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GE-100 Series

> Though their future is uncertain at this writing, the Italian-made GE-100 Series computers offer a proven combination of hardware, software, "bundled" support, and economy that qualifies them for most small-scale business data processing applications. They are also finding widespread use as remote terminals for larger computers.

MANAGEMENT SUMMARY

The GE-100 Series is a line of small-scale business data processing systems designed and produced by GE's Italian computer operation, General Electric Information Systems Italia. The steadily expanding GE-100 Series product line has achieved widespread acceptance in the international computer market; by the end of 1969 more than 1500 systems were installed or on order, mainly outside the United States.

Because its capabilities and performance overlap the lower end of the Honeywell Series 200 product line, many industry observers expect the GE-100 Series to be a casualty of the planned Honeywell purchase of GE's computer operations—at least insofar as continuing U.S. marketing efforts are concerned. Even so, the large customer base of installed and on-order systems insures that the GE-100 Series will occupy a significant role on the world computer scene for some time to come.

The GE-115, first member of the series, was introduced in March 1965, and customer deliveries began in April 1966. The 115 was originally offered to the U.S. market as a remote terminal system with a very limited complement of peripheral equipment. Later, magnetic tape and disc storage capabilities were added to equip the 115 for effective performance in most small-scale data processing applications. ▷

CHARACTERISTICS

MANUFACTURER: General Electric Company, Information Systems, 13430 North Black Canyon Highway, Phoenix, Arizona 85029.

MODELS: GE-105, GE-115, GE-120, and GE-130.

DATA FORMATS

BASIC UNIT: 8-byte, called an "octet" by GE. Each byte can represent 1 alphanumeric character, 1 or 2 BCD digits (in unpacked or packed format, respectively), or 8 binary bits.

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes in length for arithmetic operations and from 1 to 256 bytes for data movement operations. Unpacked decimal operations process only the four rightmost bits of each byte and are unsigned. Packed decimal operations are performed upon two BCD digits in each byte, with the sign represented by the four rightmost bits of the low-order byte.

FLOATING-POINT OPERANDS: No hardware facilities; floating-point arithmetic is handled by subroutines.

INSTRUCTIONS: 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively. Arithmetic instructions are 6 bytes long and consist of a 1-byte operation code, a 1-byte "operation complement" that specifies the lengths of the two operands, and two 2-byte operand addresses.

INTERNAL CODE: Standard internal code is an 8-bit code that is not directly compatible with either EBCDIC or ASCII; but an effective Translate instruction facilitates code conversions.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: See table.

CYCLE TIME: See table.

CHECKING: Parity bit with each byte is generated during writing and checked during reading.

STORAGE PROTECTION: None. ►

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▷ The GE-130 was added to the line in April 1968. It offers approximately three times the internal speed of the GE-115, together with a greatly expanded instruction repertoire, index registers, an additional I/O channel, and increased core storage capacity.

The GE-105, introduced early in 1969, is the "economy model" within the 100 Series. It uses the same instruction repertoire as the GE-115 and is slightly slower. A 4K GE-105 system with 350-cpm card reader, 60-200-cpm card punch, and 250-lpm printer can be rented for only $1,250 per month. Neither magnetic tape nor disc storage can be used in a GE-105 system.

The GE-105RTS (Remote Terminal System), announced in mid-1969, is a special configuration of the GE-105 designed to serve as a programmable communications terminal for use with larger computers made by GE or other manufacturers. A 4K GE-105RTS with 300-cpm card reader, 250-lpm printer, and 2000/2400-bps communications interface rents for $1,145 per month. Software is already available for linking the GE-105RTS with GE-400 Series, GE-600 Series, IBM System/360, and UNIVAC 1108 computers.

The GE-120 was added to the series in mid-1969. It rounds out the line by filling the performance gap between the GE-115 and GE-130. The 120 has the same processing facilities as the 130 and exactly half its internal speed. Moreover, its rental price—only $150 above the corresponding GE-115 processor—makes it an attractive upgrade for most current users of the 115.

The GE-100 Series central processor architecture is oriented toward the processing of variable-length decimal and alphanumeric operands. As in most third-generation computer systems, the basic unit of data representation is an 8-bit byte (called an "octet" in GE literature). Each byte can hold one alphanumeric character or one or two decimal digits—but the restricted instruction set of the GE-105 and GE-115 processors permits decimal addition and subtraction to be performed only in the "unpacked" mode, in which each byte contains only one digit. All addressing in the GE-105 and GE-115 is necessarily direct, since no facilities for address modification by indexing or indirect addressing are provided. Also lacking in the two smaller processors are multiply and divide instructions, though standard subroutines are available to perform these functions.

The expanded processing capabilities of the GE-120 and GE-130 processors include complete arithmetic facilities and eight index registers. Simultaneity of all the GE-100 Series processors, however, is somewhat below par for third-generation computers; complex interrelationships govern the combinations of peripheral devices that can operate simultaneously with one another and with computing, and the unbuffered card readers and printers ▷

▶ **CENTRAL PROCESSORS**

INDEX REGISTERS: The GE-120 and GE-130 Processors have 8 two-byte index registers located in reserved core storage locations. No indexing facilities are provided in the GE-105 and GE-115 Processors.

INDIRECT ADDRESSING: None.

INSTRUCTION REPERTOIRE: The GE-105 and GE-115 Processors have 38 instructions. Arithmetic operations are limited to addition and subtraction of variable-length operands in binary and unpacked, unsigned decimal formats. Also provided are efficient facilities for data movement, comparisons, editing, searching, logical operations (AND, OR, Exclusive OR), packing, unpacking, code translation, and conditional branching.

