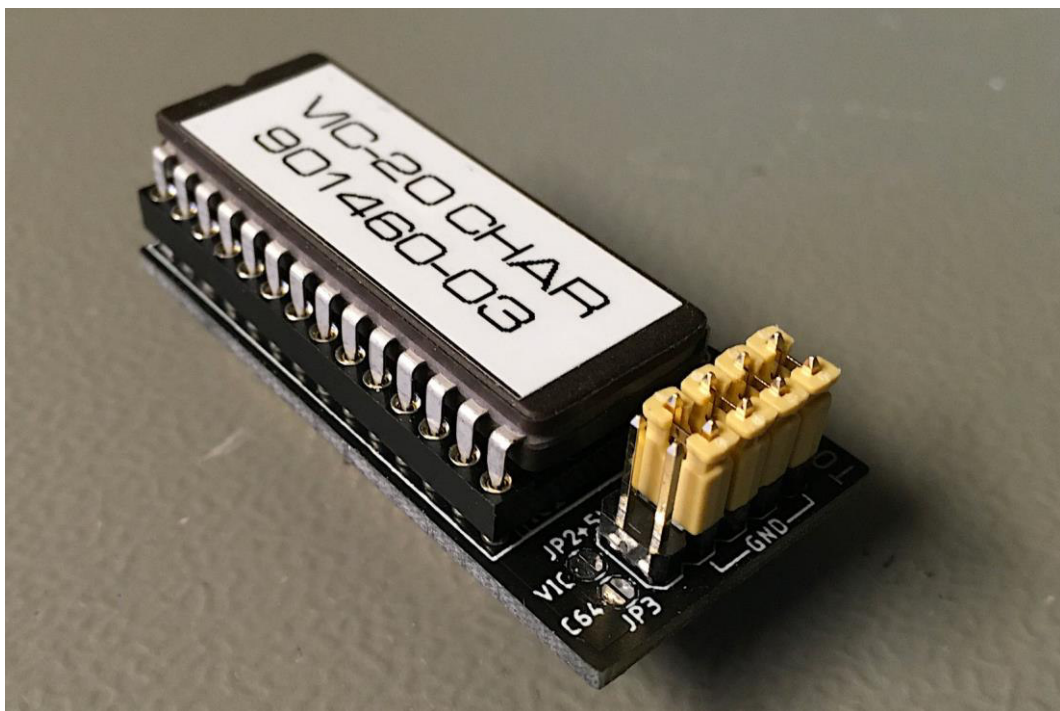# Project Documentation

Commodore VIC-20 Character ROM Adapter

Project number: 184

Revision: 0

Date: 18.07.2021

Commodore VIC-20 Character ROM Adapter Rev. 0

Module Description

The character ROM 901450-03 of the Commodore VIC-20 is a 2332 type ROM. Other than in the C64, it makes use of the 2nd chip select for address decoding. Thus, the C64 character ROM adapter (project number 126) is not suitable for the VIC-20.

The VIC-20 Character ROM adapter fixes this. Also, the geometry is different from the C64 Character ROM adapter to make it fit into ASSY250403, where it is pretty close to the RF-shield of the video circuit.
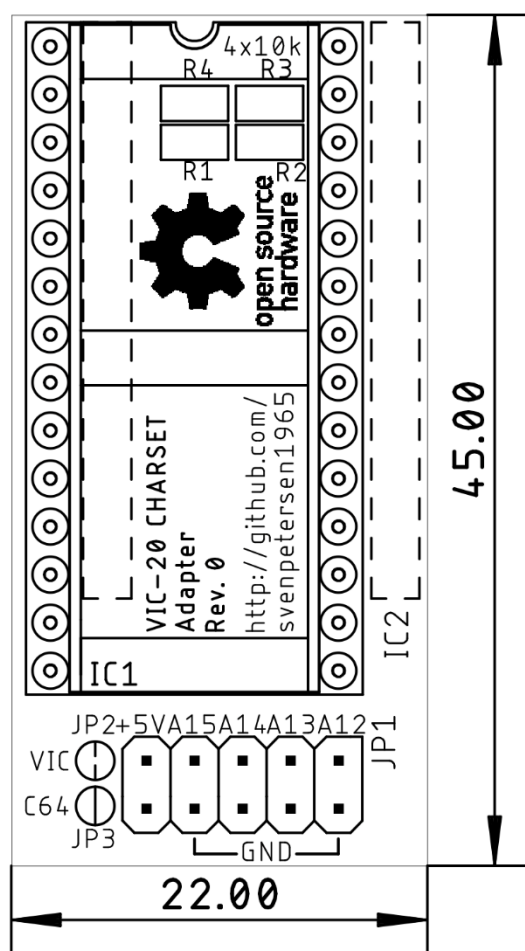

