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The OSI Model 500

"Ohio Scientific's Model 500 CPU comprises compromise between completeness and cost."

Over the past year the self-contained (almost one board) microcomputer has appeared in several forms and levels of sophistication. The MOS Technology KIM-1 represents one of the extremes in which the single board not only provides the 6502 CPU, RAM storage and PROM operating system (a monitor), but also supplies a hexadecimal keypad and display, as well as a speed-compensating cassette interface. Although this unit is almost entirely self-contained, requiring the addition of only an external power supply, it is a minimal system. The RAM memory is only 1K bytes in the basic unit, which, in addition to the I/O limitations, makes it very difficult to support higher level software (e.g., BASIC).

The Apple, Radio Shack TRS-80 and PET 2001 microcomputers offer improvements over this situation, but for a price. These machines come with some form of BASIC in PROM, along with a significant complement of RAM for program storage.

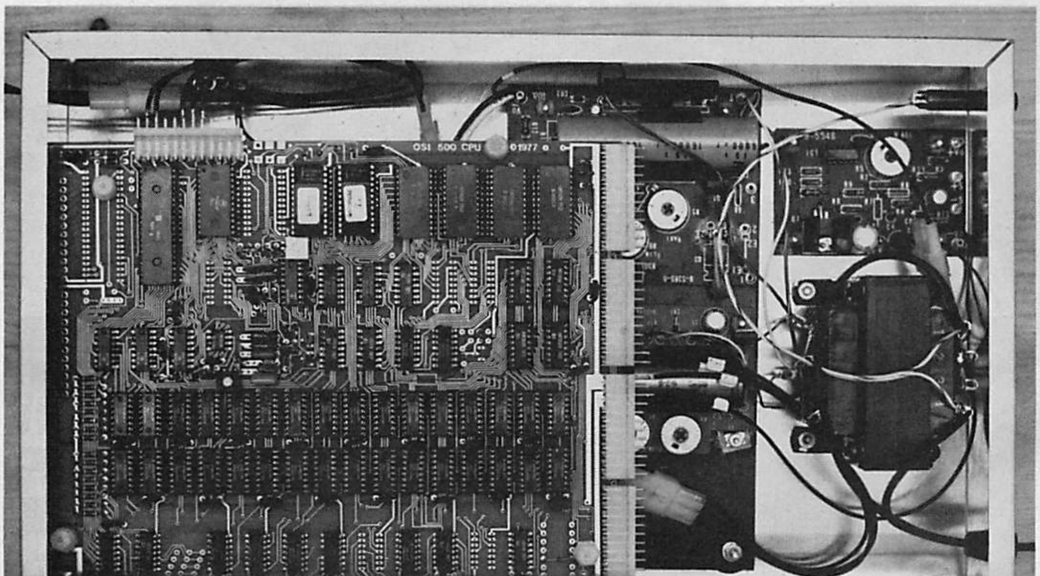

Photo 1. OSI Model 500 CPU board mounted in a BUD chassis box along with the required power supply.

The Apple is a very nice machine, which has color graphics and game controls, but it is the most expensive of the three computers. The PET 2001 is housed in an attractive enclosure, but has a keyboard that I find uncomfortable; the keys are too small and too close together, and several of the common keys are in remote positions. Also, according to a New York computer store, the originally advertised $600 4K RAM version is no longer available; only the $800 8K RAM unit can be ordered *prepaid*.

The TRS-80 outwardly appears to claim the low-cost end of the scale at a basic price of $400. This machine comes with 4K of RAM program storage space. However, once a video monitor and cassette recorder are added, the price is approximately equal to that of the originally advertised PET 2001, which included these features *and* contained a much better BASIC interpreter.

Enter the OSI 500

The Ohio Scientific Model 500 CPU provides a compromise between completeness and cost. It is a single board microcomputer having an assem-

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Photo 2. The complete system. The computer itself is underneath the CT-64 terminal.

bled price of $300. It contains an 8K BASIC in PROM, an RS-232C or 20 mA current loop interface (both available), 4K of RAM and easy expansion capabilities. The user must provide the power supply and terminal. Obviously, the Model 500 is not an "appliance" computer, but it is an interesting basic microcomputer for the hobbyist. In addition, it can serve as the base for an industrial controller or data acquisition system because of the ready availability of an on-board parallel port and other expansion features.

In the following section the hardware attributes of the Model 500 will be discussed in rather general terms. An example of incorporating the board into a small system will be given, and the speed of the software will be examined in terms of mathematical function processing times.

Hardware Features

The OSI Model 500 CPU board includes the following basic features.

