

Singer System Ten

MANAGEMENT SUMMARY

The Singer System Ten is one of the most distinctive small-scale computer systems currently on the market. Introduced in April 1970, the System Ten represents a strong bid by Singer to get into the "big league" as a major supplier of business data processing systems.

System Ten deliveries began in September 1970. By October 1971, Singer announced that over 150 systems had been installed and another 600 orders were in hand. The average monthly rental rate for the installed systems was about \$2,200. Most of the orders have come from first-time computer users, but the System Ten is also being widely used in supporting roles with larger computers. A System Ten can be configured to function effectively as a remote batch terminal, as a multistation data entry system, or as the central processing element in a specialized Singer system for factory data collection or retail transaction processing.

The System Ten hardware is neither unusually fast nor uniquely inexpensive. Instead, it is built around a much-discussed but largely untried concept in small-scale EDP: the idea that a computer system should be "people-oriented" and instantly accessible to everyone who needs it within a company. The System Ten is designed to give the individual departments control of their own records and the processing of those records—plus shared access to a central data bank. ➤

The System Ten is a low-cost business data processing system that features the unique capability to process up to 20 independent programs at the same time under hardware control. It can be used effectively either in an interactive, "people-oriented" environment or for conventional batch processing.

CHARACTERISTICS

MANUFACTURER: Business Machines Division, The Singer Company, San Leandro, California 94577.

MODEL: System Ten.

DATA FORMATS

BASIC UNIT: 6-bit character. Each character position in core storage can represent 1 alphanumeric character or 1 BCD digit.

FIXED-POINT OPERANDS: Can range from 1 to 10 characters for arithmetic operations, or up to 100 characters for move, edit, and exchange operations. Arithmetic result fields can be up to 20 characters long. Operand lengths are specified either explicitly or implicitly by the referencing instructions.

FLOATING-POINT OPERANDS: No facilities for floating-point arithmetic are provided.

INSTRUCTIONS: Each instruction is 10 characters long, and the address of its leftmost character must be a multiple ➤



Designed to show how the compact System Ten components fit into a normal office environment, this photo shows (from left to right) a printer, magnetic tape drive, processor, disc drive, card punch, and card reader, all clustered around a Model 70 Workstation.

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▷ In pursuit of this objective, Singer has designed the System Ten to be distinctively different from all the competitive small-scale computer systems in three significant ways:

- Up to 20 independent jobs can be processed at the same time, with multiprogramming controlled by the hardware rather than by software.
- Typewriter-like Workstations and/or CRT display units — as well as card readers, punches, and printers — are connected to the central processor via simple two-wire lines and can be located up to 2000 feet away.
- A System Ten can be equipped with unusually large amounts of both main and auxiliary storage; up to 110,000 characters of core memory and up to 100 million characters (10 drives) of on-line disc-pack storage.

Although the System Ten processor makes use of large-scale integration (LSI) in its circuitry, it also uses conventional magnetic core storage with a comparatively slow cycle time of 3.3 microseconds, resulting in unimpressive instruction execution times (e.g., 109 microseconds for a 5-digit decimal addition). Its most eye-opening feature unquestionably is its ability to control 20-way multiprogramming at the hardware level. This is accomplished by means of a round-robin time-slicing technique that effectively divides the processor's computational power among the various programs which are competing for its attention at any given moment.

The core memory of a System Ten processor can be physically divided into up to 20 fixed partitions, each ranging from 1,000 to 10,000 characters in size. Each partition holds one program at a time and is serviced by a single Input/Output Channel, to which up to 10 low-speed peripheral devices can be connected. A single File Access Channel, available to the programs in all the partitions, is used for disc drives and magnetic tape units. I/O operations on the Input/Output Channels are overlapped with one another and with computation, but an I/O operation on the File Access Channel causes computation to be suspended.

Central processor time is automatically allocated, in consecutive 37-millisecond "slices," to each partition containing an active program. If a program is unable to use any or all of the processor time allocated to it during a given slice (e.g., because it is awaiting completion of an I/O operation), control is automatically transferred to the program in the next partition. This hardware-controlled multiprogramming technique eliminates the need for a complex software operating system and helps the System Ten make effective use of its rather limited processing ▷

▶ of 10. The instruction format includes a 4-bit operation code and two 4-digit decimal addresses, each with an index register designator.

