Tandy TRS-80 Model 4 - Upgrade 16K to 64K

By Maurits van Wijland, June 29th, 2021

Introduction

I found a Model 4 with 16K and no drives. It turned out to be a student machine, used on an ARCNET network in a classroom. Even the cassette interface cable is missing. The machine is of little use without any drives or cassette interface, so, the idea is to add a FreHD - but that virtual drive requires at least 64K. So, had to get 64K chips, which I acquired from Ian Mavric's store on eBay: https://www.ebay.com/str/trs80universe, sold under the title: **"64K memory upgrade for Tandy Radio Shack TRS-80 Model 4 4P 4D".**

The standard 8040016 static memory chips need to be replaced with the D4164C-12 DRAM chips. The 16K RAM chip uses -5, 5, and 12 volts. The 64K RAM chip only uses the 5 volts. This requires some modification on the mainboard.

Tools needed

The tools that are needed are:

1. De-solder iron or
2. De-solder pump or de-solder braid
3. Soldering iron
4. Small plyer
5. Chip extractor
6. Anti-static bracelet

Beside these tools, you will also need a spare jumper.

Modification steps

Upgrading a machine from 16K to 64K requires some modification to the mainboard. My take on this is that it should be reversible, making it possible to get the machine back into the original state.

There are 10 easy to follow steps to perform the upgrade. I skipped the ‘opening up’ of the Model 4. This step has been documented before, please see the video on YouTube:

https://www.youtube.com/watch?v=76bVeQP8m3Y&t=508s

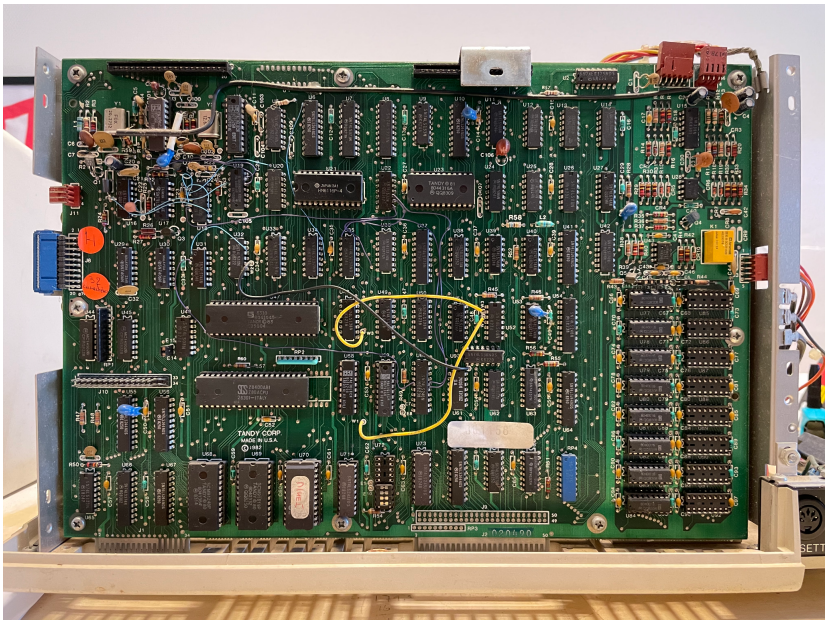
While this video pictures a Tandy model 3, the same applies for the model 4. Once you have the cover removed, we can start with the following 10 steps:

1. Remove the motherboard from the machine
2. Extract the memory
3. Remove some capacitors
4. Remove a transistor
5. Change some jumpers
6. Adding a jumper
7. Place the motherboard back
8. Checking the voltage
9. Adding the memory
10. Check the result

