

DSM-240

INSTALLATION AND OPERATOR'S GUIDE

for the

HEATH/ZENITH 88, 89, AND 90 DIGITAL COMPUTERS

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KRES Engineering
P.O. Box 1268
LaCanada, CA 91011

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IMPORTANT: Proof of purchase necessary for products returned for repair under warranty. Before returning any product please call our customer service department for a return authorization number.

ADDITIONAL HINTS

On this sheet are a few additional hints and precautions when installing the DSM-240:

1. If your computer garbles the message from the supplied SETCLK or SETCLK17 program or garbles the output from MEMTEST which should be a hex address, then you MUST move the wait state jumper to the UP position (see page 47 in the manual).

For example, just after SETCLK changes speed to 4 MHz, it should respond with "CPU (or SYSTEM) speed is now 4 MHz.". If the message comes back with improper characters, or blanks or complete characters missing, the 8250 IC that communicates with the terminal section of your H89 is NOT capable of 4 MHz operation. By setting the wait state jumper up, you add two wait states to each I/O operation (NOT memory operations, only I/O) which gives the same timing to the 8250 as if it were running at 2 MHz. You should notice NO slowing of your computer.

2. If your computer no longer properly displays graphics characters at either 2 MHz or 4 MHz, you have your operating system configured for upper case characters only. Use CONFIGUR.COM (see 3 below) and set the "Force output to upper case on CRT:" option to FALSE.

3. If you ordered CP/M software and need to install one of the supplied BIOS files using one of your MOVCPM programs, you must reconfigure your operating system for disk step times, printer accesses, cold warm boot programs etc. Do this by PIPing CONFIGUR.COM onto your new system disk, then run CONFIGUR, selecting and changing the options according to the menus presented. If you have forgotten how you had your system configured, run CONFIGUR on an existing bootable disk without changing anything, and write down the options you had selected. Then just duplicate them on your new system diskette when you run CONFIGUR after booting from the new disk.

4. We cannot emphasize enough the need to mark cables when you remove the CPU card, so that you can reinstall them properly when you put your system back together. Most problems seem to be with the serial board cables. All three look pretty much alike, and it is very easy to put them back into the wrong location, or upside down. Then, serial devices (printers, modems etc.) that used to work suddenly stop working even at 2 MHz after you install the DSM-240.

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INTRODUCTION

When you first purchased your computer you probably figured it would serve all of your computing needs. Then you discovered that you needed more memory. Then those 90K disk drives weren't enough. And now sitting and waiting for your machine to finish thinking is no longer fun. By now you have found solutions to most of your computer's other shortcomings but never to the problem of how to cut down those long waits, short of buying a whole new machine. Now with the KRES DSM-240 (Dual Speed Module) your waits are over.

CAPABILITIES OF THE DUAL SPEED MODULE

Your KRES Dual Speed Module is a very powerful addition to your computer. This little board will double the speed of your computer's CPU from 2 MHz to 4 MHz. This means that complex computations performed by the computer will take half the time they did before.

The DSM-240 has many features other than just speeding the system up to 4 MHz. The processor's speed can be set via a jumper to be either 2 MHz or 4 MHz. This speed can then later be changed by a supplied program. The module also has the ability to insert wait states during I/O operations; a very necessary feature for use with some I/O boards. Many other subtle features of the Dual Speed Module make it a very flexible and powerful addition to your computer.

This manual describes the capabilities and uses of the Dual Speed Module. It has been written for easy use by users from the technically inept as well as the technically adept. It has been organized into sections to allow for easy reference. After reading this manual you should have no problems in using the Dual Speed Module.

Many who have converted their computers to run at 4 MHz also wish to run the screen update faster, at 19,200 baud rather than the stock 9600 baud. Several articles or letters have appeared in publications such as REMark, BUSS, H-SCOOP, and possibly Sextant. Consult these, or contact KRES for availability of documentation on how to make the conversion.

For a discussion of limitations of the Dual Speed Module please see Appendix D of the Operator's Guide.

PARTS LIST

Unpack the Dual Speed Module kit and check each part against the following list. Any part that is packed in an individual envelope should be returned to the envelope after it has been checked against the list. Do not discard any of the packing materials until all parts are accounted for.

QTY ---	DESCRIPTION -----
1	DSM-240 Assembled Printed Circuit Card
1	14 Pin Dip Jumper Cable assembly
1	Floppy disk *
1	Three inch square of conductive foam
1	DSM-240 Manual

*** Your package may include two disks if you ordered both CP/M and HDOS**

DSM-240 INSTALLATION INSTRUCTIONS

Be sure to follow ALL of the steps in this section when installing the speed module. Any deviations from or alterations to these procedures will lead to a improperly installed speed module and may result in damage to the computer system. It is highly recommended to read the Operator's Guide (see Table of Contents) before installing the speed module. After the module has been installed this section should be reread.

CABINET REMOVAL

() **Disconnect the computer line cord from the AC outlet.**

Refer to Pictorial 1 and 1A to remove the cabinet shell from the rest of the computer.

() Insert the blade of a small screwdriver in the latch plate, and slide as shown in the inset drawing.

() Repeat this for the latch plate on the other side of the computer.

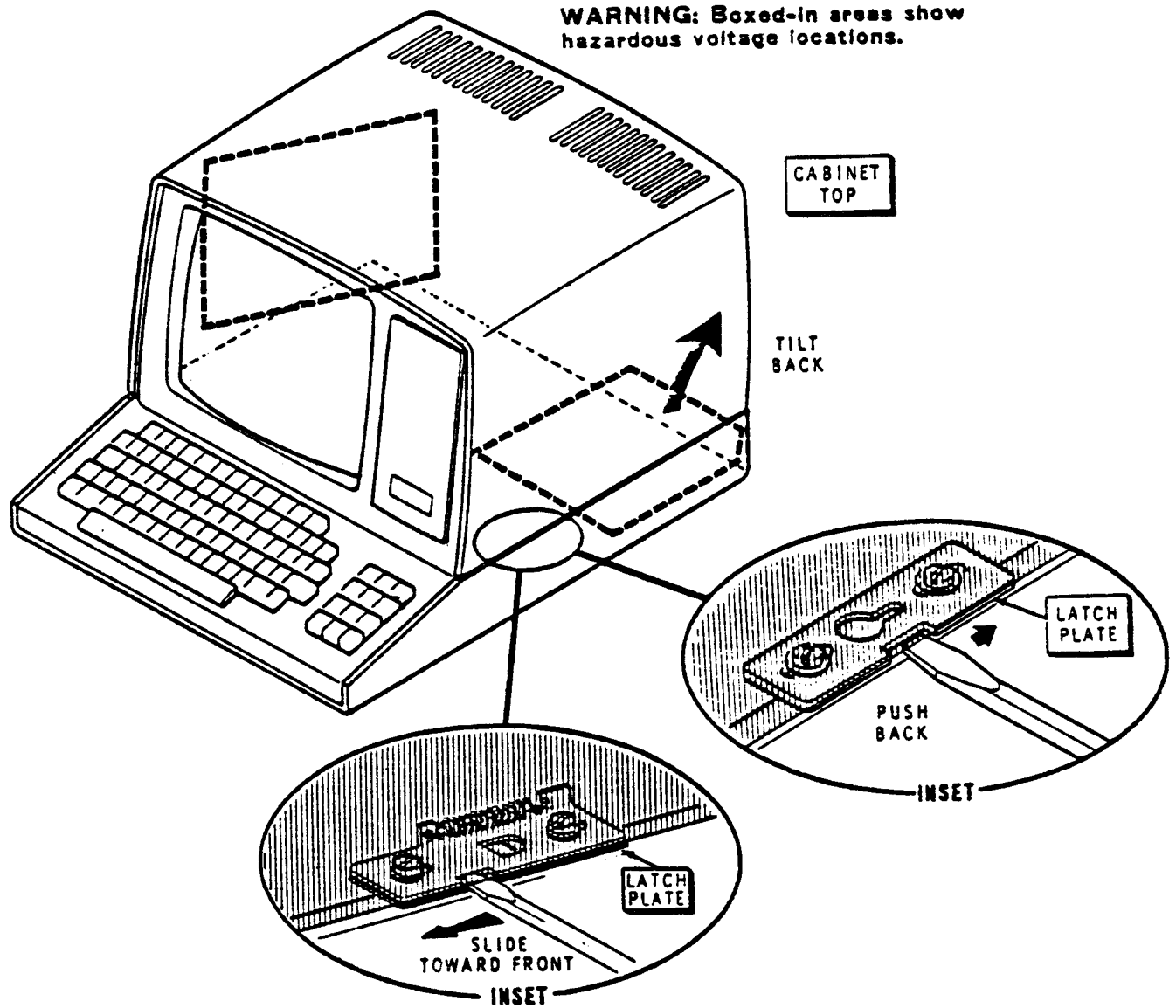
() Carefully tilt the cabinet back.

() Unplug the fan.

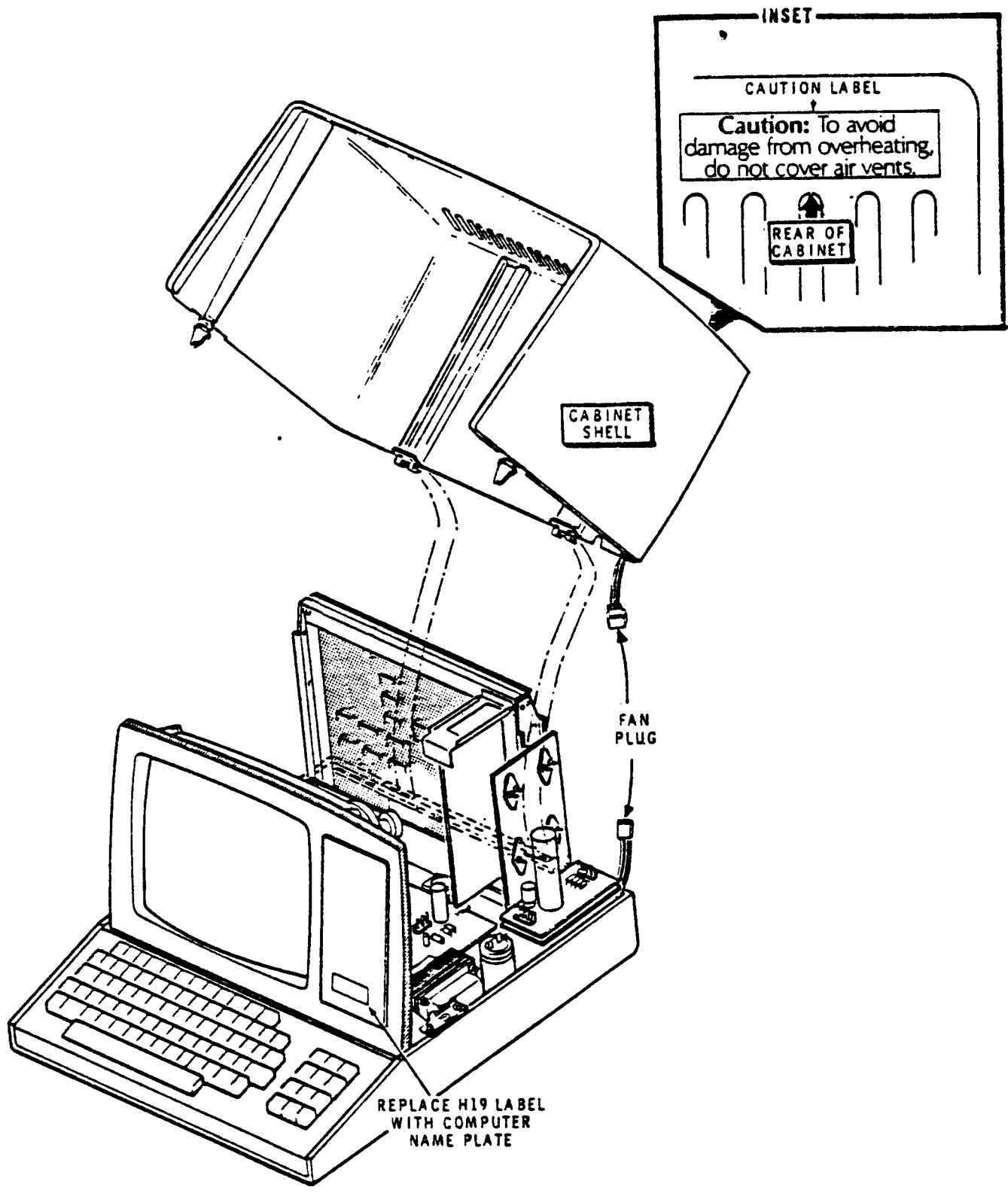
() Remove the lid.

() Set the cabinet shell aside.

WARNING: Boxed-in areas show hazardous voltage locations.



PICTORIAL 1



PICTORIAL 1A

CPU CARD REMOVAL

BEFORE PROCEEDING MAKE SURE THAT YOU HAVE REMOVED THE LINE CORD FROM THE AC OUTLET TO PREVENT HAZARD OF ELECTRICAL SHOCK

Refer to Pictorial 2 to remove the CPU card from the computer in the following steps.

() Remove all the accessory cards from the computer and set them aside. Be sure to mark all connecting cables for easy reinstallation.

() Remove the two screws that hold the CPU card in place and set them aside.

BE SURE TO MARK ORIENTATION AND LOCATION OF ANY PLUGS YOU MUST REMOVE FROM THE CPU CARD OR ACCESSORY BOARDS SO YOU MAY REINSTALL THEM PROPERLY LATER. MANY OF THE CABLES LOOK ALIKE. BE CERTAIN TO MARK WHERE THEY BELONG AS WELL AS THEIR PROPER ORIENTATION. (USUALLY NOTING THE COLOR OF THE WIRE ON ONE END OF THE CABLE AND ITS PLACEMENT ON THE CONNECTOR IS SUFFICIENT TO REORIENT THE CABLES PROPERLY).

