

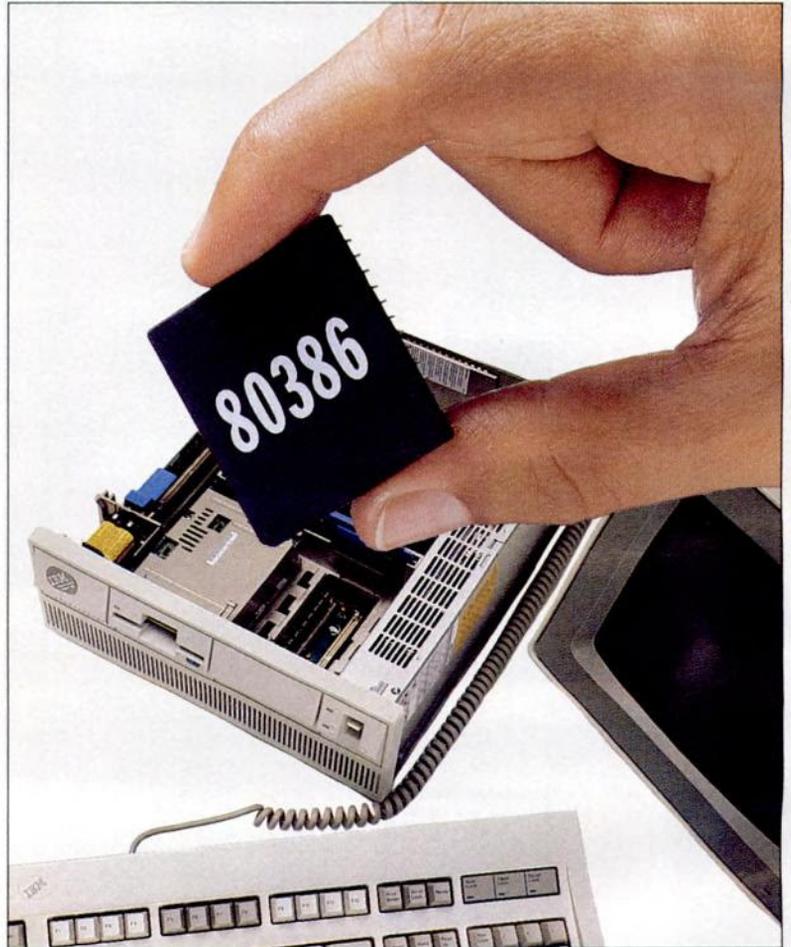
**THE
SIZE
IS
RIGHT**

PACKING

386

POWER

INTO SLEEK PCs



Photographs: Roberto Brosan

Desktop real estate is almost as valuable as Manhattan real estate. If your desk space is less than unlimited, the battle for a place on your desktop is fierce. Until recently, if you wanted a small-footprint model you had to choose from a selection of lower-performance ATs; if you wanted speed and performance, you got one of the many behemoth 386 powerhouses that took over most of your desk and pushed just about everything else onto the floor.

Prime performance and small footprint are no longer mutually exclusive. The most recent crop of small-footprint 386 machines lets you reclaim your desk without sacrificing the benefits of 386 power. We found seven brand-new entries—three 16-MHz, three 20-MHz, and one 25-MHz screamer, the second-fastest machine we've ever tested—that will take up only a fraction of the space your lethargic XT does. In addition, American Mitac and IDR both introduced 20-MHz small-footprint 386s this year.

These streamlined machines offer what most people will need in a desktop computer and are ideal for processor-intensive tasks like spreadsheets, computer-aided design and engineering, graphics, multiuser applications, and multitasking. Because these small-footprint PCs have 386 functionality, you won't be excluded from using 32-bit environments such as *Windows/386* or Unix and multitasking environments like Concurrent DOS 386 and

PC-MOS/386. And you'll see a big improvement in speed with the applications and environments you currently use in your day-to-day computing.

SIZING UP YOUR NEEDS What you do have to give up is expandability. Most of the small-footprint machines we have seen in PC Labs offer three or four slots once you have taken care of the expansion essentials (I/O, video, floppy/hard disk controller). And the number of drive bays usually limits you to three devices, restricting the amount of mass storage available. The question then becomes: Do these machines offer enough functionality for your needs?

If you're looking for a machine to act as a file server—which will require an immense hard disk or two, as well as an 80386 processor—it would be a good idea to look elsewhere. A floor-standing model, such as the ALR FlexCache 25386 (see First Looks, *PC Magazine*, September 13, 1988) would be the ideal solution to your cramped desktop, if a file server happens to reside there. The FlexCache has power and expandability to spare—it's designed to accommodate two full-height and three half-height drive bays and comes with eight expansion slots (two 8-bit, four 16-bit, and two 32-bit).

Many small-footprint machines have a single bay holding three half-height devices. With this configuration you'll need one bay for your floppy drive and a second for a hard disk (you can currently get about

Before sacrificing the open space rights to your desk, consider one of the new breed of small-footprint 386s that give you room to work and power to get the job done.

WORKING AT THE SPEED OF RAM

Hardware manufacturers struggle with physics and affordability to create faster machines with today's available technology.

How fast a given computer can process a problem is governed by three major factors: the clock speed of the computer, the number of wait states imposed on every memory cycle, and the electrical arrangement of the memory. These three factors are not independent, but they are all interrelated and are united by the same goal—helping a high-speed microprocessor cope with low-speed memory while sacrificing as little performance as possible.

Clock speed is the limit. The clock is really an oscillator, nearly always based on a crystal of quartz, beating a constant frequency that synchronizes the operation of all the logic elements inside the computer. Among other things, it determines how quickly the microprocessor cycles—that is, carries out each discrete logic operation on its way to solving a problem. Obviously, the higher the frequency of the clock, the faster the microprocessor will work.

In theory, an infinite clock speed would be best. With that, any finite problem could be solved in no time at all. Among the obstacles between reality and infinity is heat. Every time a microprocessor executes a processing cycle, it unavoidably generates heat. The rate at which the chip can radiate away this heat is limited, and accelerated operation of

the chip can generate heat faster than it can be radiated away. Excess heat builds up until the chip fails.

The heat-imposed limit on microprocessor clock speed, quantified as the chip's speed rating, is actually higher than the fastest speed at which most memory chips can operate. Memory chips are limited in their speed potential by their designs, with two different designs prevailing.

DRAM VS. SRAM CHIPS The most popular memory chips are termed DRAM (dynamic random access memory). They store information by charging up tiny capacitors. The charges have a tendency to drain away all by themselves, so the charges must be periodically refreshed. The term *dynamic* refers to this need for constant refreshing.

A more complex form of memory is called SRAM (static random access memory). SRAM chips store data bits in flip-flop latches, electronic switches that flip one way or the other and hold that setting until they are changed or power is removed. They do not require refreshing but are inherently more complicated and more expensive than DRAM chips.

Memory chips are rated in access time: the amount of time measured in nanoseconds required to pull a given bit

out of the chip (or to push one in). Access time, however, doesn't tell the whole story. Dynamic chips must be refreshed, and the time that takes must be cycled into the total time that is needed for each memory cycle. This cycle time can be two to three times longer than access time for dynamic memory chips. With static chips, which don't need refreshing, cycle time is identical to access time.

Figuring out the cycle time demanded by a memory chip is more complex than it may seem, because the microprocessor requires more than one clock cycle to make a memory access. As a practical matter, a 16-MHz 80386 requires DRAM chips rated at 70 to 80 nanoseconds. Such DRAM chips are fast but expensive.

WAIT-STATE FILLER To keep prices down, computer manufacturers try to use the least-expensive memory chips possible. Often they match slower chips to a fast microprocessor by slowing the microprocessor down. This is done by adding wait states.

Because the microprocessor accomplishes nothing during a wait state, system performance slows down. The addition of one wait state will increase each memory access from three to four cycles, slowing the system by 33 percent.

100MB of hard disk storage into a single half-height bay), leaving only one bay free. So you won't be able to equip your system with another floppy drive and a tape backup unit, or set it up with a full-height hard disk.

Assuming the number of drive bays is sufficient, you must then consider the availability of expansion slots. The machines reviewed here typically offer 6 to 8MB RAM on the system board; the exception is the Compaq Deskpro 386S, which allows up to 13MB RAM in a dedi-

cated memory slot. While 6 to 8MB RAM is considered more than enough memory for today's applications, it's a limiting factor in the long run. If you require more system memory, a memory-expansion card will have to appropriate one of your precious slots.

Today's typical business user will probably need a card for a modem, and a network or micro-to-mainframe card. That still leaves an extra slot (or two) to use for your individual computing needs—a fax board, CD-ROM, voice mail, or a high-

speed printer controller. If you're short on slots, you can plug an external modem into your COM port, but you end up with more clutter and an unsightly tangle of cables. External devices defeat the intention of a small-footprint computer, which is to remove extraneous computing equipment from your desktop.

THE FIRST CONTENDERS American Mitac and IDR were the first out with small-footprint 80386-based machines earlier this year; these were also among the

■ SMALL-FOOTPRINT 386 PCs

Width is the most important size consideration with a small-footprint machine. The machines reviewed here range from the IBM PS/2 Model 70's width of 14¼ inches to the Arche Rival 386's 17 inches, compared with the IBM PC AT's 21-inch width. Although the depth is also a factor in desktop size, it is not nearly as important as the width. And while the models we've reviewed take up less desk space, their keyboards are often wider than the system units.

In this story we look at the 16-MHz Amdek System/386, the 10/20-MHz Arche Rival 386, the 16-MHz Compaq Deskpro 386S, IBM's PS/2 Model 70 line-up of three 386 Micro Channel machines (16, 20, and 25 MHz), and the 20-MHz Normerel ATC-386. The manufacturers of these machines have taken different approaches to packing 386 power into a bantam box. As you examine the features of these machines, take note of the number of slots the motherboard saves. Does the system board include I/O ports, video, memory expansion potential, and floppy/hard disk controller? If the basics are on the motherboard, then three or four expansion slots will probably be enough. For instance, the Compaq Deskpro 386S starts out with only four slots, but none of these will be needed for the basics; VGA, memory expansion, hard disk controller, and I/O ports are designed onto the system board.

The reviews that follow prove the old adage—good things do come in small packages.—Catherine D. Miller

AMDEK CORP.

