Speeding up your Heath H-89/90

Now that you have installed the Z67-IDE, you are probably still 'WOWed' by how much faster it boots and runs with the quick read/write access on the Z67-IDE.

WARNING! – Speed is addictive!

So, now you want to make the processing faster as well. This is rather easy on the H-89/90 computer and requires **NO** modification to the CPU circuit board. There is a speed modification board that is available from Norberto Collado that simply plugs into a socket and will give you software selectable 2 or 4 mega-hertz operation.

By-the-way, you don't have to be running the Z67-IDE to use the Speed Board. It will work just as well for a floppy based system.

What's Needed:

OK, it is just a bit more complicated than what I just said. You also have to replace the CPU chip with a Z80A (4 MHz) or a Z80B (6 MHz). Occasionally, the installed memory chips aren't fast enough and also have to be replaced with faster chips. The good thing about this modification is that if you install it and it doesn't work because the memory is not fast enough, you simply simply continue to boot and run at 2 MHz just like before without modifying the software. Then, after acquiring faster memory, install the new memory chips and perform the speed test. You should now be now be able to run at 4 MHz.

Once the hardware modification is complete, there are still some software changes to be made.

The H-17 device must boot at 2 MHz, switch to 4 MHz for operation, and then drop the speed back to 2 MHz for H-17 device access. This doesn't really slow the processing as the read/write is already limited due to the floppy rotation speed and waiting for the sector to come to the head. The speed returns to 4 MHz after the read/write operation.

For HDOS, the H17.DVD must be modified to control the CPU clock speed, dropping the speed to 2 MHz for H-17 disk access.

For CP/M, we do very similar changes. Again most of the changes are for the H-17 device that only works at 2 MHz, but this time the changes are in the BIOS.

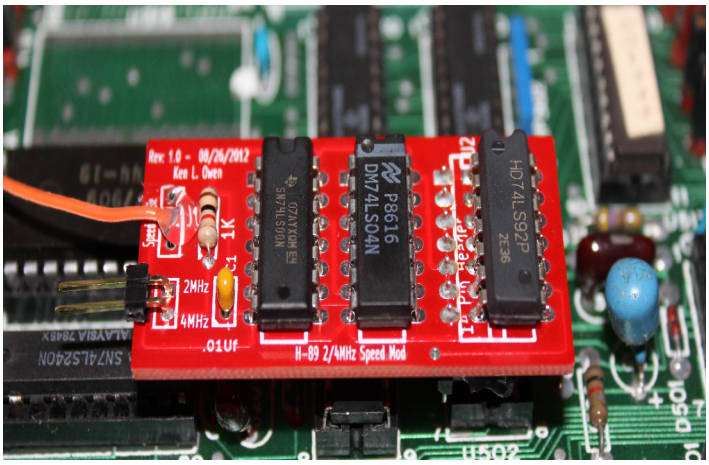
If you are running the H37/Z67-IDE setup, it is even simpler! You connect the speed select control wire to +5 volts to both boot and run at 4 MHz continuously. **No software changes are required.**

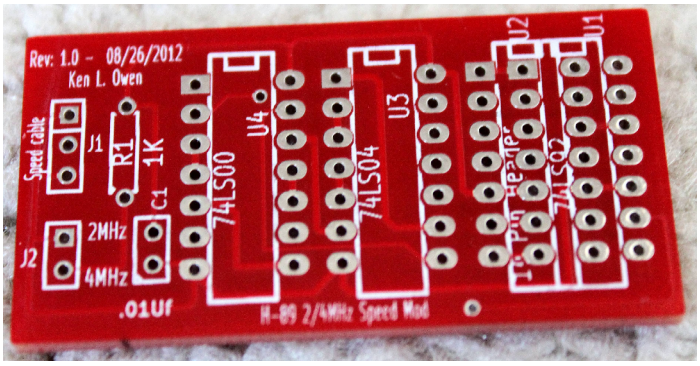
OK, so you are not really comfortable assembling HDOS drivers or modifying the BIOS. **That's Not a problem!** We already have the system modified and available for download in Les Bird's H8D format.

