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12161 Berlin  
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## MNT ZZ9000 Quickstart Manual

Dear MNT Customer,

Thank you for purchasing the MNT ZZ9000 Graphics Coprocessor Card for Commodore Amiga computers. This product was made possible by your support.

### Package Contents

- MNT ZZ9000 Zorro card with steel mounting bracket and 128MB MicroSD card containing ZZ9000OS firmware
- MNT ZZ9000CX ECS/AGA Video Slot adapter
- Video Slot ribbon cable for connecting both cards
- This manual



### Warranty

MNT Research covers the warranty to the extent required by law for the unmodified product. ZZ9000 is based on a reconfigurable Xilinx ZYNQ Z-7020 FPGA that can be updated by the user and reprogrammed to enable new functionality. Warranty does not cover user supplied firmware or any modifications made to the card, nor does it cover any damage by inserting it into a computer or other user supplied device. Use at your own risk!

### Declaration of Conformity

MNT ZZ9000 may only be operated in a closed steel enclosure. MNT Research assures that the included product complies with the requirements of the following applicable European Directives and DIN standards:

EMC Directive 2014/30/EU, Low Voltage Directive 2014/35/EU, RoHS Directive 2011/65/EU.

- DIN EN 55022:2011-12 (CISPR 22:2008, modified)
- DIN EN 55024:2016-05 (CISPR 24:2010 + Cor.:2011 + A1:2015)
- DIN EN 61000-6-1:2007
- DIN EN 61000-6-3:2007/A1:2011/AC:2012
- DIN EN 61000-3-2:2014
- DIN EN 61000-3-3:2013

Lukas F. Hartmann  
Managing Director, MNT Research GmbH, August 7th, 2019

## Hardware Installation

1. Connect the Video Slot ribbon cable by inserting one end into the blue socket of ZZ9000 and the other end into the blue socket of ZZ9000CX.

2. Insert ZZ9000 into any of the Zorro slots of your Amiga 2000/3000/4000.

3. Insert ZZ9000CX into the Video Slot of your Amiga. In Amiga 2000, the Video Slot is on the right side of the power supply. In Amiga 3000, the Video Slot is located next to the top Zorro slot on the daughterboard. In Amiga 4000, the Video Slot is located next to the bottom Zorro slot on the daughterboard. If you're unsure about the orientation of the card, visit <https://mntre.com/zz9000> for installation photos.

There are two distinct firmware (BOOT.bin) files for Zorro II and Zorro III support. ZZ9000 ships with the firmware that you selected when ordering. To change it, just visit the ZZ9000 website, download a different firmware file and copy it to the MicroSD card that is inserted in ZZ9000.

### Software Installation

1. Install the RTG (ReTargetable Graphics) system. There are two options:

- Picasso96 on Aminet: <http://aminet.net/package/driver/video/Picasso96>
- The updated P96 2.x by Individual Computers (recommended). To purchase a license, first register an account in their shop. After logging into the shop, P96 will show up as a product. Further information: <http://wiki.icomp.de/wiki/P96>

When installing Picasso96/P96, select only the **Altai's** card. The ZZ9000 Installer will copy it to create its own Devs:Monitors/ZZ9000 driver file.

2. ZZ9000 implements a SANA-II compatible network card that you can use with TCP/IP stacks such as Miami or Roadshow. **Make sure you have such a TCP/IP stack** installed before installing the network driver.

3. Double click "Install ZZ9000" from the ZZ9000 Install package available from our website or on floppy disk from our online shop. The ZZ9000 Installer will guide you through all steps necessary to set up the graphics and network functions.

4. After rebooting, you will be able to select high resolution 8/16/32 bit screen modes using ZZ9000's display engine. Native Amiga chipset screen modes will be automatically scan-doubled and flicker-fixed via ZZ9000CX.

Both Graphics and Ethernet drivers are in a beta testing stage. **Please regularly check the ZZ9000 website for updated drivers with improved performance.**

Get Updates and Source Code at:  
<https://mntre.com/zz9000>

Need Help?  
Write to [zz9000@mntre.com](mailto:zz9000@mntre.com)

Join our IRC channel **#mnt-amiga** on [irc.freenode.net](http://irc.freenode.net)

## Running ARM Software

ZZ9000 has two 32-bit ARM Cortex-A9 processor cores that run at 666 MHz. The system has access to 1 GB of DDR3 memory in total. A part of this memory is directly shared with the Amiga's chipset and 68000 family processor via the Zorro Bus. The Amiga RTG screens also occupy the same memory space, so both ARM and Amiga can draw pixels into graphics memory or read from it.

