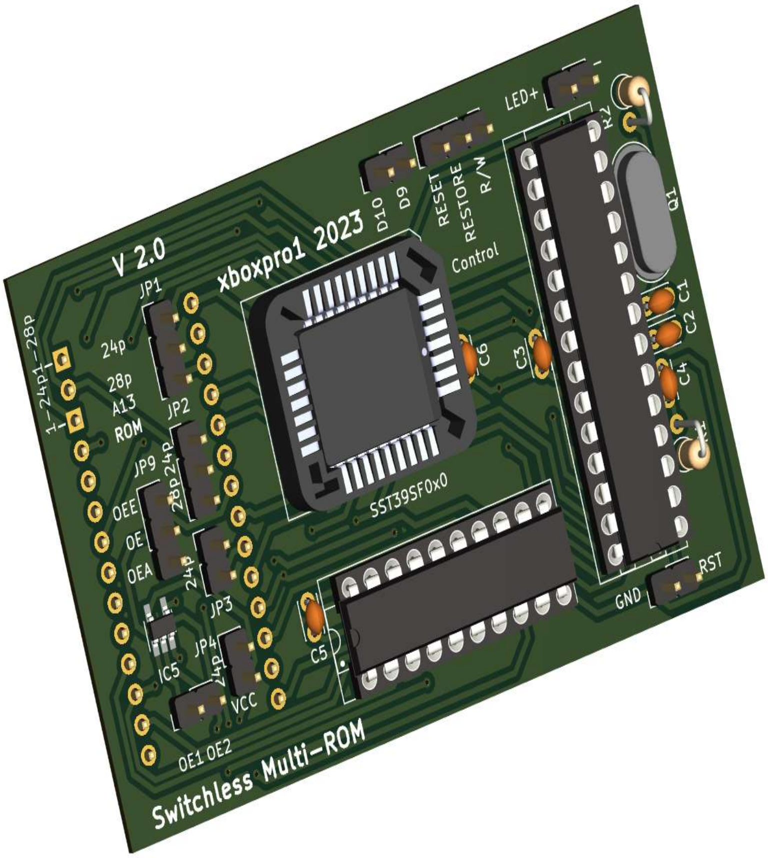
CBM Switchless Multi ROM
for 2364 & 27128 & 27256 ROMS



General Info

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Foreword

This is a fork, rework and combination of two repositories from RetroNynjah.

https://github.com/RetroNynjah/Switchless-Multi-ROM-for-2364

https://github.com/RetroNynjah/Switchless-Multi-ROM-for-27128-27256

I would like to thank RetroNynjah for the brilliant idea and excellent work.

After a long search on the internet, I finally found a perfect ROM switcher.

Overview

The Switchless multi ROM PCB is meant to sit in a ROM socket instead of
a 24-pin 2364 ROM or a 28-pin 27128/27256 ROM.

The AVR microcontroller (referred below as MCU) is connected to the data pins of the ROM socket through a flip-flop that latches the data to give the MCU more time to read the data. It is also connected to some header pins that can be connected to a clock source (r/w signal), a reset signal, a Restore key signal and optionally other signals. It also has an on-board flash chip that contains multiple ROM images.

With the help of an external clock source (r/w signal), the MCU can capture bytes that are passing on the data bus and react to a predefined command string of ”magic bytes” by switching the upper address pins on the flash circuit to switch to a different ROM image. This command string is sent from the a mini Kernal after selecting a kernel ROM. The mini kernel is selected by holding the Restore key for longer than two seconds.

The Switchless multi ROM has three firmware modes: 2364, 27128 and 27256 mode.
The 24-pin or 28-pin hardware mode is selected via jumper.

In 2364 mode, 8Kbyte ROMs, address lines A13 – A18 are set by the MCU.
In 27128 mode, 16Kbyte ROMs, address lines A14 – A18 are set by the MCU.
In 27256 mode, 32Kbyte ROMs, address lines A15 – A18 are set by the MCU.

Mode switching in the MCU firmware is done with bit shifting (flash Bank).

There is an Excel sheet in the tools folder. The macros are harmless, but not necessary.
The macros switch Excel error detection off and on. Switches to hexadecimal uppercase letters and filter non hexadecimal letters.

In this Excel sheet you can see the switching between 8k, 16k and 32k ROMs via bank switching (bit shifting). And how the address lines are controlled.

Changes

General

Instead of SMD parts, the board is mostly made of through-hole parts (THT). This makes it easier to solder for hobbyists, and reflashing the flash-chip.

The Switchless multi ROM can be used as a replacement for a 2364 24-pin ROM or a 27128 / 27256 28-pin ROM.

Hardware

MCU Port C (PC0-PC5) controls the address lines A13 - A18.

MCU Port B0 (pin 8) controls the LED.

Switching between a 24-pin ROM and a 28-pin ROM is done via jumpers.

Use of the case's power LED instead of the invisible on-board LED.

Firmware

The address lines are set with direct port manipulation instead of setting each address line individually.

Using the Pololu FastGPIO library makes the source code easier to understand and readable. The firmware is faster and the size smaller.

The firmware switches between 8k, 16k and 32k ROM´s via flash bank switching.

The LED blinking can be easy disabled.

Mini Kernal

Changed the ”magic bytes” command string and deactivated sprites.

Notes

The hardware is not compatible with the RetroNynjah firmware.

The MCU firmware currently does not support floppy drives.

