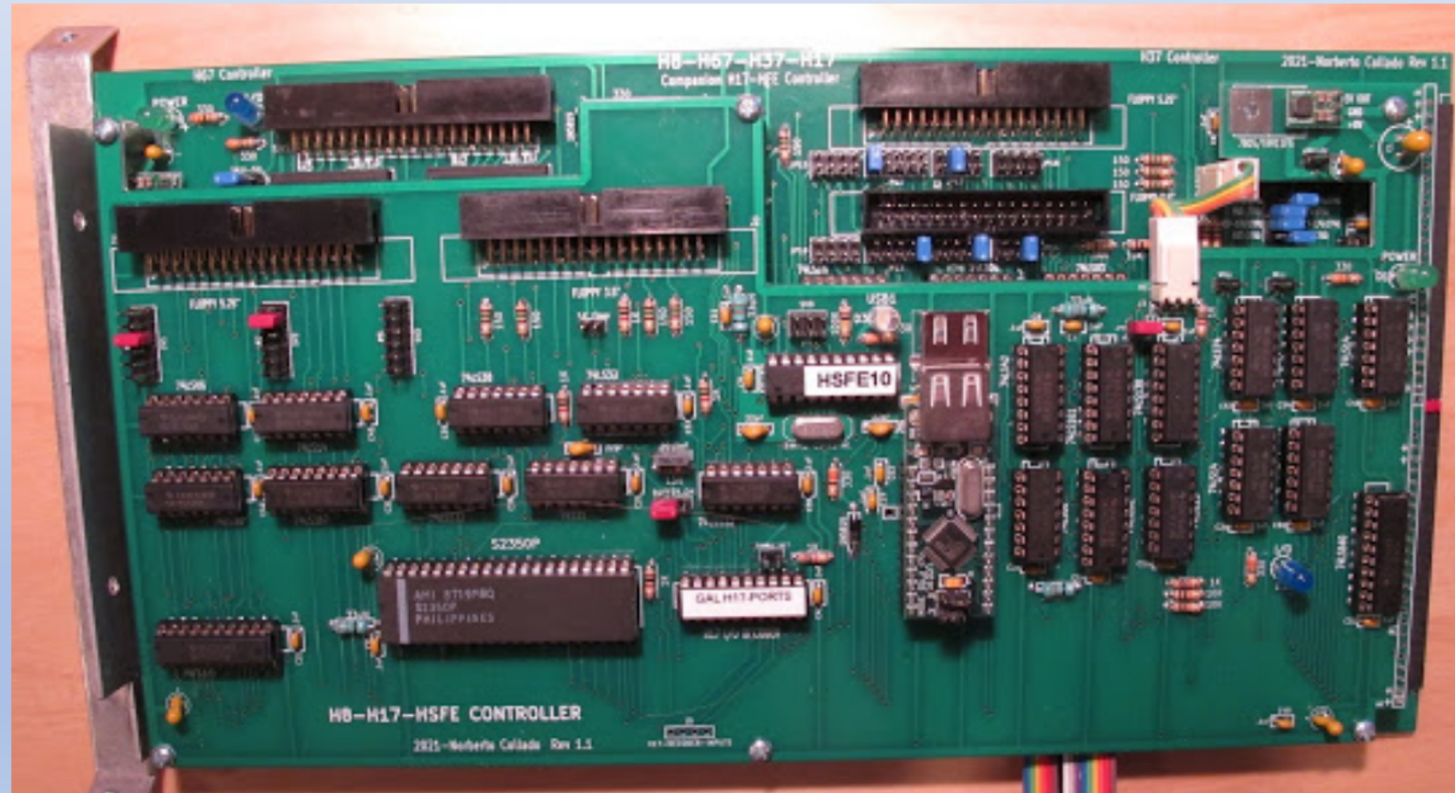


H8 Storage Controller H8-H67-H37-H17

Configuration/Connection Notes & Quick Start Guide



25 February 2021

Notes on the H37/67 Controller Board

- This is a modern replacement for the Heathkit WH-8-37 controller board, which provides:
 - Support for double-density soft-sectored floppy disk drives (or drive emulators) with capacity up to 720K (DS/DD/96TPI)
 - Support for Z-67 “Winchester” hard drive access via a Shugart Associates System Interface (SASI), an early predecessor to the Small Computer System Interface (SCSI) standard. The drive can be the original Heathkit Z-67 unit or a modern emulator such as the Z67-IDE+ (<http://koyado.com/Heathkit/Z67-IDE-plus.html>)
 - Support for an optional “companion” board for interfacing to the H17 single-density controller board plus support for Universal Serial Bus (USB) flash drives.
- This board was designed as a companion to the new Z80 Rev. 3.x CPU (and newer) boards (<http://koyado.com/Heathkit/H8-Z80-64K-RTC-ORG0-V3.html>) but will work with legacy Heath, Trionyx or other boards.
 - Legacy CPU users should upgrade their front panel ROM to [PAM-37](#) and install new Front Panel labels, if not already installed (see http://koyado.com/Heathkit/H8-Z67_files/H8-Z67DISK%20CONTROLLER%20V1_1.pdf)
 - Other pertinent configuration information including switch settings for the Z80 CPU board is contained in the original Heathkit WH-8-37 manual: https://sebhc.github.io/sebhc/documentation/hardware/H8/H8-37_Op_Sc.zip
- *Users of the Trionyx Z80 board need to make special changes as outlined later in this document*

