

Burroughs B 6700 and B 7700

MANAGEMENT SUMMARY

The Burroughs B 6700 and B 7700 Information Processing Systems are large-scale computers that are well suited for a broad range of business, scientific, and real-time applications. Their unorthodox architecture differs in many important respects from that of competitive systems such as the IBM System/370, Honeywell Series 6000, and UNIVAC 1100 Series — yet nearly all of the Burroughs design innovations seem eminently sensible and draw warm praise from users.

Here are some of the principal design concepts that collectively stamp the B 6700 and B 7700 systems as truly distinctive entries in today's computer market:

- Multiprogramming is considered the normal mode of operation and is strongly emphasized in the design of all hardware and software.
- A system can (and usually does) include two or more central processors, which can share all storage and input/output facilities. The multiprocessing capability is fully supported by the standard software.
- All system operations are scheduled and supervised by an integrated operating system called the Master Control Program (MCP).
- All user programs are written and debugged in a high-level, procedure-oriented language such as COBOL, FORTRAN, ALGOL, PL/1, APL, or BASIC. The hardware design is oriented toward efficient compilation and execution of programs written in these languages. There is no symbolic assembly

These distinctive large-scale computer systems offer multiprocessing, virtual storage, dynamic reconfiguration, and a host of other advanced hardware and software facilities. They are performing effectively in business, scientific, educational, and communications environments.

CHARACTERISTICS

MANUFACTURER: Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000.

MODELS: B 6700 and B 7700 Information Processing Systems. (Note: The B 6700 Central System is currently available in 14 different models, and the B 7700 Central System is available in 4 models; the characteristics and components of each model are listed in the "Equipment Prices" section of this report.)

DATA FORMATS

BASIC UNIT: Fixed-length memory word, consisting of 48 data bits, 3 control bits, and 1 parity bit. (Eight additional bits, used for automatic error correction, are standard in the B 6748 and B 7700 and are optionally available in the other B 6700 systems.) Each word can hold one single-precision operand, half of a double-precision operand, part of a string of 4-, 6-, 7-, or 8-bit characters, one descriptor, or six 8-bit instruction syllables.

OPERANDS: Integer and floating-point operands have the same format and may be freely combined in arithmetic operations. Each single-precision operand (integer or floating-point) occupies one word and consists of a 6-bit octal exponent with sign and a 39-bit fraction with sign. Each double-precision operand occupies two words and consists of a 15-bit octal exponent with sign and a 78-bit fraction with sign. String operands may consist of a variable number of 4-, 6-, 7-, or 8-bit characters.



B 6700 systems, now available in 14 different models, can include as many as 3 central processors, 3 input/output processors, and 6 million bytes of core storage. The dual-display operator console permits convenient communication with the Master Control Program that schedules and controls all B 6700 operations.

Burroughs B 6700 and B 7700

▷ language, and programmers are seldom, if ever, required to work at the machine-language level.

- All object programs use re-entrant coding, and all addresses are relative and/or indirect. Data areas and program segments are defined by special words called "descriptors." These facilities permit efficient dynamic relocation of both programs and data, and allow program segments to be shared by two or more jobs.
- Virtual storage is implemented by an effective logical segmentation technique. The B 6700/7700 compilers automatically divide all object programs into logical segments of varying length. At execution time, the Master Control Program loads, relocates, and overlays these segments as required.
- Input/output operations are controlled by one or more input/output processors (IOP's), which operate independently of the central processors.
- Data transmission and reception functions are handled by small special-purpose computers called Data Communications Processors, which function independently of the central processors. Up to 4 DCP's can be connected to each input/output processor, and each DCP can control up to 256 lines.
- Main memory is divided into a number of modules which operate independently and can be accessed simultaneously.
- Flexible configuration rules permit critical hardware components to be duplexed for increased system reliability and performance. In addition, there are extensive provisions for "fail-soft" operation (i.e., graceful degradation) through either automatic or manually controlled reconfiguration.
- Dynamic resource allocation, an important capability of the Master Control Program, permits hardware components to be added to or subtracted from the system at any time without necessitating recompilation of the user's programs or regeneration of the MCP.
- Though the B 6700/7700 central processors are basically binary computers with a fixed word length of 48 data bits, they can also effectively process variable-length "strings" of 4-bit, 6-bit, 7-bit, or 8-bit characters.
- Fixed and floating-point operands, as well as single- and double-precision operands, can be freely combined in arithmetic operations with no need for prior conversion.
- A "stack", operating as a push-down list on the "last in, first out" principle, provides efficient temporary

▷ INSTRUCTIONS: 1 to 12 eight-bit syllables in length. Syllables are packed six to a program word and executed sequentially from left to right.

INTERNAL CODE: 8-bit EBCDIC is standard. Information coded in ASCII or 4-bit or 6-bit codes can also be processed. ASCII is the primary data communications code, while the 6-bit BCL (Burroughs Common Language) code is used to interface with most peripheral units. In general, characters are collated according to their internal binary values.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: B 6700 systems other than the B 6748 can have from 393,216 bytes (65,536 words) to 6,291,456 bytes (1,048,576 words) in any combination of 98,304-byte (16,384-word) modules and/or 393,216-byte (65,536-word) modules.

B 6748 systems can have from 393,216 bytes (65,536 words) to 1,572,864 bytes (262,144 words) in 393,216-byte (65,536-word) modules.

B 7700 systems can have from 786,432 bytes (131,072 words) to 6,291,456 bytes (1,048,576 words) in any combination of 786,432-byte (131,072-word) modules and/or 1,572,864-byte (262,144-word) modules.

CYCLE TIME: For B 6700 systems other than the B 6748, cycle time is either 1.2 microseconds (for the 98KB modules) or 1.6 microseconds (for the 393KB modules) per word. Each memory module operates independently, and memory cycles can occur simultaneously in any four modules. Two-way interleaving of adjacent memory modules is optional.

For B 6748 systems, cycle time is 1.6 microseconds per word. Only one memory access can occur at a time unless the system includes a second B 6005-4 Basic Memory Module, in which case two memory accesses can occur simultaneously.

For B 7700 systems, cycle time is 1.5 microseconds per double-word access (12 bytes) for the 786KB modules or 1.5 microseconds per quadruple-word access (24 bytes) for the 1572KB modules. Each memory module operates independently, and memory cycles can occur simultaneously in any eight modules. The memory is two-way interleaved in the 786KB modules and four-way interleaved in the 1572KB modules.

CHECKING: Parity bit with each word is generated during writing and checked during reading. The B 6748 and B 7700 also generate and check an 8-bit error detection byte during each main memory reference, permitting automatic correction of single-bit errors. (This facility is included in the optional Failsoft Memory for the other B 6700 systems.)

STORAGE PROTECTION: Provided by a combination of hardware and software. A memory protect bit prevents user programs from writing into locations which have the protect bit set. Attempts by programs to index beyond their assigned data areas are automatically detected.

CENTRAL PROCESSORS

CONFIGURATION RULES: B 6700 systems other than the B 6748 include one, two, or three central processors, ▷

Burroughs B 6700 and B 7700

➤ storage for the operands and other data associated with each program in main storage.

The B 6700 and B 7700 systems were introduced in October 1970. Customer deliveries of the B 6700 began in February 1971. At this writing, approximately 150 B 6700 systems are believed to be in use throughout the world, with about 60 of these in the United States. Customer deliveries of the B 7700 began in May 1973, and two of the systems have been installed to date. Rental prices for practical B 6700/7700 configurations span a broad range, from about \$20,000 to over \$150,000 per month. Corresponding purchase prices range from about \$900,000 to over \$7,000,000.

BACKGROUND

The B 6700 and B 7700 systems are the currently marketed members of a line of Burroughs computers that has evolved directly from the historic B 5000. Unveiled in 1961, the B 5000 was one of the first computers to emphasize such advanced techniques as multiprogramming, virtual storage, and programming exclusively in higher-level languages. Market acceptance of the B 5000 came very slowly, as is usually the case when a comparatively small company introduces a product that deviates widely from the norm.

The B 5000 was later superseded by the improved B 5500, and by the mid-sixties the B 5500 had attracted a sizeable group of highly enthusiastic users. What's more, the advanced design concepts employed in the B 5000 and B 5500 have strongly influenced the design not only of the later computers from Burroughs itself, but of most of the other large-scale computer systems available today.

In May 1966, Burroughs announced the B 6500 system. At that time the B 6500 was slated to be a faster, integrated-circuit version of the B 5500 with full program compatibility. Later, it became apparent to the Burroughs designers that it would be wise to forego object-level compatibility with the B 5500 in order to overcome some significant performance limitations of the earlier machine. So the B 6500 specifications were changed in July 1967, and initial deliveries were delayed until November 1969.

The B 6500 was superseded by the greatly enhanced and lower-priced B 6700 systems. All installed B 6500 systems have been field-upgraded to the B 6700 level.

When Burroughs announced the revamped B 6500 specifications in July 1967, it also introduced two faster, program-compatible processors called the B 7504 and B 7506. But the B 7500 systems were never delivered, and they were replaced in due course by the still more powerful B 7700 systems.

In October 1970, concurrently with the B 6700 and B 7700 systems, Burroughs also announced a lower-priced ➤

➤ depending on the model (see "Equipment Prices"). B 6748 systems are limited to a single central processor. B 7700 systems can include from one to seven central processors; the total number of central processors plus input/output processors cannot exceed eight.

REGISTERS: Each B 6700 processor has six 51-bit information registers that can communicate with each other and with main storage. The A, B, X, and Y registers are extensions of the stack for the currently active program. The P register holds the current program (instruction) word, and C is a scratch register for the processor. In addition, 48 twenty-bit address registers are provided in two integrated-chip memory units.

The B 7700 has three bipolar integrated-circuit buffer memories, two of 32-word length and one 16 words long. These memories have a cycle time of 60 nanoseconds per word. One 32-word buffer is used for storage of program words on a look-ahead basis, and the other 32-word buffer is used as the current program's stack of operands and control words. The 16-word buffer is an associative data buffer, used to provide high-speed local storage for operands and descriptors which are frequently used but are not in the stack buffer.

STACKS: A stack is an area of memory, assigned to each B 6700 and B 7700 program, that provides temporary data storage, stores a dynamic history of the program's operating status, and holds the descriptions associated with the program. Functionally, the stack acts as a push-down list that operates on the "last in, first out" principle. In the B 6700, the top two words of the stack for the currently active program are held in the A and B registers, while the S register is a "pointer" that always holds the address of the last word stored in the stack area in main storage. If the operands stored in the A and B registers are double-precision words, the X and Y registers are used to store the second halves of these operands. In the B 7700, the top 32 words of the currently active stack are stored in high-speed buffer memory. When the processor switches from one job (and therefore from one stack) to another, all data in registers or buffer memory is stored in main memory before control is transferred. This storing of vital program information is performed automatically by hardware.

DESCRIPTORS: A descriptor is a word used to describe a data or program area in storage. There are three types: data, string, and segment descriptors. A data descriptor defines a data area by specifying its starting address in either main or disk storage, its size, and certain other descriptive information. String and segment descriptors provide similar information about data areas organized as character strings and about program segments, respectively.

