

Honeywell Series 60, Level 62

MANAGEMENT SUMMARY

Honeywell's Series 60 Level 62 system has found wide acceptance in the business community, with an estimated 3,000+ systems installed worldwide and several hundred on order. For users of smaller mainframe computer systems it represents an interesting alternative for the DP manager.

Honeywell designed the Level 62 to be a growth path for users of its established small business systems, certain members of the Honeywell-acquired General Electric product line, and other systems manufacturers. The Level 62 uses numerous hardware and software conversion aids to achieve upward compatibility.

Responding to IBM's announcement of its System/34 and System/38, Honeywell made performance changes in the Level 62, and the recent addition of the Interactive Processing System (IPS) makes the Level 62 a worthy competitor.

The Level 62 has evolved from a series of separate and distinct submodels, introduced in April 1974, to a basic processor with three performance level enhancements. Each firmware package increases processor performance, main memory capacity, and flexibility of peripherals, while minimizing conversion time. The present system configuration and packaging approach was introduced in January 1979.

HARDWARE

The Level 62 is designed as a basic system with three performance level enhancements, Modules C, D, and E. ➤

The Honeywell Level 62 has recently been enhanced by the introduction of the Interactive Processing System, a subset of the general purpose GCOS operating system. IPS offers a fully distributed, multi-user workstation environment. The Level 62 is an extremely attractive alternative to the IBM System/34 and System/38, as well as an effective migration path for earlier Honeywell small business computers and the IBM System/3.

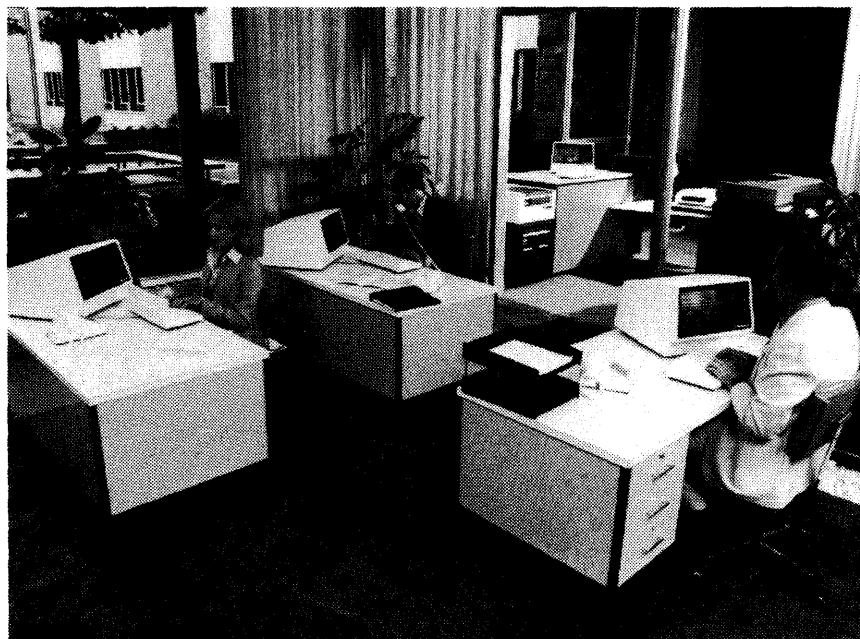
MAIN MEMORY: 96 to 992K bytes
DISK CAPACITY: 40 to 1,800 megabytes
WORKSTATIONS: 32 to 100
PRINTERS: 100 to 1600 lpm
OTHER I/O: Magnetic tape, diskette, punched card

CHARACTERISTICS

MANUFACTURER: Honeywell Information Systems, Inc., 200 Smith Street, Waltham, Massachusetts 02154. Telephone (617) 895-6000.

Honeywell Information Systems is a division of Honeywell Incorporated, an international corporation whose products include industrial and residential control systems, sophisticated test instruments for both medical and industrial applications, aircraft guidance systems and instrumentation, photographic equipment, satellite support subsystems, and electronic data processing products.

MODELS: Series 60, Level 62. ➤



Honeywell's Series 60 Level 62 system is at the lower end of the company's product line. It comes as a basic system with three different performance enhancements, plus a full complement of ancillary devices. The recently announced Interactive Processing System (IPS) offers many enhancements above the well-established GCOS operating system, and IPS users have been singing its praises.

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LEVEL 62 PERFORMANCE MODULE CHARACTERISTICS

	Basic System	Module C	Module D	Module E
Performance Increase	—	33%	78%	90%
Main Memory: Minimum (bytes) Maximum (bytes)	96K 192K	96K 224K	96K 480K	96K 992K
Disk Storage: Minimum (bytes) Maximum (bytes)	40 megabytes 175 megabytes	40 megabytes 920 megabytes	40 megabytes 1360 megabytes	40 megabytes 1800 megabytes
Additional Peripherals	100-, 200-, 300-, 450-, 650-lpm printer; 300-, 500-, 600-cpm 80-column card reader; 300-cpm 96- column card reader	1200- or 1600-lpm printer	Same as Basic System plus Module C	Same as Basic System plus Module C
Magnetic Tape Storage: Minimum (Drives) Maximum (Drives)	2 4	Same as Basic System	Same as Basic System	Same as Basic System
Communications Lines: Minimum Maximum	4 9 Optional: Extended Controller supports up to 25 lines	Same as Basic System	Same as Basic System	Same as Basic System

➤ The basic system comes with 96K of memory and a 6-channel I/O processor. It also requires two 20.0 megabyte disk drives, a line printer, a system console, and either a card reader, cassette tape subsystem, diskette subsystem, or communications subsystem.

The basic Level 62 configuration supports up to 192K bytes of main storage, 175 megabytes of disk storage, and a variety of peripherals. Modules C, D, and E offer performance level increases of 33%, 78%, and 90% over the basic system; 224K, 480K, and 992K bytes maximum main storage; and 920, 1360, and 1,800 megabytes maximum disk storage, respectively.

Line printers available in the systems are 100-, 200-, 300-, 450-, 650-, 1200-, or 1600-lpm units. One integrated communications controller (IDCC) is capable of attaching up to four asynchronous lines or four synchronous lines—or two synchronous and two asynchronous lines. A second five-line communications controller may be added to the basic CPU. An optional extended data communications controller (EDCC) supports up to 25 lines, in lieu of the standard IDCC.

The Level 62 Performance Module Characteristics chart shown above highlights the configuration limits of the various models and the additional equipment they can support.

The 80- and 96-column punched card subsystems are offered by Honeywell especially to facilitate IBM System/3 replacement. The MSU0112, MSU0113, and MSU0116 cartridge disk drives have characteristics similar to those of the IBM 5444 drives and can accept ➤

➤ **DATE ANNOUNCED:** April 1974 (original Model 62/60); January 1977 (Full-Range); July 1978 (Entry Level); January 1979 (Extended Level).

DATE OF FIRST DELIVERY: November 1974.

NUMBER INSTALLED TO DATE: Over 3,000 systems worldwide.

DATA FORMATS

BASIC UNIT: 8-bit byte (plus parity bit). Each byte can represent 1 alphanumeric character, 1 or 2 BCD digits (in unpacked or packed format, respectively), or 8 binary bits.

