

Memorex MRX/40 and 50

MANAGEMENT SUMMARY

Can a company that lost \$13 million in the computer peripherals and supplies business in 1971 find prosperity as a mainframe supplier? That's the question that echoed around Wall Street and the computer industry on March 23, 1972, when Memorex unveiled its MRX/40 and 50 computer systems.

The DATAPRO 70 staff — in common with most other industry analysts — initially questioned the wisdom of Memorex's bold thrust into the small-scale business computer market. But a thorough study of the new systems has led our staff to the conclusion that Memorex has combined a strong line of hardware and software with attractive pricing and unusually well-defined marketing strategy. The combination could prove to be a winner for Memorex, and the MRX/40 and 50 deserve serious consideration by users shopping for small-scale computers.

The Memorex computers were developed by Midwest Systems Corporation, the company's Minneapolis-based subsidiary. Eight prototype systems were in operation at announcement time, and about \$6 million had been spent on their development. Customer deliveries are scheduled to begin in August 1972, and Memorex hopes to deliver at least 20 systems by the end of the year. Monthly rental prices will begin at about \$2,400 (for a 16K MRX/40 with 600-lpm printer, 300-cpm card reader, and 29 million bytes of disc storage), and will seldom exceed \$12,000. Both larger and smaller processor models are under development and are likely to be introduced later in 1972.

Memorex claims that the MRX/50 provides "the power of a System/370 Model 135 at the price of a System/360 Model 20" — and DATAPRO 70 judges the

Memorex has entered the mainframe business with a pair of impressive small-scale computers that emphasize large-capacity disc storage, data communications, and multiprogramming. The MRX/40 and 50 are particularly well suited to serve as upgrade systems for IBM 360/20 users.

CHARACTERISTICS

MANUFACTURER: Memorex Corporation, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-1000.

MODELS: MRX/40 (based on 7200 Processing Unit) and MRX/50 (based on 7300 Processing Unit).

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a word.

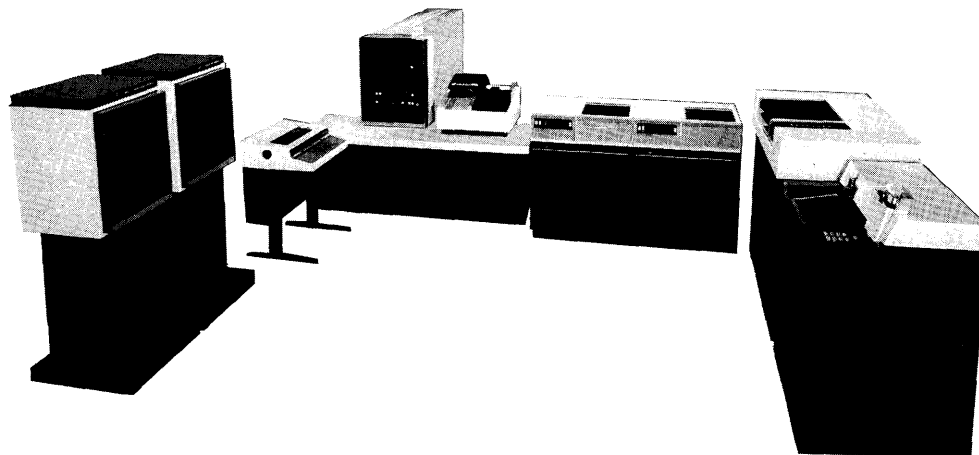
FIXED-POINT OPERANDS: Can range from 1 to 255 bytes (1 to 509 digits plus sign) in packed decimal mode; 1 or 2 words (16 or 32 bits) in binary mode.

FLOATING-POINT OPERANDS: 4 words, consisting of 56-bit-plus-sign fraction and 7-bit hexadecimal exponent.

INSTRUCTIONS: Type RR (Register to Register) instructions are 2 bytes in length and typically specify 2 general register addresses. Type RX (Register to Indexed Storage) instructions are 4 bytes in length and typically specify one general register and one main memory address. Type XX (Indexed Storage to Indexed Storage) instructions are 6 bytes in length and specify two main memory addresses. Type SS (Storage to Storage) instructions are 8 bytes in length and specify two main memory addresses plus the length of each operand field.

INTERNAL CODE: EBCDIC (Extended Binary-Coded Decimal Interchange Code).

This MRX/50 system includes (left to right) two magnetic tape drives, processing unit with console typewriter and card reader, two 29-million-byte disc drives, drum printer, and card read/punch.



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➤ claim to be only a mild exaggeration. Memorex has taken full advantage of the current state of the art in hardware and software to produce systems that promise to be exceptionally cost-effective. The MRX/40 and 50 employ large-scale integrated circuitry, MOS semiconductor main memories, and advanced micro-programming control techniques. Moreover, they offer disc storage, data communications, and multi-programming capabilities which are unusually strong for systems in their price class.

The prime prospects for the Memorex computers are the more than 8000 current users of the IBM System/360 Model 20. More specifically, Memorex believes that its "ideal prospects" are:

1. Users of stand-alone Model 20 Submodel 5 systems who are outgrowing their current equipment (particularly those users who are already oriented toward disc-based processing and are making little or no use of the 2560 Multi-Function Card Machine); and
2. Large installations that are using multiple Model 20's as programmable remote batch processors and need replacements with more processing and communications power.

Memorex notes that these users, who have gone about as far as they can go with the 360/20, can find no really attractive upgrade system in the current IBM product line. The transition to a larger System/360 or System/370 processor is bound to be complex and/or expensive. (The 360/25, which offers Model 20 emulation, is far more costly, and the 360/22, though rather attractively priced, requires extensive reprogramming.) A System/3 would require a complete conversion and offer little additional growth potential. And Memorex is betting that the forthcoming System/370 Model 125 will still fall short of the MRX/50 in price/performance because of IBM's need to control the new model's degree of impact upon its huge user base of leased systems.

Memorex has gone to great lengths to make its offerings as attractive as possible to 360/20 users. The basic data formats and instruction repertoires of the Memorex systems have much in common with the System/360, and optional compatibility features utilize Memorex's Alterable Control Memory to permit direct execution of many programs written for the 360/20. In addition, Memorex offers translators for the 360/20 Assembler, RPG, and Job Control Language statements, plus utility routines to facilitate the conversion of IBM data files.

Although it is clear that the MRX/40 and 50 systems are directed primarily toward current users of the 360/20, they will also prove attractive to many users of ➤

➤ MAIN STORAGE

STORAGE TYPE: MOS/LSI semiconductor.

CAPACITY: MRX/40—16K, 24K, 32K, 48K, or 64K bytes; MRX/50—16K, 24K, 32K, 48K, 64K, 96K, or 128K bytes. (Two optional features, the 4K ACM Increment and Relocation and Protection, are prerequisites for the 96K or 128K memory size.)