H37/67 V1.1 Jumper Definitions

| Jumper | Function |
|--------------------|--|
| JP1 | <p>Insert a jumper here to indicate that the IORQ signal is present on the H8 bus.</p> <ul style="list-style-type: none">• When using the Z80 V3 and newer boards, select position 1-2 (marked "Z80"), and then on the Z80 board insert jumper JP7 (SEL24) to put IORQ on the H8 bus.• When using legacy Z80 boards such as Heath, Trionyx, or others, select position 2-3 (marked "FAKE") to generate a fake on-board "IORQ" signal. |
| JP2, JP3, JP4, JP5 | <p>These jumpers control the port assignments for the H37 and H67 portions of the circuitry. See <i>description below for instructions on how to set the jumpers.</i></p> |
| JP6 | <p>Controls odd or even parity. Default is not installed to create "ODD" parity. (<i>Inserted would create "EVEN" parity which is not supported by the Heath operating systems.</i>)</p> |
| JP7 | <p>Selects SASI Drive 0 or 1. Default is position 1-2 marked "D0".</p> |
| JP8 | <p>Selects the internal VCO frequency for use with 5 ¼ "drives or 8" drives. Select -5 for 5 ¼ "and 8 for 8" floppy drives. Default is position 1-2 marked "5".</p> |

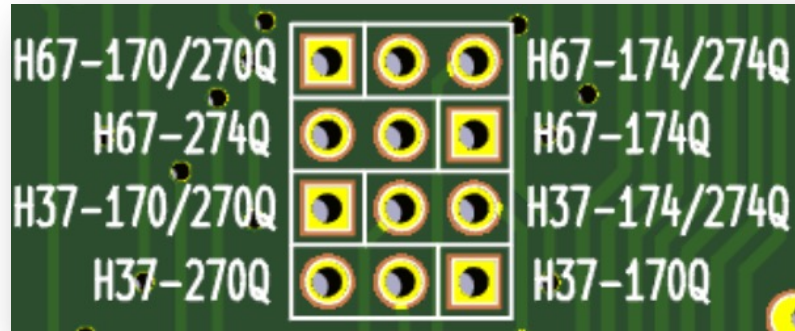
H37/67 V1.1 Jumper Definitions (cont'd)

| Jumper | Function |
|---------------------------|---|
| JP9 | Selects the Floppy Controller clock, which requires a free-running 50% duty cycle square wave clock for internal timing reference, 2 MHz \pm 1 % for 8" drives, 1 MHz \pm 1% for mini-floppies - 5 ¼". Default is position 1-2 marked "1" (not using 8" drives.) |
| JP10, JP11 JP12, JP14 | DSX5, DSX6, DSX7, DSX8 drive select jumpers for J3 (3-½" connector at J2). <i>See description below for instructions on how to set the jumpers.</i> |
| JP13 | Selects the Floppy Controller filter capacitor. The filter capacitor value is 0.22uF for 5-¼" drives and .1uF for 8" drives. 5-¼" drives operate at exactly one-half the data rate of 8" (250 Kb/sec). Default is position 2-3 marked "5" (not using 8" drives.) |
| JP15, JP16, JP17, JP18 | DSX5, DSX6, DSX7, DSX8 drive select jumpers for J3 (5-¼ " connector at J3). <i>See description below for instructions on how to set the jumpers.</i> |
| JP19, JP20 | Bypasses on-board regulators by connecting board 5V directly to bus pins 48/49. Default is not installed. (Insert jumper only if using PC-ATX style switching power supply to place regulated 5V on the bus!) |

H37/67 V1.1 Jumper Definitions (cont'd)

