We are very pleased to welcome Eric to the pages of COMPUTE. He provides a valuable perspective to the SBC Gazette. Welcome to you *6502 User Notes* readers as well. COMPUTE's a resource magazine and I solicit your help and input on the SBC Gazette. Letters, articles and comments should be sent to my attention at COMPUTE, Post Office Box 5119, Greensboro, NC 27403. With your input we'll maintain a growing, active SBC Gazette. For information on back issues of *6502 User Notes,* see COMPUTE's Book Corner on page 97.

Robert Lock, Editor

The Single-Board 6502

Eric Rehnke

For those of you who are looking at single-board 6502 systems, let's start this column off with a rundown of four of them.

KIM, AIM, SYM & SUPERKIM — Which ones' for you?

If you're looking around at 6502 single board computers and aren't quite sure which way to turn-lets examine the facts.

All four machines are similar in that they use the 6502 as the CPU and each is a complete "system-on-a-board" but that's where the similarity ends.

Software is not usually transportable among these systems because each has a different Input/Output scheme.

The only exception to this is the KIM and SUPERKIM. Since SUPERKIM is an enhanced system based on the KIM ROM set, all KIM software is useable on either of these machines. More on SUPERKIM later.

KIM-1: (This machine started it all) KIM has 1 K RAM, 2K ROM (contains operating software), calculator style keyboard and display, cassette and TTY interfaces, and 15 I/O lines which are available to the user. No on-board expansion capability is provided. This machine has been on the market about four years and is still a very reasonable entry-level system since the price has been reduced to the $150-$180 range.

There is a lot of software available for KIM since it's been around the longest. Several high-level languages such as Microsoft BASIC, Tiny Basic, FOCAL, FORTH, XPLO (a Pascal-like compiler) and as many assemblers make KIM a very good choice as the CPU in an expanded 6502 based system. Also there are at least one each full size and mini size floppy disc systems available as well as EPROM programmers, video boards, graphic display boards, etc., etc.

Going with KIM makes good sense if you're just starting out and want to get by cheaply, want to learn about micros from the ground up, plan on building a rather large 6502 machine as a development system, or maybe to run one or more higher level languages. Oh, and there's a 4800 baud cassette interface (software & hardware) available for KIM (around $25.00) that will turn your cassette interface into sort of a poor man's floppy.

KIM is not very suitable for industrial and laboratory process control or data gathering since in these applications the use of EPROM and added I/O capability is essential. An additional board would have to be constructed to support the added capability necessary for KIM to be a good controller.

The KIM-1 is manufactured by Commodore Business Machines, Palo Alto, CA., and is available through local dealers and mail order outfits such as Jade and Advanced Computer Products.

SUPERKIM should be discussed next because it is based on the KIM-1 design, but with some rather significant additions. Lots of on-board I/O, EPROM, and RAM expansion is available. SUPERKIM comes with 1K of RAM (expandable to 4K on-board), sockets for up to 16K of on board EPROM, three 8-bit I/O ports with sockets for three additional 6522 VIAs, on-board regulator, 8 priortized interrupt inputs, lots of prototyping area plus all of KIMs features mentioned in the previous section.

The relatively high price of SUPERKIM ($375) makes it unsuitable as an entry-level system for the casual hobbyist. It would, however, make an excellent entry-level system for someone who expects to get serious about putting a micro computer to work and wants to learn all about it from ground zero. Also, because of SUPERKIMs on-

board expansion and prototyping capability, it's very suitable for low-volume controller duty or wherever you need to get a computer up and running on the job quickly. SUPERKIM is not, however, a good choice for building up a large (16-64K) 6502 based system.

SUPERKIM is manufactured by MICRO PRODUCTS, 2107 Artesia Blvd., Redondo Beach, CA 90278. (213) 374-1673.

The **SYM** was designed to be an enhanced KIM style machine with all of KIM's features plus additional on-board I/O, RAM and EPROM espansion capability.

