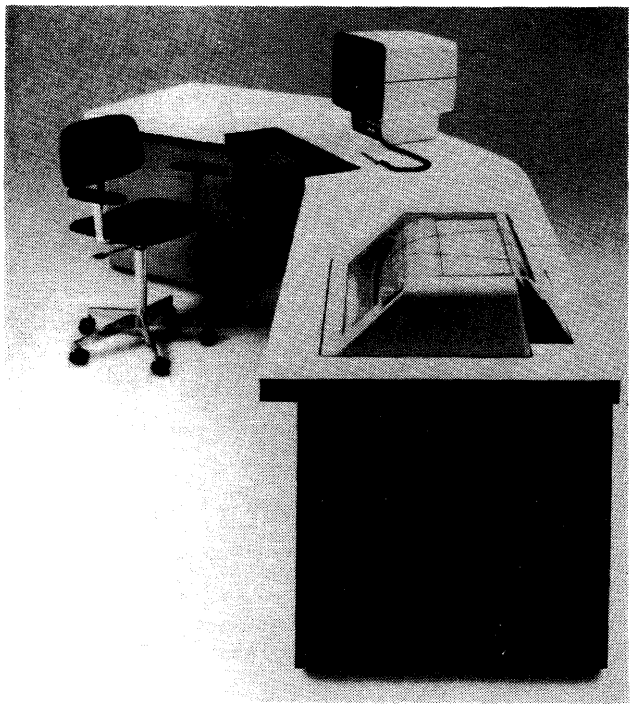
Magnuson M80 Series



All five of the current Magnuson processors are housed in this compact cabinet, which contains the CPU, console display and keyboard, up to 4 megabytes of memory, and up to 8 I/O channels. Larger configurations require an add-on Expansion Module that adds 26 inches to the overall cabinet width. The optional Console Printer is in the foreground.

MANAGEMENT SUMMARY

There are several noteworthy similarities between Magnuson Computer Systems and Amdahl Corporation. First, both companies were formed for the express purpose of manufacturing and marketing IBM-compatible mainframes. Second, two of Magnuson's four co-founders, Chairman Paul H. Magnuson and Executive Vice President Raymond A. Williams, Jr., were previously employed by Amdahl Corporation. Third, the principal designer of the Magnuson M80 Series computers is Carlton G. Amdahl, whose father, Gene M. Amdahl, founded the company that bears his name. Finally, Amdahl Corporation was the first company to achieve financial success in the risky business of competing for a share of IBM's mainframe market, and Magnuson Computer Systems currently appears to be well positioned to become the second.

There are also some significant *differences* between the two corporations and their approaches to the plug-compatible mainframe (PCM) business. Amdahl deals exclusively in large-scale mainframes that compete with IBM's most powerful computers, whereas Magnuson has focused its attention on the mid-range market and is now selling mainly against the IBM 4300 Series computers. Amdahl has achieved the necessary price/performance advantages over IBM's computers through technological

Magnuson Computer Systems now offers a family of five IBM-compatible computers that can serve as effective alternatives to the IBM 4300 Series and System/370 Models 138 through 158. The Magnuson computers offer improved performance, earlier delivery, and greater expandability than their IBM counterparts.

CHARACTERISTICS

MANUFACTURER: Magnuson Computer Systems, 2500 Augustine Drive, Santa Clara, California 95051. Telephone (408) 946-8100.

MODELS: M80/3, M80/4, M80/32, M80/42, and M80/43.

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 "halfword" of 16 bits, while 4 consecutive bytes form a 32-bit "word."

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format; or 4 words in "extended precision" format.

INSTRUCTIONS: 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

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

MAIN STORAGE

STORAGE TYPE: MOS RAM (i.e., metal oxide semiconductor random-access memory), using 16K-bit chips in Models M80/3 and /4, and 64K-bit chips in Models M80/32, /42, and /43.

CAPACITY: Models M80/3 and /32—1024K to 8192K bytes in 1024K-byte increments; Model M80/4—2048K to 8192K bytes in 1024K-byte increments; Models M80/42 and /43—2048K to 16,384K bytes in 2048K-byte increments.

CYCLE TIME: 600 nanoseconds in all models. Main storage fetch width is 8 bytes (64 bits).

CHECKING: Error checking and correction (ECC), a standard feature, detects and corrects all single-bit main storage errors and detects (but cannot correct) all double-bit and most multiple-bit errors. Parity checking verifies data transfers that do not involve main storage.