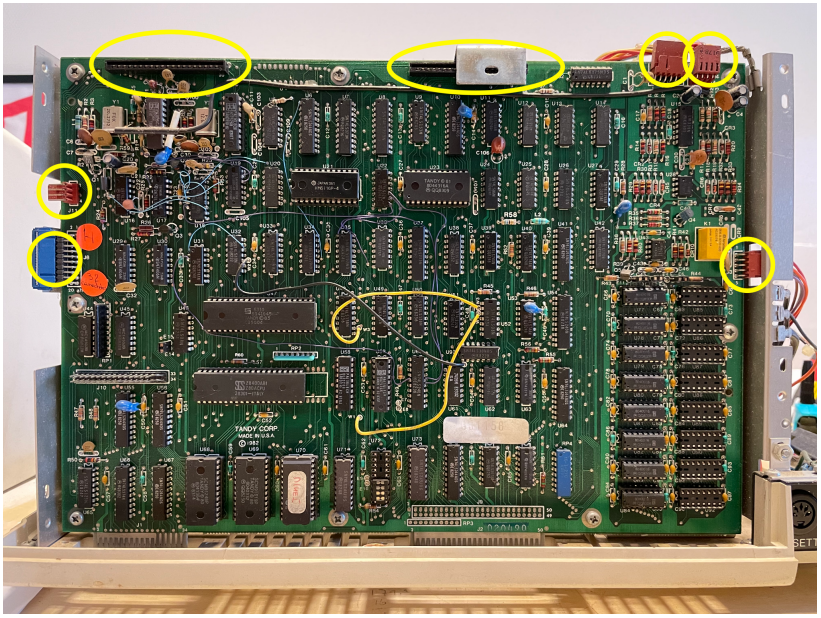
1. Remove the motherboard from the machine

Once the cover has been removed, you will need to remove the motherboard.

Start by making a picture of the motherboard, so that you can see the position of all the connectors. Beats writing things down.

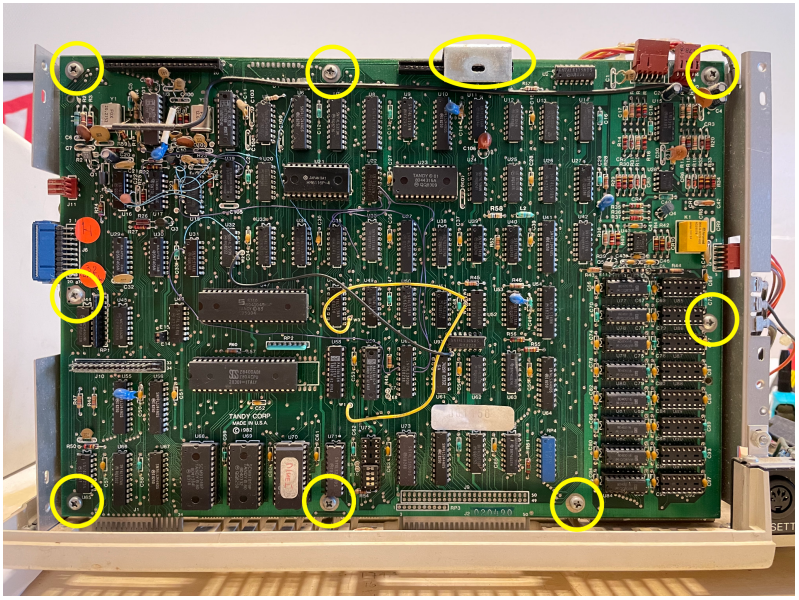


Next, detach all the connectors from the motherboard (circled in yellow in the picture below).



The top left and top center connectors may not be present in all systems (RS-232 and Floppy)

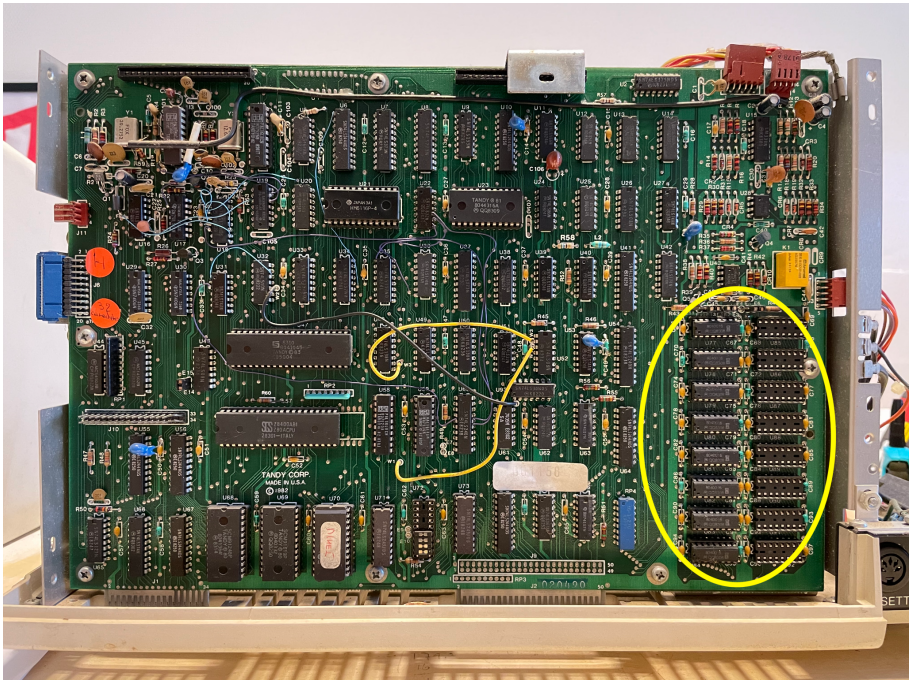
Next, remove the screws (circled in yellow, below) from the motherboard. Then, remove the metal spacer. Now, carefully take out the motherboard by first tilting the left side of the board towards you. And then, slowly remove the board upwards.



