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Burroughs B 2500 & B 3500

MANAGEMENT SUMMARY

The Burroughs B 2500 and B 3500 systems deserve careful consideration by companies shopping for small to medium-scale data processing systems. They offer an impressive complement of third-generation hardware and software, plus an unusually strong emphasis upon multi-programmed operation.

Multiprogramming, in the case of computer systems renting for less than $20,000 per month, still tends to be a concept that nearly everybody talks about and hardly anybody puts into practice. The B 2500/3500 systems are a notable exception. By taking advantage of many of the hardware and software concepts introduced nearly a decade ago in the highly unorthodox Burroughs B 5000 system, Burroughs has proved that all-out multi-programming (or "multiprocessing" in Burroughs termi-nology) can be truly practical and effective in compara-tively small computer systems.

In fact, multiprogramming is the everyday way of life for most B 3500 users. In one 150K B 3500 installation, a single console operator has completed the processing of ▷

Third-generation hardware, user-oriented software, fast-access disc files, and effective multiprogramming—these are some of the ingredients that make the B 2500/3500 systems impressive contenders for the highly competitive small to medium-scale business data processing market.
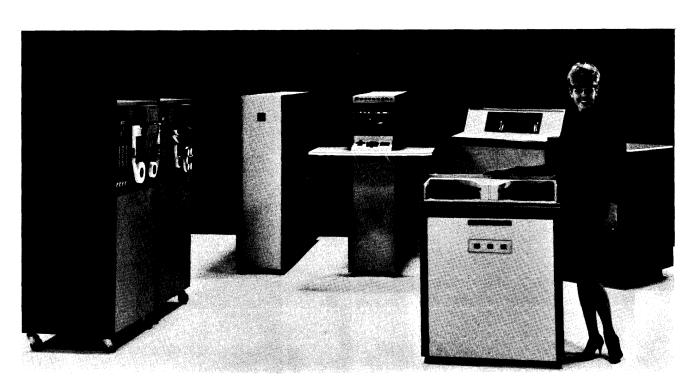
CHARACTERISTICS

MANUFACTURER: Burroughs Corporation, 6071 Second Avenue, Detroit, Michigan 48232.

MODELS: B 2500 and B 3500 Computer Systems.

DATA FORMATS

BASIC UNIT: 16-bit word (plus parity bit). Each word can hold two 8-bit bytes or four 4-bit BCD digits. Core storage is addressable by digit position.

FIXED-POINT OPERANDS: Can range from 1 to 100 digits or bytes for most instructions. Data in 4-bit format can be either signed (with 4-bit sign digit in leftmost position) or unsigned. Data in 8-bit format is always unsigned. ▶

This small B 2500 configuration includes the unique Burroughs Magnetic Tape Cluster (foreground) and paper tape I/O units (at left).

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▷ more than 200 test and production jobs during an 8-hour shift, and as many as seven COBOL compilations have been run simultaneously.

The B 2500/3500 systems are most effective in business data processing applications, though optional floating-point hardware and a FORTRAN compiler make them suitable for scientific and engineering functions as well. The banking industry, which has long been a strong Burroughs market, is well served by fast MICR sorter-readers, multi-tape listers, on-line teller consoles, and supporting software.

The B 2500 and B 3500 were announced in March 1966, and initial customer deliveries were made in May 1967. System rentals range from approximately $4,400 per month for a small 4-tape B 2500 system to about $30,000 per month for a sizable B 3500 system with 500,000 bytes of core storage and 100 million bytes of disk storage.

The B 2500 and B 3500 Processors are fully program-compatible with each other. The only significant differences between the two systems are in:

● Internal speed—the B 3500 is exactly twice as fast; core storage cycle times are 2 microseconds per two-byte access for the B 2500 and 1 microsecond per two-byte access for the B 3500.

● Core storage capacity—B 2500 storage can range from 10,000 to 120,000 bytes, whereas the B 3500 can have from 10,000 to 500,000 bytes.

● Number of I/O channels—B 2500 systems can have from 4 to 8 channels, while B 3500 systems can have from 6 to 20.

