Siemens System 7.000

MANAGEMENT SUMMARY

The Siemens System 7.000 (pronounced "seven thousand") is a series of small-to-large scale computers consisting of nine current processors spanning the range of IBM equipment from the 370/115 to the 370/158-3 at prices significantly lower than those of its IBM counterparts. The System 7.000 offers a full complement of conventional punched card, magnetic tape/disk and printer peripherals; as well as communication subsystem equipment including CRT and printer terminals; and comprehensive software support including sophisticated on-line and data base facilities.

The Siemens 7.000 family is the European successor to the Unidata partnership between Siemens (West Germany), CII (France), and Philips (Netherlands) that was formed in July 1973 and which ended in December 1975. Since that time, Philips has limited its major data processing activities to the small business computer market where it has had traditional strength; CII has merged with Honeywell-Bull (July 1, 1976) and has focused upon the U.S.-developed Honeywell product line and upon resolving product proliferation incompatibilities between its own IRIS systems and the various Honeywell products.

Siemens, now the sole indigenous continental mainframe supplier, has moved vigorously to expand the System 7.000 with release of three new processors—the 7.738, 7.748, and 7.760—as well as a variety of high performance peripherals—the 3352 laser printer, the 3470 420-million-byte Fixed Disk Module, and the 6250-bpi magnetic tape drive. The CODASYL-compatible Universal Data Base System (UDS) released in mid 1976 is intended to bolster the appeal of the System 7.000 in the rapidly growing data base/data communications marketplace in Europe, especially in Germany.

The Siemens System 7.000 is the broadest current mainframe family produced today by a native European computer manufacturer. The descendent of the Unidata computer line, Siemens' 7.000 has been enhanced vigorously since the breakup of the Unidata partnership by the addition of several processors embodying state of the art technology and a number of high-performance peripherals including a laser beam printer capable of printing up to 20,000 lines per minute.

CHARACTERISTICS

MANUFACTURER: Siemens Aktiengesellschaft, Bereich Datenverarbeitung, Hofmannstrasse 51, Postfach 70 00 78, D-8000 Munchen 70, West Germany. Telephone: (089) 722-1. Telex: 5 288-0.

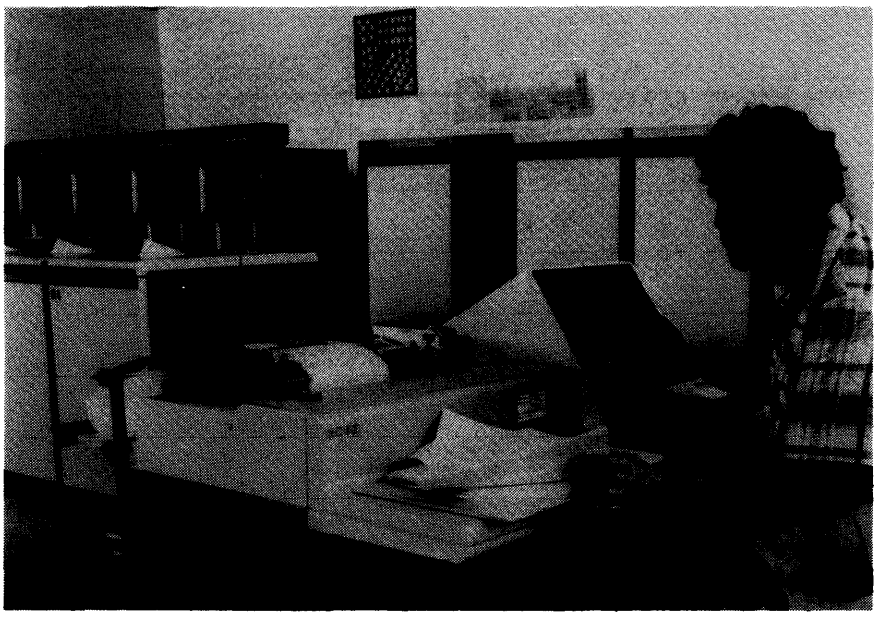
MODELS: Siemens System 7.000 Models 7.722 versions 1 and 2, 7.730 versions 1 and 2, 7.738, 7.740, 7.748, 7.755, and 7.760.

BASIC UNIT: An 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits.

DATA FORMATS: 2 bytes represent a 16-bit half-word; 4 bytes represent a 32-bit word, and 8 bytes represent a 64-bit double word.

FIXED POINT OPERANDS: A 16-bit half-word can represent a 15-bit signed integer; while a 32-bit word can represent a 31-bit signed integer or a 32-bit unsigned binary value.

FLOATING POINT OPERANDS: A 32-bit word is used to represent a signed, short floating point number with a 7-bit characteristic and a 24-bit mantissa. A signed, long floating point number can be represented in a 64-bit double



With the 7.760, Siemens has extended the top end of its 7.000 computer series. This machine uses 16K-bit MOS memory chips for main memory, and has a 32K-byte bipolar cache memory to contain the most frequently referenced data and the most active program sections. Over 95% of the 7.760's main memory requests can be satisfied by the cache, which has an access time of 200 nanoseconds per 8 bytes. Eleven configuration levels are currently provided, with a maximum system capacity of eight megabytes.

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TABLE I. CPU CHARACTERISTICS OF SYSTEM 7.000 MODELS

MODEL	7.722	7.730	7.738
OPERATING SYSTEM(s)	BS 1000 only	BS 1000 or BS 2000	BS 1000 or BS 2000
MAIN MEMORY/MOS CHIP (bits)	1K and 4K	1K and 4K	4K
MAIN MEMORY SIZE (bytes)	FE 98,304 G 131,072 GE 163,840 GF 196,608 GFE 229,376 H 262,144 HF 327,680 HFE 360,448 HG 393,216	FE 98,304 G 131,072 GE 163,840 GF 196,608 GFE 229,376 H 262,144 HF 327,680 HFE 360,448 HG 393,216 I 524,288	I 524,288 IH 786,432 J 1,048,576
BUFFER MEMORY SIZE (bytes)	—	—	2048
VIRTUAL ADDRESS SPACE (bytes)	Not Available	16,777,216	16,777,216
CYCLE TIME (MAIN MEMORY) Read Write	 615 ns/8 bytes 785 ns/8 bytes	 615 ns/8 bytes 785 ns/8 bytes	 615 ns/16 bytes 785 ns/8 bytes
CONTROL MEMORY SIZE (bytes)	32,768	32,768	49,152
INSTRUCTIONS	169	169	169
STANDARD FEATURES	Fixed Point Arithmetic Floating Decimal Arithmetic Decimal Arithmetic Interval Timer Time of Day (TOD) Clock 3 Program Timers Real-Time Clock Memory Protect Feature Automatic Instruction Retry Error Detection and Correction in Main Memory Byte Multiplex Channel Selector Channel (Version 1) Block Multiplex Channel (Version 2)	Fixed Point Arithmetic Floating Decimal Arithmetic Decimal Arithmetic Interval Timer Time of Day (TOD) Clock 3 Program Timers Real-Time Clock Memory Protect Feature Dynamic Address Translation Error Detection and Correction in Main Memory Byte Multiplex Channel Block Multiplex Channel	Fixed Point Arithmetic Floating Decimal Arithmetic Decimal Arithmetic Interval Timer Time of Day (TOD) Clock 3 Program Timers Real-Time Clock Memory Protect Feature Dynamic Address Translation Error Detection and Correction in Main Memory Byte Multiplex Channel 2 Block Multiplex Channels with 3 trunks each
OPTIONAL FEATURES	3 Auxiliary Consoles Byte Multiplex Channel Extension Block Multiplex Channel Extension (Version 2)	3 Auxiliary Consoles Byte Multiplex Channel Extension Block Multiplex Channel Extension 2-Byte Extension of the Block Multiplex Channels	3 Auxiliary Consoles Up to 2 Block Multiplex Channels 2-Byte Extension of the Block Multiplex Channels
DATA TRANSMISSION RATE-SYSTEM (kilobytes/second)	750 Version 1, 1400 Version 2	3000 Version 1 and 2	4500
CHANNELS SEL/BLMUX	1 SEL (Version-1), 1 BLMUX (Version 2)	1, 2 (BLMUX)	1, 2, 3, 4 (BLMUX)
CHANNEL ADAPTER	SEL 1, BLMUX 1 x 2	2 x 2 (BLMUX)	4 x 3 (BLMUX)
MAXIMUM TRANSFER SPEED (kilobytes/second)	SEL 450, BLMUX 1000	1250 1-Byte Access, 2400 2-Byte Access (BLMUX)	1500 1-Byte Access, 2400 2-Byte Access (BLMUX)
BYTE MULTIPLEX CHANNEL ADAPTER	1 x 5, 6, 7	1 x 6, 7, 8	1 x 8
MAXIMUM TRANSFER SPEED (kilobytes/second)	60 by slow adapter 300 by fast adapter	60 by slow adapter 300 by fast adapter	140

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TABLE I. CPU CHARACTERISTICS OF SYSTEM 7.000 MODELS (Continued)

7.740	7.748	7.755	7.760
BS 1000 or BS 2000	BS 1000 or BS 2000	BS 1000 or BS 2000	BS 2000 only
1K and 4K	4K	1K and 4K	16K
G 131,072 GF 196,608 (Version 1) H 262,144 HG 393,216 I 524,288 IG 655,360 IH 786,432 J 1,048,576	J 1,048,576 JI 1,572,864 K 2,097,152	I 524,288 IH 786,432 J 1,048,576 JI 1,572,864 K 2,097,152 KI 2,621,440 KJ 3,145,728 KJI 3,670,016 L 4,194,304	J 1,048,576 JI 1,572,864 K 2,097,152 KI 2,621,440 KJ 3,145,728 KJI 3,670,016 L 4,194,304 LJ 5,242,880 LK 6,291,456 LKJ 7,340,032 M 8,388,608
2048	4096	8192	32,768
16,777,216	16,777,216	16,777,216	16,777,216
615 ns/8/16 bytes 785 ns/8 bytes	615 ns/16 bytes 785 ns/8 bytes	615 ns/16 bytes 785 ns/8 bytes	Read cycle time for Buffer Storage 200 ns/8 bytes for 95% of instructions executed
49,152	49,152	49,152	61,440
169	169	169	169
Fixed Point Arithmetic Floating Decimal Arithmetic Decimal Arithmetic Interval Timer Time of Day (TOD) Clock 3 Program Timers Real-Time Clock Memory Protect Feature Dynamic Address Translation Error Detection and Correction in Main Memory Byte Multiplex Channel Block Multiplex Channel with 2 trunks each	Fixed Point Arithmetic Floating Decimal Arithmetic Decimal Arithmetic Interval Timer Time of Day (TOD) Clock 3 Program Timers Real-Time Clock Memory Protect Feature Dynamic Address Translation Error Detection and Correction in Main Memory Byte Multiplex Channel 2 Block Multiplex Channels with 3 trunks each	Fixed Point Arithmetic Floating Decimal Arithmetic Decimal Arithmetic Interval Timer Time of Day (TOD) Clock 3 Program Timers Real-Time Clock Memory Protect Feature Dynamic Address Translation Error Detection and Correction in Main Memory Byte Multiplex Channel 2 Block Multiplex Channels with 3 trunks each	Fixed Point Arithmetic Floating Decimal Arithmetic Decimal Arithmetic Interval Timer Time of Day (TOD) Clock 3 Program Timers Real-Time Clock Memory Protect Feature Dynamic Address Translation Error Detection and Correction in Main Memory Byte Multiplex Channel 2 Block Multiplex Channels with 3 trunks each
3 Auxiliary Consoles Up to 3 Block Multiplex Channels Extension of the Block Multiplex Channels Extension of the BLMUX Channel Adapter	3 Auxiliary Consoles Up to 4 Block Multiplex Channels 2-Byte Extension of the Block Multiplex Channels	3 Auxiliary Consoles Up to 4 Block Multiplex Channels 2-Byte Extension of the Block Multiplex Channels	3 Auxiliary Consoles Up to 4 Block Multiplex Channels 2-Byte Extension of the Block Multiplex Channels
4500 (Version 1 and 2)	6000	6000	6000
1, 2, 3, 4 (BLMUX)	2, 3, 4, 5, 6 (BLMUX)	2, 3, 4, 5, 6 (BLMUX)	2, 3, 4, 5, 6 (BLMUX)
4 x 2 or 4 x 3 (BLMUX)	6 x 3 (BLMUX)	6 x 3 (BLMUX)	6 x 3 (BLMUX)
1500 1-Byte Access, 2400 2-Byte Access (BLMUX)	1660 1-Byte Access, 3330 2-Byte Access (BLMUX)	1660 1-Byte Access, 3330 2-Byte Access (BLMUX)	1660 1-Byte Access, 3330 2-Byte Access (BLMUX)
1 x 8 or 1 x 16	1 x 8 or 1 x 16	1 x 8 or 1 x 16	1 x 8 or 1 x 16
140	200	200	200

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Since Siemens has carried on and extended the System 7.000 following the European cooperative effort demonstrated by Unidata, the development of the computer family has been marked by the release of particularly strong technology. The 7.760, released in October 1976, was the first computer from a big mainframe manufacturer to incorporate 16K-bit RAM memory technology.