() Unplug P514 and P515 located at along the left edge of your CPU card.

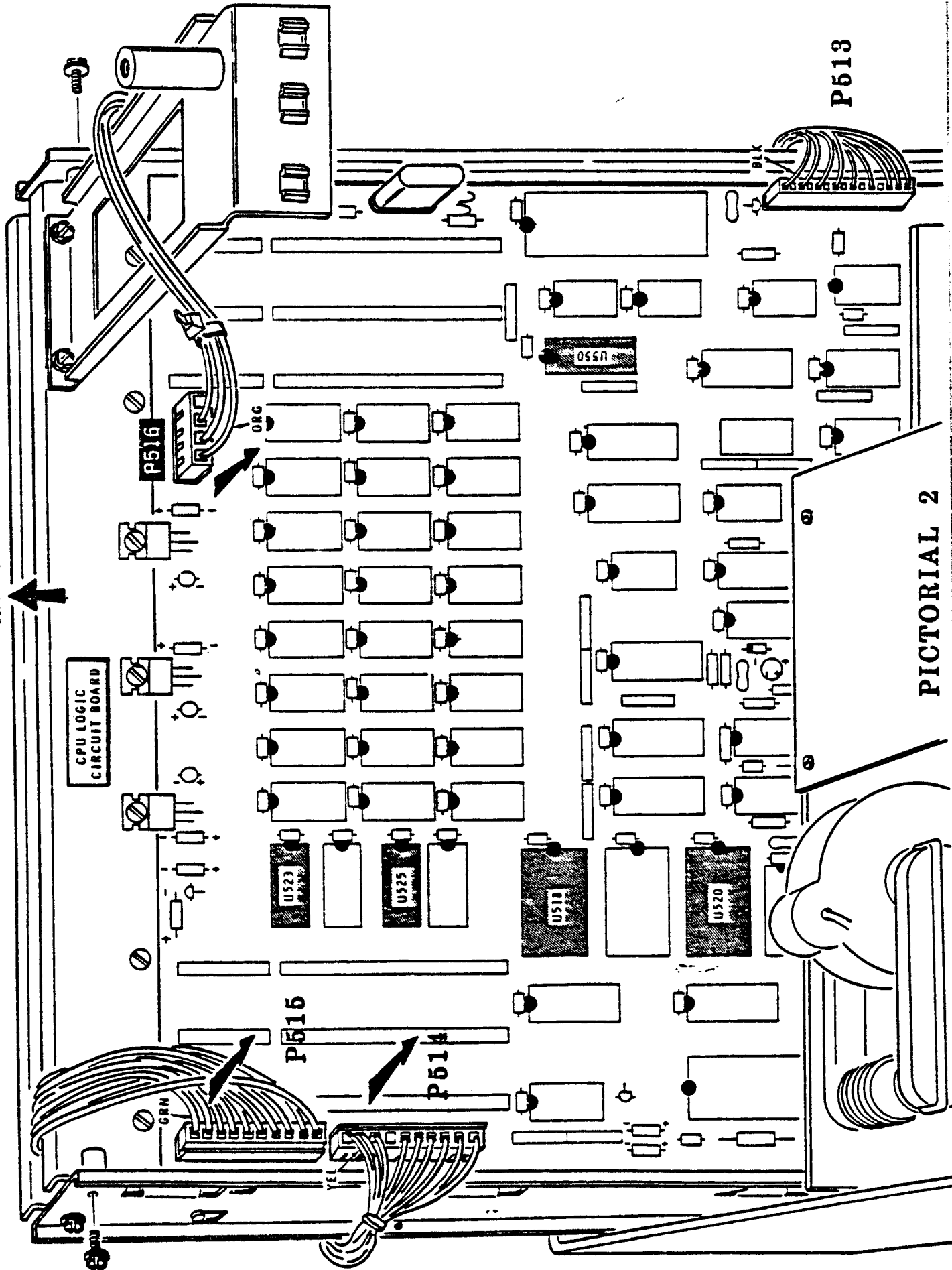
() Unplug P516 along the top edge of your CPU card.

() Slide the CPU card up and out of its guides.

() Remove P513 along the lower right edge of your CPU.

The CPU card should now be completely removed. Set it flat on a work area.

LIFT OUT



P613

PICTORIAL 2

IC* HANDLING

CAUTION:

In the following steps you will need to remove and install IC's. To remove an IC slip the tip of a small screwdriver under one end of the IC and gently pull up. Make sure that all of the pins disengage simultaneously or some of the pins may be bent. If an IC removal tool is available, simply grasp the IC at each end, squeeze and pull up as shown in pictorial 3 (Inset #1).

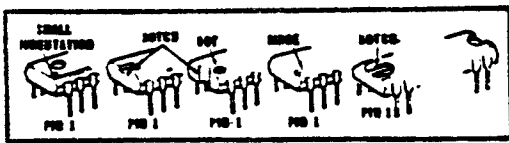
To install an IC a few precautions must be taken. The pins on many IC's are bent out at an angle and will not align with a socket. Trying to install an IC without first bending the pins in may damage the IC pins or the socket. To straighten pins on an IC, lay it down on its side and very carefully roll it towards the pins as shown in pictorial 3 to bend the lower pins into place. Turn the IC over and similarly bend the pins on the other side. Before installing the IC in its socket, make sure the pin 1 end of the IC is over the index mark on the CPU board. Make sure all pins are started into the socket, then press firmly. CAUTION: an IC pin can become bent under the IC yet will appear as though it is installed correctly. Pictorial 3 also illustrates the proper installation of an IC in its socket.

Some of the IC's that you will be handling are sensitive to static electricity. Care should be exercised when handling these parts. Once you are holding one of these parts do not set it down. If you do, then before retouching it place one hand on the workbench first, then pick up the IC. This will equalize the static electricity. You will be told when a part to be handled is statically sensitive.

* Integrated Circuit

STEP-BY-STEP INSTRUCTIONS

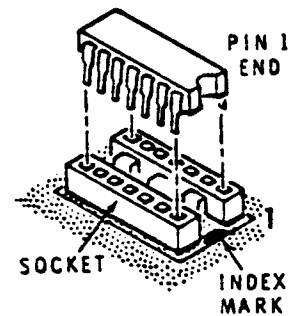
Before you install an IC, lay it down on its side as shown below and very carefully roll it toward the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same manner.



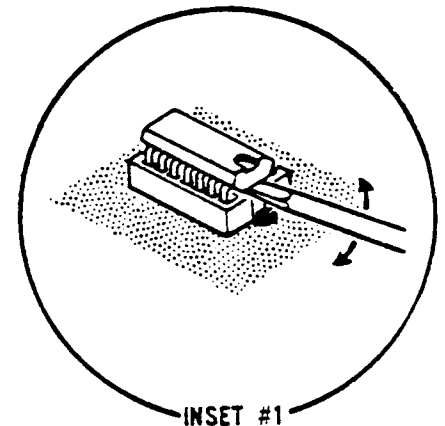
CAUTION: Integrated circuits (IC's) are complex electronic devices that perform many complicated functions in the circuit. These devices can be damaged during installation. Read all of the following information before you install the IC's.

The pins on the IC's may be bent out at an angle, so they do not line up with the holes in the IC socket. **DO NOT** try to install an IC without first bending the pins as described below. To do so may damage the IC pins or the socket, causing intermittent contact.

Make sure that the pin 1 end of the IC is positioned over the index mark on the circuit board (see the detail at the top of this page). Also make sure that all of the pins are started into the socket. Then press the IC firmly into the socket. **NOTE:** An IC pin can become bent under the IC and it will appear as though it is correctly installed in the socket.



PICTORIAL 3



**ACTUAL INSTALLATION STARTS HERE
IC INSTALLATION**

Refer to Pictorial 4 for the next steps.

() Orient the CPU card on the work surface with the metal heat sink away from the table edge.

() Check the part number on the IC at U562. This IC is located near the lower left corner of the CPU card. If it is a 74S132 (or 443-901), you have the proper IC installed and do not need to change it. If it is a 74LS132 (or 443-792) you will need to replace it with a 74S132 or (443-901). This IC is NOT supplied in the kit but is available from your local Heath/Zenith dealer as part number (443-901) or from Kres Engineering as part number (174-132).

The 74LS132 removed is no longer needed and may be discarded.

() Remove the IC at U502. It will be marked 7492 (or 443-34). Place this IC in the small piece of conductive foam supplied with the kit. NOTE: This IC is NOT statically sensitive.

() Remove the IC at U512. It will be marked 74LS74 (or 443-730) or 74S74 (or 443-900). Place this IC in the extra piece of foam. NOTE: This IC is NOT statically sensitive.

CAUTION: NORMAL STATIC ELECTRICITY DISCHARGED FROM YOUR BODY THROUGH ANY PIN ON THE NEXT IC TO AN OBJECT CAN DAMAGE THE IC. WHEN YOU REMOVE THE IC, PLACE IT DIRECTLY INTO THE EXTRA PIECE OF FOAM.

() Remove the 40 pin IC at U504. It will be marked Z-80 (or 443-81). This IC is most easily removed by slipping a small screwdriver under one end and gently prying (see inset in figure 3). Do this on both ends of the IC. Place the IC in the extra piece of foam.

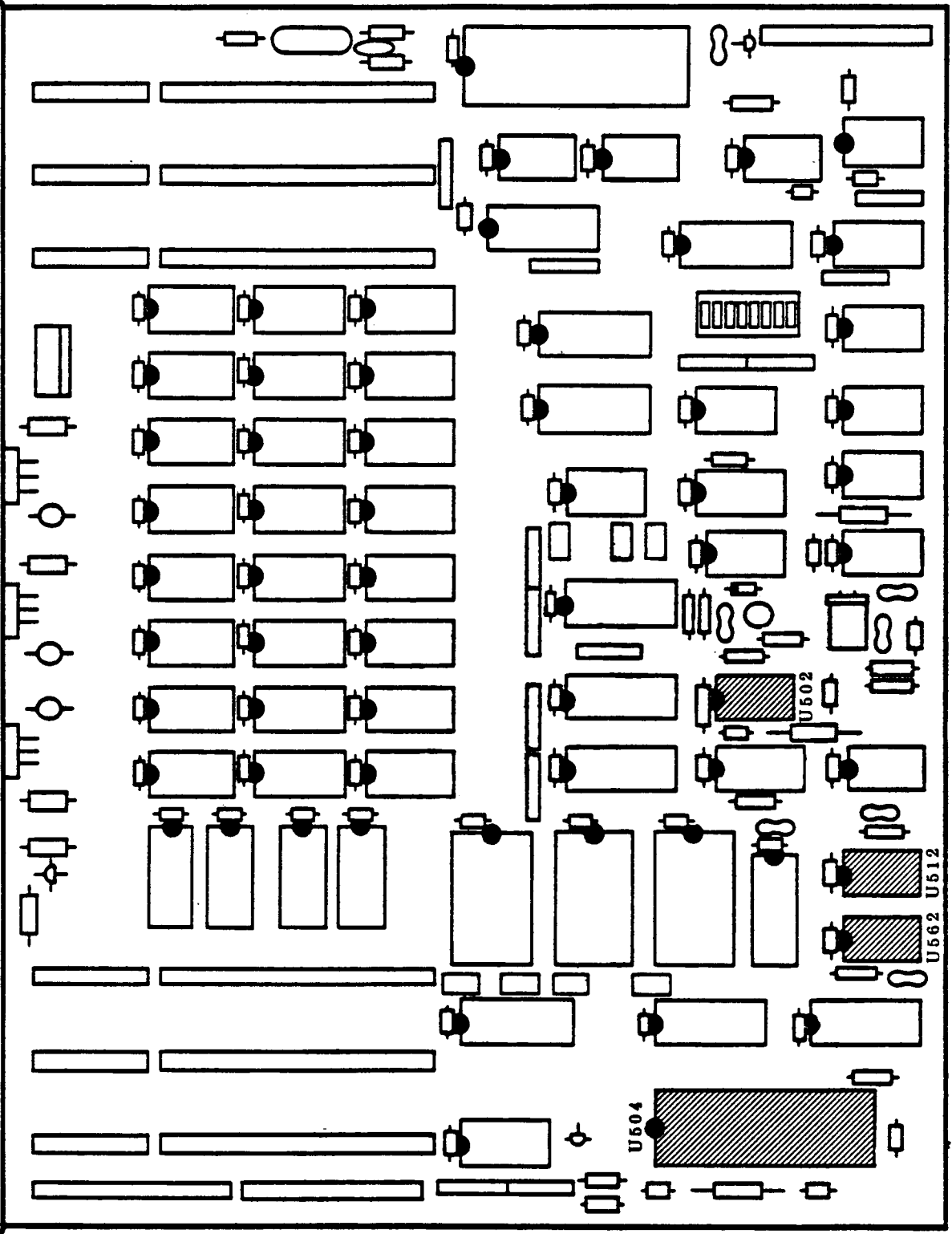
() Set the three IC's in the foam aside. They will be needed if you ever need to remove the Dual Speed Module.

() **NOW, BEFORE YOU PROCEED WITH THE INSTALLATION OF YOUR DSM-240**, write the serial number of your board in the space provided here, **AND** on your warranty card.

DSM-240 serial number: _____

The serial number can be found on the back of the printed circuit board near the smaller of the two plugs. This number is very important should you need help with your installation, or service in the future.