Though the B 2500 and B 3500 are billed as members of the Burroughs "500 Systems" computer family, there is no object-level compatibility between them and either the smaller B 500 system or the larger B 5500, B 6500, B 7500, or B 8500 systems. Burroughs, however, strongly recommends programming in COBOL or FORTRAN and provides "filter" programs which facilitate the conversion of programs wirtten in COBOL or FORTRAN for execution on various members of the 500 Systems family.

Though the B 2500 and B 3500 systems use the same byte-oriented data structure, EBCDIC internal code, and 7- and 9-track magnetic tape formats as the IBM System/360, there is no direct program compatibility between them at the machine-language, assembly-language, COBOL, or RPG level.

Emulators to provide machine-level compatibility with the IBM 1400 Series and Burroughs B 200/300 Series computers were included in the original B 2500/3500 an- ▷

► **FLOATING-POINT OPERANDS:** Consist of a 2-digit exponent and a fraction ranging from 1 to 100 digits in length; the signs of the exponent and fraction each occupy an additional digit position.

INSTRUCTIONS: May consist of from one to four 6-digit "syllables" or a single 8-digit "syllable." Each instruction may contain from 0 to 3 memory addresses.

INTERNAL CODE: EBCDIC (standard) or USASCII, depending upon the setting of a mode flip-flop.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: B 2500—10,000 to 90,000 bytes in 10,000-byte increments, or 120,000 bytes; B 3500—10,000 to 500,000 bytes in variable increments (10,000 to 90,000 in 10,000-byte increments; 90,000 to 240,000 in 30,000-byte increments; 300,000; 360,000; 450,000; or 500,000 bytes).

CYCLE TIME: B 2500-2 microseconds per 1-word (2-byte) access; B 3500-1 microsecond per 1-word (2-byte) access.

CHECKING: Parity bit with each byte is generated during writing and checked during reading.

STORAGE PROTECTION: Provided by a base register and a limit register. The high-order 3 digits of generated memory addresses are checked to ascertain that they fall within the range defined by these two registers.

CENTRAL PROCESSORS

INDEX REGISTERS: Three 8-digit index registers for each program are stored in reserved core memory locations.

INDIRECT ADDRESSING: Can be specified within the first digit of any instruction address field. If so, the indicated memory location is considered to hold the address of the required operand rather than the operand itself. Multi-level indirect addressing to any depth is possible.

INSTRUCTION REPERTOIRE: 48 standard instructions provide for efficient arithmetic, comparison, and data movement operations on variable-length operands in either 4-bit numeric or 8-bit alphanumeric mode. Included are 3-address add, subtract, multiply, and divide commands and 2-address add and subtract commands, as well as convenient edit, search, and translate instructions. No binary arithmetic is possible, but logical AND, OR, and NOT instructions are included.

Floating-point decimal arithmetic is an optional feature.

Seven of the standard instructions, including Initate I/O, are "privileged" and may not be used in normal user-written programs.

ADD TIME: For 3-address decimal addition of signed 5-digit fields: 75 microseconds for B 2500, 37.5 microseconds for B 3500.

MULTIPLY TIME: For 3-address decimal multiplication of signed 5-digit fields: 416 microseconds for B 2500, 208 microseconds for B 3500. ►

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nouncement, but these were later withdrawn, apparently because of development problems. Burroughs now offers assembly-language translators to aid in converting B 300 and IBM 1400 Series programs for operation on the B 2500/3500 systems.

The B 2500/3500 Processors utilize monolithic integrated circuits and a read-only memory, together with conventional magnetic core main storage. The internal processing speeds of the B 2500 and B 3500 are closely comparable with those of the System/360 Model 30 and Model 40, respectively.

Inside the B 2500/3500 Processors, data can be represented in the form of variable-length fields composed of either 8-bit bytes or 4-bit digits. Numeric fields expressed in the 4-bit and 8-bit modes can be combined in arithmetic operations without the need for prior format conversion. No binary arithmetic facilities are included.

The Processors operate in either the Normal State or Control State. The Normal State is used for execution of user programs. Interrupt signals cause the Processor to enter the Control State and transfer control to the MCP or BCP operating system whenever an I/O operation is completed or an abnormal condition is encountered. Seven "privileged" instructions, executable only in the Control State, enable the MCP or BCP to initiate I/O operations, control the storage protection registers, set the 6-digit interval timer, and perform other system control functions.