CYCLE TIME: MRX/40—1.8 microseconds per 2-byte access; MRX/50—900 nanoseconds per 2-byte access (or 1.0 microsecond when the Error Correction Code feature is installed).

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

The optional Error Correction Code feature (for the MRX/50 only) replaces the standard parity check. It corrects all single-bit errors which occur during a storage reference and detects, but does not correct, all double-bit errors. In either case an entry is made in the ECC Error Log register. Multiple errors initiate a microcoded routine that attempts to reread the data correctly.

STORAGE PROTECTION: Protection against writing in designated main memory areas is provided in processor states 5, 6, and 7. An Upper Bounds register and a Lower Bounds register, set by the control program, are provided for each of these three states.

The optional Relocation and Protection feature (for the MRX/50 only) provides comprehensive read and/or write protection for up to 16 memory segments in any or all of the processor states.

CENTRAL PROCESSORS

PROCESSOR STATES: The Memorex processors employ a time-division multiplexing technique that divides one complete machine cycle into eight segments called "major cycles." The combination of one of these major cycles and its associated set of dedicated hardware resources is called a "processor state." Each of the eight processor states has its own set of eight general registers, which can be used as accumulators or index registers. Other hardware resources, such as the arithmetic section, are shared by all of the processor states. The functions of the eight processor states are as follows:

State 0—communications I/O (on devices connected to the Integrated Communications Adapter).

State 1—miscellaneous I/O (on devices connected to the optional Selector Channel).

State 2—unit record and magnetic tape I/O.

State 3—disc I/O (on devices connected to the Integrated File Adapter).

State 4—control programs.

State 5—user programs.

State 6—user programs.

State 7—user programs.

The processor normally cycles through the eight processor states, allocating one major cycle to each state in turn. However, a priority scheme assigns out-of-sequence cycles to any I/O processor state that needs cycles sooner than its normal turn. The effect is similar to that of the priority interrupt systems used in most computers.

CONTROL MEMORY: 4K words of Alterable Control Memory (ACM) are standard in every Memorex processor, ➤

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▷ the IBM 1130, IBM System/3, and various other small-scale computers who need expanded processing, disc storage, and/or data communications capabilities.

The MRX/40 and 50 Processing Units are byte-oriented processors that access two bytes (or one 16-bit "word") in each main memory cycle. Cycle time of the MOS memory is 1.8 microseconds in the MRX/40 and 900 nanoseconds in the MRX/50. Main memory capacity ranges from 16K to 64K bytes in the MRX/40 and from 16K to 128K bytes in the MRX/50. Main memory is directly addressed, using 16-bit operand addresses, and most instructions can be modified by indexing and/or indirect addressing.

The Memorex complement of 158 instructions provides most of the facilities of the full System/360 instruction set. Complete arithmetic facilities are provided in both the variable-length packed decimal and fixed-length binary modes, together with editing, code translation, radix conversion, and packing/unpacking instructions. Floating-point arithmetic is optional.

Control of multiprogramming and simultaneous operations is facilitated by a novel time-division multiplexing technique that effectively divides the facilities of the processing unit into eight "processor states," each with its own set of eight general registers. Four of these processor states are dedicated to I/O control, one is reserved for the MRX/OS control programs, and three are available for user programs (though only two user partitions are supported by the software announced to date). Processor cycles are normally allocated sequentially to each of the active processor states, but a priority scheme ensures that I/O operations will get as many cycles as they need to guard against loss of data.

Memorex offers a modest complement of conventionally designed and attractively priced peripheral equipment for its computers. Memorex will produce its own processing units, disc drives, console printers, and microfilm printers, and will purchase the mechanisms for the other I/O units from well-regarded OEM sources. The principal peripheral device—and basis for all the Memorex software—is the 3664 Disc Storage Drive, a high-performance, IBM 2314-compatible unit that stores up to 29 million bytes on each removable 11-disc pack. Priced at only \$300 per month, the 3664 drives rank as a "best buy" among current disc files—and the microprogrammed Integrated File Adapter that controls them rents for only \$180 per month. In addition to the standard 600-lpm or 1200-lpm drum-type printer, Memorex permits connection of an IBM 1403 Printer or a 10,000-lpm Memorex 1603 Microfilm Printer. To date, no CRT display units or optical or magnetic readers have been announced for the Memorex systems.

▶ and one additional 4K increment is optional. Cycle time is 200 nanoseconds in the MRX/40 and 100 nanoseconds in the MRX/50. The ACM holds microprograms which implement the standard instruction set and most of the other processor functions. The microprograms are provided by Memorex and written using a machine micro-instruction repertoire of 65 instructions. The microprograms reside on a small reserved portion of a disc pack and are loaded automatically at Initial Program Load (IPL) time.

INDEX REGISTERS: There are 8 general registers for each processor state. Seven of these can be used as index registers. Most 4-byte, 6-byte, and 8-byte instructions can be indexed.

INDIRECT ADDRESSING: One-level indirect addressing can be performed on most instructions and is applicable to both register and main memory addresses. Indirect addressing can be combined with indexing.

INSTRUCTION REPERTOIRE: 158 instructions, including addition, subtraction, multiplication, and division in both variable-length packed decimal and fixed-length binary mode. (Floating-point arithmetic is optional, as described below.) Other standard facilities include edit, code translate, pack, unpack, decimal-to-binary and binary-to-decimal conversion, and a wide variety of logical, compare, move, and branch instructions. In general, the formats and functions of the Memorex instructions are similar to—but by no means identical with—those of the full System/360 instruction set.

INSTRUCTION TIMES: See table below; the figures shown are typical times for 2-address packed decimal operations on signed 5-digit (3-byte) fields and for 1-address binary operations on 1-word (16-bit) fields, using direct addressing exclusively. All times are expressed in microseconds.

| | MRX/40 | MRX/50 |
|------------------------|--------|--------|
| Add/subtract (binary): | 5.4 | 2.7 |
| Multiply (binary): | 48.8 | 24.4 |
| Divide (binary): | 93.4 | 46.7 |
| Load/store (binary): | 5.4 | 2.7 |
| Add/subtract (decimal) | 68.6 | 34.3 |
| Multiply (decimal): | 672. | 336. |
| Divide (decimal): | 956. | 478. |
| Compare (decimal): | 54.0 | 27.0 |

INTERVAL TIMER: A 16-bit program-readable interval timer with a 16.6-millisecond resolution is a standard feature in both the MRX/40 and 50 processors.

OPTIONAL FEATURES: Extra-cost adapters must be added to the processor to accommodate each of the "integrated" peripheral devices except the 1240 Console Printer; these are listed in the "Equipment Prices" section.