The GE-120 and GE-130 Processors have 67 instructions. In addition to all the instructions described above, they can perform addition, subtraction, multiplication, and division on signed, packed decimal operands. Also included are instructions for loading, incrementing, testing, and storing the eight index registers, as well as expanded logical and branching facilities.

INSTRUCTION TIMES: See table.

INPUT/OUTPUT CONTROL

I/O CHANNELS: There are, effectively, two channels in the GE-105 and GE-115 Processors and three channels in the GE-120 and GE-130 Processors.

CONFIGURATION RULES: GE-105 systems have "set" configurations and permit few additions. The GE-105A includes a 350-cpm reader, 60-200-cpm punch, and 250-lpm printer; a 500-cps paper tape reader is the only other peripheral device allowed. The GE-105B includes a 300-cpm reader/punch and 300-lpm printer; a 400-cpm card reader or 500-cps paper tape reader can be added. The GE-105 RTS includes a 300-cpm reader, 250-lpm printer, and 2000/2400-bps synchronous single-line communications controller; a 60-200-cpm card punch can be added.

The GE-115 Processor has four peripheral connectors. Connectors 1 and 2 link an unbuffered printer and card reader, respectively, to integrated controllers within the processor. Connector 4 can accommodate one card punch, card reader/punch, buffered printer, paper tape reader, or single-line communications controller. Connector 3 can accommodate up to 64 peripheral devices or subsystems, including magnetic tape, disc storage, card punches, card reader/punches, buffered printers, and/or paper tape readers; Multiple Peripheral Adapters are required if more than one device or subsystem is attached to Connector 3. A maximum of four disc storage subsystems and four magnetic tape subsystems can be connected to a GE-115.

The GE-120 and GE-130 Processors each have four peripheral connectors. Connectors 1 and 2 link an unbuffered printer and card reader, respectively, to integrated controllers within the processor. Connectors 3 and 4 can each accommodate up to 16 peripheral devices or subsystems; Multiple Peripheral Adapters are required if more than one device or subsystem is attached to either connector.

SIMULTANEOUS OPERATIONS: Two concurrent I/O operations can be performed in a GE-105 system, but ▶

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CHARACTERISTICS OF THE GE-100 SERIES PROCESSORS

	GE-105A	GE-105B	GE-105RTS	GE-115	GE-120	GE-130
MAIN STORAGE						
Cycle time, microseconds	7.5	7.5	7.5	6.5	4	2
Bytes fetched per cycle	1	1	1	1	1	1
Minimum capacity, bytes	4,096	8,192	4,096	4,096	12,288	16,384
Maximum capacity, bytes	8,192	8,192	8,192	16,384	24,576	32,768
PROCESSOR						
No. of instructions	38	38	38	38	67	67
No. of index registers	0	0	0	0	8	8
Instruction times, microseconds:						
Add (5 digits, unpacked)	120	120	120	114	88	44
Add (5 digits, packed)	*	*	*	*	68	34
Multiply (5 digits)	*	*	*	*	1020	510
Divide (10 by 5 digits)	*	*	*	*	1648	824
Move (5 bytes)	120	120	120	104	68	34
Compare (5 bytes)	120	120	120	114	88	44
Branch	30	30	30	26	20	10
INPUT/OUTPUT CONTROL						
No. of I/O channels	2	2	2	2	3	3
No. of peripheral connectors	–	–	–	4	4	4
Maximum simultaneous I/O operations (unbuffered)	2	2	2	2	3	3
Magnetic tape capability	No	No	No	Yes	Yes	Yes
Disc storage capability	No	No	No	Yes	Yes	Yes
Data communications capability	No	No	Yes	Yes	Yes	Yes

* Instruction not available.

▷ impose significant delays upon the processors. The program interrupt facility is limited to detection of interrupt signals from communications controllers.

GE offers a fairly wide choice of peripheral equipment for the 100 Series, including magnetic tape units, card readers, punches, and printers in an appropriate range of speeds. Also available are disc pack drives in a choice of three different on-line storage capacities. Data communications interfacing is handled by a variety of single-line controllers plus a recently introduced multi-line controller.

The GE-100 Series software complement is impressive in its scope. Users of tape or disc systems can do their programming in assembly language, COBOL, FORTRAN, or RPG. Four different operating systems are available, but all are straightforward batch monitors with no multiprogramming capabilities. Because no console typewriter is currently available, all communication with the operating systems is via the on-line card reader and printer.

Within the GE-100 Series, there is a high degree of upward compatibility in both hardware and software. The expanded instruction repertoires and assembly languages of ▷

▶ internal processing is suspended during unbuffered I/O data transfers.

In GE-115 systems, the two I/O channels can be switched to handle various combinations of two simultaneous I/O operations. Internal processing is suspended during magnetic tape, disc storage, and paper tape read or write operations, as well as during most of each card reading or unbuffered line printing cycle. Previously initiated operations on buffered I/O devices (card punches, reader/punches, and buffered printers) can be overlapped with unbuffered I/O operations using the same channels.

In GE-120 and GE-130 systems, the three I/O channels can be switched to handle various combinations of peripheral devices. Two I/O operations can occur simultaneously with internal processing, and three simultaneous I/O operations are possible when internal processing is suspended. In addition, previously initiated operations on buffered I/O devices can be overlapped with unbuffered I/O operations on the same channels.

MASS STORAGE

DSS110 REMOVABLE DISC STORAGE SUBSYSTEM: Provides low-cost random-access storage on interchangeable single-disc cartridges. The subsystem consists of a Disc Controller plus one to four DSU110 Double-Spindle Disc Units. Each unit has two separate drive spindles, each capable of holding one disc, and a single positioning mechanism with four heads, one for each disc surface. The discs are 14 inches in diameter and have 200 data ▶

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▷ the GE-120 and GE-130 systems include all the facilities of the smaller GE-105 and GE-115 systems, so programs written for a 105 or 115 can easily be run on the larger systems.

