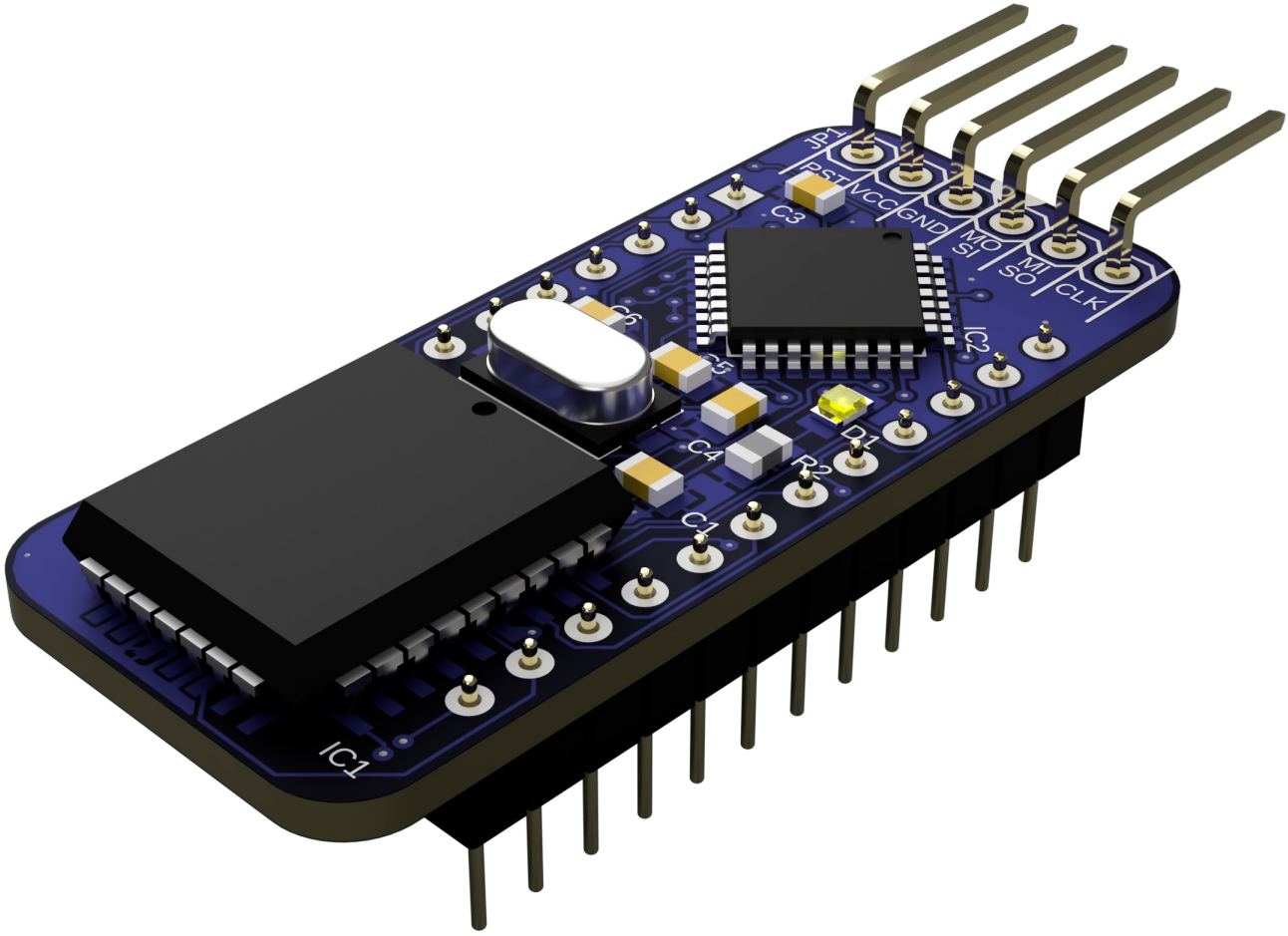
Retroninja Switchless Multi-Kernal for VIC-20