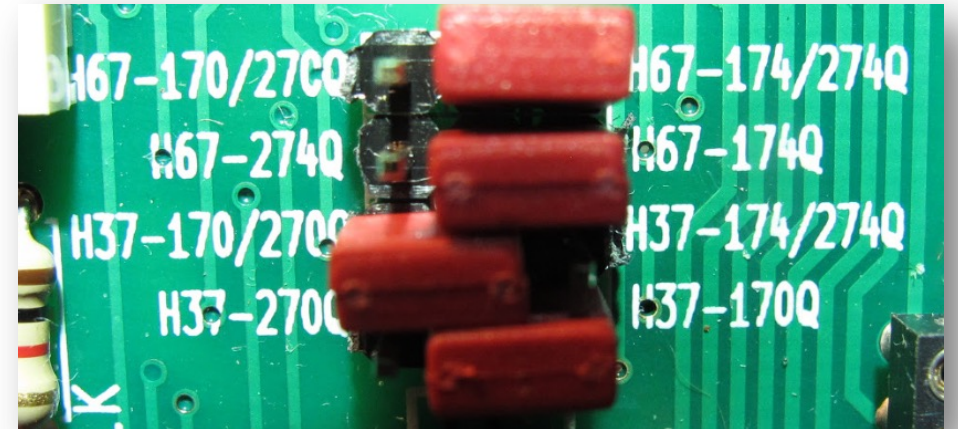
| Jumper | Function |
|------------|---|
| JP21, JP22 | WR_L and RD_L are only installed when U40 is removed for high speed Z80 clocks (> 10MHz) if there are issues. Default is not installed with U40 inserted. The Z80 V3.2 board carries the same jumpers. |
| JP23 | BUF-ON - For debugging select 1-2 (marked "DEBUG".) Default is position 2-3 (marked "ON") . |
| JP24 | Variations in drive spin-up time can confuse the Heath OS into thinking the drive is at speed, however this is unusual. Install this jumper only if having problems booting or formatting 5-¼" or 3-½" media. Default is not installed . |
| JP25 | BUS-PARITY – Most Winchester drive controllers did not support this, however a jumper option is provided for possible future needs. Default is not installed . |
| TEST | The "TEST" jumper is only used when calibrating the board. Default is not installed . |

H37/67 V1.1 Port Assignment Jumpers



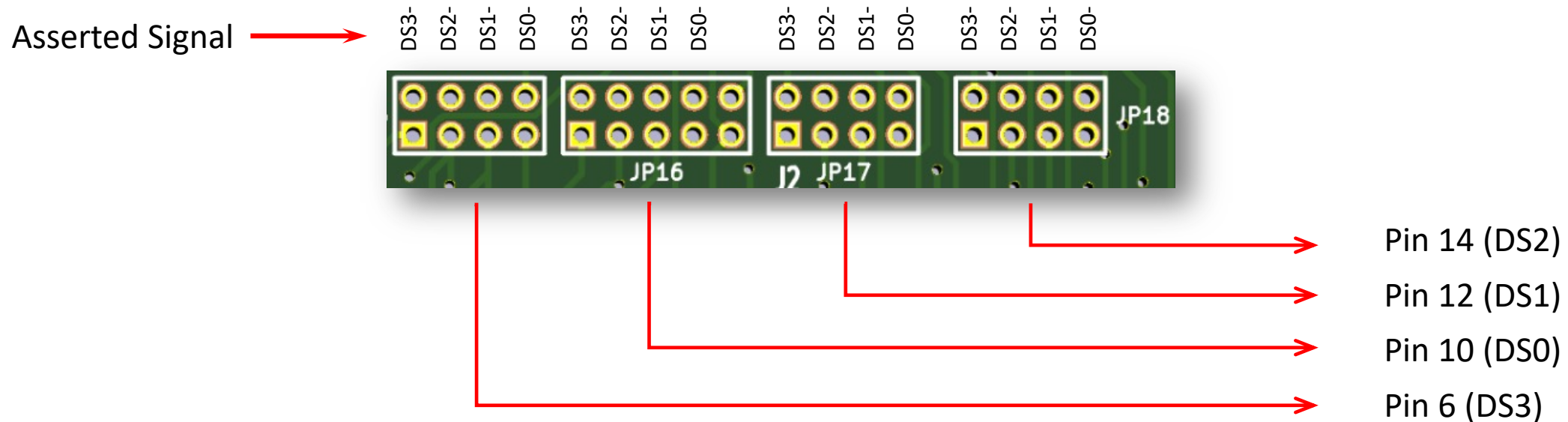
- Each device (H67, H37) can be addressed at any of four ports: 170Q, 174Q, 270Q or 274Q.
- To select a port ending in **0** place a jumper across the **left** 2 pins marked “H67-170/270Q” or “H37-170/270Q” (use **right** pins if port ends in **4**)
- Control whether it’s **17x** or **27x** by placing a jumper across the appropriate pins marked “H67-274Q/H67-174Q” or “H37-270Q/H37-170Q”

- Example at right shows the H67 set for port 174Q and the H37 set for port 170Q. This is the Heath **default** if **not** using an H17.
- The H17 uses port 174Q - see H17/USB companion board notes (below) if H17 interface is going to be used.