Requirements

Software

To compile the firmware for the MCU, the Arduino IDE needs to be installed.
See: https://www.arduino.cc/en/software

MCUdude MiniCore must be installed using the Arduino IDE's Board Manager.
See: https://github.com/MCUdude/MiniCore

To use the fastgpio library from Pololu, it must be installed using the Arduino IDE´s Library Manager.
See: https://github.com/pololu/fastgpio-arduino

In order to compile the menu mini Kernal, CBM prg Studio must be installed.
See: https://www.ajordison.co.uk/index.html

If you want to flash the MCU firmware via ISP, I recommend AVRDUDESS.
See: https://github.com/ZakKemble/AVRDUDESS

Hardware

A USB universal programmer is required to flash the MCU firmware and the flash-chip memory. Like the TL866II Plus programmer, for example.

To flash the MCU firmware via ISP, I recommend the USBASP AVR Programmer.
Use Zadig to install the USBASP driver for Windows.
See: https://www.instructables.com/USBASP-Installation-in-Windows-10/

Soldering tools, a Multimeter, a PLCC32-DIP32 adapter.

PCB

I recommend having the PCB made by a manufacturer, such as PCBWAY or ELECROW. Ten boards cost around €15 with shipping. The gerber zip file is required for production.

Preparation

In order to install the Switchless multi ROM on a CBM mainboard several preparation need to be done. If the Kernal ROM IC is soldered in, it needs to be removed and a socket needs to be installed instead.

Although the Kernal IC is located at different positions, it can be found via the label.

On the VIC20 mainboard, the label is UE12. Commodore identifier 901486.
See: http://www.zimmers.net/anonftp/pub/cbm/schematics/computers/vic20/parts.txt

On the C64 mainboard, the label is U4. Commodore identifier 901227.
See: http://www.zimmers.net/anonftp/pub/cbm/schematics/computers/c64/README

On the SX-64 mainboard, the label is U4. Commodore identifier 251104.
See: http://www.zimmers.net/anonftp/pub/cbm/schematics/computers/c64/README

On the C64C mainboard, the label is U4. Commodore identifier 251913.
See: http://www.zimmers.net/anonftp/pub/cbm/schematics/computers/c64/README

On the C128 mainboard, the label for the C64C mode ROM is U32. Identifier 251913.
On the C128 mainboard, the label for the C128 mode ROM is U35. Identifier 318020.
On the C128DCR mainboard, the label is U32. Commodore identifier 318023.
See: http://www.zimmers.net/anonftp/pub/cbm/schematics/computers/c128/parts.txt
http://www.zimmers.net/anonftp/pub/cbm/firmware/computers/c128/128ROMs.readme

In addition, the Switchless multi ROM required 3 additional signals:

- Restore key (available on keyboard connector pin 3)
- r/w (available on any CIA pin 22)
- reset (available on any CIA pin 34)

Cables can be soldered right at these pins described above on the backside of the CBM mainboard or connected thru hole. Vias may be traced from these signals and used with male headers instead. On such vias the solder needs to be removed via a desolder station or solder iron and desolder pump and then the male headers can be installed there. This allows the usage of Dupont wires.

These signals need to be connected to the Control connector on the PCB.
(r/w pin1, Restore key pin2, reset pin3)

CBM mainboard schematics can be found at:
http://www.zimmers.net/anonftp/pub/cbm/schematics/computers/

Parts

Nr.	Amount	Component	Part	Description	Comment
1	1	IC1	SST39SF0x0	32-PLCC Flash	SST39SF010/20/40
2	1	IC2	ATmega MCU	28-pin PDIP	Atmega48/88/168/328
3	1	IC3	74HCT273	20-pin PDIP	Flip-Flop
4	1	IC4	74HCT1G04	SOT23-5 1 * Inverter	Only needed if clock needs inverting
5	1	IC5	74HCT1G08	SOT23-5 1 * AND Gate	Optional
6	1	Q1	20MHz Crystal	HC49/4H THT	16MHz is ok for 1MHz systems
7	4	C1 - C4	100nF capacitor	2.5mm THT	
8	2	C5, C6	27pF capacitor	ceramic 2.5mm THT	22pF works fine too
9	1	R1	10kΩ resistor	0207 THT	
10	1	R2	560Ω resistor	0207 THT	
11	1	IC1 Socket	PLCC Socket	32-pin THT	M-PLCC 32 T
12	1	IC2 Socket	IC Socket 28-pin	7.62mm THT	For AVR
13	1	IC3 Socket	IC Socket 20-pin	7.62mm THT	For Flip-Flop
14	2	ROM Headers	14-Pin Header	Pitch2.54mm	Use machined or flat pins - not square
15	1	Connector	20-Pin Header	Straight 2.54mm	For Connection and Jumper
16	1	Connector	20-Pin Header	Angeled 2.54mm	For Connection and Jumper
17	5	J1 - J4, J9	Jumper	Pitch2.54mm	Jumpers for configuration
18	1	ROM Socket	IC Socket 28-pin	15.24mm THT	Optional additional machined Socket
19	1	ROM Socket	IC Socket 24-pin	15.24mm THT	Optional additional machined Socket

The AVR ATmega model is not critical. The firmware requires less than 2KB of MCU flash memory. I have tested Atmega48A, 328P and they have worked for me.
For 1MHz systems, it is enough with 16MHz.

IC5, JP9, connector OE1/OE2 and connector D9/D10 are optional and not necessary. These parts are for experimental purposes only. Theoretically, the flash chip could accommodate Character ROM, Basic ROM and Kernal ROM at the same time.

I usually order my components from the distributor tme.eu.

Additional Info

Hardware information can be found in the hardware folder. Application information is in the applications folder.

RetroNynjah´s Guides are in the retroninja folder. I recommend reading these guides too. You can find a lot of useful information. For example, many images where you can find the signals, r/w, reset and the Restore key on the CBM mainboards.

Keep it simple.