H-17/H-37 Dual Controller Modification

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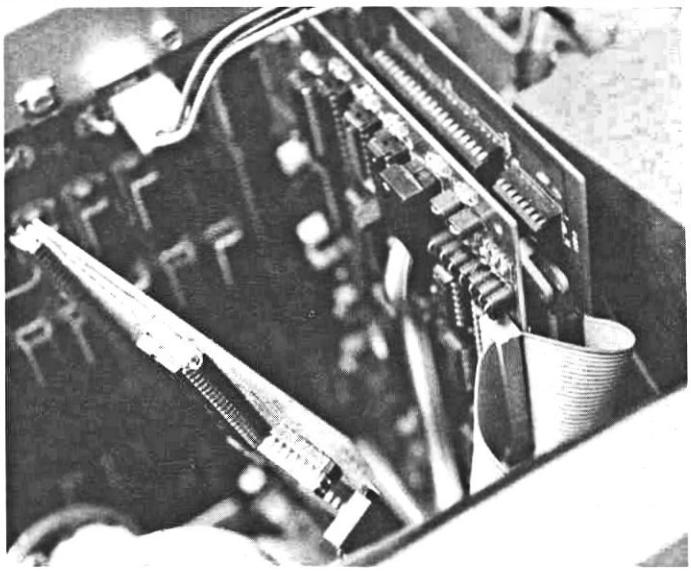


The H-17 and H-37 controller boards installed in an H-89. Notice that the drive cable starts on the H-17 board and jumps to the H- 37 board, then on to the drives.

Introduction

The H-17/H-37 dual disk controller modification is a modification to the H/Z-89 disk drive controllers which allows use of both hard sectored and soft sectored disks in the same set of drives. As presented here, this article assumes the user has up to three disk drives and both the H-17 and H-37 disk drive controllers.

Hardware modifications require several pins bent out and jumpers installed on the H-37 disk controller card only. Software modifications require minor modification to the CP/M BIOS for CP/M operation and a SET option for HDOS operation. Note that Heath/Zenith does not support hardware modifications on Heath/Zenith parts. You install this modification on your H-37 disk controller card at your own risk.

These modifications are based upon modifications defined by David Granz and modified by George Deffendall. David Granz owns Sterling Software and is the author of the public domain improved H-37 soft sectored device driver for HDOS and its improved follow-on, the Super-37 Device Driver, currently offered by Extended Technology Systems. George Deffendall is an officer of Extended Technology Systems.

Modification Discussion

This modification is designed to allow the user to use a single cable to connect both disk controllers with up to three disk drives. Both controllers can access the same disk drives only if they do not interfere with each other electrically. Therefore, hardware and software modifications must be designed to assure there is no chance that interference can happen.

To understand how this controller card modification works, let's look at the drives and cables to see how disk drives get information.

First, disk drives don't care what kind of disks are inserted; they just attempt to read or write what the disk controller tells them to. They also report other events such as track 00, door open, and the presence of an index or sector hole. It is up to the disk drive controller to make sense of what the disk drive is trying to say.

The disk drive cable is the pipeline through which the data passes. Popularly, flat cables are used with every other line on the cable tied to ground to reduce the chance of cross talk or interference in the signals being passed back and forth between the disk drives and the disk drive controllers.

The information passing through the remaining wires in the cable consists of control signals and data sent to the disk from the disk controller and status signals and data sent from the disk to the disk controller. Signals sent are said to use negative logic. That is: a zero (0) signal is indicated by high voltage (+5 volts) and a one (1) signal is indicated by low voltage (0 volts). Negative logic is used because it is easier and requires less logic to connect more than one device to the same line.

