

Honeywell Series 60, Level 62

MANAGEMENT SUMMARY

The Honeywell Series 60 Level 62 systems were designed as a magnet to attract users of other vendors' small business computer systems, and also to provide easy expansion and development for users of both Honeywell's established systems and some of the product lines acquired in the 1970 acquisition of General Electric's computer operations. To ease the transition to the Level 62, Honeywell also provided an array of conversion aids, including both hardware and software facilities to enable users to preserve their software investments. The recent introduction of the Extended Level 62 system makes the Honeywell product line more competitive with the IBM System/34 and System/38.

The Series 60 product line originally consisted of four system groups, designated "levels" to reflect their relative computing power. These four system groups were based on different processors and were even designed and manufactured in different countries. The common link between the diverse groups was the Generalized Comprehensive Operating System (GCOS) or, for the largest models, an enhanced version of the Multics operating system.

In the United States, the original April 1974 Series 60 product announcement included the Model 62/60, a small-scale system and the only processor model in the original U.S. product line designed primarily to attract new computer users. At the same time, the Level 62 Model 40 was announced in Europe as a growth path for Honeywell's large base of Gamma 10 users in Europe. That system, equipped with a complement of IBM System/3-compatible peripherals and a set of conversion aids, was introduced in the U.S. in April 1975 together

The Honeywell Level 62 continues to offer a migration path for users of the earlier Honeywell small business computers and the IBM System/3 through the use of software conversion packages. The Level 62 has again been realigned with the announcement of the Extended Level 62 system, a specially packaged unit designed to compete with the IBM System/34 and System/38.

CHARACTERISTICS

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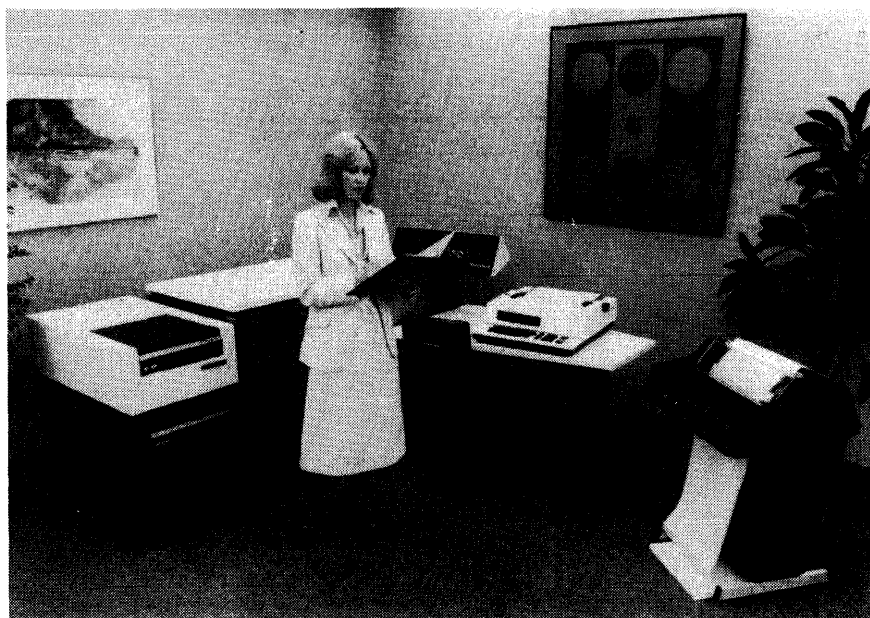
Honeywell Information Systems is a division of Honeywell Incorporated, an international corporation whose products include industrial and residential control systems, sophisticated test instruments for both medical and industrial applications, aircraft guidance systems and instrumentation, photographic equipment, satellite support subsystems, and electronic data processing products. The parent company is also a leader in solar energy research. Honeywell's computer operations were enhanced by the 1970 merger with General Electric's computer systems division. Honeywell has subsidiary companies in virtually all western countries and in some eastern-bloc countries, and currently employs about 100,000 persons worldwide.

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 1000.



