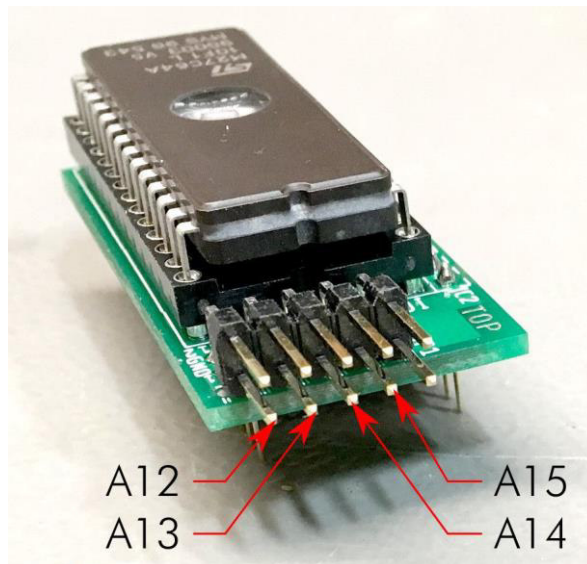# Project Documentation

C64 CHARSET-Adaptor/Switch

Project number: 126

Revision: 1

Date: 15.02.2021

C64 CHARSET-Adaptor/Switch Rev. 1

Module Description

Introduction

The board serves for adapting the CHARACTER ROM U5 (type 2332) to a 27C512 (or 27C256, 27C128, 27C64) EPROM. The pin out of both ICs are slightly different and need adaptation. Furthermore, it allows to access (up to 16) different character sets, which can be selected via the pin-header on the module.

The CHARSET-Adaptor/Switch is suitable to work together with the Keyboard Controlled Kernal Switch (Project Number 128).

This pin-header 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 1: Jumper (JP1) for Bank Selection

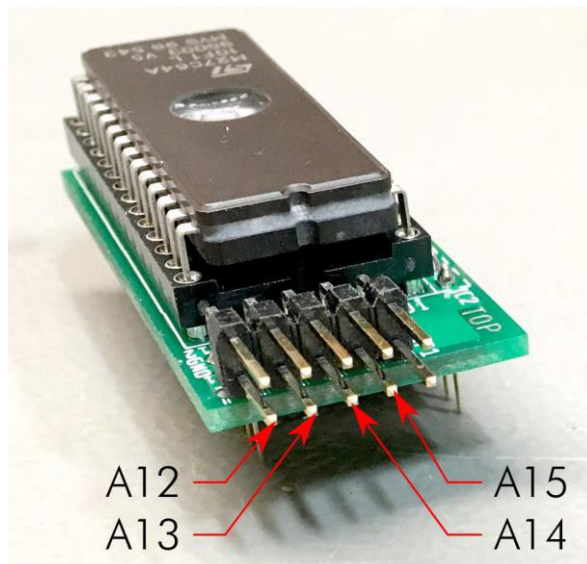The +5V pins are to provide supply voltage to a microcontroller.

Figure 1: Address pins of JP1

Bank Selection

The desired CHARACTER SET is selected at JP1. For the pinout refer to Table 1. 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 2: Selection of EPROM memory blocks

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.
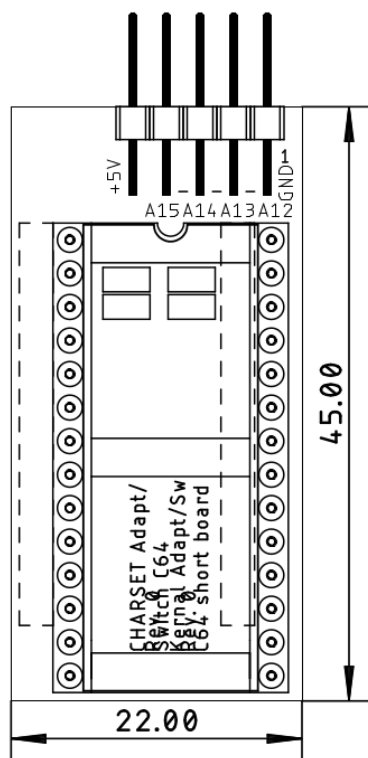
Dimensions

