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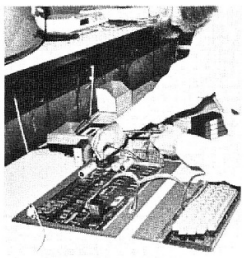
The Remarkable Apple Computer

Aside from having impressive credentials within the hobbyist community Sheila Clarke writes in an easy comfortable manner that isn't much different than just sitting and talking with her. If you'd like to join her during a recent trip up to San Francisco and walk along while she takes you on a tour of the Apple Computer . . . then, by all means, read on — John.

Once upon a time the decision of moment was whether or not to buy a computer. With a couple of kits to choose from, the only remaining problem was whether or not you could afford it. Thousands have joined the ranks of hobby computing, and many more systems have been introduced into the computer community. There are now enough choices to boggle any newcomer's mind. With three basic microprocessors (8080, 6800, and 6502) built into over a dozen popular computers (few of which are really inexpensive), a system becomes even costlier after adding I/O devices and accessories.

The picture has expanded far beyond our ability to make a simple choice, and the beginner to personal computing has my sympathy. I therefore offer the bombarded shopper a few parameters within which a choice might be made. First, consider how much you can afford to spend. Then decide *what* you're going to do with your computer. If you concentrate in these two areas, let's presume that you would like to spend a minimum (around $1,000 for everything) to obtain a complete, reliable system. Then figure that you want to use your computer to do one of three things: learn about computers from the ground up, play games, or program in BASIC or assembly language. And you want to start now . . . not three months from now when your kit is finally assembled and working and your hair is gray from aggravation.



Steve Wozniak tests an Apple-1 fresh from burn-in.

If your needs fit those mentioned, we've found a computer that doesn't appear to sacrifice quality and performance for low cost, nor does it require you to be an electronics expert. The Apple Computer, using the 6502 microprocessor, is a complete system on a board. Complete that is if you're willing to forego extras now, like hard copy output, floppy disk storage, and color graphics. But then we're talking to those who want maximum capability for minimum cost in time and money. Owning the Apple doesn't require you to be either an electronics buff or a millionaire.

What You Get for $666.66

The PC board includes the 6502 microprocessor, a video terminal, 4K bytes of RAM with room to add 4K more, 4 regulated power supplies, keyboard interface and a hex monitor in PROM. The board, measuring 9" x 15½", is solder masked, wave soldered, tested, and guaranteed to work.

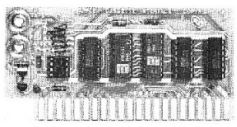
What You Need to Make It Go

You'll have to add to your initial purchase an ASCII keyboard, a video monitor (or your own TV set), and two transformers. If you use your own television, a simple modification is required, like a Pixe-verter or switch box and an rf modulator. The keyboard at approximately $90, two transformers at perhaps $12, and devices to convert your own TV at about $20 will bring your total investment to $788.66. If you must purchase a black and white monitor, add the cost to the system; but you'll probably run over my proposed budget.

Mass Storage?

Aha! Maybe you're getting greedy, expecting a lot for a small investment. But Apple recognizes the need to retain programs and offers a 2" high

Cassette interface card (ACI) is only two inches high. It comes with a tape of Apple BASIC, ready to plug in.



Shown here is the Apple System being used by the Apple Computer Company to test programs and PC boards. With the Apple-1 is a Datanetics keyboard and a Panasonic Tape Recorder. Notice the single, small transformer the system uses. Hopes are that's the one the system will use in the future, rather than the two called for now.

cassette interface (ACI), assembled and tested with a tape of Apple BASIC for $75.00. The card plugs directly into the connector of the Apple-1. If you don't have a tape recorder, most inexpensive models will do. Apple Computer Company recommends using a recorder with a tape counter; their choice is the Panasonic for less than $40. That brings the total cost to $903.66, and we're still under $1,000 for an operable system with a storage device.

Using the Cassette Interface

Connecting the cassette consists of plugging the 2" board into the upright connector of the main board and running cables between the ACI and tape recorder.

The cassette program, contained in two PROMs, runs at hex address C100. It's fast, reading and writing data at about 1500 baud (or 20 seconds for a 4K program). Using the program is as easy as hitting a W for write and an R for read. Execution begins after carriage return (CR), and the cassette program returns control to the system monitor after completion of a read or write execution. The ACI can read and write multiple address ranges. The program provides clear leader prior to memory data by giving 10 seconds of all ones, making it unnecessary to purchase leaderless tape. For the inexperienced, getting a program up seems to have been made relatively simple.

