Heathkit® Manual

for the

DOUBLE-DENSITY DISK CONTROLLER and Z-67 INTERFACE

Model WH-8-37 595-2859

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

-- Note to Readers --

This manual was scanned as I received it – several pages are missing from the numbered sequence and several "pictorial" pages are inserted throughout the manual in un-numbered form. The annotations and corrections are in Pat Swayne's handwriting – this may have been a pre-release manual that he was proofreading.

If you have a more complete manual that I might scan for the SEBHC archives, please let me know so that I can insert any missing information. In the meanwhile, this version seems to have most of the information needed to configure and install the 8-37 card.

Jack Rubin
jrubin@sebhc.org

April 27, 2004

INTRODUCTION

The WH-8-37 Double-Density Disk Controller and Z-67 Interface connects the following disk systems to your H-8 series Computer:

Z-67 Winchester Disk System with 9.76 Megabytes and 1.022 Megabytes (one Winchester disk and one 77-track, double-density 8" diskette).

It also connects one of the following to your Computer:

H-17 Floppy Disk System with up to 480 Kilobytes (up to three 40-track, single-side, double-density, soft-sectored H-17-1 disk drives; or three 80-track, double-sided, double-density, soft-sectored H-17-4 disk drives).

H-77/Z-87 Floppy Disk System with up to 320 Kilobytes (up to two 40-track, single-side, double-density, soft-sectored H-17-1 disk drives).

H/Z-37 Dual-Sided Disk System with up to 1.28 Megabytes (up to two 80-track, double-side, double-density, soft-sectored H-17-4 disk drives).

The WH-8-37 Double-Density Disk Controller and Z-67 Interface operates under the following Disk Operating Systems:

HDOS version 2.0 and later for use with the floppy disk controller portion only. Requires update HOS-5-UP. (Available on request at no cost to HDOS 2.0 owners. Contact Heath Customer Service.)

CP/M* version 2.2.03 and later for use with the Z-67 portion and the floppy disk controller portion.

*CP/M is a registered trademark of Digital Research, Inc.

SPECIFICATIONS

Note: The following specifications apply to the hardware only and not to software supported by Heath Company.

Floppy Disk System (Z-37)	
Drive Size	5-1/4"
Tracks	48 or 96 tracks per inch
Density	Single or double
Sides	Single or double
Number of drives	Four
Heath Type	H-17-1 or H-17-4
Controller	1797
Hard Disk Interface (Z-67)	
Controller Supported	Data Technology MRX 101D

HOST COMPUTER REQUIREMENTS

HARDWARE

To run your system with a WH-8-37 Double-Density Disk Controller and Z-67 Interface, your Model H-8 Computer must have a Model HA-8-6 CPU Z80 Circuit Board in place of the 8080 CPU board that was supplied with it.

To use a disk based operating system effectively, you will also need at least 48K bytes of RAM.

FIRMWARE

The following changes and additions must be made on your Model HA-8-6 Z80 CPU Circuit Board (See "Installation" for instructions):

1. Boot ROM (part number 444-70) moved from location U13 to location U19.

2. Boot ROM 2 (part number 444-140) installed at location U13 (supplied).

3. Eight-to-three line priority encoder (74LS148) removed from location U38 ~~(this is placed at location U49 of the WH-8-37 Circuit Board~~).

4. Jumper wire installed between hole 36 and pin 9 of U38.

5. Jumper installed between holes 24 and 26.

6. Jumper from hole 28 and hole 29 removed and one installed between holes 28 and 27.

DIP SWITCH SETTINGS

The CPU switch settings are detailed in the "HA-8-6 Configuration" section on Page 17.

COMPATIBILITY WITH OTHER INTERFACES

The WH-8-37 Double-Density Disk Controller and Z-67 Interface is compatible with the following interfaces (within the limits of the H-8 Computer system):

- H-8-2 Three-Port Parallel Interface.
- H-8-4 and WH-8-4 Four-Port RS-232C Serial Interfaces.
- H-8-5 and WH-8-5 9600 Baud Serial/1200 Baud Cassette Interfaces.
- WH-8-47 Z-47 Disk Interface.
- H-17 Floppy Disk System Controller Board.

INSTALLATION

UNPACKING

Check the parts you received against this Parts List. Any part that is packed in an individual envelope with a part number on it should not be removed from its envelope until it is called for in a step. Do not discard any packing materials until all parts are accounted for. PART 173-53 IS A 2-DISK PACK CONSISTING OF 890-156-1 HARD & 890-157-1 SOFT DISKS

HEATH Part No.	QTY.	DESCRIPTION
181-3774	1	Assembled circuit board
134-1241	1	Flat 16-conductor 14" cable assembly
134-1243	1	Flat 34-conductor 14" cable assembly
134-1244	1	Flat 40-conductor 14" cable assembly
134-1269	1	Flat 34-conductor cable assembly
173-53	1	Set of two 5-1/4" floppy diskettes
250-56	2	6-32 × 1/4" machine screw
331-6	1	Solder
344-167	1	4" wire
390-2333	1	Keytop label set
444-140	1	Boot ROM 2
462-1023	16	Keytop
490-111	1	IC puller
490-185	1	Desolder braid
	1	Manual (See Page 1 for part number)
	1	PAM-37 Operations Manual (See Page 1 for part numbers.)

NOTICE

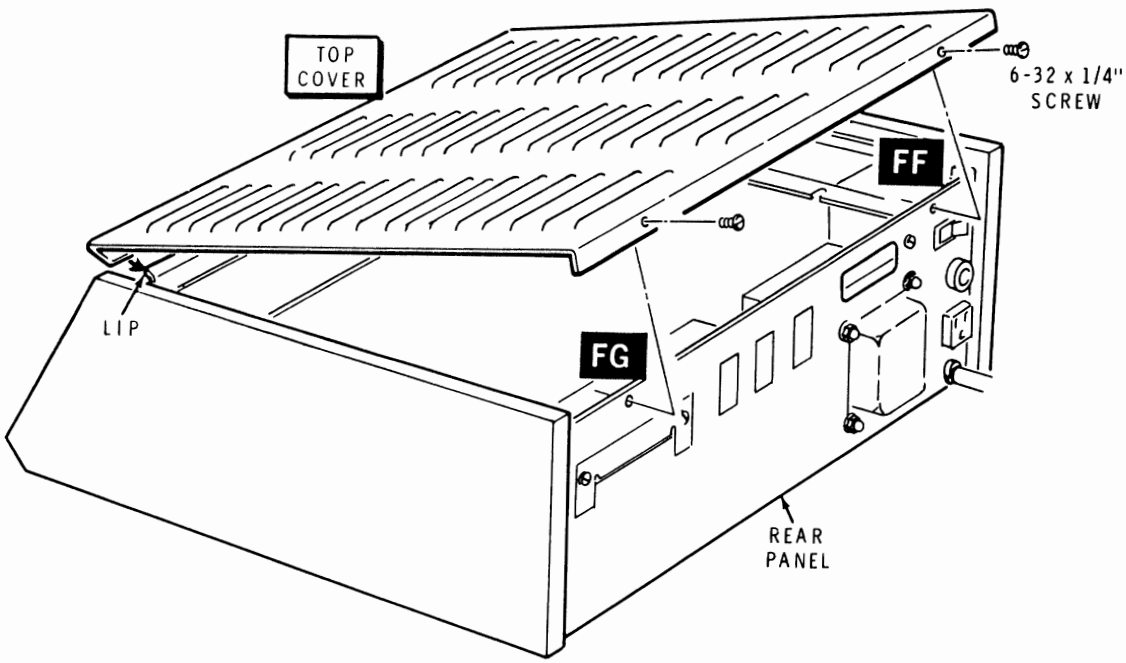
If the container in which this unit was shipped shows any evidence of rough handling, inspect the circuit board very carefully. Any shipping damage must be reported to the carrier at once.

DISASSEMBLY

NOTE: Do not discard any screws or hardware that you remove from your Computer. You will need them when you install the circuit boards and replace the top cover.

( ) Be sure your Computer is turned off.

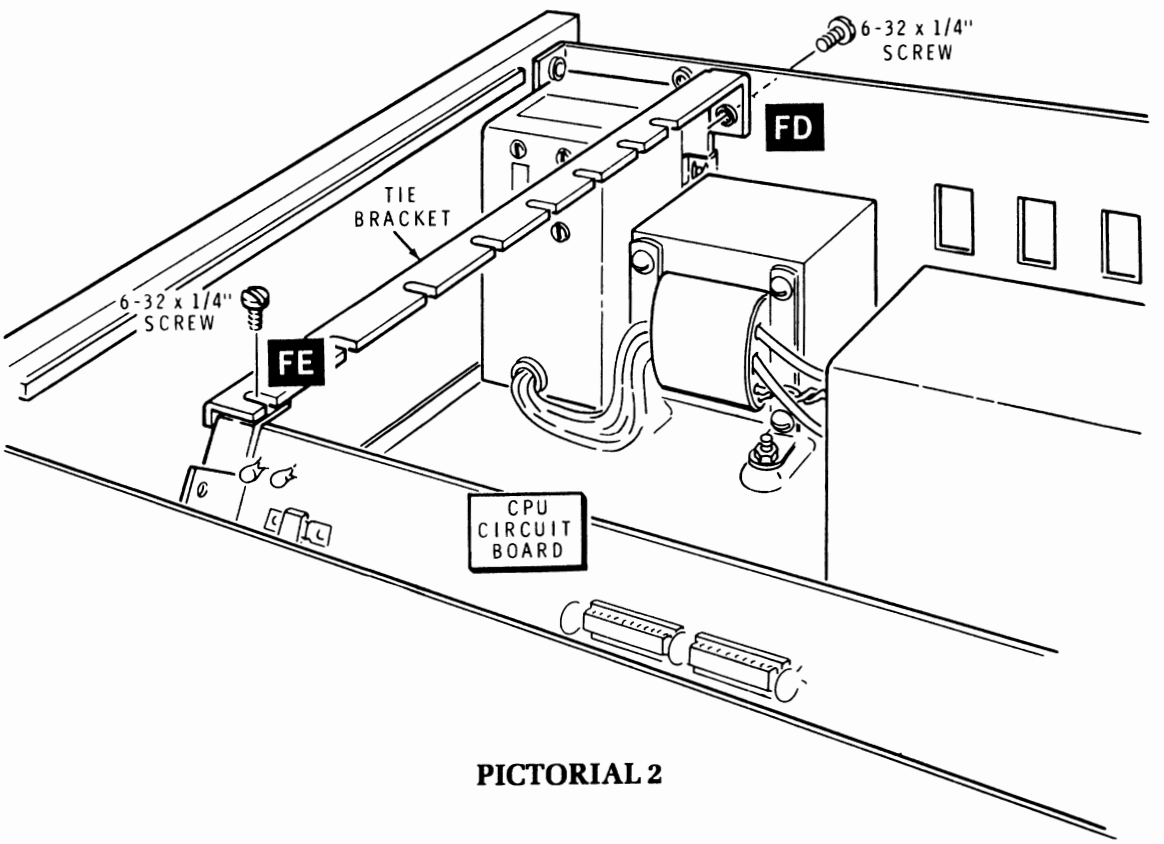
( ) Refer to Pictorial 1 and remove the two 6-32 × 1/4" screws at FF and FG that secure the top cover to the rear panel of the Computer. Then remove the top cover and set it aside.



PICTORIAL 1

( ) Refer to Pictorial 2 and loosen the screw at FE that holds the CPU board to the tie bracket. Then loosen any screws that hold other circuit boards to the tie bracket.

( ) Remove the screw at FD on the rear panel. Then remove the tie bracket and set it aside.



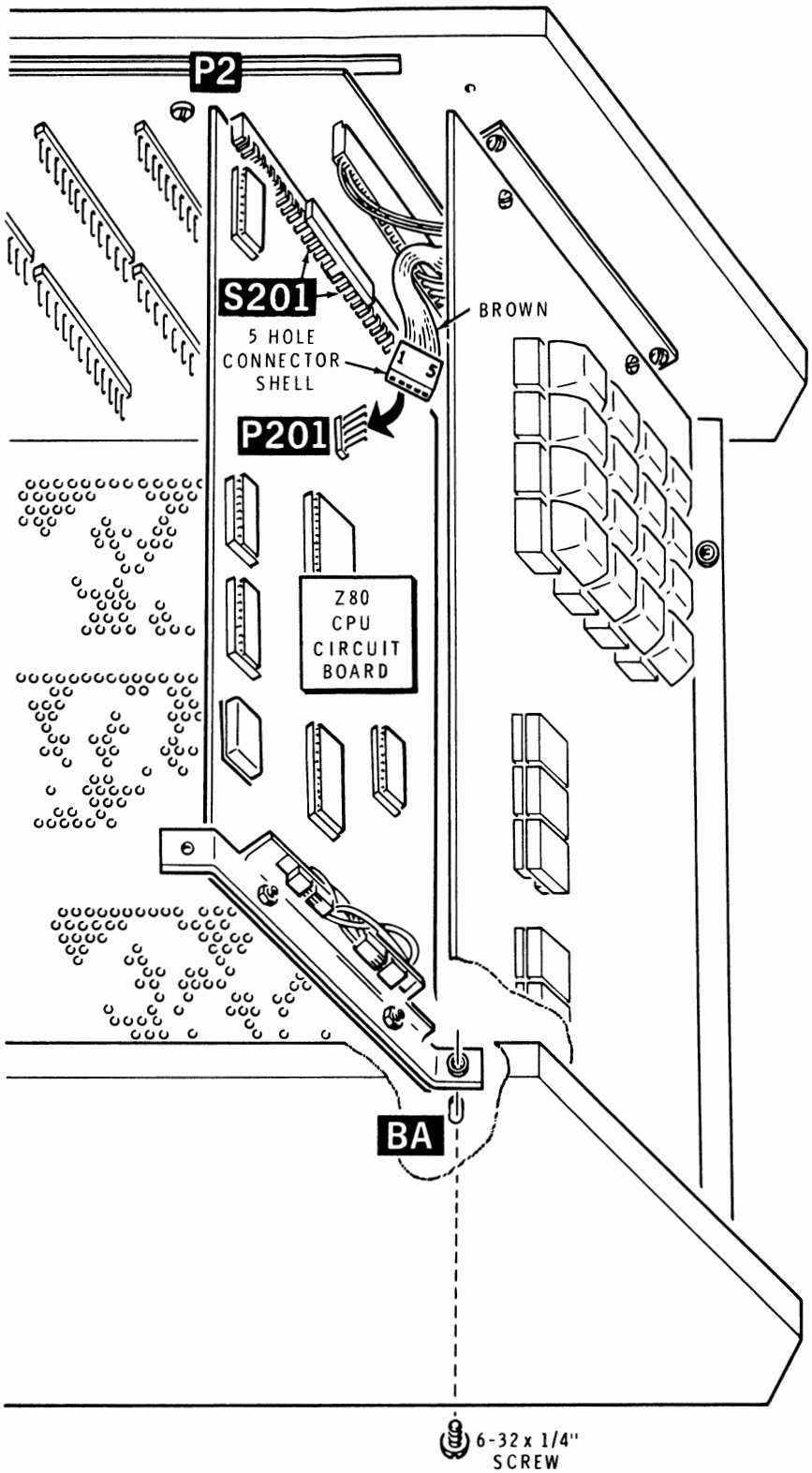
PICTORIAL 2

Refer to Pictorial 3 and perform the following steps.

( ) Remove the 6-32 × 1/4" screw at BA on the cabinet bottom.

( ) Carefully unplug the CPU board from the mother board.

( ) Remove the 5-hole connector shell from P201 on the CPU board. Then remove the CPU board and set the Computer aside.



PICTORIAL 3

Refer to Pictorial 4 and perform the following steps.