STORAGE PROTECTION: The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in all models.

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advances in electronic components and circuitry, whereas Magnuson uses industry-standard semiconductor devices but arranges them in accordance with an innovative architecture that yields increased performance, expandability, and reliability. And, of course, Amdahl has already demonstrated its ability to survive and prosper as a PCM supplier, while Magnuson is a relatively recent entrant that has yet to do so.

Magnuson Computer Systems was founded in January 1977. Within 18 months, its first major computer system had been fully designed, introduced, demonstrated to customers, and put into production. The company's initial financing came from private investors and from Fairchild Camera and Instrument Corporation, which held approximately a one-third interest in the company as of March 1979. Magnuson raised approximately $10 million of new capital—almost twice as much as it had sought—in a second round of venture capital funding that closed in June 1979. Because the second round of funding occurred after IBM's introduction of the 4300 Series computers, Magnuson views it as a successful test of the PCM industry's ability to attract new venture capital in the face of IBM's increased competitiveness. A separate financing program, which resulted in lease funding guarantees from several financial institutions, allows Magnuson to offer its customers direct leases for terms ranging from one to seven years, with various ownership-conversion options. Thus, in contrast to a number of its competitors in the PCM industry, Magnuson appears to have the financial backing it will need to support its ambitious growth plans.

PROCESSOR MODELS

Magnuson announced the first two members of its M80 Series of IBM-compatible mainframes, the M80/3 and M80/4, in May 1978 and began making customer deliveries in September 1978. The M80/3 featured substantially higher performance at a lower price than the IBM System/370 Model 138, while the M80/4 bore the same relationship to the IBM 370/148.

Magnuson responded quickly to IBM's January 1979 announcement of the 4300 Series computers and their dramatically improved price/performance relationships. In March 1979, Magnuson restructured the M80 Series by adding three new models (the M80/32, M80/42, and M80/43) and upgrading the two original models while cutting their prices. The five current M80 systems can serve as effective alternatives to any of the mid-range IBM computers, from the 370/138 and 4331 through the 370/158 and 4341. All five of the Magnuson systems utilize essentially the same central processor, which has a machine cycle time of 100 nanoseconds and a main memory cycle time of 600 nanoseconds. The IBM 4341, by contrast, has a machine cycle time of 150 to 300 nanoseconds and a 900-nanosecond main memory.

The upgraded Magnuson M80/3 offers approximately 50 percent more processing power than either the IBM

CENTRAL PROCESSORS

The Magnuson M80 processors are designed to provide total compatibility with the IBM System/360 and System/370 processors except in the cases of: 1) programs that use model-dependent data; 2) programs that use the ASCII bit (PSW bit 12); 3) programs that require features or devices which are not on the M80; and 4) programs that depend upon retention of valid data after a power-down/power-up sequence. Software written for System/360 or System/370 computers should also be checked for: 1) programs that depend on inherent S/360 or S/370 timing; 2) programs that require S/360 or S/370 model-dependent features; and 3) programs that access main storage locations 128-511 (decimal) after a diagnostic logout.

CONTROL STORAGE: All M80 Series central processor operations are controlled by microprograms that reside in high-speed control storage. The standard control storage capacities are 32K bytes in Models M80/3 and M80/4, and 64K bytes in Models M80/32, M80/42, and M80/43. These standard capacities are sufficient to hold the microcode required for the System/370 Universal Instruction Set and all of the standard software assist features. Control storage can be expanded as required to a maximum of 256K bytes in all models.

The microprograms are loaded into control storage by means of a diskette unit called the Console File. Redundant diskette drives are provided for increased system availability. Magnuson supplies read-only diskettes containing the microcode required for a specific M80 configuration, as well as other diskettes containing system diagnostics.

REGISTERS: Each of the M80 Series processors has sixteen 32-bit general-purpose registers, which can be used for indexing, base addressing, and as accumulators, plus four 64-bit floating-point registers.

INSTRUCTION REPERTOIRE: The System/370 Universal Instruction Set is standard in all of the M80 Series processors.

