# Installing The HA-108 Upgrade Kit On Older H/Z-100 CPU Boards

**Pat Swayne**
*HUG Software Engineer*

***H**i, I just finished installing the 256k–8mhz modification in my computer, and I simply would like to say that this modification REALLY WORKS! It was my job to proofbuild this mod and these instructions on the H-110 in my office. My unit was one of the very first off the production line and had no updates to it at all. It is now running at 8 megahertz and has 768k of system RAM on the motherboard. The following hints will hopefully make your job a little easier and possibly eliminate some problems. First of all, this mod is not for the faint of heart or unsteady of hand! You will be cutting foils on your one thousand dollar motherboard! The only wire you should use is the kind used for wire wrapping (#30–#32 gauge solid conductor). Your iron should be of pencil variety and be no greater than 25 watts. Only the highest quality rosin core solder should be used. Obtain the IC sockets called for in the instructions from the Heath Parts Department; these sockets work properly. Remember, make one mistake, and the computer will no longer work! I made the same mistake twice during construction, and that was to place a jumper wire on the wrong IC pin number. The following hint should help you eliminate this problem. Before you begin, make some small labels out of masking tape or blank address label stock. These labels should fit between the two rows of pins on each IC that will have jumpers going to them. Remember, when you're looking at an IC from the bottom side, the pin number rows are reversed. The following is what one label may look like:*

| | | |
|---|---|---|
| 14 | | 1 |
| 13 | U | 2 |
| 12 | 2 | 3 |
| 11 | 3 | 4 |
| 10 | 3 | 5 |
| 9 | | 6 |
| 8 | | 7 |

*Paste these labels on the foil side of the motherboard. Believe me, these will help, and speed up construction because you won't have to be searching for the IC you're looking for while trying to concentrate on which pin the next jumper should go to. Another problem that can occur is during the insertion of IC's. It is very easy to have a pin on an IC bend underneath itself, or slip outside of the socket, or just fold like an accordion when being inserted. To help alleviate this problem, bend each row of IC pins against a flat surface so that they're at a 90 degree angle to the IC body. Do both rows of pins on each IC. Once the IC is inserted, examine it very carefully; look at each individual pin!*

*The following hint works quite well for me, and will assist you in making the jumper connections on your board. Each jumper connection you make should be done with wire wrap type wire as mentioned earlier. Strip back the insulation 1/32". Yes, that's one thirty second of an inch! Add only a very small amount of solder to the IC connection to which the jumper will be added. Now take your jumper wire, and re-heat the connection again until the bare wire slides into the solder. Remove your iron from the connection, and hold the wire steady until the connection cools. You DON'T have to pre-tin the wire with solder.*

*NOTE: The Heath HA-108 modification kit is required to perform this modification. Heath/Zenith can guarantee proper system operation only if these parts or additional memory I.C.'s are purchased from them. This warning is made due to a specification problem some I.C. manufacturers have had.*

*Perform each step of the instructions carefully. Under no circumstances should you omit the power up tests. These power up tests are meant to help catch problems during each phase of modification. Finally, don't, don't hurry. This modification DOES, and CAN work for you!!*

**Jim Buszkiewicz**
*HUG Software Developer*

The HA-108 Upgrade kit allows you to alter newer H/Z-100 main circuit boards (boards with part no. 85-2806-1) to run at 8 MHz instead of 5 MHz and to use 256k RAM IC's instead of 64k IC's. This article contains instructions for modifying older boards (with part no. 85-2653-1) so that the kit can be installed. If your H-100 kit came with full height drive(s), you most likely have the old board. The part number on the main circuit board is printed near Y101 under the video board.

**WARNING! WARNING! WARNING!**

**INSTALLATION OF THESE MODIFICATIONS REQUIRES THAT YOU CUT A NUMBER OF TRACES ON THE CPU BOARD AND CONNECT SEVERAL JUMPER WIRES. THIS WORK SHOULD ONLY BE DONE BY PERSONS EXPERIENCED IN MAKING SUCH CHANGES TO PRINTED CIRCUIT BOARDS. THE POSSIBILITY EXISTS OF PERMANENTLY DAMAGING YOUR CPU BOARD. NEITHER THE HEATH/ZENITH TECHNICAL CONSULTANTS NOR THE HEATH USERS' GROUP STAFF MAY BE ABLE TO HELP YOU IF YOU ATTEMPT THE MODIFICATION AND YOUR COMPUTER DOES NOT WORK.**

These instructions are divided into three sections: some modifications that are common to both the memory and speed changes, the memory modifications, and the speed modifications. You may omit the modifications dealing specifically with either the speed or 256k memory changes if you wish. However, it is recommended that if you perform the speed modification that you also perform the memory modification, since your original memory IC's are probably too slow for 8 MHz, and will have to be replaced anyway.

## Preparation

To perform these modifications, you will need the parts contained in the HA-108 kit plus 10 feet of 30 to 24 gauge solid wire (30 gauge "wire wrap" wire is best), two 18-pin IC sockets (Heath part no. 434-310), and a 14-pin socket (part no. 434-298).

## Disassembly

Perform the steps in the HA-108 Installation Manual that apply to your computer up to but not including the page titled "Main Circuit Board Upgrade". Then perform the following steps:

( ) Remove any cables that are connected to the serial, parallel, monitor, or light pen connectors on the back of the computer.

( ) Remove all cards from the S-100 card cage. If you have a Winchester controller, you will have to remove the power connector from it first.

( ) Remove the two sheet metal screws that connect the card cage to the back of the computer. Remove the 4 8-40 × 3/8" screws that connect the card cage to the main circuit board. Set the screws aside temporarily.

( ) Remove the S-100 card cage and set it aside temporarily.

( ) Remove the 9 8-40 × 3/8" screws and the three hex standoffs that hold the main circuit board to the chassis and set them aside temporarily.

( ) Lift the main circuit board slightly and slide it forward until the connectors at the rear are clear of the computer back plate. Then lift the right side of the board carefully until it is above the side of the computer chassis. Unplug the power connectors at P101 and P102, and remove the main circuit board from the chassis. Set the chassis aside temporarily.

## Main Circuit Board Modifications

Common Modifications

The following modifications should be performed regardless of whether you are going to make the memory modifications, the speed modifications, or both. Some of the changes have little to do with the speed or memory changes, but are design improvements.

### Memory Modification (common)

The changes in this section affect memory timing and addressing.

( ) Prepare one of the 18-pin IC sockets by bending pins 9 and 10 in toward the center of the socket, and pins 15 and 16 outward to 90 degrees from the other pins.

( ) Connect one end of a 2" (5 cm) length of jumper wire to pins 9 and 10 of the socket (so that pins 9 and 10 are connected together). This wire should branch out at the pin 9 side of the socket. Connect one end of a 6" (15 cm) length of wire to pin 15, and another 6" length to pin 16. Set the prepared socket aside temporarily.

( ) Position the CPU board so that the component side is up, with the S-100 connectors away from you.

( ) Remove the IC at U111 and set it aside temporarily. Install the prepared 18-pin socket at U111 so that pin 1 of the socket is inserted at pin 1 of U111. Pins 9 and 10 of the 18-pin socket will be outside of U111. Make sure that pins 15 and 16 of the new socket do not contact the pins of the original socket that are directly below them.

( ) Connect the wire coming from pins 9 and 10 of the 18-pin socket to the leg of C112 that is nearest to pin 1 of U111. Before making the connection, route the wire close to the board and cut off any excess length.