Burroughs offers a fairly wide assortment of peripheral equipment for the B 2500/3500 systems, nearly all of which is designed and manufactured by Burroughs itself. Most of these devices, though quite conventional in concept and capabilities, are well-engineered and reliable.

Particularly noteworthy are the Burroughs fixed-head disk files, which have achieved an enviable reputation as rapid-access, highly reliable mass storage devices. Burroughs now offers disk files in a wide range of capacities (1 million to 500 million bytes) and average access times (17 to 60 milliseconds). Even so, the cost of these disk files may rule out their use in certain applications that require very large amounts of on-line storage. Burroughs, alone among the major computer manufacturers, offers no disk pack drives or any other type of interchangeable-cartridge mass storage unit as of this writing.

The Burroughs Magnetic Tape Clusters represent a novel packaging concept for magnetic tape drives. Each cluster contains up to four 36KB or 72KB tape drives in a single compact cabinet. (33 by 30 by 42 inches in size). The Tape Clusters provide effective magnetic tape capabilities in a compact, low-cost package, though reliability problems have been experienced by some of the early users.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The basic B 2500 has 4 channels, expandable to a maximum of 8. The basic B 3500 has 6 channels, expandable to a maximum of 20.

CONFIGURATION RULES: One I/O channel is required for each I/O control unit, and each type of peripheral device requires a different control unit. There are two types of I/O channels, designated Type A and Type B. In general, Type A channels are used for the slower I/O devices, while the faster or more complex peripherals require Type B channels. The maximum number of Type B channels is 5 in the B 2500 and 10 in the B 3500.

SIMULTANEOUS OPERATIONS: One input or output operation on each installed I/O channel can occur simultaneously with computing.

I/O INTERFERENCE: Only one core storage cycle is required for each unit of I/O data transferred (1 character at a time for Type A channels, and 2 characters in parallel for Type B channels).

MASS STORAGE

DISK FILES: Burroughs offers three basic types of head-per-track disk files with varying capacities and access times: Systems Memory, Modular Random Storage, and Data Memory Banks. Various mixes of these types can be included in a single disk subsystem through the use of appropriate control units, electronic units, and Disk File Exchange units. Moreover, a single disk subsystem can include one, two, or four control units, each capable of servicing any of the connected disk files. Simultaneous disk read and write operations can occur in a subsystem with two or more control units.

B 9370 SYSTEMS MEMORY: Provides fast-access storage, primarily for the systems software, on a single non-interchangeable disk. Available in two models, the B 9370-1 and B 9370-2, with capacities of 1 and 2 million bytes, respectively. There are 100 tracks per disk face. Each track is divided into 100 segments, and each segment holds 100 data bytes plus a longitudinal parity byte. Average access time is 17 milliseconds, and maximum data transfer rate is 291,000 bytes/sec.

B 9372 MODULAR RANDOM STORAGE: Provides rapid random access to moderately large volumes of data. Each disk file module contains 4 non-interchangeable disks and stores 10 million bytes. From 1 to 5 modules can be connected to a B 9371 Disk File Electronic Unit, and up to 10 of the B 9371 units can be included in a single disk subsystem. Data is recorded in 100-byte segments. Average access time is 20 milliseconds, and average data transfer rate is 200,000 bytes/sec.

B 9375 DATA MEMORY BANKS: Provide large-capacity random-access storage with a choice of three different access times. Average access times are 23, 40, and 60 milliseconds for Models 9375-0, 9375-2, and 9375-3, respectively. All three models have a basic storage capacity of 100 million bytes, and this can be expanded in increments of 20 or 25 million bytes to a maximum of 500 million bytes per subsystem.

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▷ Burroughs also offers a line of free-standing magnetic tape units with data rates of 50 to 240KB. Both 7-track and 9-track models are available.

Data communications receives plenty of attention in both the B 2500/3500 hardware and software. Single-line and multi-line controls and numerous adapters permit communication with a broad range of transmission services and terminal equipment, and the Master Control Program (MCP) provides effective software control of most communications functions. Burroughs also offers CRT display systems, an audio response system, and on-line banking equipment.