Screws

2. Extract the memory

Once the board is out, lay the board flat and locate the memory banks. They are at the lower right (see, yellow circle):

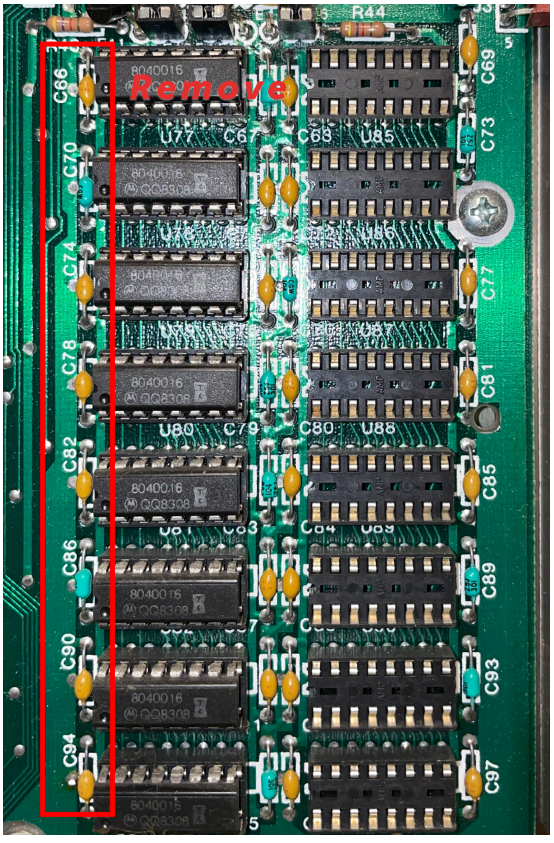
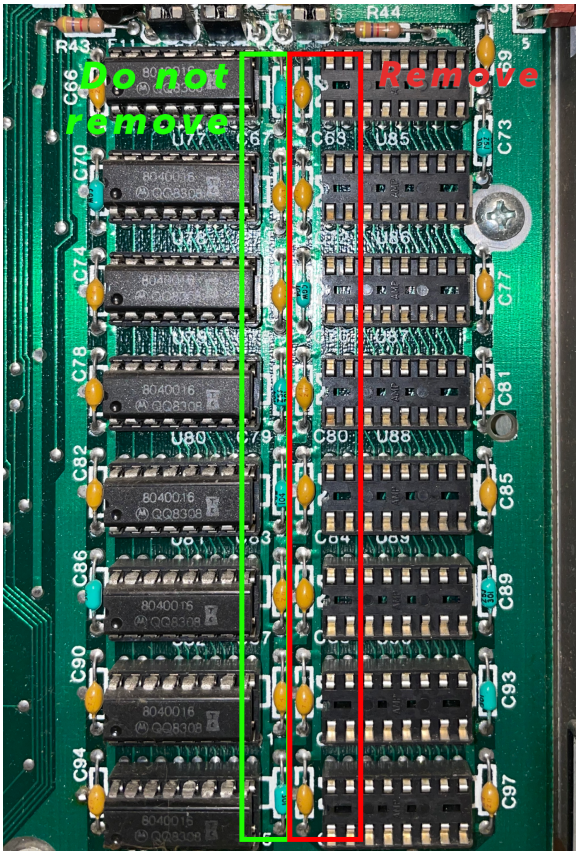


There are two banks of 8 sockets. The left bank is full 16K RAM Chips. Using the extractor tool, we can carefully pull the chips from the sockets. Make sure you pull the chips upwards. Try not to damage the chips, so you can always put the machine back into the original state.