( ) Connect the wire coming from pin 15 of the 18-pin socket to the feed-through hole that is nearest to pin 4 of U173. Route the wire close to the board and cut off any excess length before making the connection. (The feed-through hole is connected by a trace on the back of the board to U173-2.)

**Note:** To connect a wire to a feed-through hole, turn the board over to the solder side and make sure that there is no masking on the pad at the feed-through hole. If there is, gently scrape it off with a small knife. Then pass the end of the wire through the hole (from the component side) and solder it as you would solder the wire from a resistor or capacitor. Cut off any excess wire.

( ) Connect the wire coming from pin 16 of the 18-pin socket to the feed-through hole between U156 pin 7 and C169. Route the wire close to the board and cut off any excess length before making the connection. (The feed-through hole is connected to U173-1.)

( ) Reinstall the IC that you removed from U111, making sure that pin 1 of the IC is in pin 1 of the socket. Pins 9 and 10 of the new socket will be empty.

( ) Cut the traces coming from pins 7 and 8 of U173 on the component side of the board. The trace from pin 8 passes to the right of C170. The trace from pin 7 ends at a feed-through hole 5/16" (.7 cm) below the lower leg of C170. See Figure 1.

( ) Cut the trace coming from pin 9 of U173 on the component side of the board. See Figure 1.

( ) Position the board so that the foil side is up, and the S-100 connectors are away from you.

**Note:** Pin numbers of U111 in the following steps refer to the original 16-pin socket numbering.

**Note:** Make each trace cut on the bottom side of the board on the specified trace before it reaches any other pad, feed-through hole, or another trace.

( ) Cut the trace coming from U166 pin 2. See Figure 2 for this and the next 4 steps.

( ) Cut the trace coming from U151 pin 10.

( ) Cut the trace coming from U173 pin 18.

( ) Cut the trace coming from U110 pin 4.

( ) Cut the trace coming from U111 pin 9. Note the position of the first feed-through hole that this trace comes to.

( ) Jumper U173 pin 7 to U111 pin 3.

( ) Jumper U173 pin 8 to U111 pin 2.

( ) Jumper U173 pin 9 to U149 pin 4.

