SID2SID

Installation Guide

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Introduction

Thank you for purchasing the SID2SID circuit board. We are happy to provide a low cost do-it-yourself product to enhance your experience with the MSSIAH software.

By using the SID2SID board, you get a neat installation of a second SID audio circuit.
The product is provided as is, meaning that it's up to the owner to find and install the components necessary for the SID2SID to function properly.
SID2SID is compatible with the MSSIAH and all other software accessing a second SID via the IO1 address ($DE00).

Note:

A good advice is to read this whole document through before attempting to install the SID2SID.

Disclaimer
This booklet aims at giving a well enough experienced reader sufficient information to assemble his or her SID2SID circuit board. 8bit ventures does not take responsibility for any errors, injuries or malfunctions caused by operations carried out while installing the product.

The product is provided as is without any kind of warranty. A correct installation should not cause your computer to fail or misbehave. This manual issues warnings to avoid serious pitfalls that may cause damage to the SID2SID or the computer if not dealt with properly. Apart from that, owner is required to have enough knowledge to safely assemble and install standard components.
Modifications such as on/off switches, mixing SID revisions or in-depth troubleshooting are out of scope for this manual. Please visit the MSSIAH user forum at http://www.mssiah-forum.com

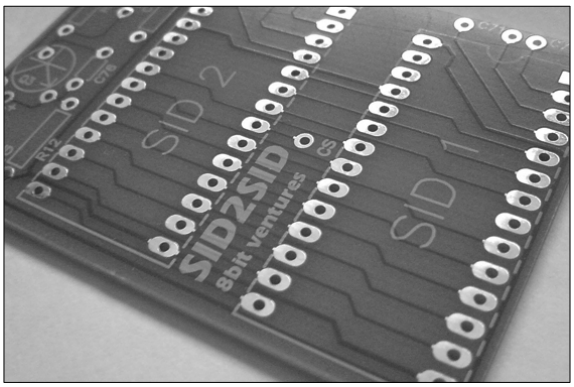
Note:

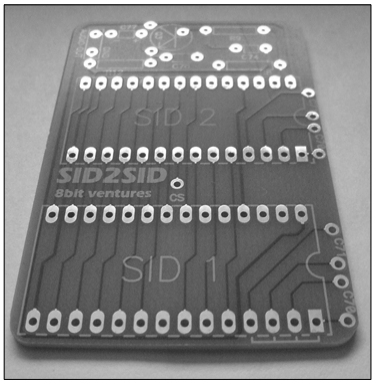
If you do not have sufficient knowledge to assemble the SID2SID board yourself, ask someone with the right skills to do it for you. Either way, 8bit ventures is not to be held responsible for any consequences of actions taken after reading this manual.

SIDs are sensitive circuits that may be damaged by careless handling.
User is advised to protect the SIDs from electrical discharges and use discretion whenever connecting and disconnecting audio equipment from the SID circuit.
The audio output design of the SID2SID is a copy of the standard Commodore 64 audio output with no extra protective circuits.

C-128 / SX-64
This booklet explains how to install the SID2SID in a standard Commodore 64. Since it comes with various circuit board revisions it is up to the owner of the SID2SID board to find the information necessary for his or her specific motherboard. The SID2SID is designed for the Commodore 64 but has been successfully tested by many others with both Commodore 128 and SX-64.

Overview





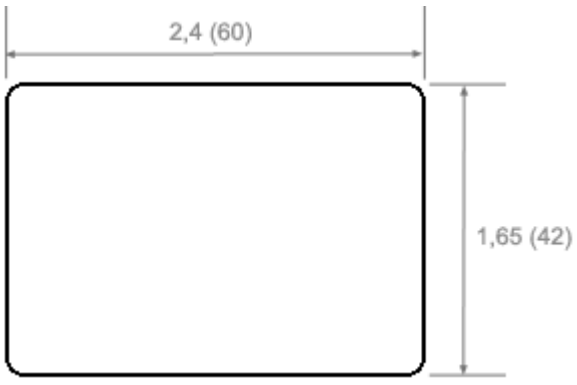
The SID2SID Printed Circuit Board is a single sided board with copper layers and silk screen text on one side only. The idea is to place the components on the opposite side and solder them on the printed side making soldering a lot easier. Installation is made with printed side facing down.

The SID2SID is very thin (1.2 mm) to fit into the limited space inside the C64. As you will see later on, lowest height possible is important especially if your motherboard houses an 8580 SID.
Being thin also means being more fragile than standard boards. It might break if too much pressure is applied on it. Be careful.

All the SID2SID holes share the same diameter, 1.0 mm (0.9 mm on older units). It is big enough to fit standard sockets and provide sufficient clearance for smaller components (resistors, capacitors etc).

SID2SID dimensions are carefully designed to fit both 6581 and 8580 motherboards.

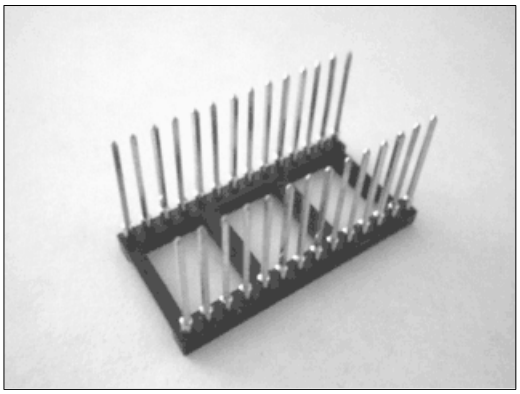
Inches (mm)



List of Components

These are the components required for the SID2SID board:

Wiring Socket, 28 pins

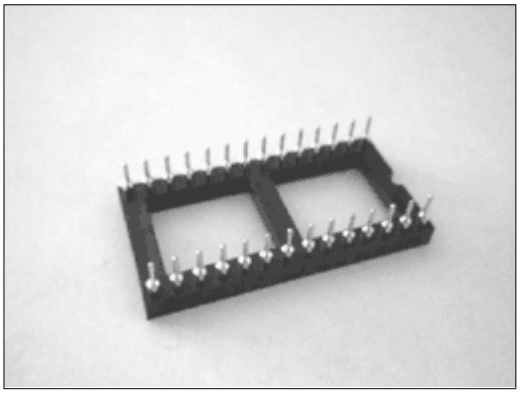


This socket is for SID #1.
It's an open frame socket, 600 mil wide.
(15.24 mm / 0.6 inches)

This type of socket has long legs and is in fact intended for wire wrapping components.
These longer legs will be a bridge between SID2SID and the original SID socket inside the C64.

Digikey Part No: AE10052-ND

Socket, 28 pins

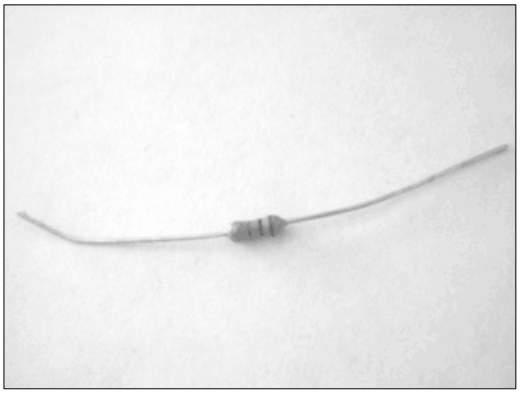


This is the socket for SID #2.

