THE ATARI 520ST

The 68000 unbounded

Editor's note: The following is a BYTE product description. It is not a review—for several reasons. Some of the equipment we received, such as the hard-disk drive, were prototypes, and at the time of this writing, software is scarce. Atari has not yet completed its BASIC interpreter, and the operating system, TOS, remains unfinished. Nonetheless, we are as intensely interested as our readership in new technology, and we feel we have learned enough to share some of the results of our investigations. We began our work on this description as soon as we were able to get a system from Atari. A full review will follow in a subsequent issue.

For many years the public has equated the Atari name with arcade games and joysticks. In truth, the Atari 400/800/XL computer line is technically at least comparable if not better than other 8-bit machines, so it should not be a surprise that the company's latest venture, the 520ST (see photo 1), is a competitive 68000 system. Indeed, we are most impressed with the clarity of the graphics, with the speed of the disk I/O (input/output), and with the 520ST's value.

The system is not without its problems. The desktop is less effective than the Macintosh's, the keyboard has an awkward feel, and the current operating system makes it impossible to switch between high-resolution monochrome and low- or medium-resolution color without installing the other monitor and rebooting. Nonetheless, we are left with a very favorable impression; several software-development languages are already available, including FORTH, Modula-2, and C. With them, you can tap the power of the 68000 at a most reasonable price.

SYSTEM DESCRIPTION

The Atari 520ST is a keyboard computer. Like the Commodore 64 and the Atari 400/800, the 520ST keyboard unit contains the microprocessor, the memory, the video and sound circuitry, and so on. The power supply, disk drives, and monitor are external devices. The 520ST has a variety of ports, but there are no internal expansion slots.

The In Brief box on page 90 summarizes the features of the Atari 520ST. For $799, you get the CPU, a 12-inch diagonal monochrome monitor, and one external single-sided double-density floppy-disk drive. For $999, you get the same system with a 12-inch RGB analog monitor in place of the monochrome monitor (see photo 1). Both systems provide 512K bytes of RAM (random-access read/write memory), a Motorola 68000 microprocessor, MIDI ports with a transfer rate of 31,250 bps (bits per second), a DMA (direct memory access) port with a transfer rate of 10 megabits per second for a hard disk or CD-ROM (compact-disk read-only memory), and much, much more. To be sure, owners will make some sacrifices. The unit does not have an RF (radio frequency) modulator for television output, every peripheral has a separate power supply (wire haters beware), and the operating system currently rests in RAM, stealing over 200K bytes from your workspace. We have summarized other problems below, but almost all are insignificant when you consider what you do get for the money. And rest assured, the system works. Our first system, like most of the first production units, had to have several chips reseated. It now functions properly, and we have not heard of any similar quality-control problems on the latest 520STs.

THE HARDWARE DESIGN

The heart of the 520ST is the MC68000, with its 16-bit data bus and 24-bit address bus, running at 8 MHz (see figure 1). The rest of the system was designed to stay out of the 68000's way. (See the 520ST motherboard in photo 2.)

The Atari design team began work on the 520ST in May 1984. From the start, they had several specific goals in mind. The first was to choose a fast microprocessor and do everything to let it run effectively at full speed. To the Atari team, that meant maximizing bus bandwidth and relegating as

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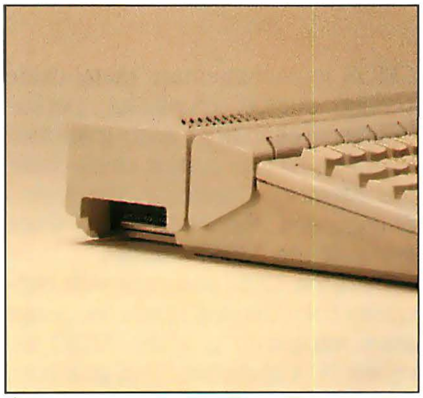
BY JON R. EDWARDS, PHILLIP ROBINSON, AND BRENDA MCLAUGHLIN

(a)



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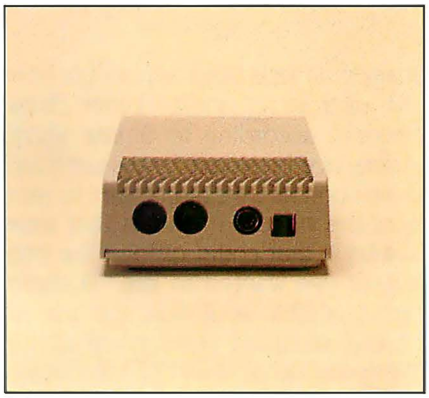

(c)

Photo 1: *The* Atari 520ST, *shown here with the color monitor and two single-sided double-density disk drives. (a) On the right side of the keyboard unit are two joystick/mouse ports. (b) On the left is the* 128K-*byte* ROM *cartridge port. (c) The rear of the disk drives has specific ports for* I/O *in and* I/O *out.*

PHOTOGRAPHED BY PAUL AVIS

many mundane tasks as possible from the microprocessor to other chips. Second, according to Shiraz Shivji, Atari's vice president for research and development, "We didn't want to reinvent the wheel . . . things that were available that could offload the processor—we wanted to use." A direct result of that goal was the use of several standard chips (such as the Western Digital WD1772 for floppy-disk-drive control) and use of custom CMOS (complementary metal-oxide semiconductor) chips for performance, reliability, and manufacturability. All four custom chips—Glue, the Memory Controller, the Video Shifter, and the DMA chip—share many of the 520ST's duties.

Third, the 520ST had to provide high-quality color displays. Finally, the design team wanted to give the 520ST excellent I/O capabilities. That goal is reflected in both the variety of ports that surround the 520ST and in the high speed of the DMA (hard-disk) port.