Figure 2: Dimensions of the Character ROM Adaptor/Switch

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 3: 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 4: 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 5: EPROM pin compatibility

Programming instructions

Character sets can be found here:

http://www.zimmers.net/anonftp/pub/cbm/firmware/computers/c64/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.
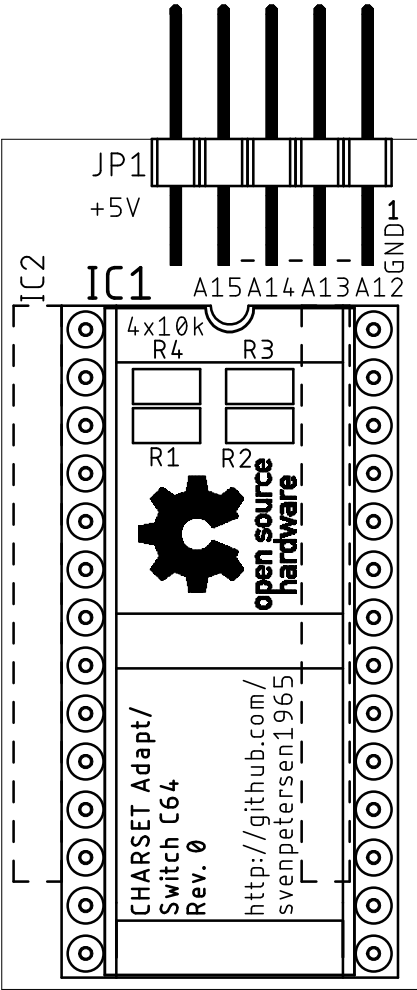
Revision History
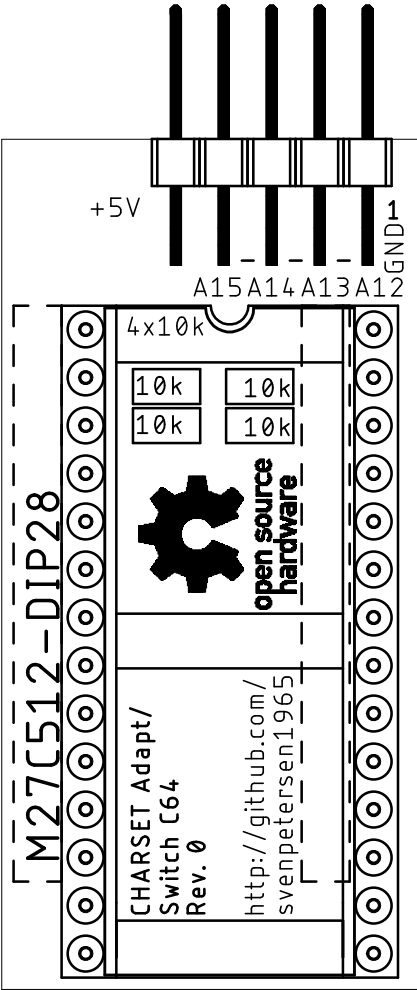
Rev. 0
Prototype, fully functional.
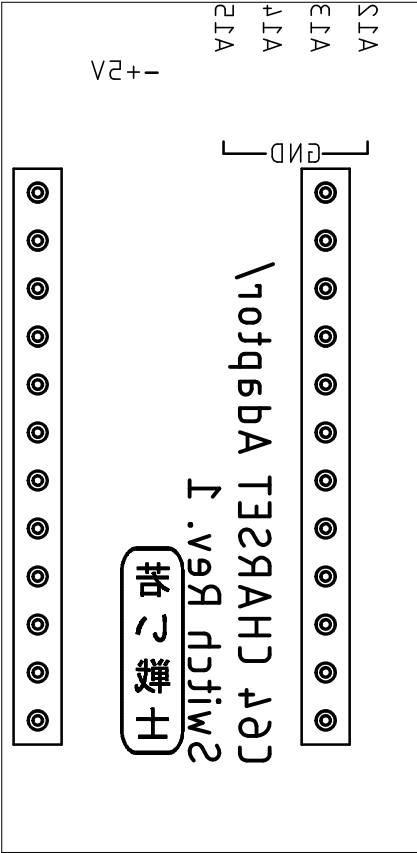
Rev. 1
Changed JP1 (solder pads, no +5V at pin 10/pin 9 only)

