3780 emulation subsystems, a 600-cpm card reader and controller, a card reader/punch rated at 175/27 to 40 cpm with controller, a 50-cps paper tape reader with controller, and a 75-cps paper tape punch with controller.

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

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

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

The MPE operating systems will support the following terminals in addition to HP's own 2640A 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.

MASS STORAGE

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

The controller is the same one employed with the now-discontinued 7905A Cartridge Disc Drive, thus allowing for an easy upgrade path. This device can control up to eight 7905A/7920A drives in any combination. The 30229A controller is a microprocessor-based, microprogrammed unit that incorporates integral error detection, marginal data recovery, and rotational position sensing, and can view the discs in cylinder mode. The controller chains commands

operating on multiple sectors (even if a head switch or new seek is required) without interrupting the CPU, retries commands that have failed, automatically selects alternate tracks, and follows data protection procedures.

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

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

INPUT/OUTPUT UNITS

Refer to the Peripherals/Terminals table.

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

COMMUNICATIONS CONTROL

30032B ASYNCHRONOUS TERMINAL CONTROLLER (ATC): The 30032B is designed to interface user terminals to the HP 3000 Series I and II via the IOP bus. Up to 16 terminals (including the system console) can be interfaced on the Series II, while on the Series I up to 16 terminals plus console can be interfaced. Terminals can be hard-wired or connected through type 103A3, 113B, 202C, 202S, and 202T modems (202S and 202T on Series I only). Series II terminals interfaced through the ATC can be configured to the multiprogramming executive (MPE II) as data entry terminals, under user program control, or as log-on terminals, accessing all the capabilities of the HP 3000 Series II. Terminals on HP 3000 Series I and II systems normally operate in character mode, except when accessed via the Data Entry Library (DEL/3000) when block mode is employed. Users who wish to access terminals in block mode directly (i.e., without using DEL/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-C or MPE-II. The controller uses half- or full-duplex operation over public telephone or leased lines (Series II only) to allow the HP 3000 Series II to be linked via modems to other computers in an HP Distributed Systems Network. The HP 30055A offers ▶

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▶ compatibility with EIA RS-232C, CCITT V.24, and Bell type 201, 208, or 209 modems. The 30055A has program-selectable parity (none, even, odd), program-selectable special character recognition, and program-selectable synchronous character. Two-character buffering is standard. The 30055A operates at speeds up to 9600 bps. Software for the 30055A is provided separately.

30130D 2780/3780 EMULATION SUBSYSTEM: Provides for the Series I most of the same capabilities as provided by the 30055A. While software is supplied with the 30130D, speeds are restricted to 4800 bps. For details of the software, see the Communications Software section of this report.

30360A HARD-WIRED SERIAL INTERFACE: Provides the hardware for an HP 3000 Series II 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 312.5 KBS is offered over distances of up to 1000 feet, with half that speed at 2000 feet; an S10 programmable rate from 12.3 KBS to 312.5 KBS is also possible. The 30360A includes four software-selectable channels; programmable error detection; call-back or line monitoring timer; automatic hardware transmission of an acknowledge word (handshaking) without program interruption; and CRC generation, transmission, and processing. The CRC uses a 15th-degree polynomial. A pair of 75-ohm coaxial cables function as a unidirectional pair of transmission lines for fast turnaround. The cable is optically isolated at the receiving end, enabling long-distance transmission with a low probability of errors due to common-mode noise or ground-level shifting.

SOFTWARE

OPERATING SYSTEMS: Each series features one operating system: MPE-C for the Series I and MPE-II, for the Series II.

The *Multiprogramming Executive II (MPE-II)* operating system is an enhanced 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. Both MPE-C and MPE-II are composed of a command interpreter, file management system, input/output system, virtual memory manager, segmenter, loader, job session scheduler, process dispatcher, user trap manager, spooling facility, disc space manager, utility intrinsics, initiator configurator, system console manager, power fail/auto restart (operator restart on Series I), 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 both MPE-C and MPE-II. In addition, MPE-II adds a backup/restore facility, APL, 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 (Series II only). 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-II 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 3000 Series I under MPE/C.

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

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

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

Recommended disc space allocation for MPE-C and MPE-II, their subsystems, and virtual memory is somewhat over 2 million bytes. MPE-C and MPE-II disc-resident, with about 8 percent (approximately 40K bytes) resident in memory at any one time.