Software support for the B 2500/3500 systems is divided into two major categories: Basic and Advanced.

The Basic software is designed for tape-oriented configurations which are too small to utilize the far more powerful Advanced software. The Basic facilities consist of a minimal operating system called the Basic Control Program (BCP), plus an Assembler, Report Program Generator, and assorted utility routines. No compilers are offered at this level, and no multiprogramming is possible.

Most B 2500 and B 3500 systems use the Advanced software, which centers around the disk-oriented Master Control Program. The MCP is an integrated operating system that complements the B 2500/3500 hardware to create an effective environment for multiprogrammed operation. One of the most striking features of the MCP is the fact that it is truly user-oriented and far easier to understand and use than most competitive operating systems. The MCP receives its orders via unusually straightforward control cards and keyboard messages. For example, the control card "COMPILE EDITB WITH COBOL SAVE" will cause the COBOL source program named EDITB to be compiled, executed, and entered into the program library in disk storage.

Other Advanced software facilities include an Assembler, Report Program Generator, USASI COBOL and FORTRAN compilers, and generators for sorting and media conversion programs. Burroughs also offers a modest assortment of application programs, most of which are designed for the manufacturing and banking industries.

The B 2500 and B 3500 have been in service for more than two years and have proved to be effective, reliable data processing systems. At the same time, most of the concepts employed in both the hardware and software are still about as up to date as those of any competitive system. Therefore, these Burroughs entries merit careful consideration by virtually every computer buyer who is not totally committed to System/360-compatible equipment and software. ☐

▶ **INPUT/OUTPUT UNITS**

MAGNETIC TAPE CLUSTERS: Contain two, three, or four tape drives in a single compact cabinet. The feed and take-up reels for each tape drive are mounted on concentric vertical shafts, with the 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.

Two basic models are available. Both use standard 1/2-inch tape, can read either forward or backward, and record in IBM-compatible formats at a tape speed of 45 inches per second. The B 9381 Cluster has a basic transfer rate of 36,000 bytes/sec in the 9-track mode at 800 bpi. The B 9382 has a basic transfer rate of 72,000 bytes/sec in the 9-track mode at 1600 bpi. The B 9381 can also operate in the 9-track mode at 200 bpi (9,000 bytes/sec). Either model can alternatively be equipped to operate in the 7-track mode at densities of 200, 556, or 800 bpi (9,000, 25,000, or 36,000 bytes/sec). It is not possible to combine 7-track and 9-track drives, or 36KB and 72KB drives, within a single subsystem because they require different control units.

FREE-STANDING 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 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.

Eight models of the free-standing 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 9390: 7 tracks; 90 ips; 200/556 bpi; 18,000 or 50,000 char/sec.

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; 200/800 bpi; 18,000 or 72,000 bytes/sec.

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

B 9393-2: 9 tracks; 120 ips; 1600 bpi; 192,000 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; 200/800 bpi; 24,000 or 96,000 bytes/sec. ▶

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B 9110 CARD READER: Reads 80-column cards serially by column, on demand, at up to 200 cpm. EBCDIC is the standard card code, and BCL or binary cards can also be read. The feed hopper and stacker hold 450 cards each.

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 BCL or binary cards can also be read. 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 9210 CARD PUNCH: Punches and read-checks 80-column cards at 100 cpm. EBCDIC is the standard card code, and BCL or binary cards can also be punched. The feed hopper and single stacker hold 800 cards each. The associated control unit contains a full-card buffer.

B 9212 CARD PUNCH: Punches 80-column cards at up to 150 cpm.

B 9213 CARD PUNCH: Punches 80-column cards at up to 300 cpm. EBCDIC is the standard card code, and BCL or binary cards can also be punched. The feed hopper holds up to 2200 cards, and three program-selectable stackers hold at least 1400 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 wide 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 wide flexibility in codes.

LINE PRINTERS: Eight printers of the conventional rotating-drum type provide printing speeds ranging from 315 to 1100 lines per minute. All models have a tape-controlled carriage capable of handling continuous forms 5 to 20 inches in width, vertical spacing of 6 or 8 lines per inch, and a standard skipping speed of 25 inches per second. Characteristics of the various models are as follows:

B 9242-1: 860 lpm; 120 or 132 print positions.

