# PC MAGAZINE

**WIN 3.0 APPS**

## DTP and Presentation Power: PowerPoint And Ventura Move to Windows 3.0

**GRAPHICS**

## OCR Comes of Age: We Test 10 Software-Only Packages for Speed and Accuracy

**SOFTWARE**

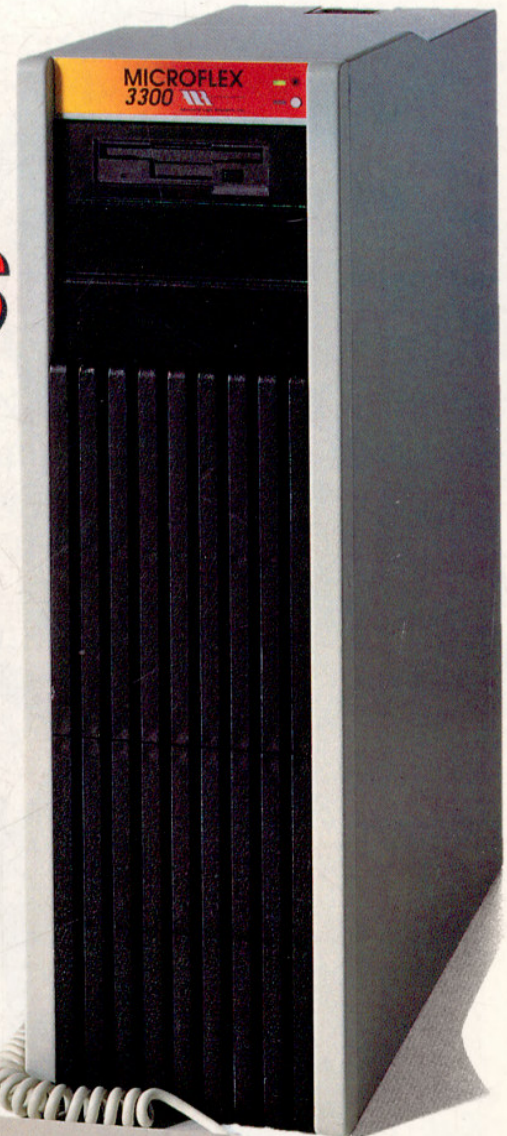## Multitasking on a Budget: 6 Low-Cost Ways to Run Your Old DOS Apps

OCTOBER 30, 1990    THE INDEPENDENT GUIDE TO PERSONAL COMPUTING    VOLUME 9 NUMBER 18

# MICRO CHANNEL ALTERNATIVES
## PC Labs Tests 12

MICROFLEX 3300

**Compatible!**
Only 2 Fail Our Tests

**Expandable!**
Yes, Even IBM

**Fast!**
ALR Tops the Pack at 33MHz

$2.95 USA
$3.95 Canada & Foreign
£2.95 UK

0  140246  9

44

36320

12391

**No longer are your choices in the Micro Channel pool limited to IBM, IBM, and Tandy. A dozen vendors have now jumped into the water with 386- and 386SX-based MCA systems.**

*by Winn L. Rosch*

# CASHING IN ON THE MICRO CHANNEL

**P**oints of view about IBM's Micro Channel architecture are as sharply split as on any religious issue. To some, IBM's current design architecture represents the biggest breakthrough in computing since beads were strung on the first abacus. Others see it as the most flagrant fraud since the Piltdown man, a mere con to keep clone makers out of the PC market.

Several facts are indisputable. The Micro Channel architecture (MCA) is real. It's an established standard that has already passed its third birthday. More than two million IBM Personal Systems incorporate the architecture, and as of this writing, at least 27 vendors have announced that they are producing MCA machines.

It is also incontestable that MCA is incompatible, physically and electrically, with expansion boards made for PCs and ATs. That incompatibility is intentional: if you can't use old boards, they can't hold back the performance

of your Micro Channel computer. Some believe that this incompatibility mirrors IBM's motivations in developing MCA, reflecting an insidious desire to wrest back total domination of the personal computer market—but even they admit that MCA is superior to the classic AT bus (also called the ISA or Industry Standard Architecture bus). It's faster, cleaner, more powerful, and more versatile.

MCA is also undeniably harder—not to mention more expensive—to clone. To make an MCA computer, you need more than the aspirations, screwdriver, and third-grade education that evidently sufficed for building a PC clone. The technology is complex enough that perfect compatibility is elusive.

Still, while two of the ten non-IBM PCs we reviewed failed to pass at least one of our compatibility tests, the machines in this roundup confirm the final fact: MCA *is* clonable. IBM fully documents the architecture's operation with a complete description of its timing characteristics, which govern when and how MCA devices react to one another's commands. (IBM never provided this timing information for the classic AT bus.) In addition, VLSI chips have become available for building both MCA computers and expansion boards.

These facts lead to an inescapable conclusion: If you care about performance, you need to know about Micro Channel architecture. PC Labs has found that ISA-bus machines are cost-effective, high-performance products that work well with today's DOS or on small LANs, yet MCA (or the non-IBM alternative, EISA) remains an intriguing choice for duty on high-end networks, as well as for future applications, because of its many advanced features.

### PHILOSOPHICALLY SPEAKING

The Micro Channel bus, the connectors into which you plug expansion boards, and the circuitry that links them together are only the embodiment of the MCA specification—the blueprint or building code that outlines all the rules for building this type of computer.

The distinction between the MCA specification and its physical embodiment is an important one. Real computers are implementations of the MCA design, defined by it rather than defining it. The MCA specification is not static; it's designed to be changeable while maintaining compatibility. It is itself more flexible

than any single computer could possibly be, allowing a wide variety of computers to be built around its architectural core. MCA computers do not have to incorporate all the features of the MCA specification to be compatible; for example, 8-, 16-, and 32-bit bus designs are possible.

Because MCA is a specification, fully defining it means understanding and absorbing reams of diagrams, scads of schematics, and a dossier of descriptions. But all of the information can be distilled to a few essential concepts that characterize

the four fundamental areas in which this architecture improves on the AT bus: performance, concurrency, reliability, and accessibility.

MCA earns a performance edge in several ways. First and foremost, it's designed to operate faster. The biggest speed limit on classic-bus computers is their tendency to emit electromagnetic interference. The MCA design minimizes this interference, so that its bus can potentially operate faster than the AT bus. Current MCA implementations are 25 percent faster than classic-bus machines on like chores simply because most MCA

## BUS MASTERS TAKE CHARGE

### by Winn L. Rosch

The conventional ISA computer is essentially nothing more than a microprocessor enhanced with incidentals like memory and an expansion bus—a pocket calculator with its wildest dreams fulfilled. In ISA computers, the microprocessor is the all-knowing brain that controls everything and also sets the limits. The rest of the computer can do nothing more or faster than the microprocessor, whose overhead constrains transfer speeds across the expansion bus.

Micro Channel architecture, however, borrows a concept from mainframe computers: The scheme turns the microprocessor and the expansion bus into separate subsystems, each freed from the limitations of the other. Instead of having a single element in control, the MCA expansion bus can be commanded by any of several devices called *bus masters*. The bus master in charge has an elegantly simple function; it just moves information across the expansion bus. MCA gives it free rein to do whatever it wants. The interactions among bus masters are coordinated by special system-board circuitry known as the central arbitration point (or CAP).

A bus master owns the MCA system as long as the CAP gives it command. Typically, the bus master will be a device such as a high-speed direct memory access (DMA) controller, which moves bytes from one place to another with extreme dispatch.

Independent bus masters accelerate

the performance of MCA computers in several ways. For one thing, they are not restricted by microprocessor performance. The MCA specification defines data transfer rates up to 160MB per second, which is nearly three times as fast as the peak transfer rate of a 33-MHz 80386 microprocessor with true zero-wait-state memory and no system overhead (that is, without certain functions that are hardly incidental, such as memory refreshing).

In addition, because bus-master transfers take place without microprocessor intervention, an MCA computer equipped with cache memory can continue working during a bus-master data transfer, achieving a small degree of parallel processing. Bus masters that have their own microprocessors and memory (as on a coprocessor board or an array processor) yield an even greater degree of parallel processing, stealing only a little expansion bus time when they need to interact with other parts of the system.

### THE SLAVE ROLE

The opposite of a bus master is the *bus slave*. As its name would imply, the slave responds to the commands of the bus master, accepting the data the bus master sends out or originating the data the bus master requests. The bus slave functions like an ordinary expansion device (such as a video card or drive controller) in a nonmastering computer such as an IBM PC or AT.

The difference between bus master and bus slave is entirely functional. In the MCA scheme, one bus master can

computers have a 10-MHz bus clock and most AT-bus (and EISA) machines have 8-MHz bus clocks. Beyond that advantage, features that are already defined but not implemented in today's PS/2s allow for speed increases of up to 800 percent in future computers.

### DOUBLE DATA

MCA gains performance over the AT bus with its full 32-bit bus width, doubling its data-handling capacity. The original MCA specification included several new bus protocols, including burst mode and matched-memory cycles, to improve data transfer speed. When the MCA specification was revised with the introduction of IBM's RISC System/6000, more fast-transfer modes were added, including streaming data mode and multiplex data transfers. Future MCA computers and peripherals that take advantage of all the provisions of the revised MCA specifications can potentially transfer data across their expansion buses at 160 megabytes per second. That compares to 16 MBps on the AT bus, 20 MBps on the original MCA, and 33 MBps under the EISA specification as it stands at the time of this writing.

MCA is designed for concurrency, which means that it is capable of supporting both multitasking and parallel processing. It combines bus masters and a hardware-controlled arbitration system to break the direct link between a computer's microprocessor and the expansion bus (see the sidebar "Bus Masters Take Charge").

In AT-style computers, the expansion bus is merely an extension of the system's microprocessor, and the microprocessor is burdened with handling every transaction that travels across the bus. The MCA design broadens the bus bandwidth beyond the data-handling abilities of any single microprocessor and allows several intelligent subsystems to share the bus effectively.

Today, bus mastering doesn't make much difference. After all, DOS is a single-tasking operating system, and the performance of the AT bus exceeds most single expansion boards. For example, the 10-MHz data speed of an ESDI hard disk controller or Ethernet adapter is not constrained by AT bus performance. But MCA comes into its own when multiple intelligent adapters have to operate simultaneously.

Right now, only multiuser systems—networks and workgroup computers—need that kind of power. In the future, new operating systems offer the hope that even single-user systems will benefit from bus-mastering designs like MCA and EISA. Imagine, for instance, an advanced version of OS/2 in which each thread of a task could automatically be directed to a separate MCA bus master.

### CRASH DUMMIES

The Micro Channel architecture is designed to be especially reliable. Thanks to such advanced technologies as surface-mount components and application-specific VLSI (very large-scale integration) circuits, IBM Personal Systems are designed to operate considerably longer without failures than PCs and ATs. For many businesses, that translates to correspondingly cheaper maintenance and service contracts. For individuals, that should mean fewer costly, frustrating trips to the repair shop.

Earlier this year, MCA's theoretical reliability seemed at odds with reality: Some MCA hardware was reportedly failure-prone. But for the most part, these

## BUS MASTERS TAKE CHARGE

**CONTINUED**

take control over another, making the second its slave. When a new situation demands, the same two devices can switch roles.

All expansion boards can function as bus slaves; consequently, there is no such thing as a special bus-slave board. Boards that can function as bus masters are special, however, and require additional circuitry to take command of the system. Such expansion boards should be called bus-mastering adapters or bus-mastering boards.

MCA is designed to support up to 15 bus masters (not counting the computer's microprocessor), limited by the coding abilities of the four hardware signals that the CAP uses for arbitration. To take control of the MCA expansion bus, a bus master sends out special hardware commands to the CAP and the CAP resolves any conflicts between competing masters. By default, each bus master is assigned an arbitration priority, although the MCA specification allows these priorities to be programmed.

Bus masters are not just for multi-microprocessor parallel computers. Any input/output device can take advantage of this technology to enhance performance, power, and overall throughput. For example, an intelligent bus-mastering hard disk controller could store disk data in internal cache memory and encrypt it off-line (from the bus and host microprocessor), on its way to or from the disk drive, providing absolute file security with minimum system overhead. The

**Unrestricted by microprocessor performance, bus masters increase the speed at which information is transferred in MCA systems.**

same technology could add advanced error correction to disk or tape mass-storage systems.

A bus-mastering network adapter can free your system's microprocessor from the layers of protocol management because the adapter can communicate directly with other expansion boards in the server. Bus-mastering communication concentrators could likewise relieve the load on the microprocessor, supporting many types of terminals by means of in-line protocol conversion or emulation. Bus-mastering microprocessor upgrades can replace the host microprocessor on the system board or operate parallel with it to improve the system's data processing capabilities. Bus-mastering display systems can extract data directly from memory and assume all the responsibility for creating a complex image. Bus-mastering technology also lends itself to developing intelligent internal subsystems for the processing of complex mathematics, speech, or electronic vision. ∎

problems were related to manufacturing difficulties on the part of IBM and MCA clone vendors and to the software short-comings of third-party peripheral vendors, rather than to actual defects in the MCA specification. In particular, the adapter description files that some peripheral manufacturers provided did not precisely follow IBM's specifications; as a result, some expansion boards failed to operate properly. Most of these problems were resolved by the time PC Labs conducted the testing for this review.

Of course, reliability means more than just having your computer work when you turn it on. You also have the right to expect that your computer won't add errors to your data or just randomly crash. MCA incorporates several error-detection systems to prevent such occurrences. Parity checking across the MCA expansion bus ensures that every data transfer is accurate. Asynchronous and synchronous error-detection systems not only stop noise-induced errors (which are admittedly rare) from rippling through your data but also help locate the exact part of your system and program in which each error occurs. In addition, MCA's watchdog timer helps prevent a crash in one task on a multitasking system from dragging down your entire computer.

The MCA design also improves the accessibility of personal computers to new users. System setup and expansion board installation are simplified through a consistent menu-driven software interface that automatically coordinates the conflicting demands of multiple expansion boards without making you adjust switches or jumpers. Expansion boards are easier to plug in, requiring no tools. They even have plastic grips to make them easy to pull out.

Unfortunately, not all manufacturers follow IBM's lead in making MCA computers more accessible. Some MCA computers and accessories still cling to their beloved DIP switches. Many still require you to twist out screws to get at their expansion boards (which you can then remove without tools!).

**PLUG-IN PROBLEMS**
When manufacturers take such liberties with the underlying concepts of MCA, the question of compatibility arises. All MCA computers are theoretically compatible. The reality may be different. Although IBM requires that all manufacturers of MCA computers be licensed to use IBM

technology (the requirement actually stretches to all personal computer manufacturers), an IBM license is no guarantee of compatibility. It's merely an authorization; like a driver's license, it is neither a certification of ability nor a promise of assistance. An IBM license only gives a manufacturer permission to attempt making an MCA computer. The only direct aid that IBM gives developers is its uneven technical reference manuals and sometimes a seminar (although the company reportedly has been assisting the makers of MCA expansion boards in creating compatible products).