This 16,384-bit chip represents a considerably increase in the degree of integration compared to the 4,096-bit chips used in the other Siemens System 7.000 machines. The physical size of the whole memory and the number of components have been reduced to a quarter, and the internal power dissipation to a third of what the system would otherwise require.

The 7.760 is further distinguished from the next lower models of the 7.000 Series through the expanded use of memory hierarchies whereby the bipolar cache, which serves to adapt the speed of the semiconductor (MOS) main memory facilities to that of the central processor, now has a capacity of 32K. Because the cache contains the most frequently referenced data and the most active program sections, Siemens claims that over 95% of memory requests can be satisfied by the cache, which has an access time of 200 nanoseconds per 8 bytes.

Another significant innovation in the 7.760 is the functional splitting of the central processor into two parallel processors, a division which considerably accelerates operations in the central unit. An integrated "instruction processor" performs instruction fetch and operand address calculation while an "execution processor" concurrently performs the actual execution of the previously fetched instruction.

All operations in the central processor and the channels are controlled by microprograms in a writable control memory that is loaded from a floppy disk. This control memory has a capcity of 4096 108-bit double words and also contains all the service and maintenance routines required for comprehensive hardware diagnoses. Individual 512K sections of main memory can be switched manually between two 7.760 Central Units, thus providing greater configuration flexibility to the user.

Because it is a common German data processing buying preference to obtain additional capacity by acquiring multiple processors rather than by upgrading to a larger single CPU, the memory module switching capability should prove helpful in the German marketplace in particular.

word with a 7-bit characteristic and a 56-bit mantissa. For extended floating point representation, a signed double precision format is available through the use of two 64-bit double words: 7-bits of the first double word are used to represent the characteristic and the remaining 56 bits of that double word plus 56 bits of the following double word are used to represent a 112-bit mantissa (28 hexadecimal or 34 decimal digits).

INSTRUCTIONS: 2, 4, or 6 bytes in length. See the table below.

Instruction Formats

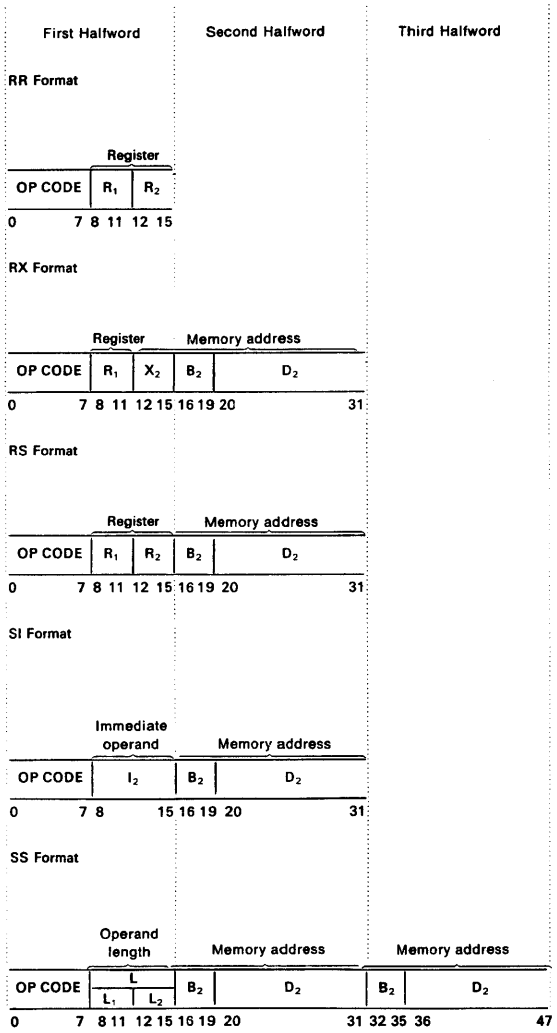

TABLE II. SUMMARY OF SYSTEM 7.000 AVAILABILITY

Model	7.722-1	7.722-2	7.730-1	7.730-2	7.738	7.740***	7.748	7.750	7.755	7.760
Date of Announcement	1972**	1/76	9/74	1/76	7/76	9/74	7/76	9/74	11/75	10/76
Date of First Customer Shipment	6/76	4/76	3/75	7/76	10/76	5/75	10/76	3/75*	3/76	6/78

*Withdrawn in 8/76
**Originally as the 4004/220
***Siemens version

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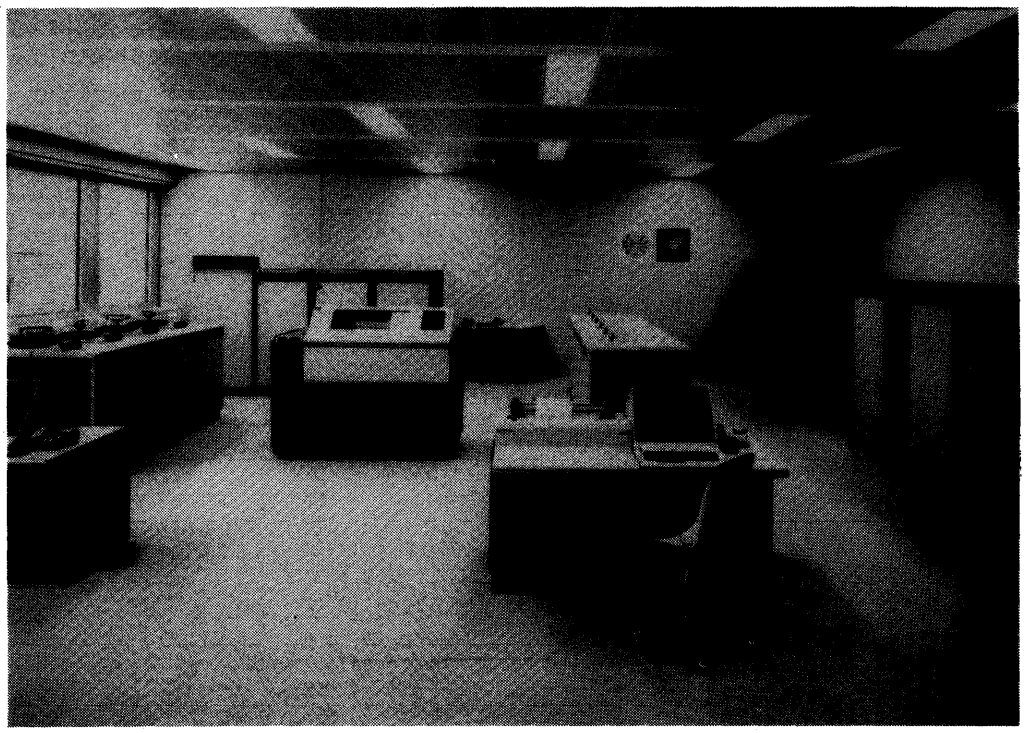

This 7.760 configuration includes a 2.5 megabyte main memory, a 3020 Central Operator Console with 3033- 01 Printer, a 3020-10 Auxiliary Console, four 3460 Disk Drives (200 megabytes each), one 3470 Fixed Disk Drive (420 megabytes), a 3343 Line Printer (1630-2000 lpm), four 3540 Magnetic Tape Drives (1600 bpi, 120 kilobytes per second), and a 9684 Transdata Data Communication unit capable of supporting up to 42 remote terminals.

The technological strengths in the 7.760 can better be viewed in the perspective of Siemens' System 7.000 activity that occurred less than three months earlier, at the end of July 1976. At that time, Siemens introduced models 7.738 and 7.748 as direct competitors to the IBM 370/138 and 148. These systems contained 4K-bit memory chips rather than the 1K chips used in earlier System 7.000 models. At the same time, Siemens announced improved performance characteristics for the 7.730, 7.740, and 7.755. In addition, upper memory ranges were increased on the 7.722 from 256K bytes to 384K; and the 7.730 memory limit increased from 384K to 512K.

Marketing of the System 7.000 today by Siemens is concentrated primarily in Europe, with emphasis upon West Germany, Switzerland, Austria, Denmark, Sweden, Spain, Italy, the Netherlands, and Eastern Europe. No large-scale marketing efforts are being made in France, the United Kingdom, the United States, South America (Siemens sold its installed base in Brazil to Univac at the beginning of 1975), or the Far East.

For the fiscal year ended September 30, 1976, Siemens reported EDP sales of US$500/million—a 14% increase over the previous year—and a backlog of US$360 million. The ratio of equipment rented to that sold is generally about 80 to 20 for the firm.

Re-structured in 1976 under Dr. Anton Peisl, formerly head of Siemens' successful telecommunications group, the Munich headquarters of Siemens computer activity is now called the Data and Information Systems Group and consists of a Systems Division and a Peripheral and Terminal Division with most manufacturing done in Augsburg and Munich.

INTERNAL CODE: EBCDIC.

MAIN STORAGE

STORAGE TYPE: N-MOS semiconductor memory is employed in all of the System 7.000 models. See Table I for memory capacity per chip for each model.

CAPACITY: See Table I.

CYCLE TIME: See the table below.

Model	Cycle Time and No. of Bytes Accessed
7.722	read 615ns/8 bytes write 785ns/8 bytes
7.730	read 615ns/8 bytes write 785ns/8 bytes
7.738	read 615ns/16 bytes write 785ns/8 bytes
7.740	read 615ns/8 or 16 bytes write 785ns/8 bytes
7.748	read 615ns/16 bytes write 785ns/8 bytes
7.755	read 615ns/8 or 16 bytes write 785ns/8 bytes
7.760	read (main memory) 1200ns/32 bytes write 600ns/8 bytes

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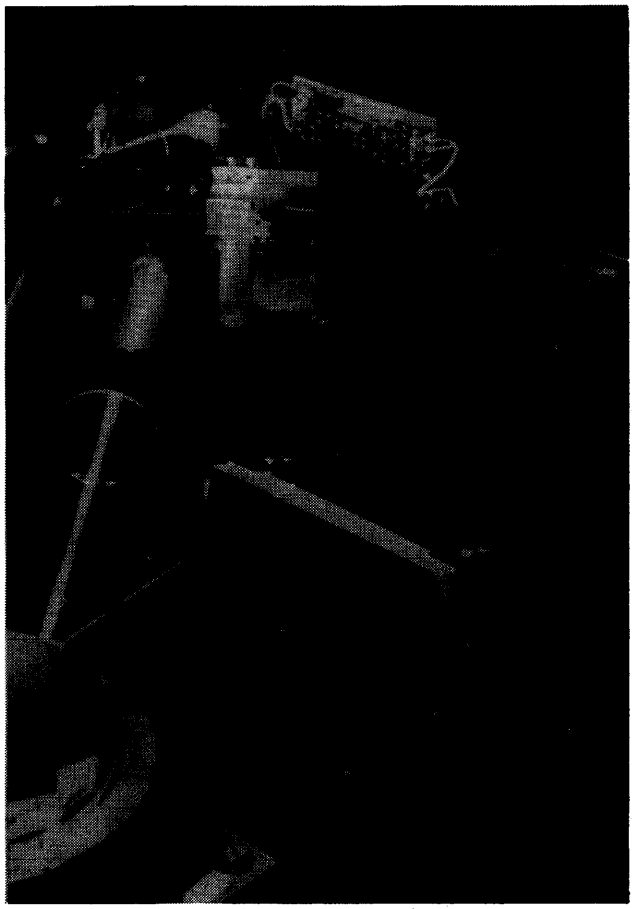
TABLE III. REGISTER-TO-REGISTER INSTRUCTION TIMES FOR SYSTEM 7.000 (MS)

Instruction	Type	Models								
		7.722-1	7.722-2	7.730-1	7.730-2	7.738	7.740	7.748	7.755	7.760
Add (A)	RX	11.06	8.36	7.40	4.97	3.421	2.796	1.517	1.157	0.572
Subtract (S)	RX	11.06	8.36	7.40	4.97	3.421	2.796	1.513	1.153	0.572
Multiply Short to Long (ME)	RX	96.46	77.16	45.84	45.83	9.415	8.790	7.021	6.661	5.666
Divide Short (DE)	RX	207.12	103.06	57.24	57.23	15.058	14.433	12.691	12.331	10.339
Add Normalized Long (AD)	RX	46.53	28.58	25.28	25.27	6.810	6.185	4.738	4.378	2.831
Subtract Normalized Long (SD)	RX	47.71	30.72	27.18	27.18	6.561	5.936	4.498	4.138	3.041
Multiply Long (MD)	RX	219.02	149.13	69.93	69.90	20.703	20.078	18.082	17.722	13.489
Divide Long (DD)	RX	538.17	206.65	121.54	121.50	35.851	35.226	32.628	32.268	27.979
Add Decimal (AP)	SS	31.92	27.43	24.26	24.25	7.012	6.387	4.618	4.258	1.937
Compare Decimal (CP)	SS	65.14	46.83	35.78	16.14	7.084	6.459	4.903	4.543	1.412
Pack (PACK)	SS	48.47	33.65	27.55	12.84	7.085	6.460	4.910	4.550	4.550
Branch on Condition (BC)	RX	5.37	6.41	4.08	3.07	2.957	2.350	0.995	0.995	0.624
Load (L)	RX	8.83	6.44	5.70	4.49	3.416	2.791	1.513	1.153	0.572
Store (ST)	RX	8.72	6.35	5.62	4.41	3.331	2.706	1.589	1.229	0.446
Load Multiple (LM)	RS	28.49	22.13	14.85	11.36	5.489	4.864	3.337	2.977	1.618
Move (MVC)	SS	27.00	23.20	20.52	20.52	9.212	8.587	7.156	6.796	2.567
Compare Logical (CLC)	SS	66.01	50.98	25.73	19.86	9.403	8.778	6.973	6.613	1.727

Among the major competitive factors that Siemens currently faces in West Germany are the U.S.-based firms, including IBM, Univac, etc.; and the emerging trend toward decentralized networks that makes it possible for DEC and other minicomputer manufacturers to compete strongly for computer systems business that only a few



The 3352 Laser Printer produces characters with the aid of laser beams, providing printing speeds of up to 1.2 million lines per hour, or around 70,000 characters per second; roughly 10 times the speed of conventional impact printers.

