

Singer System Ten

MANAGEMENT SUMMARY

The most significant computer announcement during the first few months of 1970 came from a rather surprising source: the Friden Division of the Singer Company. Unveiled on April 2, with deliveries scheduled to begin in September 1970, the System Ten represents an impressive Singer bid to get into the "big league" as a major supplier of business data processing systems.

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.

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.

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: Friden Division, The Singer Company, San Leandro, California 94577.

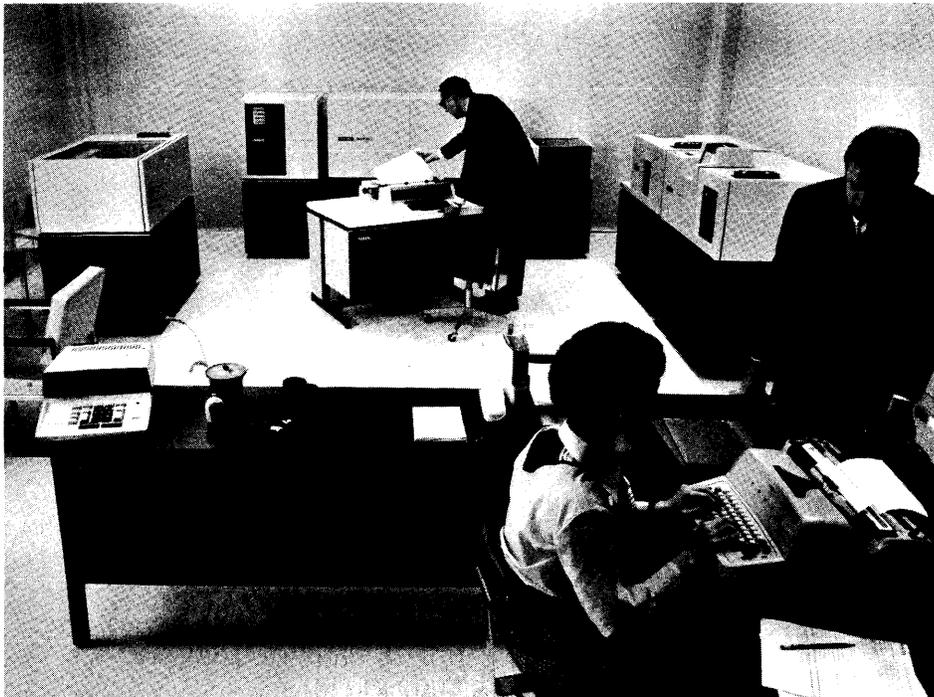
MODEL: System Ten.

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.



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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- Typewriter-like Workstations—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, magnetic tape units, and data communications.

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 should help the System Ten make effective use of its rather limited processing capabilities. Certain programming conventions will need to 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 currently offers a modest assortment of conventionally-designed peripheral equipment, including disc drives and workstations made by Singer, a printer made by NCR, magnetic tape drives made by Ampex, and a card reader and punch made by ICL of England. CRT display units, data collection systems, and on-line cash registers are likely to be added within the next few ➤

➤ **INSTRUCTIONS:** Each instruction is 10 characters long, and the address of its leftmost character must be a multiple 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 USASCII. The 6 bits of each System Ten character code correspond to USASCII bits 1, 2, 3, 4, 5, and 7, ruling out the use of lower-case letters and most of the USASCII control codes. The System Ten input/output channels automatically perform 6-bit/8-bit code conversions by adding (during output) or deleting (during input) USASCII 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: Parity bit with each character is generated during writing and checked during reading.

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, 4 magnetic tape drives, and/or a communications adapter 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 (workstation, printers, ➤

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▷ months. The System Ten processor itself is being manufactured in Friden's San Leandro plant.

The key peripheral device in most System Ten installations will be 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.

Communications adapters enable a System Ten processor to communicate effectively with either another System Ten or a larger computer. Thus, a large corporation could install a System Ten in each of its branch offices and equip them to communicate with a central computer complex at the main office. No facilities have yet been announced, however, for using data sets and common-carrier lines to extend the 2000-foot maximum distance between a System Ten processor and its associated Model 70 Workstations.

Software for the System Ten is currently limited to an assembler and a group of useful utility routines. Though the System Ten is comparatively easy to program at the symbolic assembly-language level, many potential users will naturally be disturbed by the lack of a COBOL compiler or report program generator. Application programs to handle common business data processing functions should be available soon, and will carry separate price-tags. A force of more than 100 software designers is said to be at work in San Leandro, and other facilities are being developed by independent software houses, so the software situation should improve at a fairly rapid rate.

The System Ten offers no 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 USASCII. The disc pack recording format, however, uses fixed 100-character sectors and is not compatible with that of the IBM 2311 Disk Storage Drives.