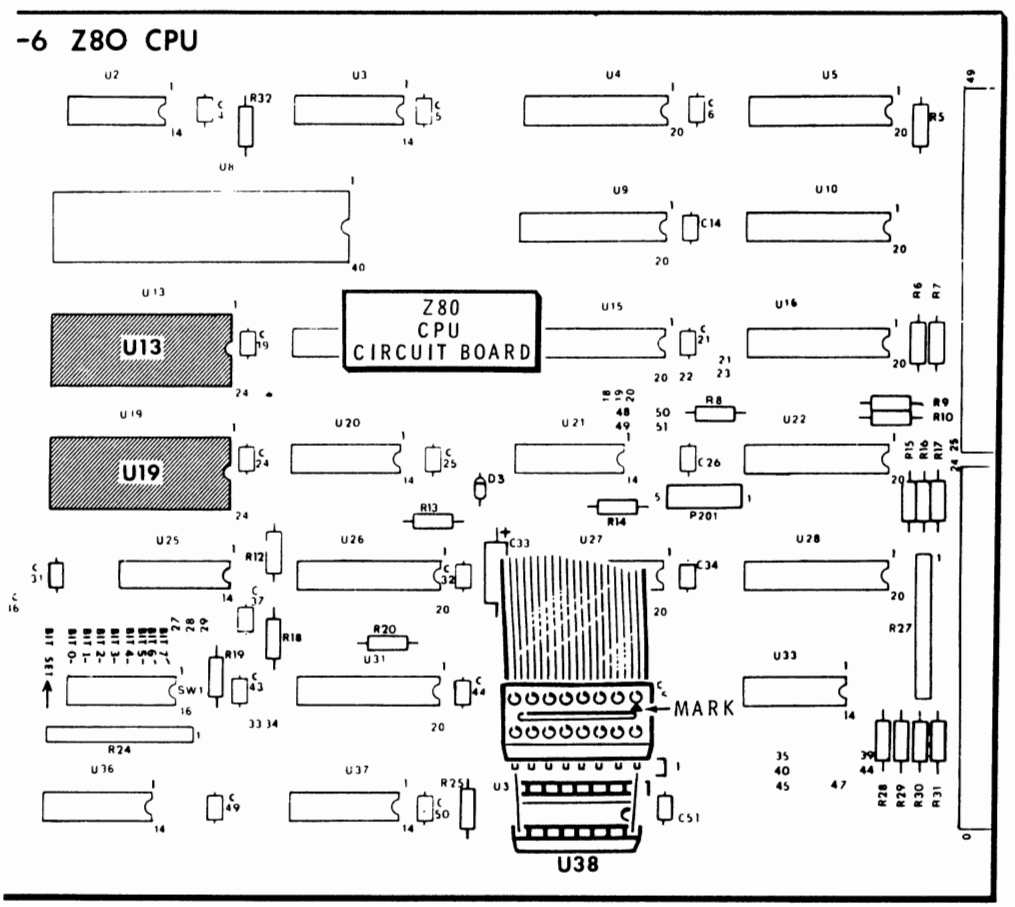
( ) Position the CPU board as shown in the Pictorial.

( ) Carefully remove IC U38 from its socket on the circuit board and store the IC in conductive foam ~~for use later in the installation~~. not needed - you may save

( ) Carefully remove IC U13 from its socket on the circuit board.

( ) Reinstall the IC at U19. Make sure you position the pin 1 end toward the index mark on the circuit board.

( ) Install the BOOT ROM 2 IC (#444-140) at U13. Make sure you position the pin 1 end toward the index mark on the circuit board.



PICTORIAL 4

Refer to Pictorial 5 (Fold-out from this page). Prepare two 3/4" bare wires by performing the following steps as shown in Detail 5A.

( ) Remove 7/8" of insulation from both ends of the 4" solid yellow wire.

( ) Cut a 3/4" bare wire from each end of the 4" solid yellow wire.

( ) Set the remaining 2-1/2" solid yellow wire aside for later use.

( ) Position the Z80 CPU circuit board printed (component) side up as shown in Pictorial 5.

( ) Push one end of one 3/4" bare wire through hole 24.

( ) Push the other end of the 3/4" bare wire through hole 26 as shown in Detail 5B.

( ) Bend the leads outward slightly to hold the wire in place.

( ) Refer to Detail 5C and solder the leads to the circuit board as follows:

1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for two or three seconds.

2. Apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.

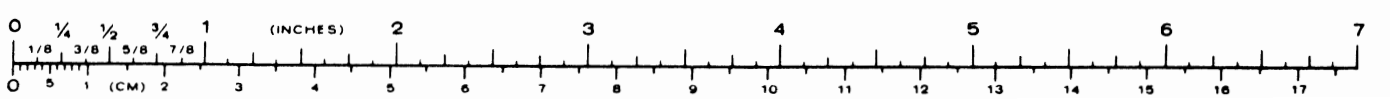
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.

( ) Cut off the excess lead lengths close to the connection. **WARNING**: Clip the leads so the ends will not fly toward your eyes.

( ) Using the desolder braid, remove all the solder around the jumper at holes 28 and 29. Then remove the jumper. Be careful that you do not damage the holes.

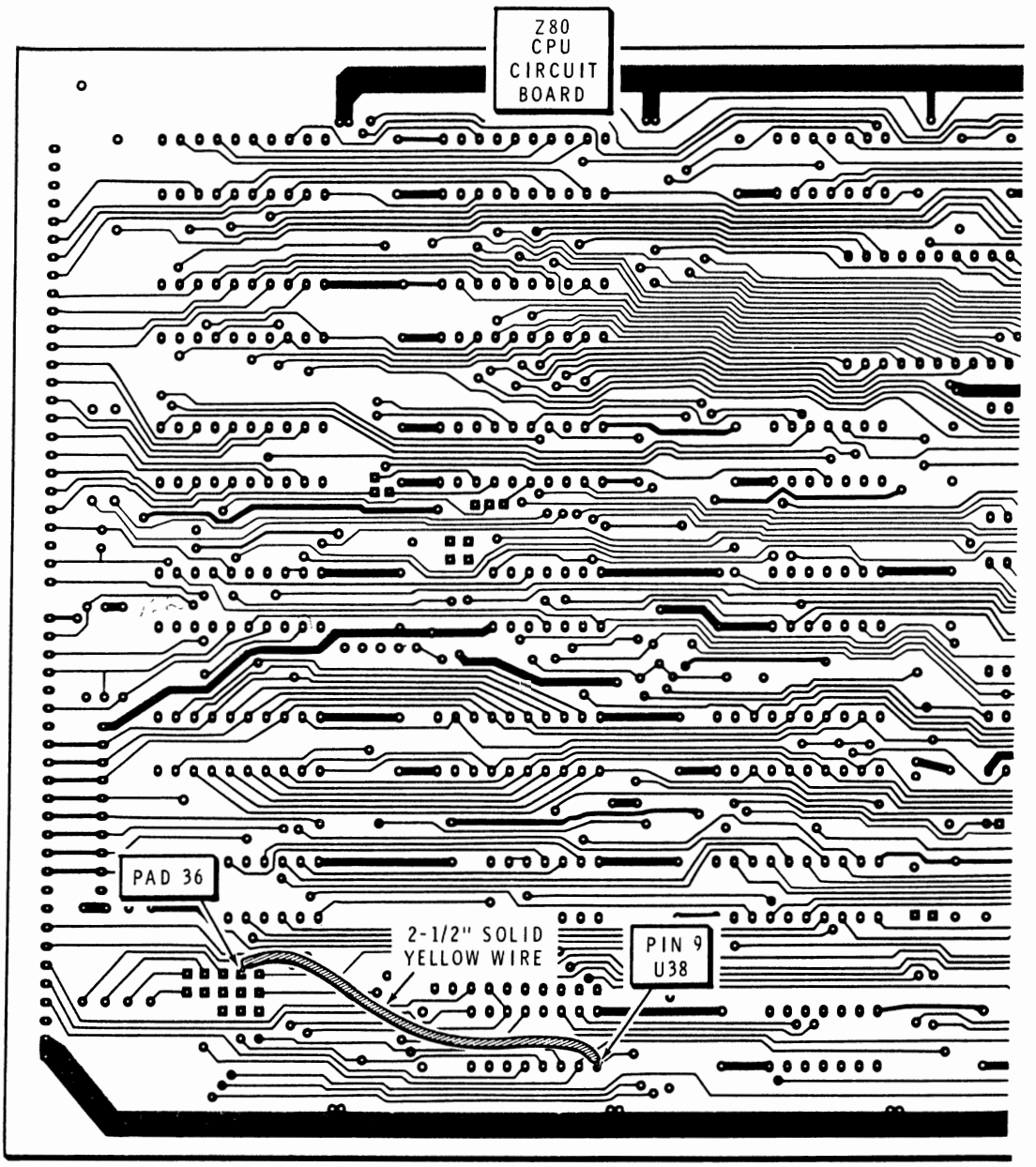
( ) Install the other 3/4" bare wire between hole 27 and 28. Solder the wire at both ends.

( ) If there is a Jumper Between 4 and 5 in the upper left of the CPU Board cut it.



( ) Refer to Pictorial 6. Turn the Z80 CPU circuit board over so that you are looking at the reverse (non-component) side.

( ) On the non-component side of the board, connect the 2-1/2" solid yellow wire from hole 36 to pin 9 of U38. Solder the wire at both ends, then check to make sure that you did not form any solder bridges when you soldered the wire to the circuit board.



PICTORIAL 6

( ) Refer to Pictorial 4. Turn the board back over to the component side.

( ) Remove the protective cover from one end of the 16-conductor flat cable (134-1241).

( ) Install the DIP connector at position U38 of the HA-8-6 Z80 CPU Circuit Board. Make sure that the marked pin lines up with pin number one of the IC socket. If the cable does not feed as illustrated in Pictorial 4, remove the connector and use the other end of the cable.

HA-8-6 CONFIGURATION

The addition of the WH-8-37 Double Density Disk Controller and Z-67 Interface brings new power and flexibility to your H-8 Computer. (By using ports 270 and 274, up to **four** mass storage devices may be used by a single H-8 Computer. As distributed, both HDOS and CP/M do not support such use. However, you can implement such a system by modifying the operating system software.) While you can control up to four different drive types with the H-8, current software from Heath and Zenith Data Systems only supports two types at any one time. When you configure your system, please consider the following legal combinations with respect to HDOS and CP/M:

- If you have an H-17 Disk Controller, the H-17 device must be assigned to port 174. With the addition of the WH-8-37, port 170 may be assigned either to the H/Z-37 or to the Z-67 device, but not both.

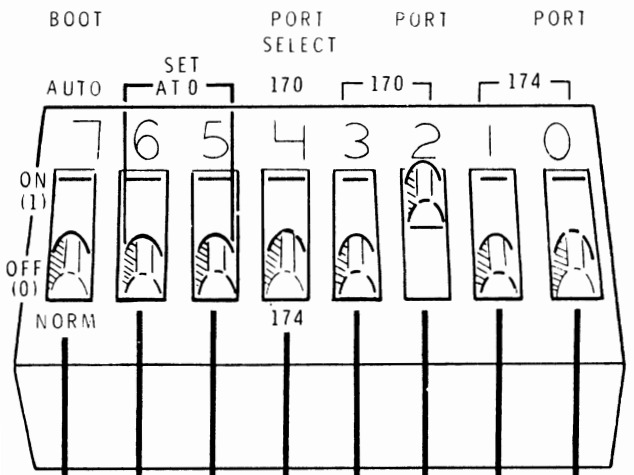
- If you have an H-47 Disk Controller, the H-47 device may be assigned either to port 170 (normal) or to port 174 when used by itself. Or, when the H-47 Controller is used with the WH-8-37 and a Z-37 device or a Z-67 device, the H-47 device must be assigned to port 174 and the Z-37 or Z-67 device assigned to port 170.

- If you are using the WH-8-37 by itself and only one device (Z-37 or Z-67), either may be assigned to port 170.

- If you are using the WH-8-37 by itself and both devices are active, the Z-37 device must be assigned to port 170 and the Z-67 device assigned to port 174.

Heath/Zenith CP/M HDOS version 2.0 or later, and some user porgrams will interrogate the status port to determine system configuration on boot-up.

Pictorial 7 shows the 8-section status port switch and defines the function of each section. Set these switches according to your system configuration before you reinstall the Z80 CPU board in your Computer.



PICTORIAL 7

Selects the device located at port 174 (Octal). The settings of these two sections are:

00 — H-17 Controller.
01 — H-47 8" Disk Controller.
10 — Z-67 Winchester Interface.
11 — No controller.

Selects the device located at port 170 (Octal). The settings of these two sections are:

00 — Z-37 Controller.
01 — H-47 8" Disk Controller.
10 — Z-67 Winchester Interface.
11 — No controller.

Determines whether the primary boot device is at port 170 or 174 (Octal). The setting is:

0 — Primary boot from port 174.
1 — Primary boot from port 170.

These two sections are not used by the H-8 Computer at this time.

Determines whether boot is automatically invoked on power up or not.

0 — Normal boot.
1 — Auto boot on power up.

( ) Set the CPU Z80 circuit board aside for now.

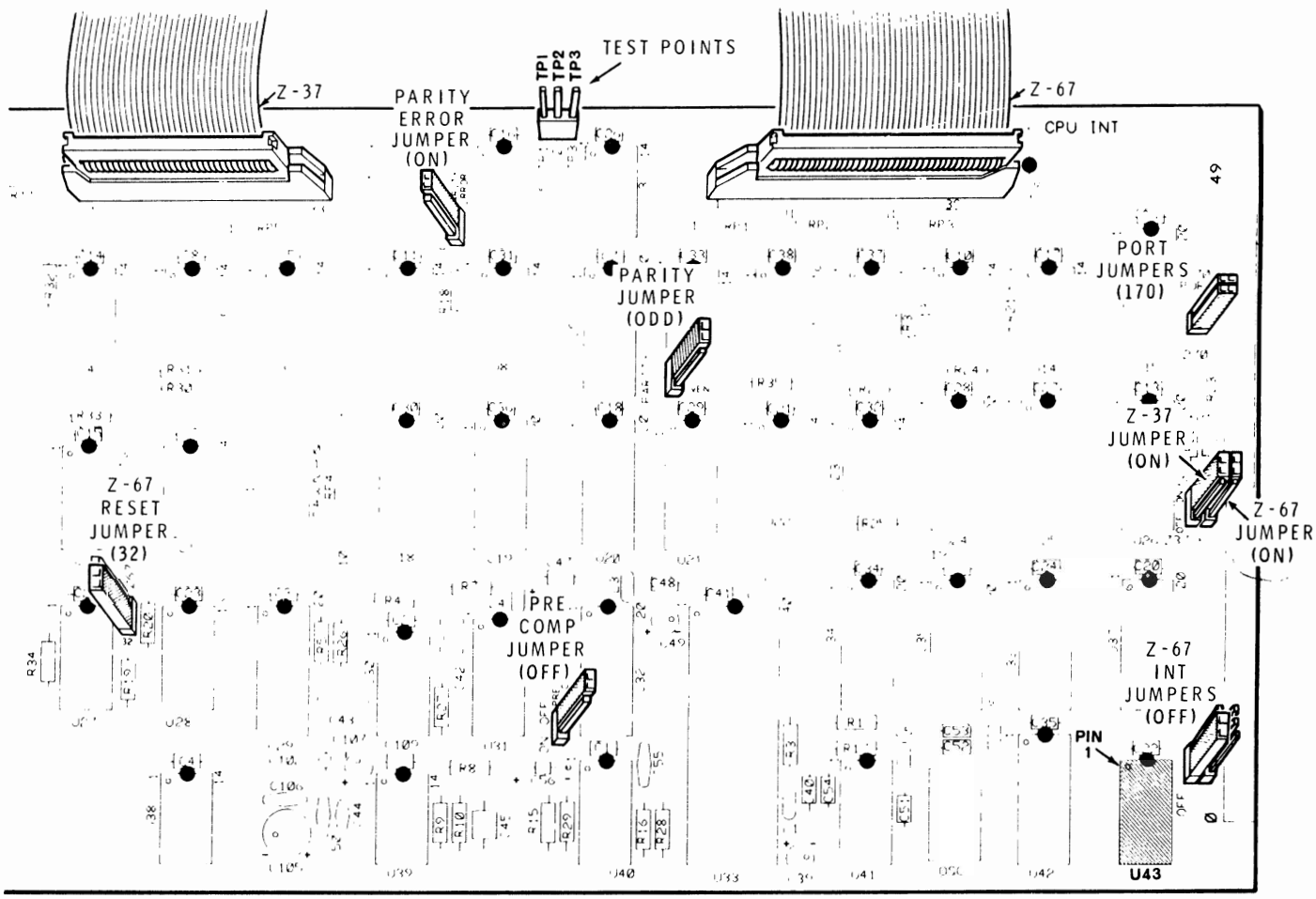
WH-8-37 CIRCUIT BOARD

Refer to Pictorial 8 for the following steps.