FIXED-POINT OPERANDS: 16-bit full in short form, 32-bit doublewords in long form. Operands are interpreted as signed, using the leftmost bit for sign storage.

FLOATING-POINT OPERANDS: 32-bit single-precision numbers or 64-bit double-precision numbers. The exponent is 7 bits including sign, and the fraction is 57 bits including sign.

INSTRUCTIONS: There are 16 instruction formats, with the instructions they represent varying in length from 2 to 8 bytes. The operation code resides in the first byte of all instructions.

INTERNAL CODE: EBCDIC.

MAIN STORAGE

The Level 62 main memory is organized as consecutively numbered byte locations. Two-byte words are always accessed regardless of operand size.

STORAGE TYPE: Metal oxide semiconductor (MOS).

CAPACITY: 98,304 to 1,015,808 bytes. The capacity is limited to 192K bytes in the basic system, 224K bytes with performance Module C, 480K bytes with Module D, and 992K bytes with Module E. Capacity can be expanded in ➤

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE EQUIPMENT		
MTU0120/0121/0111	7- or 9-track, 200/556/800/1600 bpi, 10.5-inch reels, 18.75 ips; 3750/10,425/15,000/30,000 bytes per second	Honeywell
MTU0220/0221/0211	7- or 9-track, 200/556/800/1600 bpi, 10.5-inch reels, 37.5 ips; 5625/15,637/30,000/60,000 bytes per second	Honeywell
CTU0001/0002	Cassette tape subsystem; 2 tracks, 800 bpi, 7 ips, 700 bytes per second, maximum 2 drives	Honeywell
PRINTERS		
PRS0115	IMPACT, PEDESTAL MOUNTED, 132 print positions, 64- or 96-character set, 6 or 8 lines per inch; 100 lpm, optional speeds: 200/300 lpm	Honeywell
PRS0458	Drum-type, 132 print positions; 63-character set, 450 lpm, optional 650 lpm	Honeywell
PRU1200/1600	Belt-type, 136 print positions (160 optional); 48-, 64-, or 96-character set, 6 or 8 lines per inch; 1200/1600 lpm	Honeywell
PUNCHED CARD EQUIPMENT		
CRU0300/500	Reader, 80-column, optical mark read optional; 300/500 cpm	Honeywell
CRU0600/1050	Reader, 80-column (51-column optional), optical mark read optional, 3000-card input hopper, 2500-card output stacker; 600/1050 cpm	Honeywell
CRU0306	Reader, 96-column, 600-card input hopper and output stacker; 300 cpm	Decision Data
PCU0120	Punch, 80-column, 1600-card input hopper and output stacker; 100 to 400 cpm	Honeywell
TERMINALS		
VIP7100/05	Asynchronous CRT, 12 lines of 80 characters, TTY-compatible, 05 indicates upper and lower case	Honeywell
7700/05	Synchronous CRT, 12 lines of 80 characters, 63 ASCII character set, upper case only, requires 7731 or 7732 Adapter, 05 indicates 95-character set, upper and lower case	Honeywell
VIP7804/05	Synchronous CRT, 24 lines of 80 characters, 95-character set, ASCII, upper and lower case, 04 has 12 inch screen, 05 has 15 inch screen	Honeywell
VIP7760	Subsystem, up to 32 terminals per line, compatible with VIP7700	Honeywell

➤ cartridges created on the IBM units. Also available are two 96-column multi-function card units that provide substantial throughput increases over the IBM 5424 and 2560 Multi-Function Card Units. The CCU0506 reads cards at a rate of 500 cpm, and the CCU1006 at 1000 cpm. The cartridge disks and multifunction units are available only on an RPQ basis.

SOFTWARE

The field proven GCOS Level 62 operating system provides facilities for processing up to 13 unrelated activities, including communications, batch, and spooling. Generally, between two and six users can run concurrently on typical configurations. Level 62 GCOS features spooling, dynamic resource allocation, automatic job scheduling, job accounting, and failsoft facilities that allow the system to survive certain main memory and peripheral failures. All Level 62 users may now interactively access all system facilities in either transactional or traditional batch modes from distributed, multiuser workstations through the new Interactive Processing System (IPS), an information management subsystem of Level 62 GCOS.

➤ 32K-byte increments from 96K to 224K bytes, and in 128K-byte increments from 224K to 992K bytes.

CYCLE TIME: 1 microsecond, with 500-nanosecond access per 2 bytes. The 240-bit Read-Only Storage (ROS) has an access time of 170 nanoseconds.

CHECKING: One parity bit is appended to each byte. On all Level 62 systems with more than 224K bytes of memory, single-bit memory errors are automatically corrected by the Error Detection and Correction feature.

STORAGE PROTECTION: Protection is provided by dividing user programs into two sections, designated Segment 0 and Segment 1. Segment 0 contains all data that will be changed during program execution, such as buffers and transient data storage. Segment 1 contains all constants and instructions. Each segment is defined by a base address and length, and these parameters are stored in four hardware registers. This scheme prevents attempts to execute data or to use instruction coding as data. Each pair of user segments cannot be shared or accessed by other user programs. A fifth register, the lower boundary register, contains the address of the first user location beyond the system software.

RESERVED STORAGE: A portion of main storage is reserved for firmware in addition to ROS. A special register, the P-register, prevents access to these memory locations by any software. Also protected is the 13K-byte area where the

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➤ User programs can be written in System/3-compatible RPG, in COBOL 74, or in FORTRAN IV. In addition, Honeywell offers a large selection of financial management programs, an inventory management and production scheduling and control system, plus sales order processing and inventory management programs for distributors.

Honeywell provides a large number of conversion software routines that permit users to convert existing software for operation on the Level 62 systems. These routines permit conversion from both IBM and earlier Honeywell systems.

RELIABILITY/MAINTAINABILITY FEATURES

All Level 62 CPU's have improved diagnostic capabilities that serve to increase system availability by drastically reducing diagnostic and repair times on malfunctioning systems. The advent of CPU's with multiple processing units has offered the computer industry the opportunity to incorporate fixed diagnostic routines into one or more of the internal processing units that make up these CPU's. The diagnostics routines are added to the microcode of the processing unit and invoked only on special command, and can be initiated either remotely or locally.

Honeywell's Level 62 Remote Maintenance System (RMS/62) permits field engineering personnel to diagnose hardware, firmware, software, and operational (human) problems from a remote location. One major benefit that users can derive from RMS/62 is the diagnosis of software problems and implementation of repairs by vendor personnel without the need for site visits or taking the system down for maintenance.

COMPETITIVE POSITION

The Level 62 was originally designed as a migration path for the IBM System/3 Model 10 and other well-known units. With subsequent performance improvements the Level 62 competed with such systems as the Burroughs 1700 and low-end B 1800 product line, NCR's low-end Criterion series units, and Univac's 90/25, 90/30, and 90/40 systems. In its present configuration, the Level 62 is positioned to compete with IBM's System/34 and System/38.

