Is the KIM-1 For Every-1?

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Is the KIM-1

For Every-1 ?

... find out if it's for you?

MOS Technology was recently purchased by **Commodore Business Machines**, Inc., 901 California Ave., Palo Alto CA 94304. Commodore will be manufacturing and distributing the KIM product line, and is expanding the production facilities to double or triple the number of KIMs produced. - Ed.

Of course not! No single microcomputer can serve everyone's requirements. But, the MOS Technology KIM-1 microcomputer is a well integrated package that has features which have appeal to hobbyists, educators, and industrial users. How much do you think it will cost you to buy this complete computer system with the following features:

- 6502 MOS Technology Microprocessor
- HEX Keypad plus seven Control Keys.
- six digit LED Display.
- 110 to 2400 baud 20 mA Current Loop Teletype Interface.
- 800 baud Audio Cassette Interface.
- 2K ROM Monitor which works with the Keypad/ Display or Terminal.
- over 1 K bytes of RAM.
- thirty (30) Programmable I/O Lines.
- extensive Hardware, Programming, and User Manuals.
- capable of expanding the I/O Ports.
- capable of expanding the Memory to a full 65K bytes.
- completely assembled and tested.

How much does it cost? Five hundred dollars? Eight hundred? More? Less! Would you believe $245? Look at the features again. That's quite a bundle of goodies for the price. If you have priced other systems with comparable features, you are probably wondering what the catch is. "This is a new, small, fly-by-night operation which will either have gone out of business or raised its prices by the time I place my order. Right?" Wrong! The history of the KIM1 is a bit unusual. MOS Technology which manufactures the KIM-1 also manufactures the 6502 microprocessor and other related microcomputer oriented chips. When their 6502 was first ready to be introduced to industry, they decided to make a powerful "evaluation kit" which, unlike those offered by most other vendors would be completely assembled, tested, and would be capable of performing real applications. There are now over seven thousand KIM-1s in the field. These are being used mostly by industry, but many units are also being used for educational purposes and by computer hobbyists.

The hobbyist appreciation of the KIM-1 has been a little slow to develop for two main reasons. First, there has not been very much published about the KIM-1 in the national computer hobbyist magazines (which is part of my motivation for writing this article). Second, until recently, the dealer discount structure was such that very few dealers were interested in handling the KIM-1. This has been changed and a lot of computer stores are starting to carry the KIM product line. A number of computer clubs now have formed KIM-1 sub-groups, and there is a national publication, KIM-116502 User Notes, which is hobbyist oriented and has a rapidly growing subscription list - currently over eight hundred. Assuming that about 25% of the KIM-1s sold to date have been to hobbyists, then there are about two thousand currently in hobbyists' hands, and perhaps one hundred or more being added each month. This is a significant portion of the computer hobbyist population. I do not know how extensive the international distribution of KIM-1s is, but I have received orders for software from Germany, Italy, Sweden, Taiwan and Kuala Lumpur, Malaysia!

Since you have read this far, you are probably at least considering the KIM-1 for your own. So let me discuss the features in detail. The 6502 has a good general purpose instruction set. in many ways similar to the 6800. It has one of the best sets of addressing modes available. These include Relative Branching, Indexed Indirect and Indirect Indexed modes useful in table processing, Stack Addressing, and others. The6502 microprocessor has been selected by a number of independent companies for use in their hobbyist oriented systems. These include the APPLE-1 by Apple Computer Company; BABY! by STM Systems; the

- two independent Programmable Interval Timers.

Challenger by Ohio Scientific Instruments, and Micromind by ECD Corp. to name a few. These are all assembled systems. The 6502 is also found in a number of kit systems

The keypad has twentythree keys and a slide switch. The keys include the sixteen hex digits and seven program-dependent functions. Two of the keys are tied into the interrupt structure providing "maskable" and "nonmaskable" interrupts to be generated from the keypad. The keypad, in conjunction with the LED display and the ROM monitor, make it possible to enter programs directly into memory, to execute programs, and to do extensive program debugging including single-step testing. All this without an expensive front panel or external terminal.

The LED display consists of six independent sevensegment LEDs. These are normally used to display hex data: four digits of address and two of memory contents. These same LEDs may be used to output alphabetic messages, chess board coordinates, decimal calculator values, and so forth.

If you are lucky or rich enough to own a Teletype compatible terminal you can connect this directly to the KIM-1. The KIM-1 hardware provides a 20 mA current loop interface. The KIM-1 monitor provides the software to drive the terminal at rates from 110 to at least 2400 baud, with some users reporting good transmission at 4800 baud and reasonable transmission with occasional glitches at 9600 baud. Baud rate is automatically determined by the software. There are no jumpers to move or switches to set.

easy to save and load programs via paper tape. Your terminal may be a hardcopy or video type. K I M-1 doesn't care.

