

Q&A

Part 4: Jon answers some Questions!

Last revision: April 5th, 1999, Copyright @ 1999 Jon Titus

Most of the questions here were asked of Jon by [Doug Salot](#). Some answers refer to Doug's fine website [Blinkenlights](#).

How did you come up with the Mark-8 name? Was it in homage to the Harvard Mark I and its descendants?

I came up with the name on the spur of the moment. I was putting the decals on the front panel and realized that the computer should have a name. Up until then (late 1973) it existed just as the "8008 computer," and it had no formal name. Perhaps the "Mark" came from my experience in the military, or I may have simply picked it out of the blue. The "8" related to the number of bits the computer used.

What was the first software written for the Mark-8?

The absolute first software was a simple jump test, that if I recall correctly, went something like this (in octal):

Address	Instruction	Mnemonic
000 000	104	JMP
000 001	000	000
000 002	000	000

This simply caused the computer to go into a three step endless loop, which I did the first time I tried it. As I recall, the second test also used a JMP instruction and it went something like this:

Address	Instruction	Mnemonic	
000 000	104	JMP	/Jump to
000 001	100	100	/this low address
000 002	000	000	land this hi address
000 100	104	JMP	/Jump to
000 101	000	000	/starting address
000 102	000	000	

Then I recall running a simple test that incremented a register in the 8008 and put out the binary bit pattern to an output port. I purposely placed an output port right at the front panel both for diagnostic use and for general-purpose output of binary information.

The LEOs in the prototype were tiny--about the size of a pencil point. I think they were MV-10s or something similar from Monsanto. They were very difficult to see, so I turned out the

lights on my workbench and used the single-step controls on the prototype to step through the instructions, one at a time. Doing so confirmed that the computer worked properly.

What was the most interesting software written for the Mark-8?

That's difficult to say. My brother, Chris, and I programmed some interesting math routines that produced very pretty shapes on an X-V display. We used two digital-to-analog converters to drive the plotter.

Any third-party hardware?

None that I can recall, although I did start work on a punched paper-tape reader, which I got to a prototype stage, but then abandoned as too complicated and too expensive.

Were the front panel and box plans included in the plans that Radio-Electronics magazine sold for \$5? Or was the project just the boards?

The project was just for the boards. I thought that most people would build their own cases to suit their needs. The original Mark-8 metal box was one I had purchased for another project that never got built. I made the cut out for the LED displays and found a piece of clear plexiglass that would fit into the space. I used transparent red glass dye, which came as a liquid to color the plastic. I placed a "dam" of masking tape around the edges and then poured the dye onto the plastic and let it level itself and then dry. It made a nice dark red filter for the larger LEOs used in the final version of the Mark-8.

Hal Chamberland (Chamerblain?) estimated the number of Mark-8 computers as around 1000 in 1975. Does that number sound right to you?

It sounds high. Of the top of my head I'd say several hundred sets of boards were sold.

I found my old tax forms and looked at the royalty amounts I received from Radio-Electronics and from Techniques, the company that produced the printed-circuit boards. It looks like Radio-Electronics sold about 7500 of the \$5 booklets, which is far more than I would have remembered. About 400 sets of boards were sold.

Are you familiar with the work of Nat Wadsworth, who built a commercial 8008-based micro in 1973 and marketed it from his company, Scelbi?

I was familiar with Nat's published work. He produced some interesting books about programming the 8008. I got a lot out of those books. I think my original copies went to the Smithsonian with a lot of other computer publications.

I didn't know about the Scelbi computer until right about the time that the Mark-8 came out. I recall seeing some small ads for the computer, but I never saw one of the actual computers and I don't know anyone who had one, though.

Another small "computer" came out at about the same time. I think it was called the Kenbak-1. It used one of the Texas Instruments arithmetic-logic unit (ALU) integrated circuits (SN74181?) to perform rudimentary processing operations. The computer stored a few instructions, which users set by pressing buttons on the front panel. I investigated the possibility of using Kenbak computers in a course taught at Virginia Polytechnic Institute (Blacksburg, VA). My colleagues and I decided that the Kenbak was interesting, but we couldn't use it as a real computer. Also, as I recall, the Kenbak had no provisions for any form of digital I/O, which we needed.