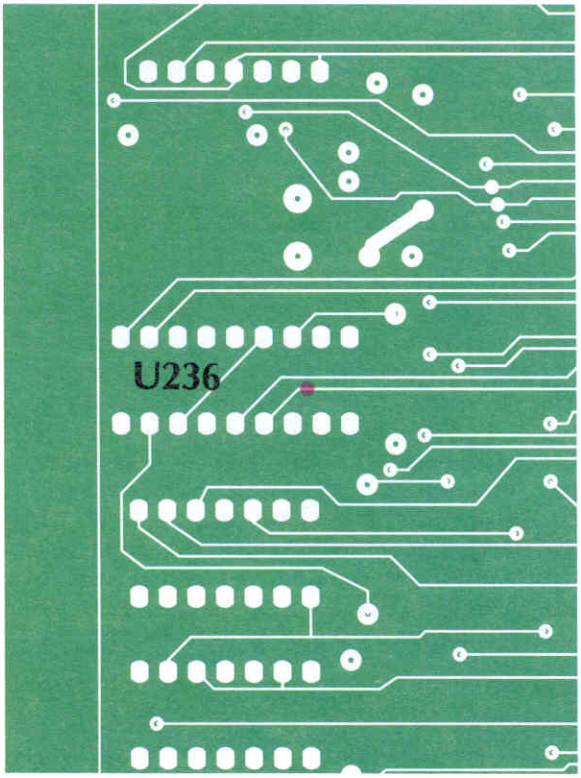


**Figure 3. Trace cut at U236 on the foil side of the board.**

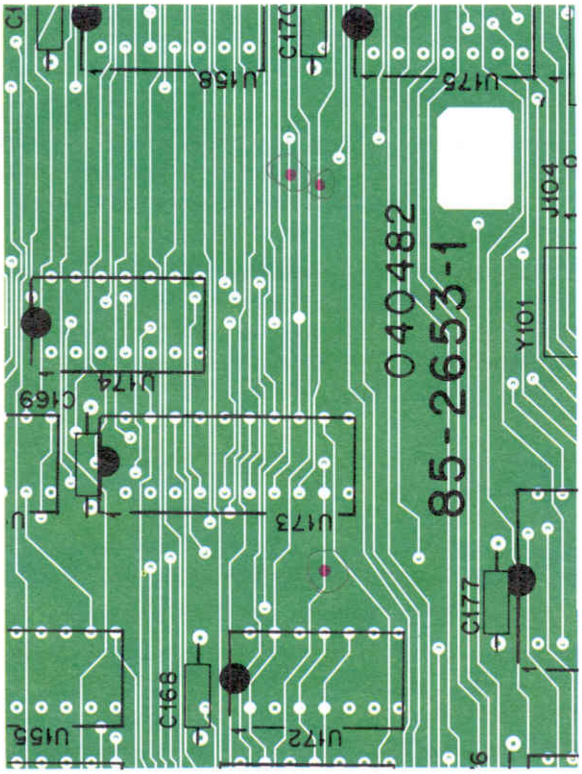


**Figure 1. Component side trace cuts around U173.**

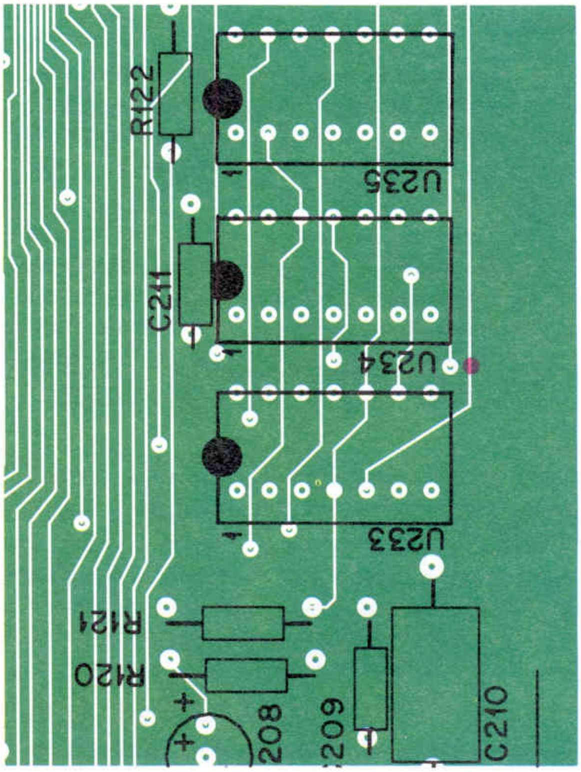


**Figure 4. Component side trace cut near U233.**

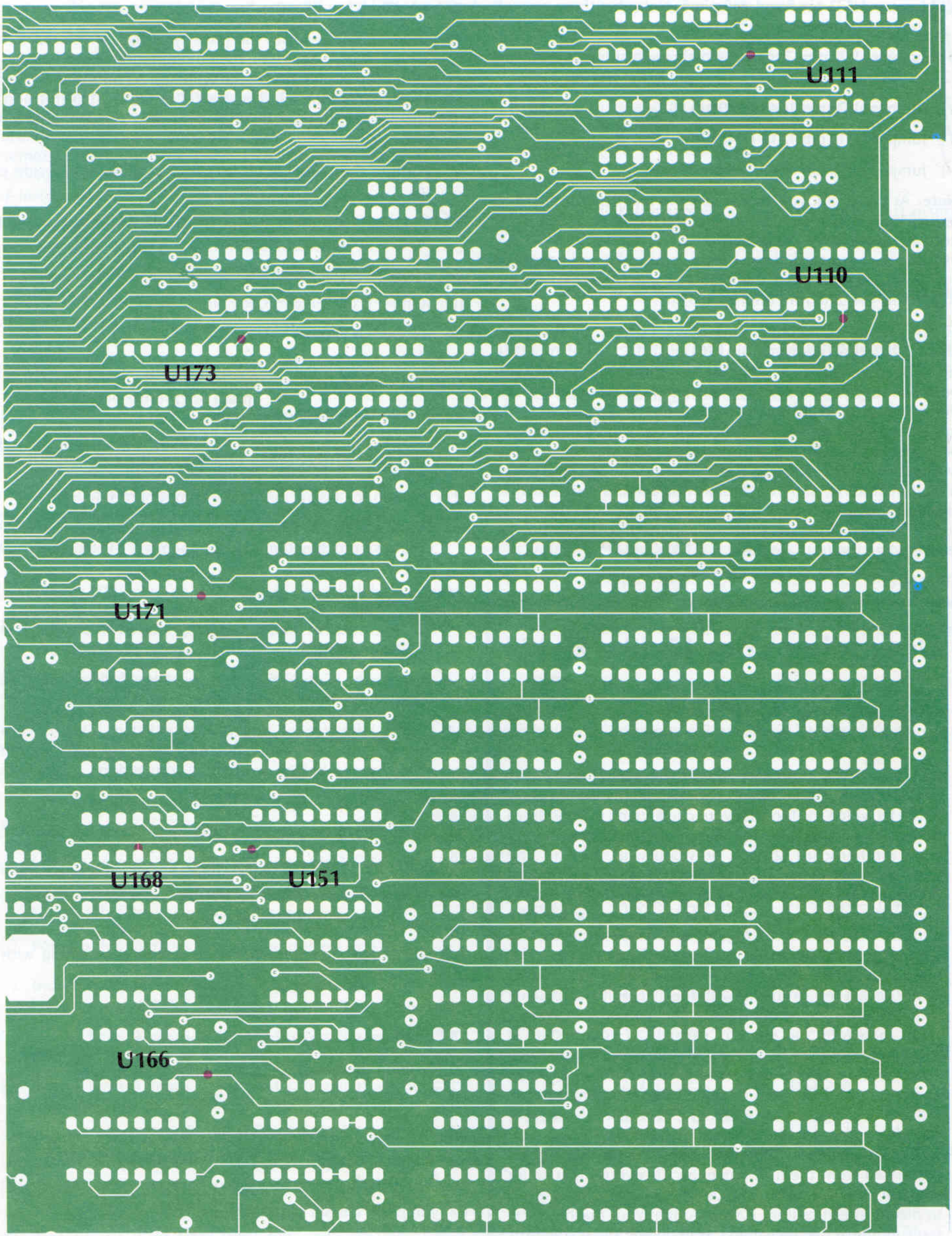


**Figure 2. Trace cuts on the foil side of the board.**

( ) Jumper U173 pin 9 to U110 pin 5. Note that there are two jumpers coming from U173 pin 9.

( ) Jumper U173 pin 17 to the feed-through hole that connects to the trace coming from U111 pin 9 that was cut earlier.

( ) Jumper U173 pin 18 to U149 pin 10.

( ) Jumper U110 pin 12 to U146 pin 1.

( ) Jumper U110 pin 4 to U149 pin 12.

**Note:** At this point, you should test the main circuit board to ensure that everything is working correctly. The test described here will work if you have version 2.5 or higher of MTR-100 installed in your board. If you do not, or you do not know what version you have, remove the IC at U190 and replace it with the IC marked 444-276 from the HA-108 kit.

To test the board, reconnect the power connectors (from the chassis) that were removed from P101 and P102. Do not install the video board or any S-100 boards. You can either reinstall the board in the chassis, or hold it so that no metal chassis parts touch the foil traces (hold the board at one of the screw pads), and plug in the computer and turn the power on. You should hear a short beep when the power is first turned on, and a longer beep about two seconds later. If you do not get these indications, your board is malfunctioning, and you should not continue with further modifications until you get it working again. Remove the power connectors from P101 and P102, and remove the board from the chassis when the tests are done.

**Refresh Clock Modification (common)**

This modification reverses the polarity of the refresh clock. It may have already been done to your computer, since it is necessary for proper operation of the Winchester controller. If there are jumper wires connected to pins 8, 9, and 10 of U130, this modification has already been done, and the next 5 steps should not be performed.

( ) Position the main circuit board so that the solder side is up.

( ) Cut the trace coming from U168 pin 11. Make the cut right next to the pin. See Figure 2.

( ) Jumper U130 pin 5 to U130 pin 10.

( ) Jumper U130 pin 8 to U152 pin 1.

( ) Jumper U130 pin 9 to U225 pin 3.

**Note:** You should test the board as described earlier, before proceeding with other modifications.

**Ready Logic Modification (common)**

This modification is a design improvement, not directly related to the use of 256k RAMs or 8 MHz operation.

( ) Position the board so that the component side is up.

( ) Prepare the remaining 18-pin socket by bending out pin 3 90 degrees from the other pins. Connect a 4" (10 cm) length of wire to pin 3.

( ) Prepare the 14-pin socket by bending out pin 6.

( ) Remove the IC at U220, insert the prepared 14-pin socket in U220, and reinstall the IC in the prepared socket.

( ) Remove the IC at U236, insert the prepared 18-pin socket in U236, and reinstall the IC in the prepared socket.

( ) Connect the wire coming from the socket in U236 to pin 6 of the socket in U220. Route the wire close to the board and cut off any excess before making the connection.

( ) Position the board so that the solder side is up.

( ) Cut the trace coming from U236 pin 4. See Figure 3.

( ) Jumper U236 pin 7 to U236 pin 9.

( ) Jumper U236 pin 4 to U206 pin 13.

( ) Jumper U206 pin 1 to U220 pin 5.

Test the board as described earlier before proceeding with other modifications.

**Swap Logic Modification (common)**

This modification is a design improvement.

( ) Position the board so that the solder side is up.

( ) Cut the trace coming from U171 pin 10. See Figure 2.

( ) Jumper U155 pin 8 to U156 pin 13.

( ) Jumper U156 pin 12 to U171 pin 1 or 2 (pins 1 and 2 are connected).

( ) Jumper U156 pin 11 to U171 pin 10.

Test the board as described earlier before proceeding with other modifications. If you do not intend to make the 256k RAM mod-

# Upgrading Your H-101/H-121

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*HUG Software Developer*

For those of you fortunate enough to have purchased either the H-101 or H-121 computer systems, Heath now has available a kit which will increase your clock speed from 5mhz to 8mhz, as well as provide for 768k of system memory on the main motherboard (256k is provided with the kit). The model number of this upgrade kit is HA-108. This kit comes with about 38 new IC's (including memory), and a new CPU crystal. If you're careful, the installation of this mod will take about 2 hours. No foil cuts or jumper wires are required, and the only solder joints made are those to the new crystal. The main motherboard isn't even removed from the chassis! Other than a few problems with the assembly manual, my modification installed quite easily, and worked the very first time! Increasing the memory capacity of your system is easily accomplished by adding additional banks of 41256, 150nS memory IC's. Each bank requires an additional 9 IC's and two more banks can be added for whopping total of 768k! Even though these memory I.C.'s are available from outside vendors for about $6 each, Heath/Zenith can only guarantee proper system operation with memory chips purchased from them. It has been discovered that some manufacturers' memory chips are not being manufactured to proper specifications. If you thought your machine was fast running at five megahertz, wait till you see it at eight!

ification, skip the next section and proceed to "8 MHz Modifications".

