Heathkit H89 VDIP1 & RTC Board Documentation

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Introduction

This document contains notes on the Heathkit H89 VDIP board designed by Norberto Collado. I have assembled one and made these notes to assist others who may do the same. Thanks to Joe Travis, Glenn Roberts, and others on the SEHBC Discord channel for providing input on this document.

Note: I built a revision 1.3 board. At the time of writing, the latest board revision is 1.4. My buffer board was V1.0; the most recent is V1.2. I've noted differences, where applicable, in the document.

Board Features

Similar to an earlier design for the Heathkit H8, the H89 VDIP1 & RTC Interface is a small circuit board that installs into one of the leftmost slots of the H89 CPU board and provides the following functions:

1. An interface using a VDIP1 module that supports file transfers to and from USB flash drives. Software utilities for file transfer are provided that run on a Heathkit H89 running HDOS or CP/M.
2. A real-time clock (RTC) with battery backup that supports maintaining date and time. Utility software is available for HDOS and CP/M.
3. A software reset circuit (only on board revision 1.4 and later). While not required, this can be useful during development to reset a board without power cycling.
4. LEDs to indicate power and USB communication status.
5. The board is compatible with the H89 2/4 MHz speed modification (not covered here).

Parts List

VDIP Board:	
BT1	Battery holder and battery, type CR1220
C1	Capacitor, electrolytic or tantalum, 2.2uF, 10V or higher
C2	Capacitor, ceramic, 0.1uF
C3	Capacitor, ceramic, 0.1uF
C4	Capacitor, ceramic, 0.1uF

VDIP Board:	
C5	Capacitor, ceramic, 0.1uF
C6	Capacitor, electrolytic or tantalum, 2.2uF, 10V or higher (47uF on v1.3)
C7	Capacitor, ceramic, 0.1uF
C8	Capacitor, ceramic, 47pF
C9	Capacitor, ceramic, 47pF
C10	Capacitor, electrolytic or tantalum, 2.2uF, 10V or higher
C11	Capacitor, ceramic, 0.1uF
C12	Capacitor, electrolytic or tantalum, 1uF, 10V or higher
C13	Capacitor, ceramic, 0.1uF
C14	Capacitor, electrolytic or tantalum, 1uF, 10V or higher (not present on rev 1.3 board)
C15	Capacitor, ceramic, 0.1uF (not present on rev 1.3 board)
D1	Diode, LED. Optional, duplicates LED on VDIP1.
D2	Diode, BAT42 or BAT48
D3	Diode, LED, Red (power).
D4	Diode, 1N5819
D5	Diode, LED. Optional, duplicates LED on VDIP1.
D6	Diode, BAT42 or BAT48
D7	Diode, BAT42 or BAT48
D8	Diode, BAT42 or BAT48
D9	Diode, BAT42 or BAT48 (not present on rev 1.3 board)
F1	Fuse, fusible link, 1.1A. Can use jumper wire if desired.
J1	2-pin header, right angle
J2	3-pin header, right angle
J3	Connector, USB. Not currently supported and can be omitted.

VDIP Board:	
J4	Edge connector, 25-pin. See notes.
J5	7-pin header, right angle
J6	Edge connector, 10-pin
J11	1-pin header
J12	1-pin header
J13	7-pin header, right angle
J14	3-pin header, right angle
J15	4-pin header, right angle
J16	2-pin header, right angle
J17	2-pin header, right angle
JP1	2-pin header and jumper
JP2	2-pin header and jumper (not present on rev 1.3 board)
R1	Resistor, 330R, 1/4W
R2	Resistor, 330R, 1/4W
R3	Resistor, 10K, 1/4W (3.3K on rev 1.3 board)
R4	Resistor, 4K7, 1/4W (3.3K on rev 1.3 board)
R5	Resistor, 330R, 1/4W
R6	Resistor, 4K7, 1/4W (3.3K on rev 1.3 board)
R7	Resistor, 4K7, 1/4W (3.3K on rev 1.3 board)
R8	Resistor, 4K7, 1/4W (3.3K on rev 1.3 board)
R9	Resistor, 330R, 1/4W
R10	Resistor, 10K, 1/4W
R11	Resistor, 330R, 1/4W
R12	Resistor, 10K, 1/4W (not present on rev 1.3 board)