The Honeywell Series 60 Level 62 represents the lower end of the company's mainframe computer line. Originally introduced in two basic models, the Level 62 is now marketed as a single consolidated family rather than as a series of distinct systems. This small-to-medium-scale configuration includes (from left) two 80-megabyte disk pack drives, a 300-cpm card reader (96-column), a 96K-byte Model 62 CPU and control panel with two cassette tape units, a 30-cps console printer/keyboard, and a 100-lpm line printer.

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ements added the System/3 Models 8, 12, and 15 to this list, as well as the IBM 360/20, NCR Criterion Series, and Univac's 90/25 and 90/30 computer systems. IBM's expansion of the System/3 Model 15 line caused Honeywell to elect to put an end to a similar proliferation of submodels, and, instead, offer the revamped Level 62 as a single expandable and upgradable product line. IBM's subsequent introduction of the System/34 and then the System/38 triggered the January 1979 announcement of the Extended Level 62, which continues the new concept of a single expandable system.

The Extended Level 62 system's main memory capacity ranges from 96K to 992K bytes, while the mass storage capacity extends from 40 million to 1.8 billion bytes. The basic configuration also includes a 30-cps printer, a console diskette or tape cassette unit, and a communications controller. Up to 25 synchronous or asynchronous lines can be configured, with a 2400-character-per-second line limit and a 4800-character-per-second system total. Terminals, line printers rated at up to 1600 lpm, and punched card equipment are optionally available.

The minimum Level 62 system includes the basic CPU with 96K bytes of main memory and a 6-channel I/O processor. The minimum configuration requires two 20.1-megabyte MSS50317 disk drives, a line printer, a system console, and either a card reader, cassette tape subsystem, diskette subsystem, or communications subsystem.

The Level 62 basic package can be expanded only to 128K bytes of main memory, and mass storage at this performance level is restricted to a maximum of four 29.2-megabyte disk drives. Line printers available to the basic system are 100-, 200-, or 300-lpm units. One integrated communications controller is capable of attaching up to four asynchronous lines or four synchronous lines, or two synchronous and two asynchronous lines.

Through the addition of one or more of the optional Performance Modules, the Level 62 system can be upgraded in terms of both its processor performance and its ability to support additional peripheral equipment. The Level 62 Performance Module Characteristics chart on the preceding page shows 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 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 now available only on an RPQ basis.

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.

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

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▷ B 800 line, and NCR with its low-end Criterion systems, the I-8230 and I-8250.

A glance at the list of Level 62 conversion aids in the Software section of this report makes Honeywell's most immediate and direct market targets abundantly clear. In addition to the conversion software developed to migrate its current Series 200/2000 installed base to the more cost-effective hardware of the Level 62 systems, Honeywell offers software packages that enable users of IBM System/3 and System/360 Model 20 equipment to convert RPG II programs and files to Level 62 RPG. Further, the Level 62 supports 96-column cards and IBM 3741-compatible disk input, permitting System/3 card and diskette users to migrate directly. Honeywell's CCU0501 and CCU1006. Multi-Function Card Units provide the necessary hardware support for this transition.

Honeywell also offers a two-pass disk file conversion package for files created on Univac 9000 systems. Program translation for this competing system is unnecessary because both systems employ ANSI COBOL; applications written in COBOL only need recompilation to be executable on a Level 62 system. Similarly, Univac's RPG can be converted to Level 62 RPG through the 360/RPG to Level 62 RPG translator.

USER REACTION

Five Level 62 users, each with one system, were contacted by Datapro in March 1979. Four of the five systems were being used for business accounting purposes, while the fifth was used for software development. Three of the configurations were 62/60's, and two were 62/40's.

The systems had been installed for an average of 23 months, with a range of 8 to 32 months. Four had 144K bytes of main memory, and one had 224K bytes. Mass storage capacities ranged from 58 to 320 megabytes. An average of five local terminals per system were installed.

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

	Excellent	Good	Fair	Poor	WA*
Ease of operation	2	2	1	0	3.2
Reliability of mainframe	2	2	0	1	3.0
Reliability of peripherals	0	4	1	0	2.8
Maintenance service:					
Responsiveness	0	5	0	0	3.0
Effectiveness	0	4	0	1	2.6
Technical support	1	1	2	1	2.4
Operating systems	2	1	1	0	3.2
Compilers and assemblers	2	3	0	0	3.2
Ease of programming	2	2	1	0	3.2
Ease of conversion	2	1	1	1	2.8
Overall satisfaction	1	3	1	0	3.0

*Weighted Average on a scale of 4.0 for Excellent.

