Tandy 102
5MHz Upgrade

November 2021

Version 1.1

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Modifications to your computer are done at your own risk!

[Bitchin100 5MHz Upgrade hacks page]

Overview

Goal:

Upgrade the circuitry of the Tandy 102 to run at 2x clock rate.

What you need:

(1) 9.8304 HC49 Crystal, 20pF load rated (others may work as well)

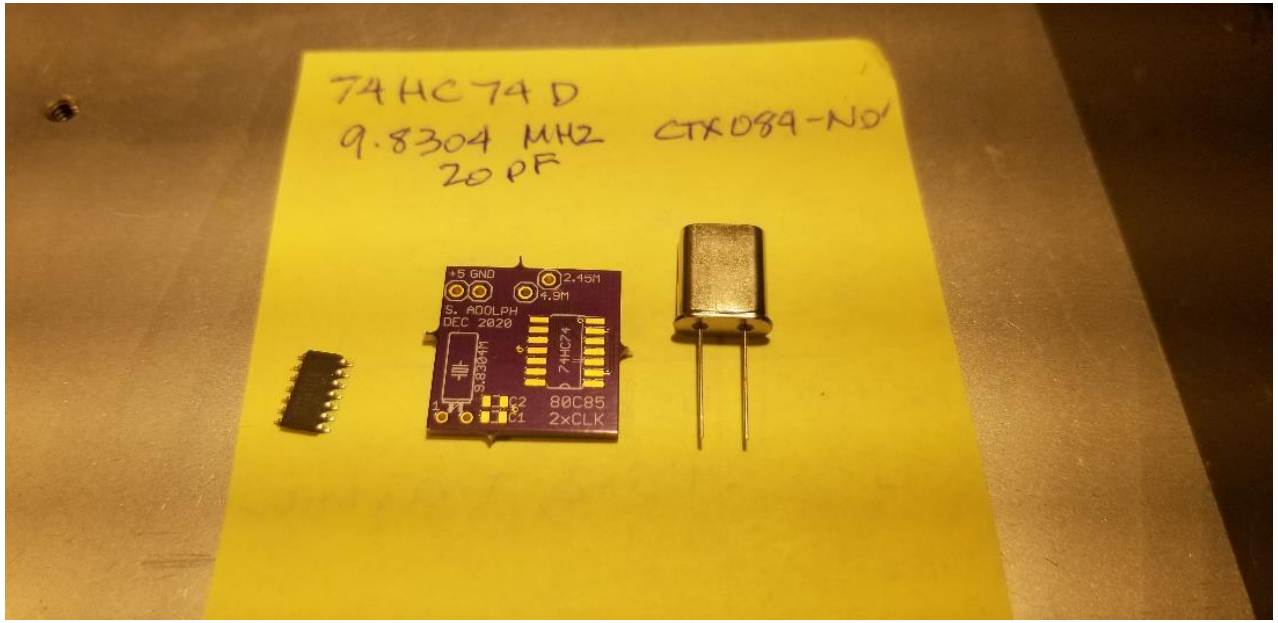
(1) clock divider PCB (Oshpark)

(1) 74HC74D flip flop IC

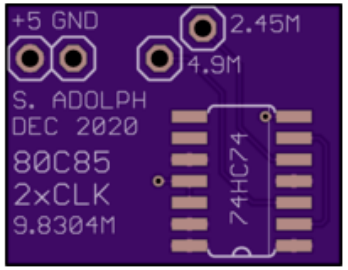
supplies, solder, tools, etc. for PCB rework

Note: The 80C85, 81C55 were not rated for 5MHz. While it appears to tolerate 5MHz operation, this is OVERCLOCKING beyond datasheet support.