INSTRUCTION REPERTOIRE: There are three basic types of instruction syllables: operators, value calls, and name calls.

A value call is 2 syllables (16 bits) long. It causes the specified operand to be brought into the top location of the stack.

A name call is also 2 syllables (16 bits) long. It causes the specified address to be placed in the top location of the stack.

Operators range from 1 to 12 syllables in length, though most are only 1 or 2 syllables long. Each operator causes the specified operation to be performed. There are approximately 200 operators in the basic B 6700 instruction repertoire. ➤

Burroughs B 6700 and B 7700

➤ system called the B 5700. But whereas the B 6700 and B 7700 were new and highly cost-effective systems, the B 5700 was just a refurbished version of the second-generation B 5500, with mostly improved capabilities and a lower pricetag. Specific B 5700 enhancements include an auxiliary core memory subsystem used for high-speed storage of data and program overlays, a shared disk file facility, and an improved COBOL compiler. B 5700 customer deliveries began in December 1970. Although the B 5700 is still available, it no longer occupies a significant position in the Burroughs product line.

B 6700 ARCHITECTURE

The B 6700 Central System, which forms the nucleus of every B 6700 configuration, is currently available in 14 different models, as listed in the "Equipment Prices" section of this report. These models offer various combinations of one, two, or three central processors with three different speed ratings: a 2.5-megahertz processor, a basic 5-megahertz processor, and a second 5-megahertz processor that includes a set of special Vector Mode operators for faster processing of vectors and arrays. In addition, four "FS" Central Systems include dynamic re-configuration hardware for fail-soft operation.

Thirteen of the fourteen B 6700 Central Systems were introduced in June 1972; they replaced the earlier B 6711, 6712, 6714, 6721, 6722, 6724, and 6734 systems, which are still in use but are no longer being marketed.

The 14th and latest B 6700 Central System is the comparatively low-priced B 6748. Introduced in June 1973, the B 6748 is specifically designed to be price-competitive with the IBM System/370 Model 145 while delivering substantially higher CPU performance. It features a 5-megahertz central processor and from 393K to 1572K bytes of core storage with a cycle time of 1.6 microseconds per 48-bit (6-byte) word and automatic error-correction facilities. A single input/output processor with eight channels is standard, and a single Data Communications Processor can be added to control a maximum of 80 lines. No further expansion of the B 6748 Central System is permitted, but any of the standard B 6700/7700 peripheral equipment can be used with it. The B 6748 is fully program-compatible with the larger B 6700/7700 systems and can utilize the MCP and all other systems software. B 6748 customer deliveries are scheduled to begin in the first quarter of 1974.

Whereas the B 6748's configuration possibilities are restricted, the other B 6700 systems are highly modular and readily expandable. A B 6700 configuration can include one to three central processors, one to three input/output processors with up to 12 channels each, and from 393,216 bytes (65K words) to 6,291,456 bytes (1048K words) of 1.2-microsecond and/or 1.6-microsecond core storage.

The B 6700 processors can operate in either the Normal State or the Control State. The Normal State is used for ➤

➤ The arithmetic operators cause the two operands at the top of the stack to be combined according to the specified binary arithmetic process, with the result placed at the top of the stack. Floating-point and integer operands of single and double precision may be freely combined. Other word-mode operators perform logical operations, comparisons, branches, field or bit manipulation, stack management functions, subroutine entry and exit, etc.

A flexible group of string operators is used to transfer, compare, scan, translate, pack, unpack, edit, and scale strings of data in the form of 4-bit, 6-bit, 7-bit, or 8-bit characters.

The Vector Mode operators, a standard feature of the B 6718, B 6728, B 6738, and B 7700 central processors, consist of a group of 40 additional operators designed to speed up the processing of vectors (or strings of numbers) and matrices (or arrays of numbers) by using high-speed processor registers to store and increment data addresses.

ARITHMETIC TIMES: The following table lists the approximate times (in microseconds) required to perform the indicated operations upon integer and/or floating-point operands already in the stack. Fastest available central processor and memory modules are assumed.

	<u>B 6700</u>	<u>B 7700</u>
Single-precision:		
Add/subtract	0.2	0.13
Multiply	2.0	0.80
Divide	10.8	2.00
Double-precision:		
Add/subtract	0.6	0.14
Multiply	16.0	3.35
Divide	36.8	16.53

INPUT/OUTPUT CONTROL

I/O CHANNELS: B 6700 systems other than the B 6748 can include from one to three input/output processors (IOP's), and each IOP can have a maximum of 12 data switching I/O channels.

B 6748 systems contain a single IOP with 8 data switching I/O channels.

B 7700 systems can include from one to seven IOP's, and each IOP contains either 28 or 32 I/O channels.

The IOP's and associated peripheral control units direct the transfer of all data between main storage and peripheral equipment, with no servicing required by the central processor. The B 6700 data switching channels "float" among the various peripheral control units as required.

CONFIGURATION RULES: Each type of peripheral device requires a different control unit. In B 6700 systems other than the B 6748, each IOP can accommodate a maximum of 10 "large" and 10 "small" control units and a total of up to 256 peripheral devices. The large control units are required for high-speed devices (magnetic tape, disk files, display consoles, etc.). The small control units are used for slower devices (printers, card readers and punches, etc.). In addition, each IOP can control up to four Data Communications Processors.

The single IOP in a B 6748 system can accommodate a maximum of 5 large and 5 small control units, up to 160 peripheral devices, and one B 6358 Data Communications Processor. ➤

Burroughs B 6700 and B 7700

▷ execution of user programs. Interrupt signals cause the processor to enter the Control State and transfer control to the Master Control Program whenever an I/O operation is completed or an abnormal condition is encountered. When in the Control State, the processor can execute all instructions, including certain "privileged" ones that are prohibited in the Normal State.

Each B 6700 processor has a comprehensive interrupt system that alerts it to special conditions arising either internally (within the processor or main storage) or externally (in the on-line peripheral equipment). In a multi-processor system, each processor handles its own internal interrupts and any processor can service the external interrupts.

Fail-soft capabilities, which enable a system to remain in operation (albeit at a reduced level of performance) when failures occur in individual components, are a strongly emphasized feature of the B 6700 hardware and software. Burroughs now offers a choice of "controlled reconfiguration", which is actuated by the system operator, or "dynamic reconfiguration," which is handled automatically by the system itself.

The central component of a controlled reconfiguration system is the Configuration Control Unit, which contains a set of switches, a changeable control panel, and a programmable configuration memory. These controls can be used, for example, to partition a dual-processor B 6700 system into two independent single-processor systems, or to switch individual components off-line for maintenance purposes. The controlled reconfiguration facilities can be added, at modest cost, to any multi-processor B 6700 system.

Dynamic reconfiguration is a further extension of the controlled reconfiguration capabilities that maximizes system availability in on-line, communications-oriented environments. When an equipment failure occurs, the faulty module is removed and the active programs are restarted, all without human intervention. Thus, if appropriate recovery procedures are built into the user's programs, system failures may be virtually transparent to the user. Dynamic reconfiguration is a built-in feature of the B 6725-FS, 6728-FS, 6735-FS, and 6738-FS Central Systems. Its cost is high, but the increased assurance of system availability it provides should justify its price in many installations.

B 7700 ARCHITECTURE

A B 7700 system can include as many as seven central processors or seven input/output processors; the total number of central processors plus IOP's, however, cannot exceed eight. Each IOP provides 28 or 32 channels. A B 7700 can have from 786,432 bytes (131K words) to 6,291,456 bytes (1048K) words of core storage with a cycle time of 1.5 microseconds per 12-byte or 24-byte access.

▶ Each B 7700 IOP can accommodate 20 standard control units (10 large and 10 small), four Data Communications Processors, four (or optionally eight) disk control units, and a Disk File Optimizer.

To utilize the standard software, every B 6700 or B 7700 system must include at least one disk subsystem, a card reader, a line printer, and a magnetic tape unit.

SIMULTANEOUS OPERATIONS: One input or output operation on each installed I/O channel can occur simultaneously with computing. Each B 6700 IOP can sustain a maximum total data rate of 1.67 million bytes per second. Each B 7700 IOP can sustain a maximum total data rate of 6.75 million bytes per second. The B 7700 disk (or dual) channels can transfer up to 4 million bytes per second using dual-word (12-byte) data transfers to main memory via the IOP. The standard B 7700 channels and the Data Communications Processor channels each have a bandwidth of 2 million bytes per second, transferring data to main memory one word (6 bytes) at a time.

I/O INTERFERENCE: B 6700—one main storage cycle (1.2 or 1.6 microseconds) is required for each 48-bit word of I/O data transferred to or from main memory. B 7700—one main storage cycle (1.5 microseconds) is required for each 48- or 96-bit word of I/O data transferred to or from main memory. The larger word size is used with the disk file I/O channels. These single-cycle storage demands will normally impose little or no delay upon any other system component, such as a central processor, since up to four (B 6700) or eight (B 7700) memory modules can be accessed simultaneously.

MASS STORAGE

HEAD-PER-TRACK DISK FILES: Burroughs currently offers five models of its head-per-track disk files with varying capacities and speeds, as described below. All models utilize noninterchangeable disks, have a fixed read/write head serving each data track, and record data in 180-byte segments. In all cases, up to 5 disk file storage units can be connected to an Electronics Unit (DFEU), and from 1 to 20 DFEU's can be connected to from 1 to 4 Disk File Controls through the use of an Exchange Unit. The Exchange Units allow great flexibility in disk file configurations, permitting four-way simultaneous read/write access to a bank of up to 2 billion bytes of disk storage.

The B 9372-20 Disk File provides 10 million bytes of storage with an average access time of 20 milliseconds. It includes one DFEU and can accommodate up to four B 9372-21 additional 10-million-byte increments of storage. Additional DFEU's can be used if desired to increase the number of simultaneous access paths to the disk files.

The B 9373-20 Disk File provides 20 million bytes of storage with an average access time of 23 milliseconds. It includes one DFEU and can accommodate up to four B 9373-21 additional 20-million-byte increments. Additional DFEU's can be used to increase the number of access paths.

The B 9373-30 Disk File provides 20 million bytes of storage with an average access time of 40 milliseconds. It includes one DFEU and can accommodate up to four B 9373-31 additional 20-million-byte increments. The B9373-30, however, is no longer available for new systems orders.

The B 9375-1 Head-per-Track Memory Bank provides 100 million bytes of storage with an average access time of 23 milliseconds. It includes one DFEU, and its capacity can be expanded by adding B 9375-2 additional 20-million-byte

Burroughs B 6700 and B 7700

➤ The 16-megahertz B 7700 central processor, which is fully compatible with the B 6700 at the object-program level, features three high-speed buffer memories to help achieve rapid instruction execution. The buffers are implemented in bipolar integrated circuits and have an access time of 30 nanoseconds. One 32-word buffer is used for storage of program words, fetched on a look-ahead basis. A second 32-word buffer is used as the current program stack for temporary storage of operands and program control words. The third buffer memory, 16 words in length, is an associative data buffer that provides high-speed storage for other frequently referenced operands and descriptors.