Amdek System/386

Talk to anyone at Amdek about the company's computer systems and the word *modularity* is bound to come up at some point in the conversation. Derived from Modular Systems Architecture (MSA), modularity is the "concept" behind Amdek's line of 8088, 80286, and 80386 desktops and workstations. This notion simply means building a box with a baseboard that provides enough 8- and 16-bit slots to allow an easy (and proprietary) upgrade and expansion path. Going from 286 to 386 computing or taking the system RAM from 2MB to 6MB is no more troublesome

AMDEK SYSTEM/386

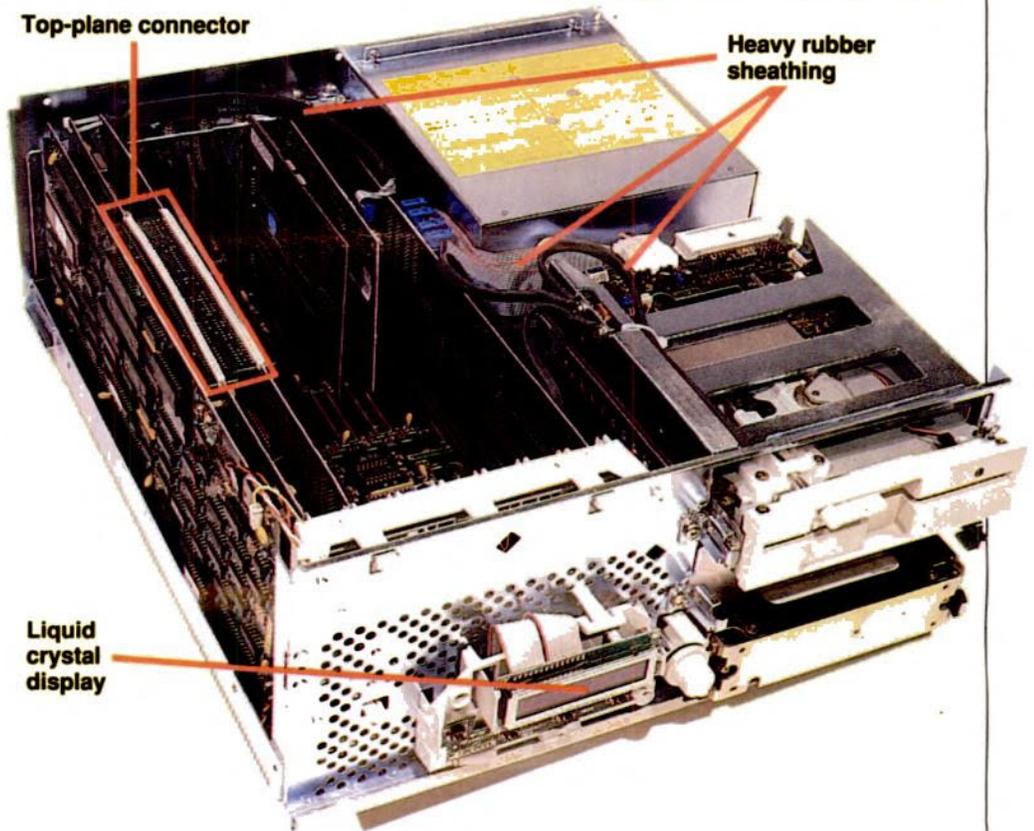
The \$6,020 Amdek System/386 runs at 16 MHz and comes with a 40MB hard disk, VGA monitor, and 1MB RAM. The computer features a **top-plane connector** that implements 32-bit processing, serving as a RAM bus extension between the system and memory boards. Note how one of the two 16-bit cards is connected to the top-plane connector from above rather than from below. The **heavy rubber sheathing** protects the cables from heat and shock. The **liquid crystal display (LCD)**, programmable to 16 characters, allows users to display time and date or any other message.



Top-plane connector

Heavy rubber sheathing

Liquid crystal display



than mounting a card and configuring your system to accept it.

Amdek, a company long known for its monitors and owned by Wyse Technologies since 1986, has laid out the guts of its 6¼- by 15- by 17-inch Amdek System/386 in an open, distinctively clean way that makes the most of its tight internal space. Inside you get zero-wait-state 16-MHz processing (switchable to 8MHz with 1 wait state), 1MB of 32-bit interleaved static column RAM (expandable to 2MB), two serial ports, one parallel port, six 16-bit slots, two 8-bit slots, a rack that holds

three half-height drives (a 1.2MB floppy with dual controller come standard), and a 190-watt power supply.

The designers of the System/386 have implemented a full 32-bit bus running at 16 MHz through the top-plane connector. This connector is a memory-only bridge, or RAM bus extension, between the system and memory boards. Up to two additional memory boards, holding 2MB each, can be added. The cards, mounted with 256K chips, don't come cheap, at \$1,695 each. However, boards are available without chips for \$395 (including an expanded

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top-plane connector) if you happen to have a cheaper source of memory chips than Amdek. A 2MB upgrade from Amdek will run \$695, so if you do it yourself, you can boost memory for \$1,090 a board. The company is working on an 8MB card mounted with 1MB SIMMs to be available this fall.

What Amdek calls the motherboard also has a piggyback daughtercard. Both occupy the two leftmost slots on the baseboard. Because of the vertical architecture of the small-footprint System/386, the term *motherboard* is really a misnomer—but that's just semantics. Its function as the system board is undeniable. It holds the 32-bit 80386 chip, sockets for a 10-MHz 80287 or 16-MHz 80387 math coprocessor, and a proprietary Phoenix ROM BIOS that has an expanded drive table for 50 drive types, including hard disks of up to 256MB. The daughtercard holds the display adapter jumper along with the battery and speaker connectors. The company is experimenting with Intel's 386SX chip, but Amdek is more likely to release system boards mounted with faster and (eventually) larger chips.

VERTICAL INTEGRATION Essentially all the components, with the exception of the Western Digital drive controller, Control Data fixed disk, Cherry keyboard and Mitsubishi floppy disk drive, are Wyse components. Even the power supply is Wyse. It's all part of another concept translated by the folks at Amdek as vertical integration. The principle: build all the elements, cut out the middleman, and deliver minus the markup. In the case of the System/386, the delivery comes from Taiwan,

where the machines are manufactured.

On the outside of the machine, the power switch and clock speed toggle are right up front. The face of the box also has an LCD panel—programmable for up to 16 characters—that serves as a handy display for the date and time. The AT-style keyboard is a mechanical keyswitch manufactured by Cherry and is the same unit shipped on all Wyse terminals.

Not surprisingly, the System/386 sent for review came configured with an Amdek MCGA/VGA-compatible monitor and video card mounted with the Tseng Labs chip set. The \$625 Amdek Monitor/732 is a 12-inch nonglare analog display with a maximum 640- by 480-pixel resolution in graphics mode and 720 by 400 in text mode. It's a quality monitor with crisp dot pitch and sharp colors. Coupled with the Amdek VGA Adapter/132 half-card, the Monitor/732 is compatible with IBM's VGA standard, but a slow performer on the PC Labs video tests.

The VGA Adapter/132 comes with drivers that let *Lotus 1-2-3*, *AutoCAD*, *GEM*, *Ventura Publisher*, and *Microsoft Windows* use 132-column screens. Although the *Windows* screen drivers are rated for *Windows/286* and *386*, Version 2.1 of the 386 program would not run past the installation setup screen. Technicians at Amdek investigated and advised that Tseng Labs will be making changes in the video BIOS to correct the problem. *Windows/286* runs without difficulty as does Release 2.0 of *1-2-3*, both at 132 columns and at the default column setting. Included with the drivers is a needed utility called FASTBIOS, which copies the VGA BIOS information into memory for faster access at RAM speeds. In many ways, this software utility is similar to the firmware shadow-RAM feature now found in many system ROM BIOS chips used by 386 manufacturers. While Amdek hasn't built it into its proprietary Phoenix chips, shadow RAM may become a part of future versions of its system BIOS chips.

Aside from the video utilities shipped with the tested System/386, there are several programs and utilities that come standard with the machine. This software includes the setup disk, LIM EMS and EEMS emulator software, and a disk defrager. Of note, the MS-DOS 3.2 supple-

mental disk has two utilities, CACHE and HELP, which enhance performance for day-to-day use.

By now, most PC users know the high value of memory-caching programs. There are many commercial programs out on the market, and nearly all manufacturers supply either utilities or disk caching controllers with their systems. Amdek's CACHE is a straightforward, easy-to-setup program. It directly reserves a portion of conventional or extended memory to hold copies of the contents of frequently accessed disk sectors. The parameters used with the command CACHE turn the cache on for the designated drives, set the cache's location, and specify the amount of memory to be dedicated. Once loaded (at 256K in extended memory), CACHE improved on an already hot performance on the PC Labs DOS File Access benchmark test by nearly 9 seconds.

HELP is a nice-touch utility that gives you on-line assistance with a variety of DOS commands, configuration statements, and special utilities. For example, if you don't know how to relocate the cache in extended memory above 1MB, just type HELP CACHE. A series of screens pops up, citing usage and syntax in



FACT FILE

Amdek System/386

Amdek Corp.
1901 Zanker Rd.
San Jose, CA 95112
(800) PC-AMDEK
(408) 436-8570

List Price: With 1MB RAM, 1.2MB floppy disk drive, \$3,850; with 40MB hard disk, \$4,950; 2MB RAM expansion card, \$1695; Amdek VGA Adapter/(CGA, EGA, VGA, extended VGA), \$445; Amdek Monitor/A732, \$625; OS/2 with LCD support and dual boot capability, \$325.

In Short: The Amdek System/386 is a smart buy for the private and corporate purchaser who's in the market for a small-footprint IBM compatible. Performance is right up there with the industry leaders. Both Amdek and its parent, Wyse, have been around for a while. They use reliable authorized dealers and are not likely to fade away. This computer is just one part of a systems-wide stable of personal computer products.

CIRCLE 685 ON READER SERVICE CARD



Benchmark Tests: Small-Footprint 386 Computers

Our roundup of small-footprint PCs includes both big names and new competitors. From IBM, PC Labs tested the trio of PS/2 Model 70s: the 16-MHz Model 70-E61, the 20-MHz Model 70-121, and the 25-MHz Model 70-A21. Compaq's entry, the Deskpro 386S, runs at 16 MHz and features the Intel 386SX microprocessor chip. Amdek, well known for monitors, produces the Amdek System/386, able to run at 8 and 16 MHz. The Arche Rival 386 is a 20-MHz machine, and Normerel's ATC-386 runs at a clock speed of 20 MHz.

Of the machines reviewed the IBM PS/2 Model 70-A21 was tops in the 80386 Instruction Mix, an indicator of processor speed. In addition to the fast clock speed, the 70-A21 has an 82385 cache controller card and uses a 64K static-RAM cache. Normerel's 20-MHz ATC-386 takes second place, optimizing its performance with memory interleaving and zero-wait-state operation. Third in line is the Arche Rival 386. Although the Arche doesn't have memory caching, its use of 100-nanosecond DRAM chips plus Phoenix's shadow RAM system and video BIOS make it a serious contender overall.

Running neck and neck with the Arche computer is the 20-MHz IBM PS/2 Model 70-121, with zero to two wait states. And the Amdek System/386 is no slouch, with optional zero-wait-state operation and a 16-MHz clock speed.

