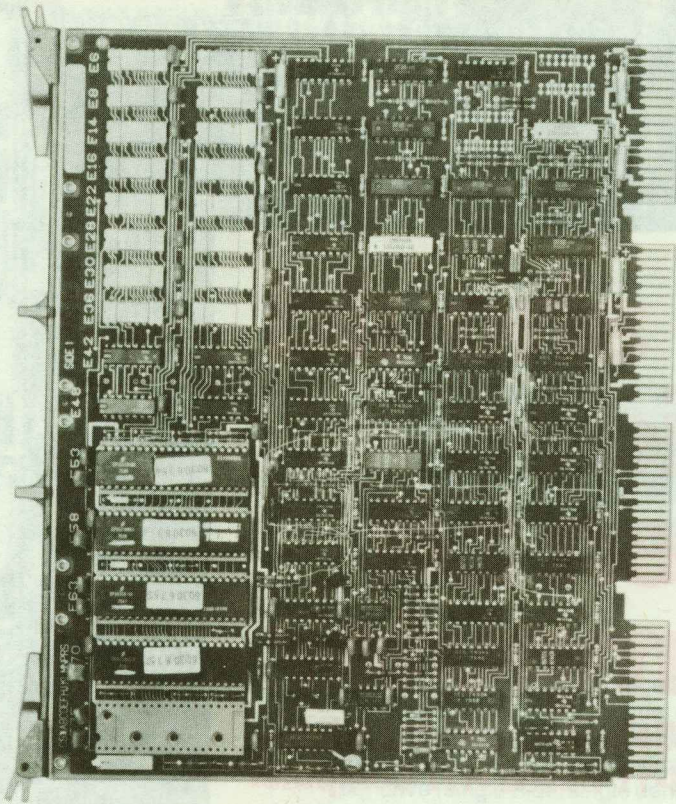




Why you should consider a sixteen bit microcomputer

**Heath Company's Guide to Selecting a 16-bit Micro
and an introduction to the LSI-11-based H11 Computer**

POWER! 8-bit vs. 16-bit



As a prospective purchaser of a low-cost microcomputer for personal computing or small business applications, you are faced with an important decision. Besides having to choose among a variety of different types and brands of microcomputers, you must now deal with the issue of whether to buy an 8-bit or a 16-bit machine. Previously, most low cost microcomputers were based on an 8-bit microprocessor. Today, the 16 bit-microprocessor is reality. Low cost computers using these high technology devices are now available. The 8 vs. 16-bit decision is an important one. The purpose of this paper is to help you make an intelligent decision and to introduce you to our DEC LSI-11-based microcomputer, the 16-bit H11.

The 8-Bit vs. 16-Bit Issue

There is no doubt about the clear superiority of a 16-bit over an 8-bit microcomputer for general purpose data processing. Most 16-bit computers are far more powerful in that they can process data faster and more efficiently. Data moves through the computer 16-bits at a time rather than 8-bits at a time, therefore many types of arithmetic, logic and data transfer operations take place at a higher speed. This is not only an advantage but also a must for many applications. Sixteen-bit microcomputers typically have a more powerful instruction set that allows them to perform a wider variety of operations than their 8-bit cousins. This further speeds up and simplifies internal operations. While an 8-bit microcomputer can be programmed to perform the same functions as a 16-bit computer, typically the 16-bit machine will do it faster, with fewer instructions and using less memory. "Computing power" which we will explain later, is the primary reason for purchasing a 16-bit computer over an 8-bit computer.

So Who Needs It?

