

# Project Documentation

C64 Cart64out

Project number: 122

Revision: 1

Date: 27.02.2022

# C64 Cart64out Rev. 1

## Module description

### Introduction

This board is a breakout board for the C64 (C128) expansion port. It can also serve several other purposes:

- Expansion port breakout board for connecting a scope or logic analyzer
- Breakout board for connecting a bread board
- Cartridge read out and analysis tool
- A simple reset-switch

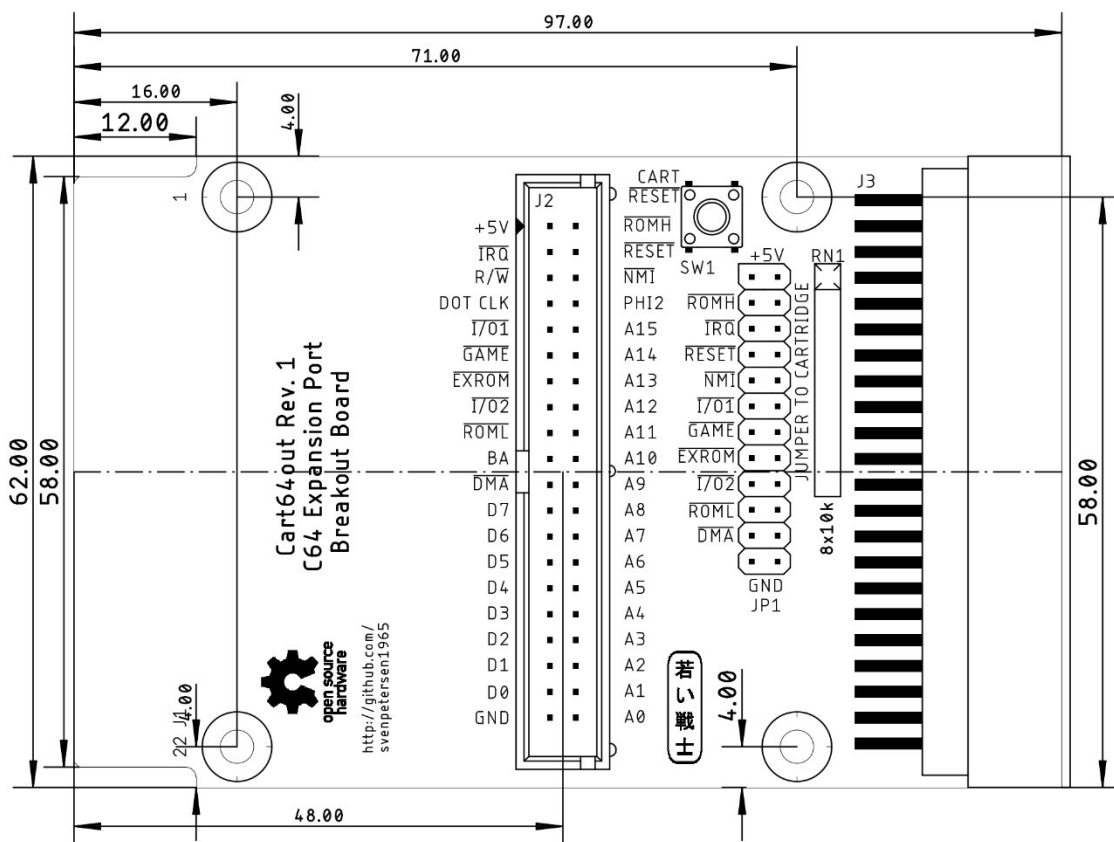


Figure 1: Cart64out dimensions

All signals of the expansion port are connected to the pin header J2. GND and +5V are only connected once to be able to use a standard 2x20p. pin header. All signals are connected to the edge connector J3. Some of those signals have to pass the jumper JP1, though, so they can be interrupted by pulling out the associated jumper. The resistor network RN1 serves as pull-up resistor on the cartridge side, so an open jumper means, that this signal is HIGH on the cartridge side.

The reset-switch SW1 is connected to the cartridge side of the reset signal. As long as the jumper labeled RESET is closed, it is effective for the cartridge and the C64. While this jumper is open, it only resets the cartridge.

JP1 can also be controlled by a micro controller for a comfortable read out of the cartridge. The supply voltage +5V and GND are connected on adjacent pins for this purpose. Those jumper pins are not required to be closed with a jumper.