Although their overall satisfaction was fairly high, these users assigned relatively low ratings to Honeywell's tech- ▷

▶ 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. The average head-positioning time is 40 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 312,000 bytes per second. These units are the Honeywell M4020 removable disk cartridge (or equivalent), which contains one disk with two recording surfaces and has 406 tracks per recording surface (including 6 spares). All spindles attached to the same control unit can perform concurrent seek operations simultaneously with a data transfer operation on one spindle. Reliability features include on-line error and status reporting to the central processor and a hardware diagnostic capability for off-line diagnosis.

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. Average head positioning time is 38 milliseconds, and average rotational delay is 12.5 milliseconds (2400 rpm). Data transfer rate is 312,500 bytes per second. The subsystem processor permits a seek operation to be performed by one drive while data is being transferred between the other drive and the CPU. The subsystem also performs a validity check by inserting "check code" characters in each data record. Write protection is also standard. 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.

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

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. Average head-positioning time is 30 milliseconds, and average rotational delay is 8.3 milliseconds (3600 rpm). Data transfer rate is 1,200,000 bytes per second. The MSU0330/0331 subsystem features rotational position sensing. Multi-block operations permit multiple blocks to be accessed (read or write) in a single operation. Extended search incorporates an implicit branch operation that enables multiple records to be interrogated once the desired record has been located.

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.

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 ▶

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► are read column by column, and each column is read twice. The results of each read are then compared for accuracy. Both the input stacker and output hopper have a capacity of 1000 cards.

CRU0600 CARD READER: Reads 80-column or (optionally) 51-column punched cards serially by column at 600 cards per minute. The input hopper capacity is 3000 cards, and the output stacker capacity is 2500 cards. An optional mark-sense facility for either Honeywell or IBM code is available. The CRU0600 is field-upgradeable to the CRU1050.

CRU1050 CARD READER: Reads 80-column or (optionally) 51-column punched cards serially by column at a 1050-cpm rate. The reader has a 3000-card input hopper and a 2500-card output stacker. An optional mark-sense facility for either Honeywell or IBM code is available.

CRU0306 CARD READER: Reads 96-column cards at a speed of 300 cards per minute. The CRU0306 card reader requires the addition of the CPA2116 addressing feature.

PCU0120 CARD PUNCH: Punches 80-column cards in Hollerith or binary code at a speed of 100 to 400 cpm depending upon the number of columns punched in each card. Both the input hopper and the output stacker have a 1600-card capacity.

VIP7100/VIP7105 CRT TERMINALS: These units feature a 960-character display screen with 12 lines of 80 characters. All characters are displayed in a 5-by-7 dot matrix on a 54-square inch screen. Characters are 0.080 by 0.160 inch. The VIP7100 can display a 64 ASCII character set, while the VIP7105 can display a 95-character upper/lower case ASCII set. Characters are refreshed at the rate of 60 frames per second. The VIP7100 and VIP7105 feature single-key CRT screen erasing, a bottom-line entry display with roll-up feed, an audible alarm when the console receives a BEL code or a character is displayed in the 75th character (or column) position, a forward and backward moving cursor on the bottom line, and a 60-mA or 20-mA current loop or Bell 103A modem compatibility interface.

The keyboard employs a typewriter layout with 60 keys which can generate a 128 ASCII character set using Shift and Control keys. Break, Escape, and Clear keys are included in the standard 10 control keys. The displayable character set includes 26 alphabetic, 10 numeric, and 32 special symbols.

The transmission rate for the VIP7100 and VIP7105 is variable by steps between 75 and 9600 bps. Characters transmitted can include one or two stop bits, as well as a choice of odd, even, or no parity bit. The terminal is provided with an extension four-wire RS-232C voltage-level interface port to accommodate an auxiliary device such as a serial printer.