The 4K ACM Increment, available for either the MRX/40 or 50, doubles the Alterable Control Memory capacity to 8K words.

The Floating-Point Arithmetic feature, available for either the MRX/40 or 50, adds 10 floating-point arithmetic instructions and 8 floating-point registers (1 for each processor state). The 4K ACM Increment is a prerequisite.

The Error Correction Code feature, available for the MRX/50 only, causes all single-bit memory reference errors to be corrected and all double-bit errors to be detected but not corrected.

The Relocation and Protection feature, available for the MRX/50 only, permits relocation of programs without instruction modification, expands the processor's addressing capability from 65K to 1 million bytes, and provides a comprehensive storage protection scheme for

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▷ The software for the Memorex computers is impressive in both its scope and its capabilities. Most of the software is scheduled for delivery along with the initial hardware installations. The central software component is MRX/OS, an integrated operating system whose facilities are generally comparable to those of IBM's DOS. MRX/OS controls multiprogramming in two independent user partitions and provides three levels of support for both data communications and conventional input/output operations. The Memorex user gets a choice of four programming languages—Assembler, COBOL, FORTRAN, and RPG II—and all four of the associated language processors can run in an 8K user partition. No PL/I compiler has been announced to date. The first three Memorex application packages equip an MRX/40 or 50 for use as a multi-terminal inquiry/retrieval system, as a multi-keyboard source data entry system, or as a HASP/RJE remote terminal.

The Memorex computers have a high degree of data compatibility with the System/360 and other current computer systems. They employ byte-oriented data formats, EBCDIC internal code, and IBM-compatible magnetic tape and card formats. The Memorex disc drives use packs which are interchangeable with the IBM 2314 and 2319 drives; but Memorex has altered the data recording format to gain improved data management capabilities and has provided standard utility routines to make the necessary format conversions. A special hardware attachment, which Memorex makes available on a no-charge basis, enables an MRX/40 or 50 to read the fixed-sector disc packs used in 360/20 systems and convert the data to the Memorex format.

The MRX/40 and 50 offer no direct program compatibility, at the machine or assembly-language level, with other current computers. The Memorex COBOL and FORTRAN compilers, however, conform with the ANS language specifications, and the Memorex Report Program Generator is compatible with IBM's RPG II for the System/3. For IBM 360/20 users, as previously noted, Memorex has developed an impressive array of hardware and software aids to make the conversion process as painless as possible.

The Memorex computers are marketed on a fully bundled basis except for the language processors, applications programs, and Model 20 Compatibility routines, which are separately (and modestly) priced. Technical support and education are provided at no extra cost by more than 75 sales and service offices across the country. The standard Memorex rental agreement allows unlimited equipment usage and includes on-call maintenance service at any time.

Notwithstanding its recent and much-publicized financial problems, Memorex boasts some impressive accomplishments that lend credibility to its entry into the

▶ each processor state. This is accomplished through the use of a Segment Relocation Table, a Storage Access Protection Matrix, a Segment Tag File, and an Address Mode Register. The 4K ACM Increment is a prerequisite.

COMPATIBILITY FEATURES: Memorex offers a choice of two distinct compatibility features, MCS-I and MCS-II, that allow user programs written for the IBM System/360 Model 20 to be run under the MRX/OS operating system in a stacked-job environment. The Model 20 jobs can be intermixed with MRX/40 or 50 native-mode jobs and can be run within one partition in a multiprogramming environment. The functions of most of the standard Model 20 peripheral devices are performed by the corresponding Memorex units, but no support is provided for the IBM 1255, 1259, or 1419 Magnetic Character Readers or the Binary Synchronous Communications Feature. Restricted support for the IBM 2560 Multi-Function Card Machine is provided by the Memorex 8010 Card Reader and/or 8025 Reader/Punch. Model 20 nine-track tape files do not require conversion, but Model 20 disc files must be physically transcribed to the Memorex disc packs.

The Model 20 Compatibility System I (MCS-I), available for either the MRX/40 or 50, permits hardware-assisted simulation of the IBM 360/20. A simulation program residing in main memory interprets the Model 20 instructions and operator messages. A limited amount of the interpretation is performed through microcode. Memory requirements are 8K bytes for the MRX/OS resident portion, 8K to 23K bytes (depending on the Model 20 configuration) for the MCS-I simulation program, and 4K to 32K bytes to simulate the user's Model 20 main memory. Thus, a 64K Memorex system can simulate the maximum Model 20 configuration. MCS-I is scheduled for delivery with the initial MRX systems in August 1972.

The Model 20 Compatibility System II (MCS-II), available for the MRX/50 only, permits microcode-level emulation of the IBM 360/20. MCS-II provides the same functional capabilities as MCS-I, but its speed is higher because the Model 20 instructions are interpreted by microprograms residing in Alterable Control Memory. (The 4K ACM Increment is a prerequisite.) Main memory requirements are 8K bytes for the MRX/OS resident portion, 4K to 19K bytes (depending on the Model 20 configuration) for the MCS-II emulation program, and 4K to 32K bytes to simulate the user's Model 20 main memory. Memorex expects the MRX/50, using MCS-II, to execute Model 20 programs at speeds equal to or greater than those of the IBM 360/20 Submodel 5. Initial deliveries of MCS-II are scheduled for February 1973.

INPUT/OUTPUT CONTROL

CONFIGURATION RULES: On the MRX/40, one 8010 Card Reader, one 8025 Card Read/Punch, one 5120 Printer, up to two 3664 Disc Drives, and up to seven communications lines can be connected via the appropriate "integrated adapters." A 1240 Console Printer is required in every MRX/40 system. The optional Selector Channel provides seven control unit positions that can be used to attach magnetic tape subsystems, additional printers, or other I/O equipment.

On the MRX/50, one 8010 Card Reader, one 8025 Card Read/Punch, one 5120 Printer, up to nine 3664 Disc Drives, and up to 15 communications lines can be connected via the appropriate "integrated adapters." A 1240 Console Printer is required in every MRX/50 system. The optional First Selector Channel provides seven control unit positions, and the Second Selector Channel provides eight more control unit positions; these positions can be used to attach magnetic tape subsystems, additional printers, or other I/O equipment.

▶ **SIMULTANEOUS OPERATIONS:** Concurrently with computing, an MRX/40 or 50 can control a maximum of one

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▷ mainframe business. Since it began delivering IBM-compatible disc drives in 1970, Memorex has installed over 11,000 drives worldwide. The company's 1200 Series Communications Terminals and 1270/1271 Transmission Control Units are important entries in the data communications marketplace. And the Memorex 1603 Microfilm Printer, which can serve as a plug-compatible replacement for the IBM 1403 Printer, is the fastest-selling COM recorder in the industry. In all, Memorex equipment is now serving more than 1500 customers in some 2500 locations.