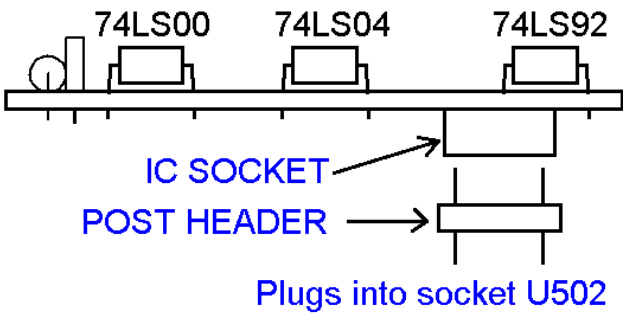
We currently have OS disks for HDOS 2.0, HDOS 3.02, and CP/M 2.2.04.

Assembly:

1. Inventory the parts:
   A) 74LS00 integrated circuit
   B) 74LS04 integrated circuit
   C) 74LS92 integrated circuit
   D) Speed Modification circuit board
   E) Z80A CPU integrated circuit (available from Jameco)
   F) a piece of wire, approximately 8”
   G) a single pin female connector (to fit on the pins of the left side bus)
   H) 1/2” of heat shrink tubing
   I) a 14 pin IC socket
   J) a 14 pin post header







2. Examine the board to get the proper orientation. The front side of the board should have the letters “Rev: 1.0” at upper left. You should also note that pin 1 of the ICs are the upper left pin.

3. Turn the board over and insert the 14 pin IC socket into the board on the bottom side leaving one row of holes to left. Note that half of the pins are in the middle of the space for the 74LS92 IC.

4. Turn the board back to the TOP side and solder all 14 pins. Trim the pins that are in the middle of the 74LS92 IC location.

5. Clip 1/16” from pins 1 through 7 of the 74LS92 IC.

6. Insert the 74LS00 (left), 74LS04 (center) and 74LS92 (right) ICs into the board ensuring pin 1 is upper left.

7. Turn the board over and solder the IC pins on the bottom side, alternating between chips to minimize heating of the ICs.

8. Turn the board back to the TOP side and solder the pins 1 through seven of the 74LS92 chip from the top side of the board.

9. Strip one end of the wire, insert it into the center hole marked as J1 and solder it on the bottom side of the circuit board.

10. Put some glue in the center of the plastic of the 14 pin post header on the short pin side and fully insert the short pins into the 14 pin socket on the bottom of the Speed Board.

11. Examine your work for proper orientation of ICs, all connections soldered and no solder bridges.

12. Set the Speed Board, single pin connector and heat shrink aside for now.

Installation:

1. Remove cables from your accessory cards and remove any accessory cards that interfere with CPU board removal. Ensure the connectors are adequately marked or **label them NOW**.

2. Remove the CPU board from the computer carefully noting plug orientation and making a checklist to use on re-installation. (**Some of these are hard to see after re-installation. It pays to get it right the first time.**)

3. Replace U504, Z80 CPU, with the Z80A or Z80B CPU ensuring proper orientation, all pins inserted and no bent pins.

4. Remove the 7492 IC from U502.

5. Install the Speed Mod Board into socket U502 ensuring that the "Rev: 1.0" marking is upper left.

6. Route the control wire to to Pin 1 of an unused location P507, P508 or P509 (25 pin header) allowing sufficient length to connect to pin 1. **Note:** P501, P502 and P503 (10 pin header) are immediately above P507 – P509.

7. Strip and solder the end of the wire to the single pin connector.

8. Install the piece of heat shrink over the single pin connector to insulate the soldered connection.

9. Connect the single pin connector of the control wire to pin 16 of either P507, P508 or P509. Count the pins again to ensure you have the right pin.

10. Reinstall the CPU board reconnecting the plugs in the reverse order of removal. Ensure the Speed Board clears the Video board heat sink and that the plugs are properly positioned onto the pins!

11. Re-install your accessory cards ensuring proper alignment on the pins. Reconnect the cables to the accessory boards.

12. Examine your work and review your checklists to ensure that everything is back into place with proper orientation of connections.