7700R/7705R DISPLAY SUBSYSTEM: The 7700R and 7705R differ only in the character repertoire they can display. The 7700R displays 63 characters, while the 7705R displays 95 distinct upper/lower case characters. The units feature a 1920-character display consisting of 24 lines of 80 characters per line. All characters are displayed in a 5-by-7 dot matrix where each character is 0.080 by 0.160 inch. The 7700R and 7705R feature a forms display facility that provides "fill-in-the-blanks" operation with protected fixed fields; partial screen transmit; cursor positioning up, down, left, right, home, and return; multiple key depression without error; automatic tab; message flashing; function code transmission; cursor blinking; addressable cursor; tabulation; character or line insert/delete; character, line, or screen delete; and character repeat.

The keyboard employs a typewriter layout with more than 60 keys for generating a 128 ASCII character set. Data keys include 26 alphabetic, 10 numeric, and 26 special characters. A separate numeric pad facilitates numeric data entry.

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-232C.

The 7700R and 7705R can be extended through the following options: 7715R Direct Connect Timing Source, 7722R Printer Adapter, 7725R/7725-1R Keyboard Keylock, RO printers, 7703A/B Multiple Interface Unit, and RK7703A/B Dual Channel Expander for Type 7703A/B.

7760 VIP 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 VIP77005R.

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. Features of the 7706-6 include character or field blinking; cursor blinking; cursor positioning up, down, left, right, home and return; addressable/readable cursor, protected format partial screen transmit; tabulation; character insert/delete; line insert/delete; and character repeat. The keyboard of the 7706-6 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 DCA2101 provides addressing for two asynchronous lines, while the DCA2102 and DCA2103 provide addressing for two synchronous remote or direct (local) lines, respectively. A line termination adapter is required for each line; the DCF2000 and DCF2001 for asynchronous lines or the DCF2002 and DCF2003 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 4800 characters per second. Individual line speeds of up to 9600 bps for asynchronous or 19,200 bps for synchro- ►

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► are logical records that do not have index entries in the main index. Each C-record is associated with a P-record via a pointer in the P-record. A C-record can in turn point to another C-record.

The indexed file organization permits up to eight secondary indexes to be created by a utility program that constructs index entries according to a key, other than the prime key, without distinguishing between P-records and C-records.

Indexed organization is best suited for files that are processed rapidly in sequence but also need to be available for direct inquiry.

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. This technique is useful for direct inquiry system and transaction processing systems in which file size is relatively stable and the control field (key) can be easily used to develop a relative record number.

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. COBOL communications verbs are supplied to provide and interface between COBOL applications programs and the communications subsystem. These include the ENABLE, SEND, RECEIVE, and DISABLE verbs.

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. Level 62 GCOS also supports several software investments when changing from certain Honeywell and non-Honeywell systems. Among the source coding that can be converted for use on Level 62 systems is IBM System/3 RPG programs; System/360 Model 20 RGP and System/360 Model 20 files; and Honeywell Series 200/2000 COBOL, Series 200/2000 Easy-coder, Series 200/2000 files, and Series 100 programs and files.

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., and is fully described in Report M12-132-101.

TRANSACTION PROCESSING SYSTEM (TPS): TPS permits users to execute real-time functions through a network of terminals. These functions are user-defined interactive Transactional Programs (ITP's) and are developed using an RPG/COBOL-like language. TPS manages a set of predefined (active) ITP's each of which may access files that have been declared as belonging to the particular environment of the TPS activity.

Multiple ITP's can be initiated through a user terminal. When this condition occurs, the TPS controls and insures the integrity of each active program and its respective file updating requirements. TPS activities can be run concurrently with other batch or communications activities.

TPS currently supports only two terminals, the VIP 7700 and the DTU7170. Terminals cannot directly establish and maintain dialogues with other terminals.

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

Level 62 COBOL: This compiler succeeds Honeywell's COBOL-68 and conforms to American National Standard specification X3.23-1974, which includes several enhancements over the older version. 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.

Honeywell, however, has implemented enhancements of its own design in certain modules. The Indexed I/O module has provisions for complementary records, and the Communications module has extensions that improve message processing. In addition, the Nucleus module contains enhancements to some basic functions.