In 1971, Memorex lost \$13.4 million on sales of \$110 million. The losses resulted from price degradation in both the IBM-compatible peripheral equipment and computer tape businesses and from a major change in the company's method of accounting for leased equipment. Memorex returned to profitability in the first quarter of 1972, earning a slim \$158,000 on revenues of \$34.5 million, but the company is still striving to improve an unfavorable cash position.

Can Memorex compete effectively in the mainframe business? On the basis of hardware performance per dollar, the MRX/40 and 50 are clearly unsurpassed by any other current systems in their class. Moreover, their product design and marketing strategy have been cleverly calculated to strike at a currently weak portion of the IBM product line—and Memorex believes that IBM will not be able to strike back effectively because of the resulting impact on its own vast user base. (The fact that Memorex has no existing user base to impact gives it a flexibility of operation that few mainframe suppliers have enjoyed in recent years.)

Thus, Memorex—in striking contrast to GE and RCA—has assembled some of the key attributes for success in the computer mainframe field. But at this writing, at least three critical hurdles remain to be overcome:

1. Can Memorex deliver the impressive software support it has promised?
2. Can Memorex demonstrate the promised easy conversions and dramatic performance improvements for 360/20 users?
3. Can Memorex convince prospective users—as well as the investment community—that it has sufficient financial strength to support its installations and offer more powerful equipment when needed?

Affirmative answers to these questions should ensure Memorex of gaining at least a modest penetration of the potentially lucrative mainframe market. ◻

▶ I/O data transfer operation on each of the installed integrated I/O adapters and Selector Channels. The only exceptions are the Integrated Communications Adapters, which can control concurrent I/O operations on each of the installed communications lines as long as the maximum aggregate data rates of 3000 char/sec on the MRX/40 and 6200 char/sec on the MRX/50 are not exceeded.

Maximum data rates for the Selector Channels are 277,000 bytes/sec on the MRX/40 and 555,000 bytes/sec on the MRX/50. All card I/O units and printers are buffered and transfer data in “burst mode.”

MASS STORAGE

3664 DISC STORAGE DRIVE: Provides large-capacity random-access storage on interchangeable 11-disc packs (Memorex Mark VI, IBM 2316, or equivalent). Each drive holds one disc pack at a time, and up to 145,880 bytes (20 tracks) can be read or written at each position of the comb-type access mechanism. There are 200 data tracks (plus 3 spares) on each of the 20 recording surfaces. Each track can hold up to 7,294 bytes of variable-length records, for a total data capacity of 29.17 million bytes per drive. A voice-coil actuator mechanism yields head movement times that range from 20 to 60 milliseconds and average 35 milliseconds. Average rotational delay is 12.5 milliseconds, and data transfer rate is 312,000 bytes/second.

A maximum of two 3664 Drives can be connected to an MRX/40 processor via the Integrated File Adapter, providing a total on-line storage capacity of 58.34 million bytes. On the MRX/50, the Integrated File Adapter permits up to nine 3664 Drives to be connected, but a maximum of eight drives (or 233 million bytes) can be on-line at any one time. When more than three drives are connected to an MRX/50, the IFA Extension feature is required.

INPUT/OUTPUT UNITS

3237 MAGNETIC TAPE SUBSYSTEM: Reads and writes on standard 1/2-inch, 9-track tape in IBM-compatible formats. A 3237 Subsystem consists of a control unit and 1 to 4 tape drives chosen from the following models:

Model 11—control unit and one 800-bpi NRZI tape drive.

Model 12—control unit and one 1600-bpi phase-encoded tape drive.

Model 21—800-bpi NRZI tape drive.

Model 22—1600-bpi phase-encoded tape drive.

Up to three Model 21 drives can be connected to a Model 11, and up to three Model 21 and/or 22 drives, in any combination, can be connected to a Model 12. Tape speed is 37.5 inches/second in all models, yielding data transfer rates of 30,000 bytes/second for the 800-bpi models and 60,000 bytes/second for the 1600-bpi models. Rewind time is 3.5 minutes per 2400-foot reel. Quicklock hubs facilitate loading and unloading. Each 3237 Magnetic Tape Subsystem occupies one control unit position on an MRX/40 or 50 Selector Channel.

8010 CARD READER: Reads standard 80-column punched cards at a choice of 300 cpm (Model 1), 600 cpm (Model 2), or 1000 cpm (Model 3). Reads EBCDIC and column binary cards. Has a 1000-card feed hopper and a single 1000-card stacker. Contains a full-card buffer, and connects to an MRX/40 or 50 processor via the Integrated Card Reader Adapter. ▶

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► **8025 CARD READ/PUNCH:** Reads standard 80-column cards at 500 cpm or punches them at speeds ranging from 100 cpm (when all 80 columns are punched) to 460 cpm (when only the first column is punched). Consists of a single card path with one 1200-card feed hopper and one 1300-card stacker. Error cards can be offset in the stacker under program control. Cards can be read and then punched in a single pass. EBCDIC and column binary cards can be read and punched. The unit is fully buffered and connects to an MRX/40 or 50 processor via the Integrated Card Read/Punch Adapter.

ASYNCHRONOUS MODE

| Bits/sec. | Char/sec. | Max. lines on MRX/40 | Max. lines on MRX/50 |
|-----------|-----------|----------------------|----------------------|
| 110 | 10 | 7 | 15 |
| 150 | 15 | 7 | 15 |
| 300 | 30 | 7 | 15 |
| 600 | 60 | 7 | 15 |
| 1200 | 120 | 7 | 15 |

5120 PRINTER: Provides printed output at a rated speed of either 600 lpm (Model 6) or 1200 lpm (Model 12), using a drum-type printing mechanism. Has 132 print positions, horizontal spacing of 10 characters per inch, and vertical spacing of 6 or 8 lines per inch. Accommodates pin-feed forms from 4 to 19-7/8 inches wide. Skipping speed is 35 inches/second and line advance time is 14 milliseconds.

BINARY SYNCHRONOUS MODE

| Bits/sec. | Char/sec. | Max. lines on MRX/40 | Max. lines on MRX/50 |
|-----------|-----------|----------------------|----------------------|
| 600 | 75 | 7 | 15 |
| 1200 | 150 | 7 | 15 |
| 1800 | 225 | 7 | 15 |
| 2000 | 250 | 7 | 15 |
| 2400 | 300 | 7 | 15 |
| 3600 | 450 | 6 | 13 |
| 4800 | 600 | 5 | 10 |
| 9600 | 1200 | 2 | 5 |

The 5120 Model 12 achieves its rated speed of 1200 lpm when printing is confined to 44 contiguous characters on the print drum; when all 64 characters are used, the speed drops to 925 lpm. For the 5120 Model 6, using all 132 print positions, the speed is 600 lpm for 44 contiguous characters or 500 lpm when all 64 characters are used. If printing is confined to the first 72 print positions, the Model 6's speed increases to 1200 lpm for 44 contiguous characters or 925 lpm when all 64 characters are used. The 5120 Printer (either model) is fully buffered, includes an integrated controller, and connects to an MRX/40 or 50 processor via the First Printer Attachment. Additional printers can be connected to any available control unit position on a Selector Channel.

