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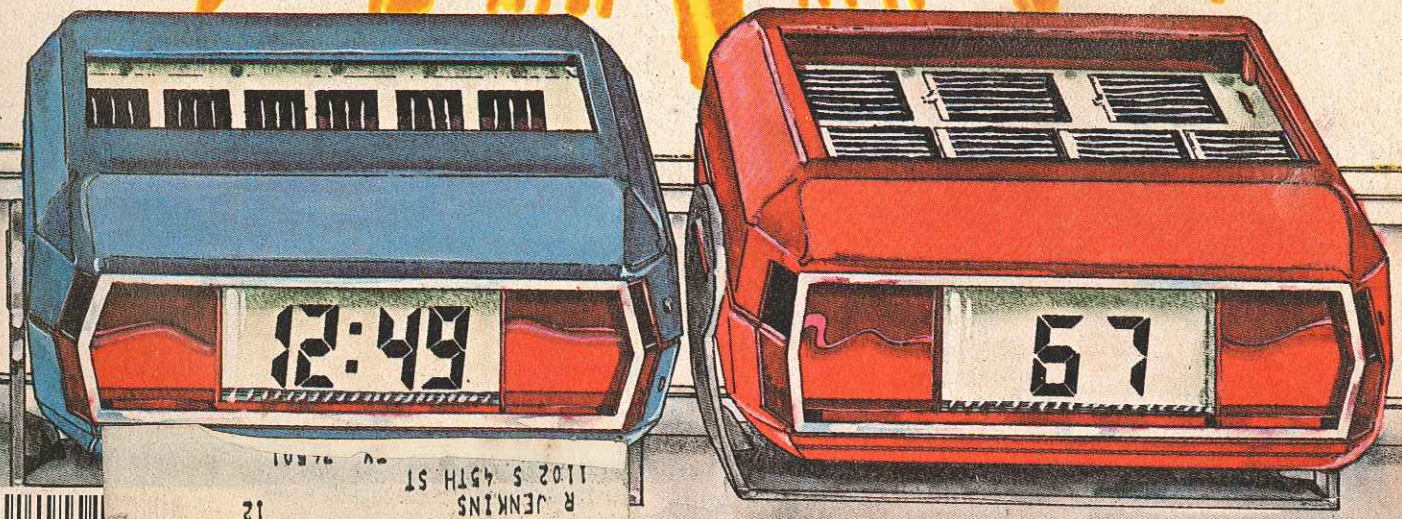

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APPLE II Computer System

Basic Guide to Computer Buying

DID YOU know that there are more than 120 companies now manufacturing home computer equipment? And 60 of them actually make computers themselves. Moreover, most provide a bevy of options, while some offer a range of radically different models in their product lines. It's no wonder, then, that buying a home computer system is such a bewildering experience for so many people. So let's establish some sense of order for the buyer to follow in this chaotic, new marketplace.

STEP I

The first step in buying a computer for personal use is to decide whether: (a) you want to build one from a kit; or (b) you want to purchase a wired, checked-out system.

If you choose approach (a), you can save about $200 to $300 on machines that sell for about $900 in wired form. That's a fat savings, but you substitute assembly time and face some possible frustrations and delays if the final product doesn't work properly the first time you use it. You do, though, gain a better idea of how the unit goes together (useful for further modifications and servicing) and have the pleasure of "rolling your own." It's not all that difficult, either. Assembling a microcomputer is easier than building an audio preamplifier.

Whatever your decision, you will have eliminated some confusion since some manufacturers offer *only* wired models, and others offer *only* kits. Many makers offer both versions, of course. Interestingly, there are slightly more wired models available today than there are kit models; but this does not necessarily reflect the number of units sold.

STEP II

The next decisions you face are: "What kind of home computing do I want to do now and in the near future?" and "Will I want a basic system that can be expanded indefinitely, or one which is pretty complete and ready to plug in and use as soon as I get it?" Your answers to these questions will help you evaluate the many types of systems available.

If, for example, you want to experiment with and learn about computers and their inner workings, with little concern for large-scale data-processing, you can get a *tutorial system* for as little as $100. Examples are National Semiconductor's SC/MP, RCA's COSMAC 1802 (as used in PE's "Elf" computer), MOS Technology's KIM-1, Paia's 8700, IMSAI's 8048, and E&L's MMD-1. Such systems usually have calculator-type keyboards for input of programs written in the computer's own "machine code," in either hexadecimal (base-16) or octal (base-8) numbers. Some systems have batteries of switches instead. Readout is most often on seven-segment LED's.