Figure 1: Dimensions

The VIC-20 Character ROM adapter can be configured to work with the C64 with solder bridges (JP2 & JP3). The default configuration is the VIC-20 mode, though. For the C64 short board, it fits mechanically quite well, due to the alignment of the socket/PCB to the left side or the ROM socket on the C64.

Computer	JP2	JP3
VIC-20	closed	open
C62	open	closed

Table 1: Compatibility configuration

This pin-header JP1 is connected in a way, that the selection can either be accomplished with standard 2.54mm jumper bridges, DIP-switches, hex-encoding switches or a microcontroller like an Arduino etc.

Signal	Pin	Pin	Signal
A12	1	2	GND
A13	3	4	GND
A14	5	6	GND
A15	7	8	GND
+5V	9	10	n.c.

Table 2: Jumper (JP1) for Bank Selection

The +5V pin is suitable to provide supply voltage to a microcontroller.

Bank Selection

The desired CHARACTER SET is selected at JP1. For the pinout refer to Table 2. The jumper is installed (vertically) in a way, that it connects the address line with the GND potential.

A15	A14	A13	A12	4k Block	Addr. Offset
set	set	set	set	#0	0x0000
set	set	set	open	#1	0x1000
set	set	open	set	#2	0x2000
set	set	open	open	#3	0x3000
set	open	set	set	#4	0x4000
set	open	set	open	#5	0x5000
set	open	open	set	#6	0x6000
set	open	open	open	#7	0x7000
open	set	set	set	#8	0x8000
open	set	set	open	#9	0x9000
open	set	open	set	#10	0xA000
open	set	open	open	#11	0xB000
open	open	set	set	#12	0xC000
open	open	set	open	#13	0xD000
open	open	open	set	#14	0xE000
open	open	open	open	#15	0xF000

Table 3: Selection of EPROM memory blocks (@JP1)

A set jumper corresponds to a LOW level (binary 0), an open jumper to a HIGH level. Do not confuse the C64 memory address and the EPROM memory address. They have the address Bit A0 to A11 in common, but the rest is different. Each of the 4k blocks appears between address $D000 and $DFFF of the C64.

Compatibility of EPROMs

Although a 27C512 type EPROM is recommended, other types of EPROMs can be installed:

EPROM	Size	Capacity
27C64	8k	2x Character Sets
27C128	16k	4x Character Sets
27C256	32k	8x Character Sets
27C512	64k	16x Character Sets

Table 4: Capacity of EPROM types

Those EPROMs are pin compatible, the jumpers, that have no function, due to the size, have to stay open.

EPROM	Size	A15	A14	A13	A12
27C512	64kx8	☑	☑	☑	☑
27C256	32kx8	open	☑	☑	☑
27C128	16kx8	open	open	☑	☑
27C64	8kx8	open	open	open	☑

Table 5: Settings per EPROM type

☑: The jumper can be open or closed, depending on the desired selection.

In case Vpp is located at a dedicated pin (pin 1), A15 has no effect anymore. A HIGH level is recommended, the corresponding jumper is open. The /PGM Pin should be set HIGH, this is accomplished by an open jumper for A14.