LANGUAGES: The HP 3000 Series I and II are multilingual systems that support five programming languages plus a data base management system. In addition, Series II 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 disc and tape.

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

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▶ provided. HP states that MPE-II, MPE-C, and all compilers are written in SPL.

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

Described below are some of the FORTRAN language extensions implemented by HP. Source programs may be written in a free-field as well as in a fixed-field format. Symbolic names may consist of up to 15 characters instead of the usual 6. Character type data may be used to facilitate string manipulation. Up to 99 files may be used during execution of a FORTRAN program. Arrays may have up to 255 dimensions instead of the standard 3. A label may be used as an actual argument in a CALL statement to allow alternative return points following execution of the subroutine referenced by CALL. STOP or PAUSE statements use a decimal integer or character string for identification rather than an octal integer. Both 16-bit and 32-bit integers are supported. 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. 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 Series I or II with the minimum equipment configuration.

APL/3000 is patterned after IBM APLSV (A Programming Language—Shared Variables) and contains all its extensions plus enhancements developed by Hewlett-Packard. These HP extensions include APLGOL, a structured language extension to APL; a text editor; virtual workspaces; batch

as well as interactive operation; MPE file facility; and extended control and debugging system functions.

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

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

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

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

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

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

COBOL/3000 requires an HP 3000 Series I with 128K bytes of memory or an HP 3000 Series II with at least 192K bytes of memory.

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

Index sequential on the HP 3000 Series I is known as the Indexed File Organization Method (INDEX/3000), while on the HP 3000 Series II, it is known as the Keyed Sequential Access Method (KSAM/3000). Here's how the two methods compare:

	INDEX/3000	KSAM/3000
Primary key	1	1
Alternate keys	None	15
Key length up to	100 bytes	255 bytes
Duplicate keys allowed	No	Yes
Data records:		
Variable length	No	Yes
Retrieval by generic key	No	Yes
Primary key field updateable	No	Yes
Files accessible from BASIC	No	Yes

▶

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	INDEX/3000	KSAM/3000
Works with FCOPY/ 3000	No	Yes
Commands in file utility	11	8
User updating of files:		
Singly	Yes	Yes
Several concurrently	No	Yes
User inquiry of files:		
Multiple	Yes	Yes
Multiple concurrently	No	Yes

Both INDEX/3000 and KSAM/3000 are compatible with MPE STORE/RESTORE commands and are accessible from RPG, COBOL, FORTRAN, and SPL programs.

COMMUNICATIONS SOFTWARE: Software support for communications is available through the 30130D 2780/ 3780 Emulation Subsystem (Series I), the 30130E 2780/ 3780 Emulation Subsystem (Series II), and the Distributed System/3000 (DS/3000) including DS/2026 and DS/1000 (Series II).

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.

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

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

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

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

HP has also implemented distributed system software on the HP 1000 and the HP 2026, thus allowing these systems to become a part of an intercomputer communications network. For example, an HP 2026 system supports up to 16 interactive terminals, which can also function as terminals to any HP 3000 in the network.

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

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

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

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

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

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

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

Eight different access modes are available for IMAGE users. Multiple users may access a data base concurrently. Restructuring of the data base is accomplished by using DBUS. ▶

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> The restructuring can be through a changed data item or data set name, changed security provisions, changed data set relationships, and increased data set capacities. Inverted data sets are not supported.

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

Additional enhancements to IMAGE for the HP 3000 Series II include 32 data extents (16 with Series I); data sets may cross volume boundaries; DBFIND and DBGET without locking in access modes 1 and 5; the intrinsic DBEXPLAIN, which explains the result of a CALL; and the intrinsic DBERROR, which supplies an English-language message to an error code. The number of data extents is a constraint of the file system, not IMAGE.

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

For the Series I and II, 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.

THE DATA ENTRY LIBRARY: DEL/3000 is a programming aid designed to simplify terminal-oriented data collection. DEL/3000 is composed of a forms generation and maintenance program and 18 library procedures for terminal data handling, callable from COBOL, BASIC, FORTRAN, and SPL. With DEL/3000, the user can define a new form; list the form file directory; modify, display, or delete an existing form; and delete an existing form file.

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.