Normally, a mini operating system called ZZ9000OS is running on ARM Core 1, and ARM Core 2 is idle. ZZ9000OS has the following functions:

- Polls the Zorro bus in the FPGA fabric for events (writes, reads, or Amiga reset)
- Receives and transmits Ethernet packages
- Controls the DVI transmitter
- Controls the USB port (not yet active, planned for a future software update)
- Executes accelerated RTG drawing functions like fills and copies (scrolling)

You can run custom code on ARM Core 2 by loading it into a place in shared memory and asking ZZ9000OS to jump into the code. On the ZZ9000 website (<https://mntre.com/zz9000>) you can download example programs and a simple SDK for writing your own ARMv7 applications, as well as the sources for ZZ9000OS.

## Updating FPGA Firmware and ZZ9000OS

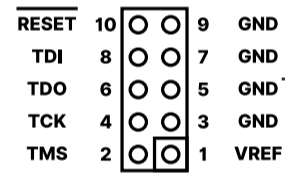
Development of ZZ9000 has taken almost two years, and it was our priority to get the hardware into your hands as soon as possible while delivering a good feature set to begin with. But ZZ9000 is highly extensible and open source. In addition to us delivering new features for the card, we believe that the hackers and makers among you will come up with fantastic new software and ideas to run on ZZ9000.

The ZYNQ on ZZ9000 normally boots from the inserted MicroSD card. This card needs to be MBR partitioned and FAT32 formatted. The system looks for a file called BOOT.bin which contains the ZYNQ FSBL (first stage boot loader) that in turn loads the FPGA image and ZZ9000OS (in ELF format). To update the card, you simply have to replace the BOOT.bin file with a new one.

ARM Address	Amiga Address*	Area
\$0010_0000	N/A	DDR3 Start, ZZ9000OS Code
N/A	\$0000_0000	ZZ9000 ARM Registers
N/A	\$0000_1000	ZZ9000 FPGA Registers
N/A	\$0000_2000	Ethernet Buffers / Scratch Space
\$0020_0000	\$0001_0000	Framebuffer Memory Start
\$005F_0000	\$0040_0000	Zorro 2 Accessible Space End (4 MB)
\$0300_0000	\$02E1_0000**	ARM Application and General Purpose Shared Space Start
\$101F_0000	\$1000_0000	Zorro 3 Accessible Space End (256 MB)
\$4010_0000	N/A	DDR3 End (1 GB)

\*Relative to card address

\*\*Currently unreachable on Zorro 2 machines, update coming



### Jumpers and Headers

**J1: JTAG.** You can debug and reprogram both FPGA and ARM through JTAG via a Xilinx Platform Cable or similar and using free Xilinx Vivado Webpack software.

**J4: Interrupt select.** Connects either Amiga interrupt INT2 or INT6 to the FPGA. Leave the jumper on INT6 to use Ethernet.

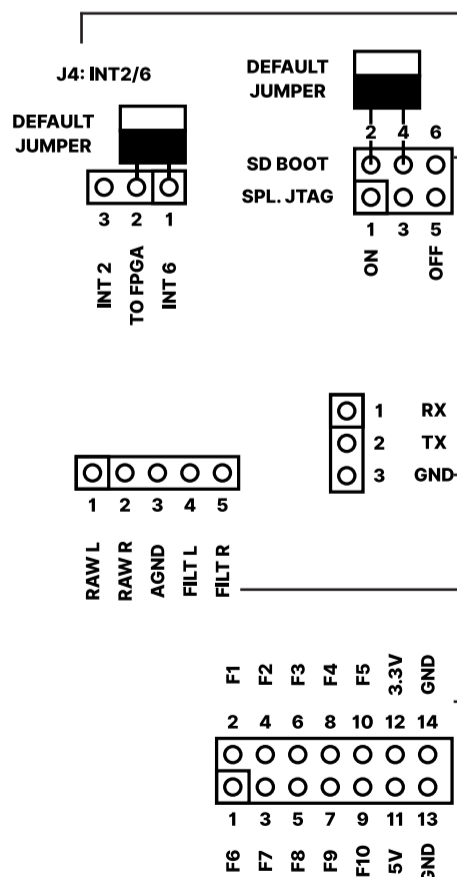
**J13: Boot select.** 2+4 = Boot from MicroSD card. This is the default and should normally not be changed. If you remove this jumper, the system will boot from a small QSPI flash ROM on the ZYNQ module. A minimal Linux distribution is installed for testing. Don't do this with ZZ9000 inside of your Amiga, because the I/O pins of the FPGA won't be configured without a correct boot image.