PICTORIAL 4



MODULE INSTALLATION

You are now ready to install the Dual Speed Module onto the CPU card. In the following steps care must be taken to insure that all steps are followed exactly as described. Also many plug pins will be engaging simultaneously and careful alignment is necessary to avoid damage to either the CPU or the Dual Speed Module.

Refer to Pictorial 5 to install the Dual Speed Module.

() Position the module on the area of the CPU board indicated. This places the board directly over the two empty sockets on the CPU card (U504 and U512).

CAUTION: CAREFULLY ALIGN ALL PINS ON BOTH PLUGS ON THE BACK SIDE OF THE MODULE WITH THESE MATCHING SOCKETS ON THE CPU BOARD.

() When you are sure all pins are straight and line up properly, push down on the module firmly applying equal pressure in the areas above the two plugs on the back of the module. You should hear the unit snap into place. Visually inspect the two plugs to be sure all pins are aligned, and no pins either missed the sockets or are bent out. As a final check, the bottom edge of the module and the bottom edge of the CPU card should be approximately in line. If they are not, recheck the position of the module to be sure it is not shifted up or down by one or more pins.

() Locate the 14 Pin Dip Jumper Cable Assembly from the kit.

() Plug one end of this cable into the empty socket on the CPU card labeled (U502). See pictorial 5. The wires from the side of this plug should be pointing toward the DSM-240 module.

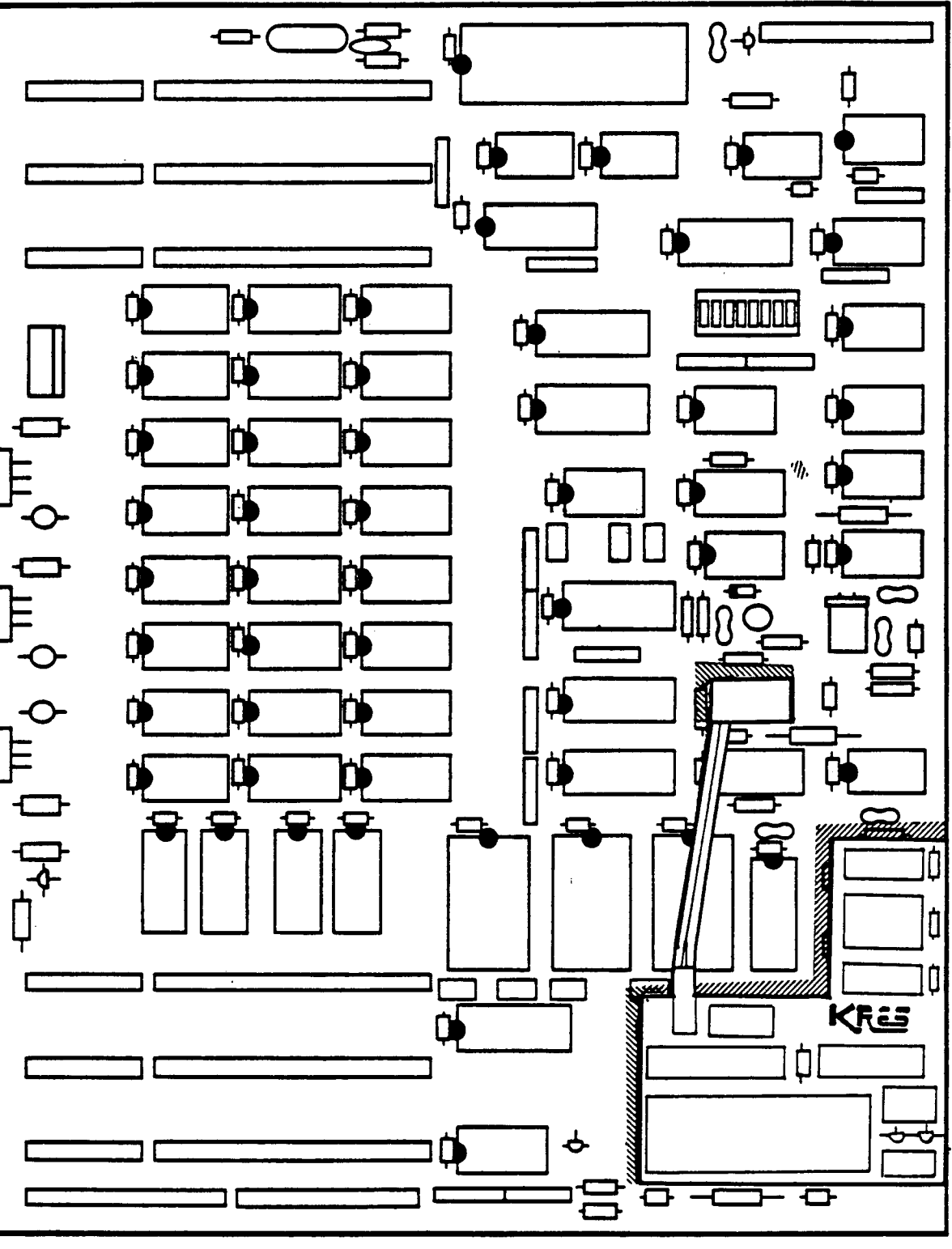
() Plug the other end of the cable assembly onto (P1) on the DSM-240 module. NOTE: This plug is polarized.

() Make certain the three blue shunts on the Dual Speed Module (JJ1 JJ2 and JJ3) are located in the down or "B" position. This will configure the system for 2 MHz on power up with no wait states. For other configurations see the "JUMPER OPTION" section of the operator's guide.

This completes the installation of your Dual Speed Module onto the CPU card.

NOTE: If you have purchased the "KRES Monitor ROM" part number (KMR-100) then now is the best time to install it. Refer to the installation guide supplied with the monitor ROM for instructions. When you have finished installing it, return to this manual and continue with the REINSTALLATION OF THE CPU CARD section on page 14.

PICTORIAL 5



DSM-240 MODULE

REINSTALLATION OF CPU CARD

One last check before you proceed. Depending on the other upgrades installed in your machine, you may have additional cables coming up to P507 and P508 (card connectors on the left hand side of the CPU board). Compare pictorials 6, 7 and 8 which show the HEATH/ZENITH upgrades against your CPU card to be certain all necessary cables are properly installed. NOTE: Your system may have none or all of these cables.

You are now ready to reassemble your computer. In the following steps, be certain to reinstall all cables to their original locations with exactly the same orientation as when you removed them.

() Reinstall your CPU card referring back to pictorial 2 if necessary.

() Reinstall P513 along the lower right edge of your CPU. Be sure the black wire is up.

() Begin to slide the CPU card into the plastic guides located on the metal brackets on either side of the machine. (On the non "A" model machines - the H/Z89 or 90 rather than the H/Z89A or 90A - these card guides are not continuous so extra care must be taken to assure that the CPU card does not miss one or more of these supports.

() As you continue to slide the CPU card down into the guides, properly reinstall all connectors to the accessory boards.

Notes:

A) On "A" model machines, as the CPU card slides in, it may be necessary to temporarily pull the heat sink slightly forward in front of the Dual Speed Module to allow clearance for protruding screws on the flyback transformer. If these screws are excessively long, it may be necessary to replace them with shorter screws, or cut them off.

B) On non "A" model machines, the power cable connecting to P514 should be routed above the Dual Speed Module.

() Reinstall the two screws that hold the CPU card in place.

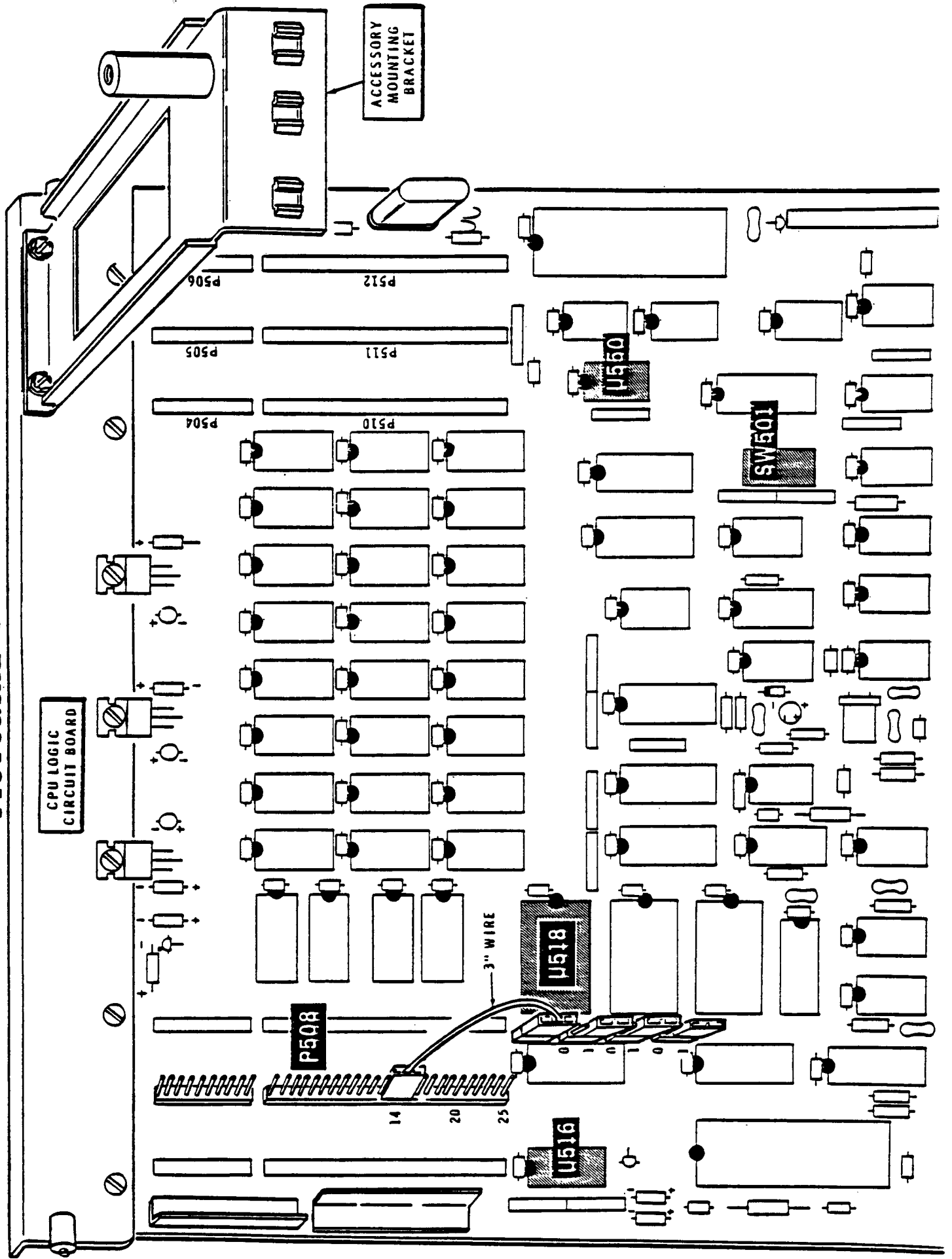
() Reconnect P514 (yellow wire up) and P515 (green wire up) along the left edge of your CPU card.

() Reconnect P516 (orange wire to the left)

() Verify that the Dual Speed Module is still fully seated in the sockets on the CPU board.

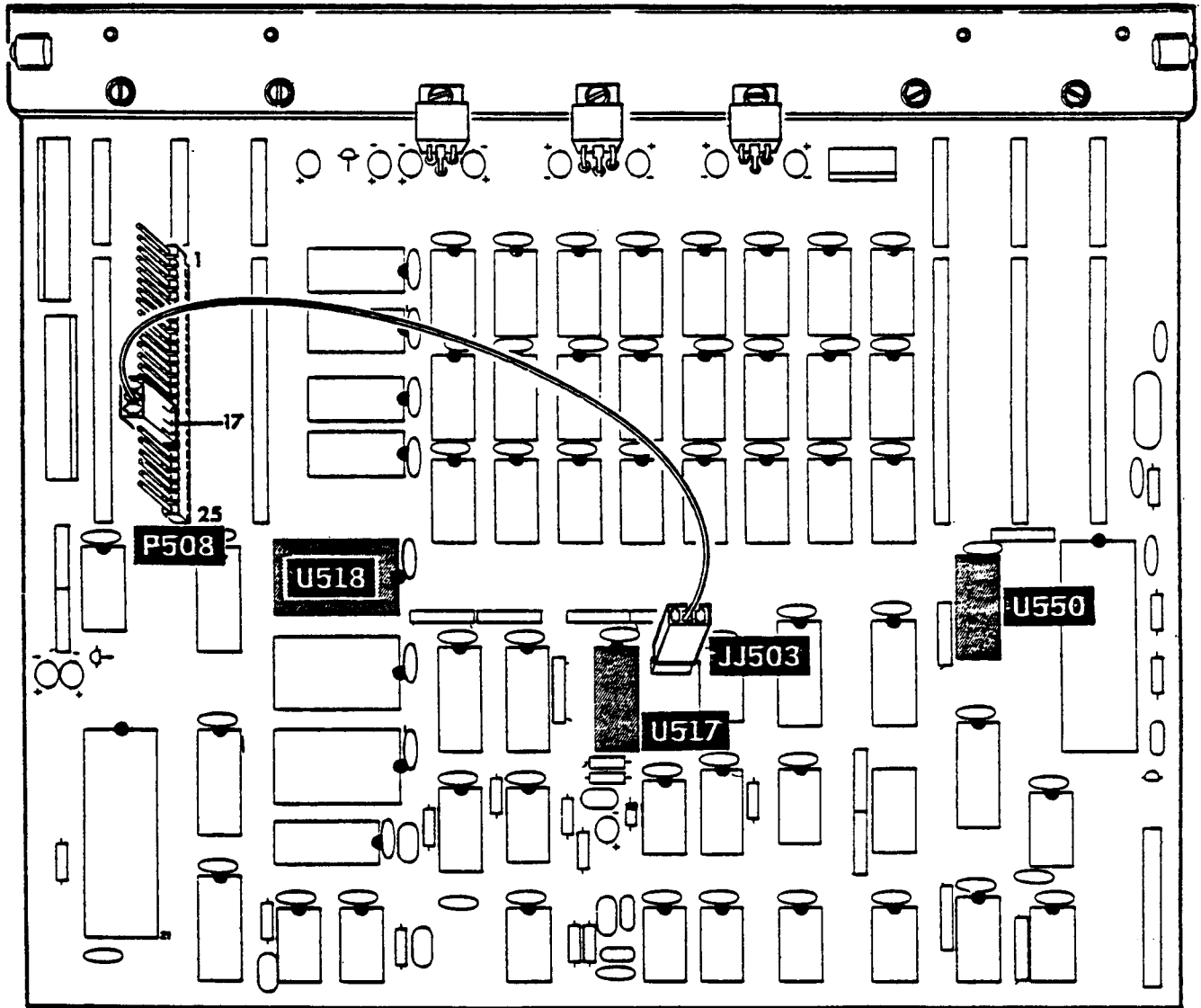
Your DSM-240 (Dual Speed Module) is now completely installed in your computer and you are now ready to do a final check out and test.