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

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

PRICING

POLICY: The HP 3000 Series I and II systems are available on a purchase or lease basis. Individual models are offered at a packaged price (processor, required peripherals, and selected software), with extensive separately priced peripheral and software options. The list of bundled software for the Series I includes MPE-C, SPL/3000, EDIT/3000, SORT/3000, FCOPY/3000, TRACE/3000, and the compiler library. Series II bundled software includes all of the aforementioned products except MPE-C, which is replaced by MPE-II.

All compilers, the BASIC Interpreter, IMAGE/3000, and QUERY/3000 can also be purchased separately. See the Software Prices at the end of this report.

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

Term, months	Percent of List Price per Month
36	3.23
42	2.83
48	2.54
60	2.13

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

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

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

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

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

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

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

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

● Statement of the mail, telephone, and on-site services a customer may expect.

● Software initial payment discounts of up to 70 percent for both volume end users (VEU's) and OEM's. ➤

Hewlett-Packard 3000 Series I and II

➤ • A prepaid plan for those who don't wish to contract for a 48-month period as required under the new standard plan.

• Yearly support contract after the initial 48-month period.

• Support for discontinued software.

Services that accompany software purchased under the support policy include phone-in consulting with an HP systems engineer (with an advertised four-hour response time) within a 100-mile radius of the HP sales office, software updates every 8 to 12 weeks, reference manual updates, software status bulletins every two weeks, and installation of software at the customer site. The phone-in consulting service may also be used for customer application bugs and interpretation of HP documentation. Software bulletins and updates also offer an avenue for interpretation of HP documentation.

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

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

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

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

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

• Full software support contracted on a yearly basis at the same rate as under the 48-month plan.

• A software subscription service, which provides bimonthly status bulletins, the latest updates and revisions to software ➤

purchased for the specific site, and an automatic supply of user manual updates pertinent to the system.

• Self support, where the customer's programmers assume responsibility for software maintenance and HP software consulting is on a time-and-material basis.

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

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

System discounts for VEU's start at 5 percent for 4 to 5 Series I systems or 2 Series II systems and range up to 20 percent for 50 or more Series I purchases or 25 or more Series II purchases. OEM system discounts start at 10 percent for up to 5 Series I or 2 Series II systems and range up to 25 percent for 50 or more Series 1 purchases or 25 or more Series II purchases.

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

HP makes available, in advance of the Series I system shipment, a set of reference manuals for the standard software, priced at $140 or $225 for all available HP software. For the Series II, the standard set is priced at $175 or $270 for all available HP software.

The HP Educational Users' Group provides a newsletter and support services. The fee for membership is $8.00 per year.

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

Hewlett-Packard 3000 Series I and II

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.

PACKAGED SYSTEMS

HP 3000 Series I and II systems are rated at 120/208 VAC, 60 Hertz, 3-phase; each includes a 50-megabyte 7920 Pack Disc Drive and Controller, a 1600-bpi 7970E Magnetic Tape Drive and Controller, a 2640B Interactive CRT Terminal Console, system clock, high-speed selector channel, multiplexer channel, and 16-port asynchronous terminal controller.

			Purchase Price	Monthly Maint.
32420A		HP 3000 Series I Computer System; includes processor with 128K bytes of memory, two system cabinets, and a console table	$ 75,000	$615
	103	Add 103 modem capability to system	1,240	6
	110	Add 103/202C-type modem control to the asynchronous terminal controller	2,480	12
	130	Substitute 800-bpi for 1600-bpi magnetic tape drive	-2,625	-9
	300	Add 10 extra I/O slots to Series I processor	2,725	11
32416A		HP 3000 Series II Model 6 Computer System; includes processor with 128K bytes of memory, two system cabinets, console table, and isolation transformer	110,000	580
	015	Operation at 230 VAC, 50 Hertz, single phase; isolation transformer deleted	-2,100	—
	050	Delete isolation transformer only	-2,100	*
	110	Add 103/202C-type modem control to the asynchronous terminal controller	1,240	6
	130	Substitute 800-bpi for 1600-bpi magnetic tape drive	-2,625	-9
	500	Expand main memory to 192K bytes	3,700	21
	501	Expand main memory to 256K bytes	7,400	42
	502	Expand memory to 320K bytes	15,000	120
	503	Expand memory to 384K bytes	18,700	141
	504	Expand memory to 448K bytes	22,400	152
	505	Expand memory to 512K bytes	26,100	183
32418A		HP 3000 Series II Model 8 Computer System; includes processor with 320K bytes of memory, three system cabinets, console table, and isolation transformer	140,000	721
	015	Operation at 230 VAC, 50 Hertz, single phase; isolation transformer deleted	2,100	—
	050	Delete isolation transformer only	-2,100	*
	110	Add 103/202C-type modem control to the asynchronous controller	1,240	6
	130	Substitute 800-bpi for 1600-bpi magnetic tape drive	-2,625	-9
	503	Expand main memory to 384K bytes	3,700	21
	504	Expand main memory to 448K bytes	7,400	42
	505	Expand main memory to 512K bytes	11,100	63