Lines of different speeds and types can be mixed in any combination, except that the aggregate data rate may not exceed 3000 char/sec on the MRX/40 or 6200 char/sec on the MRX/50.

1603 MICROFILM PRINTER: Prints up to 10,000 lines/minute on 16-millimeter roll film. The Memorex 1603 is a comparatively low-priced alphanumeric COM recorder that uses a matrix of fiber-optics tubes to form the character images, which are then exposed directly onto the microfilm without use of a CRT display. The 1603 connects to any available control unit position on an MRX/40 or 50 Selector Channel and is supported by the MRX/OS operating system.

The ICA provides the following standard facilities: automatic dialing (for BSC lines equipped with Memorex modems), automatic answering (for both asynchronous and BSC lines), speed selection (for asynchronous lines), transmit/receive break (for transmission and recognition of break signals on asynchronous lines), synchronous clock (for clocking of BSC lines at 600, 1200, or 1800 bps), loop test (to establish a processor-controlled test mode), modem compatibility (for attachment of various modems with RS-232 interfaces and appropriate transmission characteristics), and parity selection (for odd, even, or no parity checking on asynchronous lines).

IBM 1403 PRINTER: A 1403 Printer, Model 2 (600 lpm) or Model N1 (1100 lpm), can be connected to an MRX/40 or 50 via an IBM 2821 Control Unit. None of the 1403 optional features are supported by the Memorex software.

In the asynchronous mode, Memorex will provide hardware and software support for communication with the following terminals: Teletype Models 33, 35, 37, and 38 and Memorex Models 1240, 1250, and 1280. In the binary synchronous mode, communication with the following devices will be supported: other MRX/40 or 50 computers; IBM System/360 or 370 computers via the IBM 2701, IBM 2703, Memorex 1270, or Memorex 1271 transmission controllers; IBM 360/20, 360/25, or 370/135 computers via their integrated communications adapters; IBM System/3 or 1130 computers; and IBM 2770 or 2780 terminals.

1240 CONSOLE: Provides keyboard input and printed output. Required as a console input/output unit in every MRX/40 and 50 system. Uses a belt-driven impact printing mechanism with a rated speed of 60 characters/second and an interchangeable print cartridge; the standard cartridge contains 94 printable graphics of the ASCII character set. Has a removable tractor feed mechanism that accommodates continuous forms or single sheets up to 14-7/8 inches wide. Line length is 120 characters, spaced at 10 characters per inch.

SOFTWARE

COMMUNICATION CONTROL

INTEGRATED COMMUNICATIONS ADAPTER (ICA): This optional feature, implemented largely through microcode in Alterable Control Memory, enables an MRX/40 or 50 Processing Unit to control up to 7 or 15 communications lines, respectively. Both asynchronous (start/stop) and synchronous lines of the half-duplex, 2-wire or 4-wire type can be controlled. Each communications line requires one line adapter and one signal conditioner of the appropriate type. The available line adapters are ASCII Asynchronous, EBCDIC Binary Synchronous, and EBCDIC Binary Synchronous with Transparency. Signal conditioners are available for external modems and for direct connection of local terminals. The data rates and maximum number of lines supported by the ICA can be summarized as follows:

OPERATING SYSTEM: The Memorex Operating System (MRX/OS) is a comprehensive disc-resident operating system that is oriented toward general-purpose commercial data processing, with strong emphasis upon data management and data communications. Minimum equipment requirements are an MRX/40 or 50 Processing Unit with 16K bytes of main memory, one 3664 Disc Drive, one 8010 Card Reader or 8025 Card Read/Punch, one 5120 Printer, and one 1240 Console.

MRX/OS—like most of the other Memorex software announced to date—is scheduled for initial delivery in August 1972; exceptions are noted in the paragraphs that follow.

MRX/OS consists of some system modules which are resident in main memory at all times, and other modules

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► which are loaded into transient memory areas from disc storage as required to service user programs. The resident portion includes the System Control Program (SCP), portions of the data management and telecommunications systems, and transient areas. A system generation (SYSGEN) procedure is used to tailor MRX/OS to meet each user's specific needs. The resident portion of MRX/OS requires a minimum of 8K bytes of main memory. A Resident Extension, which provides improved throughput, requires another 2K bytes, and additional features and devices beyond the basic configuration listed above may require up to 3K more bytes. When equipped to support a multi-terminal communications environment, the total residence requirements of MRX/OS (including Physical and Logical TCOT and TASS) may expand to 24K bytes or more.

The System Control Program performs the central control functions of MRX/OS. It manages job processing in one or two user partitions ranging from 4K to 64K bytes in size. Services performed by the SCP include: (1) loading, relocating, and transferring control to specific user programs; (2) loading and relocating individual segments of segmented user programs; (3) scheduling input/output requests and error recovery procedures; (4) maintaining job accounting records through use of the Interval Timer; (5) controlling communication between the system and its operator; (6) terminating jobs which exceed their time limits; (7) providing memory dumps upon abnormal job termination; and (8) providing user-designated run-time snapshots to aid in program debugging. Initial Program Load (IPL) facilities enable the operator who loads MRX/OS to set the date and time of day, modify the system configuration, or change the memory partition boundaries.

The Control Language Services (CLS) provide communication between the user's jobs and MRX/OS. The user enters statements in MRX/OS Control Language which specify the memory, peripheral device, and software requirements for each job. An Input Reader routine examines the control cards, places jobs in a queue on the basis of their priority and partition designation (if the job queuing option has been selected), transcribes card data files in the job stream to disc (if the input spooling option has been selected), and selects jobs from the job queue for initiation. A Job Initiator/Terminator routine handles the internal scheduling and initiation of user programs and permits the use of catalogued Control Language procedures on disc. Release 2 of CLS, scheduled for delivery in February 1973, will add an output spooling capability to the facilities described above.

The Program Library Services of MRX/OS provide facilities for the creation, maintenance, and use of libraries of source and object programs in disc storage. A Linkage Editor routine combines independently compiled programs and subroutines into "load modules" which can be executed immediately or catalogued into a library for future execution.