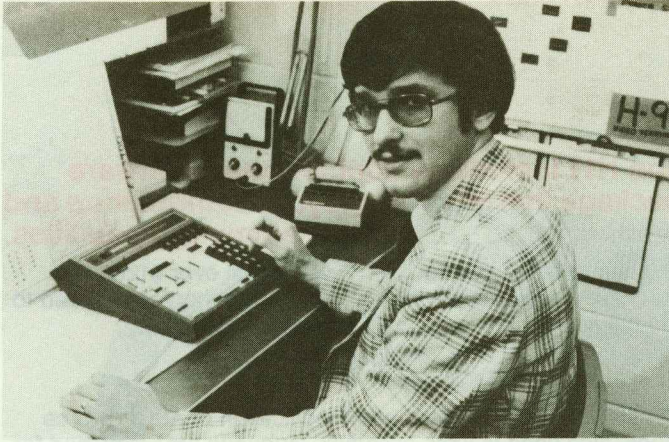
The question is, do you need the extra computing power that a 16-bit microcomputer provides? Since most 8-bit machines can do anything a 16-bit machine can do but slower, naturally you must question the need for the extra computing power. Especially since you'll typically pay slightly more for a 16-bit machine than an 8-bit machine. The answer to the question lies in your intended applications. What do you want to do with your computer now and what things have you planned for the future? If you can answer these questions, you will be closer to a solution to the 8 vs. 16-bit problem.

Most computer buyers purchase equipment to satisfy their immediate needs. While their immediate applications are adequately satisfied, most users eventually want to do more complex and advanced operations than their computer can efficiently handle. Because of this, it is desirable to buy for the future. In this way you will work into the power of the computer over a period of time. If you buy future potential, your investment will be more useful over a longer period of time. This can save you time and money in the long term. This is particularly true of your investment in software. Most hobbyists, schools and small businesses will invest a significant amount of money in software for their computers. When they run out of software computing power many will immediately seek to purchase a better, more powerful computer only to realize that their old but useful software cannot be used with the newer computer. Thus the entire software development process must be repeated at an extremely high cost in both time and money.

By purchasing a more powerful computer in the beginning, you can avoid, or at least minimize, this problem.

This concept of buying for the future may be difficult for the first time computer buyer to grasp. It is something that many in the computer field have learned the hard way. The idea that you will run out of computing power or will have to recreate all your software may be tough to buy. But it is a real problem. A 16-bit microcomputer can help you eliminate or defer this uncomfortable situation.

SERVICE & SUPPORT



The Hidden Persuaders

While it is interesting and pertinent to compare computer performance specifications and prices, there are some hidden factors that should also greatly influence your decision as to which computer to purchase. In fact, many times, it is these hidden issues that are much more important than the technical specifications or cost of the product. Some other issues that often make the decision for you are *manufacturer service, support, reputation, quality, reliability and responsibility*. The other important factor is *software*.

The questions that you should ask in selecting a computer vendor are these: can the company provide the service and sup-

port I will need to make my computer system a success? Is the company large enough to help me deal with all aspects of getting my system operating and producing useful end results? Does the company have a good reputation and is it reliable? What is the quality of the products produced by the company? Will the company assume the responsibility for helping me get my money's worth? Is there sufficient software and support available to make my computer hardware purchase worthwhile? Once you have answered these questions you will be able to better make a decision regarding whom you should purchase your computer from.

Purchasing a computer is unlike purchasing any other type of electronic equipment. The computer is more than just a box of hardware that performs some specific end function. The computer is a general purpose device that does absolutely nothing without programming. The company that bears the responsibility of supplying you quality hardware and service as well as software and related support is your best bet. What is support? It is the help and backup that the manufacturer gives you at no additional cost to get your hardware and your software operational.

Heath Company is the world's largest electronic kit manufacturer. It is also one of the largest, if not the largest, personal computing manufacturer. For that reason, Heath can provide all of the service and support you require. To be successful in the computer business, a company must provide this. Heath Company has taken full responsibility for supporting its products as well as providing products of highest quality. Larger companies like Heath have the business experience, financial strength and technical expertise to bring you a superior product with the full support you should expect. Heath's massive buying power also ensures reasonable prices.

PERFORMANCE & PRICE

Performance.

Performance is what comes from computing "power." It is hard to define and a very subtle term, but it is important. Power is wrapped up in, and influenced by, these things:

1. Number of instructions – the more instructions the greater the power.
2. Number of registers – the more the better.
3. Amount of addressable memory – again, the more the better.
4. Computing speed – that is, the faster the better. This is usually a function of semiconductor technology.
5. Software – the availability of good software is essential. More about this later.