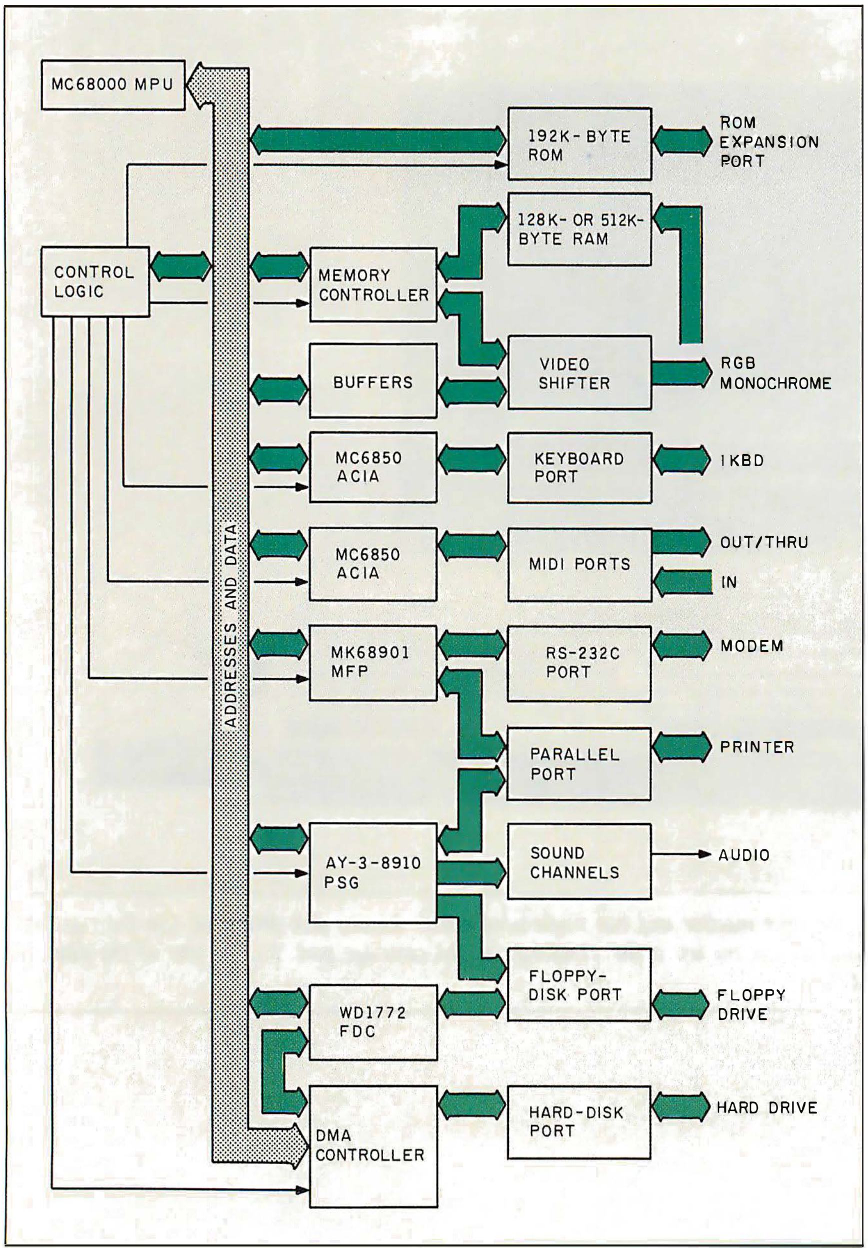

Figure 1: *The system block diagram for the Atari 520ST.*

MEMORY

The 520ST currently includes 512K bytes of RAM and 16K bytes of ROM. The RAM consists of sixteen 256K-bit dynamic RAM chips that are rated at 150 ns (nanoseconds). Atari is already talking about 1-megabyte and 2-megabyte (RAM) versions of this same computer. The 68000 CPU (central processing unit) can directly address up to 16 megabytes of ROM and RAM, but the present Memory Controller chip can only work with 4 megabytes. The circuit board has room, but it will need a slight redesign to use the 1-megabit dynamic RAMs when they become available. (The 1-megabit chips have two more pins than the 16-pin 256K-bit chips they would replace and also would have some of the signals on different pins. This change would require a small modification in manufacturing.)

Memory is configured as five 64K-byte sets of ROM and one configurable bank of 128K bytes, 512K bytes, or 2 megabytes of RAM. (Early in 1985, Atari mentioned a possible 128K-byte RAM version of the ST.) Software determines the ROM configuration. A shadow-test algorithm that loads a Memory Configuration register determines the RAM configuration. When the computer is turned on, this algorithm tries to write to and read from memory addresses unique to the possible configurations.

The memory map is shown in figure 2. The first 2K bytes (lowest address values) are reserved for the exception vector table and the supervisor stack. These 2K bytes—and the I/O space—are protected: They can only be accessed when the CPU is in supervisor mode. Four words of ROM are shadowed at the start of RAM for the reset stack pointer and the program counter.

VIDEO MEMORY

The Atari 520ST offers three display resolutions. The highest resolution is a noninterlaced monochrome 640- by