B 9242-2: 725 lpm; 120 or 132 print positions; OCR "A" numeric and standard alphabetic character set.

B 9242-3: 725 lpm; 120 or 132 print positions; OCR "B" alphanumeric set.

B 9243-1: 1100 lpm; 120 or 132 print positions.

B 9243-2: 900 lpm; 120 or 132 print positions; OCR "A" numeric and standard alphabetic character set.

B 9243-3: 900 lpm; 120 or 132 print positions; OCR "B" alphanumeric set.

B 9245-2: 315 lpm; 120 print positions; buffered.

B 9245-3: 315 lpm; 132 print positions; buffered.

The B 9242 and B 9243 models can be equipped with an optional high-speed skipping feature (75 inches per second), a powered forms stacker, and/or a "printer memory" that reduces the demands imposed upon the processor during printing. The B 9245 models are buffered.

B 9244 TAPE LISTER: Produces printed listings of documents read by a MICR Sorter-Reader on 6, 12, or 18 adding-machine tapes, each 2.5 inches wide, which can be individually advanced. The B 9244-1 Master Lister has 6 tapes, and one or two 6-tape B 9244-2 Slave Listers can be connected to it. Maximum printing speed is 1565 lpm when printing is restricted to the digits 0 through 9 and six special characters, or 800 lpm when the full 40-character alphanumeric set is used.

B 9340 CONSOLE PRINTER AND KEYBOARD: A Teletype Keyboard Send/Receive unit, used to provide keyboard input and console printouts. Required in all B 2500/3500 systems that use the Master Control Program.

MICR READER-SORTERS: Read MICR-encoded documents at up to 1565 items per minute. Can also operate in demand mode, feeding one document at a time at up to 400 items per minute. Models B 9131 and B 9132 have 13 and 16 pockets, respectively. Both models are also usable for off-line sorting. Optional features include an endorser, validity checking, and an item counter. The B 9130 is a similar, 13-pocket unit designed solely for off-line use.

B 9134-1 READER-SORTER: Reads optically and/or magnetically encoded numeric documents at up to 1625 documents per minute. Can handle both types of documents of varying sizes and weights in intermixed fashion. The sorting section is available in modules of 4 pockets each, and is expandible to a maximum of 32 pockets. The B 9134-1, announced in mid-1969, can be used either on-line or off-line.

COMMUNICATION DEVICES

SINGLE-LINE CONTROL: Provides a connection between a single Type B I/O channel and a single communications line. Contains a one-character buffer. Requires an appropriate line adapter, which determines transmission rate, code sensitivity, and character structure. Numerous adapters permit half-duplex communication with a wide range of equipment over dialed, leased, or directly connected lines at speeds of 74.2 to 2400 bits per second.

MULTI-LINE CONTROL: Permits the connection of multiple simultaneously-operating communications lines to a single Type B I/O channel. Requires an appropriate line adapter for each line. The basic Multi-Line Control houses up to 4 line adapters. Optional 8-line extensions permit a total of up to 36 lines to be connected. A "scratchpad" memory holds control information and provides a one-character buffer for each line. Numerous adapters permit half-duplex communication with a wide range of equipment over dialed, leased, or directly

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connected lines at speeds of 74.2 to 2400 bits per second. Only one Multi-Line Control can be used in a B 2500/3500 system.

ON-LINE BANKING SUBSYSTEM: Permits tellers at remote consoles to post payments and disbursements to savings or mortgage accounts, inquire into the status of these accounts, and handle various other types of window transactions in on-line fashion. Consists of a Terminal Unit Control and one or more Central Terminal Units at the computer site, and a Remote Terminal unit controlling up to 8 Teller Consoles at each remote site. Interconnection is via full-duplex private telephone lines. Up to 10 Central Terminal Units can be connected to a B 3500 system, but only one can be used in a B 2500 system. Each Central Terminal Unit has 6 channels, and each channel can service up to 16 Teller Consoles. The Teller Console serves two tellers and is a modified version of the Burroughs F 6214 Sensimatic window machine.

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.