It's a standard socket with short legs.
The width is the same as for SID #1 (15.875 mm).

Digikey Part No: ED4628-ND
ED3052-5-ND

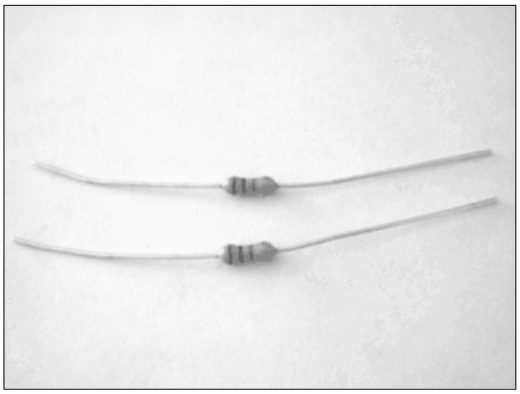
10 kohm resistor (5%)



R9

Digikey Part No: 10KQTR-ND

1 kohm resistor x 2 (5%)

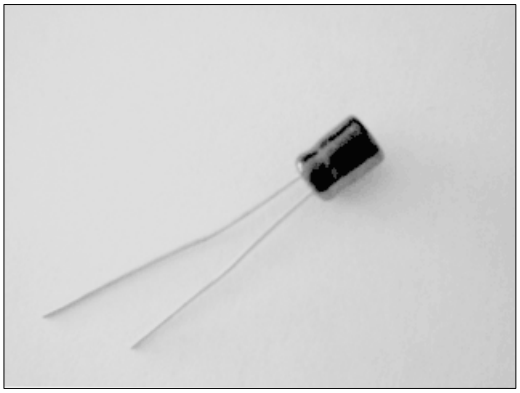


R8 and R12

If you intend to use a SID8580 you can omit the one installed as R8.

Digikey Part No: 1.0KQBK-ND

10 uF electrolytic capacitor

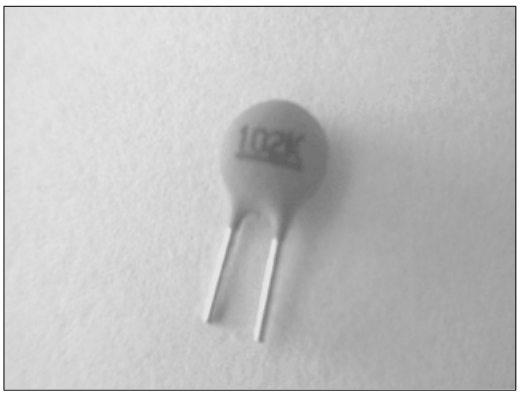


C77

Electrolytic capacitors come in all kinds of shapes and sizes. Pick a small one.

Digikey Part No: 718-2230-ND

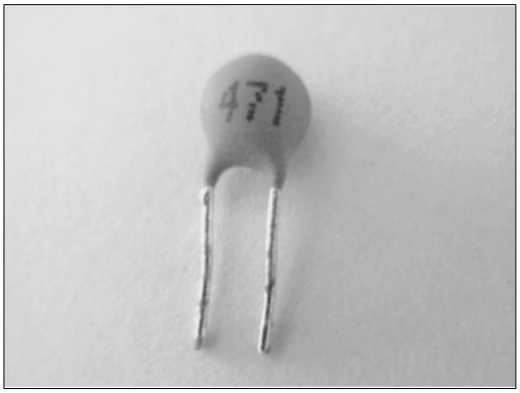
1000 pF standard capacitor



C74

Digikey Part No: 399-15258-1-ND

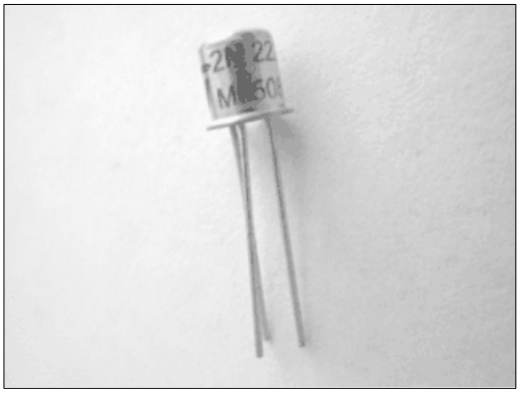
470 pF standard capacitor



C76

Digikey Part No: BC1087CT-ND

2N2222 transistor



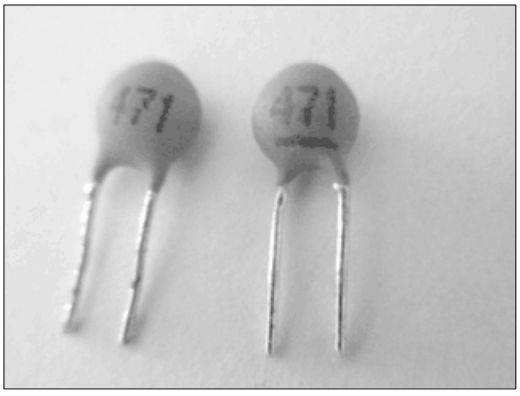
Q3

There are various models of this NPN transistor, use the one available:

2N2222, 2N2222A (TO-18) - pictured,
PN2222, PN2222A (TO-92),
MPS2222, MPS2222A (TO-92)

Digikey Part No: 2368-2N2222A-ND

470 pf standard capacitors x2 (or x4)



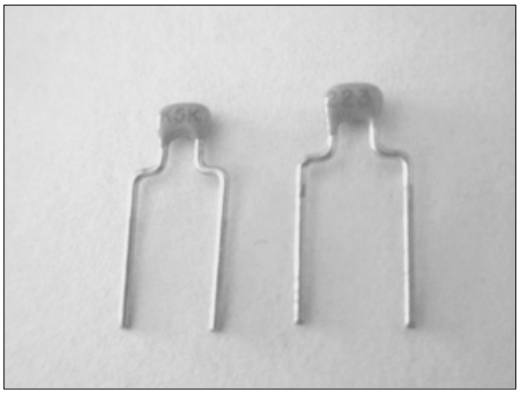
-- 6581 only! --

Filter capacitors C70/C71 (SID #2)

Note: If you also wish to replace the original filter caps for SID #1 inside the C64 you will need four of these.

Digikey Part No: BC1087CT-ND

22000 pF standard capacitors x2 (or x4)



-- 8580 only! --

Filter capacitors C70/C71 (SID #2)

Note: If you also wish to replace the original filter caps for SID #1 inside the C64 you will need four of these.