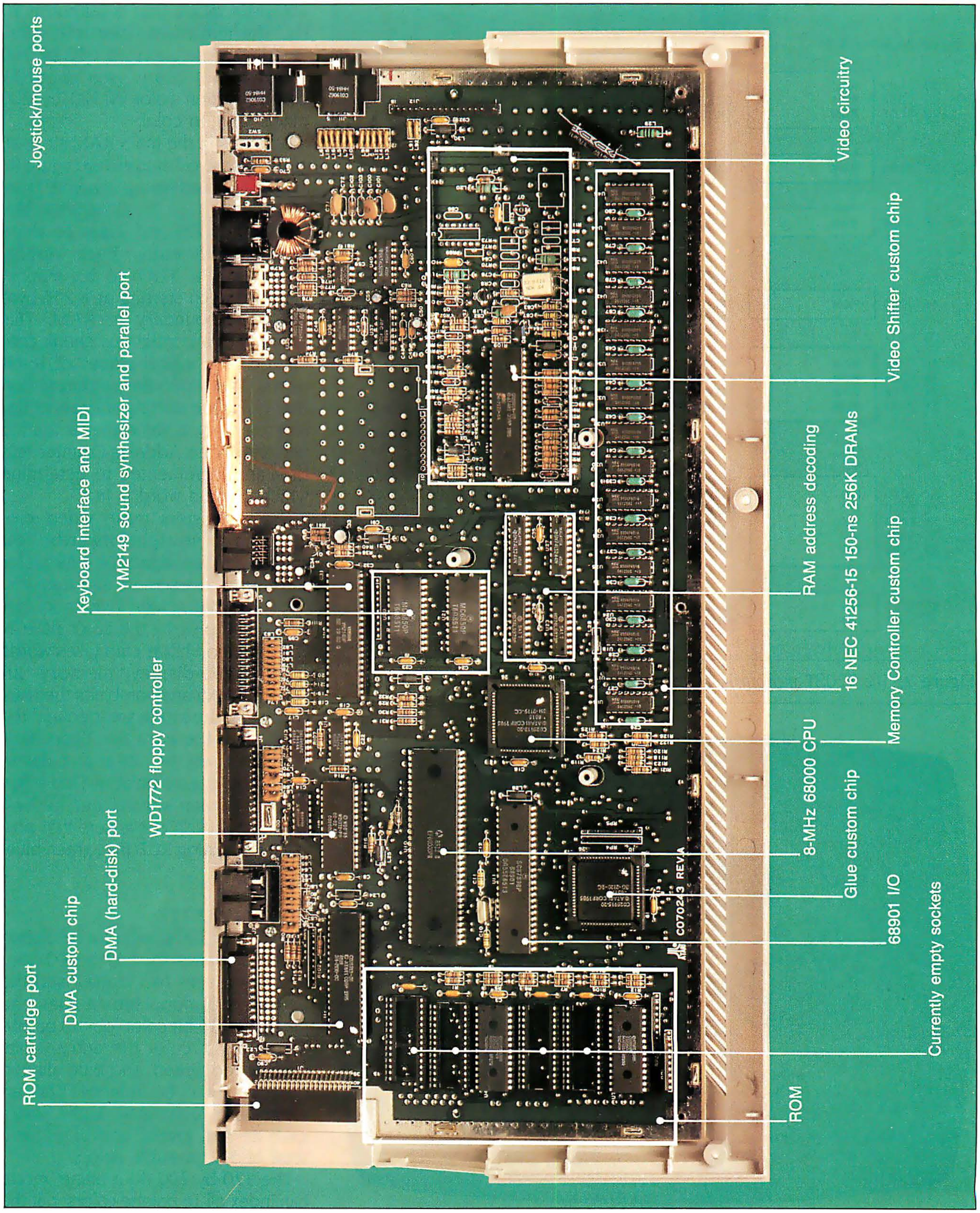

Photo 2: *The Atari 520ST motherboard.*

--ST MEMORY MAP-----

00 0000	ROM	RESET: SUPERVISOR STACK POINTER
00 0004	ROM	RESET: PROGRAM COUNTER
00 0008	RAM	0K-BYTE RAM
.		
02 0000	RAM	128K-BYTE RAM
08 0000	RAM	512K-BYTE RAM
. . .		
fa 0000	ROM	320K-BYTE ROM
.		
fc 0000	ROM	RESET: SUPERVISOR STACK POINTER
fc 0004	ROM	RESET: PROGRAM COUNTER
fc 0008	ROM	192K-BYTE ROM
fe ffff	ROM	0K-BYTE ROM
. . .		
ff 8000	I/O	CONFIGURATION REGISTERS
ff 8200	I/O	DISPLAY REGISTERS
ff 8400	I/O	RESERVED
ff 8600	I/O	DMA/DISK REGISTERS
ff 8800	I/O	SOUND REGISTERS
.		
ff fa00	I/O	MC68XXX REGISTERS
ff fc00	I/O	MC68XX REGISTERS

Figure 2: *The 520ST memory map.*

Photo 3: *Low-resolution graphics offer 16 colors in a 320- by 200-pixel array.*

400-pixel mode that is output at 70 Hz. The maximum color resolution, "medium resolution," is 640 by 200 pixels with 4 colors (see photo 3). Low-resolution color is 320 by 200 pixels with 16 colors.

Bit maps in the main RAM store all of the displayed images (see figure 3). A special interleaving scheme, managed by the Memory Controller chip, allows the CPU and video to share memory efficiently. Each display mode uses a 32K-byte bit map in memory, each starting at a 256-byte half-page boundary in RAM. This memory is a contiguous chunk configured as *n* logical planes of 16-bit words. The Video Base Address register holds the starting address of display memory, a value that is loaded into the Video Address Counter register and incremented to determine which plane a word is in.

These registers make video programming straightforward. You choose a mode, select the address for the start of the screen, and then you have a bit-map screen in memory that is affected only by the color palette.

The Video Shifter chip takes words from video-display memory (in general RAM) and combines them according to the mode selected and the position of the word (see figure 4). It then interprets the bits as an index to the color lookup palette. That information is then shifted out to 3-bit digital-to-analog converters that produce the analog RGB (red-green-blue) output.

Color Palette

The 320- by 200-pixel color resolution uses four planes, the 640 by 200 color resolution uses two planes, and the 640 by 400 monochrome uses one plane. The 16-bit color lookup palette has 9 bits of color per entry, 3 bits each of red, green, and blue aligned on low-nybble boundaries. This arrangement generates eight levels each of red, green, and blue, for a total of 512 possible colors.

The 320 by 200 (four-plane) mode can index all 16 palette colors, but the 640 by 200 (two-plane) mode works with only the first 4 palette entries.

16-BIT WORD					
4 PLANE	PLANE 0	PLANE 1	PLANE 2	PLANE 3	PLANE 0
2 PLANE	PLANE 0	PLANE 1	PLANE 0	PLANE 1	PLANE 0
1 PLANE	PLANE 0	PLANE 0	PLANE 0	PLANE 0	PLANE 0