Basically, the micro that can perform a specific function the fastest, with the fewest instructions, and address a lot of memory is best.

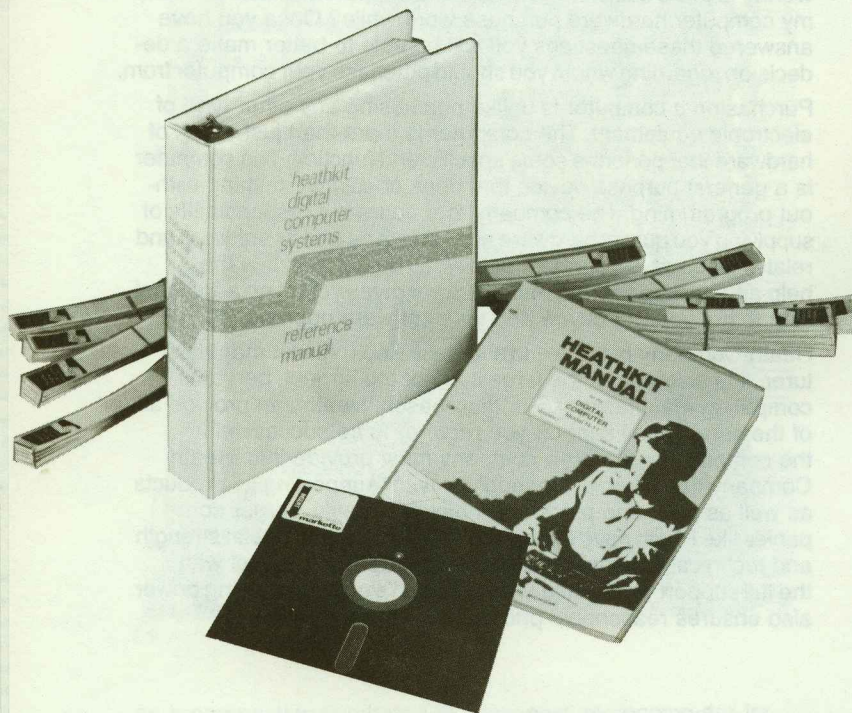
Price.

Price is important to everyone, the hobbyist as well as any company or school. But price isn't everything. You can choose the

least expensive machine but not get the performance you need. It is trite to say it, but you still get exactly what you pay for, no more, no less. 16-bit microcomputers are more expensive than 8-bit microcomputers, but let's face it, you get a whole lot more performance and potential. Just keep in mind that price is not proportional to the number of bits. A 16-bit micro doesn't cost twice as much as an 8-bit micro. It may only cost 10-20% more, but it could have up to *twice* the power of the 8-bit machine.

One final word about price. It is *not* the cost of the computer or CPU alone that affects your investment. You must also consider your video terminal, printer, mass storage devices, other peripherals, memory and interfaces, and software. You must consider the overall *system* cost. Typically, the cost of the above items is the same for 8 or 16-bit machines and they represent the greater part of your investment. While the CPU or computer is not insignificant, it is a smaller part than most people realize. For that reason, buying a 16-bit micro over an 8-bit has little effect on your system cost. For only a few percent more, you can have the best.

SOFTWARE



A general purpose digital computer does absolutely nothing. It is a totally ignorant package of electronic components until it is properly programmed. Anyone contemplating the use of a computer should know that software is the key to a successful computer system. This includes systems software made up of languages and other programs that allow the user to develop his own applications programs. It includes operating systems that simplify the use of the computer and make it more efficient. It also includes "canned" or packaged application programs that allow the user to do specific things without having to write his own. Because software is so important, it should rate high on your list of factors to weigh when choosing a computer. In fact, it has been said that the best way to choose a computer system is to select the software you need first, then buy the computer that will run it. Software is so important to microcomputer usage it could be the most important part of your decision. Lots of good software should be available, not only from the manufacturer, but also from outside sources. You should consider the hardware specifications and capabilities, the service and support issues. But if you make your decision based on software alone, you will not go wrong.