You have to remove the chips from U77, U78, U79, U80, U81, U82, U83, and U84.

3. Remove some capacitors

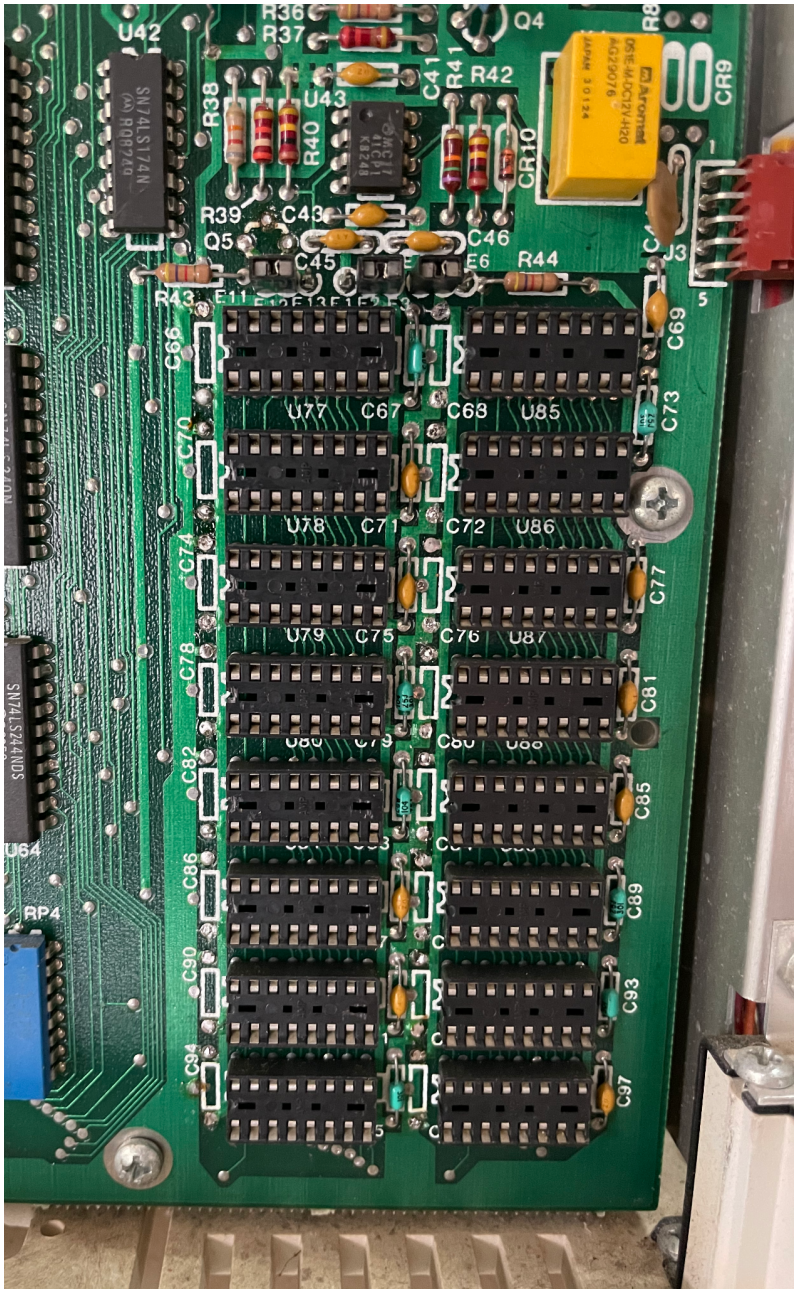
16K chips use 12, -5 and 5 volts, while 64K chips only use 5 volts. This shift requires that certain capacitors be removed for the 64K chips. I removed these capacitors by de-soldering these, instead of cutting them out.

Start with the easy capacitors. Take out capacitors C66, C70, C74, C78, C82, C86, C90, C94. These are the capacitors for the left bank. 	The next bunch of capacitors are tricky. There are two rows of capacitors between the two memory banks. You have to remove the right capacitors, see the picture. They are numbered C68, C72, C76, C80, C84, C88, C92 and C96. 

I prefer to use a de-soldering iron, but a soldering braid or a de-soldering pump with a soldering iron will also work – it just takes a bit longer.

