SPEC CHART — SMALL BUSINESS COMPUTERS (A–C)

SYSTEM IDENTITY	Burroughs L2000/3000			Burroughs L4000/5000		
CENTRAL PROCESSOR & WORKING STORAGE						
CPU Model No.	NA			NA		
Word Length (bits)	64			64		
I/O Channels	Integral			Integral		
Type of Storage	Magnetic disc			Magnetic disc		
Capacity (words)	1, 024			1, 280		
Cycle Time (μ sec)	5			5		
SOFTWARE						
Assembler	Yes			Yes		
Operating System	Yes			Yes		
Compilers	Cobol			Cobol		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	NA			NA		
MAGNETIC TAPE	Model	Type (trks) / Char/In.	Peak Xfer, cps	Model	Type (trks) / Char/In.	Peak Xfer, cps
	None			None		
CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	A595/596 A149	Reader Punch	100 19	A595/596 A149	Reader Punch	100 19
PRINTERS	Model	Type / Columns	Peak Speed	Model	Type / Columns	Peak Speed
	NA	Serial / 150	20 cps	NA	Serial / 255	20 cps
PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	A9122 A9222	Reader Punch	40 40	A9122 A9222	Reader Punch	40 40
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe		Model	Capacity, char/stripe	
	None			Yes L5000 Only		
OTHER PERIPHERALS; COMMENTS						

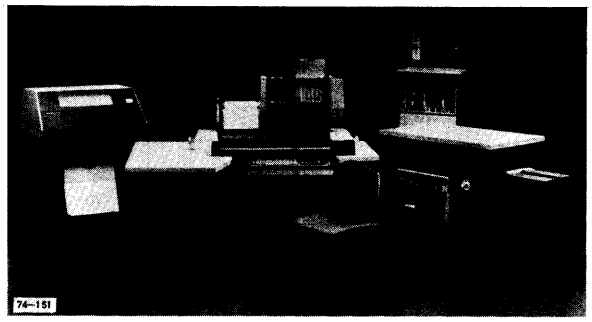
NA Not Available

SYSTEM IDENTITY	Burroughs L7000				Burroughs L8000			
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	NA 16 Integral Magnetic disc 2,560-8,704 5				8200; 8300; 8400; 8500 16 6 MOS/LSI semiconductor 4,000-48,000 1.5			
SOFTWARE Assembler Operating System Compilers	Yes Yes Cobol				No No Cobol			
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	NA	5,120		15,360	NA			
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				A9490-25	Cassette	100	1,000
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	A149 A9114	Punch Reader		19 200	NA A9114-1	96-col 80-col reader		NA 200 cpm
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	NA A9289	Serial Line	150/255 132	20 cps 60 lpm	A9249-1 NA	Line Line	132 132	90 180
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	A9122 A9222	Reader Punch		40 40	NA	5-, 6-, 7-, or 8-channel		NA
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	Yes				None			
OTHER PERIPHERALS; COMMENTS					Forms handler; communications; edged punched card; magnetic record reader (single or dual track)			

NA Not Available

BURROUGHS

L Series Business Minicomputers



OVERVIEW

The Burroughs L Series comprises a family of microprogrammed, "visible record" computers intended for small accounting applications. Individual members of the series differ in capabilities depending on the type of processor, memory, and peripherals in the system. Higher performance members can be used for data analysis and report generation. All models support a Cobol compiler, a powerful tool for programming business applications. The design emphasis is on interactive processing and simple control by novice users responding to the step-by-step guidance of indicator lights on the console.

The smaller members of the family are distinguishable from most other small business computers by the use of magnetic discs rather than core or semiconductor memory for both firmware control storage and working storage. The L2000, L3000, and L4000 Series models have no provisions for auxiliary magnetic storage; the L5000 allows auxiliary storage of sorts, in the form of magnetic stripe ledger cards, called Magnetic Memory Records (MMR) by Burroughs. The L7000 upgrades the line still further by using the higher speeds of MOS ROM for control firmware, while both working storage and auxiliary storage are master files on disc.