INTERNAL CODE: 6-bit subset of ASCII. The 6 bits of each System Ten character code correspond to ASCII bits 1, 2, 3, 4, 5, and 7, ruling out the use of lower-case letters and most of the ASCII control codes. The System Ten input/output channels automatically perform 6-bit/8-bit code conversions by adding (during output) or deleting (during input) ASCII bit 6 and a parity bit from each character.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: 10,000 to 110,000 characters, in 10,000-character modules.

CYCLE TIME: 3.3 microseconds per character.

CHECKING: None.

STORAGE PROTECTION: Provided by hardware; each program can access only the data stored within its own partition and in a Common memory area. Physical partitioning is accomplished by wiring. A System Ten can have up to 20 partitions, each consisting of 1,000 to 10,000 characters in 1,000-character segments. A Common area of at least 1,000 characters must also be established. The first 300 characters of Common memory are protected from alteration by programs and are used to hold program status information.

CENTRAL PROCESSOR

INDEX REGISTERS: 3 for each partition. Either or both addresses of most instructions can be indexed. Single or double indexing adds 31.1 or 58.9 microseconds, respectively, to the instruction execution time.

INSTRUCTION REPERTOIRE: 13 instructions, including addition, subtraction, multiplication, division, comparison, editing, and movement of variable-length fields. All arithmetic is performed in fixed-point decimal mode, using instructions of the 2-address, core-to-core type.

INSTRUCTION TIMES: For 2-address operations on 5-digit decimal fields:

Add/Subtract:	109 microseconds
Multiply:	1605 microseconds
Divide:	2265 microseconds
Move:	96 microseconds

INPUT/OUTPUT CONTROL

I/O CHANNELS: Every System Ten Processor includes a single File Access Channel (FAC) and can be equipped with from 1 to 20 Input/Output Channels (IOC's).

CONFIGURATION RULES: Up to 10 disc drives and/or 4 magnetic tape drives can be connected to the FAC. One IOC is dedicated to each memory partition, and each IOC can control up to 10 low-speed peripheral devices (Workstations, printers, card readers and punches, and/or paper tape readers and punches). The Synchronous Communications Adapter, when used, is also dedicated to a particular ▶

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➤ capabilities. Certain programming conventions must be carefully observed, however, especially in the case of references to the Common core memory area and the File Access Channel, which are shared by all the partitions.

The System Ten offers a modest assortment of conventionally-designed peripheral equipment. Singer manufactures its own central processors, disc drives, and Workstations and purchases the mechanisms for the magnetic tape drives, line printers, card reader and punch, and CRT display unit from well-regarded OEM sources.

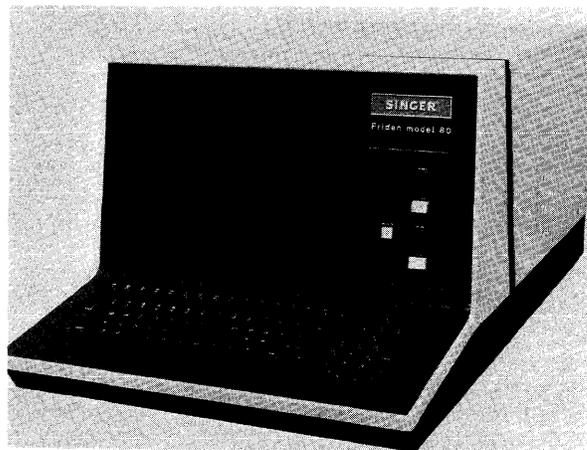
The key peripheral device in most System Ten installations is the Model 70 Workstation, a typewriter terminal that provides convenient keyboard input to and typed output from a System Ten processor located up to 2000 feet away. Singer's idea is to locate one or more Workstations in each department of a company, giving it immediate, conversational-mode access to the processing and file storage facilities of the central computer.

As an alternative to the Workstation, Singer announced the Model 80 Display in October 1971. The Model 80 is a buffered CRT display unit with a standard typewriter keyboard and impressive editing and formatting features. At a cost only a little higher than that of the Model 70 Workstation, the Model 80 Display offers considerably more flexible input/output capabilities in applications where hard-copy output is not required.

Communications adapters enable a System Ten to communicate effectively with another System Ten, with a larger computer, or with remote typewriter terminals. Thus, a large corporation can install a System Ten in each of its branch offices and equip them to communicate with a central computer complex. The System Tens can perform local batch processing operations in addition to editing the input to and output from the central computer.