H37 Drive Select Jumpers

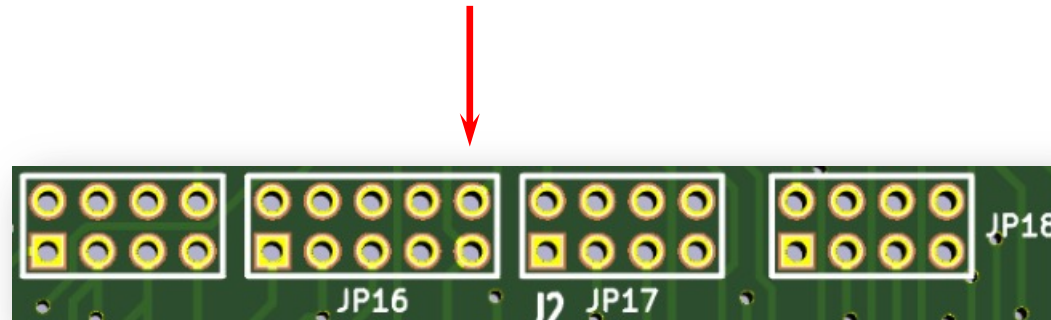
- For each 34-pin floppy drive connector there are four jumper blocks that map the four Drive Select (DS) signals asserted by the board to actual pins where they appear on the socket. Any DS signal can be directed to one of four pins on either socket:
 - Block 1 (JP10/JP15) controls the output to pin 6 – Drive Select 3
 - Block 2 (JP11/JP16) controls the output to pin 10 – Drive Select 0
 - Block 3 (JP12/JP17) controls the output to pin 12 – Drive Select 1
 - Block 4 (JP14/JP18) controls the output to pin 14 – Drive Select 2
- The second block has a fifth column for use with 3-½" drives (more on that on next page)



Considerations for 3-½” Floppy Drives

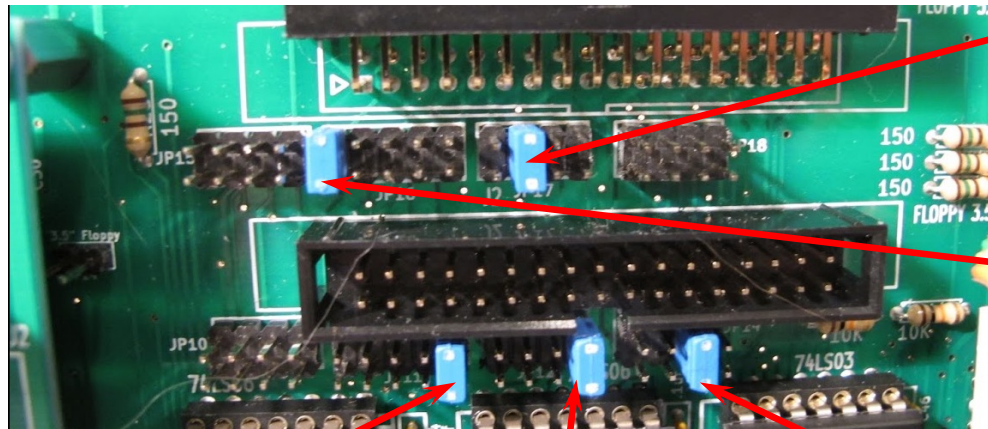
- Many 3-½” drives (especially newer ones) are hard wired to respond to DS1 (no DS jumpers!)
- Two can be installed on the same connection using a “twist” cable, which were common in IBM PC clones – between the first and second connectors they swap pins 12 & 14 and pins 10 & 16.
- The fifth jumper column on the second block (JP11/JP16) directs the MOTOR ON signal to pin 10 (so that it will be seen on the appropriate wire (pin 16) downstream of the twist. The jumper should be installed if there are two 3-½” drives connected to the socket.
- Up to four 3-½” drives can be supported by connecting two to each socket and setting jumpers properly.
- Some early 3-½” drives (e.g. [Epson SMD-300](#)) had DS jumpers, which would allow for more flexible setups.

Install jumper here if two 3-½” drives are attached to the associated socket



Example of H37 Jumper settings

- This setup supports two 3-½" drives on the bottom connector and two 5-¼" drives on the top.
- 3-½" drives hard coded for DS1 but connected with "twist" ribbon cable
- 5-¼" drive select jumpers set for DS0 and DS1



DS2 signal appears on pin 12
which is seen as DS1 and
activates the 5-¼" drive with that
jumper setting.

DS3 signal appears on pin 10
which is seen as DS0 and
activates the 5-¼" drive with that
jumper setting.

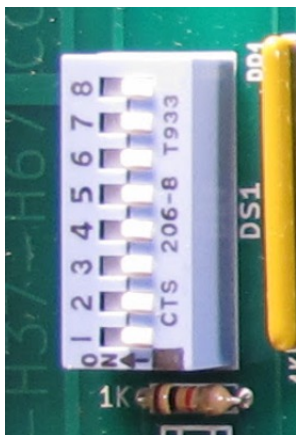
Motor jumper required
With two 3-½" drives

DS0 signal appears on pin 12
which is seen as DS1 by first 3-
½" drive (before the twist.)

DS1 signal appears on pin 14 which is
seen as DS1 by second 3-½" drive
(after the twist it appears on pin 12).