Expansion Memory

Although the Apple-1 comes with 4K bytes of onboard RAM, 4K more is available for $120. Since few programming hobbyists are satisfied with 4K bytes only, let's decide that 8K bytes of memory is a pretty good start, putting us just a hair over our budget at $1023.66. (I've never been able to keep strictly to a budget anyhow.)

The PC board contains a 44-pin edge connector, to which may be added up to 65K. It also includes the entire data and address buses, clocks, control signals and power sources, available at the connector. Additional memory is expected to double in capacity when the new 16K chips become available. Anticipated arrival is the first of '77. Since the PC board was designed with this in mind, converting the Apple to accept the add-on memory requires simple modifications involving perhaps three wires. Any Apple dealer should be able to help with the updates, I'm told.

Double the memory!
It's on the way-
Hopefully by early '77.

Getting It Together

The Apple-1 is sold at computer stores around the U.S. Dealers can provide the keyboards, transformers, monitors, and, of course, Apple accessories. More important, they can help put together the necessary components to get the system running. The Apple folks tell me they'll be spending some time with each of their dealers updating them on Apple's finer points, so the information can be passed on to you.

I've talked with at least one dealer who's offering the Apple completely assembled, including keyboard, video monitor, Apple BASIC and the extra 4K RAM, for $999 (Rich Travis, dealer of Sunshine Computer Company in Carson, CA). That's a better break than trying to assemble the separate pieces yourself. Others may be doing similar packaging.

If there is no dealer near you, you can write Apple directly. But without benefit of a dealer's help, we suggest you locate a friend who can give the necessary assistance to assemble the system and get Apple BASIC up for you.

For the Experimenter

Although we've been talking about low budget requirements for the newcomer and a computer for the guy who needs a minimum operating system, the kit hobbyist hasn't been forgotten. A breadboard area is included on the PC board to accommodate special and experimental requirements. For instance, if your keyboard has negative logic DATA outputs, you can install 7404 inverters at the breadboard area using the design suggestions in the Apple Operation Manual. Or, if your keyboard

is not equipped with upper case alpha lock (since the system monitor requires it), you may follow one of the circuits suggested in the manual and build your own.

Operation Manual

It is small; since minimal assembly is required, the necessary hookup instructions cover a mere page and a half. Several more pages cover the 6502 Hex Monitor instructions and listing. Section III discusses expansion of the Apple system and includes three complete schematics. The diagrams are for the terminal section, the processor section and the power supply. The entire manual is only 12 pages, but someone familiar with electronics who wishes to experiment with a low cost system might find the Apple a good beginning.

Using the Apple

"BASIC is the language of the people", say Steven Jobs and Stephen Wozniak, Apple Computer Company owners. Soon, they add, people won't care which chip is used in the CPU, but will want to know more about the computer's capability and how easy it is to use. They tell me Apple BASIC is the only 6502 BASIC around (except Tom Pittman's Tiny BASIC). Apple BASIC is included free of charge with the cassette interface. Forthcoming programs and updates will also be available at no charge to Apple owners. Apple users will have to keep their eyes open for new programs though, by checking availability through dealers, and public announcements. That's because the Apple Computer Company has no plans to formally advise their customers of new software. As an example, they have written a disassembler which is available to everyone who bought the September issue of *Interface Age*. Their floating point package, though not yet included in Apple BASIC, is available as published in *Dr. Dobb's Journal*, Vol. 1, issue 8. Incidentally, I've been assured that the floating point package will be built into Apple BASIC by the first of 1977.

> The Kilobaud Software Library will undoubtedly have its share of 6502 software.

Before we get into some of the features of the current version of Apple BASIC, you'll probably want to know about other programs now available for the system. Along with those listed below, dealers are generating additional programs. Specifically, Bob Moody of the Byte Shop in Palo Alto, California, has been contracted by a customer in Canada to develop several games. It's possible that before long, a network of program exchange could happen between dealers who now handle the Apple. (And, of course, the *Kilobaud* Software Library will undoubtably have its share of 6502 software.) Programs and games now available include a disassembler, the floating point package, Blackjack, Hamurabi, Lunar-Lander, Mastermind and Star Trek.