Signal	Pin	Pin	Signal
+5V	1	2	+5V
$\overline{\text{ROMH}}$	3	4	$\overline{\text{ROMH}}^*$
$\overline{\text{IRQ}}$	5	6	$\overline{\text{IRQ}}^*$
$\overline{\text{RESET}}$	7	8	$\overline{\text{RESET}}^*$
$\overline{\text{NMI}}$	9	10	$\overline{\text{NMI}}^*$
$\overline{\text{I/O1}}$	11	12	$\overline{\text{I/O1}}^*$
$\overline{\text{GAME}}$	13	14	$\overline{\text{GAME}}^*$
$\overline{\text{EXROM}}$	15	16	$\overline{\text{EXROM}}^*$
$\overline{\text{I/O2}}$	17	18	$\overline{\text{I/O2}}^*$
$\overline{\text{ROML}}$	19	20	$\overline{\text{ROML}}^*$
$\overline{\text{DMA}}$	21	22	$\overline{\text{DMA}}^*$
GND	23	24	GND

Table 1: Pinout of Jumper JP1

Cart64out aims at the experienced hardware amateur, who wants to get deeper into the functionality of C64 cartridges. It can also be helpful while repairing a C64, because some of the signals, like  $\overline{\text{RESET}}$ , PHI2 or DOT CLOCK or stuck address or data lines can be monitored by scope without opening the C64.

The drills serve to install bolts adjusted to height to support the Cart64out. A length of 17mm – 18mm works best for both sorts of cases (C64 and C64C).

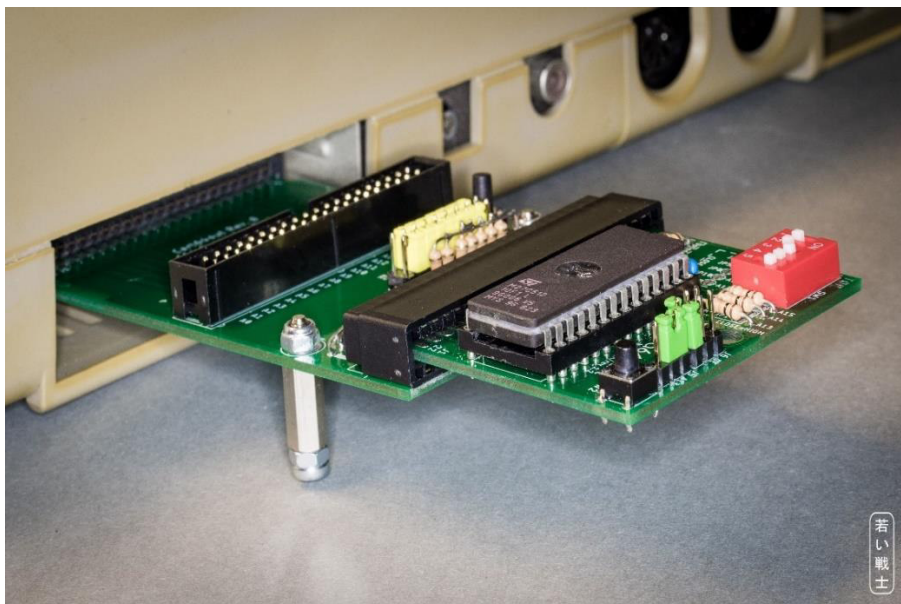


Figure 2: Supporting bolts

## Pinouts

### J1 – Expansion Port

Pin (TOP)	Signal	Pin	Signal (BOT)
1	GND	A	GND
2	+5V	B	$\overline{\text{ROMH}}$
3	+5V	C	$\overline{\text{RESET}}$
4	$\overline{\text{IRQ}}$	D	$\overline{\text{NMI}}$
5	R / $\overline{\text{W}}$	E	PHI2
6	DOT CLOCK	F	A15
7	$\overline{\text{I/O1}}$	H	A14
8	$\overline{\text{GAME}}$	J	A13
9	$\overline{\text{EXROM}}$	K	A12
10	$\overline{\text{I/O2}}$	L	A11
11	$\overline{\text{ROML}}$	M	A10
12	BA	N	A9
13	$\overline{\text{DMA}}$	P	A8
14	D7	R	A7
15	D6	S	A6
16	D5	T	A5
17	D4	U	A4
18	D3	V	A3
19	D2	W	A2
20	D1	X	A1
21	D0	Y	A0
22	GND	Z	GND