27C64											
	27C128										
		27C256									
			27C512								
				SOCKET							
Vpp	Vpp	Vpp	A15	1	A15	VCC	28	VCC	VCC	VCC	VCC
A12	A12	A12	A12	2	A12	A14	27	A14	A14	/PGM	/PGM
A7	A7	A7	A7	3	A7	A13	26	A13	A13	A13	n.c.
A6	A6	A6	A6	4	A6	A8	25	A8	A8	A8	A8
A5	A5	A5	A5	5	A5	A9	24	A9	A9	A9	A9
A4	A4	A4	A4	6	A4	A11	23	A11	A11	A11	A11
A3	A3	A3	A3	7	A3	/OE	22	/G/Vpp	/G	/G	/G
A2	A2	A2	A2	8	A2	A10	21	A10	A10	A10	A10
A1	A1	A1	A1	9	A1	GND	20	/E	/E	/E	/E
A0	A0	A0	A0	10	A0	D7	19	D7	D7	D7	D7
D0	D0	D0	D0	11	D0	D6	18	D6	D6	D6	D6
D1	D1	D1	D1	12	D1	D5	17	D5	D5	D5	D5
D2	D2	D2	D2	13	D2	D4	16	D4	D4	D4	D4
GND	GND	GND	GND	14	GND	D3	15	D3	D3	D3	D3

Table 6: EPROM pin compatibility

Using parallel EEPROMs

There are **parallel** EPROMs, which fit into the EPROM sockets. They do not require erasing with a UV eraser, like EPROMs, but the price is higher.

Since they can be written, which is controlled by the $\overline{WE}$ signal, but the Super Expander II cartridge is lacking of this functionality, this signal has to be HIGH (inactive). The 28C256 has the A14 signal connected to Pin 1, which is A15 of the EEPROM socket. This is no problem, but it has to be kept in mind, that the jumper for A15 has effect on the bank select A14 of the EPROM.

28C64	28C256	SOCKET					
n.c.	☀A14	1	A15	VCC	28	VCC	VCC
A12	A12	2	A12	A14	27	/WE	/WE
A7	A7	3	A7	A13	26	A13	n.c
A6	A6	4	A6	A8	25	A8	A8
A5	A5	5	A5	A9	24	A9	A9
A4	A4	6	A4	A11	23	A11	A11
A3	A3	7	A3	/OE	22	/G/Vpp	/OE
A2	A2	8	A2	A10	21	A10	A10
A1	A1	9	A1	GND	20	/E	/CE
A0	A0	10	A0	D7	19	D7	D7
D0	D0	11	D0	D6	18	D6	D6
D1	D1	12	D1	D5	17	D5	D5
D2	D2	13	D2	D4	16	D4	D4
GND	GND	14	GND	D3	15	D3	D3

Table 7: EEPROM pin compatibility

EEPROM	Size	A15	A14	A13
28C256	32kx8	=A14	OPEN	yes
28C64	8kx8	OPEN	OPEN	OPEN

Table 8: Settings per EEPROM type

Programming instructions

Character sets can be found here:

http://www.zimmers.net/anonftp/pub/cbm/firmware/computers/vic20/index.html or elsewhere. For instructions on setting up a complete multiple character ROM image, please refer to