There is no program compatibility, at the machine or assembly-language level, between the GE-100 Series systems and other computers from GE or competitive manufacturers. The GE-100 Series COBOL and FORTRAN compilers, however, are in reasonable accord with the current American standards for these languages, and an IBM-compatible Report Program Generator is available for the GE-120 and GE-130. The 8-bit internal code used in the GE-100 Series is neither ASCII nor EBCDIC, but a code translation instruction facilitates conversions to and from the standard codes. The 7- and 9-track tape handlers for the GE-100 Series use IBM-compatible recording formats. Although the DSU130 and DSU160 Disc Storage Units use standard 6-disc packs, their recording formats differ from the ones used in IBM disc drives.

GE has not unbundled its pricing to date, so the GE-100 Series equipment prices also cover normal technical support, educational courses, and software. The basic rental prices include equipment maintenance. Hardware reliability of the installed systems has been quite satisfactory, though some users have been less than satisfied with the quality of the maintenance service.

The GE-100 Series was the first product line to result from GE's large investment in the European computer industry. Designed by General Electric Information Systems Italia (formerly Olivetti-GE), most of the 100 Series equipment is produced in Caluso, Italy. Some of the peripheral devices are manufactured in France, the Netherlands, and the United States.

U.S. marketing of the 100 Series was initially handled by GE's Small Computer Marketing Operation (SCOMO), with headquarters in Bridgeport, Connecticut. The 100 Series was the first foreign-made computer line to be seriously marketed to U.S. computer users, and GE appeared to be somewhat apprehensive about the reception it would receive (though there can be little doubt that the GE nameplate helped a lot). Therefore, SCOMO kept a rather low profile in the computer marketplace and concentrated its sales activities in a few major cities. Within the past year, SCOMO has been integrated into GE's regular computer marketing organization, headquartered in Phoenix, and the 100 Series has begun to receive the attention it deserves both within GE's own ranks and among U.S. computer users.

In marketing the 100 Series, GE has placed particular emphasis upon manufacturing, distribution, retailing, hospital administration, insurance, and banking applications. In April 1970, GE introduced specialized banking ▷

▶ tracks on each of the 2 recording surfaces. Each track is divided into 10 sectors, and each sector can hold 384 six-bit characters or 576 four-bit numeric digits. Total storage capacity of each disc cartridge is 1,536,000 alphanumeric characters or 2,304,000 numeric digits. Average head movement time is 75 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 208,000 six-bit characters or 312,000 four-bit numeric digits per second.

DSS130 REMOVABLE DISC STORAGE SUBSYSTEM: Provides economical random access storage on industry-standard removable disc packs with 6 discs each. The subsystem consists of a DSC130 Disc Controller plus one to five DSU130 Disc Storage Units. Each unit holds one disc pack at a time and has a comb-type access mechanism with one head serving each of the 10 recording surfaces. There are 100 data tracks on each recording surface. Each track is normally divided into 20 addressable sectors, and each sector can hold 100 six-bit characters or 150 four-bit numeric digits. Total storage capacity of each disc pack is 2,000,000 alphanumeric characters or 3,000,000 numeric digits. Average head movement time is 95 milliseconds, average rotational delay is 20 milliseconds, and data transfer rate is 50,000 six-bit characters or 75,000 four-bit digits per second. (In the alternative "full track" mode, each track can hold a single record consisting of up to 2,980 alphanumeric characters or 4,470 numeric digits; data transfer rate in this mode is 77,500 characters or 116,500 digits per second.)

DSS161 REMOVABLE DISC STORAGE SUBSYSTEM: Provides moderate-capacity random-access storage on industry-standard removable disc packs with 6 discs each. The subsystem consists of a DSC161 Disc Controller plus one to eight DSU160 Disc Storage Units. Each unit holds one disc pack at a time and has a comb-type access mechanism with one head serving each of the 10 recording surfaces. There are 200 data tracks on each recording surface. Each track is divided into 10 addressable sectors, and each sector can hold 384 six-bit characters or 576 four-bit numeric digits. Total storage capacity of each disc pack is 7,680,000 alphanumeric characters or 11,520,000 numeric digits. Average head movement time is 75 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 208,000 six-bit characters or 312,000 four-bit digits per second.

INPUT/OUTPUT UNITS

MAGNETIC TAPE SUBSYSTEMS: Read and record data on standard 1/2-inch tape in IBM-compatible formats. Each subsystem consists of a controller and up to six tape handlers (or up to four of the MTH110 and MTH111 or eight of the MTH163 and MTH166 Handlers). The newer MTH101, MTH110, MTH111, MTH163, and MTH166 Handlers feature a single-capstan drive mechanism for reduced tape wear and simplified operation. Characteristics of the available tape handlers are summarized below in terms of number of tracks, tape speeds (in inches per second), recording densities (in bits per inch), and data transfer rates (in bytes or characters per second).

MTH101: 9 tracks; 18.75 ips; 800 bpi; 15,000 bytes/sec.

MTH103: 9 tracks; 37.5 ips; 800 bpi; 30,000 bytes/sec (option permits 7-track operation at 200, 556, or 800 bpi). ▶

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▷ configurations of the GE-105 and GE-115 systems, both built around a 600-dpm MICR reader/sorter. The GE-105 Remote Banking System is designed for use in a correspondent bank or remote data collection center, from which it transmits data to a central GE-600 Series computer system. The GE-115 Bank Information System is a free-standing, disc-oriented system for MICR processing in small to medium-sized banks.