### J2 – Break out connector

2x20 box header, 2.54mm pitch

Pin	Signal	Pin	Signal
1	+5V	2	$\overline{\text{ROMH}}$
3	$\overline{\text{IRQ}}$	4	$\overline{\text{RESET}}$
5	R / $\overline{\text{W}}$	6	$\overline{\text{NMI}}$
7	DOT CLOCK	8	PHI2
9	$\overline{\text{I/O1}}$	10	A15
11	$\overline{\text{GAME}}$	12	A14
13	$\overline{\text{EXROM}}$	14	A13
15	$\overline{\text{I/O2}}$	16	A12
17	$\overline{\text{ROML}}$	18	A11

Pin	Signal	Pin	Signal
19	BA	20	A10
21	$\overline{\text{DMA}}$	22	A9
23	D7	24	A8
25	D6	26	A7
27	D5	28	A6
29	D4	30	A5
31	D3	32	A4
33	D2	34	A3
35	D1	36	A2
37	D0	38	A1
39	GND	40	A0

### J3 – Cartridge Connector

Card Edge Connector 22x2P 2.54mm (0.1") Right Angle

Pin (TOP)	Signal	Pin	Signal (BOT)
1	GND	A	GND
2	+5V	B	$\overline{\text{ROMH}}^*$
3	+5V	C	$\overline{\text{RESET}}^*$
4	$\overline{\text{IRQ}}^*$	D	$\overline{\text{NMI}}^*$
5	R / $\overline{\text{W}}$	E	PHI2
6	DOT CLOCK	F	A15
7	$\overline{\text{I/O1}}^*$	H	A14
8	$\overline{\text{GAME}}^*$	J	A13
9	$\overline{\text{EXROM}}^*$	K	A12
10	$\overline{\text{I/O2}}^*$	L	A11
11	$\overline{\text{ROML}}^*$	M	A10
12	BA	N	A9
13	$\overline{\text{DMA}}^*$	P	A8
14	D7	R	A7
15	D6	S	A6
16	D5	T	A5
17	D4	U	A4
18	D3	V	A3
19	D2	W	A2
20	D1	X	A1
21	D0	Y	A0
22	GND	Z	GND

The signals marked with \* can be interrupted by a jumper (see Table 1).