B 9351 INPUT AND DISPLAY SYSTEM: Provides CRT display and keyboard input of alphanumeric data. Each system can consist of either a single monitor (display unit) with control unit and optional keyboard, or a shared control unit accommodating from 1 to 4 monitors and keyboards. An optional printer provides typed records of displayed messages. The system can be connected to the computer via either direct cables or telephone lines. The monitor displays twenty-five 80-character lines in a 9-by-12-inch viewing area. Sixty-seven different characters can be displayed. Each control unit provides 1019 character positions of buffer storage. A split-screen capability is standard, and optional insert-delete, controlled format, variable tab, and programmatic cursor control features provide operational flexibility.

B 9352 INPUT AND DISPLAY TERMINAL: Provides economical CRT display and keyboard input of alphanumeric data. Each self-contained terminal includes a display screen, typewriter-style keyboard, character generator, control logic, and 960-character buffer. Can be connected to the computer via either direct cables or telephone lines. The B 9352-1 displays twenty-four 40-character lines in a 7.5-by-8.5-inch viewing area, while the B 9352-2 displays twelve 80-character lines in an 11-by-7.5-inch viewing area. Seventy different characters can be displayed. A split-screen capability is standard; options include a printer, controlled format, and polling and select capabilities.

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 a B 2500/3500 Multi-Line Control.

SOFTWARE

OPERATING SYSTEMS: Software support for the B 2500/3500 systems is provided at two levels, each based upon an integrated operating system called a "control program." The Basic Control Program (BCP) is intended mainly for use on small B 2500 systems that do not include disk storage. Most B 2500 and B 3500 systems use the far more powerful Master Control Program (MCP).

BASIC CONTROL PROGRAM: The BCP performs basic system control functions in small B 2500/3500 configurations. It requires neither disk storage nor a console typewriter, and can be used with any system configuration. The BCP routines and related tables occupy from 2K to 6K bytes of core storage, depending upon the facilities included. A Trace facility, which aids in debugging, adds 5K more bytes to the core requirements.

The BCP performs the following principal functions: (1) loads machine-language programs from cards, tape, or disk and initiates their execution in sequential fashion; (2) initiates all I/O operations; (3) services all I/O interrupts; and (4) assists in program debugging through dump and trace routines. Multiprogramming is not possible under the BCP. The base and limit address registers are used to protect the BCP routines from destruction by errant programs.

The Basic software package is designed for use with the BCP. Its facilities include a Basic Assembler, Basic Report Program Generator, Basic Sort Generator, and Basic Media Conversion Program Generator—but no COBOL or FORTRAN compiler. All programs generated by these routines require the presence of the BCP for execution.

MASTER CONTROL PROGRAM: The MCP is a modular operating system that supervises and controls all operations of a B 2500 or B 3500 system. The MCP requires from 13K to 34K bytes of core storage, 205K to 250K bytes of disk storage, at least one magnetic tape unit, a card or paper tape reader, and a console typewriter. A high-speed trace option adds another 7.5K bytes to the core requirements. In its largest version, the MCP handles all standard peripherals plus MICR and multi-line data communications, controls 15 or more simultaneous programs, and accommodates up to 80 I/O devices and 80-request I/O queue.

The MCP performs the following principal functions: (1) schedules the loading and execution of user programs in a multiprogramming environment; (2) allocates core storage and relocates user programs as necessary to achieve efficient storage utilization; (3) schedules and initiates all I/O operations; (4) services all interrupts and attempts recovery from I/O errors; (5) provides I/O control functions such as blocking, buffering, file opening and closing, data communications control, etc.; (6) loads program segments or overlays upon request; (7) creates and maintains disk program libraries in symbolic and/or machine-language form; (8) establishes communication between the system and its operator via the console typewriter and control cards; and (9) provides dump, trace, and checkpoint/restart facilities.

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▶ Programs are loaded and executed in a sequence determined by their assigned priorities and memory requirements. To schedule I/O operations, the MCP maintains tables that show the status of each I/O unit and the priority of each I/O request awaiting initiation. Disk files can be processed either sequentially or randomly.

The Advanced software package is designed for use with the MCP and generates programs which can be run only under MCP control. Its facilities include an Advanced Assembler, COBOL and FORTRAN Compilers, Advanced Sort Generator, and Advanced Media Conversion Program Generator.