User Guide

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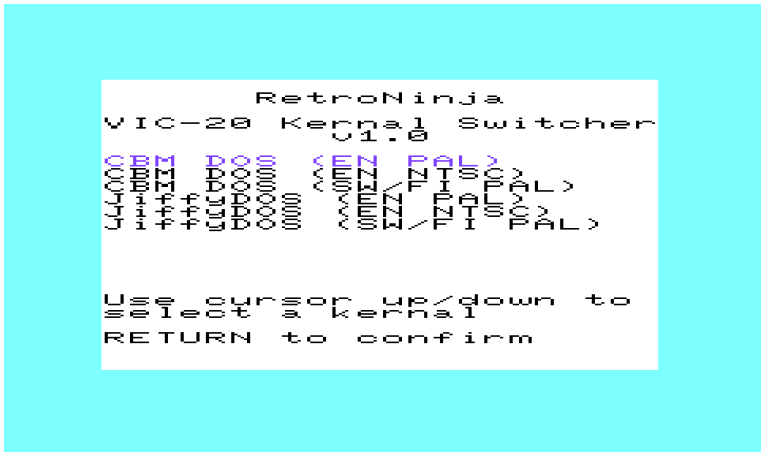
Functional description

At power on, the MCU in the Kernal switch holds the reset line active while it reads address 0 from its internal EPROM to find out which Kernal it should select, sets the A13-A18 address pins on the flash chip accordingly and releases the reset line to make sure the computer is booted using the correct Kernal.

If at any time, restore is pressed and held for a few seconds the MCU will detect this and switch to Kernal 0 which is a menu Kernal. For this application I created a custom Mini-Kernal for the VIC-20 that displays a list of Kernals to choose from.



When the user selects a Kernal image from the menu, the Mini-Kernal writes a predefined switching command to RAM along with a byte that indicates the selected image number. It does this over and over. Example of the command: RNROM20#1 where 1 is a byte with value 0x01 that tells the switch that we want to switch to kernal image 1.
The Kernal switch now captures the command from the data bus, writes the selected kernal number to the MCU EPROM for future use, then it switches the ROM address pins A13-A18 accordingly. It then resets the computer using the new Kernal by pulling the reset line. The computer will continue to start up using this new Kernal until a new choice is made.

The flash is populated with the Mini-Kernal followed by up to 10*8 KB Kernals. It would in theory be possible to add up to 63 Kernals if both the Mini-Kernal and the MCU firmware was modified in some way to accommodate that many Kernal images.
Here's an example layout that fills out an SST39SF010A:

Mini-Kernal	CBM EN PAL	CBM EN NTSC	CBM SE PAL	Jiffy EN PAL	Jiffy EN NTSC	Jiffy SE PAL	Mini-Kernal	Mini-Kernal	Mini-Kernal	Mini-Kernal	Mini-Kernal	Mini-Kernal	Mini-Kernal	Mini-Kernal	Mini-Kernal
8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB	8kB

If the same layout would be used with a larger flash chip it should be duplicated to fill out the flash.

Installing the Kernal switch

The switch will replace the kernal ROM chip (UD6 on Rev E boards, UE12 on boards 324003/250403).
The kernal ROM chip is not always socketed and if it isn't, it must first be desoldered from the board and a 24 pin socket should be soldered to the board before the switch is installed. Pay attention to the direction of the notch on the chip that indicates the location of pin 1. The notch on the socket should face the same direction and so should pin 1 on the switch. Pin 1 on the switch is at the end that has six header pins. It is also indicated by a printed notch on the bottom side of the switch.
If any EPROM adapters are installed at positionUD6/UE12 they need to be removed and the switch should be installed directly in the socket

The below pins on the switch must be connected to the right signals on the motherboard.