In summary, the GE-100 Series computer systems, while lacking any really outstanding virtues, present a well-balanced combination of hardware, software, economy, and "bundled" support that make them effective performers in many small-scale business data processing applications. ☐

▶ **MTH106:** 9 tracks; 75 ips; 800 bpi; 60,000 bytes/sec (option permits 7-track operation at 200, 556, or 800 bpi).

MTH110: 7 tracks; 18.75 ips; 200 or 556 bpi; 3,750 or 10,400 char/sec.

MTH111: 7 tracks; 18.75 ips; 200, 556, or 800 bpi; 3,750 to 15,000 char/sec.

MTH163: 9 tracks; 18.75 ips; 1,600 bpi; 30,000 bytes/sec (options permit operation in 9-track mode at 800 bpi and/or 7-track mode at 200, 556, or 800 bpi).

MTH166: 9 tracks; 37.5 ips; 1,600 bpi; 60,000 bytes/sec (options permit operation in 9-track mode at 800 bpi and/or 7-track mode at 200, 556, or 800 bpi).

CRZ100 CARD READER: Reads 80-column cards serially by column at 300 cpm. Can read Hollerith and column binary codes. Has a 500-card feed hopper and single 500-card stacker. Connects to the integrated card reader controller of a GE-100 Series Processor.

CRZ111 CARD READER: Reads 80-column cards serially by column at 400 cpm. Can read Hollerith and column binary codes. Has a 2000-card feed hopper, a 2000-card primary stacker, and a program-selectable 500-card auxiliary stacker. An option permits reading of 51-column cards. Connects to the integrated card controller of a GE-100 Series Processor.

CRZ120 CARD READER: Has all the characteristics of the CRZ111 Reader, above, plus a higher speed of 600 cpm.

CPZ101 CARD PUNCH: Punches 80-column cards serially by column at 60 to 200 cpm, depending upon the number of columns punched. Can punch Hollerith and column binary codes. Has a 1500-card feed hopper and single 1500-card stacker. Contains an integral controller and buffer.

CPZ103 CARD PUNCH: Punches 80-column cards in parallel, row-by-row fashion at 300 cpm. Can punch Hollerith and column binary codes. Has a 1200-card feed hopper, a 1200-card primary stacker, and a 100-card auxiliary stacker. Contains an integral controller and buffer. ▶
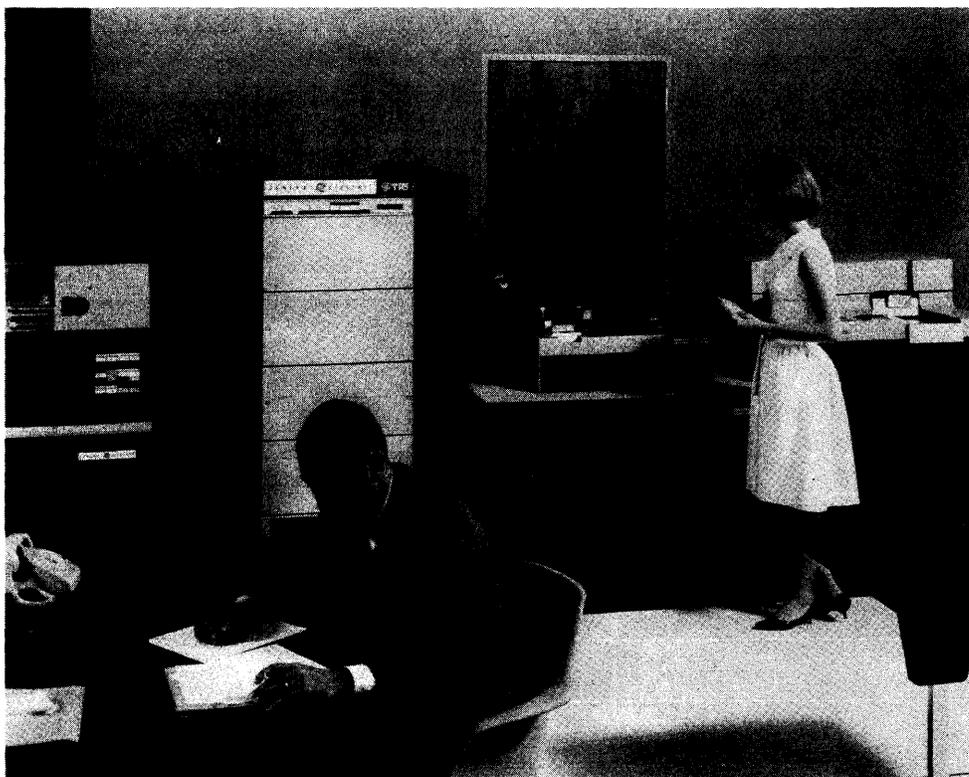
This card-oriented GE-115 system includes (from left to right) printer, central processor, card reader, and punch.

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CRP100 CARD READER/PUNCH: Can read, punch, or read and punch simultaneously at the rate of 300 cpm. Both reading and punching are done in row-by-row fashion, in Hollerith or column binary code (or both codes intermixed). Has two feed hoppers and three output stackers; the primary hopper and stacker hold 3,000 cards each. Contains an integral controller and buffers.

PTR100 PAPER TAPE READER: Reads 5-, 7-, or 8-level punched tape photoelectrically at 500 char/sec. Eight-inch supply and take-up reels hold 1,000 feet of tape. Contains an integral controller.

PTP110 Paper Tape Punch: Punches 5-, 7-, or 8-level tape at 60 char/sec. Contains an integral controller.

PTP120 PAPER TAPE PUNCH: Punches 5-, 6-, 7-, or 8-level tape at 150 char/sec. Contains an integral controller.