Figure 3: *Organization of bit-plane data in memory.*

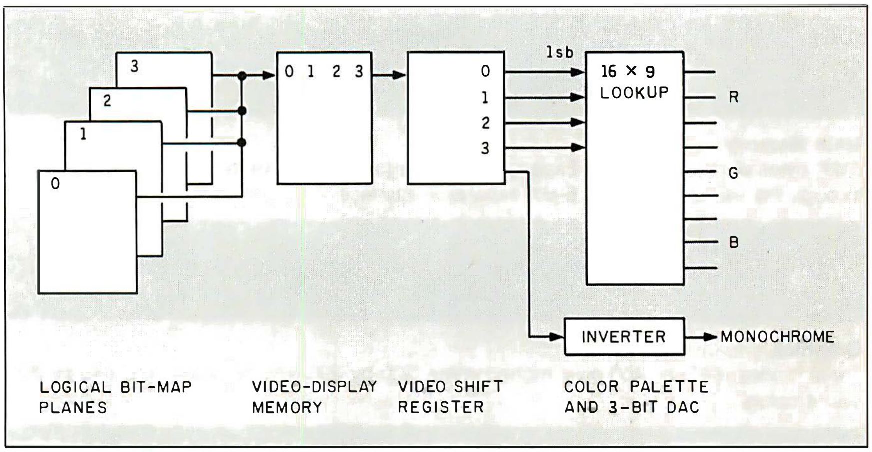

Figure 4: *The flow of data from video memory to analog* RGB *output.*

The 640 by 400 monochrome mode bypasses the palette, instead employing an inverter for inverse video. The inverter is controlled by bit 0 of palette color 0. Palette color 0 also assigns a border color in multiplane mode and a white or black border in monochrome mode.

A single call to BIOS (basic input/output system) can change the colors in the palette registers. You could show all 512 colors on a single screen by making such calls on the fly. The 520ST does not have any hardware provision for sprites or player-objects, graphics tools that are found in the Commodore 64, Amiga, and Atari 800. It does have bit-blitting, but only in the GEM software.

MEMORY CONTROLLER

Using the data bus efficiently was an absolute priority in the design of the 520ST. The CPU makes frequent use of the bus: The designers noticed that between 30 and 40 percent of program instructions would be store and load types. And the video display needs constant refreshing from memory. After all, in a bit-mapped system such as this, the display on the screen is virtually an image of what is in the RAM chips.

A 68000 running at 8 MHz takes 500 ns for each memory-access cycle. But during the first 250 ns of that time, it isn't looking at the data bus. Instead, it is just setting up the address bus and performing handshaking functions. Shivji explains that his team decided to use memory chips that could be read in a 250-ns slot, and then to put a Memory Controller custom chip between the CPU and memory. The same controller also sits between the Video Shifter custom chip and memory.

During the first 250 ns of the 68000's 500-ns read cycle, the Memory Controller gives the Video Shifter access to RAM. Then, when the 68000 is ready—during the second 250 ns of the read cycle—the Memory Controller turns RAM access over to the CPU. The Video Shifter and CPU keep taking turns. Because the RAM is twice as fast as the microprocessor, the 68000 can run at full speed and read or write to RAM as it desires without disturbing the refreshing of the display. More important, CPU tasks won't be put on hold while the video circuitry makes heavy demands on memory for high-resolution data.

Occasionally, because the 68000 has an asynchronous bus that you cannot lock exactly with the video circuitry, missed cycles will occur. All that happens is that the CPU has to wait one 250-ns cycle, a rare event according to Shivji.

GLUE

The Glue chip reduces the overall chip count on the board by integrating the functions of many smaller chips into one device. Glue generates chip selects, handles handshaking (for parts that aren't 68000-bus-oriented), and generates both the video timing and the interrupt controls. Although the 68901 handles part of the interrupt management task, Glue takes the interrupt from the 68901 and determines its priority with respect to the vertical and horizontal interrupts. Glue also handles the actual interrupt acknowledge cycles.

I/O CHIP

The 68901 MFP (multifunction peripheral) chip is a standard member of the 68000 family and provides serial I/O, parallel I/O, timers, and counters. It has eight parallel I/O pins; a 16-source interrupt controller with programmable service modes, including polling and vector generation; four separate timers with individually programmable prescaling; and a single-channel, full-duplex USART (universal synchronous/asynchronous receiver/transmitter).

SOUND

The Yamaha YM2149 sound chip has three independent monophonic voices and uses a 2-MHz clock input

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IN BRIEF

Name
Atari 520ST

Company
Atari Corp.
1196 Borregas Ave.
Sunnyvale, CA 94086
(408) 745-2000

Price

Monochrome system	$799
Color system	$999

Microprocessor
Motorola 68000, a 32-/16-bit microprocessor (32-bit internal architecture with 24-bit, nonsegmented, external data bus) running at 8 MHz

Main Memory
512K bytes of dynamic RAM. Expansion to 4 megabytes may be possible in the future through the use of a planned 8-slot expansion interface.

ROM
Current models contain 16K bytes of boot-up ROM. Atari intends to release TOS on ROM for $20, upgrading ROM to 192K bytes and freeing up that amount of RAM.

Graphics
Three modes: 640- by 400-pixel monochrome, 320 by 200 with 16 colors, and 640 by 200 with 4 colors

Sound
Three independent sound channels from 30 Hz to 125 kHz

Floppy-Disk Drive
Bundled, external 3½-inch single-sided double-density drive with capacity of 360K bytes. System supports maximum of two floppy-disk drives.

Keyboard
94-key Selectric-style QWERTY keyboard with numeric keypad, cursor controls, and rhomboid function keys

Interfaces
MIDI in and MIDI out ports
Monitor port (supports RGB analog, high-resolution monochrome)
Centronics parallel printer port (supports Epson-compatible printers)
RS-232C serial port
Floppy-disk port
Hard-disk port (10-megabit-per-second DMA transfer rate)
128K-byte ROM cartridge port
Ports for mouse or two joysticks

Bundled Software
TOS, including GEM
Atari Logo
BASIC, when completed

Optional Peripherals/Expansion

SF354 single-sided drive	$199
SF314 double-sided drive	$299
1-megabyte RAM upgrade (Lemon Micro, Redondo Beach, CA)	$300

Planned Peripherals
SMM801 dot-matrix printer, SDM121 daisy-wheel printer, 10-megabyte fixed disk, RAM disk for cartridge port, 8-slot expansion interface, local-area network for MIDI port, CD-ROM

to produce tones from 30 Hz up to 125 kHz—more than the human audio range. The chip also has a noise channel. Atari documentation calls this chip the PSG (Programmable Sound Generator). The three channels of output are mixed, converted by a built-in digital-to-analog converter, and sent to a monitor speaker. The designers were also able to use some ports and registers on the PSG for activities completely unrelated to sound generation, such as controlling parts of the parallel and serial ports.