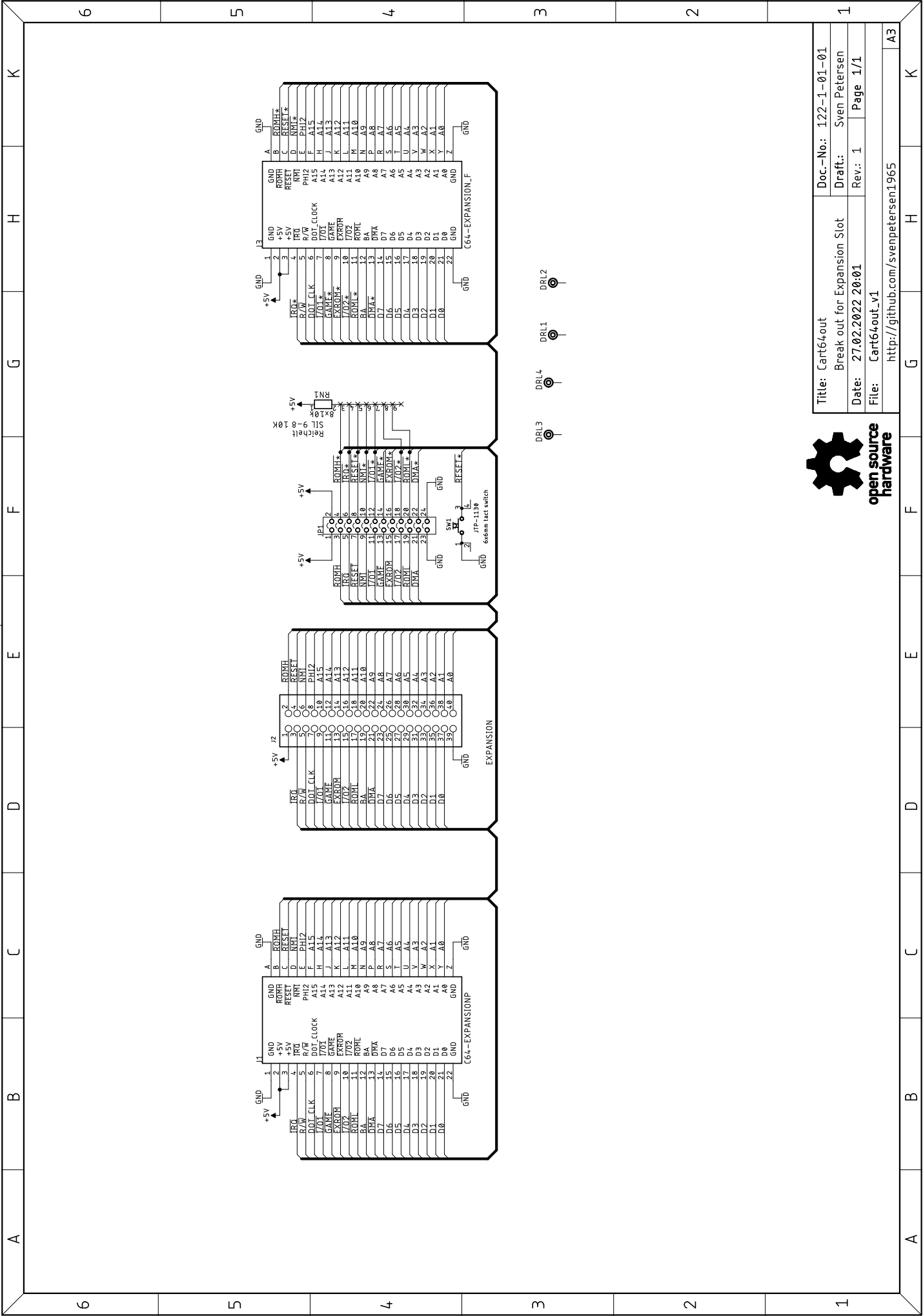
## Revision History

### Rev. 0 → Rev. 0a

- Two mounting holes added

### Rev. 0a → Rev. 1

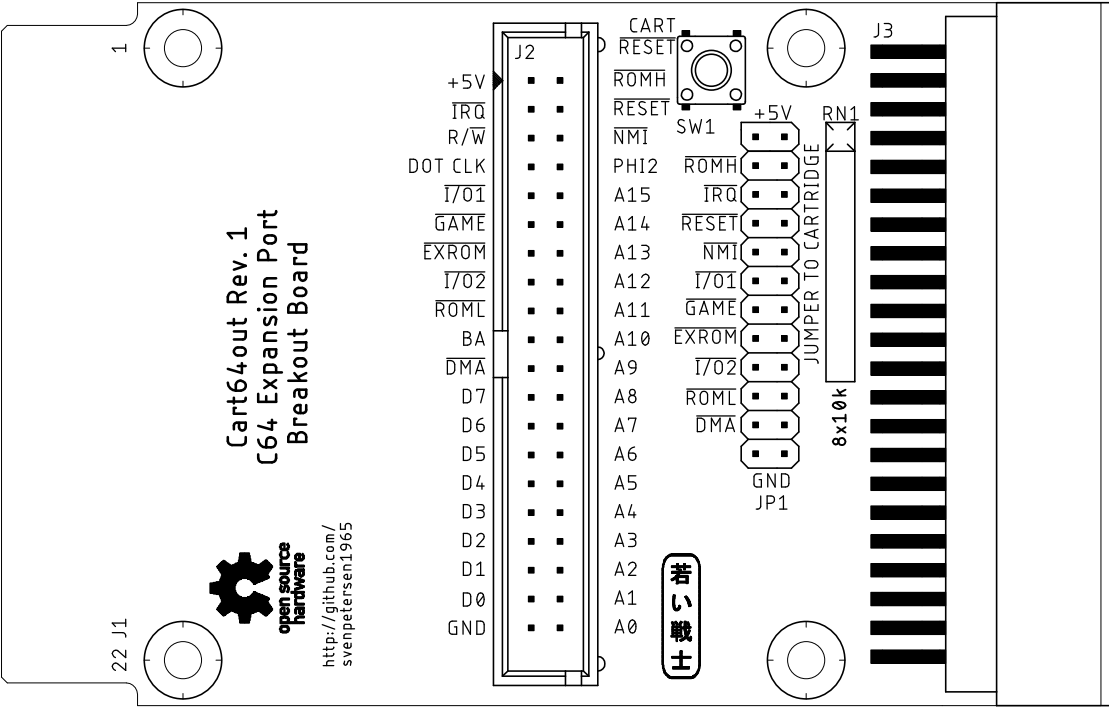
- Added  $\overline{\text{IRQ}}$  ,  $\overline{\text{NMI}}$  and  $\overline{\text{DMA}}$  to the pin header JP1 and made it suitable for solder bridges.