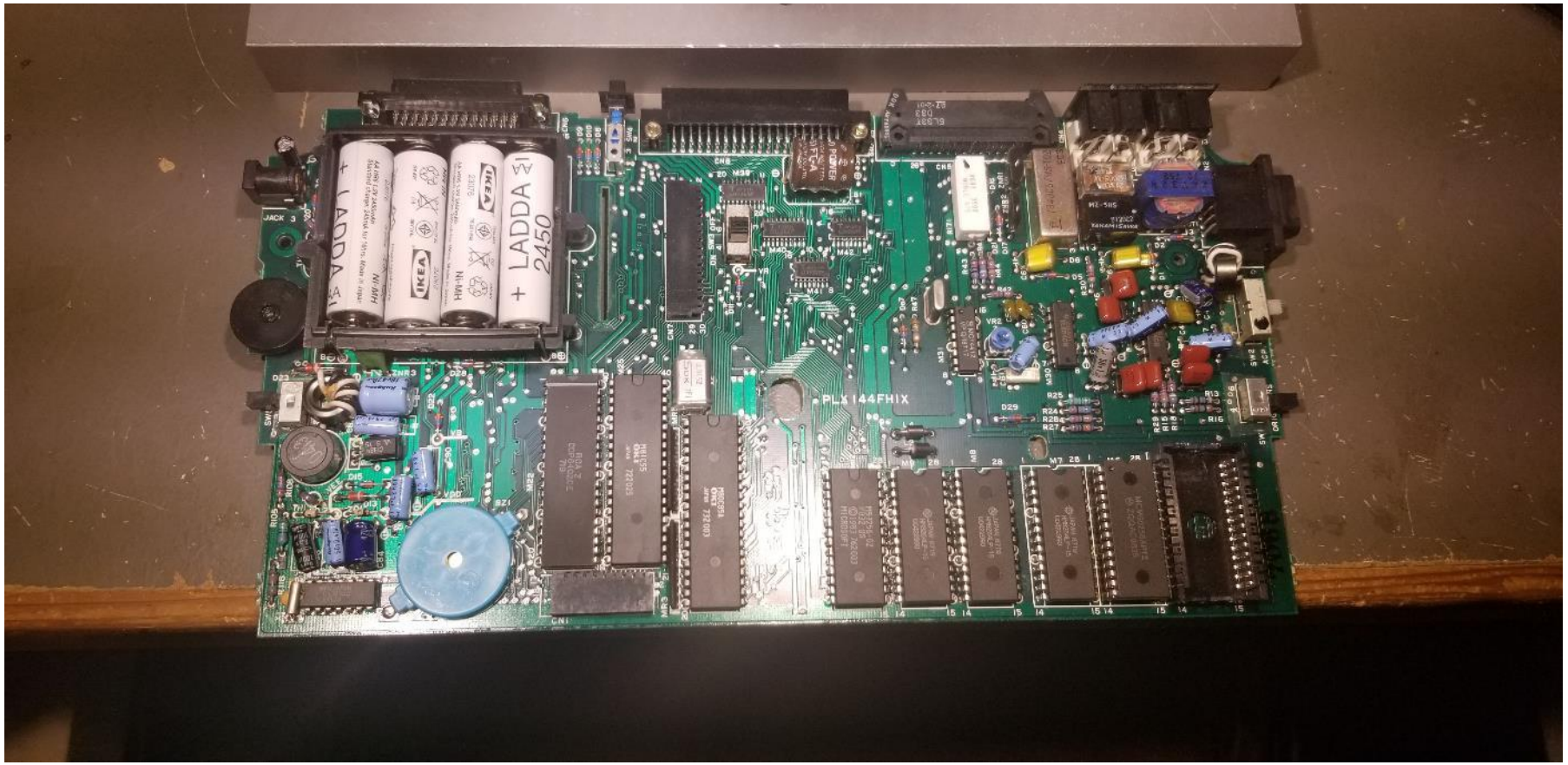
Parts:



Part	Source	Reference	Comment
74HC74D	Digikey	74HC74D	3.9mm width, variety of parts can work
9.8304MHz	Digikey	CTX084-ND	HC-49/U 20pF, 30pF may work also. Lots of possibilities
/2 clock PCB	Oshpark	/2 PCB	Slight revision, just the flip flop. Not switchable yet. 2.35$ for 3 boards

