ZPrinter 650 Mainboard Replacement

How to replace mainboard in Z Corporation/3D Systems ZPrinter 650 (powder 3D printer). Also applies to ZPrinter 450 and Zprinter 250.

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INTRODUCTION

The ZPrinter 650 color powder 3D printer has a large electronics module which is somewhat prone to failures. Replacement module is very expensive, it cost around 5000 USD in 2015. What is even worse, the original producer (Z Corporation) was bought out by 3D Systems and they stopped providing spare parts for older (pre-2012) printers. However, I figured out the main reason why the electronic modules fail: a small embedded PC mainboard based on VIA C3 processor. Taiwanese comrades who manufactured the board used a bit too cheap CPU fan and when it stops working, the CPU will burn out. In one instance, the fan started to fail after mere 2 months! You can't replace the CPU (it's soldered to the board), but it's possible to buy a new mainboard. It has **part number ENDAT-3220M** and can be usually found on Ebay. Ocassionally, it also appears in PC surplus stores and the like, just Google for it. Other Z Corporation printers also use this mainboard, Zprinter 450 and Zprinter 250 for example. Unfortunately, it also depends on production year of the printer, so I recommend to **disassemble the printer and check the actual mainboard type before you buy.**

WARNING! This repair should be performed only by skilled technician with background in electronics and/or computer service work. Moreover, it includes manipulation with very sensitive electronic components and ESD precautions must be observed during most steps!

TOOLS:

- Phillips #1 Screwdriver (1)
- PS/2 keyboard (1)
- PC monitor with VGA input (1)
- ESD Gloves or Bracelet (1)

PARTS:

- ENDAT-3220M mainboard (1)
- High quality 40x40x10 mm 3-pin PC fan (1)
- CR2032 battery (1)
- Cable ties (1)

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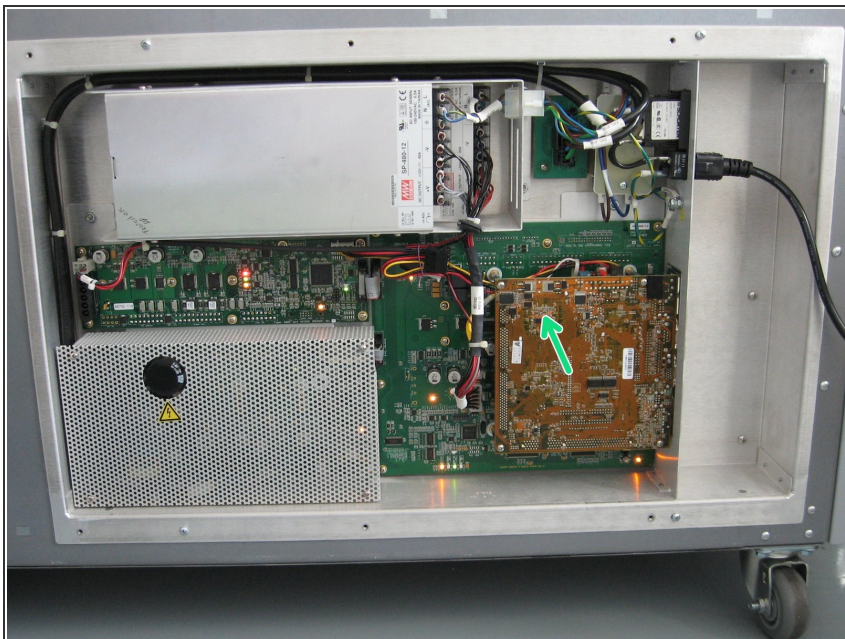## Step 1 — Verify it's really bad mainboard, part 1

- The electronics module is very complex and the mainboard is not the only component that can fail. So first you need to verify that your printer really has bad mainboard and not something else.

- Normally, the mainboard produces a short beep about 10 seconds after powerup. If it doesn't beep, then it's probably dead.

- If it beeps more than once or beeps repeatedly, then the mainboard works, but something else failed (dead CMOS battery, bad memory etc). In that case you can diagnose it like in Step 8.