When finished, fill up the ‘empty’ holes with solder. And, be careful, these capacitors will break easily.

After removing the capacitors, it should look like this:



4. Remove a transistor

Remove transistor Q5.

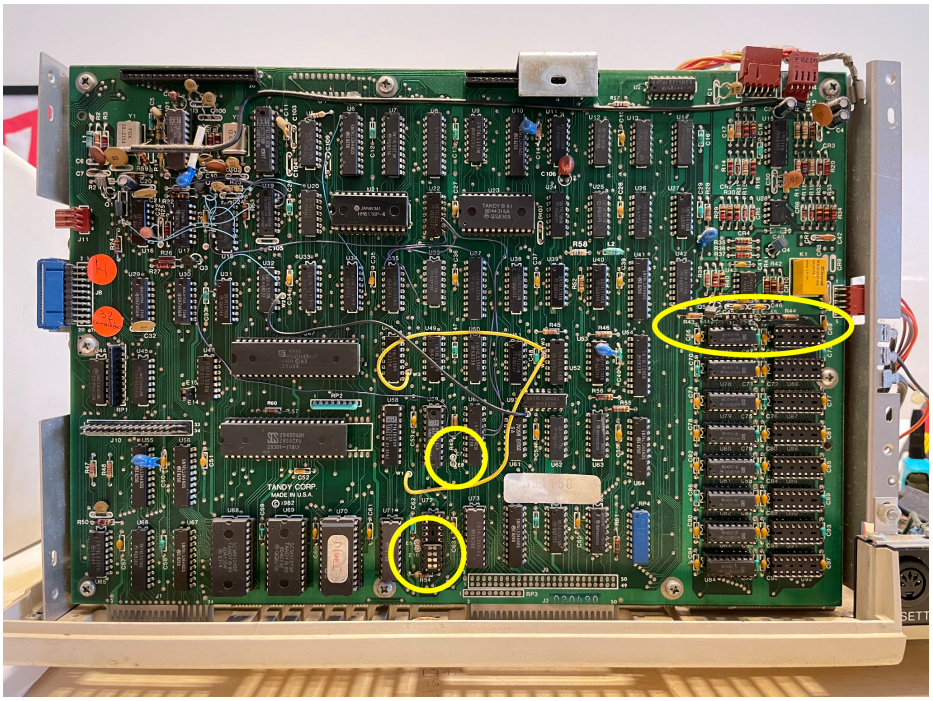
The Q5 translator is located just above the memory banks, on the right site of the board.

This transistor supplies the 12 volts required by the 16K RAM chips. The 64K RAM chips only use 5 volts, so this transistor needs to be removed. It is easy to remove the Q5 transistor by de-soldering from the back of the main board.

You have now finished the hard part!

5. Change some jumpers

To use the 64K RAM chips, some jumpers need to be changed. Some jumpers change the voltage of the pins, others change the functions of the pin. The jumpers are located here on the board: shown in yellow



To adjust the Model 4 to use the 64K chips:

Move E1-E2 to E2-E3	This changes the voltage to +5 volts on pin 8 of the RAM sockets
Move E5-E6 to E4-E5	This connects the 'A7' line onto pin 9 of the RAM sockets
Move E12-E13 to E11-E12	This connects the voltage of +5 volts on pin 1 of the RAM sockets

The Shunt

The shunt at socket U72, located bottom centre, does **not** need to be changed.

6. Adding a jumper

You need to add a jumper to E7-E8, which is at the center, bottom of the board, near the shunt. On some mainboards, there is no jumper, and you have to connect the two joints, using a wire.

E7-E8	This connects the GND to U59 on pin 11 of the RAM sockets.

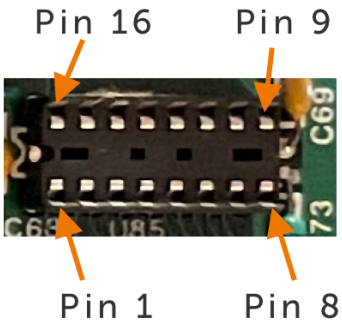
7. Place the mainboard back

Put back the mainboard and reconnect all the connectors. Also attach the monitor, so the power supply gets a load and provides the power.

8. Checking the voltage

It's important to check the voltage, just to be sure and not blow-up the 64K RAM chips. Remember that the 16K chips use 12 volts. And that doesn't go well with the 64K RAM chips.