USER REACTION

The 1980 Datapro Computer User Survey generated responses from 46 Level 62 users. These respondents varied widely in their level of experience with their Honeywell systems. The reported system life ranged from 6 months to 5 years with an average of nearly 28 months. Twenty-seven users are now leasing their Level 62 systems with eleven systems on rental and eight purchased directly.

Accounting was the principal application listed for 37 respondents. The remaining application areas are listed here in order with the corresponding number of votes:

➤ supervisor resides, including both the transient and resident areas assigned to the supervisor.

CENTRAL PROCESSORS

The Level 62 uses a microprogrammed processor. Level 62 systems are based on one central processor that can be enhanced through the addition of hardware packages. These packages, known as performance modules, permit greater main memory capacity, greater peripheral capacity, and performance increases of 33, 78, or 90 percent over that of the basic configuration.

The Level 62 central processor is divided into a CPU and an I/O control unit. The CPU consists of five functional units: the main memory control, the processor logic unit, the command generator, read-only memory (ROM), and microprogram control. The main memory control interfaces with main memory, and contains addressing and data interchange registers. The processor logic unit provides control functions to the CPU. It controls instruction fetching, decoding, and execution as well as main memory and I/O operations. The command generator decodes machine-language microinstructions from either main memory or ROM and generates appropriate control commands and transfer functions to accomplish the operations specified by the instructions.

Read-only storage contains the resident microprograms needed to control the system. The internal hardware facilities of the Level 62 CPU are used chiefly for execution of these microprograms. High-speed control microprograms, such as those used for disk storage, are stored in ROS, while control microprograms for low-speed peripherals are stored in main memory. The microprogram control can address the entire 240-bit ROS or the first 64K words of main memory. It addresses, fetches, and stores data from ROS or main memory and also calculates the succeeding microinstruction address.

A time-of-day clock is also incorporated in the Level 62 CPU.

CONTROL STORAGE: Consists of both bipolar read-only storage (ROS) and firmware routines located in main memory. Routines from both sources are executed by the CPU. Read-only memory access time is 170 nanoseconds for the Level 62 CPU.

REGISTERS: The Level 62 CPU has 29 16-bit registers that include 16 general-purpose registers, 8 base address registers, and 5 special-purpose memory protection registers. Eight of the general-purpose registers can be used for address indexing.

PROCESSOR MODES: There are two modes of processor operation, master and slave. The master mode, used only by GCOS, allows unrestricted access to all of main memory, permits initiation of I/O operations, and permits setting of control registers. The slave mode is used by user programs and also by GCOS when appropriate. In the slave mode, all storage references are relative to the base address register's contents and are restricted to assigned boundaries, program execution times are limited by the timer registers, and input/output and certain control operations cannot be executed.

INSTRUCTION REPERTOIRE: The Level 62 CPU has an instructions set that includes arithmetic instructions for performing decimal and binary operations (add, subtract, multiply, and divide) on packed or unpacked data, logical operations, editing functions, and operations for address computations. The CPU executes 141 instructions. Operands can be binary, fixed-point or decimal; in packed or unpacked format; on bytes, byte strings, or bit strings. The optional Scientific Instruction Set adds 24 instructions and floating-point capabilities.

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➤ Payroll/Personnel—23, Manufacturing—15, Transaction Processing—8, Service Bureau—5, Retail—5, Insurance—4, Construction—3, Banking and Finance—3, Distributed Processing—3, Education—2, and Medical/Health Services—2. Thirty-nine users reported that in-house personnel were their source of programs. Fourteen took the proprietary software package route and eleven purchased “ready-made” programs from Honeywell. Ten users arranged contract programming while five utilized Honeywell’s personnel as their software source.

The principal programming language was also noted in such extremes. Forty users rated COBOL their number one language and twenty responded that RPG was their primary language. FORTRAN was only able to glean three votes in total. For 1981, twenty users plan to expand the Level 62 data communications facilities. Fourteen respondents hope to buy proprietary software from other vendors while eleven are returning to the manufacturer for additional software.

The system ratings provided by the Level 62 users are summarized in the following table:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	18	18	9	0	3.2
Reliability of mainframe	16	18	10	2	3.0
Reliability of peripherals	9	26	7	3	2.9
Maintenance service:					
Responsiveness	15	22	6	2	3.1
Effectiveness	11	22	7	6	2.8
Technical support:					
Trouble-shooting	7	19	16	3	2.7
Education	7	14	21	4	2.5
Documentation	2	16	18	10	2.2
Operating systems	17	22	6	1	3.2
Compilers and assemblers	15	24	5	1	3.2
Applications programs	2	20	9	4	2.6
Ease of programming	5	34	5	1	3.0
Ease of conversion	4	22	20	3	2.7
Overall satisfaction	9	27	6	3	2.9

*Weighted Average on a scale of 4.0 for Excellent.

When these results are compared with last year’s entries, Honeywell shows some improvement in the areas of reliability of peripherals, maintenance service and technical support (excluding documentation). On the negative side, thirteen users felt that the vendor did not provide all the promised software and support services. Also, eleven users noted that the system proposed by the vendor was too small and had to be replaced or expanded. To counter this, thirty one respondents were pleased that the Level 62’s were easy to expand and reconfigure. Seventeen users were happy with their response time and sixteen noted that programs and data carried over from other systems were compatible as the vendor had promised.

The tough question facing a vendor is whether they can retain their installed customer base. Thirty of the users did not expect to replace their systems in the near future while six were planning to move to a different manufacturer. In response to the final questions “Would you recommend

➤ **INTERRUPTS:** Interrupt signals are generated by conditions such as successful completion of I/O operations, I/O errors, arithmetic overflow, timer runout, attempts to reference out-of-bounds storage locations, etc. In the Level 62 central processor, interrupts are referred to microprogrammed routines located in the central processor read-only memory for initiation of the appropriate servicing routines.

CONSOLE: The Level 62 console incorporates a 30-character-per-second serial printer (optionally 120 cps); an alphanumeric typewriter keyboard; one or two optional tape cassette drives, or, mutually exclusive of the cassette tape subsystem, a single or dual diskette subsystem; and a system operator panel for monitoring the central processor and all peripheral equipment.

INPUT/OUTPUT CONTROL

I/O CHANNELS: Six I/O channels form the basis of the Level 62 system. All six basic I/O ports can transmit data concurrently with each other and with instruction execution. Systems can be configured with a Port Expander Unit which allows up to four subsystems to operate non simultaneously on a single port. The I/O transfer rate is 837,000 to 1,587,000 bytes per second.

SIMULTANEOUS OPERATIONS: In the Level 62 systems, program execution can proceed concurrently with data transfer operations on six overlapping input/output channels. The maximum total input/output rate for the system is 1,587,000 bytes per second. The system can support a maximum of 13 concurrent activities with any combination of batch and communications and one test and development activity.

CONFIGURATION RULES

The maximum configuration parameters for a Level 62 system are as follows:

- Up to 992K bytes of main memory
- Up to 1,800 megabytes of on-line disk storage
- Up to 100 terminals
- Up to 4 magnetic tape drives

WORDSTATIONS: Up to 100 terminals can be connected to the Level 62 via 25 communications lines and assuming 4 terminals per line. Asynchronous and synchronous CRTs are available to provide the maximum flexibility for the user.