Those players appear in nearly the same order on the NOP and Floating-Point Calculation tests (where the IBM PS/2 Model 70-121 has moved up to second place). These tests measure clock and processor speed, so the enhancements mentioned above still help. The same expectation holds for the Conventional Memory test, where reads and writes are performed; a faster clock speed and fewer wait states produce better statistics.

The Extended Memory test scores seem to follow a different pattern. Particularly unusual is the Arche Rival 386, the machine that reported the slowest times. In response to our query, Arche attributed the slow times to the amount of overhead operation required when repeatedly switching from real to protected mode and back. The company is experimenting with a new BIOS to compensate for this phenomenon.

Those computers with software caching generally improved on their unenhanced times in the DOS File Access tests for small and large records, with the most dramatic results appearing on the small-record test. The Amdek System/386, Compaq Deskpro 386S, Normerel ATC-386, and IBM PS/2 Models 70-A21, 70-121, and 70-E61 all had software caching available.

Turning to the BIOS Disk Seek test, it becomes obvious that hard disks have still not caught up with the processors' enormous speed leaps. In fact, the Arche Rival 386, using a Seagate hard disk, was slower than the IBM PC AT. Normerel's ATC-386, with a faster SCSI hard drive, could not run the BIOS Disk Seek test, because SCSI technology doesn't use standard IBM BIOS calls.

Our video tests produced one clear winner: the Compaq Deskpro 386S. Compaq's 16-bit VGA controller and memory chips are on the system board, and the computer has proven its speed in previous *PC Magazine* video tests. The three IBM PS/2 Model 70s also had video capability on the system board, but didn't perform as well on the Direct to Screen test.

Processor Benchmark Tests

Disk Benchmark Tests

Performance Times

(Times given in seconds except where noted)

	NOP	80386 Instruction Mix	Floating- Point Calculation	Conven- tional Memory	Extended Memory	DOS File Access (small record)	DOS File Access (small record) with cache	DOS File Access (large record)	DOS File Access (large record) with cache	BIOS Disk Seek (milli- seconds)
IBM PC AT (8 MHz)	4.17	N/A*	35.60	0.77	11.62	72.63	N/A§	19.74	N/A§	29.20
Amdek System/386 (16 MHz)	2.11	3.87	14.94	0.76	9.34	48.00	36.93	17.53	17.38	27.42
Compaq Deskpro 386S (16 MHz)	2.09	4.48	17.37	0.77	2.60	62.86	37.54	7.54	6.97	24.72
IBM PS/2 Model 70-E61 (16 MHz)	2.09	4.11	16.14	0.77	3.05	78.08	43.89	9.05	8.32	28.64
Normerel ATC-386 (20 MHz)	1.69	3.15	12.86	0.59	2.56	74.15	73.65	14.97	14.69	N/A¶
Arche Rival 386 (20 MHz)	1.69	3.20	13.30	0.66	11.51	53.69	N/A§	17.58	N/A§	29.80
Compaq Deskpro 386/20 (20 MHz)	1.65	2.91	10.50	0.40	2.87	56.78	34.14	9.34	9.40	18.10
IBM PS/2 Model 70-121 (20 MHz)	1.65	3.24	12.69	0.60	2.09	71.16	39.62	6.54	6.49	23.60
IBM PS/2 Model 70-A21 (25 MHz)	1.34	2.25	8.34	0.28	1.68	71.49	38.69	6.53	6.49	23.44

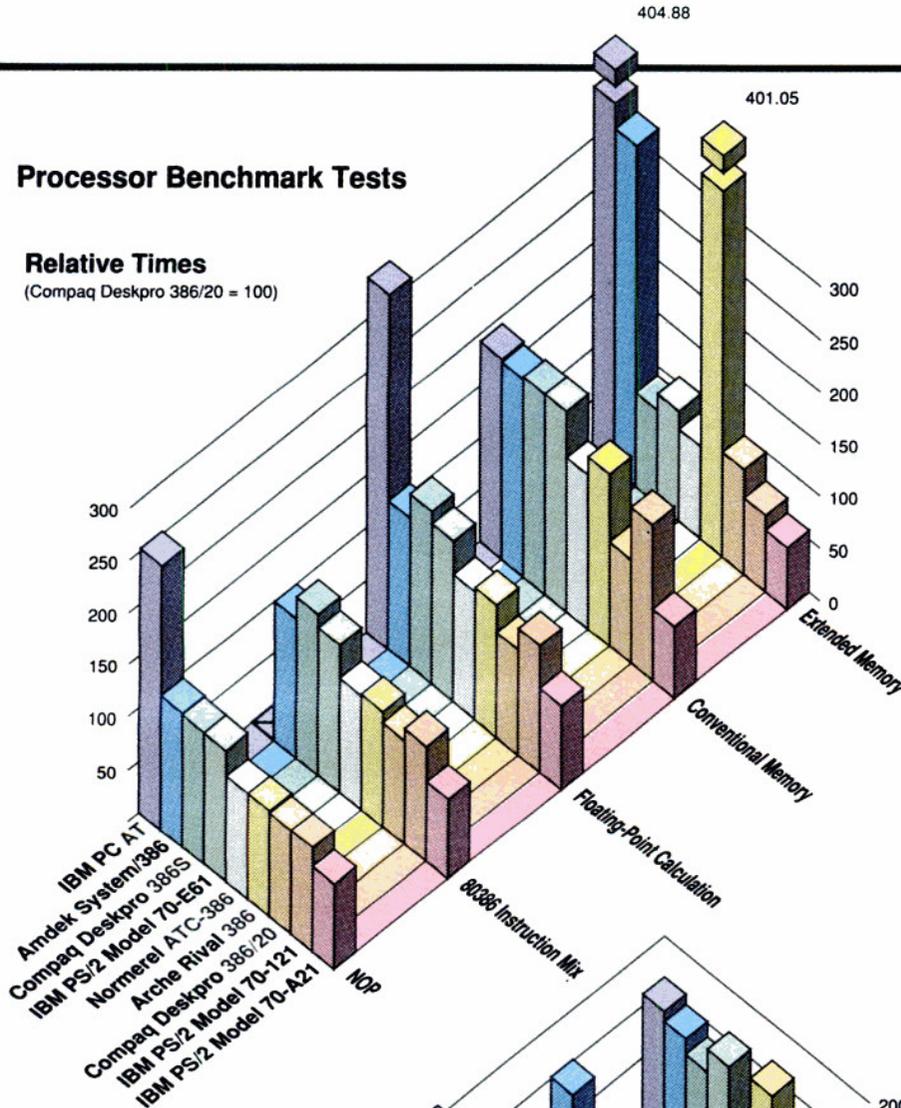
N/A*—Not applicable: the IBM PC AT is an 80286-based computer. N/A§—Not applicable: this computer has no disk caching.

N/A¶—Not applicable: the Normerel ATC-386 has an SCSI hard drive.

Processor Benchmark Tests

Relative Times

(Compaq Deskpro 386/20 = 100)



The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **Extended Memory** benchmark test allocates 256K of extended memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

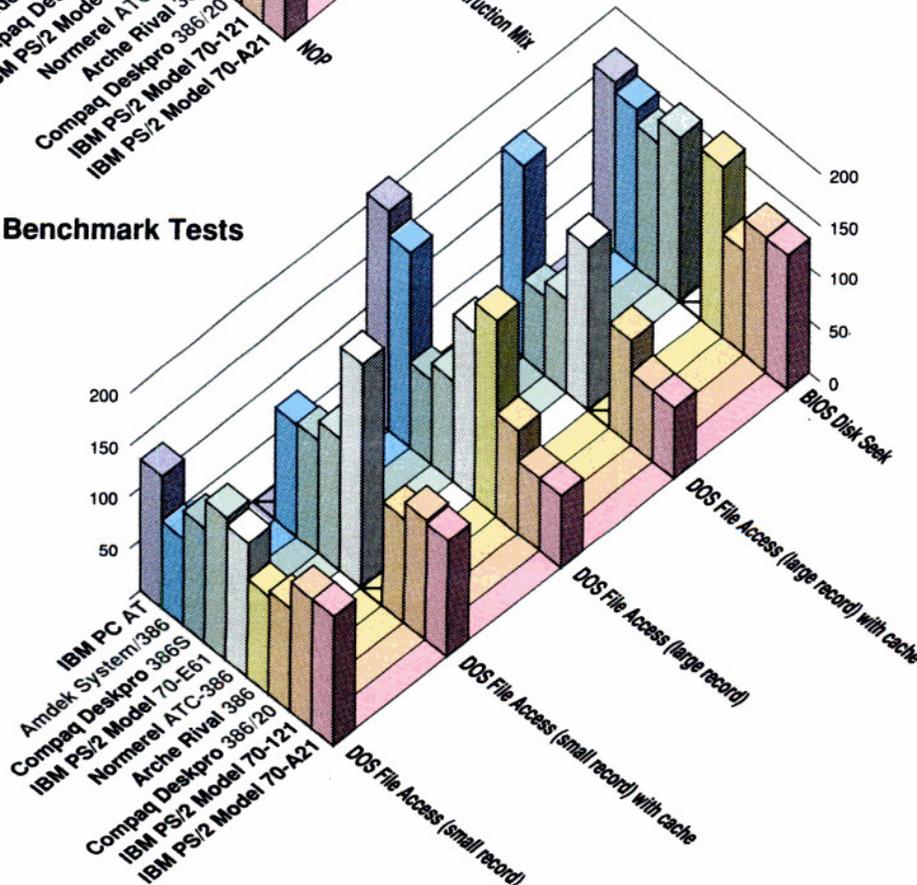
The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

If no disk caching software is supplied by the computer or disk drive manufacturer, each test is run once. Otherwise, the test for each record size is run twice: once with the caching software installed and once without it.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

Disk Benchmark Tests



(continues)



Benchmark Tests: Small-Footprint 386 Computers

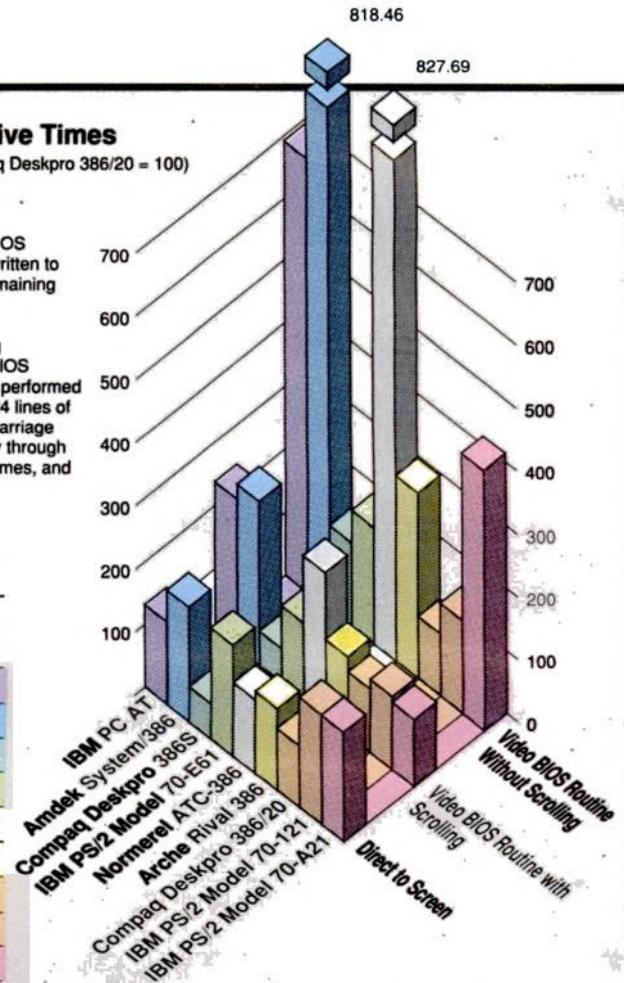
The **Direct to Screen** benchmark test measures the bandwidth of the video adapter by writing directly to the display memory buffer. The test is performed in video mode 3. The entire screen is updated using the assembly language REP STOSW instruction with register CX equal to 2000. This is done 1,000 times, and the result shown is the total of the 1,000 trials.

