# Burroughs A 15

## MANAGEMENT SUMMARY

The A 15 large-scale computer system is Burroughs' answer to the IBM 3090 Series. The A 15 has the same performance range, and is priced competitively with the IBM 3090. The A 15 is designed for companies with high-volume batch, on-line and transaction processing, and organizations with a need to expand their computing capacity. Burroughs is actively marketing to these companies, but it seems that the major source of A 15 business will come from its own customer base, mostly users of B 6900 and B 7900 systems. The full code compatibility of the A 15 with the B 6900, B 7900, A 3, and A 9 provides the users of these systems with a growth path without costly conversion.

The A 15 uses 256K-bit dynamic RAM (DRAM) chips and features extended memory management, with up to 192 megabytes of directly accessible main storage with a memory bandpass up to 768 megabytes per second. The memories include a 24K-byte code cache and a 24K-byte data cache. The use of sub-nanosecond Emitter Coupled Logic (ECL) Very Large Scale Integration (VLSI) air-cooled gate array technology has resulted in a 2.6 performance factor over the B 7900, a 35 percent reduction in power and air-conditioning requirements, and 40 percent reduction in floor space requirements. The use of cache and pipeline technology greatly enhances the speed of the system, executing almost a full instruction within a 65-nanosecond clock cycle.

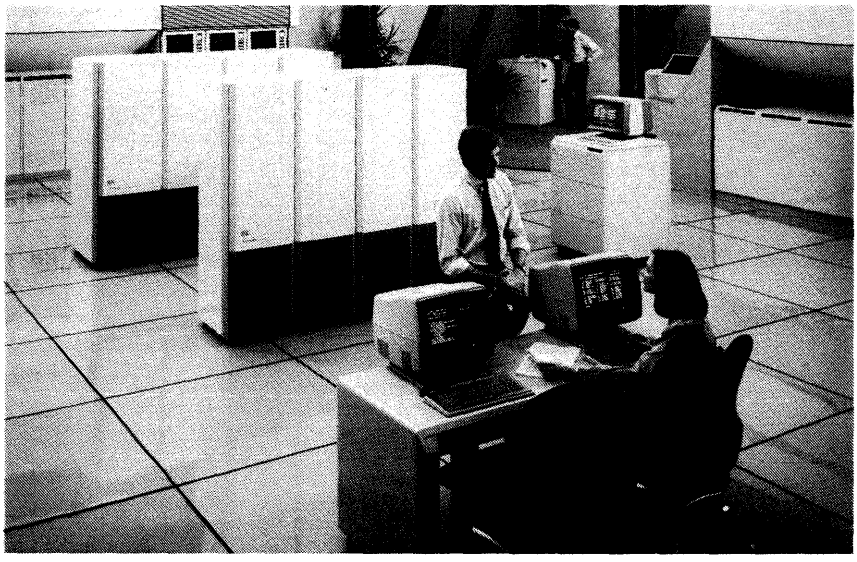
The A 15 is available in 8 models with from one to four central processors. The multiprocessor configurations are fully redundant and offer optional partitioning. Partition memory may be expanded up to 192 megabytes. The Input/Output subsystem can be expanded with the addition of independently powered I/O expansion cabinets. Specific A 15 models allow further expansion with the ➢

**Burroughs' top-of-the-line A 15 Series represents its most powerful large-scale computer offering to date. The distributed processing architecture is designed to satisfy the demands of a heavy batch load combined with high-volume transaction processing. The A 15 provides configuration flexibility and growth potential; various central processor and I/O processor modules can be combined to address a user's particular information processing requirements. The A 15 is object code-compatible with all the A Series computers, and the B 5900, B 6900, and B 7900 systems.**

**MODELS: A 15 Models F, H, I, J, K, L, M, and N.**
**CONFIGURATION: The A 15 systems have from one (Model F) to four (Models M and N) central processors. The main memory capacity ranges from 24 to 192 megabytes, expandable in 12-megabyte increments.**
**COMPETITION: Control Data Cyber 180 Model 860; IBM 3090-200 and 3090-400; Honeywell DPS 90/92, 90/93, and 90/94; NAS Alliance Series; and Sperry 1100/92.**
**PRICE: Base prices range from $2,920,000 for the A 15 Model F to $8,435,000 for the A 15 Model N.**

## CHARACTERISTICS

**MANUFACTURER: Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000. Canada: Burroughs Canada, 801 York Mills Road, Don Mills, Ontario M3B 1X8. Telephone (416) 445-4030.** ➤



*Burroughs' A 15 large-scale computer series features Emitter Coupled Logic gate array technology and 24M bytes of main memory expandable to 192M bytes. The A 15 is available in eight models ranging from one to four central processors.*

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**TABLE 1. SYSTEM COMPARISON**

| MODEL | A 15 Model F | A 15 Model H | A 15 Model I | A 15 Model J |
|---|---|---|---|---|
| **SYSTEM CHARACTERISTICS** | | | | |
| Date announced | March 1985 | March 1985 | March 1985 | March 1985 |
| Date first delivered | 3rd quarter 1985 | 4th quarter 1985 | 4th quarter 1985 | 1st quarter 1986 |
| Field upgradable to | Model H | Model I | Model J, Model K | Model L |
| Relative performance | 20.6* | 38.0* | 38.0* | 38.0* |
| Number of processors | 1 | 2 | 2 | 2 |
| Cycle time, nanoseconds | 65 | 65 | 65 | 65 |
| Word size, bits | 48 | 48 | 48 | 48 |
| Operating systems | MCP Release 3.5 | MCP Release 3.5 | MCP Release 3.5 | MCP Release 3.5 |
| **MAIN MEMORY** | | | | |
| Type | 256K-bit DRAM | 256K-bit DRAM | 256K-bit DRAM | 256K-bit DRAM |
| Minimum capacity, bytes | 24M | 24M | 24M | 24M |
| Maximum capacity, bytes | 48M | 96M | 96M | 96M |
| Increment size | 12M | 12M | 12M | 12M |
| Cycle time, nanoseconds | Not specified | Not specified | Not specified | Not specified |
| **BUFFER STORAGE** | | | | |
| Minimum capacity | — | — | — | — |
| Maximum capacity | 48K | 48K | 48K | 48K |
| Increment size | — | — | — | — |
| **INPUT/OUTPUT CONTROL** | | | | |
| Number of channels: | | | | |
| Byte multiplexer | — | — | — | — |
| Block multiplexer | — | — | — | — |
| Word | — | — | — | — |
| Other | 32 DLPs per HDU | 32 DLPs per HDU | 32 DLPs per HDU | 32 DLPs per HDU |

**Based on a relative performance of 1.0 for the A 3 Model D.*

addition of a second Host Data Unit (HDU). The modular design of the A 15 allows for a field upgrade to the next model within the A 15 series.

All models of the A 15 Series require the MCP (Master Control Program) 3.5 release of system software. All programs must be compiled on release level 3.4. The full complement of B 5000, B 6000, B 7000, and earlier A Series system software can be migrated to the A 15 without modification. This includes a complete range of compilers, data management facilities, data communications facilities, and application system generators. The A 15 supports all peripherals qualified on B 7900 systems and all Data Link Processors (DLPs) currently available on that system. Most peripherals can migrate from the B 5900, B 6900, A 3, and A 9 to the A 15. The B 9494-12 thin-film disk drive with a capacity of 1320M bytes of unformatted storage and 868M bytes of formatted storage will be available for the A 15.

## COMPETITIVE POSITION

The lineup of formidable competitors in the A 15's performance range include the Control Data Cyber, the IBM 3090, the Honeywell DPS 90, the NAS Alliance, and the Sperry 1100/92. All the systems offered by these vendors feature 256K-bit memory chips (IBM 288K-bit), and VLSI circuitry. In addition, all the processors have high-speed cache (buffer) memories of varying capacities to enhance throughput.