The System Ten offers no direct program compatibility with any other computer currently on the market, but it does have a fairly high degree of data compatibility with most current equipment. It uses standard 80-column Hollerith-coded cards, 7- or 9-track IBM-compatible magnetic tape, and an internal code that is a 6-bit subset of ASCII. The disc pack recording format, however, uses fixed 100-character sectors and is not compatible with any of the IBM disc drives.

Software support for the System Ten is quite limited in scope, but appropriate for the machine and its intended applications. There is no integrated operating system — but the System Ten's ability to control multiprogramming at the hardware level largely precludes the need for it. A comprehensive Disc Management Facility reduces the programming complexity involved in maintaining and processing disc files.



The Model 80 Display, introduced in October 1971, is a buffered CRT display terminal with impressive editing and formatting features.

➤ memory partition and used in a fashion similar to a normal IOC.

SIMULTANEOUS I/O OPERATIONS: The Input/Output Channels operate on a "cycle-stealing" basis, so their operations are overlapped with one another and with computing in other partitions. However, computing is suspended whenever an I/O operation is in progress on the File Access Channel, which is used for all magnetic tape and disc I/O operations.

I/O DATA RATES: Data is transmitted between the Input/Output Channels and the associated peripherals in bit-serial fashion at up to 1500 characters/second. The File Access Channel accommodates data rates of up to 330,000 characters/second.

MASS STORAGE

MODEL 40 DISC DRIVE: Provides interchangeable random-access storage in 6-disc packs with a capacity of 10 million characters each. Uses a comb-type access mechanism with one read/write head serving each of the 10 recording surfaces. Each surface has 200 data tracks. Each track is divided into 50 sectors, each capable of holding 100 six-bit characters of data. Each disc Read or Write instruction transfers one 100-character record. Average head movement time is 73 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 229,000 characters per second.

A Disc Controller connects up to 10 disc drives to the File Access Channel of a System Ten Processor. (When more than four disc drives are used, the Auxiliary Disc Controller is also required.) The Disc Controller permits simultaneous seek operations on every other drive connected to it (e.g., two seek operations at a time in either a 3-drive or 4-drive system); but only one drive at a time can transfer data.

INPUT/OUTPUT UNITS

MODEL 45 MAGNETIC TAPE DRIVE: Reads and records data on standard 1/2-inch tape in IBM-compatible formats. Available in both 9-track and 7-track versions. Both models ➤

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➤ System Ten users have a choice of only two programming languages: a symbolic assembler or an IBM-like Report Program Generator. Though the System Ten is comparatively easy to program at the assembly-language level, many potential users will be understandably disturbed by the lack of a COBOL compiler. Actually, many System Ten users will not need to concern themselves with the programming problem, because Singer itself is doing the programming for a high proportion of its customers.

Since the System Ten's introduction, Singer has been systematically building up the marketing and technical capabilities required to support a full-fledged business data processing system. Singer's Business Machines Division (the former Friden Division) makes and markets a broad line of office equipment and maintains more than 400 sales and service outlets in the U.S. and abroad. But the System Ten is by far the most complex and sophisticated project it has ever tackled, and extensive recruiting of marketing and support personnel from the ranks of other computer manufacturers has been necessary. Singer claims that it is now in a position to fully support System Ten installations in 23 metropolitan areas within the United States.

The System Ten is marketed on a partially bundled basis. Technical support and most of the standard software are included in the equipment prices, but educational courses and the Modular Business Management System are separately priced. The Modular Business Management System is a group of packaged programs designed to handle most of the common business data processing applications; these programs are offered on the basis of license fees plus charges for any necessary modifications to the basic routines. In installations where Singer does all the programming on a turnkey basis, the programming cost is typically in the vicinity of 10% of the total hardware cost — which should represent a real bargain for most first-time computer users.

The System Ten serves as a key element in most installations of Singer's impressive Modular Data Transaction System and Manufacturing Information System. The MDTS, a "computerized cash register" system for retailers, is the current sales leader in the hotly contested point-of-sale market, while the Manufacturing Information System provides on-line input from factory data collection stations to permit tighter control of manufacturing operations. Both systems are described in more detail in the Characteristics section of this report.