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 card punch, and 450-lpm printer can be rented for \$1,430 per month or purchased for \$44,950. This compares with a rental price of \$1,145 per month or a purchase price of \$47,800 for a System/3 with a 10K processor, 500-cpm reading and 120-cpm punching facilities, and a 200-lpm

▶ card readers and punches, and/or paper tape readers and punches). Only one Model 70 Workstation, however, can be connected to each 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. However, computing is suspended whenever an I/O operation is in progress on the File Access Channel.

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.) Seek operations on all drives can be carried out simultaneously, 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 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. 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 read-only memory that converts Hollerith card code into USASCII. 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 USASCII 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 USASCII-coded punched tape photoelectrically at 300 characters per second. Has servo-controlled supply and takeup facilities for standard 10.5-inch NAB reels, and can also read short strips of tape. Connects to a System Ten Input/Output Channel.

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▷ printer. The System Ten's advantages of faster printing speed, standard 80-column card equipment, and greater expansion potential would have to be balanced against the IBM System/3's higher processor speed, flexible Multi-Function Card Unit, and time-tested IBM 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 in an interactive, multiprogramming environment. This type of application is completely out of the question for the System/3 and practically every other low-priced business data processing system.

Singer's Friden Division makes and markets a broad line of office equipment and maintains more 400 sales and service outlets in the U.S. and abroad. The System Ten, however, is by far the most sophisticated and complex project it has ever tackled. Two prototype systems are already in operation, and the odds are good that the System Ten hardware will perform as advertised. The key questions that remain to be answered during the next few years are: (1) Will Singer be able to develop and supply the extensive technical assistance that most System Ten customers will require? (2) Will Singer's appealing but unorthodox concept of interactive, "people-oriented" business data processing find widespread acceptance and (3) Will other major computer manufacturers hasten to introduce similar equipment, thereby implicitly endorsing the Singer concept? □

▶ **MODEL 65 PAPER TAPE PUNCH:** Punches USASCII 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.

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 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 standard typewriter keyboard, a 64-character print set, and 135 print positions; a 175-position line length is optional. 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 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.

COMMUNICATION CONTROL

COMMUNICATIONS ADAPTERS: Enable a System Ten processor to communicate with either another similarly-equipped System Ten or a larger computer. Data is transmitted in synchronous mode at 2400 bits per second. Three different adapter models will, according to the manufacturer, enable a System Ten to communicate with any other major computer system, using USASCII, EBCDIC, or other transmission codes. The Communications Adapter connects to the System Ten's File Access Channel, and computing is suspended while data is being transmitted or received.

SOFTWARE

OPERATING SYSTEM: None has been announced, and the manufacturer states that there is no need for an operating system because of the System Ten's ability to control multiprogramming at the hardware level.

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 and has a comparatively simple format. Assembly is a two-phase process. During the first phase, a preprocessor detects errors in syntax or labeling. If there are no errors, phase two generates the machine-language instructions. 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: None has been announced to date.

UTILITY ROUTINES: A number of utility packages will be 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.

Sort/merge generators for both disc and magnetic tape systems. ▶

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- Communications routines to facilitate communications with other computers over private or common-carrier lines.

APPLICATION PROGRAMS: No "packaged" programs for specific applications have been announced to date, though programs to handle payroll, billing, inventory control, accounts receivable, and other common applications are said to be in preparation.

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 50 Line Printer. Monthly rental, \$1,430. Purchase price, \$44,950.

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, \$3,030. Purchase price, \$100,000.

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, \$5,835. Purchase price, \$194,750.

SOFTWARE: The Assembler and basic utility routines will be available to System Ten users at no additional charge. The sort/merge generators and forthcoming application software will be separately priced.

SUPPORT: The amount of technical support that will be available to System Ten users at no additional charge has not been firmly specified to date.

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 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 PRICING

	Purchase Price	Yearly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
PROCESSOR AND MAIN STORAGE				
Model 20 Processor with 10K characters of core storage and File Access Channel	11,000	672**	320	280
10K Core Memory Unit	4,950	74	125	105
Input/Output Channel	950	147	35	30
PERIPHERAL UNITS				
Model 40 Disc Drive	12,000	600	335	290
Disc Controller	2,500	201	75	65
Auxiliary Disc Controller	500	—	15	10
Disc Pack	400	—	—	—
Model 45 Magnetic Tape Drive	12,000	1,055	375	330
Magnetic Tape Controller	2,500	149	70	60
Model 30 Card Reader	6,000	823	210	190
Model 35 Card Punch	9,000	1,074	305	270
Model 60 Paper Tape Reader	3,800	455	130	115
Model 65 Paper Tape Punch	4,500	709	165	150
Model 50 Line Printer	18,000	1,558	560	495
Model 70 Workstation	3,950	362	125	110
On-Line Communications Adapter	5,750	147	150	130
Synchronous Communications Adapter #1	5,750	156	150	130
Synchronous Communications Adapter #2	6,250	165	160	145

* All rental prices include equipment maintenance.

** Processor maintenance charge includes one Input/Output Channel.