open source  
hardware

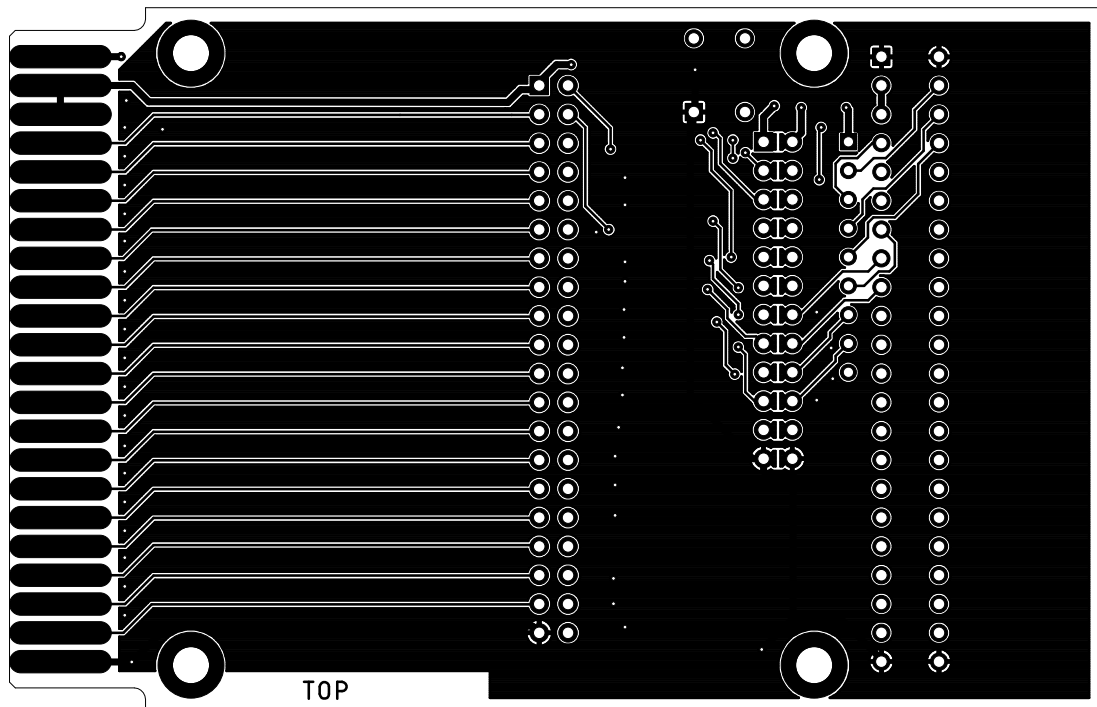
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Break out for Expansion Slot		Draft: Sven Petersen	
Date: 27.02.2022 20:01	Rev.: 1	Page 1/1	
File: Cart64out_v1			
		http://github.com/svenpetersen1965	
		A3	

Sven Petersen 2022	Doc.-No.: 122-2-01-01	
	Cu: 35µm	Cu-Layers: 2
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28.02.2022 11:51		Rev.: 1
placement component side		