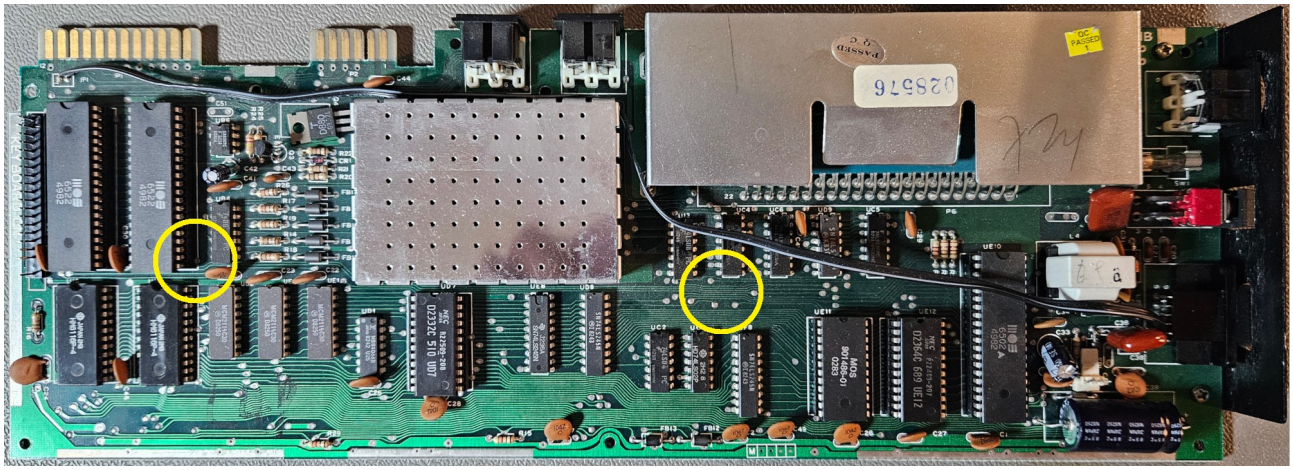
Switch pin	Computer signal	Example of locations
CLK	R/W (CRW)	6502 pin 34, 6522 pin 22
MISO	RESTORE	KBD connector pin 3
MOSI	RESET	6502 pin 40

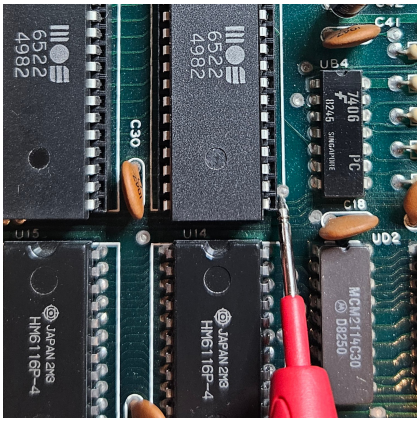
The connections can be made on the chips using test clips but it's recommended to solder pin headers to vias on the motherboard where available and connect the pin headers using Dupont wires or solder a cable to the motherboard for a permanent installation. If you want to solder pin headers to the vias you can try inserting them from the top side without taking the board out. Try heating the pins with the soldering iron while pushing them into the via using pliers but to get the best possible connection of the pins they should be soldered from the bottom of the motherboard.
The pictures in the following sections show examples of suitable vias for different motherboards.