https://github.com/svenpetersen1965/C64-Kernal-Adapter-Switch-Long-Board/blob/master/Rev.%200/pdf/C64_KernalSw_8k_v0.pdf
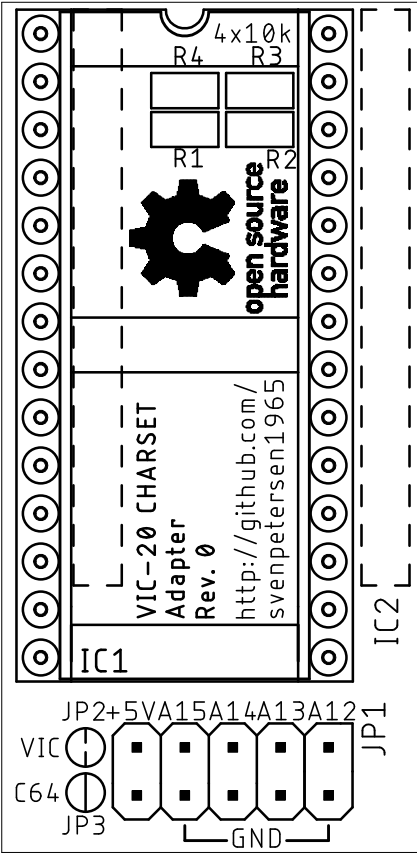
The description is about how to create a multiple Kernal ROM image, a multiple Character ROM image works pretty similar, except the size is only 4kB.
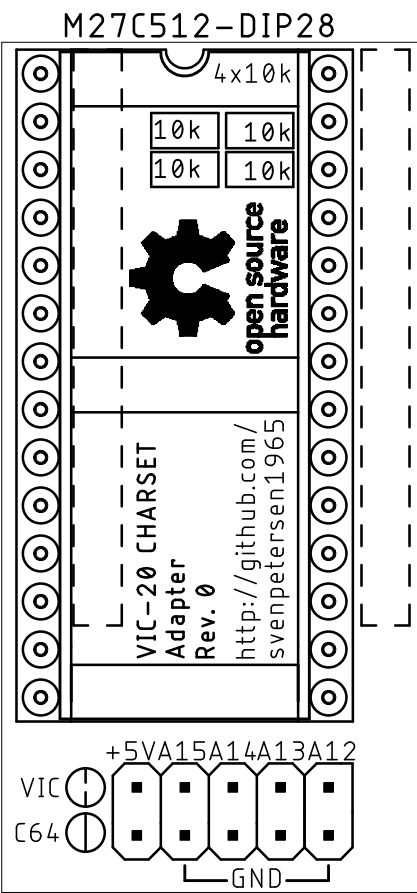
Revision History
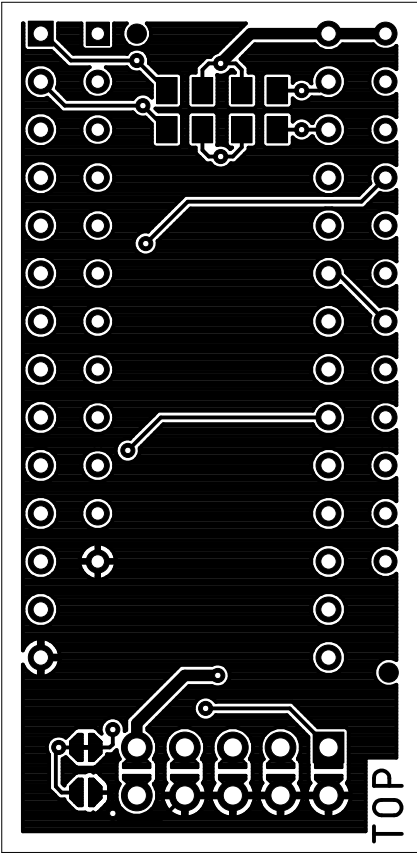
Rev. 0

- Fully working Prototype.

Sven Petersen	Doc.–No.: 184–2–01–00	
2021	Cu: 35µm	Cu–Layers: 2
VIC–20_CHARSET_adapter		
28.06.2021 14:16	Rev.: 0	
placement component side		

4x10k
R4 R3
R1 R2

open source hardware

VIC–20 CHARSET
Adapter
Rev. 0

http://github.com/
svenpetersen1965

IC1
IC2

JP2 +5V A15 A14 A13 A12
VIC
C64
JP3
JP1
GND

Sven Petersen	Doc.-No.: 184-2-01-00	
2021	Cu: 35µm	Cu-Layers: 2
VIC-20_CHARSET_adapter		
28.06.2021 14:16	Rev.: 0	
placement component side		

M27C512-DIP28

4x10k

10k 10k
10k 10k

open source hardware

VIC-20 CHARSET
Adapter
Rev. 0

http://github.com/
svenpetersen1965

+5V A15 A14 A13 A12

VIC

C64

GND

Sven Petersen	Doc.-No.: 184-2-01-00	
2021	Cu: 35µm	Cu-Layers: 2
VIC-20_CHARSET_adapter		
28.06.2021 14:16		Rev.: 0
		placement solder side