INSTRUCTION TIMES: Magnuson Systems has not released execution times for the individual M80 instructions to date. Instead, the company rates its processors in terms of "relative performance" figures. Using Magnuson's ratings, with the M80/3 as a basis, here's how the other Magnuson processors and some comparable IBM models measure up:

Manufacturer	Model	Relative Performance
Magnuson	M80/43	3.67
IBM	3031	3.67
Magnuson	M80/42	3.00
IBM	370/158	3.00
IBM	4341	2.67
Magnuson	M80/4	1.67
Magnuson	M80/32	1.67
IBM	370/148	1.33
Magnuson	M80/3	1.00
IBM	370/145	1.00
IBM	370/138	0.67
IBM	4331	0.60

OPERATIONAL MODES: The Extended Control (EC) and Extended Control Program Support (ECPS) features are standard on the M80 Series processors. As a result, all five models can operate in any of the following modes: Basic Control (for System/360 programs), Extended Control (for programs that require dynamic address translation), ECPS:VS1 (which uses microcoding to improve system performance under the VS1 operating system), and ECPS:VM/370 (which provides improved system per-

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CHARACTERISTICS OF THE M80 SERIES PROCESSORS

	M80/3	M80/4	M80/32	M80/42	M80/43
SYSTEM CHARACTERISTICS					
Relative performance level	1.00	1.67	1.67	3.00	3.67
Date announced	5/78	5/78	3/79	3/79	3/79
Date of first delivery	6/79	9/78	2nd qtr. 1980	2nd qtr. 1980	2nd qtr. 1980
Virtual storage capability	Std.	Std.	Std.	Std.	Std.
Multiprocessor configurations	No	No	No	No	No
Principal operating systems	OS/VS1, SVS, MVS, DOS/VS, DOS/VSE, VM/370	OS/VS1, SVS, MVS, DOS/VS, DOS/VSE, VM/370	OS/VS1, SVS, MVS, DOS/VS, DOS/VSE, VM/370	OS/VS1, SVS, MVS, DOS/VS, DOS/VSE, VM/370	OS/VS1, SVS, MVS, DOS/VS, DOS/VSE, VM/370
Upgradable to	M80/4, M80/32, M80/42, M80/43	M80/43	M80/42, M80/43	M80/43	—
MAIN STORAGE					
Type	MOS (16K-bit)	MOS (16K-bit)	MOS (64K-bit)	MOS (64K-bit)	MOS (64K-bit)
Cycle time, nanoseconds	600	600	600	600	600
Bytes fetched per cycle	8	8	8	8	8
Minimum capacity, bytes	1,048,576	2,097,152	1,048,576	2,097,152	2,097,152
Maximum capacity, bytes	8,388,608	8,388,608	8,388,608	16,777,216	16,777,216
Increment size, bytes	1,048,576	1,048,576	1,048,576	2,097,152	2,097,152
Interleaving	No	No	No	No	No
Error checking and correction	Std.	Std.	Std.	Std.	Std.
PROCESSOR					
Processor cycle time, nanoseconds	100	100	100	100	100
Control storage:					
Capacity, bytes	32,768*	32,768*	65,536*	65,536*	65,536*
Cycle time, nanoseconds	100	100	100	100	100
Buffer (cache) storage:					
Capacity, bytes	16,384 (opt.)	16,384 (opt.)	16,384 (opt.)	16,384 (std.)	32,768 (std.)
Cycle time, nanoseconds	50	50	50	50	50
I/O CHANNELS					
Number of channels:					
Standard	3	5	3	3	6
Maximum	6	6	6	16	16
Subchannels per channel (max.)	256	256	256	256	256
Control units per channel (max.)	16	16	16	16	16
Maximum channel data rates:					
Burst mode, bytes/second	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
Byte mode, bytes/second	100,000	100,000	100,000	100,000	100,000
Maximum aggregate data rate, bytes/second	11,000,000	11,000,000	13,300,000	13,300,000	13,300,000

*Control storage is expandable to a maximum of 256K bytes in all models.

370/138 or the IBM 4331. The basic M80/3 includes one megabyte of main memory and three I/O channels, and is currently priced at $180,000. It can be expanded to a maximum of eight megabytes of memory and six channels.

The upgraded M80/4 is rated about 30 percent above the 370/148 in processing power. The basic M80/4 includes two megabytes of memory and five I/O channels. Its current purchase price of $295,000 represents a 25 percent reduction from the original price of $395,000. The M80/4 can be expanded to a maximum of eight megabytes and six channels.