There is a natural tendency to compare the System Ten with the IBM System/3 — particularly in view of Singer's claim that the System Ten received its name because it has seven important advantages over the well-known competitive system. A small, batch-oriented System Ten consisting of a 10K processor, 300-cpm card reader, 100-cpm ➤

▶ have a tape speed of 25 inches per second and accommodate standard 10.5-inch tape reels. The 9-track model has a recording density of 800 bpi and a data transfer rate of 20,000 char/sec. The 7-track model operates at a density of 556 or 800 bpi, with corresponding data rates of 13,900 or 20,000 char/sec. ASCII is the standard magnetic tape code, but software conversion permits reading of IBM and other tape formats. A Magnetic Tape Controller connects up to four tape drives to the System Ten File Access Channel.

MODEL 30 CARD READER: Reads standard 80-column cards serially by column at 300 cpm. Has a two-card buffer, a photoelectric reading mechanism, and a real-only memory that converts Hollerith card code into ASCII. Has a 1000-card feed hopper and a single 1000-card stacker. Connects to a System Ten Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor.

MODEL 35 CARD PUNCH: Punches standard 80-column cards at 100 cpm. Reads each card after punching it to verify the accuracy of the punched codes. Contains three full-card buffers, an 800-card feed hopper, an 800-card stacker, and a read-only memory that translates ASCII into Hollerith card code. Connects to an Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor.

MODEL 60 PAPER TAPE READER: Reads 5, 6, 7, or 8-channel ASCII-coded punched tape photoelectrically at 300 characters per second. Has servo-controlled supply and take-up facilities for standard 10.5-inch NAB reels, and can also read short strips of tape. Connects to a System Ten Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor.

MODEL 65 PAPER TAPE PUNCH: Punches ASCII or other codes into paper or Mylar tape at 110 characters per second. Accommodates standard 10.5-inch NAB reels. Connects to a System Ten Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor.

MODEL 50 LINE PRINTER: Prints at a rated speed of 450 lpm, using a drum printing mechanism with a 64-character print set. Has 132 print positions and a two-line buffer. Accommodates continuous forms with a width of 3.5 to 18 inches between pinholes. Uses an 8-channel carriage control tape, although only 3 channels are actually used. Connects to an Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor.

MODEL 52 LINE PRINTER: Prints at a rated speed of 110 lpm, using a chain printing mechanism with a 64-character print set. Has 132 print positions and an integral data buffer. Accommodates continuous forms ranging from 3.5 to 14.875 inches in width. Connects to an Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor.

MODEL 70 WORKSTATION: A typewriter terminal that provides keyboard input to and typed output from a System Ten. Printing speed is 24.4 characters per second for numerals and spaces, and 15 characters per second for all other characters. Has a standard typewriter keyboard, a 64-character print set, and 170 print positions. Paper is fed by either the standard pressure platen or an optional tractor feed. When not communicating with the computer, the unit can be used as a standard typewriter. The typewriter is ▶

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➤ card punch, and 110-lpm printer can be rented for \$1,215 per month on a 1-year lease or \$1,100 per month on a 5-year lease, or purchased for \$38,200. This compares with a rental price of \$999 or a purchase price of \$44,900 for an entry-level System/3 Model 10 with an 8K processor, 250-cpm reading and 60-cpm punching facilities, and a 100-lpm printer. The System Ten's advantages of faster input/output speeds, standard 80-column card equipment, lower purchase price, and largely bundled software and support would have to be balanced against the System/3's higher processor speed, flexible Multi-Function Card Unit, lower rental price, and time-tested – but separately priced – IBM software and support.

But this type of comparison deprives Singer of the opportunity to play its strongest suit. Although the System Ten can hold its own against competitive systems in batch-oriented configurations such as the one described above, its unique characteristics can be far more effectively utilized in installations that employ multiple Workstations or display units in an interactive multi-programming environment. This type of application – which is completely out of the question for the System/3 and practically every other low-priced business data processing system – represents the principal justification for installation of a Singer System Ten. □

➤ mounted on a table 40 inches wide by 28.5 inches deep. A utility drawer holds files, forms, and personal effects.

The Workstation connects to a System Ten Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor. Because the Workstation is unbuffered, only one can be connected to each channel.