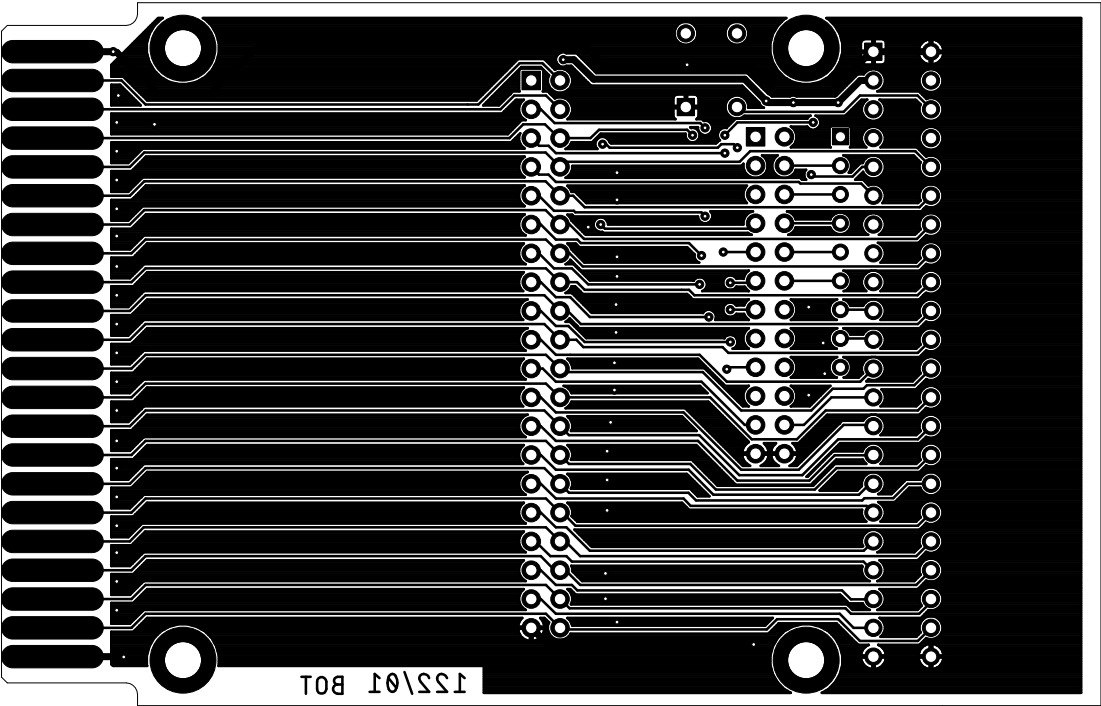




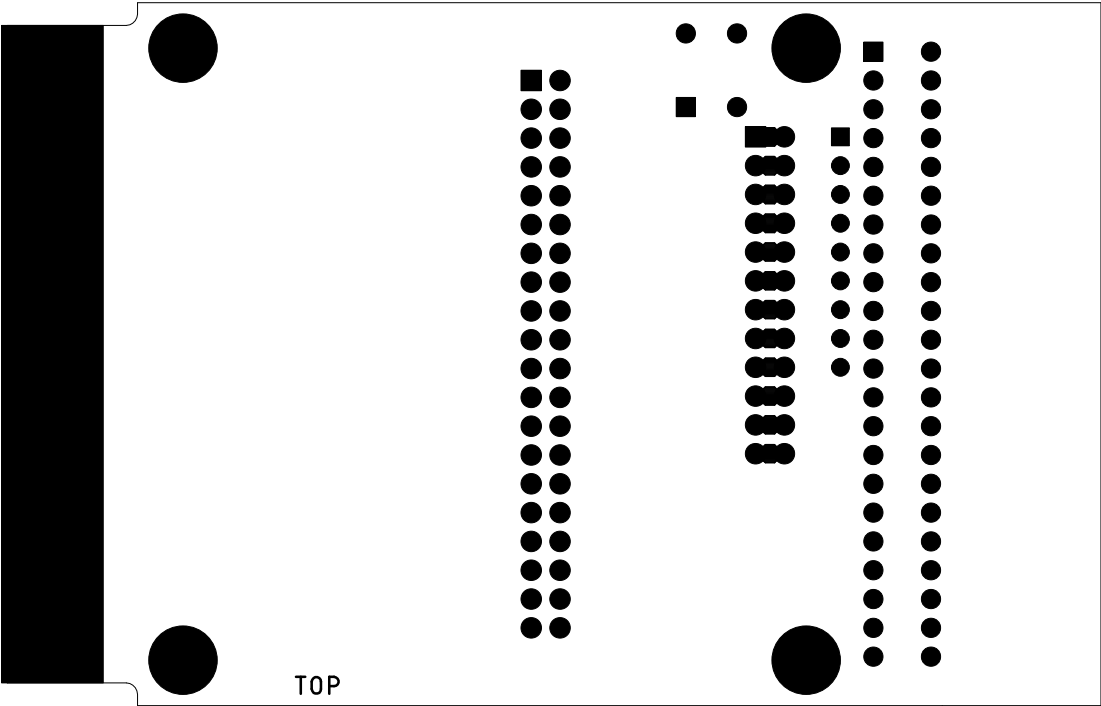
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top		