Consequently, you have no real guarantee that a supposedly compatible MCA

computer meets all of IBM's specifications. When PC Labs first began to test the compatibility of MCA computers nearly a year ago, the machines' incompatibilities and inconsistencies were not very subtle. In the last six months, however, the makers of MCA computers have addressed most of the problems the Labs turned up. With few exceptions, the incompatibilities have been corrected.

PC Labs examined not only whether a board could be installed in the manner envisioned under the MCA specification, but also whether each board would function properly once it was installed. We used only expansion products from top-name vendors that included well-written ADF files. A diversity of peripherals, from fax boards to network cards to tape backup

## EDITOR'S CHOICE

- **ALR MicroFlex 3300**
- **NCR PC386sx/MC$_{20}$**

If you're determined to have an MCA computer on your desk or use one as a file server, the ten challengers represented here give IBM a run for its money. In some cases these systems exceed the abilities of the originator of Micro Channel architecture. Most have also solved their compatibility problems; with the exception of Tandy and Wang, all passed our suite of compatibility tests.

Two computers deserve Editor's Choice. The 33-MHz ALR MicroFlex 3300 is the fastest and most versatile, offering the most bang for the buck in the 386 category. And the NCR PC386sx/MC$_{20}$ represents a good value in a 386SX machine, from a company with a tradition of providing admirable service and support.

The ALR MicroFlex 3300 blew away the 25-MHz MCA models in speed, and it ties for third place on our 80386 Instruction Mix test when compared with similarly equipped ISA machines (see ''Speed to Burn: 22 of the Fastest 386s,'' *PC Magazine,* February 13, 1990). The computer also offers remarkable power, with such features as a 642MB hard disk and the ability to hold up to 64MB of RAM. At a list

price of $7,909 for *PC Magazine*'s standard configuration (including 4MB RAM and a 120MB hard disk), the MicroFlex 3300 will set you back about $1,000 more than a typical ISA machine, but you'll be getting the assurance of a top-quality system and a company that has made a commitment to MCA.

NCR's PC386sx/MC$_{20}$ is a better choice than IBM's PS/2 Model 65SX. It offers competitive pricing; the standard configuration costs $4,844, which is $2,000 less than the similarly configured IBM. While the NCR falls a bit short, providing only a 44MB hard disk for that price, the machine still makes an excellent workstation for *Microsoft Windows*. And thanks to NCR's one-year on-site service policy, you'll get the kind of support you need as well.

IBM's PS/2 Model 70-A21 deserves honorable mention; it comes from the company that set the MCA standard, and with it, you should never have to worry about compatibility issues. It's a good performer (though by no means the fastest on our list), and is widely distributed—often at deep discounts—and widely supported. Its case construction also deserves recognition, but the small-footprint design limits the machine's usefulness as a file server.

units, were installed and tested to see whether these MCA machines were truly compatible at last.

The two failures in our tests show that plug-and-play operation of MCA computers and expansion boards is getting better, although it's still not perfect. You may still need to do some head scratching—as you would with classic AT-bus computers.

## SLOW GAIN, MUCH PAIN

Within three years of its introduction, the classic PC AT bus was the most popular expansion design among personal computers. MCA has not found such wide-ranging support. Beyond the greater difficulty in crafting compatible machines, there are other reasons, too.

One factor has been users' reluctance to abandon the classic AT bus. Not only are they comfortable with that bus, they often have a substantial investment in old expansion boards that won't work with MCA. In contrast to the United States, where the AT standard is entrenched, MCA computers are selling extremely well in the European market. The Continent was slow to embrace the classic AT bus, and few there are attached to it.

Cost is another reason why MCA has been slow to catch on in the U.S. Cloning an MCA computer takes a toll, in the form of the licensing fees IBM demands for the use of its technologies. Even renegade Compaq reportedly pays for IBM licenses. The terms of these agreements can only be speculative because IBM does not disclose the cost or nature of its licensing agreements. Costs reputedly range from nothing (as in cases of cross-licensing, where IBM and another manufacturer trade access to each other's technologies) to as much as 5 percent of the price of the finished computer. Many industry sources have reported that IBM has had to reduce the high cost of MCA licenses to increase the architecture's acceptance among manufacturers.

MCA technology still appears pricey indeed. When a manufacturer offers similar machines that use the same microprocessor but differ in bus design, the MCA version typically costs $1,000 more than its classic-bus counterpart. EISA machines incur a similar price premium. Either way, that's a lot to pay for promises, considering that the benefits of these advanced bus technologies are elusive at best with today's software.

Perhaps the most important reason that

more people haven't bought MCA computers is the limited number of MCA machines manufactured. Larger corporations have been buying MCA computers as fast as IBM could make them. (Among other factors, they like the improved reliability of IBM's MCA computers, which is actually a result of the machines' advanced circuitry, not their expansion buses.) With the exception of the rarely publicized Tandy 5000 MC, however, MCA clones weren't available until just a few months ago.

**On-paper arguments about superior technology will not guarantee a market winner, particularly when the benefits are not apparent to the average user.**

## THE COMPETITORS

Finally that situation is changing, as the 12 machines in this review demonstrate. If you want Micro Channel architecture in your next PC, you now have a choice, even if you restrict yourself to the highest-performance machines based on the latest microprocessors, such as the Intel 386SX, 386, and 486.

This review is limited to computers based on 386SX and 386DX chips, because we wouldn't recommend a lesser microprocessor in an MCA PC—or any PC. The speed ratings of these machines range through the entire power spectrum. Those with the lowest clock speeds operate at 16 MHz: the Apricot Qi 300-80, IBM PS/2 Model 65SX, and Wang MC 350/16S. Three machines have 20-MHz clocks: the NCR PC386sx/MC$_{20}$, Reply 386SX/20, and Tandy 5000 MC. Five more run at 25 MHz: the Apricot Qi PCi, IBM PS/2 Model 70-A21, Memorex Telex 7270 Intelligent Workstation, Mitac MPS3000F, and Olivetti P800. The fastest clock, at 33 MHz, belongs to the ALR MicroFlex 3300.

These compatibles are not much

cheaper than IBM's own MCA computers (presumably, thanks to the licensing fee and the cost of development). Consequently, price is not the most compelling reason to choose a compatible rather than an IBM MCA machine. Instead, you'll want to look at features and performance. The best of the compatibles handily outperform IBM's offerings. And MCA compatibles offer you more growing room—more expansion slots and more drive bays. They also offer a greater range of standard hard disks and the availability of 5.25-inch internal floppy disk drives.

Certainly you have wider choices among classic-bus computers than among these MCA compatibles. And you'll find similar offerings in the EISA camp. Which bus to choose remains a tough question.

In theory, MCA has higher performance potentials than the classic AT bus and EISA, because it's not carrying the baggage of a dead bus. But anyone who remembers the standards war between Beta and VHS videocassette recorders knows that on-paper arguments about superior technology will not guarantee a winning place in the market, particularly when the benefits are not apparent to the average user. As mentioned earlier, PC Labs recently showed that neither EISA nor MCA will demonstrably improve a PC's performance on today's DOS applications. From a functional standpoint, any one of the three available expansion buses is acceptable right now. (See "The Bus Wars: ISA's Surprising Staying Power," *PC Magazine*, June 26, 1990, for a direct comparison of the three bus architectures.)

For the future, the call between EISA and MCA is difficult. Both buses offer similar abilities (after all, EISA's designers borrowed the best ideas from MCA). And the big promises of both remain unfulfilled.
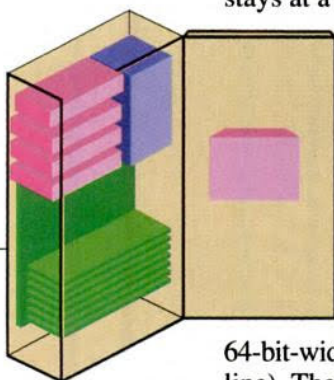
If you want an advanced-bus PC, right now you'll find a wider choice among MCA than EISA machines. Counting all manufacturer-designated model variations, 81 MCA computers with 386SX or better microprocessors had been announced by the time this story was written. (Seven 286 machines were also available.) By contrast, 57 models had been announced with the EISA bus, all of which had 386SX microprocessors or better. Hundreds of other models based on the classic AT bus were available at the time.

Thus, your computer choice is no longer limited if you favor a particular expansion bus. If you believe that MCA will ulti-

mately triumph—or if you believe that someday you'll work with an operating system that can take advantage of bus mastering and other advanced features—the 12 Micro Channel PCs reviewed here offer you some excellent alternatives. Even with today's software, they will prove themselves capable performers. If you care about the performance of the computer you use, if you care about multitasking, and if you care about staying abreast of technology, you'll want to consider one of them.

## ALR MicroFlex 3300

**ADVANCED LOGIC RESEARCH INC.**
*by Bruce Brown*



Micro Channel architecture customers, take heed; potential MCA competitors beware. ALR says it intends to be the premier second source for MCA computers. The company has a range of high-powered computers for customers who want MCA but don't want to be tied exclusively—or even partially—to IBM. Its 33-MHz 386-based MCA machine, the ALR MicroFlex 3300, is faster, less expensive, and more expandable than IBM's 25-MHz 386 flagship PS/2 Model 70-A21.

In its standard configuration in a small-footprint desktop case, the MicroFlex 3300 costs $7,909. The price includes 4MB

RAM with a 120MB hard disk with an ESDI controller; a 128K RAM cache; a 1.44MB floppy disk drive; a 16-bit VGA adapter and color monitor; parallel, serial, and mouse ports; and DOS 4.01. Our test machine, in a capacious tower case, included a 642MB 16-millisecond Maxtor hard disk, a 15-MHz ESDI controller with a 32K disk cache, and an 80387/33 coprocessor. Even with the fast numeric coprocessor and huge hard disk, the price stays at a very competitive $14,006.

ALR uses its own motherboard with an Intel 386 chip set and Phoenix ROM BIOS. The MicroFlex 3300 has an Intel 82385 RAM cache controller; special implementation circuitry in the motherboard doubles the standard maximum 64K RAM cache to work with the machine's two 64-bit-wide data paths (unique to the ALR line). The result is that memory access is speeded up: you get much faster performance than with conventional memory architecture. The single standard memory card, outfitted with the proper 4-megabit chips, can hold up to a whopping 64MB of RAM. Like other ALR computers, the MicroFlex 3300 can use off-the-shelf SIMMs, and that means you can shop around for the best price—an option not available with systems from vendors like IBM and Compaq that require you to buy special memory chips or modules directly from them.

The MicroFlex 3300 will accept a Weitek math coprocessor in place of or even in addition to the 33-MHz 80387 chip. Because the relevant circuitry is asynchronous, you can add coprocessor chips ranging from 16 to 33 MHz.

### A RUGGED PERFORMER
The MicroFlex 3300's tower case, set off by black vertical-ribbed front panels, measures 23 by 7.5 by 18.5 inches (HWD). It has room for one full-height and four half-height storage devices; three of the latter can be removable media. The standard 200-watt Astec power supply provides a generous five connectors.

The machine is built to rugged specifications. To access the inside of the case, you remove a panel on the left of the tower and then take off a single cross brace that extends from top to bottom. With the brace removed, you unscrew one side of a

heavy horizontal arm. Swing the arm wide and you have free access to the drives and expansion cards.
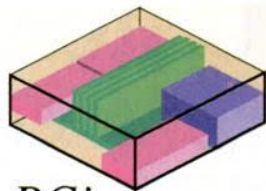
With the slots for the memory card, hard disk controller, and 16-bit VGA adapter filled, four expansion slots remain open. Two of these MCA-compatible slots are 32-bit, and two are 16-bit. In all, there are four available 16-bit slots, and two of them have extensions for high-speed video cards—useful for those who may need to run two monitors off the same machine at once. PC Labs' benchmark tests show how well ALR's killer combination of RAM cache and processor speed works. The MicroFlex had the fastest score of the 14 PCs reviewed on the processor tests. Video and drive scores were also excellent, all in first or second place except its BIOS Disk Seek test score—a respectable sixth place in a very narrow range.

ALR's standard parts-and-labor warranty is for one year. Repairs can be performed on a carry-in basis either at your ALR dealer or at authorized ALR service depots, including Intel service centers nationwide. You can also buy on-site service contracts directly from the Intel service provider.

The ALR MicroFlex 3300 is a fine, rugged 33-MHz machine. Its tower configuration beats IBM's top performer, with better speed and room for more drives and expansion cards. The MicroFlex 3300 also compares favorably in price; the relatively low-cost desktop version is attractive, especially when you keep in mind that all ALR machines are sold through dealers, and therefore substantial discounts are negotiable. Look out, Blue!

# Apricot Qi 300-80
# Apricot Qi PCi

*by Bruce Brown*

Apricot is relatively new to the United States, but the company's carefully designed computers should make a name for themselves fairly quickly. Security provisions available on the Apricot Qi (pronounced ''key'') 300-80 and PCi add to their appeal as network workstations in organizations where data and system security is of paramount concern.

The Qi 300-80 is a 16-MHz 80386SX system that sells for $5,190 in a standard configuration with 2MB RAM and an 80MB hard disk. The standard configuration of the Qi PCi, a 25-MHz 386 (DX) with 4MB RAM, a 64K RAM cache, and a 120MB hard disk, costs $8,090. Both MCA systems include a 1.44MB floppy disk drive, built-in Ethernet and VGA circuitry, a color VGA monitor, one parallel and one serial port, a mouse port, and DOS 4.01.

The standard and optional security measures provided with the systems grew out of a contract Apricot had with the United Kingdom Department of Defense, which ordered workstations that would be secure from all but the most sophisticated intruders or snoops. In line with its goal of providing optimum security, the Apricot cases have a system keylock on the back. And the company doesn't follow the common practice of using a relatively limited set of key patterns; the key pattern for each individual Apricot computer is

unique. If you lose the keys to your computer, new keys must be cut at the factory from patterns stored on a secured PC.

Additionally, our test systems came with the $295 Key Security Software option, a bundle composed of security software, an infrared hardware key, *Microsoft Windows* (Version 2.11), and a Microsoft Mouse. The infrared remote-key device can be required to activate the computer, and it also activates the *Windows*-based security program that prevents unauthorized access to your system.

## COMMON COMPONENTS

There is no difference between the 386SX- and 386DX-based systems other than their motherboards, and even here the most important components are identical. For instance, in each case Apricot uses the Chips and Technologies 386 chip set and video controller chip as well as Phoenix's ROM BIOS. Most of the device controllers that usually take up expansion slots are built into the Apricot units' motherboards, including the floppy disk drive controller, the video and Ethernet circuitry, I/O device controllers, and parallel, serial, and mouse ports.

Apricot uses the same case on all its computers, including earlier 286-based machines and newer 486 models. The small-footprint case measures 5.25 by 15.5 by 16.75 inches. All the systems' pieces are obviously and pleasingly designed to fit together. For example, the case slopes down to the front but has a dormer-like platform especially designed to act as a base for the Apricot monitor. The 101-key keyboard with 72-inch cable is notched on the back corners to fit snugly to the system case.