The MRX/OS Data Management Services (DMS) are designed to facilitate handling of the user's data files and input/output requirements. DMS permits the user to select from three levels of I/O support macros: Logical I/O, Block I/O, and Physical I/O. Each level provides support for card, printer, magnetic tape, and disc files. Regardless of the macro level selected, DMS manages and allocates disc space, maintains an optional central catalog of all disc data files, handles label creation and verification (using tape label formats which are identical with those of the IBM System/360), and handles I/O error processing.

The Logical I/O level of DMS supports three file organization techniques: sequential, relative, and indexed. Logical records in all three types of files are accessed through GET/PUT macros and can be either fixed or variable length, blocked or unblocked. Relative and indexed files can be processed either randomly or sequentially. Release 2 of DMS (scheduled for February 1973) will permit indexed data records to be accessed through multiple logical keys.

The Block I/O facilities of DMS enable users to write device-independent programs while developing their own logical record structures within the data blocks.

The Physical I/O facilities of DMS handle I/O request scheduling and device error recovery while giving the programmer full control over the operations of specific I/O devices.

COMMUNICATIONS: MRX/OS provides data communications support at three levels: Physical Telecommunications (Physical TCOT), Logical Telecommunications (Logical TCOT), and Telecommunications Application Support System (TASS).

Physical TCOT provides a comparatively low-level device-independent user interface for control of communications on either asynchronous or BSC lines. It handles line-modem disciplines, multiplexing and demultiplexing of control characters and messages transmitted and received through the ICA, timing of line operations, and error detection and recovery. The user is responsible for line control and message transmission functions when Physical TCOT is used.

Logical TCOT provides a higher-level device-independent user interface for control of communications on either asynchronous or BSC lines. A set of macros enables users to write terminal-oriented programs without extensive knowledge of line and terminal control disciplines. Logical TCOT services include transmission and reception of data in logical blocks or messages, translation between transmission codes and the EBCDIC internal code, message editing, line control, terminal identification, and error detection and retry.

TASS provides a set of facilities designed to simplify the implementation of conversational, transaction-oriented application programs in terminal-based systems. TASS is similar in scope and function to IBM's Customer Information Control System (CICS). A set of macros provides a simplified communications interface, enabling the user to write a multiple-terminal program as if he were working with only one terminal. TASS automatically provides the necessary multi-thread facilities, as well as a command language for terminal users and a set of console operator facilities. TASS supports Memorex 1240 or Teletype Model 33 or 35 terminals on either leased or dialed lines. Used in conjunction with both Physical and Logical TCOT, TASS is scheduled for delivery in February 1973.

COBOL: The Memorex COBOL Level I (or COBOL-I) compiler supports the following modules of the American National Standard COBOL language: Nucleus (Level 1), Sequential Access (Level 1), Random Access (Level 1), Table Handling (Level 2), Segmentation (Level 2), and Library (Level 1). In addition, some useful features of the higher-level ANS Nucleus, Sequential Access, Random Access, and Table Handling modules are provided. The ANS Sort and Report Writer modules, however, are not supported. Both indexed and sequential files can be processed, and USAGE may be specified as COMP, COMP-3, PACKED, or BINARY. The program segmentation facilities make it possible to write large programs which will fit into limited main memories through automatic overlays generated by the compiler. The compiler output listings include cross-reference lists and maps of the Data and Procedure Divisions, which should facilitate debugging.

Equipment requirements for the COBOL compiler are the same as those for MRX/OS. Compilation requires an 8K user partition in main memory plus 1.5 million bytes of temporary disc storage. Larger main memory partitions, if available, can be utilized to gain increased compilation speed.

FORTRAN: The Memorex FORTRAN language is designed to provide upward compatibility with both ANS Basic FORTRAN and IBM 1130 FORTRAN plus a number of ►

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► useful extensions. Among the language extensions are complex and double-precision variables, Hollerith constants, unlimited array dimensions, Assigned GO TO statements, Relational IF statements, DATA statements, and extensions of the FORMAT, FUNCTION, and CALL statements. Standard Memorex linkage conventions permit the inclusion of subroutines written in other Memorex-supported languages. Diagnostic and debugging facilities will aid in program testing, and overlay facilities will make it possible to execute large programs in limited main memories.

Equipment requirements for the FORTRAN compiler are the same as those for MRX/OS. Compilation requires an 8K user partition in main memory plus 1.5 million bytes of temporary disc storage. At execution time, 2.5K bytes are required to hold the floating-point subroutines.

Memorex Extended FORTRAN, scheduled for delivery in February 1973, will provide all the facilities of Memorex FORTRAN plus comprehensive library facilities and high-speed floating-point arithmetic. The library facilities include commercial and scientific subroutine packages similar to those of IBM 1130 FORTRAN. The Floating-Point and 4K ACM Increment features are required on the central processor, in addition to the equipment requirements specified above for Memorex FORTRAN.

REPORT PROGRAM GENERATOR II: Memorex RPG II is a business-oriented programming system that is compatible with IBM System/3 Disk RPG II. Extensions also enable the Memorex RPG II to accept most of the statements of IBM 360/20 Disk Programming System RPG. Using five different types of preprinted specification sheets, the RPG II programmer prepares a set of specifications that describe the form of the input data, the calculations to be performed, and the format of the desired output. The RPG II processor then generates an object program to perform the specified functions. Memorex RPG II supports the sequential, relative, and indexed file organizations and permits both sequential and random access. Equipment requirements for RPG II are the same as those for MRX/OS. The program generation process requires an 8K user partition in main memory plus 1.5 million bytes of temporary disc storage.

Release 2 of RPG II, scheduled for delivery in February 1973, will include all the functions of Release 1 plus three extensions:

1. A Telecommunications Feature will enable the RPG II user to transmit and receive data over communications lines in a format compatible with IBM BSC conventions.
2. An automatic overlay feature will make it possible to run large RPG II programs in systems with limited main memories.
3. References to the IBM 2560 Multi-Function Card Machine will, at the user's option, be converted into references to sequential disc files. (All references to the 2560's printing capability, however, will be deleted.)

ASSEMBLER: The Memorex Assembler is a machine-oriented symbolic programming system that enables programmers to utilize all the facilities of the MRX/40 and 50. Its format and mnemonic operation codes bear a strong resemblance to those of the IBM System/360 Assembler, though there are also some significant differences. A macro language enables the programmer to define and call macro instructions. Other features include program segmentation instructions, conditional assembly instructions, and absolute and relocatable expressions. Equipment requirements for the Assembler are the same as those for MRX/OS. Assembly requires an 8K user partition in main memory plus 1.5 million bytes of temporary disc storage.

UTILITY ROUTINES: The Disc Sort/Merge program sorts or merges records of fixed or variable length in either ascending or descending sequence. The input and output may be either tape or disc files organized in sequential, relative, or indexed fashion. Up to 15 control fields, containing a total of up to 256 bytes, can be specified. Either a full-record sort or a tag sort can be performed. Sorting requires a minimum of 1 disc drive and a 6K user partition, and the performance can be improved by allocating 2 or more disc drives and a larger partition.

