How To: Replace the ZX Spectrum 48 ROM with an EPROM

By: Marcelo (inspired by an article in spanish Microhobby #79, p22)

Why:

First off, why on earth would one want to do such a thing? Well, there are several reasons. For one, it might have gone to silicon heaven, or an owner could want to change it to fix some well-known bugs, or enhance the BASIC or any other reason (how about using the already-made-and-proven hardware to use it as a controller?). Possibilities are endless.

Skipping the gotchas:

I'll speak exclusively about differences between a **NEC ROM 23128** and **EPROM 27128**, both 16K x 8bit.
The most obvious difference is EPROMs need one extra pin to shove the programming voltage to them, normally between 12 and 25 volt (usually the older the chip, the higher the voltage). ROMs have a non-connect pin in this place. This is pin 1.
Another difference is that EPROMs have another pin to tell them they're being programmed. ROMs have an extra enable pin taking its place. This is pin 27.
So, we have to swap a device with another that has one enable pin less.

The solution:

All ZX Spectrums 48 have a jumper block with two **N** and two **H** letters close to the speaker. In the ancient times, the folks at Sinclair Research used the **N** jumpers when they smacked a **Nec** brand ROM, and the **H** jumpers when they were dealing with a **Hitachi** one (AFAIK, I could be wrong). The point here is that these jumpers selected which of the Z80's **RD** or ULA's **ROMCS** lines reached which of ROM pins **20** (**CE**) and **27** (**E**).
We will not use pin 27 in either ROM or EPROM after this modification is done. Reason being it conflicts between ROM and EPROM (opposite logical levels needed for each). In our case, we'll simply stick it to the necessary enabled logic state by wiring the chip itself (more on this later).
So, what do we do with the Spectrum signals **RD** and **ROMCS**, then? We'll combine them with an OR gate and feed them to compatible pin 20 in both ROM and EPROM. It's really THAT easy. For this we'll take advantage of these **N-H** jumpers. Bad news is my Spectrum does not have the lettering, but I traced the tracks and this will help out.
We'll take care of the extra **Vpp** (pin 1, programming voltage) pin in the EPROM by tying it to +5V in the ROM's socket we'll add. This pin in the ROM is **N/C** (not connected), so it will not interfere with normal Spectrum work.

Step by step:

If you want to do it, you'll need some tools. These would be:

- A nice table to work on
- Soldering iron
- Some solder
- Solder sucker or desoldering braid
- Philips screwdriver #2
- Small flat screwdriver
- Small, long nosed pliers
- A quad 2 input OR gate chip, 74LS32 (we'll use just one gate, though)
- A 28 pin DIP socket
- An EPROM with the new contents burned in (leave to you how you burn it), 27128
- Some wire wrap wire
- A continuity tester (DMM that goes BEEP when you short the probes)

Before doing this, I have to tell you that by opening the ZX Spectrum you'll void the warranty… But it's 2007, so who cares, huh? But first things first: **Do not do this with a powered computer; doing so WILL destroy it.**
Place the machine keys down, remove its feet and get the screws off. Do NOT lift the base. Ok, turn the set over (keys up), and **lift the keyboard VERY carefully**. You'll notice the two keyboard membrane stripes; unplug them with even more care from the connectors in the motherboard. Please note that these stripes are very sensitive, a single little crack and your keyboard will NOT work correctly.
We managed to get to the main board. Get it off the plastic base. Use the pliers and screwdrivers to remove the heat sink. Locate the ROM chip; it's to the right of the Z80.
Turn the board over and locate the ROM solder points (28 of them). Armed with the soldering iron and the sucker or braid, remove the ROM from the board (unless it's on a socket; if so, skip this part). Be **very careful** not to lift tracks. When all the solder's gone from all 28 pins, use the flat screwdriver to make sure the pins are free and try to remove the ROM **very gently**. If there's any mechanical resistance from the ROM, double-check the pins looking for not-removed solder. Repeat until you can remove the ROM without effort. Next, remove both jumpers from the **N-H** jumper block.
Well, we're getting to the easy part. With the pliers, gently remove the socket's pin #27 (the one we'll not use). Place the 28-pin socket where the ROM was. Make sure the notch is correctly aligned. Turn the board over and solder the 27 socket pins. Use the wire-wrap wire to connect pins 1 and 28 (do this in the solder side, see photo).