The **Video BIOS Routine with Scrolling** benchmark test measures the speed of the BIOS Teletype routine with scrolling. The test is performed in video mode 3. The screen is cleared and 240 lines of 60 characters each (including a terminating carriage return and line

feed) are written to the display through the BIOS Teletype routine. Although the first 24 lines written to the display do not involve scrolling, all the remaining lines scroll the display.

The **Video BIOS Routine Without Scrolling** benchmark test measures the speed of the BIOS Teletype routine without scrolling. The test is performed in video mode 3. The screen is cleared and 24 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. This is done ten times, and the result shown is the total of the ten trials.

Relative Times
(Compaq Deskpro 386/20 = 100)



Video Benchmark Tests

Performance Tests

(Times given in seconds)

	Direct to Screen	Video BIOS Routine with Scrolling	Video BIOS Routine Without Scrolling
IBM PC AT (8 MHz)	4.90	7.60	4.50
Amdek System/386 (16 MHz)	6.79	8.36	5.32
Compaq Deskpro 386S (16 MHz)	2.06	1.76	0.88
IBM PS/2 Model 70-E61 (16 MHz)	6.57	3.97	1.21
Nornerel ATC-386 (20 MHz)	4.34	7.42	5.38
Arche Rival 386 (20 MHz)	4.85	3.99	1.92
Compaq Deskpro 386/20 (20 MHz)	3.70	3.20	0.65
IBM PS/2 Model 70-121 (20 MHz)	6.54	3.71	0.97
IBM PS/2 Model 70-A21 (25 MHz)	6.53	3.43	2.69

the format of DOS manual pages. You may not use it much, but it'll be there when you need to do something really complicated like installing the VMEM.SYS with its correct parameters.

Across the board, the Amdek System/386 is a solid machine, aimed clearly at the desktop market. Aside from its slow video performance without the FAST-BIOS utility enabled, the machine held its own against the Compaq Deskpro 386S. For the price, it's competitive with any 386 out there.—Greg Pastrick

ARCHE TECHNOLOGIES INC.

Arche Rival 386

If you're thinking the name sounds familiar, you're right. The Arche Rival 286 earned an Editor's Choice in our review of nine AT-class computers in the July issue ("The Niche Factor: Nine ATs Compete for Market Share," *PC Magazine*, July 1988). Like its 286 cousin, the Rival 386 is a well-designed computer—this time

packing 20-MHz performance into an XT-size chassis.

Arche designs and manufactures all of its own components here in the United States. In fact, the heart of this machine is Arche's own motherboard design, the PAT386. Sporting a 20-MHz Intel 80386 microprocessor that is keyboard switchable between 10 and 20 MHz, this board uses the Chips and Technologies eight-chip VLSI circuit set and has eight expansion slots: two 32-bit, two 8-bit, and four 16-bit.

The motherboard itself has no on-board RAM and does not include any serial or parallel ports. One of the two 32-bit slots in the base system contains Arche's 32-bit memory card, configured with 2MB of two-way interleaved 100-nanosecond DRAM. The use of 100-ns. chips is surprising since the Rival 386 has no memory-caching capabilities. Many manufacturers of 20-MHz 80386 systems use chips rated at 85 ns. or better when a memory-caching technique is not employed.

Memory can ultimately be expanded to 16MB by filling both 32-bit slots with Arche's 8MB memory boards. (A trade-up plan for current owners of the 2MB board is in the works.) The Phoenix BIOS provided with the machine can be set to automatically move the system BIOS and EGA BIOS from slow 16-bit ROM into fast 32-bit RAM. The setup software that came with the system is disk-based and particularly easy to use.

CHANGEABLE COPROCESSORS

One interesting feature on the PAT386 is Arche's custom-designed PGA (pin grid array) socket which accepts either an 80287 or 80387 math coprocessor. Changing from one coprocessor to the other simply involves replacing the chip and changing one jumper.

The standard configuration of the Rival 386 comes with five of the eight slots occupied. While one of the 32-bit slots holds the 2MB memory card, an 8-bit slot is occupied by the standard monochrome

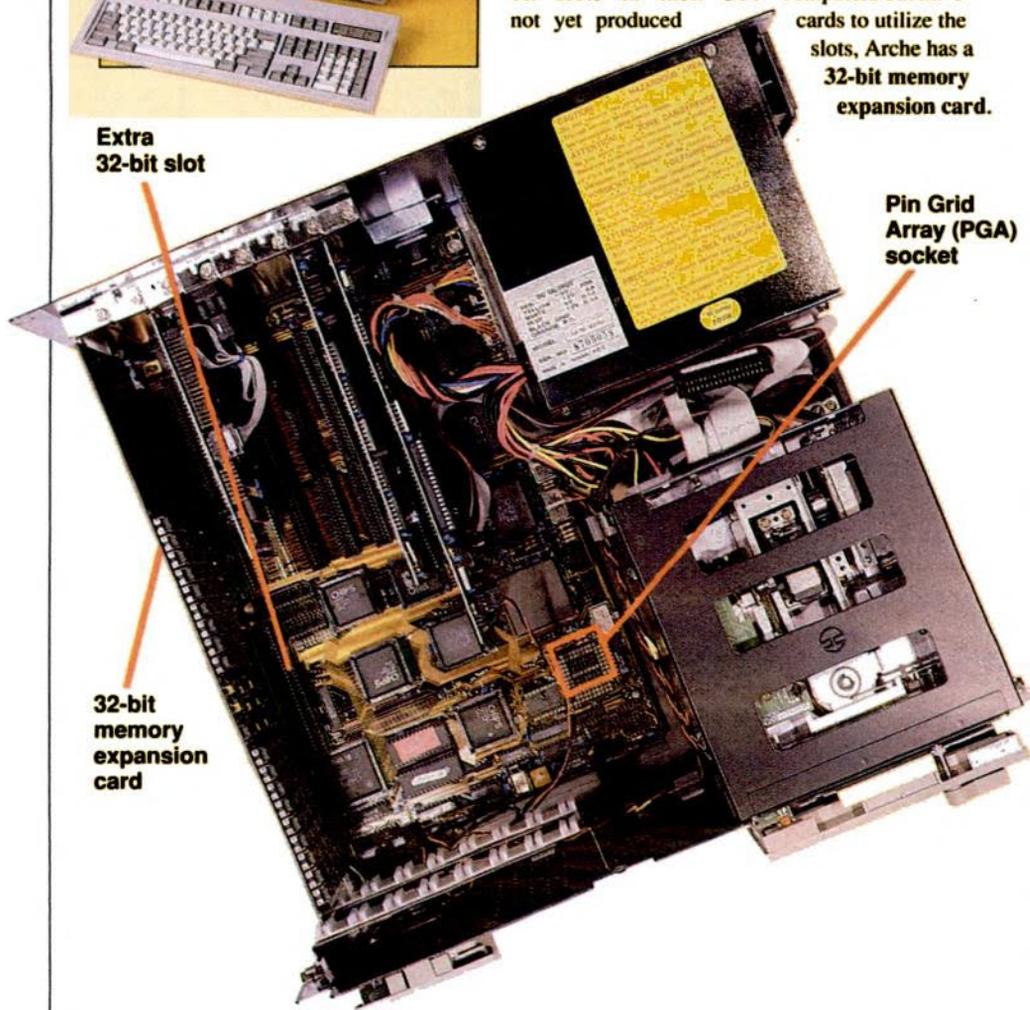
■ SMALL-FOOTPRINT 386 PCs



ARCHE RIVAL 386

The Arche Rival 386 is sluggish for a 20-MHz machine, but the \$5,190 price tag includes 2MB RAM, a 40MB hard disk, and a 14-inch monochrome monitor that comes standard even in the basic configuration. The combination Pin Grid Array (PGA)/DIP socket allows for the installation of either an 80287 or an 80387 math coprocessor. Unlike many other manufacturers, who provide 32-bit slots in their 386 computers but have not yet produced

cards to utilize the slots, Arche has a 32-bit memory expansion card.



Extra 32-bit slot

Pin Grid Array (PGA) socket

32-bit memory expansion card

graphics/parallel printer adapter, which is Hercules compatible. The standard monitor, furnished with the system even if you elect to buy a color monitor, is a very attractive 14-inch, high-resolution, flat-screen, amber display.

A second 8-bit slot is occupied by the Arche parallel/serial adapter, which provides a second parallel port as well as two serial ports. The second of these two serial ports extends via ribbon cable from the

card to occupy one of the other slot openings in the back of the case.

The Arche UDC disk controller card occupies one of the 16-bit slots and is capable of controlling four disk storage devices, although there is room for only three half-height devices in the drive bays.

The review unit contained a Teac 1.2MB floppy disk drive, an optional Seagate ST-251 40MB hard drive, and a Sony 1.44MB floppy disk drive (also optional).



FACT FILE

Arche Rival 386

Arche Technologies Inc.
48835 Kato Rd.
Fremont, CA 94539
(800) 422-4674

List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, 14-inch flat-screen amber display, \$4,395; with 14-inch paper-white flat-screen display, \$4,430; with EGA monitor and card, \$4,995; 2MB RAM expansion, \$1,221; 80387 coprocessor, \$875; 360K 5¼-inch floppy disk drive, \$139; 720K 3½-inch floppy disk drive, \$199; 1.44MB 3½-inch floppy disk drive, \$249; 28-ms. 40MB hard disk, \$795; 28-ms. 71MB hard disk, \$1,495; 28-ms. 95MB hard disk, \$1,795.