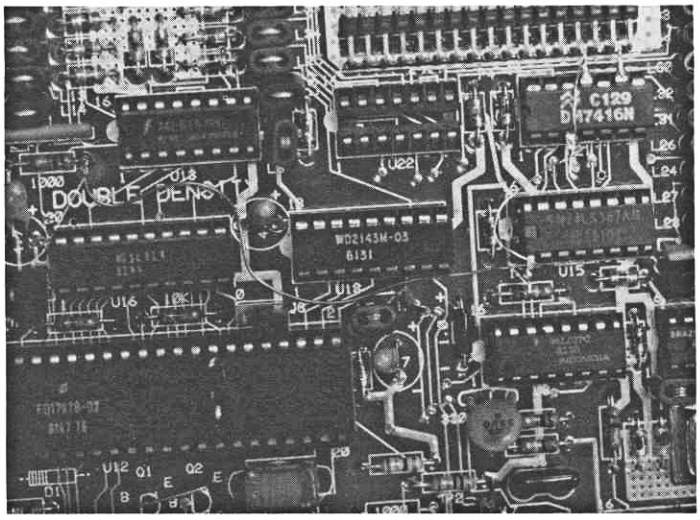
What is necessary, then, to prevent the two controllers from conflicting with each other, is (1) to make sure that a controller is prevented from sending a signal while the other is in operation, and (2) that the control signals are always off (high) when not in use. The first requirement will be accomplished via a software change, and the second requirement will be accomplished via a hardware change.

The disk drive status signals and data lines do not have to be modified. This is because both controllers simply read what is on these lines and do not try to modify these lines at any time. Similarly, the signal write data line through which the disk drives receive data from the controllers is only pulled low when the appropriate controller is writing data. Therefore, we can leave this signal alone.

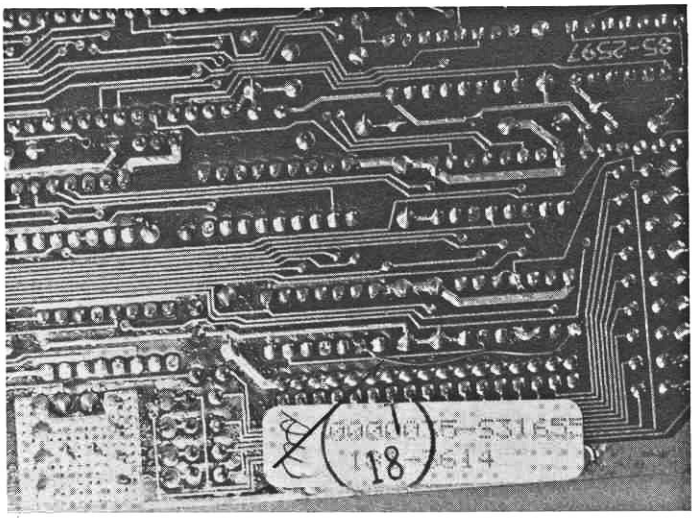
The disk control signals from the disk drive controllers, which must be tied high when not in operation, consist of the disk drive select lines, the write enable line, the head step and direction lines, and the side select line. We will steal some logic on the H-37 controller card to make sure that these lines are pulled high (+5 volts) or turned off when not in use.

A side effect of this modification will be the disabling of the lower plug (P4) of the H-37 card. Since this drive modification requires all drives to be connected to the same cable, this should cause no major difficulty. We will get our extra signals necessary to tie the disk drive control lines high from the logic which formerly was connected to this drive cable plug.

The software modifications to prevent the two controllers from interfering with each other are fairly simple. For HDOS, a set option is necessary to force each disk controller to reset itself when the other controller is in operation. For CP/M, the BIOS is modified to include a call to a controller reset routine when the opposing controller is in operation.



Component side of H-37 controller board showing jumper wires tack soldered to ICs U15 & U21, and to 1000 ohm resistor.



Foil side of H-37 controller board showing jumper wire installed (arrow).

As a consequence of this modification, the disk drive identification varies as a function of which controller is used. This is because Heath/Zenith selected different methods of addressing disks in their hard and soft sectored disk controller cards. We will explain this at the end of this article.

Now let's get to the modifications.

Hardware Modifications

On the H-37 soft sectored disk controller card, make the following changes:

☐ 1. Remove the 7416N from IC socket U22.

☐ 2. Remove the 74LS367 from IC socket U15. Bend pin 1 out at right angles and replace in the socket.

☐ 3. Remove the 7416N from IC socket U21. Bend pins 3, 9, and 11 at right angles and replace in the socket.