Features not in COBOL-68 and added to the COBOL-74 compiler include: augmented debugging facilities that permit users to specify the debugging techniques in the program and later eliminate them from the final compilation; improved capabilities for terminal communications; the ability to call other programs, including those written in other languages; device independence for sequential files; enhanced text copying capabilities, expanded sequential file functions, and improved indexed I/O techniques that effectively enlarge mass storage capacity.

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. Users can specify different equipment environments at compile time and at execution time. Compilation can be performed from mixed peripheral inputs or the source library, since all input is integrated into common disk work files.

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 ►

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► **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. 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.■

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 single-line communications controller	\$33,192	\$160	\$799	\$719
MAIN STORAGE					
CMM2354	32K-Byte Main Memory Module and addressing	3,315	13	88	80
CAB 2304	Memory Expansion above 224K bytes	11,165	12	234	211
CMM238X	128K-Byte Main Memory Module and addressing	2,750	11	78	70
PROCESSOR OPTIONS					
CPF2300	Scientific Instruction Set	456	1	10	9
CSF2309	120-cps Console Printer, replaces 30-cps printer in basic system	3,591	13	85	77
CPF2304	Performance Module C; provides 33 percent increase in performance	5,956	13	128	115
CPF2305	Performance Module D; provides 78 percent increase in performance	7,496	12	150	135
CPF2307	Performance Module E; provides 90 percent increase in performance	6,614	20	139	125
PEU2000	Port Expander Unit	12,312	27	273	246
MASS STORAGE					
DDU0001/2	Diskette Drive; maximum of two drives	6,441	47	176	159
MSS0317	40.3-Megabyte Mass Storage Subsystem; includes addressing and two spindles	16,580	135	527	470
MSF0317	18.1-Megabyte additional capacity for first two spindles on MSS0317 mass storage subsystem	2,180	NA	50	44
MSF0318	29.2-Megabyte additional capacity for each of the 3rd through 6th spindles	6,420	68	197	177
MSU0330/ 331	80-Megabyte Disk Drive and cabinet for drawer mounting (CPS 2000)	15,700	77	448	394
CPA2127	Addressing for first two MSU0330 Disk Drives	20,691	75	490	441
CPA2128	Addressing for third and fourth MSU0330 Disk Drives	5,643	20	133	119
CPA2129	Addressing for fifth and sixth MSU0330 Disk Drives	1,197	4	29	26
MSU0390	300-Megabyte Disk Drive	34,500	180	1,071	964
CPA2133	Addressing for first two MSU0390 Disk Drives	35,500	113	770	694
CPA2134	Addressing for third and fourth MSU0390 Disk Drives	12,850	38	280	253
CPA2135	Addressing for fifth and sixth MSU0390 Disk Drives	9,100	30	190	182
CPA2136	Addressing for first and second MSU0390 Disk Drives utilizing CPA2127 addressing feature	14,809	38	280	253
CPA2137	Addressing for third and fourth MSU0390 Disk Drives utilizing CPA2127 addressing feature	12,850	38	280	253
MAGNETIC TAPE EQUIPMENT					
CTU0002/2	Cassette Tape Drive; maximum of two drives	6,441	47	176	156
MTU0111	18.75-ips Slave Drive	6,389	41	177	153
MTU0120	18.75-ips Primary Drive	7,644	52	213	186
MTU0121	18.75-ips Secondary Drive	6,389	41	177	153
MTU0211	37.5-ips Slave Drive	8,160	57	243	211
MTU0220	37.5-ips Primary Drive	9,980	70	296	257
MTU0221	37.5-ips Secondary Drive	8,160	57	243	211
MTF0101	1600-bpi, 9-track Read/Write Head for MTU0211/0220/0221 magnetic tape drives	2,166	12	56	50
MTF0102	800/1600-bpi, 9-track Read/Write Head for MTU0211/0220/0221 magnetic tape drives	2,505	31	83	73
MTF0103	200/556-800-bpi, 7-track Read/Write Head for MTU0211/0220/0221 magnetic tape drives	2,505	31	83	70
MTF1002	NRZ Option	240	—	5	5

*Rental prices include maintenance.