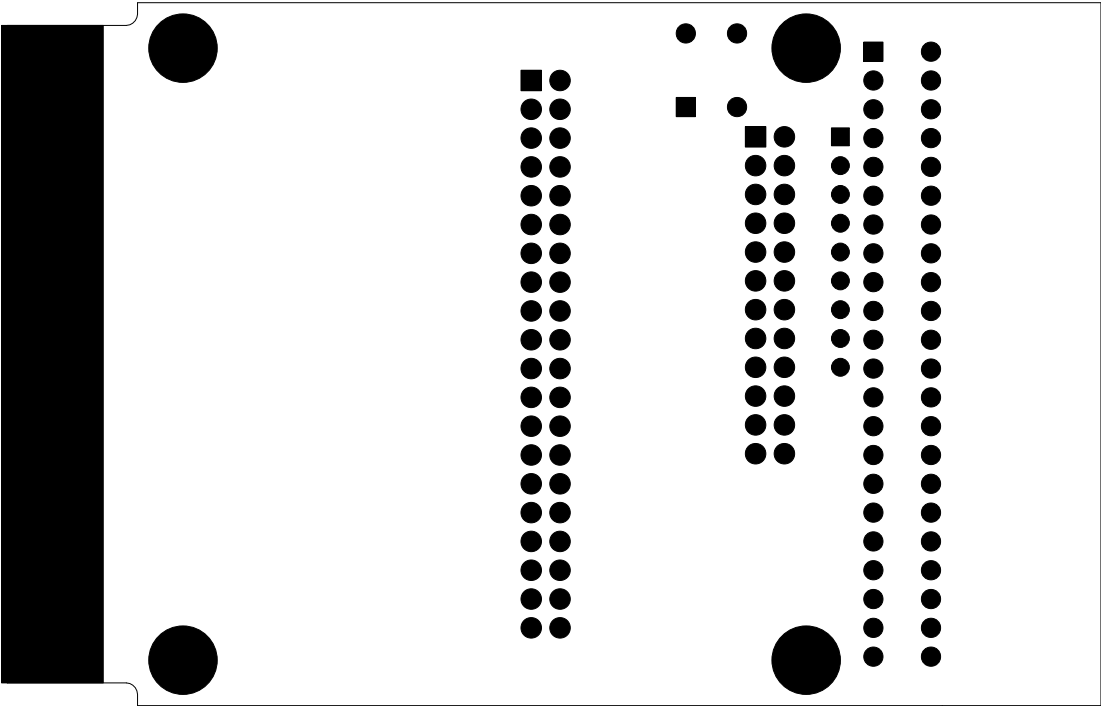
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bottom		