MODEL 80 DISPLAY: A desktop CRT terminal that provides keyboard input to and displays alphanumeric output from a System Ten. Has a standard typewriter keyboard and a separate 10-key numeric keyboard. Display capacity is 1600 characters, arranged in 20 lines of 80 characters each. Characters are formed by a 5-by-7 dot matrix and displayed in an area 7.75 inches wide by 5.25 inches high. The character set is a 64-character subset of ASCII. The unit operates in either page or scroll mode and features a "fill-in-the-blanks" formatting capability. Control keys provide flexible control of the blinking cursor and permit insertion or deletion of specific characters or lines.

The Model 80 Display, a buffered unit, connects to a System Ten Input/Output Channel via a two-wire line, and can be located up to 2000 feet away from the central processor.

MODEL 7102 CONSOLE TYPEWRITER: Provides the System Ten operator with a means of communicating with the system. The 7102 is an adaptation of the widely used "Flexowriter" automatic typewriter; it consists of a conventional typewriter keyboard and printing mechanism plus an integrated paper tape reader and punch. The 7102 includes a special Console Input/Output Channel and is associated with a 1K Console Partition in main memory.



Singer's MDTs Data Terminal, the key component of the Modular Data Transaction System, is a "computerized cash register" that can be used effectively with the System Ten in either an on-line or off-line mode.

COMMUNICATION CONTROL

SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA):

Enables a System Ten Processor to communicate with either another similarly-equipped System Ten or a larger computer over a single leased or dialed voice-grade line. Data is transmitted in synchronous mode at 1200, 2000, 2400, 3600, 4800, or 9600 bits per second, depending upon the type of line and modem employed. Singer states that the SCA will enable a System Ten to communicate with any other major computer system using ASCII.

The SCA is available in two models. One, the SCA #2, includes a "dial out" capability that enables it to initiate calls over a dialed line, while the SCA #1 does not. Each SCA replaces two physically adjacent Input/Output Channels and is associated with one specific main memory partition. The SCA operates in much the same manner as a regular Input/Output Channel. Computing in other partitions is overlapped with SCA data transmission or reception. No other peripheral devices can be connected to an SCA partition, and other partitions cannot address the SCA directly. Therefore, data to be sent or received by the SCA must be passed through either the COMMON memory region or a File Access Channel (disc or tape) unit.

ASYNCHRONOUS COMMUNICATIONS ADAPTER

(ACA): Enables a System Ten Processor to communicate with either local or remote terminals in asynchronous mode at 600, 1200, or 1800 bits per second. Permits communication with a variety of terminals that meet the EIA RS-232-B or -C interface standard, including the Singer Model 800 Individual Store and Forward Module, which is used in retail stores to collect and transmit point-of-sale information. Transmission is in 7-bit ASCII code using a 10-bit character structure.

Each ACA handles a single terminal or line. For local use, at distances up to 50 feet, the ACA connects directly to the terminal. For remote use, either leased or dialed voice-grade ➤

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► lines and Bell System Series 202 modems or equivalent can be used. An automatic "dial out" capability is optional. Up to 10 ACA's can be installed in a System Ten Processor; each ACA replaces two physically adjacent Input/Output Channels.

ASYNCHRONOUS TERMINAL ADAPTER (ATA): Enables a System Ten Processor to communicate with either local or remote terminals in asynchronous mode at 110, 150, 200, or 300 bits per second. Permits communication with a variety of terminals that meet the EIA RS-232-B or -C interface standard, including the Singer Model 7102, a typewriter terminal with paper tape I/O facilities. Transmission is in 7-bit ASCII code using a 10- or 11-bit character structure.

Each ATA handles a single terminal or line. For local use, at distances up to 50 feet, the ATA connects directly to the terminal. For remote use, either leased or dialed telephone lines and Bell System Series 103 modems or equivalent can be used. An automatic "dial out" capability is optional. Up to 20 ATA's can be installed in a System Ten Processor; each ATA replaces one standard Input/Output Channel (or two adjacent channels if the automatic dialing option is included).

MANUFACTURING INFORMATION SYSTEM

Singer's Manufacturing Information System (MIS) is a specialized on-line configuration that is built around the System Ten and designed to collect production information direct from the factory floor. In an MIS configuration, the System Ten Processor requires a minimum of 6K bytes of Common memory, 1K for a Clock partition, and 1K for a 7102 Console partition. In addition, each terminal partition requires at least 2K bytes and either a standard Multi-terminal I/O Channel, an MIS I/O Channel, or a Collectadata I/O Channel. Besides the System Ten Processor and its standard peripheral devices, a Singer Manufacturing Information System can include the components described in the following paragraphs.