The low-end A 15 Model F with 24 megabytes of memory competes with the Sperry 1100/92 with 16 megabytes of memory, and the Honeywell DPS 90/91 with 32 megabytes of memory. The tightly coupled dual processor A 15 Mod-

**MODELS: Burroughs A 15, Models F, H, I, J, K, L, M, and N.**

## DATA FORMATS

**BASIC UNIT: 60-bit word consisting of 48 data bits, 4 control bits, and 8 error correcting bits.**

**OPERANDS: Integer and floating-point operands have the same format and may be freely combined in arithmetic operations.**

**INSTRUCTIONS: One to twelve 8-bit syllables in length. Syllables are packed six to a program word and executed sequentially left to right.**

**INTERNAL CODE: 8-bit EBCDIC is standard. Information coded in ASCII can also be processed. ASCII is the primary data communications code.**

## MAIN STORAGE

**STORAGE TYPE: See Table 1.**

**CAPACITY: For memory capacities of the A 15 refer to Table 1.**

**CYCLE TIME: Not specified.**

**CHECKING: Logic in the Memory Control (MC) performs automatic correction of single-bit errors and detection of multiple-bit errors.**

**MEMORY CONTROL: The A 15 memory system consists of a single fault tolerant Memory Control (MC), up to two Memory Storage Units (MSU), and the requisite power supply modules. The MC has the capability to address 192 megabytes of memory with a requestor bandpass of 192 megabytes per second. The Memory Control contains a purgeless cache mechanism that extends the memory system to the requestors' cache, allowing only one original of the data, referenced by a main memory address to exist in**

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**TABLE 1. SYSTEM COMPARISON (Continued)**

| MODEL | A 15 Model K | A 15 Model L | A 15 Model M | A 15 Model N |
|---|---|---|---|---|
| **SYSTEM CHARACTERISTICS** | | | | |
| Date announced | March 1985 | March 1985 | March 1985 | March 1985 |
| Date first delivered | 1st quarter 1986 | 1st quarter 1986 | 2nd quarter 1986 | 2nd quarter 1986 |
| Field upgradable to | Model L, Model M | Model M | Model N | — |
| Relative performance | 54.3* | 54.3* | 70.0* | 70.0* |
| Number of processors | 3 | 3 | 4 | 4 |
| Cycle time, nanoseconds | 65 | 65 | 65 | 65 |
| Word size, bits | 48K | 48K | 48K | 48K |
| Operating systems | MCP Release 3.5 | MCP Release 3.5 | MCP Release 3.5 | MCP Release 3.5 |
| **MAIN MEMORY** | | | | |
| Type | 256K-bit DRAM | 256K-bit DRAM | 256K-bit DRAM | 256K-bit DRAM |
| Minimum capacity, bytes | 24M | 24M | 24M | 24M |
| Maximum capacity, bytes | 192M | 192M | 192M | 192M |
| Increment size | 12M | 12M | 12M | 12M |
| Cycle time, nanoseconds | Not specified | Not specified | Not specified | Not specified |
| **BUFFER STORAGE** | | | | |
| Minimum capacity | — | — | — | — |
| Maximum capacity | 48K | 48K | 48K | 48K |
| Increment size | — | — | — | — |
| **INPUT/OUTPUT CONTROL** | | | | |
| Number of channels: | | | | |
| Byte multiplexer | — | — | — | — |
| Block multiplexer | — | — | — | — |
| Word | — | — | — | — |
| Other | 32 DLPs per HDU | 32 DLPs per HDU | 32 DLPs per HDU | |

**Based on a relative performance of 1.0 for the A 3 Model D.*

els H and I with 24 to 96 megabytes of memory compete with the IBM dyadic 3090 Model 200 with 64 megabytes of memory, the Control Data Cyber Model 860 with 16 to 128 megabytes of memory, the Honeywell DPS 90/92 with 32 to 128 megabytes of memory, and the NAS AS/XL 60 with 32 to 128 megabytes of memory. The three-processor A 15 Models K and L with 24 megabytes of memory compete with the Honeywell DPS 90/93 with 64 megabytes of memory. IBM has no three-processor model in its 3090 Series. The four-processor A 15 Models M and N with 24 to 192 megabytes of memory compete with the Honeywell DPS 90/94 with 64 to 256 megabytes of memory, the IBM 3090 Model 400 with 128 megabytes of memory, and the NAS AS/XL 80 with 64 to 256 megabytes of memory.

Another important comparison is mass storage. The A 15 features the B 9494-12 disk drive with a capacity of 1.32 gigabytes. The Honeywell MSU disk drive has a capacity of 1.85 gigabytes. The NAS 7380-AE and BE have disk capacities of 5.04 gigabytes, as do IBM's 3380 AE4 and BE4 disk drives. IBM and NAS hold the advantage over Burroughs in disk capacity, but Burroughs offers favorable pricing and an early delivery schedule, especially for the high-end, four-processor models. The A 15 Model M is priced at $7,625,000 and the Model N has a price tag of $8,435,000. Both models are scheduled for delivery in the second quarter of 1986. The NAS Model 80 sells for $8,970,000 and the IBM Model 400 is priced at $8,744,000. NAS has scheduled first customer shipments for the second half of 1986, while IBM has announced a 1987 delivery date. The early delivery date of the A 15 will not only benefit Burroughs users looking for an upgrade, but may give Burroughs a chance to enlarge its user base with new customers with an immediate need to expand their systems.

**the system. If the original is in main memory, the requestors may have copies in their caches. The copies cannot be modified by the requestor. The memory controller accepts jobs from, and initiates jobs to, its requestors to cause selective blocks of data to migrate back to memory from the requestors' caches. This eliminates the need to periodically purge cache to maintain accuracy of main memory. Data will reside in a requestors' cache until it is displaced by more recently needed data or is required by another requestor. The Requestor Interface Modules (RIM) provide all the logic required to interface a requestor (Central Processor, Host Data Unit) to the memory system. The RIM contains the cache control tables and data storage for uncompleted store operations. The Storage Interface Modules (SIM) provide the interface between the memory control and the storage units. The SIMs are connected to the Requestor Interface Modules via four pairs of unidirectional buses, each pair connecting one Storage Interface Module to all the Requestor Interface Modules.**

## CENTRAL PROCESSOR

**The Central Processor Module (CPM) utilizes Very Large Scale Integration (VLSI), Emitter Coupled Logic (ECL) gate array technology. Microcode is used as the source of control for operator execution. The A 15 Central Processor Module is part of a distributed system and is functionally subdivided into the following five relatively independent submodules that perform concurrent functions:**

- **Program Control Unit (PCU)**
- **Reference Unit (RU)**
- **Execution Unit (EU)**
- **Write Unit (WU)**
- **Memory Access Unit (MAU)**

**Operations are distributed through the five concurrent units, allowing execution order to be determined by resource availability rather than code sequence order.**

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## ADVANTAGES AND RESTRICTIONS

The major advantage of the A 15 is complete code-compatibility with the B 5000, B 6000, B 7000, and the smaller A Series computer systems. With the addition of the A 15 at the top end of the product line, Burroughs has one of the widest ranges of object code-compatible systems. This compatibility provides a smooth migration path, a 1.70 increase in performance growth, from the A 3 Model D to the A 15 Model N. Eight models of the A 15 are available with from one to four processors, allowing an orderly installation growth. Each system is field upgradable to the next level configuration.

The A 15 Series features improved processor performance in both commercial and scientific environments. In an I/O intensive environment the performance of the A 15 is 3 to 4 times that of the B 7900 processor which is rated at 5.5 MIPS (Million Instructions per Second). In a batch or transaction/DMS II mode the performance is 2.5 to 3.5 times that of the B 7900, and in scientific applications the performance is 2.0 to 2.7 times that of the B 7900.

The large capacity of up to 192 megabytes of directly addressable main memory and a global memory addressing scheme is designed to overcome the storage and addressing limitations some B 7900 users are encountering.

The strength of the A 15 Series is high-volume transaction processing in a commercial environment, but the A 15 is reportedly still weak in scientific and engineering processing. Also Burroughs has no relational data base system and the selection of third-party software is limited.

### USER REACTION

The first customer shipments of the A 15 Model F did not take place until the third quarter of 1985, so no user ratings are available. Prospective buyers of the A 15 may consult the Report "User Ratings of Mainframes" on Page 70C-000EB-101 for user experiences with earlier Burroughs large-scale systems. Burroughs computers have consistently earned high marks for their operating system, hardware reliability, and conversion ease. □

**The *Program Control Unit* fetches operators from its program cache and translates the operators from the external machine stack architecture into a three-address operation for processing by the Reference Unit and the Execution Unit. These addresses are pointers to locations in the Central Data Buffer which contains 64 registers. Along with these addresses, the PCU allocates and passes a job number and other pertinent information necessary to complete the operation. The job number is used to maintain overall orderly processing of an operator in the various pipelines of the Reference Unit and Execution Unit. The Central Data Buffer locations assigned by the PCU to an operator are deallocated at the end of the operation.**

**The *Reference Unit* uses the operator queues built by the Program Control Unit and calculates the absolute address for all data required to perform the operation. It also fetches data from its data cache. If the data is not present in cache, it will prompt the Memory Access Unit to provide the data from the main memory via the cache.**

**The *Execution Unit* performs all arithmetic and logic operations on data from the preallocated locations in the Central Data Buffer. The results of an Execution Unit operation may either be stored in the Central Buffer registers or sent to cache memory and the Write Unit.**

**The *Write Unit* logic provides and manages a buffer for the storing of data from the Execution Unit before sending it to the Reference Unit for storing in the data cache. This action minimizes the impact on the Execution Unit of operators that perform write operations.**

**The *Memory Access Unit* is pipelined and can handle up to eight separate active requests simultaneously, and concurrently process returns. The Memory Access Unit performs nonlocal references, memory control initiated purge, and return operations. It also handles system message traffic and system interrupts.**

### CONFIGURATION RULES

**The A 15 Model F consists of one central processor, 24M bytes of main memory, one Input/Output subsystem supporting up to 32 Data Link Processors (DLP), and up to 256 data communications lines.**