In Short: The Arche Rival 386's benchmark-test results may not leave other 20-MHz computers in the dust, but it's a well-priced competitor with two 32-bit slots, and ports to spare. The Rival 386 achieves a small footprint without sacrificing much expandability and boasts an extra-long 2-year limited warranty.

CIRCLE 684 ON READER SERVICE CARD

The Sony drive worked especially well in transferring files between the Arche and the IBM PS/2s in PC Labs. The 200-watt power supply is made by Sentron and has four device connectors.

Included in the base system price of \$4,395 are MS-DOS 3.3 and GW-BASIC. Arche does not currently offer its own version of OS/2 and has not determined whether the company will offer one in the future.

A VARIETY OF PORTS In most small-footprint machines, achieving the small size exacts a price. In most cases the number of expansion slots is cut and drive space is reduced, producing a machine with limited expandability. The Rival 386 comes standard with one 32-bit slot and two 16-bit slots available for expansion (actually three if you count the one slot whose connector opening is occupied by the second serial port), and room for three half-height devices. With two serial and two parallel ports as standard equipment, you won't find yourself "expanding" just to be able to run a mouse and modem together.

■ SMALL-FOOTPRINT 386 PCs

A nice touch regarding the serial ports is that one is a 9-pin AT-type while the other is the old XT-standard 25-pin connector. It's a handy bonus for those of us who have found ourselves with mismatched equipment. A DB9-to-DB25 converter is included in the box as well.

The Rival 386's XT-size cabinet, a space-saving 6 by 17 by 16.5 inches (HWD), is attractively designed. A reset switch on the front panel provides an easy escape from those situations in which even the old standby Ctrl-Alt-Del won't produce a warm boot. An LCD clearly shows the current clock speed.

The power switch is located in the back on the right side of the case, XT style. Currently the Rival 386 has only attained a Class A FCC rating, although Arche is working on the more rigorous Class B certification.

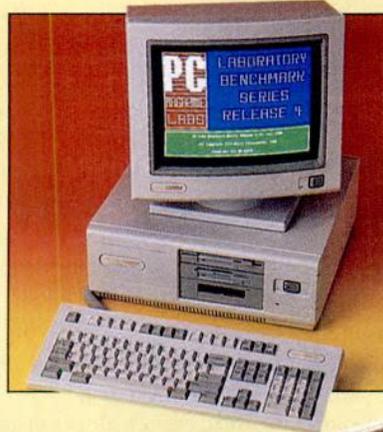
The documentation provided with the system consists of a user guide as well as several manuals covering each of the component boards installed in the system, such as the video adapter and disk controller. The user guide is well written, well illustrated, and tailored to the inexperienced purchaser. Arche's 2-year limited warranty is another welcome bonus.

While the Rival 386 didn't come out ahead of its fellow 20-MHz competitors in any of PC Labs benchmark tests, it didn't fare poorly either. Arche could speed up an already speedy 386 by using faster memory chips and incorporating a static RAM cache. And while this machine certainly won't compete with today's high-powered, tower-configuration file servers, it fares well as a high-speed workstation—and a small-footprint step into 386 technology.—**Salvatore P. Ricciardi**

COMPAQ COMPUTER CORP.

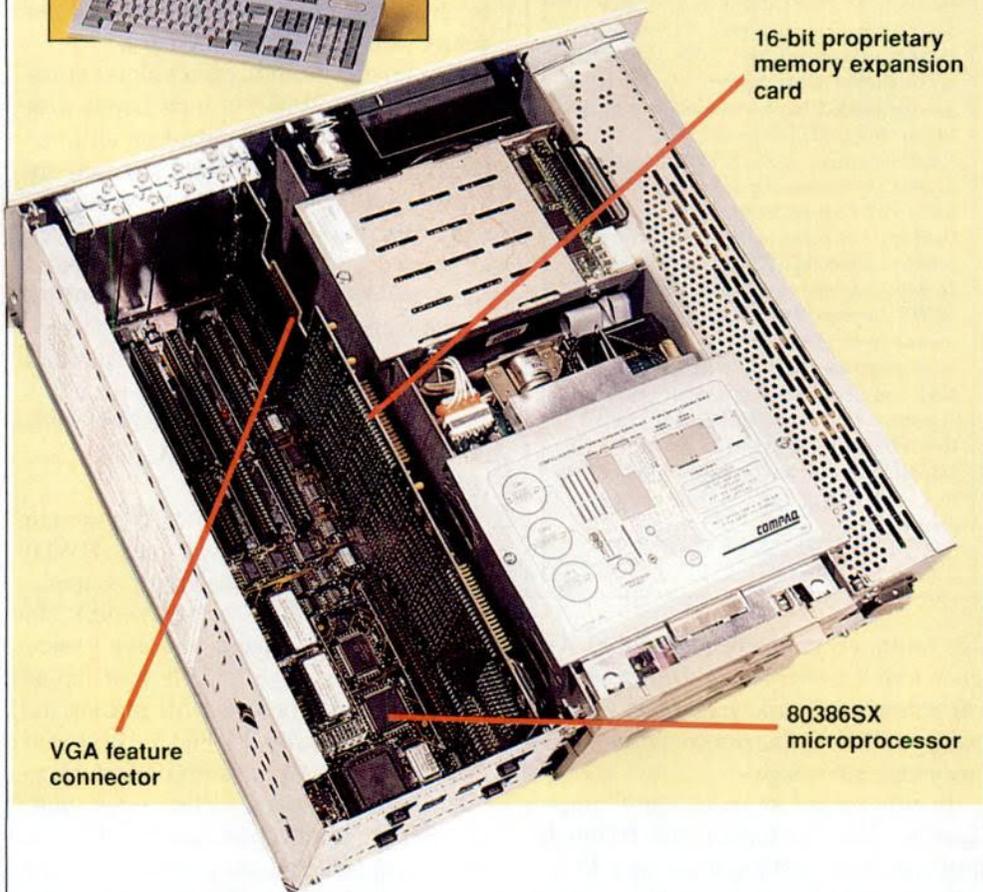
Compaq Deskpro 386S

With its recent introduction of two new 386 computers—the Deskpro 386/25 and Deskpro 386S—Compaq Computer Corp. declared that it was widening the range of 386 technology, not just advancing it. No doubt that's true: the 386/25, along with a number of other lightning-fast 25-MHz machines, redefines the upper limit of PC speed—at least for now; the small-footprint 16-MHz 386S, the first and, to date,



COMPAQ DESKPRO 386S

Based on the 80386SX chip, the 16-MHz Compaq Deskpro 386S sells for \$5,898 with 1MB RAM, 40MB hard disk, and VGA monitor. In addition to up to 13MB of RAM, the 16-bit proprietary memory expansion card includes the VGA feature connector. The 80386SX microprocessor provides performance comparable to that of a 386, while allowing a price only slightly higher than what Compaq charges for 286 models.



16-bit proprietary memory expansion card

VGA feature connector

80386SX microprocessor

only PC based on the new 16-bit Intel 80386SX microprocessor chip, reestablishes the midrange of processing power by offering 32-bit functionality at a 286 price. It's the latter machine that you can't afford to overlook if you think your budget precludes the purchase of an 80386-based machine.

Priced at \$3,799 (\$4,499 with a 20MB hard disk; \$5,199 with a 40MB hard disk), the Deskpro 386S features 32-bit internal operation and 16-bit external operation; it processes data at 32 bits per CPU cycle and supports 16-bit memory expansion and an 8-/16-bit expansion bus. The machine

competes head-to-head with IBM's small-footprint 10-MHz PS/2 Model 50 and Dell's 20-MHz System 220. In terms of performance, the 386S blows away the notoriously slow Model 50 on all of the PC Labs benchmark tests but can't catch up with the sleek and considerably cheaper System 220 on several tests. (To compare the actual test results for those machines, see John Dickinson's article, "Compaq's 386S: Less Is More," *PC Magazine*, August 1988.) You may get faster performance from the Dell System 220 or similar AT-compatibles than you will from the Deskpro 386S, but because you won't be



FACT FILE

Compaq Deskpro 386S

Compaq Computer Corp.
20555 FM 149
Houston, TX 77070
(713) 370-0670

List Price: Model 1, with 1MB RAM, 1.2MB floppy disk drive, Compaq Enhanced Keyboard, \$3,799; Model 20, with 20MB hard disk, \$4,499; Model 40, with 40MB hard disk, \$5,199; 1MB memory module, \$799; 4MB memory module, \$2,999; 1MB memory expansion board, \$799; 4MB memory expansion board, \$2,999; VGA monitor (no card needed; basic configuration supports VGA), \$699; 80387 coprocessor, \$799; 40MB tape drive, \$799; 135MB tape drive, \$1,999; asynchronous parallel printer board, \$149; 110MB hard drive, \$3,499.

In Short: Marketed as a more powerful alternative to 286 computers, this small-footprint 16-MHz machine based on the new Intel 386SX microprocessor features 32-bit internal and 16-bit external operations, built-in VGA graphics, four full-length expansion slots, and an additional proprietary memory-expansion slot for boosting RAM to 13MB. Its intelligent and economical design, host of standard features, and good performance make the Deskpro 386S an ideal midrange choice.

CIRCLE 683 ON READER SERVICE CARD

able to run programs like *Microsoft Windows/386*, *Quarterdeck's DESQview*, or *VM/386* to multitask your DOS applications, you'll be losing out on the 386 chip's processing advantage.

In this round of tests, the Compaq Deskpro 386S performed the 80386 Instruction Mix benchmark test in 4.47 seconds, executing a series of processor-intensive tasks approximately 2 seconds slower than the 25-MHz IBM Model 70, the fastest small-footprint 386 machine that we evaluated. The 40MB Connor ESDI disk drive that came with our evaluation unit completed the BIOS Disk Seek test in 24.72 milliseconds, besting its own rated access time by 4 milliseconds. (Connor also manufactures the Compaq Portable 386's hard disk drive, which has garnered a good reputation for both strong performance and reliability.) The unit finished the DOS File Access (small record) benchmark test in 62.85 seconds without using Compaq's disk-caching software,

and in 39.24 seconds with caching.

The Deskpro 386S's host of standard features and four full-length, 16-bit expansion slots mean that you won't have to give up functionality to discover anew the surface of your desk: Compaq has been able to find room in the 386S's 5.9- by 15.8- by 14.8-inch (HWD) system unit for just about anything you could want. Whether you choose the 20MB or 40MB model or decide to buy the diskless unit and add to it an optional 110MB drive (\$3,499), you'll be able to use one of two one-third-height device slots for a second hard disk.

Occupying the third device slot is a one-third-height 1.2MB 5¼-inch floppy disk drive, which comes standard on all three Deskpro 386S models. Also standard are 1MB of 100-nanosecond RAM on the system board, the Compaq 101-key enhanced keyboard, and the Compaq Expanded Memory Manager, which is a device driver that controls LIM 4.0 expanded memory and applications that use expanded memory. Other storage options include a 1.44MB 3½-inch disk drive (\$245) and a 40MB (\$799) or 135MB (\$1,999) tape backup unit.