The registers for the voices control a basic square wave while the Noise Generator register controls a frequency-modulated square wave of pseudorandom pulse width. You can mix tones and noise over individual channels by using the Mixer Control register. Amplitude registers allow you to choose fixed or variable (Envelope-register-determined) amplitude.

DMA Port

The 520ST ports fill the entire back and sides of the keyboard unit (see photo 4). One of the strongest features of the 520ST is the built-in DMA port. Using a CPU to move large blocks of data between memory and external devices is neither fast nor efficient. DMA was created to provide a speedy channel for such transfers and to leave the CPU free to calculate. Without help from the CPU, the Atari's DMA port can move data at 10 megabits per second, a rate twice the standard hard-disk transfer rate and much higher, for example, than the Macintosh, which must make do with a much slower serial port. In addition, the port can handle up to eight daisy-chained devices and is the opening to practical use of CD-ROMs and many other devices.

DMA Controller

The Memory Controller and Glue custom chips contain parts of the DMA function, but it is the DMA custom chip that directs the high-speed data transfer through the DMA port. The DMA controller and the CPU have equal access to the bus: A

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first-come, first-served scheme handles contention. Only one DMA operation can take place at a time. A DMA operation depends on the base address, the count, and the read/write status values the program loads into the DMA Base Address and Counter register. In addition, two bits are used as address lines to steer the output of the DMA to the floppy-disk port or to the hard-disk port.

DMA occurs in bursts, with the DMA chip storing information in its 32-byte FIFO (first-in/first-out) buffer and then sending it in a hurry to either RAM or to the outside world. The DMA chip and the 68000 CPU have equal access to RAM and compete for the same cycles. The DMA chip's 10-megabit-per-second rate is equivalent to 1.25 megabytes per second or 625K words per second. (The transfers to and from memory in the 520ST are handled in 16-bit words.) The 68000 can access memory every 500 ns. That means its maximum bus use is 2,000,000 words per second. A worst-case calculation (dividing the 625K words/second rate by the 2,000,000 words/second rate) shows that DMA cannot use more than 33 percent of the CPU bus cycles.

A more realistic calculation assumes a 5-megabit-per-second rate for DMA (the standard rate for hard-disk drives) and does not assume that the highest-speed bursts of DMA would run continuously, or that the CPU would reach for memory in every cycle. With these assumptions, the DMA would rarely borrow even 5 percent of the 68000's RAM access cycles.

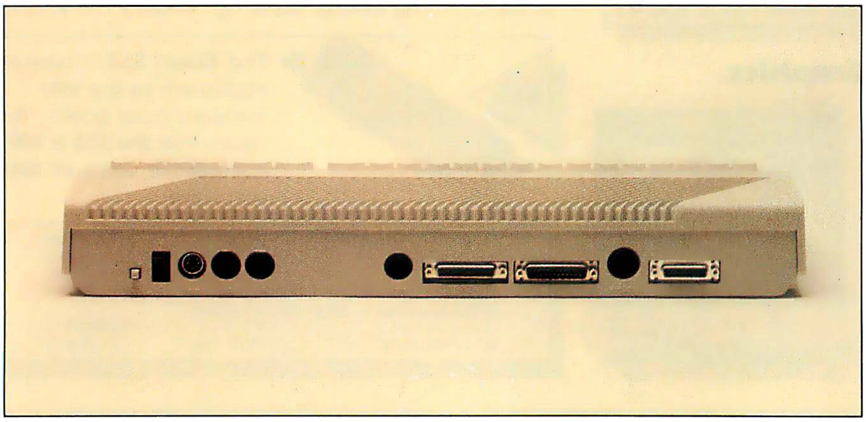

Photo 4: *The back panel of the 520ST. From left to right are a reset button, the on/off switch, power cable, MIDI out and MIDI in, the monitor port, 25-pin Centronics parallel printer port, an RS-232C serial port, the floppy-disk port, and the hard-disk (DMA) port. Out of view, on the sides, are the joystick/mouse ports and the 128K-byte ROM cartridge port. Unfortunately for left-handed users, the attachment cables for the disk drives and for the mouse are short. All but the most inventive users will place the drives on the left and the mouse on the right.*

Photo 5: *The 520ST keyboard. Wider keytops and the rhomboid shape of the function keys lessen the utility of an otherwise full-featured, well-designed layout.*

PORTS

The serial port is a standard RS-232C interface. Some of its signals come from I/O port A of the sound chip, while others are routed through the 68901 chip. The serial port can work with asynchronous data-transfer rates from 50 to 19,200 bps.

The parallel port supports the strobe and busy signals of the Centronics parallel interface standard. Both I/O port B of the sound chip and the 68901 chip help control these lines and the eight read/write data bits. The parallel lines of the sound chip are bidirectional, which could lead to some interesting hacking. For example, you might convert a parallel printer into a scanning device to digitize information. The typical data-transfer rate is 4000 bytes per second.

The two MIDI (musical instrument digital interface) ports bear special attention. MIDI is an industry-standard interface for computers and musical peripherals. The MIDI ports will allow the 520ST to attach directly to external keyboards, synthesizers, and other equipment. Atari has even been investigating the possible use of the MIDI ports for inexpensive networking of 520STs. The interfaces work at 31,250 bps for serial transfer of information from the keyboard or a program to and from external devices. Data is organized as a start bit, eight data bits, and one stop bit.

One of the 6850 chips controls the MIDI serial communication. Up to 16 channels are allowed on the MIDI bus in one of three network addressing

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modes. The Omni mode addresses all units simultaneously and is the default mode when the computer is first turned on. Poly mode addresses each unit separately. Mono mode addresses each unit voice separately.

KEYBOARD AND MOUSE

The documentation refers to the 94-key keyboard (see photo 5) as the Atari Intelligent Keyboard because it uses its own 1-MHz 6301 microprocessor with its own mask-programmed ROM. The device scans the keyboard and the joystick/mouse ports. It provides two-key rollover and sends keyboard, mouse, trackball, joystick, and time-of-day information to one of the 6850 ACIA (asynchronous communications interface adapter) chips on the main computer board. The lines are bidirectional, and the 6850 also sends commands to the keyboard.