Despite their similarities, such systems differ widely in their capabilities. The "Elf" has graphics capability, IMSAI's 8048 has on-board relays to control household devices, and the E&L MMD-1 has a "breadboard" area for experimenting with computer circuits. Some systems even provide for future expansion and the use of high-level programming languages such as limited BASIC; examples include KIM-1 and SC/MP.

These all-on-one-board computers can easily be confused with the "single-board computers" sold for engineering development use, such as the Motorola "Exorcisor" and Intel "SBC." These are less complete, lacking keyboards and readouts.

Chances are, that you'll learn more about computers with the tutorial type than types discussed later, though tutorial systems are less convenient to use and expanding them into full-blown computers can eliminate their price advantages. Since they usually come without enclosures, they're not easily blended into your living room decor, either; but they do give you a great start in hobby computing with only a small investment.

Programming in machine-language, as you must with most tutorial computers, teaches you a great deal about how the computer works; but it's a slow, demanding process. If you prefer to use a high-level language such as BASIC for writing and running useful and/or entertaining programs, you'll probably want a computer in the next major category: *mainframes.*

These may be likened to separate stereo components—a main power amplifier (the mainframe itself) a separate preamplifier with controls (the terminal) and so on. Most of the full-blown home computers sold today are of this type. It offers the greatest equipment-selection flexibility: BASIC language, internal memory expansion, provisions for plugging in a video terminal, printer, video display module, floppy disk, etc. This is where the home computer industry first started, with the introduction of the MITS "Altair." Here one also finds a myriad of different brands, including Imsai, Heath, Cromemco, The Digital Group, Southwest Technical Corp. and Polymorphic, among many others.

Mainframes are usually built around a *motherboard*, with slots to hold perhaps a dozen or more additional circuit boards. Most commonly, these boards will hold additional memory, allowing the use of longer programs and the handling of more data, or extra "*I/O*" (Input/Out-

put) ports for connection of such peripherals as printers and terminals. But you'll also find boards to display the computer's output alphanumerically or graphically on a video screen, to control external devices, to communicate with other computers by telephone, to accept vocal input or give "spoken" output, to play music, to measure frequencies or temperature, to tell time, and to read or write PROM's (memories which don't "forget" their programs when the computer is turned off).

Some mainframes have *front panels* chock full of lights and switches, while others are essentially devoid of them except for "power" and "reset." The switches allow one to program the computer directly—a laborious process, but better than nothing if you don't have a separate terminal. They're an aid in troubleshooting, though. With switchless front-panel machines you must have an external terminal. Otherwise the computer cannot be used. Usually, this host of front-panel switches raises the price of the mainframe. A few manufacturers, however, charge more for "*turnkey*" models without front-panel operation.

The next type is the all-in-one computer, such as Processor Technology's "Sol," Apple Computer's "Apple II," Radio Shack's "TRS-80," Compucolor's "8001," Ohio's "Challenger," and Commodore's "PET." The PET is a true all-in-one, coming with a built-in 9-inch black-and-white video monitor, keyboard and audio tape cassette machine for program storage. Compucolor's $2750 computer terminal features a 19" color video display, full video terminal, 8-track "Floppy Tape" cartridge and a keyboard in a separate housing. The other machines mentioned have built-in keyboards but require separate TV monitors. Therefore, some of these models may be compared to the hi-fi industry's stereo FM/AM receivers, while others could be likened to integrated amplifiers or control amplifiers.

What you gain with a computer of this type is neatness and physical simplicity. Naturally, you trade off some choice of video monitor or keyboard and may wind up with less internal space for the addition of more memory or other module boards. Also, except for "Sol" and "Challenger," the computers in this group are not available as kits.

STEP III

Program support is vital. Without programs, you can't run a computer. And writing your own programs, even if you already know how, can be time consuming. Most computer manufacturers offer a number of programs for their computers. Moreover, other sources make available such "software."

Programs written for other computers can be adapted for yours if both computers are built around the same microprocessor unit (MPU). So program availability is partially a function of your MPU's popularity. The 8080 is the most popular MPU, used by about 21 manufacturers, at last count. This is followed by the 6502 and Z-80, which have garnered about 12 companies each. (The Z-80 can also use most 8080 software, but not vice versa.) The 6800 follows with 7 companies, while the 1802 has 5 computer makers using it. The SC/MP is used by two companies. Others, such as the LSI-11, are only supported by one company in the home computer field.