## 256k RAM Modification

Perform this modification if you want to use 256k RAM IC's in place of the 64k IC's currently installed on your board. If you perform this modification, you will no longer be able to use a Z205 memory card within the normal 768k address space of the H/Z-100. The memory modification presented previously must be installed.

( ) Position the main circuit board so that the component side is up and the S-100 connectors are away from you.

( ) Remove the 9 IC's located at U101 through U109. Insert them into the conductive foam supplied with the HA-108 kit.

( ) Remove the IC's located at U117 through U125 and save them.

( ) If there are any IC's at U137 through 145, remove them and save them in conductive foam.

( ) Position the board so that the solder side is up.

( ) Jumper all pin 1's of U101 through U109 together.

( ) Jumper all pin 1's of U117 through U125 together.

( ) Jumper all pin 1's of U137 through U145 together.

( ) Jumper U109 pin 1 to U125 pin 1 to U145 pin 1.

( ) Jumper U125 pin 1 to RP101 pin 8. There will be 4 jumper wires at U125 pin 1 after this jumper is installed. Because of this, you may want to jumper U109 pin 1 instead of U125 pin 1 to RP101 pin 8.

( ) Jumper RP101 pin 9 to U155 pin 6.

( ) Jumper U155 pin 5 to U155 pin 11.

( ) Jumper U155 pin 3 to U155 pin 4.

( ) Jumper U155 pin 2 to U166 pin 8.

( ) Jumper U155 pin 13 to U166 pin 9.

( ) Jumper U155 pin 1 to U111 pin 9.

( ) Jumper U155 pin 12 to U111 pin 10.

( ) Jumper U155 pin 13 to U146 pin 1. There are now two jumpers at U146 pin 1, and two at U155 pin 13.

( ) Position the board so that the component side is up.

( ) Install 9 256k dynamic RAM IC's (#443-1268) at locations U101 through U109

( ) If you have 9 more 256k RAM's, install them at U117 through U125.

( ) If you have 9 more 256k RAM's, install them at U137 through U145.

( ) Remove the IC at U166 (74LS14, #443-872) and replace it with a 74ALS1004 (#443-1253).

( ) Remove the IC at U155 (74LS00, #443-728) and replace it with a 74AS00 (#443-1243).

( ) Remove the IC at U173 (#444-130) and replace it with a #444-368.

( ) Remove the IC at U110 (#444-126) and replace it with a #444-367.

( ) Remove the IC at U111 (#444-104) and replace it with a #444-366.

Test the board as described earlier before proceeding with other modifications. Proceed to "Reassembly" if you are not going to perform the 8 MHz modifications.

## 8 MHz Modifications

The 8 MHz modifications are given in three sections. You can test the board after each section is completed.

### Wait State Modification

This modification adds one extra wait state to input/output operations.

( ) Position the board with the component side up and the S-100 connectors away from you.

( ) Cut the trace coming from U233 pin 5. See Figure 4.

( ) Position the board with the solder side up.

( ) Jumper U233 pin 1 to U234 pin 1.

( ) Jumper U233 pin 3 to U234 pin 3.

( ) Jumper U233 pin 4 to U234 pin 4.

( ) Jumper U233 pin 5 to U234 pin 2.

( ) Jumper U234 pin 5 to U226 pin 14. This will be a long jumper, so route it carefully.

Test the board as described earlier before proceeding with other modifications.

### IC Replacement

Remove and replace IC's at the following locations. The locations marked with an asterisk (*) will have been replaced already if you did the 256k modification.

| | IC number | Old IC | New IC |
|---|---|---|---|
| ( ) | U149 | #41-10 | #41-19 |

**Note:** Pin 1 of #41-19 is marked with the word "IN".

| | IC number | Old IC | New IC |
|---|---|---|---|
| ( ) | U166* | 74LS14, #443-872 | 74LS1004, #443-1253 |
| ( ) | U200 | 74LS368, #443-1024 | 8T98, #443-1184 |
| ( ) | U153 | 74LS280, #443-1001 | 74S280, #443-1186 |
| ( ) | U221 | 74LS32, #443-875 | 74ALS1032, #443-1185 |
| ( ) | U234 | 74ALS74, #443-1051 | 74S74, #443-900 |
| ( ) | U155* | 74LS00, #443-728 | 74AS00, #443-1243 |
| ( ) | U146 | 74LS257, #443-1037 | 74F257, #443-1120 |
| ( ) | U173* | #444-130 | #444-368 |
| ( ) | U190 | #444-87-5 or other # | #444-276 |

**Note:** U190 may have already been replaced, to test the board.

| | IC number | Old IC | New IC |
|---|---|---|---|
| ( ) | U126 | 74LS244, #443-791 | 74F244, #443-1065 |
| ( ) | U128 | 74LS257, #443-1037 | 74F257, #443-1120 |
| ( ) | U211 | 8088, #443-1009 | 8088-2, #443-1187 |

| | | | |
|---|---|---|---|
| ( ) | U213 | 74LS373, #443-837 | 74ALS373, #443-1182 |

**Note:** Do not confuse the 74ALS373 with the 74AS373.

| | | | |
|---|---|---|---|
| ( ) | U241 | 74LS244, #443-791 | 74ALS244, #443-1096 |
| ( ) | U133 | 74LS373, #443-837 | 74AS373, #443-1266 |
| ( ) | U195 | 74LS240, #443-754 | 74ALS240, #443-1181 |
| ( ) | U214 | 74LS244, #443-791 | 74ALS244, #443-1096 |
| ( ) | U162 | 74LS244, #443-791 | 74ALS244, #443-1096 |
| ( ) | U180 | 74LS367, #443-857 | 74F367, #443-1267 |
| ( ) | U196 | 74LS373, #443-837 | 74ALS373, #443-1182 |
| ( ) | U163 | 74LS244, #443-791 | 74ALS244, #443-1096 |
| ( ) | U181 | 74LS244, #443-791 | 74ALS244, #443-1096 |
| ( ) | U197 | 74LS373, #443-837 | 74ALS373, #443-1182 |
| ( ) | U198 | 74LS373, #443-837 | 74ALS373, #443-1182 |
| ( ) | U217 | 74LS244, #443-791 | 74ALS244, #443-1096 |
| ( ) | U227 | 74LS373, #443-837 | 74ALS373, #443-1182 |

Test the board as described earlier before proceeding with other modifications.

### Crystal Replacement

Replace the crystal at Y103 with a 24 MHz crystal (#404-681) by following the first seven steps on the page titled "Main Circuit Board Upgrade" in the HA-108 Installation Manual. Test the main circuit board as described earlier.

### Reassembly

Replace the main circuit board in the chassis by following these steps:

( ) Plug the power connectors at the bottom of the chassis to P101 and P102. Then carefully position the board to the chassis bottom and slide it backwards until the rear connectors are through the holes in the backplate.

( ) Secure the board with the 9 8-40 X 3/8" screws and the three hex stand-offs that you removed earlier.