CHECKING: Memory protection, error detection, and single-bit-error correction in main memory are standard on all models. Microprograms continuously perform checking. An automatic instruction retry is also included. The control memory, the registers and all data paths are subject to parity checking. All data read in main memory are checked by an error correction code (8-bit Hamming code). One-bit errors are corrected while 2-bit errors and many multiple-bit errors are detected.

Error recovery routines are built into the BS 1000 and BS 2000 operating systems. Software routines for machine error recovery are aided by detailed information (four error words) concerning the machine errors detected and the internal machine status at the time the error was detected. This information is generated automatically by the hardware and stored in main memory.

STORAGE PROTECTION: A main memory access control provides both read and write protection and prevents unauthorized access to main memory or modification of the main memory contents. Storage protection is implemented by dividing main memory into 2K-byte blocks and assigning a 5-bit storage key to each block. Four of these bits specify the actual protection key for a specific block. The fifth bit controls whether the memory block is to be protected only against write accesses or against read and write accesses from other programs. Program authorization to access main memory takes the form of a 4-bit user key that enables protection of up to 15 concurrent programs.

In the virtual memory mode (for all processors except the 7.722), memory protection is implemented by 4-level ring protection. Each ring is assigned one 2-bit number for read accesses and another for write accesses; these numbers define the address space to which the ring belongs. A 2-bit ring state indicator indicates the ring levels which can be accessed.

CENTRAL PROCESSORS

There are seven current CPU models in the 7.000 series: two of these processors have two sub-models each. All of the CPUs have fixed-point, floating-point, and decimal arithmetic. Each has a time-of-day clock, a real-time clock, an internal timer and three program timers. Memory protection, error detection and correction in main memory, and a byte multiplexor channel are all standard. Each processor has one central operator console and positions to attach up to three additional service consoles. All of the processors

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years ago was exclusively the province of the mainframe vendors. Against this competitive array, Siemens has done very well in West Germany, even though the firm has been aided less by the inevitable nationalistic factors than have other home-grown European computer manufacturers in their respective countries. Examples of assisted firms include CII-Honeywell-Bull in France and ICL in the U.K. Much of Siemens' EDP success is due in part to the strength of the Siemens parent (4th largest electronics company in the world and No. 1 in Germany), and also, in part, to the vigorous R&D EDP efforts undertaken by Siemens.

In fact, while official West German governmental policy is to support specific, well-defined R&D efforts on the part of Siemens and other West German firms, there is no federal "buy German" procurement policy, and federal agencies exercise local authority to select their data processing equipment in a competitive process.

The System 7.000 was officially introduced in January 1974 with release of the 7.720 (originally developed by Philips), and the 7.730 and 7.740, both developed by Siemens. Since that time, a total of 10 models and/or submodels have been announced by Siemens (see Table II) with about 600 systems of all types shipped to date plus about 200 on order.

All of the members of the Siemens 7.000 family offer source code and operating system compatibility, as well as the ability to grow using the same peripherals. It is also possible for Siemens System 4004 users to run existing programs and data on the 7.000's without modifications.

Siemens' development strategy for the 7.000 consists of plans to strengthen the on-line and data base capabilities of the system, offer further high-performance peripherals, and focus on industry-specific terminals such as those tailored to banking and other service industry applications.

have the same 169-instruction repertoire. Except for the 7.722—the lowest level CPU—each has virtual addressing capability with dynamic address translation for a working space of 16,777,216 bytes. Other features of the individual CPUs are detailed in Table I.

REGISTERS: There are no index registers; but there are 43 4-byte general purpose registers that can be used for base and index register functions in address computations, for transferring addresses, or for holding operands in binary and logical operations. In addition, a number of special purpose registers are provided.

Processor State	No. of General Registers Usable
P1	16
P2	16
P3	6
P4	5

In P1 and P2, the complete set of general and control registers is available. In P3 and P4, the number of general registers is limited to 6 and 5, respectively; and several program-related control registers are not available. A set of floating point registers is shared by all processor states.

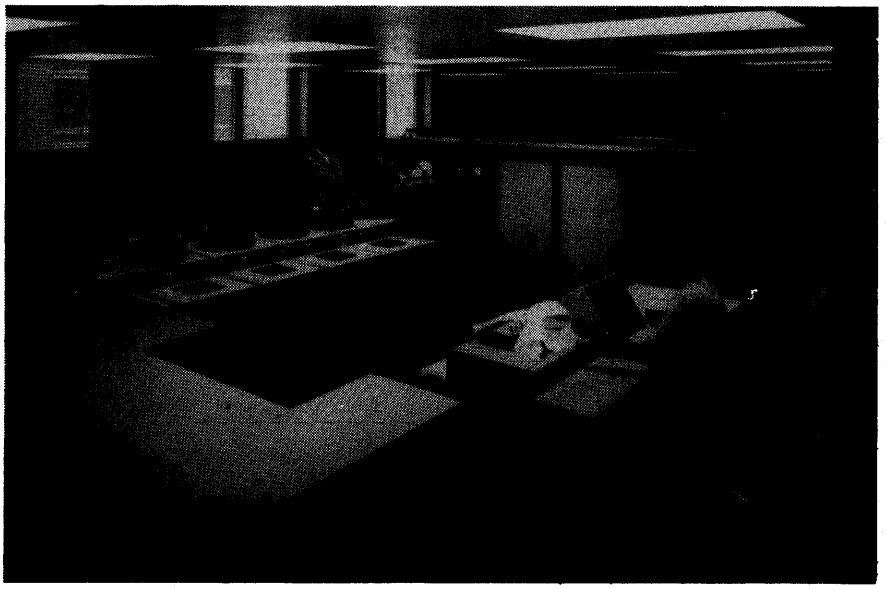
For some instructions, two adjacent 4-byte general registers are combined to form an 8-byte field. Other instructions can reference up to 16 general registers at one time.

Four 8-byte registers for floating point calculations are also provided. These registers can hold either a short 4-byte or a long 8-byte floating point number. The short floating point number is contained in the four high-order bytes of the register: in order to accommodate extended floating point numbers, two registers can be paired to form a 16-byte field.

Three 32-bit control registers are used to contain processor control information: the Program Counter Register (PCR); the Interrupt Status Register (ISR), and the Interrupt Mask Register (IMR). These registers can only be altered by privileged instructions in the system state.

INDIRECT ADDRESSING: Yes.

INSTRUCTION REPERTOIRE: There are 93 fixed-point instructions consisting of 21 data transfer instructions; 8 branch instructions; 13 logical instructions; 11 decimal in-



Each of the Siemens 7.000 models offers a wide variety of operator console configurations. Shown here is a 3020 Central Console with a CRT, keyboard, tabulator, control panel, and a 180-cps hardcopy page printer (Model 3033). Up to three auxiliary consoles (3020-10 or 3023-10) can be located up to 10 kilometers from the CPU and can be attached to any Series 7.000 model.

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A major development activity based in Erlangen, Germany, is focusing upon minicomputers (System 300). It is to be expected that the availability of these small computers will be a significant factor in the development of data networks, and Siemens can be expected to move more strongly into this area as the market demand increases.

In fact, Siemens' move into networks (or "integrated communications systems") has recently been spurred by a large contract from the German railway (to the tune of more than 100 milllion Deutsche Marks) to develop a network that makes operating data available on-line to large-scale data bases.

This kind of market activity by Siemens continues to require a high concentration of efforts upon "modular" terminals that retain compatibility with other Siemens products for the purpose of achieving manufacturing economies. Thus, a major Siemens product development strategy is seen to be the creation of modular terminal components that are based upon a set of uniform interface specifications, but which can be configured to meet specific user requirements.

As evidenced by the recent high performance peripherals announcements, Siemens is continuing to enhance the upper end of the System 7.000. A Model 7.770 was described by the firm during Unidata days as the next step in the 7.000 family after the 7.760, and it has recently been restated by the company that plans for this system are still very much alive. The 7.770 is expected to increase performance at the top of the System 7.000 line to the level of the IBM 370/168-3, and the 7.770 is widely expected to be announced in 1977.

It should be noted that Siemens continues to provide a strong level of support for its OEM customers. The new laser printer, for example, was previously available from Siemens to OEM buyers as the ND-2 (announced at the April 1976 Hanover Fair) before its October end-user availability announcement; the 420-megabyte Fixed Disk Module is available in a 500-megabyte capacity to the OEM market; and the 6250-bpi tape drive is also available on an OEM basis. Statements made by Siemens in October 1976, when these three peripherals were made available to end-users, bear out this OEM emphasis.

Another major trend in the Siemens' computer development strategy is to extend the product spectrum into the lower performance area. Toward this end, Siemens is expected to develop smaller operating systems and applications packages for high growth potential areas such as word processing. The Erlangen small-scale computer development activity is seen to play a role in this process. European customers are rightly frightened of software development costs—especially for small systems—which typically exceed the purchase price of the hardware within about two years of system acquisition. Siemens emphasis upon ready-to-use application software should address this concern well.

The 7.760 has a reloadable control memory to store the microprograms for the CPU and the I/O processor. The 7.760 control memory is shown being loaded from a diskette.

structions; 14 unsigned binary instructions; 22 signed binary instructions; and 4 edit instructions. There are 51 floating-point instructions consisting of 14 shift instructions; 33 arithmetic instructions; and 4 compare instructions. There are also 13 privileged instructions (including I/O and control instructions); 3 stack instructions; and 9 miscellaneous instructions.

INSTRUCTION TIMES: Register-to-register instruction times for a series of System 7.000 operations are shown in Table III.

CACHE MEMORY: Between the real memory and the processor is a high-speed cache memory that buffers instructions and data prior to processing. The cache is based on the memory system's 16-byte width of access. Models 7.738 and 7.740 have one 2K-byte bank of entries consisting of 128 rows of 16-byte blocks. Model 7.748 has two banks; and Model 7.755 has four banks. Model 7.760 has four 8K cache banks each consisting of 256 rows of 32-byte blocks. The entries are handled using a FIFO procedure. The processor communicates with the cache over 4-byte data paths except for the 7.760 which has an 8-byte data path. Cache memory capacity is as follows:

Processor	Cache Memory Capacity (bytes)
7.722	None
7.730	None
7.738	2,048
7.740	2,048
7.748	4,096
7.755	8,192
7.760	32,768

Cycle time for bipolar cache memory is as follows:

200 ns for an 8-byte access on Model 7.760.

360 ns for a 4-byte access on Models 7.748, 7.755.

375 ns for a 4-byte access on Models 7.738, 7.740.

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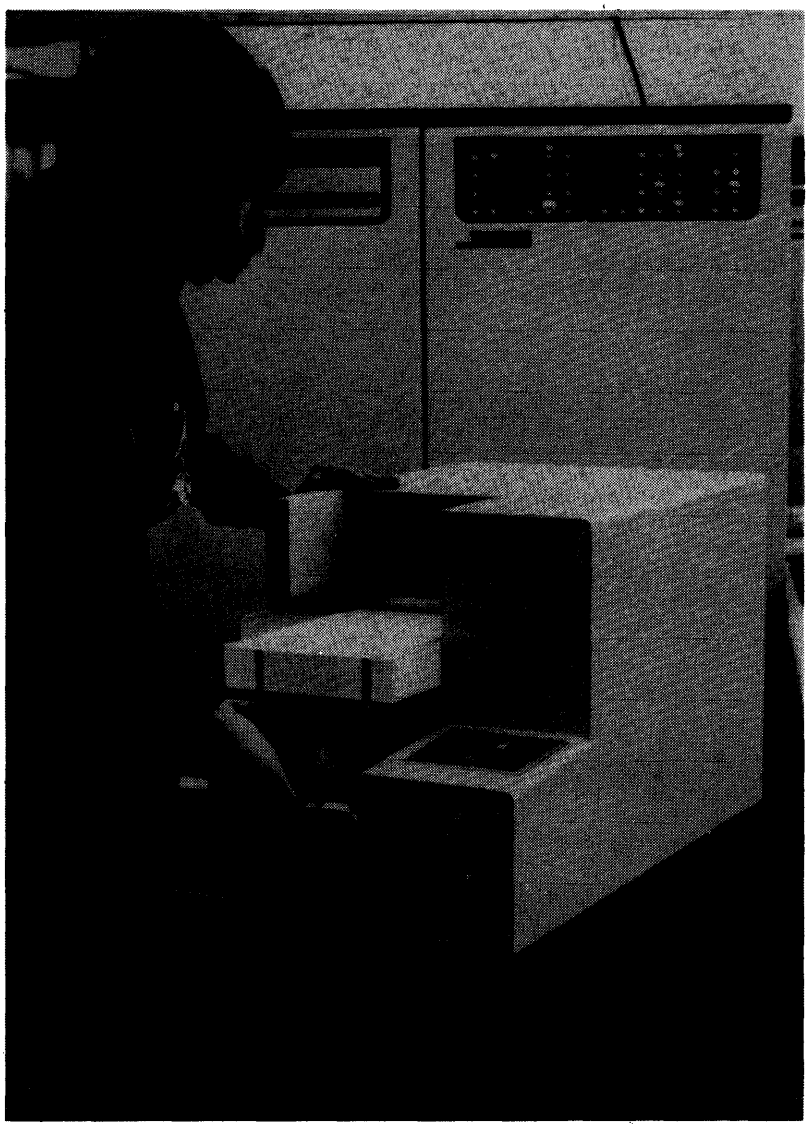

The Siemens 3262 Mark Sheet Reader can read up to 9000 documents per hour containing up to 1560 marks per document in any combination of hand printed or mechanically produced formats. Sheets to be read are taken out of the input magazine individually by a picker, carried past the read station, and deposited in the receiving tray. If a sheet is very dirty or damaged, it lands in a reject pocket. The 3262 is available in two versions with different speeds.