The QWERTY keyboard has a standard Selectric-style layout with 10 rhomboid function keys, a numeric keypad, and four cursor-control keys. Many applications for the 520ST will use two special keys, Help and Undo. We found the keyboard layout pleasant in appearance and extremely functional. It closely resembles the DEC VT-100 layout. The Control and Return keys are well placed, and the Return key is a three-key-size reverse L shape and hard to miss. The shape of the function keys, however, may make it difficult to avoid hitting more than one.

More of a problem is the feel of the keyboard. Each keytop is ⅛-inch wider than the keytops on the Macintosh and IBM PC keyboards. As a result, the keys seem much more closely packed, and you may tend to press two at a time more often than usual. In addition, the keys on our unit required noticeably more pressure than do the keys on most other small systems. And, because connectors are attached to the rear of the unit, it is relatively difficult to adjust the keyboard.

The mechanical two-button mouse, which attaches to a port on the right side of the unit, has a resolution of 100 counts per inch and can handle a maximum velocity of 10 inches per second. It has a good feel. You will use the left button for most manipulations, including select and dragging within GEM. The right button is application-dependent. For example, NEO, a low-resolution paint program, uses the right button to copy images. There are keyboard alternatives to all mouse functions, though I suspect few of you will ever use them.

DISK DRIVES

We were impressed by the high data-transfer rate of both the floppy-disk

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drives and the hard-disk drives we tested with the 520ST. The speed is a tribute to the efficiency of the DMA custom chip and the WD1772 floppy controller. I/O is quick (no endless waiting during disk reads), and, unlike the Macintosh, you can remove disks easily at the touch of a button on the drive. The standard system currently includes one single-sided double-density drive with a capacity of 360K bytes. For $299, you can obtain a double-sided drive that can store up to 720K bytes. Setting up the drives is slightly more unforgiving than daisy-chaining on Atari's 8-bit systems in that you must use the designated in and out I/O ports on the back of the drives. Still, adding the second drive is a distinct plus. With it, you can copy an entire disk (without the four swaps required if you don't have one) in 99 seconds and copy a 32K-byte file in 16 seconds. The disk-copy operation does not automatically format the disks, which requires an additional 54 seconds for the single-sided disks.

The disk format employed is very similar (down to the file-allocation tables) to that of the MS-DOS disks used on the Data General/One portable computer. However, the formats are not absolutely identical. We took a disk from a DG/One that contained a text file and slipped it into the 520ST disk drive. The GEM desktop on the 520ST recognized the disk and showed it contained a file, but the 520ST wasn't able to open the file for printing or display. When questioned about this, Atari admitted that a utility will probably be necessary to read the files.

FLOPPY-DISK CONTROLLER

Atari didn't design the floppy-disk controller. The design team chose a chip with a built-in data separator, a modified version of the 1770 chip from Western Digital. The old chip worked with 6-, 12-, 20-, and 30-millisecond drives. Atari asked Western Digital to change some of the drives that they support, and the new chip—the 1772—can work with 2-, 3-, 5-, and 6-ms stepping speeds. Atari is using

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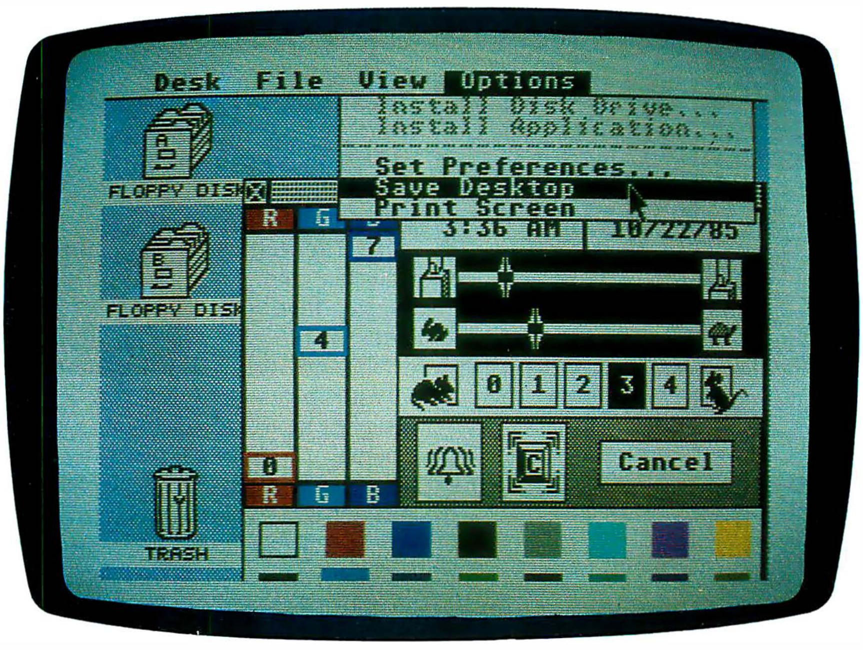

Photo 6: *The 520ST desktop in low resolution, showing the control panel and a customized background color. You can fix your choices by saving the desktop.*

3-ms drives. The chip uses the System/34 format. There is some incompatibility between the 1772 and the 765 controllers (the chip used in the IBM PC), although the format is the same.

The floppy interface will support a maximum of two daisy-chained floppy-disk drives. You send commands to the FDC (floppy-disk controller) by first writing to the DMA Mode Control register (to select the FDC internal command register) and then writing the desired 1-byte command to the Disk Controller register. The floppy controller works through the DMA controller custom chip, just as all hard-disk transfers do.

Hard Disk

Although Atari hasn't yet released its planned 3½-inch hard disk for the 520ST system, the company let us play with a 10-megabyte prototype, which transfers data at 5 megabits per second, the standard ST506 rate. Later drives will feature 15 megabytes and 7.5 megabits per second.

There is no hard-disk controller inside the 520ST. But the DMA custom chip makes for easy, fast interfacing. The AHDC (Atari hard-disk controller) will be in the hard-disk-drive unit. The DMA controller sends commands to the hard disk using the ANSI X3T9.*x* SCSI (small computer systems interface)-like command descriptor block protocol. The AHDC supports a minimal subset of SCSI commands that are sent to the AHDC in much the same way that commands are sent to the FDC. Both floppy- and hard-disk formats contain 512-byte data sectors.