The H11 includes a sophisticated software package that lets you get your computer up and running with practical programming capabilities.

This paper tape based software would cost over \$1200 if purchased separately. A minimum of 8K memory is required to run the software. The programs include:

ED-11.

Assists you in the creation and modification of ASCII source tapes, also used to write assembly language programs and for general text editing or word processing functions.

PAL-11S.

Relocatable assembler converts ASCII source tapes into relocatable binary modules. This lets you create programs in small, modular segments for easier coding and debugging. These binary modules serve as inputs to LINK-11S.

LINK-11S.

Link editor which links the modules created by the PAL-11S into a load module ready for execution on the H11. The module is loaded into the H11 via the Absolute Loader.

Loads absolute binary tapes into the H11 memory for execution.

ODT-11X.

Lets you debug the programs which you have created. Permits modifying and controlling program execution "on the fly" for quick, efficient debugging.

IOX.

I/O executive program permits I/O programming without developing device-driving programs. Links to your programs using the LINK-11S. For use with high speed paper tape reader/punch and line printer.

DUMP-AB and DUMP-R.

Lets you dump absolute binary contents of memory to the paper tape punch.

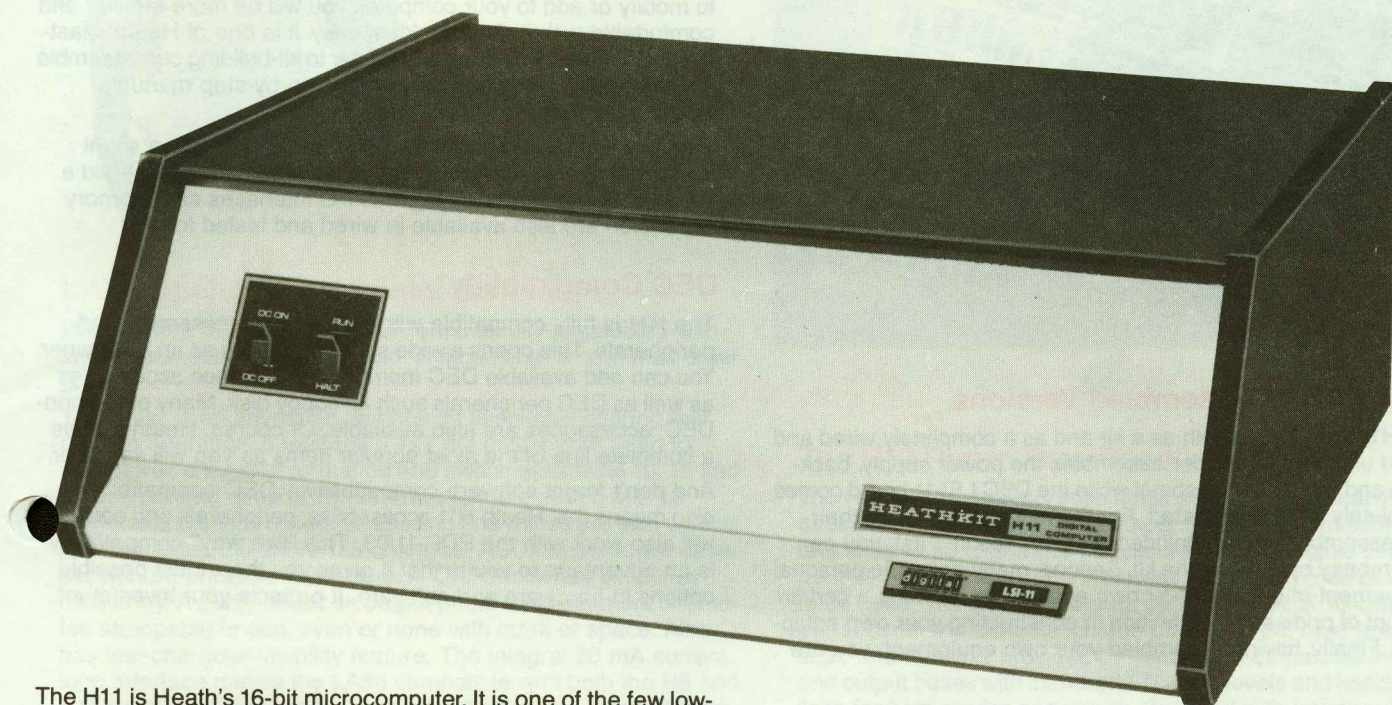
BASIC.