+5V
28 VCC
U1
10 A0
9 A1
8 A2
7 A3
6 A4
5 A5
4 A6
3 A7
25 A8
24 A9
21 A10
23 A11
2 A12
26 A13
27 A14
1 A15
14 VSS
22 GVPP
20 E

A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15

D0 D1 D2 D3 D4 D5 D6 D7

11 D0
12 D1
13 D2
15 D3
16 D4
17 D5
18 D6
19 D7

CS
GND

M27C512-DIP28

ROM

+5V
24 VCC
U2
18 A11
19 A10
22 A9
23 A8
1 A7
2 A6
3 A5
4 A4
5 A3
6 A2
7 A1
8 A0
21 CS2/CS2
20 CS1/CS1

A11 A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0

D7 D6 D5 D4 D3 D2 D1 D0

17 D7
16 D6
15 D5
14 D4
13 D3
11 D2
10 D1
9 D0

12 GND

CS
GND

2332

A12
A13
A14
A15

+5V
R4 10k
R3 10k
R2 10k
R1 10k

JP1
1 2
3 4
5 6
7 8
9 10

+5V

COMBI-5X2P90*

GND

Sven Petersen	Doc.-No.: 126-2-01-01	
2021	Cu: 35µm	Cu-Layers: 2
C64_CHARSETSw_4k		
15.02.2021 11:41	Rev.: 1	
placement component side		

Sven Petersen	Doc.-No.: 126-2-01-01	
2021	Cu: 35µm	Cu-Layers: 2
C64_CHARSETSw_4k		
15.02.2021 11:41	Rev.: 1	
placement component side		

+5V

A15 A14 A13 A12

1
GND

4x10k

10k	10k
10k	10k

M27C512-DIP28

CHARSET Adapt/
Switch C64
Rev. 0

http://github.com/
svenpetersen1965

open source
hardware

A15
A14
A13
A12

-+5V

GND

C64 CHARSET Adaptor
Switch Rev.1

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Sven Petersen 2021	Doc.-No.: 126-2-01-01	
	Cu: 35µm	Cu-Layers: 2
C64_CHARSETSw_4k		
15.02.2021 11:41		Rev.: 1
top		

TOP

Sven Petersen 2021	Doc.-No.: 126-2-01-01	
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C64_CHARSETSw_4k		
15.02.2021 11:41		Rev.: 1
bottom		
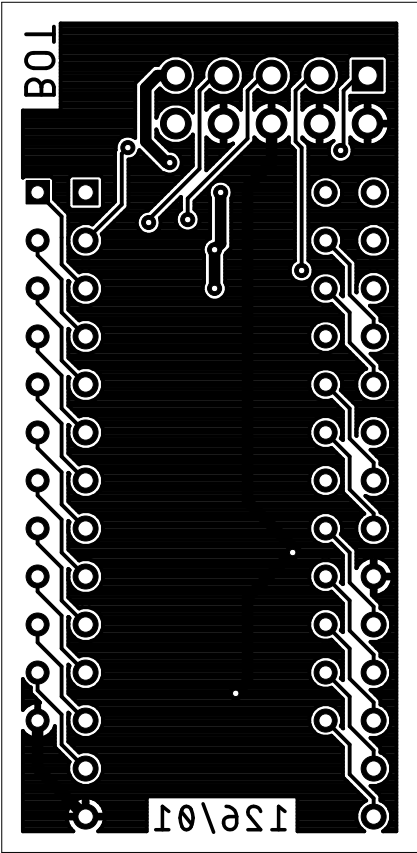
Sven Petersen	Doc.-No.: 126-2-01-01	
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C64_CHARSETSw_4k		
15.02.2021 11:41	Rev.: 1	
stopmask component side		
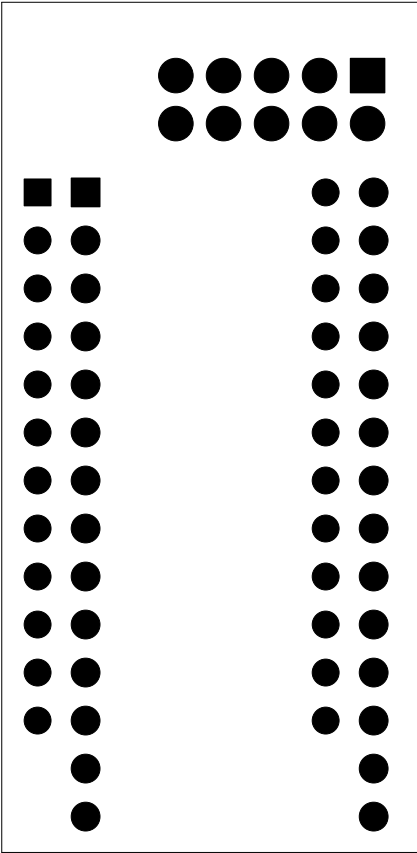
TOP