Digikey Part No: 399-4227-ND

Some tools you will need to install the SID2SID

Must Have

Solder Iron

Solder

Wire Cutter Tool or Pliers

Sandpaper

Recommended

Multimeter

IC Extractor Tool

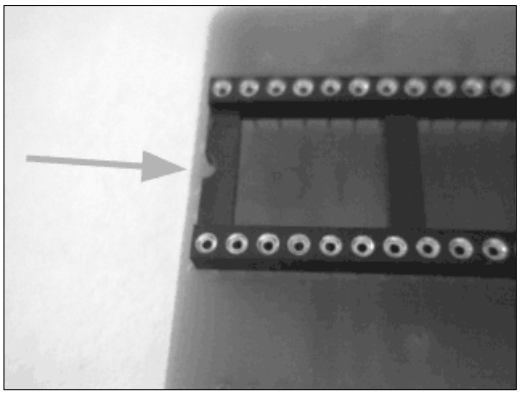
Wrist bracelet attached to ground

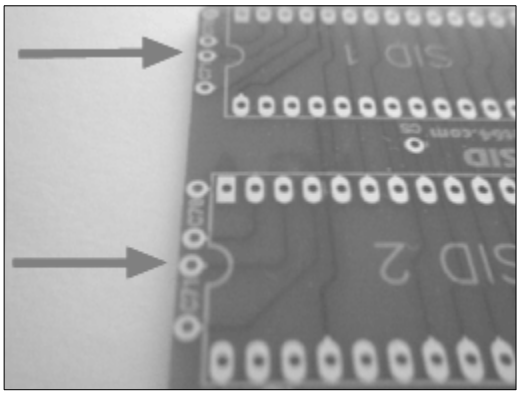
IC Pin Straightener Tool

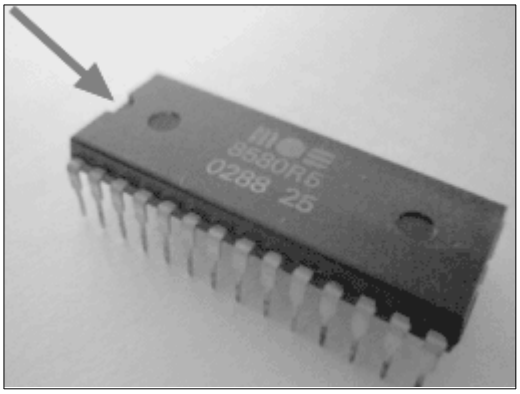
This tool is great to straighten the SID's pins once removed to ensure painless reinsertion. They can be found for less than $10.

Assembling the components

Installing the sockets



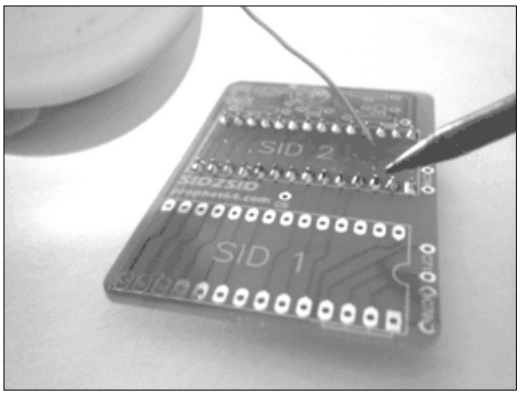




Start by installing the socket for SID #2. Insert it from the top side (the one with no text). Make sure the cavity on the socket is facing the same direction as the cavity on the white circuit outline on the opposite side of the SID2SID. When inserting the SID chips later on this very same cavity on the chips is your guide to correct alignment.

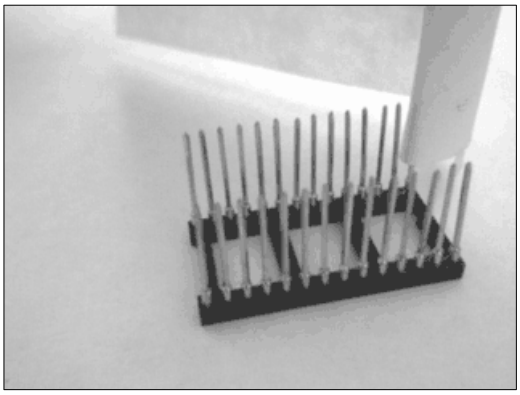
Note:

Most PCBs with circuit outlines have components installed on the same side as the outlines (why else print out IC silhouettes?).
This might add some confusion to the SID2SID design as components are placed on the opposite side of what's considered industry standard!

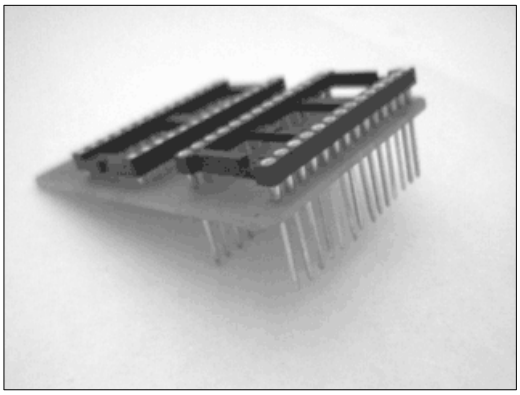


Attach the socket by soldering the pins on the bottom side.

Next, go for the long legged socket for SID #1…



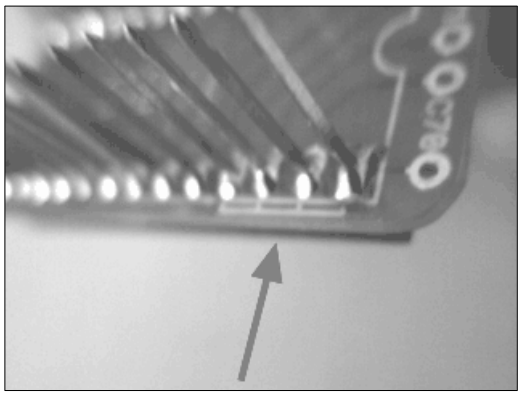
The SID2SID holes are 1.0 mm which is compatible with most sockets on the market. If you experience problems when inserting the long legged socket into the SID2SID holes you might need to sandpaper the legs a little first.
Work your way through all pins until you can fully slide it into the SID2SID with ease.



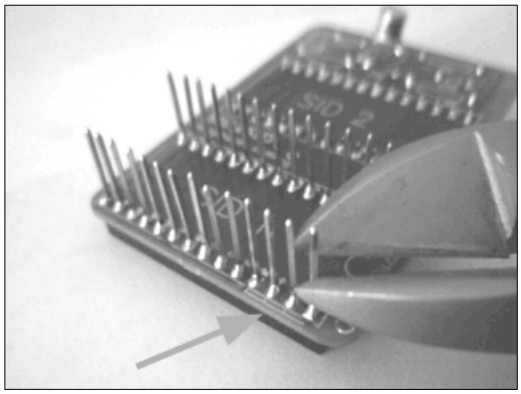
Solder the SID #1 socket just like the one for SID #2. It's a little trickier due to its long legs being in the way for the soldering iron. Be patient.

New filter capacitors for SID #1 (optional)

The next step is optional (and not recommended). Once you go through with it there is no turning back so **don't do this just yet!!**
The idea is to cut the first four legs and then install new filter capacitors for SID #1.
We recommend that you **DO NOT** cut those legs in the first place. You can always do this later, once you do there's no way back. Changing original caps is only attractive for very old C64s with really bad filter capacitors. If not determined, jump to the next section: *Resistors*.



Look at the screen text on the circuit board, the four filter cap pins are marked with a vertical line.

