**Initial Testing and Final Assembly of HA-8-3 Board**

Solder all components to the board, but do not install any socketed ICs or oscillators until the following power supply checks are made. Install the board into any open H8 bus slot.

1) Power up the H8 and verify that all power LEDs are lit: +5va (D1), +5vp (D13), +12v (D12), and -12v (D14)
2) Using a voltmeter, test for proper regulated voltages:
   JP19 Pin 1   +5v
   JP20 Pin 1   +5v
   JP9 Pin 2   +12v
   JP10 Pin 2   -12v
   TP1   +10v (ADC reference voltage)
   TP2   +5v (ADC isolated +5v supply)
3) If voltage checks are OK, power off the H8, remove the board and populate all socketed components
4) Set all jumpers according to the Jumper Settings tab in the HA-8-3 Excel worksheet
5) Reinstall the board, power on the H8 and verify another ADC reference voltage:
   TP3   -10v
6) If you are enabling I/O wait states on the HA-8-3 card, be sure you have followed the instructions for modifying the v3 or v4 CPU or H17/37/67 controller card:
   http://koyado.com/heathkit/New-H8-Website/download/reworks_for_h17_h67_h37_z80-v3_z80_v4_boards.pdf
7) If you are enabling I/O wait states, connect an oscilloscope to pin 1 of U29A (74ALS1005). Using 10K trimmer pot RV3, adjust the length of the I/O wait pulse to 700ns. This wait length has been found to support 16MHz operation with most cards.
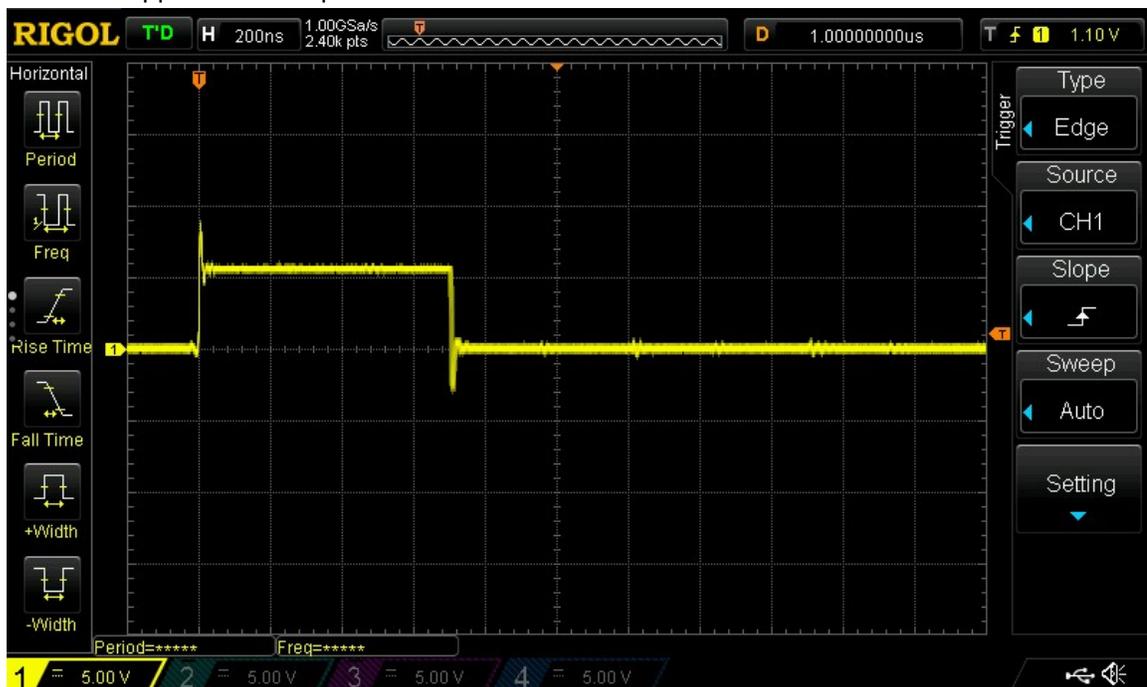
8) Set the three video level trimmers (RV1, RV2, RV4) to their middle position.
9) If you are using a component monitor (without OSSC scan converter), connect the YPbPr Video and Ch0/Ch1 Audio outputs to your equipment using shielded cables at P14.
10) If you are using the OSSC, attach an HDMI display to the OSSC and the three video cables to the AV2 input. Configure the OSSC to use the AV2_YPbPr input using either the OSSC buttons or the OSSC remote control.   If you wish to use the OSSC to send the HA-8-3 audio to your HDMI display device, use a 1/8" miniplug to RCA adapter to connect the two audio outputs from the HA-8-3 to the OSSC.   With the H8 powered on, video cables connected, and the AV2 input selected, the front panel of the OSSC should show a display similar to this:

**Software Verification of the HA-8-3 Board**

The HA-8-3-1 board by default uses different port addresses for the ADC and APU sections of the card than the original board. This was done to allow use of the board in a "three drive" (H17, H37 plus H67) system. The table below shows the port assignments for both the original and new cards:

Device	Original	New Board
VDP	270-271Q	270-271Q
PSG	272-273Q	272-273Q
APU	274-275Q	364-365Q
ADC	276-277Q	366-367Q
S/W Reset	N/A	066Q

Any software originally written for the HA-8-3 card that uses only the VDP and PSG sections will work exactly as with the original board. Software using the APU or ADC (for example, joysticks) must be modified to run with the new board in a three-drive environment by changing the port assignments as shown above.

The fastest way to initially test the new board is to run the HA83DIAG program from the original HA-8-3 distribution diskette (an H8D disk image is available from the SEBHC).   With no changes to this program, you can immediately verify the operation of the VDP and PSG sections of the card. HA83DIAG is fully documented in the original NOGDS manual for the board. Start the tests with the CPU at 2MHz.

1) Run the HA83DIAG program from HDOS2.0 or later
2) The program silently tests the VRAM which takes a while at 2MHz. It may appear to be hung but check the I/O activity LED on the HA-8-3 board. It should be lit constantly as the board is accessed to do the VRAM tests. It takes about 60 seconds to complete the VRAM test at 2MHz, during which time you will see nothing happening on either the H19 or the color display.
3) At the completion of the VRAM tests, a message should appear on the H19 console:
"No VRAM failures detected"
4) A color bar pattern should appear on the color display, and in succession you should hear four sound effects:
Laser
Whistling Bomb
Wolf Whistle
Race Car
5) The color monitor should now show two rows of eight white squares at the top of the screen. The squares indicate the status of the sixteen digital I/O pins of the AY-3-8910. An unconnected pin will show as a white square. If the pin is grounded, the corresponding square will be black. You can connect jumpers or switches to the joystick headers to test the I/O behavior.
6) That completes the testing that can be done without modifying the ADC port assignment in the HA83DIAG program. Use ^Z^Z to exit the program.
7) For further video exploration, you can run the "KALEIDO" program on the NOGDS diskette. It will produce a constantly varying kaleidoscope-style display on the color monitor.
8) To modify the HA83DIAG program for the new port assignments, use an editor to change this line in the ADDEF.ACM file on the NOGDS diskette from:
```
ADADR      EQU   276Q        ;A/D I/O port
to:
ADADR      EQU   366Q        ;A/D I/O port
```
9) No other changes are necessary. Reassemble the program using the HDOS assembler:
```
>ASM SYx:HA83DIAG,=SYx:HA83DIAG
```
(specify disk device and number as needed.)
10) Rerun the HA83DIAG program. When the test program reaches the final stage, with the two rows of eight squares at the top, you should see the numbers '1', '2', '3', '4' somewhere near the middle of the screen. These numbers correspond to the X-Y position determined by measuring the voltage at each pair of analog inputs at each joystick connector. If you vary the voltage on these pins between 0 and +10v (VRef), you should see the corresponding number move on the screen.
11) You can fabricate an ADC/joystick test using a 5K or 10K potentiometer. One end goes to AGND (pins 1 or 4 of the joystick connector), the other end goes to Vref (pin 3 of the connector), and the wiper goes to one of the analog inputs (pin 9 or 10).
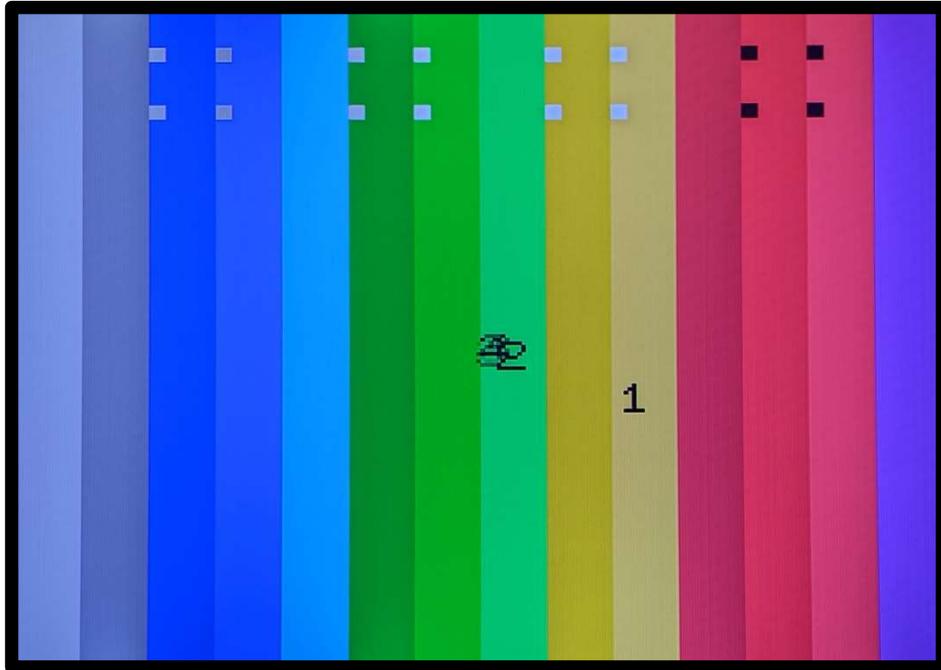
This is a photograph of the image from the HA83DIAG program displayed on an Epson projector. The actual projected image is about 100"diagonal. Even at that magnification, the edges are crisp. The image was upscaled from the HA-8-3 using an OSSC. You can see four of the AY-3-8910 DIO bits are grounded ('0', displayed as black), while the others are open ('1', displayed as white). Joystick 1 is being held slightly to the right of center. The analog inputs for joysticks 2-4 are connected to +5v for this test, so they appear directly in the center of the screen (because 5v is exactly half the 10v reference voltage).