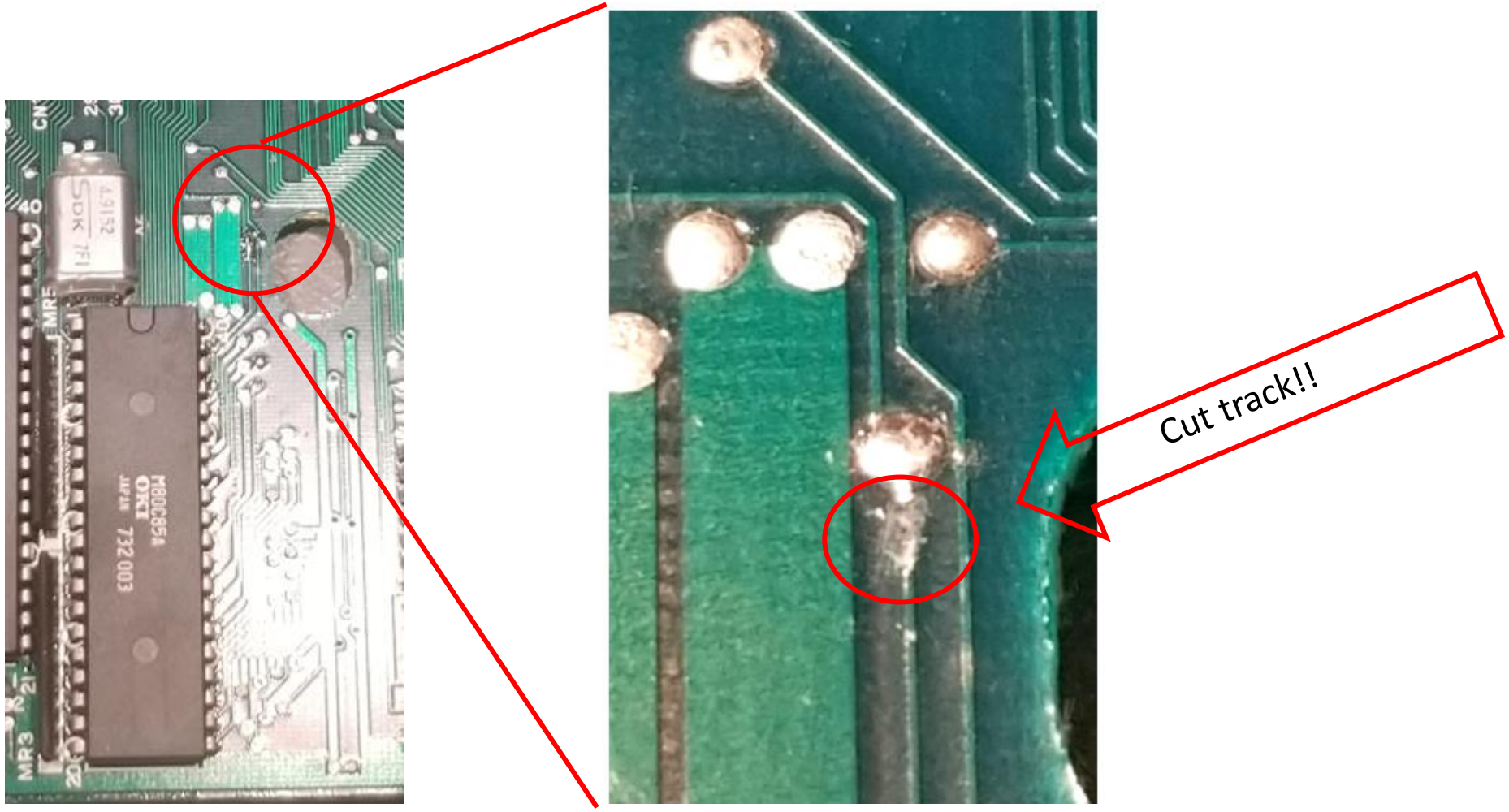


Starting point: the T102 PCB



Here we have removed the main PCB from the case. Also, removed the ribbon cables carefully.

Clock circuit 1



Pin 37 of the CPU drives the system clock signal. That must be disconnected.
One way is to cut the clock track at the indicated location.

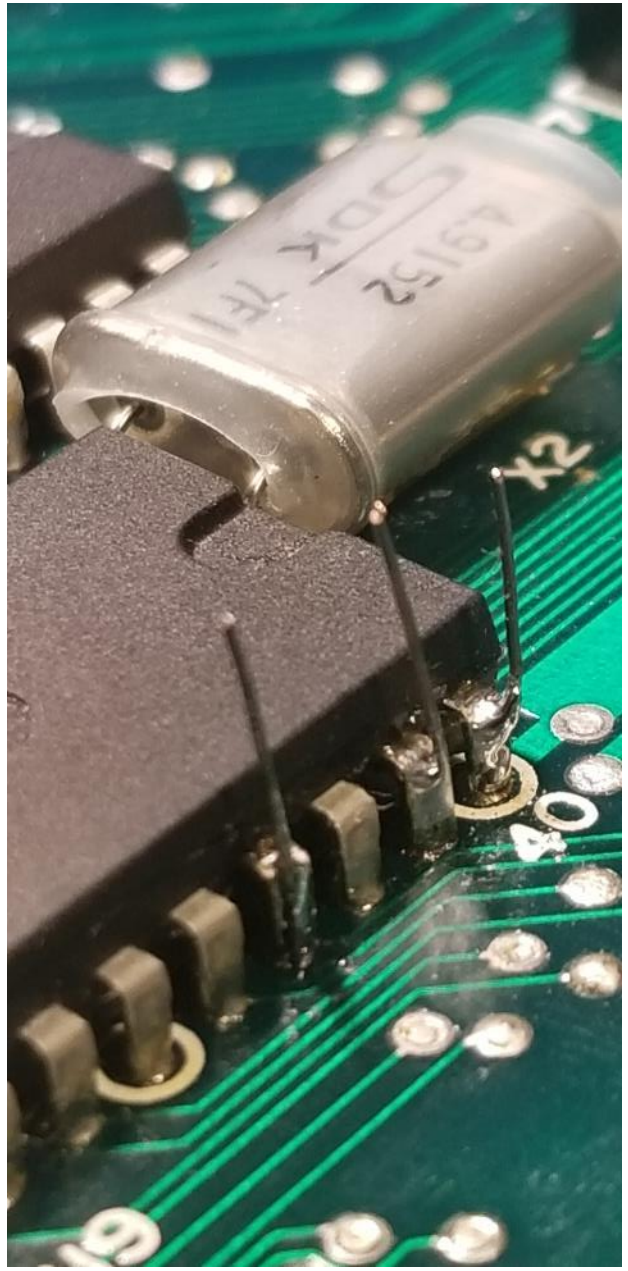
There are other ways too. But this might be the easiest.

Clock circuit 2

Solder the 74HC74 to the PCB.

The PCB gets mounted piggy-back on the processor.

Prepare the processor to mount the PCB by soldering 3 short wires vertically at pin 40, pin 39 and pin 37 as shown.



Clock circuit 3

Trial fit the PCB to the CPU.

It helps the next step if it is relatively easy to slide the PCB onto the wires.

You can see the wires are inserted into the vias marked +5, GND, and 4.9M.

The clock divider output is marked 2.5M

Clock circuit 4

Remove the PCB.

Put a dab of hot glue or similar under the location of the PCB.

Re-place the PCB onto the wires.

Check that the PCB is well mounted.

