

VIP2K rev.A Assembly Notes

(not an assembly manual; that would take too long)

By Lee Hart
814 8th Ave N
Sartell MN 56377

leeahart@earthlink.net

<http://www.sunrise-ev.com/projects.htm#vip2k>

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The [RCA VIP](#) was created by Joe Weisbecker in 1978. It was an elegant and simple home computer so that everyone could have fun and learn about personal computers. It had an RCA 1802 microprocessor, 4k of RAM, a monitor program in ROM, a 16-key hex keypad, a 64x128 pixel graphics video display, and a serial port to load/save its programs on cassette tapes. That's the VIP on top of the monitor in the photo below.

2018 is the 40th anniversary of the VIP. I decided to celebrate by making a new version you can build yourself. That's it at the bottom of the photo, below the monitor, with its tiny keyboard on top! The black box at the right is just the battery box, with four AA cells to power it.

The VIP2K has the same 1802 microprocessor, but with significant upgrades in speed, memory, and features:

- 1802 microprocessor running at 4 MHz
- 32K of RAM
- 32K of ROM, with monitor and BASIC
- NTSC B/W video output with 192x192 pixel graphics video output
- 43-key full ASCII keyboard
- TTL serial I/O port up to 9600 baud
- built entirely with vintage parts and technology
- ...and it all fits in a 3.5" x 2" x 0.75" Altoids tin!

This project is **under development**, so things are still changing. This manual is a "snapshot" of where we are today. Check the website (at the link on the top of the page) for the latest developments and software.



If you bought the bare boards, here is a **PARTS LIST** list of the parts you'll need:

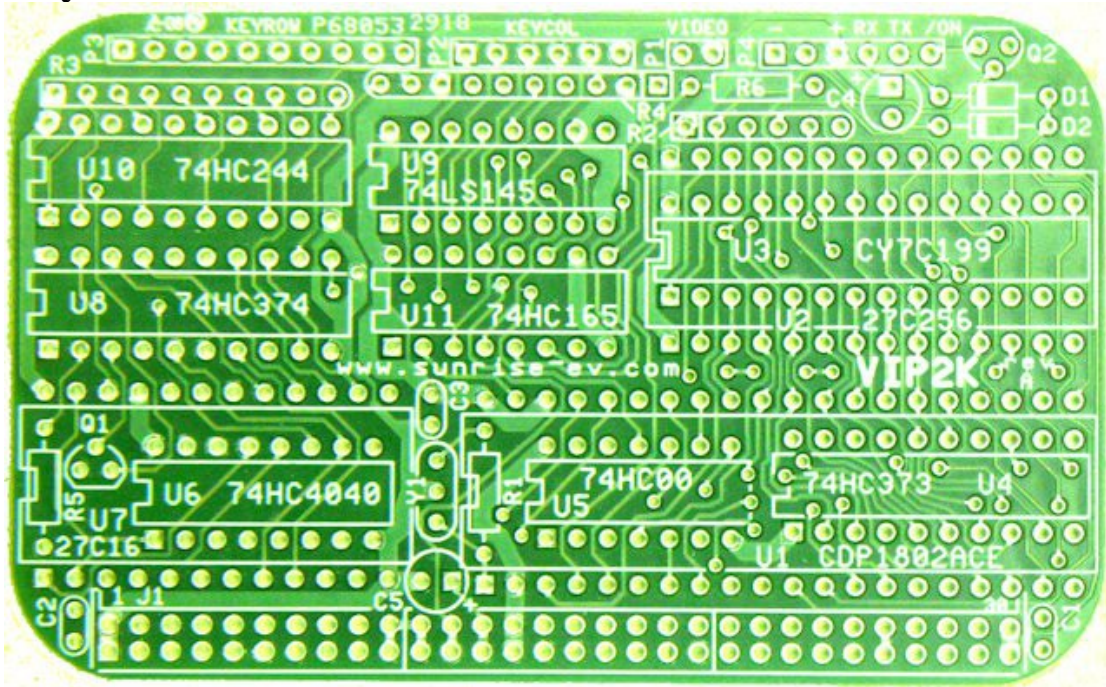
<u>Qty</u>	<u>Reference</u>	<u>Part</u>	<u>Source</u>
3	C1, C2, C3	capacitor 0.1uF 50v X7R 0.1"LS	Jameco 1570161
2	C4, C5	capacitor 4.7uF 16vdc tantalum	Jameco 94035
2	D1, D2	diode 1N4148	Jameco 36038
1	P1a,b,P1-P4	36-pin male pin header: Cut it to make	Jameco 68339
2		P1a, P1b = 2-pin header (CPU J1 pins 1-2 and 29-30),	
1		P1 = 2-pin header VIDEO (CPU card),	
1		P2 = 6-pin header KEYROW (CPU card),	
1		P3 = 10-pin header KEYCOL (CPU card),	
1		P4 = 6-pin header POWER+SER (CPU card).	
2	J1a,b, J2	6-pin male/female stacking header	Jameco 2144614
2	J3, J4	10-pin male/female stacking header	Jameco 2177627
1	Q1	FJN4303 PNP transistor w. base resistors	Mouser 512-FJN4303RTA
1	Q2	FJN3303 NPN transistor w. base resistors	Mouser 512-FJN3303RTA
1	R1	10Meg 5% 1/4w resistor	Jameco 691817
1	R2	10K x 5 6-pin SIP bussed	Mouser 652-4606X-1LF-10K
1	R3	10K x 9 10-pin SIP bussed	Mouser 652-4610X-1LF-10K
1	R4	1K x 9 10-pin SIP bussed	Mouser 652-4610X-1LF-1K
1	R5	100K 5% 1/4w resistor	Jameco 691340
1	R6	270 ohm 5% (or 267 ohm*) 1/4w resistor	Jameco 690726
43	S1-S43	tactile switch, Alps SKHHAJA010 or eq.	Mouser 688-SKHHAJ
1	U1	CDP1802ACE microprocessor (NOTE 1)	ebay etc.
1	U1a	40-pin IC socket, machined pins	Jameco 41136
1	U2	27256 or 27C256 32K EPROM (program)	Jameco 39714
1	U2a	28-pin IC socket, machined pins	Jameco 40328
1	U3	CY7C199 32k RAM	Jameco 242376
1	U4	74HC373 octal transparent latch	Jameco 45831
1	U5	74HC00 quad 2-input NAND gate	Jameco 45161
1	U6	74HC4040 12-bit binary counter	Jameco 45920
1	U7	2716 or 27C16 2K EPROM (video)	Jameco 40011
1	U7a	24-pin socket, machined pins	Jameco 39351
1	U8	74HC374 octal latch	Jameco 45858
1	U9	74LS145 (or 74HC145*) BCD decoder	Jameco 46666
1	U10	74HC244 octal buffer	Jameco 45655
1	U11	74HC165 8-bit shift register	Jameco 45495
1	Y1	resonator 4MHz with capacitors	Mouser 81-CSTS0400MG03
1	VIP2K	PC card & keyboard, rev.A	www.sunrise-ev.com/projects.htm#vip2k