Sven Petersen	Doc.-No.: 126-2-01-01	
2021	Cu: 35µm	Cu-Layers: 2
C64_CHARSETSw_4k		
15.02.2021 11:41	Rev.: 1	
placement component side measures		

JP1
+5V
1
GND
IC2
IC1
A15 A14 A13 A12
4x10k
R4 R3
R1 R2
open source hardware
CHARSET Adapt/
Switch C64
Rev. 0
http://github.com/
svenpetersen1965

45.00

22.00
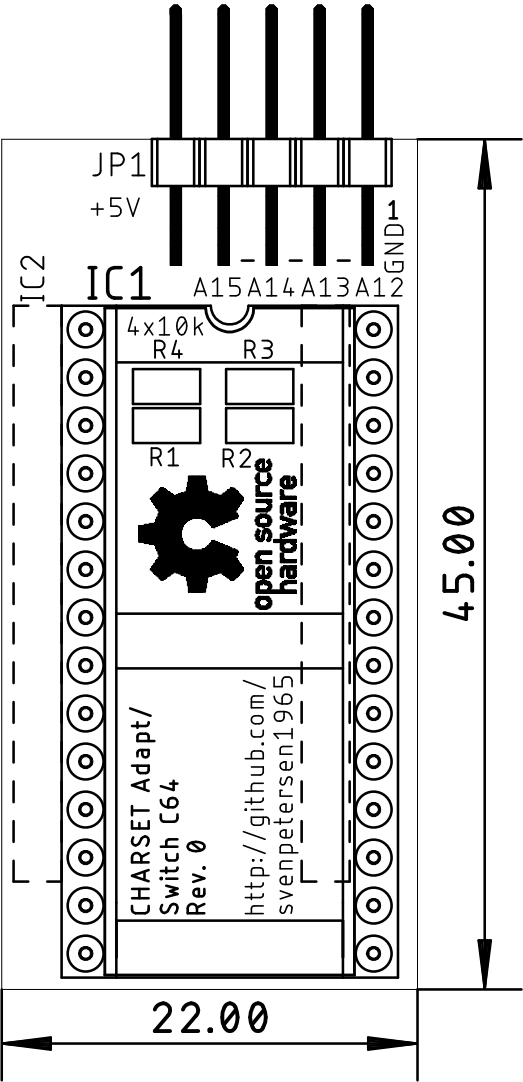
C64 CHARSET-Adaptor/Switch Rev. 1

Functional Description

IC2 is not an actual IC, these are the precision round pin contacts on the solder side of the module, that fit into the Character ROM socket on the C64 mainboard. The signals A0…A11 are connected to the address bus, D0…D7 are connected to the data bus. The chip select signal $\overline{CS}$ is connected to the C64 signal, which selects the character rom at the addresses 0xD000 - 0xDFFF.

IC1 is the EPROM, which is here represented by a 27C512 (other types are possible, see the document 126-6-01-**/Module Description).

The chip select signal is connected to pin 22, the enable signal $\overline{E}$ is permanently LOW.