Because of the availability of Siemens' new high performance peripherals under its standard BS 2000 operating system, even the smaller Siemens 7.000 processors (from the 7.730 upward) can be configured with extraordinarily powerful data handling devices. This peripheral availability, combined with a strongly enhanced functional and price-performance advantage over comparable IBM peripherals, makes the low-end of the Siemens 7.000 line an especially attractive alternative to current small-scale System/360 and 370 users, especially those presently running under DOS or DOS/VS.□

RELOADABLE CONTROL STORAGE: A control memory is used in each System 7.000:

Processor	Control Memory
7.722	8K — 32-bit words (loadable)
7.730	8K — 32-bit words (loadable)
7.738	4K — 108-bit double words* (read-only)
7.740	4K — 108-bit double words* (read-only)
7.748	4K — 108-bit double words* (read-only)
7.755	4K — 108-bit double words* (read-only)
7.760	4K — 120-bit double words (writable)

*Each 54-bit word holds one microinstruction.

On the Models 7.722 and 7.730, the control memory contains the microprograms for controlling the CPU and the I/O processor as well as the buffers for the channels and function registers. The control memory is loaded automatically without operator intervention during initial program loading from the system disk. It is inaccessible to the user. On the 7.760, a writable control memory containing 4096 120-bit double words is loaded from a floppy disk. In addition, a read-only 3072-byte microprogram memory is also provided for the 7.760.

Models 7.738 through 7.755 also have a Writable Control Memory (WCM) which is used for diagnostic and maintenance purposes.

DYNAMIC ADDRESS TRANSLATION: For Models 7.730-7.760, virtual addresses for active pages are converted during processing into corresponding real addresses by the DAT facility that uses the segment and page tables for this purpose. The segment table defines each user's virtual memory allocation and contains one entry for each segment. The segment entries refer to the real memory addresses in the page tables, which in turn indicate which pages are currently located in real memory. Each segment has an associated page table.

A special hardware facility, the Content Addressable Memory (CAM) with 8 entries, is provided to increase the

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translation speed on the 7.730. On the 7.738 and larger models, an Address Translation Memory (ATM) has 128 entries to ensure a first-level hit in the search for a page in 90-95% of all cases under normal program conditions.

To perform address translation in Models 7.738 and larger, a row in the ATM is selected by means of parts of the segment and page portions of the virtual address (7 bits). The entries in the ATM can be addressed by these bits since the pages have fixed locations. After an entry has been selected, a comparison is made between portions of the virtual address and the entry in the ATM. When the two match, or hit, the result is the real page number which, together with the displacement from the virtual address, forms the real address. If there is no hit, the DAT facility makes use of the segment and page tables.

Since the channels contain no address translation hardware, virtual addresses incorporated in channel commands must be translated before I/O operations are performed.

For 2K pages and a virtual address space of 16 megabytes, the DAT facility is designed for 2-level operation. For 4K pages and an address space of 8 megabytes, the DAT facility is designed for 3-level operation (also employed in the System 4004/151 CPU).

OPERATIONAL MODES: There are four processor states:

P1 = Processing State
P2 = Interrupt Response State
P3 = Interrupt Control State
P4 = Machine Condition State

In P1 and P2, user programs and program interrupts are processed; and in P3 and P4, program interrupts are analyzed. Each processor state has its own set of general and control registers that function independently of other processor states. All the timers run in P1 and P2; the interval timer and the program timers are deactivated for P3 and P4.

COMPATIBILITY FEATURES: The System 7.000 includes all of the System 4004 instructions, making the systems source code compatible. Because of the high degree of compatibility between the 4004 and the IBM 360/370, a relatively simple conversion is possible at the source language level between these IBM systems and the 7.000 Series. Compatibility is also excellent when converting from the Univac Series 90 (nee RCA Spectra 70).

SIMULTANEITY: Memory is interleaved in Models 7.738 through 7.760 so that 8 bytes (Models 7.738 through 7.755) or 16 bytes (7.760) are fetched from alternate memory banks resulting in 16 bytes (Models 7.738 through 7.755) or 32 bytes (Model 7.760) being fetched during a single memory read cycle. Instruction execution is also overlapped on the 7.760 by dividing the processor into an Instruction Preprocessor and an Instruction Execution Processor whereby 32-byte segments of instructions/data are fetched from main memory to cache memory. Instructions are decoded by the preprocessor prior to execution.

INPUT/OUTPUT CONTROL

CONSOLE I/O: A variety of console control equipment is available for attachment to the Series 7.000 CPUs. The 3020 Central Control Console includes a CRT, keyboard, tabulator and control panel, attachments for up to three 3020-10 or 3023-10 sub-consoles, and an attachment for one auxiliary console printer. The sub-consoles may be located up to 10 kilometers from the CPU, and can be connected to models 7.772 through 7.760. The screen can display 16 lines of 80 characters each and the optional console printer operates at 180 characters per second.

3023 CENTRAL CONTROL CONSOLE: This console includes a 180 character per second page printer capable of printing 80 characters per line, a keyboard and control panel, and attachments for up to three 3020-10 or 3023-10 sub-consoles which can be located up to 10 kilometers from the CPU. The 3023 can be connected to models 7.722 through 7.760.

3020-10 AUXILIARY CONSOLE: This console consists of a 16 line by 80 character CRT, a keyboard, a tabulator, and an attachment for a 180 cps console printer. The 3020-10 can be connected to either the 3020 or 3023 Central Control Consoles.

3023-10 AUXILIARY CONSOLE: This console consists of an 80-position, 180 cps page printer that can be attached to either a 3020 or 3023 Central Control Console.

3033-01 CONSOLE PRINTER: This unit is available for attachment to the 3020 Central Control Console or to the 3020-10 Auxiliary Console. The 3033-01 can print an 80-position line at up to 180 characters per second.

I/O CONTROL: Salient characteristics for all the System 7.000 models are summarized in Table IV. On the 7.722 version 1, a byte multiplexor channel with 5 trunks, each with a 60 kilobytes per second transfer rate, is standard: one of these trunks is reserved for the operator console. Up to 256 devices can be addressed by the byte multiplexor channel for concurrent operation in the time-division multiplex mode. The byte multiplexor channel can be extended by 2 fast trunks (options 72226 and 72227 Byte Multiplexor Channel Extensions) for an additional 300 kilobytes per second. A selector channel, capable of connecting one I/O controller with a transfer rate of 450 kilobytes per second, is also standard. The maximum I/O data transfer rate is 750 kilobytes per second; for the 7.722 version 2 the rate is 1400 kilobytes per second. The version 2 enables block multiplex operation, and a 72228 Block Multiplexor Channel Extension expands the block multiplexor channel to 2 trunks.

On the 7.730, a byte multiplexor channel with 6 trunks is standard: one of these trunks is reserved for the operator console. Up to 256 devices can be addressed by the byte multiplexor channel for concurrent operations in the time-division multiplex mode. The byte multiplexor channel can be extended by 2 fast trunks (options 73027 and 73028 Byte Multiplexor Channel Extensions). A block multiplexor channel with 2 trunks is also standard. The system can be expanded to a maximum of 2 block multiplexor channels (option 73042 Second Block Multiplexor Channel), each connecting 2 I/O controllers. The maximum transfer rate of a block multiplexor channel is 1250 kilobytes per second in the 1-byte mode, and 2400 kilobytes per second with the 2 byte features (73040). The maximum I/O data transfer rate of the 7.730 is 3000 kilobytes per second.

On the 7.738, a byte multiplexor channel with 8 trunks is standard with a maximum channel data transfer rate of 140 kilobytes per second: one of these trunks is reserved for the operator console. Up to 256 devices can be addressed by the byte multiplexor channel for concurrent operation in the time-division multiplex mode. Two block multiplexor channels that allow addressing of up to 256 devices each and that can operate in both block multiplex and selector modes are also standard. Each block multiplexor channel has 3 trunks. The system can be expanded to a maximum of 4 block multiplexor channels via the 73843 and 73844 additional block multiplexor channel options. The maximum transfer rate per block multiplexor channel is 1500 kilobytes per second using the 1-byte interface, and 2400 kilobytes per second using the 73840 2-byte feature. The maximum I/O data transfer rate for the 7.738 is 4500 kilobytes per second.

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For the 7.740, the I/O channel characteristic and configuration rules are identical to those of the 7.738 except that only 1 block multiplexor channel with 2 trunks is standard. The 2-byte feature for the block multiplexor(s) is the 74040; the additional block multiplexors are the 74045, 74047, and 74048; and the 74046 is used to extend a single block multiplexor channel to 3 trunks. The byte multiplexor channel can be extended by the 74025 Byte Multiplexor Channel Extension with 8 additional trunks.

On the 7.748, 7.755, and 7.760 systems, a byte multiplexor channel with 8 trunks capable of supporting a maximum data transfer rate of 200 kilobytes per second is standard: one of these trunks is reserved for the operator console. Up to 256 devices can be addressed by the byte multiplexor channel for concurrent operation in the time-division multiplex mode. The byte multiplexor channel can be extended by the 74825 Byte Multiplexor Channel Extension with 8 additional trunks for the 7.748 (option 75525 for the 7.755 and option 77625 for the 7.760). Two block multiplexor channels are standard with 3 trunks each that allow addressing of up to 256 devices each in either block multiplex or selector modes. The system can be expanded to a maximum of 6 block multiplexor channels via the 74843, -4, -5, and -6 Additional Block Multiplexor Channel Options for the 7.748 (75543, -4, -5, and -6 for the 7.755; or 77643, -4, -5, and -6 for the 7.760). The maximum transfer rate per channel is 1660 kilobytes per second using the 1-byte interface and 3330 kilobytes per second using the 74840 2-byte feature for the 7.748 (75540 for the 7.755; and 77640 for the 7.760). The maximum I/O data transfer rate for the 7.748, 7.755 or 7.760 is 6000 kilobytes per second.

MASS STORAGE

There are six mass storage devices available, with capacities from 55 to 420 million bytes, for use on the System 7.000 Models 7.722 through 7.760. All but the 3440 disk can be connected to a 3416 controller, and various mass storage units can be mixed in a 3416 subsystem for a maximum configuration of 16 drives with an overall capacity of 6720 megabytes.

3440 DISK DRIVE: This removable-disk drive has 19 recording surfaces with 400 tracks each and a capacity per track of 7214 bytes for an overall capacity per spindle of 54,826,400 bytes. The data transfer rate is 312 kilobytes per second, the average access time is 35 ms, and rotational speed is 2400 rpm. The 3440 connects to a 3413 controller for attachment to the System 7.000 Models 7.722 through 7.760.

3450 DISK DRIVE: This removable-disk drive has 19 recording surfaces with 404 tracks each, and a capacity per track of 13,030 bytes for an overall capacity per spindle of 100,018,280 bytes. The data transfer rate is 806 kilobytes per second, the average access time is 30 ms, and rotational speed is 3600 rpm. The 3450 connects to a 3414-01, 3416-01, or 3416-11 controller for attachment to System 7.000 Models 7.722-2 through 7.760. The Siemens 3450 is IBM 3330-01 compatible.

3455 DISK DRIVE: This removable-disk drive has nine recording surfaces with 404 tracks each, and a capacity per track of 19,750 bytes for an overall capacity per spindle of 71,811,000 bytes. The data transfer rate is 806 kilobytes per second, the average access time is 25 ms, and rotational speed is 2400 rpm. The 3455 connects to a 3414-03, 3416-03, or 3416-13 controller for attachment to any System 7.000 Models 7.722-2 through 7.760; or for mixed installation with the 3460's to a 3416-02 or 3416-12 controller for attachment to any System 7.000 Models 7.730 through 7.760.

3460 DISK DRIVE: This removable-disk drive has 19 recording surfaces with 808 tracks each, and a capacity per track of 13,030 bytes for an overall capacity per spindle of 200,036,560 bytes. The data transfer rate is 806 kilobytes per second, the average access time is 30 ms, and rotational speed is 3600 rpm. The 3460 connects to a 3414-02, 3416-02, or 3416-12 controller for attachment to the System 7.000 Models 7.730 through 7.760. The 3460 is IBM 3330-11 compatible.