( ) Replace the S-100 card cage and secure it to the main circuit board with 4 8-40 X 3/8" screws, and to the backplate with 2 #4 sheet metal screws.

( ) Replace all S-100 cards that you removed earlier, except for any Z205 cards if you made the 256k memory modification.

( ) Replace any cables that were unplugged from the back of the computer.

Complete the reassembly of your computer by proceeding to the section in the HA-108-1 Installation Manual entitled "Video Logic Circuit Board Upgrade". Perform all appropriate steps in the rest of the manual.

Heath/Zenith Users' Group

# 8 MHz 256k Update

*Pat Swayne*
*HUG Software Developer*

In the July issue of REMark, we published an article on how to upgrade an older model H/Z-100 main circuit board to run at 8 MHz and use 256k RAM chips. This article is the result of feedback from readers and personal experience since the original article was published.

First of all, I would like to mention that the 256k modification (page 27, column 1 of the July article) was originally designed by Mike Cogswell, and in the rush to get the article finished by the deadline for the July issue, I forgot to mention that. I apologize to Mike for that oversight.

### Old Monitor ROMs

If your H/Z-100 contains a very old version of the monitor ROM (version 1.1 or 1.2), you will need to make some additional modifications besides those in the July article. You can find out which version of the monitor you have by typing V at the "hand prompt" when you first turn on or reset your computer. If you have a version earlier than 2.3, you will need to replace the IC at U161 with a Heath part no. 444-129-1, and you must install the jumper at J102 on position 1.

### Wait State Modification

If after performing all of the modifications in the original article you get a "Default controller not ready" message on the screen when you turn your computer on, try removing the modifications made under the heading "Wait State Modification" (page 27, second column), and restoring that section of the board to the original configuration. At this writing, we do not know what the problem is with that modification, but if your computer will work without it, you are probably better off.

### Memory Problems

If your modified board seems to work OK, except that you get an occasional system "crash" with the message "ERROR MEMORY PARITY OR BUS", try connecting a 2.2 uF tantalum capacitor (Heath part no. 25-221) to the leads of capacitor C102 (leave C102 installed on the board). The positive lead of the tantalum capacitor should be connected to the C102 lead that is closest to the S-100 connectors.

```
A>DEBUG ZPC3.COM
-E1A04          (use 176A for ZPC1, 191F for ZPC2)
1234:1A04   D2.D0
-W
Writing 3400 bytes
-Q
A>
```

If you would like to patch the source code, the error is in the file PIXEL.ACM. Locate the label READDOT:, and a few lines below it, locate these lines:

```
    MOV     BX,OFFSET MASKTBL   ;POINT TO MASK TABLE
    XLAT                        ;GET MASK
    NOT     DL                  ;INVERT IT
```

Change the NOT DL instruction to NOT AL to correct the file. **Note:** This patch affects the first thousand or so copies of ZPC made. If your ZPC .COM files are dated 9-11-85 or later, the patch has already been made.

**DEMO1 Patch**

The DEMO1.EXE program provided with ZPC will not run under systems having less than 768k of RAM, because the program attempts to read from high memory even though it does not use it. You can patch DEMO1 with DEBUG as follows:

```
A>REN DEMO1.EXE DEMO1.BIN
A>DEBUG DEMO1.BIN
-E5696
1234:5696   B0.02
-W
Writing 12345 bytes
-Q
A>REN DEMO1.BIN DEMO1.EXE
```

**ZPC Documentation Corrections**

On page 7 of the ZPC documentation, there is an illustration of the Z-100 keyboard with the keys labeled as they are used when ZPC is in the PC mode. On the original of this illustration, some of the key cap legends are pasted on, and one came off when the first batch of copies were printed. If your illustration shows a blank key next to the key labeled PRT SC (the I CHR key on the actual keyboard), it should be labeled as follows:

```
/-------\
| PAGUP |
|       |
|       |
| PAGDN |
\-------/
```

On page 15 of the documentation, under BIOS RAM Locations, the table should show the printer addresses starting at 8 instead of 10. An additional entry should be added as shown below:

```
10      Equipment flag.  This flag is set to default Z-150
        values, and the bits in it are defined as follows:
        0            1 = diskette drives are present.
        1            1 = 8087 installed.
        3,2          00 = 64k RAM chips, 11 = 256k chips.
        5,4          Initial video mode. Set to 10 for 80x25
                     color.
        7,6          Number of diskette drives.
        8            Unused
        11,10,9      Number of RS-232 cards (010 = 2).
        12           1 = Game port attached.
        13           Unused
        15,14        Number of parallel printer ports.
```

Appendix A of the documentation is in error in stating that compiled GW-BASIC programs will run in less than 768k of RAM if they do not use graphics. They will run, but they must be patched first. Using DEBUG, search for this string of numbers: 00,B8, 33,DB. When debug finds them, add 1 to the address reported, and change the value there (B8) to 02.

**GW-BASIC Patch**

When I wrote the patches for Z-150 GW-BASIC that are included with ZPC, I neglected to consider that the BEEP command, or PRINT CHR$(7), might use the interpreter's sound generating routines, which will not work under ZPC. Well, they do, and if you execute either BEEP or PRINT CHR$(7) in GW-BASIC under ZPC, it will hang up. You can fix GW-BASIC by patching it with DEBUG, as follows:

```
A>REN GWBASIC.EXE GWBASIC.BIN
A>DEBUG GWBASIC.BIN
-A7B9A
1234:7B9A  MOV AX,E07
1234:7B9D  INT 10
1234:7B9F  NOP
1234:7BA0  NOP
1234:7BA1                    (hit return)
-W
Writing 114C0 bytes
-Q
A>
```

This patch is for the release of GW-BASIC version 2 dated 7-15-85. For the other GW-BASIC version 2 for which a patch was provided with ZPC, use 7BE6 instead of 7B9A as the address to patch. For GW-BASIC version 1, use 40BE.

*

# 8 MHz 256K Update #2

In the July issue of REMark, we published an article on how to upgrade an older model H/Z-100 main circuit board to run at 8 MHz and use 256K RAM chips. We also published an update to that article in the September issue. In that issue, we recommended, if you get a "Default controller not ready" message upon powering up after making all of the modifications, that you remove the section of the modification under the heading "Wait State Modification". Since then, we have learned that 8-inch drives may not work properly with the computer running at 8 MHz with the wait state modification out.

If your 8-inch drives do not work, and you have done all of the modifications, except for the wait state modification, go ahead and install the wait state modification, and then replace U233 with a 74S74 (443-900) or a 74AS74 (443-1209).

If you have come across any problems with the modifications that were not covered in REMark, and have found solutions to them, let us know at HUG by mail or phone, so that we can pass your findings on to other HUG members.

*

Heath/Zenith Users' Group

# Max Memory Mods

## Review Of Two Memory Modifications For H/Z-100 PC Series Computers

**Pat Swayne**
*HUG Software Engineer*

With software getting more memory hungry all the time, and memory resident utilities "popping up" everywhere, the ability to put the most memory you can in your computer and use all of it is becoming more important than ever. In this article, I will describe two modifications that let you accomplish that. These modifications are the amazing GNS PALs and software from GraphNet Systems, Inc. for H/Z-150 and H/Z-160 computers, and the ZPAL-158 by KEA Systems, Ltd. for H/Z-158 computers.