Testing Jumper settings

- If you have the PAM37 ROM installed, you can use the “universal boot” capability to test your jumper settings. Try booting from each logical device and watch for drive activity (see p. 29 of the WH-8-37 operations manual - https://sebhq.github.io/sebhq/documentation/hardware/H8/H8-37_Op_Sc.zip).
- Alternatively, you can use the H8 front panel to directly output commands to the appropriate port:
 - Port address = 170Q (standard address for H37)
 - Activate drive 0 = 020Q
 - Activate drive 1 = 040Q
 - Activate drive 2 = 100Q
 - Activate drive 3 = 200Q
 - All motors on = 010Q
- For example, to select Drive 0, the Front Panel sequence is as follows;
 - 1. Press MEM
 - 2. Enter “020 170”
 - 3. Press OUT
 - 4. Insert a jumper in different positions until Drive 0 floppy drive activity LED turns on



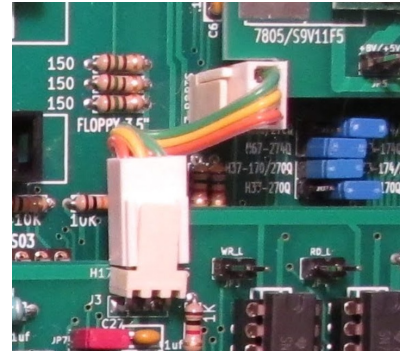
H67 switch DS1

- Switch DS1 is used to define the boot partition from Hard Disk 0 or Hard Disk 1 for use with QSB BIOS
- This functionality was originally implemented in the QUIKSTOR QS-15 interface from Quikdata Computer Services Inc.
- The QSB BIOS supports 15 partitions per drive and all of them are bootable if QSPUTSYS.COM was used to enable them.
- The table on the right shows the switch settings for 15 partitions for Drive 0 and 1
- The recommended **default is all switches on**, which triggers a menu-selectable boot screen with the QSB BIOS
- More information at <http://koyado.com/Heathkit/Z67-IDE.html>

| DS1: | | | | | | | | | |
|------|------|------|------|------|------|------|------|------------------------|------------------------|
| SW 8 | SW 7 | SW 6 | SW 5 | SW 4 | SW 3 | SW 2 | SW 1 | Boot Partition Drive 0 | Boot Partition Drive 1 |
| OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON | DRIVE0 2 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF | DRIVE0 3 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | OFF | OFF | ON | ON | DRIVE0 4 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | OFF | ON | OFF | OFF | DRIVE0 5 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | OFF | ON | OFF | ON | DRIVE0 6 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | OFF | ON | ON | OFF | DRIVE0 7 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | OFF | ON | ON | ON | DRIVE0 8 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | OFF | OFF | OFF | DRIVE0 9 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | OFF | OFF | ON | DRIVE0 10 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | OFF | ON | OFF | DRIVE0 11 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | OFF | ON | ON | DRIVE0 12 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | ON | OFF | OFF | DRIVE0 13 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | ON | OFF | ON | DRIVE0 14 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | ON | ON | OFF | DRIVE0 15 | DRIVE1 1 |
| OFF | OFF | OFF | OFF | ON | ON | ON | ON | MENU SELECTABLE | DRIVE1 1 |
| OFF | OFF | OFF | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 2 |
| OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 3 |
| OFF | OFF | ON | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 4 |
| OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 5 |
| OFF | ON | OFF | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 6 |
| OFF | ON | ON | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 7 |
| OFF | ON | ON | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 8 |
| ON | OFF | OFF | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 9 |
| ON | OFF | OFF | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 10 |
| ON | OFF | ON | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 11 |
| ON | OFF | ON | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 12 |
| ON | ON | OFF | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 13 |
| ON | ON | OFF | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 14 |
| ON | ON | ON | OFF | OFF | OFF | OFF | OFF | DRIVE0 1 | DRIVE1 15 |
| ON | ON | ON | ON | OFF | OFF | OFF | OFF | DRIVE0 1 | MENU SELECTABLE |