The most recent addition to the line, the L8000 Series, is not simply further extensions at the top end of the line, but the L8000 also provides alternative models at each L Series level with greater working storage capacity, higher processing speeds, and a new cassette-based, software-controlled "dynamic memory overlay" technique. None of the 8000 Series use discs. Instead, MOS LSI RAM stores the control firmware and operates as user working memory, while optional cassette tape drives provide auxiliary storage and support for the dynamic memory overlay feature at every level. Thus, for a modest increase in cost an L2000 or L3000 system can be upgraded to an 8200 or 8300 without cassette. The addition of the cassette drive and supporting software expands on-line and working storage at considerably less cost than upgrading from an L2000 to an L7000, for example.

Most L-Series models can be easily converted to a corresponding TC terminal computer model; the data communications memory and logic are housed in a separate unit. The TC 500, 1500, 2500, and 3500 Series roughly correspond to the L2000, L3000, L4000, and L8000 Series, respectively. Like the L8000, the TC 3500 straddles the entire series; certain TC 3500 models are direct upgrades for TC 500/1500/2500 models. The basic differences among L8000 Series models and the correspondence of L8000 models L-Series and TC-Series models are presented in Table 1.

PERFORMANCE AND COMPETITIVE ANALYSIS

The addition of the L8000 Series has enabled Burroughs to keep its popular L Series competitive in a market generally experiencing price drops as a result of the lower costs of large-scale MOS circuitry. Because the L Series design was originally innovative for its time, using microprogramming to implement Cobol on a small system, Burroughs has been able to upgrade the series with faster, *less* expensive, higher-performance models and still use the software developed for earlier systems.

NCR recently introduced the NCR299 Accounting Computer that can handle visible records (ledger cards). The NCR299 allows exceptionally easy and inexpensive program development through a mark-sense form that enters long macro instruction words that even novices can use. The NCR299 will be a formidable competitor for the L8000 Series, particularly for novices in accounting machine use, but it suffers from a lack of peripheral offerings at this point in time and limited-size programs. NCR's installed base in the world-wide accounting machine market numbers more than 375,000 machines; thus, it is one of Burroughs' major competitors.

IBM does not compete in the steadily growing accounting computer market; its accounting machines are still of the old electromechanical variety. Litton Industries, Singer-Friden, and the European-based Philips and Nixdorf companies have made substantial inroads into the U.S. market for small accounting computers. All provide for production of ledger cards; the Litton ABS and Singer Series use edge-punched cards while Philips and Victor also provide for the magnetic stripe ledger cards more popular in Europe.

Philips and Nixdorf, as well as Olivetti, Kienzle, and a number of other European-based manufacturers provide the major competition for Burroughs in Europe. Although NCR is also a formidable competitor, its NCR299 will have to be further developed before competing directly with the European accounting computers currently available with the range and price/performance of the Burroughs L Series.

User Reactions

We interviewed several small users for this report and discovered that all had recently upgraded from an old L-Series system to an L8000 model. A small manufacturer of replacement parts for appliances exchanged an L5000

Table 1. Burroughs L8000 Models Compared With Other L Series and TC Models

L8000 Models	Forms Feed	Platen Type	Platen Width (in.)	Cassette Drive*	Corresponding Models L Series	TC 3500	Other TC
L8200-100	Rear	Split	15.5	No	L2000	TC 3520	500
L8200-200	Rear	Split	15.5	Yes	L2000	TC 3520	500
L8300-100	Front	Split	15.5	No	L3000	TC 3530	1500
L8300-200	Front	Split	15.5	Yes	L3000	TC 3530	1500
L8400-100	Front	Split	26.0	No	L4000	TC 3540	2500
L8400-200	Front	Split	26.0	Yes	L4000	TC 3540	2500
L8541-100	MMR**	Split	26.0	No	L5000	TC 3570	—
L8541-200	MMR**	Split	26.0	Yes	L5000	TC 3570	—
L8541-104	MMR**	Solid	26.0	No	L5000	TC 3570	—
L8541-204	MMR**	Solid	26.0	Yes	L5000	TC 3570	—
L8542-100	MMR** (dual track)	Split	26.0	No	L7000	TC 3580	—
L8542-200	MMR* (dual track)	Split	26.0	Yes	L7000	TC 3580	—

Notes:
* Refers to L8000 and TC 3500 Series only.
** Magnetic Memory Reader; i.e., magnetic stripe ledger card reader. Unless otherwise stated, refers to single track holding 352 bytes.

for an L8500; a line printer was added to support billing and inventory control applications. An accounting firm, which markets its own client billing package for CPAs, exchanged an L2000 for an L8300. A software/services house that developed a mortgage-loan documentation package for banks, savings institutions, and mortgage companies switched from an L3000 to an L8300. All three users cited better performance at virtually no change in price (the CPA firm was actually paying a lower price when cassette tapes were substituted for paper tape I/O) and cassette tape storage as reasons for their switch.