### The GNS PALs

The H/Z-150 and H/Z-160 series computers contain a memory board that has room for 5 banks of memory ICs. They were originally intended to be populated with 64k chips, so that the total memory on the board was 320k. Various independent manufacturers have provided replacement memory decode PALs (Programmable Array Logic) that allow 256k chips to be used in at least some of the banks, so that the board could hold 640k or even 704k of memory. Now GraphNet Systems has developed two new PALs that allow you to put 256k chips in all 5 banks, for a total of 1.2 megabytes of memory on the board. One of them, model GNS64MB, lets you use 640k of the memory as program memory, and 578k as "hidden" memory, while the other one, model GNS70MB, lets you use 704k as program memory and 512k as hidden memory. (Note: Some peripherals may not work if you have 704k of program memory.) Only 64k of the total memory in 5 256k banks is not used at all by the GNS system. The only thing that you can currently do with the hidden memory is to use it for a RAM disk (memory disk). However, I have been told that GraphNet Systems is working on a way to allow the use of the extra memory as Lotus/Intel expanded memory. Lotus/Intel expanded memory is a specification for using memory beyond 640k for certain spreadsheets or other programs.

The GNS PAL "kit" consists of a single memory decode PAL that is used to replace the one on your memory board, a disk containing RAM disk software, and a single sheet of documentation. When you install the GNS PAL, you must solder a jumper wire on the back of the board. This jumper apparently taps a port that selects the hidden memory (bank switching). After the GNS PAL and the jumper wire have been installed, along with the 256k chips, your computer will work as before (except that it will report 640k or 704k of RAM). Neither the MFM-150 ROM nor the CHKDSK program will "see" the hidden memory.

The RAM disk software provided with the GNS PAL works quite well, and you can actually make the memory disk larger than the 512k or 578k of hidden memory. You can use up to 767k for your RAM disk (why not 768k?), which means that a combination of hidden memory and program memory is used. The RAM disk software can be made to cause a beep every time the memory disk is accessed, but that is annoying, and it slows access of the memory disk down considerably. The beep "feature" is actually the default mode of operation, and you must include the word MUTE in the CONFIG.SYS command line that activates the RAM disk program, if you do not want beeping.

You can set up the RAM disk software to re-initialize the memory disk when you boot up (after resetting), to leave the data intact, or to prompt you to select re-initialization or not. You can also configure it to provide a 60 character keyboard buffer, if you find the normal 15 character buffer inadequate.

If you cannot afford to buy 5 banks of 256k memory chips at one time, you can install the GNS PAL and 3 banks, to give you 640k or 704k of program memory. Later, you can get the other two banks to allow use of the RAM disk software.

The GNS PALs represent the ultimate memory upgrade for the H/Z-150 and H/Z-160 series computers that does not require an additional board. The only bad thing about them is that you are locked into having 640k or 704k of program memory, but you can probably trade in your PAL for the other option if you change your mind after buying your kit.

The GNS PALs were developed by GraphNet Systems, Inc., P.O. Box 337, Reading, PA 19603. They are available directly from GraphNet, and are also available (at a slight discount, I believe) from Graymatter Application Software, 1501 Township Line Road, Norristown, PA 19401, (215) 279-4460. Graymatter sells the PAL kits with or without RAM chips at the following prices:

| | |
|---|---|
| PAL alone | $ 49 |
| PAL and 27 chips (3 banks) | $129 |
| PAL and 45 chips (5 banks) | $179 |

All kits come with RAM disk software. Be sure to specify GNS64MB or GNS70MB when you order.

**The ZPAL-158**

On the CPU/memory card of an H/Z-158 series computer, there is room for 3 banks of memory ICs. If all three banks are populated with 256k chips, you have a total of 768k of memory on the board, but the computer can use only 640k of it. The ZPAL-158 from KEA Systems allows you to use all 768k of your memory. Some or all of the extra 128k of memory can be used to expand your program memory to 704k, to add a memory disk, or both.

The ZPAL-158 "kit" consists of a single memory decode PAL chip that is used to replace the one on your CPU/memory card; and 16 pages of instructions. The instructions present two methods for installing ZPAL-158, called the "Physical Jumper Alternative" and the "Programmable Jumper Alternative". The simplest method is the Physical Jumper method, which consists of removing your old memory decode PAL, plugging in the new one, and setting some jumpers to configure the way you want to use your extra memory. You can configure ZPAL-158 in 4 ways, as explained in the following table:

| Configuration | Memory Usage |
|---|---|
| 1 | 704k of program memory and 64k unused. |
| 2 | 704k of program memory and a 64k block at D0000-DFFFF. |
| 3 | 640k of program memory and a 128k block at C0000-DFFFF. |
| 4 | 640k of program memory and a 128k block at D0000-EFFFF. |

The Programmable Jumper Alternative provides the same 4 configurations, but you do not have to change jumpers to change from one to another. Instead, you write to a port using the built-in MFM-150 debugging program to select a configuration. To install ZPAL-158 using the Programmable Jumper method, you must make some wiring changes (add jumper wires, etc.) to your CPU/memory card. I did not want to do the extra wiring, so I selected the Physical Jumper method, and used configuration 4.

After you install ZPAL-158, a little extra work is required to get your computer working when you turn it on, and in the case of configurations 1 and 2, each time you reset it. The reason for this is that the ROM monitor does not recognize the extra memory. If you select configurations 2, 3, or 4, the computer will not auto-boot when you turn it on, but instead display a memory parity error message. If you use configuration 1, you must press Ctrl-Alt-Ins to prevent your computer from auto-booting when you first turn it on. With all four configurations, you must initialize the extra memory somehow before you can use it. This can be done by entering some commands given in the ZPAL-158 instructions with MFM-150, but with configurations 3 and 4, it can also be done entirely in software, so that all you have to do after the parity error message appears is to boot your disk or winchester manually. I never liked auto-boot on power up anyhow, so I don't mind the way ZPAL-158 changes the system. With configurations 3 or 4, the computer will auto-boot if you press Ctrl-Alt-Del after you have booted up initially, because the initialization of the extra memory in those configurations only has to be done at power up.

To make good use of the extra memory enabled by ZPAL-158, especially in configurations 3 and 4, you need a memory disk program that can access the new memory at its non-contiguous location. KEA does not currently supply memory disk software, but they may in the future. The VDISK program supplied with MS-DOS version 3 will not work, but the MDISK program supplied with MS-DOS version 2 and also with the Programmer's Utility Pack works fine. You can use it as is, if you initialize the memory manually using MFM-150 when you turn on your computer and include a line in your CONFIG.SYS file like this

```
DEVICE=MDISK.DVD SIZE=128 START=D000
```

The above example is for memory configuration 4. If you have the Programmer's Utility Pack, you can modify the source code of MDISK and reassemble it so that it will initialize the extra memory for you, and also so that you can reset and reboot without destroying data in the memory disk. These modifications are presented below. The modification to allow resetting without destroying data was devised by John Stetson, and first printed in CHUG, the newsletter of the Capital Heath Users' Group in Fairfax, Virginia. The modifications are presented by permission from CHUG. They have been modified to work in the ZPAL memory environment.