- Another indication is the front display - if it lights up but all pixels stay black like in the photo, then it's likely the mainboard is dead. If it doesn't light up at all, then there is some other problem (dead power supply for the entire electronics module, for example).

Step 2 — Remove electronics module cover
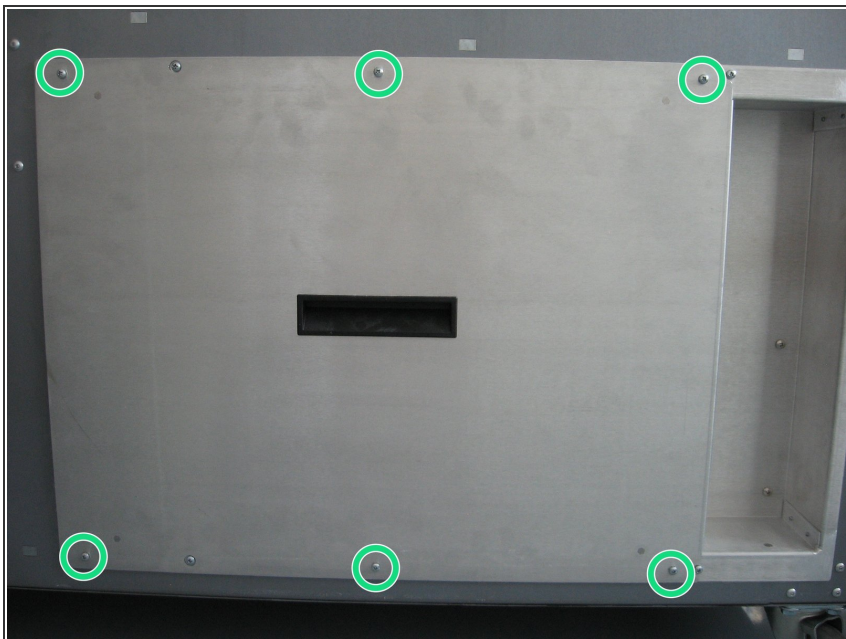
- Power down the printer and unplug all cables from the electronics module on the back. Remove 6 screws from its cover and put it away.

- ⓘ Note that you don't need to remove the entire module from the printer, just its cover. Remove only screws indicated in the photo.

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## Step 3 — Verify it's really bad mainboard, part 2

- Power up the printer and let it run for at least 10 minutes. Then place your finger to the board on the back side of the CPU (green arrow). If it's hot (>50 degrees Celsius), it means the CPU had burned out.

- You can also check if the original CPU fan works - if it doesn't, then your CPU burned out for sure. See Step 9 as to how to check.

- ⚠ Warning! The power inlet and wires are right above the mainboard, be careful or you may get an electric shock!

- ⓘ This photo shows status LEDs in a fully working printer. Maybe they will help you with diagnostics if your printer has some other problem.