**Model H has two central processors, 24M bytes of main memory, one I/O subsystem supporting 32 Data Link Processors, and up to 256 communications lines.**

**Model I has two central processors, 24M bytes of main memory, two I/O subsystems supporting up to 64 Data Link Processors, and up to 512 communications lines.**

**Model J has two central processors, 36M bytes of main memory, two I/O subsystems supporting up to 64 Data Link Processors, and up to 512 communications lines.**

**Model K has three central processors, 24M bytes of main memory, two I/O subsystems supporting up to 64 Data Link Processors, and up to 512 communications lines.**

**Model L has three central processors, 36M bytes of main memory, two I/O subsystems supporting up to 64 Data Link Processors, and up to 512 communications lines.**

**Model M has four central processors, 24M bytes of main memory, two I/O subsystems supporting 64 Data Link Processors, and up to 512 communications lines.**

**Model N has four central processors, 36M bytes of main memory, two I/O subsystems supporting up to 64 Data Link Processors, and up to 512 data communications lines.**

**Models J, L, and N have a partitioning option. This option allows the system to be split into two logical A 15 subsystems. Each logical subsystem is under the control of its own copy of the operating system. A second memory control with an additional 12M-byte memory is included in the partitionable system. For Model J the additional partition memory may be expanded up to 96 megabytes; for the Models L and N, up to 192 megabytes.**

### INPUT/OUTPUT CONTROL

**The Input/Output Subsystem Module (IOSM) is a modular subsystem that houses the following components:**

- **Host Data Unit (HDU)**
- **Input/Output Subsystem**
- **System Maintenance Processor (SMP)**
- **Data Communications**

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The *Host Data Unit* handles all I/O data transfers between the A 15 main memory and the I/O subsystem. All data transfers to and from memory are 48-byte transfers when possible. The Host Data Unit also has the ability to address the 192 megabytes of main memory through the use of its Memory Environment Registers. The Host Data Unit contains the Memory Bus Control, the Host Dependent Port, and the Queue Manager.

The Memory Bus Control is responsible for controlling the memory operations between the Memory Subsystem Module and the internal requestors in the Host Data Unit. The Memory Bus Control can service up to four internal requestors, three Host Dependent Ports, and the Queue Manager. A bus architecture is used to transfer data and any bus-parity errors are detected by the Control.

The Host Dependent Port provides the physical link between the Host Data Unit and the I/O subsystem via a Message Level Interface. The Host Dependent Port controls the Message Level Interface and is responsible for the format, integrity, and transfer of all I/O data directly to and from main memory. Only one Message Level Interface per Host Dependent Port is active at a time, although two are provided. The Host Data Unit is configured with three Host Dependent Ports, and provides direct connection to 32 Data Link Processors. Additional Data Link Processors can be connected through the use of independently powered I/O expansion cabinets.

The Queue Manager maintains the I/O jobs for the Host Dependent Ports. The Queue Manager contains 12,000 bytes of local memory which is used to store copies of Input/Output Control Blocks relating to I/O requests in progress. The Queue Manager maintains two queue pointers, one pointing to the address of the Host Data Unit's home address queue and the second pointing to the Host Data Unit's error command queue. A 256-word RAM is maintained by the Queue Manager and is used in the Halt/Load sequence. The RAM contains information concerning the Halt/Load unit and the bootstrap code to be executed by the processor.

The *Input/Output Subsystem* consists of a series of specialized microprocessor-based Data Link Processors (DLP). These units control the transfer of information to and from the peripheral subsystem, thereby relieving the central processor of that responsibility. The Data Link Processors are also responsible for information transfer to and from memory via the Message Level Interface. Each type of peripheral subsystem has its own specialized DLP. Some DLPs (such as those for disk drives) can service multiple peripheral devices of the same type. In operation, a DLP receives a request for an I/O data transfer from the central processor via the Message Level Interface. Some DLPs will accept multiple I/O message requests, and queue them for processing. The DLP then initiates the peripheral dependent functions required to perform the I/O transfer, independent of the central system. Each DLP includes local memory that is used to buffer the data transfer operations.

The *Maintenance Subsystem* comprises a System Maintenance Station and a System Maintenance Processor. The System Maintenance Station contains the electronics and storage for the ET2000-based soft console. Two ET2000 terminals are provided, each with its own Maintenance Interface Processor, dual Winchester disk drives, disk controller, and diskette drive. Each Maintenance Interface Processor is cabled to the Maintenance Exchange in order to access all the mainframe units. The dedicated System Maintenance Processor executes diagnostic programs on the A 15, and is intended to operate at all times. The A 15 can also be supported remotely from a Remote Support Center via a data communications link to the System Maintenance Processor. Diagnostic programs may be initiated remotely to run on the System Maintenance Processor to test various hardware components such as the Central Processor, Host Data Unit, or the Memory Subsystem.

The *Data Communications Subsystem* is described in the "Communications Control" section of this report.

## SYSTEM CONTROL CABINET

The *System Control* is housed in its own cabinet and contains the Central Power Control for the A 15, the Maintenance Exchange and the Master System Clock. The Central Power Control function allows all mainframe components to be powered up or down fron one central location. The Maintenance Exchange provides connectivity from the system maintenance processor to each possible mainframe unit under test. The Master System Clock provides the proper clock rate signals to each of the mainframe units that require a clock signal.

## MASS STORAGE

For information on mass storage devices for the A 15, refer to Table 2.

## INPUT/OUTPUT UNITS

For information on magnetic tape units and printers used with the A 15, refer to Table 3.

## TERMINALS

For information on terminals used with the A 15, refer to Table 4.

## COMMUNICATIONS CONTROL

The modular Data Communications Subsystem off-loads communications responsibilities from the central processor and distributes them to a series of Function Processors, including the Network Support Processor (NSP), Line Support Processor (LSP), and Quad Line Adapters (QLA). The A 15 communications networks are serviced with the advanced Network Support Processor (NSP IV).

*Network Support Processor*: The NSP is a programmable front-end processor that serves as the central element of the communications subsystem; it contains 512K bytes of integrated-circuit memory. Interaction between the NSP and the central system is performed at the message level, eliminating the need to interrupt the central system each time a character or word of data is to be transferred. The NSP handles subsystem control, data link control, and line discipline control functions. Subsystem control includes control of data links and stations, information transfer and network reconfiguration. Data link control involves tracking logical status of communications lines; making and breaking connections on switched lines; first-level recovery and determining which line-protocol function is to be performed next, and, on multipoint lines, for which station. Station control includes keeping track of the ready/not ready and enabled/disabled conditions for input status of stations on a communication line, device control for properly formatting output display, and handling user options.

The information transfer function includes translating between logical station addresses, transmitting output messages to stations, forwarding input messages from stations to the central system, and performing application-dependent editing upon both output and input messages on a per-station basis. The network reconfiguration function allows an installation to assign, remove, or swap stations or communication lines, permitting dynamic network revisions as the environment changes.

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## TABLE 2. MASS STORAGE

| MODEL | B 9484-12 | B 9494-5 | B 9494-10 | B 9494-12 |
|---|---|---|---|---|
| Cabinets per subsystem | 2 | 2 | 1 | 1 |
| Disk packs/HDAs per cabinet | 1 removable | 1 fixed | 2 fixed | 1 fixed |
| Capacity | 252MB formatted | 482MB formatted | 964MB formatted | 868MB formatted |
| Tracks/segments per drive unit | — | — | — | — |
| Average seek time, msec. | 20.3 | 13.7 | 13.7 | 7.7 |
| Average access time, msec. | 28.5 | 22 | 22 | 16 |
| Average rotational delay, msec. | 8.3 | 8.3 | 8.3 | 8.3 |
| Data transfer rate | 1.2MB per sec. | 1.2MB per sec. | 1.2MB per sec. | 3MB per sec. |
| Controller model | B 9387-51, B 9387-52 | B 9387-51, B 9387-52 | B 9387-51, B 9387-52 | B 9389, B 9399 |
| Comments | Requires A 304-91 DLP; can be intermixed with B 9494-5 and B 9494-10 for a maximum of 16 drives | Requires A 304-91 DLP; can be intermixed with B 9494-10 and B9484-12 for a maximum of 16 drives | Requires A 304-91 DLP; can be intermixed with B 9484-12 and B 9494-5 for a maximum of 16 drives | Requires A 304-91 DLP |

*Line Support Processors*: Low-level details of Data Link Control are off-loaded by the Network Support Processor to the Line Support Processor (LSP) by down-line loading the appropriate line discipline and parameters in the Line Support Processor. The LSP performs individual line protocol functions as directed by the NSP and translation between the character set of the line and the character set of the central system.