Inside the case, Apricot's standard setup includes a 145-watt power supply with three device leads and space for three 3.5-inch storage devices: the standard hard and floppy disk drives and an optional tape unit. Apricot currently sells a 40MB tape backup system for $675, but it will be offering 60MB and 125MB units by the time this article is in print. Apricot also plans to expand the hard disk options to include SCSI 200MB and 320MB disks.

## MINOR DIFFERENCES

There are a few differences between the two machines. The SX-based Qi 300-80 can hold up to 8MB of RAM on the motherboard using proprietary 100-nano-

second memory modules. For additional memory (up to 16MB), you need to add a third-party, 16-bit MCA expansion card that uses the same interleaved page-mode memory scheme that the motherboard memory slots use. On the motherboard, there is also a slot for an 80387SX math coprocessor. Apricot plans to introduce a faster, 20-MHz unit—as soon as 20-MHz SX chips become widely available—to

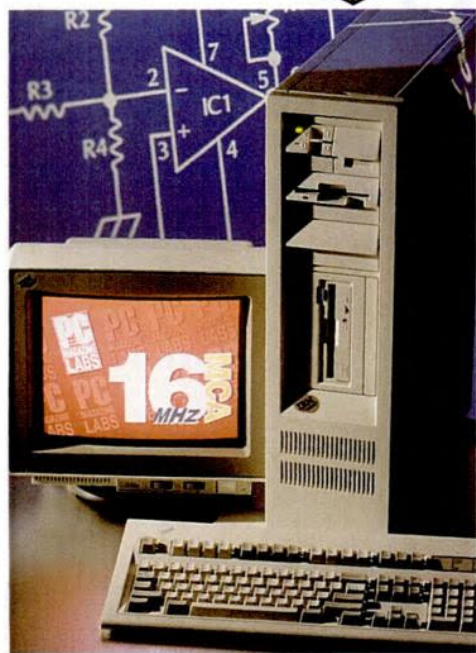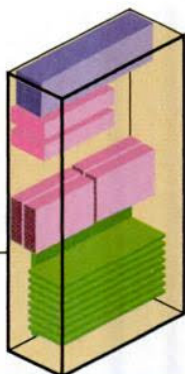sell at the same price as the 16-MHz model.

The 25-MHz Qi PCi has a 64K 35-ns. RAM cache, and it can take up to 16MB of RAM on the motherboard using faster 80-ns. SIMMs. The system can support an 80387/25 or Weitek math coprocessor but not both. Whenever more than 1MB of RAM is installed in either Apricot system, the system defaults to ROM BIOS shadowing. If you prefer not to use the memory this way, you can turn it off.

Apricot systems are sold largely through VARs and system integrators. The standard parts-and-labor warranty is good for one year, and on-site service contracts are available at extra cost.

One strong point of the Apricot systems is their consistent hardware platform. The only differences in Apricot's 286, 386SX, 386, and upcoming 486 systems are the motherboards, so upgrades from one machine to a higher-end model are reasonably simple. While Apricot systems are priced at a premium to cover the security features and the array of standard components, if you need a high-security LAN workstation, these systems deserve a close look.

## IBM PS/2 Model 65SX

**IBM CORP.**
*by Bruce Brown*

Just because no other company pushes an 80386SX-based computer as a file server doesn't mean that IBM's idea is a bad one. After all, it was only four or five years ago that people were running small networks of eight to ten PCs for simple applications like word processing, using 8- or even 6-MHz ATs as file servers. For anyone who plans to use a network for relatively light work today, IBM's PS/2 Model 65SX offers plenty of memory and drive expansion room for a good deal less than the price of the company's Model 80 servers.

The 16-MHz Model 65SX comes in a tower case measuring 23.5 by 6.5 by 19 inches. The legs fold out on the bottom for stability. The standard configuration lists for $6,395, including 2MB RAM (the motherboard can hold 8MB, and the system a total of 16MB), a 60MB hard disk, a 1.44MB floppy disk drive, an IBM 8515 VGA monitor, one parallel and one serial port, a mouse port, a 101-key keyboard, and DOS 4.01.

While our tested system wasn't exactly maxed out, it wasn't skimpily equipped either. It included 6MB of RAM on the motherboard and 8MB on an expansion card. The motherboard also has a slot for an 80387SX/16 math coprocessor, which IBM sells for $795. Eschewing the standard video, IBM packaged the system with an 8514A 1,024 by 768 display adapter to work with the 8515 monitor. The hard disk was a 120MB model, and other goodies included a 3270 emulation card and an internal IBM CD-ROM player. The CD-ROM unit is a particularly apt accessory for a file server with second-tier performance: since CD-ROM devices are notorious for wasting processor and system time because of their relatively slow access of massive storage, they are not exactly sought after in top-of-the-line, 25-MHz 386 file servers.

The price for all this? $18,617. That high figure is explained largely by the fact that going from the standard 2MB of RAM to 14MB costs $8,280 at IBM's list price. Unfortunately, you can't use off-the-shelf memory with this machine; you must use IBM's proprietary-design memory modules. Here's hoping you can get big discounts.

### HOMEMADE WITH ROOM TO GROW
IBM makes most of the components used in the Model 65SX, including the motherboard, the ROM BIOS, the hard disk and

its controller. The floppy disk drive in the test machine was manufactured by Mitsubishi. IBM makes the rugged 250-watt power supply, which, like that on the Model 80, extends from front to back at the top of the vertical case. The case is the same style the Model 80 uses; you can open it using a dime for a screwdriver and take most of it apart with your hands alone. This system may be expensive, but it's simply and beautifully built.

If you decide to stuff a 65SX with storage devices, you'll find lots of room. You can put in one full-height and two half-height drives, as well as four 3.5-inch drives. The 65SX has more space for expansion cards than IBM's small-footprint PS/2s do; it offers eight 16-bit MCA slots. Even our stuffed test unit had three free slots.

IBM sells systems directly, through its dealers, and through IBM Business Partners (companies that have developed hardware or software products that work in conjunction with IBM computers). The standard warranty is for one year, including parts and labor. You can have repairs made at any authorized service center, and if you choose, you can always ship IBM hardware directly to the manufacturer (no matter what you've heard, you *can* do this). Most dealers also offer on-site service contracts.

Using an SX as a file server is an interesting concept, but you have to question whether the IBM machine offers any price advantage. While the Model 65SX certainly has the drive and slot expansion capability to let it function in a network or multiuser situation, the $6,395 standard-configuration price is rather high, and the cost of memory expansion is especially

# CACHING IN BIG

by John C. Dvorak

Hardware caching is a way to increase system performance without spending a lot of money. It is necessary only on relatively new, high-speed machines whose memory banks are too slow to feed and receive data as fast as the processor would like. A cache machine has a minimal amount of expensive high-speed memory acting as an expediter between the processor and the sluggish low-speed main memory. If you loaded a fast machine with 20-nanosecond main memory, a cache would be unnecessary. But this proposition is too expensive and hard to justify, especially when compared with the cost benefits of a cache.

A hardware cache operates under the "locality of execution" principle, which makes one assumption: what the processor is likely to reach for in main memory will be within a few kilobytes of what it reached for previously. By loading all the data within, say, a 32K vicinity into a high-speed cache memory, the processor can spend most of its time running full tilt in and out of the cache rather than the slower main memory. A "hit" occurs every time the processor goes to the cache instead of main memory.

An old rule of thumb, developed by Intel in 1985, says that a 32K direct-mapped cache will have an 86 percent hit rate. A 64K cache has an 89 percent hit rate. From there, the hit rate inches toward 100 percent, achieved at 640K—when the entire machine could be using high-speed memory.

The most controversial issue surrounding cache memory concerns its size. While hit rates do increase in proportion to cache size, does having a big cache—say, 128K or 256K—really matter? Does a large cache really accomplish much, except in a multi-tasking environment where a small cache would be constantly flushed?

Certainly, vendors often take the opportunity to trumpet their caching schemes. A 256K cache should show only an incremental improvement in speed, but that's enough that a manu-

**Caches are important for getting the most out of newer systems with fast processors. But do larger caches significantly increase performance?**

facturer can claim superior performance. Theoretically, the bigger the cache, the more likely it is to do well on any benchmark test that starts to require large chunks of memory.

I'm impressed by the performance gain of the on-board 8K cache that the 486 chip uses. The on-chip cache is a whole new approach as the distance the electrons have to travel from memory to processor becomes an issue in high-speed environments.

It's hard to say what cache size to recommend to most users. Personally, I like to go by the feel of the machine. While benchmark-test numbers for 128K- or 256K-cache machines can be impressive, I can't say that these machines "feel" any faster than a 32K-cache machine when I compare them side by side using various applications. Of course, all of them feel faster than machines with no cache, but sometimes the large-cache machines actually seem slower than the others!
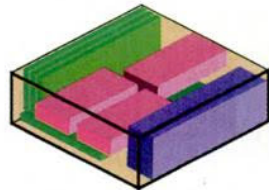
Most engineers agree that the specific application you use most will determine what size cache best suits you. You can also benefit from an opportunity to play with various machines to find out what you really need. In theory, at least, a 32K cache should do the job for most users in most applications. It's also the cheapest solution.

For now, with exceptions, cache size is mostly a marketing game. We know that benchmark tests don't show the effects of caching in real-world situations. Yet today's popular tests, which show impressive numbers for many large-cache machines, will probably make them fashionable (if they're priced to compete against small-cache machines), even among users who don't really need them. ∎

tough to swallow. You can buy other brands' 386SX or even DX units for a lot less, and you will usually have the advantage of being able to use off-the-shelf RAM, at a current street price of about $100 per megabyte.

Even with the heavy discounting often available through IBM dealers (30 percent or more is not unusual), the PS/2 Model 65SX remains an expensive solution. But if you're a straight IBM house and you want IBM's obvious engineering quality, this model makes sense for use as a server in a small department.

## IBM PS/2 Model 70-A21

**IBM CORP.**
*by Bruce Brown*

IBM is, of course, the standard-bearer in the MCA arena. It introduced Micro Channel architecture to the world back in 1987, and today the 25-MHz IBM PS/2 Model 70-A21, its fastest 386 machine to date, enjoys well-deserved acclaim for its engineering and small-footprint design. The Model 70-A21 certainly isn't the fastest 386 around, nor is it the most expandable or least expensive. And it hasn't been without its problems: in 1989 the line was the focus of negative attention brought on by a run of machines with faulty memory module connectors. Yet the Model 70-A21 remains a strong force in the MCA marketplace.

In its standard configuration, the Model 70-A21 costs $11,490, including 4MB

RAM, a 120MB hard disk, a 1.44MB 3.5-
inch floppy disk drive, IBM's own Model
8515 color VGA monitor, and DOS 4.01.
Our test machine, with 6MB of RAM and
an 80387/20 math coprocessor, lists for
$14,115.

The IBM-made motherboard uses an
Intel 386 chip set in conjunction with an
Intel 82385 cache controller to manage
the 64K 25-nanosecond cache memory.
You can put up to 8MB of standard RAM
on the motherboard, using 2MB IBM
SIMMs. The Model 70-A21 can use 16-,
20-, or 25-MHz 80387 math coprocessor
chips because the coprocessor runs asyn-
chronously to the CPU. There is no provi-
sion for a Weitek coprocessor.

The Model 70-A21's compact size
belies the power within. Inside the case,
its few components are small, neat-look-
ing, and held in place by tough plastic
levers. You can remove the hard and floppy
disk drives in seconds. Other compo-
nents—the motherboard, memory mod-
ules, and so on—can be removed from the
case just as easily. With practice, you can
probably separate or put together all the
major modules in a couple of minutes. Try
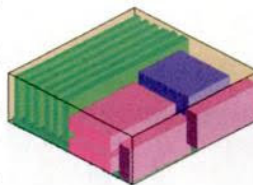that with most small-footprint computers!

One of the reasons the high-powered
Model 70-A21 seems sparsely populated
is its integration of components on the
system board. Built-in ports include a
parallel port, a 25-pin serial port, and a
PS/2 mouse port. The video adapter and
the hard and floppy disk controllers are
also built in—no separate interface cards
needed here. The power supply puts out a
maximum of 132 watts, which is enough
for the standard components and the few
that can be added (there is room for three
extra storage devices). Only three expan-
sion slots are found in the machine: two

are 16-bit, and one is a 32-bit slot that will
accept a memory card to bring the system
to its 16MB maximum.

Like all IBM personal computers, the
Model 70-A21 is sold by authorized deal-
ers as well as by IBM Business Partners
and IBM's direct sales force. The stan-
dard warranty is for one year, covering
parts and labor on a carry-in basis. IBM
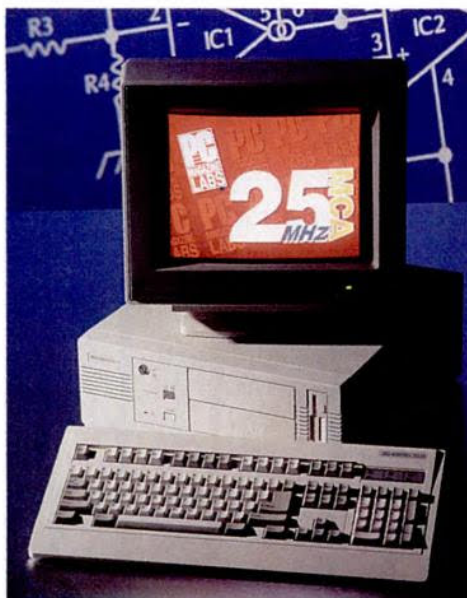also offers many service contract options.

When the Model 70-A21 came out, its
25-MHz processor in a small-footprint
case delivered exceptional power for the
single user. Today, with other 25-MHz
machines available that are faster and
more amenable to expansion, the Model
70-A21 is not quite such a leading-edge
machine. You wouldn't want to use it as a
serious file server because of the lack of
room for card and drive expansion. Yet
although it has been surpassed in some
areas, it remains a finely constructed
workstation that leaves you a good amount
of desk space. At the same time, despite
price cuts within the past year and the dis-
counts you can usually get from IBM
dealers, the system still sports a pretty sig-
nificant price tag, and a further reduction
would be welcome.

## Memorex Telex 7270 Intelligent Workstation

**MEMOREX TELEX CORP.**
*by M. David Stone*



The small-footprint Memorex Telex 7270
Intelligent Workstation has much in
common with the Mitac MPS3000F also
reviewed here. Both 386 25-MHz sys-
tems use the same Mitac motherboard and
the same chassis. If you take their covers
off and set them side by side, you'll be
tempted to ask, "Is it Mitac or is it
Memorex?" Their similarities don't ex-
tend to price, but the premium you'll pay
for the Memorex Telex system gets you a
notable level of support.