But numbers alone don't tell the whole story. It makes a difference which companies support each chip, as well as how many companies do. Models with Intel's 8080 are offered by MITS, Processor Technology, Heath, IMSAI, Polymorphic, Parasitic, HAL, Compucolor, and Vector Graphic, to name just a few. The Z-80 (from Zilog, a group of designers who broke off from Intel)has Radio Shack, Cromemco, and Technical Design Labs, among others. Motorola 6800 users include Southwest Technical Products Corp (SWTPC), MITS and M&R. The MOS Technology 6502 and its closely-related 6503 are incorporated into computers from Commodore (MOS Technology's parent company), Ohio Scientific, Microcomputer Associates, and Apple, with more joining them. RCA and Netronics are among the companies using RCA's 1802 in kits.

The LSI-11, used only by Heath, is made by Digital Equipment Corp., the leader in the commercial minicomputer industry. It employs the same programs as DEC's PDP-11, which means there is a great deal of very useful software already available for it. The SC/MP, too, is supported by a major manufacturer—National Semiconductor Corp.—which makes the chip and also provides great support for it.

Mainframe producers do not always supply wholly satisfactory documentation, but such information can be expanded by seeking out other sources such as the chip manufacturer and a variety of available texts.

There are some MPU's not noted because there aren't enough end-users to make computers based on them wise choices for most hobbyists. It's helpful to have plenty of users like yourself who can get together at a computer club and exchange operating, modifying, and servicing ideas, as well as trading of programs and discussions about the latest hardware and software. However, there are many new models that will eventually have many users.

At this time, there are more 8080-based computers in use among hobbyists than any other type; probably more than half of the total. (A Homebrew Computer Club 1976 survey of 100 members found 53 using the 8080, for example.) As a consequence, the 8080 has hung on for some time now as the MPU employed by many computer manufacturers. Other types, however, are indeed making inroads. The 6800-based machines appear to be an easy second in numbers already in the field. However, don't sell the other MPU's short. As the market expands, more software will become available for them.

Aside from program support, the choice of MPU makes surprisingly little practical difference to the average hobbyist. Choosing a computer for its MPU is like shopping for a car on the basis of its engine—usually, you first find the car you're interested in and then, perhaps, give some consideration to the engine. But since some readers are intent on weighing the various MPU's, let's briefly explore them:

The computing "power" of an MPU chip is a function of the number of its internal registers, its speed, and the size of its instruction set. More registers and more instructions mean you can shorten your programs by doing directly, in one step, operations which might take several steps otherwise.

Speed is not very important in most home computing applications. The difference between an average-speed MPU and an extremely fast one will rarely be obvious unless you're either running very long, involved programs or using the computer to control a device whose status changes rapidly.

Some MPU's require as many as three different supply voltages; others require only one. The number of power supplies needed will influence the cost of the computer and the time required to build it from a kit.

STEP IV

Another factor that may or may not be important to you is the computer's *bus structure*. This is the system of leads that carry signals and power to various parts of the computer. The first powerful hobbyist computer, the Altair 8800, uses a 100-pin bus with its 8080 MPU. Manufacturers of add-on equipment who moved into the field naturally made

module boards that mated with what was then the only hobby-computer bus. Computer mainframe makers who subsequently entered the hobbyist market with 8080-based machines also used the "Altair bus," calling it the "S-100" bus. Even more module boards were made for it. Thus, today, there is a wider range of module boards (for memory expansion, vocal interfaces, etc.) that can plug into this bus than into any other.

Bus pinouts have to match, of course, so the 100-pin plug-ins cannot be used on a computer with a different bus structure, such as SWTP's 6800 model, Radio Shack's new entry, Heath's recently introduced computers, or others that utilize different bus systems. Many of these companies have their own lines of module boards and peripherals to match their mainframes. Aside from the 100-pin bus, only SWTP's 6800 computer has drawn the attention of add-on manufacturers thus far. Other buses will probably attract multi-manufacturer support in time.

STEP V

The keypads or switches of tutorial or front-panel computers are useful for machine-language programs. But if you want to use a high-level language such as BASIC (which is much easier to learn), you'll need both a means of loading the program that lets the computer understand BASIC and a typewriter-style keyboard to address that program once it's in.