Step 4 — Prepare new mainboard
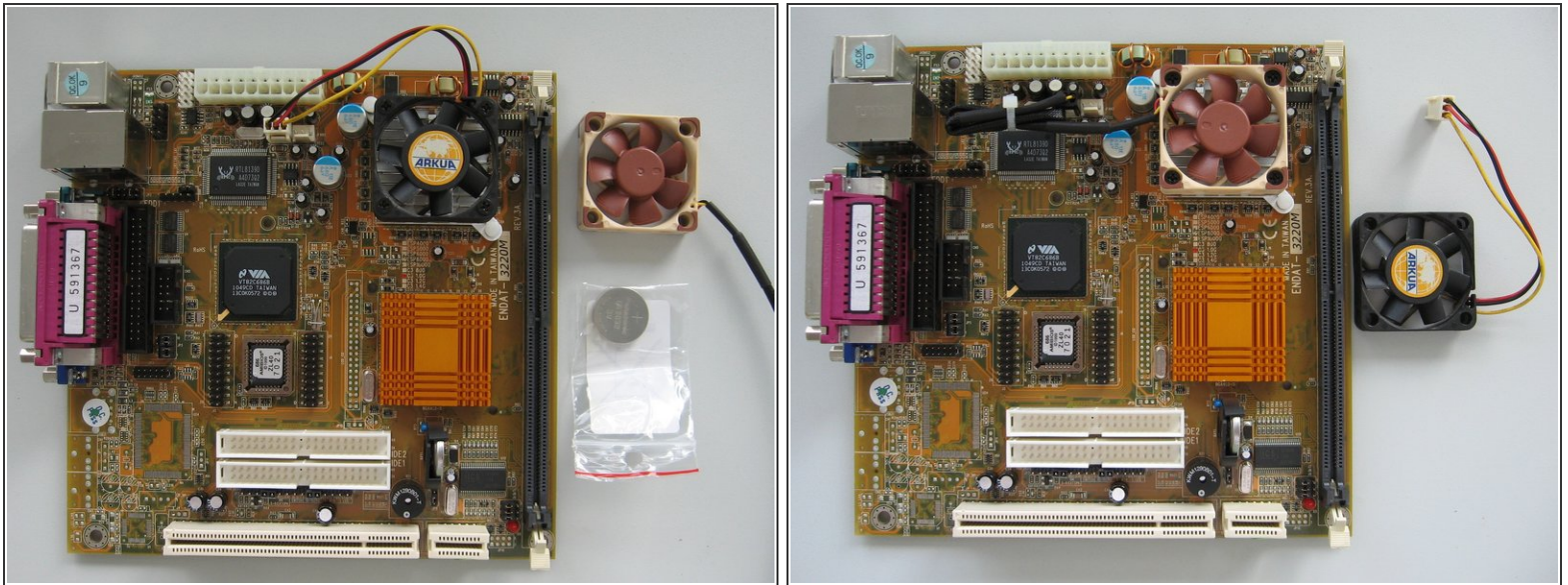
- If you confirmed you have bad mainboard and bought a new one, you need to prepare it first.

- Firstly, preventively replace the original fan - as I said in introduction, it may fail in a few months. **Don't try to skimp here, use the best fluid dynamic bearing fan you can get!** I'm using Noctua NF-A4x10 FLX in the photo, but any other 40x40x10 mm fan with 12V 3-pin connector will do. Don't forget to connect the fan cable.

- Secondly, preventively replace the original CMOS battery (CR2032 type). The mainboard sat in a warehouse for 8 or more years by now, so the original battery will be dead anyway.

⚠ I've seen a variant of the mainboard which had no CPU fan at all. In that case you **must** add a fan on it, otherwise the CPU **will** overheat and burn out!

ⓘ Mainboards produced at different dates use different screws for the CPU fan, so you may encounter some difficulties there. If that happens, you may need to buy 2.5x15 mm wood screws or M2.5x15 screws with washers.

## Step 5 — Unscrew the original mainboard from the printer
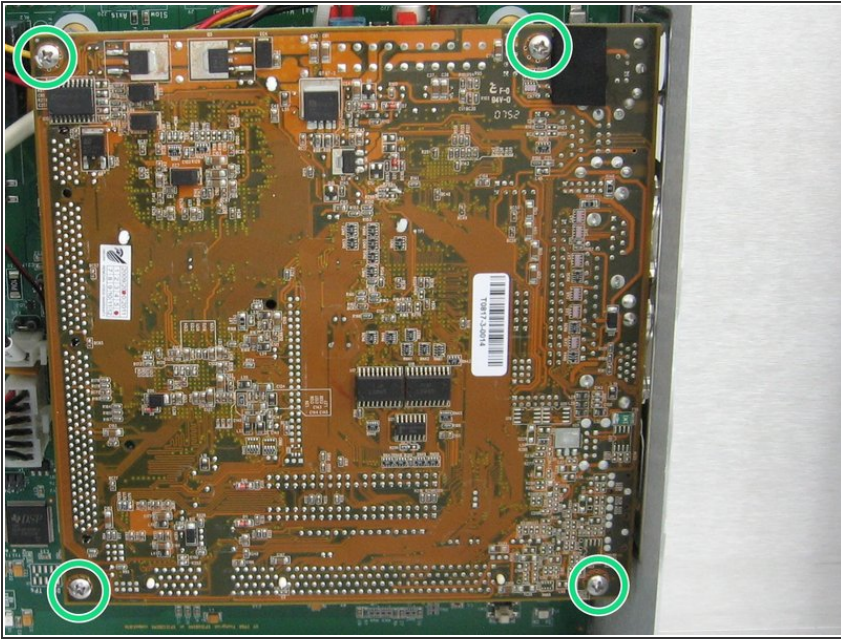
- Unplug all cables from the printer and remove 4 screws as indicated. Then gently pull on the **left vertical edge** of the mainboard. You will feel some resistance as a PCI riser card disconnects (see Step 7 for more details about it).

