Burroughs L Series

MANAGEMENT SUMMARY

The Burroughs L Series has seen extensive growth since their first release in 1968. These accounting mini-computers have competed effectively against similar equipment from NCR, Litton, Phillips, and Nixdorf. The L Series offered higher performance than the older electromechanical bookkeeping machines, but offered no compatibility, since the L Series uses COBOL programming while the bookkeeping machines used a series of pins and stops on a moving carriage.

The original L Series consisted of the L 2000, L 3000, L 4000, and L 5000 minicomputers, which are no longer actively marketed. The L 7000 was a short-lived version of the first L series systems that featured multiple disk memory modules. Although the L 7000 never gained a large user base, there are still a few in active service.

In 1974, Burroughs announced the L 6000 line, and this was soon followed with the announcement of the L 8000 line of minicomputers. The L 6000 models were essentially the same as the earlier L series systems but featured improvements in the areas of program loading, keyboard touch, and I/O buffering. The L 8000 series used MOS memory, which yielded a 30-to-1 increase in program execution, and also offered new peripheral devices such as tape cassettes, line printers, expanded memory, and reel-to-reel magnetic tape units. Both the L 6000 and L 8000 lines offered complete upward compatibility, enabling users to gain increased output with little or no conversion.

The L 8200, 8300, 8400, and 8500 models all retained the 20-cps ball printer that was found on the L 6000's and the original L Series models. Burroughs later released 30-cps versions of the L 8000 Series. Some of these models are ▷

The current line of Burroughs ledger card and keyboard-oriented accounting minicomputers consists of the L 9935, L 9938, and L 9948. Basic system prices range from $22,190 to $28,315.

MAIN MEMORY: 6K to 49K bytes
DISK CAPACITY: Not available
WORKSTATIONS: Single station system
PRINTERS: 60 cps, 75 cps, 150 cps
OTHER I/O: Magnetic tape, punched card, punched tape

CHARACTERISTICS

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

MODELS: L 9935, L 9938, L 9948.

DATA FORMATS

BASIC UNIT: 64-bit word. Each word in memory can hold 15 decimal digits plus sign, 8 alphanumeric characters, or up to 4 instructions. (Note: Memory capacities are usually expressed in 8-bit bytes, with 8 bytes equalling one 64-bit word).

FIXED-POINT OPERANDS: Consist of 15 decimal digits plus sign or 8 alphanumeric characters.

FLOATING-POINT OPERANDS: No provision for floating-point arithmetic.

INSTRUCTIONS: SL3 basic instruction format is 4 digits in length. However, systems with more than 6K bytes (768 words) of user memory use SL5 machine instructions with an expanded 6-digit format for instructions that reference memory. Arithmetic instructions are of the one-address "add-to-accumulator" type. All instructions are decimal in ▶
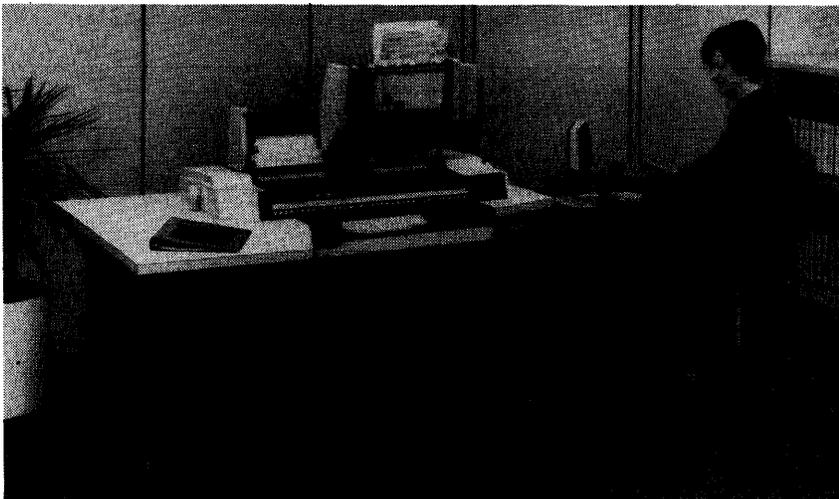
The Burroughs L 9900 Magnetic Record Computer is shown with some of the peripheral devices that are currently available. From left to right are four Magnetic Tape Cassette Stations, the 26-inch console with an A9362 Feeder/Stacker for magnetic striped ledger cards, and the TD 700 keyboard and display unit. The Basic L 9935 with 6K bytes of user memory, a 60-cps matrix printer, and one cassette station sells for $22,190.