Monitors

We used both the monochrome SM124 and RGB SC1224 monitors with excellent results. The color monitor supports low and medium resolution. You can use the monochrome monitor only for high resolution. All of the displays are clear, sharp, readable, and flicker-free, but we were particularly impressed by the clarity of the high-resolution monochrome.

The monitor you connect when you boot will determine the resolutions you will have available; there is only one monitor port, and you cannot unplug one and connect the other, since they have no compatible resolution. This may give some users a difficult choice, since much of the early software will work with one monitor or another but not both. For the moment, if you are interested in buying the 520ST for business or programming uses, you would be best served with the high-resolution monochrome system. Nonetheless, developers will undoubtedly make available resolution-independent software, in part because the developer's kit includes an appropriate directive.

TOS

TOS (the 520ST's operating system), including the GEM overlay, was to be in ROM and obviously would boot very quickly. As of this writing, however, it is in RAM where, in addition to taking up over 206K bytes of RAM, it requires 32 seconds to boot. Still, this leaves you with a reasonable amount of workspace until Atari releases the ROM version. In the meantime, 16K bytes of ROM (two 64K-bit ROM chips) hold the boot-up code for the computer. Four empty sockets within the 520ST await the new ROM chips.

The appearance of the desktop depends upon the monitor and the resolution (see photos 6 through 8). It has some unusual features and some annoyances, but for the most part, those familiar with the operation of the Macintosh will feel at home. The menu bar is at the top, you can use the mouse to resize and move windows and to work scroll bars and sliders, and you can click on file icons to format disks, to get directories, and to rename or get detailed information on files and folders. Like the Macintosh, you double-click on icons to open them, drag icons to copy files and disks, or use shift-clicks for multiple file copying. Undoubtedly, the most impressive aspect of the interface is the speed with which you are able to resize and move windows.

Those expecting a clone of the Macintosh interface, however, will be disappointed. And several of the differences are annoying. It takes slightly but noticeably longer to click on the boxes within the windows, and resizing, though quicker, is somewhat more awkward. For example, when you click on the Resize box, the new 520ST window automatically reduces in size. On the Macintosh, it stays the same size until you decide to alter it.

There are other important differences between the 520ST and Macintosh desktops. The trash can is actually an incinerator. Move a file or folder there and it's gone permanently. Unlike the Macintosh, whenever the pointer even touches the menu bar, you bring down the menus. To eliminate the menu, you have to bring the pointer off the menu and click the mouse button. It's amazing how often this happened to us by accident. The selection process would be much improved if only you had to press the button to select menus. Second, the 520ST desktop seems to have partitions into which icons can fit. Unlike the Macintosh, in which you can place icons where you wish, the icons have a finite number of possible locations. Third, there is no option to move files, folders, and applications. The only available options are copy and delete. Therefore, to move an icon into a folder you will need to copy it there and then delete the original. And, to move a file out of a folder, matters are further complicated by the fact that the folder opens to take over the window from which it derived. You would first have to move the file to a different disk, delete the original file from the folder, then copy the file back to the original disk but not within the folder, and then delete the first copy you made. It sounds difficult because it is.

From the current desktop, you have access to a VT-52 emulator, you can install your printer, you can configure the RS-232C port, and you can set any of several defaults on a control panel. For example, if you have the color system, you can alter the palette and thus affect, if you wish, the appearance of the desktop and other applications. In low resolution, you can modify all 16 colors from the palette of 512; in medium resolution, you can modify up to 4. You can also set when and at what rate the keys will repeat with the keyboard response selectors, you can alter the double-click response time, and you can activate or deactivate the keyboard click and the pleasant-sounding error warning bell. However, there are few editing amenities when resetting the time and date, a small annoyance since the 520ST has no internal battery maintaining the clock. Most of the time, you will have to type in the entire date and time string.

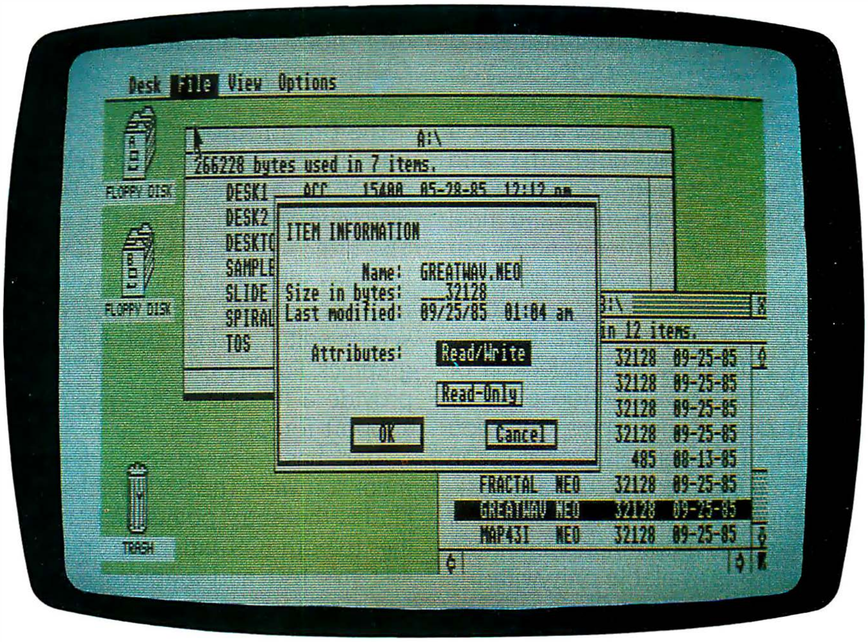

Photo 7: *The 520ST desktop in medium resolution. Icons are the default, but you can easily set your preference to text.*

