Cii Honeywell Bull Series 60, Level 62

MANAGEMENT SUMMARY

Equally at home in either business data processing or data communications environments, the small-scale Level 62 systems can support up to 15 batch and communications programs concurrently. Level 62 users can write their own applications software in high-level languages, develop interactive communications programs using the facilities of the Transaction Program System, or employ thoroughly tested CII-HB business-oriented applications packages.

The Series 60, Level 62 systems were first introduced in April 1974 as part of a consolidated family of computers intended to provide a straightforward user migration path from the diversity of systems that represented Honeywell's own previous efforts plus the product lines acquired in the 1970 acquisition of General Electric's computer operations. 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 designed and manufactured in different countries.

The Italian-developed and -built Level 62 systems fall between the entry-level Level 61 and the medium-scale Level 64 computers in the Series 60 product line. The Level 62 family currently consists of five models—62/10, 62/20, 62/40, 62/50, and 62/60. In January 1977, a new CPU was incorporated in the Level 62 line making all Level 62 processors essentially the same. Model lines are delineated by the presence of firmware packages that increase CPU performance, expand the maximum memory capacity, and permit the connection of a greater variety of peripherals.

The small-scale Level 62 computer systems are designed for business data processing or data communications duties. Recently revamped, the systems now have expanded memory capacities and greater configuration flexibility. Entry-level system prices start at under 500,000 FF.

CHARACTERISTICS

VENDOR: Cii Honeywell Bull, 94, avenue Gambetta, 75960 Paris, Cedex 20, France. Telephone 355 44 33. Telex 220 898.

MANUFACTURER: Honeywell Information Systems Italia, 32 Via Pirelli, 20124 Milano, Italy. Telephone (39) 2 6257. Telex 32308.

MODELS: Level 62, Models 62/10, 62/20, 62/40, 62/50, and 62/60.

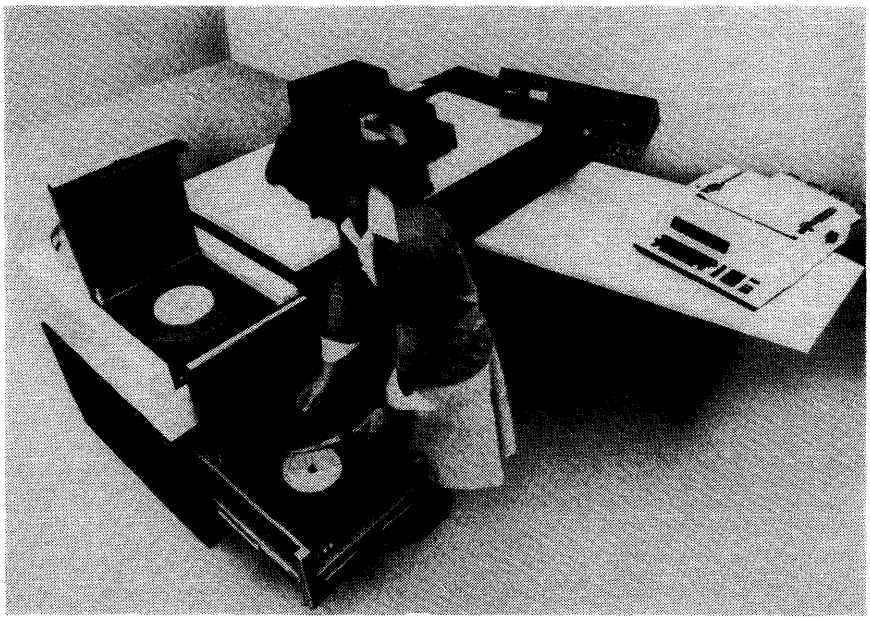
DATA FORMATS

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: The basic instruction set includes 141 instructions in 16 instruction formats varying from 2 to 8 bytes in length. The operation code resides in the first



This minimum configuration of the 62/40 includes two disk-pack drives, an optional card reader, a console with two cassette tape drives (the second drive is an option), and the console keyboard/printer. A floppy-disk drive can be mounted under the end of the extension that supports the keyboard/printer. The system can be expanded with additional peripherals and, when necessary, field-upgraded to a 62/50.

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For all Level 62 models, the minimum configuration consists of a CPU with either 80K bytes (62/20 and 62/40), 96K bytes (62/50 and 62/60), or 176K bytes (62/10) of memory; an integrated I/O controller with six channels; a system console with keyboard, printer, and integrated diskette or cassette subsystem; a system printer; and two disk drives.

Main memory is implemented in large-scale integrated MOS technology with a density of 4K and 16K bits per chip. Basic memory size is expandable in 16K-byte increments up to 128K bytes, in 32K-byte increments up to 256K bytes, and in 64K-byte increments over 256K, up to 512K bytes. The similarity of the processors allows on-site upgrade from one model to another.