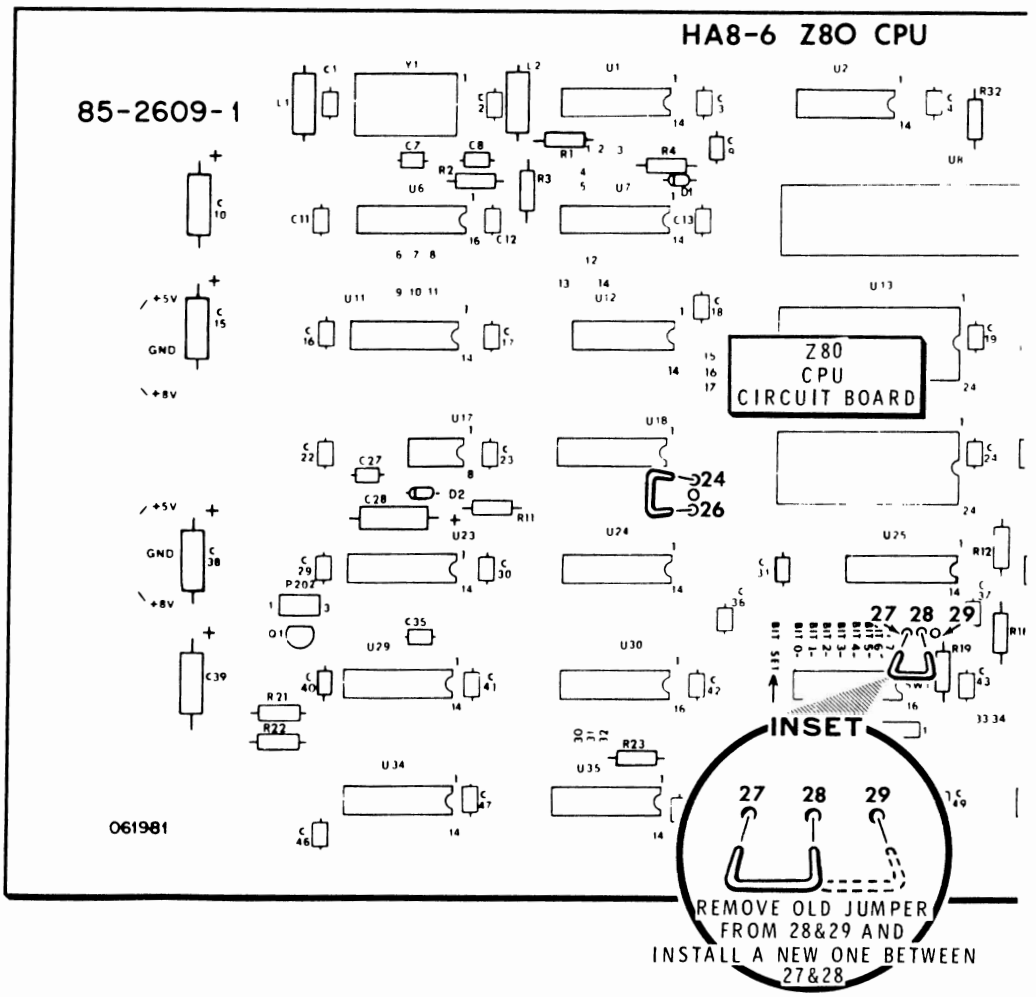
( ) Position your WH-8-37 circuit board as shown in the Pictorial.

( ) Install the 74LS148 IC (that was previously at location U38 on the Z80 CPU circuit board) into the socket at location U43. Make sure you position the pin 1 end toward the index mark on the circuit board.

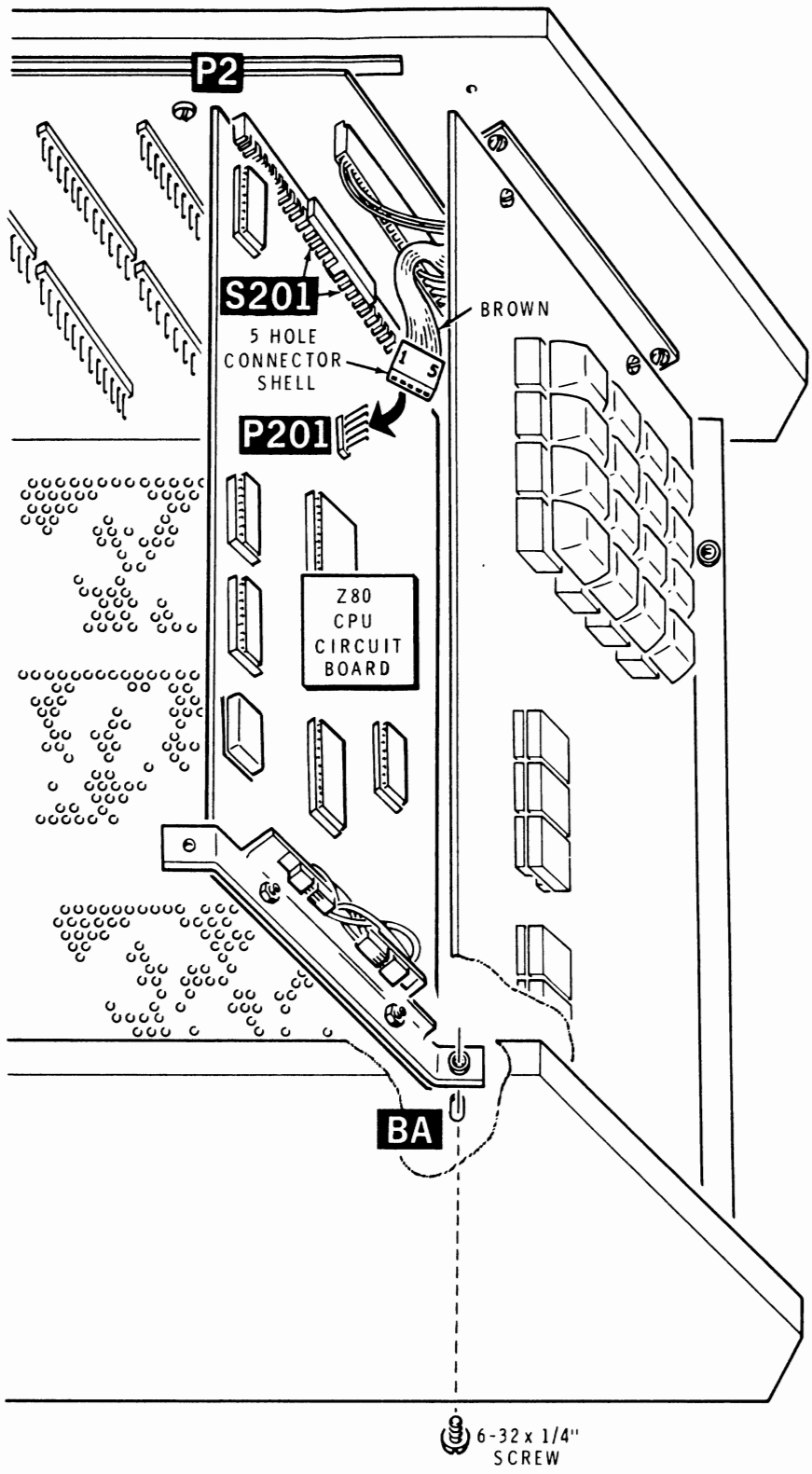
Refer to pictorial 8 for the discussion on the following 2 places



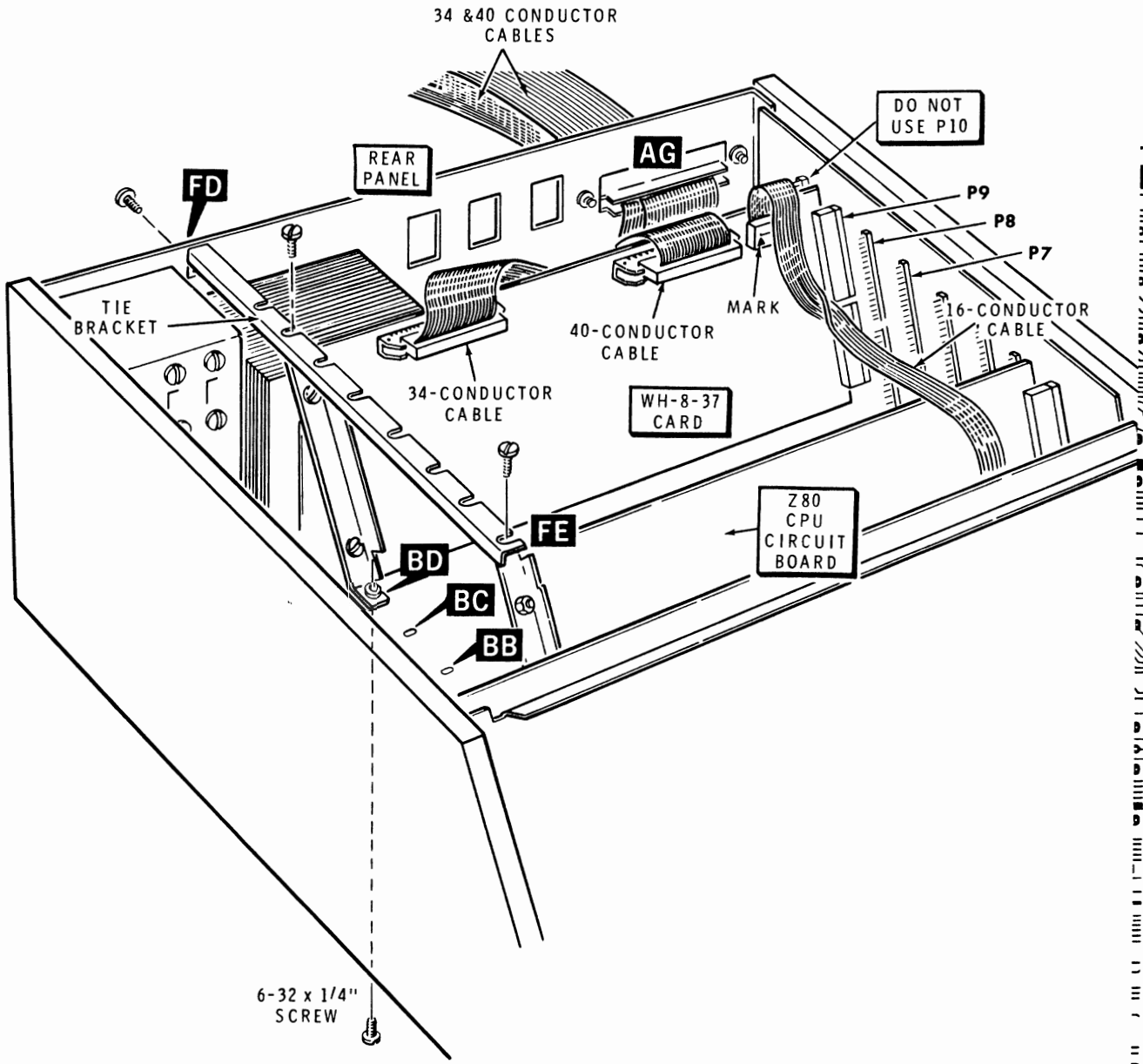
PICTORIAL 8


HA8-6 Z80 CPU
85-2609-1
Z80
CPU
CIRCUIT BOARD
061981
INSET
27 28 29
REMOVE OLD JUMPER
FROM 28&29 AND
INSTALL A NEW ONE BETWEEN
27&28

PICTORIAL 5


P2
S201
5 HOLE
CONNECTOR
SHELL
BROWN
P201
Z80
CPU
CIRCUIT
BOARD
BA
6-32 x 1/4"
SCREW

PICTORIAL 9



PICTORIAL 10

WH-8-37 CONFIGURATION

The following jumpers are shown installed in their recommended positions.

( ) Port jumpers: Position two jumpers horizontally (as shown) for port base address 170 octal (normal). If you want to use port base address 270 octal, position the two jumpers vertically.

( ) Z-67 jumper: Position one jumper in the upper (ON) position as shown if the WH-8-37 will be connected to a Z- 67. Otherwise, position this jumper in the lower position (OFF).

( ) Z-37 jumper: Position one jumper in the upper (ON) position as shown if the WH-8-37 will be connected to any 5-1/4" floppy disk drive or system (H-17-1, H-17-4, H-17, H/Z-37, H-77, or Z-87). Otherwise, position this jumper in the lower (OFF) position.

( ) Z-67 INT jumper: Position one jumper in the vertical position as shown in the Pictorial. This is the normal "OFF" (no interrupts) position; the Z-67 does not generate interrupts in this sense. If you want to allow interrupts to be passed to the Computer, position a jumper horizontally in one of the three available positions:

NOTE that:

* INT 3 is used by the Console.
* INT 4 is used by the Z-37 when running.
* INT 5 is normally unused.

( ) PARITY jumper: Position one jumper in the upper position (as shown) for odd parity generation and checking. This is the normal position for Heath and Zenith Data Systems software. For even parity generation and checking, position the jumper in the lower position.

( ) PARITY ERROR jumper: Position one jumper in the upper position (normal) for parity error checking. If you do not want parity error detection, position the jumper in the lower (normal) position as shown.

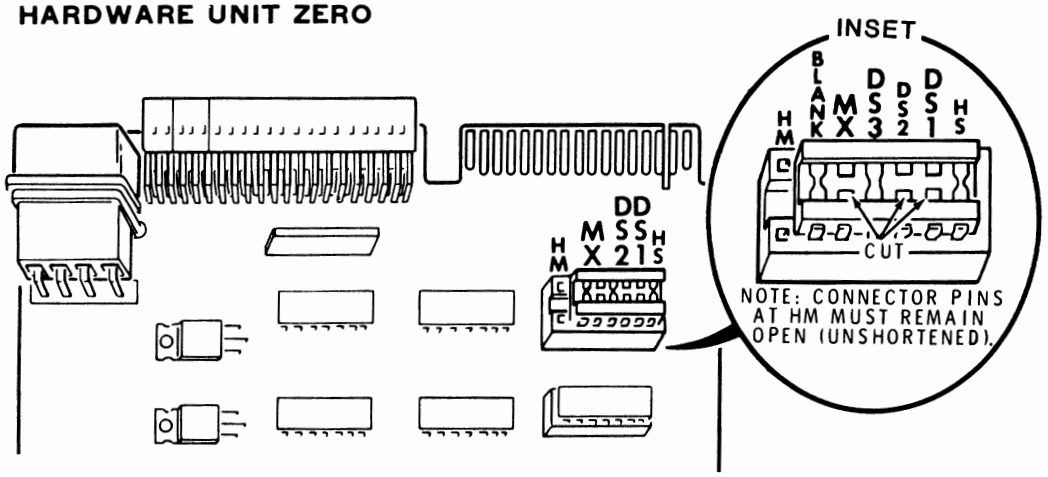
( ) PRE COMP jumper: Precompensation may be needed for proper operation by some disk drives. Check with your dealer for information regarding non-Heath/Zenith disk drives (Heath/Zenith disk drives normally do not require precompensation). If you have 48 tpi drives that require precompensation on all tracks or 96 tpi drives that require precompensation on tracks 43 and higher, position one jumper in the lower position; otherwise, position it in the upper (normal) position for no precompensation.

( ) Z-67 RESET jumper: Position one jumper in the lower position (32 µs) as shown for normal operation with a Z-67. If you need to use the shorter pulse width (4 µs), use the upper position.