**J12: UART.** Connect a USB-to-UART cable to RX, TX and GND pins (115200 baud) to see ZZ9000's debug output.

**J6: Audio.** Breaks out the raw and filtered audio signals of the video slot for use in future sound expansions.

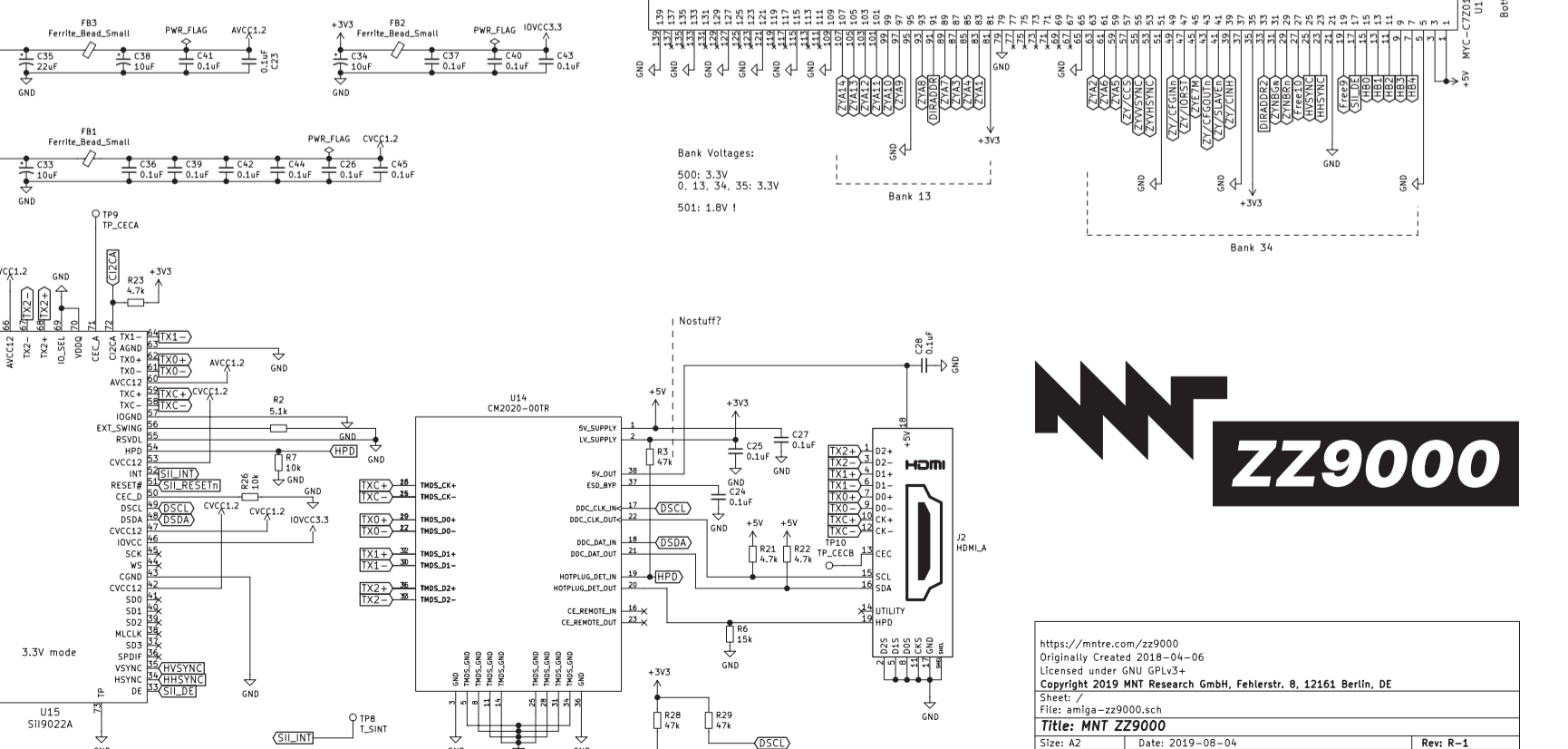
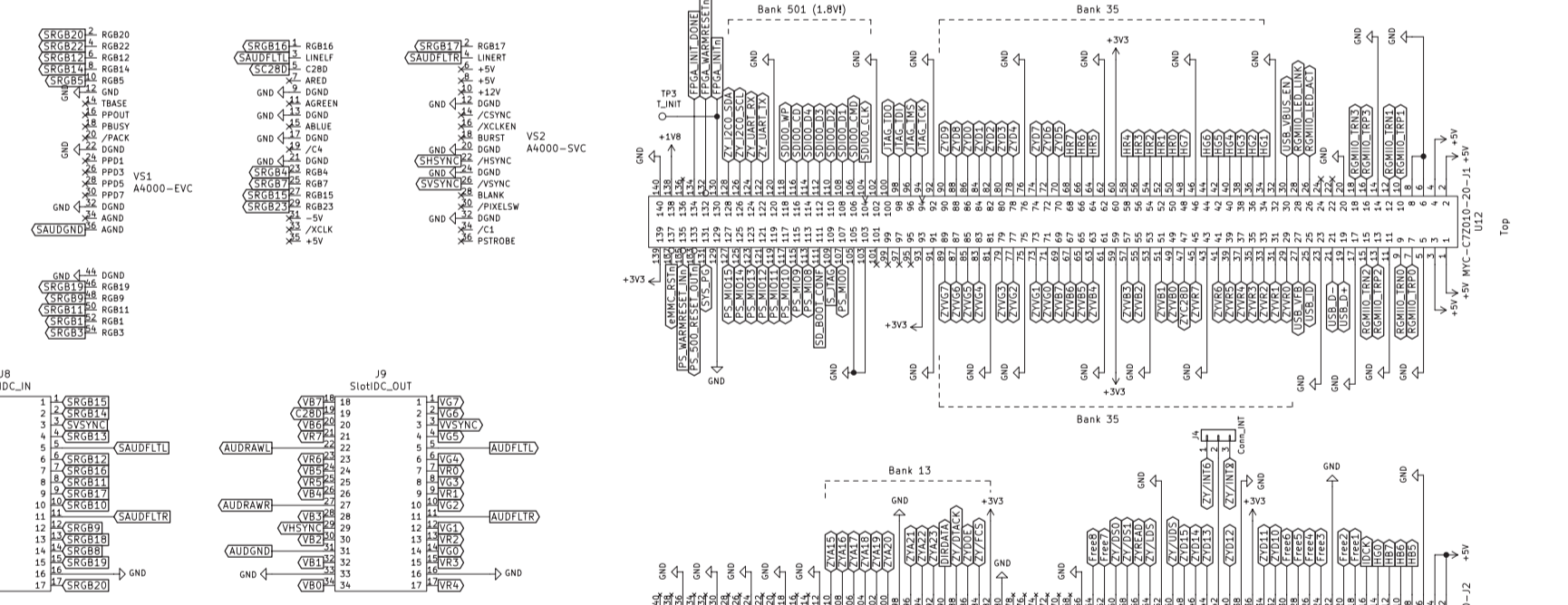
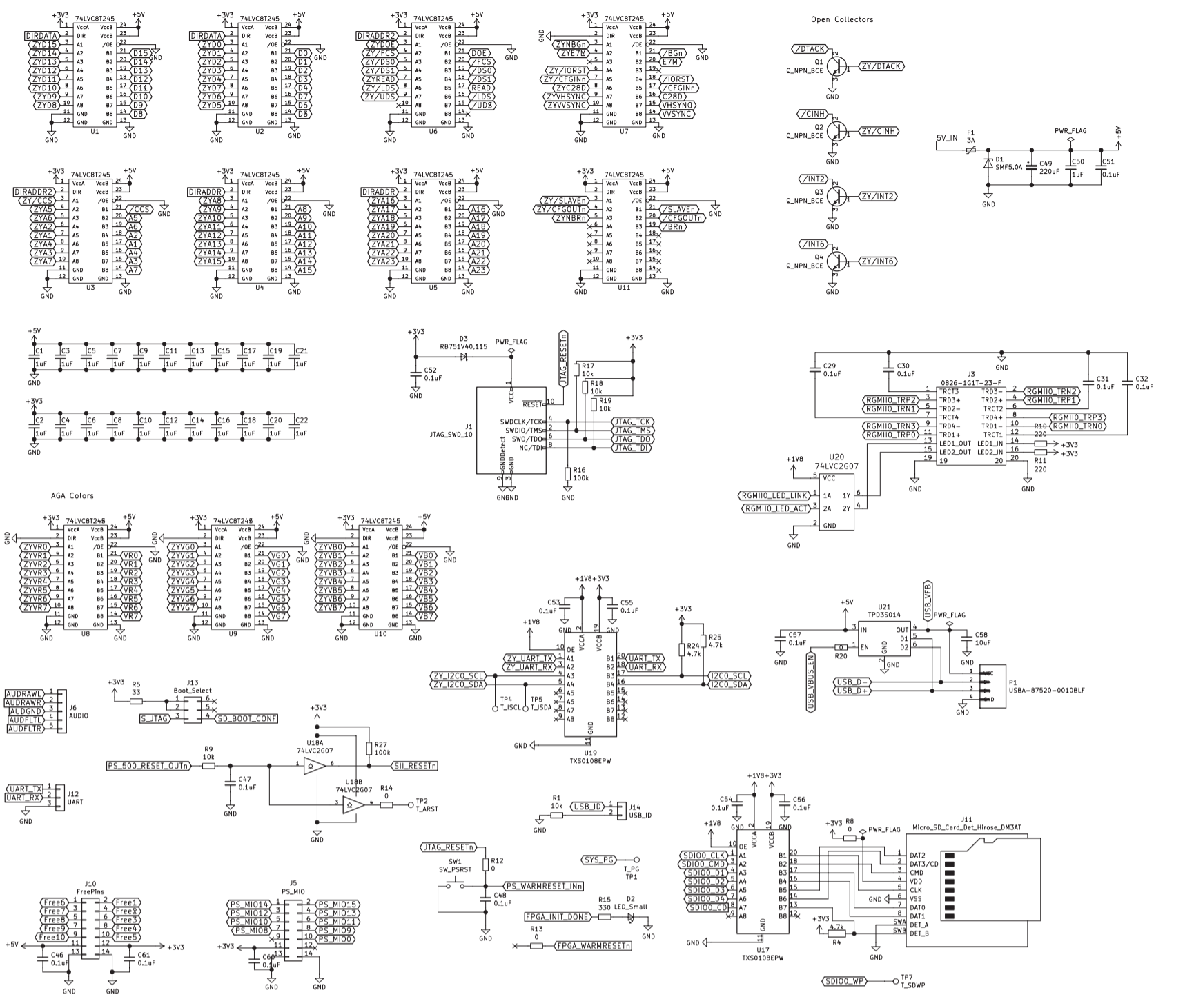
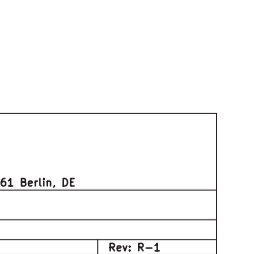
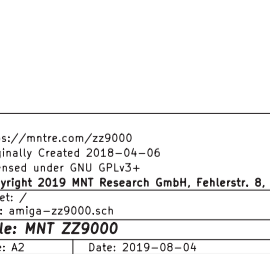
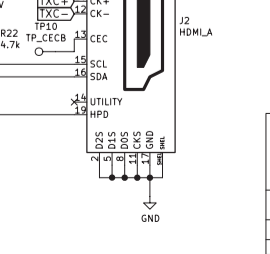
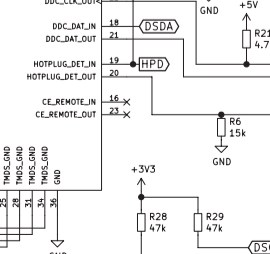
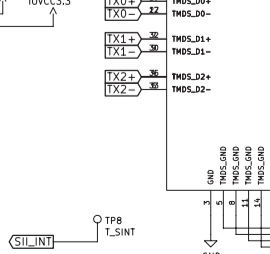