R1 – R4 are pull-up resistors. The desired character set can be either jumpered at JP1 or selected by a micro controller, which is connected to the same pin header.

C64 CHARSET-Adaptor/Switch Rev. 1

Testing

The module was tested on a C64 Mainboard ASSY250425. The test was conducted with various character sets, which were obtained from the internet. The character sets were selected by jumpering JP1.

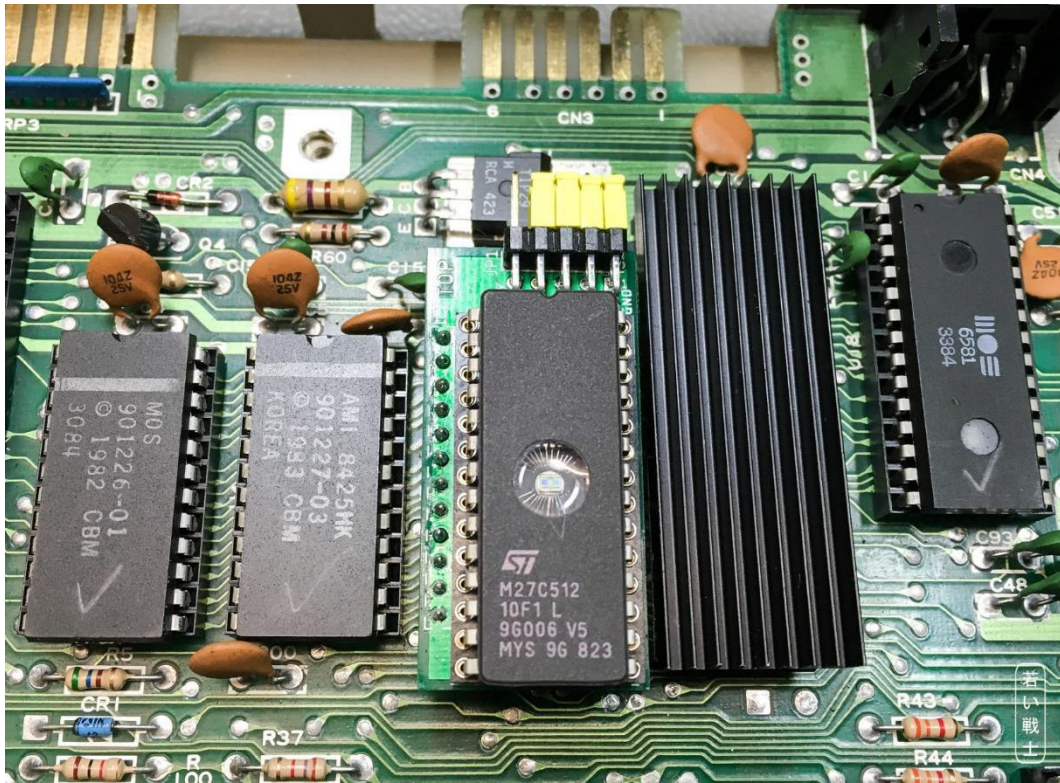The EPROM, which was used for the test was ST M27C512-10F1 (100ns).

Figure 1: The module installed on an ASSY 250425 mainboard

It was required to slightly bend a capacitor away from the socket. Other than that, no collisions with other components have occurred. The module was sitting firmly in the socket.

After switching on the C64, the selected character sets worked properly. The selection was changed by modifying the jumpering of the pin header JP1.

Conclusion: **The C64 CHARSET-Adaptor/Switch is fully functional.**

Rev. 1

Due to the minor changes, Rev. 1 is not yet tested.

C64 CHARSET-Adaptor/Switch Rev. 1
Bill of Material Rev. 1.0

Pos.	Qty	Value	Footprint	Ref.-No.	Comment
1	1	126-2-01-01	2 Layer	PCB Rev. 1	2 layer, Cu 35µ, HASL, 45mm x 22mm, 1.6mm FR4
2	1	2x05pin/90°	2X05_90_SERIES 088	JP1	90° pin header, 2.54mm pitch. E.g. Reichelt MPE 088-2-010
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