Step 6 — Move components to new mainboard
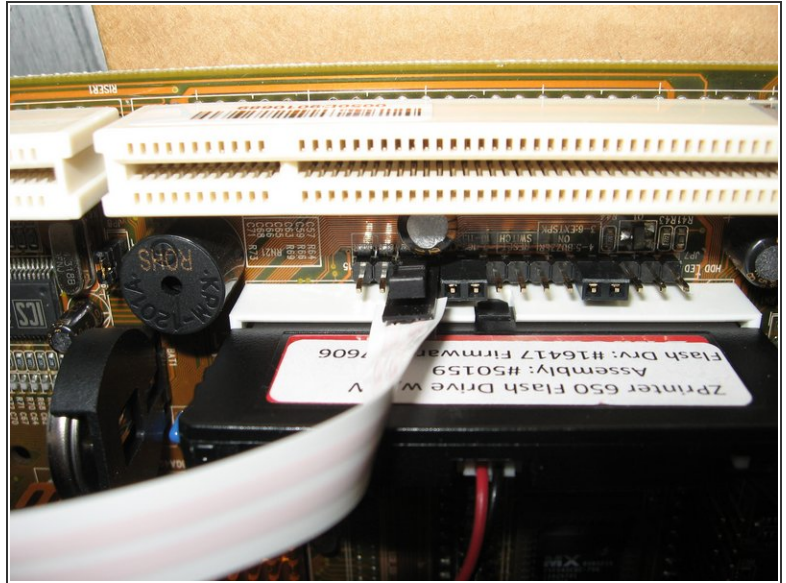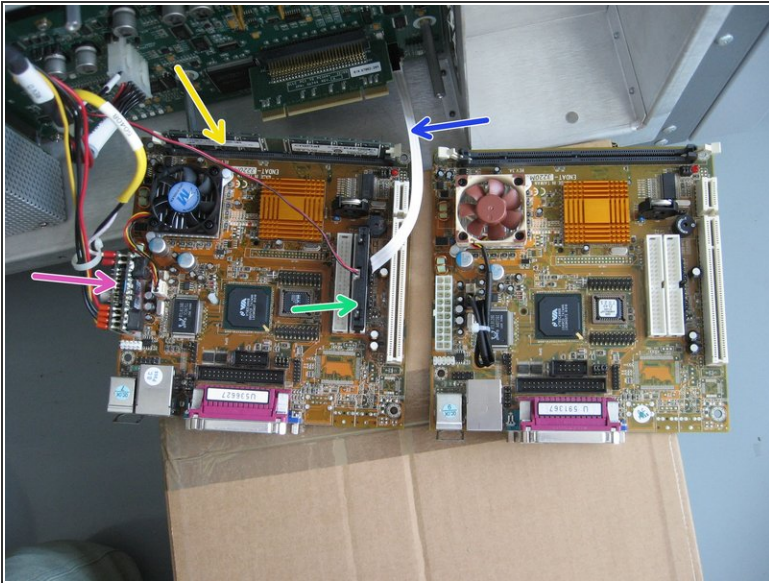
- Place some sort of pedestal on the ground, so the original mainboard wouldn't hang from the cables. I'm using a cardboard box in the photo.

- Now you can review all the components you need to move to the new mainboard: 1. DDR memory stick (yellow arrow), 2. small Parallel ATA solid state hard drive (green arrow), 3. power supply converter and connector (purple arrow) and 4. white flat cable (blue arrow) for "power button" header.

- ⚠ Important! You must connect the white flat cable exactly as is shown in the second photo, otherwise signal from the printer will not be able to boot up the mainboard! Also, be sure to put the hard drive into the correct ATA slot.