DISK STORAGE: Four different storage sizes are available for the Level 62. These sizes are 20.13-, 29.2-, 80-, and 300-megabytes. The 20.13-megabyte system is available only in a two-unit configuration. The remaining sizes may be arranged in configurations of from two to six units. A diskette unit with 256K or 512K bytes of storage is also available.

MAGNETIC TAPE: Drives of 18.75 and 37.5 inches per second may be used on the Level 62. Both types read and record on seven- or nine-track magnetic tape in a variety of densities from 200 to 1600 bits per inch. A subsystem includes from two to four drives.

PRINTERS: The Level 62 supports a wide range of line printers with speeds ranging from 100 to 1600 lines per minute. Impact-, belt-, and drum-type printers are available.

MASS STORAGE

DDU001/0002 DISKETTE UNIT: This unit consists of one DDU001 drive and, optionally, one DDU002 drive. ➤

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➤ this system to another user in your situation", Honeywell received thirty four positive votes to eleven negative responses.

Several users were then contacted by phone to verify the ratings that Honeywell's Level 62 had received. Comments from these interviews follow.

The first user we contacted was a winery in the Northeast who uses his Level 62 for all the traditional financial processing activities, as well as for sales order entry, product analysis, and production control. A successful user of Interactive Processing System, he was very pleased with IPS and its substantial improvement in his overall system productivity. His CPU had the "D" level performance enhancement, and is able to handle most all of his processing needs. His previous system was the IBM System/3 Model 10, the most frequently mentioned prior system, which typifies Honeywell's marketing strategy for the Level 62.

A manufacturer in the Northeast also replaced a System/3 Model 10 with a Level 62. He is presently operating with the "E" performance enhancement, and uses the Level 62 for financial, personnel, and manufacturing applications. Although he felt the service was pretty good overall, he wasn't altogether happy with the system's performance and said he was "looking around." He noted a three-month period in 1979 where he averaged two service calls each day on his system until Honeywell got to the heart of the trouble. Since then the system has functioned satisfactorily.

Moving westward, we interviewed a Midwestern chemical manufacturer who was generally pleased with his Level 62.

He had an older Honeywell Series 200 Model 115/2 which he replaced with the new system in mid-1979. His Level 62 works on all standard financial/payroll and various manufacturing activities, and he now has Interactive Processing System (IPS) on order.

Another Midwestern user who manufactures magnetic metals has had his Level 62 for over three years, and is quite pleased with it, saying that his Level 62 delivers "more bang for the buck." He is using IPS and runs his own in-house as well as outside programs very successfully.

Moving southwesterly, we interviewed a furniture manufacturer who only eight months ago replaced a Univac 9300 with a Level 62. Although he is still learning about his new system's capabilities, he is quite eager to get rolling into full gear. His comments were generally positive, although he gave low marks to Honeywell's training and documentation. The system has IPS, and he observed that IPS is quite powerful, albeit challenging to learn.

Again in the Southwest, a non-profit organization's DP manager told us he had experienced some operating ➤

➤ **Subsystem capacity is 256K or 512K bytes, respectively.** The unit records IBM 3740-compatible diskettes by formatting data onto 77 tracks, each containing 26 sectors of 128 bytes.

MSU0112/0113/0116 MASS STORAGE UNITS: These mass storage units feature a combination of fixed-disk and removable disk cartridge storage media. The disk units have the capability to read cartridge disk originally created on the IBM System/3 Model 5444 Disk Storage Drives. The basic subsystem configuration consists of a dual-spindle MSU0112 Mass Storage Unit, which includes one 5.8-million-byte removable disk cartridge and one 5.8-million-byte removable disk cartridge and one 5.8 million-byte fixed disk for a total capacity of 11.6 million bytes. The same cabinet can house an additional dual-spindle MSU0116 unit containing one 5.8-million-byte fixed disk and one 5.8-million-byte removable disk cartridge, or a single-spindle MSU0113 containing one removable disk cartridge with a capacity of 5.8 million bytes.

Total cabinet capacity is 23.2 million bytes for an MSU0112 and MSU0116 combination. A second cabinet can house an additional MSU0112 spindle and can be expanded to include an MSU0113 or MSU0116 unit for a total subsystem capacity of 46.4 million bytes.

MSS0317 MASS STORAGE SUBSYSTEM: Consists of two 20.13-megabyte drives plus the addressing option. The MSS0317 uses the Honeywell Type M4180 (or equivalent) disk pack, an 11-disk unit with 20 recording surfaces. Data is formatted at 7294 bytes per track on 138 tracks per surface. The MSU0317 is field-upgradable to a 58.4-megabyte MSF0317. Four additional spindles and additional capacity for the first two may be added, for a system subtotal of 175.2 megabytes.

MSUU0330/0331 MASS STORAGE UNITS: This subsystem consists of two 80-megabyte disk drives: the MSU0330 primary drive with stand-alone cabinet and the MSU0331 secondary drive that mounts in a drawer in the MSU0330 cabinet. The subsystem also includes the CPA2027/2028 addressing features, each providing addressing capabilities for one two-drive cabinet. Both drives are identical in characteristics and use the Type 4130, or equivalent, 5-disk removable pack. Data is recorded on 5 surfaces, each with 808 tracks.

MSU0390 MASS STORAGE UNIT: A 2-drive, 11-disk system that is similar to the MSU0330 except for its larger 300-megabyte drive capacity. Data is recorded on 19 surfaces of 823 tracks each. The drives can be added to an MSU0330 subsystem.

Level 62 systems can operate with from two to six mass storage units through an integrated mass storage controller.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

COMMUNICATIONS CONTROL

The Level 62 CPU includes, as standard equipment, an asynchronous line interface for the system console. This interface can be expanded into an integrated data communications controller that supports up to four additional communications lines. The communications system can be configured as synchronous, asynchronous, or synchronous/asynchronous. A second five-line controller can also be added to the CPU. For greater capacity, one or two Extended Data Communications Controllers (EDCC's) can ➤

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➤ problems with his Level 62 over its three-year installation period. Even after assistance from Honeywell, the system did not function to his satisfaction, and he decided to replace the system with a competitive model.

Returning to the Northeast, we contacted a computer components manufacturer who was very pleased with his Level 62, after replacing a System/3 Model 10 with it over three years ago. He is actively pursuing IPS, and commented on its recent introduction as taking Honeywell "out of the ice age." He gave high marks on just about every aspect of his Level 62, and was looking forward to increasing his data communications operations and software procurements for 1980. □

▶ be attached, supporting up to 25 lines. Honeywell states that four or five terminals are normally served by each line with either system.

Special addressing features to address and access communications equipment are offered in multiples of two lines: the DCA2301 provides addressing for two asynchronous lines, while the DCA2302 and DCA2303 provide addressing for two synchronous remote or direct (local) lines, respectively. A line termination adapter is required for each line; the DCF2301 and DCF2302 for asynchronous lines or the DCF2302 and DCF2303 for synchronous lines.