The LSPs are a series of specialized microprocessors that provide the connection between the Line Adapters and the NSP. Information is transferred between the LSP and the NSP at the message level, reducing NSP interruptions and allowing more information to be transferred at a time. A single Line Support Processor can support up to 16 half- or full-duplex communication lines with sub-broadband speeds of up to 19.2 bits per second. A special version of the LSP is available for installations requiring 56K-bit transmission speeds. This specialized LSP services a single 56K-bit Line Adapter and supports transmission rates of 56K bits per second. The same configuration flexibility available with Network Support Processors is available with Line Support Processors. Multiple communication paths may be activated through the use of MCP operator console commands.

*Quad Line Adapters*: A Quad Line Adapter provides the electrical interface between the LSP and each communication line. The Quad Line Adapter maintains physical control of the line, accumulates characters, and transfers them to or from the LSP. Each Quad Line Adapter includes 4K bytes of local memory for storage of translation tables, message buffers, line parameters, polling sequences, and the code required to control the communication line and line discipline.

The Quad Line Adapters are packaged in sets of four. Each set accommodates the electrical interfaces for four lines, and may be specified as either character-oriented or bit-oriented. (Character-oriented transmission is used in most of the current communications protocol, while bit-oriented transmission is employed in newer protocol such as Burroughs Network Architecture.) For each line position within a Quad Line Adapter, one of three types of electrical interfaces must be specified: RS-232, for U.S. modem connection; CCITT V.24, for international modem connection; or TDI/20, for direct connection. Different electrical interfaces can be intermixed within the same Quad Line Adapter, and character- and bit-oriented Quad Line Adapters can be intermixed on the same Line Support Processor. Each LSP accommodates up to four Quad Line Adapters and up to 16 lines.

## SOFTWARE

The System Software Facility for the A 15 System includes the Master Control Program (MCP) operating system, NSP/LSP Firmware, Microcode, utilities, an Algol compiler, a DC Algol compiler, a Program Binder, the SMF II Site Management, the Work Flow Language (WFL), Menu Assisted Resource Control (MARC), and Cross Reference Symbolic.

MASTER CONTROL PROGRAM: The MCP is an integrated system that oversees and controls all A 15 operations. MCP Release 3.5 offers the following: file names can extend up to 14 levels of 17 characters each, user code can extend up to 17 characters, multipack families are supported, and data base structures can extend over the pack boundary. Other capabilities are an advanced, powerful library, and data communication operations from the Operator Display Terminal (ODT).

The MCP consists of groups of routines organized in three-level hierarchical fashion. The first level is a kernel 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 multilevel MCP also allows processing to continue while faulty hardware is being diagnosed or new system software is tested and debugged.

Jobs are submitted to the MCP through the Operator Display Terminal (ODT) and/or the systems input unit, which can be a card unit or a disk or tape file performing as a "pseudo card unit." As the control statements for each task are analyzed, a partial stack is created on a schedule queue containing the estimated main memory requirements, the priority, the maximum amount of processing time and I/O time, the size and location of the file parameter block, the working storage stack size, and the size and location of code segments. The program scheduling priority ordinarily is specified by the programmer, although a default option automatically assigns a priority of one-half the maximum allowable priority.

The MCP maintains a queue of jobs available for initiation. A scheduling routine evaluates the equipment and priority requirements of the programs in the queue and schedules

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TABLE 3. INPUT/OUTPUT UNITS

| Magnetic Tape Units | Number of Tracks | Recording Density, Bits/Inch | Encoding | Tape Speed Inches/Sec. | Transfer Rate, Bytes/Sec. |
|---|---|---|---|---|---|
| B 9495-82 | 9 | 1600 | PE/NRZ | 75 | 120,000 |
| B 9495-83 | 9 | 1600 | PE/NZR | 125 | 200,000 |
| B 9495-24 | 9 | 1600 | PE | 200 | 320,000 |
| | 9 | 6250 | GCR | 200 | 1,250,000 |
| B 9495-32 | 9 | 1600 | PE | 75 | 120,000 |
| | 9 | 6250 | GCR | 75 | 470,000 |
| B 9495-33 | 9 | 1600 | PE | 125 | 200,000 |
| | 9 | 6250 | GCR | 125 | 780,000 |
| **Printers** | **Printing Speed** | **Print Positions** | **Horizontal Spacing, Chars./Inch** | **Vertical Spacing, Lines/Inch** | **Form Size, Inches** |
| B 9290-30 | 30 ppm | — | 2.5-20 | 2.5-13.3 | 8.5 by 11 |
| B 9246-12 | 1200 lpm | 132 | 10 | 6 or 8 | 15 |
| B 9246-21 | 2000 lpm | 132 | 10 | 6 or 8 | 15 |

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 schedule. When the required resources are available (for example, when a job completes processing or suspends itself to await completion of an input/ouput operation) an available job with the highest priority is added to the processing mix. Jobs submitted from remote terminals are interpreted and entered into the schedule queue and are added to the multiprogramming mix in much the same way as batch jobs.

The MCP maintains control of tasks through the use of stacks, descriptors, and tables that summarize the history and current status of each task in process. A stack is assigned to each job in the system to provide storage for basic program and data references. When a task is activated, four high-speed registers are linked to the task's stack memory area. In addition, an area of high-speed local memory is available to contain additional portions of the active stack, for fast access. The contents of the top-of-stack registers are maintained automatically by the central processor hardware according to the requirements of the executing program. Central processors can handle multiple active stacks organized into a tree structure. The tree-structured organization allows program code and program data and variables to be described at different stack levels, thus permitting program code to be reentrant and shared. The tree-structured stack also enables a single task to split itself into two independent tasks by establishing a new link on the stack to make full use of a multiprocessor configuration or to multiprogram independent processes.

Both data and program segments are referenced through descriptors. A Data Descriptor is used to fetch data to the stack or to store data in a storage area outside the stack. Both the absolute address and the length of the data array are specified in the Data Descriptor, along with a Presence Bit which indicates whether the reference data is located in main memory or in disk storage. Segment Descriptors, maintained in a portion of the stack base known as the Segment Dictionary, are the basis for the Burroughs implementation of virtual memory. In contrast to the fixed-page concept utilized in many storage allocation schemes, Burroughs programs can be divided into variable-length segments, which are brought into main memory only as they are needed.

The dynamic memory allocation is a feature of the MCP. The compilers automatically divide all object programs into logical, relocatable segments. All object programs are reentrant because code 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 that have not been accessed recently. If the old segment contains modifiable data, it is written on a disk file prior to the overlay.

Main memory is allocated to programs in working sets, which represent the amount of memory each program most often requires during execution to process efficiently. The optimum working set size is calculated first by the compiler, and afterward it is recalculated by the MCP each time the program is executed.

Communications between the system operator and the MCP is accomplished through a combination of CRT display units, keyboards, control statements, 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 ODT. Jobs are usually submitted to the system in the form of a set of control statements accompanied by a source-language deck, or alternatively through control statements entered through the console keyboard if the programs have previously been compiled and stored on disk. Jobs to be compiled must be accompanied by a compile statement identifying the compiler to be used and specifying one of three types of compilations: compile and execute, compile for the library, or compile for the syntax. Optional control statements for all jobs contain an execute statement, process time statement, priority statement, core requirement statement, I/O time statement, and I/O statements which associate file labels with specific input/output devices.

Memory protection is provided by a combination of hardware and software features. Two registers associated with the stack mechanism, the Base of Stack register and the Stack Limit register, define the upper and lower limits of the stack. An interrupt is generated if an attempt is made to exceed these limits. When an element in a data array is referenced, an automatic comparison of the index value of the data element and the length of the data area as specified in the Data Descriptor identifies any attempt by a program to reference beyond its designated data area. In addition, control bits in each word prevent a user program from altering program segments, data descriptors, segment descriptors, memory links, control words, and tables maintained by the MCP.

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The MCP provides comprehensive input/output and file control facilities. It automatically assigns peripheral devices to symbolic files whenever possible, to minimize operator intervention. Three tables are maintained by the operating system containing label equation and file attribute information such as the access type, peripheral type, and physical unit being used. This allows modification of file specifications at program execution time. 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 used as backup or "pseudo" devices for card readers, punches, and printer. This makes it unnecessary to delay the processing of a job because a particular I/O unit is not available.

Work Flow Management is an MCP facility that provides enhanced facilities for control of task initiation and resource allocation. The Work Flow Language (WFL) 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 statements, 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.

The Menu Assisted Resource Control (*MARC*) provides menu guidance for all system operation commands. Complete on-line HELP text is available for any command. MARC also allows an operator workstation to emulate a data communications interface into the system or conversely allowing a data communications station to emulate an operator workstation.

LANGUAGES: Languages supported on the A 15 are: Cobol 68 and 74, PL/1, RPG II, Fortran 66 and 77, Basic, APL, Algol, and Pascal.

INTERPRO: Burroughs' InterPro software is made up of the following separate products which can function individually in any combination or together as a complete synergistic package.