TOP

Sven Petersen 2021	Doc.-No.: 184-2-01-00	
	Cu: 35µm	Cu-Layers: 2
VIC-20_CHARSET_adapter		
28.06.2021 14:16	Rev.: 0	
bottom	███████	

Sven Petersen	Doc.–No.: 184–2–01–00	
2021	Cu: 35µm	Cu–Layers: 2
VIC–20_CHARSET_adapter		
28.06.2021 14:16		Rev.: 0
stopmask component side		

TOP

Sven Petersen	Doc.-No.: 184-2-01-00	
2021	Cu: 35µm	Cu-Layers: 2
VIC-20_CHARSET_adapter		
28.06.2021 14:16		Rev.: 0
stopmask solder side		

Sven Petersen	Doc.-No.: 184-2-01-00	
2021	Cu: 35µm	Cu-Layers: 2
VIC-20_CHARSET_adapter		
28.06.2021 14:16	Rev.: 0	
placement component side	measures	

4x10k
R4   R3
R1   R2

open source
hardware

VIC-20 CHARSET
Adapter
Rev. 0
http://github.com/
svenpetersen1965

IC1

IC2

JP2 +5V A15 A14 A13 A12
VIC
C64
JP3
JP1
GND

45.00

22.00
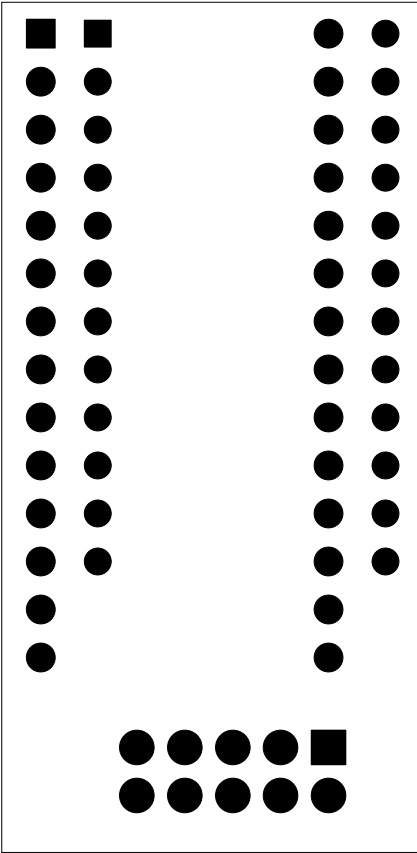
Commodore VIC-20 Character ROM Adapter Rev. 0

Test

Test Setup

The Character ROM adapter Rev. 0 was electrically tested in two **VIC-20**:

1. A Vicky Twenty, which is a clone of ASSY250403 (the VIC-20 CR)
2. An original ASSY324003 (two prong VIC-20)

It was further mechanically tested in an original (non-functional) ASSY250403 with shield around the video circuit.

Finally, the adapter was reconfigured as a **C64** adapter and tested with an

- ASSY250469 (short board)
- ASSY250425 (long board)

Figure 1: Test Setup with an ASSY324003 VIC-20

The screen shots were taken with a (cheap) CSL USB 2.0 Video Grabber.

Test Execution

Electrical testing

A ST 27C512 EPROM (120ns) was programmed with the original Commodore character sets:

- English/International
- Danish
- Swedish/Finnish
- VC-1001

Then installed in the Vicky Twenty. A test software was written, which puts all 256 characters on the screen.

The characters were displayed properly. Pulling/stetting jumpers resulted in switching character sets (the characteristic umlauts of the particular language became visible). The special Japanese characters became visible when switching to upper/lower case characters.