Intel produced a number of small "computers" at about this time, too, although they required a teletypewriter for I/O. The first one was a SIM-4 board that included a 4004 4-bit processor. Then Intel produced a SIM-8 board for the 8008 processor. They also sold a PROM-programmer board as a companion for it, but the set, including a nice blue box that provided connectors and some lights, sold for over \$1000. I still have a set of those boards and one of the boxes, although I can't recall the model number of the box. I know that it required external power supplies. And it required on-board PROMs that contained a monitor program that controlled the teletypewriter. Very basic. The lights and switches weren't used to load program steps into the computer. I think they could generate an interrupt or jam an instruction into the CPU.

I used the basic SIM-8 circuit as the basis for the Mark-8, but with many modifications so that the computer could accommodate a real front panel that would give users access to the memory and let them control the computer.

Were you familiar with any of the earlier hobbyist groups, such as the ACS, organized around machines like the PDP-8?

Yes, and I was a member of the ACS for several years. I've covered some of this history elsewhere, so I won't get repetitious here. I did use PDP-8/1 minicomputers in my research work at Virginia Tech, so I had a natural interest in the possibility of duplicating a PDP-8/1 for my own use. The catch always seemed to be getting core memory. Many companies sold arrays of core planes, but few came with electronics, so they were difficult to control. Those few that came with electronics usually had only part of the electronics--the drivers, and not the control electronics. I spent quite a bit of time investigating core memory, but never got further than driving and sensing a single core--one bit!

I don't know if any ACS members ever did get a PDP-8 "clone" working.

I don't suppose you were influenced at all by the work of Edmund Berkeley were you?

No. I just looked him up on your web site ([Blinkenlights](#)) and found some interesting facts about him, but prior to that I had not heard of him. I am pretty much self-taught in electronics. I got my start in "computers" by teaching myself about Boolean logic and numbering systems in high school. I built a 4-bit binary adder from my own design and I still have it in the basement. I also have a punched-card reader I built. It took 3-inch X 5-inch punched cards and used a 7-bit code. That was in 1962-1963. I later improved the design

by adding a better stepping motor to move the cards through the reader.

A friend of mine and I built some relay-based "learning machines" in 1962 and 1963 when we were seniors in high school, but they could only react to a few stimuli at a time, so after we had fun with them we put them aside and never tried to do anything practical with them. In relay circuits, power is the limiting factor. We needed many large 24-volt power supplies to drive our creations, and we just couldn't figure out how to build as many as we needed.

When I was in junior high school, or perhaps in early high-school grades, my Dad bought a Geniac "computer" for about \$20. It provided a cumbersome switching arrangement of brass clips and shorting strips that had to be positioned properly to get the circuits in the right configuration to "compute." I can't remember what the circuits actually did, but I found it almost useless because it was so darn hard to wire and get working.

By the way, on your site you show a Heathkit analog computer. That was the second analog computer from Heath. Previous to that model they had a much larger one with a sloped front panel and many, many banana jacks and lots of potentiometers. Cost was about \$1000, so they didn't exactly appeal to hobbyists. You had to know a lot of math and calculus to get much out of a computer like that. I think the computer could drive an oscilloscope and a strip-chart recorder so you could "see" the results of a computation which you wired up with discrete components.

A magazine in the UK, *Wireless World*, published a series of articles in the mid 60s. It required builders to use discrete transistors to build up operational amplifiers. I thought about building some of the circuits, but getting the special transistors and other components from the UK proved too expensive. My employer, Reed Elsevier, now owns *Wireless World*, and if you would like, I can do a bit of digging to see what more I can find about this series of articles.

Also, we need to give credit to Don Lancaster, who published a lot of digital IC projects in *Popular Electronics* in the late 60s. To a great extent it was Don's articles that convinced a lot of us that we could actually use these new-fangled things called integrated circuits. Many of Don's projects relied on DTL ICs, and later on TTL ICs. I can't recall building any of Don's projects, but I built parts of them--power supplies, clock circuits, lamp drivers, counters, and so on that I needed to construct some of my own projects. SouthWest Technical Products in Texas produced a lot of kits for Don's projects. Don lives in Thatcher, AZ., so you might want to contact him for his perspective.

Any who can forget Don's TV Typewriter, a device that could use a TV set to display alphanumeric information. I used one with the Mark-8 to display octal and hex codes for testing and debugging.

There was also a company in Colorado called Environmental Products that sold a lot of digital IC kits and parts. I may have a contact who could tell you more about the company, but it has been quite a while since I talked with him.