In theory, the Deskpro 386S's system unit and 1.7- by 18.5- by 7-inch (HWD) keyboard are small enough to sit on the L-shaped return of a secretary's desk. In practice, though, unless you don't mind balancing your keyboard on your lap as you type, you'll be better off placing the unit on your desktop. I found the keyboard to be responsive, solid, and comfortable to use. On the rear panel of the system unit, you'll find a parallel port, serial port, and a PS/2-compatible mouse port, all of which are identified by icons. Compaq also chose to place a security lock on the back panel—a less than accessible spot.

SLOT-SAVING DAUGHTERBOARDS

Right out of the box the Deskpro 386S is set to run VGA, making use of a 16-bit VGA daughterboard that is based on the Paradise chip set. You won't find a VGA Feature Connector on the daughterboard. Instead, it resides on Compaq's proprietary memory expansion card, an add-in board that, in increments of 1MB and 4MB, can bring your RAM up to 13MB. Both the VGA daughterboard and the proprietary memory expansion card are slot

savers: you won't have to give up an expansion slot to get VGA's high resolution and brilliant palette or to get the extra RAM you'll need to run OS/2. Instead, you can use the four slots to expand your system, adding to it, say, a network card and a scanner card, while still keeping two slots free for more additions. Unlike AT-class machines, which use 220-watt power supplies, the Deskpro 386S uses a 140-watt power supply, which should be adequate for powering up a fully configured machine.

The Deskpro 386S's system board, which houses a Toshiba hard disk controller, a Zylog floppy disk controller, and an Intel keyboard controller, also exemplifies thoughtful engineering and economy of design. The board uses surface-mount technology, which makes for efficient layout of components and aids in heat dissipation. All input/output functions are built into the system board, which can also play host to an optional 16-MHz Intel 80387SX coprocessor (\$799).

From surface-mount technology to a modular means of expanding memory, the Compaq 386S uses many clever methods to save space but makes no sacrifices in the way of standard features. Its intelligent design, expandability, and good performance show that you don't have to trade functionality for desktop real estate.

—Robbin Juris

IBM CORP.

**IBM PS/2 Model 70-E61
(16 MHz)**

**IBM PS/2 Model 70-121
(20 MHz)**

**IBM PS/2 Model 70-A21
(25 MHz)**

IBM's most recent additions to the PS/2 product line bring 386 power to your desktop in a package small enough to leave you a lot of desk for other pursuits. In fact, the Model 70 lineup packs all this 386 power in a case the size of the Model 50—5½ by 14¼ by 16½ inches (HWD)—making the Model 70 one of the smallest of the small-footprint 386 machines reviewed here. And at 21 pounds, the Model 70 is lighter than some luggables.

■ SMALL-FOOTPRINT 386 PCs

There are three variations of the IBM PS/2 Model 70, each running at a different clock speed: the Model 70-A21, \$11,295, races at 25 MHz; the Model 70-121, \$7,995, runs at 20 MHz; and the Model 70-E61, \$5,995, cruises along at 16 MHz. As you might expect, as the processor speed increases, so does the number of features.

The high-end Model 70-A21 is a marvel of clever engineering and design, starting with the two-tiered system board de-

The PS/2 Model 70 packs 386 power in a case the size of a Model 50, making it one of the smallest 386 machines around. At 21 pounds, it's lighter than some luggables.

sign—the key to packing so much power into such a small box. On the main system board, covering most of the bottom portion of the case (the 132-watt power supply takes up the remaining space), you'll find the Micro-Channel-architecture (MCA) circuitry which uses a 32-bit data path to move data along the bus. A VLSI chip handles the system's VGA graphics, three slots for expansion cards (one 16-bit with a video extension and two 32-bit), and a system clock powered by an extended-life lithium battery. Parallel, serial, and mouse ports are also found on the system board.

The Model 70-A21 ships with 2MB of 80-nanosecond dynamic RAM, and three empty 2MB SIMM sockets allow you to increase the system board RAM to 8MB. This system is capable of addressing 16MB RAM; while the IBM PS/2 Memory Expansion Option card will provide from 2MB to 8MB additional RAM, the board will take one of your 32-bit MCA slots.

The second-tier daughterboard contains



IBM PS/2 MODEL 70

IBM's PS/2 Model 70-E61, -121, and -A21 speed along at 16, 20, and 25 MHz, respectively; the 16-MHz unit shown supplies a 60MB hard disk, 1MB RAM, and a VGA monitor for \$6,618. IBM uses ESDI hard disk drive controllers in all three versions of the PS/2 Model 70. Using a 32-bit MCA memory expansion card, each version can address up to 16MB of RAM. Motherboard-mounted SIMMs allow the expansion of system-board RAM to a maximum of 8MB in the 25-MHz unit and 6MB in the 16- and 20-MHz versions.

ESDI hard disk drive

32-bit MCA memory expansion card

Motherboard-mounted SIMMs

the 25-MHz Intel 80386 processor, a socket for an optional 25-MHz 80387 coprocessor, and RAM cache consisting of 64K of 30-ns. static RAM managed by an Intel 82385 cache controller. Although the 82385 is equipped to handle only a 32K RAM cache, IBM's engineers have altered its operation to let it handle 64K to provide maximum performance.

Both the midlevel Model 70-121 and the 16-MHz Model 70-E61 put all the system components on the system board; neither makes use of a daughterboard or cache

memory. The Model 70-121's 20-MHz Intel 80386 chip and socket for an optional 20-MHz 80387 coprocessor are moved onto the system board, as is the case with the 70-E61's 16-MHz Intel 80386 and its 16-MHz 80387 socket. The other components of the system board are the same as those found on the Model 70-A21.

The 20-MHz 70-121 ships with 2MB of 85-ns. RAM on the system board, whereas the 16-MHz 70-E61 ships with 1MB of 100-ns. system board RAM. Both models are expandable to 6MB system board

■ SMALL-FOOTPRINT 386 PCs



EDITOR'S
CHOICE

FACT FILE

IBM PS/2 Model 70-E61 (16 MHz)
IBM PS/2 Model 70-121 (20 MHz)
▶ IBM PS/2 Model 70-A21 (25 MHz)

IBM Corp.

Contact your nearest authorized IBM dealer.
(800) IBM-2468

List Price: Model 70-E61, with 1MB RAM, 1.44MB 3½-inch floppy disk drive, 60MB hard disk, \$5,995; Model 70-121, with 2MB RAM, 1.44MB 3½-inch floppy disk drive, 120MB hard disk, \$7,995; Model 70-A21, with 2MB RAM, 1.44MB 3½-inch floppy disk drive, 120MB hard disk, \$11,295; 1MB Memory Module (85 ns.), \$695; 2MB Memory Module (85 ns.), \$1,395; 2MB Memory Module (80 ns.), \$1,495; 8512 VGA monitor (no card needed; basic configuration supports VGA), \$623; 80387 coprocessor, \$2,395; 150MB tape drive, \$2,095.

In Short: Each member of IBM's PS/2 Model 70 trio delivers top performance, tiny footprint, and light weight for a premium price. The real stunner of the bunch is the 25-MHz Model 70-A21, the second-fastest computer ever tested by PC Labs. The 25-MHz machine has a two-tiered motherboard system not implemented by its 20- and 16-MHz siblings; they also lack the 25-MHz machine's cache memory. The main drawback of these Micro Channel machines is their limited expansion possibilities; all three have just three expansion slots.

CIRCLE 682 ON READER SERVICE CARD

RAM and have three SIMM sockets that can hold either 1MB or 2MB 85-ns. chips. To improve performance, these machines make use of interleaved memory that allows for operation between zero and two wait states. (For a discussion on different memory architectures, see the sidebar "Working at the Speed of RAM.")

There's 128K ROM divided among system BIOS support—the Advanced Basic Input/Output System (ABIOS) a BASIC language interpreter and a power-on auto-sense feature that identifies the hardware present in the system and adjusts the setup RAM accordingly. The auto-sense feature is supported by the MCA found in Models 50, 60, and 80 as well.

Each of the three machines has a snap-in plastic tray that fits over the top of the system board, between the power supply and the three expansion slots. This tray contains the 3½-inch 1.44MB micro-

floppy drive and the hard disk; there is also a bay for an additional microfloppy drive.

IMPROVED HARD DRIVES Both the Model 70-A21 and the Model 70-121 ship with a 120MB hard drive rated at 23 milliseconds with a 10.2 megabit-per-second data-transfer rate, while the Model 70-E61 ships with a 60MB drive rated at 27 milliseconds with an 8.4 megabit-per-second data-transfer rate. These drives are a big improvement over the infamous drives included with the Model 50. For one thing, they are of a reasonable size, although 120MB may still not be large enough for some users. For another, they have an ESDI (Enhanced Small Device Interface) controller built right into the drive. ESDI improves hard disk performance by moving data from the bus to the drive twice as fast as the older ST-506 standard. The hard drive is connected to the system board through a bus extension.

IBM doesn't provide a monitor with the system. The Model 70, as is the case with the rest of the PS/2 family of computers, requires an analog VGA monitor. With an adapter, the PS/2 can also use a multiscanning monitor.

The greatest shortcoming of the Model 70 is the lack of expansion slots. With only three slots available, you won't be able to turn your Model 70 into the ultimate power machine. And there are still few expansion cards that will work with the MCA bus. Since so many features and ports are included on the system board, three slots could satisfy many users. Even so, the Model 70 is plagued by a basic lack of expandability. And the 60MB or even 120MB hard disk may not be large enough for some of the memory-intensive applications like CAD, CAE, or multiuser applications, for which you would want to purchase a powerful 386 in the first place.

So just how does the Model 70's performance on PC Labs benchmark tests stack up with the competition? Among the small-footprint 386 PCs reviewed in this article, the 25-MHz 70-A21 took top honors in the PC Labs 80386 Instruction Mix benchmark test, with a time of 2.25 seconds. In fact, the only machine we've tested in PC Labs that is faster than the Model 70-A21 in our 80386 Instruction Mix benchmark test is the ALR FlexCache

25386—a less-expensive, floor-standing model.

However, the 20-MHz 70-121, at 3.24 seconds, is slower than both the Arche Rival 386, at 3.20 seconds and the Normerel ATC-386, at 3.15 seconds. Both of these computers run at 20 MHz. But all three

The ATC-386 by Normerel is a reasonably priced top-performance PC from France with design savoir faire.

IBM machines, particularly the Model 70-A21, do quite well when tested for extended memory performance.

Because PS/2s are manufactured in an exceptionally automated factory, they can be designed with smaller footprints. For example, IBM uses surface-mount soldering to attach the chips to the system board. In standard mount technology, the pins of the chips are fit through the system board manually. Since the chips are placed on the board by a machine, surface-mount technology allows the chips to be placed closer to one another.