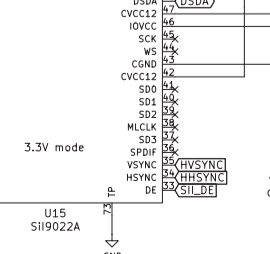
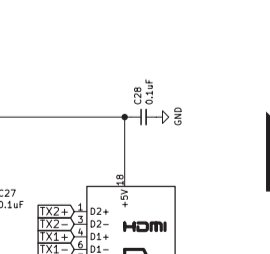
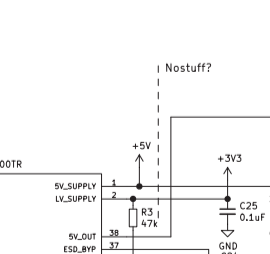
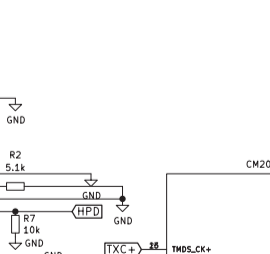
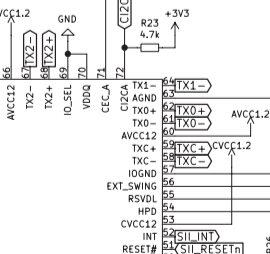
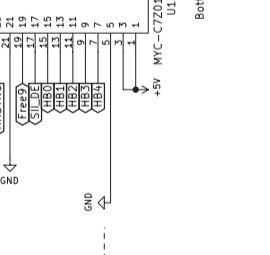
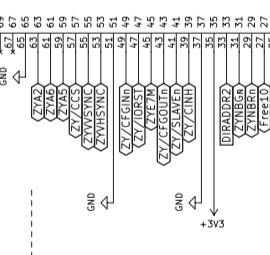
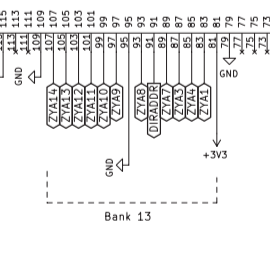
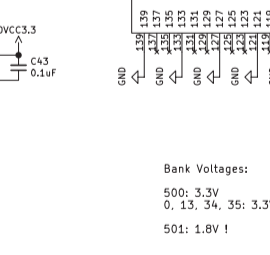
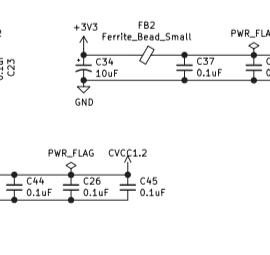
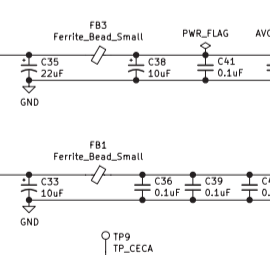
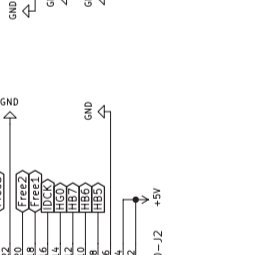
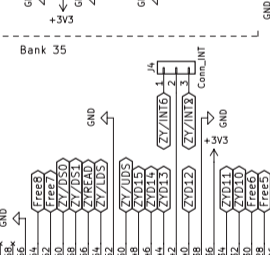
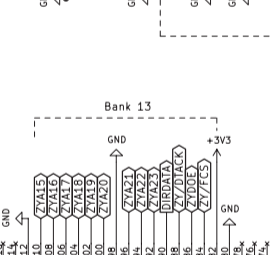