- ⓘ If you can, make an image from the hard drive (see Step 8 as to why). You will need another PC with ATA slot and HDD imaging software for this task, because there are several different partitions on in. The drive is powered via thin cable from Molex connector, so you will need to borrow it from the printer. The drive has only 64 MB capacity.

Step 7 — Slide new mainboard into printer
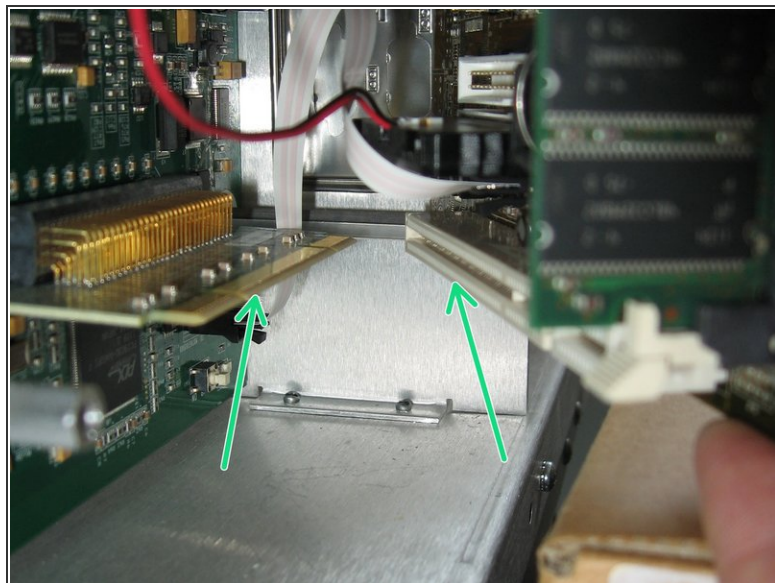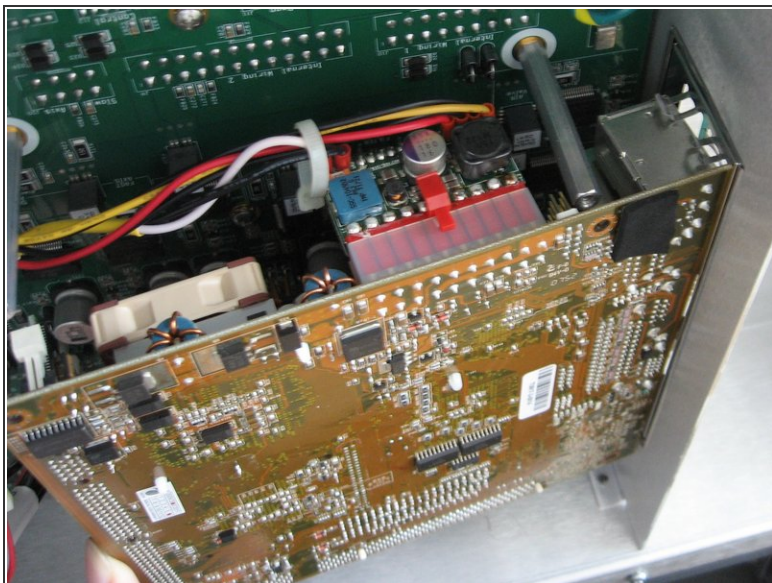
- This part is a bit tricky, because you need to connect the mainboard onto PCI riser card as you slide it in.

- First, place mainboard's connectors on the I/O shield at an angle, as shown in the first photo. Then gently push the left edge of the board and check if the riser card is properly mating with the PCI slot (green arrows in the second photo). If it's OK, push the mainboard all the way onto the hexagonal mounting posts and secure it with screws.

Step 8 — Standalone functionality test

- Now you should test if the new mainboard helped (i.e. if it really was the source of the fault). **Do NOT connect Ethernet cable at this point**, otherwise the printer will not boot.

- Connect a PS/2 keyboard and a VGA monitor to the mainboard. Then plug in the power cord to the printer and turn it on. The mainboard should beep and show BIOS logo. It will probably stop there and report corrupted CMOS settings (beause of the battery in Step 4).