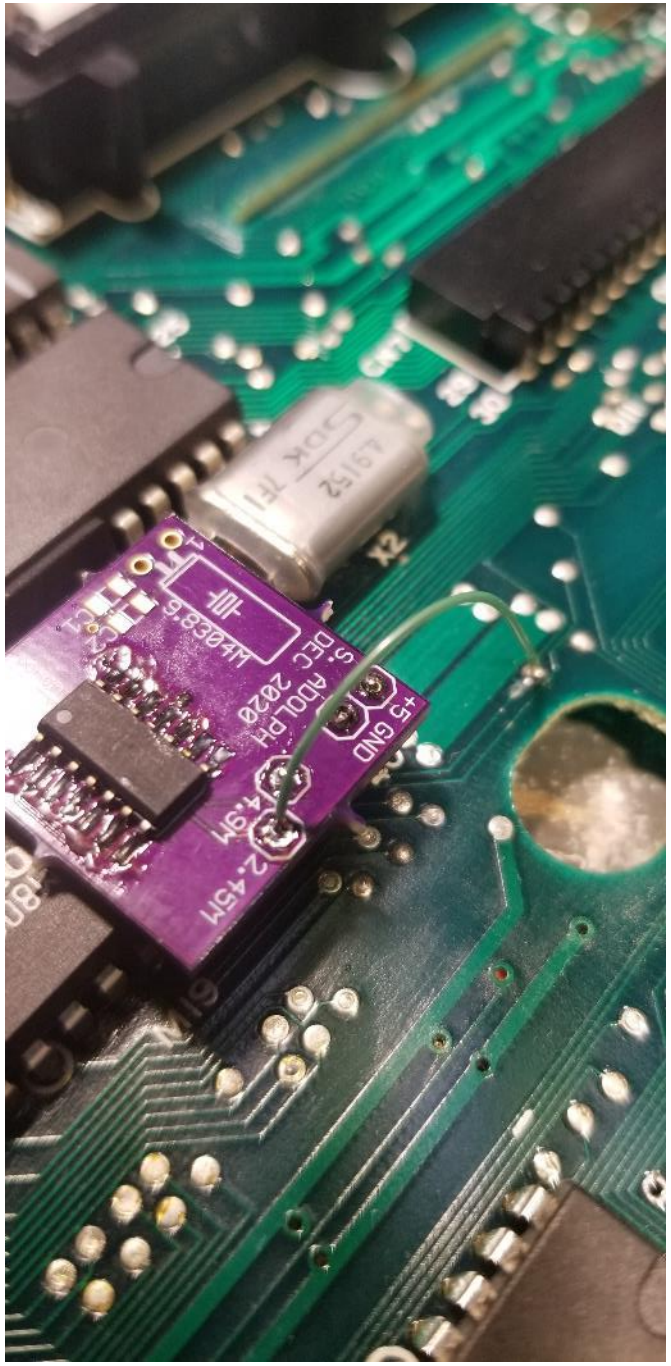
Carefully solder the wires at the vias, being careful not to reflow the original solder joints. Be light! Trim excess wire.

Clock circuit 5

Now that the clock divider is installed, you must connect the new 2.5MHz clock to the system clock signal.

Solder a wire that runs from the via immediately next to the cut track, to the via marked 2.5M. If you use a fine gauge wire, you can insert it into the main PCB via.

Now the CPU can run at 2x speed, while the system remains at 1x speed.



Clock circuit 6

The crystal can now be replaced.

Gently pry with a plastic tool the existing 4.9152MHz crystal upwards, to release the glue that is holding it in place.

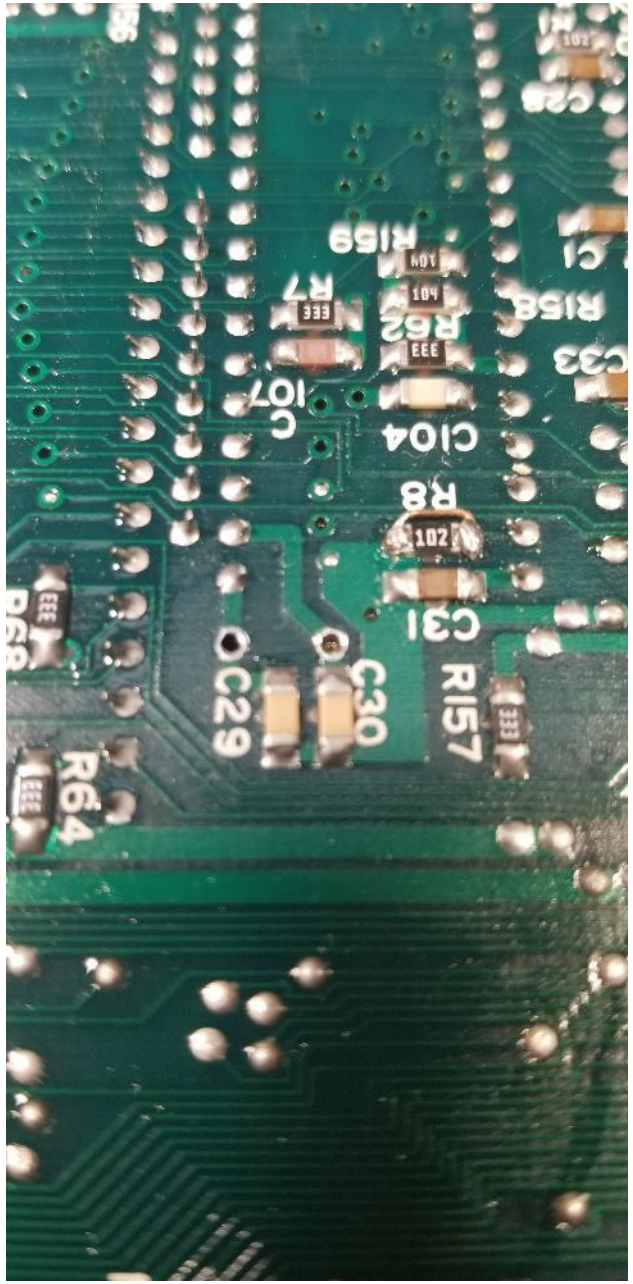
Clock circuit 7

Remove the crystal. There are lots of ways and techniques to remove a part like this. Keep in case you need it later.

One way is to cut the leads and clean out the vias. What I do is heat each lead with an iron, and rock the part side to side as each leg frees up. Eventually the part is easily freed. Solder wick, or solder pump to remove excess solder.

Make sure the holes are free of solder, so you can easily install the new crystal.