MODEL 100 JOB INFORMATION STATION: A special-purpose data terminal that collects data from factory locations and transmits it to a System Ten Processor. Data can be entered by means of a 10-key numeric keyboard, 10-character badges, and/or 22-, 51-, 66-, or 80-column punched cards. Up to 40 operator instructions on the display panel can be lighted in a programmed sequence to guide the operator through each transaction. Up to 10 transaction programs can be stored in each station, and up to 90 additional programs can be called into the station from the computer. A 13-digit display can be used to indicate the time of day or the value of numeric variables. Data is transmitted to and from the Model 100 at 1200 bits/second over a twisted-pair line up to 8 miles in length. Options include an alphanumeric printer, an additional badge reader, and a scale adapter. Up to ten Model 100 or Model 105 stations, in any combination, can be connected to a System Ten MIS I/O Channel.

MODEL 105 ATTENDANCE STATION: A special-purpose data terminal that records and transmits the time when each employee enters and leaves the plant. Data is entered by inserting 10-character, Hollerith-coded employee badges. A buffer holds up to 13 transactions, permitting data entry to continue when the System Ten Processor is otherwise occupied. A built-in clock displays the time of day. An optional printer provides an audit trail and a printed receipt for each transaction. Data is transmitted at 1200 bits/second over a twisted-pair line up to 8 miles in length.

MODEL 30 COLLECTADATA NETWORK: In use for some years as an off-line plant data collection network, the Model 30 Collectadata system can now be used on-line with the System Ten as part of a Manufacturing Information System. There are two types of Collectadata input terminals: the Model 3002 Transmitter and Model 3022 Badge Transmitter. The Model 3002 accepts input from 10 variable entry dials, 8 semi-variable entry dials, a tab card reader, and/or a badge reader, while the Model 3022 accepts badges only. The terminals are cable-connected to a Model 3000 Terminator Module which serves as the interface to the System Ten Processor. The Model 3000 accommodates up to 18 cables, and up to 20 Collectadata terminals can be connected to each cable. A separate Collectadata I/O Channel in the System Ten Processor is required for each cable.

MODEL 191 LINE SWITCHING UNIT: Interconnects two System Ten Processors so that if one Processor goes off-line for any reason, its network of remote terminals will be switched over to the other Processor. The Model 191 is a free-standing unit with its own power supply; it can switch up to 180 terminal lines.

DIGITAL CLOCK: This optional feature for the System Ten Processor supplies time signals for synchronizing the terminal clocks and adding the time to messages received by the Processor. The Digital Clock occupies one I/O Channel position, and the associated software module requires a dedicated 1K memory partition.

MODEL 195 EXTERNAL CLOCK INTERFACE: Accepts signals from a Factory Master Clock system and ensures that the System Ten's clock program is synchronized with it.

MODULAR DATA TRANSACTION SYSTEM

Singer's Modular Data Transaction System is an electronic point-of-sale system designed to facilitate entry of the data required for sales audits, accounts receivable, sales reports, and inventory control. The system is built around the MDTS Data Terminal, a compact, free-standing unit that contains computer-like LSI logic and replaces conventional cash registers. Function keys light in a programmed sequence to guide the clerk through each transaction. Numeric data is entered through a simple 10-key keyboard, and multiplication and addition are performed by the terminal. A 13-digit display indicates each entry. All pertinent information is printed on a throw-out receipt or on a multi-part sales check, as well as on an internal audit tape. Hard totals for cash, sales, sales tax, and discounts are stored in the terminal and can be read or cleared at any time through the use of a special key.

The Model 710 Magnetic Media Reader can be added to the MDTS Data Terminal to provide rapid entry of data read from magnetically coded Kimball tags and labels, as well as credit cards and employee badges. The 710 is a small, hand-held unit that can read labels on flat, curved, or irregular surfaces, both hard and soft. Alternatively, the Model 705 Merchandise Ticket Reader can be used with the MDTS Data Terminal to read punched data from the Kimball print/punch tickets that have long been widely used in retail stores.

An MDTS system can have any of three basic configurations, as described in the following paragraphs.

INDIVIDUAL STORE AND FORWARD SYSTEM: In this off-line configuration, each MDTS Data Terminal has a ►

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► companion MDTS Individual Store and Forward Module, which stores up to 50,000 characters of transaction data on magnetic tape. The module, in turn, is linked to the central computer via a pair of modems and appropriate communications facilities. The module can be polled and the previously recorded data transmitted at any time without affecting the Data Terminal's normal operation. As an option, several Data Terminals and their associated modules in one store can utilize a single communications modem.

