User Guide

V0.3

Contents

1 Introduction

neatROM is a replacement circuit for 24 & 28 pin 8bit ROMs used in retro computers.

It started as a basic flash based 2364 & 23128 replacement PCB. The idea was to have a neat design like my other projects neatPLA, neat8701 & neatSRAM. All the components are on the bottom side.

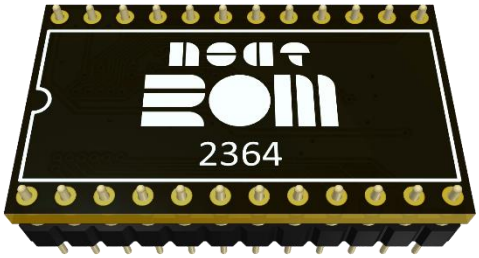


Figure 1. neatROM 2364

The 24pin version is called neatROM 2364. It supports:

- Use like a generic 2332 or 2364 replacement ROM.
- 16 jumper selectable 4/8kB banks.
- CS signal to pin 20. Also supports CS2 signal to pin 21 in VIC-20 character ROM mode.
- Reprogrammable with an adapter.
- Switchless Kernal selector for VIC-20 & C64. Switch between two different Kernals with the Restore-key. Third Kernal selectable with a jumper.
- multiROM. Use only one neatROM 2364 in a C64 or VIC20 and replace missing ROMs with a connection to the missing ROM CS signal. In a long motherboard C64 one neatROM 2364 can replace all 3 ROMs (Basic, Kernal, Character). In VIC-20 one neatROM 2364 can replace both Kernal & Basic ROMS.

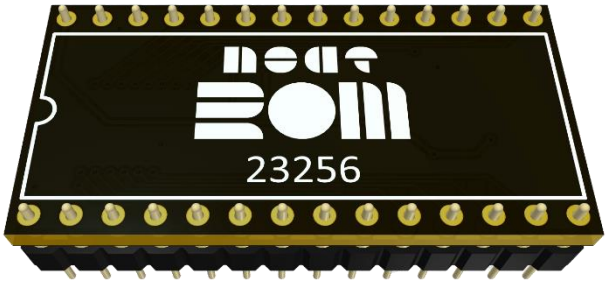


Figure 2. neatROM 23256

The 28pin version is called neatROM 23256. It supports:

- Use like a generic 2764, 23128, 27128, 23256 or 27256 replacement ROM.
- 8 jumper selectable 16kB banks or 4 jumper selectable 32kB banks.
- CS signal to pin 22.
- Reprogrammable with an adapter.
- Switchless Kernal selector for C64 & C128. Switch between two different Kernals with the Restore-key.
- multiROM. Use only one neatROM 23256 in a short motherboard C64 and replace missing character ROM with a connection to the character ROM CS signal. Usage in C128 is under study.

2 Generic ROM replacement

2.1 neatROM 2364: generic 2332 or 2364 ROM replacement

The neatROM 2364 got 16pcs of 8kB banks selectable with jumpers. If you use 4kB ROM images, then it's easiest to copy the ROM image twice to fill an 8kB bank. There is a pulldown resistor on the A12 signal on the PCB, but the target motherboard may have the pin pulled high.

The banks 1 to 16 are selected with jumpers as shown in Table 1. Jumper positions 2 & 3 set the A13 & A14 signals to 0 if jumper is present. In positions 5 & 6 the A15 & A16 signals are set to 1 if jumper is present. The neatROM 2364 is disabled if there is no jumper in positions 1-3. Position 1 grey cells can be left empty or populated with a jumper with the same functionality.