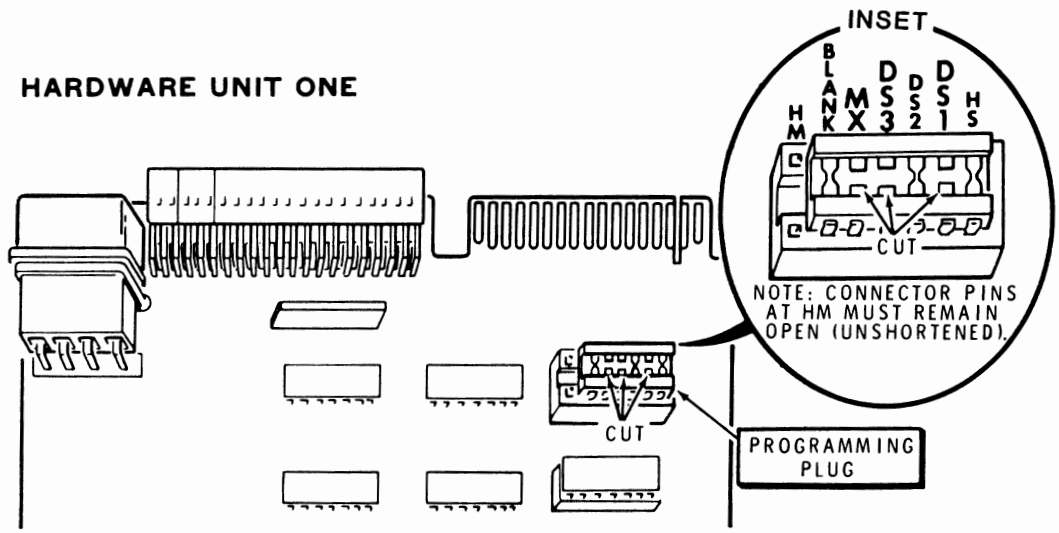
( ) If you are going to use a 5-1/4" disk drive or system with your WH-8-37 Board, install the 34-connector cable (134-1243) at position Z-37. Make sure that the cable exits from the top of the board as shown in the Pictorial. Two cables are supplied: one for connection directly to an H-17-4 (which may be mounted inside an H-17 cabinet), and the other for connection to an H/Z-37 system. 134-1269 or H-17

( ) If you are going to use a Z-67 Winchester Disk System with your WH-8-37, install the 40-conductor cable (134-1244) at position Z-67. Make sure that the cable exits from the top of the board as shown in the Pictorial.

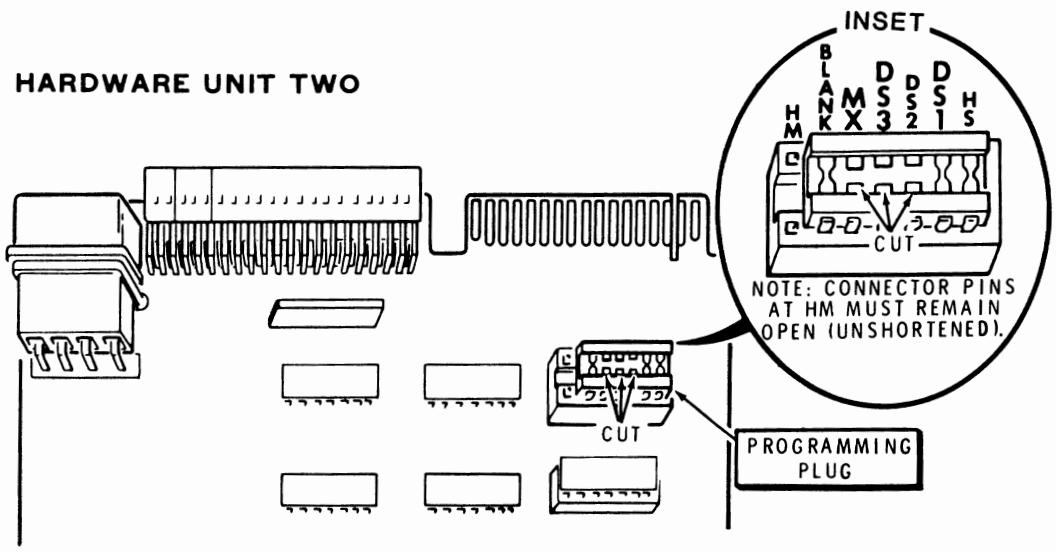
HARDWARE UNIT ZERO



HARDWARE UNIT ONE



HARDWARE UNIT TWO



PICTORIAL 3

CIRCUIT BOARD INSTALLATION

( ) Refer to Pictorial 9 (Fold-out from Page 16) and carefully place the HA-8-6 Z80 CPU Circuit Board in your H-8 Computer. Use position P2.

( ) Connect the 5-hole connector shell to P201 on the CPU board.

( ) Carefully plug the HA-8-6 into the H-8 mother board.

( ) Secure the HA-8-6 into the H-8 by using a 6-32 × 1/4" screw at BA on the cabinet bottom.

( ) Refer to Pictorial 10 (Fold-out from Page 16) and carefully place the WH-8-37 Board in your Computer. Use one of the rear positions (P7, P8, or P9).

( ) Carefully plug the WH-8-37 board into the H-8 mother board.

( ) Secure the WH-8-37 board into the H-8 Computer by using a 6-32 × 1/4" screw at BB (if the WH-8-37 is plugged into P7), BC (if the WH-8-37 is plugged into P8), or BD (if the WH-8-37 is plugged into P9) on the cabinet bottom.

( ) Replace the tie bracket and secure it with a 6-32 × 1/4" screw at FD on the rear panel.

( ) Secure the top of the CPU board to the tie bracket with a 6-32 × 1/4" screw at FE.

( ) Secure the top of the WH-8-37 board to the tie bracket with a 6-32 × 1/4" screw.

( ) Secure all remaining circuit boards in the H-8 to the tie bracket by tightening the remaining 6-32 × 1/4" screws.

( ) Route the 16-conductor cable from the HA-8-6 CPU Circuit Board to the WH-8-37 board and plug the loose end into the DIP socket marked CPU INT. Be sure that the mark on the plug lines up with pin number one of the socket.

( ) Route the Z-37 34-conductor cable from the WH-8-37 board out hole AG on the back panel of the H-8 Computer.

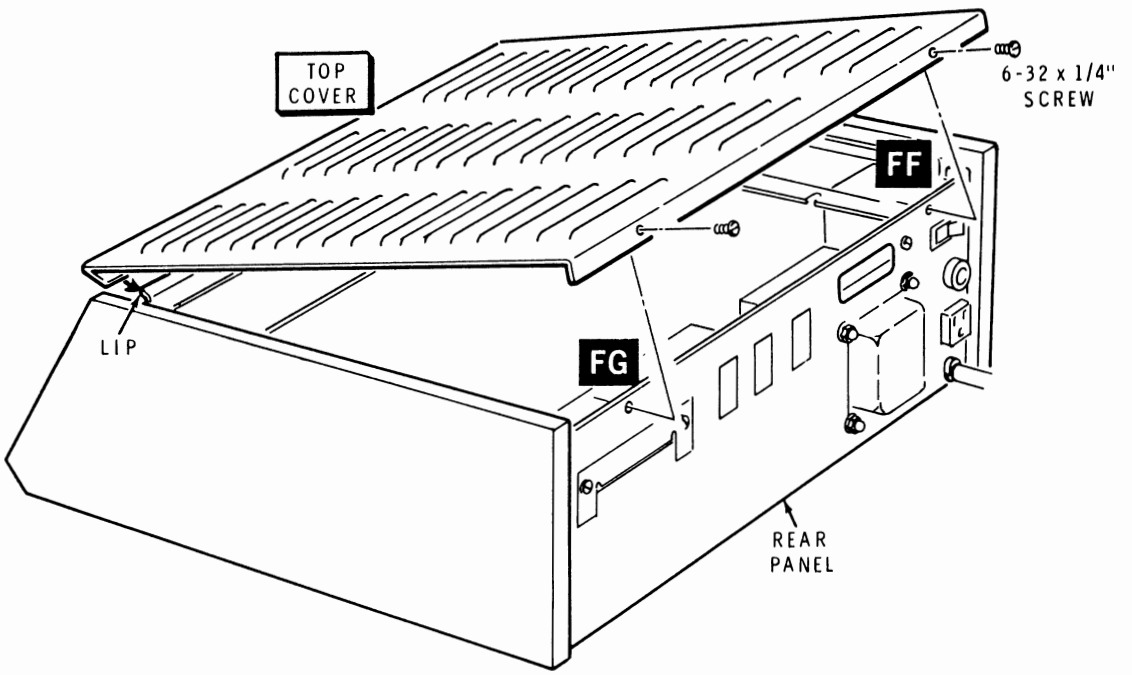
( ) Route the Z-67 40-conductor cable from the WH-8-37 board out hole AG on the back panel of the H-8 Computer.

( ) Refer to Pictorial 11. Hook the front of the top cover over the lip on the front panel of your H-8 Computer. Then push the rear of the top cover down onto the edge of the rear panel.

( ) Secure the top cover to the rear panel with 6-32 × 1/4" screws at FF and FG.

( ) Connect your disk drives to their respective cables.

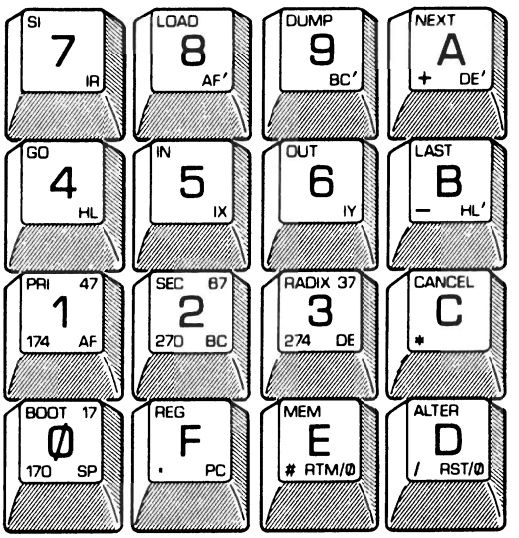
This completes the installation of your new WH-8-37 Double-Density Controller Board and Z-67 Interface into your H-8 Computer.



PICTORIAL 11

FRONT PANEL MODIFICATION

The new Boot ROM that you installed allows one step booting from the Z-37 or Z-67 sections of the WH-8-37 Double-Density Disk Controller and Z-67 Interface and their respective disk drive. Refer to Pictorial 12 for the following steps.



PICTORIAL 12

( ) Refer to Detail 12A and remove the sixteen keytops from your H-8 Computer by using the following method on each key:

1. Attach one end of a 3" piece of tape to the top of the key you want to remove.

2. Attach the other end of the tape to the bottom of the same key.

3. Pull the tape and key straight out from the front panel. The key should come off easily. If it does not, use a fresh piece of tape and try again, making sure that the tape is firmly attached to the key.

( ) Refer to Detail 12B and install each new keytop label onto a key.

( ) Install each of the sixteen keytops onto the keyboard. The arrangement is shown in Pictorial 12.

DISK DRIVE CONFIGURATION

Various programs and operating systems refer to numbers (called "hardware unit numbers") and letters (called "disk drive names") that your Computer uses to recognize each individual drive. The association between a particular drive name and a hardware unit number is determined by the following three conditions:

1. The program jumper on the 5-1/4" disk drive.
2. The programming of the WH-8-37 and HA-8-6 circuit boards.
3. Which drive device (of two) is used to boot the system. (A drive device is classified as a complete system, for example, an H-17, H/Z-37, H/Z-47, or Z-67).

The disk drive names expressed in the chart apply during normal boot of a primary device: the boot device (whether H-17, H/Z-37, H/Z-47, or Z-67) will have SY0:—SY2: or A:—C: drive specifications and the second system will have DK0:—DK2: or D:—F: drive specifications. (NOTE: the H/Z-47 Disk System will use A:-B: and the secondary device C:-E: when the H/Z-47 is used as the primary (boot) device.)

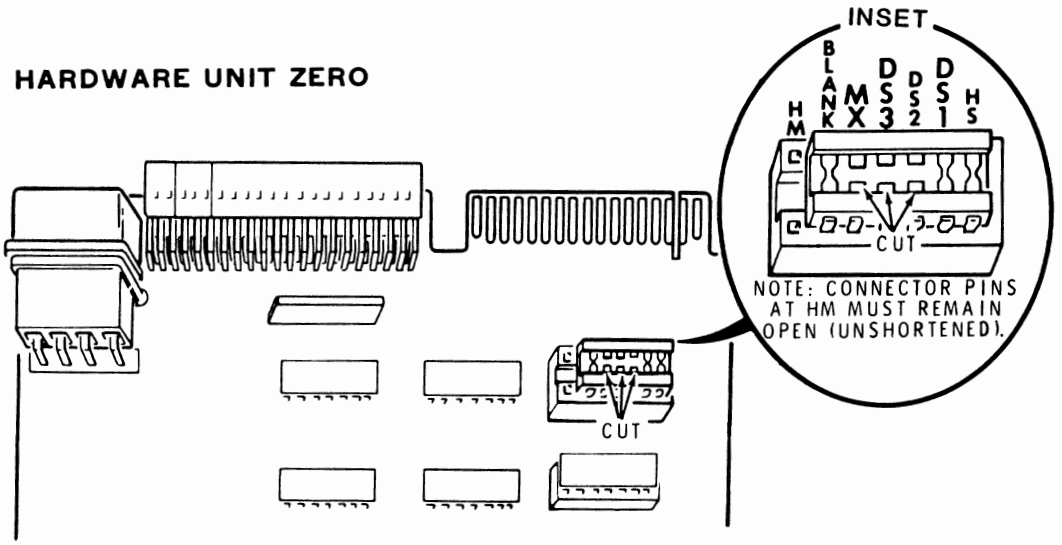
Assignment of drive names may vary if you boot on other than drive 0 of the primary device, or if the hardware unit numbers are numbered other than as illustrated in the chart. Refer to your HDOS or CP/M Manuals.

Primary (Boot) System (Disk Drive Name)		**Hardware Unit Number (5-1/4")**	**Secondary System** (Disk Drive Name)	
HDOS	CP/M	Programmed Jumper	HDOS	CP/M
SY0:	A:	0	DK0:	D:
SY1:	B:	1	DK1:	E:
SY2:	C:	2	DK2:	F:

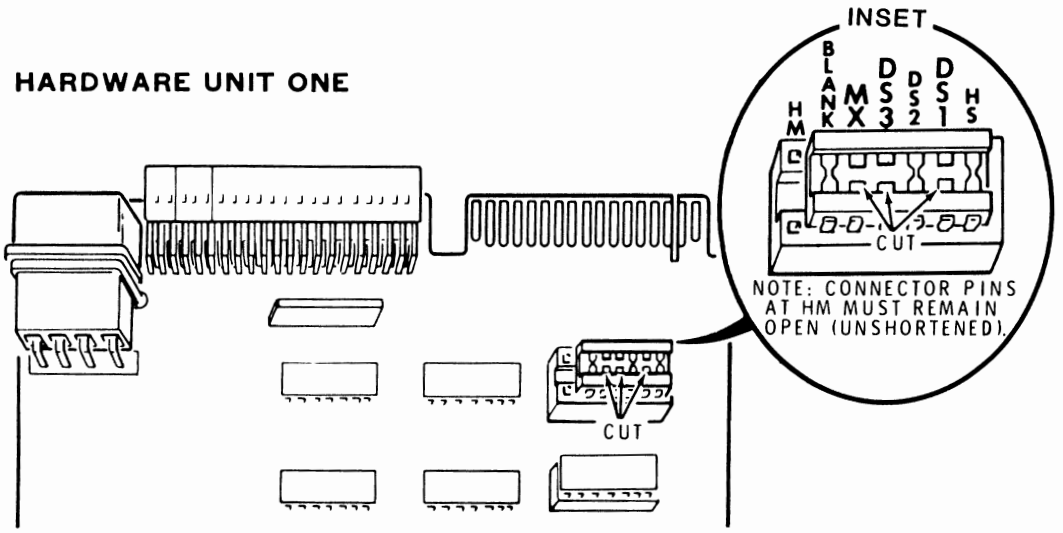
You may wish to alter the drive configuration of your 5-1/4" drives, but it is not necessary unless hardware unit numbers conflict within the same device or you do not have a unit 0 connected to your WH-8-37 Controller Board.

Although the hardware (WH-8-37 circuit board) does accommodate up to **four** 5-1/4" disk drives, Heath and Zenith Data Systems do not support the fourth drive.