PRT100 PRINTER: Prints 300 lines per minute, using all 64 graphic characters on the rotating print drum. Has 104 print positions, optionally expandable to 120 or 136 positions. Skipping speed is 17 inches per second, and vertical format is controlled by a paper tape loop. Accommodates continuous forms from 3.5 to 22 inches in width. Connects to the integrated (unbuffered) printer controller of a GE-100 Series Processor.

PRT110 PRINTER: Has all the characteristics of the PRT100 Printer, above, plus a higher speed of 620 lpm when all 64 characters are used. A Fast Skip option provides a skipping speed of 63 inches per second on skips of more than 3 lines.

PRT120 BUFFERED PRINTER: Prints 620 lines per minute when all 64 graphic characters are used, or 780 lpm when printing is restricted to a set of 48 contiguous characters. Has 120 print positions, optionally expandable to 136. Skipping speed is 17 inches per second; a Fast Skip option provides a speed of 63 inches per second on skips of more than 3 lines. Vertical format is controlled by a paper tape loop. Accommodates continuous forms from 3.25 to 22 inches in width. Contains an integrated controller and buffer.

PRT130 BUFFERED PRINTER: Has all the characteristics of the PRT120 Printer, above, plus a higher speed of 830 lpm when all 64 characters are used or 1100 lpm for a 48-character subset. The Fast Skip feature is standard.

MRS101 DOCUMENT READER/SORTER: Reads and sorts MICR-encoded documents at a speed of up to 600 six-inch documents per minute. Usable for on-line MICR input or off-line sorting. Has 10 sorting pockets and 1 reject pocket. Handles documents from 5.8 to 8.75 inches in length and 2.5 to 4.25 inches in width.

MANUAL PERIPHERAL SWITCHES: Permit manual switching of the physical connections between GE-100 Series processors and peripheral subsystems. The PSU100 is used to switch one processor connector between two peripheral subsystems, while the PSU101 is used to switch one peripheral subsystem between two different processors.

COMMUNICATIONS CONTROL

SINGLE-LINE COMMUNICATIONS CONTROLLERS: These devices equip a GE-100 Series Processor to transmit and receive data over a single communications line. Most models perform a transverse parity check on each character and a longitudinal parity check on each message. The available models and their principal characteristics are as follows:

SLC100: Operates in synchronous mode at 2000 bps over switched voice-grade lines or 2400 bps over a private line.

SLC102: Operates in synchronous mode at 19,200, 40,800, or 50,000 bps.

SLC103: Links a GE-100 Series Processor directly to another computer located within 150 feet of it; data is transferred at up to 150,000 bps.

SLC111: Operates in asynchronous mode at 110, 150, 300, 600, or 1200 bps, using ASCII code.

SLC112: Operates in synchronous mode over Telpak lines at up to 150,000 bps, using ASCII code.

SLC113: Operates in synchronous mode at 2000 or 2400 bps, using ASCII code.

SLC114: Operates in synchronous mode at variable speeds, depending upon the data set used.

SLC115: Operates in synchronous mode at 1200, 2000, 2400, or 4800 bps, using XS3 code.

MLC104 MULTI-LINE COMMUNICATIONS CONTROLLER: Enables a GE-115, GE-120, or GE-130 Processor to transmit and receive data over up to 16 communications lines. Controls asynchronous transmission at up to four different speeds selected at installation time from ten possible speeds: 45.5, 50, 75, 110, 131.5, 150, 200, 300, 600, and 1200 bits per second. Consists of a basic controller (the MLC104) and one to four line control modules (LCA104). Each module can handle either four half-duplex or two full-duplex transmissions. Each connected line also requires one of five different types of Line Terminators. The basic controller includes a 4K buffer, which can be divided into either eight 510-byte sections (when eight lines or less are connected) or sixteen 254-byte sections. The terminals that can be used with the MLC104 are the Teletype Models 33, 35, and 37. An MPA (Multiple Peripheral Adapter) makes it possible to connect up to four MLC104 subsystems to a single processor.

SOFTWARE

Software support for the GE-100 Series is furnished at five basic levels, designed for:

● Card-oriented GE-105 and GE-115 systems with a minimum of 4K bytes of core storage.

● Magnetic tape-oriented GE-115 systems with at least 8K bytes.

● Disc-oriented GE-115 systems with at least 8K bytes.

● Magnetic tape-oriented GE-120 and GE-130 systems.

● Disc-oriented GE-120 and GE-130 systems.

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► An operating system is associated with each software level except the lowest (card-oriented) one; these systems are described in the following paragraphs.

TAPE OPERATING SYSTEM: TOS is a simple batch-mode operating system designed to facilitate the operation of tape-oriented GE-115 systems. It requires an 8K GE-115 with card reader, printer, and 3 magnetic tape handlers. Under the direction of system control cards, TOS handles the loading, processing, termination, and linking of successive jobs with a minimum of operator intervention.

DISC OPERATING SYSTEM: DOS is a simple batch-mode operating system for disc-oriented GE-115 systems. It requires an 8K GE-115 with card reader, printer, and 2 disc drives. Larger storage capacities, magnetic tape handlers, and other peripheral devices are also supported. DOS requires the first 1600 bytes of core storage, plus an additional 500 bytes if magnetic tape is used. Under the direction of system control cards, DOS handles the loading, processing, termination, and linking of successive jobs. Facilities for compilation, debugging, and library maintenance are also provided. DOS maintains three important program files: (1) the System Disc, which holds compilers, utility programs, subroutines, system management programs, etc.; (2) the Library Disc, which contains debugged user programs; and (3) the Master Disc, which holds all the linked-together programs that are to constitute the job flow within the system for a given period of time.