Notes on the H17/USB Companion Board

- The “companion” board is designed to attach to the H37/67 main board via dual 25-pin SIP headers plus a short 3-connector ribbon cable
- The board is *optional* as the H37/67 board is fully functional without it.
- The H17/USB companion board adds three more kinds of support:
 1. Access to “legacy” H17 5-¼” drives including all drives supported by the original H17 design, e.g.:
 - Tandon TM-100-1, Wangco-80 and Siemens FDD-100-5 (Single Side, Single Density, 40 Track, Hard Sector – 100K capacity)
 - Tandon TM-100-2 (**Double** Side, Single Density, 40 Track/48TPI, Hard Sector – 200K capacity)
 - Tandon TM-100-4 (**Double** Side, Single Density, **80** Track/96TPI, Hard Sector – 400K capacity)
 - Up to 3 drives maximum supported. **Drives must connect to connector “J1” on the board.**
 - To access higher capacity disks (200K, 400K) must have - for HDOS: Dean Gibson’s **HUG SY:** driver (885-1095), or for CP/M: Ray Livingston’s **BIOS-80.**
 2. A Hard Sector Floppy Emulator (HSFE) microcontroller that generates simulated index hole pulses to allow soft-sectored 3-½” media to appear to be hard-sectored
 - HSFE capability implemented **only for 3-½” drives connected via J2 on the board**
 - With appropriate **SY: driver or BIOS** (see above) can store 400K on a floppy disk
 - Unless needed here for legacy/compatibility reasons consider instead attaching your 3-½” drive(s) via the H37 interface for more speed and storage
 3. An optional Universal Serial Bus (USB) capability to transfer files via flash drive
 - Uses FTDI VDIP-1 to implement USB host protocol https://www.ftdichip.com/Support/Documents/DataSheets/Modules/DS_VDIP1.pdf
 - Not necessary if user has Rev 3.x Z80 CPU board (which includes VDIP-1) or an existing H8-USB board. If using separate H8-USB board, **board should be configured for ports 331/332QQ** (be sure to de-conflict with H-8-4 serial port settings.)



H17/USB Companion Board Jumper Definitions

| Jumper | Function |
|----------|---|
| JP1 | ENABLE H17 – <i>(should probably have been labeled “DISABLE H17”)</i> Insert a jumper here to <i>disable</i> the board. To enable normal H17 operation <i>remove</i> the jumper Default is not installed . |
| JP2 | <p>BUFFER ON – Default is installed on pins 1-2. Explanation: When the H17 “/CS” signal is enabled for writes, the H17 data buffer will turn on to allow the data to be present on the H17 bus. When H17 “/CS” signal is disabled, the H17 data buffer is off for any write operation on the H8 bus.</p> <p>If JP2 is installed on 2-3: The H17 data buffer is always on for any write operation on the H8 data bus. The H8 data will be present on the H17 bus for any write operation regardless of the H17 “/CS” signal (useful for debugging).</p> |
| JP3, JP4 | WR_L and RD_L are only installed when U25 is removed for high speed Z80 clocks (> 10MHz) if there are issues. Default is not installed with U25 inserted. The Z80 V3.2 board carries the same jumpers. |
| JP5 | Bypasses on-board regulators by connecting board 5V directly to bus pins 48/49. Default is not installed . <i>(Insert jumper only if using PC-ATX style switching power supply to place regulated 5V on the bus!)</i> |

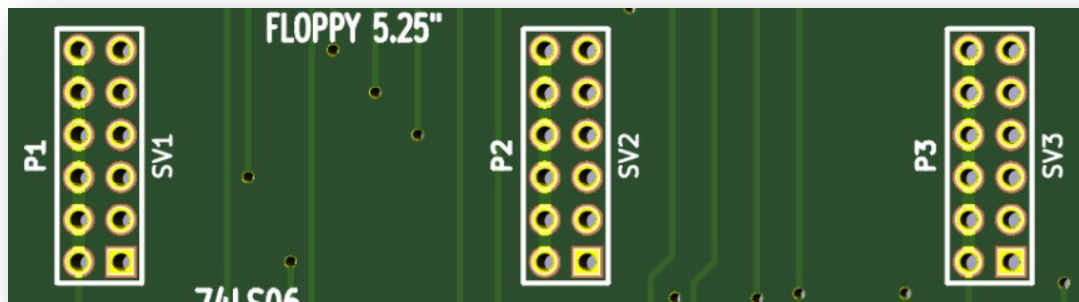
Companion Board Jumper Definitions (cont'd.)

| Jumper | Function |
|----------------|---|
| JP6 | Variations in drive spin-up time can confuse the Heath OS into thinking the drive is at speed, however this is unusual. Install this jumper only if having problems booting or formatting 5-¼" or 3-½" media. Default is not installed. |
| JP7 | This jumper activates the optional VDIP-1 breakout board to support USB flash drives. For newer generation Z80 CPU boards (3.x and newer) the VDIP-1 is included on the CPU's serial daughterboard, therefore its use here is primarily intended for legacy Z80 boards. <ul style="list-style-type: none">• If using the latest Z80 CPU board (3.x) the default is not installed (and no VDIP-1 installed)• If using legacy Z80 boards and VDIP-1 is installed, then the default is installed. |
| P1, P2, P3, P4 | Drive select jumpers. <i>See description below for instructions on how to set the jumpers.</i> |

H17 Drive Select Jumpers

- The H17 hardware supports by design three drives, SY0:, SY1:, and SY2:. There are three possible configurations:
 - One 5-¼" floppy drive and two 3-½" floppy drives
 - Two 5-¼" floppy drives and one 3-½" floppy drive
 - Three 5-¼" floppy drives
- The first 4 rows of jumpers are to select combinations of 5-¼" floppy drives. The last two rows are to select only the 3-½" floppy drives.
- The header labeled "SV0" is only used for programming the Micro-controller using the AVR programmer. That is it's SPI bus <https://www.sparkfun.com/products/9825>