3465 DISK DRIVE: This removable-disk drive has nine recording surfaces with 808 tracks each, and a capacity per track of 19,750 bytes for an overall capacity per spindle of 143,622,000 bytes. The data transfer rate is 806 kilobytes per second, the average access time is 25 ms, and rotational speed is 2400 rpm. The 3465 connects to a 3414-04, 3416-04, or 3416-14 controller for attachment to any System 7.000 Models 7.722-2 through 7.760; or for mixed installation with 3460's to a 3416-02 or 3416-12 controller for attachment to Models 7.730 through 7.760.

3470 FIXED-DISK DRIVE: This device has 19 recording surfaces with 1350 tracks each, including spares, and a capacity per track of 16,384 bytes for an overall capacity of 420,249,600 bytes. The data transfer rate is 806 kilobytes per second, the average access time is 20 ms, and rotational speed is 2400 rpm. Average bit density is approximately 6000 bpi (roughly 240 bits per mm). Up to eight 3470's can be connected to a 3416-05, or up to sixteen 3470's to a 3416-15 controller for attachment to Models 7.730 through 7.760. The 3470 operates under BS 2000. A maximum subsystem can consist of 16 drives per channel for an overall capacity of 6720 megabytes.

3170 FLOPPY DISK I/O UNIT: This unit is a peripheral device for the Siemens System 4004 (Models /35 to /151) and System 7.000. Connected via a byte multiplexor channel or selector channel, it enables the computer to read and write floppy disks.

TABLE IV. SALIENT I/O CONTROL CHARACTERISTICS

I/O CONTROL CHARACTERISTIC	MODEL						
	7.722	7.730	7.738	7.740	7.748	7.755	7.760
Max. Channel Throughput (kilobytes per second)	750**	3000	4500	4500	6000	6000	6000
No. Byte Multiplexors	1	1	1	1	1	1	1
Thruput-Mux Mode (kilobytes per second)	60	60	140	140	200	200	200
Thruput-Burst Mode (kilobytes per second)	300	300	233	233	238	238	238
No. Block Multiplexors	1*	1-2	2-4	1-4	2-6	2-6	2-6
Thruput/Mux-1-Byte (kilobytes per second)	450***	1250	1500	1500	1660	1660	1660
Thruput/Mux-2-Byte (kilobytes per second)	—	2400	2400	2400	3330	3330	3330

*Selector Channel with version 7.722-1; the 7.722-2 uses a BLMUX.
**1400 kilobytes per second with version 7.722-2.
***1000 kilobytes per second with version 7.722-2.

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Apart from the standard disk initialization, as used in the TRANSDATA 920 Floppy Disk Data Entry System, floppy disks can also be initialized and processed with variable formats on the 3170. Thus it is possible via the 3170 Floppy Disk I/O Unit to read data stored by various systems on floppy disks into a Siemens System 4004 or 7.000 computer.

The basic 3170 consists of one I/O station. This unit can be field upgraded with an expansion feature to include a second I/O station. The 3170 has a channel adapter with a controller which operates in the time-division multiplex mode in the dual configuration. Each I/O station has two 128-byte buffers for data storage as standard and a stacker with a capacity of 20 floppy disks. Feed, alignment and stacking of the floppy disks are fully automatic.

The controller is microprogrammed and consists of a fast bipolar LSI microprocessor. The data medium has a standard storage capacity of 1898 records of up to 128 bytes each. A single floppy disk can store a maximum of 19 independent files. A variable block length feature enables records to be written in multiple lengths of 128 bytes, up to a maximum of 4096 bytes, corresponding to a number of 26 down to 1 sector per track.

The maximum reading rate is 4680 records per minute (standard format), and the maximum writing rate is 3120 records per minute (standard format).

Rotational speed of the 3170 is 360 rpm, with a recording density of 3200 bpi, and an average access time of 242 ms. Data is organized into 77 tracks consisting of 74 data tracks plus 3 spares. In standard format, there are 26 sectors per track and 128 bytes per sector to give a maximum disk capacity of 246,272 bytes. In variable format there can be 26, 15, 8, 4, 2, or 1 sectors per track and 128, 256, 512, 1024, 2048, or 4096 bytes per sector to give a maximum disk capacity of about 245K to 303K bytes.

Options for the 3170 include the 31701 Floppy Disk Initialization feature to enable program controlled initialization of floppy disks in accordance with the ECMA proposed standard; the 31702 Variable Block Length feature to enable processing of variable block lengths with simultaneous buffering of 4096 data bytes (up to one complete track); and the 31703 Dual I/O Station Expansion feature that enables overlapped reading and writing on two I/O stations connected to one channel.

MAGNETIC TAPE EQUIPMENT

There are nine different magnetic tape units available for use with the System 7.000. All are 9-track units.

3570 MAGNETIC TAPE UNIT: This is a 9-track device that has a recording density of 640 bytes per cm (1600 bpi), a read/write speed of 30 kilobytes per second, a rewind speed of 7.6 meters per second, and a forward tape speed of 0.48 meters per second. The 3570 MTU consists of two magnetic tape drives, the MT-controller, and the power supply. The 3570 connects directly to Models 7.722 through 7.760 and has control circuitry for four additional 3530 tape drives.

3571 MAGNETIC TAPE UNIT: This is a 9-track drive that has a recording density of 640 bytes per cm (1600 bpi), a read/write speed of 60 kilobytes per second, a rewind speed of 7.6 meters per second, and a forward tape speed of 0.95 meters per second. The 3751 MTU consists of two magnetic tape drives, the MT-controller, and the power supply. The 3751 connects directly to Models 7.722 through 7.760 and has control circuitry for four additional 3531 tape drives.

3530 MAGNETIC TAPE DEVICE: This drive is identical in characteristics to the 3570 except that it has no control circuitry. This device connects to the 3570 and uses its control circuitry and power supply.

3531 MAGNETIC TAPE DEVICE: This drive is identical in characteristics to the 3571 except that it has no control circuitry. This device connects to the 3571 and uses its control circuitry and power supply.

3540 MAGNETIC TAPE DEVICE: This is a 9-track unit that has a recording density of 320 (NRZ), or 640 (PE) bytes per cm (800 or 1600 bpi, respectively), a read/write speed of 60 (NRZ) or 120 (PE) kilobytes per second, a rewind speed of 5.7 meters per second, and a forward tape speed of 1.9 meters per second. The 3540 connects to a 3510-01, -02, -03, or -04 controller on the System 7.000 Models 7.222 through 7.760.

3550 MAGNETIC TAPE DEVICE: This is a 9-track unit that has a recording density of 320 (NRZ) or 640 (PE) bytes per cm (800 or 1600 bpi, respectively), a read/write speed of 120 (NRZ) or 240 (PE) kilobytes per second, a rewind speed of 10.4 meters per second, and a forward tape speed of 3.8 meters per second. The 3550 connects to a 3510-01, -02, -03, or -04 controller on the System 7.000 Models 7.722 through 7.760.

3554 MAGNETIC TAPE DEVICE: This is a 9-track unit that has a recording density of 320 (NRZ) or 640 (PE) bytes per cm (800 or 1600 bpi, respectively), a read/write speed of 160 (NRZ) or 320 (PE) kilobytes per second, a rewind speed of 14.5 meters per second, and a forward tape speed of 5.1 meters per second. The 3554 connects to a 3512-01, -02, -03, or -04 controller on the System 7.000 Models 7.730 through 7.760.

3557 HIGH DENSITY MAGNETIC TAPE DEVICE: This 9-track unit has a recording density of 640 (PE) or 2460 (GCR) bytes per cm (1600 or 6250 bpi, respectively), a read/write speed of 200 (PE) or 780 (GCR) kilobytes per second, a rewind speed of 12.2 meters per second, and a forward tape speed of 3.18 meters per second. Up to eight 3557's connect to a 3513 controller on the System 7.000 Models 7.730 through 7.760.

3559 HIGH DENSITY MAGNETIC TAPE DEVICE: This 9-track unit has a recording density of 640 (PE) or 2460 (GCR) bytes per cm (1600 or 6250 bpi, respectively), a read/write speed of 320 (PE) or 1250 (GCR) kilobytes per second, a rewind speed of 16.2 meters per second, and a forward speed of 5.1 meters per second. Up to eight 3559's connect to a 3513 controller on the System 7.000 Models 7.730 through 7.760.

HIGH SPEED PRINTERS

There are three line printers available for the System 7.000. They operate at speeds of 960-2000 lines per minute for the chain printers; and up to 21,000 lines per minute for the ultra-fast 3352 laser beam printer. All of the printers except the laser printer can be attached to Models 7.722 through 7.760; the laser printer can be attached only to Models 7.730 through 7.760 operating under BS 2000. All of the printers are fully buffered.

3340 PRINTER: This device is a chain-driven unit that can print either 136 or 160 characters per line, using a character set of 48, 64 or 106 characters plus the blank or space. Using the 48-character chain, the print speed is 1170 lines per minute; with the 64-character chain, the print speed is 960 lines per minute. Horizontal spacing is 10 characters per inch, and vertical spacing is 6 or 8 lines per inch. Powered forms stacking and a form feed are available as optional features 33401 and 33410, respectively. Forms feed is standard on sub-models -12 and -14.

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Sub-models 3340-11 and -12 have one forms feed and can accept forms from 52-555 mm in width. Sub-models 3340-13 and -14 have two forms feeders and can accept forms from 52-471 mm on the first feeder and 104-523 mm on the second feeder. All of the printer sub-models can format pages from 8-16 inches in length. Line advance for each sub-model is performed at the speeds shown in the table below.

3343 PRINTER: This device is a chain-driven unit that can print either 132 or 136 characters per line, using a 48, 64, or 96-character set plus the blank or space. Using the 48-character chain, the print speed is 2000 lines per minute; with the 64-character chain, the print speed is 1630 lines per minute. Horizontal spacing (print density) is 10 characters per inch, and vertical spacing is 6 or 8 lines per inch. Powered forms stacking and a forms feeder are standard. The 3343 can accept forms from 102-508 mm in width, and can format pages from 8-14 inches in length. Line advance is performed at the speeds shown in the table below.

3352 LASER PRINTER: This device is a laser-beam unit that can print 136, 163, or 204 characters per line, using a 128 (standard) or 255 (option 33522) character set plus the blank or space. Horizontal spacing (print density) is 10, 12, or 15 characters per inch; and vertical spacing is 6, 8, or 12 lines per inch. Print speed for both character sets is shown in the table below:

Vertical Spacing (lines/inch)	Print Speed (lines/minute)
6	10,500
8	14,000
12	21,000

On a character basis the 3352 can print up to 70,000 characters per second. Powered forms stacking and a forms feeder are standard.

The 3352 can accept forms from 165-400 mm in width and can format pages from 8-14 inches in length. Line advance is performed at a rate of 0.74 ms per line no matter how many lines are advanced at once.

PUNCHED CARD EQUIPMENT

There are three models of 80-column card reader and one 80-column card punch available for the System 7.000. All attach to any model from the 7.722 through the 7.760.

3150-01 CARD READER: This unit operates at 1000 cpm. The card input hopper can hold 1200 cards, and two 1200 card output stackers are used. Attachments for the 3150-01 include the 31501 Binary Read feature, the 31502 Ticket/Stub Card feature, the 31503 Mark Read feature, the 31504 Automatic-End-of-File feature, and the 31505 90-column feature.

3150-02 CARD READER: This unit differs from the 3150-01 only in having a 3000 card capacity input hopper.

3150-03 CARD READER: This unit operates at 660 cpm. The card input hopper can hold 1200 cards, and two 1200 card output stackers are used. Attachments include all of the optional features available for the 3150-01 or 3150-02 except the 31503 Mark Read feature.

3160 CARD PUNCH: This unit operates at 100-290 cpm, and has a 1200-card input hopper and two 1100-card output stackers. A 31601 binary punching feature is available as an option.

PUNCHED PAPER TAPE EQUIPMENT

There are four paper tape readers and two paper tape punches available for use with any System 7.000 Model 7.222 through 7.760.

4223 PAPER TAPE READER: This device can read up to 1200 characters per second in a forward direction, and accepts 5, 6, 7, or 8-channel tape or Olivetti-LS code-on tapes 17.4, 25.4, 22.2, or 20.5 mm wide. Attachments include a tape collection bin, a manual rewinder, and an unwinder (standard). A 4222 or 4220 controller is required.

4229 PAPER TAPE READER: This device can read up to 1500 characters per second in a forward direction, and accepts 5, 6, 7, or 8-channel tape in widths of 17.4, 22.2, or 25.4 mm. Attachments include a tape collection bin and an unwinder. A 4222 or 4220 controller is required.

4229-S PAPER TAPE READER: This device can read up to 1500 characters per second in either forward or reverse direction, and accepts 6-channel typesetting tapes with a width of 22.2 mm. Attachments include a tape collection bin, and an unwinder. A 4222 or 4220 controller is required.

4229-O PAPER TAPE READER: This device can read up to 1270 characters per second in either forward or reverse direction, and accepts 6-channel rectangular Olivetti code-on tapes with a width of 20.5 mm. Attachments include a tape collection bin, and an unwinder. A 4222 or 4220 controller is required.