PICTORIAL C



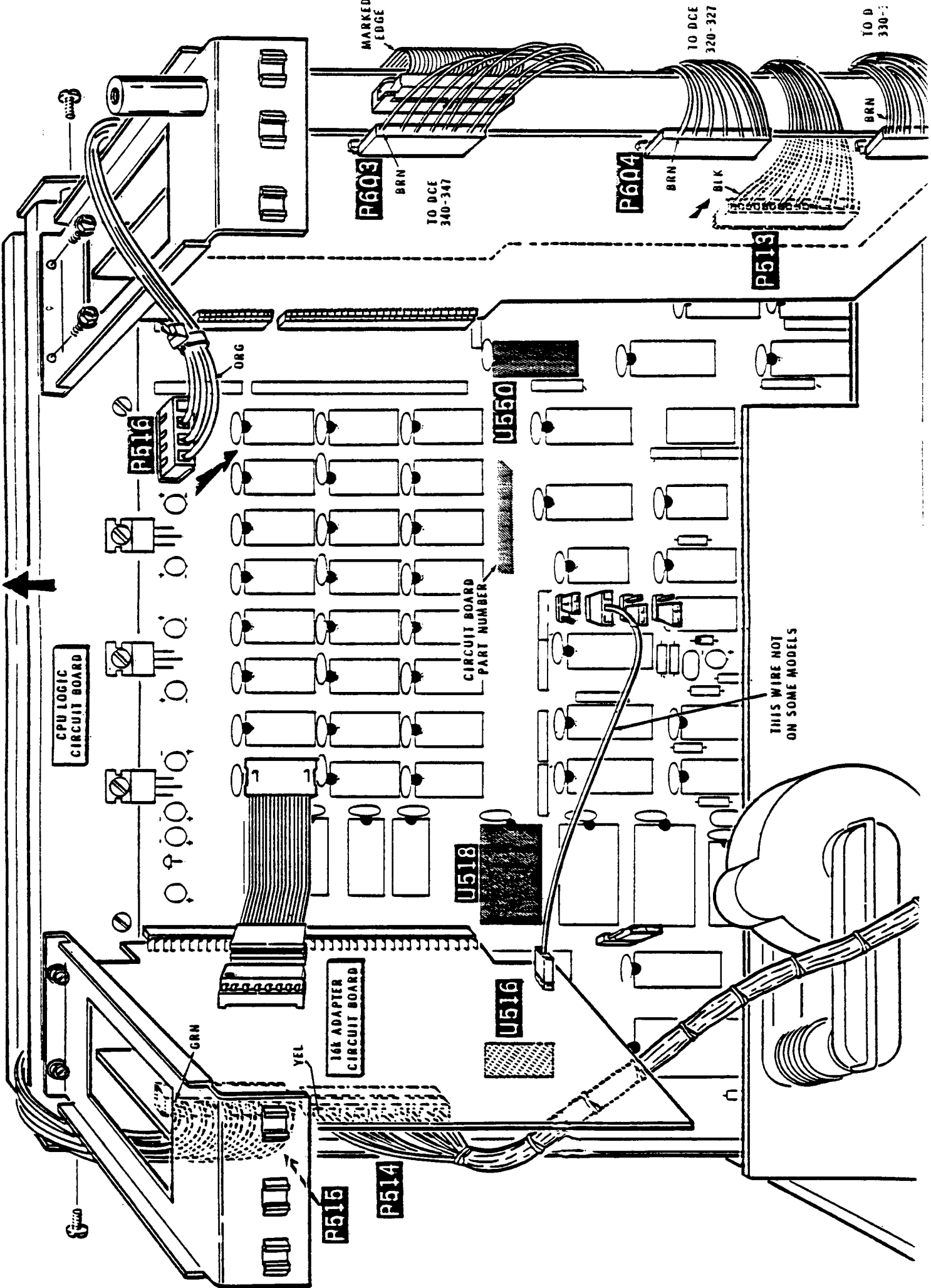
PICTORIAL 7

CPU LOGIC CIRCUIT BOARD



PICTORIAL 8

LIFT UP



FINAL CHECK OUT AND TESTING

() Verify that all cables and jumpers are connected and configured as stated in the installation section.

() Connect your computer to an AC outlet and turn the power on. It should beep just as before (most units beep twice) followed by the H: prompt on the screen. (NOTE: If you have installed the KRES Monitor ROM (KMR-100) then your prompt should read "2 MHz reset" followed by "KE:"). If not, go back and recheck your installation to be certain all steps have been followed properly. Most failures at this stage can be traced to bent under pins, connectors improperly reinstalled or inadvertently pulled loose. If all checks out well then you now have a faster computer. For a detailed test of the module see the Operator's guide.

() Disconnect the power cord and perform the remaining steps.

() Reinstall all accessory cards.

() Make one last check of all connectors to be certain they are properly installed and none have been omitted or have pulled loose. Again verify that the Dual Speed Module is fully seated into its sockets and that the connector on P1 is fully connected.

() Refer to Pictorials (1,1A) and reverse the procedure to reinstall the cabinet shell. Do not forget to reconnect the fan cable.

This completes the hardware installation for your dual speed module. For information on its operation and use see the Operator's Guide section of this manual.

OPERATOR'S GUIDE

In the following guide the features and powers of the Dual Speed Module will be discussed in detail. Step by step instructions will be given to aid in the modification of the operating systems for use with the Module. This guide has been broken down into several independent sections.

Carefully read this entire guide before attempting to operate your system with the module installed. It has been found that most problems occur from users not fully understanding the features of the module, and not from defective hardware, software or improper installation.

NOTE: Before attempting to use your Dual Speed Module run the memory test program outlined in first section intitled "CHECKING MEMORY SPEED".

- . Checking Memory speed
- . Heath/Zenith CP/M Installation
- . HDOS Installation
- . Other System Manufacturers
- . Using Module under CP/M
- . Using Module under HDOS
- . Jumper Options
- . Monitor ROM considerations

CHECKING THE MEMORY SPEED

Reliable operation of system RAM at 4 MHz is extremely important. RAM IC's are manufactured with different access time ratings. The better parts have a faster access time and thus a lower nanosecond (ns) rating. Your system MUST have RAM with an access time less than 250 ns to run at 4 MHz. Using slower RAM, though it may seem to work most of the time, is just inviting trouble. Should you need to replace them, the IC's are not too expensive (compared to your total investment in your computer system) and easily obtained either through Heath/Zenith, KRES, or any other number of local or mail order vendors. There are two simple methods to check the speed of your RAM.

1. Visually inspect the IC's. They are located in the upper center of your CPU card, in three rows of eight each. The IC's are labeled on the CPU card as U526 through U549. If you have the 16K RAM upgrade, nine more IC's will be located in a card on the left hand side of your machine. The exact part number and speed varies from manufacturer to manufacturer, consult the table in Appendix C for a listing of type numbers and speeds by manufacturer.

2. Run the memory test program MEMTEST included on the DSM-240 software disk. This program is a public domain program found in various forms with WORM somewhere in its name. The "worm" is a 12 byte program that actually "crawls" through memory, executing and moving itself as it goes, leaving a trail of FF's as it travels. Rather than just write to and read from a memory location, you actually execute a program at all memory locations. It continuously reports the address at which it is executing in the upper left corner of your screen. The cursor may seem erratic - this is normal. The program will stop normally when it tries to move the worm onto the stationary part of the program in lower memory. A normal stop will display:

```
000CE8
```

If the program stops and displays an error message, you have a memory problem. The error messages are:

D - Bits were dropped

P - Bits were picked up

T - Trap error (a memory error has caused the program counter to get out of synch). This is followed by the address.

You WILL get a trap error if you do not have a 64K system. The continuous errors will begin where your memory ends:

32K - 8000 Hexadecimal

48K - C000 Hexadecimal

If you do NOT have continuous memory to 64K, the Trap error is the only error that can be ignored. (The program does map RAM into the lower 8K to operate). All others indicate a potential problem.

Run the program by PIPing MEMTEST.COM onto a usable disk, then type its name. It will ask you what speed you wish to use to test RAM. You may type 2 or 4 for 2 or 4 MHz respectively, or you may just type RETURN for 4 MHz.

For example, if you had transferred MEMTEST.COM onto disk A, and you were logged onto A (the prompt reads A>) then you would type:

```
MEMTEST <cr>
```

Your system will respond with

```
Run Memory Test at 2 or 4 MHz ? <4>
```

If you type only a RETURN, the memory test will automatically toggle the system to 4 MHz, inform you of the toggle by measuring the speed and displaying the current system speed for the memory test.

```
Begin Memory Test at 4 MHz
```

If you requested 4 MHz, and the screen returns "Begin Memory Test at 2 MHz", then you have a hardware problem. Go back to the installation section and recheck each step to make sure there are no errors.

The MEMTEST program will also run at 2 MHz if you respond 2 to the prompt. Should you encounter errors at 4 MHz, you might want to check the memory at 2 MHz to see if the problem is speed related, or simply bad memory.

MEMTEST will also take a command line of 2 or 4 corresponding to 2 or 4 MHz, respectively. Thus, by typing:

```
MEMTEST 4 <cr>
```

you will begin running the memory test program at 4 MHz. Again, the program will measure CPU speed as the memory test program is started, and display the result on the screen.

To return to the monitor ROM so you can reboot, reset the machine - there is no other exit from MEMTEST since it has written over your operating system in RAM.

SOFTWARE CONFIGURATION FOR HEATH/ZENITH CPM

You should now have completed the hardware modifications to your system. Some software modifications may also be needed. If you ordered CP/M software, the disk that was included with your DSM-240 has all the support software that is required to run your computer at 2 or 4 MHz. Included are all necessary modifications to CP/M, a SETCLK utility program that will allow you to toggle between 2 and 4 MHz under software control, and a memory test program that will help determine if you need to change your system RAM.

NOTE: This section is for users with Heath/Zenith CP/M. If you have BIOS-80, Magnolia Microsystems CP/M, CDR CP/M, or HDOS, refer to those sections for instructions on what to do (if anything) to allow your system to run at 4 MHz.

Carefully read this entire section before performing the modifications to your software. Then slowly and carefully carry out the step-by-step instructions EXACTLY and in the order specified.

DESCRIPTION OF SUPPLIED CP/M FILES

The CP/M diskette contains several files needed to operate your system at 2 or 4 MHz. The explanation of each file is as follows:

BIOS.ASM: The original Heath/Zenith BIOS.ASM with timing constant modifications to allow the 5 1/4 inch, 10 hard sector disk drives to run at 2 MHz or 4 MHz. These are the H17 or H77 disk drives from Heath/Zenith. Except for the timing modifications to the H17/H77 code, the BIOS is otherwise unmodified and will perform identically to your present CP/M system. Any utilities that acted on BIOS.ASM (e.g. MAKEBIOS) will perform exactly as they did before.

The next four files are the actual BIOS required by your system to run at 2 MHz or 4 MHz. They were obtained by running MAKEBIOS as outlined in Chapter 3, page 53 of the CP/M manual "CP/M Version 2.2 for the HEATH/ZENITH 8-Bit Computer Systems". Each of these supports the 5 1/4 inch 10 hard sector floppy disk drives, either alone or in combination with another drive type. Other versions of the BIOS are not included on this disk because they require NO MODIFICATION from the original as furnished by Heath/Zenith. The following naming suffix convention to BIOS applies to the drive types as sold by Heath/Zenith:

- 17 - H17 or H77 5 1/4 inch 10 hard sector drives
- 37 - H37 5 1/4 inch soft sector drives
- 47 - H47 8 inch drives
- 67 - H67 hard disk drive

BIOS17: Heath/Zenith BIOS to support the H17 or H77 disk drives only.

BIOS1737: Heath/Zenith BIOS to support the H17 or H77 disk drives AND the H37 disk drives.

BIOS1747: Heath/Zenith BIOS to support the H17 or H77 disk drives AND the H47 disk drives.

BIOS1767: Heath/Zenith BIOS to support the H17 or H77 disk drives AND the H67 disk drive.

SETCLK17.COM: The program to toggle your computer's speed between 2 and 4 MHz. This program is designed to be used IF YOU HAVE THE H17 or H77 DRIVE types or any other cards that require 2 MHz on the bus regardless of processor speed. It leaves 2 MHz on the Bus (as required by the H88-1 5 1/4 inch 10 hard sector controller) whether the CPU is running at 2 MHz or 4 MHz.