Model 62/10 can be expanded up to 192K bytes of main memory and supports up to three 40- or 80-megabyte disk drives. Line printers available include 180-, 300-, and 400-lpm units. An 80- or 96-column, 300-cpm card reader can be used as an input device in addition to the diskette subsystem integrated within the console.

Model 62/20 can be expanded up to 192K bytes of main memory and supports up to three 20-, 29.2-, 40-, or 80-megabyte disk drives. Line printers available include 180-, 300-, and 400-lpm units. A 96-column, 300-cpm card reader can be used as an input device in addition to the diskette or cassette subsystem integrated within the console.

Model 62/40 can have up to 256K bytes of main memory and up to three 29.2-, 40-, 58.4-, or 80-megabyte disk drives. Line printers with speeds up to 800 lpm and a variety of punched card and paper tape equipment can be connected. Magnetic tape subsystems of from two to four 7-track and/or 9-track drives are also supported by the 62/40.

Both the 62/50 and 62/60 support all of the 62/40 peripherals plus line printers with speeds up to 1600 lpm and a three-channel port expansion unit that allows the connection of up to three additional low-speed peripherals.

Model 62/50 has a maximum main memory capacity of 384K bytes and supports up to four 29.2-, 40-, 58.4-, or 80-megabyte disk drives. Model 62/60 supports up to 512K bytes of main memory and can have up to six 29.2-, 40-, 58.4-, or 80-megabyte disk drives.

A wide variety of punched card devices is offered for Level 62 systems, and cardless operations can be implemented via the integrated diskette or cassette subsystem in the system console. As a direct replacement for card input, these reusable media subsystems can simplify operation and provide a cost savings.

Each model includes one integrated data communications controller capable of supporting up to 6 (62/10 and 62/20) or 12 (62/40 and up) asynchronous or synchronous lines. A second integrated data communications byte of all instructions. The scientific instruction set, available as an option on all models, adds 24 floating-point operations and provides the capability for 128-bit quad words.

INTERNAL CODE: EBCDIC (Extended Binary Coded Decimal Interchange Code).

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: See Characteristics table.

CYCLE TIME: 1050 nanoseconds per 2-byte access.

CHECKING: One parity bit is appended to each byte.

STORAGE PROTECTION: Protection is provided by dividing user programs into two sections, designated Sector 0 and Sector 1. Sector 0 contains all data that will be changed during program execution. Sector 1 contains all constants and instructions. Each sector 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 instructions as data. Sectors cannot be shared or accessed by other user programs. A fifth register, the lower boundary register, contains the address of the first user location below the system software.

RESERVED STORAGE: A portion of main storage is reserved for firmware. A special register, the P-register, prevents access to these memory locations by any software. Both the transient and resident areas assigned to the supervisor also are reserved.

CENTRAL PROCESSOR

All Level 62 models use the same basic microprogrammed processor. The increased performance through the model line progression is gained by firmware packages that increase processor performance, extend the maximum memory capacity, and allow greater flexibility in configurations.

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 memory 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 ROM, while control microprograms for low-speed peripherals are stored in main memory. The microprogram control can address the entire 240K-bit ROM or the first 64K words of main memory. It addresses, fetches, and stores data from ROM or main memory and also calculates the succeeding microinstruction address.

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

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CHARACTERISTICS OF THE LEVEL 62 SYSTEMS

	Model 62/10	Model 62/20	Model 62/40	Model 62/50	Model 62/60
SYSTEM CHARACTERISTICS					
Date of introduction	August 1978	June 1977	April 1975	December 1976	April 1974
Date of first delivery	January 1979	March 1978	June 1975	September 1977	June 1974
Number installed to date by CII-HB	2	36	410	65	175
MAIN STORAGE					
Type	MOS	MOS	MOS	MOS	MOS
Cycle time, nanoseconds	1050	1050	1050	1050	1050
Minimum capacity, bytes	180,224	81,920	81,920	98,304	98,304
Maximum capacity, bytes	196,608	196,608	262,144	393,216	524,288
Increment size, K bytes	16 to 128K, 32 over 128K	16 to 128K, 32 over 128K	16 to 128K, 32 over 128K	16 to 128K, 32 over 128K 64 over 256K	16 to 128K, 32 over 128K 64 over 256K
Bytes fetched per cycle	2	2	2	2	2
CENTRAL PROCESSOR					
Number of registers	29 std., 4 opt.	29 std., 4 opt.	29 std., 4 opt.	29 std., 4 opt.	29 std., 4 opt.
Number of instructions	141 std., 24 opt.	141 std., 24 opt.	141 std., 24 opt.	141 std., 24 opt.	141 std., 24 opt.
CONTROL MEMORY					
Type	Bipolar	Bipolar	Bipolar	Bipolar	Bipolar
Cycle time, nanoseconds	170	170	170	170	170
Capacity, K bits	240	240	240	240	240
Bytes fetched per cycle	2 (plus 4 parity bits)	2 (plus 4 parity bits)	2 (plus 4 parity bits)	2 (plus 4 parity bits)	2 (plus 4 parity bits)
INPUT/OUTPUT CONTROL					
Maximum channels	6	6	6	6 std., 3 opt.	6 std., 3 opt.
Maximum channel data rate, bytes per second	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000
CONFIGURATION					
Minimum disk capacity, megabytes	80	40	58.4	58.4	58.4
Maximum disk capacity, megabytes	240	240	240	320	480
Magnetic tape transports, maximum	—	—	2	4	6
Communications lines, maximum	6	6	12	25	25