One problem that I have with SYM is that it was promoted as having a closer compatability with KIM hardware & software than it actually has. Mods which aren't even mentioned are needed to let SYM use KIM expansion hardware and the SYM keyboard/display routines are handled totally different than KIM. Converting software from KIM to SYM is not a job for beginners.

SYM does have some monitor functions which KIM doesn't have such as block move and fill, and a relative branch calculator but these advantages are more than offset by the fact that the SYM cassette and TTY interfaces fall very short of even working as well as KIM's I/O.

(Editor's Note: Synertek's new Mon 1.1, soon to be standard on all SYM-1's, clears up many of these problems. RCL)

The SYM is a classic example of a machine which was designed to do everything and ends up not doing anything all that well.

At its new price of $239, SYM would make an inexpensive dedicated controller system if everything could be done onboard. If more capability is needed, the SUPERKIM would make a better choice.

Optional BASIC and Assembler ROMs are available, but an ASCII terminal is necessary to use them.

The KIM-1 would still be the better choice if substantial system expansion was planned.

SYM is manufactured by SYNERTEK Systems, POB 552, Santa Clara, Ca 95052 (408) 988-5600. It's available through local dealers and mail order outfits such as RNB Enterprises, Jade, and Advanced Computer Products.

The **AIM 65** from Rockwell is a bit different from the previous systems because the AIM comes equipped with a full size ASCII keyboard, a 20 character wide LED display and 20 column thermal printer. Besides the usual monitor, and cassette and TTY interfaces, AIM 65 comes equipped with a mneomic entry psuedo-assembler, a text editor and some trace routines which really improve debug procedures.

There are also BASIC and Assembler ROM options available which make a lot of sense in this case because they both can be used with AIM's built-in keyboard and display/printer. On-board RAM should be expanded to the full 4K limit with either or both of the ROM options installed to take full advantage of the increased system capability.

AIM makes a good entry-level system for someone who wants the added dimension of ASCII input/output (instead of the calculator-style I/O on the KIM, SUPERKIM, and SYM) which alleviates the need for purchasing a separate ASCII terminal to use with BASIC or the Assembler ROM options.

AIM (with the Assembler and 4K RAM options) also makes a livable development system for programs up to about 1K long. Much beyond that, the small display and printer start becoming annoying and assembler listings are hard to read.

An area in which AIM is hard to beat is in controller applications where the keyboard, display and printer are essential such as when operator input is required or where data output is needed. Here is where AIM really shines. Three EPROMS may be added to the bare AIM.

Stay away from AIM, however, where significant amounts of system expansion are necessary. The extra money that you paid for the on-board display and printer will be wasted when a terminal and full size printer become needed.

For a portable, full featured machine with no foreseeable need for off-board expansion, AIM is a good buy.

AIM's TTY interface works almost as well as KIM's.

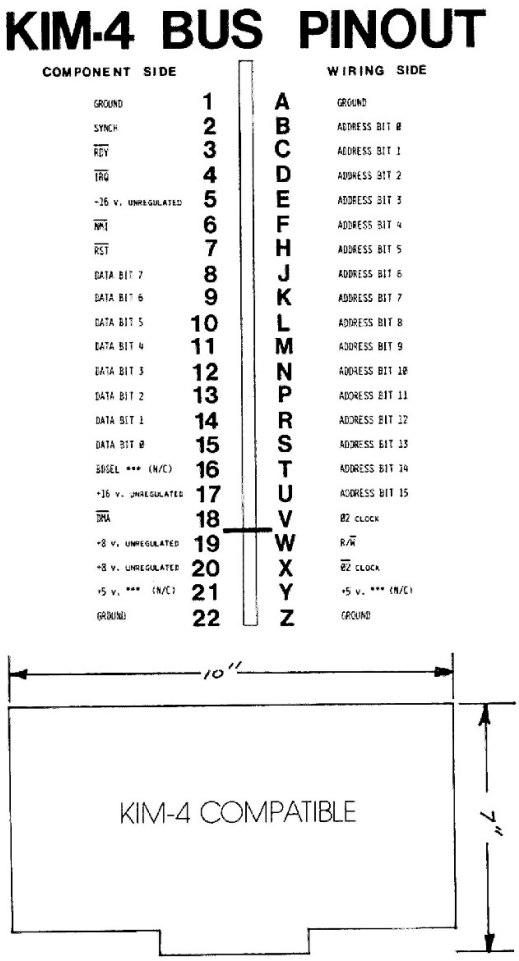
AIM 65 is manufactured by ROCKWELL International, Microelectronics Devices, POB 3669-RC 55, Anaheim CA 92803 (714) 632-3729.