In *PC Magazine*'s standard configura-
tion, the Memorex Telex offering is a
hefty $9,790—almost $3,000 more than
the similarly configured Mitac unit. For
this price, you get 4MB of RAM, 32K of
25-nanosecond cache (a 64K cache is not
available), an 18-millisecond 107MB
Microscience hard disk, a 1.44MB 3.5-
inch floppy disk drive and its controller,
and a Tatung VGA monitor with a Mem-
orex Telex label, plus parallel, serial, and
mouse ports, and DOS 4.01. Memorex
Telex added a 1.2MB floppy disk drive to
the test configuration, for a total price of
$10,035. The $6,495 base price leaves out
the hard disk, the additional drive, and the
monitor.

### NEARLY IDENTICAL TWINS
Physically, the Memorex Telex 7270 is
identical to its Mitac near-twin. The unit
measures 6.25 by 14.75 by 16.5 inches
(HWD), with the power switch, reset
switch, and keyboard lock all placed on
the front panel. In the back, you'll find
the three ports and a PS/2-style keyboard
connector.

Open the Memorex's box and you'll
find the same bay arrangement as in the
Mitac, with two 5.25-inch half-height bays
and one 3.5-inch bay in the front of the
system, plus one 3.5-inch bay in the back
by the power supply. This second 3.5-
inch bay is a welcome touch: your 3.5-
inch hard disk goes there, and you still
have three bays accessible in the front of
the system.

The Mitac motherboard includes an
Intel chip set, a Phoenix BIOS, and a
coprocessor socket for an 80387 or Weitek
3167. Four of the tested unit's eight SIP
sockets were filled with 1MB SIP mod-
ules, yielding 4MB for the system. Mem-
orex Telex says that if you need more than
the 8MB of RAM that fits on the mother-
board, you can add a memory board from
almost any third-party vendor. In addition
to the two 32-bit slots suitable for memory
boards, you'll find three standard 16-bit

# SUMMARY OF FEATURES: MCA-BASED PCs

**Price of standard configuration** For 386SX MCA computers, our standard configuration includes 2MB RAM, a 60MB hard disk or the closest available approximation, one high-density floppy disk drive, a color VGA video display, at least one parallel and one serial port, a keyboard, and DOS. For 386 (DX) MCA computers, we increase the requirement to 4MB RAM and a 100MB hard disk.

In some instances, manufacturers do not offer the exact configuration *PC Magazine* requested, but all 12 of the PCs reviewed here provide a reasonably close match for this list of requirements. Check each machine's fact file for a more exact indication of what is included at the quoted price.

**Distribution channel** Some machines are sold directly through mail order. When machines are sold by dealers, the purchaser may find discounts of 25 percent or more off the list price (although there is no guarantee that the discounts will run this high).

**Case type** indicates whether each computer has a small-footprint, desktop, or tower design.

**Chip set manufacturer** indicates which company makes the support logic that connects the CPU with the other functions managed by the system board. Chip sets that employ VLSI (very large-scale integration) technology reduce the discrete component count, which in turn helps to reduce power consumption and increase component life. In some cases the computer uses discrete logic rather than a chip set.

The **system RAM arrangement** is the method in which memory is addressed. The design of system RAM aims at avoiding the wait states imposed when CPU speed outpaces conventional memory speed.

*Interleaved* memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

*Page-mode* memory allows back-to-back memory accesses within blocks of memory called pages, avoiding wait states.

*Row/column* is the traditional method of accessing data at a memory address. RAM is mapped as a matrix, and a particular address is given using a row and a column number.

**Wait states** On the average, most machines run at between zero and one wait state. The figures printed here were supplied by the respective manufacturers.

**Maximum installable RAM** Separate rows indicate the maximum 32-bit memory possible on the motherboard and on a dedicated memory board.

**RAM packaging (and rated speed)** Memory chips come in a variety of styles: DIPs, SIPs, SIMMs and SMDs.

The *dual in-line package (DIP)* is the traditional buglike computer chip sprouting 8, 14, 24, 40, or more metal legs (evenly divided between right and left sides).

*Single in-line packages (SIPs)* are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection.

*Single in-line memory modules (SIMMs)* consist of individual logic devices installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates easy installation and replacement.

*Surface mount devices (SMDs)* hold logic circuitry in a reduced-size case, mounted directly on the motherboard.

**Installed chip size** Kb and Mb refer to kilobits and megabits, respectively.

The **BIOS version and date** can affect PC Labs' benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

**Setup** can reside either on a floppy disk or in ROM.

**Shadowing** Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed. This feature uses the 384K of system memory located between the boundary of conventional memory and the end of the first megabyte of installed RAM. The ability to disable shadowing is important with some applications to resolve memory conflicts.

**Hard disk interface** Within the 386 PC environment, the three most common hard disk interfaces are *ST-506, SCSI (small computer system interface),* and *ESDI (enhanced small device interface).* ST-506 uses one of two data encoding methods, *RLL (run length limited)* and the older *MFM (modified frequency modulation)* scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. The MFM format uses nine such bits to store the same amount of data that RLL can store with only six polarity changes.

Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers. A new interface that offers good performance at a lower price than ESDI or SCSI is *IDE (integrated drive electronics).*

**Hard disk options** We are listing up to four of what we believe are the most popular disk choices.

**Bus speeds** The higher the bus speed, the faster the bus can transfer information, allowing you to make the most of a fast microprocessor. MCA expansion boards are designed to operate at a speed of at least 10 MHz; thus, any bus that runs at 8 or 10 MHz should be compatible with any MCA expansion board.

The **display circuitry** can be either on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled it prevents upgrades.

**Interface** 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

**Software available** The availability and price of DOS 3.3 and 4.01 are listed here. If no price is shown, the base-priced system includes DOS. (*PC Magazine*'s standard configuration includes DOS 4.01—or, if it is not available, DOS 3.3—to allow more accurate price comparisons.)

Where OS/2 is available, the version number and list price are provided.

**Disk caching software** Some companies provide software to facilitate data retrieval from the hard disk. This software speeds overall system performance by anticipating what data the processor will need next.

An **expanded memory manager** is software that emulates the Lotus/Intel/Microsoft (LIM) expanded memory manager within the extended memory of a 386 or 386SX PC.

**Dual voltage** on the power supply permits a computer's use in both the United States and Europe.

**Number of device connectors** indicates how many internal storage devices the system can support without the use of Y cables (power splitters).

**FCC certification class** Two classes of FCC (Federal Communications Commission) approval, Class A and Class B, may be given to computers. Class A approval signifies that a computer has sufficiently low radio-frequency emissions for operation in a business locale. The more stringent Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

## SUMMARY OF FEATURES: MCA COMPUTERS

Products listed in ascending price order

| | NCR Workstation Products Division **NCR PC386sx/MC₂₀** | Apricot in Canada Inc. **Apricot Qi 300-80** | Reply Corp. **Reply 386SX/20** | Wang Laboratories Inc. **Wang MC 350/16S** | IBM Corp. **IBM PS/2 Model 65SX** |
|---|---|---|---|---|---|
| Price of standard configuration | $4,844 | $5,190 | $5,335 | $5,790 | $6,395 |
| Hard disk capacity | 44MB | 80MB | 60MB | 76MB | 60MB |
| Distribution channel | Dealers, direct | Dealers | Direct | Dealers, direct | Dealers |
| **TESTED CONFIGURATION** | | | | | |
| Price | $7,794 | $5,485 | $7,105 | $6,875 | $18,617 |
| Microprocessor | 20-MHz 80386SX | 16-MHz 80386SX | 20-MHz 80386SX | 16-MHz 80386SX | 16-MHz 80386SX |
| Case type | Small-footprint | Small-footprint | Small-footprint | Desktop | Tower |
| Dimensions (HWD, in inches) | 5.2 x 15 x 16.6 | 5.25 x 15.5 x 16.75 | 5.5 x 14.2 x 16.5 | 5.4 x 18.4 x 14.4 | 23.5 x 6.5 x 19 |
| Motherboard manufacturer | NCR | Apricot | Reply | Wang | IBM |
| Chip set manufacturer | Intel | Chips and Technologies | Chips and Technologies | Chips and Technologies | IBM |
| System RAM arrangement | Page-mode | Interleaved, page-mode | Interleaved, page-mode | Interleaved, page-mode | Interleaved |
| Wait states | 0 | 0 | 0 | 0 | 0 |
| **MOTHERBOARD MEMORY** | | | | | |
| Installed RAM | 8MB | 2MB | 8MB | 8MB | 6MB |
| Maximum installable RAM | 8MB | 8MB | 8MB | 8MB | 8MB |
| RAM packaging (and rated speed) | SMD (70 ns.) | DIP (100 ns.) | SIMM (80 ns.) | SIMM (100 ns.) | SIMM (80 ns.) |
| Installed chip size | 1Mb | 1Mb | 1Mb | 2Mb | 1Mb |
| Other chips supported | 4x256Kb | None | 256Kb | 1Mb | None |
| Accepts generic chips | ❏ | ■ | ■ | ❏ | ❏ |
| **ADD-IN MEMORY BOARD** | | | | | |
| Installed RAM | N/A | None | None | N/A | 8MB |
| Maximum installable RAM | N/A | 8MB | 8MB | N/A | 8MB |
| RAM packaging (and rated speed) | N/A | DIP (100 ns.) | SIMM (80 ns.) | N/A | SIMM (80 ns.) |
| Chip size | N/A | 1Mb | 1Mb | N/A | 1Mb |
| Accepts generic chips | N/A | ■ | ■ | N/A | ❏ |
| **PROCESSOR RAM CACHE** | | | | | |
| Cache controller | N/A | N/A | N/A | N/A | N/A |
| Installed RAM | N/A | N/A | N/A | N/A | N/A |
| RAM packaging (and rated speed) | N/A | N/A | N/A | N/A | N/A |
| Chip size | N/A | N/A | N/A | N/A | N/A |
| **BIOS** | | | | | |
| BIOS version and date | Phoenix 1.02.07 (5/9/90) | Phoenix 1.02.18 (10/88) | Chips and Technologies 1.2 (7/18/90) | Phoenix 1.02.03/1.15.00 (10/10/88) | IBM (2/90) |
| Setup in ROM/Password in ROM | ■ / ■ | ❏ / ■ | ■ / ■ | ❏ / ■ | ❏ / ■ |
| Video shadowing/Can be disabled | ■ / ■ | ■ / ■ | ❏ / ❏ | ■ / ■ | ❏ / ❏ |
| System shadowing/Can be disabled | ■ / ■ | ■ / ■ | ■ / ■ | ■ / ■ | ❏ / ❏ |
| **HARD DISK** | | | | | |
| Manufacturer | Conner | Quantum | Conner | Imprimis | IBM |
| Disk capacity | 100MB | 80MB | 120MB | 76MB | 120MB |
| Interface | SCSI | SCSI | ESDI | ST-506 | SCSI |
| Controller location | Motherboard | Card | Drive | Card | Motherboard |
| Controller manufacturer | NCR | Adaptec | Conner | Adaptec | IBM |
| Integrated floppy/hard disk controller | ❏ | ❏ | ■ | ❏ | ❏ |
| Drive bays | 3 one-third-height | 3 3.5-inch | 2 half-height, 3 3.5-inch | 3 3.5-inch | 1 full-height, 2 half-height, 4 3.5-inch |
| Hard disk options | 44MB, 200MB (SCSI) | 200MB, 320MB (SCSI) | 325MB (ST-506); 30MB, 60MB, 120MB (IDE) | 40MB (ST-506) | 60MB (SCSI) |

🔳—Editor's Choice    ■—Yes    ❏—No
N/A—Not applicable: the product does not have this feature.

| | American Mitac Corp. **Mitac MPS3000F** | Tandy Corp. **Tandy 5000 MC** | Advanced Logic Research Inc. **ALR MicroFlex 3300** | Apricot in Canada Inc. **Apricot Qi PCi** | Memorex Telex Corp. **Memorex Telex 7270 Intelligent Workstation** | Olivetti Office USA **Olivetti P800** | IBM Corp. **IBM PS/2 Model 70-A21** |
|---|---|---|---|---|---|---|---|
| | $6,875 | $7,628 | $7,909 | $8,090 | $9,790 | $11,475 | $11,490 |
| | 100MB | 150MB | 120MB | 120MB | 100MB | 135MB | 120MB |
| | Dealers | Dealers | Dealers, direct | Dealers | Direct | Dealers | Dealers |
| | $6,875 | $7,897 | $14,006 | $8,385 | $10,035 | $11,475 | $14,115 |
| | 25-MHz 80386 | 20-MHz 80386 | 33-MHz 80386 | 25-MHz 80386 | 25-MHz 80386 | 25-MHz 80386 | 25-MHz 80386 |
| | Small-footprint | Desktop | Tower | Small-footprint | Small-footprint | Tower | Small-footprint |
| | 6.25 x 14.75 x 16.5 | 6.5 x 17 x 15.5 | 23 x 7.5 x 18.5 | 5.25 x 15.5 x 16.75 | 6.25 x 14.75 x 16.5 | 22.5 x 8.5 x 27 | 4.1 x 14.1 x 16.5 |
| | Mitac | Tandy | ALR | Apricot | Mitac | Olivetti | IBM |
| | Intel | Intel | Intel | Chips and Technologies | Intel | Chips and Technologies | IBM |
| | Interleaved, page-mode | Page-mode | Interleaved | Interleaved, fast page-mode | Interleaved, page-mode | Row/column | Row/column |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 4MB | N/A | N/A | 4MB | 4MB | 4MB | 6MB |
| | 8MB | N/A | N/A | 16MB | 8MB | 16MB | 8MB |
| | SIP (80 ns.) | N/A | N/A | SIMM (80 ns.) | SIP (80 ns.) | SIMM (80 ns.) | SIMM (80 ns.) |
| | 1Mb | N/A | N/A | 1Mb | 1Mb | 1Mb | 1Mb |
| | 256Kb | N/A | N/A | 256Kb | None | None | None |
| | ■ | N/A | N/A | ■ | ■ | ■ | ❏ |
| | N/A | 4MB | 4MB | None | N/A | None | None |
| | N/A | 4MB | 64MB | 32MB | N/A | 24MB | 8MB |
| | N/A | SIMM (100 ns.) | SIMM (80 ns.) | SIMM (80 ns.) | N/A | SIMM (80 ns.) | SIMM (80 ns.) |
| | N/A | 256Kb, 1Mb | 256Kb, 1Mb | 2Mb, 4Mb | N/A | 1Mb | 1Mb |
| | N/A | ■ | ■ | ❏ | N/A | ■ | ❏ |
| | Intel 82385-25 | Intel 82385 | Intel, ALR | Apricot | Intel 82385-25 | Intel 82385 | Intel 82385 |
| | 32K | 32K | 128K | 64K | 32K | 64K | 64K |
| | DIP (25 ns.) | DIP (25 ns.) | DIP (25 ns.) | DIP (35 ns.) | DIP (25 ns.) | DIP (25 ns.) | DIP (25 ns.) |
| | 32Kb | 2Kb | 64Kb | 64Kb | 32Kb | 64Kb | 64Kb |
| | Phoenix 1.02.00 (Mitac R2.10.10B) (10/88) | Phoenix 1.02.04 (7/29/88) | Phoenix 1.02.08 (10/88) | Phoenix 1.02.17 (10/88) | Phoenix 1.02.00 (Mitac R2.10.10B) (5/88) | Olivetti (10/89) | IBM (2/89) |
| | ❏ / ■ | ❏ / ❏ | ■ / ❏ | ❏ / ■ | ❏ / ■ | ❏ / ■ | ❏ / ■ |
| | ■ / ■ | ■ / ■ | ❏ / ❏ | ■ / ■ | ■ / ■ | ❏ / ❏ | ❏ / ❏ |
| | ■ / ■ | ■ / ■ | ❏ / ■ | ■ / ■ | ■ / ■ | ❏ / ❏ | ❏ / ❏ |
| | NEC | Miniscribe | Maxtor | CDC | Microscience | NEC | IBM |
| | 100MB | 150MB | 642MB | 120MB | 107MB | 135MB | 120MB |
| | ESDI | ESDI | ESDI | RLL | ESDI | ESDI | SCSI |
| | Card | Card | Card | Card | Card | Card | Motherboard |
| | Adaptec | Western Digital | Western Digital | Western Digital | Western Digital | Western Digital | IBM |
| | ❏ | ❏ | ❏ | ❏ | ❏ | ❏ | ❏ |
| | 2 half-height, 2 3.5-inch | 2 half-height, 2 3.5-inch | 1 full-height, 4 half-height | 3 3.5-inch | 2 half-height, 2 3.5-inch | 2 full-height, 5 half-height | 3 3.5-inch |
| | 60MB (ESDI) | 40MB, 80MB, 170MB, 440MB (SCSI) | 70MB, 150MB, 330MB (SCSI) | 80MB, 200MB, 320MB (SCSI) | 40MB, 70MB, 170MB (ESDI) | 300MB (ESDI) | 60MB (SCSI) |