COBOL: Two COBOL compilers are available for operation under the MCP. Both versions offer the same language facilities, but the larger one provides faster compilation and higher limits on the number of data names, procedure names, and pictures that can be used. The smaller compiler, called simply "COBOL", requires 17K bytes of core storage and 190K bytes of disk storage; the larger one, "COBOL L", requires 27K bytes of core and 240K bytes of disk (in addition to the MCP requirements). Both compilers can accept source-program input from cards, paper tape, and/or magnetic tape.

The B 2500/3500 COBOL language is generally consistent with USASI COBOL and includes most of its facilities, although the Sort and Report Writer modules have not been implemented. Effective (though nonstandard) language facilities are included for the control of data communications, MICR sorter-readers, and multi-tape listers.

The COBOL Cross-Reference Utility System accepts COBOL source programs as input and generates convenient cross-reference listings that show where each data name, internal program switch, and special register is used.

FORTRAN: The B 2500/3500 FORTRAN Compiler runs under control of the MCP. It requires 25,000 bytes of core storage (in addition to the MCP requirements) and a card or paper tape reader and line printer. Also required is 120,000 bytes of disk storage for the compiler, plus 332,000 bytes of working storage for each 1000 source-program cards. The language conforms with USASI FORTRAN.

REPORT PROGRAM GENERATORS: Burroughs offers Report Program Generators for operation under both the BCP and MCP. The Basic RPG requires 8K bytes of core storage, card or paper tape reader, printer, and two magnetic tape units. The Advanced RPG requires 11K bytes of core and 69K bytes of disk storage (in addition to the MCP requirements), plus a card or paper tape reader, printer, and two magnetic tape units.

Both versions provide essentially the same facilities. They use problem-oriented specifications from three types of coding sheets (Environment, Data, and Procedure) to generate object programs which perform common business data processing functions. The object programs can handle a maximum of three input files on cards, paper tape, magnetic tape, or disk and produce up to four output files on cards, paper tape, magnetic tape, disk, or printer. Add, subtract, multiply, and divide capabilities and relational tests permit reasonably flexible computations. Up to 9 levels of totals can be accumulated for each of 30 accumulators. Printed output can be edited to conform with COBOL-like "Pictures." There is no source-language compatibility between the Burroughs and IBM Report Program Generators.

ASSEMBLERS: Assembly Language is the symbolic programming language used to write machine-oriented programs for the B 2500 and B 3500. Separate Assemblers are provided for operation under the BCP and the MCP. The Basic Assembler requires at least 8K bytes of core storage and two magnetic tape units, plus card or paper tape reader, punch, and printer. The Advanced Assembler requires 11K bytes of core storage and at least 20K bytes of disk storage (in addition to MCP and working-storage requirements), plus card or paper tape reader and printer. Magnetic tape may be used for input and/or output with either Assembler if desired.

The Assembly Language programmer normally uses a fixed-format coding sheet whose arrangement corresponds closely with the 3-address format of the B 2500/3500 machine instructions. If the programmer chooses, he can code in a Free-Form Assembly Language which is translated into the regular Assembler format in a pre-assembly pass; Free-Form Translators are offered at both the Basic and Advanced levels.

The Basic and Advanced Assembly Language are essentially the same except in their I/O control facilities. The Advanced Assembler provides many macro and pseudo operations which are not available in the Basic version, including data communications control macros. Facilities such as blocking, label checking, and comprehensive error recovery procedures are provided by the MCP but not by the BCP. Therefore, programmers using the Basic Assembler must explicitly provide for these functions. A set of Special I/O Routines can be assembled into the object program to handle many of the common I/O devices and functions, or the programmer can elect to code them at the machine-language level. (The latter approach, however, rules out direct upward compatibility with the Advanced software.)

UTILITY ROUTINES: Sort Program Generators are offered at both the Basic and Advanced software levels. Both accept parameters specified by the user and generate sort programs tailored to meet his specific requirements. The Basic Sort Generator is tape-oriented, while the Advanced Sort Generator can use either tape or disk files.

Media Conversion Program Generators are also supplied at both the Basic and Advanced levels. Using parameters specified in a single control card, they generate programs tailored to satisfy most data transcription needs.