Table 1. neatROM 2364 banks selection

	Jumpers position					
Address	**1**	**2**	**3**	**4**	**5**	**8Kb banks**
0000-1FFF	:	■	■	:	:	BANK 1
2000-3FFF	:	:	■	:	:	BANK 2
4000-5FFF	:	■	:	:	:	BANK 3
6000-7FFF	■	:	:	:	:	BANK 4
8000-9FFF	:	■	■	■	:	BANK 5
A000-BFFF	:	:	■	■	:	BANK 6
C000-DFFF	:	■	:	■	:	BANK 7
E000-FFFF	■	:	:	■	:	BANK 8
10000-11FFF	:	■	■	:	■	BANK 9
12000-13FFF	:	:	■	:	■	BANK 10
14000-15FFF	:	■	:	:	■	BANK 11
16000-17FFF	■	:	:	:	■	BANK 12
18000-19FFF	:	■	■	■	■	BANK 13
1A000-1BFFF	:	:	■	■	■	BANK 14
1C000-1DFFF	:	■	:	■	■	BANK 15
1E000-1FFFF	■	:	:	■	■	BANK 16

Rows represent the pin header on the neatROM. The black and grey boxes represent jumpers and the colons represent empty pin header pin pairs. Pin header viewed as in Figure 3.

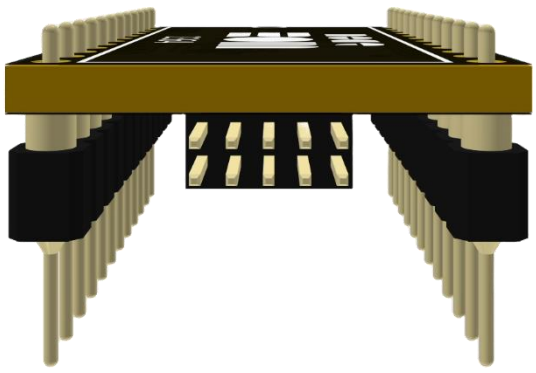
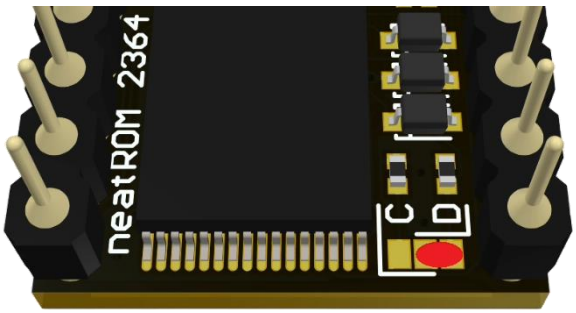


Figure 3. neatROM 2364 pin header

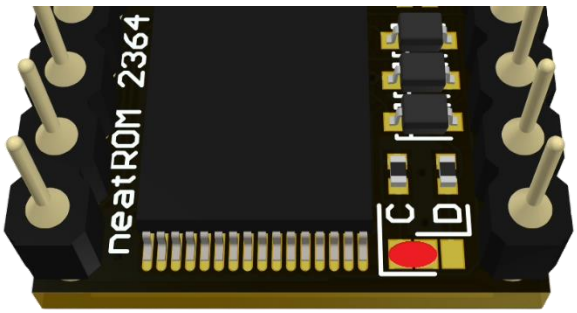
2.1.1 neatROM2364 VIC-20 character ROM mode

The VIC-20 character ROM got an extra chip select signal CS2. To enable the CS2 signal the short on the bottom side of the PCB need to be in the C (Character) position. For default use the short need to be in the D (Default) position. Change the short if needed. Notice the flash IC is not programmable if the short is in the C position.

Default ROM mode



VIC-20 character ROM mode



2.2 neatROM 23256: generic 2764, 23128 or 23256 ROM replacement

The neatROM 23256 got 8pcs of 16kB banks or 4pcs of 32kB banks selectable with jumpers. If you use 8kB ROM images, then it's easiest to copy it twice to fill a 16kB bank. There is a pulldown resistor on the A13 signal on the PCB, but the target motherboard may have the pin pulled high.

The 16kB banks and 32kB banks are selected with jumpers as shown in Table 2. Jumper positions 3-5 set the A14-A16 signals to 1 if jumper is present. Jumper position 1 is for multiROM CS signal. About that later in chapter 2.4. Jumper position 2 is for mapping A14 signal and enabling 32kB bank mode.