- Two 256-byte 1702 EPROMs containing a system monitor and a serial input/output controller.
- Four Signetics 2616 ROMs containing a version of BASIC written by Microsoft (the same people who wrote the corresponding Mits software).
- Four kilobytes of 2102 static memory.
- A 6502 microprocessor operated at 1 MHz.
- A Motorola 6850 ACIA (asynchronous communications interface adapter) based serial interface having both RS-232C and 20 mA current loop capabilities; 110 to 9600 baud.
- Provisions for a Motorola 6820 PIA (peripheral interface adapter) based parallel I/O port (the 6820 is provided by the user).
- Space for an additional 256 byte 1702 EPROM.
- Convenient pin-bus connectors (for power, expansion). These are similar to SWTP 6800 connectors.
- The majority of the integrated circuits are in sockets.

In addition, the CPU board comes with a 57-page hardware manual that is very complete and reasonably well written. The manual is presented in a modular "how to build" and "how it works" format. Prior to doing anything with the board, you should read the manual in its entirety. In doing so you will be rewarded with an errata sheet, which is hidden in Part V, Appendix II. The manual also contains a considerable amount of discussion regarding troubleshooting. This treatment is a welcome change from the documentation I have been accustomed to in the past.

The power requirements for the board (including the 6820 PIA) are +5 volts at 2 amperes and −9 volts at 500 mA. Photo 1 shows the OSI Model 500 board mounted in a BUD chassis box along with the required power supply.

The 16X clock for the 6850 serial interface is derived from a 555 oscillator. The baud range spanned is 110 to 9600. The baud is chosen by jumpering to one of five pads to pick the approximate RC frequency components and then fine-tuning with a variable resistor (trim pot).

I selected the 300 baud pad and adjusted the trim to be in the center of the appropriate frequency range by observing the computer's output response to "reset." However, when the unit warmed up, the clock frequency drifted well out of the acceptable range. The baud should be adjusted when the unit is warm, or, better yet, the 16X baud clock existing in the external terminal should be routed to the CPU board and used instead of the 555 timer circuitry. The manual discusses how this may be done.

The addition of a 6820 16-line (e.g., eight in and eight out) par-

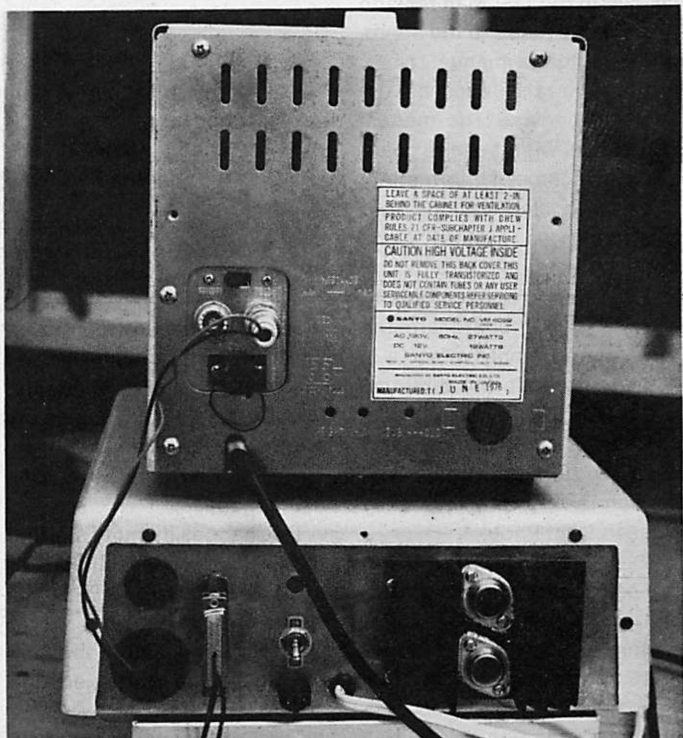

Photo 3. Back view of the system. The RS-232C output of the Model 500 CPU is connected directly to the CT-64 terminal, which is, in turn, connected to the video.

Function	Function Time (milliseconds)				Speed (/time) Ratio				
	Mits	OSI	North Star	North Star FP	Mits/NS	FP/NS	FP/OSI	FP/Mits	OSI/Mits
Division	7	3	16	2	2.3	8.0	1.5	3.5	2.3
Multiplication	4	2	5	2	1.2	2.5	1.0	2.0	2.0
Power	55	37	167	18	3.0	9.3	2.0	3.1	1.5
Sin/Cos	23	17	99	11	4.3	9.0	1.5	2.1	1.8
Square Root	46	33	92	4	2.0	23.0	8.2	11.5	1.4
Logarithm	19	14	99	9	5.2	11.0	1.6	2.1	1.4
Exponent	28	22	73	8	2.6	9.1	2.8	3.5	1.3
Mixed	160	143	521	60	3.3	8.7	2.4	2.7	1.1

Table 1. Incremental time to do function.

allel port appears to be straightforward, though I have not had a chance to implement it yet. All the circuitry required is presented on the board (upper left-hand corner of Photo 1) in terms of foil patterns. The address (F7XX) of the 6820 is decoded by an eight-input NAND gate (7430). Solder in the parts and the port will be in place. That is the easy part.