The B 7700 central processor also features parallel and independent operation of its three main sections: program, execution, and storage. These sections intercommunicate by means of queues of operations, making possible a high degree of parallelism within each central processor.

Main storage in the B 7700 is interleaved two or four ways and is additionally "phased" in two- or four-word phases, depending on the model. Word phasing has the net result of permitting two or four 48-bit data words to be read or written within a single 1.5-microsecond core storage cycle.

The B 7700's actual word size is 60 bits, including the 48 data bits and 3 bits for control, 1 for parity, and 8 for error detection. The 8-bit error detection capability enables the B 7700 memory controller to automatically correct all single-bit errors and detect all two-bit errors.

Fail-soft hardware facilities of the B 7700 include extensive error checking and reporting logic, module and bus redundancy, duplication of major components, and a power supply in every module and cabinet. In addition, the software, via the MCP, supports these hardware capabilities and thus provides error detection, error analysis and isolation, on-line diagnostics, restart and error recovery routines, and automatic reconfiguration.

PERIPHERAL EQUIPMENT

Burroughs offers an appropriate complement of peripheral equipment for the B 6700/7700 systems, with principal emphasis on mass storage units, magnetic tape drives, and data communications equipment. In general, these devices are well-engineered and reliable, but far more conventional in design than the B 6700/7700 mainframes.

Mass storage buyers can choose either head-per-track disk files or moving-head disk pack drives. The head-per-track disk files that have long been a key element in most Burroughs computer systems are still offered in a broad range of capacities and access speeds. An optional Disk File Optimizer reduces access times by queuing disk file data requests and servicing them as the desired segments pass under the read/write heads. Disk pack drives, which

➤ increments. Additional DFEU's can be used to increase the number of access paths.

The B 9375-4 Head-per-Track Memory Bank provides 100 million bytes of storage with an average access time of 40 milliseconds. It includes one DFEU, and its capacity can be expanded by adding B 9375-5 additional 20-million-byte increments. The B 9375-4, however, is no longer available for new systems orders.

The Disk File Optimizer (DFO) is an optional hardware unit that greatly reduces average disk file access times by queuing data requests and servicing them as the desired segments pass under the read/write heads, rather than on a first-come, first-served basis. A single DFO can be connected to as many as 40 DFEU's. The basic DFO has 8 words of memory for queuing I/O control words, and this can be expanded in 8-word increments to a maximum of 32 words.

DISK PACK DRIVES: Burroughs offers two basic models of high-performance disk pack drives for use with the B 6700/7700 systems. Both units feature two independent disk drives per module and either single or dual access control units. Up to 16 drives can be serviced by one control unit. The comb-style access mechanisms, with one read/write head for each disk surface, are driven by magnetic voice-coil head actuator mechanisms.

The disk pack drives are software-supported by the MCP for I/O operations in either the full-track or 180-byte segment mode. Error detection and correction are provided by a block-count check byte (a count of "one" bits for each full track or 180-byte segment) and an 11-bit checking word appended to each 90 bytes of user data. All single-bit errors are detected and corrected, and all multiple-bit errors are detected.

The B 9484-3/9485-3/9486-3 Magnetic Actuator Disk Pack Drives are dual-drive units that provide up to 121 million bytes of data storage, 60.5 million bytes per disk pack, in full-track mode. In the 180-byte segment mode, the capacity is 95.5 million bytes per dual-drive unit. Up to 968 million bytes of storage (16 drives) can be provided via a single control unit. Average arm movement time is 30 milliseconds, and average rotational delay is 12.5 milliseconds. Data is recorded at 2200 bits per inch, producing a data transfer rate of 312,500 bytes/second. Data is recorded on an 11-high disk pack, which is physically compatible with the IBM 2316 pack; the packs, however, are not data-compatible with the IBM equivalents. Twenty surfaces are used for data recording, and each surface contains 406 tracks.

The B 9484-4/9485-4/9486-4 Magnetic Actuator Disk Pack Drives are dual-drive units that provide up to 242 million bytes of data storage, 121 million bytes per disk pack, in full-track mode. In the 180-byte segment mode, the capacity is 174.4 million bytes per dual-drive unit. The B 9486-45 is a single-drive increment that stores up to 121 million bytes. Up to 16 drives, or 1.936 billion bytes of storage, can be connected to a single control unit. Average arm movement time is 30 milliseconds, and average rotational delay is 12.5 milliseconds. Data is recorded at 4400 bits per inch — twice the density of most competitive units — resulting in a data transfer rate of 625,000 bytes/second. Data is recorded on an 11-high disk pack, which is physically compatible with the IBM 2316 pack; the packs, however, are not data-compatible with the IBM equivalents.

Burroughs B 6700 and B 7700

➤ were conspicuously absent from the Burroughs product line until late 1970, are now available in two high-performance models that provide approximately two or four times the capacity of an IBM 2314 drive. Although some of the B 6700/7700 software still supports only the head-per-track disk files, it is clear that the trend is toward increased usage of the more flexible and economical disk pack drives.

The B 6700/7700 systems are strongly oriented toward data communications. The Data Communications Processor (DCP) is an independently programmed computer that relieves the central processors of the basic functions associated with the transmission and reception of data. Each DCP can control up to 256 communications lines, and as many as 4 DCP's can be connected to each input/output processor in a B 6700 or B 7700 system. The Burroughs product line also includes an audio response system, CRT display terminals, intelligent terminals, remote peripheral controllers, and remote terminal concentrators.

SOFTWARE

Software support for the B 6700/7700 systems naturally centers on the Master Control Program, the integrated operating system that oversees and controls all operations. The B 6700/7700 MCP evolved directly from the B 5500 MCP, which has been winning user accolades for more than a decade. Many of the MCP functions that were unique when Burroughs introduced them in the early sixties are now provided by competitive large-scale operating systems as well — but the MCP continues to draw users' praise for being easier to understand and use than most of its competitors. The MCP receives its orders via straightforward messages entered via control cards or the console keyboard/display units.

B 6700/7700 users have an unusually wide choice of programming languages. Compilers are now available for COBOL, FORTRAN, ALGOL, PL/1, APL, BASIC, and ESPOL (a systems software development language). The compilers divide all object programs into logical, relocatable segments, and all coding generated by the compilers is re-entrant. Subprograms coded in different languages can readily be intermixed. The unconventional design of the B 6700/7700 computers yields unusually high compilation speeds; overall speeds of around 5000 card images per minute are frequently achieved in COBOL, FORTRAN, and ALGOL.

Burroughs also offers appropriate software facilities for data communications control (e.g., NDL, CANDE, RJE, and MCS II), file management (Disk FORTE II), and data base management (DMS), as well as a number of specialized application programs.

In September 1972, Burroughs partially unbundled the B 6700/7700 software by placing separate license fees on ➤



The B 7700 is the largest and most advanced computer in Burroughs' broad "700 Systems" product line. The B 7700 central exchange can accommodate up to 6 million bytes of core storage and a total of up to 8 central processors and input/output processors.

➤ INPUT/OUTPUT UNITS

MAGNETIC TAPE CLUSTERS: Contain two, three, or four tape drives in a single cabinet. The feed and take-up reels for each tape drive are mounted on concentric vertical shafts, with the feed reel feed reel directly above the take-up reel. Pinch rollers and short vacuum-column buffers are employed. Each of the tape drives has its own drive mechanism, but they share a common power supply and read/write circuitry. Up to eight tape drives (two clusters) can be connected to a Cluster Control. Two of the drives in a cluster can read and/or write simultaneously if two Cluster Controls and an Exchange unit are used.

Burroughs offers numerous models of the Magnetic Tape Clusters, as listed in the Equipment Prices section of this report. All models use standard 1/2-inch tape, can read either forward or backward, and record in IBM-compatible formats at a tape speed of 22.5 or 45 inches per second. The 9381 series units record in 9-track NRZI mode at 800 bpi and transfer data at either 18,000 or 36,000 bytes/sec; these units can alternatively be equipped to operate in the 7-track NRZI mode at densities of 200, 556, or 800 bpi. The 9382 series units record in 9-track phase-encoded mode at 1600 bpi and transfer data at either 36,000 or 72,000 bytes/sec. The 9383 series units are 9-track models that can operate in either the 800-bpi NRZI or 1600-bpi phase-encoded mode, with data transfer rates of either 18/36 KB or 36/72 KB.

B 9390 SERIES MAGNETIC TAPE UNITS: These units record data on 1/2-inch tape in IBM-compatible formats. Each tape drive is housed in a separate cabinet of the ➤

Burroughs B 6700 and B 7700

➤ most of the application programs and on certain program development aids and utility routines. The MCP and compilers, along with normal technical support and training, are still offered on a bundled basis at no additional cost.

COMPATIBILITY

Though the B 6700/7700 systems are billed as members of the Burroughs "700 Systems" computer family, there is no object-level program compatibility between them and the smaller B 700, B 1700, B 2700, B 3700, B 4700, or B 5700 systems. But Burroughs strongly recommends the use of higher-level languages for programming all its computers, and provides "filter" programs that facilitate the conversion of COBOL, FORTRAN, or ALGOL source programs from one Burroughs computer to another. Moreover, the latest COBOL Compiler for the B 6700/7700 systems accepts B 2700/3700/4700 ANS COBOL directly, eliminating the need for filtering.

The B 6700/7700 systems use the same byte-oriented data structure, EBCDIC internal code, and magnetic tape formats as the IBM System/360 and 370 computers, but there is no direct program compatibility between them at the machine-language or assembly-language level. Most programs written in ANS COBOL, FORTRAN, or PL/1 for the IBM computers, however, should be transferable to a B 6700/7700 computer without undue conversion difficulty.

COMPETITIVE POSITION

The highly modular B 6700/7700 systems can be configured to handle virtually the entire spectrum of large-scale computer applications and workload volumes. They compete with systems such as the larger IBM System/370 models (especially Models 145 through 168), the UNIVAC 1100 Series, the Honeywell Series 6000, and the Control Data Cyber 70 Series.

The new B 6748, designed to reduce the entry-level cost of B 6700-style computing, essentially matches the price of the IBM 370/145 in equivalent configurations. As to performance, Burroughs expects the B 6748 to deliver from 25 to 100 percent more CPU power than the 370/145, depending upon the application. The B 6748 is also directly competitive with the UNIVAC 1106 and the Honeywell 6040.

The B 6723 system (with two 2.5-megahertz central processors) and the B 6715 and B 6718 systems (each with one 5-megahertz central processor) are all directly competitive with the System/370 Model 158. (The B 6718 central processor, which includes the Vector Mode operators, delivers about the same performance as the less costly B 6715 in most business applications but outperforms it by as much as 3 to 1 on jobs that involve extensive array processing.) In typical cases, Burroughs ➤

➤ conventional vertical type. Pinch rollers and vacuum-column buffers are employed. Tape can be read in either the forward or reverse direction. Up to 10 free-standing tape drives can be connected to a Tape Control. Simultaneous read/write operations are possible if two Tape Controls and an Exchange unit are employed.