All the firms interviewed chose the original Burroughs equipment after studying NCR and IBM; in one case, Litton and Philips systems were also considered. All checked the marketplace before converting and were satisfied with the reliability and maintenance support for the original system; all had some software investment. Thus, none really wanted to switch unless a significant price saving could be made. One user remarked that his market check showed the L8000 to be very price/performance competitive, and he thought it would be hard for other manufacturers to beat.

The upgrade from an old L Series model to the L8000 version can result in enormous performance benefits, at little change in cost. The software house with the mortgage loan documentation package wrote one subroutine that ran in 3 minutes 4 seconds on the L3000; it ran in 3 seconds on the L8300. The manufacturer of appliance parts upgraded because two shifts on the L5000 were needed to enter 1,000 to 1,200 line items daily. With the 8500, rarely was overtime required on the first shift to complete the day's entries; this performance was even better than the Burroughs specification of 800 to 900 line items daily.

For the manufacturer and the software house the type of visible record produced was an important part of the reason for using the L Series. The manufacturer likes the visible record with the magnetic stripe ledger card because it does not require a separate report run. The software house requires the front feed because its system prints legal documents than cannot be pin-fed forms. The CPA who markets software as a side business also mentioned that the L8000 is easier to convert to its corresponding TC 3500 communications version than earlier models had been to their corresponding communications version.

CONFIGURATION GUIDE

All L-Series accounting computers include keyboard, "golfball" printer, and processor in a single, large, desk-like unit. When magnetic stripe ledger handling equipment is included in the system, it is superimposed over the carriage. When up to four cassette drives are included, they are also integrated into the basic work station. The line printer, card reader and punch, paper tape and edge-punch card readers and punches, and the polling magnetic tape unit are all freestanding devices.

Table 2 outlines the configuration differences among the models or lines. Table 1, as mentioned previously, shows the characteristics of each L8000 Series processor

Table 2. Configuration Differences in the L Series

MODEL	L2000/L3000 L4000	L5000	L7000	L8000
MEMORY				
Cycle Time (μ sec)	0.5	0.5	0.5	0.3
Firmware Location	Disc	Disc	MOS ROM	MOS ROM
RAM (user memory)				
Type	Disc	Disc	Disc	MOS
Size (bytes)	512-6,144	512-6,144	512-6,144	4K to 44K
Data Structure				
Bits/Word	64	64	64;16	64
Bytes/Word	8	8	8;2	8
Auxiliary Memory	—	—	Disc	Cassette
PERIPHERALS, I/O				
Punch Cards				
80-Col Reader	A595; A596	A595; A596	9114	A9114-1
80-Col Punch	A149	A149	A149	A9119-1
96-Col Reader	—	—	—	A9119-2
96-Col Multifunction	—	—	—	A9119-6
P. Tape/EP Card				
Reader	A581	A581	A9122	A9122-1
Punch	A562	A562	A9222	A9222-1
Computer Tape	A1495	A1495	A1495	A1495
Transport Magnetic				
Stripe				
1-trk	—	A4005	A9161	A9161-1
2-trk	—	—	A9162	A9162-1
Console Forms Handler	—	—	—	A9361/A9362
Auxiliary Printers	—	—	A9249	A9249-1, -2
Magnetic Tape				
Cassette Transport	—	—	—	A9490-25

model and its related processor of the L2000, L3000, L4000, L5000, or L7000 Series and its corresponding TC 3500 model.

The L2000, L3000, and L4000 are essentially similar as far as I/O capabilities are concerned; the L2000 has a rear feed, the L3000 has a front feed, and the L4000 has a front feed with a larger platen (26.0 inches). The L5000, however, can handle Magnetic Memory Records (MMR), Burroughs' name for magnetic stripe ledger cards. The L7000 expands this capability further; it can handle dual tracks on each ledger card.