REFERENCE EDITION: This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

▷ still available, although they are now classified as "Previous Styles." In June 1975, the first of the L 9000 models were unveiled. With the L 9000, Burroughs introduced a matrix printer rated at 60 characters per second. Throughout all of these upgrades in the L Series product line, Burroughs maintained compatible programming to allow users of the earlier versions great flexibility in choosing subsequent models.

The predominant programming language for the entire L Series line is COBOL, although an assembler language is also available. The use of COBOL gives the user a wide choice of sources for his programming needs. Some software houses offer "turnkey" packages, designed specifically around one or more of the L Series computers.

The current L 9900 Series utilizes a matrix printer that offers printing speeds of 60, 75, or 150 characters per second for a 50 or 100 percent increase in raw printing speed over the earlier L 9000 models. All the Burroughs matrix printers feature a positioning speed of 330 characters per second, and position to the most significant digit at high speed.

As a standard feature, all L 9900 systems utilize the full 94-character ASCII print set, which includes both upper and lower case alpha characters. All present program products will operate in the upper case, and require no modification. However, to take advantage of the bidirectional feature of the matrix printer, the output must be formatted as if it were being printed on a line printer.

Programs can be prepared in-house by users who have the personnel and facilities available to write COBOL or Assembler programs and compile object programs on punched tape or cards. Programs can be written in Burroughs L/TC COBOL or Assembler language and either compiled or assembled on the Burroughs medium-scale data processing systems, or assembled only on the L or TC Series systems themselves. Programs are prepared on punched paper tape and are easily loaded either at the console or through peripheral input units.

Software support is available from Burroughs Corporation. Application program packages, including documentation and program tapes, can be purchased from the company. The program packages cover a wide range of applications, including wholesalers, contractors, credit unions, hospitals, clinics, school boards, local governments, banks, etc.

Earlier L and TC Series computers used a machine language called System Language 3 (SL3). The L 9000 family maintains upward compatibility with these L and TC programs by incorporating SL3 as one of two machine languages available for all L 9000 systems. The other System Language (SL5) is basically an extension of SL3 that allows increased memory and addressing and additional peripheral device handling capability. ▷

▶ nature. SL5 memory reference instructions have a 16-bit (2-byte) address specification field and an 8-bit (1-byte) operation code.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: Dynamic MOS (metal oxide semiconductor).

CYCLE TIME: 1.5 microseconds. (Memory access times will average 1.2 microseconds, but the rate of access is 3.0 microseconds, the same as the central processor's machine cycle time.)

CAPACITY: 6,144 to 49,152 bytes of user memory, in 2,048-byte increments; plus 8,192 to 16,384 bytes of microprogram memory (MPM). The basic processor and console require 8,192 bytes of MPM, and additional MPM is automatically furnished with each additional peripheral device. Minimum user memory capacity is 6K bytes for Magnetic Record Computers and 4K bytes for all other models. The A 2011 or A 2012 Extended Memory Potential feature is required for total user memory capacities in excess of 16K or 40K bytes, respectively.

CHECKING: Parity check on each 8-bit byte.

STORAGE PROTECTION: The control area of memory is protected, since this area is not accessible to users and cannot be written into.

CENTRAL PROCESSOR

GENERAL: One particularly interesting feature that is standard on all L 9000 systems is an automatic power failure/automatic restart capability. At the time of a power failure, an interrupt is generated that causes activation of a cassette recording device in the processor that operates under battery power. Battery power is then used to copy the contents of memory and the status of all registers to the cassette. Upon resumption of normal power, the memory and register contents are automatically restored from the cassette.

The following entries refer to the "S-level" machine, which provides program compatibility with the earlier Burroughs L and TC series computers. The S-level machine is, in fact, a "soft" processor whose functions are implemented through standard microprograms.

CONTROL STORAGE: 8K bytes of memory used for the basic Interpreter function of translating or "interpreting" the S-level object program code at execution time, causing the execution of the M-level microinstructions; not user-accessible.

REGISTERS: No user-accessible registers, except for index registers, are provided. Accumulators are set up by programs in user memory.

INDIRECT ADDRESSING: Yes, in SL5 instructions via an indirect branch instruction.

INDEXING: Four index registers are provided. Indexing is specified by a "Modify" instruction which immediately precedes the instruction to be modified.