Table 2. neatROM23256 bank selection

	Jumper position					
Address	**1**	**2**	**3**	**4**	**5**	**16kB banks**
0000-3FFF	:	:	:	:	:	BANK 1
4000-7FFF	:	:	■	:	:	BANK 2
8000-BFFF	:	:	:	■	:	BANK 3
C000-FFFF	:	:	■	■	:	BANK 4
10000-13FFF	:	:	:	:	■	BANK 5
14000-17FFF	:	:	■	:	■	BANK 6
18000-1BFFF	:	:	:	■	■	BANK 7
1C000-1FFFF	:	:	■	■	■	BANK 8

	Jumper position					
Address	**1**	**2**	**3**	**4**	**5**	**32kB banks**
0000-7FFF	:	■	:	:	:	BANK 1
8000-FFFF	:	■	:	■	:	BANK 2
10000-17FFF	:	■	:	:	■	BANK 3
18000-1FFFF	:	■	:	■	■	BANK4

Rows represent the pin header on the neatROM. The black boxes represent jumpers and the colons represent empty pin header pin pairs. Pin header viewed as in Figure 4.

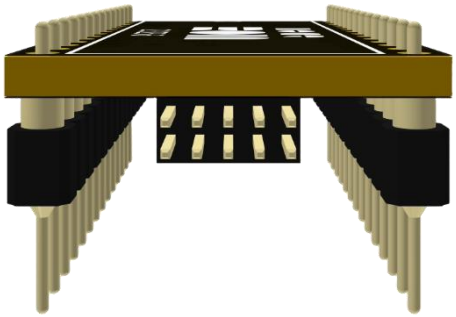


Figure 4. neatROM 23256 pin header

2.3 Switchless Kernal Selector

There are some alternative Kernal ROMs for the C64, C128 and VIC-20 which bring extra features to the computers. The most common Kernal alternative is the JiffyDOS [1]. It's mostly used for speeding up the disk drive loading speed.

The old Kernal switching method included a toggle switch which was installed into the case and required to drill a hole. Switchless Kernal Selector design was made to save the drilling and spoiling of cases. I first published it in my blog back in 2014 [2].

Figure 5. First ever Switchless JiffyDOS installation

The Switchless Kernal selector circuit works by capturing the state of the Restore-key signal at power-up or reset. The state is saved into a D-type flip flop.

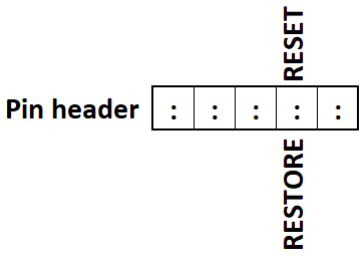
The output of the D-type flip flop IC handles the bank switching of the flash chip containing the original Kernal and JiffyDOS (or other alternative Kernal) images.

Pressing the Retore-key down while power-up/reset maps the same memory bank as having no jumper in the pin header position 4. Power-up/reset the computer without pressing the Restore-key maps the same memory bank as having a jumper in the pin header position 4. Flash the neatROM memory banks accordingly. See chapter 3.1 for examples.

2.3.1 Installation

For the circuit to work two wires need to be connected to the motherboard. The signals are RESTORE and RESET. The signals are connected to the neatROM pin header location 4. The upper pin is RESET and the lower pin is RESTORE.

Table 3. Restore & Reset signal pins



You can solder wires directly to the motherboard or use pin headers and female headers. On the neatROM use the provided female header. See figures X-X for reference.

INSERT EXAMPLE FIGURES OF LONG & SHORT BOARD C64 & VIC-20.

2.4 multiROM

In a long board C64 one neatROM 2364 can replace one, two or all three ROM chips (Basic, Kernal & Character ROMs).

In a short board C64 one neatROM 23256 can replace the Basic+Kernal ROM or Basic+Kernal and Character ROMs.

In VIC-20 one neatROM2364 can replace the Basic ROM or the Kernal Rom or both.

The use in a C128 is under investigation. It's also possible to use the multiROM feature in other machines where multiple ROM chips are on the same data and address bus.

multiROM has been popular with SixtyClone and other replica builders who want to reduce the current consumption of the computer. Using a flash chip already reduces the current consumption compared to the old masked ROM chips. Using multiROM you can cut the ROM chip current consumption further by getting rid of extra ROM chips.