As far as technology is concerned, the L Series group themselves into three divisions, as shown in Table 2. The L2000, L3000, L4000, and L5000 use discs for both working storage and control memory microprogram storage. The L7000 stores control memory in a 32- to 256-word LSI/MOS ROM module which is not accessible to the user; disc provides working storage, and can also be used for auxiliary storage. The L8000 does not use disc storage; LSI/MOS modules provide both working storage and control storage. Cassette tapes are used for auxiliary storage.

The L8000 Series provides far greater memory capacity than that provided by the other L Series systems. Basic user memory (memory available for storage of user programs and data) is 4K bytes. Memory can be added in 2K-byte increments up to a maximum capacity of 20K bytes for firmware storage and 44K bytes for user memory. This is equivalent to more than 10 times the capacity of the 416-word maximum for the previous models; each word is eight bytes long.

Common Characteristics

All L-Series accounting computers use the same basic keyboards, platens, and printers. All use a similar processor architecture (to maintain compatibility), although the basic architecture is implemented with a variety of technologies as explained earlier. The L8000 uses more extensive buffering in keeping with its higher performance.

The accumulator, a fixed-storage, 16-digit field within normal memory, serves as a working register with 15-digit positions allocated to data storage. The sixteenth digit is reserved for special indicators. Shift, compare, and arithmetic operations manipulate data in the accumulator.

The keyboard incorporates two separate groups of keys: one set of 53 keys is arranged similar to a regular typewriter format and the other 21 keys incorporate a numeric 10-key set arranged like a calculator. Both groups contain control keys. Items entered via either key group are temporarily stored in a buffer. A typewriter instruction transfers nonnumeric characters from the keyboard buffer for printing, storage in memory, or both. Numeric characters from either group of keys are transferred from the buffer to the accumulator, where they can be manipulated under program control.

Program-select keys are positioned across the top of the keyboard, up to 16 on the L2000 and L3000 and 24 on all other models. They are used to select and execute instructions that have previously been stored in memory, such as the user's subroutines.

A 64-character removable type ball holds the character set for the printer. Peak printing speed is 20 characters per second; either red or black characters can be printed. Maximum line length is either 150 or 255 characters (15.5 or 26-inch platen) depending on the computer model. The friction-feed platen can be split to accommodate two independent forms. An optional continuous forms feed is available in three styles for flexible forms-feed arrangement.

The Magnetic Memory Record available for the L5000, L7000, and L8500 systems enables the system to read single- or dual-track (depending on model) magnetic stripe ledger cards 6, 8, 10, 12, or 14.5 inches in width. The L8500 systems include an A9362 Magnetic Record Handler that automatically feeds and stacks the magnetic records from a 150-record hopper. Alignment is automatic and based on data stored on the track or the controlling program. Single tracks hold 352 digits, dual tracks 704. The MMR forms handler can also handle normal (nonmagnetic) forms and continuous forms.

L2000/L3000/L4000/L5000 Peripherals

The following optional input and output peripherals are available for the older models: edge-punched-card perforator (A562) punches 40 characters per second; paper-tape, edge-punched-card reader (A581) reads 40 characters per second; an 80-column-card reader (A595) reads 100 BCL- or EBCDIC-punched cards per minute; a card keypunch (A149) punches 25 columns per second under control of one of the terminal computers or in response to the operation of its own character keys; and a computer-compatible magnetic tape unit (A1495). All speeds are rated speeds; effective speeds often depend upon such items as the controlling program.

The tape and edge-card punches and readers can handle paper, mylar, or aluminized 11/16- or 1-inch wide tape and individual, fanfold, paper, or mylar-reinforced 3- to 5-inch wide cards. Five-, 6-, 7-, or 8-level codes can be used. The A595 card reader and A149 keypunch use a stored table to translate between their own operating codes and the ASCII code used by the computers. The A596 card reader performs code conversion in the reader itself.

The basic magnetic tape unit incorporates two ports; up to three, two-port expansions are permitted, so as many as eight TC units can share a single tape drive.