EXTENDED TAPE OPERATING SYSTEM: ETOS is a batch-mode operating system for tape-oriented GE-120 and GE-130 systems. It requires a 12K GE-120 or 16K GE-130 processor, card reader, printer, and 4 magnetic tape handlers. ETOS also requires a reserved area of approximately 2400 bytes of core storage to hold the Supervisor and other necessary routines and data. Under the direction of system control cards, ETOS handles the loading, processing, termination, and linking of successive jobs. Programs can be assembled or compiled, tested, debugged, inserted into a library tape, maintained, and executed through the use of ETOS and its related software facilities.

EXTENDED DISC OPERATING SYSTEM: EDOS is a batch-mode operating system for disc-oriented GE-120 and GE-130 systems. It requires a 16K GE-120 or 16K GE-130 processor, card reader, printer, and 2 disc drives. Up to 16 disc drives, 8 magnetic tape handlers, and a variety of other peripheral equipment can be supported. The facilities of EDOS are similar to those of DOS, as described above.

COBOL: GE offers COBOL compilers for tape and disc-oriented GE-115, GE-120, and GE-130 computer systems. The GE-115 compilers require a 12K processor, card reader, printer, and either 4 tape handlers (for operation under TOS) or 2 disc drives (for operation under DOS). The GE-120/130 compilers require a 16K processor, card reader, printer, and either 4 tape handlers (for operation under ETOS) or 2 disc drives (for operation under EDOS). There are no significant differences in the COBOL language elements implemented in the various compilers. GE-100 Series COBOL is a reasonably comprehensive implementation of the COBOL-65 language. It includes the Random Access, Report Writer, and Segmentation features which are missing from many competitive COBOL compilers, as well as facilities for the inclusion of subprograms written in assembly language.

Among the COBOL-65 facilities which are not included in GE-100 Series COBOL are the Sort and Library modules.

FORTRAN: GE offers FORTRAN compilers for GE-100 Series systems with the following hardware configurations: 12K GE-115 systems with either 4 tape handlers or 2 disc drives, or 16K GE-120 or GE-130 systems with 4 tape handlers. (A card reader and printer are also required in all cases.) The source language is essentially USASI Basic FORTRAN, with a few useful extensions such as the Logical IF statement and the ability to use 6-character names.

LOGEL: A "medium-level" programming language, designed to facilitate the coding of programs for report writing and other common business data processing functions on small GE-100 Series systems. LOGEL (for LOgic GEnerating Language) is comparatively easy to learn and use. Source programs are written on fixed-format coding sheets and composed of five divisions: General, which describes the I/O media and peripheral devices; Input, which describes the input records to be processed; Data, which defines the data fields, work areas, and constants; Calculation, which defines the processing to be performed; and Format, which describes the output records to be produced. There are three different versions of LOGEL:

LOGEL 1 provides a basic program-generating capability and can be used on a 4K GE-105 or GE-115 system with card reader, punch, and printer. It provides 28 instructions and can handle only one input file, one output file, and one printed report per program. The LOGEL 1 processor generates a Basic APS source program which is then assembled to produce the desired object program.

LOGEL 2 is an extension of LOGEL 1 for use on 8K GE-105 and GE-115 card systems. It provides 58 instructions and can process two input files and produce up to three output files plus a printed report.

LOGEL 3 is a further extension, designed for use on 8K GE-115 systems with card reader, printer, and either three magnetic tape handlers or two disc drives. It can handle up to 10 files, in various combinations, plus a printed report. The LOGEL 3 processor generates an Extended APS program that can be assembled and executed under either TOS or DOS. Programs written in LOGEL 1 and 2 can be compiled by the LOGEL 3 processor.

RPG: The GE-120/130 Report Program Generator enables users of the larger GE-100 Series systems to write business data processing programs in the widely-used IBM RPG language. Data from five types of user-prepared specification sheets (File Description, File Extension, Input, Calculation, and Output-Format) is used to generate machine-language object programs. Any combination of up to 10 files can be handled in an RPG object program, and disc files can be organized in sequential, indexed sequential, or random fashion. The RPG processor runs under either ETOS or EDOS and requires a 12K GE-120 or 16K GE-130 processor with card reader, printer, and either two disc drives or three magnetic tape units.

ASSEMBLY PROGRAMMING SYSTEM: APS is the symbolic programming language used to write machine-oriented programs for the GE-100 Series systems. It is provided in three different, upward-compatible versions: (1) Basic APS, for card-oriented GE-105 and GE-115 systems; (2) GE-115 Extended APS, for tape and disc- ►

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GE-100 Series

▶ oriented GE-115 systems running under TOS or DOS; and (3) GE-130 Extended APS, for tape and disc-oriented GE-120 and GE-130 systems running under ETOS and EDOS.

Basic APS is a simple one-for-one assembler that permits the use of mnemonic operation codes and symbolic addresses. It also provides a number of pseudo-instructions that control the assembly process, reserve storage areas, define data fields and constants, and define I/O operations. The programmer uses a fixed-format coding sheet, and the assembly process requires two passes of the source program deck. Basic Input/Output System (BIOS) subroutines can be incorporated into the Basic APS programs to facilitate I/O programming.

GE-115 Extended APS provides all the facilities of Basic APS plus macro-instructions and program segmentation facilities. Macros are provided for input/output, multiplication, division, signed addition and subtraction, radix conversions, and a variety of other functions. The segmentation facilities make it possible to divide a program into logical segments and overlay these segments in core storage.

GE-130 Extended APS is designed for use on GE-120 and GE-130 systems operating under ETOS or EDOS. It permits full use of the expanded instruction repertoires of the GE-120 and GE-130 processors, as well as an extensive library of macro-instructions. Programs written in either of the lower-level versions of APS can be assembled by GE-130 Extended APS.