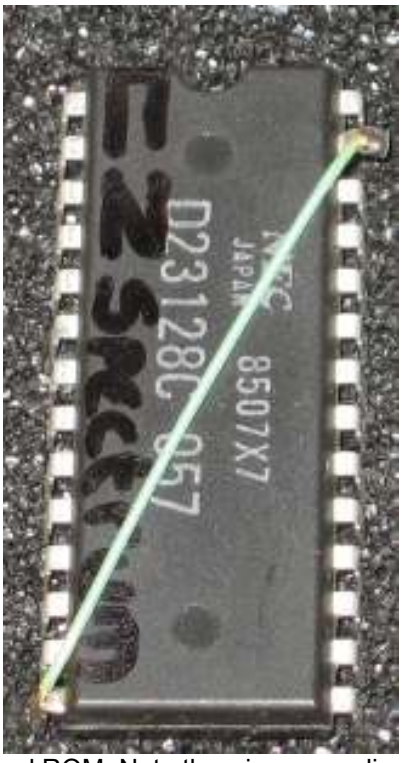
We'll work on the 74LS32 next. Cut off pins 3, 6 and 11 completely so they cannot touch anything. Use the thin pin part on pins 1, 2, 4 and 5 to connect them to pin 7. Use the thin pin part on pins 12 and 13 to connect them to pin 14. This procedure assures there are no floating input pins in the chip, and we're left alone with the single OR gate in pins 8 (out), 9 (in) and 10 (in). Now, locate some standard 14-pin TTL chip in the board. We'll use it to power our 74LS32. Put our 74LS32 above the selected chip and make sure the wired pins do not touch the chip below, except for pins 7 (GND) and 14 (+5V). Solder them.

We're getting very close. Now, use the wire-wrap wire to connect pin 8 on the 74LS32 to the **N-H** jumper block's lower-left pad (this goes to ROM/EPROM's pin 20). Now, connect the upper-left pad (Z80 **RD** pin 19) in the **N-H** jumper block to pin 9 in the 74LS32, and the lower-right pad (ULA **ROMCS**, edge connector pin 25B) to pin 10 in the 74LS32.

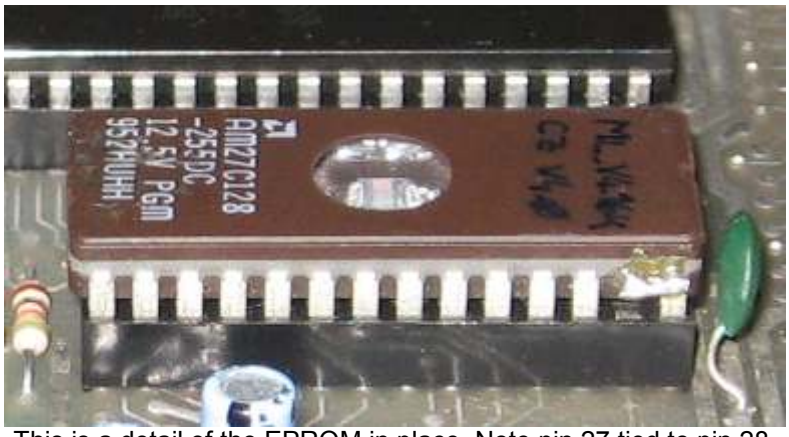
We're almost done! Now, clean the ROM pins very thoroughly of any remaining solder, and use some wire-wrap to connect its pin 27 (**E**) to pin 14 (**GND**), and the EPROM's pin 27 (**PGM**) to pin 28 (**Vcc**) (you can use the thin pin part to do this).

Ok, now replace the heat sink; make sure it does not short circuit any nearby tracks, and place either the ROM or the EPROM in the socket. Making sure there's nothing in the table that might short anything in the Spectrum, power it up. If you put the ROM, the normal "**© 1982 Sinclair Research Ltd.**" message should appear. If not, power off immediately and look for shorted pins, solder in the board, etc. It should work first try.
Last step is to reassemble the machine by reversing the disassembly steps. Enjoy.