controller that supports an additional 13 asynchronous or synchronous lines can be added to models 62/50 and 62/60.

When the operating system is generated, the user must select the number and types of lines as well as the specific types of terminals to be used in the communications network. The following classes of terminals are supported by Level 62 hardware and software: TTY-like, VIP-like, ISO-like, and computer systems and terminals that support the IBM multi-leaving and Binary Synchronous Communications protocols.

SOFTWARE

Software support for the Level 62 systems centers on the GCOS operating system, the common link among all of the Series 60 computers. GCOS Level 62 is a modular, interrupt-driven operating system that can support up to 15 concurrent batch and communications programs. It features spooling, dynamic memory allocation, automatic job scheduling, and fail-soft facilities that allow the system to survive certain main memory and peripheral failures. To increase user memory, only the supervisor module of

CONTROL STORAGE: Consists of both bipolar read-only memory (ROM) and firmware routines located in main memory. Routines from both sources are executed by the CPU. Read-only memory cycle 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 registers. Eight of the general-purpose registers can be used for address indexing. The scientific instruction set adds four 64-bit floating-point registers.

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 instruction 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. Oper-

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GCOS is permanently resident, and it calls the other modules as required.

The spooling feature, which was implemented in the latest release of GCOS, enhances the multiprogramming capabilities of the Level 62 by reducing contention for slower peripheral devices and increases throughput by improving CPU utilization.

GCOS provides three high-level programming languages, COBOL, FORTRAN, and RPG II, for the development of user programs, and the TPS language for the development of interactive communications programs. CII-HB also offers a large number of software conversion routines, which permit users to convert existing programs for operation on Level 62 systems.

Applications software available includes a distribution inventory management system (DIMS), a production scheduling and control system (PSC), an inventory management system (IMS/62), and a sales order processing system (SOP).

COMPATIBILITY AND COMPETITION

Originally, the Level 62 systems were introduced to compete with IBM's highly popular System/3 and to provide a migration path for users of the earlier small Level 61, G100, and Series 200/2000 systems. The main competition for the Level 62 remains IBM's System/3, Models 8, 12, and 15. The recent improvements to the Level 62 have enabled it to effectively compete with systems such as the Univac 90/25, the Burroughs B 1800, and the NCR 8430 and 8450.

All Level 62 models are compatible with each other, and the requirement that all programming be in high-level languages ensures upward compatibility with the other Series 60 systems. In addition to the conversion software developed to support the migration of the small Level 61, G100, and Series 200/2000 installed base to the more cost-effective hardware of the Level 62 sytems, CII-HB offers software packages that enable users of the IBM System/3 and System/360 Model 20 to convert RPG II programs and files to Level 62 RPG.

Further, the Level 62 supports 96-column cards and IBM 3741-compatible diskette input, permitting System/3 card and diskette users to migrate directly. The Multi-Function Card Units provide the necessary hardware support for this transition.

USER REACTION

In June 1977, Datapro contacted six Level 62 users in the United States. Each of these users had one system. The system population included three 62/40's and three 62/60's. Five of the six Level 62's were being used exclusively for business data processing purposes, while one was also being used for data communications applications.

ands 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 floating-point instructions.

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, except for the 62/10, 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: The Level 62 systems are single-processor systems with integrated input/output and communications controllers. The central processors include six overlapping I/O channels with integrated controls for data transfer.

Channel 1 is always used for mass storage devices and Channel 2 for the system printer. On the 62/10 and 62/20, channels 3 and 4 can be used for the connection of an 80- or 96-column card reader. On models 62/40 and up, channels 3 and 4 can be used for the connection of any two of the following: magnetic tape drives, card or paper tape devices, and a second printer. On the 62/50 and 62/60 only, a second data communications controller for up to 13 additional lines can be connected to channel 3 or 4 in place of one of the aforementioned choices. Channel 5 is always used for the connection of the system console via an integrated data communications controller with the capacity for up to 6 (62/10 and 62/20) or 12 (62/40 and up) synchronous or asynchronous lines. Channel 6 is always used for the integrated diskette or cassette subsystem. A port expander unit (PEU), optionally available for 62/50 and 62/60 systems, can be connected to channel 6 to provide three additional channels for low-speed devices. Transfers among the PEU are interleaved among the devices connected.