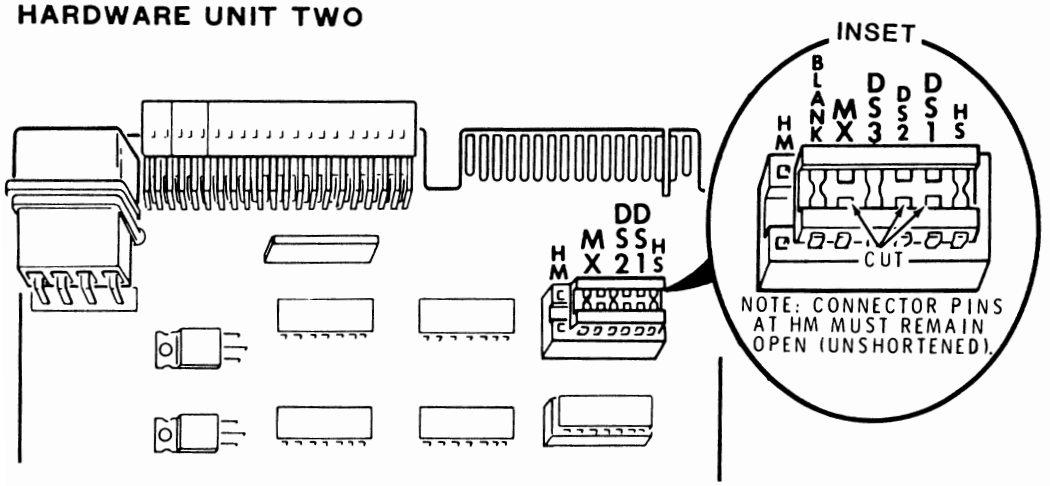
HARDWARE UNIT ZERO



HARDWARE UNIT ONE

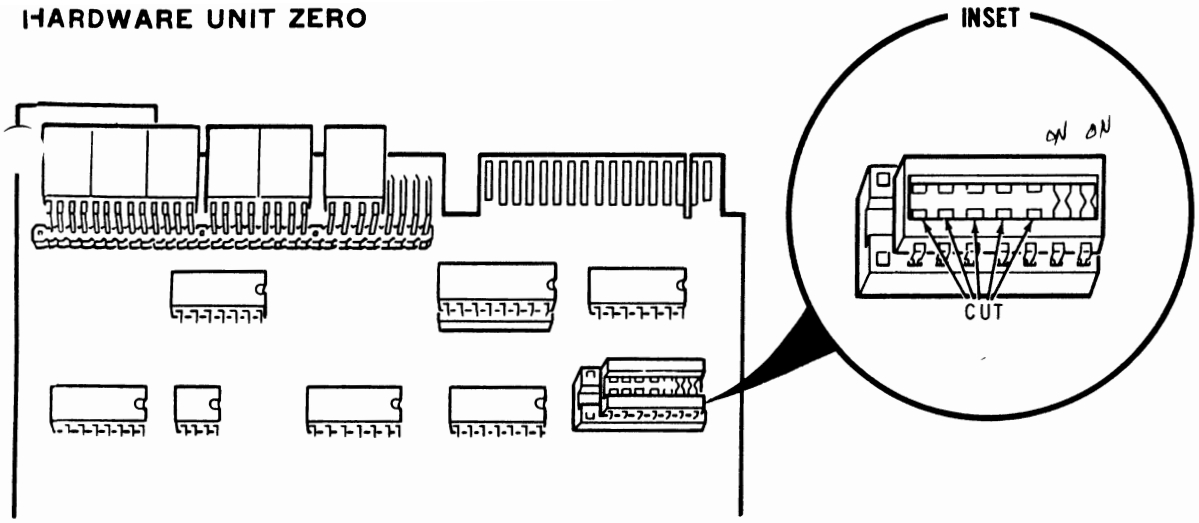


HARDWARE UNIT TWO

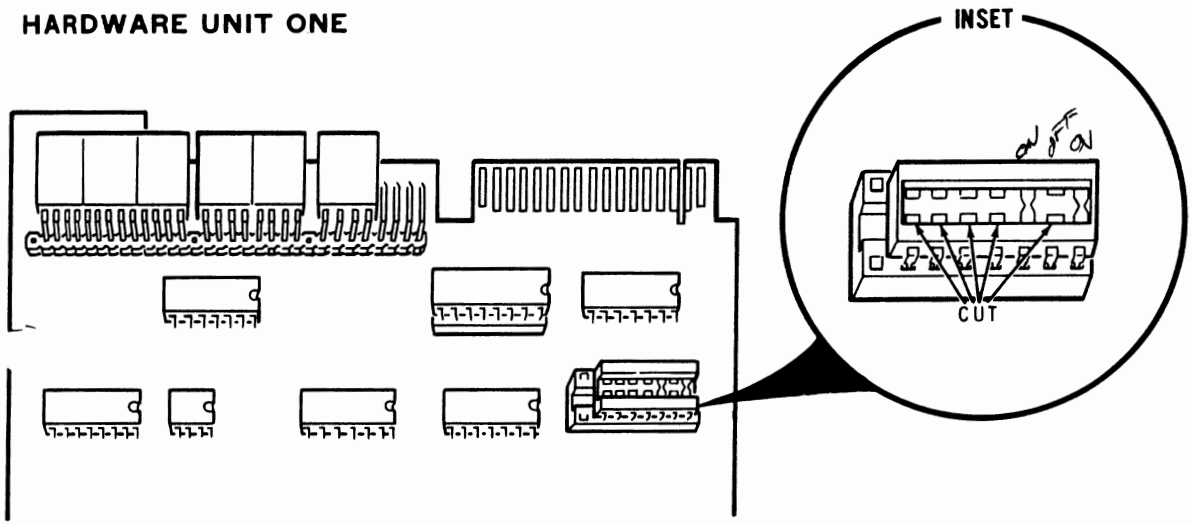


PICTORIAL 14

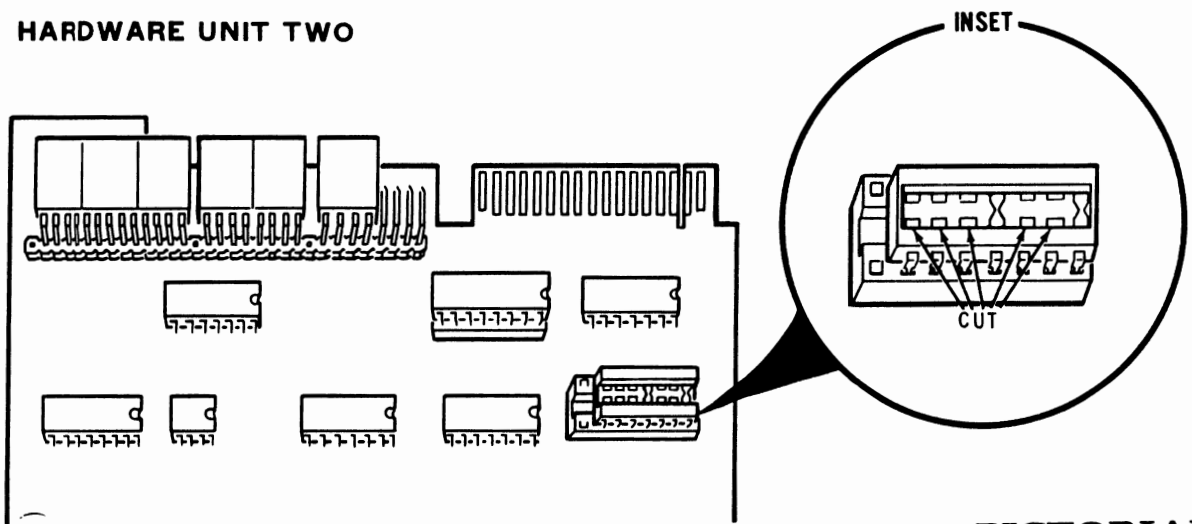
HARDWARE UNIT ZERO



HARDWARE UNIT ONE



HARDWARE UNIT TWO



PICTORIAL 15

Drive programming for 5-1/4" disk drives is illustrated in Pictorials 13, 14, and 15 (Fold-out from Page 26). Pictorial 13 shows 48 tpi drives programmed to be used with the H-17 Controller Board, Pictorial 14 shows 48 tpi drives programmed to be used with the WH-8-37 Board, and Pictorial 15 shows 96 tpi drives programmed to be used with the WH-8-37 Board. NOTE: When they are used with the WH-8-37, drives must be programmed as illustrated in Pictorial 14 or 15.

There were some early 48 tpi drives which are different than those shown. If you have one or more of these drives, they will be covered in your H-17 manuals.

If you purchased a Dual-Drive Z-37 Disk System, they come preprogrammed as hardware unit zero and hardware unit one.

You can program your disk drives by physically interchanging preprogrammed drives, interchanging the programming plugs, cutting the programming plugs (if presently uncut); or by replacing the programming plug with a properly set DIP switch.

MEDIA

96 tpi drives should ONLY be used with media certified for 96 or 100 tpi service; double-density recording should only be done on diskettes that are certified for such use; and double-sided diskettes should always be used in double-sided disk drives (H-17-4).

OPERATION

The new ROM, PAM-37, contains the code necessary to boot an operating system from the H-17 (with the H-17 Controller Board), H/Z-37, H/Z-47 (with the WH-8-47 Disk Interface), or Z-67.

There are four methods you can use to boot your system: Primary, Secondary, Universal, and Auto. Primary and Secondary Boot allow you to boot from a primary or secondary drive system with one keystroke. The Universal Boot allows you to boot your system from any drive in any device. Auto Boot allows **turnkey** operation from drive 0 of the primary device when you turn the power on.

APPLYING POWER TO THE H-8

With your HA-8-6 Z80 CPU Circuit Board, modified and installed back into your H-8 Computer and your new WH-8-37 board properly installed, you are ready to apply power to your Computer.

( ) Turn on the power to your Computer. You will hear a beep and your front panel display will show all four indicator lights on (ION, MON, RUN, and PWR) and:

n77 377 xxx

The **n** will be 0 for 16K of memory, 1 for 32K of memory, 2 for 48K of memory, and 3 for 64K of memory. The **xxx** will be a random number, usually zero. If your Computer does **not** show this display, press **both** the **0** and the **D** keys at the same time. Your Computer should beep once and show the proper display.

Note that the above display is **not** necessary for the proper operation of the H-8. It will, however, serve as a quick check for the proper operation of the new ROM. If you cannot obtain the display at power up, refer to "In Case Of Difficulty" on Page 68.

PRIMARY OPERATION

Select the primary device by setting switch SW1 on the HA-8-6 Z80 CPU Circuit Board (Refer to Page 17, "HA-8-6 Configuration"). To Boot from this device, Press the **1** key. The display will show:

Pri **xxx**

The **xxx** will display the device name: H17, H37, H47, or H67.

To cancel this boot command, press the C key (Cancel).

SECONDARY OPERATION

Select the secondary device by setting switch SW1 on the HA-8-6 Z80 CPU Circuit Board (Refer to Page 17, "HA-8-6 Configuration"). To Boot from this device, Press the **2** key. The display will show:

Sec **xxx**

The **xxx** will display the device name: H17, H37, H47, or H67.

To cancel this boot command, press the "C" key (Cancel).

UNIVERSAL OPERATION

Primary and secondary operation provide one-key-boot operations from drive 0 of a device. To boot from another drive on a device when it is configured according to the legal specifications set forth on Pages 17 and 24 of this Manual, follow these steps:

( ) Press the **0** key (Boot). The display will show:

dEU ("Device")

( ) Press one of the following keys to indicate the device: **0** for H-17, **1** for H-47, **2** for H-67 (Z-67), or **3** for H-37 (Z-37). The display will show:

xxx Por ("Port")

The **xxx** will be the device name (H17, H37, H47, or H67).

( ) Press the key which corresponds to the port address: **0** is for port 170, **1** is for port 174, **2** is for port 270, and **3** is for port 274. The display will show:

xxx ppp Uni ("Unit")

"NOTE: You cannot use the universal operation sequence to boot the CP/M operating system from a Z-67 unless you have set SW1 on the Z80 CPU Circuit Board to recognize the Z-67 for primary or secondary operation (single key boot)."

The **xxx** is the device name (as specified in step 2) and the **ppp** is the port address in Octal (170 for 0, 174 for 1, 270 for 2, and 274 for 3).

( ) Press the key which corresponds to the hardware unit number of the disk drive (**0, 1, 2,** or **3**). The display will show:

Uni **xxx**

The **xxx** will be the device name (H17, H37, H47, or H67).

The disk unit will be activated, and the initial boot routine will be read from disk into memory. If an error occurs, the Computer will beep and the display will show:

Err or **xxx**

Again, the **xxx** will be the device name. To cancel the error or stop the operation, press the **C** key (Cancel).

NOTE: By using ports 270 and 274, up to **four** mass storage devices may be used by a single H-8 Computer. As distributed, both HDOS and CP/M do not support such use. However, you can implement such a system by modifying the operating system software.

AUTO OPERATION

If section 7 of Switch SW1 on the HA-8-6 Z80 CPU Circuit Board is set to 1, the system will automatically boot from hardware unit 0 on the primary device when you turn the power on or perform a master clear (by pressing both the **0** and the **D** keys).

NOTE: We do not recommend auto-booting (from a floppy disk system) with diskettes in any drives and the doors closed at power up. The diskette could be accidently erased during the power-up sequence inside the Computer. Rather, power up the H-8 and the peripherals (including the disk drives) first, and then insert the diskette and close the drive door. If you do this within 15 seconds of turning on the H-8's power, the auto-boot function will perform normally.

Z-67 WINCHESTER DISK DRIVE PREPARATION

The Z-67 Winchester Disk System is supplied with an 8″ diskette containing software utilities that provide for a unique and innovative approach to rigid (Winchester) disk allocation and management. By using these utilities, you will be able to define the partition allocation of the disk and specify which operating system will manage each allocated portion.

The 8″ diskette is labeled, "Winchester Disk Utilities" and is distributed in "bootable" form. That is, your H-8 monitor can read in and "boot" the operating system and program without any additional software.

( ) To boot the Z-67 Software Utilities disk, turn your Computer and Z-67 on.

( ) Place the diskette containing the utilities in the 8″ disk drive and close the door. Make sure the diskette label is to the left as illustrated in your Z-67 Operation Manual.

( ) In the Z-67, the 8″ floppy disk drive is not wired as hardware unit zero. Therefore, to boot from the floppy, you must use the Universal boot procedure. Press the **0** key. The display will show:

dEU

( ) Press the **2** key. The display will now show:

H67 Por

( ) If your Z-67 is connected to port 170, press the **0** key. The display will show:

H67 170 Uni

If your Z-67 is connected to port 174, press the **1** key. The display will show:

H67 174 Uni

( ) Press the **1** key. The display will show the following and the 8" disk will be booted into the system:

```
Uni      H67
```

After a few moments, your terminal will display:

```
H/Z-67 PARTITIONING/PREPARATION MENU

A - WINCHESTER DISK PARTITIONING UTILITY
B - WINCHESTER DISK DIAGNOSTIC/PREPARATION UTILITY
C - EXIT

SELECTION ?
```

To use either of the disk utilities, respond to the "SELECTION ?" prompt by typing either an **A** or **B**, and then pressing the RETURN key. Both utilities will return to this menu once they have finished. Selection of **C** will return control to the H-8 monitor.

NOTE: It should not be necessary to run Selection B, as this test is performed at the factory prior to shipment.

Sections two and three of the H/Z-67 Software Utilities Manual fully describe the partitioning utility (PART) and the preparation utility (PREP67), respectively.

( ) Follow the instructions in section two of the H/Z-67 Software Utilities Manual and partition your Winchester Disk Drive.

( ) Refer to your opertaing system Manual for instructions for using the Z-67 Winchester Disk System.

THE Z-37 DOUBLE-DENSITY CONTROLLER

Diagnostic Routines

The diagnostic routines supplied with your WH-8-37 Double-Density Disk Controller and Z-67 Interface allow you to "check out" and test your 5-1/4" soft-sectored disk system and diskettes.