NOTE 1: The VIP2K 1802 runs at 4 MHz. 1802's are only specified to 2.5 MHz (for the original non-A version CDP1802), or 3.2 MHz (for the later A-version CDP1802A). This means you have to **select** a fast enough 1802. So far, I have found that most early non-A 1802's are too slow. But most later 1802A's easily run at 4 MHz; in fact, some will go as fast as 12 MHz!

To select a fast enough part, I look at the waveform on 1802 pin 39 (/XTAL out) with an oscilloscope. The 4MHz waveform should look like a 4 volts peak-to-peak sine wave, with a low-state voltage less than 0.5v, and a high-state voltage within 0.5v of VCC (1802 pin 16). Most of 1802's I've tested meet this criteria, and work in my VIP2K. A "slow" 1802 may still oscillate at 4 MHz; but Vpp<3v won't be able to clock video shift register U11.

* Alternate parts. If you get a parts kit from me, I'll send what I have on hand, which may differ slightly.

Assembly Notes



Assembly is a work in progress; so I'll just tell you how I built mine. Let me know if you find a better way! Most parts are easy to install (just like any other kit), but I added notes for the “tricky” parts:

- () Install resistors R1, R5, and R6.
- () Install 0.1uF capacitors C1, C2, and C3.
- () Install diodes D1 and D2. The end with the band must match the board.
- () Install U3, U4, U5, U6, U8, U9, and U10. Sockets are not supplied, but you can add them if you like. Note that U4, U5, and U6 are **under** ICs! If you want to socket them, I recommend **socket pins** (Digkey.com ED5037-ND). They drop right into the holes to make a “zero height” socket.
- () U11: There is one cut-and-patch on the VIP2K rev.A card. **CUT** the trace between U11 pin 15-16. Then **ADD A WIRE** from U11 pin 15 to pin 8. It's easier to do this before you install U11.
- () Install transistor Q1 (marked “R4303”). Q1 must fit under U7. Put its wires in the holes, with the flat side as shown. Then bend it over so the flat side is tight against the board. **Now** solder it in.
- () Install IC sockets U1, U2, and U7. Use open-frame screw-machined sockets. Cut the thin plastic bars that hold the left and right sides together (to make room for the parts underneath).
- () Install SIP resistors R2, R3, and R4. Put pin 1 on the **left** end for R2 and R3; **right** for R4. Don't mix up R3 and R4 – they look alike but are **different** values!
- () Install transistor Q2. It is marked “R3303”.
- () Install ceramic resonator Y1.
- () Install capacitors C4 and C5. They are polarized, so be sure to get the + and – right.