UTILITY ROUTINES: Three input/output control systems facilitate the coding of I/O operations. The Basic Input/Output System (BIOS) is a set of subroutines that handle reading and writing of physical records on card units, printers, and magnetic tape units. The GE-115 Extended Input/Output System (EIOS) is a set of macro-instructions that handle the input and output of logical records on tape and disc-oriented GE-115 systems. GE-130 EIOS is a more powerful version for use on tape and disc-oriented GE-120 and GE-130 systems.

Tape and disc sort/merge generators are available for GE-115 systems with at least 8K bytes and three tape handlers or two disc drives, and for GE-120 and GE-130 systems with at least 12K bytes and four tape handlers or two disc drives.

Each level of GE-100 Series software support also includes an appropriate complement of data transcription, diagnostic, and other utility routines.

APPLICATION PROGRAMS: The limited number of packages announced to date include:

Remote Terminal Routine Package—controls a GE-100 Series computer linked to another computer in a message exchange and processing environment, with the GE-100 acting as either the central or satellite computer.

GE Inventory Management System (GEIMS)—a random-access system for manufacturing operations; requires a 12K processor with two disc drives.

PROCON-115—a production control system for small manufacturers; requires a 4K card system.

Critical Path Method—aids in scheduling and control of complex projects; available in 4K card and 8K tape versions.

Matrix Inversion—inverts square matrices in floating point format.

PRICING

EQUIPMENT: The following systems are typical of the types of GE-100 Series systems that are commonly installed and are supported by standard GE software. All necessary control units and adapters are included in the indicated prices, and all rentals include equipment maintenance.

GE-105A CARD SYSTEM: Consists of 4K GE-105 Processor, 350-cpm card reader, 60-200-cpm card punch, and 250-lpm printer. Monthly rental and purchase prices are $1,250 and $57,370, respectively.

GE-105 REMOTE TERMINAL SYSTEM: Consists of 4K GE-105 Processor, 300-cpm card reader, 250-lpm printer, and 2000/2400-bps synchronous single-line communications controller. Monthly rental and purchase prices are $1,145 and $56,670, respectively.

GE-115 TAPE SYSTEM: Consists of 8K GE-115 Processor, four MTH101 Magnetic Tape Handlers (15KB), 300-cpm card reader, 60-200-cpm card punch, and 300-lpm printer. Monthly rental and purchase prices are $3,020 and $123,570, respectively.

GE-120 DISC SYSTEM: Consists of 16K GE-120 Processor, two DSU130 Disc Storage Units, 600-cpm card reader, 60-200-cpm card punch, and 780-lpm buffered printer. Monthly rental and purchase prices are $3,690 and $146,890, respectively.

GE-130 TAPE SYSTEM: Consists of 32K GE-130 Processor, six MTH163 Magnetic Tape Handlers (30KB), 600-cpm card reader, 300-cpm card punch, and 1100-lpm buffered printer. Monthly rental and purchase prices are $7,280 and $301,971, respectively.

SOFTWARE AND SUPPORT: GE has not "unbundled" to date, so the equipment prices listed above include all of the GE software described in this report and all normal educational courses and professional assistance.

CONTRACT TERMS: The standard GE rental agreement entitles the customer to unlimited usage of the equipment. However, if the equipment is used for more than 25 shifts per month, an additional charge of 20% of the basic monthly maintenance charge is imposed to compensate for increased stress on the equipment. If usage exceeds 50 shifts per month, the additional charge is 30% of the basic monthly maintenance charge. The standard agreement provides maintenance of the equipment for five 9-hour days per week. Extended periods of maintenance coverage are available at extra cost.

Long-term leases of GE computer equipment, with full GE support, are offered by the Systems Capital Corporation under its "4-5-6 Plan." Monthly savings, as compared with the GE rental charges under a standard one-year rental agreement, are approximately 9% for a four-year lease, 12.5% for a five-year lease, and 18% for a six-year lease. ■