The new M80/32 delivers about three times the processing power of the IBM 4331 and is essentially equal to the Magnuson M80/4 in performance. The basic M80/32, however, is a smaller and considerably lower-priced package than the basic M80/4. The minimum M80/32 configuration includes one megabyte of memory

formance under VM/370). In addition, the newer M80/32, /42, and /43 processors can operate in ECPS:VSE mode, which uses microcoding to reduce overhead and improve system throughput under the new DOS/VSE operating system.

PROCESSOR FEATURES: The following features are standard on all of the M80 processors: Advanced Control Program Support, Audible Alarm, Byte-Oriented Operand, Channel Command Retry, Channel Indirect Addressing, Clock Comparator and CPU Timer, Console File, Control Registers, Doubleword Buffer, Dynamic Address Translation, Extended Control, Extended Control Program Support, Extended-Precision Floating Point, Interval Timer, Machine Check Handling, Program Event Recording, Storage Protection (Store and Fetch), System/370 Universal Instruction Set, Time of Day Clock, and Virtual Machine Assist. The following additional features are also standard on Models M80/32, /42, and /43: ECPS:VSE Mode, Channel One-Level Addressing, CPU One-Level Addressing, and Move Inverse Instruction.

Optional features available for any of the M80 Series processors include: Channel-to-Channel Adapter, Direct

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and three I/O channels, and sells for $185,000. The M80/32, like the M80/3 and M80/4, can handle a maximum of eight megabytes and six channels.

The Magnuson M80/42 is rated 10 percent higher than the IBM 4341 in performance. The basic system includes two megabytes of main memory, 16K bytes of high-speed buffer storage, and three I/O channels, and is priced at $275,000. The M80/42 can be expanded to a maximum of 16 megabytes and 16 I/O channels.

The top performer in the current Magnuson line is the M80/43, which delivers about 30 percent more processing power than the IBM 4341 and roughly equals the performance of the IBM 370/158. Two megabytes of main memory, 32K bytes of high-speed buffer storage, and six I/O channels are standard on the basic M80/43, at a purchase price of $315,000. The system can be expanded to a maximum of 16 megabytes and 16 channels.

Additional memory for the three new Magnuson systems is priced at $15,000 per megabyte—the same price as IBM's 4300 Series add-on memory before the recent IBM price increase to $15,700 per megabyte. Capacity upgrades for the older M80/3 and M80/4 systems, however, cost $30,000 per megabyte. Additional I/O channels are priced at $5,300 each for the three new systems and at $8,930 each for the M80/3 and M80/4.

A noteworthy feature of the M80 Series is the fact that any model can readily be upgraded to any higher model within the series. An installed M80/4 can be upgraded to an M80/43, for example, while an M80/3 can be converted to any M80/4, M80/32, M80/42, or M80/43. Field upgrades can be accomplished by simply replacing circuit boards rather than entire processors. The cost of an upgrade is equal to the difference in purchase price between the two models, so the user pays no cost penalty for starting out with a small M80 Series system and upgrading to progressively more powerful ones as his workload expands. Upgrades from the M80/3 to the M80/4 are available now, and the other upgrade options will become available in the third quarter of 1980.

Magnuson began delivering its M80 Series computers in September 1978 and had installed a total of 55 systems by the end of 1979. All of the currently installed systems are M80/3's or M80/4's, but most of the current users plan to upgrade their systems to the newer and considerably more cost-effective M80/32, M80/42, or M80/43 systems. Deliveries of the three new models are scheduled to begin in the second quarter of 1980, approximately three months after IBM begins shipping the 4341 with four megabytes of memory. Magnuson says the delay is necessary to ensure full compatibility with the larger 4341's.

ARCHITECTURE

In common with other PCM suppliers, Magnuson offers the twin advantages of more performance per

Control, Integrated Console Printer, Light Pen, Remote Console, and additional main storage increments, control storage increments, and I/O channels. The M80/3, /4, and /32 processors can optionally be equipped with the buffer (cache) storage that is standard on the M80/42 and /43.