- Enter the BIOS (Delete or F1 key), and choose Save settings (second photo). This will set and save default CMOS settings and the mainboard will reboot itself. It then should fully boot into printer firmware (ASCII GUI similar to the third photo). Also, the small display at the front of the printer should work now.

- ⓘ If you encounter problems, keep in mind it's like troubleshooting an ordinary PC - check for loose cables/connectors, improperly seated components, bad power supply, faulty memory, BIOS errors etc.

- ⓘ The worst problem would be bad HDD, because it stores various calibration data for valves, rollers and other mechanical components which were uniquely tuned in the factory. I made a HDD image from one Zprinter 650 in Acronis, but it probably won't work very well in another printer.

- ⓘ Nevertheless, I'm willing to provide you with my HDD image if you really need it. Contact me in that case.

Step 9 — Check that the new fan works
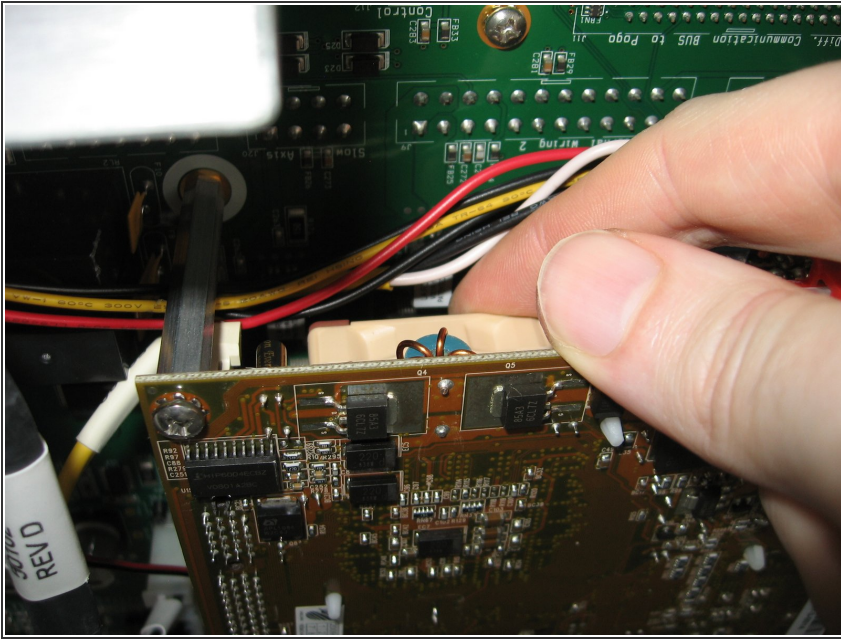
- When the printer is running, you should check that you've mounted and plugged the new CPU fan correctly. You can see it rotating with a small mirror or you can carefully feel it with your finger, like in the photo.

- Tie up the nearby cables, so they can't move and block the fan.

- ⚠ Warning! The power inlet and wires are right above the mainboard, be careful or you may get an electric shock!

Step 10 — Setting up BIOS part 1
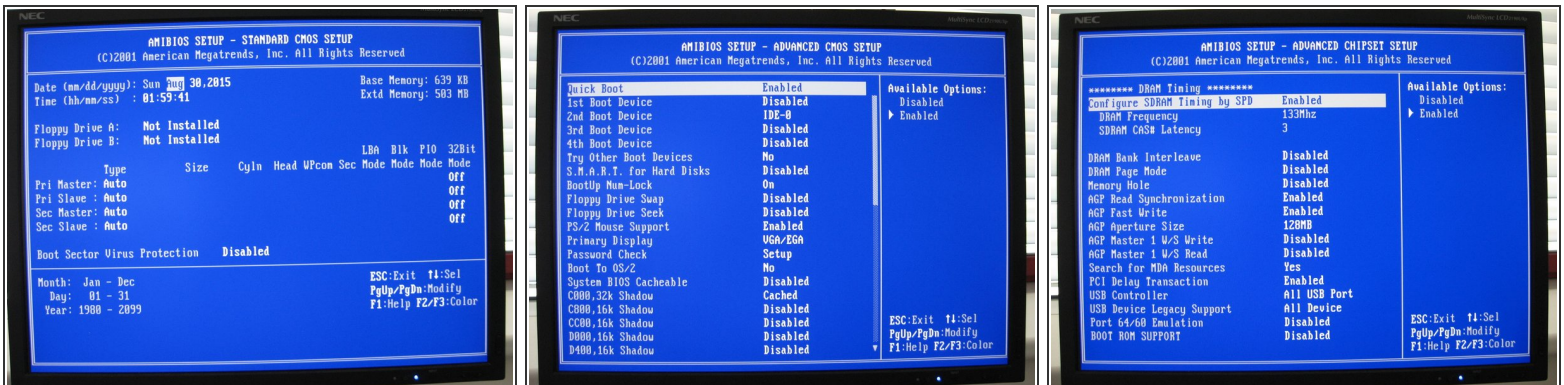
- You need to change some settings in the BIOS, otherwise the printer firmware will always freeze as soon as you plug in the Ethernet cable. Specifically, you need to disable some onboard devices to prevent IRQ conflicts (the firmware runs on FreeDOS, which is not Plug and Play OS).