SYSTEM UPGRADES

			Purchase Price	Monthly Maint.
30408A		Upgrade for HP 3000 Series II Model 5, 6, or 7 to a system similar to Model 8; rated at 120/208 VAC, 60 Hertz, 3-phase. Upgrade consists of a memory expansion kit to accommodate up to 512K bytes, the addition of a third system cabinet for I/O expansion, and one 64K-byte board	25,000	*
	001	For Model 6 with 256K bytes or less	—	*
	002	For Model 6 with 320K bytes of memory or greater; deletes memory expansion kit and 64K-byte board	-10,000	*
30306A		Upgrade to HP 3000 Series II Model 6 for HP 3000, HP 3000CX, or HP 3000 Series I Systems; rated at 120/208 VAC, 60 Hertz, 3-phase. Upgrade consists of Series II processor and 192K bytes of MOS main memory. HP grants a $225 maintenance charge credit allowance during the warranty period	52,500	*
	001	Addition of a 30310A power supply; for upgrade from Series I	5,000	*
	132	Upgrade of 30030A selector channel to 30030B selector channel	3,000	*
	150	Series II style 29402B Peripheral Cabinet	2,800	*
	152	Upgrade early version of asynchronous terminal controller board (30060-60001 to 30032B-003)	—	*
	501	Expand main memory to 256K bytes	3,700	*
	502	Expand main memory to 320K bytes	11,300	*
	503	Expand main memory to 384K bytes	15,000	*
	504	Expand main memory to 448K bytes	18,700	*
	505	Expand main memory to 512K bytes	22,400	*
	200	Trade-in allowance for 128K-byte Series I or other pre-Series II	10,000	*
	201	Trade-in allowance for 96K-byte pre-Series II	8,000	*
	202	Trade-in allowance for Series I or other pre-Series II selector channel printed-circuit assembly (two boards)	500	*
30409E		Upgrade to HP 3000 Series II Model 8 for HP 3000, HP 3000CX, or HP 3000 Series I systems; rated at 120/208 VAC, 60 Hertz, 3-phase. Upgrade consists of a Series II processor and 320K bytes of MOS main memory. HP grants a $350 maintenance charge credit allowance during the warranty period	77,500	*
	001	Addition of a 30310A power supply; for upgrade from Series I	5,000	*
	132	Upgrade of 30030A selector channel to 30030B selector channel	3,000	*
	150	Series II style 29402B Peripheral Cabinet	2,800	*
	152	Upgrade early version of asynchronous terminal controller board (30060-60001 to 30032B-003)	—	*
	503	Expand main memory to 384K bytes	3,700	*
	504	Expand main memory to 448K bytes	7,400	*
	505	Expand main memory to 512K bytes	11,100	*

*With this change in configuration, monthly maintenance charges must be recalculated for the basic system.

Hewlett-Packard 3000 Series I and II

			Purchase Price	Monthly Maint.
200		Trade-in allowance for 128K-byte Series I or other pre-Series II	10,000	*
201		Trade-in allowance for 96K-byte pre-Series II	8,000	*
202		Trade-in allowance for Series I or other pre-Series II selector channel printed-circuit assembly (two boards)	500	*

MEMORY

30008A		64K-byte MOS Memory Expansion module	4,000	21
30411A		Field-installed 256K to 320K-byte memory module for processors upgraded to Series II from HP 3000CX	15,800	78
30411B		Memory Expansion Kit for Series II Model 6; expands capacity for memory to 512KB; includes one 64KB memory board; add 30008A memory modules to reach desired memory size	10,000	78
30431A		32K-byte core Memory Expansion module	5,500	22