Notice R8: Optional – short across this resistor. You can see the wire jumper I installed to short it out. R8 is on Pin 39 of the CPU. (makes a better ground for the /2 PCB)



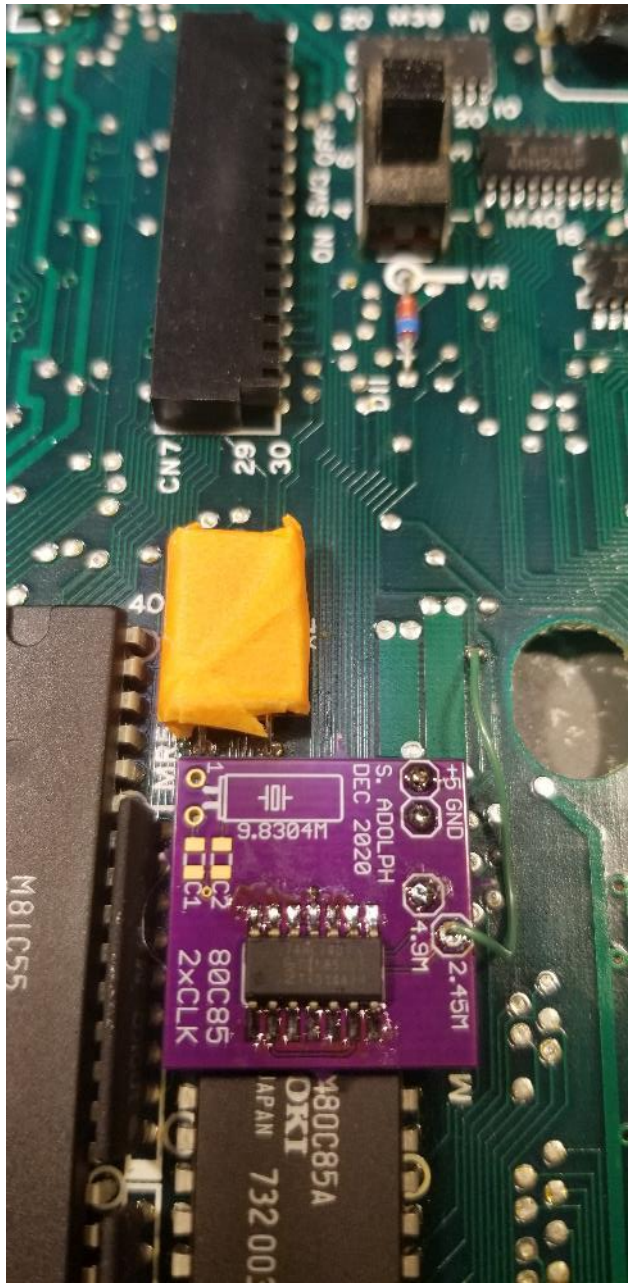
Clock circuit 8

Insert and solder down the new crystal. The new crystal should be 9.8304 MHz.

It is a good idea to also glue down the crystal. I wrapped this one in tape so it would not short anything.

OK, the clock circuit mod is done.

Next… the Chip select mod.