Other Software for the HA-8-3

NOGDS Distribution Diskette

> KALEIDO continuous kaleidoscope pattern
> BARS the same color bar display shown in HA83diag

There are also individual programs to display a full screen of each color (LBLUE, DRED, GRAY, etc). You can use these programs to help adjust the relative amounts of Green, Blue, and Red in the video signal using the three trimmer pots on the HA-8-3-1 board. You can experiment with the full range of settings to see how the image and color are affected. You will probably find that you get the best color balance when all three trimmers are in about the same position, close to their midpoint. There are also color adjustments (dozens!!) possible within the OSSC menus.
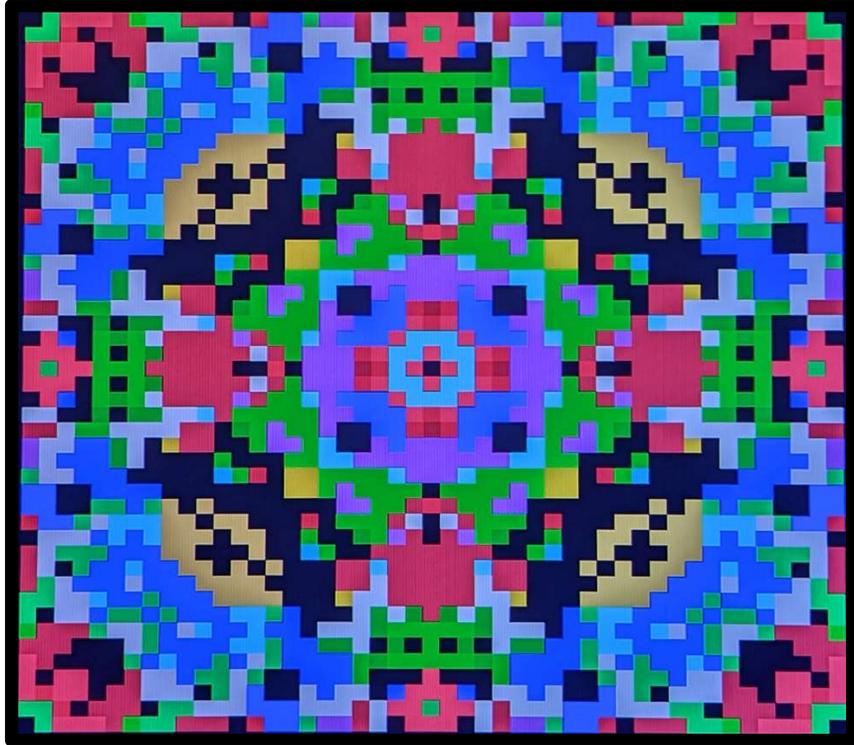
Photograph of the projected image from the KALEIDO program. Transitions between colored squares are crisp. Using the OSSC scan converter and an Epson projector.