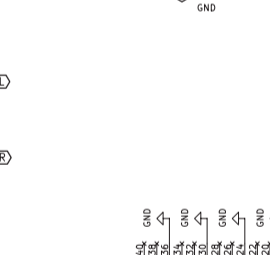
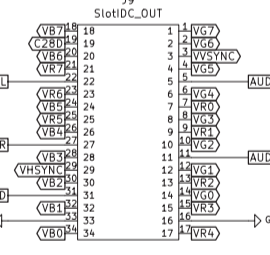
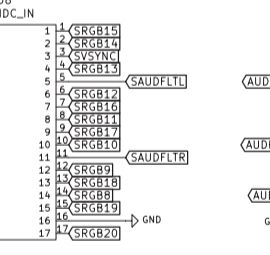
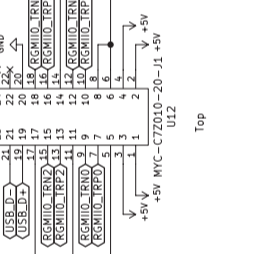
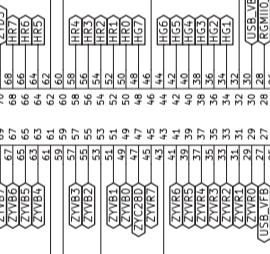
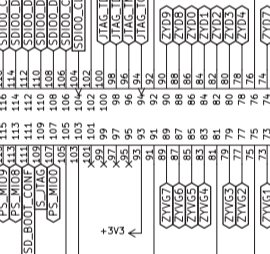
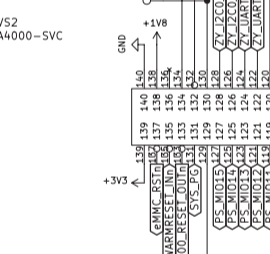
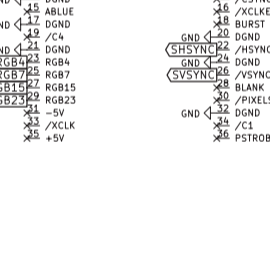
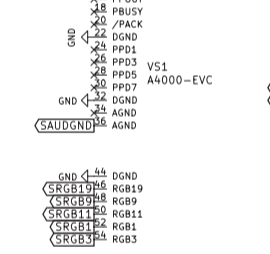
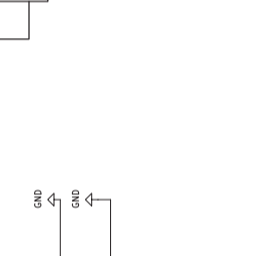
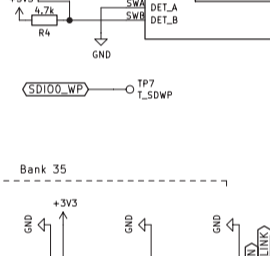
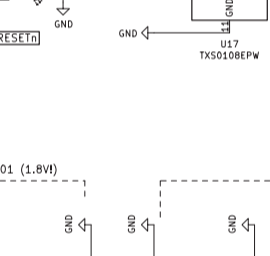
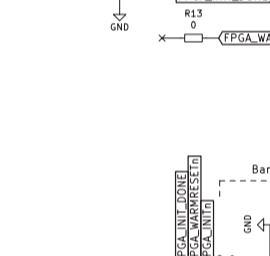