Despite some real shortcomings—high price, lack of expansion slots, and relatively small (and limited) disk size—the Model 70's elegant design makes it a machine you would love to love. And the 25-MHz Model 70-A21 may be considered the most attractive PS/2 offering yet. With all this power and performance packed into such a small case, the Model 70 just might be the PS/2 to convince you to make the Micro Channel leap.

—Catherine D. Miller

NORMEREL U.S.A. INC.

Normerel ATC-386

Hong Kong, Taiwan, and Malaysia are familiar place names on chip sets and shipping boxes. But how about a computer from France with a DOS manual sporting



Small-Footprint 386 PCs: Summary of Features

(Products listed in ascending price order)

The following definitions explain the terms and analyze the aspects represented in this table of features. The phrases are listed in the same order as in the left-hand column of the table.

Basic configuration Because hardware vendors frequently offer a choice among various hard disk drives and monitors—at different prices—we are reporting the price of a completely stripped-down model as a “basic” configuration. Note that all seven computers in this roundup are equipped with IBM Enhanced-style keyboards, which is why the question of keyboard design does not appear in the table.

Software included Hardware manufacturers may or may not bundle software with their computers. Bundled software may include DOS, disk caching programs, setup and install programs, and various utilities. DOS is often available only at an additional cost.

Reset switch Many computers now come with a reset switch allowing a cold reboot of the computer. This switch saves wear and tear on the power switch.

Bus clock speeds (MHz) Bus speed becomes more important as computers run at faster clock speeds. A computer’s bus speed may actually be too fast for expansion cards, most of which operate at 8 or 10 MHz. Time-out periods, sometimes called wait states, are often used to slow down the bus. (See the sidebar “Working at the Speed of RAM.”)

Disk controller manufacturer/type Several interfaces are used to control the way data is transferred from the hard disk to the computer. The most common disk interface standard is the ST-506/412, used in the IBM PC-XT and PC AT. Two other common data transfer interfaces are SCSI (Small Computer System Interface) and ESDI (Enhanced Small Device Interface). Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers.

BIOS version and date The BIOS date is also important to those planning to use 3½-inch disk drives. Earlier BIOS versions cannot handle this format.

Chip packaging Memory chips may be soldered or socketed in place, and they use one of two styles of packaging: SIMM (Single In-line Memory Modules) or DIP (Dual In-line Package). With socketed chips, problem chips can be removed and new chips placed into their sockets. If a soldered chip goes bad, the entire board must be replaced.

SIMM technology involves soldering RAM chips onto a small board, which is then installed on an expansion board or directly on the system board. Easy installation in minimal space has made this a popular method of expanding RAM. DIP technology was widely implemented on older boards. The newest technique uses surface-mount technology, whereby chips are soldered directly to the surface of the board rather than to holes drilled into the board.

RAM chips RAM chips come in two basic types: static and dynamic. Static RAM chips (SRAMs) are faster and more efficient but costlier. Dynamic RAM chips (DRAMs) cost less and are more common, but the trade-off is in slower processing and operation.

Interleaved memory CPU speed is usually faster than memory speed. Interleaved memory increases processing speed by splitting the memory into two or more portions. The CPU then sends information to a section at a time, allowing one section to process while another receives data.

Shadow RAM Shadow RAM is a technology that loads system BIOS or video BIOS directly into fast RAM on bootup of the computer. The BIOS then operates much faster.

Type of cache controller Using a cache controller chip is one method of increasing computer speed via caching. Intel’s 82385 Cache Memory Controller is an example of a static RAM cache. (See “Working at the Speed of RAM.” Additional background may be found in the sidebar “What Is Caching Anyway?” *PC Magazine*, June 28, 1988, page 98.)

Maximum 32-bit RAM There is currently no standard for 32-bit cards, and not many cards are available today. Many computer manufacturers, however, have designed their own 32-bit memory expansion cards. 32-bit slots for memory cards are especially important in the era of OS/2, a memory-hungry operating system.

FCC certification class Two classes of FCC (Federal Communications Committee) approval may be given to computers: Class A and Class B. These classes concern levels of radio-frequency interference. With Class A approval, a computer may be operated in a business locale. The tougher Class B rating allows home use as well, where computers are likely to be placed near radios and television sets. Certification tests must be performed by private testing companies. The passing results are then sent to the FCC for final certification, a process taking several months or more.

Basic configuration

List price
Dimensions (HWD, inches)
RAM

Floppy disk drives

Hard disk drive
Drive bays

Software included

OS/2 supplied

Monitor
Ports

Slots

32-bit bus type

Power supply (watts)
Reset switch

Configuration tested

List price
Upgrades and additions to
the basic configuration

Microprocessor clock speeds
Wait states

Bus clock speeds

Disk controller manufacturer and type

System drive capacity

BIOS version and date

System board manufacturer

386 chip set manufacturer
Memory chip type
Chip packaging

Memory specifications

RAM chips
Interleaved memory
Shadow RAM

Type of cache controller
Cache software
Maximum RAM on motherboard

Maximum 32-bit RAM
Math coprocessors supported

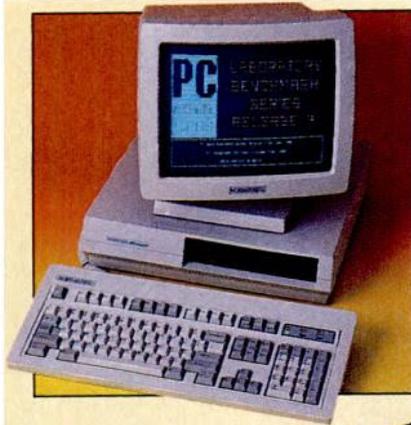
Other

Warranty
FCC certification class

						PC
Normrel ATC-386	Compaq Deskpro 386S	Amdek System/386	Arche Rival 386	IBM PS/2 Model 70-E61	IBM PS/2 Model 70-121	IBM PS/2 Model 70-A21
\$3,795	\$3,799	\$3,850	\$4,395	\$5,995	\$7,995	\$11,295
3.8 × 15.9 × 15.3	5.9 × 15.8 × 14.8	6.3 × 15 × 17	6 × 17 × 16.5	5.5 × 14.3 × 16.5	5.5 × 14.3 × 16.5	5.5 × 14.3 × 16.5
2MB	1MB	1MB	2MB	1MB	2MB	2MB
One 1.44MB 3½-inch None Two half-height	One 1.2MB 5¼-inch None Two one-third-height, one half-height	One 1.2MB 5¼-inch None Three half-height	One 1.2MB 5¼-inch None Three half-height	One 1.44MB 3½-inch 60MB Two 3½-inch half-height, one full-height	One 1.44MB 3½-inch 120MB Two 3½-inch half-height, one full-height	One 1.44MB 3½-inch 120MB Two 3½-inch half-height, one full-height
DOS 3.3, diagnostics, setup, disk cache	CEMM, disk cache	DOS 3.2, GW-BASIC, utilities, diagnostics, disk cache	DOS 3.3, GW- BASIC, setup	Setup, diagnostics, disk cache	Setup, diagnostics, disk cache	Setup, diagnostics, disk cache
○	Optional (\$325)	Optional (\$325)	○	Optional (\$325 standard edition, \$795 extended edition)	Optional (\$325 standard edition, \$795 extended edition)	Optional (\$325 standard edition, \$795 extended edition)
None 3 serial, 1 parallel, 1 floppy disk, 2 video	None 1 serial, 1 parallel, 1 auxiliary	None 2 serial, 1 parallel	Amber monochrome 2 serial, 2 parallel	None 1 serial, 1 parallel, 1 mouse	None 1 serial, 1 parallel, 1 mouse	None 1 serial, 1 parallel, 1 mouse
Two 16-bit, one 8-bit	Four 16-bit	Six 16-bit, two 8-bit	Two 32-bit, four 16-bit, two 8-bit	Two 32-bit, one 16-bit (all MCA)	Two 32-bit, one 16-bit (all MCA)	Two 32-bit, one 16-bit (all MCA)
N/A	Compaq	Wyse Technologies	Proprietary	MCA	MCA	MCA
100	140	190	200	132	132	132
●	○	●	●	●	●	●
\$4,595	\$9,740	\$6,020	\$5,190	\$6,618	\$8,618	\$11,918
40MB hard disk, VGA monochrome monitor	40MB hard disk and 40MB backup tape, VGA monitor, 16-MHz 80387SX coprocessor, 4MB memory module	40MB hard disk, VGA card and monitor	40MB hard disk	Analog VGA monitor	Analog VGA monitor	Analog VGA monitor
20 MHz	16 MHz	16 MHz	10/20 MHz	16 MHz	20 MHz	25 MHz
0	0	0 at 16 MHz; 1 at 8 MHz	0	0 to 2	0 to 2	0
20 MHz	16 MHz	8/16 MHz	10 MHz	16 MHz	20 MHz	25 MHz
Western Digital (SCSI)	Compaq (proprietary)	Western Digital (ST-506)	Arche (ST-506)	IBM (ESDI)	IBM (ESDI)	IBM (ESDI)
Motherboard handles 2 floppy disk drives or 1 floppy and 1 hard disk drive	Controller card handles 2 floppy and 2 hard disk drives and 1 tape drive	Controller card handles 2 floppy and 1 hard disk drive or 1 floppy and 2 hard disk drives	Controller card handles 2 floppy and 1 hard disk drive or 1 floppy and 2 hard disk drives	Motherboard handles 2 floppy and 1 hard disk drive	Motherboard handles 2 floppy and 1 hard disk drive	Motherboard handles 2 floppy and 1 hard disk drive
Normrel, Version 2.04 (July 1988)	Compaq ROM BIOS, Version F2M 03 (June 1988)	Phoenix ROM BIOS, Wyse Version 3.52 (September 1987)	Phoenix ROM BIOS Plus, Version 11002 (January 1988)	Advanced BIOS (April 1988)	Advanced BIOS (April 1988)	Advanced BIOS (April 1988)
Normrel	Compaq	Wyse Technologies	Arche	IBM	IBM	IBM
Chips & Technology 256K	Intel 1MB	Tseng Laboratories 256K	Chips & Technology 256K	Intel 1MB, 2MB	Intel 1MB, 2MB	Intel 2MB
SIMM	Surface mount	DIP	DIP	SIMM	SIMM	SIMM
DRAM	DRAM	SRAM	DRAM	DRAM	DRAM	DRAM
●	●	●	●	●	●	○
○	○	○	○	○	○	○
N/A	N/A	N/A	N/A	N/A	N/A	Intel (82385)
●	●	●	○	●	●	●
8MB	N/A	2MB	N/A	6MB	6MB	8MB
8MB	13MB	6MB	16MB	16MB	16MB	16MB
80287 or 80387	80387	80287 or 80387	80287 or 80387	80387	80387	80387
1 year A	1 year B	1 year B	2 years A	1 year B	1 year B	1 year B