ROM chips are replaced by connecting the CS signal from the extra ROM empty socket to the pin header of the neatROM. The neat2364 can have extra ROM CS signals connected to the pin header locations 1, 2 and 3. Both 2332 and 2364 chips can be replaced with multiROM. The neatROM 23256 can have the extra ROM CS signal connected to the pin header position 1 only. 2764, 23128 and 27128 chips can be replaced by multiROM.

If the extra ROM is accessed, then the CS signal maps a different memory bank from neatROM to the data bus. The CS signal is low active and matches the same as having a jumper in the same pin header position. See chapter 3.1 for memory bank mapping examples.

Chapters 2.4.2 to 2.4.4 show examples for VIC-20 and C64 computers. They can be used as an example if implementing the feature to some other computers with multiple ROM chips on the same address and data bus.

2.4.1 CS adapter

A connection to the extra ROM CS signal can be made with a single wire or use a neatROM CS adapter PCB. The neatROM CS adapter got 6 soldering pads all connected to the CS signal pin. There is also a pin header in case a "DuPont connector" is used. If you purchased the neatROM CS adapter in parts you can use a round pin IC socket as a soldering jig.

Figure 6. neatROM CS adapter

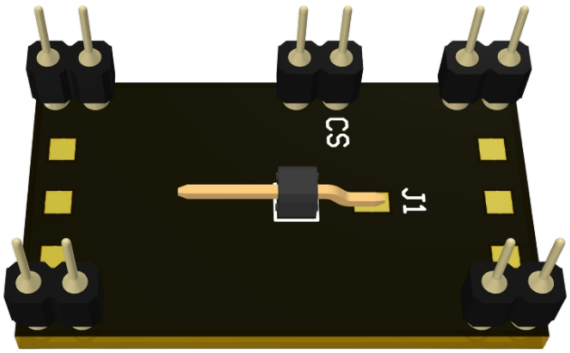


Figure 7. neatROM CS adapter bottom view

2.4.2 multiROM in a VIC-20

The neatROM can be in the Basic or Kernal ROM socket.

Select the location of the neatROM 2364 with a jumper in locations 1 Basic or 2 Kernal. Connect a wire from pin header locations 1 Basic or 2 Kernal lower pin to missing ROM socket pin 20. See C64 images in the next chapter for reference. VIC-20 images will be added later. See chapter 3.1.1 for memory mapping working with this connection.

Table 4. neatROM 2364 pin header

ROM	Basic	Kernal			
Location	1	2	3	4	5
Pin header	:	:	:	:	:

2.4.3 multiROM in a longboard C64

The neatROM 2364 must be in the Basic or Kernal ROM socket. Character ROM socket is missing the A12 signal.

Select the location of the neatROM 2364 with a jumper in locations 1 Basic or 2 Kernal. Connect a wire from pin header locations 1 Basic, 2 Kernal or 3 Character lower pin to missing ROM socket pin 20.

Table 5. neatROM 2364 pin header

ROM	Basic	Kernal	Character		
Location	1	2	3	4	5
Pin header	:	:	:	:	:

Below is an installation example of using neat 2364 in the Kernal ROM socket and replacing both Basic and Character ROMs. Locations 4 & 5 in the pin header can be used for bank switching with jumpers and/or Switchless Kernal selector feature. See chapter 3.1.2 for memory mapping for this example.

INSERT EXAMPLE IMAGE

2.4.4 multiROM in a short board C64

The neatROM 23256 fits only into the Basic+Kernal ROM socket U4.

Place a 2-pin female header to the pin header locations 1 Character. Both pins of the female header have to be shorted together and connected to the missing Character ROM socket U5 pin 20.

Table 6. neatROM 23256 pin header

ROM	Character				
Location	1	2	3	4	5
Pin header	:	:	:	:	:

Below are installation examples of using neatROM 23256 and replacing both Basic+Kernal and Character ROMs. Locations 2-5 in the pin header can be used for bank switching with jumpers and/or Switchless Kernal selector feature. Figure 8 show an installation with a wire connected to Character ROM socket pin 20. Figure 9 show an installation using a neatROM CS adapter board. Both figures also got the Switchless Kernal Selector wires. See chapter 3.1.3 for memory mapping for this example.