HUG COLOR GRAPHIC SOFTWARE 885-1098

MUSICK   plays HA-8-2 .PLA music files through the HA-8-3 PSG with kaleidoscope video

HUG COLOR RAIDERS AND GOOP 885-1114

The two games on this diskette do not use the ADC (analog inputs), so they will run just fine on the new board with no modification.

Programs Written by SEBHC Members

<u>WARLORDS by Les Bird</u>

WARLORDS is a fast-paced game that runs under CP/M 2.2   It takes full advantage of the capabilities of the HA-8-3, with great graphics, sound effects, and real analog joystick control.

Because this program uses the ADC to read the joystick position, it needs a very small change for the new port addresses.   In WARLORDS.ASM, locate these EQUates and change from:

```
JOYDAT      EQU   0BCH
JOYCTL      EQU   0BCH

to:

JOYDAT      EQU   0F6H
JOYCTL      EQU   0F6H
```
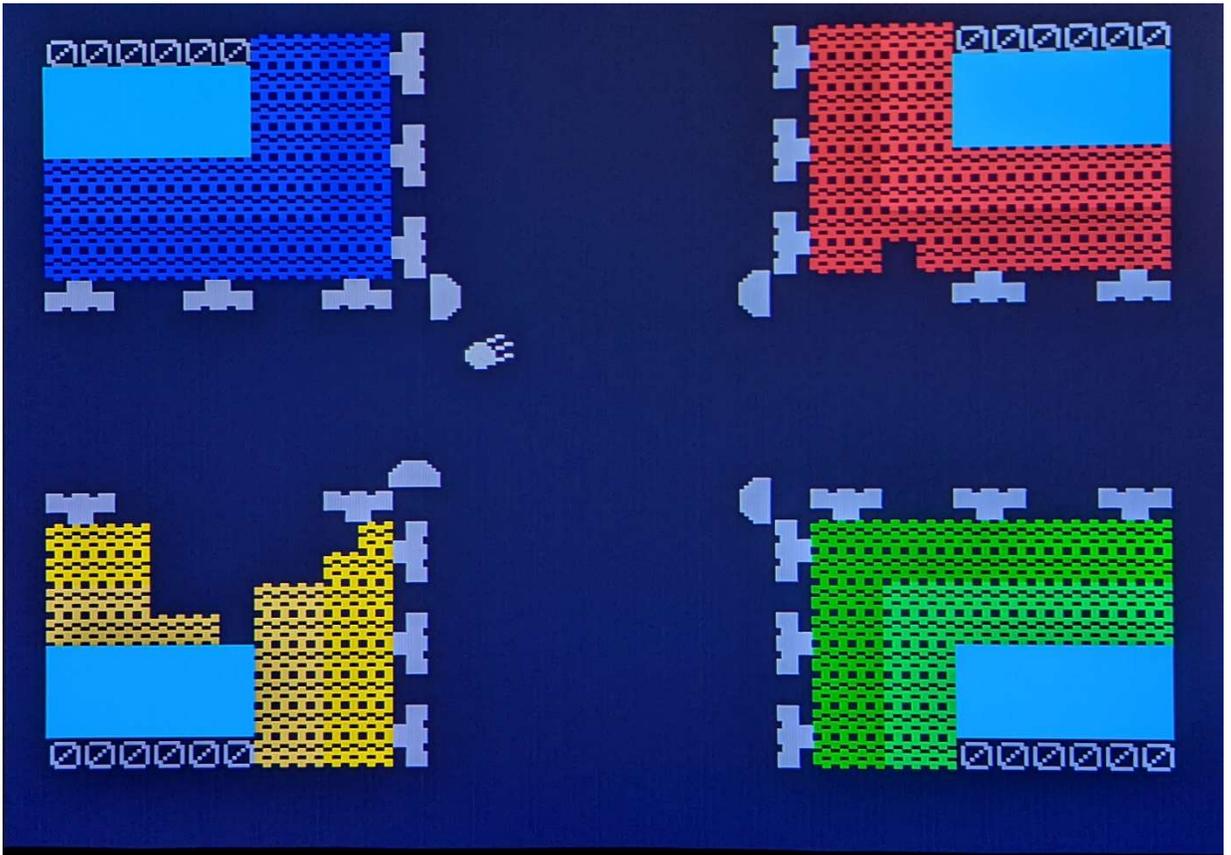
Reassemble with the CP/M assembler:

```
ASM WARLORDS.AAZ
LOAD WARLORDS
```
(you may need to change .AAZ to the drive letter you are using for the WARLORDS source files)

Les Bird has written other games for the HA-8-3 as well.