To measure the voltage, use a multimeter. The black goes to the ground (I hold it against the body of the machine that is grounded. The red probe goes into the applicable socket. We need to check the pins 1, 8, and 16.

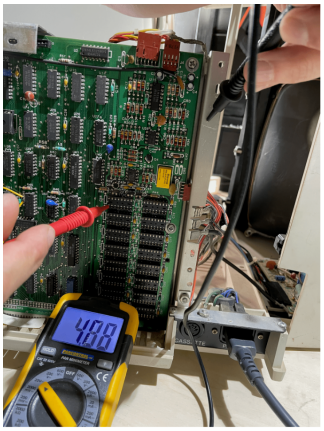


The pins 1, 8 and 16 should have the following read-outs:

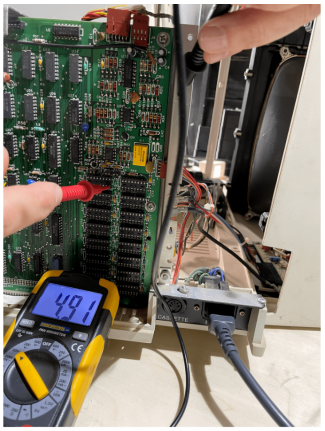
Pin 1 = 5v

Pin 8 = 5v

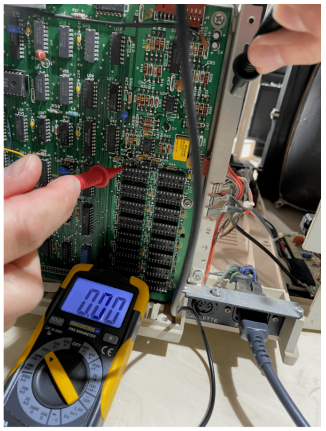
Pin 16 = 0v



Pin 1 - 5 volts



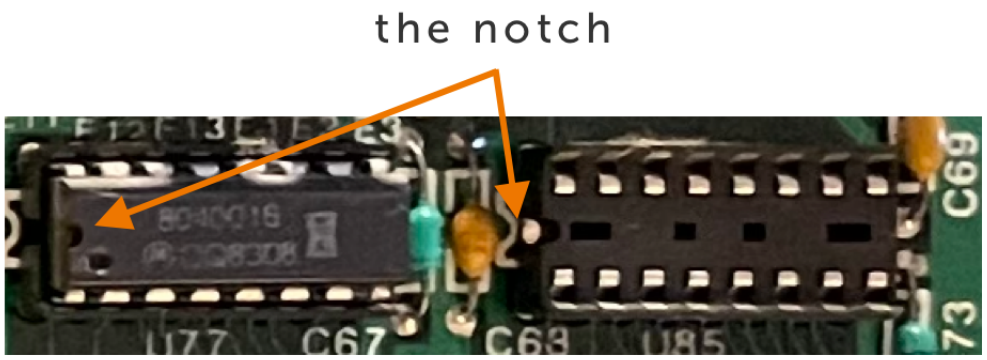
Pin 8 - 5 volts



Pin 16 - 0 volts

9. Adding the memory

Once the voltages are all checked, you can add the 64K RAM chips. Please notice the small notch on one side of the socket. This corresponds to the notch on the RAM chip.



Insert the RAM Chips. Bend its two rows of pins to a 90-degree angle on a flat surface, so it fits the socket neatly. Press the RAM Chips into the sockets, U77, U78, U79, U80, U81, U82, U83, and U84. This replaces the old 16K chips with the 'new' 64K chips.

10. Check the result

When all the modifications are done you should check the results. Reassemble the TRS-80 and power it on. If there is a prompt on your screen, that is of course a good sign. But let's check further.

- Hold down the <BREAK> key and press the orange reset button.
- At the "Cass ?" prompt press <ENTER>
- At the "Memory Size? " prompt give it 32000.
- Type in the following program and run it.

```
10 A=-32768:P=132
20 POKE A,128:OUT P,48:POKE A,64:OUT P,0:PRINT PEEK(A)
```

If all went well, then, this program should print: 64

Sources and references

This document came together thanks to a number of people and information sources:

1. Ira Goldklang, https://trs-80.com
2. Ian Mavric, sells trs-80 parts and is a great source of information
3. Discord group: Tandy -

   Patrick Bureau, Amardeep, Peter Bartlett, thank you for your input.

Happy computing.