SETCLK.COM: Another program to toggle your computer's speed between 2 and 4 MHz. Use this program if you do NOT have the H17 or H77 drive types or any other cards that require 2 MHz on the bus regardless of processor speed. This toggles the Bus speed along with the processor speed. Thus, when your computer is running at 4 MHz, every card on the bus also receives 4 MHz.

SETCLK17.ASM: The assembly language listing for the two SETCLK programs above. As provided, SETCLK17.ASM, when assembled and loaded, will give the SETCLK17.COM program. If you use an editor to change the H17 equate within the program to FALSE before assembly, and change the program name to SETCLK.ASM, the result will be the SETCLK.COM program. This file is included for any customization you wish to do. NOTE THAT THE ONLY VERSIONS OF SETCLK SUPPORTED BY KRES ARE THE ONES PROVIDED. IF YOU ALTER OUR PROGRAM YOU ARE ON YOUR OWN.

MEMTEST.COM: This is a memory test provided to let you test your system RAM at 2 or 4 MHz.

SOFTWARE MODIFICATIONS AND INSTALLATION

The software modifications are presented in two formats:

1. An outline form for those who are sufficiently familiar with CP/M to proceed if just given simple instructions.
2. A detailed, keystroke by keystroke explanation of precisely what must be done. Use this set of instructions if you are not completely familiar with all of the intricacies of CP/M.

NOTE: Running your system at 2 MHz with the DSM-240 in place requires no software modifications be done. If you followed the instructions in the hardware installation section and left the jumpers all DOWN, your system is now running at 2 MHz and you will be able to use all of your existing software without a problem.

I - BRIEF DETAIL OF SOFTWARE INSTALLATION

NOTE: Follow these instructions only if you are VERY FAMILAR with the CP/M operating system. Otherwise skip to Section II "DETAILED EXPLANATION OF SOFTWARE INSTALLATION on page 25.

PART ONE

If you are NOT using the 5 1/4 inch 10 hard sector disks (H17 or H77) on the Heath/Zenith H88-1 controller, skip to PART THREE.

In this section you will use a SUBMIT file furnished by KRES to patch DUP, FORMAT, and MOVCPM17 to allow them to run at 2 or 4 MHz.

() Use PIP to move the following CP/M files onto your bootable disk:

SUBMIT.COM
XSUB.COM
DDT.COM
DUP.COM
FORMAT.COM
MOVCPM17.COM

() Use PIP to move the following KRES files onto your bootable disk:

DUP.HEX
PATCH.SUB

() Run PATCH.SUB by typing SUBMIT PATCH. You will be left with a new patched DUP.COM, FORMAT.COM, and MOVCPM17.COM usable at 2 or 4 MHz.

PART TWO

In this section you will create a bootable disk using one of the BIOS files furnished on the DSM-240 CP/M software disk.

() Use the appropriate version of MOVCPM and SYSGEN to create a new CP/M with the required BIOS from the DSM-240 CP/M software disk.

() Use PIP to copy the files modified in PART ONE onto your new system disk.

PART THREE

() Use PIP to copy the appropriate version of SETCLK.COM over to your new bootable disk:

SETCLK.COM If you DO NOT have the 5 1/4 inch hard sector drives on your system.

SETCLK17.COM If you DO have the 5 1/4 inch hard sector drives on your system.

() Run CONFIGUR (supplied on your original Heath/Zenith CP/M system disk I) to reconfigure your system as you had it before.

This completes the modifications necessary to your Heath/Zenith CP/M system software. The bootable disk you have created above, together with the modified files are all usable at 2 MHz or 4 MHz.

II - DETAILED EXPLANATION OF SOFTWARE INSTALLATION

NOTE: If you are VERY FAMILAR with the use of CP/M then do NOT follow the instructions in this section and use those in section I on page 24.

NOTE: Any time you give CP/M a command or a command file name (e.g DIR or PIP or STAT it is necessary to follow that with a RETURN key stroke, which is specified here as <cr>

() Boot your system with one of your current CP/M diskettes.

() Insert the CP/M software disk that came with your DSM-240 into drive B if you have one, or follow the system prompts that tell you when to switch disks on a one drive system. Examine the directory of the disk that came along with your DSM-240 by typing:

DIR B: <cr>

The disk should contain the following files:

BIOS.ASM, BIOS17, BIOS1737, BIOS1747, BIOS1767, SETCLK17.COM, SETCLK.COM, SETCLK17.ASM, MEMTEST.COM

NECESSARY SOFTWARE MODIFICATIONS

There are three separate procedures you need to perform to allow your Heath/Zenith CP/M to run at 2 MHz or 4 MHz. Read all instructions over carefully first, then reread and perform them EXACTLY as specified, in the order specified. Take NO shortcuts or the procedure WILL NOT WORK!!

***** NOTE: Using PIP *****

All of the procedures below require the use of a program called PIP, originally furnished on your CP/M distribution disk I from Heath/Zenith. PIP.COM is the CP/M Peripheral Interchange Program. Although it allows many operations, you will use it here to transfer files between disks. Complete documentation on PIP is found in the Digital Research section of your CP/M manual under "An Introduction to CP/M Features and Facilities" section 6.4 page 18. To use PIP, type:

```
PIP <cr>
```

Your computer will respond with

*

You now tell it the name and drive of the source file you want transferred, and the name and drive of the file you want to be the destination. The general form, then is:

```
destination = source <cr>
```

For example, if you wanted to transfer FORMAT.COM from drive B to drive A, leaving the name unchanged, you would type (after you get the "*" prompt):

```
A:=B:FORMAT.COM[V] <cr>
```

The A: is the destination drive

Since no name is between the A: and the "=", the destination file will be the same name as the source file

The =B: tells PIP to get the file from B:

The FORMAT.COM is the file we wish to transfer

The [V] tells PIP to verify the file transfer against the original

To leave PIP, press the RETURN key

If you have only one file to transfer, you may type PIP followed by a single space, followed by the same information you typed in at the asterisk prompt:

```
PIP A:=B:FORMAT.COM[V] <cr>
```

The above line would have the same effect as the command sequence given before, and would return control to CP/M immediately after the file was transferred.

There are more uses for PIP and other ways to do exactly the same thing; if you are NOT familiar with PIP, stick with this form to transfer the files required.

PART ONE

NOTE: If you are NOT using the 5 1/4 inch 10 hard sector disks (H17 or H77) on the Heath H88-1 controller (your present BIOS is configured only for the H37, H47 or H67 disk drives either alone or in combination), SKIP TO PART THREE

During PART ONE you will use a SUBMIT program, furnished on the KRES DSM-240 disk to patch timing constants within MOVCPM17.COM, FORMAT.COM, and DUP.COM for use with the H17 or H77 disk drives. The procedure should go quite smoothly provided you have read all the steps and do not rush.

For the following steps you will need your present system disk with the following files. If they are not on your disk, use PIP to transfer them. All of these files are on your original Heath/Zenith distribution disks as outlined below:

() Boot your system using your present bootable CP/M diskette. Use the DIR command to examine the directory of your system diskette by typing:

```
DIR <cr>
```

() Use PIP to transfer any of the following files onto your present bootable CP/M disk that are not already present (it is assumed that you already have PIP.COM on this disk). All of these files are on your original Heath/Zenith distribution diskettes I as outlined below:

```
( ) SUBMIT.COM    - from disk I
( ) XSUB.COM      - from disk I
( ) DDT.COM       - from disk I
( ) DUP.COM       - from disk I
( ) FORMAT.COM    - from disk I
( ) MOVCPM17.COM - from disk I
```

You will also need the following files from the KRES software disk that was included with your DSM-240:

```
( ) DUP.HEX      - from KRES disk
( ) PATCH.SUB    - from KRES disk
```

Next, you will run a patch program which will modify the timing constants in DUP.COM, FORMAT.COM, AND MOVCPM17.COM. The program runs automatically and requires no intervention on your part once started. The program will stop running in a minute or so, and return with the CP/M system prompt.

() Type:

```
SUBMIT PATCH <cr>
```

Your computer will begin a series of operations and automatically modify the necessary programs. When the program stops running, the DUP.COM, FORMAT.COM and MOVCPM17.COM on your disk will be patched to run at 2 MHz or 4 MHz.

PART TWO:

During PART TWO you will create a bootable disk using the new modified BIOS as supplied on the disk with your DSM-240. You will be replacing the Heath/Zenith BIOS with the same identical BIOS, except some software timing constants have been changed. The procedure is quite simple and if followed step by step should go quite smoothly. Should you have trouble at any step, quit, go back and reread the entire procedure, then start again from the beginning if necessary.

For the following steps you will need your present bootable CP/M disk with the following files present. If they are not on your disk, use PIP to transfer them onto the diskette.

() Boot your system using your present bootable CP/M diskette. Use the DIR command to examine the directory of your system diskette by typing:

DIR <cr>

() Use PIP to transfer any of the following files onto your present bootable CP/M disk that are not already present (it is assumed that you already have PIP.COM on this disk). All of these files are on your original Heath/Zenith distribution diskettes I as outlined below:

- () SYSGEN.COM - from disk I
- () STAT.COM - from disk I

You will also need ONE of the following, depending on the bootable disk type you are going to create in the following steps. Use the MOVCPM17.COM file created in PART ONE, NOT the original MOVCPM17.COM on your Heath/Zenith distribution disk, if you are creating a 5 1/4 inch 10 hard sector disk. All other files are on the original CP/M distribution disk II:

MOVCPM17.COM - if you want to create a 5 1/4 inch 10 hard sector disk - created in PART ONE

MOVCPM37.COM - if you want to create a 5 1/4 inch soft sector disk - from disk II

()

MOVCPM47.COM - if you want to create an 8 inch disk from disk II

MOVCPM67.COM - if you use the Heath/Zenith H67 hard disk from disk II

You will also need ONE of the following, depending on the drive types your new 2/4 MHz CP/M system is going to support. All are located on your KRES software disk that was included with your DSM-240.

- BIOS17 - If you want to run the H17 or H77 drives only from KRES disk
- BIOS1737 - If you want to run the H17 or H77 together with the H37 - from KRES disk
- BIOS1747 - If you want to run the H17 or H77 together with the H47 - from KRES disk
- BIOS1767 - If you want to run the H17 or H77 together with the H67 - from KRES disk

Next, we will create a formatted disk on which we will move your new 2/4 MHz CP/M system. Use a blank disk or an old disk that no longer contains good data since when you format the disk all data on that disk will be lost.

() Boot your Heath/Zenith system and use FORMAT.COM to format a fresh diskette by typing FORMAT <cr> and answering the questions that format asks and following the instructions that FORMAT types on your computer's screen. This diskette will be referred to as the "New System Disk" throughout the remainder of these instructions.

Next, we will create a copy of CP/M in your computer's RAM that will support your available memory and uses the modified BIOS you transferred in step one.

() Type:

```
MOVCPMxx * BIOSyyyy <cr>
```

xx is 17, 37, 47, or 67 and corresponds to the MOVCPM you transferred in step one.

yyyy is 17, 1737, 1747, or 1767 and corresponds to the BIOS you transferred in step one.

The asterisk (*) instructs MOVCPM to use all available memory. You may put another number in place of the * to specify a memory size SMALLER than available memory on your system

Example:

If you wanted to create an H17 disk that supported the H17's and H37's, and using all available memory, you would type:

```
MOVCPM17 * BIOS1737 <cr>
```

Or, if you wanted to create an H37 disk that supported the H17's and H37's but used only 48K of RAM, you would type:

```
MOVCPM37 48 BIOS1737 <cr>
```

***** End Example *****

Your system will respond with:

```
MOVCPM-- VERSION 2.2---
CONSTRUCTING --k CP/M vers 2.2
READY FOR "SYSGEN" OR
"SAVE 38 CPM--.COM
```

Where the "-"'s will be various numbers depending upon the particulars of your system.

Next, we will place the newly created CP/M on your New System Disk.

() Type:

```
SYSGEN <cr>
```

Your system will respond with:

```
SYSGEN VER 2.0.--
SOURCE DRIVE NAME (OR RETURN TO SKIP):
```

() Type:

```
<cr> (hit the key marked RETURN only)
```

Your system will respond with:

```
DESTINATION DRIVE NAME (OR RETURN TO REBOOT):
```

() Type:

```
A (no <cr>)
```

Your system will respond with:

```
DESTINATION ON A, THEN TYPE RETURN
```

() Insert your New System Diskette into drive A, then type:

```
<cr>
```

Your system will respond with:

```
DESTINATION DRIVE NAME (OR RETURN TO REBOOT):
```

() Insert your original system diskette into drive A, then type:

```
<cr>
```

Your system will reboot your original CP/M.

Next, we will put a copy of the new BIOS.SYS onto your New System Diskette; after this operation it will be a bootable disk.

() Insert your New System Diskette into drive B if you have one, or follow the system prompts that tell you when to switch disks on a one drive system, and type:

```
PIP B:BIOS.SYS=A:BIOSyyy[v] <cr>   Where yyy corresponds to
                                     the BIOS you transferred
                                     previously.
```

Finally, we will use STAT to set your new BIOS to a read only system file.

() Leaving your New System Diskette in drive B, or again following the prompts in a one drive system, type:

```
STAT B:BIOS.SYS $R/O <cr>
```

Your computer will respond with

```
BIOS.SYS set to R/O
```

() Type:

```
STAT B:BIOS.SYS $SYS <cr>
```

Your computer will respond with

```
BIOS.SYS set to SYS
```

() Use PIP to copy the patched files from PART ONE over to your New System Disk. Your original system disk should still be in A, and your New System Disk in drive B, (or swapped with the disk in drive A as per the prompts if you have only a one drive system). You type:

```
PIP <cr>
```

The computer responds with:

```
*
```

You type:

```
B:=A:DUP.COM[V] <cr>
B:=A:FORMAT.COM[V] <cr>
B:=A:MOVCPM17.COM[V] <cr>
```

One line each time you see the asterisk prompt. Exit from PIP via RETURN.