CONTINUES

## SUMMARY OF FEATURES: MCA COMPUTERS

Products listed in ascending price order

| | NCR Workstation Products Division **NCR** **PC386sx/MC₂₀** | Apricot in Canada Inc. **Apricot Qi 300-80** | Reply Corp. **Reply 386SX/20** | Wang Laboratories Inc. **Wang MC 350/16S** | IBM Corp. **IBM PS/2 Model 65SX** |
|---|---|---|---|---|---|
| **FLOPPY DISK DRIVES** | | | | | |
| Type | 1.44MB | 1.44MB | 1.2MB, 1.44MB | 1.44MB | 1.44MB |
| Manufacturer | TEAC | Sony | TEAC | Mitsubishi | Mitsubishi |
| **EXPANSION BUS** | | | | | |
| Bus speeds (MHz) | 10 | 10 | 10 | 10 | 10 |
| Expansion slots | Four 16-bit (one with 8514 extension) | Four 16-bit (one with 8514 extension) | Five 16-bit (one with 8514 extension) | Five 16-bit | Eight 16-bit |
| Slots left free after hard and floppy disk drives, video, one parallel and two serial ports are installed | 4 | 3 | 5 | 3 | 6 |
| Ports originate on motherboard | ■ | ■ | ■ | ■ | ■ |
| **VIDEO** | | | | | |
| Display circuitry location | Motherboard | Motherboard | Motherboard | Motherboard | Motherboard, card (optional) |
| Interface | 16-bit | 16-bit | 16-bit | 16-bit | 16-bit |
| Manufacturer | NCR | Apricot | Reply | Wang | IBM |
| Chip set manufacturer | NCR | Chips and Technologies | Chips and Technologies | Chips and Technologies | IBM |
| **KEYBOARD AND MOUSE** | | | | | |
| Keyboard: | | | | | |
|    Manufacturer | Cherry | Apricot | Reply | Honeywell | IBM |
|    Number of keys | 101 | 101 | 101 | 101 | 101 |
|    Function keys | 12 | 12 | 12 | 12 | 12 |
|    Cable length (inches) | 72 | 75 | 72 | 60 | 98 |
| Mouse port | ❑ | ■ | ■ | ■ | ■ |
| **SOFTWARE** | | | | | |
| DOS | 4.01 ($150) | 4.01 (included) | 4.01 ($145) | 3.3 ($100), 4.01 ($150) | 4.01 ($150) |
| OS/2 | 1.1 ($340) | 1.2 ($295) | 1.2 ($295), Extended Edition 1.2 ($795) | 1.1 ($340) | Extended Edition 1.2 ($830) |
| Disk caching software | None | None | None | None | None |
| Expanded memory manager | None | None | *Reply* 1.0 (included) | MCEMM.SYS (included) | None |
| **MISCELLANEOUS** | | | | | |
| Coprocessor supported | 80387SX | 80387/16 | 80387SX | 80387SX | 80387SX/16 |
| Physical features: | | | | | |
|    Power supply (watts) | 175 | 145 | 200 | 111 | 250 |
|    Dual voltage | ■ | ■ | ■ | ■ | ■ |
|    Number of device connectors | 5 | 3 | 5 | 3 | 2 |
|    Keyboard lock | None | None | None | None | Side |
|    Case lock | Front | Back | Back | Back | Side |
|    Power-on switch | Front | Side | Front | Front | Front |
|    Reset switch | None | None | Front | None | None |
| Warranty | 1 year | 1 year | 1 year | 1 year | 1 year |
| Service | On-site | Return to dealer or manufacturer; on-site optional | On-site | Return to sales office or service center | Return to dealer or manufacturer |
| FCC certification class | B | A | B | B | A |

**PC**—Editor's Choice    ■—Yes    ❑—No

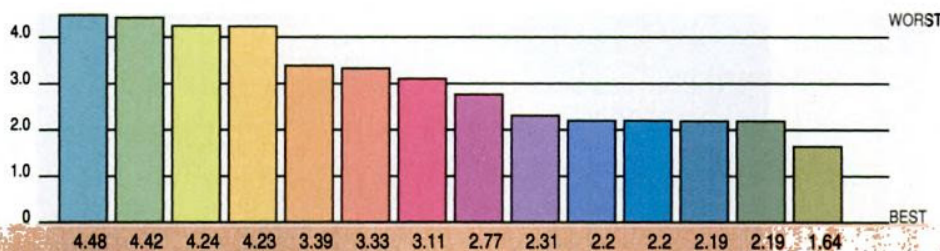| | | PC | | Memorex Telex Corp. | | |
|---|---|---|---|---|---|---|
| American Mitac Corp. **Mitac MPS3000F** | Tandy Corp. **Tandy 5000 MC** | Advanced Logic Research Inc. **ALR MicroFlex 3300** | Apricot in Canada Inc. **Apricot Qi PCi** | **Memorex Telex Intelligent 7270 Workstation** | Olivetti Office USA **Olivetti P800** | IBM Corp. **IBM PS/2 Model 70-A21** |
| 1.44MB | 1.44MB | 1.44MB | 1.44MB | 1.2MB, 1.44MB | 1.44MB | 1.44MB |
| Alps | TEAC | Toshiba | Sony | Panasonic, TEAC | NEC | Alps |
| 10 | 10 | 10 | 10 | 10 | 8 | 10 |
| Four 16-bit, two 32-bit | Three 16-bit, two 32-bit, two 32-bit proprietary | Four 16-bit, three 32-bit | Two 16-bit, two 32-bit | Four 16-bit, two 32-bit | Five 16-bit, three 32-bit | One 16-bit, two 32-bit |
| 4 | 3 | 4 | 3 | 4 | 7 | 3 |
| ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Motherboard | Motherboard | Card | Motherboard | Motherboard | Motherboard | Motherboard |
| 16-bit | 8-bit | 16-bit | 16-bit | 16-bit | 16-bit | 16-bit |
| Mitac | Tandy | ALR | Apricot | Mitac | Olivetti | IBM |
| Chips and Technologies | Intel | Chips and Technologies | Chips and Technologies | Chips and Technologies | Chips and Technologies | IBM |
| Chicony | Tandy/Fujitsu | Hi-Tek | Apricot | Hitec | Olivetti | IBM |
| 101 | 101 | 101 | 101 | 101 or 102 | 101 | 101 |
| 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 83 | 60 | 100 | 75 | 93 | 100 | 98 |
| ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 4.01 (included) | 3.3 ($100), 4.01 ($140) | 4.01 ($150) | 4.01 (included) | 4.01 ($130) | 4.01 (included) | 4.01 ($150) |
| None | 1.0 ($325) | None | 1.2 ($295) | 1.1 ($325) | 1.1 ($340) | Extended Edition 1.2 ($830) |
| None | None | None | None | None | None | None |
| Mitac MEMS (included) | None | None | None | None | QEMM-386 (included) | None |
| 80387, Weitek 3167 | 80387 | 80387, Weitek 3167 | 80387/25 | 80387, Weitek 3167 | 80387/25, Weitek 3167 | 80387/16, -/20, -/25 |
| 150 | 200 | 200 | 145 | 150 | 295 | 132 |
| ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 4 | 3 | 5 | 3 | 4 | 3 | 3 |
| Front | None | None | None | Front | None | Back |
| None | Front | None | Back | None | Back | Back |
| Front | Front | Top | Side | Front | Front | Front |
| Front | Front | None | None | Front | Front | None |
| 1 year | 1 year | 1 year | 1 year | 1 year | 1 year | 1 year |
| On-site | Return to dealer | Return to dealer | Return to dealer or manufacturer; on-site optional | On-site (90 days), then return to manufacturer | Return to dealer | Return to dealer or manufacturer |
| B | A | A | A | B | B | B |

ENDS

## PC LABS

# BENCHMARK TESTS: MCA COMPUTERS

Our tests continue to prove there is just no substitute for processor speed and processor RAM caching. The ALR MicroFlex 3300, a 33-MHz 386 machine, places among the top two on every test but the BIOS Disk Seek. Compared with similarly configured ISA-bus machines we have reviewed in the past, these systems are among the fastest.

**PROCESSOR AND MEMORY BENCHMARK TESTS**

## 80386 Instruction Mix
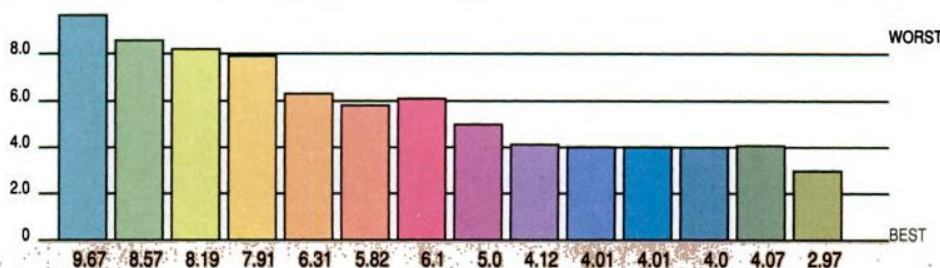*Elapsed Time (seconds)*

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

WORST / BEST

4.48  4.42  4.24  4.23  3.39  3.33  3.11  2.77  2.31  2.2  2.2  2.19  2.19  1.64

## Floating-Point Calculation Without Coprocessor
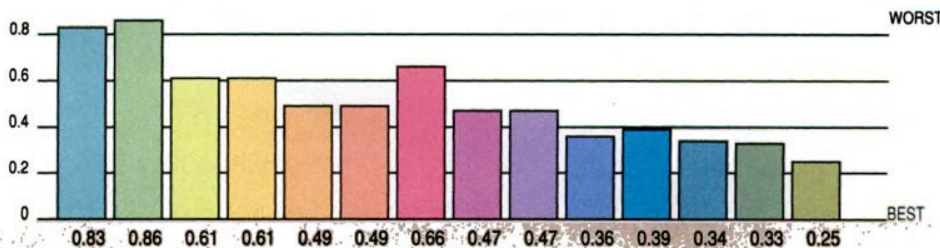*Elapsed Time (seconds)*

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

WORST / BEST

9.67  8.57  8.19  7.91  6.31  5.82  6.1  5.0  4.12  4.01  4.01  4.0  4.07  2.97

## Conventional Memory
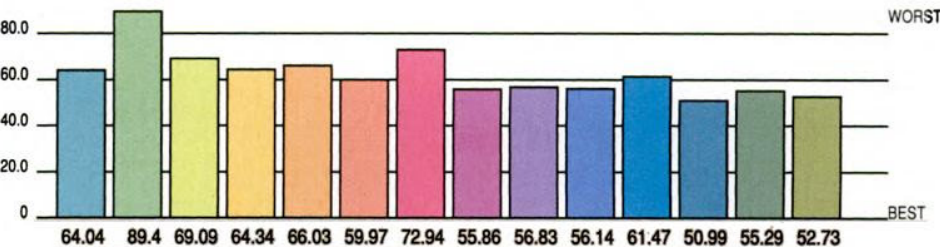*Elapsed Time (seconds)*

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

WORST / BEST

0.83  0.86  0.61  0.61  0.49  0.49  0.66  0.47  0.47  0.36  0.39  0.34  0.33  0.25

**DISK BENCHMARK TESTS**

## DOS File Access (Small Records)
*Elapsed Time (seconds)*

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

WORST / BEST

64.04  89.4  69.09  64.34  66.03  59.97  72.94  55.86  56.83  56.14  61.47  50.99  55.29  52.73

*Compaq Deskpro 386S (16-MHz 386SX)
IBM PS/2 Model 65SX (16-MHz 386SX)
Wang MC 350/16S (16-MHz 386SX)
Apricot Qi 300-80 (16-MHz 386SX)
Reply 386SX/20 (20-MHz 386SX)
NCR PC386sx/MC (20-MHz 386SX)
IBM PS/2 Model 70-A21 (20-MHz 386SX)
Tandy 5000 MC (20-MHz 386)
*Compaq Deskpro 386/25 (25-MHz 386)
Memorex Telex 7270 (25-MHz 386)
Mitac MPS3000F (25-MHz 386)
Apricot Qi PCi (25-MHz 386)
Olivetti P800 (25-MHz 386)
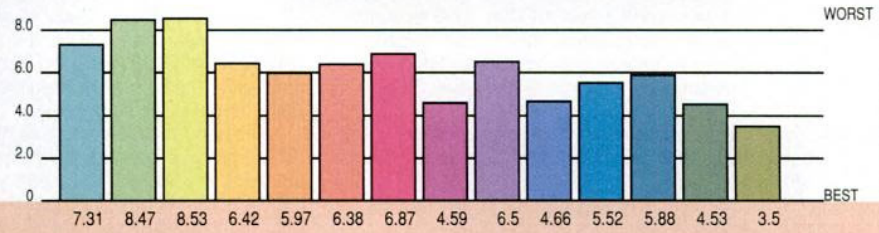ALR MicroFlex 3300 (33-MHz 386)

* Reported for comparison.