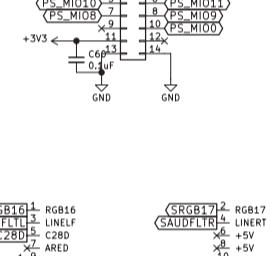
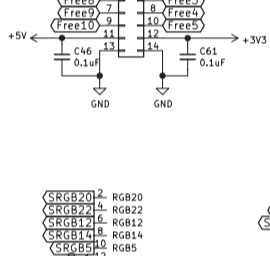
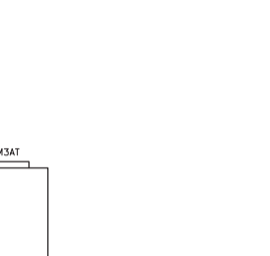
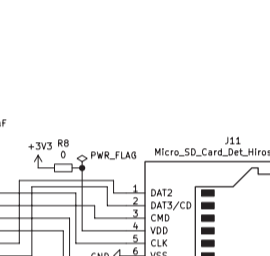
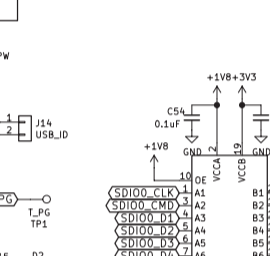
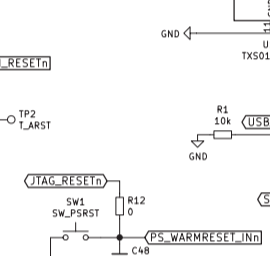
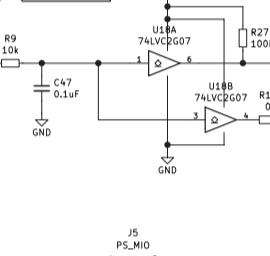
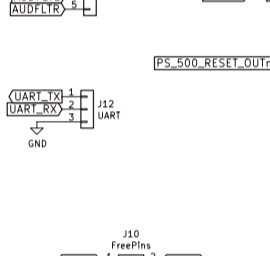
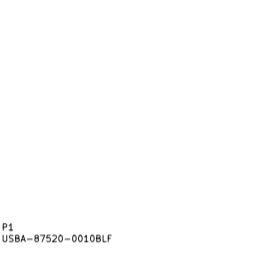
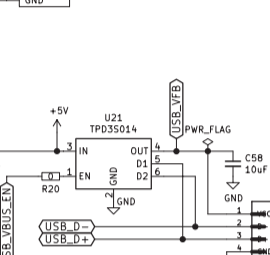
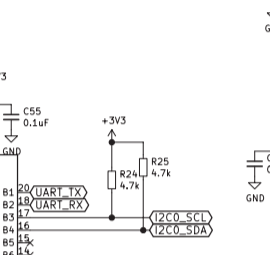
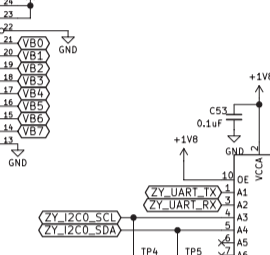
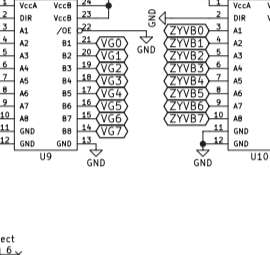
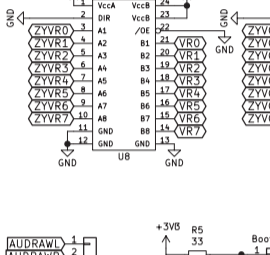