Six models of the free-standing B 9390 series tape units are available, with the following recording modes, tape speeds (in inches per second), recording densities (in bits per inch), and data transfer rates (in bytes or characters per second):

B 9391: 7 tracks; 90 ips; 200/556/800 bpi; 18,000, 50,000, or 72,000 char/sec.

B 9392: 9 tracks; 90 ips; 800 bpi; 72,000 bytes/sec.

B 9393-1: 9 tracks; 90 ips; 1600 bpi; 144,000 bytes/sec.

B 9393-3: 9 tracks, 150 ips; 1600 bpi; 240,000 bytes/sec.

B 9394-1: 7 tracks; 120 ips; 200/556/800 bpi; 24,000, 66,700, or 96,000 char/sec.

B 9394-2: 9 tracks; 120 ips; 800 bpi; 96,000 bytes/sec.

B 9495-5 & B 9495-6 MAGNETIC TAPE UNITS: These high-performance 9-track units record data on 1/2-inch tape in IBM-compatible phase-encoded mode at 1600 bpi. The B 9495-5 has a tape speed of 200 ips and a data transfer rate of 320,000 bytes/second, while the B 9495-6 has a tape speed of 250 ips and a data transfer rate of 400,000 bytes/second. Both models have a rewind speed of 700 ips, enabling a 2400-foot reel to be rewound in less than 45 seconds. Both drives feature a single vacuum-driven capstan, a sealed tapepath chamber, a power access window, a positive reel latch, automatic tape threading and loading, and "on-the-fly" detection and correction of most errors. A unique "coaxial" hub mounts the feed reel directly in front of the take-up reel, reducing the overall width of the unit to just 24 inches.

A basic B 9495-5 or B 9495-6 subsystem consists of a Dual I/O Control (which permits simultaneous read/write operations), a Basic Electronics/Exchange, and up to 8 tape drives. The addition of an Electronics/Exchange Extension permits the use of a second Dual I/O Control and up to 16 tape drives. B 9495-5 and B 9495-6 Tape Units cannot be intermixed in the same subsystem.

B 9495-2 & B 9495-3 MAGNETIC TAPE UNITS: These 9-track units, released in August 1973, offer all the features of the faster B 9495-5 and B 9495-6 units described above. Data is recorded on 1/2-inch tape in IBM-compatible phase-encoded mode at 1600 bpi. Data transfer rate is 120,000 bytes/second for the B 9495-2 and 200,000 bytes/second for the B 9495-3. These units can be used in a subsystem consisting of up to 4 tape controls, up to 16 tape units, and an appropriate Master Electronic Exchange (1 x 4, 1 x 8, 2 x 8, 2 x 16, or 4 x 16). First deliveries are scheduled for the first quarter of 1974.

B 9496-2 & B 9496-4 MAGNETIC TAPE UNITS: Introduced in August 1973, these low-cost 9-track tape drives feature improved reliability and "low-boy" cabinets (44 inches high). Data is recorded on 1/2-inch tape in IBM-compatible phase-encoded mode at 1600 bpi. The B 9496-2 has a tape speed of 15 ips and a data rate of 40,000 ➤

Burroughs B 6700 and B 7700

▷ has found that adding a second CPU to a B 6700 system (together with appropriate memory and peripheral resources) will increase the system throughput by 70 to 80 percent, while adding a third CPU will boost the throughput by another 30 to 40 percent.

The B 7700 systems compete with large, expensive computers such as the System/370 Model 168. The dual-processor B 7728, for example, provides processing power comparable to that of a single-processor 370/168, together with a substantially lower pricetag and the improved availability that is inherent in a dual-processor configuration.

USER REACTION

Datapro interviewed ten users of the large-scale Burroughs computers, including the only two current B 7700 users. Their high overall level of satisfaction makes it clear that the vexing hardware and software problems that plagued early B 6700 installations have now been largely overcome. Here's how the B 6700/7700 users rated the equipment and its vendor with respect to 11 important parameters:

	Excellent	Good	Fair	Poor
Ease of operation	6	4	0	0
Reliability of mainframe	3	6	1	0
Reliability of peripherals	0	4	6	0
Maintenance service:				
Responsiveness	3	5	1	0
Effectiveness	2	5	2	0
Technical support	4	3	2	0
Manufacturer's software:				
Compilers	5	4	0	0
Operating system	4	3	1	0
Application programs	0	3	1	0
Overall satisfaction	3	6	0	0
Credibility of vendor	1	6	1	0

Thus, the B 6700/7700 users were well pleased with virtually all aspects of their hardware, software, and vendor support. The Burroughs compilers and operating system drew especially high praise, as did the system's ease of operation. One enthusiastic B 6700 user said his system is "fantastically cost-effective, requires no in-house systems software staff, and is easy to program, debug, and operate." Other users noted that the Burroughs compilers — especially COBOL and ALGOL — are fast and virtually bug-free.

Reliability of peripherals was the only parameter in which the average user rating fell below the "good" mark, with four of the users assigning "good" ratings and six assigning "fair" ratings. This is hardly surprising, since peripheral equipment has traditionally caused the most problems for users of nearly all computer systems. Specifically, four of

▷ bytes/second, while the B 9496-4 has a tape speed of 50 ips and a data rate of 80,000 bytes/second. These units can be used in a subsystem consisting of one or two tape controls, up to eight tape units, and an appropriate Master Electronic Exchange (1 x 4 or 1 x 8). Deliveries are scheduled to begin in the third quarter of 1974.

B 9111 CARD READER: Reads 80-column cards of either standard or postcard thickness serially by column, on demand, at up to 800 cpm. Can also read 51-, 60-, or 66-column cards. EBCDIC is the standard card code, and binary, BCL, ICT, or Bull card codes can also be read. The photoelectric read circuitry is automatically monitored between card cycles, and invalid characters are detected. The feed hopper and stacker hold up to 2400 cards each and can be loaded and unloaded while the reader is operating. Optional features permit reading of 40-column Treasury Checks and/or round-holed Postal Money Orders.

B 9112 CARD READER: Reads up to 1400 cpm. Otherwise, has the same characteristics and features as the B 9111 Card Reader described above.

B 9115 CARD READER: A compact, table-top unit that reads 80-column cards serially by column at a rated speed of 300 cpm. Cards are read photoelectrically, with a double strobe comparison for each column to help ensure reading accuracy. The single input hopper and output stacker hold up to 1000 cards each.

B 9116 CARD READER: Reads up to 600 cpm. Otherwise, has the same characteristics as the B 9115 described above.

B 9117 CARD READER: Reads up to 800 cpm. Otherwise, has the same characteristics as the B 9115 described above.

B 9213 CARD PUNCH: Punches 80-column cards at up to 300 cpm. EBCDIC is the standard card code, and binary, BCL, ICT, or Bull card codes can also be punched. An echo check verifies that the proper punches have been actuated. The feed hopper holds 1000 cards, and three program-selectable stackers hold 1200 cards each. The associated control unit contains a full-card buffer.

B 9120 PAPER TAPE READER: Reads 5-, 6-, 7-, or 8-level punched tape at 500 or 1000 characters per second. The lower speed must be used for fanfold or metallized Mylar tape. Handles reels either 5.5 or 7 inches in diameter. A standard channel-select plugboard and optional Input Code Translator permit flexibility in codes.

B 9220 PAPER TAPE PUNCH: Punches 5-, 6-, 7-, or 8-level tape at 100 characters per second. Handles supply reels up to 8 inches in diameter and 5.5- or 7-inch take-up reels. A standard channel-select plugboard and optional Output Code Translator permit flexibility in codes.

LINE PRINTERS: Burroughs currently offers six printers of the conventional rotating-drum type which are improved versions of its earlier B 9242 and B 9243 series printers. All models have a carriage capable of handling continuous forms from 5 to 20 inches in width, a vertical spacing of 6 or 8 lines per inch, and a standard skipping speed of 25 inches per second. High-speed skipping (75 inches per second) is available as an optional feature. Characteristics of the various models are as follows:

B 9242-11: 860 lpm; 120 or 132 print positions.

▷ **B 9242-12:** 725 lpm; 120 or 132 print positions; OCR "A" numeric and standard alphabetic set. ▶

Burroughs B 6700 and B 7700

➤ the ten B 6700/7700 users mentioned problems with their line printers, three with the head-per-track disk files, one with the disk pack drives, and one with the card reader.

Most of the interviewed B 6700/7700 users were using large, complex configurations. Eight of the ten systems had dual central processors, and all of the systems included remote terminals, with the number ranging from 6 to 700 terminals per installation. The dual-processor systems routinely operate in a true multiprocessing mode, except when one of the processors is down for maintenance. The users were asked to express their overall system reliability in terms of the percentage of uptime they normally achieve. The answers ranged from 90% to essentially 100% (for a fail-soft system that is on-line for 24 hours every day), and averaged 96% uptime.

Thus, it is clear that the B 6700/7700 systems are effectively handling a wide variety of applications — and thereby proving that there is still room for fresh ideas in the design of computer hardware and software. Large-scale computer buyers should take a hard look at what Burroughs has to offer before making their decisions. □

➤ B 9243-13: 725 lpm; 120 or 132 print positions; OCR "B" alphanumeric set.

B 9243-11: 1100 lpm; 120 or 132 print positions.

B-9243-12: 900 lpm; 120 or 132 print positions; OCR "A" numeric and standard alphabetic set.

B 9243-13: 900 lpm; 120 or 132 print positions; OCR "B" alphanumeric set.

These printers incorporate a number of engineering improvements designed to provide increased reliability, print quality, and ease of operation. The changes include new hammer construction, new tractor gears, new power supply, new control knobs, and new end-of-paper sensing device. A "paper stabilizer" holds the paper motionless during each print cycle by activating six stabilizing arms located below the print station.

The printers feature a Burroughs innovation called "Forms Self-Align." With this feature, forms are advanced under program control to printed marks on the right-hand edge of the forms, eliminating the need for a format control tape. The three standard marks are line, field, and end-of-page. The Burroughs Business Forms and Supplies Group offers both stock and custom forms with the require Forms Self-Align markings. A switch allows the operator to select vertical format control by means of either the Forms Self-Align marks or a conventional 12-channel paper tape loop.

B 9246-2 HIGH SPEED PRINTER: This fast drum-type printer, announced in June 1973, prints 1800 lines per minute when using only the first 36 characters of its 64-character set. The speed is 1250 lpm when the full character set is used, and normal alphanumeric character mixes should result in a throughput of 1500-plus lpm. An optional 64-character set with OCR A numeric characters and 4 special characters yields a print speed of 1200 lpm when the first 46 characters are used and 925 lpm for the full character set. The B 9246-2 is fully buffered, has 132

print positions, prints 6 or 8 lines to the inch, and has a skipping speed of 36 inches/second. First deliveries are scheduled for December 1973.