SIMULTANEOUS OPERATIONS: Program execution can proceed concurrently with data transfer operations on the six overlapping input/output channels. The maximum total input/output rate for the system is 1,800,000 bytes per second.

CONFIGURATION RULES

The minimum Level 62 configuration consists of a central processor with 80K bytes (62/20 and 62/40), 96K bytes (62/50 and 62/60), or 176K bytes (62/10) of memory; an integrated I/O controller for peripherals, communications, and the system console; six I/O channels; a system console with keyboard, printer, and integrated diskette or cassette subsystem; a printer; and two mass storage devices.

Memory increments are in 16K-byte modules up to 128K, 32K-byte modules up to 256K, and 64K-byte modules over 256K. Please refer to the Characteristics chart for details on memory capacities.

Disk storage for Model 62/10 systems is provided by two or three 40- or 80-megabyte MSU 0320/0330 disk drives. On Model 62/20 systems, disk storage can be provided by two or three 20-megabyte MSU 0306 or 29.2-megabyte MSU 0312 disk drives or by two or three 40- or 80-megabyte MSU

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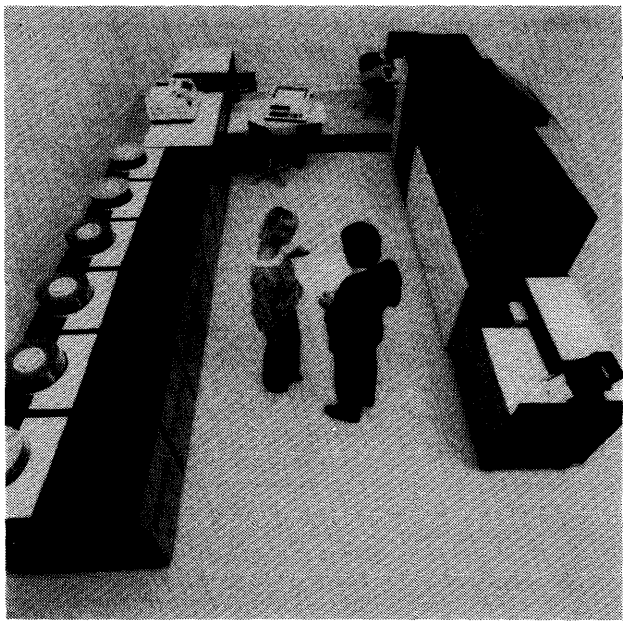

This large Level 62 configuration illustrates how systems can be installed without the expense of raised flooring.

The six systems had been installed for between 16 and 31 months, averaging about 21 months. Four of the six systems had 98K bytes of main memory, one had 64K, and one had 128K. There were two or more 29-megabyte MSU0310 drives on each of the systems. Three of the Level 62 systems had replaced IBM System/3 Model 10's, while two others had replaced Honeywell Series 200/2000 equipment.

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

	Excellent	Good	Fair	Poor	WA*
Ease of operation	4	2	0	0	3.7
Reliability of mainframe	2	4	0	0	3.3
Reliability of peripherals	2	2	1	1	2.8
Responsiveness of maintenance service	2	3	1	0	3.2
Effectiveness of maintenance service	1	3	2	0	2.8
Technical support	1	4	1	0	3.0
Operating systems	3	3	0	0	3.5
Compilers and assemblers	3	3	0	0	3.5
Applications programs	0	3	1	1	2.4
Ease of programming	2	4	0	0	3.3
Ease of conversion	3	2	1	0	3.3
Overall satisfaction	3	3	0	0	3.5

*Weighted Average on a scale of 4.0 for Excellent.

Although the users awarded above-average ratings to the Level 62 systems in most categories, they assigned comparatively low ratings to the categories of peripheral reliability, maintenance service effectiveness, and applications programs. Two specific problems cited by the users, recurring printer problems and disk drive problems, had been encountered mainly during the early lives of the systems. The Level 62 users attributed their

0320/0330 disk drives. On Model 62/40 systems and up, two 29.2-megabyte MSU0312, two 40-megabyte MSU0320, two 58.4-megabyte MSU0360, or two 80-megabyte MSU0330 disk drives are required; these drives cannot be intermixed. Models 62/40, 62/50, and 62/60 can have a maximum of 3, 4, and 6 drives, respectively, of the same capacity.

Each model's minimum configuration can be enhanced to include a variety of magnetic tape, card and paper tape, line printer, and terminal equipment. Connection of these peripherals is discussed in the I/O Channels section under the Input/Output Control heading.