5.25 – DS0
5.25 – DS1
5.25 – DS2
5.25 – DS3
3.5 – DS0
3.5 – DS1



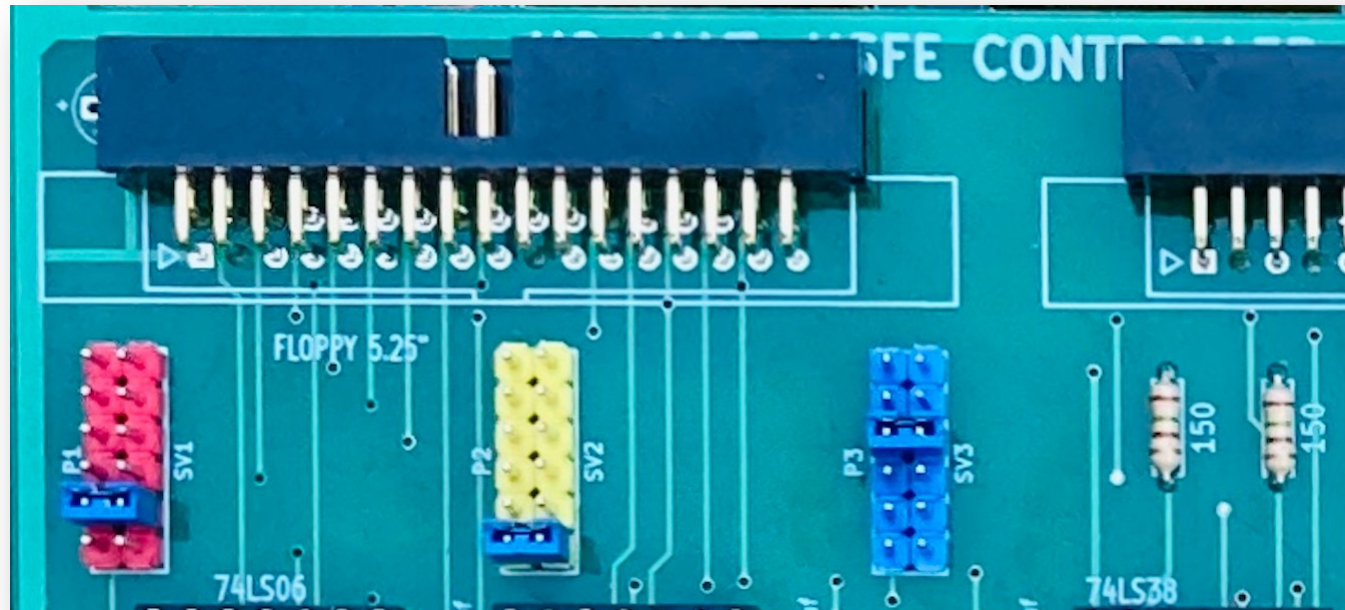
To SY2: drive

To SY1: drive

To SY0: drive

H17 Drive Select Example

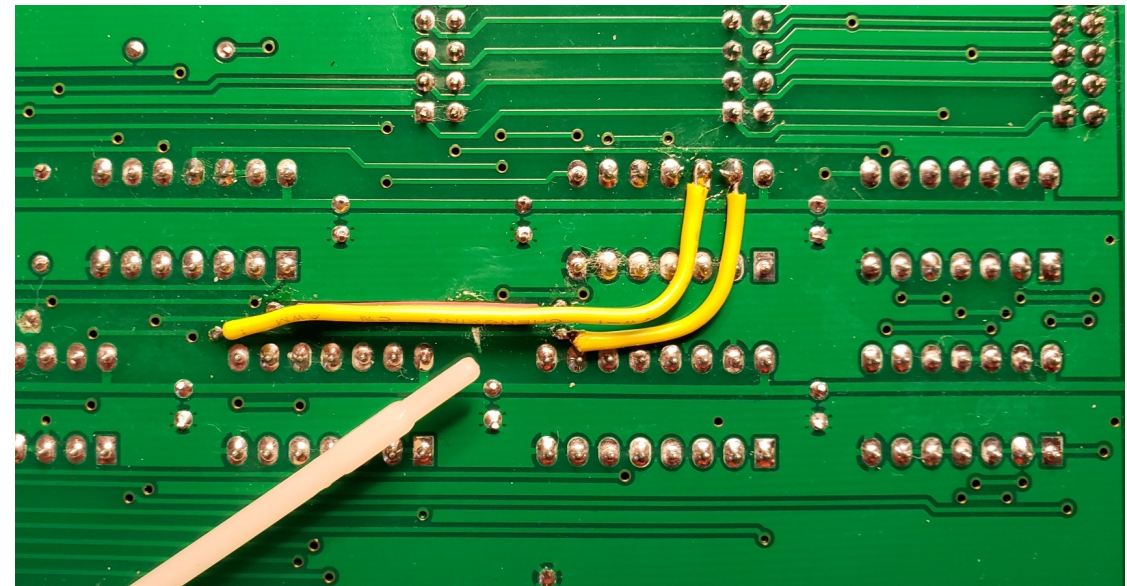
- Here is a sample configuration:
 - Header “SV1” is configured for a 3-½” floppy selected as “SY0”
 - Header “SV2” is configured for a 3-½” floppy selected as “SY1”
 - Header “SV3” is configured for a 5-¼” floppy drive selected as “SY2”.
- The 3-½” drives are connected to the socket on the right (J2) using a “twist” ribbon cable; the 5-¼” drive is connected on the left (J1).