B 9247-14 TRAIN PRINTER: This high-performance train printer, announced in August 1973, prints 1100 lines per minute and has 132 print positions. The standard 48-character train module can be replaced by other interchangeable modules. The B 9247-14 handles vertical format control through either the Burroughs "Forms Self-Align" system, which uses codes preprinted on the forms, or an optional 12-channel carriage control tape. Deliveries are scheduled to begin in the first quarter of 1974.

B 9342-1 CONSOLE DISPLAY TERMINAL: Provides a 960-character CRT display and typewriter-style keyboard, plus the switches and indicators required for operator control of the B 6700 and B 7700 systems. Can also be equipped with an optional printer/keyboard or an additional display unit. (All B 6700 and B 7700 systems include at least one Console Display in the price of the central processor. The B 9342-1 can be added when additional Console Displays are desired.)

COMMUNICATION DEVICES

B 6350/7350 DATA COMMUNICATIONS PROCESSOR: The DCP is a small special-purpose computer that performs the basic functions associated with the transmission and reception of data. It contains arithmetic registers, logic circuits, 8 words of scratchpad memory, and (optionally) up to 4 memory modules, each containing 4,096 52-bit words of instruction memory. Up to 4 DCP's can be connected to an I/O Processor, and each DCP can handle up to 256 communications lines.

From 1 to 16 Adapter Clusters can be attached to each DCP, and each Adapter Cluster accommodates up to 16 Line Adapters. An appropriate Line Adapter is required for each communications line. The available Line Adapters permit transmission over leased or switched facilities, in asynchronous or synchronous mode, at speeds of up to 9600 bits per second. Line adapters are also available for Touch-Tone, audio response, and automatic dial-out operations. In addition, recent enhancements permit communication with binary synchronous (BSC), full-duplex, reverse-channel, and broad-band equipment. (For details of the available line adapters, please see the "Equipment Prices" section at the end of this report.)

The DCP can be programmed, and can execute coding stored either in its own memory or in B 6700/7700 main memory. Thus, it can perform many of the line control functions which are normally wired into individual line adapters, permitting greater operational flexibility. It can also scan the communications lines for activity or poll the various terminals in a network. Burroughs states that each DCP is fast enough to readily handle a situation in which Teletype messages are being sent or received at 10 characters per second over all 256 lines. Each DCP operates independently of all others in a system.

B 6358 DATA COMMUNICATIONS PROCESSOR: This version of the DCP can be used only with the B 6748 Computer System. The basic B 6358 includes 12K bytes (2K words) of local IC memory and 4 line adapter positions. By adding the B 6358-5 DCP Local Memory Module, the B 6351-1 Line Expansion Cabinet, and up to five B 6450-1 Adapter Clusters, the B 6358 can be expanded to a maximum of 24K bytes (4K words) of memory and 80 line adapter positions. Only one B 6358 DCP can be used in a B

Burroughs B 6700 and B 7700

- ▶ 6748 system. The B 6358 accesses main memory directly, whereas DCP's in the larger B 6700/7700 systems are connected via an I/O Processor.

B 9350 TYPEWRITER INQUIRY STATION: Provides remote keyboard input and hard-copy output at 10 characters per second via a Teletype Keyboard Send/Receive unit. Can be located up to one mile from the computer if connected via direct multi-conductor cables, or at any distance if dialed telephone lines are used.

AUDIO RESPONSE SYSTEM: Provides responses, in recorded human-voice form, to digital inquiries from pushbutton telephones. Accommodates up to 128 lines, in 2-line increments. Spoken words or phrases are recorded on film wrapped around a revolving drum. The drum contains 63 audio tracks, each capable of storing either one phrase (up to 1.5 seconds in length), the same word recorded three times, or three different words. The Audio Response Generator is used in conjunction with Touch-Tone Telephone Input Line Adapters, Audio Response Output Line Adapters, and a Data Communications Processor.

SOFTWARE

MASTER CONTROL PROGRAM: The MCP is an integrated operating system that oversees and controls all operations of the B 6700 and B 7700 systems. It consists of a group of routines organized in three-level hierarchical fashion. The first level is a small "hard core" routine that fields all interrupt signals and transfers control to the appropriate MCP routines. The second-level routines handle the MCP's major task: dynamic resource allocation of main memory, disk storage, I/O devices, processors, and time among the concurrently-operating programs. The third-level routines handle utility functions such as job scheduling, control-card interpretation, file control, library maintenance, etc.

The first- and second-level MCP routines reside in main memory at all times, whereas the third-level routines are called in from disk storage when required. The third-level routines are considered part of the B 6700/7700 generalized library system and can easily be modified to meet each user's specific needs.

Principal elements of the MCP include:

- An executive routine that coordinates MCP operations, controls the execution of program segments, initiates all I/O operations, responds to all interrupt conditions, maintains an operations log, handles communication with the system operator, and transfers control to other MCP routines when necessary.
- A scheduling routine that evaluates the equipment and priority requirements of a group of programs and schedules their execution so as to utilize the system's resources efficiently in a multiprogramming mode, using either single or multiple processors. The job sequence is dynamically rescheduled whenever a high-priority job is introduced into the mix.
- An environment control routine that dynamically allocates main memory and assigns I/O devices according to the needs of each program.
- An exception condition routine that provides standard error-handling procedures.

The MCP continuously maintains an internal description of the system's physical resources (memory, processors, peripheral devices, I/O channels, etc.). This enables it to adjust immediately to changes in the system configuration, so that the system can often continue operating when failures occur in individual components.

The MCP provides comprehensive input/output and file control facilities. Serial I/O operations can be programmed for all peripheral devices, while random I/O operations are allowed on the various disk units. Blocking, buffering, label checking, and other standard I/O control functions are performed in accordance with the programmer's specifications. Magnetic tape drives or disk files can be freely used as backup or "pseudo" devices for card readers, punches, and printers. This makes it unnecessary to delay the processing of a job because of non-availability of a particular I/O unit.

True dynamic memory allocation is a feature of the MCP. The compilers automatically divide all object programs into logical, relocatable segments. Moreover, all object programs use re-entrant coding, so that the coding is never modified during execution and two or more jobs can concurrently make use of a single program segment residing in main memory. Program and data segments are automatically transferred from disk storage to main memory when needed. When necessary, the MCP automatically overlays these new segments over other program or data segments in main memory that have not been accessed recently. If the old segment contains modifiable data, it is written on a disk file prior to being overlaid; if it is a program segment or a read-only data segment, this "roll-out" operation is unnecessary.

Communication between the system operator and the MCP is accomplished through a combination of CRT display units, keyboards, control cards, and a comprehensive system log. The status of the system and of the jobs in progress is presented on the CRT displays. Messages and requests can be keyed by the operator, and the system responses are displayed on the CRT. Jobs are usually submitted to the system in the form of a set of control cards, which will be accompanied by a source-language deck if the necessary programs have not previously been compiled and stored on disk. The system log, maintained on disk by the MCP, is a record of all activities of the system, including error and maintenance statistics and job processing times.

Work Flow Management is a recent addition to the MCP that provides enhanced facilities for user control of task initiation and resource allocation. The Work Flow Language (WFL), an extension of the previous MCP job control statements, enables users to describe each job as a network of interrelated tasks. The WFL compiler accepts these control statements as input and generates machine code to control the tasks within each job as the user prescribes. Facilities provided by the Work Flow Management System include: sequencing and synchronizing of related tasks via input from control cards, improved consistency in task restarts after system failures, job summary printouts, multiple job scheduling queues for different levels of service, interfaces for installation-tailored system control programs, and accounting records grouped by job.

COBOL: The B 6700/7700 COBOL language is based on COBOL-68 and now includes all the facilities of full American National Standard COBOL, including the Sort, Report Writer, and Segmentation modules. Source-language program debugging facilities, data communications constructs, and a number of other useful extensions are also included. The EBCDIC and BCL character sets are now

Burroughs B 6700 and B 7700

supported, and ASCII will soon be added. The compiler accepts a COBOL source program and generates a machine-code object program which is placed in disk storage, ready for execution; it can also be written on magnetic tape if desired. The compiler automatically divides all object programs into logical, relocatable segments, and all coding generated by the compiler is re-entrant. COBOL compilation is a 2-pass process, and overall speeds of 5000 to 6000 card images per minute are commonly achieved.

FORTRAN: The B 6700/7700 FORTRAN language is generally compatible with IBM's FORTRAN IV, Level H, and includes American National Standard FORTRAN as a fully compatible subset. Programs written in Burroughs B 3500 or B 5700 FORTRAN, and in most other versions of the FORTRAN language, are acceptable to the B 6700/7700 compiler with certain exceptions. The compiler generates re-entrant object code and automatically divides all object programs into logical, relocatable segments. Subprograms coded in FORTRAN can be intermixed (or "bound") with other subprograms coded in ALGOL or COBOL. Extensive compile-time diagnostic and debugging facilities are provided. FORTRAN compilation is a 4-pass process, and overall speeds of 4000 to 5000 card images per minute are commonly achieved.

ALGOL: Burroughs has long been the leading proponent among major U.S. computer manufacturers of ALGOL, the international algorithmic language for scientific computation. The B 6700/7700 ALGOL language is based upon the "Revised Report on the Algorithmic Language ALGOL 60" (Communications of the ACM, January 1963), with extensions to handle I/O operations, character manipulation, partial-word operands, and diagnostic facilities. DC ALGOL is a specialized version of ALGOL oriented toward the writing of message control systems for communications networks; it features additional constructs for handling queues. ALGOL compilation is a 2-pass process, and overall speeds of around 5000 card images per minute are commonly achieved.

PL/1: The B 6700/7700 PL/1 language is an implementation of the proposed American National Standard PL/1 language. There are some differences from IBM's PL/1 in various machine-dependent constructs, but Burroughs claims that little difficulty has been encountered in field conversions from IBM to B 6700/7700 PL/1. ISAM files are supported in PL/1. Compilation is a 2-pass process. The PL/1 compiler was released to users late in 1972.

APL: Burroughs recently released to its users an APL compiler that has been used internally for more than two years. The APL system is a compiler and a special-purpose message control system combined to provide efficient service to multiple users at remote terminals.

BASIC: B 6700/7700 BASIC is a non-interactive implementation of the BASIC language that is generally compatible with the offerings of GE's Mark II time-sharing service.

ESPOL: This special-purpose language/compiler, which was used to code the MCP and other systems software for the B 6700/7700 computers, is now available to users. It will be used primarily to code "installation intrinsics," which are small user-coded routines bound into the MCP. ESPOL-coded intrinsics enable users to take full advantage of the Vector Mode operators.

DATA COMMUNICATIONS SOFTWARE: Communications control functions in B 6700/7700 systems are divided between the MCP, a message control system, and programs in the Data Communications Processor (DCP). Together, these facilities can handle interactive time-sharing, remote inquiry, remote job entry, and various other communications functions.

Programs for the DCP can be produced by the Network Definition Language (NDL) compiler. The user simply describes the characteristics of his terminals and their associated line disciplines, and punches these specifications into cards. Then the compiler produces the code needed to drive the DCP and establish the interfaces with its terminals. These programs equip the DCP to poll communications lines, answer and terminate calls, format messages, translate codes, manipulate data, and perform line discipline functions.