MASS STORAGE

MSU0306 MASS STORAGE UNIT: Use of these 20-million-byte drives is restricted to the Model 62/20 and two are required on each system. Each drive uses 11-disk packs with 20 recording surfaces. Data is formatted at 7294 bytes per track on 138 tracks per surface; there are 3 spare tracks per surface. Average access time is 35.5 milliseconds including an average rotational delay of 12.5 milliseconds. Data transfer rate is 312,500 bytes/second. A seek operation can be performed by one drive while data is being transferred between the other drive and the CPU.

MSU0312 MASS STORAGE UNIT: Designed for medium-capacity storage, these units can be used with all Level 62 models. The minimum configuration for these units is two drives. Each MSU0312 stores up to 29.2 million bytes on standard 11-disk packs with 20 recording surfaces. Data is formatted at 7294 bytes per track on 200 tracks per surface; there are 3 spare tracks per surface. Average access time is 37.5 milliseconds including an average rotational delay of 12.5 milliseconds. Data transfer rate is 312,500 bytes/second. While data transfer is taking place on one drive, simultaneous seek operations can be performed on all other drives attached to the controller.

MSU0360 MASS STORAGE UNIT: This unit provides up to 58.4 million bytes of storage per drive and can be used with models 62/40 and up; minimum configuration is two MSU0360 drives. The 20 recording surfaces each have 400 tracks of 7294 bytes. Average access time is 42.5 milliseconds including an average rotational delay of 12.5 milliseconds. Data transfer rate is 312,500 bytes/second. MSU0360 drives cannot be intermixed with MSU0312 drives.

MSU0320/0330 MASS STORAGE UNITS: The 40-million-byte MSU0320 provides medium-capacity data storage on five recording surfaces, with 404 data tracks per surface. Average access time is 25 milliseconds, average rotational delay is 8.3 milliseconds, and rotational speed is 3600 rpm. Data transfer rate is 1.2 million bytes/second. The MSU0330 is a double density version that provides 80 million bytes of storage.

MSU0112/0113/0116 MASS STORAGE UNITS: These mass storage units feature a combination of fixed-disk and removable disk cartridge storage media and are primarily used for conversion of files originally created on the IBM System/3 Model 5444 and Model 5445 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 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.

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low ratings in these categories to lack of experience on the part of Honeywell's technical support personnel rather than to shortcomings in the products. They noted that the level 62 systems are produced in Italy and that U.S. personnel need more exposure to the systems. Documentation shortcomings, for the same reason, were also cited.

On the positive side, Honeywell's system software and language processors received enthusiastic comments from the users, as did the mainframe reliability. Overall satisfaction, the most significant general indicator, was rated quite highly.□

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.

INPUT/OUTPUT UNITS

DISKETTE UNIT: Physically part of the console, this unit records IBM 3740-compatible diskettes, formatting data onto 77 tracks, each containing 26 sectors of 128 bytes. One 256K-byte diskette drive is standard on all models and a second drive can be added as an option to increase capacity to 512K bytes. Average head positioning time is 260 milliseconds, average rotational delay is 83.3 milliseconds, and rotational speed is 360 rpm. Data transfer rate is 32K bytes/second.

CASSETTE UNIT: As an alternative to the integrated diskette unit, this unit includes a single drive unit integrated into the system console. A second drive unit can be added as an option. Data is recorded serially on two separate tracks at a recording density of 800 bpi. One tape cassette can store up to 520K bytes of data in blocks of up to 256 characters. Tape speed is 7 ips, and the peak data transfer rate is 700 bytes/second.

MTU0100/0101 MAGNETIC TAPE UNITS: The MTU0100 master unit supports two tape transports and controls the operation of MTU0101 dual transport slave units. The drives operate at 18.75 ips and are available as 9-track, 1600 bpi, PE, 30,000 bytes/second units, or optionally, as 7-track, 200/556/800 bpi, NRZI units. A 9-track, 800/1600 bpi, NRZI/PE dual density version is also available. Drives of different configurations can be intermixed.

MTU0200/0201 MAGNETIC TAPE UNITS: These units differ from the MTU0100/0101 units only in tape transport speed, which is 37.5 ips, and in data transfer rates, which are twice as high.

CRU0300/0500 CARD READERS: Offered for use with all models, these units read 80-column cards at either 300 cpm (CRU0300) or 500 cpm (CRU0500). Both units feature mark-sense options that permit reading of mark-sense cards in either Honeywell or IBM mode. Cards are read column by column, and each column is read twice to eliminate errors. The input hopper and output stacker each hold up to 1000 cards.

CRU0306 CARD READER: Available for all models, this unit reads 96-column cards at a speed of 300 cpm. The CPA2016 addressing feature is required with this reader. The input hopper and output stacker each hold up to 600 cards.

CCU0506/CCU1006 MULTIFUNCTION CARD UNITS: Available for all models, 62/40 and up, these units perform reading, punching, printing, and stacker selection operations on 96-column cards. The CCU0506 reads at a rate of 500 cpm, and the CCU1006 reads at a rate of 1000 cpm. Both units have a punching speed of 120 cpm. The printing speed is 120 cpm for both units. The printing area on each 96-column card consists of 4 lines of 32 characters each.

