MODIFYING THE HEATH H89 TO 4 MHZ SYSTEM CLOCK

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(From the HUG FORUM on CompuServe)

Hardware Mods for H89

On the CPU board of the H89, U502, a 74LS92 is used to divide down the clock. Pins 9 or 11 have 4 mHz on them. What is needed is to cause the CPU and memory to see 4 mHz while the rest of the board sees 2 mHz.

To accomplish this, on the REAR (NOT the parts side) of the CPU board, cut the trace leading to pin 3 of U512. Connect 4 mHz from pin 9 or 11 of U502 to this pin (pin 3 of U512). You may want to put a single-pole double-throw switch in so you can switch between 2 and 4 mHz operation.

This patch connects 4 mHz to the CPU, the single-step logic, and the memories.

You may have to swap out the Z80 for a Z80A, although I have not had any problems. If you got an early H/Z89, you may have memory parts which are already fast enough to run 4 mHz. If your machine crashes often at 4 mHz, you probably will need to change them. I have not had any problems with the original parts.

A similar patch can be made on the CRT board, since the clock divider circuitry is almost identical, and also, a jumper is provided for 3.1 mHz operation. At 4 mHz the screen will run at 19.2K baud with no trouble. At 3.1 mHz, it isn't fast enough to keep up.

The static RAMs on the screen board (the 2114's and the 2112's) can't deal with 4 mHz, they should be replaced with 250 nSec parts. Everything else should handle it OK.

Note: Both of these patches have been running in my H89 for about 6 months with no problems at all. If you need more details or help in the hardware patches, let me know.

Software Patches for 4 mHz HDOS

You must change the contents of the H17 disk controller ROM as follows:

Addr	Old	New	(Values in Octal)
====	===	===	
37.145	24	50	
37.146	24	50	
37.147	120	265	

This patch works for HDOS 1.6 and 2.0; I don't know about other versions.

Software Patches for 4 mHz CP/M

You must make the above HDOS patch and ALSO patch the following:

In the file BIOS.ASM (supplied with CP/M by Heath) change the following equates:

Symbol	Old	New	(Values in Decimal)
======	===	===	
WHNA	20	40	
WHDA	20	40	
WSCA	...	181	;The old value is 64*25/20

Then prepare your BIOS as described in the Heath modification manual using PREL.

Finally, you must patch your BIOS preloader, which resides with CP/M in the first 3 tracks of the diskette, as follows:

With a GETPUT type program (as described in the CP/M manual) load the first three (3) tracks of the bootable diskette into memory, starting at location 4380H. Then change the following instruc-tions:

Addr	Old	New	(Values in HEX)
====	===	===	
5D93	MVI A,14	MVI A,28	
5D9E	MVI A,14	MVI A,28	
5DBF	MVI A,50	MVI A,0B5H	

Then write the three tracks back out onto the diskette.

General:

The procedure in which to do this is as follows:

I. Install hardware mods and use a 2/4 mHz switch as described.

II. Patch the H17 boot rom as described, then, if you have HDOS, test it out at 4 mHz.

III. Patch CP/M for 4 mHz. [Note! the modified boot rom works fine at EITHER 2 or 4 mHz.]

IV. Make sure CP/M is working properly at 4 mHz.

V. Remove switch from circuit.

Some other comments:
Certain programs under both operating systems do their own disk I/O. Under HDOS, TEST, TEST17 and many of the HUG utilities have portions of them which don't work. Under CP/M, DUP doesn't work. I have had no difficulties with MBASIC or ASM either under CP/M or HDOS.

Be careful when you go cuttin' on the boards!