Testing the Installation:

The software modifications are not required for the initial test of the Speed Board. If all is working properly the computer should boot and run at 2 MHz.

1. Power on your Heath and verify that you get two beeps. If not, **IMMEDIATELY** power off and check your connections. Also verify that the keyboard ON/OFF-LINE key is up. When the problem is corrected, repeat this step.

2. Boot your computer with a known good disk. Verify proper operation. It should work exactly the same as before the modification.

3. This completes the initial test. Shut down the computer.

Testing 4 MHz Operation:

If you have replaced the Boot ROM with a faster chip **capable of operating at 4 MHz** such as the MMS 444-84B used with the Z67-IDE, perform the following steps.

1. Move the control wire from pin 16 to pin 1 of P507, P508 or P509. This is +5 volts and the CPU clock will run at 4 MHz.

2. Power up your Heath and verify that you get two beeps.

3. We will now verify that the memory can run at 4 MHz: {auto complete in ( ), <cr> is Enter}

   A) If you are running an upgraded faster ROM with Heath monitor 90 code, type:
      H: G(o) 7375<cr> to run the built in memory diagnostic.
   B) If you are running the MMS 444-84B, at the IDE: prompt type:
      IDE: M(emory)<cr> to perform the memory diagnostic.
   C) If you get no errors prior to the counter looping back to zero to start a second pass, you are done. The memory can run at 4 MHz.

4. Power off your Heath and return the control wire to pin 16 of P507, P508 or P509. Double check to ensure you have it on the correct pin.

If you have the **original Heath Boot ROM**, it will not work when the clock is at 4 MHz. You will need a boot disk with the Speed modifications installed to boot at 2 MHz and then switch to 4 MHz. Download the system disk(s) listed in "Upgrading Your Software" in the next section and perform the following:

1. Boot the 2/4 MHz system boot disk. The system should boot and report 4 MHz operation.
2. Use the test below based on your operating system:

CP/M:

A) If you are running CP/M, type SPEED and press the return key. The computer should report that you are now running at 2 MHz.
B) Now, type PI and press return. Time the program run.
C) Again, type SPEED to return to 4 MHz and re-run the PI calculation program. It should complete in one half of the time for the previous test.
D) Run several programs or a memory diagnostic program at 4 MHz to test your memory.

Program Notes: Use FORMAT.COM to format an H37 floppy. Use FORMAT8R.COM to format an H17 floppy. FORMAT8R will drop the clock speed to 2 MHz, format the disk(s) and return to 4 MHz on exit. Use MOVCPM37.COM to move the system to an H37 disk. Use MOVCPM80.COM to move the system to an H17 disk. SYSGEN.COM will only work to move the system from one disk to another of the **SAME** type.

HDOS:

A) If you are running HDOS, type SPEED (SPD3 for HDOS 3.02) and press the return key. The computer should report that you are now running at 2 MHz.
B) Now, type TIME (TIMETEST for HDOS 3.02) and press return. Note the reported time of execution.
C) Again, type SPEED (SPD3) to return to 4 MHz and re-run the TIME (TIMETEST) program. It should report one half as long to execute.
D) Run several programs or a memory diagnostic program at 4 MHz to test your memory.

Program Notes: Use FORMAT or FORMAUTO to initialize an H17 floppy. This will drop the clock speed to 2 MHz, format the disk(s) and return to 4 MHz on exit. TIME is an intrinsic command in HDOS 3.02, so the TIME.ABS program was renamed TIMETEST.ABS. The speed change utility is different for HDOS 3.02 and named SPD3 to differentiate since HDOS 3.02 can also use HDOS 2.0 disks which may have SPEED.ABS.

Upgrading Your Software:

On Norberto's web site, there are packages to support the 2/4 MHz Speed Mod. Download the packages to build a system disk that has all of the needed changes incorporated.

For the H17/Z67-IDE, there is a CP/M package for 4 MHz operation using the 2/4 MHz Speed Mod.

For the H37/Z67-IDE, no changes are required other than moving the control wire to pin 1 of P507, P508 or P509 (+5 volts). The system will boot and run at 4 MHz continuously for both HDOS and CP/M.