L7000/L8000 Peripherals

The L7000 and L8000 can attach the same types of peripherals as previous models. Some have been upgraded, reflecting the more powerful performance of these systems, particularly the L8000 Series. The A9122-1 Paper Tape/Edge Punched Card Reader reads 40 characters per second and the A9222-1 Paper Tape/Edge Punched Card Perforator punches 40 characters per second, like their predecessors. The A9114-1 80-column card reader, however, reads 200 cards per minute; it automatically translates EBCDIC- or BCD-coded cards into machine language for the TC 3500; and its hopper holds 350 cards. The A9419-2 Card Reader Punch offers 96-column card I/O capabilities; it reads 300 cards per minute and punches 60 cards per minute; it has two feed hoppers and can be furnished with six stacking hoppers to permit off-line sorting and merging, then designated the A9419-6. The A9419-2 is also available in a read-only version, the A9419-1.

Two chain line printers are available, one rated at 90 lines per minute and the other at 180 lines per minute. Maximum line length is 132 characters.

Both a magnetic tape drive and a magnetic tape cassette are available. The tape drive records data at 800 bits per inch. The cassette unit records at 100 8-bit characters per inch. Read/write speed of the cassette is 10 inches per second; usable tape capacity is about 280 feet. The magnetic tape unit is the same one used on earlier series, allowing eight systems to be connected to a common polling tape subsystem.

COMPATIBILITY

The Burroughs L Series is upward compatible from the L2000 through the newer L8000 Series and between corresponding models of older and newer series, given the same peripheral complement. These relationships are best understood by examining Table 1. For compatibility purposes, the L2000 and L3000 can be grouped as a single system because the rear versus front feed does not affect the programming. Thus, a program written for the L4000, for instance, can run on an L5000, L7000, and an L8400 and up, but it can not run on an L2000, L3000, L8200, or L8300 because of the longer print line. An L8400 program, on the other hand, can not run on the L4000 because of the L4000's small memory size. Programs written for a system with tape cassettes and dynamic memory overlay feature implemented will not run on an L4000.

Members of the TC 3500 Series are upward compatible with the L Series in relationships paralleling L8000 Series compatibility relationships as listed in Table 1.

SOFTWARE

The L Series is unusual in terms of programming flexibility, because it still remains the only accounting computer of its size that permits Cobol programming for small operator-attended systems. Such Cobol programs must be compiled on a Burroughs B 3500 computer. If the L Series system has data communications ability (i.e., if it is a TC 3500), the program can be transmitted to a remote B 3500 for compilation.

This series can also be programmed in Assembler language. The programs are assembled either on the L Series machines or on a B 3500 if desired. The company provides, at no extra cost, preprogrammed routines to assist in program debugging, as well as several utility routines.

Burroughs offers the following wide range of standard application packages — accounts payable, general ledger and financial statements, payroll accounting with reports, public utility billing, hospital accounting, job costing, billing and account updating, cash receipts and posting, general ledger and month-end reports, payroll accounting, accounts receivable, age analysis, general billing, and many others. Currently, over 150 packages are on the Burroughs applications software list. System software is also supplied to all users.

In addition, Burroughs will either modify these standard packages to meet the user's specialized needs or write appropriate customized programs.

One of the users interviewed felt that Burroughs is not as oriented toward customized programming as is, for instance, Nixdorf. Consequently, when he bought the L Series system for the hardware/software package, he would resell for a particular specialized application (the home mortgage documentation system mentioned earlier). This user was not concerned about competition from his own supplier. The extensive list of applications software, which does include programs related to home mortgage documentation, seems to belie his remarks.

Dynamic Memory Overlay

The L8000 and its sister line, the TC 3500, make use of a software-controlled feature called "dynamic memory overlay." When operating in dynamic memory overlay mode, programs are automatically loaded from cassette tape stations and are executed in segments. Programs larger than available main memory can be executed without operator intervention. The concept is similar to virtual memory, but it uses cassettes (slower but cheaper) as the auxiliary or virtual memory storage medium.

MAINTENANCE

L Series maintenance is performed by Burroughs service personnel available for on-call emergency service during normal business hours. Preventive maintenance is performed at mutually agreeable hours. Microcoded diagnostic routines use test cards and a dictionary to isolate memory failures.

First-year maintenance is covered by a warranty. A separate contract covers subsequent service. Maintenance personnel are located in more than 200 branches across the United States and in most computer-using countries in the world.

HEADQUARTERS

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