A preliminary 14-page Apple BASIC Users Manual was issued in October. Here is a brief rundown of the material it covers. After it describes how to load BASIC and what the abbreviations mean, it goes on to briefly discuss:

- Reading and writing BASIC programs on tape
- Program execution
- Numeric representation
- Variables
- Expressions
- Arithmetic and relational operators
- Functions
- Arrays
- Strings
- Substrings
- Destination strings
- LEN Function
- String if statement
- BASIC instructions
- Commands
- Statements
- Error messages

A few of the Apple BASIC features, along with those usually found in BASIC programs, include:

- Line at a time input
- Multiple statements per line separated by colon (:)
- Immediate execution mode
- CLR command clears symbol table without destroying program
- Each line checked for syntax error on entry
- Full error messages; e.g., SYNTAX ERR, rather than SN ERR
- DEL deletes specified line or lines
- Direct memory read/write
- Space savers like: NEXT I,J,K rather than NEXT I, NEXT J, NEXT K
- Runtime errors stop program and notify user of error and line number

The above lists only a few of the features, but this version is admittedly not as powerful as it will be once features such as read/data, transcendentals and other input commands are added. Apple also has a trace program which, I'm told, is very fast. The disassembler prints out in mnemonics. All programs are available on cassette for the cost of the blank cassette plus handling ... approximately $3.

Future plans include putting all programs in ROM to be available as an option. They'll also duplicate any program a user wishes, free of charge.

System Monitor

Apple's monitor is a PROM program written in hex. There are no front panel switches on the Apple ... all the user does is hit the RESET switch to enter the program. Commands are typed a line at a time, and each line may consist of any number of commands up to 128 characters. Typing RETURN executes the command. It backspaces when you type SHIFT-O and hit the backarrow. ESC cancels a line and echoes a slash-return.

The operation manual explains that: (1) one or more hexadecimal digits are used for address and data values; (2) addresses use the four least significant digits of a group; (3) data values use the two least significant digits. Commands enable you to:

- Examine contents of a single address
- Examine a block from last examined location to specified one
- Print a block of memory using single command
- Examine several locations at once
- Examine several blocks of memory at once
- Examine successive blocks
- Deposit data in a single location
- Deposit data in successive locations from last one used in a deposit command
- Combine the two previous items into a single command
- Deposit data in successive locations with separate commands
- Examine a block, then deposit data into it
- Run program at specified address
- Run at most recently examined location
- Enter a program into memory and run it in one line
- On-line error correction

Monitor routines which may be accessed by user programs

Of course there's a great deal more, and we didn't mean to imply that it could all be listed here but hope that this preview gives you an idea of the possibilities. Later we'll discuss opinions of dealers and Apple owners.

Apple Accessories

If lack of support hardware produced by other manufacturers keeps you from choosing the Apple, maybe you're spoiled! The makers of the Apple are designing peripherals to fit their system, specifically, and intend to continue the economic design throughout. I'm held to secrecy until they're ready to ship, but you can look for accessories, or small peripherals, that'll fall into the $50 to $100 range and will easily connect to the Apple-1. I *can* tell you about the enclosure to be offered very soon as an option. Actually two cases may be available. I saw a walnut prototype that will house the mother board and keyboard in a one piece low profile unit, atop which will sit the monitor. The cassette will hook up at the rear. A more economical metal version will also be available. Some computer stores that now sell the Apple assembled and running are expecting to include the package in the case for one price.

If not having a hard copy device seems a deterrent, Steve Jobs has written an article describing how to interface the Apple to the Southwest Technical Products printer. So although they're not yet making a printer available, they're not keeping a secret as to how you can achieve one.

Transformers are not being provided with the Apple-1, as Jobs states, because they're inexpensive by themselves, but cost as much to ship as does the entire computer package. They feel purchasing the transformers is a relatively simple matter. Some dealers don't mind stocking them. Others feel it's a drag. Regardless, Apple is having a special, single transformer produced that is smaller and will replace the two originally called for.

Apple Philosophy

"We're not in the business of making things more expensive," say Jobs and Wozniak, when discussing their design philosophy. They feel they've demonstrated the opposite by using fewer components and ICs in a tight design. The same designing technique is reflected in the cassette interface. Recent buyers of the Apple have attested to its quality and reliability.