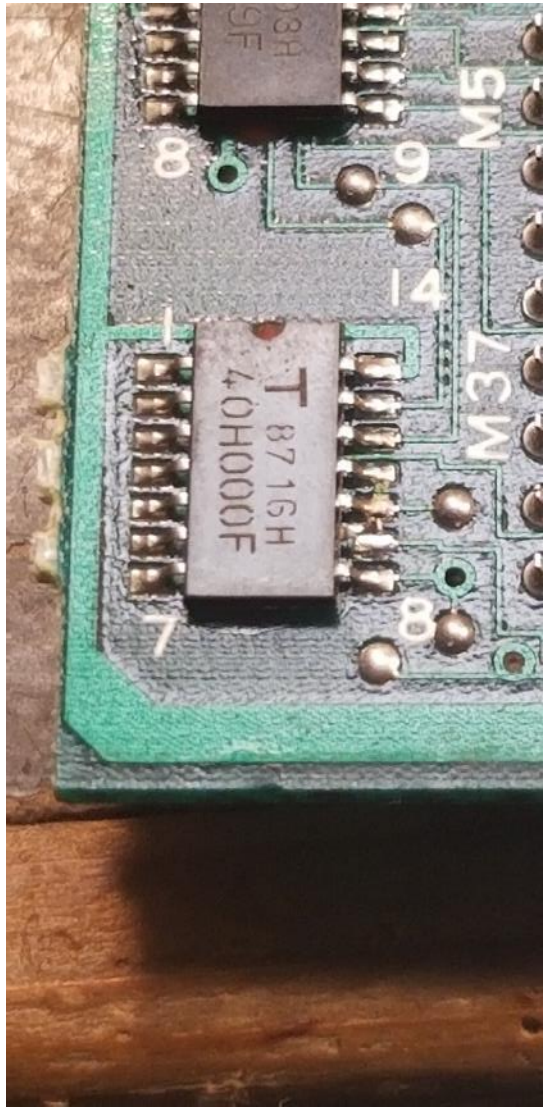


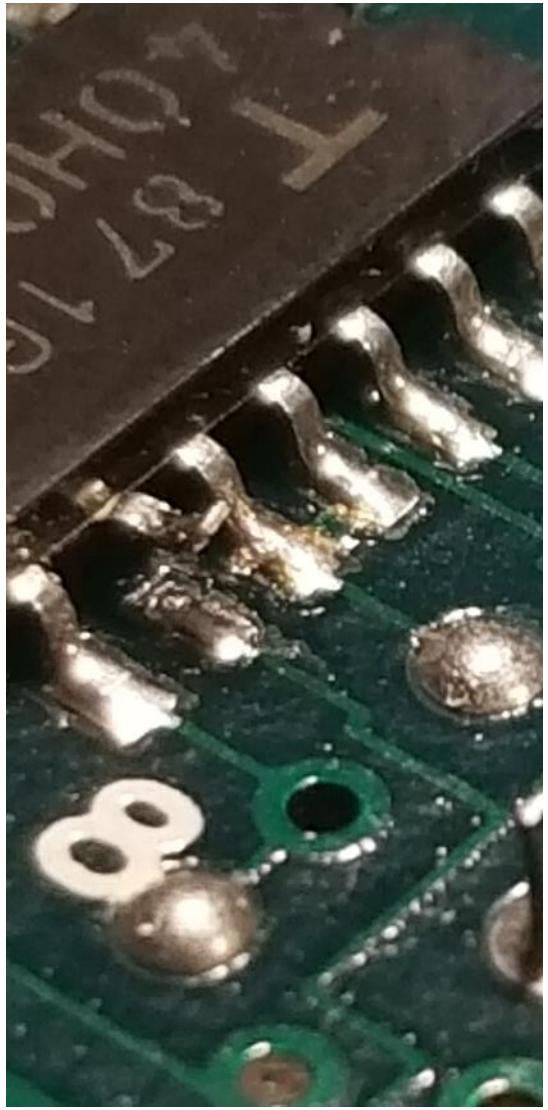
Chip Select circuit

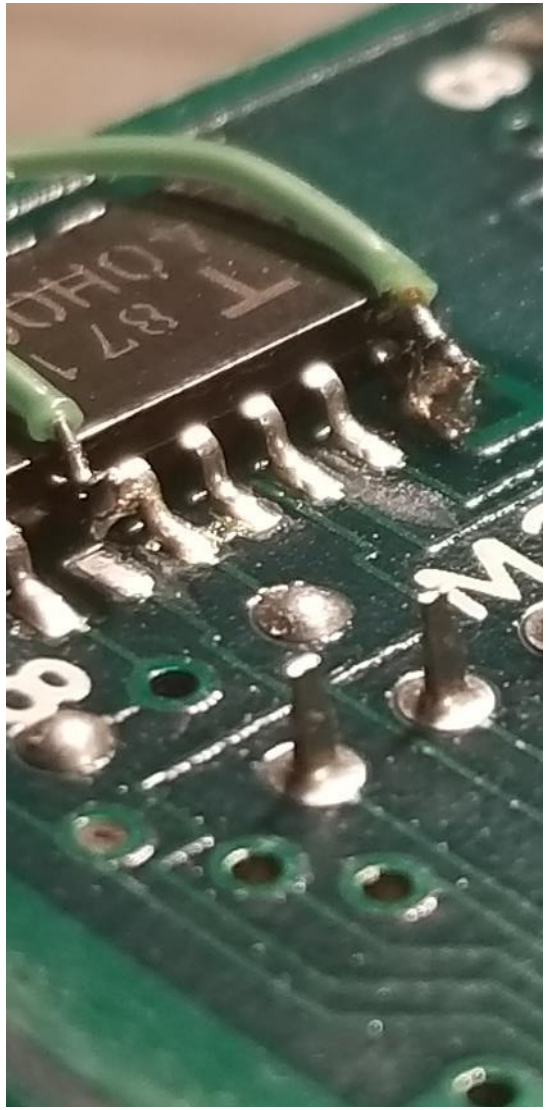
Here, we are modifying how the SRAM chip select operates, to speed up the RAM.

Essentially you do 2 things:

1) You lift pin 9 of M37
2) You install a jumper to short pin 9 to +5V at pin 14 of M37