VDIP Board:	
R14	Resistor, 120K, 1/4W (not present on rev 1.3 board)
R15	Resistor, 10K, 1/4W (not present on rev 1.3 board)
R16	Resistor, 150R, 1/4W (not present on rev 1.3 board)
R17	Resistor, 10K, 1/4W (not present on rev 1.3 board)
U1	IC, GAL, Atmel G16V8AS
U2	IC, 74LS04
U3	IC, 74LS125
U4	IC, 74LS125
U5	IC, VDIP1 (Either original VDIP1 or newer V2DIP1-48. See text.)
U6	IC, EconoReset, DS1233, TO92 package (DS1233-5, DS1233-10, or DS1233-15 should all work).
U7	IC, RTC-72421 (Suggested source is eBay. See text.)
U8	IC, 74LS123 (not present on rev 1.3 board)
-	IC sockets

Buffer Board:	
C1	Capacitor, ceramic, 0.1uF
C2	Capacitor, ceramic, 0.1uF
J1	2-pin header, right angle
J2	7-pin header, right angle
J3	2-pin header, right angle (not on v1.0 board)
R1	Resistor, 4K7, 1/4W (3.3K on V1.0 board)
R2	Resistor, 4K7, 1/4W (3.3K on V1.0 board)
R3	Resistor, 4K7, 1/4W (3.3K on V1.0 board)

R4	Resistor, 4K7, 1/4W (not on V1.0 board)
U1	IC, 74LS125
U509	IC, 74LS241. Can be taken from the H89 CPU board.
-	0.5" SIP machined pin headers, 2x10. See text.

Board Assembly and Test

Install the components on the two boards using the schematic, board layout picture, and PCB silkscreen as guides. See references [1] and [3].

Also build up the VDIP1 U509 buffer board which is on a separate small PCB. It requires two capacitors, four resistors, two ICS, and some header pins. See reference [1]. The 74LS421 IC from location U509 on the H89 CPU board will be removed and installed on the top of the buffer board as indicated on the board silk screen. Header pins on the bottom of the board will insert into the original IC socket on the CPU board. Use 0.5" SIP machined pin headers for the daughter board. I used DigiKey part number ED3864-10-ND. The end of the headers with the smaller diameter pins go into the CPU board socket, the larger diameter pins are soldered into the buffer board PCB. You may need to make sure the board has sufficient clearance when placed in the U509 socket and may need to cut and file the pins on the component side of the board before soldering the 74LS241 over it. I recommend soldering the ICs directly to the board (no IC sockets) to ensure there is sufficient clearance between it and the video board mounting bracket (and the flyback mounting screws in particular). You should also trim the leads of the 74LS125 on the daughter board to avoid contacting the Z80 CPU beneath it.

In general, the recommendation is to install the lowest height parts first, e.g. resistors, small caps, IC sockets. Last to be assembled would be LEDs and electrolytic or tantalum caps, ICs, and the VIP1 module.

Ensure the correct orientation of the electrolytic or tantalum caps, diodes, and LEDs.

The 25-pin Molex edge connectors are no longer available. You can use two 10-pin with one 5-pin in the middle. They are available from Digikey, Newark, Mouser, etc. The part numbers are 5-pin: Molex #22-15-2056, 10-pin: Molex #22-15-2106.

It is highly recommended to use sockets for all ICs (except on the buffer board).

If using any NOS ICs, clean the pins if they look tarnished or oxidized.

The GAL is an Atmel G16V8 and requires programming using a suitable device programmer (I used a Minipro TL866II Plus). The programming files can be found at reference [1].

The RTC chip is an EPSON part which is obsolete but can be obtained from sources like eBay. Make sure it has the EPSON label on the IC as there are fake devices being sold.

The Vinculum VDIP module can be the original VDIP1 or the newer V2DIP1-48. The latter has larger header style pins that require a dual leaf socket. Possible sources for the VDIP are Mouser and Digikey. It is not recommended to use the V2DIP1-48 unless you have the ability to reprogram it – it doesn't have the same firmware as the VDIP1.