Each unit includes two 2000-card input stations to provide two simultaneous card paths, one of which is used for reading and the second for reading, punching, and/or printing. Cards can be directed to any of six 1200-card output stackers under program control to perform sorting, collating, merging, interpreting, and reproducing. Data integrity features include read comparison, read cell check for each card, parity check on all data transferred between the multifunction unit and the I/O control, and read-after-punch checking. On-line error status reporting is performed under control of the central processor. The CCU0506 can be field-upgraded to a CCU-1006.

CRU1050 CARD READER: Available for models 62/40 and up, this unit reads 80-column or (optionally) 51-column punched cards serially by column at a rate of 1050 cpm. 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 offered.

PCU0120 CARD PUNCH: Available for models 62/40 and up, this unit 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. The input hopper and output stacker each have a 1600-card capacity.

PRU0200/0300 LINE PRINTERS: These printers are available for all models and print either 200 lpm (PRU0200) or 300 lpm (PRU0300) using a 63-character print belt. Print format is 10 characters/inch and 6 lines/inch. Line width is 132 characters. Single- or multiple-part (one original and up to five copies) forms can be used. Vertical formatting is software controlled.

PRU0440/0640/0840 LINE PRINTERS: Available for all models (except 62/10 and 62/20 which are limited to the PRU0440 only), these printers use a print-belt cartridge. Rated speeds with a 48-character set are 400 lpm (PRU0440), 600 lpm (PRU0640), and 800 lpm (PRU0840). Print format is 10 characters/inch and 6 or 8 lines/inch (under software control). Line width is 120 characters, expandable to 136 characters with the PRF0020 option. Single- or multiple-part (1 original plus up to 5 carbon or 10 carbonless copies) can be used. Vertical formatting is software controlled. A variety of print belts with various character arrangements is available.

PRU1200 BELT PRINTER: Only available for 62/50 and 62/60 systems, this unit prints 1200 lpm using a print belt/cartridge with a special 48-character set, and has a burst speed of 2300 lpm with a limited character set. Printers equipped with this limited set cannot be used as the system printer because they cannot correctly print out the results of system diagnostic routines. Other character sets are optional, including sets with 63, 64, and 96 characters. The standard data format is 136 print positions per line (160 print positions optional), spaced 10 characters per inch, with 6 or 8 lines per inch vertical spacing. The PRU1200 prints on single-part or multipart forms (one original and up to five carbon copies).

The print belt is packaged in a lightweight cartridge designed to facilitate removal, interchange, and storage. Each character on the print belt is mounted on a flexible "finger." During printing, the belt passes continually in front of the

print hammers. When the character is struck, the flexibility of the finger causes the character to be immobilized at the moment of impact, reducing ribbon drag and improving print quality. The printer is equipped with an Automatic Standby feature that deactivates the operating mechanism of the printer when it is not being used. Programmed printer operations include recognition of belt type (48-, 63-, 64-, or 96-character set) from a code on the cartridge, print and space, space only, skip, vertical line spacing, and error status reporting. The PRU1200 belt printer is field-upgradable to the PRU1600 printer.

PRU1600 BELT PRINTER: This is a 1600 lpm version of the PRU1200.

PTU0600/1000 PAPER TAPE READERS: These readers operate at 600 (PTU0600) or 1000 (PTU1000) frames/second and can be used on all models except the 62/10 and 62/20.

PTU0110 PAPER TAPE PUNCH: This unit can be incorporated within one of the above described readers to punch tape at 110 frames/second.

TERMINALS: The Level 62 will support TTY-like, asynchronous, unbuffered terminals such as TTY33/36/37/38, TN300, TTU8124/8126, TE318, DTS7200; VIP-like, synchronous, buffered terminals such as VIP7700/7760, VIP7001, MTS7500, TTU8221, and KDS7255/7256; Olivetti synchronous, buffered terminals such as TCV260/7760, TC349 BI, and TC380/800; and other processors and terminals that support IBM's Binary Synchronous Communications protocol including CII-HB's Series 60, Level 61, 62, 64, and 66; IBM's System/370 computers and 3741 terminals; and Olivetti's TCV 275 terminals in BSC3 mode.

The number of terminals that can be connected to a single line depends on the terminal class. Unbuffered terminals (TTY-like) must be used in point-to-point connections, one terminal to a line. Buffered terminals (VIP-like and ISO-like) are used in multipoint connections, with several terminals on a single line. Computer systems must be used in point-to-point connections, with only one system per line at a time. The GCOS communications system permits different types of terminals to be mixed in the same job stream.

COMMUNICATIONS CONTROL

Each 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 6 additional communications lines on the 62/20 and up to 12 additional lines on Models 62/40 and up. The communications system can be configured as synchronous, asynchronous, or synchronous/asynchronous. A second 13-line controller can be added to model 62/50 and 62/60 systems to increase to 25 the maximum number of lines.