The message control system runs on the central processor(s) and operates in conjunction with the MCP. Its main functions are: (1) to handle all message queuing to and from the DCP, and (2) to control communications between remote terminals and user programs running under the MCP. The message control system may also accept input from a variable number of remote stations, perform various command and edit functions, deal with exception conditions, initiate specified jobs, maintain file security, etc.

Many B 6700/7700 users find it advisable to write their own message control systems, and Burroughs offers a specialized ALGOL compiler called DC ALGOL to facilitate the process. Alternatively, Burroughs also offers three ready-made message control systems called CANDE, RJE, and MCS II; all are coded in DC ALGOL and can easily be modified by users.

CANDE (Command and Edit) is a message control system that enables users at remote terminals to enter programs or data files into disk storage, compile and execute programs, edit and alter programs or files, search files, send messages to other terminals, and perform a variety of other functions.

RJE (Remote Job Entry) is a message control system designed for use with remote batch terminals, each consisting of a small computer equipped with a card reader, line printer, and supervisory console. RJE permits introduction of programs and/or data from the remote card reader, printing of output data on the remote line printer, and monitoring and controlling of programs via the remote console.

MCS II is a message control system oriented primarily toward message switching applications. It can "broadcast" messages to any or all of the attached remote stations, and it includes various network monitoring and diagnostic functions.

DISK FORTE: This file management system enables users to structure multiple files in disk storage and to establish complex interrelationships among these files. The files can have any of four distinct types of organization: indexed sequential, random, indexed random, and unordered. Appropriate search strategies are used to access the data records in each type of file. "Pointers" can be defined to establish chaining and linking network structures among the files. Disk FORTE generates COBOL source code which is compiled along with the user's application programs. An improved version called Disk FORTE II was announced in

Burroughs B 6700 and B 7700

► mid-1973; it handles files on disk pack drives as well as head-per-track storage and provides audit facilities, improved file security, and better recovery procedures.

DATA MANAGEMENT SYSTEM (DMS): This comprehensive data base management system is designed to reduce application programming costs and provide improved data integrity by creating and maintaining common data bases that can be readily accessed by multiple application programs. It consists of: (1) a Data Definition Language and processor that provide for the logical description of data in terms of sets; (2) a Structure Definition Language that provides for mapping of the logical data into physical structures; (3) a program to initialize the data base structures and to control resources at run time; (4) extensions to the COBOL language to allow storage and retrieval of elements in the data base; (5) A program, DM 6700, to control all storage and retrieval of elements in the data base; (6) special MCP procedures to allow communication among the other components of the system; and (7) utility programs that enable users to view, evaluate, reorganize, and recover the data base.

UTILITY ROUTINES: The Master Control Program includes a variety of utility routines that perform functions such as data transcription, library maintenance, debugging, and system log analysis.

In addition, a group of "Fail-Soft" routines controls the graceful degradation of hardware components when one or more such units begin malfunctioning. These routines include confidence routines which check components, elimination routines which remove troublesome devices from operation and transfer their functions to other units, operator notification routines, device reinstatement routines, and facilities to maintain multiple copies of the MCP's control tables.

The COBOL Filter is a program designed to aid in converting COBOL source programs written for the Burroughs B 200, B 300, B 2500, B 3500, B 5000, or B 5500 computers into a form acceptable to the B 6700/7700 COBOL compiler. The Compatible ALGOL Filter similarly aids in converting B 5500 or B 6700 Compatible ALGOL (XALGOL) programs into a form acceptable to the B 6700/7700 Extended ALGOL compiler. In either case, language constructs which the Filter cannot handle are flagged for review and modification by programmers.

An IBM 360 COBOL to Burroughs COBOL Translator, announced in August 1973, is designed to facilitate the conversion of COBOL source programs from IBM computers to the B 6700/7700 systems. Facilities to handle IBM ISAM files are now available for the MCP.

APPLICATION PROGRAMS: Among the programs currently available from Burroughs are:

- BICS (Burroughs Inventory Control System)
- Production Control System
- PROMIS (Project Oriented Management Information System)
- BASIS (Burroughs Advanced Statistical Inquiry System)
- APT III (numerical control)
- Dynamo (mathematical modeling)
- Simula (simulation language)
- Tempo (mathematical programming)
- ALPS (linear programming)
- Gamma (linear programming)

PRICING

EQUIPMENT: The following typical systems illustrate the wide range of configurations that are practical within the highly modular B 6700 and B 7700 lines. All necessary control units are included in the indicated prices. The quoted rental prices are for the basic one-year lease and include equipment maintenance.

TYPICAL B 6748 SYSTEM: Consists of B 6748 Central System, 786K bytes (131K words) of 1.6-microsecond core memory, 20 million bytes of 23-millisecond Disk File storage, 348.8 million bytes of Disk Pack storage (two dual-drive units), six 120KB magnetic tape units, one 1400-cpm card reader, one 300-cpm card punch, and one 1800-lpm printer. Monthly rental and purchase prices are approximately \$26,970 and \$1,237,000, respectively.

DUAL-PROCESSOR B 6700 SYSTEM: Consists of B 6725 Central System (with two 5MHz central processors, 196K bytes of 1.2-microsecond core memory, and 10-million-byte System Memory Disk), one B 6015 Memory Subsystem (1376K bytes, consisting of three 393K, 1.6-microsecond modules and two 98K, 1.2-microsecond modules), 697.6 million bytes of Disk Pack storage (four dual-drive units), eight 200KB magnetic tape drives, two 800-cpm card readers, one 300-cpm card punch, and two 1100-lpm train printers. Monthly rental and purchase prices (exclusive of any data communications or remote terminal equipment) are approximately \$54,000 and \$2,577,000, respectively.

DUAL-PROCESSOR B 7700 SYSTEM: Consists of B 7728 Central System (with two central processors and 786K bytes of 1.5-microsecond core memory), 1572K bytes of additional 1.5-microsecond core memory, 40 million bytes of 20-millisecond Disk File storage and two controls, 1.4 billion bytes of Disk Pack storage (two subsystems with four dual-drive units each), twelve 320KB magnetic tape units and two tape controls, two 1400-cpm card readers, one 300-cpm card punch, and two 1800-lpm printers. Monthly rental and purchase prices (exclusive of any data communications or remote terminal equipment) are approximately \$95,900 and \$4,699,000, respectively.

SOFTWARE: In September 1972, Burroughs inaugurated a Program Products marketing plan covering most of the application programs and certain program development aids and utility routines for the B 6700/7700 systems. The Program Products are offered under either an Unlimited-Time License Plan, for a one-time charge followed by an annual maintenance fee, or a Limited-Time License Plan, with monthly payments during either a 3-year or 5-year lease term. The available Program Products and their associated license fees are listed under "Software Prices" at the end of this report. The Master Control Program, compilers, and all other software facilities not classified as Program Products are still available to B 6700/7700 users at no extra cost.

TECHNICAL SUPPORT: The B 6700/7700 hardware prices include "normal and reasonable" technical support to assist in training and advising the customer in the use of his system.

CONTRACT TERMS: The standard equipment lease agreement includes equipment maintenance and entitles the customer to unlimited use of the equipment. The standard agreement covers maintenance of the equipment for eight

Burroughs B 6700 and B 7700

► consecutive hours a day, Monday through Friday. (No 176-hour nor Measured Time Usage lease plans are available for the B 6700/7700 systems.)

In addition to the standard 1-year lease, Burroughs offers 3-year and 5-year leases at prices 5 and 10 percent lower, respectively, than the 1-year lease prices shown in the equipment price list. A 5-year lease plan providing unlimited maintenance coverage (24 hours/days, 7 days/week) is available at a 5% discount from the 1-year lease price.

All lease plans may include Option to Purchase provisions, which allow 50% of the rental paid during the first 36 months to be applied toward the purchase price at any time during the lease period.

Purchased B 6700/7700 equipment is covered by a 1-year warranty on the Central System, memory, and related controls and channels, and by a 90-day warranty on all peripheral equipment. ■

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Rental (1-year lease)*</u>
B 6700 PROCESSORS AND MAIN STORAGE			
B 6713	Central System; includes one 2.5MHz Central Processor, 98K bytes of 1.2-microsecond core memory, and 4 I/O channels**	\$ 543,840	\$11,000
B 6715	Central System; includes one 5MHz Central Processor, 196K bytes of 1.2-microsecond core memory, and 6 I/O channels**	782,400	16,300
B 6718	Central System; includes 5MHz Central Processor with Vectors, 196K bytes of 1.2-microsecond core memory, and 8 I/O channels**	878,400	18,300
B 6723	Central System; includes two 2.5MHz Central Processors, 98K bytes of 1.2-microsecond core memory, and 4 I/O channels**	840,480	17,000
B 6725	Central System; includes two 5MHz Central Processors, 196K bytes of 1.2-microsecond core memory, and 6 I/O channels**	1,166,400	24,300
B 6728	Central System; includes two 5MHz Central Processors with Vectors, 196K bytes of 1.2-microsecond core memory, and 8 I/O channels**	1,272,000	26,500
B 6733	Central System; includes three 2.5MHz Central Processors, 98K bytes of 1.2-microsecond core memory, and 4 I/O channels**	1,238,400	25,800
B 6735	Central System; includes three 5MHz Central Processors, 196K bytes of 1.2-microsecond core memory, and 6 I/O channels**	1,680,000	35,000
B 6738	Central System; includes three 5MHz Central Processors with Vectors, 196K bytes of 1.2-microsecond core memory, and 8 I/O channels**	1,752,000	36,500
B 6748	Central System; includes one 5MHz Central Processor, 1 I/O Processor with 8 channels, 1 MDL Processor, 1 Operator Console with display and control, 1 Peripheral Control Cabinet with 5 large and 5 small peripheral control positions, and 1 Power Control Cabinet	345,000	7,500
B 6725-FS	Dynamic Reconfiguration Central System; includes B 6725 Central System (excluding the 1.2-microsecond core) plus 2nd I/O processor, 6 channels, four 393K-byte modules of 1.6-microsecond failsoft memory, 2nd System Memory Disk (10 million bytes) with DFEU and control, 2nd console desk, 2nd dual display, 2nd MDL Processor, dual power supply, scan bus control unit, dual group control cabinets, reconfiguration control unit, and 4 memory configuration adapters	2,892,800	60,200
B 6728-FS	Dynamic Reconfiguration Control System; includes B 6728 Central System (excluding the 1.2-microsecond core) plus 2nd I/O Processor, 8 channels, and all additional equipment specified for B 6725-FS, above	3,010,400	62,650
B 6735-FS	Dynamic Reconfiguration Central System; includes B 6735 Central System (excluding the 1.2-microsecond core) plus 6 more channels and all additional equipment specified for B 6725-FS, above	3,264,800	67,950
B 6738-FS	Dynamic Reconfiguration Central System; includes B 6738 Central System (excluding the 1.2-microsecond core) plus 8 more channels and all additional equipment specified for B 6725-FS, above	3,348,800	69,700

*Rental prices include equipment maintenance.