The Advanced Data Dictionary System (*ADDS*) is designed to provide centralized definition, storage, and retrieval of descriptions of information and information relationships including forms designed with the Screen Design Facility (SDF). The Interactive Definition Module (IDM) is an integrated component of ADDS. It affords interactive support of DMS II data base definition. To simplify the process of defining and maintaining DMS II data bases, IDM has been designed to provide all Data and Structure Definition Language (DASDL) facilities through a series of descriptive menus.

The Interactive Datacomm Configurator (*IDC*) is an extensive tool to aid in the on-line development, implementation, and maintenance of data communications. It provides a menu-driven interface to configure the data communication subsystem from a workstation or operator display terminal.

The Communications Management System (*COMS*) features modular support of extended transaction processing, synchronized recovery with DMS II, as well as support of Transaction Processing System (TPS) synchronized recovery. Multiple windows may be established from a terminal into the host system, making a given terminal appear as multiple terminals to the system. COMS provides a continuous operating environment through the ability to add new and updated processing modules without bringing down the network. The COMS environment is defined through an on-line menu-based configurator. The Communication Management System is offered in two versions: COMS and COMS Entry. COMS Entry eliminates the need for any locally written message control systems and is largely integrated with the system software (MCP).

Extended Retrieval with Graphic Output (*ERGO*) is a query program designed to provide quick on-line access to the DMS II data base producing tabular and graphic reports. Information may be retrieved from several (maximum of five) data bases concurrently; up to 400 structures may be accessed in a single request.

The Screen Design Facility (*SDF*) is designed to complement other InterPro software products. However, it can be implemented by itself. SDF features both screen painting facilities and data entry system functions, such as field verification, status checking, required field, and many more.

REPORTER III: Provides an effective method to retrieve, analyze, and report on information maintained in the system. Reporter III accepts specifications coded in a free-form report description language and generates a Cobol program tailored to produce the required report. The system can retrieve input data from multiple files and/or DMS II data bases, select data based on a wide range of criteria, perform arithmetic and statistical functions, sort data in ascending or descending order according to multiple keys, control access through a password system, produce automatically formatted reports, and create one or more files of extracted data for subsequent processing or reporting. On-Line Reporter III is a separate module which provides the ability to enter, generate, compile, and execute report programs from remote terminals.

Burroughs offers a variety of communications control software facilities for the A 15, including NDL II for network control, Gemcos for transaction processing, Cande for time-sharing and on-line program development, as well as RJE and Burroughs Network Architecture (BNA) for distributed data processing. These facilities are individually described in the following paragraphs.

NDL II: The Network Definition Language is a high-level language designed to simplify the programming of network control functions for networks based on Network Support Processors and Line Support Processors. Programs written in NDL II are compiled and loaded into the Network Support Processor (NSP) to perform communications subsystem control, data link control, and line discipline control functions.

GEMCOS: The Generalized Message Control System manages a transaction-oriented communications network, provides security, handles transaction routing, controls message formatting, and provides a transaction processing interface of applications programs. Gemcos enables users to develop transaction-processing application programs independently of the network environment.

CANDE: The Command and Edit Program enables multiple users at remote terminals to create programs or data files, compile and execute programs, edit and alter programs or files, search files, send messages to other terminals, and perform a variety of other functions. Cande provides the capability for interactive program development and testing concurrently with the execution of applications programs.

EDITOR: A programmer productivity aid that runs as a task under Cande. The Editor is a general line- and page-oriented text editor that creates and maintains program text and simple documents.

RJE: Remote Job Entry enables users at remote batch terminals to enter jobs into the computer system in the same manner as if they were on-site in the computer room. RJE

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## TABLE 4. TERMINALS

| MODEL | ET 1100 | ET 2150 |
|---|---|---|
| **DISPLAY PARAMETERS** | | |
| Max. chars./screen | 2080 | 2080 |
| Screen size (lines x chars.) | 24 x 80 | 24 x 80 |
| Symbol formation | 7 x 9 dot matrix | 7 x 9 dot matrix |
| Character phosphor | P39 green | P39 green |
| Total colors/no. simult. displayed | — | 8 |
| **KEYBOARD PARAMETERS** | | |
| Style | Typewriter | Typewriter |
| Character/code set | 128 ASCII | 128 ASCII |
| Detachable | Standard | Standard |
| Program function keys | 10 | 10 |
| **OTHER FEATURES** | | |
| Buffer capacity | 256K | 256K |
| Tilt/swivel | Standard | Standard |
| Graphics capability | No | Yes |
| **TERMINAL INTERFACE** | RS-232-C, TDI | RS-232-C, TDI |

allows files to be transferred between remote systems, and enables terminals attached to remote systems to be controlled by the host system.

BNA: Burroughs Network Architecture software is designed to enhance the interaction of terminals with host CPUs in a network environment. BNA provides distributed data processing capabilities. Through the Burroughs Network Architecture, Burroughs processors and terminals can be granted access to data bases throughout a network, and job tasks and information files can be transferred from one point to another. Available data processing resources in a network can be shared among participants regardless of location. BNA is designed to work with existing Burroughs terminal networks and with the Global Memory multiprocessing facility available on Burroughs large-scale processors. BNA depends on logical links rather than physical links, relying on network tables maintained in the host processors for routing. All routing is through host mainframes. Services provided by BNA include those designated host and those designated network. Host services include coordination of communication between tasks being executed at various hosts; control of the creation, updating, and transfer of data from host to host; and handling of communication with logical points within the network. Network services perform message routing, linking hosts using the Burroughs Data Link Control (BDLC) bit-oriented protocol. Network services also permit connection of Burroughs processors to packet switching services, such as Tymnet and Telenet using X.25 procedures. Links can also be established to non-Burroughs machines using NDL II and Gemcos software.

BNA also supports the Inter-System Control (ISC) subsystem, which is used to physically establish a local processor-to-processor network of large-scale Burroughs computer systems. ISC permits users on one system in a local network to access and share the resources of other systems through the BNA Host Services and Network Services.

TPS: The Transaction Processing System provides a framework and methodology for implementing an application system for high-volume, on-line transaction processing. TPS has the ability to synchronize data base and input message recovery, centralize, formalize, and simplify message interfaces and user programming. It also provides an interface to access remote data bases using the BNA network.

LINC: The Logic and Information Network Compiler is a fourth-generation programming language which generates complete, on-line, realtime systems, including programs, data base descriptions, screen formats, transaction management, and network management. It is designed to do so with only one set of English-like specifications. The system includes the Linc Definition Language (LDL), a high-level, nonprocedural, business-oriented language used to identify and define the user's needs. LDL allows for a single system specification without regard to actual program and application construction and provides full syntax checking. It includes both the systems and data definitions and is used to define the report and inquiry requirements. Linc optimizes the generated systems to the host Burroughs system, and eliminates redundant programming code and data elements as well as data and logic inconsistencies.

DMS II: This comprehensive Data Base Management System is integrated with the MCP operating system and uses MCP facilities for accessing records in the data base to achieve greater run-time efficiency. Through the MCP facilities, the DMS II data base can be accessed by applications programs operating in multiple processing environments, such as batch, remote job entry, time-sharing, and transaction processing. DMS II incorporates a Data and Structure Definition Language (DASDL) that provides for the logical description of data in sets or subsets and for mapping the logical data into physical structures. A variety of retrieval methods is supported, including indexed sequential, indexed random, and bit vectors. The latter method creates indices that require small amounts of disk storage and permit very fast searches.

DMS II permits multiple indices to be established for accessing a file, and each file can be accessed by any of the available access methods to provide retrieval of information by different applications programs. User-language interfaces to the data management system are provided for the Cobol, Algol, RPG, and PL/1 languages. When multiple programs are accessing the data base, DMS II provides lockout protection at the record level to prevent simultaneous updating of a record. DMS II recovery capabilities include the ability to audit transactions as they are referenced or added to the data base and a checkpoint/restart capability. A recovery utility is automatically initiated by the operating system in the event of system failure to effect recovery of the data base and restart of applications programs. In addition, DMS II permits the data base to be dumped concurrently with updates to the files, so that dumps correspond to the current audit trail.

For more information on DMS II, refer to the software report on Page 70E-117MM-101 in Volume 3.

DMS INQUIRY: This optional extension of DMS II provides an easy-to-use language that enables non-EDP personnel to access the data base via remote terminals. Users can "browse" through information stored in the data base and retrieve it either serially or randomly, without the delays normally associated with programming and debugging an

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inquiry program. Users with appropriate security clearances can also update existing information in the data base and add new records or delete existing records. The DMS II audit trail captures a record of all data base maintenance functions to facilitate automatic recovery.

DB ANALYZER: This DMS II extension provides detailed statistical and descriptive attributes of both the physical and logical data base implementation. The information is presented by means of a series of predefined report programs. This information can aid the user in determining the efficiency of the current implementation, changing the structure for increased efficiency, and deciding when reorganization is needed.

DB MONITOR: This DMS II extension provides realtime monitoring and control of the status of a DMS II data base. DB Monitor provides dynamic monitoring of current data base performance statistics such as memory usage, audit trail attributes, syncpoint/controlpoint frequency, buffers allocated for each structure, and user counts of the number of programs accessing the data base and one or more structures within it.