Dump and trace routines to aid in debugging are furnished as part of both the BCP and MCP.

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

BICS (Burroughs Inventory Control System)
ACTION (physical inventory system)
Production Control System
PROMIS (Project Oriented Management Information System)
Disk FORTE (data base management system)
ALPS (Advanced Linear Programming System)
BASIS (Burroughs Advanced Statistical Inquiry System)
APT-RX & ADAPT-RX (numerical control compilers) ▶

Burroughs B 2500 & B 3500

▶ **PRICING**

EQUIPMENT: The following systems are representative of the types of B 2500/3500 systems that are being widely installed and are supported by the standard Burroughs software. 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.

SMALL B 2500 TAPE SYSTEM: Consists of 10K B 2501 Processor with 4 I/O Channels, B 9381-4 four-drive Magnetic Tape Cluster (36KB), B 9245-2 Printer (315 lpm), B 9110 Card Reader (200 cpm), and B 9212 Card Punch (150 cpm). Monthly rental and purchase prices are approximately $4,400 and $213,000, respectively. An additional 10,000 bytes of core storage rents for $450 or sells for $21,600.

B 2500 TAPE/DISK SYSTEM: Consists of 30K B 2501 Processor with 6 I/O Channels, Console Printer and Keyboard, B 9370-2 Systems Memory (2 million bytes), B 9381-4 four-drive Magnetic Tape Cluster (36KB), B 9242-1 Printer (860 lpm), B 9111 Card Reader (800 cpm), and B 9212 Card Punch (150 cpm). Monthly rental and purchase prices are approximately $6,600 and $324,000, respectively.
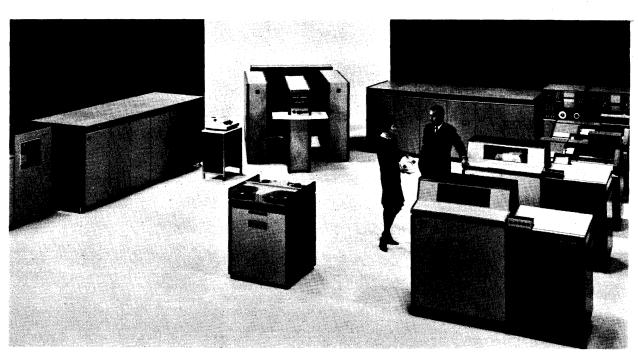
B 3500 TAPE/DISK SYSTEM: Consists of 60K B 3501 Processor with 6 I/O Channels, Console Printer and Keyboard, B 9372-2 Disk File (20 million bytes), two

B 9382-3 three-drive Magnetic Tape Clusters (72KB), B 9243-1 Printer (1100 lpm), B 9112 Card Reader (1400 cpm), and B 9213 Card Punch (300 cpm). Monthly rental and purchase prices are approximately $12,600 and $613,000, respectively.

LARGE B 3500 TAPE/DISK SYSTEM: Consists of 240K B 3501 Processor with 8 I/O Channels and Floating-Point Arithmetic, Console Printer and Keyboard, B 9370-2 Systems Memory (2 million bytes), B 9375-3 Data Memory Bank (100 million bytes), eight B 9393 Magnetic Tape Units (144KB) and two tape controls, B 9243-1 Printer (1100 lpm), B 9112 Card Reader (1400 cpm), and B 9213 Card Punch (300 cpm). Monthly rental and purchase prices are approximately $22,200 and $1,060,000, respectively.

SOFTWARE AND SUPPORT: Burroughs has not "unbundled" the B 2500/3500 systems to date, so the equipment prices listed above include all of the Burroughs software described in this report and all normal educational courses and professional assistance.

CONTRACT TERMS: The standard equipment lease agreement includes equipment maintenance and entitles the customer to up to 176 hours of operational time per month. Time used in excess of that amount is billed at an "extra operation" rate of 7.5% of the basic hourly rate (i.e., 7.5% of 1/176 of the monthly rental for each hour of extra use). The standard agreement covers maintenance of the equipment for eight consecutive hours a day, Monday through Friday. ■

Dual printers and card readers plus several disk file modules equip this B 3500 system for effective multiprogramming.