INSTRUCTION REPERTOIRE: Approximately 650 instructions are defined at the hardware or microprogram ("M") levels in approximately 70 functional categories. These hardware instructions are activated by 190 SL3 or 257 SL5 commands at the user or source ("S") level. These commands can be categorized as 94 or 128 I/O instructions, 21 ▶

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	SPEED
MAGNETIC TAPE		
A9490-25	Cassette station (includes controller); 12.5 ips, 800 bpi; 860 (256-character) records	1KCS
A1495	Industry-compatible; 12.5 ips, 9-track, 800 bpi	10 KBS
PUNCHED PAPER TAPE		
A9122-1	Reader, 5-8 channel	40 cps
A9222-1	Punch, 5-8 channel	40 cps
PUNCHED CARD		
A9114-1	Reader, 80-column	200 cpm
A9418-2	Reader/Punch/Data Recorder, 80-column	200/45/45 cpm
A9119-1	Reader, 96-column	300 cpm
A9419-2, -6	Reader/Punch/Data Recorder, 96-column	300/60/60 cpm
LINE PRINTERS		
A9249-2	132 positions, 48/64 characters	160 lpm
DATA ENTRY MODULE		
TD 701-1	256-character screen	—

▷ The L 9000 Series computers are controlled by "variable micrologic"—an advanced form of microprogramming. Each L 9000 system has from 8K to 16K bytes of microprogram memory, and from 4K to 48K bytes of MOS *user memory* in 2K-byte increments. (Minimum user memory capacity of the Magnetic Record Computers is 6K bytes).

Designed primarily for applications employing visible records and keyboard entry of transaction data, the L 9000 Series computers feature "human engineered" controls and flexible forms-handling facilities that can accommodate a wide variety of continuous and cut forms, either singly or in various combinations. In addition, the L 9000 Series magnetic record computers can read and write up to 704 digits of data on magnetic-stripe documents, which can be fed, held, and stacked automatically by a unique console device. This feature can "park" a ledger card temporarily following processing for recall, if needed, prior to stacking.

L 9000 Series computers can be equipped with a single or dual data communications interface to become TC 3500 or TC 3800 Series Terminal Computers. Data can be transmitted in either asynchronous or synchronous mode, at speeds ranging from 75 to 9600 bits per second. A TC 3500 can communicate with other Burroughs computers or terminals, as well as with BSC-mode devices from other vendors, enabling it to serve effectively in a wide range of communications functions.

Since the introduction of the first L Series models in 1968 as non-communications versions of the keyboard-oriented TC 500 Terminal Computers, Burroughs has delivered and installed more than 150,000 of its small business systems in a broad range of industries and applications.□

▶ or 21 arithmetic, 6 or 6 index, 54 or 84 move and load, and 15 or 18 branch and test instructions for the SL3 or SL5 machine language, respectively. Because the L 9000 processors are microprogrammed, the entire "S" level instruction sets can be altered as desired by Burroughs.

INSTRUCTION TIMINGS: All times are in *milliseconds* for signed 15-digit (1-word) operands at the user level. The times assume that the machine language instructions being executed are SL5 instructions. However, the shorter SL3 instruction format produces timings about 10 percent faster than the SL5 timings listed below.

Move:	0.745
Add/Subtract:	1.55/1.63
Multiply*/Divide:**	18.25/2.70
Compare & Branch:	1.77

* 1-digit multiplier and signed 16-digit multiplicand.
**5-digit divisor into signed 16-digit dividend.

INTERRUPTS: Four levels, three of which are initiated by peripheral device conditions and can result in programmed action, operator notification (signal light, etc.), or termination of operation. The fourth level permits device status interrogation by the processor.

PHYSICAL SPECIFICATIONS

Processors are 29.875 inches high (at the work surface), 53.25 or 62.5 inches wide (depending on whether the console printer is a 15.5-inch or 26-inch unit), and 41 inches deep. The maximum weight ranges up to about 550 to 600 pounds.

Operational ambient conditions for the processors are 50° to 105°F. with a relative humidity between 5 and 95 percent. Storage conditions (non-operating) are 50° to 160°F. with a relative humidity between 5 and 100 percent. Special air conditioning and raised flooring are not normally required. The power line should be "clean."