DM INTERPRETER: A DMS II facility that provides non-DMS II languages, such as Fortran 77 and APL, with an interpretive interface to a DMS II data base. DM Interpreter decouples the application from the data base, so that, in most cases, changes to the data base do not require the recompilation of applications programs.

HOST-LINK: Allows intelligent workstations, such as an ET 2000 or ET 1100, to connect to a mainframe to utilize its resources.

## PRICING AND SUPPORT

CONTRACT TERMS: The A 15 system is available for purchase or lease under a 1-year, 3-year, or 5-year lease agreement. The standard lease agreement entitles the customer to unlimited use of the equipment and includes full-time equipment maintenance coverage (24 hours/day, 7 days/week). The standard maintenance agreement for purchased systems covers maintenance of the equipment for eight consecutive hours per day on Monday through Friday only; extended maintenance is available at higher rates.

All maintenance charges listed in this report are for monthly maintenance Metro 1 (city) plan A.

All lease plans may include purchase options that allow 50 percent of the rental paid during the first 36 months to be applied toward the purchase price at any time during the lease period.

SOFTWARE: All software is unbundled. Program products for the A 15 are offered under a plan which provides for the use of the products on a designated system on a month-to-month basis.

TECHNICAL SUPPORT: Users can purchase Burroughs' Program Product Service Agreement which provides various Support Service packages. The availability of a particular service package (PSA) is product dependent. Generally, PSAs provide for ongoing program product service and/or field service. Program product service deals with corrections by the program product design facility. Field service provides program product problem identification assistance via telephone and/or on-site. Five service packages (PSAs) are defined: Software Product Support (PSA 1), for computers and customers who will not require on-site program product problem assistance; Extended Software Product Support (PSA 2), for computers and customers who will require on-site program product problem assistance; Centralized Software Product Support (PSA 3), for selected program products where only telephone service is needed; and Basic Software Product Support (PSA 5), for certain products for which telephone and on-call services are not generally available.

EDUCATION: Users can obtain the necessary training by paying for individual courses. The currently available courses range from 1 to 10 days in length, and fall into the following broad categories: Systems Management and Operations, Control Systems, Network Systems, Data Base Systems, Programming Systems, and Applications.

EQUIPMENT: The following configurations illustrate the A 15 Model F, Model I, and Model N systems. The quoted prices include all necessary hardware components, but no software. The leasing prices are based on a one-year lease, with the exception of the B 9494-12 disk drives, network support processors, line support processors, and quad line adapters, for these products prices were calculated on a three-year lease.

ENTRY-LEVEL A 15 MODEL F: Includes an A 15-F Central System (one single processor, one Memory Subsystem with two 12-megabyte Memory Modules, one I/O Subsystem including a System Maintenance Processor, one System Maintenance Station, one System Control Cabinet, one Console Table, two Maintenance/Operator Displays, one Operator Display, one F System Installation Kit), plus two B 9484-12 252-megabyte removable disk drives, two B 9494-5 542-megabyte fixed disk drives, one B 9387-52 dual disk drive controller, one AX 304-90 Disk DLP, four B 9495-24 PE/GCR tape drives (200 ips), one B 9499-22 PE/GCR tape controller, one AX 395-92 tape DLP, two B 9246-21 train printers (2000 lpm), one B 9246-12 band printer (1200 lpm), three AX 246-92 printer DLPs, three AX 372-5 network support processors (512KB), 12 AX 378-1 line support processors, 48 AX 369-4 quad line adapters, and ten ET 1100 terminals. The purchase price is $3,820,879 plus monthly maintenance of $10,280. A one-year lease including 24-hour, 7-day maintenance service is $185,896.

MEDIUM-LEVEL A 15 MODEL J: Includes one A 15-J Central System (one dual processor, two Memory Subsystems with three 12-megabyte Memory Modules, one I/O Subsystem including a System Maintenance Processor, one I/O Susbsystem Module, one System Maintenance Station, one System Control Cabinet, two Console Tables, one Partitioning Option, two Maintenance/Operator Displays, three Operator Displays, one J System Installation Kit), plus one memory cabinet with 12 megabytes of memory, two 12-megabyte memory modules, (72 megabytes total main memory) one B 9494-12 868-megabyte (formatted) fixed disk, one B 9389 dual disk drive controller, one B 9399 dual string controller, two B 9494-10 1084-megabyte fixed disk drives, one B 9387-52 dual disk drive controller, three AX 304-90 disk DLPs, eight B 9495-24 PE/GCR tape drives (200 ips), two B 9499-22 PE/GCR tape controllers, two AX 395-92 tape DLPs, two B 9246-21 train printers (2000 lpm), three B 9246-12 band printers (1200 lpm), five AX 246-92 printer DLPs, three A 372-5 network support processor (512KB), 16 A 378-1 line support processors, 64 AX 369-4 quad line adapters, and 50 ET 1100 terminals. The purchase price is $7,152,939 plus monthly maintenance of $11,643.50. A one-year lease including 24-hour, 7-day maintenance service is $350,446.

HIGH-LEVEL A 15 MODEL N: Includes one A 15-N Central System (two dual processors, two Memory Subsystems with three 12-megabyte Memory Modules, one I/O Subsystem with a System Maintenance Processor, one I/O Subsystem, one System Maintenance Station, one System Control Cabinet, two Console Tables, one Partitioning Option, two Maintenance/Operator Displays, three Operator Displays, one N System Installation Kit), plus six memory

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**cabinets with 12 megabytes of memory each, seven 12-megabyte memory modules, (192 megabytes total main memory), two B 9494-12 868-megabyte (formatted) fixed disk drives, one B 9389 dual disk drive controller, one B 9899 dual string controller, four B 9494-10 1084-megabyte fixed disk drives, two B 9387-52 dual disk drive controller, six AX 304-90 disk DLPs, 14 B 9495-24 PE/GCR tape drives (200 ips), three B 9499-22 PE/GCR tape controllers, four AX 395-92 tape DLPs, five B 9246-21 train printers (2000 lpm), one B 9290-30 laser printer, six AX 246-92 printer DLPs, four AX 372-5 network support processors, 32 AX 378-1 line support processors, 96 AX 369-4 quad line adapters, and 100 ET 1100 terminals. The purchase price is $13,330,260 plus monthly maintenance of $31,281. A one-year lease including 24-hour, 7-day maintenance service is $623,302.**

## EQUIPMENT PRICES

| | | Purchase Price ($) | Monthly Maint.* ($) | 1-Year Lease** ($) | 5-Year Lease** ($) |
|---|---|---|---|---|---|
| **PROCESSOR AND MEMORY** | | | | | |
| A 15 Model F | Basic System; includes one single processor, one memory subsystem module, 24MB main memory, one I/O subsystem module with a system maintenance processor (SMP), one system maintenance station, one system control cabinet, one console table, two maintenance/operator displays, one freestanding operator display terminal, one F System installation kit | 2,920,000 | 3,620.00 | 147,850 | 112,225 |
| A 15 Model H | Basic System; includes one dual processor, one memory subsystem module, 24MB main memory, one I/O subsystem module with a system maintenance processor (SMP), one system maintenance station, one system control cabinet, one console table, two maintenance/operator displays, one freestanding operator display terminal, one H System installation kit | 4,215,000 | 5,860.00 | 213,675 | 162,425 |
| A 15 Model I | Basic System; includes one dual processor, one memory subsystem module, 24MB main memory, one I/O subsystem module with a system maintenance processor (SMP), one I/O subsystem module, one system maintenance station, one system control cabinet, one console table, two maintenance/operator displays, one freestanding operator display terminal, one I System installation kit | 4,530,000 | 6,740.00 | 229,970 | 174,970 |
| A 15 Model J | Basic System; includes one dual processor, two memory subsystem modules, 36MB main memory, one I/O subsystem module with a system maintenance processor (SMP), one I/O subsystem module, one system maintenance station, one system control cabinet, two console tables, two maintenance/operator displays, three freestanding operator display terminals, one J System installation kit, one partitioning option | 5,145,000 | 7,280.00 | 260,770 | 198,270 |
| A 15 Model K | Basic System; includes one dual processor, one single processor, one memory subsystem module,24MB main memory, one I/O subsystem module with a system maintenance processor, one I/O subsystem module, one system maintenance station, one system control cabinet, one console table, two maintenance/ operator displays, one freestanding operator display terminal, one K System installation kit | 6,080,000 | 9,140.00 | 308,520 | 234,770 |
| A 15 Model L | Basic System; includes one dual processor, one single processor, two memory subsystem modules, 36MB main memory, one I/O subsystem module with a system maintenance processor (SMP), one I/O subsystem module, one system maintenance station, one system control cabinet, two console tables, two maintenance/ operator displays, three freestanding operator display terminals, one L System installation kit, one partitioning option | 6,790,000 | 9,680.00 | 344,320 | 261,820 |
| A 15 Model M | Basic System; includes two dual processors, one memory subsystem module, 24MB main memory, one I/O subsystem module with a system maintenance processor (SMP), one I/O subsystem module, one system maintenance station, one system control cabinet, one console table, two maintenance/operator displays, one freestanding operator display terminal, one M System installation kit | 7,625,000 | 11,540.00 | 387,075 | 294,575 |
| A 15 Model N | Basic System; includes two dual processors, two memory subsystem module, 36MB main memory, one I/O subsystem module with a system maintenance processor (SMP), one I/O subsystem module, one system maintenance station, one system control cabinet, two console tables, two maintenance/operator displays, three freestanding operator display terminals, one N System installation kit, one partitioning option | 8,435,000 | 12,080.00 | 427,870 | 325,370 |
| A 15-FTH | Model F to Model H upgrade includes one single central processor module V kit, one F to H installation kit | 1,420,000 | 2,245.00 | 72,070 | 54,885 |
| A 15-HTI | Model H to Model I upgrade includes one I/O subsystem module, one H to I installation kit | 350,000 | 880.00 | 17,800 | 13,675 |
| A 15-ITJ | Model I to Model J upgrade includes one memory subsystem module, one console table, one 12MB memory module, one partitioning option, two freestanding operator display terminals, one I to J installation kit | 670,000 | 540.00 | 33,800 | 25,550 |
| A 15-ITK | Model I to Model K upgrade includes one single central processor module V, one I to K installation kit | 1,695,00 | 2,400.00 | 86,050 | 65,430 |
| A 15-JTL | Model J to Model L upgrade includes one single central processor module V, one J to L installation kit | 1,805,000 | 2,400.00 | 91,550 | 69,550 |

