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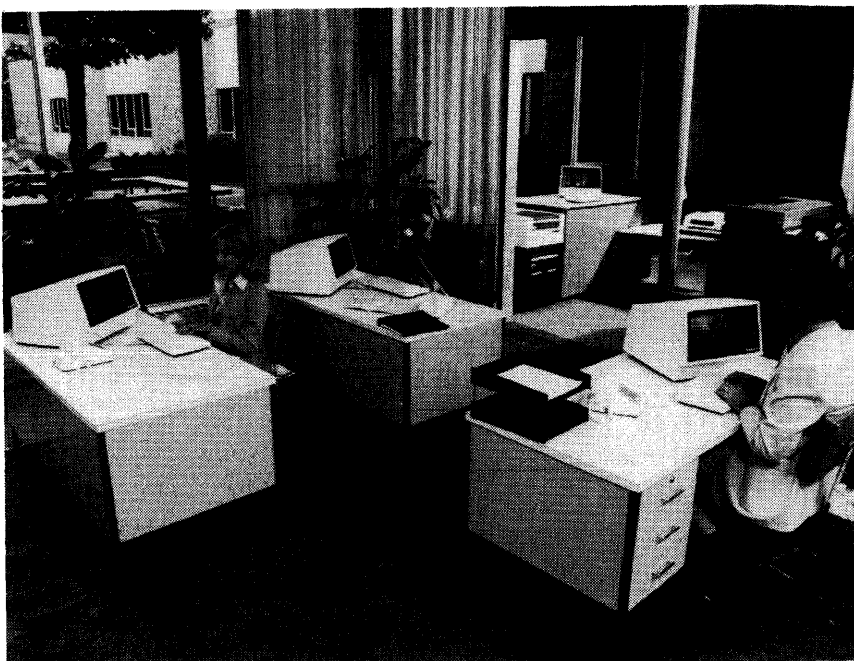
Honeywell designed the Level 62 to be a growth path for users of its established small business systems, certain members of the Honeywell-acquired General Electric product line, and other systems manufacturers. The Level 62 uses numerous hardware and software conversion aids to achieve upward compatibility.

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. ▷

To further enhance its Level 62 Honeywell has made available 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.

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.

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. ▶

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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▷ 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.

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. ▷

▶ 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 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. ▶

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> The technical support ratings reflect a general satisfaction with Honeywell's trouble-shooting efforts, but lower marks in training and documentation. Most users developed their applications programs in-house, with only a few programs acquired from Honeywell and other software houses. They were pleased with the system's performance and response time, but were concerned that the original system as proposed by the vendor was inadequate and had to be upgraded sooner than anticipated. When asked if they would recommend the system to another potential user 5 answered "yes," and 3 said "no." Six users were not planning to change their systems, but one was actively shopping around and another had already ordered a new system from a competitor.

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 ▷

> 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

MTU0120/0121/0111 MAGNETIC TAPE UNITS: These units make up a subsystem that includes an integral controller for up to four drives. The minimum configuration requires one MTU0120 primary drive and one MTU0121 secondary drive. Up to two MTU0111 slave drives can be added to the subsystem. The drives are 18.75-ips units and are available in three configurations: 9-track, 1600 bpi, 30,000 bytes/sec.; 9-track, 800/1600 bpi, 15,000/30,000 bytes/sec.; and 7-track, 200/556/800 bpi, 3750/10,425/15,000 bytes/sec. Drives with different configurations can be intermixed on one subsystem, but all drives must have the same tape speed.

MTU0220/0221/0211 MAGNETIC TAPE UNITS: These units differ from the MTU0120/0121/0111 drives only in tape speed, which is 37.5 ips instead of 18.75, and in data transfer rates, which are twice as high.

CTU0001/0002 CASSETTE TAPE SUBSYSTEM: Includes a single drive unit (CTU0001) and optional second drive unit (CTU0002) integrated into the Level 62 operator ▶

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➤ The 7700R and 7705R feature a forms display facility that provides ease of format development. The keyboard employs a typewriter layout with more than 60 keys for generating a 128 ASCII character set.

The 7700R or 7705R can operate as a single station or in clusters of 2 to 10 stations. Transmission is half-duplex synchronous employing ASCII code at 2400, 4800, or 9600 bps. The terminal interface is RS-232-C. The VIP 7700R is supported by IPS.

VIP 7760 TERMINAL DISPLAY SUBSYSTEM: A multiple-terminal subsystem with the capacity to handle up to 32 terminals on the same communications line. As many receive-only printers may be connected to a control unit as there are displays on the control unit (a maximum of eight). One printer may be shared by up to seven CRT displays for local print functions. The 7760 subsystem is compatible with Honeywell's single-station units, the VIP7700 and VIP7705R. The VIP7760 is also supported by IPS.