The Level 62 communications subsystem provides a communications throughput of up to 4800 characters per second. The maximum line capacity is 2400 characters per second. In the asynchronous mode, line speeds are software-selectable from 110 to 9600 bits per second. Synchronous line speeds to 19,200 bits per second are supported. The data communications terminals must conform to TTY, ISO, VIP, or BSC line procedures.

SOFTWARE

OPERATING SYSTEM: Level 62 systems run under Level 62 GCOS, a subset of the General Comprehensive Operating System (GCOS) used on all Series 60 systems.

GCOS Level 62 features multiprogramming, spooling, 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 spooling feature employs a scheduling facility to optimize the use of system resources. It restricts the direct use of slower peripherals (such as card readers, cassette tape drives, diskette drives, and line printers) to system programs called Input Readers (IR's) and Output Writers (OW's).

IR's read input streams job by job onto a spooling file. An IR occupies 14K bytes of memory and can be permanently memory resident or used in a roll-in mode so that its memory space to released to user programs when all of the job descriptions have been read. When user programs terminate, the IR can be reloaded to process additional job descriptions. Two or more IR's can be used concurrently.

The spooling file is a special system file which stores job descriptions awaiting execution, data associated with those jobs, and output reports awaiting printing.

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 disk if it has been changed while in memory. Instruction coding is re-entrant and is never modified. Therefore, these segments never have to be written back to disk and

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can be overlaid. Swapping and moving of the segments is invisible to the programmer, who has apparent access to a memory capacity equal to the size of the backing store.

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 de-allocated when each job step is completed. GCOS Level 62 allocates resources to job steps rather than to whole jobs to ensure effective use of the available resources. Space is allocated for files, and files are assigned to programs at the start of the job step requesting them. The files are then unassigned, and space for temporary files is normally released as soon as the job step has completed.

When assigning a file, the user defines the file as either permanent or temporary. If the user wishes to retain a temporary file for several job steps, a parameter in the ASSIGN statement prevents the file space from being released until the end of the job.

To request space for a file, the user specifies the type of device, the identity of the volume, and the amount of space required. GCOS then searches the specified volume and automatically allocates any space available. Disk space need not be contiguous; GCOS can allocate space for a file using up to 16 extents on any one volume, and can spread the file over a number of volumes if required.

When a new file is created, file management automatically creates the appropriate labels, and those are subsequently checked every time the file is opened for processing. On disk, labels are stored in a special area called the volume table of contents (VTOC). On tape, the labels are created at the head and tail of each file.

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. This makes it unnecessary to rewrite the entire file, a process that would usually be required when adding records to a sequential file. Although the added records are not physically in key sequence, the indexes make it possible to retrieve the added records in key sequence, permitting rapid sequential processing. The retrieval of records added to the file can be accomplished immediately and without any need to sort the index. Two types of records are available for indexed organization: primary records (P-records), which are logical records that have a key and associated disk address in the main index, and complementary records (C-records), which 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.

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 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 nine 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: ANS COBOL-74, RPG II, 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 RPG and System/360 Model 20 files; and Honeywell Series 200/2000 COBOL, Series 200/2000 Easy-coder, Series 200/2000 files, Series 100 programs and files, and Level 61 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 70E-132-01.

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 COBOL and an RPG-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 terminal families: the VIP 7700 and the DTU7170. Terminals cannot directly establish and maintain dialogues with other terminals.

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

FORTRAN: Level 62 FORTRAN is a version of ANS FORTRAN IV with some extensions. The language processor consists of two packages, the FORTRAN compiler and the FORTRAN run-time package. Level 62 FORTRAN requires the implementation of the scientific instruction set. The language processor executes either in a compile-only environment (with or without the production of compile units) or in a compile-and-go environment in which the output is submitted directly to a linking loader and the resulting program is executed as part of the job stream. The compiler produces two levels of diagnostic messages: syntax errors and fatal errors.

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 II: The RPG language processor used in Level 62 systems permits the interchange of data files among RPG, FORTRAN, and COBOL programs. Object programs written in RPG can also be linked with programs written in COBOL, FORTRAN, or other languages.

The RPG compiler features automatic file manipulation and disk handling, support for sequential, indexed, and relative file organization, physical sequential reading of indexed files, relative access to index files, device independence of sequential files, dynamic table handling capabilities, and the use of standard data management access routines by object programs.

RPG uses five files: two work files; a compute unit library for the generated program; and two input files, one for job control and one for input data. The processor accepts data from card, tape, or disk, and its output can be directed to any device supported by the GCOS output writer.