WHATEVER HAPPENED TO THE "STANDARD" KIM BUS?

The KIM-4 (44-pin) bus as originally defined by MOS Technology/Commodore is the only bus that was designed specifically for KIM. Unfortunately, Commodore never seriously supported the bus and most folks went their separate ways to expand KIM.

Three companies are presently supporting expansion systems which are based "more-or-less" on the KIM-4 bus definition. They are: Hudson Digital Electronics, RNB Enterprises and Seawell Marketing. I say more or less because not one of the companies products corresponds exactly to both the KIM-4 electrical and mechanical specs.

Let's take a look at the KIM-4 pinout and board size.



You'll notice that the pins at positions 16, 21, and Y have signal definitions but are not connected. These signals were used when a single board was attached directly to a KIM-1 without using a KIM-4 motherboard.

Hudson Digital Electronics is the only one of the three companies whose boards are truly electrically KIM-4 compatible. But HDE's boards, are 4.5'' x 6'' which differs from the normal 7''x10'' KIM-4 compatible board size. (Now I happen to like the HDE card size a whole lot and feel that it makes more sense, but I own an HDE expanded KIM system so I'm probably prejudiced).

The boards from RNB Enterprises can be made fully KIM-4 compatible (mechanically and electrically) by installing a +5 volt regulator on their boards. (RNB regulates the whole bus instead of providing regulators on each card as in a normal KIM-4 system.) Whether this is better or not is debatable. However, RNB does provide a place on the board to install a regulator so this is not much of a problem.

Seawell Marketing has made the following reassignments to the KIM-4 bus:

PIN #	OLD SIGNAL	
16	BDSEL	$\overline{\text{EX CLOCK}}$
21	+5	+8
Y	+5	BANK SELECT
X	$\overline{02}$	01

Since 01. is not necessarily equal to 02, there could be problems when using the Seawell motherboard with non-Seawell expansion boards. You see, clocks very rarely have a perfect 50% duty cycle. Also, if you try to use an electrically KIM-4 compatible board in the Seawell backplane, the voltage regulator on the expansion board will have a very heated debate with itself. It's output has been shorted to its input by pin 21 on the backplane which has been changed from +5 to +8 (on a KIM-4 compatible board the output of the on-board regulator also goes to this +5 volt connection). The solution to this problem is simply to cut the trace from the regulator to the 5 volt output connection on the card BEFORE it's installed in the Seawell backplane. Seawell also sells a prom programmer board and a very nice looking 16K static RAM board.

So everyone sort of went their own way with their KIM expansion efforts. HDE changed the card size but kept electrical compatibility. RNB and Seawell use the normal card size but RNB pulled the regulators off their expansion boards, and Seawell redefined some of the bus connections.

Watch your step before you get on the bus.

What's Happening?

Hudson Digital Electronics has purchased source-code rights to Microsoft BASIC. They are in the process of turning it into a full-fledged disc BASIC and have added some neat features up to this point.

They've already added a line edit capability, line move, line copy, line and file append (file append also resequences the line numbers in the appended file so duplicates don't occur), a file delete, and a capability for loading machine language programs off disc (that would eliminate the problem of having

to convert machine language programs to a string of DATA statements for incorporation into BASIC).