**DISK BENCHMARK TESTS**

## DOS File Access (Large Records)
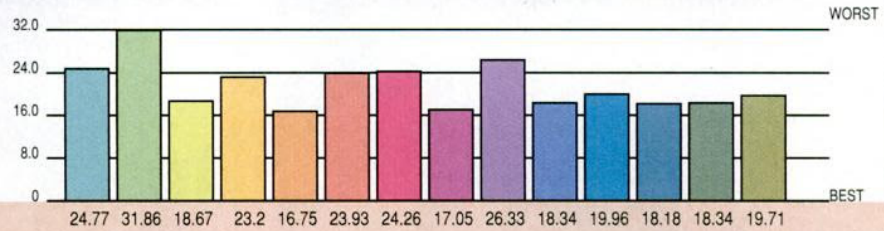Elapsed Time (seconds)

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching.

WORST — BEST

| 7.31 | 8.47 | 8.53 | 6.42 | 5.97 | 6.38 | 6.87 | 4.59 | 6.5 | 4.66 | 5.52 | 5.88 | 4.53 | 3.5 |

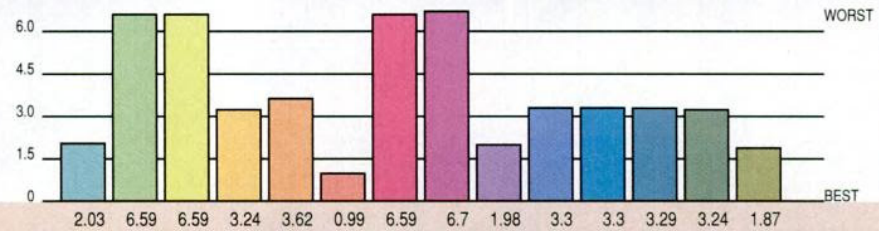## BIOS Disk Seek
Elapsed Time (milliseconds)

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

WORST — BEST

| 24.77 | 31.86 | 18.67 | 23.2 | 16.75 | 23.93 | 24.26 | 17.05 | 26.33 | 18.34 | 19.96 | 18.18 | 18.34 | 19.71 |

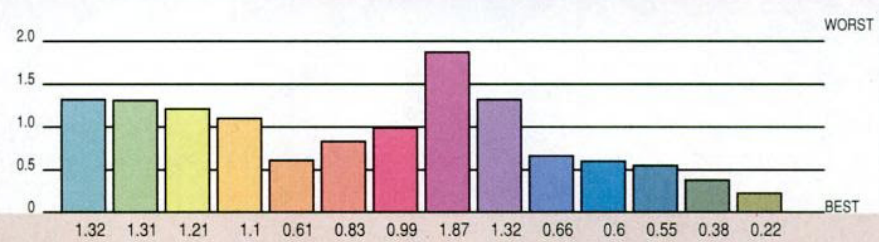**VIDEO BENCHMARK TESTS**

## Direct to Screen
Elapsed Time (seconds)

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.

WORST — BEST

| 2.03 | 6.59 | 6.59 | 3.24 | 3.62 | 0.99 | 6.59 | 6.7 | 1.98 | 3.3 | 3.3 | 3.29 | 3.24 | 1.87 |

## Video BIOS Routine Without Scrolling
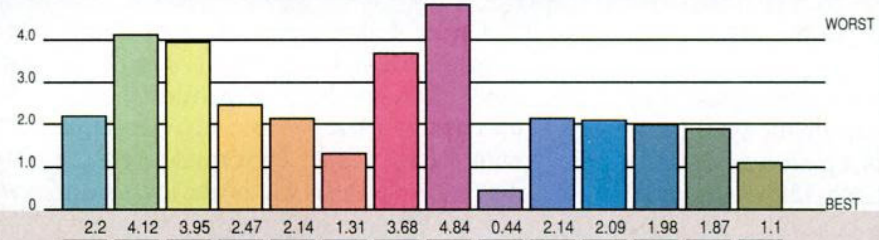Elapsed Time (seconds)

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

WORST — BEST

| 1.32 | 1.31 | 1.21 | 1.1 | 0.61 | 0.83 | 0.99 | 1.87 | 1.32 | 0.66 | 0.6 | 0.55 | 0.38 | 0.22 |

## Video BIOS Routine with Scrolling
Elapsed Time (seconds)

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

WORST — BEST

| 2.2 | 4.12 | 3.95 | 2.47 | 2.14 | 1.31 | 3.68 | 4.84 | 0.44 | 2.14 | 2.09 | 1.98 | 1.87 | 1.1 |

Computers tested:
- *Compaq Deskpro 386S (16-MHz 386SX)
- IBM PS/2 Model 65SX (16-MHz 386SX)
- Wang MC 350/16S (16-MHz 386SX)
- Apricot Qi 300-80 (16-MHz 386SX)
- Reply 386SX/20 (20-MHz 386SX)
- NCR PC386sx/MC (20-MHz 386SX)
- IBM PS/2 Model 70-A21 (20-MHz 386)
- Tandy 5000 MC (20-MHz 386)
- *Compaq Deskpro 386/25 (25-MHz 386)
- Memorex Telex 7270 (25-MHz 386)
- Mitac MPS3000F (25-MHz 386)
- Apricot Qi PCi (25-MHz 386)
- Olivetti P800 (25-MHz 386)
- ALR MicroFlex 3300 (33-MHz 386)

CONTINUES

# PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

PC Labs tested 12 MCA computers ranging from 16-MHz 386SXs to a 33-MHz 386. The scores for the Compaq Deskpro 386S and Compaq Deskpro 386/25 are also reported for comparison. We performed all the tests with buffers set at their defaults and the system and video BIOS enabled.
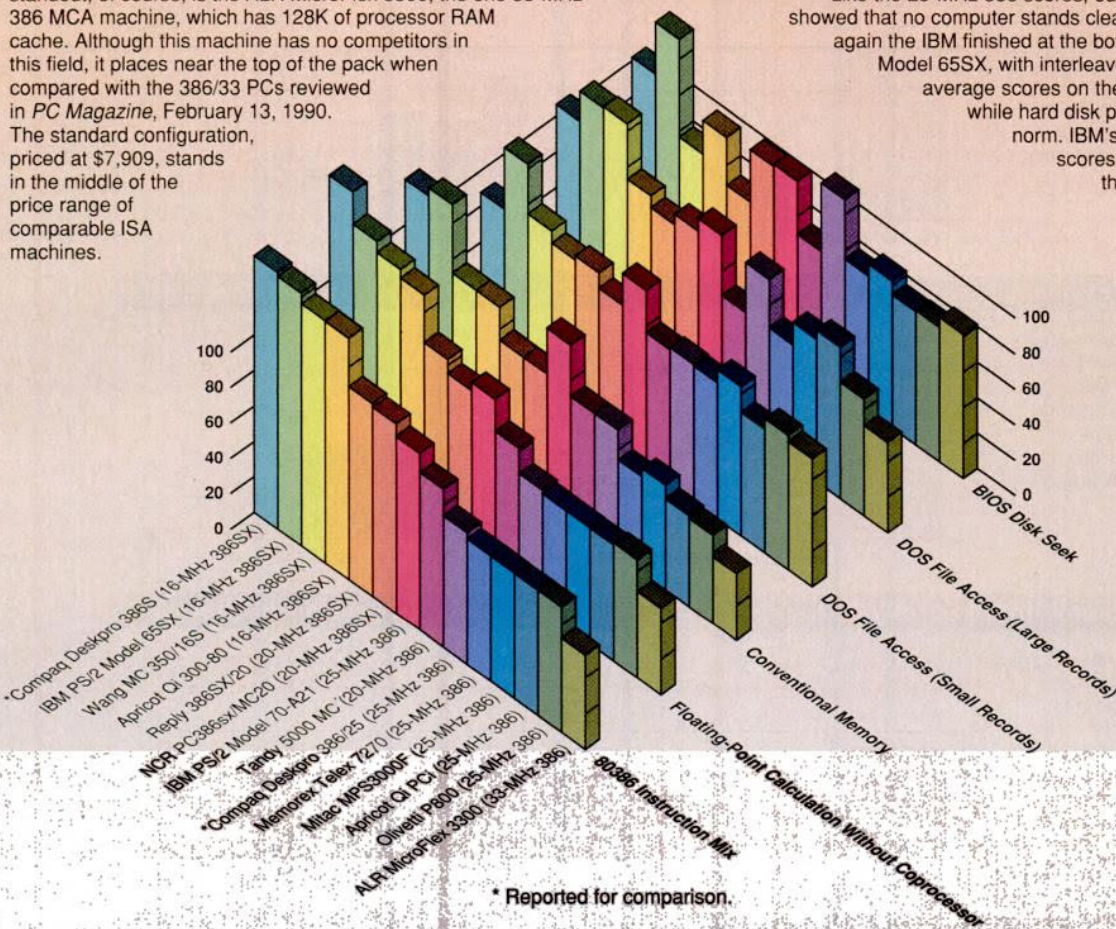
Since there are so few machines with each type of processor, comparing test results is difficult. But we can look back to previous issues of *PC Magazine* for additional data.

Most of these machines compare favorably with the best of the ISA machines we have tested previously. While we still cannot make any sweeping generalizations about MCA versus ISA, the scores show us that the MCA clone makers have concentrated on performance. The standout, of course, is the ALR MicroFlex 3300, the one 33-MHz 386 MCA machine, which has 128K of processor RAM cache. Although this machine has no competitors in this field, it places near the top of the pack when compared with the 386/33 PCs reviewed in *PC Magazine*, February 13, 1990. The standard configuration, priced at $7,909, stands in the middle of the price range of comparable ISA machines.

Among the 25-MHz 386s, all of the machines except the IBM PS/2 Model 70-A21 compare respectably with the 386/25 computers reviewed in *PC Magazine*, July 1990. Still, the Mitac MPS3000F's disk scores are less impressive than the 19-millisecond average access time for the NEC 100MB ESDI hard disk would suggest.

The performance of the IBM PS/2 Model 70-A21, a 25-MHz 386, reflects IBM's conservative stance on computing. Although it may be an industry standard, the Model 70-A21 barely surpassed the processor speed of the Reply 386SX/20, fell behind the floating-point performance of the NCR PC386sx/MC$_{20}$, and was toppled on both processor tests by the Tandy 5000 MC, a 20-MHz 386. Its performance was more on a par with the 16-MHz 386SXs on the memory and disk tests.

Like the 25-MHz 386 scores, our 16-MHz machines' test results showed that no computer stands clearly above the others—although again the IBM finished at the bottom of the pack. The IBM PS/2 Model 65SX, with interleaved memory, received below-average scores on the processor and memory tests, while hard disk performance fell far below the norm. IBM's 120MB SCSI hard disk turned in scores that were surprisingly close to the bottom even when compared with the inexpensive 386SXs reviewed in *PC Magazine*, August 1990.

**Relative Times**
(IBM PS/2 Model 70-A21 = 100)

* Reported for comparison.

---

slots plus one 16-bit slot with an 8514 extension.

A Chips and Technologies Super VGA chip set comes with the system, although the monitor is a plain-vanilla VGA unit. This chip set, the 32K cache, and Intel's 82385 cache controller are all on the motherboard, along with the floppy disk drive controller and I/O and mouse ports. This explains why five of the six slots on the tested unit were empty, leaving plenty of room for growth. The sixth slot was filled with a Western Digital ESDI controller card.

On PC Labs' processor and memory tests, the Memorex Telex 7270 turned in much the same level of performance as the other 25-MHz 386 systems, even those with a 64K cache. Performance on the disk and video tests was on the low side of average but not slow enough to become an issue. Most important, the system passed our compatibility tests without any problems.

### EMPHASIS ON SERVICE

Part of what makes the Memorex Telex 7270 worth considering is the company's

generous support policy. In an unusual approach to warranty service, the vendor has included in the system price your choice of either 90-day on-site service from Memorex or one year of carry-in service. For a meager $35 premium, you can opt for a warranty covering a full year of on-site service.
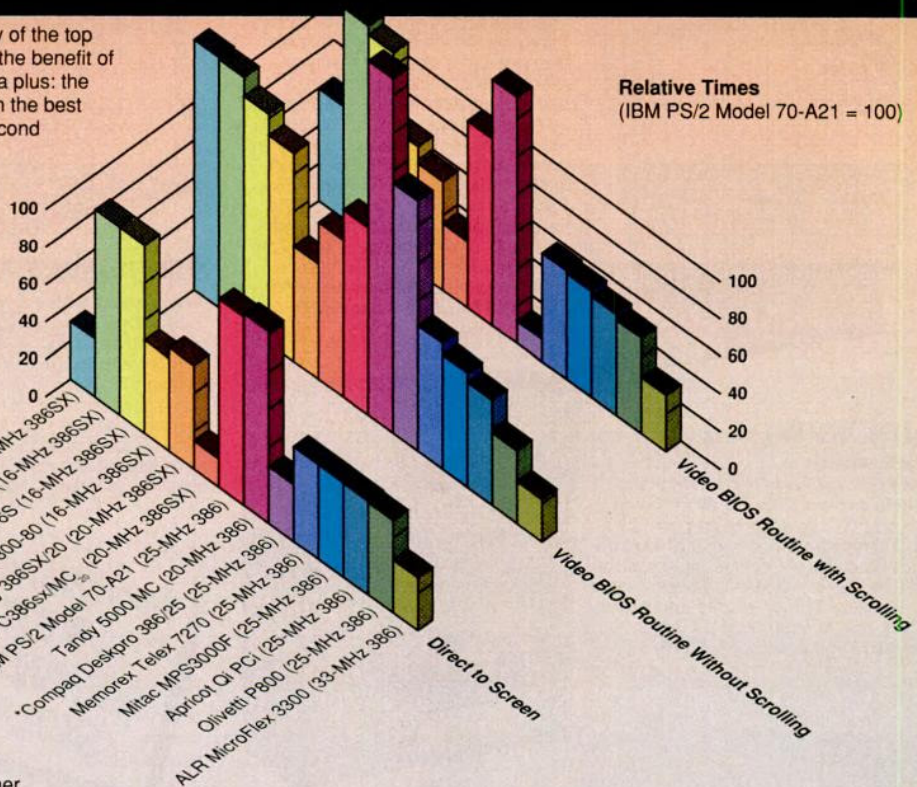
The company also has an 800 number for technical support, which is available 12 hours each business day. If you have on-site service and you run into a problem that you can't resolve over the phone, the customer support department will

**PC LABS**

Among the machines tested in this issue, many of the top performers on the video tests excelled without the benefit of video shadowing. But shadowing could still be a plus: the ALR MicroFlex 3300's video shadowing helped it turn in the best scores on both Video BIOS Routine tests and place second on the Direct to Screen test. The only machine that managed to best its 1.87-second score on that test was the NCR PC386sx/MC$_{20}$, which also had shadowing, and which chalked up a score of 0.99 seconds. This Super VGA machine also performed well on the Video BIOS tests, showing that NCR has really paid attention to video design on this unit.

The Olivetti P800 and the Apricot Qi PCi prove that among 386/25 machines, you don't need shadowing to have a video winner. Even without video shadowing, these systems managed to edge out the Mitac MPS3000F and the Memorex Telex 7270 Intelligent Workstation, both of which had shadowing enabled. The Apricot Qi 300-80, also without shadowing, turned in good performance in the 16-MHz SX class, with Video BIOS scores comparable to those of the Compaq Deskpro 386S, a reference machine known for its swift video performance.