They are supplied on two 5-1/4" bootable diskettes, labeled "Soft-Sectored" and "Hard-Sectored." The programs contained on the two diskettes are identical; the only difference is the type of media. Hard-sectored diskettes are used by your H-17 Controller Board and associated disk drive(s); soft-sectored diskettes are used by the Z-37 portion of the WH-8-37 and associated disk drive(s). You can use either diskette to perform the diagnostic routines, but be sure to use the diskette labeled "Soft-Sectored" in disk drives that are connected to the WH-8-37 circuit board, and the diskette labeled "Hard-Sectored" in disk drives that are connected to the H-17 Controller Board.

To perform the diagnostics, you will need at least two blank, 5-1/4", soft-sectored diskettes. It does not matter whether these diskettes are single- or double-density, nor whether they are single- or double-sided.

STARTING THE DIAGNOSTIC PROGRAMS

To start the diagnostic programs, boot up the system using **either** the hard- or soft-sectored Diagnostic diskette in the proper drive. The following procedure outlines how you should boot-up.

1. Turn on the power to your Computer and disk drive(s). You will hear a beep and your front panel display will show all four indicator lights on (ION, MON, RUN, and PWR) and:

   n77 377 020

   The **n** will be 0 for 16K of memory, 1 for 32K of memory, 2 for 48K of memory, and 3 for 64K of memory. If your Computer fails to display the above, press both the **0** and **D** keys at the same time to perform a reset. If your Computer still fails to show the proper display, refer to your H-8 Manual for assistance.

2. Determine which drive is the boot drive by following the procedure in step 4 **without** putting a diskette in any drive. The red light on one and only one drive should come on after you press the appropriate key. Then reset the computer by simultaneously pressing both the **O** key and the **DD** key. Now insert the diagnostic diskette into the boot drive as follows:

   - Place the diskette labeled "Soft-Sectored" in the boot drive if it is connected to the WH-8-37.
   - Place the diskette labeled "Hard-Sectored" in the boot drive if it is connected to the H-17 Controller Board.
   - If none of the drive lights turn on, or if more than one turns on, it will be necessary to refer to the "Disk Drive Configuration" section to define one and only one boot drive. (NOTE: If NO lights turned on, be sure power was applied to the drive(s) before you assume that you will have to reconfigure the drives. Also check to be sure that your WH-8-37 Circuit Board is properly seated in the H-8 and the disk drive cables are properly connected.)

3. Close the disk drive door.

4A. If the boot drive is connected to the WH-8-37 and section 4 of SW-1 on your HA-8-6 Circuit board is in position 1, press the **1** key on your Computer's front panel. The display will show:

Pri H37

The drive light will come on and the display will flash as the data is read into your Computer's memory.

4B. If the boot drive is connected to the H-17 Controller Board and section 4 of SW-1 on your HA-8-6 Circuit Board is in position 0, press the **0** key. The display will show:

Pri H17

You will hear some clicking noises from the disk drive and its light will turn on and then off again. This is normal. You will hear clicking noises whenever your Computer is reading from or writing to the diskette. The clicks will continue for about 15 seconds. If the terminal does not automatically display the following message, press both the right SHIFT key and RESET key at the same time and then release them. Your terminal will display:

```
ZENITH DATA SYSTEMS Z37 SUPPORT SYSTEM

ENTER THE NUMBER CORRESPONDING TO THE TYPE
 OF THE PROGRAM YOU WISH TO RUN.

1. DISK CONTROLLER CHECKOUT

2. GENERAL DRIVE/CONTROLLER DIAGNOSTIC

YOUR CHOICE ->
```

From this main menu, you can select either diagnostic utility. To select an option, simply type the number which corresponds to the option on the terminal. When you are finished running either of these two options, the system will return you to this main menu.

Also, you can safely remove all diskettes and turn off the power whenever the main menu is displayed.

OPTION 1: DISK CONTROLLER CHECKOUT

The Disk Controller Checkout is used to verify the operation of the Z-37 Double-Density Disk Controller portion of the WH-8-37 Circuit Board. This diagnostic program turns on the disk drive motors, loads the disk drive read/write heads as a program would if it were trying to read from or write to the disk, and then tries to position and reposition the read/write head. If the program can successfully complete all these tests, it will display a message which indicates that the controller works properly. If the program cannot successfully complete any test, it will display an error message that tells you how to correct the problem.

The Disk Controller Checkout diagnostic will refer to various drive numbers. These numbers are the drive hardware unit numbers, and they range from 0 (zero) through 2. Pay close attention to which drive number the program associates with a drive as it activates it. This "drive hardware unit number" will be referred to frequently throughout these diagnostics.

To run the Disk Controller Checkout, select diagnostic programs' main menu option 1. The terminal will display:

```
DETAILED CONTROLLER CHECKOUT.

THIS PROGRAM ATTEMPTS TO VERIFY THE OPERATION
OF THE H37 DISK CONTROLLER BOARD.

PLEASE ANSWER THE FOLLOWING QUESTIONS WITH 'Y'
FOR YES AND 'N' FOR NO. BY LOOKING AT YOUR
DISK DRIVES AND VERIFYING PROPER OPERATION.

ARE ALL DRIVE MOTORS TURNING?
```

Before you respond, open the doors of your soft-sectored 5-1/4" disk drive(s). On the right-hand side of the drive, about two inches back from the drive door, there is a metal cylinder about an inch in diameter. Make sure this cylinder is turning in each of the 5-1/4" disk drive(s) connected to your WH-8-37 Circuit Board. It **does not matter** whether this cylinder is turning in any drives connected to an **H-17** Controller Board.

If the drives are not turning, proceed with the following steps; otherwise, respond by pressing the **Y** key and continue with the next section and test drive zero.

1. Check to make sure that the power to the drive is on.

2. If the power is on, check the connection of the ribbon cable on the circuit board (at location Z-37), the connection between the ribbon cable from the circuit board (Z-37) and the ribbon cable from the disk drive, and the connection of the disk drive cable to the disk drive.

3. If the cable is connected correctly, check the jumper selection on the WH-8-37 board and make sure that the Z-37 jumper is in the correct position (ON).

4. If the jumper is correct, check the port select jumper and make sure that they are in a horizontal position as shown in Pictorial 8 (Port 170).

5. Repeat the test.

If you are still experiencing difficulty, refer to the "In Case of Difficulty" section on Page 68.

If you responded by pressing the **Y** key to the preceding question, the terminal will display:

```
SELECTING DRIVE ZERO.

IF THIS IS A NON-EXISTENT DRIVE FOR YOUR SYSTEM,
ANSWER 'Y' TO THE FOLLOWING QUESTION.

IS DRIVE SELECT LIGHT ON AND HEAD LOADED?
```

Note that this "Drive Zero" is the drive that you will normally use to boot up, unless you are booting from a hard-sectored diskette that is connected to the H-17 Controller Board or if you are using the Z-67 or H/Z-47 system to boot up.

Check to make sure the red light on drive 0 is glowing. If it is, press the **Y** key, continue with the next section, and test drive one. Otherwise, check the following:

1. Be sure that the drive is jumpered for the proper drive select as discussed in the "Disk Drive Configuration" section on Page 26.

2. Be sure that the ribbon cables are properly connected and are tight.

3. Be sure that the 8-section status port switch on the HA-8-6 Z80 CPU board is set correctly as discussed in the "HA-8-6 Configuration" section.

4. Repeat the test.

If you still experience difficulty, refer to the "In Case of Difficulty" section on Page 68.

If you have responded by pressing the **Y** key to the preceding question, the terminal will display:

```
SELECTING DRIVE ONE.

IF THIS IS A NON-EXISTENT DRIVE FOR YOUR SYSTEM,
ANSWER 'Y' TO THE FOLLOWING QUESTION.

IS DRIVE SELECT LIGHT ON AND HEAD LOADED?
```

Check to make sure the red light on drive 1 is glowing. If it is, press the **Y** key, continue with the next section, and test drive two. Otherwise, check the following:

1. Be sure that the drive is jumpered for the proper drive select, as discussed in the "Disk Drive Configuration" section on Page 26.

2. Be sure that the ribbon cables are properly connected and are tight.

3. Be sure that the 8-section status port switch on the HA-8-6 Z80 CPU board is set correctly as discussed in the "HA-8-6 Configuration" section.

4. Repeat the test.

If you still experience difficulty, refer to the "In Case of Difficulty" section on Page 68.

The program will activate the drive in this way for drive two. You should respond by pressing the **Y** key if the drive exists and the red light glows, and check the above only if the drive exists but the drive light does not come on.

If all the drive motors work properly and the program was able to successfully select all the drives, the system will now display:

```
VERIFYING HEAD POSITIONING SYSTEM. STAND BY...
```

The program will now attempt to position the disk drive zero's read/write head, much as it would as if it were reading from or writing to a diskette. If this test is successful, the program will display:

```
YOUR CONTROLLER APPEARS TO BE OK. PLEASE CONTINUE
ON TO SELECTION 2 TO MAKE FURTHER CHECKS.
```

If you do not receive this message, and there is no track indication, call Heath or Zenith Technical Consultation for assistance.

OPTION 2: GENERAL DRIVE/CONTROLLER DIAGNOSTIC

The General Drive/Controller Diagnostic (called "TEST") is a diagnostic utility used to test soft-sectored 5-1/4" diskettes and disk drives. TEST verifies the drive rotation speed, step rate, read/write mechanism, and the quality of the recording surface of the diskette used for the tests.

You must use the **F** option (format disk) before you run the tests and format the disk for the diagnostic routines. After you use the diskette to perform "TEST," use an operating system disk formatting program (CP/M FORMAT or HDOS INIT) before you use the diskette for data or program storage.

The amount of time you need to run the tests varies with the number of sides and the density of the media under test. It will take about two hours to run all tests using a single-sided, single-density diskette. It will take about four and a half hours to run all tests using a double-sided, double-density diskette.

Initialiazing the Diagnostic

To run TEST, boot up your system using the Diagnostic Utilities diskette and select the main menu option 2. Your Terminal will display:

```
                    TEST
                VERSION: 2.0
              ISSUE #50.07.00

      THIS  PROGRAM TESTS YOUR DISK SYSTEM.  CERTAIN TESTS
DESTROY THE DATA ON THE VOLUME UNDER TEST.  THIS VOLUME MUST
HAVE BEEN INITIALIZED AT LEAST ONCE, AND MAY  HAVE TO  BE
REINITIALIZED BEFORE BEING USED FOR ANYTHING ELSE.

PROCEED (YES/NO)?
```

If you type YES and press the RETURN key, the program will continue. If you type NO and press the RETURN key, TEST will return you to the diagnostic programs main menu.

If you choose to continue proceed with the following:

1. Remove all diskettes from your disk drives. The terminal will display:

```
WHICH DRIVE (0/1/2/3)?
```

2. Now enter the hardware unit number of the drive that you want to test and press the RETURN key. If this is your first time through the test, we recommend that you test drive 0. After you have selected a drive number between 0 and 2 (3 may be selected but it is **not** supported by any other Heath or Zenith software), your Computer's terminal will display the following menu:

```
FUNCTIONS AVAILABLE:

T - DISPLAY DRIVE ROTATIONAL SPEED      U - SELECT ANOTHER DRIVE UNIT
D - GENERAL DRIVE CHECKOUT              E - EXIT TO BOOT PROGRAM
M - MEDIA CHECK (SECTOR VALIDITY)       A - ALIGN DRIVE HEAD
S - PERFORM SEEK TIME CHECKOUT          F - FORMAT DISK

CTRL-C CANCELS THE TEST IN PROGRESS. OPTION:
```

To start any test, type the letter that precedes the name of the test in the menu and press the RETURN key. Since you must format the diskette before performing any tests, select menu option **F** by pressing the F key and then press the RETURN key.

Option F: Format Disk

This option prepares a soft-sectored diskette for use with these diagnostics. However, any data on the diskette will be destroyed, so use a diskette that is new (blank) or one that does **not** contain valuable data.

The option begins by instructing you to insert a diskette into the drive. For instance, if you selected drive 0, the terminal will display:

```
INSERT THE VOLUME YOU WISH TO FORMAT INTO DRIVE 0,
REMEMBER, ANY DATA ON THIS VOLUME WILL BE DESTROYED.

HIT RETURN WHEN READY.
```

Insert the diskette into drive 0. If you selected another drive, insert the diskette into that drive, as instructed by the display. Then press the RETURN key. The terminal will now display:

```
DOUBLE DENSITY <YES>?
```

If you want to format your disk in double-density (it must be certified for double-density use), press the RETURN key; if you want to format the diskette in single-density, type NO and press the RETURN key. The terminal will display:

```
DOUBLE SIDED <YES>?
```

To create a double-sided diskette (it must be certified for double-side use), press the RETURN key. However, you **must** have drives that are capable of double-sided operation, such as H-17-4 disk drives or the Z-37. If you want a single-sided diskette, type NO and press the RETURN key. Your terminal will display:

```
80 TRACKS <YES>?
```

To create an 80 track diskette (it must be certified for 96 tpi or 80-track use), you must have the proper drive, such as an H-17-4 or Z-37 system. Press the RETURN key for 80 tracks or type NO, and press the RETURN key for 40 tracks.

The disk drive will come on and you will hear a regular clicking sound as the read/write head steps across the diskette while it is being formatted. When the drive is finished, the terminal will display the TEST menu.

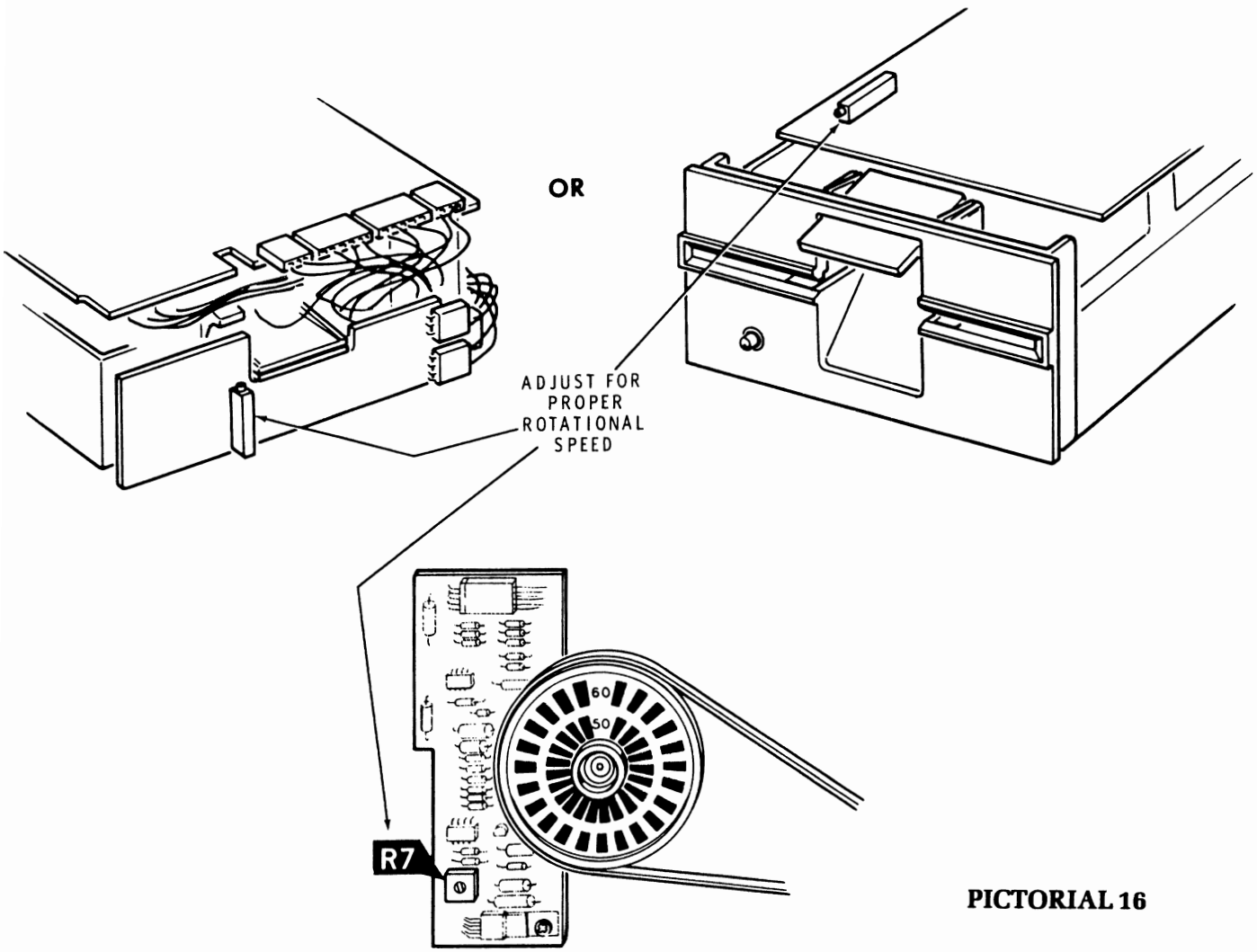
Each time you want to format a diskette for use by the TEST program, use the **F** option at the TEST menu.