PCB 250403

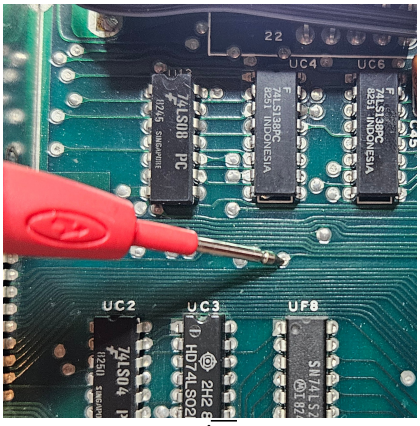
TBD

PCB 251037

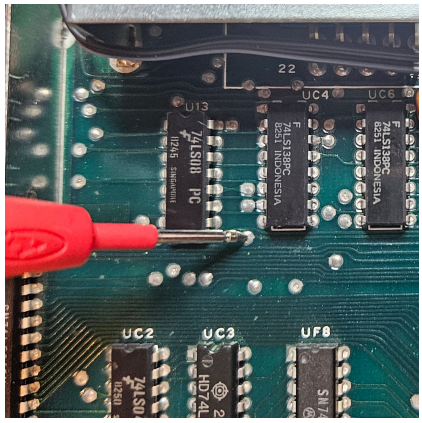




RESTORE

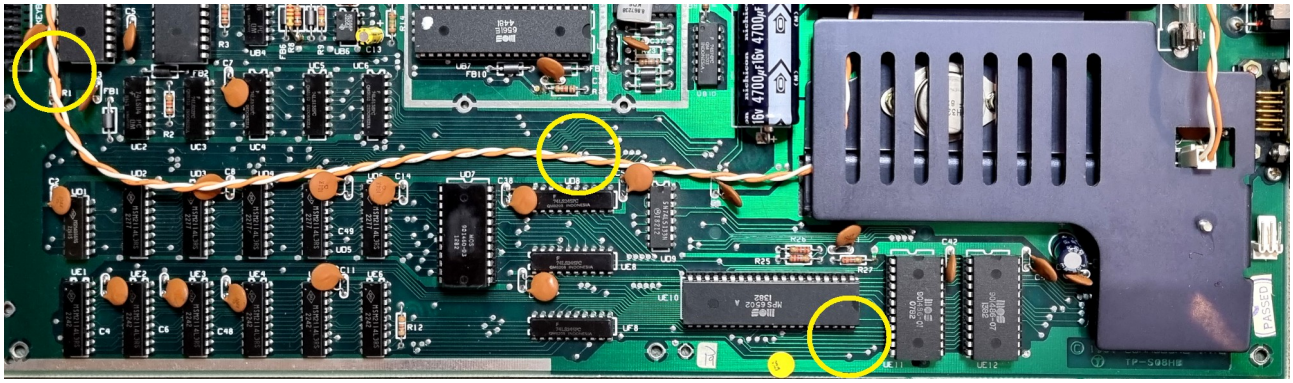


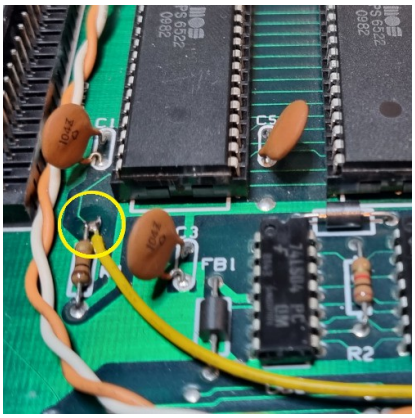
R/W



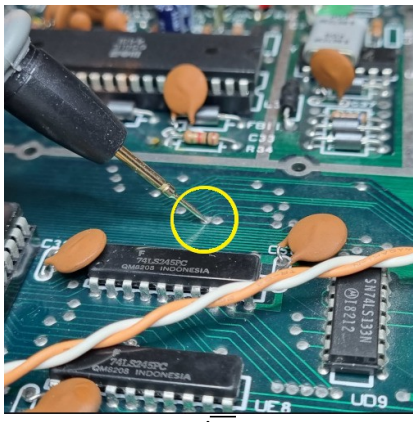
RESET

PCB 324003

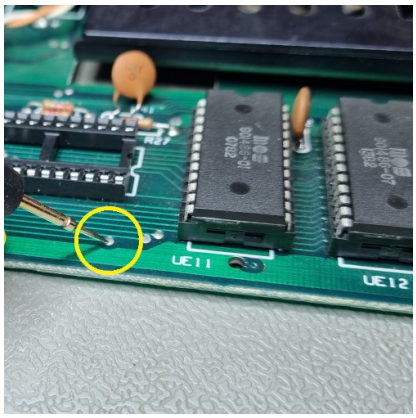




RESTORE



R/$\overline{W}$



RESET

The restore signal doesn't go through any VIAs on this PCB. Solder the restore wire to the upper end of resistor R1 or solder it to the bottom of the PCB. Pin 40 of VIA UAB3 is the point closest to the ROM socket. Make sure none of the header pins on the switch touches the heat sink.

Using the Kernal switch

Hold the restore key for about three seconds until the kernal menu is activated. Once in menu you can use cursor up/down to move to the Kernal you want to switch to and press return. The switch resets the computer with the new Kernal and saves your choice for next power-on.

Upgrading the firmware

The firmware in the microcontroller can be upgraded using the 6-pin ISP header. The source code is written for Arduino and programming the firmware can be done directly from the Arduino IDE using an ISP programmer.
If your device is using an Atmega328 it can be programmed as an Arduino UNO. The other variants require custom board definitions. I have used the MiniCore from MCUdude (https://github.com/MCUdude/MiniCore) with default board settings.

If you can't or don't want to use Arduino I have some precompiled hex files for the Kernal switch and drive ROM switch along with fuse configurations and syntax examples for how to program them using avrdude. These can be found under the Applications folder in the GitHub repository at:
https://github.com/RetroNynjah/Switchless-Multi-ROM-for-2364

Programming the flash chip (ROM)

The flash chip needs to be programmed before soldering it. If you need to reprogram the flash later it must first be desoldered and then resoldered again after reprogramming.

The flash chip should contain the Mini-Kernal image followed by all switchable kernal images in correct order. All images needs to have a size of exactly 8KB.

Document revision history

1.0 Initial version

1.1 Added PCB 251037, minor corrections