**For 5-day, 8-hour service.*
***Includes 7-day, 24-hour maintenance coverage.*
*NC—No charge.*

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| | | Purchase Price ($) | Monthly Maint.* ($) | 1-Year Lease** ($) | 5-Year Lease** ($) |
|---|---|---|---|---|---|
| **PROCESSOR AND MEMORY (Continued)** | | | | | |
| A 15-KTL | Model K to Model L upgrade includes one memory subsystem module, one console table, one 12MB memory module, one partitioning option, two freestanding operator display terminals, one K to L installation kit | 780,000 | 540.00 | 39,300 | 29,675 |
| A 15-KTM | Model K to Model M upgrade includes one single central processor module V, one K to M installation kit | 1,695,000 | 2,400.00 | 86,050 | 65,430 |
| A 15-LTN | Model L to Model N upgrade includes, one single central processor module V, one L to N installation kit | 1,805,000 | 2,400.00 | 91,550 | 69,550 |
| A 15-MTN | Model M to Model N upgrade includes one memory subsystem module, one console table, one 12MB memory module, one partitioning option, two freestanding operator display terminals, one M to N installation kit | 890,000 | 540.00 | 44,800 | 33,800 |
| **SYSTEM OPTIONS** | | | | | |
| A 15 95-90 | Expansion Cabinet | 60,000 | 625.00 | 4,089 | 3,074 |
| AX 95-92 | Distribution Module | 1,756 | 7.00 | 54 | 44 |
| AX 95-93 | Logic Expansion Module | 3,696 | 19.00 | 139 | 113 |
| A 1510-MEM | Memory Module; 12 megabytes | 144,000 | 45.00 | 7,270 | 5,470 |
| A 1511-MEM | Memory Cabinet with 12MB memory module | 250,000 | 200.00 | 12,800 | 9,700 |
| **DATA LINK PROCESSORS** | | | | | |
| AX110-90 | Card Reader DLP-2 | 3,739 | 38.00 | 121 | 105 |
| AX112-90 | Card Punch DLP-2 | 3,676 | 37.00 | 119 | 103 |
| AX246-92 | Line Printer DLP-2; 2000 lpm | 4,620 | 37.00 | 149 | 129 |
| AX247-94 | Train Printer DLP-2 | 4,620 | 37.00 | 149 | 129 |
| AX293-30 | Non-Impact Printer DLP-3 | 4,500 | 28.00 | 222 | 177 |
| AX393-90 | NRZ Magnetic Tape DLP-3 | 7,200 | 46.00 | 357 | 285 |
| AX395-91 | PE Magnetic Tape DLP-2 | 7,350 | 56.00 | 236 | 204 |
| AX395-92 | GCR/PE Magnetic Tape DLP-3 | 7,350 | 56.00 | 236 | 204 |
| AX304-90 | Disk Pack DLP-2; interlaced | 7,581 | 56.00 | 243 | 210 |
| AX304-91 | Disk Pack DLP-3; sequential/interlaced | 7,581 | 39.00 | 374 | 267 |
| **MASS STORAGE** | | | | | |
| B 9484-12 | Removable Disk Pack Drive; 252 megabytes | 30,000 | 126.00 | 1,440 | 1,080 |
| B 9494-5 | Fixed Disk Drive; 542 megabytes, single spindle interlaced | 26,500 | 110.00 | 1,624 | 1,219 |
| B 9494-10 | Fixed Disk Drive; 1084 megabytes, single spindle interlaced | 48,000 | 210.00 | 2,927 | 2,197 |
| B 9387-51 | Disk Pack Drive Controller | 15,000 | 66.80 | 694 | 524 |
| B 9387-52 | Dual Disk Pack Drive Controller | 20,000 | 100.00 | 922 | 692 |
| B 9387-24 | Disk Exchange | 20,000 | 62.40 | 904 | 679 |
| B 9494-12 | Fixed Disk Drive; 868 megabytes, single spindle, thin-film head | 32,220 | 120.00 | — | 1,401 |
| B 9389 | Dual Disk Drive Controller | 53,600 | 176.00 | 2,515 | 2,292 |
| B 9399 | Dual String Controller | 26,100 | 85.00 | 1,224 | 1,115 |
| **MAGNETIC TAPE UNITS** | | | | | |
| B 9495-82 | Magnetic Tape Drive; 75 ips, PE/NRZ | 18,100 | 152.00 | 734 | 576 |
| B 9495-83 | Magnetic Tape Drive; 125 ips, PE/NRZ | 22,447 | 173.00 | 926 | 724 |
| B 9499-14H | Magnetic Electronics Controller (MEC); PE/NRZ | 19,100 | 132.00 | 745 | 573 |
| B 9495 | Magnetic Tape Drive; 200 ips, 1250/320KB, PE/GCR | 36,225 | 27240 | 1,061 | 1,315 |
| B 9495-32 | Magnetic Tape Drive; 75 ips, 470/120KB, PE/GCR | 21,736 | 182.00 | 920 | 661 |
| B 9495-33 | Magnetic Tape Drive; 124 ips, 780/200KB, PE/GCR | 24,917 | 192.00 | 1,044 | 748 |
| B 9499-22 | Magnetic Tape Controller; 2x8, PE/GCR | 85,288 | 495.00 | 2,954 | 2,356 |
| B 9499-42 | PE/GCR Tape Exchange; 2x16, for B 9499-22 | 7,951 | 27.50 | 284 | 222 |
| **PUNCH CARD EQUIPMENT** | | | | | |
| B 9116 | Card Reader; 600 cpm, 80 column | 11,372 | 112.00 | 478 | 375 |
| B 9113 | Card Punch; 300 cpm | 31,085 | 539.00 | 1,249 | 1,014 |
| **PRINTERS** | | | | | |
| B 9246-21 | Train Printer; 2000 lpm, with HSS interface | 69,300 | 721.00 | 3,229 | 2,629 |
| B 9246-12 | Band Printer; 1200 lpm, with HSS interface | 42,500 | 407.00 | 1,615 | 1,340 |
| B 9290-30 | Intelligent Laser Printing System; 30 ppm | 65,000 | 698.00 | 4,013 | 3,201 |
| **TERMINALS** | | | | | |
| ET 1100-ODT | Operator Display Terminal; 14-inch, with keyboard, RS-232-C/TDI data communications | 1,580 | 20.33 | 105 | 79 |
| ET 2150-ODT | Maintenance Display Terminal; 14-inch, monochrome, with keyboard, bit-mapped graphics capabilities, 512K-bit RAM | 3,4950 | 27.00 | 222 | 179 |