If you are running a floppy based CP/M system with the Speed Modification, download the Standard Heath CP/M 2.2.04 (with LLL BIOS80 and the 2/4 MHz Speed Mod enhancements) system disk (H8D) based on your drive complement.

For HDOS 2.0 and HDOS 3.02. there are disk images (H8D) for H17/Z67-IDE that will download using Les Bird's H8D program to create a minimum system disk to make your full system floppy disk or to install on the Z67-IDE. These disks are configured for H17, single-sided, 40 track drives. Run SET to configure the disk to your drives. If you do not have the Z67-IDE, you can rename DK.DVD to HD67.DVD.

HDOS 2.0 is using a modified version of the HUG SY.DVD (885-1121) and needs the following SETs:

```
|
| => SET SY: DKH37          (or NODKH37 if you do not have an H37)
| => SET SYx: nnTRK         (x = PHYSICAL drive number, nn  =  40 or 80 track)
| => SET SYx: SIDES m       (m = 1 or 2)
| => SET SYx: STEP yyy      (yyy is the step rate in milliseconds)
|
```

HDOS 3.02 Sets are similar. Type SET SY: HELP or SET DK: HELP.

Roll Your Own:

Additionally, for the curious who want to know exactly what is changed or the do-it-yourself type, the *.ASM files are available as well. The process is outlined below, but does not list every step.

HDOS:

For HDOS, the H17 driver files will need to be assembled. There are two files, the *DVD.ASM (.H8A for HDOS 3.02) and *INIT.ASM (H8A). These files will need to be assembled into *DVD.ABS and *INIT.ABS and then combined into a new H17 driver. **NOTE: The new driver will be in default configuration for a single-sided, 40 track drive.** You will need to replace the SY.DVD on a single-sided, 40 track boot disk to test the driver. It can then be configured to your drives' tracks, sides and step rates. Use this disk to SYSGEN your new system working disks.

For HDOS 2.0, the changes are applied to the HUG HSYDVD.ASM (HUG Hard Sector Support Package # 885-1121). Download HSYDVDSp.ASM (modified with the speed change code) and HSYINIT.ASM from the HUG disk. Assemble these two files and use the program named COMBINE.ABS from the HUG disk to convert the two *.ABS files to the final H17.DVD.

For HDOS 3.02, the source files, H17DVDr0.H8A and H17INITr0.H8A, have been modified to work with the supplied Heath assembler to exactly reproduce the distributed driver. Additionally, there are modified files that include the speed mod code named H17DVDSp.H8A (DVD section) and H17LOAZ.ACM that will need to be added to your ACM files. The file MAKEDVD.BAT will automate the process of building the driver. This will require some minor editing to add the “H8A” extension for the source files (the Heath assembler defaults to ASM) and to adjust for your drive/disk utilization. Copy the source files to your ASM working disks without the 'r0' and 'Sp' in the file name

and run the batch file.

```
|
| H> MAKEDVD H17<cr>
|
```

CP/M:

For CP/M, the process is similar. Download H224B8Sp.ASM (Heath 2.2.04 BIOS with LLL Bios80 enhancements and modified for the 2/4 MHz SpdMod). Include any additional changes for your hardware. Copy this file to a bootable disk containing ASM.COM, PREL.COM, SUBMIT.COM, XSUB.COM, MAKEBIOS.SUB and MAKEBIOS.COM. Boot the disk and type:

```
|
| A> SUBMIT MAKEBIOS NEWBIOS.SYS A:
|
|      Select from the presented menu based on your installed drive types.
|
```

SYSGEN a test disk and copy the NEWBIOS.SYS to it. On the test disk, RENAME BIOS.SYS to OLDBIOS.SYS. PIP BIOS.SYS=NEWBIOS.SYS. Boot the test disk to check the new BIOS.SYS. Configure the new BIOS for your system. Run STAT to set the flags.

There is also a revised version of FORMAT80.COM named FORMAT8R.COM that will automatically drop the speed to 2 MHz when formating an H17 floppy disk. The speed will return to 4 MHz when you exit the program. (You must manually drop the speed to 2 MHz before running the original FORMAT80.COM program and manually switch back to 4 MHz when done.)