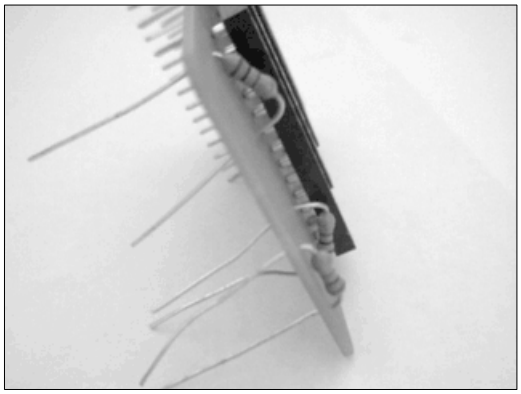


Once determined to proceed, cut the four marked out upper legs completely.

Resistors

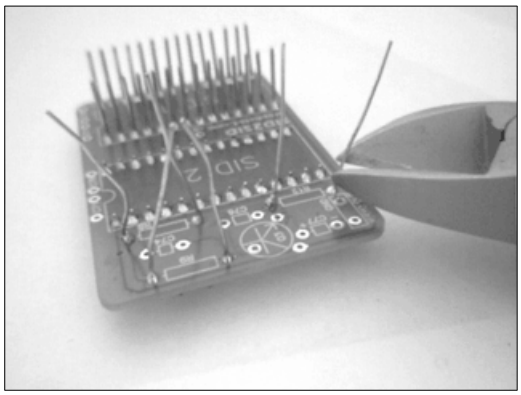
Now attach the resistors. Look at the screen text and put them in the right spots:

R8 1 kohm - omit this for the SID 8580
R9 10 kohm
R12 1 kohm



Insert the resistors from the top down just like the sockets, solder them and cut the legs.

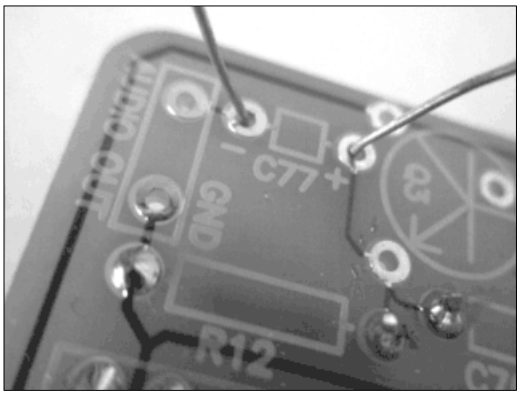
Alignment is not an issue, these resistors do not have fixed plus and minus poles.



Cut the legs after you've soldered them.

Capacitors

Put capacitor **C74** (1000 pF) and **C76** (470 pF) in place just like the resistors. Solder them and cut the legs. These capacitors do not have fixed plus and minus poles so alignment is not an issue.



C77 (10 uF) does however have a fixed plus and minus pole so make sure it's inserted correctly.

Put the capacitor's + and - legs in the corresponding holes marked up with + and – in the SID2SID.

If the capacitor lacks indication of polarity you need to find out yourself (like checking the datasheet).

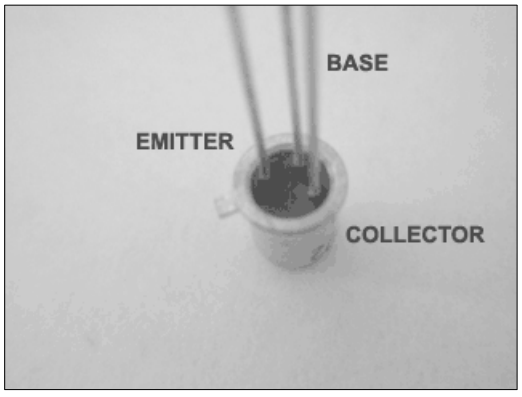
Transistor

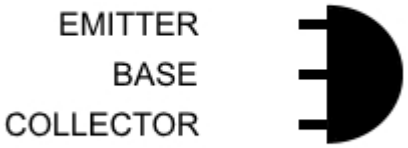
There are two types of casings for the transistor used in this design:
TO-18 Metal casing (2N2222).
TO-92 Plastic casing (PN2222or MPS2222).

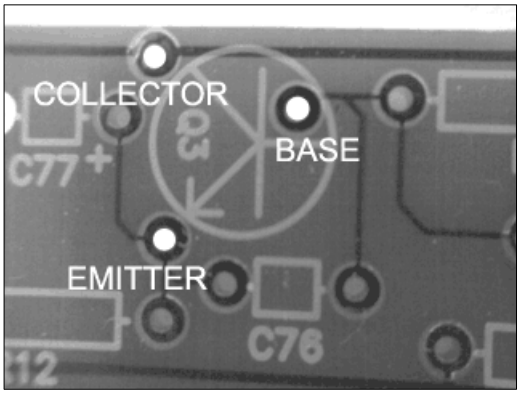
To fit the emitter-base-collector layout the TO-18 case must be attached on the opposite side. TO-92 can be attached on either side.
Beware: There is deviant model, P2N2222 that is a mirror of the standard layout even though it's housed in a TO-92 casing.

Please consult the datasheet for your transistor of choice and assure yourself that you have the appropriate info about your component's base/emitter/collector-pattern before proceeding!
The transistor will suffer from an instant failure at startup if it's not connected properly. Therefore it is crucial that you take the time and see to it that it's connected correctly on the SID2SID board. Make sure to get two or three of these transistors to be on the safe side.

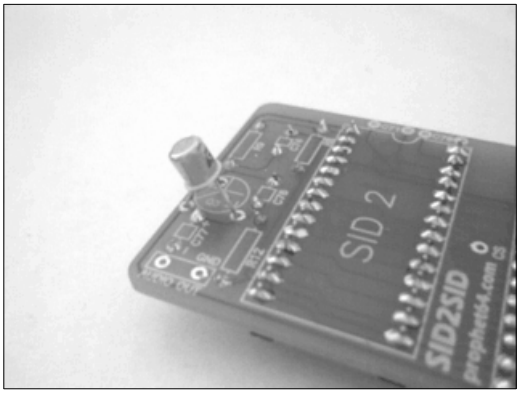
Start by identifying the legs of the transistor. On the left: metal case (TO-18) depicted from below, on the right: plastic case (TO-92) illustrated top down.







This is where you find the corresponding symbols on the SID2SID .



Even though space is an issue you need to make some room for the transistor to move.

As you will see later the transistor needs to be bent away from circuits on the computer's motherboard, especially if your C64 has the 8580 SID.

Filter capacitors

The last components that go into the SID2SID are the filter capacitors.
As we have learned already, 6581 uses 470 pF and 8580 uses 22000 pF (22 nF) capacitors.

These go into the **C70** and **C71** holes above each SID.

99% of all SID2SID installations will probably keep the original capacitors for SID #1 (as recommended), that is, the ones inside the C64. In that case: leave the C70 and C71 holes above SID #1 empty!

If you are determined to use your own caps, insert them into the C70/C71 holes above SID #1 and cut the four legs of the SID #1 socket as explained earlier in this manual.