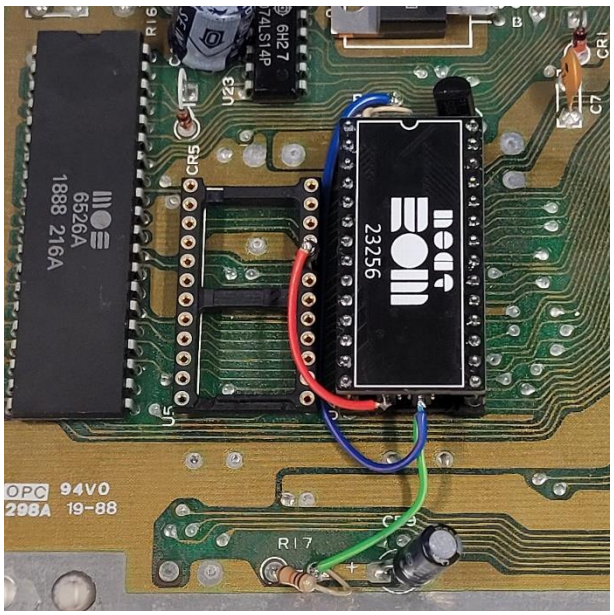


Figure 8. neatROM 23256 with wired multiROM

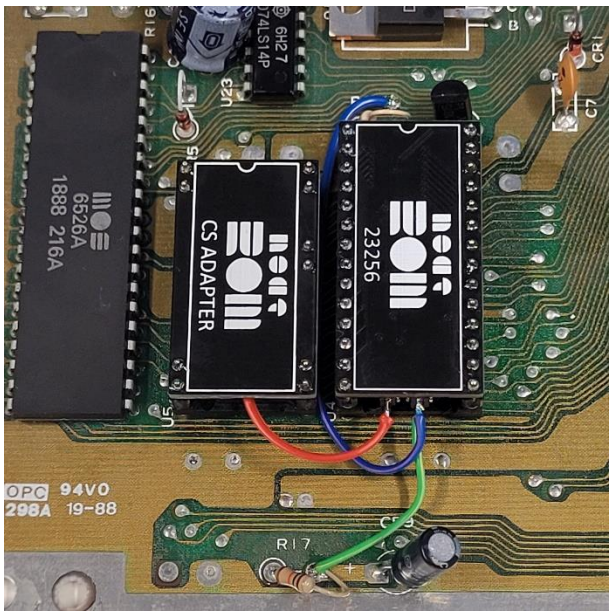


Figure 9. neatROM 23256 with multiROM & CS adapter

2.4.5 multiROM in C128

TBD.

3 Programming

Use a neatROM programming adapter to update the content of the flash IC. Remove all jumpers and connectors from the pin header. Connect the flat cable to the pin header. Push the neatROM into the programming adapter IC socket. There are separate IC sockets for both neatROM models. A 24-pin socket for neatROM 2364 and a 28-pin socket for neatROM23256. Connect only one neatROM at once. neatROM 2364 need to have the bottom side solder bridge in the D position. See chapter 2.1.1.