The Level 62 communications subsystem provides a communications throughput of up to 2400 characters per second. The maximum line capacity is 1200 characters per second. In the asynchronous mode, the following line speeds are software-selectable: 110, 150, 300, 1200, or 2400 bits per second. Synchronous line speeds to 9600 bits per second are supported. The optional EDCC subsystem provides throughput of up to 7200 characters per second depending on system configuration. Individual line speeds of up to 9600 bps for asynchronous or 19,200 bps for synchronous transmission are possible. The data communications terminals supported include the Honeywell VIP7804/7805/7700/7760/7100/7200, matrix serial printers; the GE TermiNet 300; the Teletype Models 33, 35, 37, and 38; the IBM BSC 2780, 3270, and 3741; and ISO.

SOFTWARE

GCOS: All Series 60 systems run under either a subset or the full implementation of the GCOS operating system.

LEVEL 62 GCOS: The subset of GCOS for the small-scale Level 62 computers features multiprogramming, dynamic memory management, and fail-soft operations. Each activity is a stream of jobs to be processed by the system. Activities are associated with a given input device and are initiated by the system operator. Transition from job to job is automatic within an activity. System resources are allocated at the beginning of a job step and de-allocated at the end of a job step. If resources required for a job step are not available, the job step is placed into a "wait queue." The job is automatically started when resources become available. Jobs within an activity are executed sequentially. Jobs belonging to different activities can be processed concurrently. Any number of jobs can be processed concurrently, limited only by the amount of physical memory present in the system. GCOS also maintains a "run queue," a list of jobs ready for initiation. Whenever an executing job is interrupted, the operating system selects a ready-to-run job from the run queue and processes the job.

The dynamic main memory feature provides automatic memory management. GCOS maintains a map of the locations and sizes of all available memory areas. When a job requires additional memory space, the operating system searches the map for a suitable area and assigns the area to the requesting activity. If no single area is large enough to accommodate the request, GCOS dynamically relocates activities within memory to create one contiguous area large enough to accommodate the request.

GCOS Level 62 uses segment-relative addressing to optimize the use of main memory. All programs on a Level 62 system are executed as fully relocatable segments. Level 62 machine instructions refer to segment-relative addresses, without regard to the physical location of the referenced operand. A segment may reside anywhere in memory, and at different times may reside in different places.

With GCOS, the segments of a program are defined by the compilers and, optionally, under the control of the programmer. Segments are variable in length, permitting segmentation to follow the logic of the program and ensuring that distinct elements, such as iterative loops, are not split between segments.

When a program is ready for execution, the Initiator routine first constructs a portion of the core image on the system disk file and subsequently loads the core image into main memory.

Whenever a new segment is needed, GCOS searches main memory for a large enough space to load the segment. If there is no space large enough, GCOS relocates the segments already in memory to collect all available space into one continuous area. As a last resort, GCOS may remove the least active segment in main memory to make room for a new segment. The removed segment is only written back to the backing store if it has been changed while in memory. Instruction coding is re-entrant and is never modified.

Job flow through the system is controlled by GCOS job management. The input reader reads the job input while other jobs are executing and translates the job control information into an internal format to speed job processing. A job scheduler schedules the execution of the jobs using a system of job classes and priorities within each class.

Resources are allocated at file, volume, and device levels to each job step, and deallocated when each job step is completed.

Disk files are sharable under Level 62 GCOS. However, if file protection is required, multiple access can occur only in read mode.

The GCOS Level 62 file management facilities support five file organizations: sequential, indexed, relative, queued-partitioned, and queued-linked. The latter two organizations are used only by the GCOS operating system and are invisible to users.

Sequential files are organized solely on the basis of their successive physical locations in the file. The records are also arranged in a logical sequence according to their keys as well as in physical sequence, and are usually read or updated in the same order they appear.

Indexed files are similar to sequential files in that rapid sequential processing is possible. The indexed organization makes it also possible to locate individual records quickly for direct (random) processing. Moreover, new records can be inserted by referring to sequentially ordered indexes associated with the file and physically added at the end of the file. ▶

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Relative files are characterized by a predictable relationship between the key of each record and the address of that record on a disk device. This relationship is established by the user. Relative file organization is used when the time required to locate individual records must be kept to an absolute minimum.

The GCOS fail-soft feature allows the operator to reconfigure main memory in the event of a memory failure or to bypass or make a substitution for certain malfunctioning peripheral devices. If a memory module fails, only those jobs directly affected by the failure are aborted. The operator can allow unaffected jobs to run to completion and then reconfigure main memory, or all executing jobs can be suspended, memory reconfigured, and suspended jobs restarted.

The Level 62 GCOS Communications Subsystem supports up to 25 communications lines operating in the synchronous or asynchronous transmission modes. It performs such functions as line discipline, terminal device handling, control character editing, message queuing, error handling and recovery, and synchronization of multiple simultaneous data transmission activities.

GCOS Level 62 supports three standard programming languages: ANSI standard COBOL-74, RPG, and FORTRAN. A version of the Cincom Systems TOTAL data base management system is also provided.

TOTAL: TOTAL Universal, available for Level 62 systems, is designed for small-scale implementations. It requires 14K bytes of main memory plus an additional amount for I/O buffers. A read-only version that requires only 7K bytes is also offered. The TOTAL Data Base Management System is designed and marketed by Cincom Systems, Inc.

INTERACTIVE PROCESSING SYSTEM (IPS): IPS is an information management subsystem of Level 62 GCOS, and provides decentralized, conversational access to all system facilities. It offers a distributed, multi-user work station environment that accepts transactional as well as batch processing requirements. These facilities can be interactively selected from work stations using a menu approach.

IPS is made of five main functional components, a set of utilities which supports them, and a Support File. The components include Interactive File Services, Interactive Job Management, Transaction Programming System, Interactive Data Facilities, and the IPS Monitor. Utility services include Interactive System Management, Text Editor, Screen Formatting, and IPS Utilities.

IPS COMPONENTS:

Interactive File Services (IFS): Provide capability to enter data, update, inquire, and generate reports without having to write programs.

Interactive Job Management (IJM): Provides interactive handling of various activities, such as source programs, job descriptions, data video screen formats, and online documentation. The user can interactively (1) develop applications and (2) interface with other jobs outside the IPS environment.

Transaction Programming System (TPS): A rapid, economical method of implementing online, transaction-oriented applications written in an RPG- and/or COBOL-like language. Each transaction type is called an interactive transaction program (ITP), and consists of one or more message routines, each of which possesses a single logical function.

Interactive Data Facilities (IDF): Permit various interactive data entry applications using an RPG-like language. IDF is

similar to TPS in the use of interactive transaction programs (ITP) composed of message routines. Unlike the data entry facilities available with IJM and IFS, the full data processing functionality of TPS is available with IDF.

IPS Monitor: Provides control of the dialogues between the system and the user. It manages traffic in and out of the system and controls the orderly flow of the workload.

IPS SERVICES:

System Management: Provides means to operate all aspects of system administration such as security, passwords, users, functions, menus, etc.

Interactive Text Editor: Powerful device that provides a full range of editing features for any kind of text.

Interactive Screen Formatting: Provides flexible screen modifications on a field-by-field basis by specifying the position and attributes of each field. A batch version of this service is also provided.