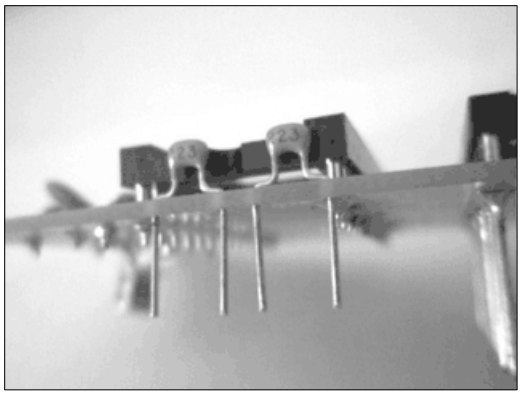


Image shows 22000 pF (22 nF) capacitors for 8580 SID #2 inserted and ready to be soldered. Alignment of the legs is unimportant as these resistors do not have fixed plus and minus poles.

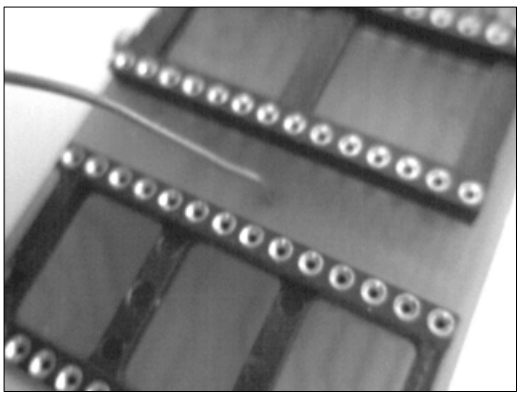
Note:

IMPORTANT!
If you have missed the most important thing when switching SID circuits in the C64, here comes the ground rule once again:
DO NOT MIX SID CIRCUITS WITHIN YOUR COMPUTER!
If the motherboard contains a 6581, it's built for the 6581 chip and vice versa. No SID2SID board should have two SIDs of different types. No SID2SID board with 8580s should be installed in a computer with a 6581 motherboard and no SID2SID board with 6581 is to be installed in a 8580 motherboard C64!

Audio out / Chip select

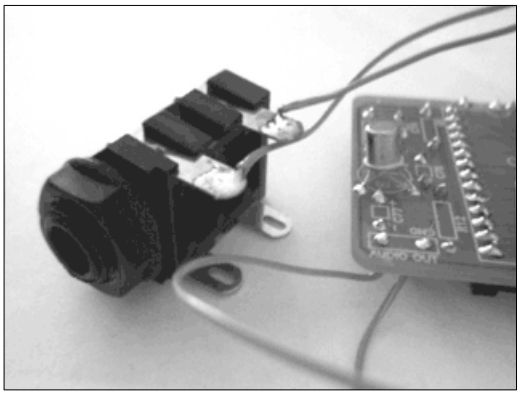
Before you finally install the SID2SID in your computer, solder the three wires in the remaining holes for CS, Audio out and Audio Out GND. It's easier while you have the SID2SID in your hand.

These wires are the ones that you will later solder onto the C64 address bus and a phono audio connector to be able to connect SID #2 to an audio amplifier.



Start with CS, the hole in the middle of the board in between the two sockets. CS is short for "Chip Select" and lets the computer activate the second SID while communicating.

Use a simple electric wire. If you don't purchase one, rip it off any audio or electric cable by cutting it open and pulling it out. Make it about 9-10 inches (25 cm).



Do the same thing with the wires for SID #2 audio out, make them as long as you like, it's up to you to decide whether to drill holes in the computer's case or simply stretch the wires out of the C64 (through the opening for the cassette connector for example) and keep the plug outside.

If you go for the latter it might be wise to solder the wires onto the plug later. The cassette connector's opening is most likely smaller than the phono plug itself.

Note:

SID #2 does not produce audio through the C64's regular audio outputs (DIN audio out or the TV signal). In other words, you won't be able to hear any audio from the second SID circuit unless you connect the audio output from the second SID to an external amplifier.

SID #1 audio is routed to the regular audio outputs of the C64 (DIN audio out and the TV signal), just like before.
You can find a description on how to build audio cables for SID #1 audio output in the booklet *MSSIAH – Getting Started* available on the MSSIAH site.

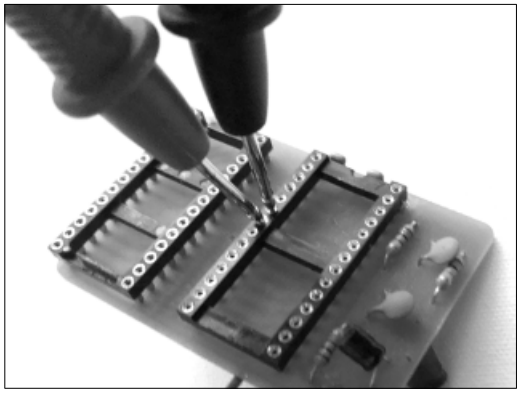
Final Checks

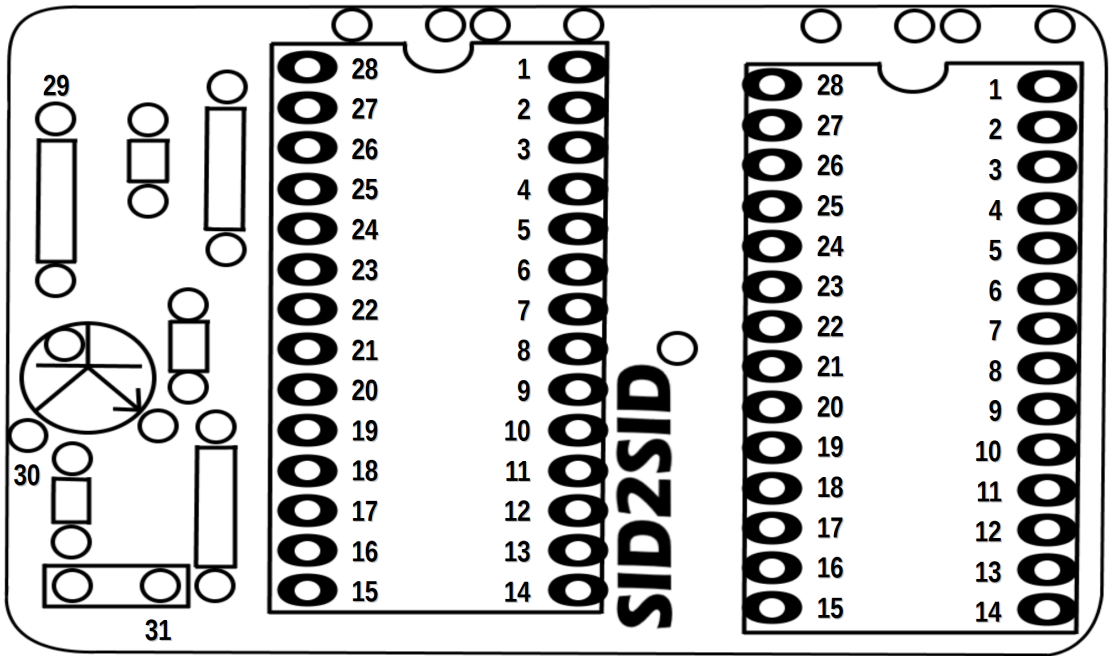
Before you plug in the SID2SID you should double-check all solder joints to rule out obvious short circuits and to verify that everything is ok. Even if it looks ok you can still have shorts or bad solder joints. It only takes a minute and we really recommend you to do this as much trouble can be avoided.