DEC's powerful version of standard Dartmouth BASIC interpreter uses English-type statements and mathematical symbols to perform operations. Immediately translates, stores and executes the program. Includes string capability.

FOCAL™

DEC's own interpretive computer language which combines simplicity with computing power. Ideal for most scientific, engineering and math applications. FOCAL™ programs can be written and executed easily. Both 4K and 8K versions are included.

INTRODUCING THE H11



The H11 is Heath's 16-bit microcomputer. It is one of the few low-cost, 16-bit micros on the market. It is reasonably priced, has plenty of software, and has enough power and potential to satisfy your most demanding applications for the present and future.

If you want and need a 16-bit micro, you should consider the H11.

The main feature of the H11 is that it uses the popular Digital Equipment Corporation (DEC) LSI-11 CPU.

The LSI-11 is part of a large family of PDP-11 minicomputers. The LSI-11, in fact, executes the instruction set of the popular PDP-11/40 and PDP-11/34 minicomputers. For that reason, it can run most of the software available for these machines. In addition, most of the software written for any of the long line of PDP-11 computers can generally be adapted to run on the LSI-11. A tremendous amount of software is available. The reason for this is that the PDP-11 is the world's most widely-used minicomputer. There are more (50,000+) PDP-11 models in the field today — more than any other minicomputer.

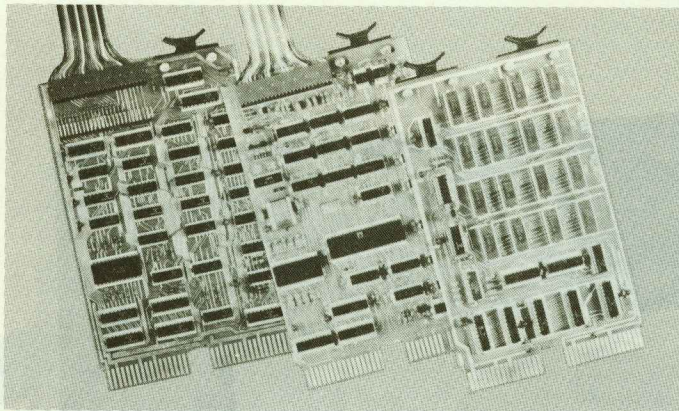
Because there are so many PDP-11's around, a tremendous amount of software exists in one form or another. Some of the software is available through DEC.[®] Other software is available from DECUS, the Digital Equipment Computer User's Society — which all H11 purchasers are eligible to join. The PDP-11 software is available through a variety of other sources. And we haven't even talked about the Heath H11 software. This tremendous software base is one excellent reason for choosing the H11. You can take advantage of this tremendous software base, which is unavailable for other computers.

The H11 vs. the DEC PDP-11/03.

The Heathkit H11 computer is similar to DEC's popular PDP-11/03. Both computers incorporate the LSI-11 board with 4K of memory mounted in a card file with backplane bus that can accommodate up to 6 additional accessory cards. Both units also contain a heavy-duty power supply and a cabinet. The similarity between the H11 and PDP-11/03 ends with the technical specifications. The H11 offers significant advantages over the DEC PDP-11/03. First, the H11 is available in kit form or assembled and tested. For those who wish to assemble their own equipment, a significant price savings can be had. Second, the H11, either kit or assembled, is significantly lower in cost than the PDP-11/03. Another advantage of the H11 is fast delivery. H11's are in stock and available for immediate shipment. H11 delivery is typically much shorter than delivery of a PDP-11/03.