- Unfortunately, I don't remember which settings exactly have to be changed, but I made photos on a working printer, so you can use them as a guide.

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Step 11 — Setting up BIOS part 2

- Ifixit allows only 3 photos per step, so here are some more BIOS settings. Incidentally, I think the last one (Peripheral Setup) is the most important one.

- Don't forget to save the new settings when you're done. Then let the printer boot into its ASCII GUI.

Step 12 — Networked functionality test
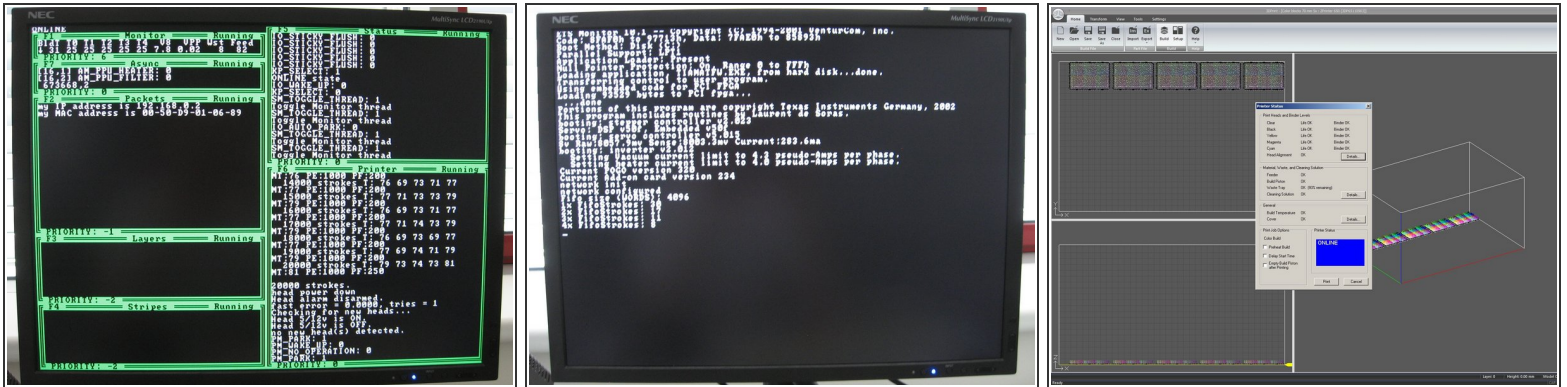
- Connect Ethernet cable to the printer and check the ASCII GUI. Normally, some values change every second and they should continue to do so after you plug in the cable. If the firmware freezes, you need to check the BIOS settings again.

- Moreover, the firmware displays various information during boot (second photo). If you reboot the printer and it always freezes at a particular stage, then that's the likely culprit. Unfortunately, it seems the only way to do a reboot from frozen firmware is by turning the printer off and on again.

- The printer should now work normally. You should be immediately able to connect to it with ZPrint or 3DPrint software, because all settings were stored on its internal HDD. But keep in mind the new mainboard has different MAC address, so some network configuration changes in your institution/workplace may be necessary.

Finally, you should turn off the printer, disconnect all cables and put back cover on the electronics module. That completes the repair.