Power requirements are a nominal voltage of 120 VAC at 8 amperes with a voltage range between 108 and 126 volts at 60 Hertz; heat is dissipated at the rate of 2,389 BTU/hour (maximum). ▶

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> ## INPUT/OUTPUT CONTROL

I/O CHANNELS: Each type of peripheral device or subsystem except the console can use any available I/O control, and each I/O control, in turn, requires an appropriate "slot" or port in the central processor.

SIMULTANEOUS OPERATIONS: The L 9000 systems include a 32-character hardware keyboard buffer and a 32-character hardware output buffer, both of which permit simultaneous input/output and processing operations. The keyboard buffer accepts alphanumeric program select and operation control data while processing and printing previously entered data. Thus, indexing, processing, and printing operations can be performed simultaneously.

All models can be equipped with locally connected TD 700 Data Entry Terminals (keyboards with Self-Scan displays) for data entry onto a dedicated magnetic tape cassette station concurrently with execution of a program.

CONFIGURATION RULES: The number of peripheral devices and/or memory modules that can be used in an L 9000 Series system is limited by the capacity of the processor backplane, which can house a maximum of 100 circuit cards. The basic processor logic and first 16K bytes of user memory require 50 card slots, leaving the other 50 slots for additional memory and/or peripheral control logic.

MASS STORAGE

No magnetic disk unit nor any other type of random-access mass storage device has been announced for the L Series computers to date.

PROCESSOR CONSOLE

The console is 53 or 59 inches wide (for 15.5-inch or 26-inch forms handlers, respectively), 41 inches deep, and 30 inches high. It houses the system's processing logic, memory, keyboard, basic printer and forms handler, control keys and indicators, and basic program loader (a small paper tape reader). In some models, the console also contains Magnetic Memory Record facilities and/or cassette tape drives.

All currently available L Series minicomputers have electronic keyboards for rapid, convenient data entry. Features of the keyboard include: a set of program selection keys (16 keys for the 15.5-inch forms handlers, 24 keys for the 26-inch forms handlers), a set of operator communication lights, an alphanumeric keyboard, a 10-key numeric keyboard, and four operational control keys on each of the two keyboards.

The program control keys are used for starting programs, loading programs, starting utility routines, and selecting alternate application-program routines. Each key has a light above it to indicate the availability of its use at any particular time, and a strip of abbreviated operating instructions is located above the lights. The combination of prompting messages and program control keys should reduce the need for an inexperienced operator to refer to a book of operating instructions.

This same console is the operator's input device on the Burroughs B 700 Series systems, and a very similar keyboard has been incorporated into the B 80 Series of computers, making the upward transition for operators as simple as possible.

The basic program loader on all models is a photoelectric paper tape reader that reads 8-channel paper tape from self-threading cartridges at a speed of 100 characters per second. Designed solely for program loading, the unit cannot be used for input of transaction data.

Programs can also be loaded from various peripheral devices. The L 9000 models are offered with one cassette station, which may be omitted. Program loading via the cassette station is very simple; the operator merely types in the program I.D., and the cassette will be searched until the program is found. Since the capacity of the cassette is approximately 220K bytes, 25 programs averaging 8K bytes each could easily fit on one cassette. This same cassette station could also be used to store data for retrieval via program control.

Optional dynamic overlay of memory permits the loading of program segments via the tape cassette station, so that programs that are larger than the memory size can be executed if they are written in segments.

INPUT/OUTPUT UNITS

INTEGRATED PRINTER: The L 9000 Series systems use matrix printers. The L 9935 model is rated at 60 cps, the L 9938 at 75 cps, and the L 9948 at 150 cps.

All of the matrix printers have a positioning speed of 330 positions per second. The L 9000 Series systems are offered with a bidirectional printing feature that can take advantage of output that is formatted the same as line printer formats. The matrix printers are also "intelligent," in the sense that the head can calculate the optimum print direction for each line and move to the most significant character position at high speed. Up to 6 carbon copies are possible with the matrix printers. All models feature the full 94-character ASCII print set, which includes both upper and lower case characters.

While the matrix printers do not employ red/black printing, as the ball printers do, this is seldom a problem, since the programs are usually written to print minus signs after negative amounts for carbon copies. The matrix printers simply ignore ribbon shifting commands.

Forms can be inserted from the front on all models. A split platen is standard.