The release version of HDE BASIC will also include the capability for disk file handling and a few other goodies. For more information, contact HDE Inc. P.O. Box 120, Allamuchy, N.J. 07820 (201) 362-6574.

Synertek is now offering a monitor upgrade for the SYM microcomputer board. The new monitor ROM (MON-1.1) sells for $15.00 and is supposed to clear up some of the problems with the original monitor. According to a source at the factory, a new monitor listing is included as well as some discrete parts to improve the cassette interface.

Get more info from: SYNERTEK SYSTEMS, 150 S. Wolfe Rd., Sunnyvale, CA 94086 (408) 988-5689.

SYM owners will have a newsletter written especially for their systems. It's called SYM-PHYSIS and is being done independently of SYNERTEK. The introductory issue contains useful information and programs that should prove useful to you SYM owners. Six issues cost $9.00 in North America ($12.00 otherwise) and is available from : SYM User Group, P.O. Box 315, Chico CA (916) 895-8751.

AIM users will be happy to hear that Rockwell will be publishing a newsletter especially for them. The first issue looks very good (I ought to know since I'm editing it!) and should be out in January. It's called INTERACTIVE, will cost $5.00 for 6 issues, and is available directly from Rockwell.

Newsletter Editor, Rockwell Microelectronics, P.O. Box 3669 - RC 55, Anaheim CA 92803.

6502 Software Situation

When I got my KIM, I really wasn't sure what software was. When I finally found out what it was, I couldn't find any around.

Now that was awhile ago (seems like ages) and things have improved quite a lot since then.

(You know you've arrived when Microsoft writes a version of BASIC for your machine.)

Two years ago, I predicted that in two years (e.g. now) the amount of software available for the 6502 "would surpass that available to the 8080. Well. . . . . .was I right? I'm asking you 'cuz I don't know.

I haven't seen a Fortran or C compiler for the 6502, but, there is FORTH and XPL0. . .and Rockwell sells a compiler they call PL/65 (I guess PL stands for Programming Language). There still isn't any widely supported disc operating system for the 6502 on the order of C/PM which runs on the 8080/Z80. (I feel that the lack of a standard 6502 hardware configuration has been largely responsible for this problem.)

Hudson Digital Electronics has recently crossed the hardware barrier by adapting their disc operating software to the S-100/KIMSI environment. So KIMSI owners can now use all that good HDE software that's available. While the present HDE disc software is not oriented towards the small business environment, they do provide the most complete collection of 6502 system development software available anywhere.

To sum it up: there are several good assemblers and high-level languages available for 6502 machines but, unless you own an APPLE or a PET, not much in the way of application software.

If you're using the 6502 in dedicated systems (it really shines in that area) you're in a "pioneer mode" anyway since you have to write all your own application software. In this mode you're more interested in the ease of programming and interfacing that the 6502 offers and not in how many game programs are available.

SYNERTEK SYSTEMS CORPORATION (150 South Wolfe Road, Sunnyvale, CA 94086) has announced the availability of a new Micro Development Tool for users of the 6500 series microprocessor family. The new product, called the MDT 1000, enables the user to write programs and debug both hardware and software.

According to the company, the MDT 1000 includes the following hardware: 54-keyboard and case; 12 inch (black/white) video monitor; dual cassette interface; power supply; EPROM Programmer; 4K byte static RAM board; CPU board with both serial and parallel printer interfaces; video interface; sockets for four ROMs, system RAM and ACIA for serial communications; and a four slot motherboarded with two sockets installed.

Software support for the MDT 1000 comes as 12K bytes of ROM-resident firmware; a 4K monitor with debug features; and an 8K byte assembler/editor which operates on line-numbered text. An 8K floating-point BASIC in ROM is available as an option. Additional software is provided for CRT control, printer interfacing, dual cassette interfacing, EPROM programming and keyboard. Additionally, the hardware is fully compatible with Motorola's EXORcisor™ bus to facilitate easy expansion. The MDT 1000 carries a unit price of $1495 and deliveries are being made now.