The user must supply the software for initializing and controlling the port, which is confusing for a beginner. Initialization and use are not discussed in the OSI manual, and reference is made to the appropriate Motorola manual. Note, the 6820 is also used on the Mits 4PIO board. The manual that comes with the Mits board is a good source of information, along with clarifications that have appeared in Mits' "Computer Notes" publication.

The required connections to the Model 500 board are the three power supply wires (+5, −9 and ground), the three I/O wires (RS-232C: receive, transmit and ground) and the two wires for the reset switch. Connection is very simple, as may be seen from Photo 1.

The Model 500 CPU board can be used to form the central unit in a small microcomputer system as shown in Photos 2 and 3 by adding an SWTP CT-64 video terminal and a video monitor. The CPU board is initialized via the reset button. The computer's response to this is "C/W/M?" which is the subject of the next section.

The PROM Monitor

There are two general versions of the monitor: one for the basic Model 500 serial I/O configuration and one for the optional OSI video board. The single board unit discussed here comes with the former. The CRT screen image on Photo 2 shows the computer response to being reset: "C/W/M?". In that case BASIC was called by answering with a "C." If instead the reply were "M," the monitor command mode would have been entered. The commands available, and their implementations, follow.

P: Sequentially displays memory contents in lines containing eight hexadecimal bytes. The display continues until any key is depressed on the keyboard. For example, P0000 (hex) displays memory starting at the origin.

R: Returns monitor to command mode.

L: Changes memory starting at the location specified. For example, L0000 A1 A7 F6 01. Escape is via "R."

G: Go command. For example, G0000 will start execution at 0000.

The OSI manual contains little information regarding machine-language programming other than specifying where the character input/output and similar routines are. The user is referred to the MOS Technology Programming Manual and the Ohio Scientific Small Systems Journal for information. The former is the manual that comes with the KIM-1 microcomputer; it is very complete. The latter is an OSI publication that is (in my opinion) highly overpriced at $1.50 per issue. Neither of these comes with the Model 500, and they must be obtained separately.

A better source than the OSI journal for machine-language software information is the informal publication called "KIM-1 User's Notes" or "The First Book of KIM." Personally, I find no pressing need to do machine-language programming because of the presence of a good BASIC resident in ROM.

Interpreter	Relative Speed
North Star Floating Point	1.0
Ohio Scientific	0.54
Mits 8K (Extended)	0.35
North Star (Version 6, Release 2)	0.13

Table 2. Relative function calculating speeds of the Mits, North Star and OSI BASIC interpreters.

OSI BASIC

The eight-kilobyte BASIC interpreter resident in ROM on the Model 500 CPU board was written by Microsoft. Although an instruction manual was not included with the board, this interpreter appears to be similar to Mits 8K BASIC, which was also written by Microsoft. Even the initialization questions (see the CRT display on Photo 2; "C/W/M?" was answered with a "C"; "W" does the same) are similar. This software is unquestionably better than TRS-80 Level I BASIC.

Reviews of Mits 8K BASIC can be found elsewhere. My interest in software is from a mathematical calculation perspective. In an earlier article presented in the August 1978 *Kilobaud* ("Mits vs North Star: which is faster?" p. 44), I compared the mathematical function processing times for Mits 8K, regular North Star and North Star Floating Point BASIC. I repeated this comparison for the OSI Model 500 with the results shown in Table 1.

Compared with North Star BASIC run in conjunction with the North Star Floating Point Board, which is very fast, the average relative speeds of the other three interpreters are as shown in Table 2.

The conclusion from the two tables is that the Ohio Scientific interpreter is very fast in its ability to perform mathematical calculations. A comparison between OSI and Mits is fair in that each has the same accuracy: six digits. OSI has claimed a 20 percent speed advantage in the literature. The two North Star examples are at a disadvantage as the mathematical functions are calculated to greater accuracy: eight digits. In any case, OSI fairs well in the comparison.

Conclusion

The OSI Model 500 CPU board offers an attractive set of features for the hobbyist or designer who wishes to begin with a small system that is in a class between the KIM-1 and Altair/Imsai. The Model 500 is definitely more powerful than the KIM-1 . . . more than might be expected from the small difference in price.

The major additional cost in assembling a small system using this board is the required input/output terminal and the optional cassette interface. These could probably be obtained for perhaps another $200 to $300. The $80 SWTP ACR-30 would be a good choice for the cassette interface. If the object were to obtain the capabilities of a PET 2001 and go no further, it would be difficult to justify not simply buying a PET. The lure of the OSI Model 500 is in its use as a basic building block for the experimenter.■