**For 5-day, 8-hour service.*
***Includes 7-day, 24-hour maintenance coverage.*
*NC—No charge.*

# Burroughs A 15

| | | Purchase Price ($) | Monthly Maint.* ($) | 1-Year Lease** ($) | 5-Year Lease** ($) |
|---|---|---|---|---|---|
| **COMMUNICATIONS EQUIPMENT** | | | | | |
| AX372-5 | Network Support Processor (NSP4); 512K-bit memory | 40,000 | 215.00 | — | 1,386 |
| AX378-1 | Line Support Processor (LSP3) | 4,000 | 29.00 | — | 147 |
| AX369-7 | Line Support Processor (LSP2); 56K-bit | 9,800 | 42.00 | — | 337 |
| AX369-3 | Quad Line Adapter; character | 3,000 | 26.00 | — | 120 |
| AX369-4 | Quad Line Adapter; bit | 3,000 | 26.00 | — | 120 |
| AX378-3 | Quad Line Adapter (QLA-2); character | 3,000 | 26.00 | — | 120 |
| AX378-4 | Quad Line Adapter (QLA-2); bit | 3,000 | 26.00 | — | 120 |
| AX369-10 | RS-232 Electrical Interface | NC | — | — | — |
| AX369-11 | CCITT V.24 Electrical Interface | NC | — | — | — |
| AX369-12 | TDI/20 Electrical Interface | NC | — | — | — |
| AX369-41 | Autocall Feature; character/bit | NC | — | — | — |
| AX369-61 | CCITT V.35 Electrical Interface | NC | — | — | — |
| **Inter-System Control** | | | | | |
| AX321-2 | Inter-System Host Control DLP-3 | 11,866 | 72.00 | 441 | 364 |
| A 320-5 | HUB 16; includes 2 port capabilities | 8,610 | 58.00 | 338 | 277 |
| A 320-6 | HUB Expansion; provides additional 1 port capability | 735 | 6.00 | 37 | 30 |
| CB 736 | Inter-System Control Cable; 50 ft. (FCC) | NC | — | — | — |
| CB 737 | Inter-System Control Cable; 100 ft. (FCC) | NC | — | — | — |
| A 320-IHC | Independently Powered HUB Cabinet | 21,210 | 140.00 | 810 | 667 |
| **Peripheral Reconfiguration** | | | | | |
| A 890-PRC | Peripheral Reconfiguration Cabinet | 5,250 | 38.00 | 225 | 187 |
| A 890-3 | PRC Disk Pack Control Kit; (B9387-51/52) | 1,681 | 15.00 | 68 | 58 |
| A 890-34 | PRC Disk Pack Control Kit; (B9387-41/42) | 1,681 | 15.00 | 68 | 58 |
| A 890-4 | PRC PE/NRZ Magnetic Tape Control Kit | 3,676 | 23.00 | 153 | 120 |
| A 890-8 | PRC GCR Magnetic Tape Control Kit | 1,996 | 15.00 | 85 | 68 |

**For 5-day, 8-hour service.*
***Includes 7-day, 24-hour maintenance coverage.*
*NC—No charge.*

## SOFTWARE PRICES

| | | Limited Time-Plan | Annual Product Service Agreements | |
|---|---|---|---|---|
| | | Monthly License Fee ($) | PSA 2 ($) | PSA 1 ($) |
| **Product Description** | | | | |
| A 15-SSF | System Software for Model F includes Master Control Program (MCP), Algol Compiler, DC Algol Compiler, Program Binder, Microcode, NSP/LSP Firmware, SMF II Site Management, Utilities, Workflow Language, Cross Reference Symbolic, Menu Assisted Resource Control | 3,000 | 25,200 | 11,400 |
| A 15-SSH | System Software for Models H, I, and J includes Master Control Program (MCP), Algol Compiler, DC Algol Compiler, Program Binder, Microcode, NSP/LSP Firmware, SMF II Site Management, Utilities, Workflow Language, Cross Reference Symbolic, Menu Assisted Resource Control | 3,500 | 29,400 | 13,320 |
| A 15-SSK | System Software for Models K and L includes Master Control Program (MCP), Algol Compiler, DC Algol Compiler, Program Binder, Microcode, NSP/LSP Firmware, SMF II Site Management, Utilities, Workflow Language, Cross Reference Symbolic, Menu Assisted Resource Control | 4,000 | 33,600 | 15,180 |
| A 15-SSM | System Software for Models M and N includes Master Control Program (MCP), Algol Compiler, DC Algol Compiler, Program Binder, Microcode, NSP/LSP Firmware, SMF II Site Management, Utilities, Workflow Language, Cross Reference Symbolic, Menu Assisted Resource Control | 4,500 | 37,800 | 17,100 |
| **Compilers** | | | | |
| A 15-APL | APL/700 | 340 | 2,100 | 1,200 |
| A 15-ATD | Test and Debug (Algol) | 200 | 1,140 | 660 |
| A 15-BSC | Basic Compiler | 250 | 1,320 | 720 |
| A 15-COB | Cobol Compiler (ANSI 68) | 250 | 1,440 | 840 |
| A 15-C74 | Cobol Compiler (ANSI 74) | 250 | 960 | 540 |
| A 15-FOR | Fortran Compiler (Level H) | 250 | 1,440 | 840 |
| A 15-F77 | Fortran Compiler (ANSI 77) | 250 | 1,200 | 660 |
| A 15-PAS | Pascal Compiler | 375 | 2,280 | 1,320 |
| A 15-PL1 | PL/1 Compiler | 325 | 1,920 | 1,080 |
| A 15-RPG | RPG II Compiler | 250 | 1,320 | 720 |
| A 15-SRT | Sort Utility | 225 | 840 | 480 |
| A 15-LN2 | Logic and Information Network Compiler (LINC II) | 7,000 | 39,900 | 18,600 |

# Burroughs A 15

| | | Limited Time-Plan | Annual Product Service Agreements | |
|---|---|---|---|---|
| | | Monthly License Fee ($) | PSA 2 ($) | PSA 1 ($) |
| **Support Utilities** | | | | |
| A 15-BAR | Activity Reporting | 125 | 720 | 420 |
| A 15-SMR | SMF II System Resource Management | 400 | 2,280 | 1,320 |
| A 15-LOG | Logger | 75 | 420 | 240 |
| A 15-BSL | Billing Support Library | 75 | 420 | 240 |
| A 15-SSL | Security Support Library | 75 | 420 | 240 |
| A 15-IPF | Intelligent Printer Support Facility | 160 | 900 | 540 |
| A 15-MLS | Multilingual System | 250 | 1,440 | 840 |
| **Data Communications** | | | | |
| A 15-DCS | Data Communications Software Package includes Network Definition Language II (A 15-NDL), Interactive Data Communications Configurator (A 15-IDC) | 250 | 960 | 540 |
| A 15-BNS | BNA Network Service | 1,200 | 6,840 | 3,960 |
| A 15-CDE | CANDE; Command and Edit | 325 | 1,200 | 720 |
| A 15-COE | Communications Management System; Entry | 800 | 3,000 | 1,740 |
| A 15-COT | Communications Management System | 1,500 | 5,700 | 3,300 |
| A 15-DIA | Diagnostic MCS | 75 | 420 | 240 |
| A 15-EDI | The Editor | 200 | 1,140 | 660 |
| A 15-MCB | GEMCOS (Basic) | 750 | 4,560 | 2,640 |
| A 15-MCA | GEMCOS (Advanced) | 1,000 | 5,700 | 3,300 |
| A 15-MCT | GEMCOS (Total) | 1,300 | 7,440 | 4,320 |
| A 15-MCF | GEMCOS; Format Generator (requires MCA or MCT) | 250 | 1,440 | 840 |
| A 15-NDA | NDL II Analyzer | 75 | 420 | 240 |
| A 15 RJE | Remote Job Entry | 100 | 540 | 300 |
| A 15-SDF | Screen Design Facility | 250 | 1,440 | 840 |
| A 15-X25 | X.25 MCS | 400 | 2,280 | 1,320 |
| **Data Management** | | | | |
| A 15-DM2 | Data Management System II | 1,750 | 6,660 | 3,840 |
| A 15-ERG | Extended Retrieval with Graphic Output (requires DMT) | 500 | 2,760 | 1,500 |
| A 15-D12 | DMS II Inquiry | 300 | 1,740 | 1,020 |
| A 15-IDD | Advanced Data Dictionary System | 850 | 4,860 | 2,820 |
| A 15-DBA | DMS II Data Base Analyzer | 200 | 1,140 | 660 |
| A 15-DDM | DMS II Data Base Monitor | 200 | 1,140 | 660 |
| A 15-DMT | DMS II DM Interpreter | 175 | 960 | 540 |
| A 15-DMC | DMS II DB Certification | 200 | 1,140 | 660 |
| A 15-TPS | DMS II Transaction Processing System | 225 | 1,280 | 720 |
| **Reporting** | | | | |
| A 15-RP3 | Reporter III | 650 | 3,600 | 1,920 |
| A 15-OR3 | Online Reporter III (requires RP3) | 75 | 420 | 240 |
| **Workstation Integration** | | | | |
| A 15-DES | Data Entry System | 375 | 2,100 | 1,200 |
| A 15-DTS | Data Transfer System | 200 | 1,140 | 660 |
| A 15-HLS | Host-Link Server | 500 | 2,700 | 1,500 |
| A 15-FDE | Intelligent Distributed Editor (Fortran 77) | 250 | 1,440 | 840 |
| A 15-RGF | Remote Graphics Facility | — | 1,140 | 600 |
| A 15-AGF | Attached Graphics Facility | — | 2,100 | 1,200 ■ |