This completes the modifications necessary to the CP/M BIOS. Use PIP to copy any of the files you normally have on your system disk onto the New System Disk, including PIP.COM Then continue with PART THREE.

PART THREE

This is the last procedure you need follow to create the software to run your system at 2 MHz or 4 MHz. You will copy a program called SETCLK or SETCLK17 over to your New System Disk. This is the program that, when run, will toggle your system speed between 2 and 4 MHz.

() Reset your system by holding down the right SHIFT key and the RESET key at the same time.

() Boot your system on your New System Disk (or on an existing disk if the H17/77 drives are not part of your system and you skipped directly to PART THREE) if you have not already done so.

() Use PIP to copy the appropriate version of SETCLK - either SETCLK.COM or SETCLK17.COM from the KRES software distribution disk included with the DSM-240. Insert your KRES distribution disk into drive B if you have one, or follow the system prompts that tell you when to switch disks on a one drive system, and type:

```
PIP A:=B:SETCLK.COM[V] <cr> if you DO NOT have the 5 1/4 inch
                             hard sector drives on your system
```

OR:

```
PIP A:=B:SETCLK17.COM[V] <cr> if you DO have the 5 1/4
                               inch hard sector drives
                               on your system
```

() If the H17/77 drives are part of your system, you have created a New System Disk. Your system configuration has now reverted back to the configuration as supplied by Heath/Zenith. All of the specifics for your system are gone, such as disk drive step rates, printer configuration, upper/lower case mapping etc. You must now run the CONFIGUR.COM (supplied on your original Heath/Zenith distribution disk I) and set up your specific system. If you have forgotten exactly how you had your system configured, reboot on any bootable disk you were using before, and run CONFIGUR, looking at how you had the options set rather than changing anything. If you have a printer, you can use the "CTRL P" printer on option from the keyboard to obtain a hard copy of your system settings.

This completes the software modifications that you need to do to support your new 2/4 MHz Dual Speed Module. You may now skip to the section that explains the use of the SETCLK programs. We suggest that you put a write protect label on the disk you just created and set it aside, using it as a "Master Disk" from which to pull your CP/M system and the DUP.COM, FORMAT.COM, MOVCPM17.COM, and SETCLK.COM onto work disks. After you have played with the board and familiarized yourself with the software for a time, you may want to come back and repeat PART TWO (if required) for each bootable disk type and each supported drive type you will be using. Copy DUP.COM, FORMAT.COM, MOVCPM17.COM and SETCLK.COM from the first disk you created in PART TWO, and SYSGEN.COM from your Heath/Zenith distribution disk; write protect these and set them aside. Then it will always be easy for you to use DUP or SYSGEN to create working copies of the bootable disks you will require.

MAKING ADDITIONAL OPERATING SYSTEM COPIES

The following paragraphs are suggestions for maintenance of your distribution software. They assume you have booted your system on one of the Master Disks you created above.

1. You do NOT need repeat PART TWO every time you create a bootable disk supporting the same drive types and on the same disk type. You can use DUP.COM to create a new disk by typing:

```
DUP <cr>
```

and following the menu as presented. NOTE THAT IF YOU ARE DUPLICATING SOFT SECTORED DISKS, THE DISK ONTO WHICH YOU ARE DUPLICATING THE ORIGINAL MUST BE FORMATTED FIRST FOR THE DUP PROGRAM TO WORK.

2. Or, to create a bootable disk supporting the same drive types and on the same disk type, you can use SYSGEN.COM. THE NEW BOOTABLE DISK YOU ARE CREATING MUST BE FORMATTED FIRST. Type:

```
FORMAT <cr>
```

and answer the questions FORMAT asks. Note that any information on the disk you are formatting will be destroyed, so use either a new disk, or one with no usable information on it. Then install the New System Disk with the CP/M version you want and boot your system. Type:

```
SYSGEN <cr>
```

Follow the menu, using the source drive name as A and and appropriate destination drive name as your system configuration permits (B or C)

SOFTWARE CONFIGURATION FOR HDOS

At this point the hardware modifications to your system should be complete. This section contains HDOS support instructions. Nothing needs to be modified in HDOS code proper. Included on the HDOS disk are several utility programs that allow you to run HDOS at 2 MHz or 4 MHz.

DESCRIPTION OF SUPPLIED HDOS FILES

If you ordered HDOS software for your DSM-240, one diskette was included that contains several files needed to operate your system at 2 or 4 MHz. The explanation of each file is as follows:

SETCLK17.ABS: The program to allow you to toggle your computer's speed between 2 MHz and 4 MHz. This program is designed to be used IF YOU HAVE THE H17 or H77 DRIVE types or any other cards that require 2 MHz on the bus regardless of processor speed. It leaves 2 MHz on the bus (as required by the H88-1 5 1/4 inch 10 hard sector controller) whether the CPU is running at 2 MHz or 4 MHz.

SETCLK.ABS: Another program to toggle your computer's speed between 2 MHz and 4 MHz. Use this program if you do NOT have the H17 or H77 drive types or any other cards that require 2 MHz on the bus regardless of processor speed. This toggles the bus speed along with the processor speed. Thus, when your computer is running at 4 MHz, every card on the bus also receives 4 MHz.

SETCLK17.ASM: The assembly language listing for SETCLK17.ABS above. When assembled it will give SETCLK17.ABS. Type this .ASM listing to note which .ACM files are required as XTEXT's - there are several. This file is included for any customization you wish to do. NOTE THAT THE ONLY VERSIONS OF SETCLK SUPPORTED BY KRES ARE THE ONES PROVIDED. IF YOU ALTER OUR PROGRAM YOU ARE ON YOUR OWN.

SETCLK.ASM: The assembly language listing for SETCLK.ABS. See SETCLK17.ASM above for additional comments.

PROLH17.SYS: This is a prologue program to automatically toggle a system containing an H17 to 4 MHz after the system has booted. To use this feature, rename this program PROLOGUE.SYS on your bootable disk, and it will be automatically run each time you boot. After your system has settled and you receive the HDOS prompt (>) the CPU speed will be 4 MHz.

PROL.SYS: This is a prologue program to automatically toggle a NON H17 system to 4 MHz after the system has booted. Rename this program PROLOGUE.SYS on your bootable disk, and it will be automatically run each time you boot. The program operates similar to PROLH17.SYS, except the SYSTEM speed, both CPU and bus will be at 4 MHz.

PROL2MHZ.SYS: This is a prologue program to automatically toggle ANY system back to 2 MHz on boot. Such a program might be useful if the hardware jumpers have been set to 4 MHz (see the "Jumper Option" section on page 47) but certain disks have software that requires 2 MHz.

PROLH17.ASM: The assembly language source to PROLH17.SYS for inclusion in your own PROLOGUE.SYS program that needs to do more than just toggle speed. NOTE THAT YOU ARE ON YOUR OWN WHEN WRITING YOUR OWN PROLOGUE PROGRAM. THIS SECTION OF CODE IS INCLUDED FOR YOUR CONVENIENCE ONLY.

PROL.ASM: The assembly language source to PROL.SYS.

PROL2MHZ.ASM: The assembly language source to PROL2MHZ.SYS.

TEST17.ABS: This is a patched version of the TEST17 program furnished with your original HDOS system disks from Heath/Zenith. Constants have been patched to allow operation at 4 MHz.

GBYE.ABS: A temporary program to toggle the system back to 2 MHz. when you wish to issue the BYE command. Once the system is at 2 MHz, it will dismount all disks and prompt for carriage return to reboot, just as if you had typed BYE

GBYE.ASM: Assembly language source to GBYE.ABS.

H17.DVD: The Heath/Zenith H17 device driver suitably modified to allow operation at 4 MHz. This device driver will allow you run your system at 4 MHz AFTER you boot. You still must boot at 2 MHz, then toggle to 4 MHz via one of the prologue programs, or one of the setclk programs.

H47.DVD: The Heath/Zenith H47 device driver suitably modified to allow operation at 4 MHz. This allows both booting and operation at 4 MHz.

MEMTEST.ABS: A memory test program that will allow you to check system RAM at both 2 MHz and 4 MHz.

REVISION.DOC: This file outlines the changes made in the HDOS software since the original release. It is included for those receiving this disk as an update whose manual lists different files on the disk. Your manual is accurate through HDOS Rev 20-Dec-83.

ACTUAL SOFTWARE INSTALLATION

The SETCLK programs modify software timing constants in RAM required by the 5 1/4 inch 10 hard sector disk drives, as well as toggle speed. Consequently patches to your system are automatically performed every time you run SETCLK. Unfortunately, HDOS will occasionally go back and reinitialize the patched constants to their original value so certain precautions must be taken. The following sections explain the precautions you must take, and outline which of the supplied programs to use. If you are using disk device drivers from manufacturers other than Heath/Zenith, consult the section on "HDOS Drivers from Other Manufacturers" on page 42.

() If you are running HDOS version 2.0 and have the H17/H77 5 1/4 inch 10 hard sector drives on line, replace your current Heath/Zenith device driver for the H17/H77 5 1/4 inch 10 hard sector drives with the H17.DVD included on the disk. This device driver will allow you to run at 4 MHz, but not boot at 4 MHz. If you want to boot at 4 MHz, you must purchase a device driver that was originally written to run at 4 MHz, such as the Ultimeth device driver (see section II).

() If you are running HDOS version 2.0 and have the H47 Heath/Zenith eight inch drives on line, replace your current H47 device driver with the H47.DVD file on the disk.

() Consult the table below to determine which sections of the installation guide to follow for your computer configuration.

VERSION	H17 ON LINE	BOOT FROM H17	H17 DRIVER	SECTION TO USE
2.0	YES	YES	HEATH/ZENITH	I.1
2.0	YES	NO	HEATH/ZENITH	I.2
2.0	YES	YES/NO	ULTIMETH	II.*
2.0	YES	YES/NO	OTHER	I/II
2.0	NO	--	--	III.
1.X	YES	YES	--	I.1

* See the section on device drivers from other manufacturers on page 42, and the documentation that came with your device driver, to see if was written to run at 4 MHz or not. Follow section I if it was not, or section II if it was written to run at 4 MHz.

SECTION I

Follow these instructions if you use the 5 1/4 inch hard sector drives H17/H77 either alone or in conjunction with another drive type AND the device driver you use for the H17/H77 is the standard Heath device driver or any other driver that was not designed to run at 4 MHz.

1.) IF YOU BOOT FROM THE H77 (H17) DISK DRIVES (with or without other drive types on line), PIP the following files to your system disk:

- () SETCLK17.ABS
- () GBYE.ABS

You will use the SETCLK17 program to toggle between 2 MHz and 4 MHz. Use of this program is explained in the section on using the SETCLK programs. All other operation under HDOS remains unaltered. The only restriction is that when you BYE, then reBOOT, you MUST be at 2MHz, since the patched 4 MHz constants for the H17 will be written over. When you are running your system at 4 MHz, DO ONE OF THE FOLLOWING:

A. Issue the BYE command, then reset your system using SHIFT/RESET IF the jumpers on the DSM-240 are set to 2 MHz (see "Jumper Option" section on page 47). You may DELETE GBYE.ABS if you choose to use this method.

OR

B. Use SETCLK17 to toggle the system to 2 MHz before issuing the BYE command.

OR

C. Use GBYE furnished on the disk to perform both of the steps in (2) above from one command.

NOTE: It will not hurt to always use the GBYE program, whether at 2 or 4 MHz, it is just not necessary.

2.) IF YOU BOOT FROM SOME OTHER DRIVE THAN THE H77 (H17), PIP the following files to your system disk:

() SETCLK17.ABS

You will use the SETCLK17 program to toggle between 2 MHz and 4 MHz. Use of this program is explained in the section on using the SETCLK programs.

SECTION II

Follow these instructions if you use the 5 1/4 inch hard sector drives (H17 or H77) either alone or in conjunction with another drive type AND the device driver you use for the H17/77 is one that is meant to operate at 2 MHz or 4 MHz, such as the Ultimeth driver. It does NOT matter which drive you boot from. Operation with a device driver supporting 2 or 4 MHz makes life much easier:

() PIP SETCLK17.ABS onto your system disk

You will use the SETCLK17 program to toggle between 2 MHz and 4 MHz. Use of the program is explained in the section on using the SETCLK programs on page 45.

SECTION III

Follow these instructions if you DO NOT use the 5 1/4 inch hard sector drives (H17 or H77) at all, either as the boot device, or any of the disks that you mount after booting:

() PIP SETCLK.ABS onto your system disk

You will use the SETCLK program to toggle between 2 MHz and 4 MHz. Use of the program is explained in the section on using the SETCLK programs on page 45.

RUNNING SETCLK AUTOMATICALLY AT BOOT (USING A PROLOGUE.SYS PROGRAM)

You will probably want your system to run at 4 MHz most of the time, and just toggle down to 2 MHz when it is absolutely necessary. There are two ways to get your system to 4 MHz from the beginning of your computing session, right after booting:

1. Set the default jumpers so that your system will reset at 4 MHz. This is detailed in the "Jumper Options" section on page 47, with some possible limitations outlined in the next section "Monitor ROM Considerations" on page 49.

2. Install a program to automatically toggle the speed to 4 MHz after booting.

Any program named PROLOGUE.SYS on the disk you boot from will be run just after booting is completed. On the HDOS software disk, there are three programs, any one of which can be renamed PROLOGUE.SYS and PIPed to the disk(s) you boot.