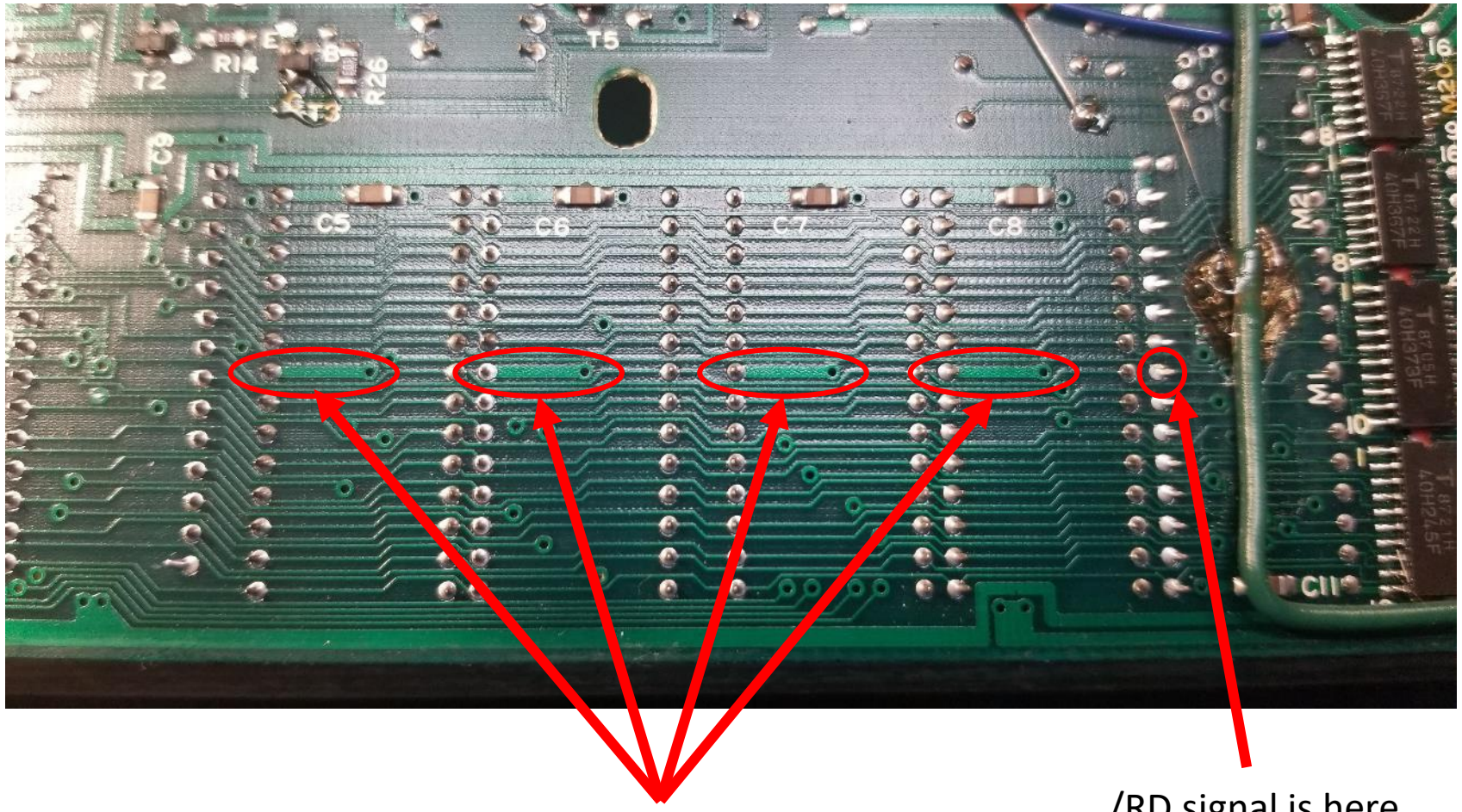


/RD Signal (1)

Pin 22 of all 4 SRAMs is grounded in T102.

After the change to the chip select, pin 22 of each SRAM must be connected to /RD signal, which is at pin 22 of the main ROM.

We must disconnect ground in 4 places, then bridge /RD to those pins.



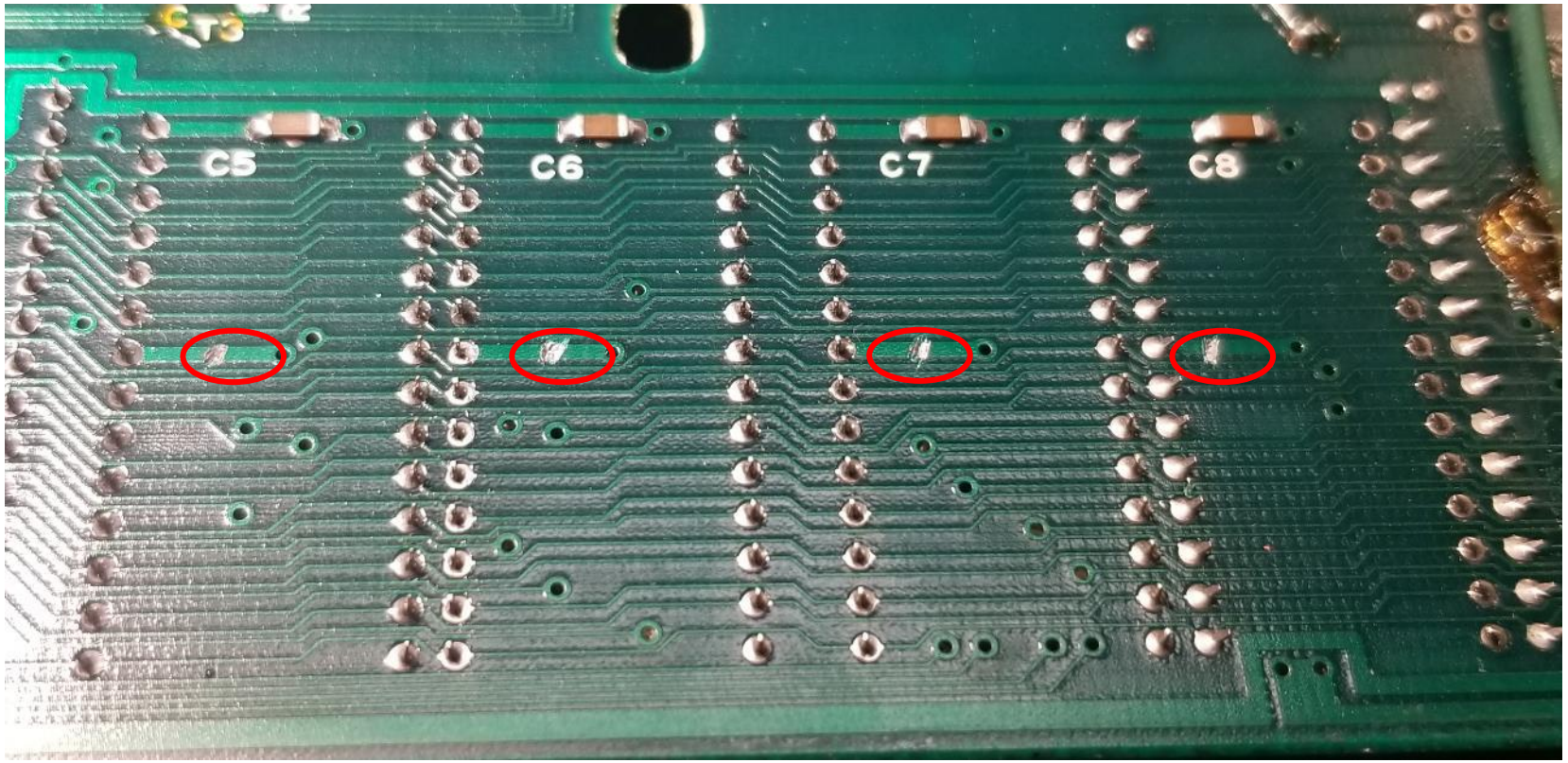
The thick tracks are ground.
These 4 tracks need to be cut.