CONSOLE: The M80 system console is supplied with all of the central processor models. It consists of a control panel, keyboard, CRT display with optional light pen, the Console File (a pair of diskette drives used to load the M80 microcode and system diagnostics into control storage), and an optional console printer. The system console can operate in either of two modes, as selected during the initial microprogram load (IMPL) procedure:

- **Display mode, in which the CRT and keyboard appear to the operating system as an IBM 3277 Display Station with keyboard. This mode requires the Device-Independent Display Operator Console Support (DIDOCS) software or its equivalent. If the optional console printer is included, it requires the Multiple Console Support (MCS) software or its equivalent and must be addressed separately as an IBM 3213 Console Printer.**

- **Printer-keyboard mode, in which the CRT, keyboard, and optional console printer appear to the operating system as an IBM 3215 Console Printer-Keyboard. This mode is supported by DOS, DOS/VS, OS, OS/VS, and VM/370.**

The system console also contains a microprocessor for diagnostic functions and a remote data link facility that provides on-line communications with a remote console, such as the one at Magnuson's Technical Support Center at its Santa Clara headquarters. The data link enables personnel at the Support Center to operate the user's system remotely in order to diagnose problems.

PHYSICAL SPECIFICATIONS: The M80 processor is housed in a desk-high cabinet that can also contain up to 4 million bytes of memory and 8 I/O channels. The add-on Expansion Module increases these capacities to 16 million bytes and 16 channels. Listed below are the dimensions and power requirements of the basic M80 processor (all models), the M80/E (basic processor with Expansion Module), and the optional console printer.

	M80	M80/E*	Console Printer
Dimensions:			
Width, in (cm)	112 (285)	138 (351)	30 (76)
Depth, in (cm)	45 (114)	60 (152)	30 (76)
Height, in (cm)	30 (76)	30 (76)	30 (76)
Weight, lb (kg)	820 (372)	1196 (542)	245 (111)
Power requirements:			
Voltage	208±10%	208±10%	110±10%
Phases	3 (4-wire)	3 (4-wire)	1 (3-wire)
Frequency, Hz	50-60	50-60	50 or 60
Power, KVA	3.7	4.4	0.2
Fan air flow, cfm	1284	2344	110
Heat output, BTU/hr	10,000	15,000	513

*M80 processor with Expansion Module.

Environmental requirements for all the above units are as follows: operating temperature range—60 to 90 degrees F. (15 to 32 degrees C.); relative humidity range—20 to 80 percent; maximum wet bulb temperature—78 degrees F. (25.5 degrees C.).

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dollar and earlier delivery than IBM can provide. But Magnuson also offers a third benefit that may be even more significant to many computer buyers. The M80 Series hardware is based on a highly modular design concept, called "Strategic Architecture," that yields considerably more expandability and flexibility than the competitive systems from IBM and most other manufacturers. Magnuson claims that its Strategic Architecture removes most of the traditional constraints on system expansion, performance range, and software compatibility, in addition to reducing system costs, facilitating upgrades, improving reliability, and making the system easier to use and maintain.

Magnuson's equipment is modular in structure as well as in function. This means that the printed-circuit boards containing system logic and memory are essentially independent subsystems, and these subsystems are interconnected by means of a central bus rather than the usual maze of cabling. In this respect, the Magnuson design represents an extension of the bus-structured architecture of many contemporary minicomputers. The entire system consists of a relatively small number of printed-circuit boards, and the same family of boards is used in all the current M80 Series models. For example, an M80 processor with 4 megabytes of main memory and 8 I/O channels requires only 27 memory and logic boards plus 3 console cards. Cabling is required only to connect the CPU and channels to the console.

Magnuson takes pride in the relatively high system performance it has achieved without "pushing" the state of the art in semiconductor technology. In the current M80 Series equipment, the company is using standard, off-the-shelf TTL MSI logic and MOS RAM memory. Magnuson emphasizes, however, that when higher-performance technologies become economical, they can readily be utilized by substituting card modules built with the new devices for the current cards.

A significant advantage of Magnuson's structural modularity is the fact that future advances in both hardware and software technology can readily be incorporated. For example, the Magnuson hardware is capable of addressing up to four billion bytes of main memory. Thus, if and when IBM removes the 16-megabyte memory size limitation currently imposed by its system software, Magnuson users will be able to maintain IBM compatibility. The architecture also allows software functions to be incorporated into microcoded "firmware" for increased performance. Up to 256K bytes of control storage is available to hold microcoded system control and software assist functions, and only 32K bytes of this space is needed for the entire System/370 instruction set and Virtual Machine Assist features. Furthermore, the Magnuson architecture will accept "intelligent" peripheral controllers if and when IBM adopts this concept.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The M80 Series processors include from 3 to 6 standard channels and can have a maximum of either 6 or 16 channels, as detailed below:

Model	Standard Channels	Optional Channels	Total Channels
M80/3	3	3	6
M80/4	5	1	6
M80/32	3	3	6
M80/42	3	13	16
M80/43	6	10	16

The channels can be configured as either block multiplexer or byte multiplexer channels, and the user can select any desired combination of the two types. Up to 16 control units can be connected to each channel. Moreover, each channel has 256 subchannels and can address up to 256 I/O devices. A unique (i.e., unshared) unit control word (UCW) is assigned to each attached I/O device and holds a dynamic record of the status of the I/O operation on the corresponding subchannel.