<u>SLIDESHO</u>

This program was written at the suggestion of Norberto Collado to display a pre-processed photographic image through the HA-8-3. A Windows PC program (CONVERT9918.EXE, from Harmless Lion) processes a .JPG file into a pattern and color file in the TMS99x8 format. The processed files can be quickly copied to the H8 by USB transfer using the V-Utilities by Glenn Roberts.   SLIDESHO was a quick proof-of-concept program, so it has no bells and whistles. It continuously displays three image files (named TM99181.TIC/TIP, TM99182.TIC/TIP, and TM99183.TIC/TIP). The images are remarkably good for a VDP with just 256x192 16-color capability.

Get the CONVERT9918.EXE file here: http://harmlesslion.com/cgi-bin/onesoft.cgi?2
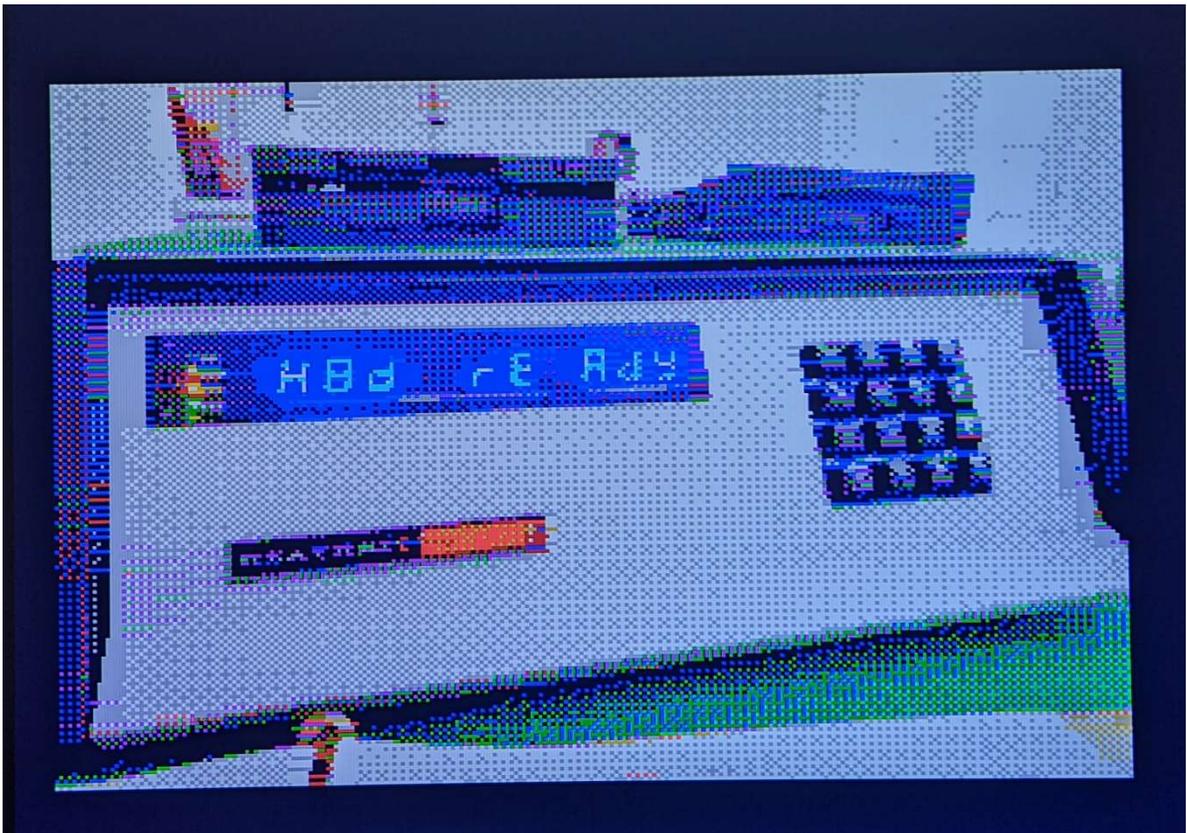
CLS – Clear Screen

Sometimes simple things help a lot. The TMS99x8 VDP on the original HA-8-3 can only be reset by a Master System Reset – in other words, a complete system restart. Especially during software development, that's a pain. A "soft reset" has been implemented on the HA-8-3. Any WRITE to port 066Q will reset the VDP, PSG, and APU without doing a full system reset. This tiny program does just that – writes an arbitrary value to port 066Q. This very simple program also clears the color display completely, a handy feature because many programs end and leave the color display forever showing whatever was last written to it.