The program loaded will stay in the computer unless the computer is turned off or there is a blackout. More and more hobbyists, however, are paying an extra buck to have BASIC in ROM so that it will not be eradicated in the event power is shut down. This is sometimes called "firmware" as opposed to "software," which is what tape would be called.

There are different levels of BASIC, each usurping some of your computer's memory (which costs about $40 or so per kilobyte). The more memory it requires, the greater the instruction and data-handling power it provides. Tops is 12k, followed by 8k, 4k, and 2k (called "Tiny BASIC"). To this you should add at least 2k more memory for your own programming use.

Most mainframe manufacturers have a form of BASIC available. Some are better than others. Also, the language differs slightly from one manufacturer to the next. As a result, if you run someone else's program based on another brand's BASIC on your computer, you'll have to do some editing. This sounds easy, but it could be very frustrating as you search for the correct command. For example, on one form of BASIC, the word "CLEAR" is used to wipe out whatever programs are in memory. In another BASIC version, the word is "NEW." This is another reason why many computer hobbyists band together in choosing a particular model. It makes it easier to trade software.

STEP VI

There is a *potpourri* of other factors to throw into your computer buying evaluations. For example, you will probably run out of memory in time—no one ever seems to have enough memory. So look ahead if you've gone past the tutorial-type computers, to the day you will require more memory. Check how much can be added inside the computer (usually by plugging more memory boards into the motherboard) and, if that's limited, whether more memory can be added externally.

Given some practical computer operating experience, you'll surely want some means of *mass storage* for storing programs outside the computer. This protects you from having your programs wiped out by a blackout or a blown fuse, and allows you to write and store more programs than the computer could possibly hold at once.

Here you have a choice of a paper tape reader/perforator, an audio cassette interface, or a floppy disk. There are many different cassette storage methods, each, of course, incompatible with the other. For example, there is the "Kansas City Standard" that's not really a standard but used by many hobbyists. Then there's the "Tarbell" type, which is much faster than the KC method. And a few manufacturers have their own special audio tape cassette systems for recording data. Here, too, it's best to check your friends or local computer stores to see which one is best to use in your area for program exchange purposes. Floppy disks are the most useful, but also the most expensive. Even if you own one you might also want a cassette or paper tape system for program interchange. Most hobbyists don't move up to "floppies" till their systems are quite far along.

For high-level languages, you also need a keyboard (separate or on a terminal), and either CRT or printer output. CRT terminals are quieter, faster, and don't use up paper. (But printers give you a permanent record.) Check CRT's for number of lines of text on screen—the more the merrier. Cursor control and page mode help you edit, too. For both printers and CRT's, check the number of characters per line (again, more is better). If you need both capital and lowercase letters, get a terminal whose "character set" includes 96, not just 64 different ASCII characters. (Don't confuse this with the number of characters per line.)

STEP VII

If you have an opportunity to view computer equipment you're considering buying, there are a few other things to look for. For example, check the keyboard to see if you like the way it performs; listen to the noise level the microcomputer produces (some fans can be very noisy); check a video monitor for reading ease (both size and resolution). If it's a kit, check the assembly instructions to see if they're clearly written and satisfactorily illustrated.

We won't belabor cost here, because that's a judgement *you'll* have to make. It's your pocketbook. But do weigh in all the factors so that you get the most value for your money. There's no set weighting factor for each consideration simply because every person probably places more value on one factor than another—whether it's appearance, the ready availability of program tapes, service, what most of the local computer hobbyists own or plan to buy, and so on.

STEP VIII

Lastly, the manufacturer's reputation should be considered. Has the company been in business for many years? This is a new field so many will not have been, but a company that has been around for awhile evokes a feeling of confidence. Is there a local service center for warranty or out-of-warranty work? It's always nice to be able to talk to someone eyeball-to-eyeball if necessary. Besides, who wants to pack and ship a heavy, bulky product across the country if it can be avoided? Can someone at the factory be reached by telephone in the event of a problem? And if so, are they courteous and helpful? Is the company's general image a good one, as judged from its advertising and promotional literature, and from talking to computer store personnel and computer hobbyists? Balance your judgements with care, though. Some companies don't offer especially good communications with customers, but make up for it in very good product value.

One final word—get a copy of our latest annual, the 1978 ELECTRONIC EXPERIMENTER'S HANDBOOK. It includes a complete home computer product directory for mainframes, peripherals and module boards. ◇