COMMUNICATIONS CONTROL

When equipped with a data communications interface, an L 9000 Series computer becomes a TC 3500 or TC 3800 Terminal Computer. Transmission can be in either asynchronous or synchronous mode, at speeds ranging from 75 to 9600 bits per second. In addition to the Burroughs standard line control procedures used for communication with other Burroughs computers and terminals, the TC models can be equiped to use the binary synchronous communications (BSC) procedures as well as numerous other disciplines and communicate with various IBM and IBM-compatible devices. Transmit and receive buffers can vary in length to a maximum of 4096 characters, as defined by the COBOL program, or greater if written in assembly language.

The TC Series units can be equipped to handle dual data communications operations, with each operation occurring independently of the other. In addition, the two operations can use different transmission speeds, different modes, and different line control procedures. Thus, a TC 3500 or TC 3800 can control a "mini-network" of smaller terminals while simultaneously communicating with a larger central computer, or it can act as a data concentrator for other Burroughs terminal systems.

SOFTWARE

OPERATING SYSTEMS: None.

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▶ PROGRAMMING: The principal programming language for the L 9000 Series computers is COBOL, a revised, upward-compatible version of Burroughs' earlier L/TC COBOL. Compilation of programs written in COBOL must be performed on a Burroughs B 3500, B 3700, or B 4700 computer with at least 90K bytes of main storage. The compiler produces object programs in an S-level language that can be loaded into the L 9000 Series for execution by the Interpreter, i.e., by the standard microprograms.

For users who wish to program their L 9000 Series computers in symbolic machine-oriented language, the SL3 Assembler language is fully upward-compatible with that of the earlier Burroughs L and TC Series computers. SL3 programs can be assembled on the earlier L and TC Series systems as well as Burroughs' medium-scale computer systems.

The SL5 Assembler includes additional instructions for the L 9000 Series peripheral devices, and expanded addressing facilities for user memories larger than 6K bytes. SL5 assembly—unlike COBOL compilation—can be performed on the L 9000 Series computer itself.

APPLICATIONS: Burroughs offers a wide assortment of ready-made programs for specific applications from its "Hall of Programs" and its library of Business Management Systems.

The Business Management Systems include programs designed to provide operational control of specific types of businesses through the production of comprehensive management reports. Business Management Systems are cur-

rently offered for the wholesale, retail, manufacturing, governmental, hospital, and banking industries. Each system maintains a general ledger using a standard chart of accounts, and produces profit-and-loss statements, balance sheets, and various other reports. Each system is available either with or without formal training at a Burroughs training site.

PRICING

POLICY: Burroughs is now offering the L Series computer systems for purchase or on a 1-year or 3-to-5-year lease. The standard maintenance agreement includes equipment servicing and permits use of the equipment during one eight-hour period per day. For usage in excess of eight hours per day, Burroughs may negotiate for extra-shift charges; however, this is not normally done unless the user wants extended maintenance coverage during these extra use periods.

SUPPORT: One-time charges for individual application programs range from approximately $200 to $2,500. Prices of the Business Management Systems range from about $1,500 to $4,000, depending upon the industry and whether or not user training is included.

Burroughs also offers fixed-price turnkey contracts, under which it assumes total responsibility for the programming and installation of a system.

EQUIPMENT: The following L Series equipment is currently available from Burroughs according to the latest price book.■

EQUIPMENT PRICES

		Purchase Price	Monthly Lease 1-year*	Monthly Lease 3- to 5-years*
L 9000 SERIES SYSTEMS				
L 9935-259	Processor, 6KB user memory, 26-inch front-feed forms handler, 60 cps matrix printer, 1 cassette station	$22,190	$716	$679
L 9938-259	Processor, 6KB user memory, 26-inch front-feed forms handler, 75 cps matrix printer, 1 cassette station	23,190	748	710
L 9948-259	Processor, 6KB user memory, 26-inch front-feed forms handler, 150 cps matrix printer, 1 cassette station	28,315	989	895
MEMORY				
A4011	2KB Memory Module	824	26	25
A4011-2	4KB Memory Module	1,442	45	44
A4011-3	6KB Memory Module	2,060	65	63
A4011-4	8KB Memory Module	2,575	80	78
A2011	24KB Extended Memory Potential (required for total user memory capacity of 18KB through 40KB)	773	23	22
A2012	32KB Extended Memory Potential (required for total user memory capacity of 42KB through 48KB)	824	24	23
MAGNETIC TAPE EQUIPMENT				
A9490-25	Cassette Tape Subsystem:			
—	First station (includes A2391-1 controller)	1,689	57	55
—	Second, third or fourth station	1,689	57	55
A1495-2	Magnetic Tape Unit; 4 ports	12,103	388	325
PRINTERS (L 8000, L 9000)				
A2362-1	Line Printer Controller	505	22	21
B9249-2	Line Printer; 160 lpm	5,990	222	200
PUNCHED CARD EQUIPMENT				
B9114-1	80-Column Card Reader; 200 cpm	1,990	84	80
B9418-2	80-Column Card Reader/Punch/Data Recorder	12,420	349	311

*Equipment rental prices include maintenance.