Channels configured as byte multiplexer channels can operate in either burst mode or byte mode, while channels configured as block multiplexer channels transfer data in burst mode only. Burst mode accommodates high-speed data transfers, whereas byte mode allows the byte multiplexer channel's single data path to be time-sliced in order to service multiple low-speed I/O devices operating simultaneously.

I/O DATA RATES: For all of the current M80 Series processors, the maximum channel data rates are 2.5 million bytes per second in burst mode and 100,000 bytes per second in byte mode. The maximum aggregate data rates (for all channels operating simultaneously) are 11 million bytes per second for Models M80/3 and /4, and 13.3 million bytes per second for Models M80/32, /42, and /43.

SIMULTANEOUS OPERATIONS: Concurrently with computing, an M80 Series processor can control a maximum of one high-speed I/O data transfer operation on each block multiplexer channel and one low-speed I/O data transfer operation on each subchannel of each byte multiplexer channel, subject to the maximum channel and aggregate data rates specified above. Alternatively, a byte multiplexer channel can operate in burst mode and handle a single high-speed I/O operation instead of multiple low-speed operations.

CONFIGURATION RULES

Magnuson M80 systems can be configured in essentially the same manner as IBM System/370 computer systems, except that no integrated peripheral controllers or adapters are available for the Magnuson computers. Up to 16 control units and 256 I/O devices can be connected to each M80 I/O channel, and any channel can be configured to operate as either a block multiplexer or byte multiplexer channel.

PERIPHERAL EQUIPMENT

The Magnuson M80 systems can utilize all IBM System/370 and 4300 Series input/output and mass storage subsystems, except those that require integrated controllers or adapters, as well as the plug-compatible counterparts of these IBM subsystems offered by other vendors. Detailed coverage of many of these peripherals can be found in Volume 2 of DATAPRO 70.

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SOFTWARE AND SUPPORT

All of the current Magnuson computers can utilize any of the following IBM operating systems: DOS/VS, DOS/VSE, OS/VS1, OS/VS2 (SVS or MVS), or VM/370. Virtual Machine Assist and Extended Control Program Support (ECPS) for both VS1 and VM/370 are standard features in all models, and ECPS for DOS/VSE is also standard in Models M80/32, M80/42, and M80/43.

In planning its strategy for winning a significant share of the PCM market, Magnuson has not overlooked the importance of customer support. The company has established its own support organization, with service offices currently located in Atlanta, Boston, Chicago, Dallas, Detroit, Los Angeles, New York, San Francisco, and Washington, D.C.

Magnuson supports its products by means of an innovative bundled support program that provides local and remote maintenance for both hardware and system software. Local support for both hardware and software is provided by a Systems Support Representative (SSR). The local SSR is backed up by an on-line communications link between the customer's computer and a Technical Support Center at Magnuson's headquarters. This allows headquarters technical specialists to operate the computer and aid the on-site SSR in diagnosing and solving problems. Magnuson says that the remote maintenance facility, together with the reliability and easy maintainability of its equipment, make it practical for a single local representative to provide both hardware and software maintenance.

USER REACTION

Magnuson was just beginning to deliver its computers when Datapro's most recent mail survey of computer users was conducted, so no responses from M80 Series users were received. Therefore, we conducted telephone interviews in February 1980 with five M80 users whose names were supplied by the vendor.

These five installations had been using their Magnuson computers for an average of eight months. Three of the users had purchased the equipment, while the other two were leasing it from Magnuson.

The five users we interviewed exhibited a number of common traits. All five were engaged primarily in business data processing. All five were using IBM's DOS/VS operating system and were programming mainly in COBOL. All five were veteran EDP users who had gained experience with independent peripherals and multi-vendor shops before making the move to plug-compatible mainframes. And all five were unusually well pleased with virtually every aspect of the Magnuson equipment and support. Even after making allowances for the fact that these were vendor-selected reference accounts rather than randomly selected users, we can't recall encountering a higher level of user enthusiasm for any product we've analyzed.