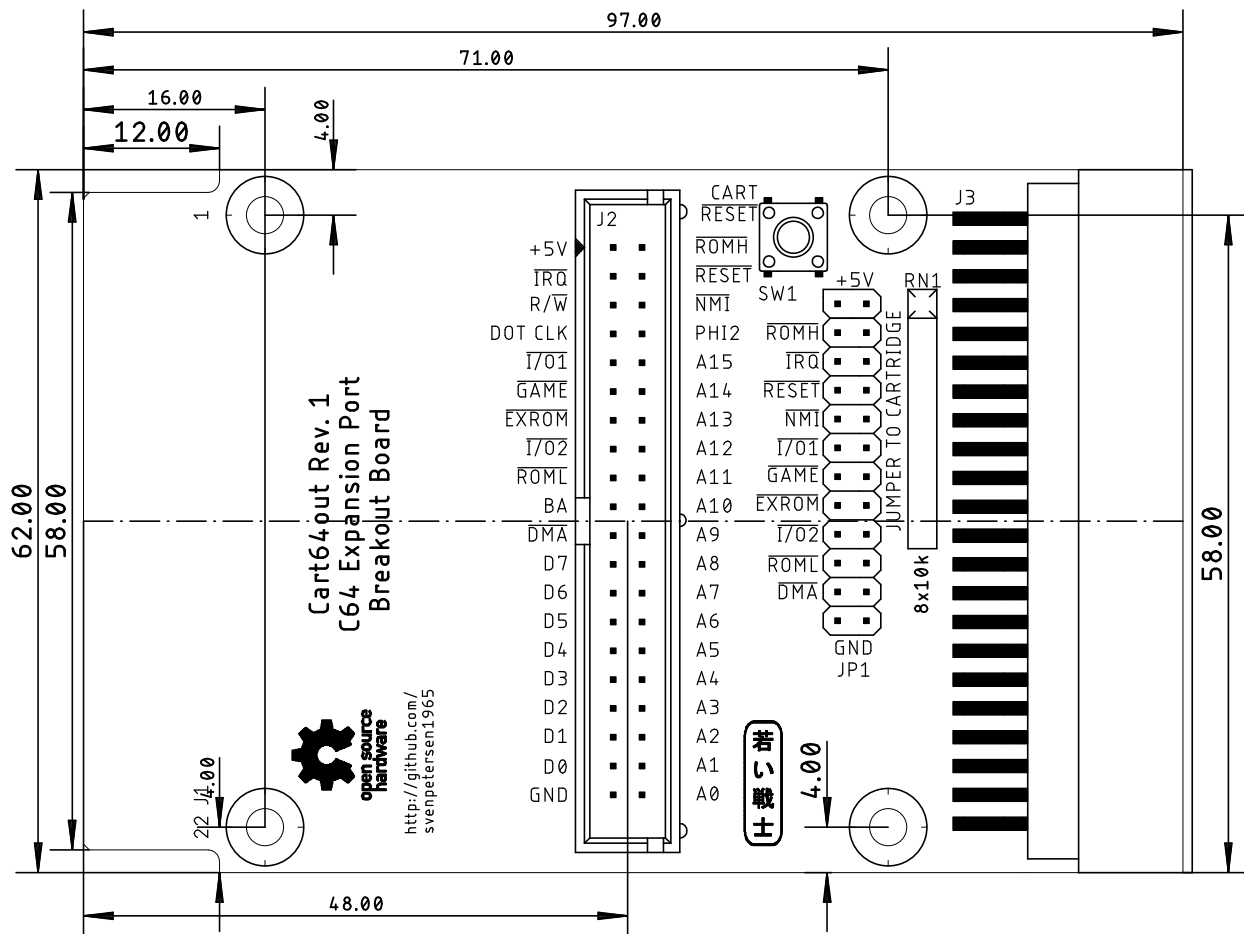
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nicht gespeichert!		Rev.: 1
stopmask component side		



Sven Petersen 2022	Doc.-No.: 122-2-01-01	
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Cart64out_v1		
nicht gespeichert!		Rev.: 1
stopmask solder side		



Sven Petersen 2022	Doc.-No.: 122-2-01-01	
	Cu: 35µm	Cu-Layers: 2
Cart64out_v1		
28.02.2022 11:51		Rev.: 1
placement component side		measures



# C64 Cart64Out Rev. 1

## Testing

The tests were conducted with three different motherboards (250469 Rev. 4 and Rev B.) and several cartridges:

- Versa64Cart Rev. 1.6 with different software
- Final Cartridge III+
- Kernal64cart Rev. 1
- Dela DOS
- Handic FORTH 64
- Ultimate II+

All jumpers installed. All cartridges work flawlessly with the Cart64Out connected



Figure 1: Test with Ultimate II+

The reset-switch resets the system.

While inserted into the C64, J2 can be accessed and the labeling on both sides of the connector can be read.

Cart64Out is fully functional.

# C64 Cart64out Rev. 1

## Bill of Material Rev. 1.0

Pos.	Qty	Value	Footprint	Ref.-No.	Comment
1	1	122-2-01-01	2 Layer	PCB Rev. 1	2 layer, Cu 35 $\mu$ , HASL, 97.0mmmx 62.0mm, 1.6mm FR4
2	1	2x20 boxed header	2X20WV	J2	2x20, boxed pin header or standard pin header, e.g. reichelt.de WSL 40G
3	1	2x12	2X12(2.54)	JP1	standard pin header 2x12 pins, 2.54mm (=0.1") pitch
4	10	Jumper 2.54mm pitch	jumper	(JP1)	Standard jumper (0,1"), e.g. reichelt.de MPE 149-2-002-F1
5	1	8x10k	RN-9	RN1	resistor network, 8 resistors 10k, SIL 9pin. E.G. reichelt.de SIL 9-8 10K
6	1	2x22 pin edge connector, 90°	EXPANSION_OU T	J3	<a href="#">1/5 x 5pc Industrial Card Edge Slot Socket Connector</a> <a href="#">22x2P 44P 2.54mm 0.1" Right Angle</a>
7	1	JTP-1130	JTP-1130	SW1	Standard 6x6mm tact switch, e.g. Nanae JTP-1130 or any other, e.g. reichelt.de JTP-1130