Option T: Display Drive Rotational Speed

The drive speed test checks the speed at which the disk rotates in the selected disk drive. During this test, the relative rotational speed of the drive under test will be shown by displaying a series of decimal numbers, which should be close to 1.000. Since the acceptable speed tolerance is one percent, the final value may safely range anywhere from 0.990 to 1.010. It is not necessary to adjust the speed of any drive unless it is out of tolerance. Allow the test to run for 30 seconds; then press CTRL-C to return to the TEST menu.

If the speed of your disk drive(s) are out of tolerance, the numbers displayed will be either less than 0.990 or greater than 1.010. Using Pictorial 16 as a guide to locate the speed adjustment control on your disk drive, carefully adjust the control with a small screwdriver until the number is within tolerance. The speed adjustment control may be extremely sensitive, so if an adjustment is necessary, do not turn it far in either direction.

You may wish to perform this test periodically, depending on how heavily you use your drive(s). The linear servo loop (which regulates the drive speed) makes the speed stable. But as the drive bearings begin to wear (after many hours of use), the speed may change slightly. Fluctuations within acceptable speeds are normal and are generally attributed to variations in temperature and humidity.



PICTORIAL 16

Option D: General Drive Checkout

The purpose of the General Drive Checkout is to verify that your system is reading from — and writing to — the diskette properly. Each sector on the diskette is tested a number of times with various patterns that test the head seek mechanism and the read/write head itself. The test is repeated three times.

Do not be alarmed if this test takes a long time to finish. It is a very thorough test, and requires from 45 minutes to 1-1/2 hours to complete. The duration of the test will depend on the format you used on the diskette under test. Run this test only if you suspect problems in your system.

If you selected drive 0 for your tests, your terminal will display:

```
INSERT THE DISKETTE YOU WISH TO USE FOR THIS TEST
INTO DRIVE 0, AND HIT RETURN.
READY?
```

After you have inserted the diskette and pressed the RETURN key, the terminal will display:

```
3 PASS GENERAL DRIVE TEST FOR UNIT 0
```

While each pass is being executed, the program will print the letters "ABCDEFG", one after the other, at intervals of a few minutes. These letters indicate the various phases of the test and give you an idea of how far it has progressed.

The program will print an "END OF PASS" message at the end of each test cycle. If everything proceeded normally, without any system or diskette errors, the output for the first pass will read:

```
ABCDEFG END OF PASS 1
```

However, if the test discovers any problems on the current pass, the output will include the number of "hard" and "soft" errors, and the display will be similar to:

```
ABCDE 001/005 FG END OF PASS 1
```

In this example, test E failed with 1 "hard" error and 5 "soft" errors. The tests corresponding to each letter are:

```
A = Write all zeroes
B = Read all zeroes
C = Write all ones
D = Read all ones
E = Write identification pattern
F = Read identification pattern
G = Random read/write test
```

Let the program run through all three test cycles, even if it discovers errors.

Soft errors usually indicate that the disk drive temporarily had difficulty reading from or writing to the diskette. They may be caused by dust, noise, static electricity, and so forth. Soft errors are nothing to be concerned about as long as they do not exceed one or two an hour; you may correct them by simply repeating the failed test.

If, after you perform ten retries (in an attempt to correct a soft error), the program still cannot perform the read or write operation, TEST reclassifies the soft error as a hard error. Hard errors are usually caused by malfunctions in the electronic or electro-mechanical hardware and/or a defective diskette.

If you have any hard errors, the best approach is to exit this program (type **E** at the option menu), format another diskette, and repeat the entire TEST procedure. If this approach is successful, it is probably because the first diskette had one or more bad sectors, possibly caused by dust, dirt, or mishandling. If replacing the diskette corrects the hard errors, continue through the other TEST options and then use the **U** option to restart TEST. Insert the bad diskette and perform a "Media Check" test to identify bad sectors. If the diskette contains bad sectors, discard it. Do not use a defective diskette to store data or programs.

Hard errors that occur on the inside (high numbered) tracks will usually be caused by using diskettes that have not been certified for double-density, double-sided, 80-track use. Format the diskette for single-density, single-sided, 40-track use and test it under the "Media Check" test. A diskette that does not pass the "Media Check" test with a double-density, double-sided, 80- track format, will usually pass as a single-density, single-sided, 40-track diskette, unless it has been physically damaged.

If you are getting both hard and excessive soft errors (more than one or two an hour), and "Media Check" finds nothing wrong with the "bad" disk, you may have a hardware problem.

If changing the diskette does not correct the problem, or if you do suspect that you have hardware problems, refer to the "In Case of Difficulty" section.

Option M: Media Check (Sector Validity)

The media check option will examine the diskette under test for defects in its magnetic oxide coating. If you had any hard or soft errors during the General Drive Checkout, defects in the diskette coating could be the cause. If the media check finds any bad sectors, the bad sector numbers will be listed at the end of the test. Run this test on all new diskettes to confirm the quality of the coating.

The Media Check will take anywhere from 20 to 45 minutes. At the end of the test, the following message will be printed:

```
nnnn BAD SECTORS LOCATED
```

The number "nnnn", which can range from 0 to 2560, will show how many of the sectors on the diskette are defective. The bad sector numbers will be listed and should be recorded for future reference. If the media check discovers a bad sector, try using a less demanding format (single-density versus double-density, 40 tracks versus 80, etc.) and run the test again. If media errors still occur when it has been formatted as a single-density, single-sided, 40-track diskette, then throw it away. Do not use it to store data or programs.

Option S: Perform Seek Time Checkout

This test will determine your drive's highest reliable track- to-track (seek time) speed. The H-17-1 drive assemblies are guaranteed to perform reliably with a seek time of 30 milliseconds per track, and H-17-4 drive assemblies are guaranteed to perform reliably with a seek time of 6 milliseconds per track.

The maximum seek speed may change as the drive unit "ages" slightly. If frequent read errors occur with one of your drives, you should rerun this test to check for possible changes in the drive speed.

The program will attempt descending step rates of 30, 20, 12, and 6 milliseconds per track until it has determined your drive's fastest reliable track seek time. The program will print what speed is being attempted as the test is being run. For each successful pass, the program will print the message "OK!" to indicate that the drive performs reliably at that speed. A typical display for an H-17-4 disk drive (Z-37, hardware unit 0) will show:

```
SEEK TIMING TEST:
SEE THE MANUAL BEFORE RUNNING THIS TEST.
        **************************************************
        **************************************************
        **   NOTE:                                      **
        **     96 T.P.I. DRIVES ARE SPECIFIED  TO STEP  **
        **     AT 6 MS/TRACK,  AND  48  T.P.I.  DRIVES  **
        **     ARE SPECIFIED TO STEP  AT  30 MS/TRACK.  **
        **     OCCASIONALLY,  DRIVES  STEP FASTER THAN  **
        **     THE  SPECIFIED RATE.   THIS TEST DETER-  **
        **     MINES  THE MINIMUM STEP RATE  FOR  YOUR  **
        **     PARTICULAR DRIVE. HOWEVER, HEATH/ZENITH  **
        **     DOES NOT  GUARANTEE THAT ANY DRIVE WILL  **
        **     STEP FASTER THAN THE SPECIFIED RATE.     **
        **                                              **
        **     THE  H/Z-37  CONTROLLER  SUPPORTS  STEP  **
        **     RATES OF: 30 MS, 20 MS, 12 MS, AND 6 MS  **
        **     PER TRACK.                               **
        **************************************************
        **************************************************

PROCEED (YES/NO)? YES

TRYING 30 MILLISECONDS PER TRACK - OK!
TRYING 20 MILLISECONDS PER TRACK - OK!
TRYING 12 MILLISECONDS PER TRACK - OK!
TRYING 6 MILLISECONDS PER TRACK
DRIVE PERFORMS RELIABLY AT 6 MILLISECONDS PER TRACK.
```

When the seek time test is complete, the message "DRIVE PERFORMS RELIABLY AT nn MILLISECONDS PER TRACK." will be printed, where "nn" is the optimum seek time of your drive. Record this number for future reference.

Note that if TEST attempts a pass at 6 milliseconds per track, it may not print the "DRIVE PERFORMS RELIABLY..." message, but instead may "hang up" and stop execution. If the test attempts a speed of 6 milliseconds per track but fails to print the "DRIVE PERFORMS RELIABLY..." message, the fastest reliable seek time is 12 milliseconds per track. If the test stops executing without printing any message, type CTRL-C before you proceed to the next test.

You will probably want to perform this test on your other drives in order to determine the seek speed for all drives in the system. To do this, use the **U** TEST menu option to change the drive to be tested; then run the seek time test again. Set your operating system seek speed to that of the slowest drive in your system unless the operating system has the ability to use different speeds for different drives.

Option A: Align Drive Head

NOTE: **Do not attempt** to align the read/write heads of your disk drive(s) unless you are qualified to do so. The read/write heads are aligned at the factory and will seldom, if ever, need realignment.

The align menu option is used when you align the disk drive's read/write head. To use this option you will need an alignment diskette (not included) and the service tools mentioned on Page 49 (also not included). This option causes the disk drive's read/write head to read a track, that you specify, on the disk. The drive will continue to read that track while you adjust the alignment. You can then specify a different track number, and continue the adjustment procedure until the tracks on the alignment diskette produce the desired displays on the oscilloscope. Be sure to read the disk drive manufacturer's instructions and the alignment disk manufacturer's instructions before using this program.

To use the align option, enter **A** and press the RETURN key when the TEST menu is displayed. The program will display (for drive 0):

```
                RADIAL HEAD ALIGNMENT:
WARNING -- CHECK YOUR MANUAL BEFORE PROCEEDING!
INSERT THE ALIGNMENT DISKETTE IN DRIVE 0.
HIT RETURN WHEN READY?
```

To begin the alignment procedure, insert the alignment diskette into the drive whose hardware unit number appears in the message and press the RETURN key. The program will display:

```
ENTER TRACK NUMBER <0>
```

At this point, enter the first track number (as directed by the manual provided with the alignment disk) and press the RETURN key. The system will display:

```
ENTER SIDE NUMBER <0>
```

Calibration

You will need the following equipment to calibrate the Z-37 portion of your WH-8-37 circuit board.

1. A Digital Volt Meter (DVM) with a 3-1/2 digit readout.
2. A calibrated dual-trace oscilloscope with algebraic-add capability and with sweep speeds of 100 ns/cm and 200 ns/cm, and an operating scale of 5V peak-to-peak.
3. (Optional) A frequency counter capable of measuring 2.00 MHz.
4. HDOS with INIT or CP/M with FORMAT software.

If you cannot obtain the proper results in the following steps, refer to the "In Case of Difficulty" section of this manual and correct any difficulties before you proceed.

Refer to Pictorial 8 for the location of the test points when you perform this calibration.

VCO BIAS ADJUSTMENT

Warm up the Computer for a minimum of 15 minutes with the lid closed.

Connect your DVM (positive lead) to test point 3 (TP3) on the WH-8-37 board and connect the negative lead to ground. The reading should be 1.38 to 1.42V (this is the VCO bias voltage). If you do not obtain the proper voltage, adjust control R11.

Disconnect the DVM.

VCO CENTER FREQUENCY ADJUSTMENT (With Frequency Counter)

This is the preferred method of adjusting the VCO's center frequency.

Connect the frequency counter to test point 1 (TP1) on the board. Set the counter to the 100 ms time base. The counter should read from 1975 to 2025 kHz. If it does not, adjust control R13.

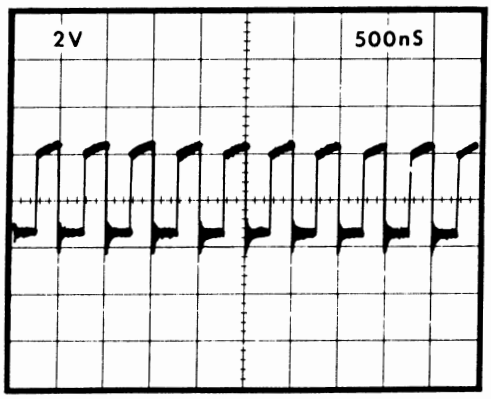
Disconnect the counter.

VCO CENTER FREQUENCY ADJUSTMENT (With Oscilloscope)

Connect the oscilloscope's input lead to test point 2 (TP2).

Set the oscilloscope's sweep to 500 ns/cm. The period of the square wave displayed on the screen should be 493 to 506 ns. If it is not, adjust control R13 until you obtain a display similar to Pictorial 17.

PICTORIAL 17



Disconnect the oscilloscope.

PRECOMPENSATION ADJUSTMENT

Connect the oscilloscope to test point 2 (TP2).

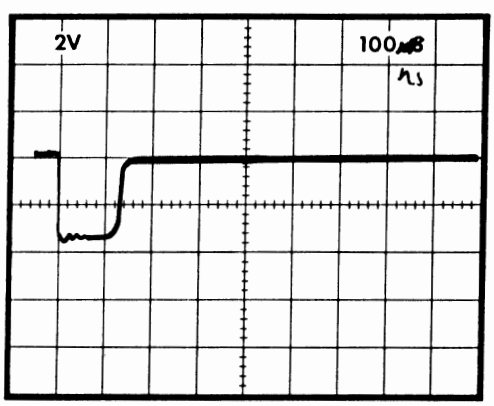
Set the oscilloscope's sweep to 100 ns/cm.

Using your system's software (INIT in HDOS or FORMAT in CP/M), write on the disk in double-density mode. The period of the pulse displayed on the screen should be 125 to 150 µs. If it is not, adjust control R6 until you obtain a display similar to Pictorial 18.

Disconnect the oscilloscope.

This completes the calibration of the Z-37 portion of the WH-8-37 circuit board.

PICTORIAL 18



Circuit Description

The Model WH-8-37 Double-Density Disk Controller and Z-67 Interface circuit board allows the H-8 Computer to store and retrieve large quantities of data and programs. The Controller Circuit Board selects the correct drive when two or more drives are used for a write or a read operation and properly handles the flow of data to or from the drive or system. All data and address exchanges between the Controller Circuit Board and the H-8 bus are buffered to protect the H-8 bus from spurious signals.

The Controller Circuit Board contains a soft-sector, double-density disk controller for 5-1/4" disk drives (H-17-1 or H-17-4) and an interface for the Z-67 Winchester Disk Drive. Enabling and control signals from the H-8 Computer are used to select either the Z-37 Controller or the Z-67 Interface by the control decoder (U26). The Z-67 portion of the circuit description is on Page 53.

Refer to the Block Diagram (fold out) of the WH-8-37 Circuit Board, while you read the following description of the Controller.

THEORY OF OPERATION

The Controller's function is to translate and transmit the instructions of the processor to the disk drives. To illustrate this operation, assume that you have instructed the processor to write on disk drive number one. First, the processor sends the proper enabling and control signals over the control lines. These signals are made compatible with the 1797 disk controller by the control decoder and inverter. The controller then blocks all interrupts to the processor (except its own by sending a "block interrupts" signal to the interrupt control ICs). This prevents another peripheral from interfering with the transfer of data between the processor and the disk drive. The controller also signals the buffer direction control IC to allow input from the processor to pass through the data buffer to the controller.

The interface control latch then starts the motor(s) of the disk drive(s) by translating the drive control signals from the processor. The data from the processor is now sent over the data bus, through the 1797, the support logic and disk interface logic, and to drive number one over the serial disk data line (the support logic and disk interface logic help the 1797 disk controller communicate with the drive electronics). The function of each individual IC is described on Page 63.