Perhaps the most significant benefit of the H11 over the PDP-11/03 is the software. Included with the H11 at no additional cost is a complete software package which consists of the paper tape software system which DEC sells at a premium. This software package consists of an editor, assembler, linker, and a variety of utilities programs, including absolute loaders, dumps, I/O executive and others. The software package also includes two higher level languages, BASIC and FOCAL. (See page 4 for a complete description.) The H11 is truly a value when compared to the DEC PDP-11/03.

THE H11 (cont'd)



Both Kit and Assembled Versions.

The H11 is available both as a kit and as a completely wired and tested unit. The kit builder assembles the power supply, backplane and bus, and the cabinet while the DEC LSI-11 board comes completely wired and tested. For those who want to do their own assembly, some significant benefits result. First, you can save money by building the kit. Second, many enjoy the personal involvement of building their own equipment. There is a certain amount of pride and satisfaction in constructing your own equipment. Finally, having assembled your own equipment, you are

better prepared to understand its operation and to deal with service and maintenance problems if they occur. When you decide to modify or add to your computer, you will be more familiar and comfortable with it. And the kit is easy. It is one of Heath's fastest and simplest kits. Even a beginner to kit-building can assemble it successfully. Our world renowned step-by-step manuals insure your success.

The fully assembled and tested H11 is available, for a slight additional charge, for those who simply do not care to build a kit. All of the accessories such as I/O interfaces and memory expansion are also available in wired and tested form.

DEC Compatibility.

The H11 is fully compatible with most DEC accessories and peripherals. This opens a wide spectrum to you as an H11 owner. You can add available DEC memory and interface accessories as well as DEC peripherals such as floppy disk. Many other non-DEC accessories are also available. Of course, Heath carries a complete line of the most popular items as you will see later.

And don't forget software compatibility....DEC compatibility also means that Heath H11 accessories, peripherals and software will also work with the PDP-11/03. This "two way" compatibility is an advantage to you in that it gives you the widest possible options in hardware and software. It protects your investment.

PERIPHERALS

The H9 Video Terminal.

The H9 video terminal is a general-purpose peripheral designed for use with both the Heathkit H8 and H11 computers. It provides keyboard input and a CRT for the convenient entry and display of computer programs and data. It can be used with any computer in dedicated stand-alone applications or in time-sharing systems.

The H9 features the standard upper case 5 x 7 dot matrix character format and you may select either the long-form display mode, with twelve 80-character lines, or the short-form display in four 12-line columns.

Also featured are auto-scrolling, a cursor mark to indicate next character position, and erase and plot modes. For extra convenience a built-in serial interface provides EIA RS-232C levels, a 20 mA current loop and standard TTL levels. For 110/230 VAC, 60/50 Hz. 12½" H x 15½" W x 20¾" D.



PERIPHERALS



LA36 DEC Writer II Printer Terminal

Heath offers this famous printer terminal fully assembled with immediate delivery by prepaid shipment at a low mail-order price.

The LA36 is an advanced technology teleprinter offering fast, reliable operation. It features a 7x7 dot matrix print head for crisp, clear character formation and switch selectable 10, 15 and 30 cps printing speeds. Print format is 132-column, with 10 characters per inch horizontal spacing and 6 lines per inch vertical spacing. Uses the entire 128 character ASCII upper/lower case set with 96 printable characters. A CAPS-lock key simplifies data entry. A parity check on output prints a replacement character, strappable to odd, even or none with mark or space. Also has last-character visibility feature. The integral 20 mA current loop interface makes the LA36 compatible with both the H8 and H11 computers, as well as most other hobby and personal computers. With connecting cable and stand. 27½" W x 33¼" H x 24" D.