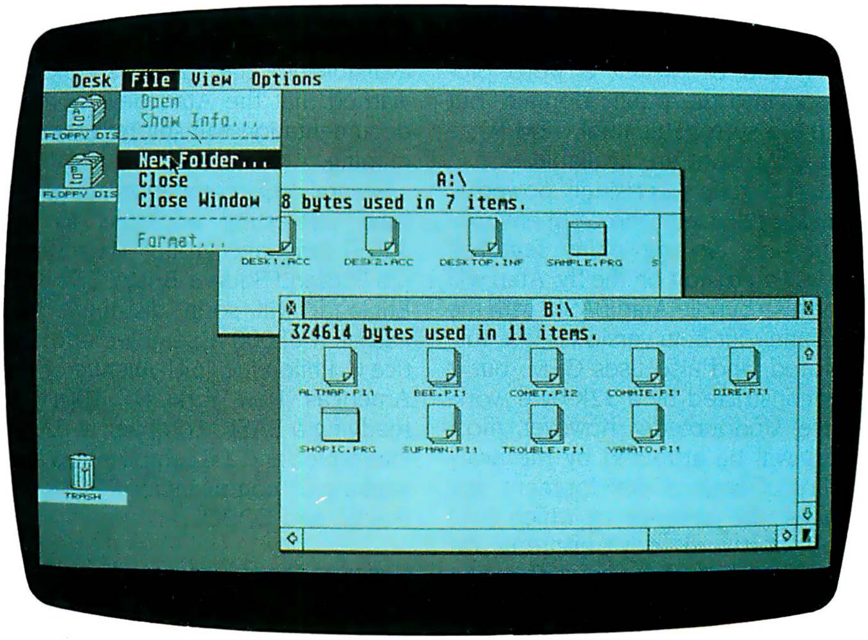

Photo 8: *The 520ST desktop in high resolution.*

(continued)

The RS232 Port Configuration window lets you fix the data-transmission rate, XON/XOFF, the parity, duplex, and the number of bits per character. The Install Printer window allows you to select between dot-matrix and daisy-wheel, between black-and-white and color, between draft and final quality, and the number of pixels per line. A Set Preferences window allows you to set the screen resolution, though your choices here are obviously limited by your selection of monitor. You can also choose not to confirm deletes and copies. Once you have set all your preferences, you can save them by selecting the save desktop option. The only absent option of importance is a command-line interface, which is available only with the 520ST developer's package.

SOFTWARE

The system comes bundled only with TOS and Atari Logo, and like other new systems, there is at present a dearth of software. Already, however, Atari has released NEO, a paint program, and ST Writer, a word processor, into the public domain, but both are surrogates until GEM Write and GEM Paint are available.

Atari Logo is surprisingly powerful. It makes full use of the GEM environment and, among many features, allows you to edit on the fly. Atari will soon also bundle Atari BASIC with the machine. Our beta version is fast, full-featured, and also uses GEM, but it was constricted by a 32K-byte workspace. Undoubtedly, however, most users will be attracted by the availability of serious development languages, the absence of which held back software development on Apple's Macintosh for most of its first year.

TDI Software Ltd. (29 Alma Vale Rd., Clifton, Bristol BS8 2HL, England) has released Modula-2/ST, a 32-bit development system that includes an editor, compiler, linker, and library facilities. TDI's Modula-2 is a full implementation, has complete libraries for TOS, and provides full access to the 520ST's graphics features. TDI is also marketing a version of UCSD Pascal with the p-System, which, however, does not include support for GEM. Both TDI products cost £195 each.

The Dragon Group (148 Poca Fork Rd., Elkview, WV 25071) has released 4xFORTH, a series of 32-bit FORTH development systems for the 520ST. The basic 4xFORTH system ($99.95) includes support for multitasking and multiuser access, a compiler, a full-screen editor, and support for 520ST graphics. For $149.95, 4xFORTH also provide a floating-point system and support for GEM calls.

Atari has released its C development software. The $300 package includes the entry points and C bindings to both TOS and to the operating system's text and graphics routines (such as text size, attributes, alignment, and angle, as well as circle drawing, area fill, and bit-blitting). The documentation also provides the "Hitchhiker's Guide to the BIOS," information on Kermit and MIDI, a C programmer's guide, and much more. Purchasers of Haba's Hippo-C, now available for the 520ST, should be warned that the Atari development documentation will still be essential reading.

Several other companies are promising interesting additions to the 520ST language group. Metacomco (26 Portland Square, Bristol BS2 8RZ, England) will soon distribute ISO Pascal, a 68000 assembler, and Lattice C. Philon Inc. (641 Avenue of the Americas, New York, NY 10011) is readying a BASIC compiler, a BASIC interpreter, and a C compiler. It is also working on compilers for FORTRAN, Pascal, and COBOL.

SYSTEM DOCUMENTATION

It is fortunate that the system is so easy to learn to use because the documentation is quite poor. The 80-page owner's manual has requisite sections on setting up the system, getting started, touring the GEM desktop, and managing disks, files and folders, but it has very little technical material. Materials with the disk drive and monitors are also sadly lacking. Undoubtedly, users will have to wait for the trickle of technical references on working with the hardware.

CONCLUSION

Judging from the conversations around the office and on BIX (BYTE Information Exchange), CompuServe, and The Source, there is a storm of interest in comparing the relative capabilities of the 520ST, the Amiga, and the Macintosh. There is, in fact, far more interest than there seemed to be in comparing the merits of the 8-bit computers from Atari, Apple, and Commodore. An upcoming special edition of BYTE on the 68000 will make comparisons of processor and application speeds, ease of development and portability, and user interfaces, but we are still left with our conclusion that these are very different machines, with very different markets.

The 520ST is an architecturally simple 68000 computer with high-quality video output and a high-speed DMA port. The easiest way to summarize our first look at the hardware is that the 520ST presents the 68000 unbounded. Not only does it offer an excellent price/performance ratio, but we expect it to produce some impressive benchmarks on tasks with heavy computation.

The 520ST's complete keyboard and impressive array of ports add up to an attractive system. Finally, the 520ST's use of standards (for example, 68000, MIDI, Yamaha sound chip, and Western Digital FDC) should make it easier to program, expand, and manufacture.

There are also the promised cheap, powerful peripherals: a 10-megabyte hard disk for $700, a ½-gigabyte CD-ROM optical disk for around $500, and a 1200-bps modem for $150.

The Atari 520ST is certainly an excellent value. For the moment, there is not much application software and you still have to deal with an unfinished operating system; but with the current availability of several high-level languages, the 520ST will undoubtedly provide many users with what they seek—a means to tap the power of the 68000 at a price they can afford. ■