IPS Utilities: A set of batch utility programs that transfers data between the Support File and either sequential files or libraries, lists Support File directories, lists the contents of the Support File, and modifies the size of the Support File data zone.

IPS SUPPORT FILE:

At the heart of the Interactive Processing System is the Support File. It contains the various system and user subfiles required for successful execution of IPS activities. The Support File includes such items as menus, screen formats, interactive documentation, job descriptions, source program code, and user subfiles containing data. It is protected from unauthorized entry by the security mechanisms within IPS.

At least 224K bytes of main memory in the Level 62 are required to support the following: One IPS activity, one batch activity, and one output writer. In addition, one or both of the following communications supervisors is required for terminals: SBC0005 and/or SBC0006 for synchronous and asynchronous, respectively.

PROGRAMMING LANGUAGES: Honeywell provides three popular programming languages for Level 62 Systems: COBOL, RPG, and FORTRAN.

Level 62 COBOL: This compiler conforms to American National Standard specification X3.23-1974. The level of implementation of each of the functional processing modules is as follows:

<u>Module</u>	<u>Level of Implementation</u>
Nucleus	2
Table Handling	1
Sequential I/O	2*
Relative I/O	2*
Indexed I/O	2*
Sort	2
Segmentation	2
Inter-Program Communication	1
Debug	2
Library	1
Communications	2

*Not a complete implementation.

Three modules are incomplete implementations of the indicated levels. The Sequential I/O module omits variable-length and spanned record capabilities, the Relative I/O

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module omits variable-length record capabilities, and the Indexed I/O module omits ALTERNATE KEY and variable-length record capabilities.

The compiler is disk-resident and accepts inputs from 80- or 96-column cards or from the source unit library disk. It produces object-code modules from disk work files that can be linked into executable load modules.

Comprehensive diagnostic and debugging tools are included with Level 62 COBOL. The diagnostic routines produce listings, data maps, card maps, and cross-reference listings. The debugging routines permit specification of data items and procedures to be monitored during program execution. All debugging statements can be automatically omitted from the compilation once the program is finished.

The Level 62 COBOL compiler requires 34,816 bytes of main memory, one disk unit, a printer or spooling file, and a sequential input device or source library.

The COBOL Data Communications Extension (GTC/MCS) is an optional extension to the basic COBOL ANS 74 language processor that provides language and functions representing Level 1 support of the Communications Module of the 1974 COBOL ANS Standard.

RPG: The RPG language processor used in Level 62 systems permits the interchange of data files among RPG, FORTRAN, and COBOL programs. Object programs can be written in COBOL, FORTRAN, or other languages. The Level 62 RPG compiler occupies 28,672 bytes of main memory and requires one disk unit, one printer or spooling file, and one sequential input device or source library.

FORTRAN: Level 62 FORTRAN is a version of ANSI FORTRAN IV with some extensions. The language processor consists of two packages, the FORTRAN compiler and the FORTRAN run-time package. Level 62 FORTRAN occupies 28,672 bytes of main memory and requires one disk unit, one printer or spooling file, and one sequential input device, input stream, or source library.

APPLICATIONS SOFTWARE: Honeywell offers several vendor-supported user applications as well as its Applications Reference Index (ARI). The ARI program is a service established by Honeywell that lists applications software packages that have been developed by non-Honeywell sources and are offered for sale by the developer. The ARI currently lists and describes over 100 applications packages.

Application packages available for Level 62 systems include Accounts Payable, Accounts Receivable, General Ledger, Payroll, Inventory Management, and Production Scheduling and Control System. A complete list of all Honeywell-supported packages is listed in the Equipment Prices section of this report.

PRICING

EQUIPMENT: The following systems are representative of the wide range of possible Series 60 Level 62 configurations. The quoted rental prices are for the basic one-year lease and include equipment maintenance.

MINIMUM LEVEL 62 SYSTEM: Includes a Level 62 CPU with 96K bytes of memory, a 40.2-megabyte disk subsystem consisting of two 20.1-megabyte MSS0317 disk pack drives, a 100-lpm PRS0115 line printer, and one of the following system input devices: a cassette tape drive or a diskette drive. This minimum configuration is priced at \$65,703 or \$1,590 per month on a five-year lease. Maintenance charge is \$435 per month.

TYPICAL TWO-USER LEVEL 62 SYSTEM: Includes a 160K-byte CPU with the type "C" performance upgrade (33 percent) module, 30-cps console printer/keyboard, and two synchronous direct line adapters; a 160-megabyte disk subsystem consisting of two 80-megabyte MSU0300/0331 drives; a 450-lpm PRS0458 line printer; a 200-cpm CRU0300 card reader; and two VIP7804 1920-character CRT display terminals. This configuration can be purchased for \$109,353 or rented for \$2,569 per month on a five-year lease. Maintenance charge is \$590 per month.

LARGE LEVEL 62 SYSTEM: Includes a 224K-byte CPU with the type "D" performance upgrade (78 percent) module, 120-cps console printer/keyboard, dual cassette tape drives, port expander unit, and two local and six remote synchronous lines; a 480-megabyte disk subsystem consisting of six 80-megabyte MSU0330/0331 disk drives; four 37.5-ips, 9-track MTU0220 magnetic tape units; a 1600-lpm PRU1600 line printer; a 1050-cpm CRU1050 card reader with mark sense capabilities; and a PCU0120 card punch. The system can be purchased for about \$374,605 or rented for about \$9,371 per month. Monthly maintenance charge is \$2,070.

SOFTWARE: Generally, the basic operating system, basic job management and file systems, programming tools such as linking and debugging aids, the job control language, and conversion aids are provided to Level 62 users at no additional cost. Users also receive communications supervisors at no extra cost. A basic kit of documentation is also provided with the system. Monthly license fees are charged for language processors, utilities, application packages, communications software, and advanced job management and file systems. Extra charges are also levied for customer services, such as education, program development, system design, implementation and conversion, and network design.

CONTRACT TERMS: Level 62 equipment is available for purchase or for rental under a 1-year, 5-year or 6-year lease. Selected peripherals are offered on a 3-year lease. Monthly rental prices include on-call maintenance between the hours of 8 a.m. and 12 midnight. ■