MASS STORAGE

30229A		Controller for up to eight 15-megabyte 13180B Cartridge Disc Drives or 50-megabyte 7920S Pack Disc Drives in any combination; requires 30030A or B selector channel	4,500	31
7920S		Add-on 7920A Pack Disc Drive; includes 13394A Disc Pack; 2nd to 8th drive	14,000	54
	001	Specify this option if system cabinet contains a rack-mounted 7905A or for first 7920A in system	—	—
13395A		Two 7920A Disc Drives; includes two 13394A Disc Packs; 2nd to 8th drives	26,000	108
	050	Third drive purchased at the same time	13,000	54
12940A		7905 Disc Cartridge	180	—
13394A		7920 Disc Pack	700	—

MAGNETIC TAPE EQUIPMENT

30215A		Magnetic Tape Controller for up to four 7970B or 7970E drives	2,700	21
7970B		Nine-track, 800-bpi, 45-ips drive; select option 300, 302, 304, or 350	6,360	61
	300	Use this option for 2nd, 3rd, or 4th drive on the 30215A controller; drive is racked in Series I/II-style cabinet	3,160	—
	304	Use this option for 1st drive on the 30215A controller; drive is racked in Series I/II-style cabinet	3,160	—
	305	In pre-CX-style cabinet	3,320	—
7970E		Nine-track, 1600-bpi, 45-ips drive; select one of options 300 through 305	8,885	70
	300	Use this option for 2nd, 3rd or 4th master drive on the 30215A controller; drive is racked in Series I/II-style cabinet	3,260	—
	302	In pre-CX-style cabinet	3,420	—
	301	Use this option for 2nd, 3rd or 4th slave drive on the 30215A controller; drive is racked in Series I/II-style cabinet	1,415	—
	303	In Pre-CX-style cabinet	1,575	—
	304	Use this option for 1st drive on 30215A Controller; Drive is racked in Series I/II-style cabinet	3,260	—
	305	In pre-CX-style cabinet	3,420	—

PRINTERS

30209A		Controller for one of the listed printers	1,275	7
2607A		Combination line printer with 64-character set; 200 lpm	7,675	72
	001	128-character set option; 165 lpm	500	—
	300	Interface cable, documentation, and installation	450	—
2613A		Drum line printer with 64-character set; 300 lpm	10,825	133
	001	96-character set option; 240 lpm	1,675	—
	002	64-character set option with OCR-B font	—	—
	003	96-character set option with OCR-B font	1,675	—
	300	Interface cable, documentation, and installation	450	—
2617A		Drum line printer with 14 character set; 600 lpm	15,700	147
	001	96-character set option; 436 lpm	1,675	—
	002	64-character set option with OCR-B font	—	—
	003	96-character set with OCR-B font	1,675	—
	300	Interface cable, documentation, and installation	450	—
2618A		Drum line printer with 64-character set; 1250 lpm	35,400	150
	001	96-character set option	1,900	—
	002	64-character set option with OCR-font	—	—
	003	96-character set option with OCR-B font	1,900	—
	300	Interface cable, documentation, and installation	450	—

PUNCHED CARD EQUIPMENT

30106A		Card Reader Subsystem; 600 cpm	7,700	64
30119A		Card Reader Subsystem; reads 200 cpm, punches/interprets to 75 cpm (Series II); reads 175 cpm, punches/interprets to 40 cpm (Series I)	17,500	129
	002	Off-line punch and verify capability	2,000	—

PAPER TAPE EQUIPMENT

30104A		Reader, 500 cps	3,585	23
	001	Series I/II cabinet	2,500	—
	002	Pre-CX cabinet	3,000	—
30105A		Punch, 75 cps	5,000	48
	001	Series I/II cabinet	2,500	—
	002	Pre-CX cabinet	3,000	—

*With ths change in configuration, monthly maintenance charges must be recalculated for the basic system.