Figure 2: Danish character set on a VIC-20

Figure 3: Swedish character set on the VIC-20

Figure 4: Japanese character set on a VIC-20

Figure 5: Danish character set on a C64

The character ROM adapter works in a VIC-20 when configured for this computer and works in a C64, when configures as a C64 adapter.
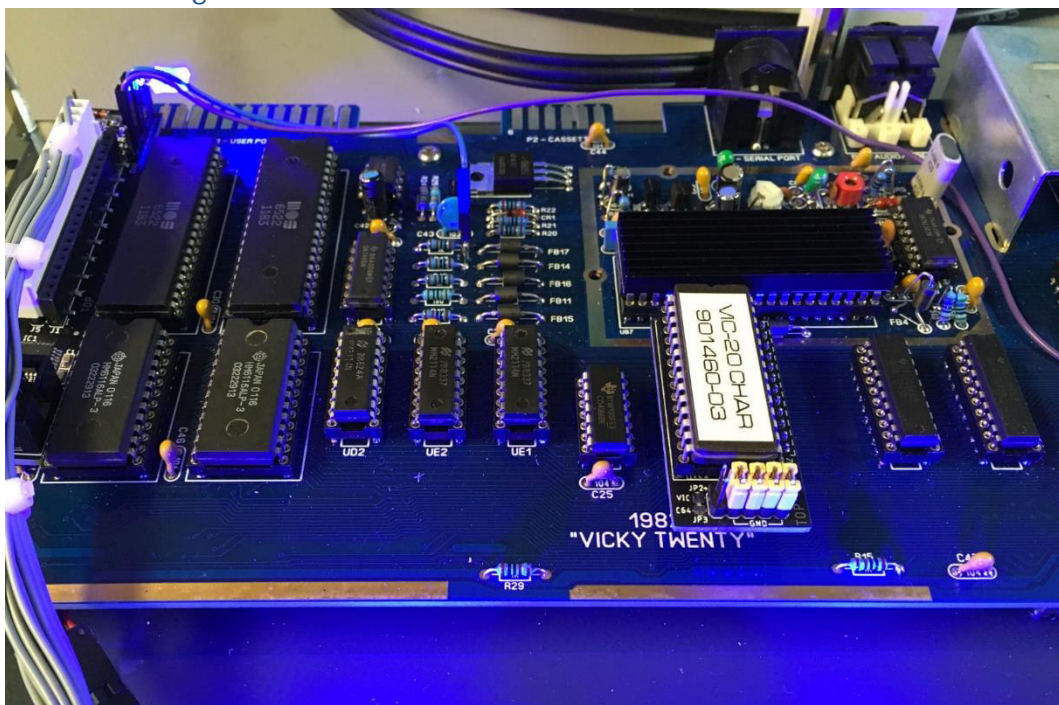
Mechanical Testing

Figure 6: Character ROM Adapter in the VickyTwenty

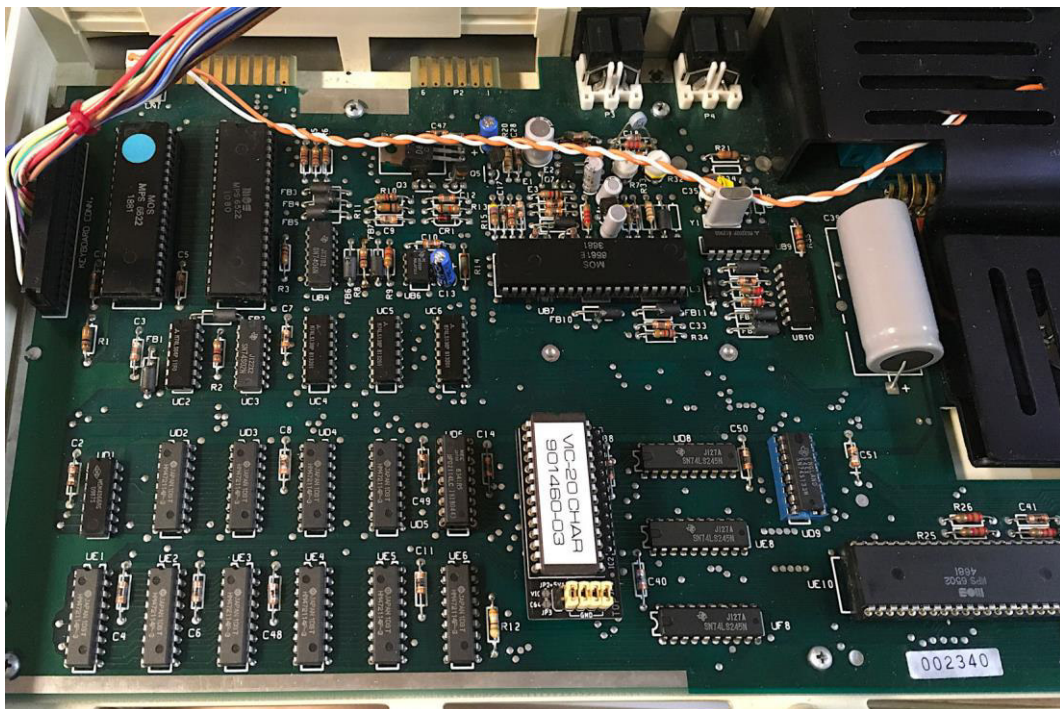*Figure 7: Character ROM Adapter in an ASSY 250403 (VIC-20 CR)*