H17 Side Select Fix

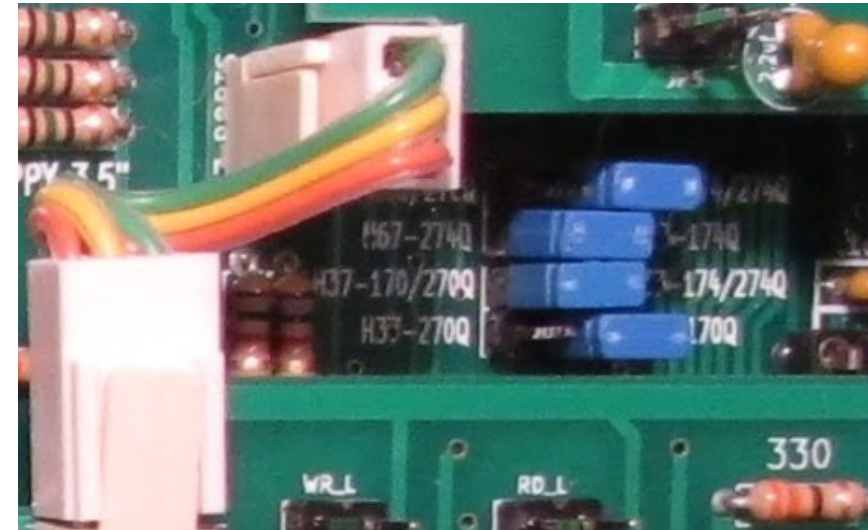
(for Legacy CPU Boards)

- Legacy CPU boards (Heath, Les Bird, DG and Trionyx) employ a different polarity for the side select function (fix needed only if using side select).
- This fix uses a spare inverter to match the expected polarity.
- Requires trace cut and two jumpers (see picture).
- Alignment tool points to trace cut. Be sure to cut the right trace! It is the one running closest to U8 and U19.
- Red wire (barely visible in picture) *not* required – was a fix due to cut of wrong trace!
- Yellow wires soldered from eyelets on each end of the cut trace to (previously unused) pins 12 & 13 of U13 (74LS14). (Gently scrape/sand solder mask from eyelets before attempting to solder wires).



Using All Three Simultaneously (H17/H37/H67)

- The H17 uses port 174Q, so in order to use H37, H67 and H17 simultaneously set the H67 to port 274Q and configure the operating system and drivers accordingly. (Heath did not support all three at once, but there are no issues if configured properly.)
- Boards must be connected with 3-connector ribbon cable, as shown.
- Standard drivers (Heath or HUG) can be used for H17 and H37 but special drivers or BIOS must be installed for using H67 on port 274Q (Heath drivers/BIOS configured for H67 on 174Q)
- More info at <http://koyado.com/Heathkit/Z67-IDE-plus.html>



H37 on Port 170; H67 on Port 274

Reworks Needed for Trionyx Z80 CPU Board

- The unique design of the Trionyx CPU board creates the possibility for doubled-up write pulses. *When using the Trionyx CPU card please implement the following setup changes to avoid that problem:*
- H37/H67 controller board:
 1. Remove U40 (74LS74)
 2. Insert jumpers JP21 and JP22
 3. Change JP23 to position 1-2.
- H17 controller companion board (if used):
 1. Take out U25 (74LS74) and bend out pin#6.
 2. Insert back U25 IC.
 3. Insert jumper JP3.
 4. Change JP2 to position 2-3.

Using GoTek drives



<http://www.gotekemulator.com/>

- GoTek drive emulators should work with no issues for soft-sectored (H37) storage
- They can also be used for hard-sectored (H17) storage on connector J1 with certain limitations:
 - Must install hxc firmware from <http://hxc2001.com/store/>
 - Firmware functionality currently limited to **read only** on H17 disk format
- The following power-on/off sequence must be observed:
 - Startup: power-on *first the H8 system* and then power-on the GoTek drive.
 - Shutdown: Power-off *first the GoTek drive* and then power-off the H8 system.