The read process is similar to the write process. First, the processor sends the proper enabling and control signals over the control lines, just as before (but this time the signals enable the disk controller board to read instead of write). The signals are made compatible with the 1797 disk controller by the control decoder and inverter. The 1797 controller again blocks all interrupts (except its own) to the processor by sending a "block interrupts" signal to the interrupt control ICs, preventing another peripheral from interfering with the transfer of data. The controller also signals the buffer direction control IC to allow output to the processor to pass through the data buffer from the controller. The interface control latch then starts the motor(s) of the disk drive(s) by translating the drive control signals from the processor. Then the data from the disk is sent over the drive serial line, through the disk interface logic, the support logic, the 1797 disk controller, the data buffer, and data bus to the processor.

The phase lock loop (PLL), which is part of the support logic along with the variable control oscillator (VCO), track the frequency of data read from the disk. This tracking generates a read clock (RCLK) signal that tells the disk controller how fast to read the data. (The speed of the incoming data changes due to variations in the rotating speed of the disk and the position of the data on the disk.)

Z-67 Interface Bus Pin Assignment

The Z-67 interface is connected to the Z-67 controller through a 40-pin connector.

The pin assignments are as follows:

Signal	Pin No.
DATA0	2
DATA1	4
DATA2	6
DATA3	8
DATA4	10
DATA5	12
DATA6	14
DATA7	16
PARITY	18
———	20 (spare)
———	22 (key)
———	24 (spare)
BUSY	26
ACK	28
RST	30
MSG	32
SEL	34
C/D	36
REQ	38
I/O	40

NOTE: All signals are active low and all odd pins are connected to ground. The signal lines are terminated with 220 ohms to 5 volts and 330 ohms to ground.

Circuit Description

The Model WH-8-37 Double-Density Disk Controller and Z-67 Interface circuit board allows the H-8 Computer to store and retrieve large quantities of data and programs. The controller circuit board selects the correct drive when two or more drives are used for a write or a read operation and properly handles the flow of data to or from the drive or system. All data and address exchanges between the controller circuit board and the H-8 bus are buffered to protect the H-8 bus from spurious signals.

The Controller Circuit Board contains a soft-sector, double-density disk controller for 5-1/4" disk drives (H-17-1 or H-17-4) and an interface for the Z-67 Winchester Disk Drive. Enabling and control signals from the H-8 Computer are used to select either the Z-37 controller or the Z-67 interface by the control decoder (U26). The Z-37 portion is described on Page 51.

Refer to the Block Diagram (fold out) of the WH-8-37 Circuit Board, while you read the following description of the Interface.

HARDWARE THEORY OF OPERATION

Data is read and written through the bidirectional data buffer, the read/write data latches, and the data transceivers. The data transceivers communicate with the Z-67 transition and controller boards (in the Z-67).

Read/Write control, status buffering, and resets are accomplished by the control signal decoder, interrupt logic, status buffer, control latch, and reset/acknowledge latch and generator. These circuits communicate with the Z-67 Winchester Disk Drive through the control line drive and receive buffers.

Parity generation and checking is accomplished by the data parity generator/checker. When a write is performed, the WH-8-37 Controller Circuit Board sends a parity bit to the Z-67 drive along with the data word. When a read is performed, the interface checks the parity bit sent from the Winchester Disk Drive to determine if the data is correct.

The positions of the DIP switches are read through the DIP switch buffer and data bus, although they are not currently used by Heath or Zenith Data Systems software.

Please refer to the schematic (fold-out) as you read the following description.

Reset Operation

When the Computer is turned on, it sends a reset signal to the WH-8-37 Controller Board Z-67 interface circuits. This reset clears whatever state the circuits happen to be in. The reset signal comes in at pin 29, is buffered by U24, and resets control latch U16, interrupt logic U5A and U5B, and divide-by-eight counter U27.

Read Operation

When the Computer wants to read data from the Winchester Disk Drive, it sends control signals to the disk drives through U35 and U36, the bidirectional buffers (which are normally set to allow input from the Computer rather than input from the drives). The control signals travel over the internal data bus to control latch U16, which passes the SEL (drive select) control signal to the drives through the buffer U1 and the Z-67 cable.

When the proper drive receives the select signal, it responds with a BUSY signal, which the Computer reads from status buffer U19 by changing the direction of buffers U35 and U36 with a IORD signal. The Computer then removes the select signal from the line by resetting control latch U16. The Winchester drive responds with a REQ, or request, signal. This signal is ANDed with a 67 REQ INT EN (Z-67 request interrupt enable) at U7B to produce an interrupt to the Computer via buffer U6B (The REQ INT EN comes from the U16 control latch).

The other control signals are ACK hold (Acknowledge hold) and REQ INT EN (request interrupt enable). The first is used to prevent the Z-67 controller from asserting a REQ to the interface, while the latter allows the drives to interrupt the Computer (However, in the standard system software, interrupts are not used, so REQ INT EN is ignored).

Another control signal that comes from the data bus is the software controllable reset signal (data bit 4). This data bit is routed directly to reset latch U4A. From there, the reset is strobed by counter U27 to buffer U1B, where it is passed on to the drives.

To continue the read process after receiving an interrupt, the Computer sends an IORD (I/O Read) through U25 into U26 where RD DATA is generated when the proper port is addressed by signals from the Computer (decoded by ICs U15, U25, and U14). RD DATA causes data to be read from the appropriate disk drive (or partition), while RD SWITCH allows the DIP switch DS1 to be read.

RD DATA enables the read latch U9. RD DATA also sets the acknowledge flip flop U8B (through OR gate U7A), sending an acknowledge signal to the Z-67 Winchester drive (by means of buffer U1C) that tells it that the interrupt was received.

Data can now be transmitted from the Z-67 Winchester Disk Drive unit to the H-8 Computer.

Write Operation

When the Computer needs to write data to the Winchester Drive, it sends control signals to the disk drives through U35 and U36. The drives respond with the same handshaking procedure as before. However, instead of receiving an IORD, an IOWR is received by the Controller Board at pin 21.

The IOWR (I/O write) signal is received and decoded in the same manner as the IORD. The resulting signal activates the LD DATA (load data) and LD CON (load control) lines from U26. LD DATA enables the write latch U21 and the acknowledge flip flop U8B (through or gate U7A). The acknowledgment tells the Winchester that data will now be written onto the drive that was selected.

IN CASE OF DIFFICULTY

Troubleshooting Information

The WH-8-37 Interface Board was not designed to be user-serviceable. If it does not function properly, or if the Computer does not boot or read disks, check the jumpers on the Interface Board for the following settings:

Parity	Odd
Parity Error	On
Pre Comp	Off
Z-67 Reset	32
Port	170
Z-67	On (If connected)
Z-37	On (If connected)
Z-67 INT	Off

DIP switch (DS1) settings are defined by your software needs. Consult your operating system manual for proper switch settings. If your system does not read the DIP switch, you can leave the switch in any position.

Make sure the correct ROM's and ROM jumpers are installed on the CPU board.

Make sure the WH-8-37 and HA-8-6 boards are seated correctly on the backplane and are not installed a pin or two off.

Make sure the data cable between the HA-8-6 and WH-8-37 boards are properly connected and that pin 1 (marked with a triangle) is lined up with the notch on the DIP socket.

Make sure the cables to your disk drives are secure and properly lined up.

Make sure the configuration of the 8-section status port switch is properly set.

If you have a Z-67, make sure that it has been properly prepared. This means that you may have to run the PREP program prior to partitioning the hard disk for use. Also be aware that CP/M requires that partitions (other than the first) be assigned each time the Z-67 is started from a cold boot (unless the partition is used as the boot partition).

To boot from the floppy drive in the Z-67, you must follow the Universal boot procedure. Although the Z-67 (during single key primary or secondary boot procedure) will only boot from the Winchester Disk, the floppy drive is considered (under CP/M) as the third hardware unit in the system.

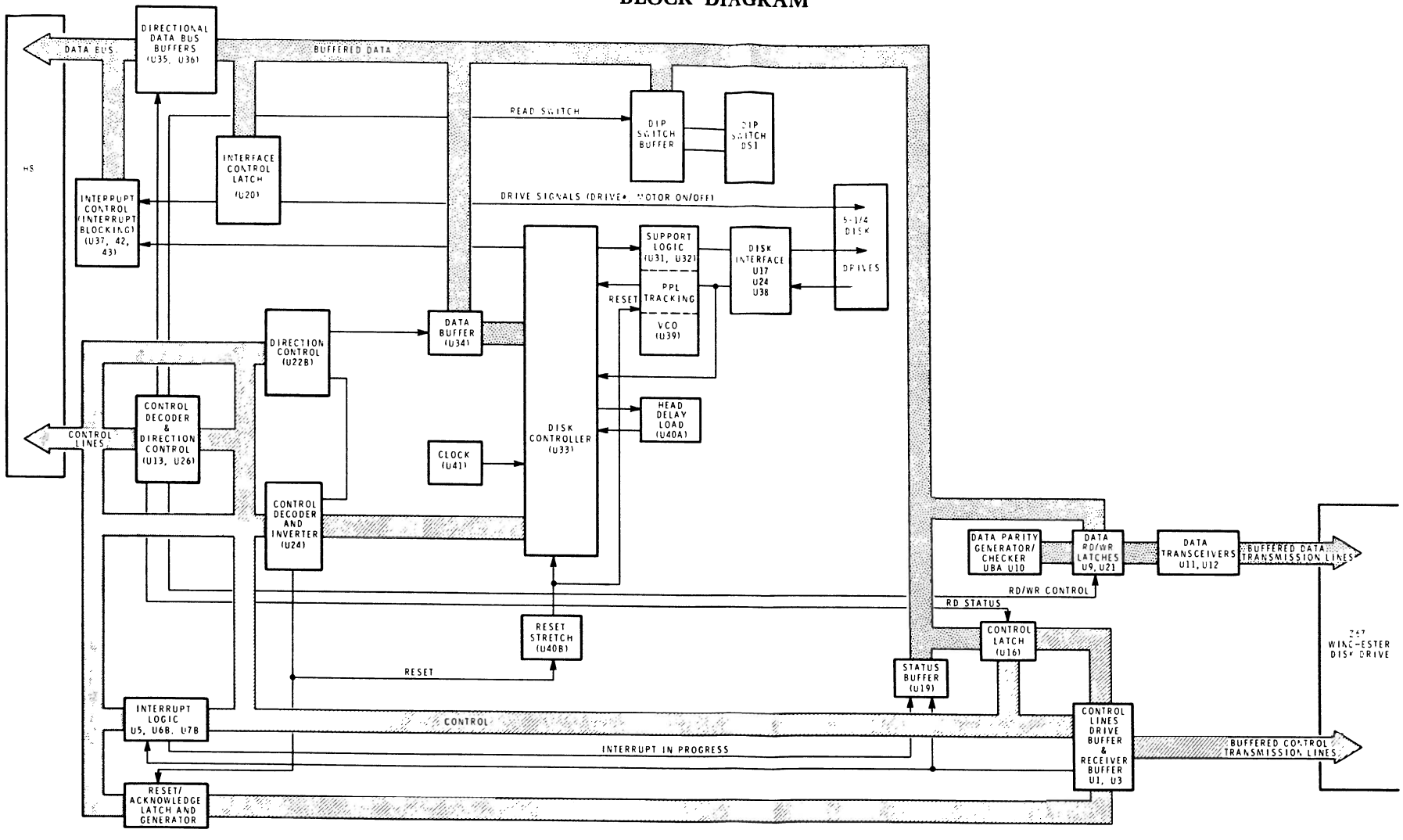
Refer to the following chart to see if the problem you are having is listed. If it is, check the items in the "Possible Cause" column to help you locate the area of trouble.

PROBLEM	POSSIBLE CAUSE
Drive access light does not turn on when disk is booted.	1. Check for proper connection of cables inside the computer. 2. Be sure the disk drive unit(s) are turned on. 3. Check U13 on the CPU circuit board for proper part and installation. 4. Check for proper installation of jumper wires on CPU circuit board. 5. Check for proper installation of the jumpers on the WH-8-37.
All disk access lights turn on and remain on.	A cable is connected with the marked edge on the wrong side.
Two drives turn on when a boot operation is selected.	Two drives have their disk selection jumpers programmed the same. See "Disk Drive Configuration" on Page 26.
The disk appears to boot but the terminal screen remains blank except for the cursor in the upper left-hand corner of the screen.	1. Terminal is "Off Line." 2. The terminal has not been reset (press the right SHIFT key and RESET at the same time).

If your Interface Board needs servicing, call the nearest Heathkit Customer Center. IMPORTANT: Be prepared to furnish the following information. It will be helpful in diagnosing and repairing your unit.

1. The problem you are having.
2. Name and model of your computer system.
3. Baud rate.
4. System configuration.
5. Any additional information that will help describe your system.

BLOCK DIAGRAM



Replacement Parts List

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
RESISTORS		
R1-R3	6-103-12	10 k ohm 1/4-watt
R4-R5	6-1002-12	10 k ohm 1/4-watt 1%
R6	10-1138	10 k ohm 3/4-watt control
R7	6-222-12	2200 ohm 1/4-watt
R8	6-473-12	47 k ohm 1/4-watt
R9	6-680-12	68 ohm 1/4-watt
R10	6-473-12	47 k ohm 1/4-watt
R11	10-1180	100 k ohm 1/2-watt control
R12	6-103-12	10 k ohm 1/4-watt
R13	10-1154	10 k ohm 1/2-watt control
R14	6-103-12	10 k ohm 1/4-watt
R15	6-124-12	120 k ohm 1/4-watt
R16	6-104-12	1000 ohm 1/4-watt
R17	6-332-12	3300 ohm 1/4-watt
R18-R36	6-102-12	1000 ohm 1/4-watt
RP1-RP3	9-123	220/330 ohm (6) resistor pack
RP4	9-119	10 k ohm (8) resistor pack
RP5	9-120	150 ohm (5) resistor pack
CAPACITORS		
C1-C38	21-769	.01 μF, 50 V ceramic
C39	25-925	4.7 μF, 50 V electrolytic
C40-C41	21-769	.01 μF, 50 V ceramic
C42	20-188	30 pF, 500 V mica
C43	20-148	100 pF, 500 V mica
C44	21-744	82 pF, 50 V ceramic
C45	27-217	.68 μF, 100 V mylar
C46	25-925	4.7 μF, 50 V electrolytic
C47-C48	21-769	.01 μF, 50 V ceramic
C49	25-925	4.7 μF, 50 V electrolytic
C50	21-192	.1 μF, 50 V ceramic
C51-C54	21-769	.01 μF, 50 V ceramic
C55	21-141	.0033 μF, 100 V ceramic
C56	25-197	1.0 μF, 25 V tantalum
C101-C104	25-924	2.2 μF, 50 V electrolytic
C105	25-883	47 μF, 35 V electrolytic
C106	21-192	.1 μF, 50 V ceramic
C107	25-924	2.2 μF, 50 V electrolytic
C108	21-769	.01 μF, 50 V ceramic
C109-C110	25-924	2.2 μF, 50 V electrolytic
INDUCTORS		
L1-L6	235-229	35 μH, RF Choke

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION

INTEGRATED CIRCUITS

See "Semiconductor Identification Chart"

CABLE

	134-1241	16-conductor ribbon cable
	134-1243	34-conductor ribbon cable
	134-1244	40-conductor ribbon cable
	134-1269	34-conductor ribbon cable

MISCELLANEOUS

DS1	60-621	8-section DIP switch
OSC	150-107	16 MHz crystal oscillator
	204-2308	H-8 heat sink bracket
	250-56	6-32 × 1/4" pan head screw
	252-3	6-32 nut
	254-1	#6 lockwasher
	266-966	H-8 bus connector key
	432-1041	Female Berg connector (65474-001)
	432-1063	Male Molex connector (08-50-0114)
	432-1076	Female crimp Molex connector (22-16-2251)
	432-1080	Female shell Molex connector (10-17-2032)
	432-1102	Male Molex connector (22-10-2031)
	432-1121	Male connector (3M-3432-2002)
	432-1171	Male Molex connector (22-10-2021)
	434-253	40-pin socket
	434-298	14-pin socket
	434-299	16-pin socket
	434-310	18-pin socket
	434-311	20-pin socket
	434-320	Socket (3M-3431-2002)
	434-310	18-pin socket
	434-311	20-pin socket
	434-320	Socket (3M-3431-2002)