Headers: I bought a 36-pin header, and cut it up to make P1a, P1b, and P1-P4:

- () P1a and P1b: Install a 2-pin header at each end of the 30-pin connector J1 on the VIP2K card. One in pins 1-2, and one in pins 29-30. They go on top of the board, in the holes **closest to the outer edge** of the board. These 2-pin headers just serve as “feet” to support the Keyboard.
- () Install P1, a 2-pin header on the VIP2K card at the VIDEO location.

- () Install P2, a 6-pin header on the VIP2K card at the KEYCOL location.
- () Install P3, a 10-pin header on VIP2K card at the KEYROW location.
- () Install P4, a 6-pin header on VIP2K card at the + / RX / TX / ON location.
- () Program a 2716 or 27C16 EPROM with <http://sunrise-ev.com/photos/1802/vip-2716.hex>, and install it at U7.
- () Program a 27256 or 27C256 EPROM with your choice of programs from <http://sunrise-ev.com/projects.htm#vip2k> and install it at U2. As this is written, there are programs for a serial monitor, a TV Typewriter, and a monitor with BASIC that uses the VIP2K keyboard and display.
- () Install CDP1802ACE microprocessor U1. (It needs to be a 4 MHz part; see Note 1 on page 2.)

Keyboard

Male/female stacking connectors (used on Arduinos etc.): They go on the **bottom** of the Keyboard. To be sure the connectors line up, plug the female part onto the pins on the VIP2K board. Put the Keyboard on top. Then solder the pins on top of the keyboard. Cut off the excess pin length.

- () Install J2, a 6-pin stacking connector. Plug the female part onto KEYCOL on the VIP2K card.
- () Install J3, a 10-pin stacking connector. Plug the female part onto KEYROW on the VIP2K card.
- () Install J1a and J1b. I bought 6-pin connectors, and cut one down to make 2-pin connectors for J1a and J1b. To cut it, pull out a pin with pliers, then cut the plastic body in the center of the removed pin location with a sharp knife or diagonal cutters. Plug these onto P1a and P1b.
- () Install J1+J4. I used a single 10-pin part, and removed pins 7 and 10. Plug it onto P1 (VIDEO) and P4 (POWER/SERIAL) on the VIP2K card. The male pins are long, and not soldered to the Keyboard. Use them to connect to your video monitor, power, and serial I/O.
- () Install tactile switches S1-S43. I have lots of SM (surface-mount) switches; so I used them. SM switch pins stick out horizontally. I pinch them with pliers to bend the pins down to fit into the holes on the Keyboard. Solder them from the TOP and keep them tight against the board.

Testing

Apply 5v power. Supply current is ~20ma with 27Cxx CMOS EPROMs, or ~75ma with 27xx NMOS EPROMs. Check for a nice 4vpp 4MHz signal on 1802 pin 39 (see Note 1 on page 2).

The 1802 is cleared on power-up, then runs the program in U2. Look for pulses on TPA, TPB and SC0 (1802 pins 34, 33, and 6). The program needs to have a video Interrupt handler (or, it needs to turn interrupts off as its first instruction).

Video sequencer U6-U7-U8 generates video independently from the 1802. It is clocked by TPA. The U6 outputs will count up, U7 converts the count into commands, and there will be Hsync and Vsync pulses on U8 pins 9 and 12.

DMA is controlled by the TVON latch (Q1-R5-U8 bit 0). An IN6 instruction turns it ON, and IN7 turns it off. The program needs to turn it OFF until R0 and the interrupt handler are initialized. If you are having problems debugging, ground U9 pin 9 to keep TVON=0 so you don't get unwanted DMA or interrupts.

If all is well, connect an NTSC monitor to P1, and you should have video. With the monitor or TV Typewriter program ROM, what you type will appear on the screen. Now the fun begins! :-)



"OK, I think I found your problem. You didn't use the right swear words to assemble it."