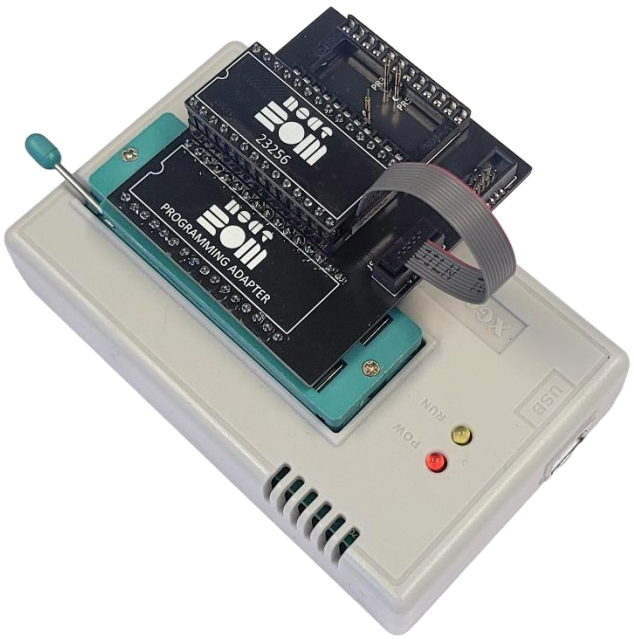
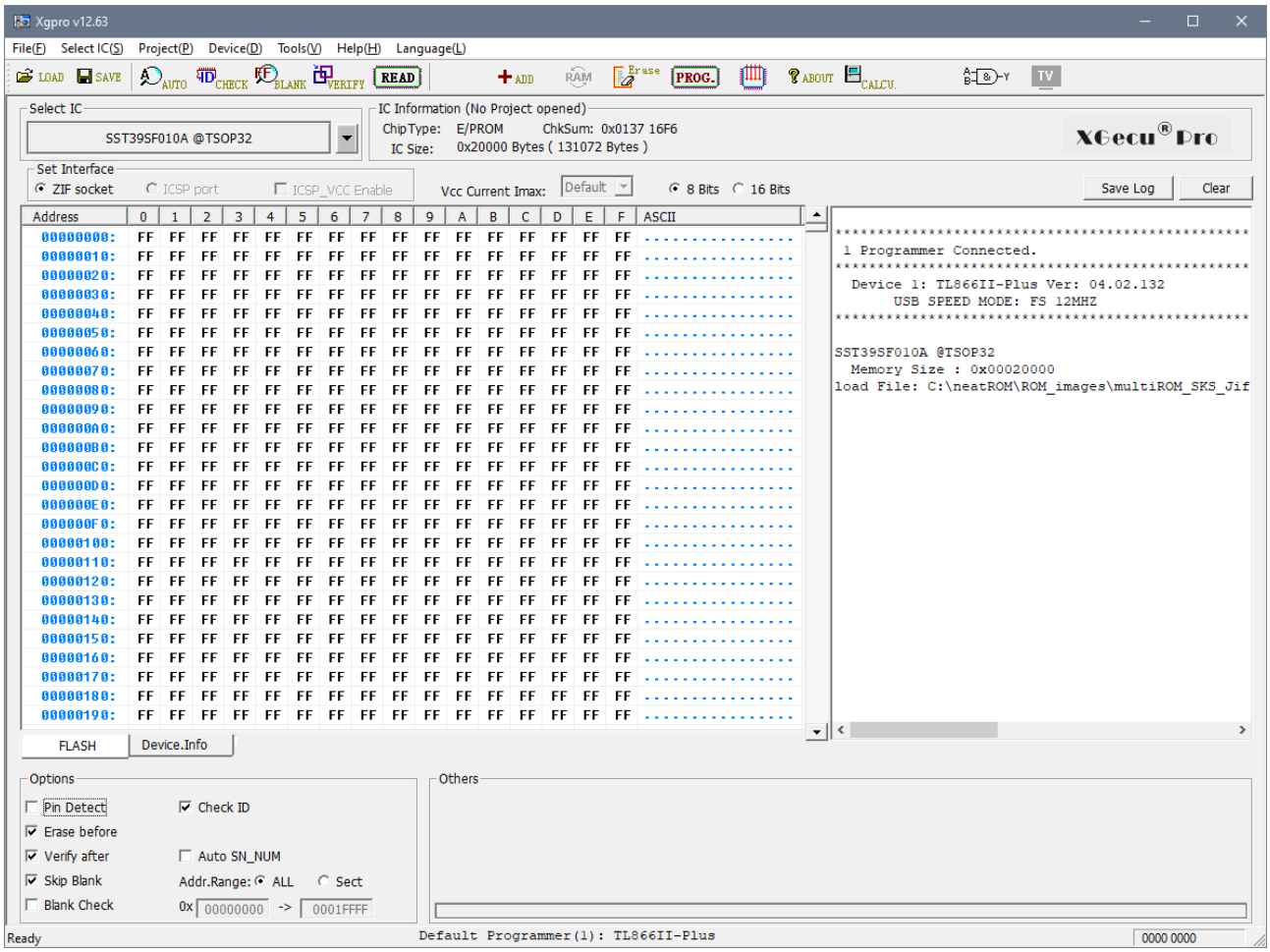


Figure 10. neatROM programming adapter

Programming have been tested with a TL866-II programmer with the Xgpro software. Select IC SST39SF010A TSOP32. Deselect “Pin Detect” from the options.