Dealers Applaud

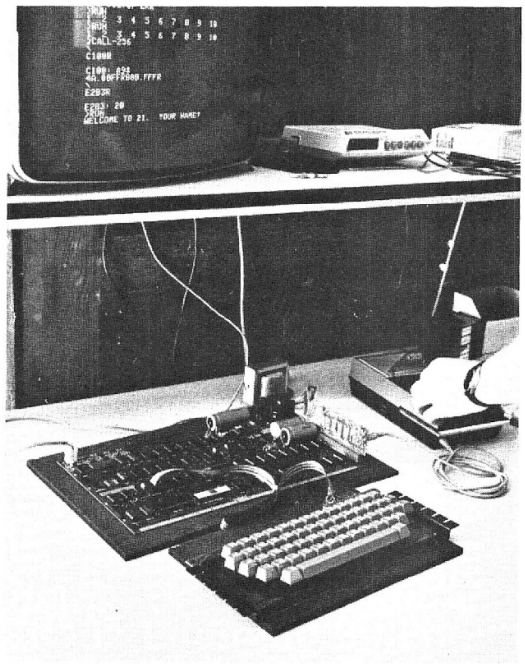
Rich Travis of the Sunshine Computer Company in Southern California reports he sold ten Apples in three weeks to hobbyists who preferred the 6502 mpu. His customers were looking for a complete, ready-to-run system that was inexpensive. I'm not plugging anything or anyone ... that's exactly what Rich told me. But he makes the Apple easy to buy. For $999 he puts it together with the two transformers, a Sanyo monitor, a Datanetics keyboard, all connectors and the additional 4K RAM. He and his customers agree that the Apple is extremely well designed with high quality components. Their response has been very enthusiastic with no failures (hardware, that is) reported to date. The only difficulties encountered have been in using Apple BASIC. The feeling is that the program is not yet powerful enough to be truly useful and will be greatly improved with the introduction of the floating point package. Although the limited BASIC doesn't yet permit the elasticity, it is expected in time to be complete enough to overcome those objections, allowing the new owner to take the computer home, plug it in, and proceed with whatever application is desired.

Steve Jobs, reflected in the monitor's glass, is loading Blackjack to demonstrate Apple BASIC.

The Home Computing Novice

Barton Phillips is neither an electronics technician nor a programmer. He's a production manager in documentary films, and perhaps is the type of computer hobbyist that the Apple Computer Company assumes will buy their product. I listened to his opinions with interest.

For the money Barton feels it's the best computer system he's seen. His previous experience included the HP-25 and the KIM. For well under $1,000, he says, he had the PC board, TV, keyboard, and cassette. Forty-five minutes after getting it home he had it running. After playing with his computer for a month though, he does have a criticism that might be expected of a novice to home computing. Barton is frustrated with the documentation. As a newcomer to programming, he needs to see program examples and would feel more secure with indications of the memory map and RAM locations. For example, he makes the following suggestion. In the manual, it is explained that LOMEM= (expression) sets the boundaries of memory on the low end (he thinks). The manual actually says, "sets the low memory boundary for user programs ..." And all Barton is getting is that it's set at 2408 in decimal and 800 in hex. But he doesn't really know what that means. Or, the CALL, POKE and PEEK statements could use more explanation and detailed examples because they are not standard BASIC commands. He feels he's spending more time than necessary, but realizes that the Apple BASIC and its documentation are still at an interim stage and will probably end up being a very powerful BASIC. Meanwhile, he gropes for discovery and enlightenment. Some might advise Barton to



find a programmer friend, or take a class in preliminary BASIC. Others might take his side and also wish to see more explicit documentation. We'll leave it for you to decide whether you have sufficient programming background. I think Barton has a lot of guts and will get it all eventually, the hard way.

Despite his difficulties, Barton Phillips says he would buy the Apple again, even if it included *no* paperwork. Although he feels the software documentation leaves something to be desired, it's "an absolutely super piece of hardware." And when he needed help, the service provided by the manufacturers was first rate.

For You to Decide

There are other drawbacks now to owning an Apple. Especially if you want to share and exchange programs or do some of the things other systems have been doing for a couple of years now. Steve Jobs confesses that the Apple is not for everybody. Steve Wozniak says they're not trying to please everyone who might buy a computer, and he realizes they can't. But compared to perhaps an IMSAI at $2,000 with features similar to Apple's, an owner will have less than $1100 invested. Eventually he will have similar expansion capabilities. Admittedly it won't do everything, but the potential is there. Not the least important is that the two Steves care ... they're responsive to user inquiries and are open to suggestions and criticisms (to a point). Because the Apple is really easy to buy and use, the system may well be in the homes of several hundred hobbyists within a few months. Then objections to limited program exchange will be overcome. In time enough peripheral devices will augment the system to overcome those objections, too.

Gee, if there weren't so many computers around here already, I might consider ...■