3340 Printer Vertical Line Spacing	PRINTER FORMS ADVANCE TIME (MS)					
	Single Line	Double Line	Triple Line	Quadruple Line	Quintuple Line	Each Additional Line
Sub-models -11 or -13 6 lines/inch	12.50	18.63	24.76	30.89	34.35	2.15
Sub-models -12 or -14 6 lines/inch	12.50	20.39	28.28	36.17	40.55	2.59
Sub-models -12 or -14 8 lines/ inch	12.50	18.42	24.34	30.26	33.46	1.94
3343 Printer 6 lines/ inch	9.4	13.6	18.8	24.0	29.0	1.85
8 lines/inch	9.4	11.0	15.0	19.0	23.5	1.79

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4228 PAPER TAPE PUNCH: This device can punch up to 150 characters per second in 5, 6, 7, or 8-channel code-on 17.4 or 25.4 mm tape. An unwinder is standard and a 45294 Take-Up Winder is available as an option. A 4221 or 4220 controller is required.

4228-S PAPER TAPE PUNCH: This device can punch up to 150 characters per second in 6-channel typesetting tape with a width of 22.2 mm. Attachments include a standard unwinder, and an optional 45294 Take-Up Winder. A 4221 or 4220 controller is required.

DOCUMENT READERS

Two document readers are available for attachment to models 7.722 through 7.760. Both can read either pencil marks or high-speed printer characters from documents with a thickness of 0.10-0.18 mm, a width of 95-200 mm, and a length of 145-305 mm. The acceptable document format allows for a maximum of 65 columns; each with 24 positions. Each reader has one document input bin capable of holding 500 documents, one output bin capable of holding 500 documents, and a reject pocket holding 150 documents.

The 3262-01 Document Reader operates at 100-150 documents per minute; and the 3262-02 Document Reader operates at 50-75 documents per minute.

DATA COMMUNICATIONS

3630 DATA COMMUNICATIONS CONTROLLER: This controller can transfer data to the computer at up to 25,600 characters per second and can handle up to 30 lines at 4800 bps, 16 lines at 9600 bps, or 8 lines at 19,200 bps. Of the limit of 30 lines that can be attached to the 3630, 8 can be used for audio-response units. Data rates of 50 to 19,200 bps are standard and the 3630 can be equipped with an option to accommodate a 50,000 bps line. The 3630 can be connected directly to any System 7.000 Models 7.722 through 7.760.

8170 and 8171 MULTIPURPOSE CONTROLLERS: The 8170 and 8171 can connect the 8161 CRT, the 8112 printer terminal, or the 8121 printer to a Siemens 7.000 or 4004 via a multiplexor channel. The 8170 can be connected directly to the channel and data transfer between the terminal subsystem and the channel takes place at up to 230,400 bps. The 8171 is connected via a half-duplex communications line, and can transfer data at 9600-19,200 bps. For either system, up to 32 data stations can be connected.

8150 DATA DISPLAY STATION: This unit consists of a controller, a keyboard, and a fully-buffered CRT. The screen provides for a 20-line display with up to 54 characters per line. The 64-character set is used. Asynchronous, half-duplex data communications lines with rates of 1200 or 2400 bps are handled. The 8150 accepts ISO 7-bit code.

8151 DATA DISPLAY STATION: This unit has characteristics identical to those of the 8150 except that either asynchronous or synchronous, half-duplex lines of 1200, 2400, 4800 or 7200 bps are handled.

8152 DATA DISPLAY STATION: This units consists of a controller, a keyboard, and a fully buffered CRT capable of graphics representations. The screen provides for a 16-line display with up to 81 characters per line. Either a 64 or 95-character set is supported. Either asynchronous or synchronous half-duplex lines of 1200, 2400, 4800, or 9600 bps are handled. The 8152 accepts ISO 7-bit code.

8153 DATA DISPLAY STATION: This unit consists of a controller, a keyboard, and a fully buffered CRT. The screen provides for a 6-line display with up to 40 characters per line. The 64-character set is used. Asynchronous half-duplex lines with rates of 600, 1200, or 2400 bps are handled. The 8153 accepts ISO 7-bit code.

8161 DATA DISPLAY STATION: This unit consists of a CRT with an integrated controller and a keyboard. The screen provides for a 24 line display and 54, 64, or 80 characters per line. Either a 64 or 95-character set is supported with 12 special characters. Synchronous half-duplex lines with rates from 600 to 9600 bps are handled. The 8161 accepts ISO 7-bit code.

3976 CRT TERMINAL: This unit is a graphic display, 7-color terminal capable of displaying 2048 alphanumeric characters. Data transmission rate is 9600 bps.

TRANSDATA 9660, MODEL DUET 9661: This subsystem for banking and financial institutions has from 128K to 256K of programmable memory, and includes a floppy disk and, optionally, a printer. Up to 10 data lines can be connected to a 9661 subsystem consisting of a 9760 Dialog Station, 8151 or 8161 Display Terminals, or a 8415 Printer Terminal. Network support is provided for point-to-point, star, or ring configurations. Data transfer rates of 600-9600 bps are supported.

9760 DIALOG STATION: This unit is available for use with the DUET 9661, and consists of a keyboard, a visual display screen, and a printer. The keyboard can be either numeric, alphanumeric, or function driven. The visual display is a plasma-type unit with one display line of up to 32 characters or 8 lines of up to 32 characters each. The printer is a journal-type unit capable of printing 100 characters per second. An external Book and Page printer is available that can print up to 100 characters per second. The 9760 is suitable for use as a universal interactive terminal, a counter terminal, or for use in an off-line mode of operation.

TRANSDATA 960 DATA COMMUNICATIONS PROCESSORS: Siemens offers a series of six TRANSDATA 960 programmed communications processors that attach to Models 7.722 through 7.760 and range in memory size from 32K to 512K and can handle from 22 to 180 lines ranging in overall throughput speeds from 5 to 25 kilobytes per second. All of the TRANSDATA 960 models have 54 instructions, use 16-bit words, and can accommodate line speeds of 50-50,000 bps. Models 9683-9687 are front-end processors, while Models 9674 and 9675 are used as remote processors. The characteristics of the individual models of the TRANSDATA 960 are detailed in the table on the facing page.

TRANSDATA 920: This subsystem is a Floppy Disk Data Entry System for centralized and decentralized data entry. The TRANSDATA 920 consists of a 9210 Data Entry Station, a 9212 Dual Data Entry Station, a 9230 Data Converter, and a 3170 Floppy Disk I/O Unit.

The machine-readable data medium employed by the TRANSDATA 920 is a floppy disk with a maximum capacity of 1,898 records (246,272 bytes). A record corresponds to a sector and direct access is possible to any sector.

Files may extend over several floppy disks, and a disk may contain data and/or programs, as required.

The operator keyboard is identical to that of a punch/verifier.

For centralized data entry, the 9212 Dual Data Entry Station is used. A display for each of two operators at this dual workstation is used for visually checking keyed data and the current device status, and provides support when updating and verifying. The 9212 display unit provides for viewing of three 40-character lines per operator on a 5.5 x 2.3 inch screen.

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For decentralized data entry, the 9210 Data Entry Station is used. The 9210 has a larger screen than the 9212 and provides program-controlled operator guidance. The 9210 can be tailored to meet specific customer requirements by doubling the storage capacity with a second floppy disk drive, by connecting a printer, and by using a communication adapter feature. Both point-to-point circuits and multipoint networks may be configured. The station can also send and receive data in unmanned operation. The 9210 display unit provides for viewing of six 40-character lines on a 5.5 x 3.7 inch screen. Transmission speed is 600, 1200 or 2400 bps in synchronous half-duplex mode using EBCDIC format.

For indirect data transfer to the computer, the 9230 Data Converter is used.

Data written on floppy disks by the data entry stations is read in batches by the 9230 Data Converter and transferred to a computer-compatible magnetic tape. Conversely, the contents of a tape recorded by a computer can be transferred to floppy disk. The autoloader can hold 20 floppy disks. The conversion speed to tape is 1000 records per minute and from tape is 600 records per minute.

During conversion, records may be blocked, unblocked, or reformatted with simultaneous checking for errors.

The prepared tapes can be transported physically to the computer location and read, or, when a communication adapter feature is used, data can be transmitted via a point-to-point circuit to a remote computer. Connection to another 9230 Data Converter or to a 9210 Data Entry Station is also possible. The tape drive handles 10.5-inch reels of magnetic tape recorded at 800 bpi (NRZ) or 1600 bpi (PE).

When fitted with an autocall feature, the data converter can fetch data entered during the day on 9210 Data Entry Stations equipped for data communication.

The 9230 Data Converter can be connected to the TRANSDATA 960 Communication Unit (DUET), the 4666 Communication Controller (DUST), or the TRANSDATA 9210 Data Entry Station.

Transmission speed is 600, 1200 or 2400 bps in synchronous, half-duplex mode using EBCDIC format.

For direct data transfer to the computer, the 3170 Floppy Disk I/O Unit is used (see Mass Storage section in this report).

PRINTER TERMINALS

8101 KEYBOARD-PRINTER TERMINAL: This unit can print 6-10 characters per second using a print bar mechanism; or can transmit data at 50, 75, or 100 bps. The 8101 provides a 32-character set and can print up to 104 characters per line on continuous forms.

8103 KEYBOARD-PRINTER TERMINAL: This unit can print 18.67 characters per second using a print bar mechanism, or can transmit data at 200 bps. The 8103 provides either a 64 or 95-character set, and can print up to 143 characters per line on continuous forms.

8110 KEYBOARD-PRINTER TERMINAL: This unit includes a buffered keyboard and can print 120-180 characters per second using a print bar mechanism; or can transmit data at up to 4800 bps. The 8110 provides either a 64 or 95-

CHARACTERISTIC	TRANSDATA 960 MODELS					
	9683	9684	9685	9687	9674	9675
Memory Range (bytes)	—	32,768 49,152 65,536 81,920 98,304	32,768 49,152 65,536 81,920 98,304 114,688 131,072 147,456	32,768 to 557,056 (in increments of 32,768)	32,768 49,152 65,536 81,920 98,304 114,688 131,072	32,768 to 557,056 (in increments of 32,768)
Maximum Data Throughput (kilobytes per second)	5	16	25*	25*	16	25*
Programmable Controller	yes	yes	yes	yes	no	no
Front-End Processor	no	yes	yes	yes	no	no
Programmable Network	no	no	no	no	yes	yes
Maximum Lines	22	42	180	180	60	180
Operations Time Register Instruction Memory Instruction	 1667 ns 3335 ns	 833 ns 1667 ns	 500 ns 833/1333 ns	 500 ns 833/1333 ns	 833 ns 1667 ns	 500 ns 833/1333 ns
Operating System	BS 1000 with TCS	BS 1000 with TCS; or BS 2000 with TCS or PCAM	BS 1000 with TCS; or BS 2000 with TCS or PCAM	BS 1000 with TCS; or BS 2000 with TCS or PCAM	BS 1000 with TCS; or BS 2000 with TCS or PCAM	BS 1000 with TCS; or BS 2000 with TCS or PCAM
Connects to CPU Model:	7.722 thru 7.740	7.722 thru 7.760	7.722 thru 7.760	7.722 thru 7.760	Over a communications line to the 9684, 9685, or 9687 via the Front-End Processor	

*A further increase of the data throughput can be achieved by the use of more sophisticated line-buffers.

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character set, and can print up to 143 characters per line on continuous forms.

8100 HARDCOPY PRINTER: This unit is a print-only terminal that can print at a rate of 22 characters per second using a print bar mechanism. The 8100 provides either a 64 or 95-character set, and can print up to 80 characters per line on continuous forms.

8111 REMOTE PRINTER TERMINAL: This unit can print 180 characters per second using a 7 x 7 dot matrix and receive data over a communictions line at up to 7200 bps. The 8111 provides a 68-character set, and can print up to 132 characters per line on either of two continuous forms feeds. An auxiliary 8120 printer can be attached.

8120 PRINTER: This unit can print 180 characters per second using a 7 x 7 dot matrix. The 8120 provides a 68-character set and can print up to 132 characters per line on either of two continuous-form feeds or a single sheet feed. The 8120 can be attached to either the 8111 Remote Printer Terminal or the 815X Display Station.

8121 PRINTER: This unit is similar to the 8120 Printer except that it has a 69-character print set and connects to either the 8112 Printer Controller or the 8161 Display Station.

8415 BATCH PRINTER STATION: This unit includes a printer and controller and can print up to 900 lines per minute. The 8415 provides a 46, 64, or 94-character set, and can print up to 104 characters per line. The 8415 connects to a DUST 3630 or a TRANSDATA 960 and accepts 6-bit BCD-Transcode, 7-bit CCITT No. 5, or 8-bit EBCDIC over a 9600 bps line.

8418 BATCH PRINTER/CARD INPUT STATION: This subsystem includes a printer, a punched card reader, and a controller. The 8418 is identical to the 8415 except that the 8418 has the ability to read standard 80-column cards at up to 667 cpm.

OPERATING SYSTEMS

BS 1000: This operating system is a real-memory, batch, remote batch, and transaction-processing system control program that is supported on all 7.000 systems except the 7.760, and all 4004 models from the 4004/35 upward. BS 1000 was made available for use on the 7.000 series in April, 1975 as Version 1.3. BS 1000 had previously been available on the 4004 as early as November, 1973. Each of up to 14 independent programs may be loaded at any location in main memory for simultaneous execution. Each program must reside in a single block of contiguous memory, and each program is assigned a priority that can be changed during execution. Depending upon the user's requirements, a BS 1000 system can be generated with a minimum resident main memory requirement of 12K bytes.