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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>	<u>Rental (1-year lease)*</u>	<u>Rental (5-year lease)*</u>
CENTRAL PROCESSOR					
CPS2004	Basic Level 62 Central Processor; includes CPU, 96K bytes of MOS memory, six integrated channels, and a system console consisting of a keyboard, 30-cps printer, console diskette or tape cassette unit, and integrated communications controller for support of 1 to 4 lines	\$33,192	\$160	\$855	\$719
MAIN MEMORY					
CMM2354	32K-Byte Main Memory Module and addressing	3,315	13	94	80
CAB 2304	Memory Expansion above 224K bytes	11,165	12	250	211
CMM238X	128K-Byte Main Memory Module and addressing	2,750	11	83	70
PROCESSOR OPTIONS					
CPF2300	Scientific Instruction Set	456	1	11	9
CPF2304	Performance Module C; provides 33 percent increase in performance	5,956	13	137	115
CPF2305	Performance Module D; provides 78 percent increase in performance	7,496	12	161	135
CPF2307	Performance Module E; provides 90 percent increase in performance	6,614	20	149	125
CSF2309	120-cps Console Printer, replaces 30-cps printer in basic system	3,591	13	91	77
PEU2300	Port Expander Unit	12,312	27	292	246
CPK2003	Retrofit kit, upgrade CPS2003 CPU to CPS2004	9,458	—	77	65
MASS STORAGE					
DDU0002	Second Diskette Drive; maximum of two drives	6,441	52	197	167
CTU0002	Second Cassette Drive	6,441	52	197	167
MSS0317	40.3-Megabyte Mass Storage Subsystem; includes addressing and two spindles	16,580	135	564	470
MSF0317	18.1-Megabyte additional capacity for first two spindles on MSS0317 mass storage subsystem	2,180	—	54	44
MSF031X	29.2-Megabyte additional capacity for each of the 3rd through 6th spindles	6,420	75	222	186
MSU0330/1	80-Megabyte Disk Drive and cabinet for drawer mounting (CPS 2000)	15,700	81	479	394
CPA2327	Addressing for first two MSU0330 Disk Drives	8,320	10	163	137
CPA2328	Addressing for third and fourth MSU0330 Disk Drives	1,035	4	30	25
CPA2329	Addressing for fifth and sixth MSU0330 Disk Drives	1,035	4	30	25
MSU0390	300-Megabyte Disk Drive	34,500	189	1,146	964
CPA2333	Addressing for first two MSU0390 Disk Drives	8,320	10	163	137
CPA2334	Addressing for third and fourth MSU0390 Disk Drives	1,035	4	30	25
CPA2335	Addressing for fifth and sixth MSU0390 Disk Drives	1,035	4	30	25
CPA2336	Addressing for first and second MSU0390 Disk Drives utilizing CPA2327 addressing feature	1,035	4	30	25
CPA2337	Addressing for third and fourth MSU0390 Disk Drives utilizing CPA2327 addressing feature	1,035	4	30	25
MAGNETIC TAPE EQUIPMENT					
CTU0001/2	Cassette Tape Drive; maximum of two drives	6,441	52	197	167
MTU0111	18.75-ips Slave Drive	6,389	52	208	169
MTU0120	18.75-ips Primary Drive	7,644	66	251	205
MTU0121	18.75-ips Secondary Drive	6,389	52	208	169
MTU0211	37.5-ips Slave Drive	8,568	76	321	279
MTU0220	37.5-ips Primary Drive	9,980	89	350	284
MTU0221	37.5-ips Secondary Drive	8,160	72	287	233
MTF0101/201	1600-bpi, 9-track Read/Write Head for MTU0211/0120/0121 magnetic tape drives; MTU0220/0221/0211 drives	2,274	16	74	66
MTF0102/202	800/1600-bpi, 9-track Read/Write Head for MTU0211/0120/0121 magnetic tape drives; MTU0220/0221/0211 drives	2,630	41	109	96
MTF0103/203	200/556-800-bpi, 7-track Read/Write Head for MTU0211/0120/0121 magnetic tape drives; MTU0220/0221/0211 drives	2,630	41	109	96
MTF1002	NRZ Option	240	—	5	5
LINE PRINTERS					
PRS0115	100-lpm Belt Printer Subsystem for CPS2004 central processor; includes 132 print positions and addressing, requires print belt	9,490	101	288	242
PRF0215	200-lpm Speed Feature for PRS0115 belt printer	2,080	12	76	63
PRF0315	300-lpm Speed Feature for PRS0115 belt printer; requires PRF0215 feature	2,075	41	68	58
PRC0600	Print Belt, 94 characters, ASCII	670	3	20	17
PRS0458	450-lpm, 132-Print Position Line Printer	13,645	146	432	362
PRF0658	650-lpm feature for PRS0458	1,975	20	63	53

*Rental prices include maintenance.

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EQUIPMENT PRICES

LINE PRINTERS (Continued)		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
PRU1200	1200-lpm, 136-Print Position Line Printer	44,420	386	1,698	1,463
PRU1600	1600-lpm, 136-Print Position Line Printer	64,940	538	2,482	2,112
CPA2110	Addressing for PRU1200/1600	13,224	45	331	297
PRF0022	160 Print Positions, PRU1200/1600 Line Printers	2,610	15	93	78
PRB0402	Print Belt, 48 characters, IBM	2,567	95	165	151
PRB500/24	Print Belt, 63 characters, G100/IBM/ASCII/OCR-A/B	2,460	90	151	134
PRB0600	Print Belt, 94 characters, ASCII	2,567	90	165	151
PRB0703	Print Belt, 64 characters, Series 200/2000	2,460	90	151	134
PEA2110	PEU Addressing for PRU1200/1600	13,224	47	331	278
PRK1216	Retrofit kit to upgrade PRU1200 to PRU1600	20,520	152	784	649
CARD EQUIPMENT					
CRU0300	80-Column Card Reader, 300 cpm	6,441	55	197	167
CRU0306	96-Column Card Reader, 300 cpm	6,441	55	197	167
CPA2116	Addressing for CRU0306	969	3	25	21
PEA2116	Port Expansion Unit Addressing for CRU0306 Card Reader	969	3	25	21
CRU0500	80-Column Card Reader, 500 cpm	7,560	68	247	219
CPA2111	Addressing for CRU0300/0500	1,995	10	55	46
CRF0001	IBM Mark Sense for CRU0300/0500 Card Reader	4,305	19	141	125
CRF0002	HIS Mark Sense for CRU0300/0500 Card Reader	4,305	18	141	125
CRU0600	80-Column Card Reader, 600 cpm	21,126	125	715	620
CRU1050	80-Column Card Reader, 1050 cpm	25,290	185	891	766
CRF0003	51-Column Card Capability for CRU0600/1050	2,079	5	67	55
CRF0004	Mark Sense for CRU0600, HIS and IBM format	7,787	48	237	205
CRF0005	Mark Sense for CRU1050, HIS and IBM format	7,787	48	237	205
CPA2112	Addressing for CRU0600/1050	3,078	11	80	67
PEA2112	PEU Addressing for CRU0600/1050	3,078	11	80	67
PCU0120	80-Column Card Punch, 100 to 400 cpm	19,078	116	700	589
CPA2114	Addressing for PCU0120	3,762	13	99	83
PEA2114	PEU Addressing for PCU0120	3,762	13	99	83
CRK0305	Retrofit kit, upgrade CRU0300 to CRU0500	1,119	14	50	53
CRK0610	Retrofit kit, upgrade CRU0600 to CRU1050	3,192	67	221	184
TERMINALS					
VIP7100	Asynchronous CRT, 12 lines of 80 characters, TTY-compatible	1,500	23	—	64
VIP7105	Asynchronous CRT, 12 lines of 80 characters, upper and lower case, TTY-compatible	1,600	24	—	67
VIP7200	Asynchronous CRT, 63-character set	1,980	28	—	80
VIP7205	Asynchronous CRT, 95-character set	2,100	28	—	83
VIP7804	Synchronous CRT, 24 lines of 80 characters, 95 ASCII character set, 12-inch screen	3,060	33	—	114
VIP7805	Synchronous CRT, 24 lines of 80 characters, 95 ASCII character set, 15-inch screen	3,360	39	—	128
7700R	Synchronous CRT, 24 lines of 80 characters, 63 ASCII character set, upper case only; requires 7731 or 7732	3,990	36	—	142
7705R	Same as 7700R but with 95 ASCII character set	3,990	36	—	142
7715R	Direct Connect Timing Source	350	3	—	13
7722R	10-cps/30-cps/120-cps Printer Adapter and Timing Source	750	8	—	29
7729R	30-cps/120-cps Adapter and Timing Source	550	8	—	30
TWU1001	Asynchronous, 30-cps serial printer with keyboard, 64-character buffer, 300 bps	2,470	29	—	95
TWU1003	Asynchronous, 30-cps serial printer with keyboard, 64-character buffer, 110/200/300 bps	2,850	40	—	116
TWU1005	Asynchronous, 120-cps serial printer with keyboard, 1000-character buffer, 1200 bps	3,600	51	—	147
PRU1001	Asynchronous, 30-cps serial printer, 64-character buffer, 300 bps	2,620	28	—	88
PRU1003	Asynchronous, 30-cps serial printer, 64-character buffer, 110/200/300 bps	2,640	39	—	109
PRU1005	Asynchronous, 120-cps serial printer, 1000-character buffer, 1200 bps	3,390	50	—	131
TWU1901	Synchronous, 120-cps serial printer with keyboard, 960-character buffer, up to 4800 bps	4,500	66	—	186
PRU1901	Synchronous, 120-cps serial printer, 960-character buffer, up to 4800 bps	4,000	64	—	159
7760-60	Master Control Unit; includes diskette drive and interface, terminal controller, communications controller, program loader, and program media	16,800	66	—	457
7761-60	Auxiliary Control Unit; includes data path interface, terminal controller, and program loader; requires 7760-60 and 7767	11,200	36	—	305
7731	Display Adapter for 1920 characters; includes ASCII video generator and storage for 24 lines of 80 characters; required for each display	1,200	5	—	33
7732	Display Adapter for 960 characters; includes ASCII video generator and storage for 12 lines of 80 characters; provides connection for two display stations	1,200	5	—	33