SOFTWARE

All of the current M80 Series computer systems fully support the following IBM operating systems: DOS/VS, DOS/VSE, OS/VS1, OS/VS2 (SVS and MVS), and VM/370. Detailed descriptions of these operating systems can be found in Reports 70C-491-04 (IBM System/370) and 70C-491-08 (IBM 4300 Series). Extended Control Program Support (ECPS) for VS1 and VM/370 is standard in all models, and ECPS for DOS/VSE is also standard in Models M80/32, /42, and /43.

Magnuson users purchase their system software from IBM and then obtain software support from Magnuson as part of the company's bundled hardware and software maintenance program.

PRICING

The Magnuson M80 Series systems are offered for outright purchase or under an unusually flexible direct leasing program.

Five basic types of leases are available:

- **Operating leases—12- to 36-month leases with purchase option accruals of up to 50 percent of the monthly payments and optional investment tax credits.**
- **Finance leases (commercial)—48- to 72-month leases with options to either terminate or purchase at the end of the initial term.**
- **Finance leases (government)—48- to 84-month leases with full payout and equipment ownership together with fiscal funding protection.**
- **Operating/finance leases—60-month leases with early termination privileges after 24 and 36 months.**
- **Tax-oriented leases—60- to 84-month leases under which the lessor retains tax benefits and equipment ownership, resulting in a low effective interest rate for the lessee.**

Detailed lease prices are not available, but Magnuson states that typical monthly lease rates for the basic M80/4 processor with 2 megabytes of memory and 5 I/O channels would be $10,925 for a 1-year lease, $9,500 for a 2-year lease, $8,675 for a 3-year lease, $7,080 for a 4-year lease, $6,350 for a 5-year lease, and $5,900 for a 6-year lease. The purchase price of this processor is $295,000, and the minimum monthly maintenance charge (which is not included in the lease rates) is $2,350.

The cost of an upgrade from one M80 Series model to another is equal to the difference in purchase price between the two models.

Magnuson has established its own customer support organization, with service offices currently located in Atlanta, Boston, Chicago, Dallas, Detroit, Los Angeles, New York, San Francisco, and Washington, D.C. Under the company's bundled hardware/software maintenance program, support for both the hardware and system control programs (SCP's) is provided by a local Systems Support Representative (SSR). Backup support for the SSR is provided by the M80 Remote Support Facility, which establishes an on-line link between the user's computer and Magnuson's Technical Support Center in Santa Clara. The Remote Support Facility provides access to technical specialists who can assist the local SSR in diagnosing and correcting both hardware and SCP problems.

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The users' ratings are tabulated below. Because Magnuson does not supply peripheral equipment or software at this time, we've omitted the usual questions dealing with these areas.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	5	0	0	0	4.0
Reliability of mainframe	5	0	0	0	4.0
Responsiveness of maintenance service	4	1	0	0	3.8
Effectiveness of maintenance service	4	1	0	0	3.8
Technical support	4	1	0	0	3.8
Ease of conversion	5	0	0	0	4.0
Overall satisfaction	5	0	0	0	4.0

*Weighted Average on a scale of 4.0 for Excellent.

The first Magnuson user we interviewed was a Midwestern bank that installed a 2-megabyte M80/4 to replace an IBM 370/138. This installation was one of Magnuson's earliest ones, and the configuration is unusually large: approximately 450 interactive terminals, 30 Control Data disk drives, 8 IBM tape drives, and a high-speed IBM 3890 MICR Document Processor. The terminals include Datatrol teller terminals and Genesis One 3270-replacement CRT's. Because of the system's size and complexity, there were some start-up difficulties and "initially, quite a few board problems." But the problems were all corrected, and the system's on-line up-time is now running between 98 and 99 percent. The bank also has an IBM 370/158, and states that the M80/4 has been more reliable than the Model 158. The bank is planning to convert from DOS/VS to DOS/VSE and to upgrade the M80/4 to an M80/43 as soon as possible—probably in the third or fourth quarter of 1980. This user praised the system's diagnostic capabilities and its "unbelievably small" size, and had only two mild complaints: "The audible alarm doesn't beep loudly enough, and the operator documentation should be indexed better."