The "piece de resistance" of the KIM-1 is its built-in audio cassette interface. An audio cassette is the type of recorder you use to record and listen to music. Nothing

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special. The recording technique implemented in the KIM-1, and described in some detail in the KIM-1 User Manual, is very conservative and provides tapes that may be readily interchanged between all KIM-1s, and most types, brands, and qualities of cassette recorders. (Tapes are not interchangeable with any other recording system). I have distributed over three hundred tapes recorded directly from my KIM-1 with only a few problems. These problems have all turned out to be due to out-of-alignment cassette recorders.

While the tape dump routine of the KIM-1 monitor puts data out at the tediously slow rate of about three minutes per 1 K of memory, there is a software routine available called Supertape which will dump KIM-1 compatible tapes at six times the standard rate or about thirty seconds for 1 K bytes. These tapes may be loaded via the KIM-1 monitor tape load routine at the higher rate with no modifications. Other tape routines are possible (and simply storing and retrieving programs from standard audio cassettes is a great benefit to the average hobbyist.

The 2K ROM monitor, which is contained in the ROM portion of two 6530 multi-purpose chips, is an integral part of the KIM-1 system and has a number of
clever and useful functions. It provides the standard capabilities of examining and modifying memory locations from either the keypad/ display or terminal. It also supports single-step program execution for debugging purposes. Whenever a program is stopped, either via the stop (ST) interrupt key or while in single-step mode, any memory location can be examined and modified. To resume processing there is a program counter (PC) key which restores the value of the program counter before restarting the program with the execution (GO) key. The 6502 has a BREAK instruction which generates a software controlled interrupt. This may be used in conjunction with the monitor to insert a trap into a program for debugging. The monitor also contains all the software required to control the keypad/display, terminal, and audio cassette. Many of the monitor's routines may be used by user generated programs, especially to perform standard input/ output functions. The ROM even has a special program for fine tuning the audio cassette interface, should the need ever arise.

There are two sections of

read/write memory on the KIM-1. The main RAM is 1K (1024) bytes of 2102 type static RAM. In addition, the 6530 multipurpose chips each contain 64 bytes of RAM, for an additional 128 bytes total. Of these extra memory bytes, 25 are normally reserved for use by the monitor and 103 bytes are always available to the user. While a total of 1152 bytes of RAM may not seem like much memory, you can actually do quite a bit with it. I will list a few programs which operate in this amount of memory in the software section. If you require more memory for your application, it is simple to add memory to the KIM-1. MOS Technology offers two completely assembled and tested memory boards for direct connection to the KIM-1 with no additional buffers. The KIM-2 is a 4K RAM and the KIM-3 is an 8K RAM. These boards both use the 2102 type static RAM chips. One of these boards may be interfaced to the KIM-1.

If you require more than 9K bytes of RAM, MOS Technology offers the KIM-4 which is a board with buffers and connectors that permit the addition of memory up to a total of 65K bytes for the system. The additional memory may be any combination of RAM and ROM. Some of the ROMs to be offered by MOS Technology include a floating point math package and an editor/assembler package. Each of the 6530 multipurpose chips includes a programmable interval timer, which may be set from a few microseconds to a quarter of a second. They may be tested under program control

In addition to providing the standard commands (enter, modify, execute, etcetera debugging) the monitor also supports punching and reading paper tape. The user simply sets the starting and ending addresses for the dump and the monitor takes care of formatting the data, calculating check digits, and transmitting the data to the terminal. This support makes

are documented in HELP) which work with the KIM-1 hardware and produce data transfer rates at 800 baud or 100 bytes per second. The capability of

or may be set to cause an interrupt on completion of the specified time interval. These two timers take a tremendous burden off of the software for many real-time programs, and can be very useful in programming clocks, music generators, and the like. Communication with the

outside world" is handled by the peripheral interface ports of the 6530 multipurpose chips. Each chip handles 15 input/output lines. One set of I/0 lines is used by the KIM-1 to control the keypad, display, terminal interface and audio cassette interface. The other set is available to the user. These

Now you have your KIM-1 and it's powered up. What would you like to do?

are configured and programmed as standard parallel interface adapters (PIA). They may be used to turn devices on and off, to sample external devices, and so forth.

The documentation which comes with the KIM-1 is pretty good. The KIM-1 User Manual includes the information necessary to attach your audio cassette and terminal; descriptions and examples of using the monitor in both the keypad/ display and terminal modes; a simple programming example; a "real application" example which includes using the programmable I/O ports; info on expanding your memory and I/O capacity; and the complete monitor source listing. The Programming Manual is a 170+ page document which covers the 6502 instruction set, addressing modes, peripheral programming, and other pertinent materials. The Hardware Manual contains

supply the power, +5 volt at about 1.2 Amps and -12 volts at about 100 milliamps (the -12 being required only if you are using the audio cassette and may be supplied by a battery). You can build your own power supply following the circuit diagram provided in the KIM-1 User Manual, or, The Computerist has a new power supply designed specifically for the KIM which can power the KIM-1 and additional memory. It costs $40 for the completely encased unit. Or a surplus power supply (adequate for the minimal KIM-1 but no additional memory) is available for $25.