The MDISK source file, MDISK.ASM, is on the disk marked "UTILITIES" if you have the MS-DOS Version 2 Pack, or on the disk marked "Z-100 BIOS SOURCES DISK #2" if you have the MS-DOS Version 3 Pack. To modify MDISK.ASM, load it into an editor and locate this line:

```
;                SIZE=num-Kb and START=start-paragraph
```

Add some comments after the line as follows:

```
;                SIZE=num-Kb and START=start-paragraph
;       Modifications for data protection on reset by
;               John Stetson, as presented in CHUG, Aug. 1985
;       ZPAL-158 memory initialization mod by P. Swayne, HUG
```

Next, locate the following line:

```
        LDS      DX,ES:DWORD PTR CIN_KADDR[BX]
```

Add a label EXITOK: to the line as follows:

```
EXITOK: LDS      DX,ES:DWORD PTR CIN_KADDR[BX]
```

Next, locate the following line:

```
DRIVE            DB       ?, ":", CC_CR, CC_LF, "$"
```

Modify the line, and add lines following it, to look like this:

```
DRIVE            DB       ?, ":"
CRLF             DB       CC_CR, CC_LF, "$"

;       Message for user reformat prompt
PROMPT_MSG       DB       CC_CR, CC_LF
        DB       "Re-initialize the Memory Disk (Y/N)? $"
```

The next modification has to be done only if you got MDISK .ASM from the MS-DOS Version 2 Programmer's Utility Pack. If you got it from the MS-DOS Version 3 Pack, the modification has already been done. Locate the following line:

```
MD_SIZE_END      =        OFFSET $
```

Change it to look like this:

```
MD_SIZE_END        =         OFFSET $ - OFFSET MD_SIZE
```

The remaining modification is for all versions of MDISK.ASM. For this modification, locate the following two lines:

```
        INT     21H
        JMP     MD_INIT4          ; Finish init. overwrite tra
```

Insert lines between them, so that you have this:

```
        INT     21H

;       Allow the user to skip disk initialization

        MOV     DX,OFFSET PROMPT_MSG
        MOV     AH,DOSF_OUTSTR
        INT     21H               ; PROMPT FOR RE-FORMAT
        MOV     AH,DOSF_CONIN
        INT     21H               ; GET REPLY
        PUSH    AX                ; SAVE IT
        MOV     DX,OFFSET CRLF
        MOV     AH,DOSF_OUTSTR
        INT     21H               ; PRINT CRLF
        POP     AX                ; GET REPLY
        AND     AL,5FH            ; CAPITALIZE
        CMP     AL,'Y'            ; YES?
        JZ      REINIT            ; IF SO, RE-INITIALIZE
        JMP     EXITOK            ; ELSE, SKIP
REINIT:

;       Clear ZPAL'S extra memory (configuration 4) [PWS]

        PUSH    ES
        CLD
        MOV     AX,0D000H         ; FIRST EXTRA BANK
        MOV     ES,AX
        MOV     CX,8000H
        XOR     AX,AX
        REP     STOSW             ; CLEAR FIRST EXTRA BANK
        MOV     AX,0E000H         ; SECOND EXTRA BANK
        MOV     ES,AX
        MOV     CX,8000H
        XOR     AX,AX
        REP     STOSW             ; CLEAR SECOND EXTRA BANK
        POP     ES

        JMP     MD_INIT4          ; Finish init. overwrite tra
```

After you have made the modifications to MDISK.ASM, copy it and the following files to the same disk: PARMS.ASM, MACLIB .ASM, DEFASCII.ASM, DEFMS.ASM, and DEFDEV.ASM. These files are available on the disk marked "Z-100 BIOS SOURCES" if you have the MS-DOS 2 Pack, or the disk marked "Z-100 BIOS SOURCES DISK #2" if you have the MS-DOS 3 Pack. Boot up on a system disk containing MASM, LINK, and EXE2BIN, and enter these commands to assemble your new MDISK:

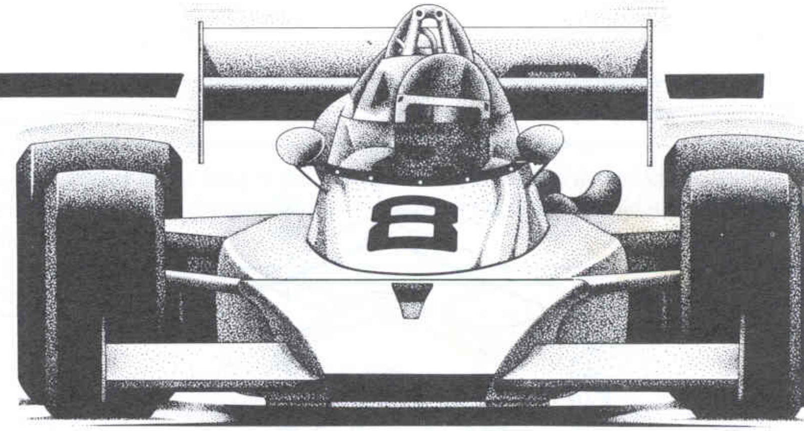
```
MASM B:MDISK,B:MDISK;
LINK B:MDISK,B:MDISK;  (ignore error message)
ERASE B:MDISK.OBJ
EXE2BIN B:MDISK B:MDISK.DVD
```

The above example assumes that MDISK.ASM and the supporting files are on drive B:. An error message may be generated by LINK, but ignore it. When the assembly is finished, copy the new MDISK.DVD to your system disk, set up your CONFIG.SYS, and reset and reboot. Your memory disk should now be operational. You should be able to boot right after turning your computer on, without clearing the extra ZPAL memory first. Each time you boot, you will be prompted "Re-Initialize the Memory Disk (Y/N)?". You must answer Y the first time you boot after turning on the power, but every time you boot after a reset, you may type N or just hit RETURN, and the data in your memory disk will be left intact.

When the H/Z-158 series was first introduced, some people were disapointed that it was not as versatile in its memory expansion capabilities as the H/Z-150 series (using the original memory boards). I guess that is still true, but at least with the ZPAL-158 you can use all of the memory that you can put on the board. To make the ZPAL-158 more "user friendly", perhaps KEA should look into modifying the monitor ROM so that it recognizes and clears the extra memory.

The ZPAL-158 kit is available for $36 (US) from KEA Systems, Ltd., #412-2150 West Broadway, Vancouver, B.C., Canada V6K 4L9, (604) 732-7411. There is also a ZPAL-148 for H/Z-148 computers. Quantity discounts are available.

# Speeding Up The Z-100




*Tom Huber and John Rogers*

A direct comparison of the H/Z-100 (and other computers that use the 8088) against 4 MHz Z-80 and 8080 computers often reveal slower operation than one might expect. For instance, the IBM PC is a very slow computer, particularly when compared to a machine, such as the H/Z-89, running at 4 MHz.

One of the reasons behind this is the fact that the IBM, along with the Heath and Zenith counterparts and the H/Z-100 manage a greater amount of memory than the H/Z-89. What does that have to do with the cost of tea in China, you ask? Simply this, the 8088 is still an 8-bit device, as far as the outside world is concerned. It still talks with the rest of the system over 8-bit data channels and when it wants to execute a 16-bit command, it has to go out to memory twice as often as a true 16-bit processor, such as the LSI-11 in the older H-11 and DEC PDP-11 series. Furthermore, it is designed to work with 64-kilobyte blocks of memory, called segments, and not the entire 1 megabyte that it is capable of addressing. Again, the reason is the same: its 8-bit data lines. To obtain the bits necessary to directly address a 1 megabyte memory block, it would have to have at least 12 bits of information available to it at one time.

So why did Heath/Zenith Data Systems choose the 8088 over the 8086 for the H/Z-100? I am going to offer some conjecture here, because I wasn't around when that decision was made. However, I suspect that the major factor was the choice of making the H/Z-100 compatible with the CP/M-80 world. And, the only two processors that really work efficiently together are the 8085 and the 8088. In fact, from all outward appearances, they look as though they were made for each other.