You will need to insert a USB flash drive, either directly into the VDIP module or via a USB extension cable from the VDIP module to the outside of the H89 case. The holes H1, H2, H3, and H4 can be used for holding a flash drive or USB cable in place using zip ties.

Connector J3 is for an extra USB port. It can be omitted as is not currently supported and it is not anticipated that it will be.

Installation

The VDIP board can be installed in any of the three left slide slots of the CPU board, connectors P501/P507, P502/P508, or P503/P509. Usually the middle slot is used as there is often a RAM card in the rightmost slot and the left slot may interfere with power cables.
There is no keying on the connectors, so take care not to offset the pins or you may damage the VDIP and/or H89 CPU board or power supply.

The real-time clock is optional. If you have an H89 with a CF Flash card installed, the same RTC circuit is present on that board and they will conflict. If this is the case, you can disable it by not installing the RTC chip and battery on the VDIP board.

The CPU board IC U509 is removed and installed on the buffer board. The buffer board header pins install where U509 was removed. A 7-pin ribbon cable or Dupont jumper wires connect from the buffer board connector J2 to the VDIP board connector J5.

The two jumpers on the VDIP1 module should be set to J3 (left jumper) upper 2 pins, J4 (right jumper) lower two pins.

Normally, you should set the VDIP board jumpers to JP1 not installed, JP2 not installed.

Connect a FAT-formatted USB flash drive to the VDIP module. If desired, run a USB cable from the VIP1 module to the outside of the case so the flash drive can be external to the computer.

Jumper Settings Reference

Jumper	Normal Setting	Description

JP1	Not Installed	Insert for VDIP at i/o 331Q/332Q, remove for 261Q/261Q. Remove if you have a modem port at i/o address 330Q.
JP2	Not Installed	Insert for VDIP connected to bus reset (not present on rev 1.3 board).

Connector Reference

Connector	Description
J1	Can connect to an optional external LED to indicate VDIP1 activity (not present on rev 1.3 board)
J2	RAS signals for a future memory board.
J3	Connector for extra USB interface. Not currently supported and can be omitted.
J4/J7/J9	Connect to CPU board P507/P508/P509.
J5	Control signals to/from the buffer board.
J6/J8/J10	Connect to CPU board P501/P502/P503.
J11	Ground test point.
J12	Ground test point.
J13	Signals to/from a future MSX controller board.
J14	Address decoding for a future memory board.
J15	(J1 on rev 1.4 board). Memory Bank signals for future memory board or use with 2/4 MHz speed mod.
J16	I/O decoding outputs for use with H37/H67.
J17	Can connect to an optional external LED to indicate 2/4 MHz CPU clock speed when using H89 speed mod.

Operation

Install the VDIP1 utilities on the H89 as described in reference [2]. See the docs folder for documentation. Versions for HDOS and CP/M are available, including binaries. You will initially need a way to get the VDIP software onto the H89, such as a serial port transfer using Maple and xmodem. Note that with the recommended VDIP board jumper settings, the i/o address used is 261. At the time of writing the VDIP utilities default to using port 331, so you will need to

either pass the command line option -P261 or use a VPORT.DAT file as described in the documentation.

If using the real-time clock, software utilities are available to set or get the date/time. They work under HDOS or CP/M. These can be run on boot to set the operating system time and date. You may also want to check that your version of HDOS has been patched with Y2K fixes.

Board Images

Some pictures of the assembled boards can be found at reference [7].

References

1. Schematics and board layout: https://koyado.com/heathkit/New-H8-Website/h89-vdip1_rtc-left-side-slots.html
2. VDIP Utilities: https://github.com/sebhc/vdip-utilities/
3. Image of installed board: https://www.facebook.com/groups/heathkitcomputers/posts/1576437279671771/
4. REMarks Article on VDIP: https://sebhc.github.io/sebhc/REMarks/REMarks%20Issue%206%20%20-%2014%20February%202022.pdf
5. VDIP board for H8: https://koyado.com/heathkit/h-8_usb.html
6. SEBHC Discord Chat (there is a VDIP1 channel): https://discord.gg/jAg8JcAc
7. Latest version of this document, as well as images and other files: https://github.com/jefftranter/Z80/tree/master/H89VDIP1