Now you have your KIM-1 and it's powered up. What would you like to do? Play games? The Computerist offers two games packages, each of which comes with the programs on a Supertape cassette tape and includes complete documentation and source listings. "PLEASE" is an assortment of games and demonstrations, including a 24-hour clock, a millisecond timer, the Shooting Stars puzzle, the Mastermind game, Hi-Lo game, a simple adding machine, an intoxication tester, and more. It runs on a minimal KIM-1 system and costs $10. The second package is MicroChess which plays a pretty good game of chess on the minimal KIM-1. It was written by Peter Jennings and is available for $15.

When you are done playing games and are ready to put your KIM-1 to work, you can

work with the minimal KIM-1, a terminal, and a pair of audio cassette recorders with relays for turning them on and off under program control. The HELP packages include a source and text editor, a mailing list preparation/printing package, a form letter generator/printer, and an information retrieval package. Each package comes on a Supertape cassette tape and includes complete documentation and source listing. HELP is written in a high level language which permits the user to write his own applications and/or customize existing applications to suit his particular requirements. They cost $15 per package, and a relay package containing all of the components (less mounting board) to control two cassette recorders is available for $10, all from The Computerist.

Add 4K bytes of RAM and you can run Tom Pittman's Tiny BASIC. He has aversion specifically for the KIM-1. There are a number of groups that are actively developing software for the 6502 and the KIM-1. Lack of software has somewhat limited the growth

of the KIM-1 as a hobby computer, but availability is rapidly improving.

One other factor that has limited KIM-1 growth has been the fact that it does not conform to the Altair bus structure. Since there are a lot of very nice peripherals which are Altair compatible, similar capability for the KIM-1 would be valuable. Forethought Products has just announced the KIMSI S-100 Interface/Motherboard which connects to any unmodified KIM-1 computer and converts its signals to the Altair bus format. The board also contains 8-100 pin slots making it a useful motherboard as well. The price is $125 in kit form and $150 assembled. The use of this board will permit the simple addition of a wide variety of peripherals to the KIM-1 and greatly extend its usefulness to the hobbyist.

Are you hooked? Since computer stores are now carrying the KIM-1, you can probably see one in action locally. Or some other computerist in your area probably owns one and would be happy to show it off. Have fun. ■

1. MOS Technology, 950 Rittenhouse Road, Norristown PA 19401, 215/666-7950, Manufacturer of the KIM-1, KIM-2, KIM-3, ..., 6502, 6530 ...
2. KIM-1/6502 User Notes, c/o Eric C. Reknke, 425 Meadow Lane, Seven Hills OH 44131. Independent hobbyist magazine covering the KIM-1 and 6502. Published every 5 to 8 weeks. It contains software routines, games, notes, announcements, etc. ($5 for issues 1-6, $8 foreign subscriptions).
3. The Computer Shop, 288 Norfolk St., Cambridge MA 02139. 617/661-2670. 4K RAM kit which can be used with the KIM-1. $74.50 with 2102 type static RAM.

over 150 pages on the 6502 Microprocessor, the 6530 Peripheral Interface/Memory Device, and the 6520 PIA (which is not used on the KIM-1). You also get a multi-colored wall chart, programmers card, etc.

That pretty much covers the KIM-1 system. You must get "HELP," a series of application packages which

4. The Computerist, P.O. Box 3, S. Chelmsford MA 01824. -617/256-3649. Creator and distributor of the PLEASE and HELP software packages, MicroChess, and a KIM-1 power supply and surplus power supply. The Computerist is a monthly publication dealing with microcomputers in the New England region from a hobbyist point of view ($6/year).
5. Forethought Products, P.O. Box 386-A, Coburg OR 97401. Manufacturer of the KIMSI S-100 Interface/Motherboard.
6. Newman Computer Exchange, 1250 N. Main, Ann Arbor MI 48104. Distributor for a composite video peripheral for the KIM-1 ($239).
7. The 6502 Program Exchange, 2920 Moana Lane, Reno NV 89509. Games and Utility software for 6502 based systems.
8. Johnson Computer, P.O. Box 523, Median OH 44256. KIM-1 related hardware and software.
9. Tom Pittman, P.O. Box 23189, San Jose CA 95153. Tiny BASIC which will run in 2K bytes on a KIM-1 with additional memory ($5).