Bring out your multimeter and set it to "Continuity Measurement" mode in which you can confirm two points being connected or not.

Some multimeters make a sound where continuity is found, other reads '00.0' in the display or something similar.

Go through all the numbered connections pictured below according to the list .





NO Connection Between:			
	1 – 2		28 – 27
	2 – 3		27 – 26
	3 – 4		26 – 25
	4 – 5		25 – 24
	5 – 6		24 – 23
	6 – 7		23 – 22
	7 – 8		22 – 21
	8 – 9		21 – 20
	9 – 10		20 – 19
	10 – 11		19 – 18
	11 – 12		18 – 17
	12 – 13		17 – 16
	13 – 14		16 – 15

Connection Between:			
	31 – 14		5 – 5
	30 – 28		6 – 6
	29 – 27		7 – 7
	28 – 28		9 – 9
	25 – 25		10 – 10
	22 – 22		11 – 11
	21 – 21		12 – 12
	20 – 20		13 – 13
	19 – 19		14 – 14
	18 – 18		
	17 – 17		
	16 – 16		
	15 – 15		

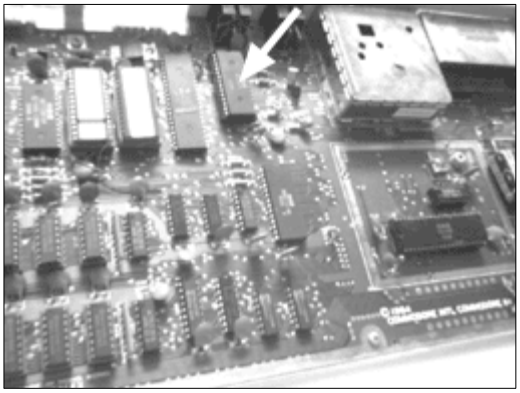
Installing the SID2SID

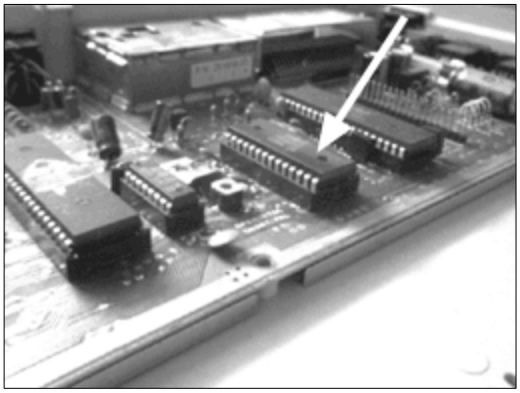
Opening the C64

Once you have assembled the SID2SID, soldered everything and done the final check with a multimeter it's time to install it into your C64. Start by opening it, gently remove the plastic top cover.
Go ahead and remove everything that blocks your way to access the motherboard. You do not have to dismount the board. Just make sure you can reach the components inside.

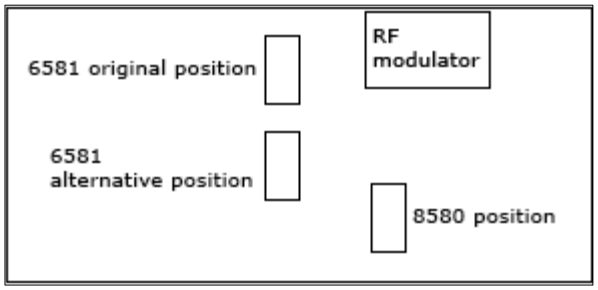
Removing the SID

Now find the SID circuit, it's either marked with a printing saying *6581* if it's a 6581 or *8580* if it's an 8580.





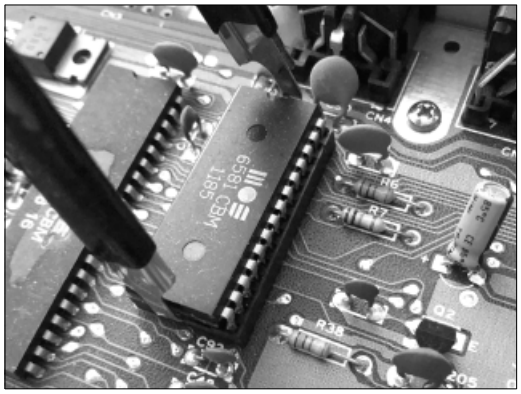
There are three places to find the SID circuit on C64 motherboards. The most common are shown in the pictures above. To the left is the 6581. Right beside the RF modulator (TV output) and to the right is the 8580, placed right below the RF modulator.

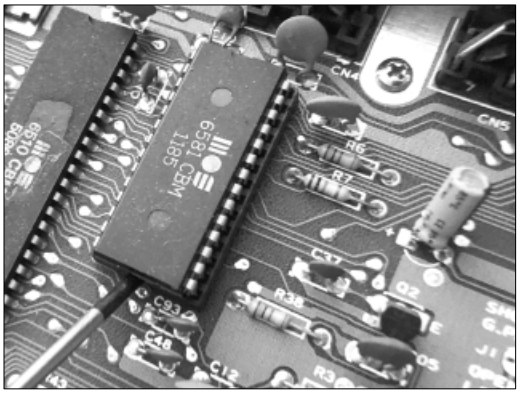


The third place to find 6581s is in the center of the motherboard. This is true for very few older boards. Read the printing on the circuits to make sure it really is a SID before you proceed.
This manual does not cover any extra hardware modifications that may be required to fit the SID2SID into these older motherboards.

Note:

This manual assumes your SID is in a socket, most of them are. If it's soldered directly onto the motherboard you will either have to desolder it and manually attach a socket or simply find another C64.
Desoldering components can be quite messy and cause damage if you're not experienced. In that case, consider getting another C64.



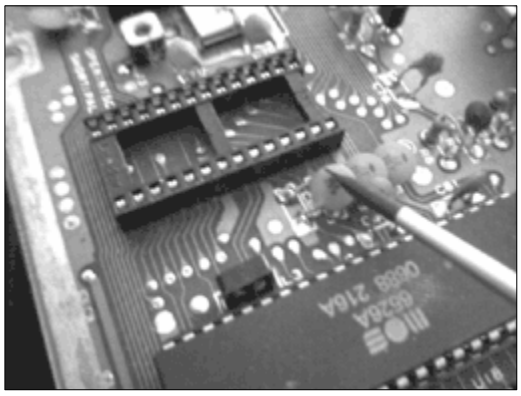


If you use an IC extractor tool you need to pull the chip straight up or the pins might bend. Many people find it easier to use a screwdriver: Insert it gently under one side of the SID and jerk the circuit upwards. Alternate sides evenly. You need to put one finger on the black top on the opposite side and push back a little to keep it leveled (don't touch the pins though). Watch out for electrostatic discharges, wiring your wrist to ground is recommended.

When you have taken the SID out of the socket, put it in a safe place like an IC pin straightener tool if you have one. Don't insert it into the SID2SID just yet.