The RPG language processor features a fixed logic cycle that uses default values and specifications for certain control functions. The need to make many processing decisions (such as file selection, record input, input record formatting, and description of matching fields) is eliminated by the fixed logic cycle. Record selection and output are reduced to operations described by previously defined specifications rather than by individual procedural statements. During each cycle, the fixed logic presents the user with a single input record already in the form required for calculations. Any number of output records can be produced by one cycle.

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: GCOS supports several applications packages that can be run as stand-alone systems or as composite parts of user-designed systems. All of the following packages are written in COBOL and operate under the minimum Level 62 GCOS configuration.

Distribution Inventory Management System (DIMS)—DIMS is a data-base oriented inventory management system with the following features: seasonal analysis and autoadaptive exponential smoothing forecasting techniques, choice of replenishment policies, order-quantity and service-level projection and optimization capabilities,and multiple warehouse capability.

Production Scheduling and Control System (PSC)—PSC provides production control capabilities for manufacturers including creation, storage, and updating of routing and work-center data in a centralized data base. The system generates cost information and schedules order flows, highlights over- and under-loads on a long-run basis, and produces a variety of reports.

Inventory Management System/62 (IMS/62)—IMS/62 is a transaction-oriented inventory management system that plans, schedules, and controls the flow of materials and the utilization of resources. The package consists of the

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following six subsystems: inventory reporting, bill of materials processing, requirements management and reporting, material requirements planning, resource inventory planning, and standard cost control. IMS/62 operates from a data base and produces a variety of reports concerning stock levels, orders, demands, and costs.

Sales Order Processing (SOP)—This package consists of three modules: the order entry module which accepts, validates, and fills orders based on substitution, minimum quantity, partial shipment, and back-order factors; the Billing and Shipment module which prepares warehouse documents and produces sales analysis reports; and the Inventory Accounting module which tracks the status of each item to allow the current stock to be checked.

UTILITIES: Level 62 GCOS provides three utilities to assist users in managing data and testing software. The Sort routine can handle up to eight record classes. All files to be sorted must be on disk and organized as sequential, indexed, or relative. Output files are organized sequentially. The Merge routine can process up to five sequentially-organized disk input files and can handle up to eight record classes. Omitted records from either the sort or merge routine can be output to an exception file.

The Test Data Generator (TDG) generates data files for debugging user-written programs. TDG produces either indexed or sequential files. The sequential files can be written on disk, tape, or cards; indexed files are only written on disk. The format of the generated records is controlled by definitions submitted to the utility on control cards.

PRICING

Pricing and policies may vary slightly from country to country, but the information below, although specifically applicable only to France, may be considered a guide to CII-HB's worldwide marketing of the Level 62.

SOFTWARE: 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 all Series 60 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 and under rental, leasing, and full-payout-leasing plans.

Under the purchase plan, one year of maintenance on the central processing unit and three months on peripheral devices are provided without additional charge. Maintenance beyond these initial periods is provided under a separate contract.

The rental plan entitles the user to 182 hours of central processor usage per month and includes maintenance in the monthly fee. The user pays 10 percent of 1/182 of the basic monthly fee for each additional hour of usage beyond this 182-hour period.

The leasing plan entails a fixed equipment fee and a separate maintenance contract that allows maintenance rates to vary on a quarterly basis. Five- and six-year leases are available. For a five-year lease, the monthly charge including maintenance is approximately 93 percent of the monthly charge under the rental plan. For a six-year lease, the charge is approximately 89 percent of the rental charge.

The full-payout-lease (FPL) is available as a five- or six-year plan.

EQUIPMENT: Following are the minimum Level 62 configurations and their approximate prices in French francs.

MODEL 62/10 SYSTEM: Consists of a CPU with 176K bytes of memory; console with keyboard, 30-cps serial printer, and one diskette drive; two 40-million-byte disk drives; and a 180-lpm line printer. Purchase price is approximately 657,000 FF.

MODEL 62/20 SYSTEM: Consists of a CPU with 80K bytes of memory; console with keyboard, 30-cps serial printer, and one cassette tape drive; two 20-million-byte disk drives; and a 180-lpm line printer. Purchase price is approximately 498,000 FF.

MODEL 62/40 SYSTEM: Consists of a CPU with 80K bytes of memory; console with keyboard, 30-cps serial printer, and one cassette tape drive; two 29.2-million byte disk drives; and a 400-lpm line printer. Purchase price is approximately 742,400 FF.

MODEL 62/50 SYSTEM: Consists of a CPU with 96K bytes of memory; a console with keyboard, 30-cps serial printer, and one cassette tape drive; two 29.2 million-byte disk drives; and a 400-lpm line printer. Purchase price is approximately 807,000 FF.

MODEL 62/60 SYSTEM: Consists of a CPU with 96K bytes of memory; console with keyboard, 30-cps serial printer, and one cassette tape drive; two 29.2-million-byte disk drives; and a 400-lpm line printer. Purchase price is approximately 1,031,000 FF.■