As on the processor, memory, and disk benchmark tests, both IBMs failed to distinguish themselves on the video tests. These units, without shadowing, fared worse than any machines with comparable processors except the last-place Tandy 5000 MC. The Tandy's scores, in turn, were crippled by the use of an 8-bit rather than 16-bit video card.

**Relative Times**
(IBM PS/2 Model 70-A21 = 100)

* Reported for comparison.

ENDS

---

immediately order a service call. Memorex promises a response within 4 business hours for the vast majority of the United States, and next-day service for the rest of the country. This level of support is clearly a plus if you don't want to do your own troubleshooting and repair. Once the unit is out of warranty, you can extend the service contract if you like.
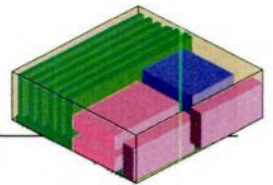
**COMPLETE SOLUTION**

Possibly more important than support issues is the company's determination to provide a complete solution for 3270 and LAN connectivity needs. Memorex Telex started out in the 3270 market and backed into personal computers because its terminal customers were looking for PC-based terminal emulation. The company's response was to zero in on the connectivity market and add LANs to the array of solutions.

Today, according to Memorex Telex, the direct sales force operates almost as a consulting team, custom-designing solutions for network users. If the solution involves peripheral or LAN options that Memorex does not normally handle, the company will obtain the hardware anyway. And the company will also supply on-site support through its usual channels.

Judged strictly by the price of the hardware, the Memorex Telex 7270 Intelligent Workstation is no match for its American Mitac counterpart. But if you really need responsive support and are willing to pay for it, you may decide that the Memorex Telex 7270 is worth the premium price.

## Mitac MPS3000F
**AMERICAN MITAC CORP.**
*by M. David Stone*

American Mitac Corp.'s 25-MHz Mitac MPS3000F is a good choice for anyone who doesn't want to give up a lot of desktop real estate; the small-footprint

## PERFORMANCE TESTS: MCA COMPUTERS

**Our performance tests show that both MCA system vendors and add-on board manufacturers are succeeding in making their equipment more compatible with each other.**

Until recently, owners of MCA clones complained about the lack of compatibility between the available add-on boards and the PCs themselves. Their complaints were valid: it was often impossible to get the various MCA vendors' configuration utilities to load the adapter description files (ADFs) that accompanied certain third-party boards. Even when it was possible, the boards did not always function properly.

That's why when we decided to review MCA machines, we knew it would be important to include our own compatibility tests. We knew it wouldn't be enough to tell

you whether we could install the boards in the machines correctly or not; to get at the truth, we had to put the equipment to use in real-world applications.

We chose add-in products from major LAN, tape-backup, and fax-board vendors, who generally have the facilities to test their products on a variety of MCA systems. This helped to insure that any compatibility problems that occurred would lie with the machines themselves, rather than with the files supplied by the add-in board manufacturers.

The results of our tests should be

welcomed by the many MCA users who formerly had cause to complain. The only two machines that failed any of the tests were the Tandy 5000 MC and the Wang MC 350/16S. Both were unable to load the ADF for the tape backup unit, preventing us from performing either tape backup test using them.

Overall, it seems as if clone vendors are working to make their machines conform better than ever to IBM's MCA spec, while add-in board manufacturers are doing a better job of testing and correcting bugs found in their ADFs.

machine measures just 6.25 by 14.75 by 16.5 inches. In fact, this system deserves to be considered by most users: no cut corners, no oversights, and no questionable design choices mar its performance.

Priced at $6,875, the test unit came with *PC Magazine*'s standard configuration: 4MB of RAM, a 23-millisecond 100MB NEC hard disk, a 3.5-inch high-density floppy disk drive, a Tatung VGA monitor bearing a Mitac label, and DOS 4.01. The base price of $4,995 includes only 1MB of RAM and leaves out the hard disk and monitor, but is otherwise identical to the tested configuration. Both prices include a one-year on-site warranty, with service provided by Bell Atlantic Business Systems Services.

As is typical of small-footprint systems, on the front panel you'll find the

power and reset switches as well as the keyboard lock. Inside the box is Mitac's own motherboard with an Intel chip set, a Phoenix BIOS, and a coprocessor socket for either an 80387 or a Weitek 3167. Also on the motherboard are four 1MB SIP chips, plus four empty SIP connectors. If you need more than 8MB of RAM, you'll have to add a memory board (two 32-bit slots are available). While Mitac does not sell such boards itself, the company says the system will work with any third-party board designed for the MCA bus.

**Perhaps the best compliment for the American Mitac is that it behaves just the way it should.**

The motherboard also has 32K of 25-nanosecond cache, handled through an Intel 82385 cache controller; this is both the minimum and maximum available for the system. PC Labs' benchmark tests suggest that 32K is sufficient, since the unit's performance on processor and memory tests is on a par with the other 25-MHz 386 MCA systems we tested, including machines with a 64K cache.

The floppy disk controller and the parallel, serial, mouse, and video ports are all on the motherboard. Interestingly, Mitac says that the motherboard's Chips

and Technologies video chip set offers Super VGA resolution, although only a VGA monitor was provided for review.

Of course, the key features on an MCA motherboard are the MCA slots. In addition to two 32-bit slots, the MPS3000F offers three standard 16-bit slots and one 16-bit slot with the 8514 extension. On the review unit, only one slot was filled—with an Adaptec ESDI controller—leaving plenty free for expansion.

### A NICE FIT

The bay arrangement on the MPS3000F manages to offer more storage space than you might expect from a small-footprint system. On the front of the chassis are two horizontal half-height 5.25-inch bays plus one vertical 3.5-inch bay on the extreme right. A second 3.5-inch bay for the hard disk is tucked away at the back of the system, directly in line with the front bay. The power supply is positioned slightly to the left, but not far enough over to interfere with the slot arrangement. The result looks as if you'd need a shoehorn to fit everything in, but it all fits quite nicely.

Beyond its good performance on our memory and processor tests, the MPS3000F was also on a par with other 25-MHz systems on PC Labs' disk and video benchmark tests. More important, it passed all our compatibility tests.

Perhaps the best compliment for the Mitac MPS3000F is that it behaves just the way it should. If you want a 386/25 with an MCA bus and you like the idea of a small-footprint design, the Mitac is a sensible choice.

### FACT FILE

**Mitac MPS3000F**
American Mitac Corp., 410 E. Plumeria Dr., San Jose, CA 95134; (800) 648-2287, (408) 432-1160.
**List Price:** With 1MB RAM, 32K processor RAM cache, 1.44MB 3.5-inch floppy disk drive, VGA support on motherboard (no monitor), one parallel and one serial port, mouse port, DOS 4.01, $4,995; with 4MB RAM, 100MB hard disk, VGA monitor, $6,875.
**In Short:** The Mitac MPS3000F offers 386-25 performance, a small-footprint design, and one more drive bay than you might expect. The system delivers just what it promises and is well worth a look.

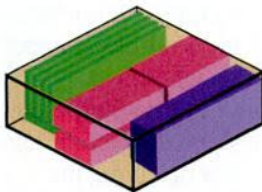CIRCLE **608** ON READER SERVICE CARD

**Local Area Network Tests.** On each MCA machine, we installed IBM's 16/4 Adapter/A, a Token-Ring adapter running at 4 megabits per second, and then attempted to log on to a local area network using Novell's *Advanced NetWare 286*, Version 2.15. If the attempt was successful, the machine passed the **Log-on** test. We then transferred a file from the local hard disk to the network server. If we were able to access the file, uncorrupted and in perfect condition, the machine passed the **File Transfer** test.

**Tape Backup Tests.** We installed a 2.2-gigabyte tape backup unit, The VAST Device from Emerald Systems Corp., on each system. We then backed up a file to that unit; if the operation proceeded without any problems, the computer passed the **Backup** test. Next we deleted the same file from the hard disk and restored the original file to the machine from the tape backup unit. If the file was uncorrupted when we accessed it again, the machine passed the **Restore** test.

**Fax Board Tests.** We installed an MCA board, the GammaFax CP from GammaLink, in each PC. We then sent a fax from the PC to a fax machine at the *PC Magazine* offices. If the transmission went well, the machine passed the **Send** test. We also sent a fax from our fax machine to the GammaLink board; if the transmission was successful, the system passed the **Receive** test.

| | LOCAL AREA NETWORK TESTS | | TAPE BACKUP TESTS | | FAX BOARD TESTS | |
|---|---|---|---|---|---|---|
| | Log-on | File Transfer | Backup | Restore | Send | Receive |
| ALR MicroFlex 3300 (33-MHz 386) | P | P | P | P | P | P |
| Apricot Qi 300-80 (16-MHz SX) | P | P | P | P | P | P |
| Apricot Qi PCi (25-MHz 386) | P | P | P | P | P | P |
| IBM PS/2 Model 65SX (16-MHz SX) | P | P | P | P | P | P |
| IBM PS/2 Model 70-A21 (25-MHz 386) | P | P | P | P | P | P |
| Memorex Telex 7270 Intelligent Workstation (25-MHz 386) | P | P | P | P | P | P |
| Mitac MPS3000F (25-MHz 386) | P | P | P | P | P | P |
| NCR PC386sx/MC$_{20}$ (20-MHz SX) | P | P | P | P | P | P |
| Olivetti P800 (25-MHz 386) | P | P | P | P | P | P |
| Reply 386SX/20 (20-MHz SX) | P | P | P | P | P | P |
| Tandy 5000 MC (20-MHz 386) | P | P | F | F | P | P |
| Wang MC 350/16S (16-MHz SX) | P | P | F | F | P | P |

## NCR PC386sx/MC$_{20}$

**NCR WORKSTATION PRODUCTS DIVISION**

*by Bill O'Brien*



The NCR PC386sx/MC$_{20}$ represents a near-milestone for a company whose PC prices are usually more in line with machines from other major players like Compaq and IBM. In *PC Magazine*'s standard configuration, including 2MB of RAM, a 44MB hard disk, 1.44MB 3.5-inch floppy disk, a VGA display, and DOS, this small-footprint system carries a $4,844 price tag. It's actually priced to compete with comparably equipped machines sold by smaller or less well-known vendors.

Unfortunately, the price doesn't remain in the moderate category for long. While the above quote gives you a fully configured system that's ready to go, upgrade costs can be painful. NCR charges $750 for each 2MB upgrade, and $1,695 for a 100MB hard disk. The tested configuration, with 8MB of RAM and the 100MB disk, sells for $7,794—nearly $700 more than a similar offering from Reply Corp.

On the face of things, the PC386sx/MC$_{20}$ is a rather plain box, with the power switch and case lock found on the front. Two one-third-height drive bays also adorn the front of the enclosure; in the review machine, one bay was filled by a 3.5-inch high-density floppy disk drive. The front-facing drive bays are part of a removable drive chassis that extends to the back of the machine. The rear section of the module contains an additional 3.5-inch bay, the mounting point for the hard disk. With the hard disk installed, there is room for only one more storage device.

The 100MB Conner hard disk is operated by a noncaching SCSI controller integrated onto the motherboard. The computer's disk is competitive with those on the other 20-MHz machines; PC Labs' benchmark test results show that while it runs slightly slower, it is still a good performer.

## WHAT'S INSIDE

The platform for the computer is an NCR motherboard that heavily employs surface-mount technology. Intelligence comes from the combination of an Intel chip set and a Phoenix BIOS. Four MCA slots are included; all are available because the essential video, disk, parallel, and serial I/O functions are integrated into the motherboard. The power supply is a Teapo device custom-designed for NCR and fitting neatly along the left side of the chassis. It's rated at 175 watts and should be durable enough for any collection of boards.

The chips that make up the machine's standard complement of 2MB of RAM are soldered onto the motherboard, and initial memory expansion beyond that level is achieved via three SIMM slots tucked under the speaker bracket. The machine NCR sent for review had all three slots filled, bringing the total memory to the motherboard maximum of 8MB. All of the chips were high-speed 70-nanosecond devices running at zero wait states without processor RAM cache. If you need to install further memory, you'll have to sacrifice an expansion slot and use one of the currently available Micro Channel architecture-compatible add-in memory boards.

The integral video system uses an NCR chip set to produce 800 by 600 Super VGA output, and ''super'' is definitely the correct name to apply to it. PC Labs' video benchmark tests peg it as one of the fastest video systems in any reviewed machine, second in overall performance only to the 33-MHz ALR MicroFlex 3300. The NCR video system is 16-bit, and video shadowing is permanently on to assist in providing near-stellar performance.
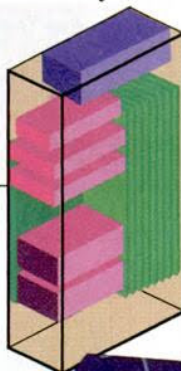
## CLAIM TO FAME

One of NCR's claims to fame, and the reason many users are willing to pay its higher prices, is its support. Its SX MCA machine comes with a full year of on-site service backed by the company. NCR's traditional customers—very often, large corporate bases—appreciate that level of service. They are also likely to appreciate the SX machine's upgrade options, and to be able to swallow the price for them. Other users with less money to burn, however, should be well pleased with the price of the PC386sx/MC$_{20}$ in its standard configuration. Provided they do not need the additional power the upgrades afford,

that version of this machine will make a reliable workstation for *Microsoft Windows.*

# Olivetti P800

**OLIVETTI OFFICE USA**
*by Bruce Brown*



The Olivetti P800 is a Micro Channel machine of considerable dimensions: its vertical case measures 22.5 by 8.5 by 27 inches (HWD). Its large size is well matched to its rather high price tag, and also to users who are interested in a file server for network and multiuser installations.

The standard-configuration price for this 25-MHz 80386 system is $11,475, including 4MB RAM, an 18-millisecond 135MB NEC hard disk, a 1.44MB or 1.2MB floppy disk drive, an Olivetti VGA monitor, a 101-key keyboard, memory management software, and DOS 4.01. The same system with a 300MB hard disk—the only other disk option—costs an additional $2,500.

The P800 uses Olivetti's own ROM BIOS and the common Chips and Technologies chip set on an Olivetti-made motherboard. Floppy disk drive controllers, VGA capabilities, I/O port circuitry, and a mouse port are all integrated onto the motherboard.

The motherboard can hold up to 8MB

of 80-nanosecond SIMMs. The system is able to handle a maximum of 40MB, and memory upgrades cost $1,595 per 4MB module; while this cost is higher than current street prices, it's lower than IBM's asking price. The machine comes equipped with a 64K RAM cache that uses 25-ns. SRAM chips, and it can accommodate an Intel 80387/25 math coprocessor or a Weitek 3167 coprocessor or both.

## A FORCEFUL PRESENCE

The P800's case is a monument to be reckoned with. The interface ports are on the top, covered by a metal panel. Each side panel comes off for access to the expansion slots or the bottom side of the motherboard. All these protective panels no doubt contribute to the system's FCC Class B rating.