A Southwestern insurance company replaced two IBM 360/40's with a pair of 1-megabyte Magnuson M80/3 systems in June 1979. The peripherals include Memorex disk drives, STC magnetic tape drives, and 77 local Courier CRT terminals. This installation reported no conversion problems, has experienced a total of "five minutes of down-time since the systems were installed," and has found the performance of the Magnuson computers to be even better than expected.

An Eastern publishing company replaced an IBM 360/50 with a Magnuson M80/4 in what a spokesman called "the smoothest conversion I've ever seen." This user expressed complete satisfaction with both the equipment and the vendor support, and could recall no specific problems.

The minimum monthly maintenance charges, as shown in the following price list, include support for both the hardware and system control programs for one shift per day, five days per week. Full maintenance coverage for 24 hours per day, seven days per week, is available for a premium of 39 percent over the indicated minimum monthly maintenance charges.■

A Southeastern bank installed two Magnuson M80/3 systems, each with 2 megabytes of main memory, to replace a pair of IBM 370/135's. The bank has 20 interactive terminals on-line and is using disk drives from Control Data and STC, tape drives from STC, and printers from Documation. The entire installation process for the second M80/3, from uncrating to production, took just 1½ hours. Installation of the first M80/3, by contrast, took 4½ hours because of a burned-out power supply that took 3 hours to replace. Since then, one of the systems has been down for 6 hours because a new relay had to be flown in. This user pointed out that Magnuson normally "stocks a complete spare computer on-site," but the relay that failed had been omitted from the spare parts inventory. The bank has noticed some deterioration in the service it gets from IBM since the Magnuson mainframes replaced the two System/370's: "IBM now takes longer to do things, and the IBM customer engineers tend to blame peripheral problems on the Magnuson CPU's."

The subject of our final user interview was a Midwestern insurance company that replaced an IBM 370/138 with a 2-megabyte Magnuson M80/4. The system includes 50 local CRT terminals and more than 2 billion bytes of on-line disk storage, and is used for both business data processing and text processing. This user reported that Magnuson "rolled out the old system, rolled in the new, and placed it in operation within three hours; there were no glitches at all in the conversion process." Since then, the system has been down for one 24-hour period because a replacement card was shipped to the wrong site. This user "heartily recommends Magnuson computers."

The reactions of these early users make it clear that the Magnuson equipment is passing the three-way test of reliability, compatibility, and performance with flying colors. The company now faces the equally formidable challenges of building and maintaining an effective nationwide support organization and of achieving profitability while vying for a share of the industry leader's mainframe business. It won't be easy, but Magnuson's impressive start and solid financial backing make the company a promising candidate for long-term success.□

Magnuson M80 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maintenance
PROCESSORS AND MEMORY			
M80/3	Processing Unit with 1024K bytes of storage, 3 configurable I/O channels, and system console	$180,000	$1,275
3500	Additional I/O Channel for M80/3	8,930	12
4600	1024K-Byte Additional Processor Storage Increment for M80/3	30,000	50
M80/4	Processing Unit with 2048K bytes of storage, 5 configurable I/O channels, and system console	295,000	2,350
3500	Additional I/O Channel for M80/4	8,930	12
4600	1024K-Byte Additional Processor Storage Increment for M80/4	30,000	50
M80/32	Processing Unit with 1024K bytes of storage, 3 configurable I/O channels, and system console	185,000	975
3600	Additional I/O Channel for M80/32	5,300	12
4600	1024K-Byte Additional Processor Storage Increment for M80/32	15,000	20
M80/42	Processing Unit with 2048K bytes of storage, 3 configurable I/O channels, and system console	275,000	1,150
3700	Additional I/O Channel for M80/42	5,300	12
4700	2048K-Byte Additional Processor Storage Increment for M80/42	30,000	40
M80/43	Processing Unit with 2048K bytes of storage, 6 configurable I/O channels, and system console	315,000	1,350
3700	Additional I/O Channel for M80/43	5,300	12
4700	2048K-Byte Additional Processor Storage Increment for M80/43	30,000	40
OPTIONS (FOR ALL MODELS)			
3750	Channel-to-Channel Adapter	12,500	19
4550	Cache Buffer Storage (for M80/3, /4, or /32)	20,650	80
7820	Remote Console	7,500	4
7840	Console Printer	9,000	35
8500	Expansion Module	43,380	130
8550	Direct Control	5,640	4
8560	Light Pen	430	1