So what does this preliminary garbage have to do with a speed-up kit for the H/Z-100? A lot -- because the 8085 and 8088 share many common functions and the "faster" 8088 performs many functions for the 8085 under CP/M-85. The 8085 has its own clock that runs at 5 MHz; it won't handle faster speeds. Any speed-up conversion will only affect the 8088's operation. Fortunately, the 8088 handles I/O for the system and anything that has to be sent to the screen (in the upper 1/4 megabyte of the system) must be addressed through the 8088. Even though the 8085 executes 8080 code for CP/M-85, it is the 8088 that handles the video I/O.

Now, what about the IEEE 969 Std-1983 standard to which this computer is built? One of standard's specifications is that no signal on the bus be running faster than 6 MHz. Any modification that increases the 8088's clock to faster than 6 MHz will mean that your computer no longer meets that standard. And that means that some S-100 boards may not run at the faster speed. To put it another way, the standard for S-100 systems is being violated, and so if you do run a faster clock, you run the chance of not having accessories operate properly. Speed-sensitive devices, such as additional memory, are the most likely to have problems at higher speeds.

John Rogers and I tried the CDR Systems, Inc., ZS100 speed-up modification in several different computers; here are our findings.

First, installation is a snap, or almost so. You don't have to touch a soldering iron to any part of your computer. So if anything goes wrong after you have installed the kit, it can be easily removed, and the unit returned for service to an authorized dealer. However, don't expect the dealer (or Heathkit store) to work on the unit with the speed-up kit installed. Nor, for that matter, expect warranty service to take care of any slow parts. That is your responsibility.

Installation involves removing the IC at U236 on the main board. That location is under the video board, so disassembly will have to include the video board (you have to remove the drives before you can access it). Once the video board is out of the way, it is easy to remove the IC -- just insert a small, flat-bladed screwdriver under one end of the IC and work it up (carefully) and out of the socket. The speed-up board plugs in the empty socket and the IC into the board. The next thing to do is mount a switch to the back panel in one of many empty RS-232 slots. I picked J10, although J5 is equally as good a choice. The switch can be easily reached from the front of the computer around the right side. There was enough wire provided in one of the kits to reach any of the empty DB-25 holes, but not the other. If the longer wire is standard, the choice of mounting locations is yours (though I doubt that you would select any hole other than J5 or J10). After that is done, you are ready to reassemble your computer and try out the modification.

First things first. The switch is provided so you may select the normal operating speed of the H/Z-100 or the faster 7.5 MHz. Therefore, the first test we tried was the normal speed to make sure we didn't create any problems when we installed the board. Everything worked fine. The computer ran without any problems.

Ok, so next we turned off the computer and moved the switch to the "F" position for "fast," and without further todo, turned on the computer. One beep -- nothing else. Hummm... What could be wrong? The instruction booklet, which I haven't mentioned so far, is unusually thorough in that it provides a logical sequence of parts to check for being slow. The first part? The 8088, naturally. Oh well. The current going price for the 8088 isn't too bad, but you don't know if that will get you a fast part. Even then, checking magazines such as Radio Electronics reveals that the price for the faster part isn't too much more than the standard speed version. Yeah, I know, double the price is a lot more, but when you are talking less than $25.00 as compared against the cost of a complete H/Z-100 even as a kit, the cost is still reasonable.

A note here, though. If you have ready access to one or more 8088s, try several. The 7.5 MHz speed was chosen over the slightly faster 8 MHz because many 5 MHz 8088s will run very well at 7.5 MHz, but not at 8 MHz. I am told by CDR that the majority of 8088s will operate at 7.5 MHz. My unit was one of the very first kits, which means that it is close to two years old. Unfortunately, all the computers we tried with the modification fell into this same category. All of them exhibited the same problem, a slow 8088. Substituting a more recent 8088 resolved the problem. No, we did not try the faster-rated 8088s for the simple reason that we wanted to see if what the vendors were telling us was true -- at this point, we believe that their claim is as they state it: the majority of the 8088s will run at 7.5 MHz. However, be prepared to replace yours if you buy this kit.

On one other computer, we ran into several disk problems. The FDC exhibited problems while trying to format disks. It would not do a successful disk format and verify (FORMAT B:/V). We checked the drive and it was fine. The problem was in a slightly slow Floppy Disk Controller. Again, my home unit exhibited no problems beyond the 8088.

Next, we ran into an unusual problem with a Winchester system. This appears to be uniquely isolated to a flakey part that only shows up after the computer has been on and running for a half-hour. At the slower clock speed, everything was fine, but at 7.5 MHz, the problem appeared. Talk about one that will be very difficult to fix! It turned out to be the "scratch" RAM on the controller.

I mentioned problems associated with the IEEE Std 969-1983 for the S-100 interface. The problem really showed up in the Z-205 card. At first, no matter what we did, we could not use the Z-205 card in the fast mode. In his research of this problem, John found that the engineers tested the Z-205 card during development to 10 MHz, well beyond the 7.5 MHz under which we were trying to get it to run. So, armed with that information, we tried faster RAM chips (120 ns) and a faster delay line (125 ns). Unfortunately, we were unable to test this theory out immediately as our only Z-205 card went up to the illustrating department in a CAD application. After several months, we "borrowed" another Z-205 card from another department (they are extremely hard to obtain through normal channels), and tested the card once again. It still didn't work, even with the appropriate memory parts and delay lines (very difficult to obtain). Going back to the engineer of the original project revealed several other important factors. It seems that with some of the product Z-205s, some of the TTL chips may be at the "slow" end of their specified speed. If this is the case, that Z-205 card may or may not work at the faster speed. Placement in the card cage will affect the card, so before you start wholesale replacement of parts, move the card to the first slot (as viewed from the front of the computer) in the card cage.

These "slow" TTL chips slow down the access timing of the memory chips themselves, resulting in the wrong "window" for read/write operations. In order to resolve this problem without resorting to replacement of ICs, you would normally implement one or more wait states on the Z-205. But here again, the TTL ICs in the wait-state circuit may be too slow in asserting the RDY signal on the S-100 bus.

To properly resolve the problem, you need to replace the slower ICs with faster ones so that the access times are no longer too long and then, if needed, replace the appropriate parts in the wait-state circuit. Here are the parts to replace:

U2, U3, U44, and U45: replace the 74LS244 with 74ALS244 (443-1096); U11: replace the 74LS04 with 74F04 (443-1137); and U14: replace the 74LS74 with 74ALS74 (443-1153).

For the wait-state circuit, replace U24, the 74LS175 with 74S175 (443-983).

John tells me that this should correct the problem with the Z-205. In some cases, you may be able to correct a problem by replacing only some of the chips, but he does not recommend this since the computer would then be operating in a marginal state and a low-voltage condition could easily cause the system to fail.

I tried out the modification with Software Wizardry's P-SST card and had no problems other than those one would expect with a faster clock -- mostly associated with software operating faster than originally intended. For instance, music played as a foreground task (and controlled by the system clock) ran much too quickly (tempo) though the notes were correct.

Therefore, we suspect that any problems will be limited to only those systems with slightly slow parts and expansion memory cards that rely heavily on exact system timing and are sensitive to propagation delays. (Does anyone remember the problems with the original Radio Shack Model I Expansion Interface?)