The 7760-60 Master Control Unit includes communications and terminal controllers and a diskette unit for local forms storage and limited backup storage to the host processor. The 7760-60 handles up to eight CRT's, and up to three auxiliary controllers can handle eight CRT's each.

The 7706-6 Display Keyboard Unit displays either 960 or 1920 characters, employing a 7-by-9 dot matrix for each character. The 7706-6 can display 96 distinct characters and is similar to the VIP7100/VIP7105 keyboard.

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 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. ➤

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▶ **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:

Module	Level of Implementation
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 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.

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.

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.

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.

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.

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

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
LINE PRINTERS (Continued)					
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	58	133	116
PRB0513	Print Belt, 63 characters, ASCII	2,460	59	120	103
PRB0600	Print Belt, 94 characters, ASCII	2,567	58	134	120
PRB0703	Print Belt, 64 characters, Series 200/2000	2,460	59	120	103
CARD EQUIPMENT					
CRU0300	80-Column Card Reader, 300 cpm	6,441	52	197	167
CRU0306	96-Column Card Reader, 300 cpm	6,441	52	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	65	247	219
CPA2111	Addressing for CRU0300/0500	1,995	10	55	46
CRF0001	IBM Mark Sense for CRU0300/0500 Card Reader	4,305	18	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	114	662	574
CRU1050	80-Column Card Reader, 1050 cpm	24,318	161	825	709
CRF0003	51-Column Card Capability for CRU0600/1050	2,079	5	67	55
CRF0004	Mark Sense for CRU0600, HIS and IBM format	7,787	42	237	205
CRF0005	Mark Sense for CRU1050, HIS and IBM format	7,787	42	237	205
CPA2112	Addressing for CRU0600/1050	3,078	11	80	67
PCU0120	80-Column Card Punch, 100 to 400 cpm	18,344	101	648	545
CPA2114	Addressing for PCU0120	3,762	13	99	83
TERMINALS					
VIP7100	Asynchronous CRT, 12 lines of 80 characters, TTY-compatible	1,500	23	—	60
VIP7105	Asynchronous CRT, 12 lines of 80 characters, upper and lower case, TTY-compatible	1,600	24	—	63
VIP7804	Synchronous CRT, 24 lines of 80 characters, 95 ASCII character set, 12-inch screen	3,060	33	—	107
VIP7805	Synchronous CRT, 24 lines of 80 characters, 95 ASCII character set, 15-inch screen	3,360	39	—	120
7700R	Synchronous CRT, 24 lines of 80 characters, 63 ASCII character set, upper case only; requires 7731 or 7732	3,990	36	—	133
7705R	Same as 7700R but with 95 ASCII character set	3,990	36	—	133
7715R	Direct Connect Timing Source	350	3	—	12
7722R	10-cps/30-cps/120-cps Printer Adapter and Timing Source	750	8	—	27
7725R	Keyboard Keylock	57	2	—	3
7703A/B	Multistation Interface Unit	2,420	20	—	91
7719A/B	Multistation Interface Unit, MIL STD 1886	3,025	20	105	91
RK7719	Dual Channel Expander for 7719; maximum of four	—	—	—	—
RK7703A/B	Dual Channel Expander for 7703A/B	—	—	—	—
7760-60	Master Control Unit; includes diskette drive and interface, terminal controller, communications controller, program loader, and program media	16,800	52	462	420
7761-60	Auxiliary Control Unit; includes data path interface, terminal controller, and program loader; requires 7760-60 and 7767	11,200	31	—	285
7731	Display Adapter for 1920 characters; includes ASCII video generator and storage for 24 lines of 80 characters; required for each display	1,200	4	—	31
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	4	—	31
7734	RO Printer Adapter; includes 1920-character print buffer and logic; for 30-cps or 120-cps RO printer	1,360	4	—	34
7767	Datapath Interface; requires 7760-60	960	7	—	25
7768	Direct Timing Source; requires 7760-60	240	1	—	6
7769	Line Repeater Unit; requires 7706-60 or 7707-60	399	2	—	10
7706-60	Display/Keyboard Unit; requires 7731 or 7732	1,750	15	—	47
7707-60	Display Monitor Unit; requires 7731 or 7732	1,350	8	—	32
7707-64	Keyboard with Numeric Pad; requires 7707-60	400	8	—	15
7716A/B	RO Printer; 30 cps, 120 positions; includes tractor feed	3,600	31	—	141
7717A/B	RO Printer; 120 cps, 120 positions, includes tractor feed	4,360	54	—	168
7741-60	Additional Diskette Device; requires 7760-60	2,166	17	—	57

*Rental prices include maintenance.