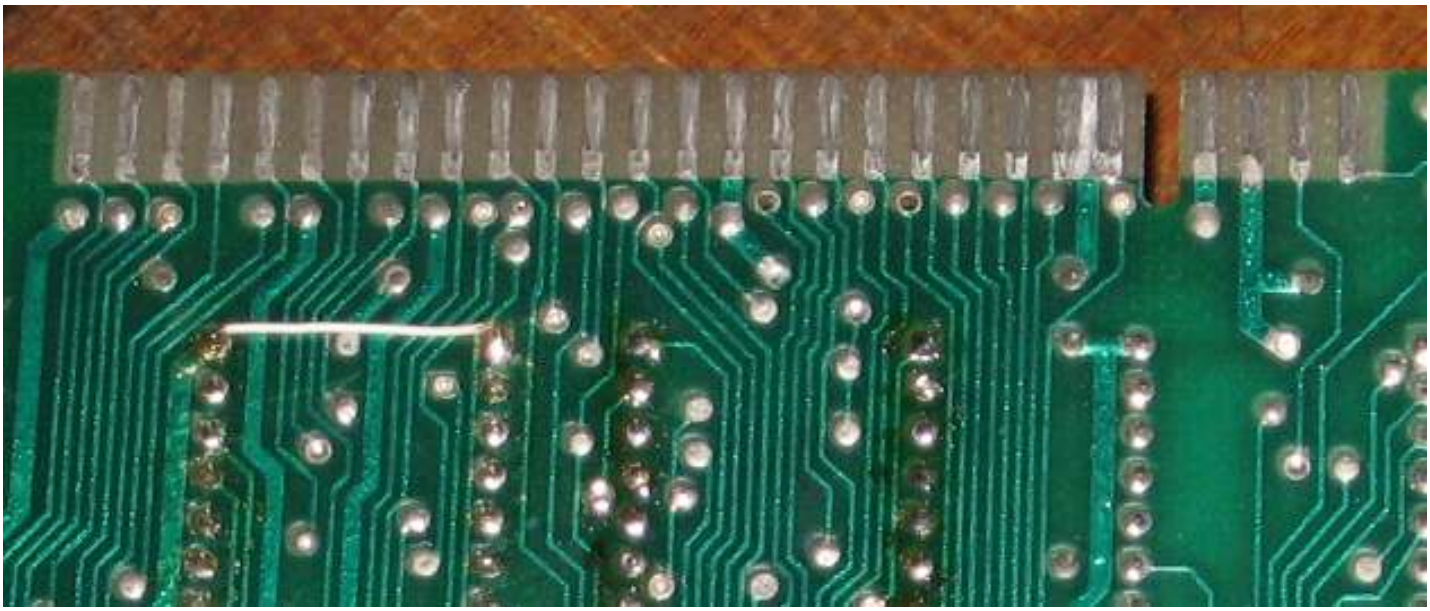
Now, some close-ups:



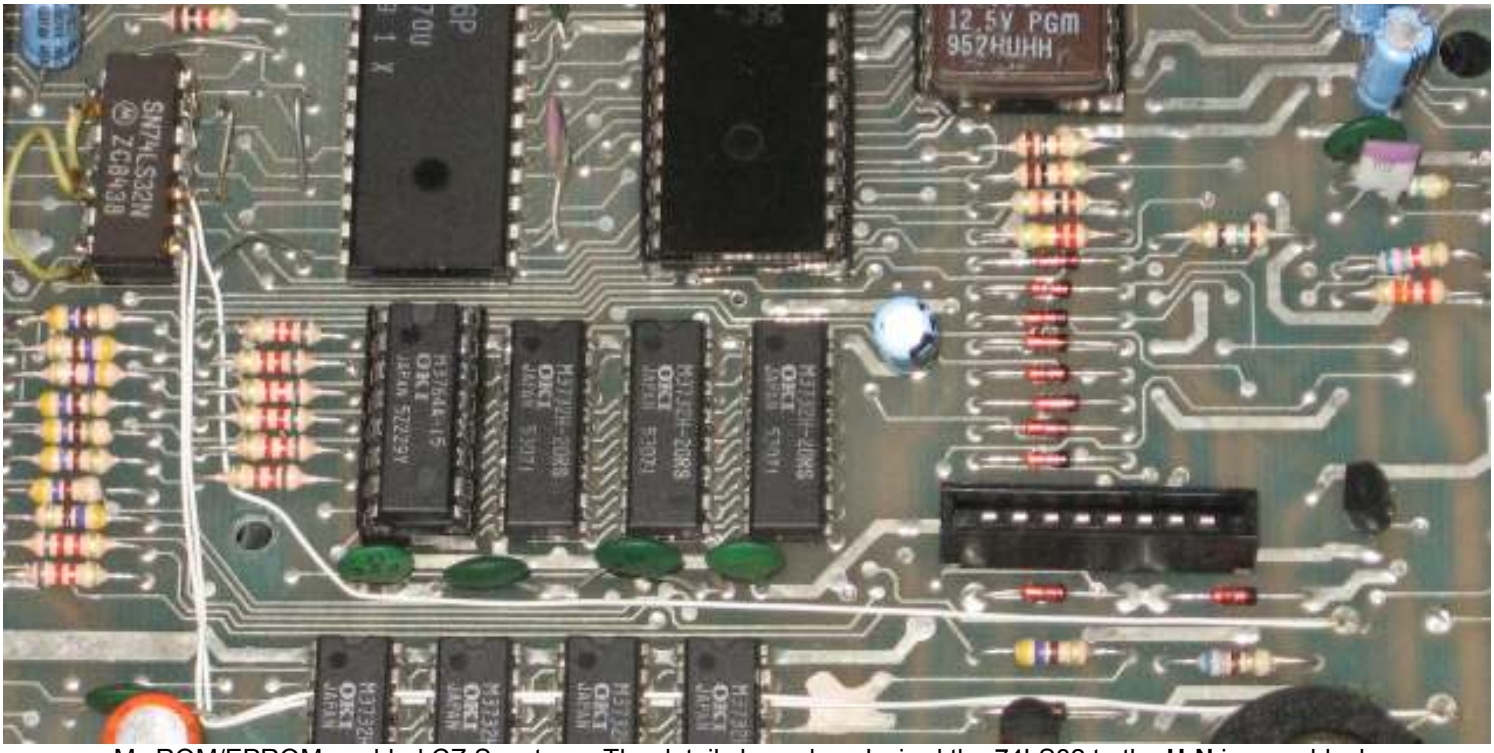
My original ROM. Note the wire, grounding pin 27.



This is a detail of the EPROM in place. Note pin 27 tied to pin 28.



This is a detail of the jump between pins 1 and 28 in the ROM/EPROM socket.



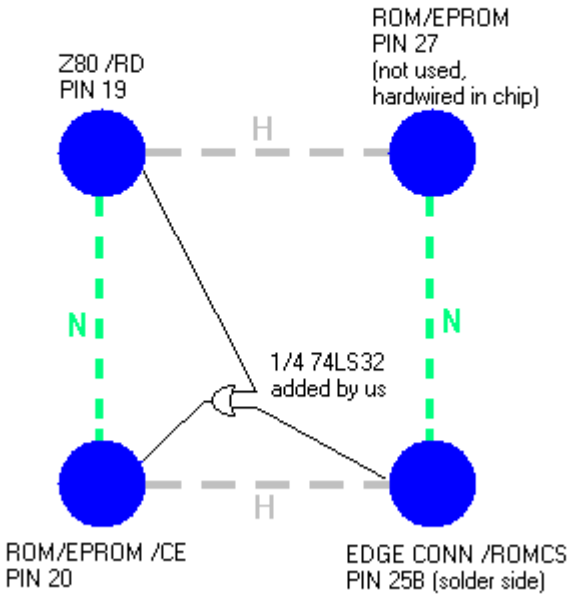
My ROM/EPROM enabled CZ Spectrum. The detail shows how I wired the 74LS32 to the **H-N** jumper block.
(note my board has no lettering on the jumper block, and the Speaker hides a pad)

Here's a side-photo, showing the jumper block used pads.

This is the Argentinean CZ Spectrum 48K, by Czerweny. The 8-pin DIN connectors are for Sinclair Joysticks; the red thing above is a reset button. Note the lack of coil for RAM power; it's been replaced with a NE555 as astable.

DETAIL

Wiring of the N-H jumper block in the ZX Spectrum 48 to use either ROM or EPROM



The wiring, as it's intended to be. The drawing assumes the board components up, the speaker to the bottom-right.

Disclaimer: This article was made from scratch from my own work on my own CZ Spectrum 48k, inspired in an article in the Spanish magazine Microhobby. Some knowledge and experience on electronics (especially soldering/desoldering) is recommended to try this modification. My computer had a NEC ROM (thus it had the jumpers in the **N** position) and I replaced it with an AMD EPROM: Nothing blew up, and the computer works correctly. I cannot be held responsible if anything you try on your computer goes wrong.