/RD signal is here

/RD Signal (2)

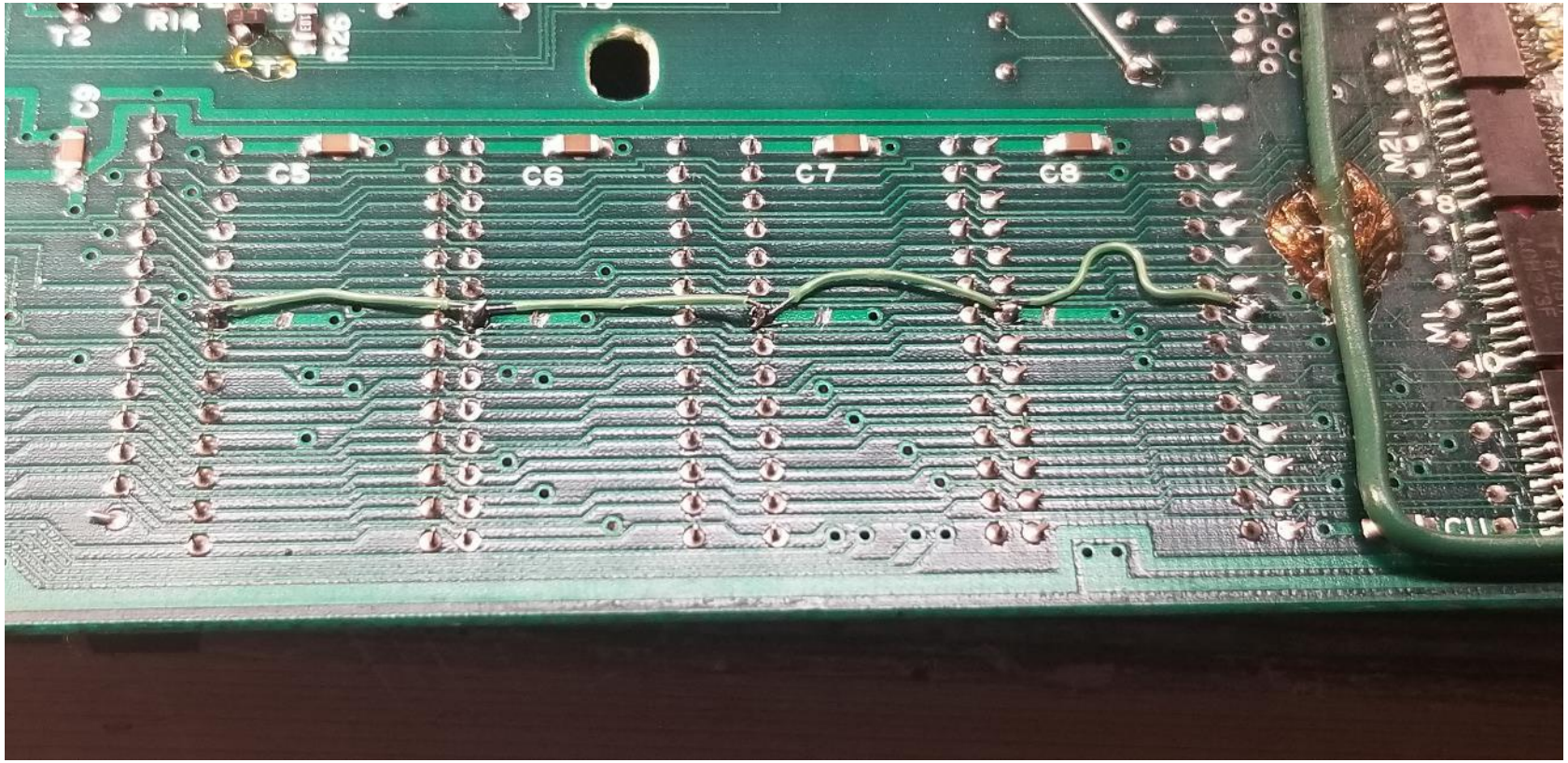
Using an Xacto knive, carefully cut the ground traces as shown.

Ensure the pins are disconnected from ground, and be careful not to damage other tracks.



/RD Signal (3)

Now, connect pin 22 of the main ROM to each pin 22 of the SRAMs, as shown.



Finishing comments

This modification permanently changes the clock rate. Future modifications may be available that are software switchable.

The changes are reversible, to the extent that you can repair the cut traces.

I have modified 2 Tandy 102 to date with no issues observed. I also have 2 M100s similarly modified to run at 5 MHz.

If you have any questions, don’t hesitate to ask!

Steve Adolph

November 2021