☐ 4. Using wire wrap wire, or other fine wire, solder wire from the four pins bent out, above to the end of the 1K resistor at R8. A single wire can be used to connect the pins bent out on the IC at socket U21. Solder the wires to the end of the resistor at R8 NEAREST THE CENTER OF THE CIRCUIT BOARD. The other end is +5 volts which could damage both controllers and the disk drives electrically. BE CAREFUL.

☐ 5. Turn the H-37 controller card over so that the solder side faces up.

☐ 6. Using wire wrap wire or similar wire, connect a jumper between pins 3 and 4 of IC socket U21.

☐ 7. Using wire wrap wire or similar wire, connect a jumper between pins 10 and 11 of IC socket U21.

☐ 8. Using wire wrap wire or similar wire, connect a jumper between pin 8 of IC socket U21 and pin 9 of IC socket U22.

☐ 9. Turn the H-37 controller card component side up and install jumper plugs at pins J4, J5 and J6.

☐ 10. Carefully inspect the modifications you have made to your H-37 disk controller card with these instructions. Be sure that you have connected the jumpers properly to the resistor at R8 AWAY FROM THE FIVE VOLT SUPPLY SIDE.

☐ 11. Install the H-37 disk drive controller into the center I/O slot of the processor board.

Make the following change to the internal drive cable:

☐ 12. Add a 34 connector female ribbon connector to the drive cable.

Finally:

☐ 13. Plug the drive cable back into the H-17 disk controller and to the H-37 disk controller. Use connector P3 (top connector) on the H-37 controller card.

Software Modifications

To operate both controllers simultaneously in HDOS, if you are using the stock Heath/Zenith controllers, there are no changes required. If you use the Ultimeth SY: driver, it is necessary to use the SET command as follows:

SET SY: SELECT ZERO

There, that was simple!

In CP/M, the modification is a bit more complex. It will be necessary to add a call to each of the disk controller routines to reset the opposite drive controller. The reset calls are added as follows:

Old H17 Code:

```
RDYH17D:
        MVI     A,D$E$UNR
        CALL    H17E
RDYH17E:
        JMP     XIT
ONH17:  EI
        LXI     H,0
        SHLD    DLYMO
        LDA     CTLPRT
        ANI     0FFH-040H
        STA     CTLPRT
        OUT     H88CTL
        LHLD    HSTDPB
```

New H17 Code:

```
RDYH17D:
        MVI     A,D$E$UNR
        CALL    H17E
RDYH17E:
        JMP     XIT
ONH17:  EI
        IF      H37T            ;MOD TO RESET H37
        CALL    RESH37          ;MOD TO RESET H37
        ENDIF                   ;MOD TO RESET H37
        IF      NOT H37T        ;MOD TO RESET H37
        LXI     H,0
        ENDIF                   ;MOD TO RESET H37
        SHLD    DLYMO
```

```
                LDA     CTLPRT
                ANI     0FFH-040H
                STA     CTLPRT
                OUT     H88CTL
                LHLD    HSTDPB
Old H37 Code:
                JC      RST37
                MVI     A,FD$TS
                OUT     FD$INT
                MOV     A,M
                OUT     FD$TRK
                RET
        ONH37:
                LXI     H,0
                SHLD    DLYM037
                LHLD    HSTDPB
                MOV     A,M
                ANI     DPEDD
                JZ      ONH37A
                MVI     A,CONMFM
        ONH37A: INX     H
New H37 Code:
                JC      RST37
                MVI     A,FD$TS
                OUT     FD$INT
                MOV     A,M
                OUT     FD$TRK
                RET
        ONH37:
                IF      H17T            ;MOD TO RESET H17
                CALL    RESH17          ;MOD TO RESET H17
                ENDIF                   ;MOD TO RESET H17
                IF      NOT H17T        ;MOD TO RESET H17
                LXI     H,0
                ENDIF                   ;MOD TO RESET H17
                SHLD    DLYM037
                LHLD    HSTDPB
                MOV     A,M
                ANI     DPEDD
                JZ      ONH37A
                MVI     A,CONMFM
        ONH37A: INX     H
```

Note that the LXI H,0 is replaced with the call.

Loose Ends

When booting from a soft sectored disk, CONFIGUR does not find all hard sectored drives. This is because it does not use this part of the BIOS code, but uses its own internal code. The equivalent code within CONFIGUR (and CONFIG80) must be found and patched to include this reset call. When that is done, CONFIGUR (and CONFIG80) will work properly.