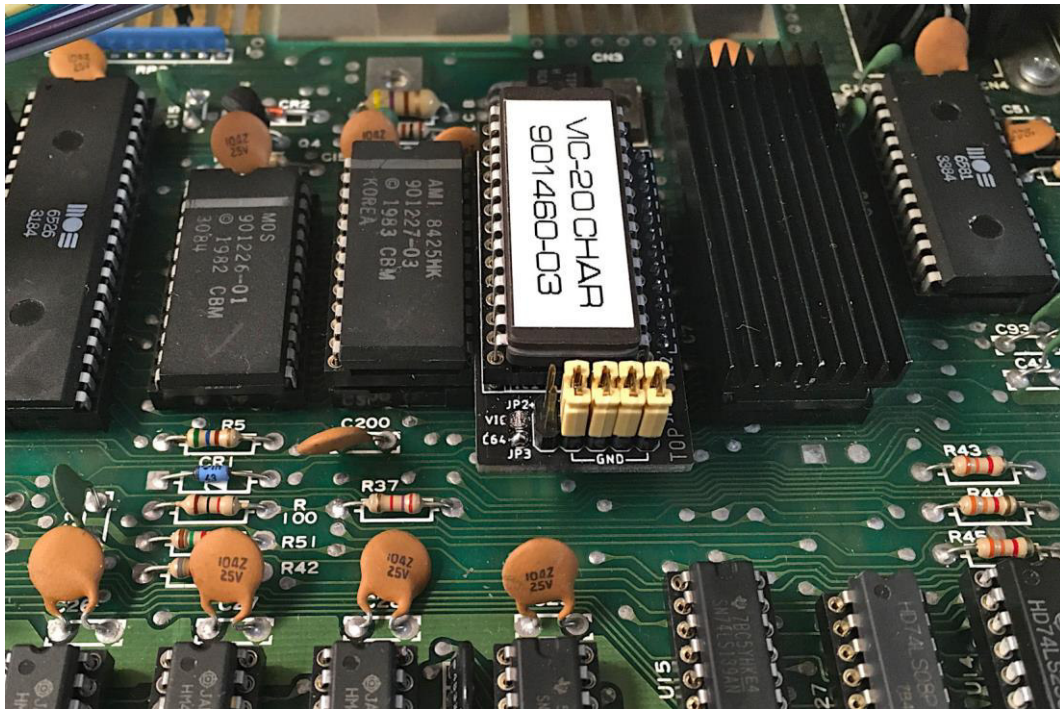*Figure 8: Character ROM Adapter in an ASSY 324003 (two-prong VIC-20)*

Figure 9: Test in the C64 ASSY 250425 (long board)