A. If you use the H17/H77 disk drives, and want to automatically switch to 4 MHz immediately after you boot:

() PIP PROLH17.SYS to your bootable disk
() RENAME PROLH17.SYS as PROLOGUE.SYS

B. If you do NOT use the H17/H77 disk drives, and want to automatically switch to 4 MHz immediately after you boot:

() PIP PROL.SYS to your bootable disk
() RENAME PROL.SYS as PROLOGUE.SYS

C. If you have the jumper options set for 4 MHz, and want certain disks to automatically switch to 2 MHz immediately after you boot:

() PIP PROL2MHZ.SYS to your bootable disk
() RENAME PROL2MHZ.SYS as PROLOGUE.SYS

Any of these PROLOGUE.SYS programs will be automatically run after you boot your system. Should you already have a PROLOGUE.SYS program installed on your system, the .ASM source code for the three programs is included on disk and can be integrated into your existing code.

SOFTWARE CONFIGURATION FOR OTHER MANUFACTURERS

Several other manufacturers have their own version of CP/M, a CP/M BIOS, or HDOS device driver available for the Heath/Zenith computer. Some of those systems are listed below, along with what you must do to operate at 4 MHz. In some cases, their software was never designed to operate at 4 MHz, and as a result they do not support operation in a 4 MHz system.

CP/M FROM OTHER MANUFACTURERS**CDR SYSTEMS INC**

Current versions of the CDR supplied BIOS 2.7C and above will work at 2 MHz or 4 MHz, and support switching of speeds after booting. If you have an earlier version of the CDR BIOS, (versions prior to 2.7C), contact CDR directly to obtain an update for a nominal charge.

Your CDR supplied monitor ROM will probably work at 4 MHz, should you decide to change the jumper on the DSM-240 to default to 4 MHz. You may not be able to boot the 5 1/4 inch 10 hard sector disk drives at 4 MHz. Again, should you have difficulties, contact CDR directly to obtain an update for a nominal charge. Or, the KRES monitor ROM KMR-100 is available as an extra cost option and includes code that supports the DSM-240 and EXP-700 seven slot expansion.

Use SETCLK.COM from the software disk supplied; this allows the bus clock speed to follow the processor speed. (You can use SETCLK17.COM, if you have any other cards on line that require 2 MHz on the bus - the CDR card has its own crystal on board to furnish the required clock and does not care about the bus clock speed.)

DO NOT install the BIOS versions included on the diskette; these are for the Heath/Zenith CP/M only.

LIVINGSTON LOGIC LABS BIOS-80

Current versions of BIOS-80 work at 2 MHz or 4 MHz, and support switching of speeds after booting. Earlier versions will either support operation at 2 MHz or 4 MHz without switching, or not run at 4 MHz at all:

Versions before 82.16.05 will NOT run at 4 MHz

Early copies of 82.16.05 before January 1983 will run at 2 or 4 MHz, but cannot be toggled between speeds after you boot.

Current copies of 82.16.05 since January 1983 will not only run at 2 MHz or 4 MHz, but also allow you to toggle after you boot. Read the documentation file ON THE DISK to see if you can toggle speeds; this feature will be mentioned in that file. If this ability is not explicitly mentioned, or the documentation file is completely absent, then you CANNOT toggle speeds once you have booted, since timing constants are calculated from the speed of the CPU at boot time. Contact Livingston Logic Labs directly for updates at a nominal charge.

Use SETCLK17.COM from the software disk supplied if you have an H88-1 5 1/4 inch 10 hard sector controller board in your system, since this board requires 2 MHz on the bus, otherwise use SETCLK.COM.

If you wish to boot your system directly at 4 MHz, you must have a Monitor ROM that supports operation at 4 MHz, with your drive type such as the KRES KMR-100. Consult page 49 for information on monitor ROMs.

DO NOT install the BIOS versions included on the diskette, these are for the Heath/Zenith CP/M only.

LIVINGSTON LOGIC LABS CDR BIOS

The BIOS from Livingston Logic Labs for the CDR controller card will operate properly at either 2 or 4 MHz, and you may switch speeds once you boot. Use SETCLK.COM from the software disk supplied. (You can use SETCLK17.COM if you need, see comments under the CDR SYSTEMS section). The BIOS versions on the diskette should NOT be used, since these are for Heath/Zenith BIOS only.

LIVINGSTON LOGIC LABS CONTROLLER CARD

The software supplied with the controller card for the Livingston Logic Labs eight inch controller card will run at 2 MHz or 4 MHz, but once you boot you MUST access the H17/H77 disks at the boot speed, since the CPU speed is measured at BOOT time, and software timing constants are adjusted accordingly. Use SETCLK.COM on the supplied disk to change speeds if you access only the eight inch drives. The KMR-100 monitor ROM from KRES can boot the LLL controller, has commands to set speed from the monitor before you boot, will run at 4 MHz. The BIOS versions on the diskette should NOT be used, since these are for Heath/Zenith BIOS only.

MAGNOLIA MICROSYSTEMS CP/M

Magnolia Microsystems does NOT support operation of their products (except the networking card) at 4 MHz. The KRES documentation supplied in this section together with some optional extra-cost patches, if necessary, should allow your Magnolia CP/M system to operate at 4 MHz.

If you have the hard disk controller card together with the Magnolia CP/M, and no floppy disk you wish to use at four MHz, you need make no modifications to your system to run at 4 MHz and toggle processor speeds between 2 and 4 MHz. Just copy the SETCLK.COM program to your disk using PIP and you can toggle between 2 MHz and 4 MHz.

If you have the Magnolia double density controller card with the Magnolia CP/M, and eight inch drives, you must purchase patches for your system to allow it to run at 4 MHz. With these patches, you can create disks that are bootable and will run at 2 or 4 MHz. No provisions are made to software toggle the speed if you are using eight inch DSDD* drives, this must be selected from the monitor ROM before booting begins. Your present disks will still be bootable at 2 MHz and usable with the DSM-240 should you encounter some software that requires operation at 2 MHz. The monitor ROM supplied by Magnolia does NOT support booting some of your drives at 4 MHz. You must purchase a ROM that supports booting drives on the Magnolia controller card at 4 MHz and is fast enough to run at 4 MHz. The KRES KMR-100 is one such ROM available through KRES Engineering. This ROM supports commands that allow you to toggle the speed of your system from the monitor.

DO NOT install the BIOS versions on the software disk included with your Dual Speed Module. They are for the Heath/Zenith CP/M only. Also, the SETCLK program will work on your system if you are using only 5 1/4 inch drives.

* Double Sided, Double Density

HDOS DRIVERS FROM OTHER MANUFACTURERS**D-G ADVANCED H17/H77 DRIVER**

The D-G driver for the H17/H77 driver will operate at 2 or 4 MHz, but you CANNOT switch speeds after you boot. The optional KMR-100 monitor ROM from KRES allows you to easily select processor speed before you BOOT, thus you may still run your system at 2 or 4 MHz and use the software speed switch at the proper time.

LIVINGSTON LOGIC LABS CDR.DVD

The Livingston Logic Labs HDOS support for the CDR controller card will operate at either 2 MHz or 4 MHz, and you may switch speeds after you boot. You may use SETCLK.COM with the CDR controller alone, or SETCLK17.COM if you also have the H88-1 controller present.

ULTIMETH CORP DKH17V3.DVD

This Ultimeth Corporation device driver for the H17 drives will operate at either 2 or 4 MHz, and allow you to toggle speeds after you boot. The driver incorporates many advanced features, including the ability to use 80 track drives, and dual sided drives. The driver operates more efficiently than the original H17 device driver from Heath/Zenith. This device driver is available from KRES Engineering for an additional charge.

ULTIMETH CORP MAGNOLIA HDOS DRIVER

This device driver for the Magnolia disk controller card can operate at either 2 MHz or 4 MHz but you cannot toggle speeds once you have booted. The optional KMR-100 monitor ROM from KRES will allow you to toggle speed easily before you boot, and boot the Magnolia controller at 2 MHz or 4 MHz.

USING THE MODULE UNDER CP/M

There are two different ways to set the speed of your computer. The first of these is via a program called SETCLK. The other is through the use of hardware "default jumpers".

USING SETCLK

There are two separate programs supplied to allow the system to switch between 2 and 4 MHz. These are called SETCLK and SETCLK17. If you have an H-17 5 1/4 inch controller card then you will use SETCLK17. If not then use SETCLK.

Example:

() Boot up your system. If you are using CP/M then use a copy of your newly configured system.

() Make sure you have the appropriate toggle program (SETCLK.COM or SETCLK17.COM) on your properly modified system disk. (See CP/M software installation section of this manual). Use PIP to copy it over. For this example it will be assumed that SETCLK is the required program. Use SETCLK17.COM in the same manner.

CAUTION: SETCLK and SETCLK17 are not identical programs and can NOT be interchanged.

NOTE: If you are using SETCLK17 the program will respond with "CPU Speed is ...". If you are using SETCLK the response will be "SYSTEM Speed is ...".

() Now type "SETCLK 4 <cr>". The system will respond with:

```
SETCLK - Version 1.XX
```

```
CPU speed is now 4 MHz.
```

() Your computer is now running at 4 MHz.

() Now type "SETCLK 2 <cr>". The system will tell you that you are now operating at 2 MHz.

NOTE: Any response other the 2 or 4 will cause the program to ask you what speed you want to change to.

() Now type "SETCLK <cr>". The system will respond by typing:

```
Present CPU speed is 2 MHz. Do you wish to change to 4 MHz (Y/N)? <Y>
```

() Now type <cr> or "Y". The system will respond with:

CPU speed is now 4 MHz.

If a "N" had been entered, no speed change would have occurred. Any other responses will be ignored.

() Experiment with the SETCLK program by trying all the different combinations, including some illegal responses and speeds.

From this point on you now have complete software control of your computer's speed. You can now freely change between 2 and 4 MHz.

The second way to control the speed of your system is via the hardware "Default Jumpers". The use of these jumpers is covered in the section on USING THE DEFAULT JUMPERS.

USING THE MODULE UNDER HDOS

There are two different ways to set the speed of your computer. The first of these is via a program called SETCLK. The other is through the use of hardware "default jumpers".

USING SETCLK

There are two separate programs supplied to allow the system to switch between 2 and 4 MHz. These are called SETCLK and SETCLK17. If you have an H-17 5 1/4 inch controller card then you will use SETCLK17. If not then use SETCLK.

Example:

() Boot up your system.

() Make sure you have the appropriate toggle program (SETCLK.ABS or SETCLK17.ABS) on your system disk. If you do not use PIP to copy it over. For this example it will be assumed that SETCLK is the required program. Use SETCLK17.ABS in the same manner.

CAUTION: SETCLK and SETCLK17 are not identical programs and can NOT be interchanged.

NOTE: If you are using SETCLK17 the program will respond with "CPU Speed is...". If you are using SETCLK the response will be "SYSTEM Speed is ..." .

() Now type "SETCLK 4 <cr>". The system will respond with.

```
SETCLK - Version 1.XX
```

```
CPU speed is now 4 MHz.
```

() Your system is now running at 4 MHz.

() Now type "SETCLK 2 <cr>". The system will tell you that you are now operating at 2 MHz.

Note that any response other the 2 or 4 will cause the program to ask you what speed you want to change to.

() Now type "SETCLK <cr>". The system will respond by typing

```
Present CPU speed is 2 MHz. Do you wish to change to 4 MHz (Y/N)? <Y>
```

() Now type <cr> or "Y". The system will respond with:

CPU speed is now 4 MHz.

If a "N" had been entered, no speed change would have occurred. Any other responses will be ignored.

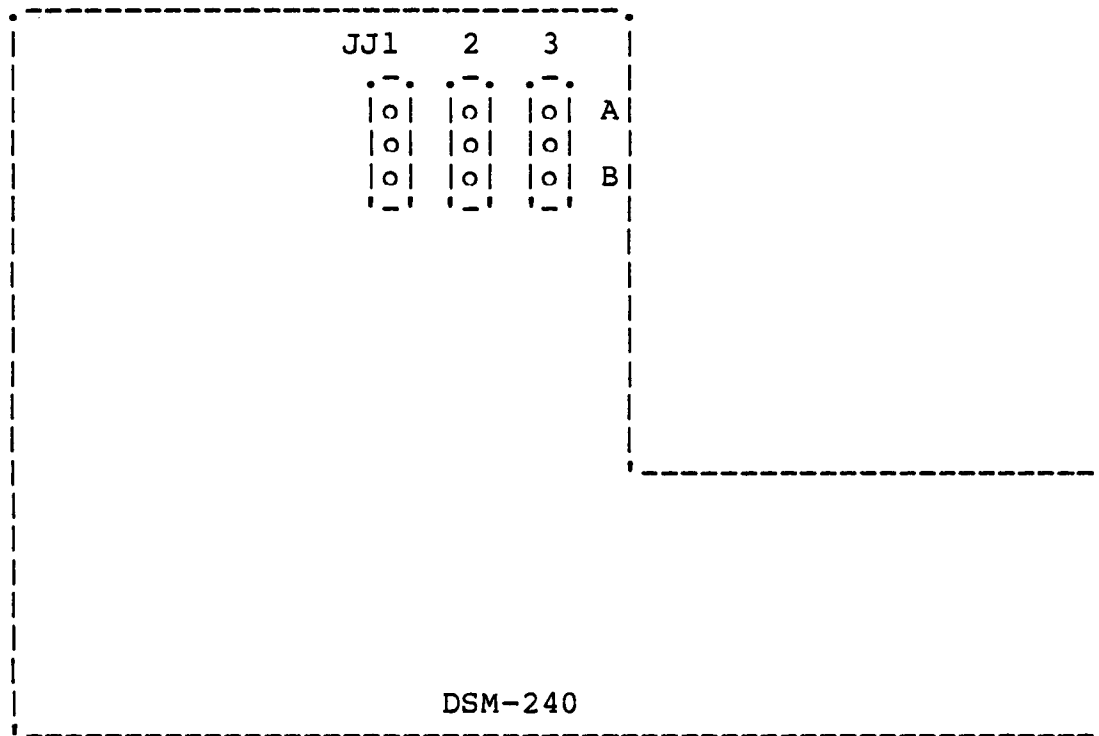
() Experiment with the SETCLK program by trying all the different combinations; including some illegal responses and speeds.