The principal control system components of the BS 1000 include:

- Executive (EXEC)
- Job Management System
  - —Monitor (MONITR)
  - —SPOOL 1 System
  - —SPOOL 2 System
  - —Job Control System 1 (JCS1)
  - —Resource Management System (RMS)
  - —Job Control System 2 (JCS2)
  - —Data Set Catalog System (DACS)
  - —Job Accounting System (MESACNT)
- File Control Processor (FCP)
- Telecommunications System (TCS)
- Real Time Control Programs (ASMUS, DIACUP)
- Voice Output System

The main functions of the EXEC are to manage main memory, analyze and service interrupts, schedule I/O, and communicate with the operator through the system console(s). EXEC occupies 12K bytes of main memory as a minimum. An optional System Overlay feature of the EXEC permits system disk overlays to be made resident in main memory in an area that can be 4K to 50K bytes in size.

The Job Management System (JMS) comprises the systems for automatic job execution.

In order to reduce the workload on the operator, the MONITR allows a "job" consisting of several programs to be processed in a job stream. MONITR is always overlaid by the next program to be started so that it does not occupy any memory space during program processing.

SPOOL 1 is used for small-to-medium configurations and supports systems with available main memory of at least 64K bytes. SPOOL 2 is for large configurations and supports systems with available main memory of 128K bytes or larger. Both spoolers support input of jobs and files from local peripherals and intermediate storage and output of print and punch files via local peripherals. In addition, SPOOL 2 also accepts input from remote terminals, supports intermediate storage and output to remote terminals, and reads/writes temporary files via a virtual magnetic tape interface.

SPOOL 2 also offers an extensive function catalog and can support dual systems with the multi-channel switch and two-channel disk controller.

JCS 1 is an integral part of SPOOL 1 and supports FIFO automatic job execution under a 64-class job classification system that assigns any of 3 priorities to an individual job. JCS 2 is intended for use with SPOOL 2 and runs as an internal process that does not require its own time slot. JCS 2 supports up to 10 priority levels.

DACS catalogs and manages data sets by generation dates, assigns proper data sets to user programs, and initializes storage space for disk output, as well as permitting temporary or permanent storage of job variables for interchange between programs.

FCP controls I/O data communications between the CPU and the peripherals.

TCS is analogous to FCP except that it controls communication between the CPU and remote terminals connected to a communcations controller as well as the interconnection of 2 or more CPU's via a data exchange controller. TCS runs in conjunction with SPOOL 2.

Two TCS access methods are available under BS 1000:

- TCS for non-programmable communications controllers (3630),
- TCS-NEA for programmable communication controllers (TRANSDATA 960) and communications front-end processors. TCS-NEA supports communication network configurations.

TCS and TCS-NEA consist of a communication control program and up to 8 user programs.

ASMUS, a real-time control program that runs under BS 1000, supports overlapped (re-entrant) operation of several interactive data terminals and/or remote batch peripherals. ASMUS supports overlapped execution of several active programs by providing segment-reentrant control. User programs with ASMUS can be written in Assembler or COBOL.

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DIACUP is an interactive program that supports the writing of up to 137 communication user programs that can be run as subroutines in the same program slot as DIACUP. DIACUP requires a minimum of 4096 bytes of main memory.

The minimum configuration required to run the BS 1000 operating system consists of any System 7.000 CPU with at least 64K bytes of main memory, 1 console, 1 disk storage device connected via a selector channel, 1 card reader, and 1 printer.

BS 2000: This is a virtual memory operating system that provides significant functional enhancements over BS 1000. BS 2000 was introduced for the 7.000 as Version 1 in December, 1973. BS 2000 can be run on any medium-to-large scale System 7.000 from the model 7.730 up; as well as the System 4004/151. The essential features of BS 2000 include dynamic memory management for a virtual address space of up to 16 million bytes; concurrent support of local or remote batch processing, multiprogramming of up to 120 tasks, and interactive processing (time-sharing) for more than 100 users under control of a batch-oriented task management system; and real-time operation. BS 2000 treats all programs as either Class I (memory resident) or Class II (pageable). A Class II program can be up to 5 million bytes in length. Users are classified as system administrators, operators, or user/programmers.

There are two main types of programs under BS 2000: privileged and non-privileged routines. The Control System is privileged and consists of the Executive, the Data Management System, the Teleprocessing System, and System Services. Non-privileged routines consist of language processors, utility routines, and user programs.

The Executive performs the following functions:

- Handling console I/O
- Processing user command language
- System accounting, spooling
- Interrupt handling.

The Data Management System handles I/O operations except for data terminals and the console(s), including file management and the shareability of files. Access methods supported by the Data Management System include SAM (Sequential Access Method), ISAM (Indexed Sequential Access Method), PAM (Primary Access Method), and BTAM (Basic Tape Access Method). PAM can only access 2048-byte pages.

The Teleprocessing System supports remote access to the computer system including facilities for resource management, logon/logoff, support of logical or virtual terminals, data transfer, and error handling.

System Services include an Interactive Debugging Aid, a Desk Calculator function, a Dynamic Linking Loader, and an Audit Mode for generation of branch address tables.

For execution, tasks are classified as either interactive or background (batch). Interactive tasks are initiated via the keyboard of a data terminal. Batch tasks can be assigned any of 9 priorities.

Operating system components (except the Executive), user programs and application programs are stored in virtual memory and relocated into real memory during execution. Virtual memory space is reallocated to the programs during loading. Virtual memory for Models 7.730 and above is divided into consecutive 64K-byte segments each containing 32 pages.

Real memory under BS 2000 is divided into two sections: one is reserved for the Executive and the real-memory resident programs, and the other is divided into 2K page frames. All paging is done on demand only.

Virtual memory is subdivided into 6 classes. Classes 1-4 are reserved for the system, while Classes 5 and 6 are available to the user. Class 6 memory is available for user-written programs and begins at the low-order end of the available memory area. Class 5 memory comprises the high-order 64K and is used for tables and buffer areas that have to be set up for user tasks.

Dynamic Address Translation is handled via a special Address Translation Memory (ATM) that holds 128 entries. Each ATM entry contains a Segment and Page reference that is combined with a virtual address displacement to result in a real address. A hit will result in 90-95% of all address references using this multi-level address translation scheme. When an address cannot be determined on the first pass through the ATM, a fall back to Segment/Page tables with an additional 256 entries is required. A maximum of 2-levels are required for 2K-page addressing, and 3-levels are required for 4K-page addressing schemes (4004/151).

LANGUAGE PROCESSORS

A variety of language processors are supported on the System 7.000 under the BS 1000 and BS 2000 operating systems:

Language	BS 1000 (Memory Requirement)	BS 2000
Assembler	yes (34K)	no
Assembler	yes (70K)	yes**
RPG 2	yes (Min. 26K)	no
ALGOL 60	yes (66K)	yes
ANS COBOL	yes (24 or 46K)	yes
FORTRAN IV	yes (56 or 92K)	yes
PL/I	yes (86K)	yes
BASIC	no	yes**
BASICL*	no	yes**

*Double-precision version.
**Shareable.

Two versions of the ANS COBOL compiler are available under BS 1000: a basic version that requires 24K of resident main memory; and an enhanced version that requires 46K bytes.

The PL/I compiler offers capabilities that are midway between the IBM D-level and the ECMA level. The Assembler contains an extensive macro capability.

All language processors available under BS 2000 are pageable. All but BASIC and BASICL produce pageable object modules.

UTILITY ROUTINES

A full set of utilities is available for BS 1000 and BS 2000, including a Sort/Merge program, library maintenance routines, a linkage editor, system service routines, diagnostic routines, debugging aids, test data generators, and peripheral/media conversion routines.

UNIVERSAL DATA BASE MANAGEMENT SYSTEM (UDS): UDS, a separately priced product, is available for the System 7.000 and System 4004 computers. Minimum requirements are a 128K main memory, a card reader, a printer, and two disk drives. For smaller systems, Siemens offers UDS Version 1 Variant A, which requires a minimum of 46K of real memory. UDS runs under BS 1000, with BS

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2000 support scheduled to become available in the second quarter of 1978. UDS interacts with ASMUS for real-time operations when used in conjuction with TCS. User programs supported under UDS Version 1 must be written in COBOL. UDS follows the recommendations of the April 1971 Report of the CODASYL DBTG, the CODASYL COBOL Data Base Facility Proposal of March 1973, and the COBOL JOD for 1975. UDS is functionally upward compatible with Siemens other data base systems: SESAM and PRISMA.

The major components of UDS are:

- Data Definition Language (DDL)
- Storage Structure Language (SSL)
- Data Base Handler (DBH)
- Data Manipulation Language (DML)
- Interactive Query Language (IQL)
- Service Programs.

GOLEM INFORMATION RETRIEVAL SYSTEM: This system provides access under BS 2000 to the central processor from remote data communications terminals. GOLEM uses a flexible, interactive, conversational language for data access that includes features for browsing, specification of descriptor ranges, etc. GOLEM also supports simultaneous terminal operations for multiple application programs, and can handle stored data in variable formats, contents, and lengths. Documents are logically divided into segments, and 5-level access codes are used to ensure data access security. Under BS 2000, GOLEM is a pageable program. GOLEM is a separately priced program product.■

EQUIPMENT PRICES*

CONFIGURATION		Approx. Purchase (DM)	Approx. Monthly Rental** (1-year lease) (DM)	Approx. Monthly Rental** (3-year lease) (DM)	Approx. Monthly Rental** (5-year lease) (DM)	Approx. Monthly Maint. (DM)
SIEMENS 7.722 ENTRY LEVEL SYSTEM						
7.722-FE1	7.722 Version 1 Processor With 96K Bytes of Memory, 1 Byte Multiplexor Channel and 1 Selector Channel					
3023	Central Operator Console					
3150-03	Card Reader, 660 cpm					
3340-11	Line Printer, Single Form, 6 Lines/Inch, 960/1170 lpm, 132 Print Positions					
3540	Magnetic Tape Drives (2) 9-Track, 800 bpi, 60/120 KBS					
3510-01	Magnetic Tape Control Unit					
	TOTAL PRICE *	**750,000**	**21,000**	**18,500**	**18,000**	**3,000**
SIEMENS 7.722 MEDIUM-TO-LARGE SCALE SYSTEM						
7.722-HZ	7.722 Version 2 Processor With 256K Bytes of Memory, 1 Byte Multiplexor Channel and 1 Selector Channel					
72232	Channel and Throughput Extension Feature					
72228-02	Block Multiplexor Channel Extension					
72226-02	Byte Multiplexor Channel Extension					
3020	Central Operator Console					
3160	Card Punch, 100-290 cpm					
3150-01	Card Reader, 1000 cpm					
3340-14	Line Printer, Dual Form, 6 or 8 Lines/Inch, 96/1170 lpm, 160 Print Positions					
3571	Magnetic Tape Drive, 9-Track, 1600 bpi, 60 KBS					
3531	Magnetic Tape Drives (2) (Add-on to 3571)					
3465	Mass Storage Drives (4), 144 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE*	**1,650,000**	**60,000**	**54,000**	**52,000**	**5,500**

*Note that all configurations and configuration prices have been estimated by Datapro based upon publicly available information and have not been approved by Siemens. No communications subsystems or software product prices are shown in these configurations.
**Prices include maintenance.