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			Purchase Price	Monthly Maint.
COMMUNICATIONS				
30032B		Asynchronous Terminal Controller; 16-port; may be ordered in addition to standard equipment on Series II only	3,000	15
	001	Add 103-type modem control	1,240	6
	002	Add 103 and 202-type modem control	2,480	12
30055A		Synchronous Single Line Controller	2,000	18
30130D		2780/3780 Emulation Subsystem; for the HP 3000, HP 3000CX, and Series I	4,500	25
30360A		Hard-wired Serial Interface; for coaxial links	2,300	20
30441		Asynchronous Terminal Controller Field Upgrade Kit; converts 30032B-001 and 30032B-001 to 30032B-002	1,500	6
2640B		Interactive CRT Terminal; 24 lines by 80 characters; block or character mode (switch-selectable); 64-character upper case Roman set; 1024 bytes of storage/expandable to 8192 bytes maximum; inverse video; 110-2400 bps; RS-232 interface; includes 2 option slots (does not include computer interface)	2,600	20
	001	128-character Roman Set (adds lower case and displayable control codes)	100	—
	020	Extended Asynchronous Communications Card	150	2
2641A		APL Display Station; same as 2640B except 4K-byte memory, eight user-defined soft keys, 128-character APL and 64-character APL overstrike sets; not for Series I	4,100	22
	001	128-character Roman Set (adds lower case and displayable control codes)	100	—
	007	Integrated Dual Cartridge Tape Drives	1,600	8
	013	Five Mini-Cartridges	90	
2645A		Interactive Display Station; same as 2640B except 4K-byte memory expandable to 12K bytes, user-defined soft keys, and off-line data preparation and editing	3,500	22
	001	128-character upper and lower case Roman Set	100	—
	007	Integrated Dual Cartridge Tape Drives	1,600	8
	013	Five Mini-Cartridges	90	—
2648A		Interactive Graphics Display Terminal; same as 2645A except 8K-byte memory expandable to 12K bytes, 360 by 720 dot resolution, pan and zoom graphics, and simultaneous alpha/graphics viewing	5,500	22
	007	Integrated Dual Cartridge Tape Drives	1,600	6
	013	Five Mini-Cartridges	90	—
13234A		Additional 4K byte memory for 2640 Series terminals	300	—
2762A		Printer terminal; 75-column friction feed	3,950	29
	015	220 VAC/50 Hz	230	—
	016	240 VAC/50 Hz	230	—
	017	Pin-feed instead of friction feed	195	—
	018	Adds pedestal	195	—
2762B		Printer terminal; 120-column tractor feed; 10, 30, or 120 cps, switch-selectable	5,650	58
	002	Vertical forms control	255	—
	003	Horizontal tabs	240	—
	005	Pedestal	210	—
	015	220 VAC/50 Hz	260	—
	016	240 VAC/50 Hz	260	—
PLOTTERS				
30126A		Calcomp 565 Series Plotter Interface	1,350	14
	001	Calcomp 702 Series Plotter Interface	—	—
HARDWARE				
30412A		Add-On I/O Power Supply for Series I	5,200	—
	001	Additional card cage	800	—
30413A		I/O Expansion for Series I; field installed, 10 I/O slots	2,725	11
30030A		High-Speed Selector Channel for Series I	4,200	38
30030B		For Series II	3,600	38

SOFTWARE PRICES

When ordering software, specify product number and monthly software fee number (22823A) together with appropriate option number listed below.

			Price	Monthly Software Fee
22823A		Monthly software fee for Fundamental Operating Software (bundled with hardware)		$125
	32105A	APL/3000	$5,000	
	001	Monthly fee for APL/3000		125
	32111A	BASIC/3000	1,500	
	002	Monthly fee for BASIC/3000		50
	32213B	COBOL/3000 (Series I or pre-Series II)	1,500	
	32212C	COBOL/3000 (Series II)	1,500	
	003	Monthly fee for COBOL/3000		100

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		Monthly Software	
		Price	**Fee**
32206A	DEL/3000	300	
004	Monthly fee for DEL/3000		50
32190A	DS/3000	3,000	
005	Monthly fee for DS/3000		125
30130D	2780/3780 Emulation subsystem software (for Series I or pre-Series II)	750	
30130E	2780/3780 Emulation subsystem software (for Series II)	750	
006	Monthly fee for Emulation software		25
32102B	FORTRAN/3000	1,500	
007	Monthly fee for FORTRAN/3000		50
32235A	IMAGE/QUERY	3,000	
008	Monthly fee for IMAGE/QUERY		125
32207A	INDEX/3000	750	
009	Monthly fee for INDEX/3000		25
32208A	KSAM/3000	1,500	
010	Monthly fee for KSAM/3000		25
32104A	RPG/3000	1,500	
011	Monthly fee for RPG/3000		100
32205B	Scientific Library	300	
012	Monthly fee for Scientific Library		25
32900A	SIS/3000; also requires license agreement	3,000	
—	Monthly fee for SIS/3000		200