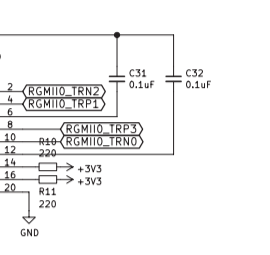
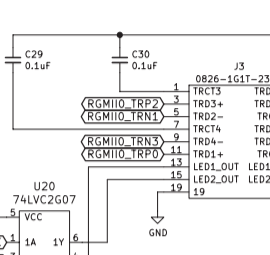
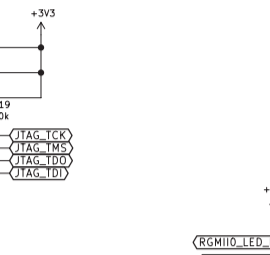
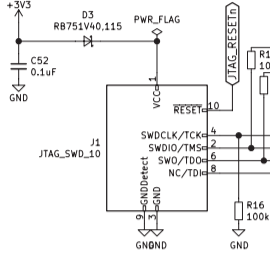
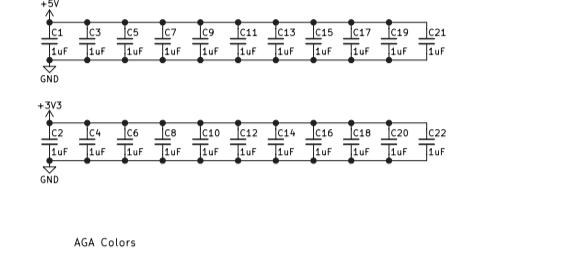
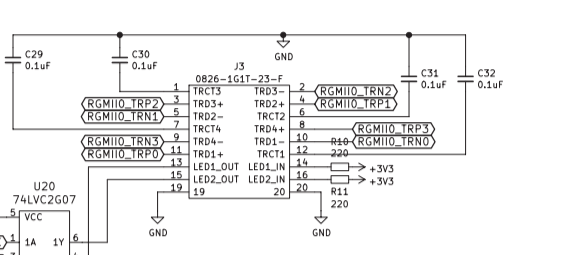
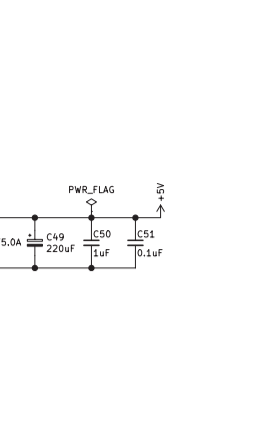
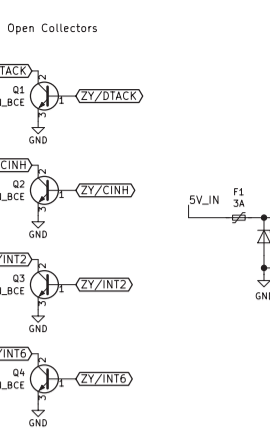
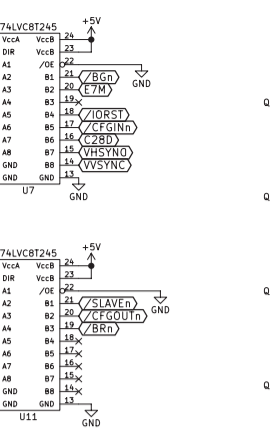
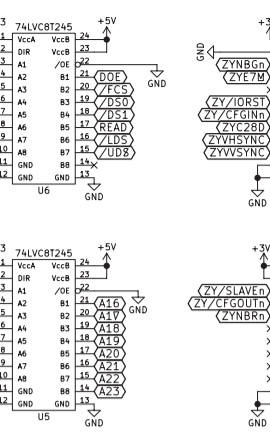
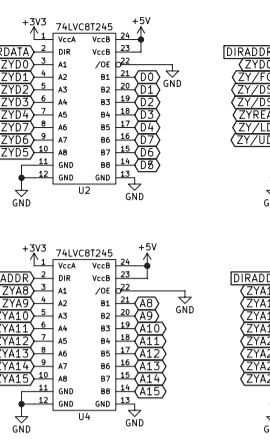
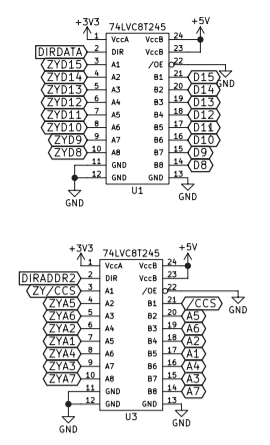
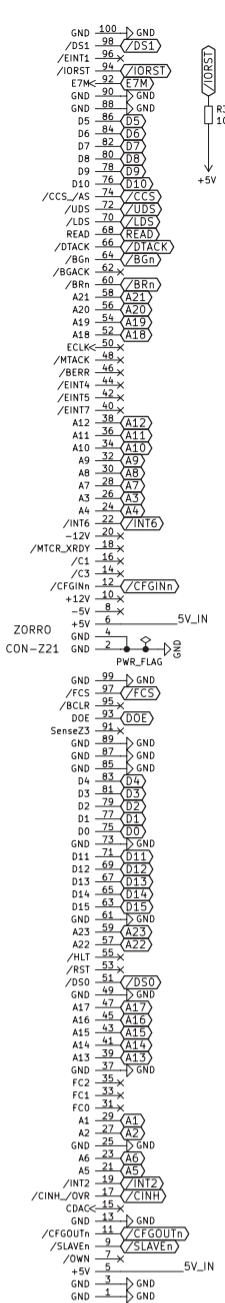
**J10: FPGA Expansion.** 10 additional unused FPGA inputs/outputs for later use.

**J5: MIO.** Breaks out 8 unused ZYNQ MIO pins. Reserved for later use, not shown here.



Your unique Ethernet MAC address is:  
**68:82:F2:00:01:XX**

MAC addresses for ZZ9000 are sponsored by grandcentrix. Visit <https://grandcentrix.team> for exciting career opportunities.



<https://mntre.com/zz9000>  
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 Copyright 2019 MNT Research GmbH, Fehlerstr. 8, 12161 Berlin, DE  
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