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EQUIPMENT PRICES*

CONFIGURATION		Approx. Purchase (DM)	Approx. Monthly Rental** (1-year lease) (DM)	Approx. Monthly Rental** (3-year lease) (DM)	Approx. Monthly Rental** (5-year lease) (DM)	Approx. Monthly Maint. (DM)
SIEMENS 7.730 SMALL-TO-MEDIUM-SCALE SYSTEM						
7.730-GE1	7.730 Version 1 Processor With 160K Bytes of Memory, 1 Byte Multiplexor Channel, 1 Block Multiplexor Channel					
73027	Byte Multiplexor Channel Extension					
3023	Central Operator Console					
3160	Card Punch, 100-290 cpm					
3150-01	Card Reader, 1000 cpm					
3340-12	Line Printer, Single Form, 6 or 8 Lines/Inch, 960/1170 lpm, 132 Print Positions					
3571	Magnetic Tape Drive, 9-Track, 1600 bpi, 60 KBS					
3531	Magnetic Tape Drives (2) (Add-on to 3571)					
3455	Mass Storage Drives (6), 77 MB/Disk Pack					
3414	Mass Storage Controller					
	TOTAL PRICE *	**1,600,000**	**44,500**	**40,500**	**38,500**	**4,750**
SIEMENS 7.730 LARGE-SCALE SYSTEM						
7.730-I2	7.730 Version 2 Processor With 512K Bytes of Memory, 1 Byte Multiplexor Channel, 1 Block Multiplexor Channel					
73027, 73028	Byte Multiplexor Channel Extensions (2)					
73040	2-byte Feature					
73042	Second Block Multiplexor Channel					
3023	Central Operator Console					
3023-10	Sub-console					
3160	Card Punch, 100-290 cpm					
3150-01	Card Reader, 1000 cpm					
3340-11	Line Printers (2), Single Form, 6 Lines/Inch, 960/1170 lpm, 132 Print Positions					
3554	Magnetic Tape Drives (4), 9-Track, 800/1600 bpi, 160/320 KBS					
3512-04	Magnetic Tape Controller					
3450	Mass Storage Drives (8), 100 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE*	**3,100,000**	**85,000**	**76,000**	**72,500**	**10,000**
SIEMENS 7.738 MEDIUM-TO-LARGE SCALE SYSTEM						
7.738-IH	7.738 Processor With 768K Bytes of Memory, 1 Byte Multiplexor Channel, 2 Block Multiplexor Channels					

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EQUIPMENT PRICES*

CONFIGURATION		Approx. Purchase (DM)	Approx. Monthly Rental** (1-year lease) (DM)	Approx. Monthly Rental** (3-year lease) (DM)	Approx. Monthly Rental** (5-year lease) (DM)	Approx. Monthly Maint. (DM)
SIEMENS 7.738 MEDIUM-TO-LARGE SCALE SYSTEM (continued)						
73840	2-Byte Feature					
73843	3rd Block Multiplexor Channel					
3023	Operator Console					
3023-10	Sub-Console					
3160	Card Punch, 100-290 cpm					
3150-01	Card Reader, 1000 cpm					
3343	Line Printer, 1630/2000 lpm					
3262-02	Document Reader, 50-75 Documents/Minute					
3571	Magnetic Tape Drive, 9-Track, 1600 bpi, 60 KBS					
3531	Magnetic Tape Drives (2) (Add-on to 3571)					
3450	Mass Storage Drives (6) 100 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE *	**2,750,000**	**75,000**	**67,500**	**64,000**	**10,500**
SIEMENS 7.740 MEDIUM-SCALE SYSTEM						
7.740-IG1	7.740 Processor With 640K Bytes of Memory, 1 Byte Multiplexor Channel, 1 Block Multiplexor Channel					
74040	2-Byte Feature					
74045	2nd Block Multiplexor Channel					
3023	Operator Console					
3160	Card Punch, 100-290 cpm					
3150-01	Card Reader, 1000 cpm					
3343	Line Printer, 1630/2000 lpm					
3571	Magnetic Tape Drive, 9-Track, 1600 bpi, 60 KBS					
3531	Magnetic Tape Drives (2) (Add-on to 3571)					
3450	Mass Storage Drive (2), 100 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE*	**3,250,000**	**82,000**	**75,500**	**72,000**	**9,750**
SIEMENS 7.748 MEDIUM-SCALE SYSTEM						
7.748-J1	7.748 Processor With 1,536K Bytes of Memory, 1 Byte Multiplexor Channel, 2 Block Multiplexor Channels					
74825	Byte Multiplexor Channel Extension					
74840	2-Byte Feature					
74843	3rd Block Multiplexor Channel					
3023	Operator Console					

*Note that all configurations and configuration prices have been estimated by Datapro based upon publicly available information and have not been approved by Siemens. No communications subsystems or software product prices are shown in these configurations.
**Prices include maintenance.

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EQUIPMENT PRICES*

CONFIGURATION		Approx. Purchase (DM)	Approx. Monthly Rental** (1-year lease) (DM)	Approx. Monthly Rental** (3-year lease) (DM)	Approx. Monthly Rental** (5-year lease) (DM)	Approx. Monthly Maint. (DM)
SIEMENS 7.748 MEDIUM-SCALE SYSTEM (continued)						
3160	Card Punch, 100-290 cpm					
3150-01	Card Reader, 1000 cpm					
3343	Line Printer, 1630/2000 lpm					
3571	Magnetic Tape Drive, 9-Track, 1600 bpi, 60 KBS					
3531	Magnetic Tape Drives (2) (Add-on to 3571)					
3450	Mass Storage Drives (8), 100 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE*	**4,000,000**	**110,000**	**100,000**	**95,000**	**14,000**
SIEMENS 7.748 LARGE-SCALE SYSTEM						
7.748-K	7.748 Processor With 2048K Bytes of Memory, 1 Byte Multiplexor Channel, 2 Block Multiplexor Channels					
74825	Byte Multiplexor Channel Extension					
74840	2-Byte Feature					
74843	3rd Block Multiplexor Channel					
74844	4th Block Multiplexor Channel					
74845	5th Block Multiplexor Channel					
3023	Operator Console					
3023-10	Sub-Console					
3160	Card Punch, 100-290 cpm					
3150-02	Card Reader, 1000 cpm					
3352-01	Laser Printer, 20,000 lpm					
3343	Line Printer, 1630/2000 lpm					
3557	Magnetic Tape Drives (6) 9-Track, 1600/3200 bpi, 780 KBS					
3513	Magnetic Tape Controller for 3557's					
3550	Magnetic Tape Drive, 9-Track, 800/1600 bpi, 120/240 KBS					
3510-03	Magnetic Tape Controller for 3550					
3450	Mass Storage Drives (12), 100 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE*	**6,250,000**	**170,000**	**158,000**	**150,000**	**20,000**
SIEMENS 7.755 MEDIUM-SCALE SYSTEM						
7.755-K	7.755 Processor With 2048K Bytes of Memory, 1 Byte Multiplexor, 2 Block Multiplexors					
75525	Byte Multiplexor Channel Extension					

*Note that all configurations and configuration prices have been estimated by Datapro based upon publicly available information and have not been approved by Siemens. No communications subsystems or software product prices are shown in these configurations.
**Prices include maintenance.

Siemens System 7.000

EQUIPMENT PRICES*

CONFIGURATION		Approx. Purchase (DM)	Approx. Monthly Rental** (1-year lease) (DM)	Approx. Monthly Rental** (3-year lease) (DM)	Approx. Monthly Rental** (5-year lease) (DM)	Approx. Monthly Maint. (DM)
SIEMENS 7.755 MEDIUM-SCALE SYSTEM (continued)						
75540	2-Byte Feature					
75543	3rd Block Multiplexor Channel					
3023	Operator Console					
3023-10	Sub-Console					
3160	Card Punch, 100-290 cpm					
3150-01	Card Reader, 1000 cpm					
3343	Line Printer, 1630/2000 lpm					
3340-14	Line Printer, Dual Form, 6 or 8 Lines/Inch, 960/1170 Lines/Minute, 160 Print Positions					
3557	Magnetic Tape Drives (6), 9-Track, 1600/3200 bpi, 780 KBS					
3513	Magnetic Tape Controller					
3450	Mass Storage Drives (8) 200 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE*	**6,600,000**	**170,000**	**160,000**	**150,000**	**21,000**
SIEMENS 7.760 LARGE-SCALE SYSTEM						
7.760-LJ	7.760 Processor With 5,120K Bytes of Memory, 1 Byte Multiplexor, 2 Block Multiplexor Channels					
76025	Byte Multiplexor Extension					
76040	2-Byte Feature					
76043	3rd Block Multiplexor Channel					
76044	4th Block Multiplexor Channel					
76045	5th Block Multiplexor Channel					
3023	Operator Console					
3023-10	Sub-Console					
3150-02	Card Reader, 1000 cpm					
3352-01	Laser Printer, 20,000 lpm					
3343	Line Printers (2), 1630/2000 lpm					
3559	Magnetic Tape Drives (6), 9-Track, 1600/3200 bpi, 1,250 KBS					
3513	Magnetic Tape Controller for 3559's					
3460	Mass Storage Drives (12), 200 MB/Disk Pack					
3416	Mass Storage Controller					
	TOTAL PRICE*	**12,000,000**	**310,000**	**295,000**	**275,000**	**25,000**

*Note that all configurations and configuration prices have been estimated by Datapro based upon publicly available information and have not been approved by Siemens. No communications subsystems or software product prices are shown in these configurations.
**Prices include maintenance.

Siemens System 7.000

NEW PRODUCT ANNOUNCEMENT

In a major expansion of the System 7.000 line, Siemens has announced four new high-end mainframe models with performance ranging from 1.6 to 4.0 million instructions per second. The new models include the 7.761 and 7.762 biprocessor systems that run under BS 2000, and the larger 7.770 and 7.780, which feature 64K-bit memory chips and can run under either BS 2000 or BS 1000.

Coincident with the announcement of these Siemens-built models, four IBM/MVS-compatible Fujitsu supercomputers, dubbed the System 7.800, were added to the West German giant's product offerings, and the System 7.000 was renamed the System 7.700 to distinguish the two incompatible lines.

Siemens emphasizes the reliability/availability/serviceability (RAS) of the new System 7.700 models. The 7.761 and 7.762 biprocessor systems feature dynamic processor and I/O system reconfigurability, and extensive software-supported diagnostic routines. The 7.770 and 7.780 have enhanced error detection/correction facilities that recover 1- to 4-bit control memory errors, correct 1- and 2-bit main memory errors, and detect all 3-bit and some multiple-bit main memory errors. In addition, the two larger models use a service processor that executes system maintenance routines and stores error information on two dedicated floppy disks integrated into the operator console.

The four new System 7.700 models will be available in all countries in which Siemens is currently marketing computer systems, plus France, where the company is returning with its complete EDP product range. First deliveries are tentatively scheduled for late in 1979.

Current System 7.700 users who wish to convert to the new models will be able to transport their application software with only minor modifications. Existing 7.760 installations can be field-upgraded to 7.761 or 7.762 biprocessor status through the attachment of a second, modified 7.760 processor, yielding about a 50-percent improvement in instruction throughput.

The 7.761 and 7.762 mainframes each include two modified 7.760 processors, two hardware multiply/divide units, two control memories, two cache memories, one common main memory, and an input/output system. The two processors in a 7.761 or 7.762 mainframe each handle a separate instruction and data flow, and communicate with each other via a processor/processor interface. Each processor has a writable 61,440-byte control memory and a 32,768-byte cache memory. Main memory, which is shared between the two processors, is composed of 16K-bit chips and ranges in capacity from 2,097,152 to 8,388,608 bytes. Sections of main memory, called "shaded" or "shadow" memory, are reserved for information required for servicing peripheral devices, error logout, and diagnostic routines. These sections are not accessible to the user and their size depends on the system configuration. In addition to "shaded" memory, 65,536 bytes of memory are reserved for maintenance purposes.

The 7.761 input/output system consists of one channel control unit with one byte multiplexor channel and up to eight block multiplexor channels. The 7.762 input/output system features two channel control units, each handling one byte multiplexor channel and up to six block multiplexor channels. The maximum input/output data transfer rate for both the 7.761 and 7.762 is 10.2 megabytes per second.

Purchase prices for the 7.761 and 7.762 with minimum main memory start at about DM 4,500,000.

At the top of the System 7.700 line, the 7.770 and 7.780 feature a number of enhancements over the smaller models, including a processor with physically split instruction and execution units that use 5-level pipelining, 64K-bit-chip main memory, and improved dynamic address translation hardware. Instruction throughput on the 7.770 and 7.780 is about 2.5 and 4.0 times greater, respectively, than on the previous top-of-the-line 7.760.

The pipelining technique used by the 7.770 and 7.780 processors breaks instruction processing into five steps that are executed by the instruction and execution units. The instruction (or pipeline) unit, which includes dynamic address translation hardware and a branching unit, handles instruction prefetch and interpretation, operand address calculation, and memory operand reading prior to, or simultaneously with, instruction execution. The execution unit

executes the preprocessed instructions, stores results in the register set or main memory, and performs management tasks (e.g. interrupt handling).

Specifically, the five steps in the pipelining technique are as follows: 1) reading of an instruction block and dynamic address translation, 2) interpretation of an instruction (microprogram branch), 3) calculation of an actual memory address, 4) reading of a memory operand or instruction at a branch destination, including dynamic address translation, and 5) execution of an instruction. Steps 1 through 4 are handled by the instruction unit, and step 5 is handled by the execution unit.

The instruction and execution units that make up a 7.770 or 7.780 processor are controlled by separately loaded microcode. Control memory capacity is 2,048 64-bit microinstructions for the instruction unit, and 8,192 144-bit microinstructions for the execution unit. Cache memory, which is directly linked to the instruction unit, has a total capacity of 65,536 bytes, divided into four 16,384-byte banks. The 7.770 and 7.780 also feature an 8,192-byte bipolar write buffer which smooths the flow of data from the central processor to main memory.

Main memory for the 7.770 and 7.780 ranges in capacity from 2,097,152 to 8,388,608 bytes and is composed of 65,536-bit (64K-bit) chips, 40 of which make up a 262,144-byte module.

The improved dynamic address translation hardware for the 7.770 and 7.780 features three address translation buffers, each with 64 entries. During address translation, a row is selected in each of the buffers by using parts of the segment and page portions of the virtual address. Results of previous two-level address translations can be held in the buffers for up to eight tasks, each with its own virtual address space.

The 7.770 and 7.780 feature an input/output processor as standard equipment, and can optionally be equipped with a second. The 7.770 input/output processor has one byte multiplexor channel and from four to six block multiplexor channels; the 7.780 input/output processor, one byte multiplexor and four block multiplexor channels. With one input/output processor, the maximum I/O data transfer rate for both mainframe models is 6.0 megabytes per second; with two, 10.2 megabytes per second.

Purchase prices for a 7.770 with 4,194,304 bytes of main memory start at about DM 5,500,000; for a 7.780 with 6,291,456 bytes of main memory, at about DM 9,000,000.□