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EQUIPMENT PRICES

		Purchase Price	Monthly Lease 1-year*	Monthly Lease 3- to 5-years*
PUNCHED CARD EQUIPMENT (Continued)				
B9119-1	96-Column Card Reader; 300 cpm	4,553	121	107
B9419-2	96-Column Card Reader/Punch/Data Recorder	9,013	296	269
B9419-6	96-Column Multi-Purpose Card Unit (programmable stacker select)	9,528	354	315
PUNCHED TAPE EQUIPMENT				
A2322-1	Card/Tape Controller (for A9122-1, A9222-1, and/or B9114-1)	773	23	22
A9122-1	Paper Tape Reader; 40 char/sec.	1,638	44	42
A9222-1	Paper Tape Punch; 40 char/sec.	2,050	56	53
TERMINALS				
TD701	256-Character Self-Scan Station	2,300	85	—
TD12	TD701 Keyboard	340	13	—

*Equipment rental prices include maintenance.

SOFTWARE PRICES

		One-Time License Fee	Annual Maint.
L9900-W01	Business Management System (payroll, sales and expense accounting, general ledger, invoicing, and related reports)	$4,305	—
L9000	Business Management System components:		
	General Ledger BMS	1,045	158
	Accounts Receivable BMS	1,420	158
	Inventory Control and Reporting System BMS	1,675	158
	Accounts Payable BMS	1,315	158
	Invoicing BMS	1,150	158
	Payroll BMS	1,315	158
L9900-D01	Doctors and Clinic System (account update, insurance statement, doctors' daily report, age analysis, delinquent notices, trial balance, cash receipts, patient statement preparation, related reports)	2,575	158
L9900-C07	Contractor Accounting System (labor posting, labor reporting, payroll writing, 941A, W2 reports, HUD reports, union reports, asset depreciation reports, job cost, accounts payable, check writing, general ledger, financial statements, related reports and maintenance routines)	3,625	179
L9500-U03	Credit Union Accounting System (member record update cash posting, trial balance, dividend rebate statements, 1099, proxy preparation, share and loan analysis report, delinquency report, CUNA insurance and federal report)	2,310	158
L9900-M05	Property Management System (rent billing, charge posting, cash receipts, lease expiration report, delinquency report, escalation notice, collection report, security and vacancy report)	3,675	158
L9900-R07	Route Accounting System (invoice audit, daily settlement sheet, daily sales, inventory and warehouse report, store report, customer A/R, driver's ledger)	2,260	158
L9900-W07	Budgetary Accounting System (budget posting with appropriation ledger, revenue ledger and fund ledger, budgetary and related reports, payroll, 941A and W2)	3,100	158
L9900-H05	Hospital Accounting System (new patient set-up admission report, ticket entering and pricing, patient posting, trial balance, revenue posting, cash receipts, age analysis, operational reports, related reports)	3,885	194
L9900-H03	Hospital Accounting System (in-patient and out-patient accounting, management reports, age analysis and notice, billing, Medicare forms preparation)	2,520	158
L9800-X01	Insurance Agency System (daily transaction journal, customer master file, maintenance, open item status, monthly billing, age analysis and statement preparation, salesman and activity update, all related reports)	2,887	158
L9900-K01	School Board Accounting System (encumbrance accounting with check writing, budgetary reports, vendor reports, purchase order report, payroll, check writing, government reports, school board accounting, related reports)	2,725	158
L9700-U01	Utility Billing System (file maintenance, data entry, bill creation, cash receipts, age analysis report, consumption analysis report)	1,837	158
L9700-C03	Client Accounting System (income statement, balance sheet, client accounting journalizing and reports, detailed general ledger, supporting schedules, gross profit analysis payroll update, time and charges, asset depreciation, A/R statement preparation and age analysis; 96-column card system only)	2,940	158