The VIC-20 Character ROM adapter fits in ASSY 250425 (and the other long boards). It would likely collide with a Kernal Adapter. Adding one or two precision round pin sockets might solve this problem.
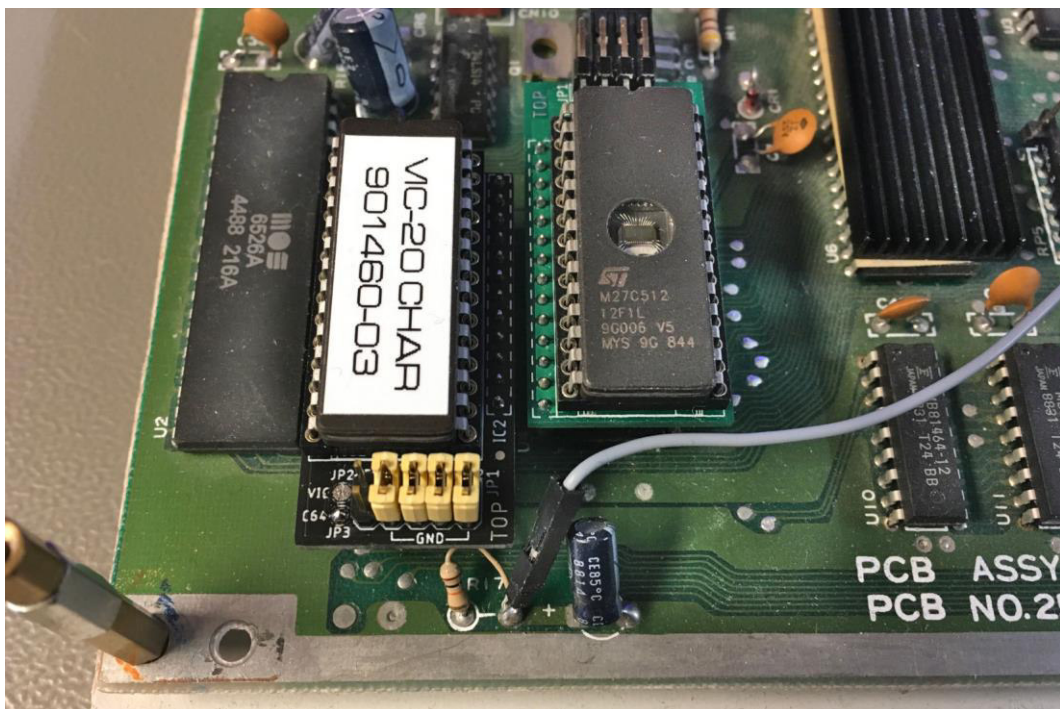

Figure 10: Test in a C64 ASSY250469 (short board)

Conclusion

The VIC-20 Character ROM adapter Rev. 0 is fully functional in both the VIC-20 and the C64. For the C64 long boards, the dedicated character ROM adapter is recommended.

VIC-20 Character ROM Adapter Rev. 0
Bill of Material Rev. 0.0

Pos.	Qty	Value	Footprint	Ref.-No.	Comment
1	1	184-2-01-00	2 Layer	PCB Rev. 0	2 layer, Cu 35µ, HASL, 45mm x 22mm, 1.6mm FR4
2	1	2x05pin, 2.54mm pitch	2x05	JP1	Standard pin header, 2.54mm pitch. E.g. Reichelt MPE 087-2-010
3	4	Jumper	2.54mm	(JP1)	Jumpers for address selection (in case it is intended to jumper the kenal selection)
4	4	10k	0805	R1, R2, R3, R3	SMD resistor
5	1	two Pinstrip, precision round pins, cut to 12 pins length	DIL24_SOCKET	IC2	Precision Round pins **mandatory**! E.g. Reichelt BKL 10120540 or
					10PCS Single Row 40Pin 2.54mm Round Male Pin Header machined
6	1	M27C512	DIL28-6	IC1	EPROM 200ns or faster recommended, alternative sizes: 27C64, 27C128, 27C256 possible
7	1	DIP28 socket	DIL28-6	(IC1)	Precision round pin is recommended