3.1 Memory bank mapping

Addresses and memory banks have been already presented in Table 1 and Table 2. Following tables present memory banking options for use in VIC-20 and C64 long and short board versions. The tables match the examples in the 2.3 Switchless Kernal Selector and 2.4 multiROM chapters.

3.1.1 VIC-20 example

With the memory mapping example presented in Table 7, the jumper position 1 and 2 select if the neatROM 2364 is in Basic or Kernal ROM socket. The order is the same as how the Basic and Kernal ROM chips are located on the motherboard. Basic is the left one and Kernal is the right one of the ROM chips pair.

The memory mapping also supports the character ROM with a jumper in position 3. Notice the solder bridge on the bottom side of the PCB must be in C position.

For the above single ROM replacement functionality, it is enough to fill banks 2, 3 & 4 only and use a single jumper in position 1, 2 or 3.

Switchless Kernal Switcher requires filling banks 7 and 8. Kernal 2 is selected by default and Kernal 1 is selected if Restore-key is pressed down during power-up or reset.

Jumper in position 5 can be used to select the default boot Kernal (Restore-key not pressed). This requires filling banks 11, 12, 15 and 16. If jumper position 5 empty, then Kernal 2 is booted by default. If there is a jumper in position 5, then Kernal 1 is booted by default.

	Jumper positions						
Address	1	2	3	4	5	8Kb banks	ROM image
0000-1FFF	:	■	■	:	:	BANK 1	Not in use
2000-3FFF	:	:	■	:	:	BANK 2	Character x2
4000-5FFF	:	■	:	:	:	BANK 3	Kernal 1
6000-7FFF	■	:	:	:	:	BANK 4	Basic
8000-9FFF	:	■	■	■	:	BANK 5	Not in use
A000-BFFF	:	:	■	■	:	BANK 6	Not in use
C000-DFFF	:	■	:	■	:	BANK 7	Kernal 2
E000-FFFF	■	:	:	■	:	BANK 8	Basic
10000-11FFF	:	■	■	:	■	BANK 9	Not in use
12000-13FFF	:	:	■	:	■	BANK 10	Not in use
14000-15FFF	:	■	:	:	■	BANK 11	Kernal 2
16000-17FFF	■	:	:	:	■	BANK 12	Basic
18000-19FFF	:	■	■	■	■	BANK 13	Not in use
1A000-1BFFF	:	:	■	■	■	BANK 14	Not in use
1C000-1DFFF	:	■	:	■	■	BANK 15	Kernal 1
1E000-1FFFF	■	:	:	■	■	BANK 16	Basic

Table 7. VIC-20 memory bank mapping example.

neatROM 2364 can be ordered preprogrammed with two following options:

VIC-20 option 1. Original ROMs only. Both Kernal 1 and Kernal 2 are original Kernals.

VIC-20 option 2. JiffyDOS. Kernal 1 is original and Kernal 2 is JiffyDOS. Extra fee is added for the JiffyDOS licence.

3.1.2 C64 long board examples

TBD

3.1.3 C64 short board examples

TBD

3.2 ROM images

There are several ready made ROM images for the neatROM. Depending on where you purchase the neatROM you can select the content of the flash IC. JiffyDOS needs a licence. This adds an extra fee for the price.

List of ready made ROM images

Link to downloads.

4 References

[1] c64-wiki.com JiffyDOS https://www.c64-wiki.com/wiki/JiffyDOS

[2] Switchless JiffyDOS blog post http://pasilassila.blogspot.com/2014/06/switchless-jiffydos-for-c64.html