**In addition to the specified components, the B 6713 through B 6738 Central Systems also include one Input/Output Processor (or two in the B 6733, 6735, and 6738), System Memory Disk (10 million bytes, 20-msec average access) with Disk File Electronic Unit and control, operator console and control, MDL Processor, and memory tester.

Burroughs B 6700 & B 7700

EQUIPMENT PRICES

		Purchase Price	Rental (1-year lease)
B 6700 PROCESSORS AND MAIN STORAGE (Continued)			
System Options:			
B 6780	Input/Output Processor	\$ 153,600	\$ 3,200
B 6780-1	Data Switching I/O channel (up to 12 per I/O Processor)	6,000	125
B 6790	Optional MDL Processor (2nd I/O Processor is required)	120,000	2,500
B 6791	Optional Power Supply	24,000	500
B 6793	Auxiliary Cabinet	4,800	100
Controlled Reconfiguration Units:			
B 6098	Optional Additional Configuration Control Panel (for B 6792)	4,800	100
B 6099	Memory Configuration Adapter (1 required per memory cabinet)	7,200	150
B 6792	Configuration Control Unit (includes 2 Control Panels)	96,000	2,000
Main Storage:			
B 6000	Optional Memory Control/Cabinet	48,000	1,000
B 6004-1	98,304 bytes (16,384 words) 1.2-Microsecond Memory Module; 1 port	81,600	1,700
B 6005-1	393,216 bytes (65,536 words) 1.6-Microsecond Memory Module; 1 port	259,200	5,400
B 6005-FS	393,216 bytes (65,536 words) 1.6-Microsecond Failsoft Memory with 1-bit error correction	297,600	6,200
B 6010	884,736 bytes (147,456 words); consists of two B 6005-1 modules plus one B 6004-1 module; 3 ports	600,000	11,000
B 6015	1,376,256 bytes (229,376 words); consists of three B 6005-1 modules plus two B 6004-1 modules; 5 ports	678,600	13,600
B 6020	1,867,776 bytes (311, 296 words); consists of four B 6005-1 modules plus three B 6004-1 modules; 7 ports	930,752	17,200
B 6005-4	Basic Memory Module for B 6748 only; 393,216 bytes (65,536 words) of 1.6-microsecond error-correcting memory and memory control	161,000	3,500
B 6005-5	Optional Memory Module for B 6748 only; 393,216 bytes (65,536 words) of 1.6-microsecond error-correcting memory (max. of 1 per B 6005-4)	128,800	2,800
B 7700 PROCESSORS AND MAIN STORAGE			
B 7718	Central System; includes one 16MHz Central Processor, 786K bytes of 1.5-microsecond two-way-interleaved core memory, one I/O Processor (contains 4 multi-word channels for disk controls, 20 word channels for peripheral controls, 4 word channels for DCP's, and 1 DFO adapter), 2 x 2 central exchange, operator console with control and dual displays, and maintenance diagnostic unit	1,825,000	38,800
B 7728	Central System; includes two Control Processors plus B 7718 basic features, 4-requester exchange, and two operator consoles with controls	2,607,000	54,200
B 7738	Central System; includes three Central Processors plus B 7718 basic features and two I/O Processors (each with B 7718 channel features), 6-requester exchange, and two operator consoles with controls	3,667,000	77,200
B 7748	Central System; includes four Central Processors plus basic B 7738 features (including two I/O Processors and two operator consoles with controls) and 8-requester exchange	4,442,000	90,200
System Options:			
B 7701	Additional Central Processor	1,008,000	21,000
B 7780	Additional Input/Output Processor (contains 4 multi-word channels for disk controls, 20 word channels for peripheral controls, 4 word channels for DCP's, and 1 DFO adapter)	362,800	7,560
B 7780-1	Multi-Word Channels (4 additional multi-word channels and 1 DFO adapter; max. of 1 per B 7780)	96,000	2,000
B 7792	Additional 2 x 2 Exchange (for B 7712 and B 7724 systems; max. of 1 per system)	120,000	2,500
Main Storage:			
B 7001-2	786,432 bytes (131,072 words) 1.5-Microsecond Memory Module; 12 bytes, 2-way interleaved	215,000	3,900
B 7001-4	1,572,864 bytes (262,144 words) 1.5-Microsecond Memory Module; 24 bytes, 4-way interleaved	430,000	7,800
OPERATOR CONSOLES			
B 6341/7341	Additional Operator Display Control (for up to 8 terminals)	12,000	250
B 9342-1	Additional Operator Display Terminal	10,800	225
B 9951-7	Console Display Stand, low	80	—

Burroughs B 6700 & B 7700

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Rental (1-year lease)</u>
OPERATOR CONSOLES (Continued)			
B 9951-8	Console Display Stand, high	\$ 100	—
B 9951-9	Console Display Stand Work Table, right/left	25	—
MASS STORAGE			
Head-per-Track Disk Files:			
B 9372-20	10 million bytes, 20 msec (includes 1 DFEU)	57,600	1,200
B 9372-21	Additional 10-million-byte increment (max. of 4 per B 9372-20)	36,000	500
B 9373-20	20 million bytes, 23 msec (includes 1 DFEU)	95,760	1,995
B 9373-21	Additional 20-million-byte increment (max. of 4 per B 9373-20)	38,800	540
B 9373-30	20 million bytes, 40 msec (includes 1 DFEU)	66,690	1,350
B 9373-31	Additional 20-million-byte increment (max. of 4 per B 9373-30)	24,170	450
Head-per-Track Memory Banks:			
B 9375-1	100 million bytes, 23 msec (includes 1 DFEU)	250,960	4,155
B 9375-2	Additional 20-million-byte increment for B 9375-1	38,800	540
B 9375-4	100 million bytes, 40 msec (includes 1 DFEU)	163,360	3,150
B 9375-5	Additional 20-million-byte increment for B 9375-4	32,670	575
Disk File Electronics Units:			
B 9371-8	Optional Additional DFEU for B 9373-20/21 and B 9375-1/2	31,200	650
B 9371-9	Optional Additional DFEU for B 9373-30/31 and B 9375-4/5	31,200	650
B 9371-20	Optional Additional DFEU for B 9372-20	31,200	650
Disk File Controls, Exchanges, and Features:			
B 6373/7373	Control for B 9373 and B 9375 series Disk Files	16,800	350
B 6471/7471	N1 x N2 Disk File Exchange for B 9373 and B 9375 series (up to 4 x 20)	9,600	200
B 6471-5/7471-5	Control Adapter (for N1 side; up to 4 per B 6471 or 7471)	2,400	50
B 6471-6/7471-6	Control Adapter (for N2 side; up to 20 per B 6471 or 7471)	1,440	30
B 6471-7/7471-7	Exchange Extension (for connection of more than 10 DFEU's to a B 6471 or 7471)	7,200	150
B 6473/7473	1 x 2 Disk File Exchange	4,080	88
B 6871	Dual Port DFEU Adapter	1,920	40
Disk File Optimizer and Features:			
B 6375/7375	Basic Disk File Optimizer (includes 8 words of DFO memory)	115,200	2,400
B 6675-1/7675-1	DFO Memory Increment of 8 words (32 words max.)	9,600	200
B 9971-11	DFSU Adapter for DFO (1 required per Disk File Storage Unit controlled by DFO)	1,200	25
Magnetic Actuator Disk Pack Drives:			
B 9484-3	Dual Drive; single data access, 95.5 million bytes total in segment mode	48,000	1,000
B 9484-4	Dual Drive; single data access, 174.4 million bytes total in segment mode	74,400	1,550
B 9485-3	Dual Drive; simultaneous data access, 95.5 million bytes total in segment mode	57,600	1,200
B 9485-4	Dual Drive; simultaneous data access, 174.4 million bytes total in segment mode	84,000	1,750
B 9486-3	Dual Drive Increment for B 9484-3 or B 9485-3; 95.5 million bytes (max. of 3)	33,600	700
B 9486-4	Dual Drive Increment for B 9484-4 or B 9485-4; 174.4 million bytes (max. of 3)	67,200	1,400
B 9486-45	Single Drive Increment for B 9484-4 or B 9485-4; 87.2 million bytes	38,400	800
Disk Pack Drive Controls and Features:			
B 6380-1/7380-1	Single Control for B 9484-3	86,400	1,800
B 6380-2/7380-2	Dual Control for B 9485-3	100,800	2,100
B 6383-1/7383-1	Single Control for B 9484-4	88,800	1,850
B 6383-2/7383-2	Dual Control for B 9485-4	103,200	2,150
B 6483-5/7483-5	Control Expansion Adapter (increases B 6383-1 or B 7383-1 to 1 x 16; increases B 6383-2 or B 7383-2 to 2 x 16)	38,400	800
B 9974-1	Disk Pack (certified at 200 tpi for B 9484-3, B 9485-3 and B 9486-3)	575	25
B 9974-4	Disk Pack (certified at 200 tpi for B 9484-4, B 9485-4, and B 9486-4)	690	30

Note: Controls and features with 6000-series model numbers are used with B 6700 systems; their 7000-series counterparts are used with B 7700 systems.