The Data Utility is a generalized data transcription routine that facilitates the transfer of data from card to disc, disc to tape, tape to printer, etc. The routine resides on disc and can be invoked through the Control Language Services of MRX/OS.

The System Service Utilities are a set of generalized routines that aid in maintaining disc files and other system service functions. They reside on the systems disc and can be invoked through the MRX/OS Control Language Services.

CONVERSION AIDS: In addition to the MCS-I and MCS-II compatibility features described in the Central Processor section of this report, Memorex offers a number of software aids designed to facilitate conversion from an IBM 360/20 to an MRX/40 or 50 system.

The Model 20 Assembler Language Translator is designed to facilitate the conversion of programs written in 360/20 Assembler language into the Memorex Assembler language. The translator converts the following types of Model 20 statements to their Memorex equivalents: machine instructions, Assembler instructions, Logical IOCS statements, macro instructions, monitor macros, overlay directives, and Assembler-language subroutines in RPG programs. At the user's option, the translator will convert references to the IBM 2560 MFCU into references to sequential disc files. (References to the 2560's printing capabilities, however, are deleted.) The Model 20 Assembler Language Translator is available in two versions: ALTOS, which runs on an MRX/40 or 50, and ALTDPS, which runs on a 360/20 under the Disk Programming System.

The Model 20 RPG Translator is designed to convert source programs written in 360/20 RPG into source programs ready for compilation by Memorex RPG II. The output listing is flagged to indicate places where additional user action is required. The translator is available in two versions: RPTOS, which runs on an MRX/40 or 50, and RPTDPS, which runs on a 360/20.

The Model 20 JCL Translator is designed to convert 360/20 Job Control Language (JCL) statements, which control program compilation, linkage, and execution, into the corresponding Memorex Control Language Services (CLS) statements. The output listing contains suggestions for additional actions, if any, to be taken by the user. The translator is available in two versions: JCLTOS, which runs on an MRX/40 or 50, and JCLTDPS, which runs on a 360/20.

The Conversion Utilities are a series of generalized programs designed to facilitate data file transfers between IBM and Memorex systems. Routines to handle both disc and tape files are available.

APPLICATION PROGRAMS: To date, Memorex has announced only the three application packages described in the paragraphs that follow. Memorex intends to provide additional programs in the areas of data base management, inventory management with on-line inquiry, and general accounting with inquiry capability.

The Inquiry/Retrieval System (IRS) permits users at remote Memorex 1240 or Teletype Model 33 or 35 terminals to retrieve selected data from disc files organized in either indexed or relative fashion. The IRS user predefines and ►

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- catalogs record description tables and data display formats for each file to be accessed. English-like commands then enable the terminal operators to select records on the basis of their logical relationship to the record key.

The HASP/RJE Workstation Package enables an MRX/40 or 50 to serve as a remote terminal for a central IBM System/360 or 370 using the HASP/RJE communications facilities. The HASP "multileaving" technique is employed, enabling card input and printed output to proceed concurrently. The package can operate in one partition of a multiprogrammed system while other jobs are processed in the other user partition. The basic HASP/RJE Package is intended to meet minimum user requirements and will be available in August 1972; it requires a 6K user partition, supports leased lines only at a maximum of 2400 bps, and is not tailorable to specific installation needs. The HASP/RJE Workstation System, scheduled for delivery in February 1973, is much more powerful; it requires an 8K user partition, supports leased, dialed, or autocalled lines at up to 9600 bps, provides multiple I/O buffers, supports the EBCDIC Transparency and Data Compression features, and can be tailored to each installation's specific needs.

The Source Data Entry (SDE) Application System, scheduled for delivery in February 1973, permits data entered from keyboard terminals to be collected in disc files for later batch processing. The system supports both local and remote Memorex 1240 or Teletype Model 33 or 35 terminals, connected via leased or dialed lines. Data validation and editing functions can be performed in real-time fashion. The SDE system accepts records containing up to 240 characters in a variable number of fields, and provides automatic duplication, automatic skip, left and right justification, zero and space fill, and alternate format functions. The system maintains statistics on both operators and jobs and permits dynamic job status inquiries. Main memory residence requirements for SDE are a function of the number of connected terminals and stored edit formats, and can range up to 40K bytes.

PRICING

EQUIPMENT: The following systems comprise a sampling of the varied MRX/40 and 50 configuration possibilities. All necessary adapters and control units are included. The quoted rental prices are for one-year leases and include equipment maintenance. (Data communications facilities will be part of most MRX installations, but are omitted from these sample configurations to facilitate valid comparisons with other computer systems in DATAPRO 70.)

BASIC MRX/40 DISC SYSTEM: Consists of 16K Model 7200 Processing Unit, one 3664 Disc Drive (29 million bytes), 600-lpm printer, 600-cpm card reader, and console printer. Monthly rental and purchase prices are \$2,435 and \$187,960, respectively.

MRX/50 DISC SYSTEM: Consists of 32K Model 7300 Processing Unit, two 3664 Disc Drives (58 million bytes), 1200-lpm printer, 1000-cpm card reader, card reader/punch, and console printer. Monthly rental and purchase prices are \$5,380 and \$256,160, respectively.

MRX/50 DISC/TAPE SYSTEM: Consists of 65K Model 7300 Processing Unit with First Selector Channel, Floating-Point Arithmetic, Relocation and Protection, and 4K ACM Increment; two 3664 Disc Drives (58 million bytes), six 60KB magnetic tape drives (two 3-drive subsystems), 1200-lpm printer, 1000-cpm card reader, card reader/punch, and console printer. Monthly rental and purchase prices are \$8,525 and \$407,120, respectively.

SOFTWARE: Most of the Memorex software described in this report is supplied to MRX/40 and 50 users at no additional cost. The separately priced software packages announced to date and their monthly charges are as follows:

| | |
|---|-------|
| COBOL Level I | \$ 50 |
| FORTRAN | 50 |
| Extended FORTRAN | 75 |
| RPG II | 75 |
| Telecommunications Application Support System | 100 |
| Inquiry/Retrieval System | 50 |
| HASP/RJE Workstation Package | 25 |
| HASP/RJE Workstation System | 50 |
| Source Data Entry Application System | 50 |
| Model 20 Compatibility System I | 100 |
| Model 20 Compatibility System II | 100 |

SUPPORT: Technical support will be provided by Memorex systems engineers at no additional cost to the user; the company expects to supply an average of approximately 8 manweeks of support per system. In addition, Memorex will provide regional datacenters for demonstrations, training, pre-installation testing, and file conversion. The first four datacenters will be located in Minneapolis, Chicago, Santa Clara, and Washington, D.C., and are scheduled to open in July 1972.