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		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
TERMINALS (Continued)					
7707-64	Keyboard with Numeric Pad; requires 7707-60	400	7	17	14
7716A/B	RO Printer; 30 cps, 120 positions; includes tractor feed	4,500	28	152	132
7717A/B	RO Printer; 120 cps, 120 positions, includes tractor feed	5,450	49	182	157
1741-60	Additional Diskette Device; requires 7760-60	2,166	15	62	53
DATA COMMUNICATIONS EQUIPMENT					
DCC2000	Integrated Data Communications Controller	2,451	5	54	49
DCA2301	Addressing for two Asynchronous Lines	1,653	23	56	51
DCA2302	Addressing for two Synchronous Remote Lines	1,653	23	56	51
DCA2303	Addressing for two Synchronous Direct Lines	342	3	10	9
DCF2300	Terminator for Asynchronous Direct Line	342	3	10	9
DCF2301	Terminator for Asynchronous Remote Line	456	5	14	13
DCF2302	Terminator for Synchronous Remote Line	912	11	31	28
DCF2303	Terminator for Synchronous Direct Line	57	NC	1	1

*Rental prices include maintenance.

SOFTWARE PRICES

		Monthly License Fee	Paid-Up License
SYSTEMS SOFTWARE			
SBC0005	Communications Software—Synchronous Terminals	138	NA
SBC0006	Communications Software—Asynchronous Terminals	138	NA
SBC0007	Bisynchronous Communications, IBM 2780 Mode (CP-to-CP)	138	NA
SBC0008	Bisynchronous Communications, IBM 3741 Terminal Mode	11	NA
SBC0014	Binary Synchronous 3 Communications Control Supervisor	138	NA
SBC0015	Binary Synchronous 3 Communications Tributary Supervisor	138	NA
SBC0016	Binary Synchronous Communications Multileaving Supervisor	138	NA
SBD0001	Universal TOTAL 12; includes maintenance for one year	515	14,175*
SBL1002	RPG	13	NA
SBL0005	COBOL-74	96	NA
SBL0007	FORTRAN	425	NA
SBL0008	COBOL Macroprocessor	53	NA
SBU0002	SORT/MERGE	59	NA
SBU0005	Basic Utilities & Test Data Generator	14	NA
SBU0007	IBM 2780 Emulator Utility (CP-to-CP)	12	NA
SBU0008	IBM 3741 Emulator Utility	12	NA
SBJ0001	Transaction Response System	NA	1,260
SBJ0002	Data Collection System for VIP7700	NA	630
APPLICATION SOFTWARE			
0010	Sales Order Processing—Order Entry Module	81	2,500
0012	Sales Order Processing—Inventory Accounting Module	54	1,675
0016	Sales Order Processing—Billing and Shipment Module	81	2,500
0017	Sales Order Processing	216	6,675
6011	Sales Order Processing—On-Line Order Entry	130	4,400
6013	Sales Order Processing—On-Line Inventory Accounting; requires SBJ0001 Transaction Response System	90	2,750
6018	On-Line Sales Order Processing; requires SBJ0001 Transaction Response System	332	10,640
ABD0020	PROFIT—Inventory Forecasting Module	179	6,284
ABD0023	PROFIT—Level I	268	9,427
ABD0024	PROFIT—Level II	328	11,522
ABF0001	Accounts Receivable	82	2,067
ABF0002	Accounts Payable	82	2,067
ABF0003	General Ledger	82	2,067
ABF0004	Payroll	82	2,067
ABF0011	Accounts Receivable On-Line	104	2,619
ABF6004**	Payroll Tax Update (for ABF0004)	NA	NA**
ABH0001	Hospital Accounting System (HAS/62)	276	8,269
ABM0002	Production Scheduling and Control (Infinite)	154	5,402
ABM0012	Production Data Management	66	2,315
ABM0022	Capacity Requirements Planning/Production Control Reporting	88	3,087
ABM0011	Inventory Reporting/Bill of Material Processor	91	3,225
ABM0041	Material Requirements Planning	83	2,922
ABM0021	Material Requirements Planning/Resource Inventory	170	5,954
ABM0031	Standard Cost Control	47	1,661
ABM0051	IMS On-Line Inquiry Data Entry	84	2,940

*Software maintenance is required at \$900 per year.

**The Payroll Update is available for an annual fee of \$247 to all customers.