From this point on you now have complete software control of your computer's speed. You can now freely change between 2 and 4 MHz.

The second way to control the speed of your system is via the hardware "default jumpers". The use of these jumpers is covered in the next section.

JUMPER OPTIONS

There are three jumper plugs located along the top edge of the Dual Speed Module. See Pictorial 9 below. One of these is labeled JJ1 and controls the number of wait states inserted during I/O operations. The other two are labeled JJ2 and JJ3. They control Bus speed and CPU speed respectively at power up and reset. Unlike wait states, these speed functions can be altered under software control



PICTORIAL 9

WAIT STATE JUMPER (JJ1)

Sometimes even though the computer's memory can operate at 4 MHz some I/O cards cannot. Thus it may be necessary to extend the time the computer allows for these cards to respond. This is accomplished by adding wait states to the I/O instructions.

Jumper (JJ1) allows you to insert either zero or two wait states during each I/O operation. In the "B" (down) position no wait states are inserted. In the "A" (up) position two wait states are inserted during each I/O operation.

NOTES:

A) These wait states are only inserted during I/O operations; not memory cycles.

B) Most systems will require NO wait states and therefore this jumper is normally left in the "B" position.

BUS SPEED JUMPER (JJ2)

Normally the computer's bus will run at the same speed as the CPU, but in the H/Z 89-90 some cards require 2 MHz on the bus at all times. The Dual Speed Module allows you to independently control the clock speed seen by your I/O cards. This is invaluable for cards such as the H/Z - 17 5 1/4 inch hard sector floppy disk controller.

Thus the bus speed jumper (JJ2) allows you to reset the speed of your computer's bus to either 2 MHz or to the processor speed. When in the "B" (down) position the bus will run at 2 MHz. When in the "A" (up) position the bus will run at the CPU speed. The bus will default to the speed selected every time the computer is turned on or the computer is reset. This selected (default) speed can later be changed using the supplied SETCLK program.

NOTES: A) The SETCLK17 program always sets the bus to 2 MHz. B) The normal setting for this jumper is dependent upon the right hand cards you have in your system:

1. If you use the H17 controller card (H88-1), the jumper should be in the "B" (down) position.
2. If you do not use the H17 controller card, the jumper should be in the "A" (up) position.

PROCESSOR SPEED JUMPER (JJ3)

This jumper allows you to reset the speed of your CPU to either 2 or 4 MHz. When in the "B" (down) position the CPU will run at 2 MHz. When in the "A" (up) position the CPU will run at 4MHz. The CPU will default to the speed selected every time the computer is turned on or the computer is reset. This selected (default) speed can later be changed using the supplied SETCLK program. NOTE: This jumper is normally left in the "B" position and switching to 4 MHz is done by SETCLK after booting. This assures operation will all monitor ROMS.

Refer to the CONFIGURATION GUIDE in Appendix A of this manual for more details on jumper settings and software selection for your system.

MONITOR ROM CONSIDERATIONS

The owners of most systems with 4 MHz upgrades would like to set them to 4 MHz and leave them there. Very seldom does the need arise to switch back down to 2 MHz. You have two options if you want to have your system always at 4 MHz after booting.

1. Let the hardware always come up at 2 MHz whenever you turn power on to your system or hit shift/reset. Then automatically run a program that toggles the system to 4 MHz. This is done via a cold boot autorun CONFIGUR option in CP/M or a PROLOGUE.SYS file in HDOS.

2. Let the hardware always come up at 4 MHz whenever you turn power on to your system or hit shift/reset. Then you are instantly ready to run at twice the speed, with no cold boot programs or PROLOGUE.SYS.

The DSM-240 has provisions to allow you to power-up your system at 4 MHz and just leave it there. You can still always override these settings and toggle down to 2 MHz and back up to 4 MHz from the operating system using SETCLK. But next time you hit shift/reset or power your system back down, then back up again, you'll be at 4 MHz. Consult the default Jumper Options" section for details on hardware configuration of the DSM-240 to 4 MHz.

There is one possible hardware limitation of your machine which may prevent you from doing this - your Monitor ROM. This ROM must fulfill two requirements.

1. The part must be electrically fast enough to be accessed at 4 MHz.
2. The Monitor ROM must contain code to boot the drives you require at 4 MHz.

HEATH/ZENITH MTR-88, MTR-89, MTR-90

In general, these parts are NOT fast enough to run at 4 MHz. The default CPU speed jumper is easy to move; try changing it (see page 40 for settings) and see if the monitor and all of its features still work. Note: even though your ROM may appear to work, it still may not be reliable if the actual part is not rated to work at 4 MHz. We still recommend that you be sure the part is RATED to run at 4 MHz (has an access time of 250ns or less). The code in the ROM will boot the H37, H47, and H67 drive types at 4 MHz. It will NOT boot the H17 5 1/4 inch, 10 hard sector drives at 4 MHz.

CDR SYSTEMS MONITOR ROM

This monitor ROM is furnished with the floppy disk controller sold by CDR systems. Most of these parts will run at 4 MHz and are rated at 4 MHz. Code in ROM's delivered since summer of 1983 will boot at 4 MHz all drive types supported including the H17 5 1/4 inch 10 hard sector drives. ROM's delivered before this date will operate at 4 MHz except they will NOT boot the H17 5 1/4 inch 10 hard sector drives. For a nominal update charge, owners of the older ROM may exchange the part for the newer version. Consult the Appendix for the address and phone number for CDR systems

KRES ENGINEERING KMR-100

This monitor ROM is sold only as a 4 MHz part. It is the Ultimeth Corporation ROM which includes boot code for all of the drives at 2 or 4 MHz. But it also includes some special new commands to toggle the CPU speed directly from the ROM, and support the KRES I/O expansion. The ROM is available directly from KRES only to owners of the DSM-240 or the EXP-700. Request more detailed information directly from KRES Engineering.

MAGNOLIA MICROSYSTEMS

The monitor ROM furnished with Magnolia products does not, in general, support operation at 4 MHz. Unless you are using only a hard disk drive and no floppy disk drives, and the part is fast enough, you will probably have to replace the ROM with one from another vendor.

ULTIMETH CORPORATION

The Ultimeth ROM is available as a 2 MHz part or a 4 MHz part. The 4 MHz part supports booting most popular drive types at 2 or 4 MHz. More detailed information is available from the Ultimeth Corporation. (The KRES KMR-100 is one version of the ULTIMETH ROM with added code for the KRES products).

APPENDIX A JUMPER OPTION CONFIGURATION GUIDE

The table below outlines the uses for the three hardware jumpers on the DSM-240 module. "A" and "B" represent the two positions for each jumper as labeled on the module. For a detailed description of each jumper's function see the section on JUMPER OPTIONS in the OPERATOR'S GUIDE.

JUMPERS

JJ1 (Wait State Jumper)

A: If system has trouble performing any I/O operation. (Inserts 2 wait states)

B: Normal Setting (NO wait states).

JJ2 (Bus Speed Jumper)

A: If system has no H-17 5 1/4 inch hard sector controller.

B: If system contains an H-17 controller (or any other card requiring 2 MHz on the bus).

JJ3 (Processor Speed Jumper)

A: Use with KRES monitor ROM or with any similar ROM supporting operation at 4 MHz.

B: Use with MTR 88, 89, 90, Magnolia Microsystems or any monitor ROM that does not support operation at 4 MHz.

SOFTWARE SELECTION GUIDE

SETCLK17

If system has the H-17 5 1/4 inch hard sector controller card or any card requiring 2 MHz on the system bus.

SETCLK

If you do not have any of the cards mentioned above.

APPENDIX B MINIMUM SYSTEM REQUIREMENTS

In order to insure proper operation of the DSM-240 (Dual Speed Module) it is necessary that the computer system meet the minimum requirements listed below.

1) All main system RAM (Random Access Memory) IC's must have a rated speed of at least 250 nanoseconds. These are the IC's located in the center of the CPU board in sockets labeled U526 thru U549. If you have a 64K system, then you will have 9 more of these chips located on a small board plugged into one of the left hand connectors. If you own a KRES Expansion then these IC's will be located across the bottom of the expansion board. If your memory IC's do not meet the minimum specifications then they should be replaced with faster ones. Refer to the table at the end of this section to see if your memory needs to be replaced.

If you need to replace your system memory, faster chips are available from KRES Engineering in 16K blocks (8 chips). Order part number RCS-160. A full 64K system requires four 8 chip sets. They may also be purchased from your local HEATH/ZENITH dealer in blocks of 16K (8 chips). These sets are HEATH/ZENITH part number H-88-3. NOTE: Be sure that the chips purchased from your dealer are designed for operation at 4 MHz.

2) The system must contain at least 32 of RAM (Random Access Memory). This is the minimum memory size allowed for operation with the operating systems. NOTE: If you are not running either CP/M or HDOS then these requirements may be different.

APPENDIX C
MEMORY IC SELECTION GUIDE

FUJITSU

Part Number	Speed	Acceptable
MB8116E	200 ns	YES
MB8116H	150 ns	YES

HITACHI

Part Number	Speed	Acceptable
HM4716-4	250 ns	Marginal
HM4716-3	200 ns	YES
HM4716-2	150 ns	YES
HM4716-1	120 ns	YES

MOSTEK

Part Number	Speed	Acceptable
MK 4116-3	200 ns	YES
MK 4116-2	150 ns	YES

NATIONAL SEMICONDUCTOR

Part Number	Speed	Acceptable
MM5290-4	250 ns	Marginal
MM5290-3	200 ns	YES
MM5290-2	150 ns	YES

NEC

Part Number	Speed	Acceptable
uPD416	300 ns	NO
uPD416-1	250 ns	Marginal
uPD416-2	200 ns	YES
uPD416-3	150 ns	YES
uPD416-5	120 ns	YES

TEXAS INSTRUMENTS

Part Number	Speed	Acceptable
TMS 4116-25	250 ns	Marginal
TMS 4116-20	200 ns	YES
TMS 4116-15	150 ns	YES

APPENDIX D LIMITATIONS OF THE DUAL SPEED MODULE

The Dual Speed Module doubles the clock speed of your computer's microprocessor from 2 MHz to 4 MHz. This means that the computer will process twice as many instructions in a given time as it did before the module was installed. This means it will take one half as long to perform a given calculation task. This does not mean that everything will take half as long; i.e. running at 4 MHz will not effect the time required to load file from disk. Disk operations in the H/Z 89-90 computers are not a function of how fast the processor is running, but are limited by thge rotational speed of the drive itself.

In short, operation at 4MHz will not appreciably change the time required for any I/O operation for these are limitations of the computer hardware in general and not the processor's clock speed. Examples of these operations are:

- . Disk access operations
- . Modem communication
- . Terminal comunications
- . Generally any I/O operation

The original system was designed to operate at 2 MHz. Kres Engineering has exercised state of the art engineering practices to assure you of trouble free operation of your computer at 4 MHz. You will need to carefully read this manual to be sure you are using the proper software, and have set jumper options correctly. Despite all precautions taken, there still will be some hardware I/O and some software that absolutely WILL NOT operate at 4MHz. We suggest you toggle your system back down to 2 MHz when using hardware and software in which problems are encounterd.

**APPENDIX E
ADDRESSES OF SUPPORT VENDORS**

CDR SYSTEMS

CDR Systems Inc.
7210 Clairmont Mesa Blvd.
San Diego, CA 92111
(619) 560-1272

KRES ENGINEERING

Kres Engineering
Post Office Box 1268
LaCanada, CA 91011
(818) 957-6322

LIVINGSTON LOGIC LABS

Livingston Logic Labs
Post Office Box 5334
Pasadena, CA 91107
(818) 792-4763 Mon-Fri 5PM-8PM Pacific Time

MAGNOLIA MICROSYSTEMS

Magnolia Microsystems
4039 - 21st Avenue West
Seattle, Washington 98119
(206) 285-7266

APPENDIX F TECHNICAL SPECIFICATIONS

CPU

Processor Z 80A (4 MHz micro processor)
 Clock 2.048 MHz or 4.096 MHz derived from 16.384 MHz

CLOCK

Rise Time (tr) 15 ns (typ)
 Fall Time (tf) 15 ns (typ)
 Logic Low (Vilc) 0.3 Volts (typ)
 Logic High (Vihc) ... 4.7 Volts (typ)

HARDWARE

Sockets Zero profile gold plated
 Connectors gold plated
 Shunts gold plated

CONTROL PORT

Port 74 Hex
 Bit D2 Controls processor speed (L = 2 MHz, H = 4 MHz)
 Bit D3 Controls bus speed (L = 2 MHz, H = Processor
 Speed)

JUMPERS

JJ1 I/O wait states (A = 2, B = 0)
 JJ2 Bus speed (A = Proc., B = 2 MHz)
 JJ3 Processor speed (A = 4 MHz, B = 2 MHz)

CONTROL LOGIC

U1, U2 Custom logic ICs for synchronization
 of processor and bus speeds