In the meantime, it is suggested that the user run CONFIGUR on a hard sectored disk and copy the BIOS modified to the soft sectored disk. This procedure should be used until a patch is defined for CONFIGUR (and CONFIG80).

Disk Drive Identification

As we said previously, Heath/Zenith did not choose the same addressing logic for the hard sectored controller as they did for the soft sectored controller. In the hard sectored controller, Data Select line 3 is defined to be Drive 0, Data Select line 2 is Drive 1, and Data Select line 1 is Drive 2. In the soft sectored controller, Data Select line 1 is defined to be Drive 0, Data Select line 2 is defined to be Drive 1, and Data Select line 3 is defined to be Drive 2. The soft sectored drive selection logic is in accordance with industry standard.

The following table should aid in determining how the drives are identified.

	Normal Boot on H-17			Normal Boot on H-37		
	DS1	DS2	DS3	DS1	DS2	DS3
HDOS						
H-17	SY2:	SY1:	SY0:	DK2:	DK1:	DK0:
H-37	DK0:	DK1:	DK2:	SY0:	SY1:	SY2:
CP/M						
H-17	C:	B:	A:	F:	E:	D:
H-37	D:	E:	F:	A:	B:	C:

When booting from other than the low order disk in either system, the drive designations rotate for the boot controller only. This can get tricky, so be careful of your drive designations until you get used to the way they change depending on how you boot.

Using Alternate Disk Drives

One of the questions which frequently arises when discussing the modification of disk drive hardware or software is the feasibility of changing disk drives. This is particularly relevant when considering the fact that the H-37 soft sectored card and BIOS software will support both 40 and 80 track drives and both single and double sided drives.

As most of you know, Heath/Zenith selected 40 track, double sided drives for the H/Z-100 rather than 80 track, double sided drives. This reflects industry concern that the floppy disk media is not acceptably reliable in 80 track, drives due to thermal expansion properties and reduced error tolerances. This is also why I am using 40 track, double sided as my 5 inch soft sectored format for mastering the public domain software disks, which I personally make available to the rest of the Heath community for a copying donation.

With the large number of disk drive manufacturers currently offering a large variety of full height and half height disk drives including both 40 and 80 track and both single and double sided models, you generally won't go wrong if you get a new tested unit from a reliable name manufacturer. You, however, must make the decision between 40 and 80 track formats. If your system is not moved around very much and is not subject to wide temperature variances, 80 track will probably be fine. I have chosen 80 track double sided for my 5 inch hard sectored public domain software masters.

Most readers know, of course, that Heath/Zenith supports only 40 track single sided drives in hard sectored format. Therefore, the user must go outside Heath/Zenith to get disk driver software to support 80 track and double sided formats. I personally recommend, and use, the Ultimeth SY: driver for HDOS and Livingston Logic Labs BIOS80 for CP/M. *ED) HSY.DVD is also available from HUG on disk part #885-1121, this 2 disk set is supported by the Heath Users' Group.* Henry Fale is also one of two master distributors for Ray Livingston's BIOS80, the other is Ray Massa of Studio Computers, in Birmingham, Michigan.

We at ETS are a dealer for BIOS80 (we buy from Henry Fale) and also offer a version of the HDOS SY: driver for those customers of ours which require the SY: driver to use the capabilities of our other products.

My system, which uses the modifications described in this article, consists of an H-89 with two 40 track, double sided Qume Model 142 drives and one 80 track, double sided Tandon Model 100-4 drive. George Deffendall, my business partner, uses two 80 track, double sided Tandon Model 100-4 drives and a 40 track, single sided Siemens Model 100-5 drive. Both systems work fine. (My other system, also an H-89, uses the hard sectored controller with a 40 track, single sided Siemens Model 100-5b drive and two 80 track, double sided Tandon Model 100-4 drives, along with the H-47 controller with two Remex soft sectored 8 inch drives.)

Epilog

This concludes the modifications and discussions necessary to use both hard and soft sectored controllers with the same disk drives. As you can see, it's really not too hard and quite powerful once you get used to it.

Happy computing, Bob Todd.