COLLECTIVE STORE AND FORWARD SYSTEM: This off-line MDTS configuration is used when many terminals are required in one store. An in-store MDTS Line Concentrator buffers up to 180 Data Terminals, which are connected via simple 2-wire lines. The transaction data captured in each store is stored either on a disc file (which can also provide instantaneous negative credit authorization) or on magnetic tape. At the end of the day, or whenever desired, the computer polls the Line Concentrator and the stored sales data is transmitted to the central site.

ON-LINE, REAL-TIME SYSTEM: By replacing a single printed-circuit card in each MDTS Data Terminal, the terminals can be operated on-line to the computer. This configuration permits positive credit authorization and immediate processing of all transactions. Up to 180 terminals are cable-connected to a Line Concentrator in each store. The concentrators, in turn are linked to the central computer by means of high-speed data communications facilities. If the computer goes down, the terminals can operate in a free-standing mode and capture all transactions on the audit tape for later processing.

SOFTWARE

OPERATING SYSTEM: The System Ten's ability to control multiprogramming at the hardware level eliminates the need for many of the functions normally performed by an operating system. To facilitate the management of programs and data files stored on disc packs, Singer offers the Disc Management Facility. The DMF consists of a group of System Support Programs, used to create and maintain files, and a set of LIOCS (Logical Input/Output Control System) subroutines, called by macro-instructions, which handle file and record I/O operations in user programs. Records are organized in "linked sequential" fashion, with the last 6 characters of each 100-character sector containing the disc address of the next logical sector. The normal access mode is linked sequential, but random accessing is possible through creation and use of an index to the linked sequential file.

COMPILERS: No compiler for COBOL or any other procedure-oriented language has been announced to date.

ASSEMBLER: The System Ten Assembler converts programs coded in a symbolic assembly language into executable machine-language programs. The language consists of only 24 commands (15 machine instructions and 9 Assembler commands) and has a comparatively simple format. The source program can be entered via punched cards or paper tape or typed in from a Workstation. Assembly is a two-phase process. During the first phase, a preprocessor checks for errors in syntax or labeling and builds the label table. If there are no errors, phase two generates the machine-language instructions. In disc-oriented systems, only one pass of the source program deck is required. The assembly process requires at least a 9K memory partition. An alternative assembler uses the same source language but runs on an IBM System/360 computer,

enabling System Ten users to assemble programs prior to delivery of their equipment.

REPORT PROGRAM GENERATOR: The System Ten RPG facilitates the coding of programs to produce formatted reports and files. The programmer, using four different types of preprinted specification sheets, prepares a set of specifications that describe the form of the input data, the calculations to be performed, and the format of the desired output. These specifications are transcribed into punched cards or entered via a System Ten Workstation. The RPG compiler then generates a machine-language object program to perform the specified functions. The specification sheets and language facilities of System Ten RPG are quite similar to those of the IBM Report Program Generators. RPG compilation requires a 9K memory partition, one or more disc drives, and a Workstation. In addition, a card reader is required if the source program is on cards, and a line printer is required unless the program listing is to be produced on the Workstation.

UTILITY ROUTINES: A number of utility packages are available to assist users in the programming and implementation of their systems. These include:

- Loading routines for storing, relocating, and linking programs in memory.

- Media routines for reading, punching, duplicating, verifying, sequencing, identifying, listing, and converting punched cards and paper tape.

- Program debugging routines for performing memory dumps (in interpretive or machine-language form) and program traces.

- General service routines for handling input/output, common calculation procedures, etc.

- A sort/merge generator (for disc-oriented systems only).

APPLICATION PROGRAMS: All of the "unbundled" application programs that have been delivered or announced for the System Ten to date are grouped under the title "Modular Business Management System." The system includes the following applications:

- Sales Order Writing
- Invoicing
- Accounts Receivable
- Inventory
- Sales Analysis
- Accounts Payable
- Payroll
- General Ledger
- Data Management System

Each application is offered on a license fee basis plus charges for any necessary modifications. The price for each implementation of the Modular Business Management System depends upon the applications, the options chosen within each application, and the extent of modifications to the basic programs. Minimum equipment requirements are a 20K Processor (10K Common region and 10K Partition 0), one disc drive, and one Workstation. Each additional Workstation requires another 10K memory partition. Additional disc drives, line printers, and other peripheral devices can be utilized when available. ►

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► PRICING

EQUIPMENT: The following systems comprise a sampling of the varied System Ten configuration possibilities. The quoted rental prices are for one-year leases and include equipment maintenance. Singer also offers three-year and five-year leases at progressively lower monthly rates.