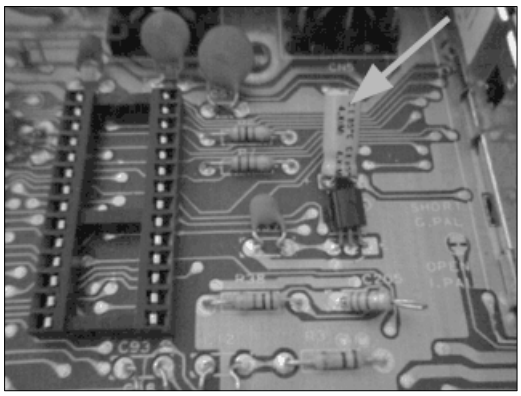
Making way for the SID2SID

The area around the SID is pretty crowded with capacitors that will be in the way for the SID2SID. You will need to take care of this before installation is possible.



Gently put your finger or a tool onto the capacitors and slowly push them downwards.

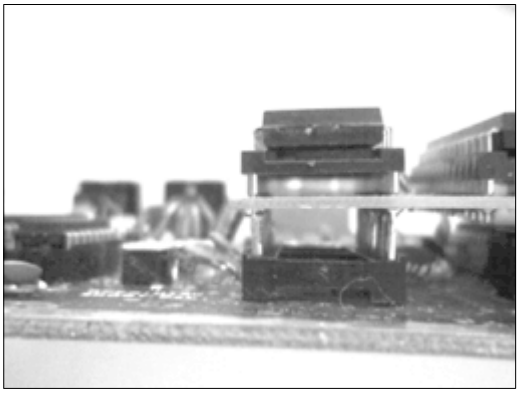
Flat capacitors are pretty easy to bend down and won't hurt if you do it once. Bending them on and off continously will fatigue the legs and make them crack.

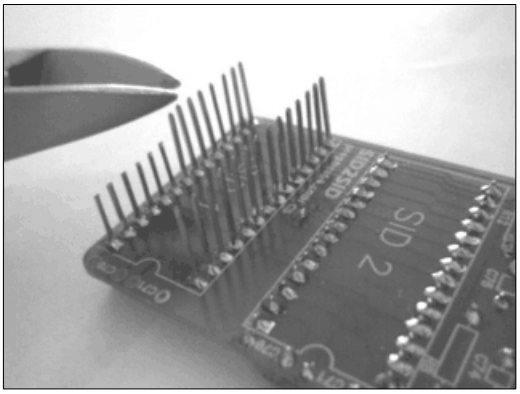


If you have a C64 with the 6581 SID there's only one obstacle, the large capacitor to the right of the socket (as seen in the middle of the image above). You can bend it a little, it won't go all the way down but it's nothing to worry about.

If you have a C64 with an 8580 there are even more capacitors around it but as they are all flat it shouldn't be an issue. However, one specific chip right beside it may cause serious problems. More on that a little later.

Adjusting the height of the SID2SID





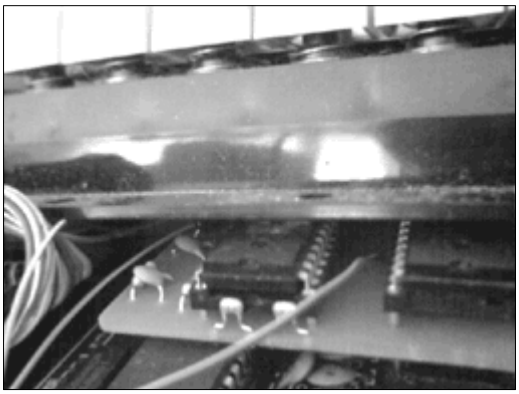
The SID2SID is a very thin board yet sockets and SIDs on top of that bring additional height. By cutting the legs of the long SID #1 socket you can adjust that height. In fact, if your computer has the 8580 motherboard you will find that the keyboard and top cover won't come back on unless the SID2SID is lowered. For 6581 motherboards it's not that big a deal but it is still advisable to lower the SID2SID just a little bit.

Start by measuring up the space in your C64. Insert the SID2SID into the old SID socket inside the computer and try to estimate the optimum length for the socket legs. The example in this manual, an 8580, ended up being 0.31 – 0.35 inches (0.8 - 0.9 mm). To clarify, it's the space between the motherboard and the bottom side of the SID2SID.

Cut a little bit at a time so you don't overdo it. Finding another long legged socket and start over again might not be a good idea. Desoldering can make copper loosen from the board.

Note:

Warning! Cutting metal releases small particles of metal that can cause short circuits so make sure your SID2SID is clean afterwards (and don't lean over your C64 while cutting!).



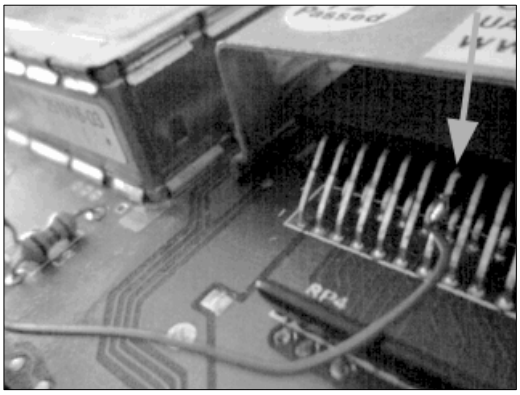
This image shows the keyboard/top cover clearance issue.

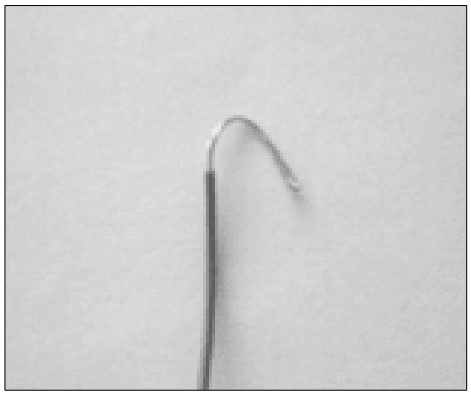
A SID2SID is finished and installed into an 8580 comupter and the keyboard is being put back in place.

Pretty tight!

Connecting the Chip Select

Now it's time to solder the other end of the CS-wire.
Find the back of the cartridge connector ("Expansion Port") and count the upper pins from the left. You should solder the CS-wire to pin number 7 from the left.





A good advice is to make a curve out of the end of the wire and thereafter hook it onto the pin from behind. Solder it and trim it so that it doesn't short the other pins.

Note:

Caution! It must not touch any other pins of the cartridge port! That will affect not only SID2SID operation but also prevent your MSSIAH cartridge from proper functioning.

Be aware! When connecting the SID2SID to the expansion port other cartridges than the MSSIAH may fail to operate properly. If you plan to use your C64 with other cartridges it might be a good idea to install an on/off switch that disconnects and pulls CS high when SID2SID is not in operation.

Audio out

Now connect the wires from Audio Out and Audio Out GND on the SID2SID board to the phono plug and put it where you want it.