Expansion room is admirable. The case can hold up to five half-height and two full-height drives. The optional $625 600VAC American Power Conversion standby power supply (SPS) plugs into Olivetti's 295-watt power supply. The battery in the SPS will keep the system running for approximately 10 minutes after a power failure. With Olivetti's standby software implemented, the computer monitors the battery level once the SPS takes over; when the battery voltage reaches a certain level, the software automatically saves open files and shuts the system down.

Altogether, there are eight expansion slots: three 32-bit and five 16-bit. In the test machine, the only occupied slot held the Western Digital ESDI hard disk controller.

Olivetti computers are sold through computer dealers; therefore, you can probably negotiate a significant discount
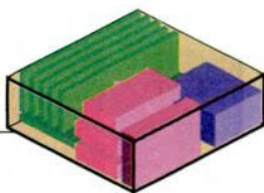
for the P800. Your first line of support is the dealer itself, but you also have access to Olivetti's toll-free support line. If you call Olivetti and the staff determines that you need on-site service, the company will send someone out to your installation site.

The size (not to mention the price) of the Olivetti P800 obviously provides a clue to its intended use—as a heavy-duty network or multiuser file server in heavy-workload sites. If that description dovetails with your particular needs, you may want to consider putting this system on your list.

# Reply 386SX/20

**REPLY CORP.**
*by Bill O'Brien*



Reply's MCA entry represents one of the new crop of turbo 386SX machines running at 20 MHz. The $5,335 price for *PC Magazine*'s standard configuration— 2MB of RAM, a 60MB hard disk, 3.5-inch floppy disk drive, VGA color display, and DOS 4.01—is competitive among its peers. While the Reply 386SX/20 is no barn-burner in terms of performance, it is a steady contender from a company that does well in the support and service arena.

The tested configuration, with 8MB of RAM and a 120MB hard disk, costs $7,105. Both the power switch and reset button are mounted on the front of the machine's case for easy access; no other controls are present on the face of the computer. Oddly enough, the case lock is located on the rear panel—which is trou-

blesome if you need to use it and your machine is up against the wall, but its location would be more bothersome if it were a keyboard lock.

Reply has carved out a 3.5-inch drive bay at the top edge of the front panel. This minor excavation allows you to install a 3.5-inch floppy disk drive without sacrificing either of the two half-height bays that are also included. Although the Reply 386SX/20 is a small-footprint machine measuring 5.5 by 14.2 by 16.5 inches, Reply has managed to mount an incredibly thin 3.5-inch IDE hard disk vertically along the right side of the chassis. In this configuration, a computer containing both hard and floppy disk drives still has two half-height bays available for expansion.

The drives and the 200-watt power supply occupy a third of the real estate from front to back along the right side of the chassis. Aside from this, you'll find vast areas of unused open space. The Reply 386SX/20 uses an active backplane with a 386SX processor board plugged into a proprietary slot. The backplane contains room for 8MB of SIMMs, five accessible 16-bit MCA slots, another dedicated MCA slot used solely for the cable that connects to the IDE controller, and all of the support chips needed to make the computer work. With the hard disk controller mounted on the disk itself, and the electronics for the 800 by 600 Super VGA video and parallel and serial ports originating on the motherboard, all five of the nondedicated 16-bit MCA slots remain vacant.

## RESPONSIVE SUPPORT

During the review process, Reply instituted a revised ROM BIOS and asked us to retrofit the review machine to reflect the product it is currently selling. The attempted upgrade was a dismal failure. With the new ROMs installed, the computer refused to boot or show any sign of life. A call to Reply's technical support service got us on-line with a technician who diagnosed and solved the problem in less than a minute, and that's not as common a happening among computer vendors as you might like. The problem stemmed from the fact that with the new ROMs, a jumper on the processor board needed to be removed temporarily to clear the CMOS of existing ADF (adapter description file) MCA device-driver information. Once this was cleared, the jumper
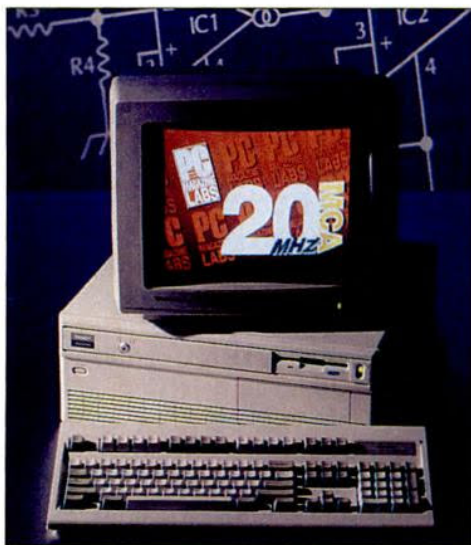
was replaced, the machine turned on, and all ADFs reinstalled.

While telephone support is Reply's first line of defense in maintaining its computers, it's not the only one. If your machine breaks down within the one-year warranty period, Reply will dispatch on-site service personnel to repair it. There's no extra cost for the service, nor are there any limits as to where the company will send its personnel.

The level of support you get, along with the machine's moderate pricing, competitive performance, and FCC Class B rating, make the Reply 386SX/20 capable of doing honorable duty in either the home or the office.

# Tandy 5000 MC

**TANDY CORP.**
*by Edward Mendelson*



The Tandy 5000 MC was the first non-IBM Micro Channel machine on the market. It should have been— but unfor-

**Tandy 5000 MC**
Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; (817) 390-3011.
**List Price:** With 2MB RAM, 1.44MB 3.5-inch floppy disk drive, one parallel and one serial port, mouse port, $3,999; with 4MB RAM, 150MB hard disk, VGA monitor, DOS 4.01, $7,628; with VGA monitor, $7,897.
**In Short:** Tandy's 20-MHz MCA entry has performance close to that of IBM's 20-MHz Model 70-121, but it failed one of PC Labs' compatibility tests. Five slots and two 5.25-inch drive bays give it more expansion room than the IBM.

tunately isn't—the computer that IBM's PS/2 Model 70-121 also should have been but unfortunately isn't. Each computer gets the basic idea right but may lack the features to make it the machine you need.

Like its IBM counterpart, Tandy Corp.'s system runs its 80386 CPU at 20 MHz. Unlike IBM, which offers three expansion slots, Tandy supplies five. And also unlike IBM, Tandy's case has room for 5.25-inch devices, including a hard disk or an optional 1.2MB floppy disk drive.

Tandy got right the expandability that IBM's more compact machine got wrong. But the Tandy 5000 MC doesn't fulfill MCA's promise of switchless installation and tool-free expansion, and it was one of two machines that didn't pass all of PC Labs' compatibility tests (Wang's was the other). At $7,628 for a system with 4MB of RAM, 32K of processor RAM cache, a 150MB ESDI hard disk, a 1.44MB floppy disk drive, a VGA monitor, and DOS 4.01, the 5000 MC is pricier than many other MCA computers, although you can get a stripped-down model with 2MB of RAM but no hard disk or monitor for $3,999.

Except for upgrades to the Phoenix BIOS, the 5000 MC hasn't changed since its release in late 1988. The base-priced model has a motherboard with a built-in floppy disk drive controller, 8-bit VGA, and parallel, serial, and mouse ports. You also get a 101-key keyboard with a positive feel but a lighter touch than IBM's model. The total price of PC Labs' test machine, including a 16-bit $430 Western Digital ESDI controller connected to a $1,999 150MB MiniScribe hard disk, plus the $629 VGM-300 VGA monitor, was $7,897. When it released this ma-

chine, Tandy told *PC Magazine* that it was working on having the 5000 MC upgraded from an FCC Class A certification to Class B. Two years later, the computer is still certified Class A.

From the outside, the 5000 MC looks like a taller version of the IBM PS/2 Model 70, with more switches and more drive bays. Arrayed across the front are a reset switch, a keylock, and a power switch. At the front right are bays for two 3.5-inch devices, one filled with the 1.44MB floppy disk drive. Below these are bays for two exposed or hidden half-height 5.25-inch devices.

**FIDDLING AROUND**
While PS/2s and many other MCA machines can be simple to open, Tandy makes you unpack a screwdriver to get inside the 5000 MC's case. There you'll see an unusual layout consisting of a motherboard mounted with its video circuitry, ports, floppy disk drive controller, five expansion slots, 32K of cache RAM with an Intel 82385 cache controller, and quite a few jumper wires and traces. The 80386 and optional 80387 are plugged into a separate CPU card; the standard 2MB of RAM sits on a memory card in a 32-bit dedicated slot. A second dedicated slot can hold another memory card, which also has a maximum capacity of 2MB of RAM. On our tested unit, this slot held the second 2MB RAM board, which is a $600 option.

Of the five MCA expansion slots, two are 32-bit and three are 16-bit. One of the latter has the video extension that IBM's 8514/A card uses.

You set up the 5000 MC with a reference disk that includes functions much like those on IBM's PS/2 reference disks. But unlike IBM, Tandy makes you fiddle with two sets of jumpers and 16 DIP switches if you want to add RAM using Tandy's proprietary memory cards. In PC Labs' compatibility tests, the machine worked successfully with all add-in boards except the Emerald City tape drive, which wouldn't install. The only other machine that failed this test was Wang Laboratories' MC 350/16S.
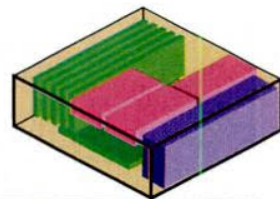
In PC Labs' benchmark tests, the 5000 MC performed among the better 20-MHz computers, although its video performance wasn't especially impressive. But in "*PC Magazine* Endurance Tests: 386s and Portables," (January 16, 1990), the

Tandy lost points for problems with its serial ports: The power-on self test reported a bad port when a serial port was linked to another computer by a cable, and the Tandy's expanded memory manager conflicted with the serial ports, resulting in time-out errors and other failures with file-transfer programs.

As for service, Tandy provides a one-year parts-and-labor warranty. If anything goes wrong with the system, you carry it back to the dealer (not too burdensome if it's your local Radio Shack Computer Center).

The 5000 MC doesn't offer the smooth compatibility and effortless installation that MCA promises. And if you compare it with classic-bus 20-MHz 386 machines, Tandy makes you pay a steep price for the still-questionable privilege of owning an MCA computer. The unit does offer more room for MCA expansion than its IBM counterpart does, but that's true of some better-designed systems as well.

## Wang MC 350/16S

**WANG LABORATORIES INC.**
*by Edward Mendelson*



Wang Laboratories' 16-MHz 386SX Micro Channel machine is almost everything this model of desktop computer should be. At $5,790 with 4MB of RAM, a 76MB hard disk, built-in 16-bit VGA card and monitor, and no RAM cache, it isn't cheap. Yet it's a compact and beautifully constructed piece of hardware, with room for more expansion cards than

you normally get in a machine measuring 5.4 by 18.4 by 14.4 inches.

With an Adaptec controller and 8MB of RAM, the price of the test system comes to $6,875. The basic configuration, with 2MB of RAM, a 1.44MB floppy disk drive, and keyboard, but no hard disk and no monitor, costs $2,995.

In addition to the standard 1.44MB disk drive, Wang's small desktop case includes a second exposed 3.5-inch drive bay, as well as the single internal 3.5-inch bay for the hard disk. If you want to add a 5.25-inch floppy disk drive, you'll need an external model. You get five 16-bit MCA slots, including one with the video extension you'll need for an 8514/A card. You'll need one slot for the hard disk controller, but parallel, serial, and mouse ports are on the motherboard.

Wang doesn't give you a confusing set of options when you buy this machine. You can get a fast Imprimis 3.5-inch 76MB MFM hard disk, a slower 40MB hard disk, or no disk at all. Wang will sell you an 80387SX coprocessor chip for $695. You can choose a 14-inch VGA monitor in monochrome or color. On either one you'll see the rather boxy screen font characteristic of the Chips and Technologies VGA chip set built into the motherboard.

### EASY EXPANSION

Installation and expansion are simple enough to live up to most of the promises made for MCA designs. You don't need a screwdriver to open the case; you don't even need the coin required to get into IBM's PS/2 cases. Twirling two thumbscrews will get you inside, where you're likely to be impressed by the elegant solidity of the Wang-built interior.

You add RAM via standard SIMM banks located not too conveniently under the floppy disk drives. The sockets accept up to four 2MB SIMMS rated at 100 nanoseconds or better, for a total motherboard capacity of 8MB, but you can add 8MB more via a standard MCA add-in card. To reach the SIMMs or the socket for a 387SX coprocessor chip, you have to lift off a shelf that holds the hard and floppy disk drives, but the manual illustrates and explains this simple task with exemplary clarity.

Although the setup disk allows you to install hardware effortlessly, software installation requires some manual labor with CONFIG.SYS and AUTOEXEC .BAT. The SMARTDRV disk cache in-

**PC MAGAZINE FACT FILE**

**Wang MC 350/16S**
Wang Laboratories Inc., One Industrial Ave., Lowell, MA 01851; (800) 835-9264, (508) 459-5000.
**List Price:** With 2MB RAM, 1.44MB 3.5-inch floppy disk drive, one parallel and one serial port, mouse port, $2,995; with 4MB RAM, 76MB hard disk, VGA monitor, DOS 3.3, $5,790; with 8MB RAM, mouse, $6,875.
**In Short:** Wang's 16-MHz 386SX Micro Channel machine is solidly constructed and reasonably priced, and it generously offers five expansion slots. But it failed one of PC Labs' compatibility tests and doesn't offer much room for additional storage.

CIRCLE **613** ON READER SERVICE CARD

stalls automatically, but you have to install the expanded memory driver by manually copying filenames. This is worth the effort, because the driver has a remarkably flexible set of options and runs in the OS/2 compatibility box. By the same token, the utilities that help control the keyboard and switch the VGA to CGA or Hercules-emulation modes do not install themselves automatically.

The Wang's front panel contains a power switch and the floppy disk drives, which display green and amber lights to show you whether they're reading a 720K or 1.44MB disk. The back panel holds the case lock and connectors, and you can also lock the keyboard via a password chosen during setup.

Wang offers one year of parts and labor service, available via any Wang sales office or authorized service dealer. While that kind of support policy is standard, you should note that the Wang MC 350/16S failed to install the Emerald City tape drive, although it passed all our other compatibility tests. It ranked among the slower machines in its class, but the differences among these machines are generally so slight that you should make a purchase decision based on features and quality rather than benchmark test results. If you're in the market for a compact machine with room for expansion cards, but you don't need much room for additional disks, Wang's MC350/16S deserves your attention. ■

**Bruce Brown, John C. Dvorak, Edward Mendelson, Bill O'Brien, Winn L. Rosch,** *and* **M. David Stone** *are contributing editors of PC Magazine.*

## Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

Computers certified by the FCC as meeting the Class B standard are less likely to cause interference to radio and TV reception than those that have been verified by the manufacturer or importer to the Class A standards. Only Class B certified computers may be advertised, sold, or leased for use in residences. A similar regulatory program applies in Canada.

Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.