MINIMUM CARD SYSTEM: Designed for conventional batch processing, this system consists of a Model 20 Processor with 10K characters of core storage and the File Access Channel, one Input/Output Channel, Model 30 Card Reader, Model 35 Card Punch, and Model 52 Line Printer. Monthly rental, \$1,215. Purchase price, \$38,200.

4-WORKSTATION DISC SYSTEM: Consists of Model 20 Processor with 30K characters of core storage and File Access Channel, four Input/Output Channels, two Model 40 Disc Drives and controller, Model 30 Card Reader, Model 35 Card Punch, Model 50 Line Printer, and four Model 70 Workstations. Monthly rental, \$3,350. Purchase price, \$107,600.

10-WORKSTATION DISC/TAPE SYSTEM: Consists of Model 20 Processor with 60K characters of core storage and File Access Channel, ten Input/Output Channels, four Model 40 Disc Drives and controller, two Model 45

Magnetic Tape Drives and controller, Model 30 Card Reader, Model 35 Card Punch, Model 50 Line Printer, and ten Model 70 Workstations. Monthly rental, \$6,510. Purchase price, \$211,200.

SOFTWARE: All Singer software is currently available to System Ten users at no extra cost except for the Modular Business Management System, which is offered on a license fee basis plus modification charges.

SUPPORT: Technical support is provided on a "bundled" basis at no extra cost. The amount of support provided for a particular system is "a management decision based upon many factors."

EDUCATION: Brief customer orientation courses are offered at no additional charge. An intensive 2-week programming course is priced at \$375 per attendee.

CONTRACT TERMS: The System Ten is available for purchase or on a 1-year, 3-year, or 5-year lease. The standard lease agreement includes equipment maintenance and permits single-shift operation. For a full second shift, monthly rentals will increase by 50% of the basic equipment rentals (less maintenance charges). If maintenance is desired for a full second shift, the maintenance charges will increase by 39% of the basic figures. ■

Equipment Prices

	Purchase Price	Yearly Maintenance	Rental (1-year lease)*	Rental (5-year lease)*
PROCESSOR AND MAIN STORAGE				
Model 20 Processor with 10K characters of core storage	9,500	672**	320	290
10K Additional Core Memory Unit	5,200	74	135	120
File Access Channel	2,500	—	40	30
Input/Output Channel	1,100	147	40	35
PERIPHERAL UNITS				
Model 40 Disc Drive	12,500	600	360	325
Disc Controller	3,000	201	95	85
Auxiliary Disc Controller	650	—	25	20
Disc Pack	400	—	—	—
Model 45 Magnetic Tape Drive; 7- or 9-track	12,000	1,055	390	355
Magnetic Tape Controller	2,700	149	85	75
Model 30 Card Reader; 300 cpm	6,000	823	220	200
Model 35 Card Punch; 100 cpm	9,000	1,074	320	290
Model 60 Paper Tape Reader; 300 cps	4,000	455	140	125
Model 65 Paper Tape Punch; 110 cps	5,000	709	180	165
Model 50 Line Printer; 450 lpm	18,000	1,558	585	530
Model 52 Line Printer; 110 lpm	12,600	840	315	—
Model 70 Workstation	4,950	362	155	130
Model 80 Display	5,950	300	160	145
Model 7102 Console Typewriter, including Input/Output Channel	5,700	350	185	160
Synchronous Communications Adapter (SCA) #1	5,750	156	160	150
Synchronous Communications Adapter (SCA) #2	6,250	165	170	155
Asynchronous Communications Adapter (ACA)	4,000	?	120	—
Auto Dial Feature (for ACA)	500	?	20	—
Asynchronous Terminal Adapter (ATA):				
Direct-Connect Model	1,500	?	50	—
Communicator Model	2,500	?	90	—
Communicator Model with Auto Dial	3,000	?	100	—

*Rental prices include equipment maintenance

**Processor maintenance charge includes File Access Channel and one Input/Output Channel.