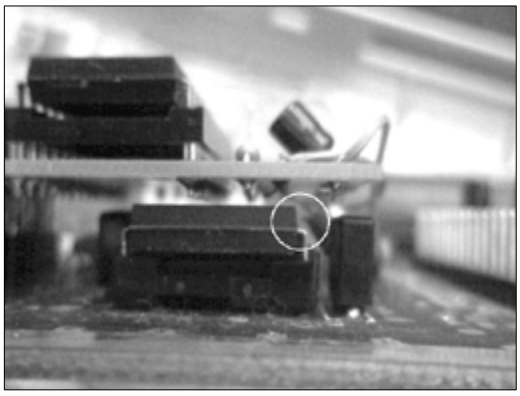
Inserting the SID2SID into the C64 socket

Finally insert the SID2SID into the computer's socket and put both SIDs into the SID2SID sockets. Be careful when you put pressure on the SID2SID so that you do not break it.

Note:

CAUTION! If you have an 8580 motherboard and use the TO-18 metal casing for the transistor you must pay close attention to its placement!
The big IC to the right of the SID in the C64 is CIA Timer B. It is **absolutely crucial** that you assure the transistor sticking out of SID2SID's bottom **does not touch the timer B chip!!**
If it does, it can short out and ruin the timer circuit resulting in computer failure.

If you are installing a SID2SID in a 6581 motherboard you are safe, same goes for using a transistor with plastic casing (TO-92).

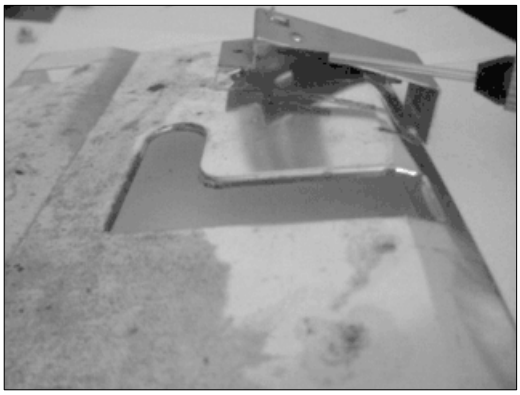


The image above visualizes the problem. At the bottom you see the CIA timer B chip in a socket (which brings the timer circuit even closer to the transistor making the problem worse) and the transistor nearly touching the legs. Metal against metal means a nasty short circuit. (If you can't see it, look inside the white circle. The transistor is slightly out of focus.)
Cover the transistor with a piece of tape and bend it carefully away from the timer chip. Keep an extra eye on this!

Putting it all back together

Now it's time to wrap it up and put the top cover back on the computer.
For 6581 motherboards this shouldn't be a problem, even if you didn't adjust the height of the long socket legs earlier on, there is probably sufficient clearance inside the C64 anyway.
In case of an 8580 motherboard, with a properly adjusted height the keyboard case should slide into place easily.

Metal covers



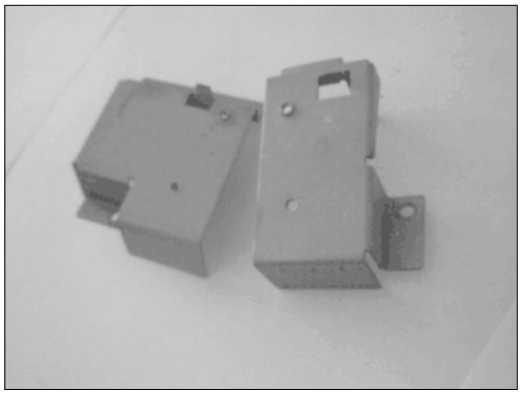
Most of the Commodore computers have some sort of cover on top of the motherboard whether it is cardboard paper or metal. In case your C64 has a metal cover you need to take some action to make room for the SID2SID. It will not fit with the cover back on.

CAUTION:

The edges of the metal covers are razor sharp. It does not take much pressure to make deep cuts into your fingers!

You have two options to go in case your C64 has a metal cover:

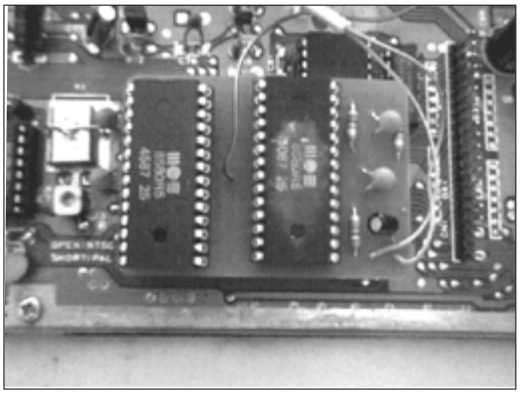
1. Find a cutter and cut out a hole above and around the SID2SID's position.
2. Remove the metal cover completely. You need the side clamps to attach the keyboard (if not mounted in the top case), Pry them off the cover with a screwdriver.



Since the cover's purpose is to dissipate heat from the circuit board, option 1 would be the best choice. Option 2 however, keeps the metal metal cover intact stowed away somewhere - preferably in a cardboard box because of its sharp edges. It's up to you.

Finished and ready to go!

If you have followed the instructions in this booklet from the start you should now have a fully installed SID2SID and are ready to enjoy double SID power with your Commodore 64 when using the MSSIAH Cartridge.



Start up your MSSIAH cartridge, connect the audio out of SID #2 and use the Test Audio option in the start menu.

If all things work you should hear SID #2 voice 1,2 and 3 sounding.

Now start up your favorite MSSIAH application and have the time of your life!

Good luck!

Troubleshooting

Regardless of how thorough you've been when reading and installing, soldering etc, things could end up not working at all. Now, we can't really help you with that, a 100% operating SID2SID calls for an error-free C64, error-free SIDs, all the correct components and a completely correctly assembled board.
It is up to you as the SID2SID owner to fulfill those requirements.

To still help you in your way of finding the error, here is a quick troubleshooting guide with some suggestions and explanations of the most common sources of malfunction:

-No sound of SID #2

- Is the volume turned up, your mixer turned on?
- Is Audio out connected correctly to your mixing device? The SID #2 is not routed to the ordinary DIN audio output or the TV audio signal. It needs to be connected to a separate audio amplifier.
- Is SID #2 working at all? Try it in SID socket #1.
- Are all components connected and soldered correctly? Check soldering and wirings, use a volt-meter and test connections.
- Are resistors R8 and R12 connected properly? (6581 only)
- Is the transistor's base-collector-emitter connected correctly?
- Is CS soldered onto pin 7 from the left on the back of the user port?
- Are the SIDs inserted in the sockets with correct alignment?
- Is your C64 malfunctioning? Does it fail to address SID #2 address DE00?

-No sound out of either SID #1 or SID #2

- Is the SID2SID inserted correctly into the socket on the C64 motherboard?
- Does your transformer have sufficient power? If it's too poor, the SIDs can stop producing audio (that effect has been observed on 8580 computers)
- Are all components connected and soldered correctly?

-Weird graphics on the screen.
-MSSIAH cartridge works only in start up menu, loaded applications have the same weird graphics.
You have a blown out CIA timer B chip. This is why it is so important to make sure the transistor on the SID2SID does not make contact with the timer chip whatsoever!! Read the section "Inserting the SID2SID into the C64" in the "Installing the SID2SID" chapter. There's an extra warning about this potential hazard!
Problem can also be related to the PLA ("Programmable Logic Array") chip of the C64 but is not linked to the SID2SID installation.