GE-100 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*
PROCESSORS AND MAIN STORAGE				
105A04	GE-105A Central Processor with 4K Memory, 350-cpm Reader, 60-200-cpm Punch, and 250-lpm Printer	57,470	261	1,250
105B08	GE-105B Central Processor with 8K Memory, 300-cpm Reader/Punch, and 300-lpm Printer	66,410	285	1,450
105RT1	GE-105 Remote Terminal System with 4K Memory, 300-cpm Reader, 250-lpm Printer, and 2000/2400-bps Synchronous Single-Line Communications Controller for ASCII code	56,670	194	1,145
105RT2	Same as 105RT1, except for XS3 communications code	56,670	194	1,145
AMM105	4K Additional Memory Module (for 105A04, 105RT1, or 105RT2)	8,520	13	180
OPT105	16 Additional Print Positions (for any GE-105 system)	1,540	8	35
115A04	GE-115 Central Processor, 4K Memory	25,440	40	570
115A08	GE-115 Central Processor, 8K Memory	30,910	50	700
115A12	GE-115 Central Processor, 12K Memory	41,760	80	950
115A16	GE-115 Central Processor, 16K Memory	52,800	100	1,200
OPT005	GE-115 Accelerator	2,200	5	50
MPA115	GE-115 Multiple Peripheral Adapter	3,075	6	70
120A12	GE-120 Central Processor, 12K Memory	46,750	126	1,100
120A16	GE-120 Central Processor, 16K Memory	57,600	150	1,350
120A24	GE-120 Central Processor, 24K Memory	70,320	185	1,650
MPA120	GE-120 Multiple Peripheral Adapter	3,340	5	75
130A16	GE-130 Central Processor, 16K Memory	88,800	150	2,000
130A24	GE-130 Central Processor, 24K Memory	111,120	185	2,500
130A32	GE-130 Central Processor, 32K Memory	133,440	220	3,000
MPA130	GE-130 Multiple Peripheral Adapter	3,312	6	75
MASS STORAGE				
DSS110	Basic Double-Spindle Random Access Subsystem (controller and 1 DSU 110)	26,975	63	625
DSU110	Additional Double Spindle Disc Unit	13,728	39	325
DSC130	Removable Disc Storage Controller	13,055	28	300
DSU130	Removable Disc Storage Unit	10,705	52	275
DSC161	Removable Disc Storage Controller	19,872	36	450
DSU160	Removable Disc Storage Unit	25,510	70	590
INPUT/OUTPUT UNITS				
MTS101	Basic Magnetic Tape Subsystem; 9 tracks, 15KB (controller and 1 handler)	30,096	73	700
MTH101	Magnetic Tape Handler; 9 tracks, 15KB	10,128	39	250
OPT171	7-Track Compatibility Option (1 required per MTS101 (subsystem)	2,208	4	50
MTC103	Magnetic Tape Controller; 9 tracks, 30KB	18,870	57	450
MTH103	Magnetic Tape Handler; 9 tracks, 30KB	11,430	82	320
MTC106	Magnetic Tape Controller; 9 tracks, 60KB	18,870	57	450
MTH106	Magnetic Tape Handler; 9 tracks, 60KB	17,480	116	480
MTS110	Basic Magnetic Tape Subsystem; 7 tracks, 10.4KC (controller and 1 handler)	20,880	65	500
MTH110	Magnetic Tape handler; 7 tracks, 10.4KC	8,450	39	215
MTS111	Basic Magnetic Tape Subsystem; 7 tracks, 15KC (controller and 1 handler)	23,280	65	550
MTH111	Magnetic Tape Handler; 7 tracks, 15KC	10,128	39	250
MTS163	Magnetic Tape Subsystem; 9 tracks, 30KB (controller and 1 handler)	34,416	83	800
MTH163	Magnetic Tape Handler; 9 tracks, 30KB	12,240	45	300
OPT183	200/556/800 bpi Recording Density Option (1 required per subsystem)	8,832	16	200
OPT173	7 Tracks, 200/556/800 bpi Option (1 required per handler)	1,008	4	25
OPT193	9 Tracks, 800 bpi Option (1 required per handler)	1,008	4	25

* Rental prices include equipment maintenance.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*
INPUT/OUTPUT UNITS (cont)				
MTS166	Magnetic Tape Subsystem; 9 tracks, 60KB (controller and 1 handler)	51,744	122	1,200
MTH166	Magnetic Tape Handler; 9 tracks, 60KB	18,528	64	450
OPT186	200/556/800 bpi Recording Density Option (1 required per subsystem)	8,832	16	200
OPT176	7 Tracks, 200/556/800 bpi Option (1 required per handler)	1,008	4	25
OPT196	9 Tracks, 800 bpi Option (1 required per handler)	1,130	4	25
CRZ100	Card Reader; 300 cpm	5,390	30	140
CRZ111	Card Reader; 400 cpm	9,180	45	230
OPT024	51-Column Card Option (for CRZ111)	2,016	8	50
CRZ120	Card Reader; 600 cpm	10,320	60	275
OPT025	51-Column Card Option (for CRZ120)	1,300	8	35
CRP100	Card Reader/Punch and Control; 300 cpm	21,510	142	590
CPZ101	Card Punch and Control; 60-200 cpm	11,670	72	315
CPZ103	Card Punch and Control; 300 cpm	22,420	138	605
PRT100	Printer; 300 lpm, 104 columns	15,120	100	415
OPT075	120 Column Option	1,300	8	35
OPT076	136 Column Option	2,545	17	70
PRT110	Printer; 600 lpm, 104 columns	22,080	145	605
OPT077	120 Column Option	1,635	11	45
OPT078	136 Column Option	3,279	22	90
OPT079	Fast Skip Option	2,545	17	70
PRT120	Buffered Printer; 780 lpm, 120 columns	32,835	216	900
OPT085	136 Column Option	3,650	24	100
OPT086	Fast Skip Option	2,545	17	70
PRT130	Buffered Printer; 1100 lpm, 120 columns	40,175	263	1,100
OPT087	136 Column Option	3,650	24	100
PTR100	Paper Tape Reader; 500 cps	4,520	26	120
PTP110	Paper Tape Punch; 60 cps	4,080	25	110
PTP120	Paper Tape Punch; 150 cps	13,550	68	350
PSC100	Manual Peripheral Switch; Single CPU	6,480	25	160
PSC101	Manual Peripheral Switch; Dual CPU	6,480	25	160
PSU100	Additional Manual Switch; Single CPU	1,632	6	40
PSC101	Additional Manual Switch; Dual CPU	1,632	6	40
COMMUNICATION CONTROLS				
SLC100	Single-Line, Synchronous, 2000/2400 bps	9,320	16	210
SLC102	Single-Line, Synchronous, 19,200/40,800/ 50,000 bps	12,100	48	300
SLC111	Single-Line, Asynchronous, 110-1200 bps	8,592	31	210
SLC112	Single-Line, Synchronous, up to 150,000 bps	12,288	44	300
SLC113	Single-Line, Synchronous, 2000/2400 bps	8,592	31	210
SLC114	Single-Line, Synchronous, variable speed	8,592	31	210
SLC115	Sinlge-Line, Synchronous, 2000/2400 bps	8,592	31	210
MLC104	Multi-Line Communications Controller (with buffer and one LCA104)	28,655	103	700
LCA104	Additional Line Controller	3,265	12	80

* Rental prices include equipment maintenance.