Burroughs B 6700 & B 7700

EQUIPMENT PRICES

MAGNETIC TAPE UNITS		Purchase Price	Rental (1-year lease)
9-Track Magnetic Tape Clusters:			
B 9381-12	2 Stations, 800 bpi, 18KB	\$ 25,200	\$ 525
B 9381-13	3 Stations, 800 bpi, 18KB	26,960	570
B 9381-14	4 Stations, 800 bpi, 18KB	32,160	680
B 9381-22	2 Stations, 800 bpi, 36KB	33,600	700
B 9381-23	3 Stations, 800 bpi, 36KB	43,200	900
B 9381-24	4 Stations, 800 bpi, 36KB	52,800	1,100
B 9382-12	2 Stations, 1600 bpi, 36KB	29,670	620
B 9382-13	3 Stations, 1600 bpi, 36KB	34,320	715
B 9382-14	4 Stations, 1600 bpi, 36KB	40,560	845
B 9382-22	2 Stations, 1600 bpi, 72KB	34,800	725
B 9382-23	3 Stations, 1600 bpi, 72KB	45,600	950
B 9382-24	4 Stations, 1600 bpi, 72KB	56,400	1,175
B 9383-12	2 Stations, 800/1600 bpi, 18/36KB	30,720	640
B 9383-13	3 Stations, 800/1600 bpi, 18/36KB	36,000	750
B 9383-14	4 Stations, 800/1600 bpi, 18/36KB	43,200	900
B 9383-22	2 Stations, 800/1600 bpi, 36/72KB	36,000	750
B 9383-23	3 Stations, 800/1600 bpi, 36/72KB	48,000	1,000
B 9383-24	4 Stations, 800/1600 bpi, 36/72KB	60,000	1,250
Free-Standing Magnetic Tape Units:			
B 9391	18/50/72KC, 7 tracks, 200/556/800 bpi	18,000	375
B 9392	72KB, 9 tracks, 800 bpi	20,400	425
B 9393-1	144KB, 9 tracks, 1600 bpi	19,440	405
B 9393-3	240KB, 9 tracks, 1600 bpi	24,960	520
B 9394-1	24/66/96KC, 7 tracks, 200/556/800 bpi	18,000	375
B 9394-2	96KB, 9 tracks, 800 bpi	20,400	425
B 9495-2	120KB, 9 tracks, 1600 bpi	16,650	400
B 9495-3	200KB, 9 tracks, 1600 bpi	21,110	505
B 9495-5	320KB, 9 tracks, 1600 bpi	29,760	620
B 9495-6	400KB, 9 tracks, 1600 bpi	34,080	710
B 9496-2	40KB, 9 tracks, 1600 bpi	12,800	270
B 9496-4	80KB, 9 tracks, 1600 bpi	15,300	320
Magnetic Tape Controls:			
B 6381-11/7381-11	18/36KB NRZ Control (9-track) for B 9381 series clusters	26,400	600
B 6381-12/7381-12	36/72KB Phase-Encoded Control (9-track) for B 9382 series clusters	25,200	525
B 6381-14/7381-14	18/36KB Dual NRZ Control (9-track) for B 9381 series clusters	36,000	750
B 6381-15/7381-15	36/72KB Dual Phase-Encoded Control (9-track) for B 9382 series clusters	43,200	900
B 6381-16/7381-16	18/36/72KB Dual NRZ/Phase-Encoded Control (9-track) for B 9383 series clusters	45,600	950
B 6391-3/7391-3	72KC Control (for B 9391)	15,360	320
B 6391-4/7391-4	96KC Control (for B 9394-1)	15,360	320
B 6393-1/7393-1	72KB Control (for B 9392)	16,800	350
B 6393-2/7393-2	144/240KB Control (for B 9393-1/9393-3)	24,000	500
B 6393-3/7393-3	96KB Control (for B 9394-2)	16,800	350
B 6394-4/7394-4	40/80KB Control (for B 9496-2/9496-4)	15,740	325
B 6395-2/7395-2	120/200KB Control (for B 9495-2/9495-3)	21,060	515
B 6395-7/7395-7	320/400KB Control (for B 9495-5/9495-6)	23,500	560
Magnetic Tape Exchanges and Adapters:			
B 6490/7490	2 x 10 Tape Exchange for B 9391/9392/9394-1/9394-2	10,500	250
B 6492/7492	4 x 16 Tape Exchange for B 9391/9392/9394-1/9394-2	18,900	450
B 6493-1/7493-1	1 x 8 Common Electronics Exchange for B 9393-1/9393-3	19,920	415
B 6493-2/7493-2	2 x 8 Common Electronics Exchange for B 9393-1/9393-3	39,840	830
B 9499-10	1 x 4 Master Electronics Exchange for B 9495 Series	5,500	125
B 9499-11	1 x 8 Master Electronics Exchange for B 9495 Series	8,800	200
B 9499-12	2 x 8 Master Electronics Exchange for B 9495 Series	13,200	300
B 9499-13	2 x 16 Master Electronics Exchange for B 9495 Series	22,000	500
B 9499-14	4 x 16 Master Electronics Exchange for B 9495 Series	38,400	800
B 9499-30	1 x 4 Master Electronics Exchange for B 9496 Series	5,500	125
B 9499-31	1 x 8 Master Electronics Exchange for B 9496 Series	8,800	200
B 6680-1/7680-1	7-Track NRZ Control Adapter for B 6381-12/13/14 clusters (1 required per 7-track port)	2,400	50
B 9989-1	7-Track NRZ Station Adapter for B 6381 series clusters	2,400	50

**Burroughs B 6700 and B 7700
EQUIPMENT PRICES**

		<u>Purchase Price</u>	<u>Rental (1-year lease)</u>
CARD INPUT/OUTPUT UNITS			
B 9111	Card Reader; 800 cpm	\$ 17,550	\$ 350
B 9112	Card Reader; 1400 cpm	23,325	485
B 9115	Card Reader; 300 cpm	4,500	110
B 9116	Card Reader; 600 cpm	6,500	195
B 9117	Card Reader; 800 cpm	9,000	250
B 6110/7110	Card Reader Control for B 9111/9112	4,200	100
B 6110-5/7110-5	Card Reader Control for B 9115/9116/9117	4,200	100
B 9213	Card Punch; 300 cpm	25,440	530
B 6212/7212	Card Punch Control for B 9213	4,200	100
B 6610/7610	BCL-BCL Code Translator for B 6212/7212	630	15
PAPER TAPE INPUT/OUTPUT UNITS			
B 9120	Paper Tape Reader; 500/1000 char/sec.	16,000	300
B 6120/7120	Paper Tape Reader Control for B 9120	4,200	100
B 9926	Input Code Translator for B 6120/7120	6,960	145
B 9220	Paper Tape Punch; 100 char/sec.	15,300	260
B 6220/7220	Paper Tape Punch Control for B 9220	4,200	100
B 9928	Output Code Translator for B 6220/7220	6,850	130
PRINTERS			
B 9242-11	Printer; 860 lpm, 120 print positions, with Forms Self-Align feature	50,400	910
B 9242-12	Printer; 725 lpm, 120 print positions, OCR A numeric and std. alpha, with Forms Self-Align	50,400	910
B 9242-13	Printer; 725 lpm, 120 print positions, OCR B numeric and std. alpha, with Forms Self-Align	50,400	910
B 9243-11	Printer; 1100 lpm, 120 print positions, with Forms Self-Align feature	50,750	1,015
B 9243-12	Printer; 900 lpm, 120 print positions, OCR A numeric and std. alpha, with Forms Self-Align	50,750	1,015
B 9243-13	Printer; 900 lpm, 120 print positions, OCR B numeric and std. alpha, with Forms Self-Align	50,750	1,015
B 9246-2	Printer; 1800 lpm, 132 print positions	65,000	1,550
B 9247-14	Train Printer; 1100 lpm, 132 print positions	46,500	1,000
B 6240/7240	Printer Control for B 9242 series, B 9243 series, and B 9246-2 Printers	7,200	150
B 6247-4/7247-4	Printer Control for B 9247-14 Train Printer	9,600	200
B 9940	High-Speed Slew (for B 9242/9243 series Printers)	3,000	60
B 9941	12 Additional Print Positions (for B 9242/9243 series Printers)	2,000	40
B 9942-10	Additional Train Module for B 9247-14	3,150	95
B 9949-2	12-Channel Format Tape Reader for B 9247-14	3,050	61
DATA COMMUNICATIONS			
B 6350/7350	Data Communications Processor	43,200	900
B 6358	Data Communications Processor with 12K bytes of local IC memory and 4 line adapter positions (for B 6748 system only)	46,000	1,000
B 6350-1	Adapter Cluster for B 6350/6358/7350 DCP	9,600	200
B 6350-5	DCP Memory; 24,576 bytes (4,096 words); up to 4 per B 6350/7350 DCP	54,000	1,125
B 6351-1	Line Expansion Cabinet with Independent Power (for B 6748 system only)	24,000	500
B 6358-5	Optional DCP Local Memory Module with 12,000 bytes of IC memory (for B 6748 system only)	16,100	350
Data Communications Line Adapters:			
B 6650-1/7650-1	Line Adapter 1; direct or modem connection, up to 600 bps, synchronous; 2-wire or 100 Series type modem using RS-232 interface; serial transmission in half-duplex mode	720	15
B 6650-2/7650-2	Line Adapter 2; same as Line Adapter 1 except up to 1800 bps and 202 Series type modem	2,160	45
B 6650-3/7650-3	Line Adapter 3; asynchronous direct connection or modem connection via 202 Series type modem up to 2400 bps; or synchronous modem connection up to 2400 bps via 201 Series type modem using RS-232 interface; serial transmission in half-duplex mode	2,880	60
B 6650-4/7650-4	Line Adapter 4; same as Line Adapter 3 except up to 4800 bps	4,800	100
B 6650-5/7650-5	Line Adapter 5; same as Line Adapter 3 except up to 9600 bps	7,200	150
B 6650-6/7650-6	Touch-Tone Telephone Input	960	20
B 6650-7/7650-7	Audio Response	1,920	40
B 6650-8/7650-8	Automatic Dial-Out	960	20

Burroughs B 6700 & B 7700

EQUIPMENT PRICES

DATA COMMUNICATIONS (Continued)		Purchase Price	Rental (1-year lease)
B 9350	Typewriter Inquiry Station	\$ 2,640	\$ 55
Audio Response Subsystem:			
B 6355-1/7355-1	Voice Response Generator	37,200	795
B 9955-1	Audio Recording (special)	2,575	—
B 9955-2	Audio Recording (library)	750	—

SOFTWARE PRICES

		UNLIMITED-TIME PLAN			LIMITED-TIME PLANS	
		Single Payment	12 Monthly Payments	Annual Maint. Charge	Monthly Fee (3-Year Plan)	Monthly Fee (5-Year Plan)
BIA	Burroughs Inventory Control System—Analysis	\$12,600	\$1,155	\$300	\$300	\$288
BIC	Burroughs Inventory Control System—Control	8,400	770	200	200	192
PCE	Engineering Data Control	8,400	770	200	200	192
PCR	Requirements Planning	8,400	770	200	200	192
PCI	Production Control System Inventory	8,400	770	200	200	192
PCW	Work in Process	6,000	550	140	140	135
PCL	Shop Loading	6,000	550	140	140	135
DEC	Decomposition	8,400	770	200	200	192
BAS	BASIS	9,450	866	225	225	216
ALP	ALPS (linear programming)	0	0	0	0	0
DYN	Dynamo	6,000	550	140	140	135
SIM	Simula	6,000	550	140	140	135
GAS	GASP	2,000	183	47	47	45
GAA	Gamma-3/ALPS-I	6,000	550	140	140	135
GAD	Gamma-3/Decomposition	12,000	550	140	140	135
TEB	Tempo Basic (linear programming)	12,600	1,155	300	300	288
GAM	Tempo Gamma-3	8,400	770	200	200	192
GUB	Tempo Gubtran	8,400	770	200	200	192
TDE	Tempo Decomposition	8,400	770	200	200	192
TEM	Tempo All	39,000	3,575	928	928	891
NSL	Numerals Subroutine Library	6,000	550	140	140	135
NCO	Numerals Conversational	8,400	770	200	200	192
FOS	Disk FORTE Standard	12,600	1,155	300	300	288
FOT	Disk FORTE II	11,000	1,008	275	275	264
FO4	IBM 360 COBOL to B 6700/7700 COBOL	5,400	495	150	150	—
DMS	Data Management System	70,000	6,417	1,667	1,667	1,600
DMI	DMS Inquiry	23,000	2,108	547	547	525
REP	DMS Reporter	6,000	550	140	140	135
PRT	PROMIS Time	5,000	458	150	150	144
NCS	APT III	6,300	578	150	150	144
NCC	APT III Conversational	8,400	770	200	200	192