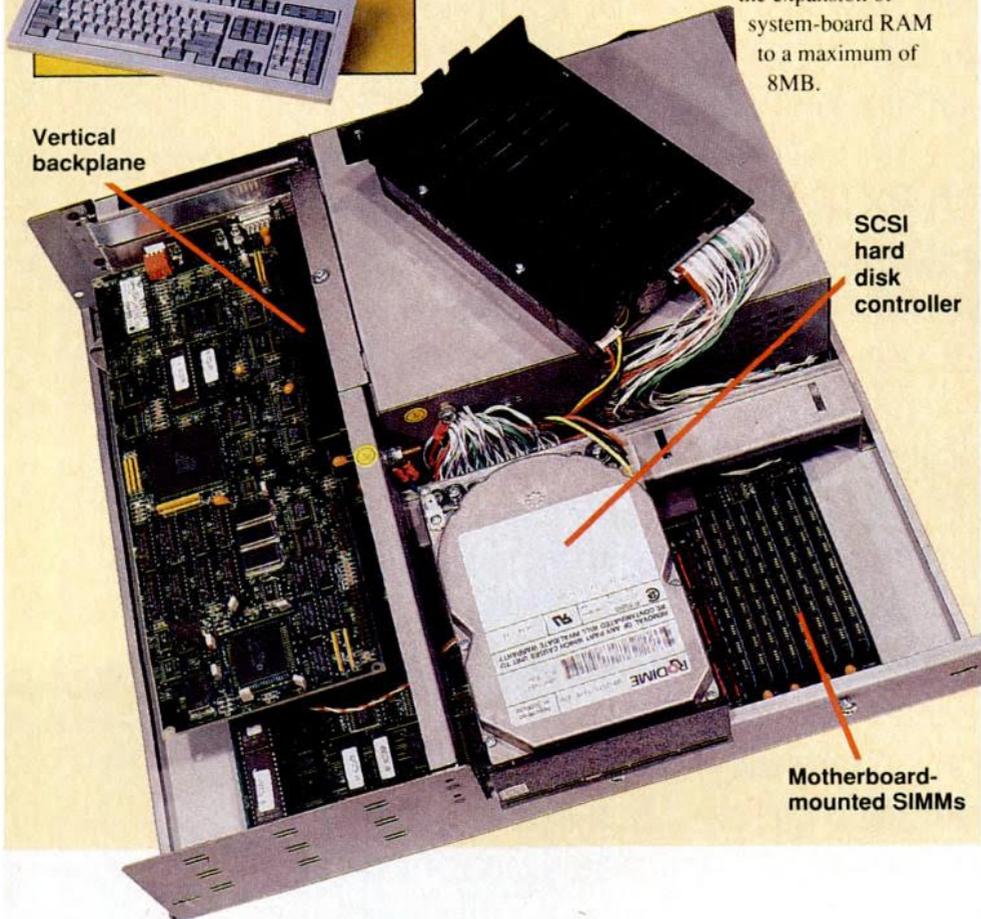
PC — Indicates Editor's Choice ● — Yes ○ — No N/A — Not applicable; product does not have this feature.

■ SMALL-FOOTPRINT 386 PCs



NORMEREL ATC-386

The thin-as-a-textbook Normerel ATC-386 is a top-performing 20-MHz computer with a 40MB hard disk, 2MB RAM, and a VGA monochrome monitor for \$4,595. Normerel's vertical backplane expansion-slot construction allows the horizontal mounting of expansion boards. Normerel is the only company in this roundup to use an SCSI hard disk controller. Motherboard-mounted SIMMs allow the expansion of system-board RAM to a maximum of 8MB.



a pink-and-black logo? The ATC-386 by Normerel is a reasonably priced top-performance PC with design savoir faire. Of the 386-based PCs clocking in at 20 MHz, this French number bears a closer look.

Down to the smallest detail, this machine has raised "making more out of less" to a high art. The CPU is the most compact of the machines reviewed here. At 3.8 inches high, it is about the height of a standard keyboard drawer or the size of a briefcase. Small design is grandly implemented in the Normerel ATC-386. Its three slots accept full-size AT cards and can be filled with 3270 boards, LAN cards

or a CD ROM Interface. The machine tested well for throughput, is comfortable to use, and conserves power and space. Priced at \$4,595 for a 40MB system unit with VGA monochrome monitor, its debut in America may be worth applause.

Something that looks this good on the outside has to be well built. Innovations in motherboard design, combined with SCSI technology, lie underneath the ATC-386's elegant and ergonomic external cover. A SCSI interface is strategically employed for its low-power-consumption and high-performance properties.

The evaluation unit was configured



FACT FILE

Normerel ATC-386

Normerel U.S.A. Inc.
1309 44th St.
Orlando, FL 32809
(800) 327-9877
(407) 843-5224

List Price: With 2MB RAM, 1.44MB 3½-inch floppy disk drive, \$3,795; with 40MB hard disk, \$4,395; with 70MB hard disk, \$4,595. VGA monochrome monitor, \$200. VGA color monitor, \$595. 80387 coprocessor, \$735.

In Short: A speedy, elegant 20-MHz 386 with a slender CPU design. Slightly built, this French-made computer sacrifices some functionality in favor of design. The Normerel ATC-386 lacks a 32-bit bus and provides only three expansion slots. You're also limited to one floppy disk drive; a second floppy can be added internally only at the expense of the hard disk.

CIRCLE 681 ON READER SERVICE CARD

with a 40MB hard disk drive, a 3½-inch 1.44MB diskette drive, and 2MB of SIMM memory, expandable to 8MB. The motherboard is impressive. It has everything you might want except for the VGA adapter: three serial ports, one parallel port, a mouse port, space for a math coprocessor, and three slots for add-in boards. There are one 8-bit and two 16-bit expansion slots. At present, the 8-bit slot is occupied by Normerel's own VGA board, which incorporates the Paradise chip set. By the end of the year, VGA capability will be integrated on the motherboard, bringing the expansion slot count up to three. The system board supports either an 80287 or an 80387 math coprocessor.

For those who prefer a standard hard disk to SCSI minidrives, the proprietary Normerel BIOS will support an ST-506 drive. The base unit ships with DOS 3.3, a diagnostic diskette, and setup utilities including a 386 options kit. The options kit allows you to set the speed going out over each of the internal buses and interleaves base memory with zero wait states. The ability to adjust the bus speed is a good hedge against possible board incompatibilities.

Compatibility with IBM's vision of the future has become de rigueur for those

■ SMALL-FOOTPRINT 386 PCs

PC EDITOR'S CHOICE

• IBM PS/2 Model 70-A21 (25 MHz)

Who could refuse the fastest computer IBM has ever built, housed in a box no wider than a monitor? If you've got the extra bucks to spend for performance, the 25-MHz IBM PS/2 Model 70-A21 is the second-fastest machine we've ever tested; only the floor-standing ALR Flex-Cache 25386 is faster. Our Editor's Choice applies only to the 25-MHz Model 70; the 16- and 20-MHz versions lack the sophisticated engineering that helps to justify the price of the 25-MHz computer. The 25-MHz Model 70 isn't without drawbacks, however: a near-\$12,000 price tag (with 120MB hard disk, 2MB RAM, and VGA monitor), and just three expansion slots.

Of the 16- and 20-MHz group, two computers—both 16-MHz models—deserve honorable mention. The Amdek System/386 is an inexpensive, cleanly designed box with four free expansion slots and a high-quality (if somewhat slow) VGA

monitor. By using the 386SX chip, the Compaq Deskpro 386S can offer 16-MHz 386 speed and Compaq quality for only about \$400 more than a similarly equipped Compaq Deskpro 286/12. The SX chip is a 386 chip—with the exception that its memory access is only 16 bits wide, the same as in an AT. Compaq's fast VGA is on the motherboard, and a proprietary expansion slot lets you boost RAM to 13MB, leaving the four 16-bit expansion slots free for options.

The small-footprint 386 market, unlike the 286 market, is a still-evolving category; most of the major players haven't introduced their offerings. But your options aren't as limited as they seem. If your needs can be met by a 386 luggable, there are four streamlined, high-performing portables to choose from (see "Take It or Leave It: Portables with Desktop Power," PC Magazine, October 11, 1988).

who would compete in the American marketplace. Normerel has its own version of OS/2 with SCSI drivers, which the company expects to be available by year's end.

SPEEDIEST 20-MHZ "Can it perform?" is the real question. On the 80386 Instruction Mix benchmark test the ATC-386 was outperformed only by the IBM Model 70 running at 25 MHz. In other tests the ATC-386 consistently placed near the top of the group.

If 70MB of hard disk storage isn't enough for you, larger disk sizes are available, as is an external tape drive with 60MB cartridges for backup. There is no 32-bit slot in the Normerel ATC-386, but because the motherboard can accommodate 8MB of RAM, you may find that you can live without the faster slot.

Also missing is the extra floppy disk drive. The present configuration will support two floppy disk drives only at the expense of the fixed drive. Nor will the ATC-386 support more than one fixed drive internally. The low height of the CPU would have to be compromised quite a bit in order to fit a second floppy disk drive into this machine.

The Normerel ATC-386 is petite, powerful, and unique, delivering good functionality in a compact unit for a reasonable price. Normerel is the Original Equipment Manufacturer for Memorex/Telex in the United States, and it plans to distribute through value-added resellers and directly to Fortune 1000 companies. Well-styled and easy on the pocketbook, this machine may find its way into many a front office.—Priscilla Tate-Austin

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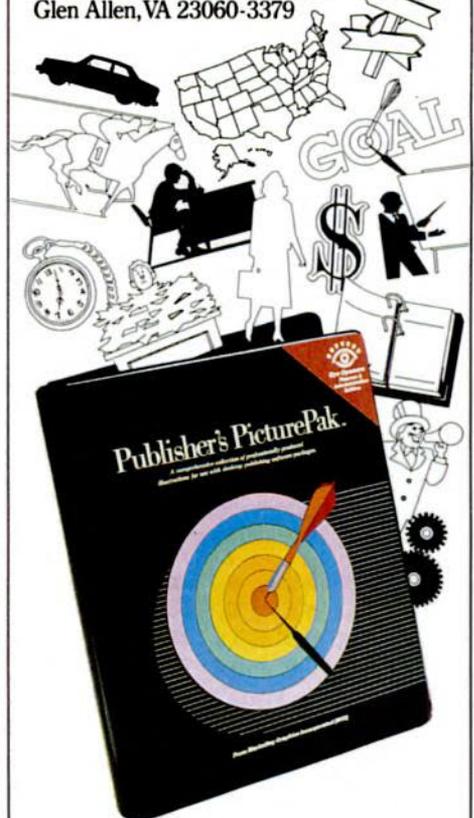
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