*Rental prices include maintenance.

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EQUIPMENT PRICES

TERMINALS (Continued)		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
7734	RO Printer Adapter; includes 1920-character print buffer and logic; for 30-cps or 120-cps RO printer	1,360	5	—	36
7767	Datapath Interface; requires 7760-60	960	8	—	27
7768	Direct Timing Source; requires 7760-60	240	1	—	6
7769	Line Repeater Unit; requires 7706-60 or 7707-60	399	2	—	11
7706-60	Display/Keyboard Unit; requires 7731 or 7732	1,750	17	—	50
7707-60	Display Monitor Unit; requires 7731 or 7732	1,350	9	—	34
7707-64	Keyboard with Numeric Pad; requires 7707-60	400	9	—	16
7714A/B	RO Printer, 30 cps, 118 positions, pin feed	3,312	26	—	133
7716A/B	RO Printer; 30 cps, 120 positions, includes tractor feed	3,600	31	—	151
7717A/B	RO Printer; 120 cps, 120 positions, includes tractor feed	4,360	54	—	180
7741-60	Additional Diskette Device; requires 7760-60	2,166	20	—	61
DATA COMMUNICATIONS EQUIPMENT					
DCC2001	Integrated Data Communications Controller	2,451	5	58	49
DCA2301	Addressing for two Asynchronous Lines	1,653	23	60	51
DCA2302	Addressing for two Synchronous Remote Lines	1,653	23	60	51
DCA2303	Addressing for two Synchronous Direct Lines	342	3	11	9
DCF2300	Terminator for Asynchronous Direct Line	342	3	11	9
DCF2301	Terminator for Asynchronous Remote Line	456	5	15	13
DCF2302	Terminator for Synchronous Remote Line	912	12	33	28
DCF2303	Terminator for Synchronous Direct Line	57	—	1	1

*Rental prices include maintenance.

SOFTWARE PRICES

SYSTEMS SOFTWARE		Monthly License Fee	Paid-Up License
SBC0005	Communications Software—Synchronous Terminals	160	NA
SBC0006	Communications Software—Asynchronous Terminals	160	NA
SBC0007	Bisynchronous Communications, IBM 2780 Mode (CP-to-CP)	160	NA
SBC0008	Bisynchronous Communications, IBM 3741 Terminal Mode	13	NA
SBC0014	Binary Synchronous 3 Communications Control Supervisor	160	NA
SBC0015	Binary Synchronous 3 Communications Tributary Supervisor	160	NA
SBC0016	Binary Synchronous Communications Multileaving Supervisor	160	NA
SB00001	Universal TOTAL L2; includes maintenance for one year	567	15,593*
SBC0070	Interactive Processing System	54	NA
SBC6002	Host File Transceiver for Level 6	12	NA
SBL0002	RPG	14	NA
SBL0005	COBOL-74	106	NA
SBL0007	FORTRAN	138	NA
SBL0008	COBOL Macroprocessor	58	NA
SBU0002	SORT/MERGE	65	NA
SBU0005	Basic Utilities & Test Data Generator	15	NA
SBU0007	IBM 2780 Emulator Utility (CP-to-CP)	13	NA
SBU0008	IBM 3741 Emulator Utility	13	NA
SBJ0001	Transaction Response System	NA	1,386
SBJ0002	Data Collection System for VIP7700	NA	693
SBU0011	Multileaving Utility	13	NA
SBU0010	Transaction Programming System	13	NA
APPLICATION SOFTWARE			
ABD0020	PROFIT—Inventory Forecasting Module	197	6,912
ABD0023	PROFIT—Level I	295	10,370
ABD0024	PROFIT—Level II	361	12,674
ABF0001	Accounts Receivable	95	2,387
ABF0002	Accounts Payable	95	2,387
ABF0003	General Ledger	95	2,387
ABF0004	Payroll	95	2,387
ABF0011	Accounts Receivable On-Line	120	3,025
ABF0012	Accounts Payable On-Line	120	3,025
ABF0013	General Ledger On-Line Module	25	638
ABF6004**	Payroll Tax Update (for ABF0004)	NA	NA**
ABH0001	Hospital Accounting System (HAS/62)	319	9,550
ABM0002	Production Scheduling and Control (Infinite)	178	6,239
ABM0012	Production Data Management	76	2,674
ABM0022	Capacity Requirements Planning/Production Control Reporting	101	3,565
ABM0011	Inventory Reporting/Bill of Material Processor	106	3,725
ABM0041	Material Requirements Planning	96	3,375
ABM0021	Material Requirements Planning/Resource Inventory	197	6,877
ABM0031	Standard Cost Control	54	1,918
ABM0032	Production Scheduling and Control On-Line Inquiry Data Entry	92	3,234
ABM0051	IMS On-Line Inquiry Data Entry	92	3,234

*Software maintenance is required at \$1,040 per year.

**The Payroll Update is available for an annual fee of \$427 to all customers.