The H10 Paper Tape Reader/Punch

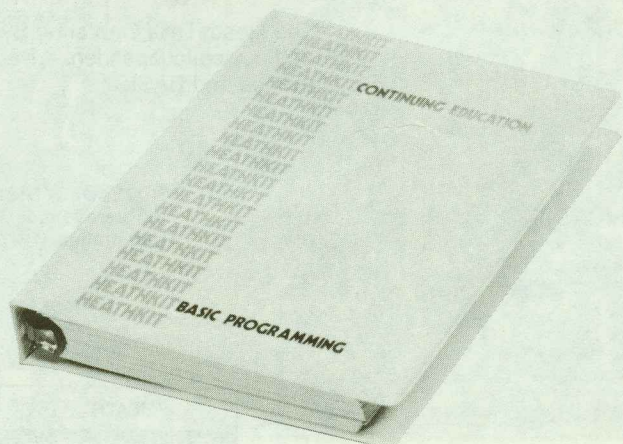
The H10 is a general-purpose mass storage peripheral designed to use reliable, low-cost paper tape. It reads at a maximum rate of up to 50 characters per second and adjustable sensitivity permits paper of any color, thickness, or quality (oiled or unoled) to be used. The punch operates up to a speed of 10 characters per second and controls include power on-off, read and punch start. Interfacing is provided by separate 8-bit parallel input and output buses with standard TTL logic levels and handshaking lines for both reader and punch. Supplied with interface connector and mating cable. 12⅝" H x 9¾" W x 19⅝" D.

BASIC

BASIC Programming Self-Instructional Course

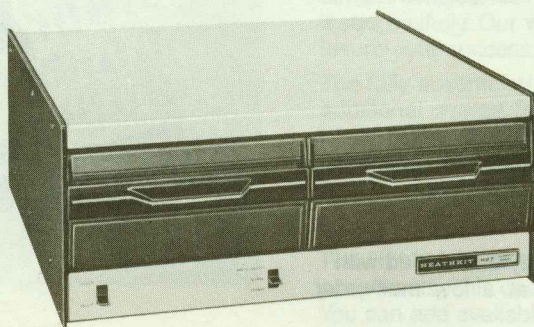
This course teaches you how to program your computer using the popular BASIC language. BASIC (Beginner's All-Purpose Symbolic Instruction Code) is essential for hobby and personal computing; it is also widely used in education and business. The course covers all formats, commands, statements and procedures plus the creative aspects of computer programming, so you can make practical use of it in solving problems and creating your own unique programs. Like other Heathkit self-instructional courses, it uses programmed instructions backed by practical hands-on computer experiments and demonstrations to reinforce and personalize the text material. An optional final exam (passing grade 70%) brings you a Certificate of Achievement and 3.0 Continuing Education Units.* While the BASIC course is keyed to Heathkit computers, it is also equally applicable to any computer system using BASIC.

*Continuing Education Units (CEU's) are nationally recognized means of acknowledging participation in non-credit adult education.



MORE TO COME

Heath's line of personal computer products is relatively new and is soon to be further enhanced by the addition of a fantastic array of new accessories, peripherals and software. Here is an advanced look at some of the coming "goodies"!



1. Floppy Disk System.

H27 Floppy Disk Mass Storage Peripheral for the H11 Computer. General Specifications include: Standard full size drives use 8" diskettes. Single or dual configuration. Standard soft-sectored format (DEC software compatible). 256K bytes max. storage per drive (single-side, single density). Black and grey cabinet with power supply, compatible in appearance with H11. Controller/interface card plugs into H11 backplane, includes ROM boot loader and Z80 processor. Fully compatible with H11 as well as DEC PDP 11/03 and other LSI-11 based systems. Will run RT-11 operating systems software.

The wired and tested version (WH27) will be available October, 1978. A kit version will be available early 1979.

2. Memory.

Dual-wide Memory Cards featuring denser dynamic memories. 8K x 16, 16K x 16 and 32K x 16 will be available, all with on-board refresh.

3. Software.

The Heath Disk Operating System (HDOS) with files capability and device-independent drivers plus assembler, editor, linker, utilities and BASIC.

NOTE: DEC, DIGITAL, FOCAL and PDP are registered trademarks of Digital Equipment Corporation.

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