EDUCATION: Customers will be trained on a local basis, at no additional charge, through courses taught by Memorex systems engineers on an "as required" basis.

CONTRACT TERMS: The MRX/40 and 50 systems are available for purchase or rental. The standard rental contract is for a 1-year term, can be cancelled on 90 days' notice after the first year, allows unlimited usage of the equipment, and includes around-the-clock on-call maintenance service for installations within 25 miles of a Memorex sales or service location. ■

Memorex MRX/40 and 50 EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental (1-year lease)* |
|---------------------------------------|--|-------------------|-------------------|------------------------------|
| MRX/40 PROCESSORS AND FEATURES | | | | |
| 7200-D | Processing Unit with 16K bytes | 91,120 | 200 | 670 |
| 7200-DC | Processing Unit with 24K bytes | 97,600 | 220 | 910 |
| 7200-E | Processing Unit with 32K bytes | 104,080 | 240 | 1,140 |
| 7200-ED | Processing Unit with 48K bytes | 117,040 | 270 | 1,510 |
| 7200-F | Processing Unit with 64K bytes | 130,000 | 300 | 1,900 |
| 7200-6552 | 4K ACM Increment | 3,600 | 10 | 75 |
| 7200-6402 | Selector Channel | 3,360 | 10 | 70 |
| 7200-6802 | Floating-Point Arithmetic | 2,400 | 5 | 50 |
| 7200-6001 | Integrated Reader Adapter | 1,920 | 5 | 40 |
| 7200-6154 | First Printer Attachment | 480 | 10 | 10 |
| 7200-6101 | Integrated Read/Punch Adapter | 2,880 | 5 | 60 |
| 7200-6254 | Integrated File Adapter | 8,640 | 20 | 180 |
| 7200-6805 | Model 20 Compatibility I | 1,200 | 5 | 25 |
| 7200-6602 | Integrated Communications Adapter | 4,800 | 10 | 100 |
| 7200-6620 | Line Adapter; ASCII Asynchronous | 1,200 | 5 | 25 |
| 7200-6621 | Line Adapter; EBCDIC BSC | 2,400 | 5 | 50 |
| 7200-6622 | Line Adapter; EBCDIC BSC/Transparency | 4,800 | 10 | 100 |
| 7200-6651 | Signal Conditioner; Asynch. External Modem | 960 | 5 | 20 |
| 7200-6652 | Signal Conditioner; Asynch. Local Terminal | 1,440 | 5 | 30 |
| 7200-6661 | Signal Conditioner; BSC External Modem | 1,440 | 5 | 30 |
| 7200-6662 | Signal Conditioner; BSC Local Terminal | 2,400 | 5 | 50 |
| MRX/50 PROCESSORS AND FEATURES | | | | |
| 7300-D | Processing Unit with 16K bytes | 104,400 | 230 | 1,845 |
| 7300-DC | Processing Unit with 24K bytes | 110,880 | 250 | 2,140 |
| 7300-E | Processing Unit with 32K bytes | 117,360 | 270 | 2,445 |
| 7300-ED | Processing Unit with 48K bytes | 130,320 | 300 | 2,715 |
| 7300-F | Processing Unit with 64K bytes | 143,280 | 330 | 2,985 |
| 7300-FE | Processing Unit with 96K bytes | 169,200 | 390 | 3,525 |
| 7300-G | Processing Unit with 128K bytes | 195,120 | 450 | 4,065 |
| 7300-6552 | 4K ACM Increment | 3,600 | 10 | 75 |
| 7300-6402 | First Selector Channel | 3,360 | 10 | 70 |
| 7300-6404 | Second Selector Channel | 3,840 | 10 | 80 |
| 7300-6802 | Floating-Point Arithmetic | 2,400 | 5 | 50 |
| 7300-6807 | Model 20 Compatibility I | 1,200 | 5 | 25 |
| 7300-6808 | Model 20 Compatibility II | 4,800 | 10 | 100 |
| 7300-6809 | Error Correction Code | 7,200 | 15 | 150 |
| 7300-6001 | Integrated Reader Adapter | 1,920 | 5 | 40 |
| 7300-6154 | First Printer Attachment | 480 | 5 | 10 |
| 7300-6101 | Integrated Read/Punch Adapter | 2,880 | 5 | 60 |
| 7300-6252 | Integrated File Adapter | 8,640 | 20 | 180 |
| 7300-6301 | IFA Extension | 7,200 | 15 | 150 |
| 7300-6801 | Relocation and Protection | 4,800 | 10 | 100 |
| 7300-6601 | Integrated Communications Adapter | 6,000 | 10 | 125 |
| 7300-6620 | Line Adapter; ASCII Asynchronous | 1,200 | 5 | 25 |
| 7300-6621 | Line Adapter; EBCDIC BSC | 2,400 | 5 | 50 |
| 7300-6622 | Line Adapter; EBCDIC BSC/Transparency | 4,800 | 10 | 100 |
| 7300-6651 | Signal Conditioner; Asynch. External Modem | 960 | 5 | 20 |
| 7300-6652 | Signal Conditioner; Asynch. Local Terminal | 1,440 | 5 | 30 |
| 7300-6661 | Signal Conditioner; BSC External Modem | 1,440 | 5 | 30 |
| 7300-6662 | Signal Conditioner; BSC Local Terminal | 2,400 | 5 | 50 |
| PERIPHERAL EQUIPMENT | | | | |
| 3664-001 | Disc Drive; 29 million bytes | 15,000 | 100 | 300 |
| 3237-011 | Magnetic Tape Control & Drive; 30KB | 25,220 | 115 | 485 |
| 3237-012 | Magnetic Tape Control & Drive; 60KB | 25,680 | 120 | 535 |
| 3237-021 | Magnetic Tape Drive; 30KB | 14,800 | 105 | 285 |
| 3237-022 | Magnetic Tape Drive; 60KB | 14,880 | 105 | 310 |
| 8010-001 | Card Reader; 300 cpm | 9,600 | 45 | 160 |
| 8010-002 | Card Reader; 600 cpm | 10,400 | 50 | 200 |
| 8010-003 | Card Reader; 1000 cpm | 12,480 | 70 | 260 |
| 8025-001 | Card Read/Punch; 500/100-460 cpm | 21,600 | 150 | 450 |
| 5120-006 | Line Printer & Control; 600 lpm | 54,800 | 215 | 850 |
| 5120-012 | Line Printer & Control; 1200 lpm | 55,200 | 300 | 1,150 |
| 1240-007 | Console Printer | 5,600 | 45 | 185 |

*Rental prices include equipment maintenance.