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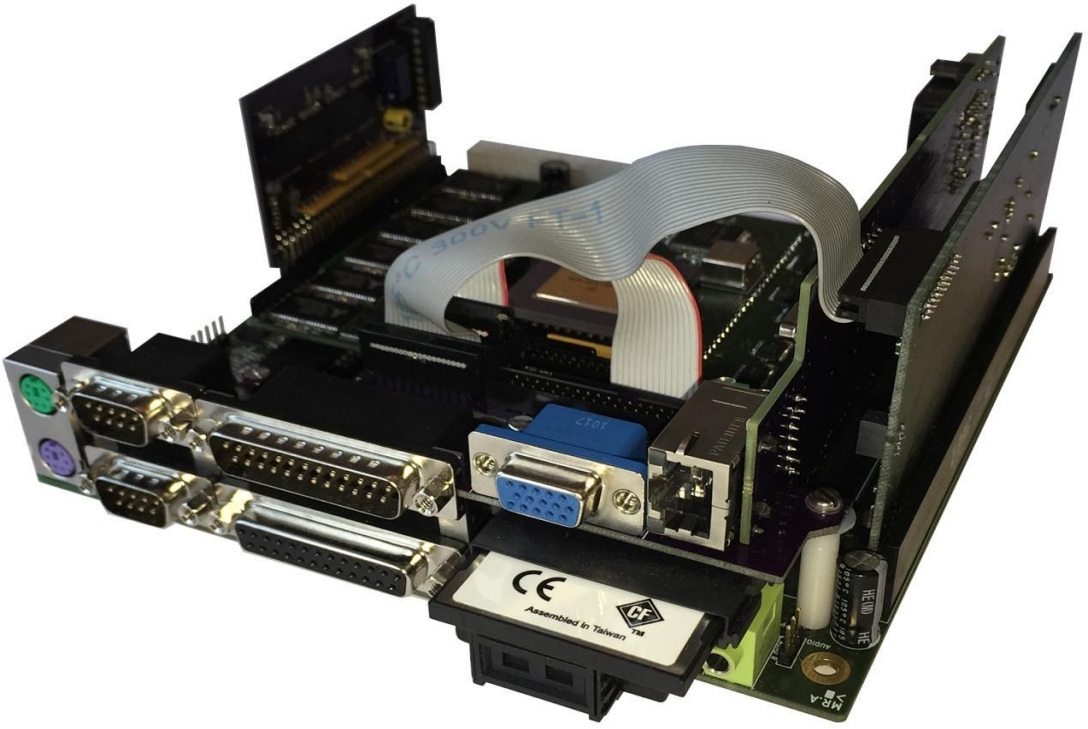
# Amy

## *'Spellbound'*

*"A brilliant design, and perfect use of the original components in a Modern Classic" - **Earlybird enthusiast***

*"I LOVE the Amy, I want one!" - **Dave Haynie***



# About Amy

Amy Spellbound is a re-engineered and highly optimized Small Form Factor motherboard based on the original Classic Amiga(™) computer by Commodore(™).

With a footprint of only 170x170 mm (standard Mini-ITX) she manages to deliver not only superior compatibility with the original system and software but also throw in a couple of much appreciated extras. Created by true Amiga enthusiasts, much care has been taken to keep the “spirit” of the Classic Computer while integrating the extra features into the design. Amy's core logic is **not** based on *emulation* or *re-programmable gate arrays (FPGA)* to mimic the original hardware. Instead it’s creator decided to base the system on the ***actual custom chips*** from CBM. This allows for superior compatibility not to mention a Classic look and genuine feeling of our beloved 80’s home computer.

# Introduction

Let us start with the obvious question – **why** design yet another Amiga clone?

First off – Amy is not really a clone. She is a completely re-engineered and re-designed home computer system based on a few (yet critical) legacy components. This design make her very compatible with existing software and hardware from the first and second generation of Commodore Amiga computers. Obviously this was no accident. A huge amount of excellent products already exist for this platform. Many excellent games and applications are still well worth spending hours playing and working with. We’re also proud to be part of a vibrant and friendly community, full of great ideas, passion and inspiration.

So the question should really be – **Why not** design a modern and flexible Amiga compatible system?

The idea was to create a design as simple and flexible as possible. To allow enthusiasts to build their own computer from a bare PCB. Since the start Amy has undergone a few major design changes over the past 5 years. Initially she was based on semi-ATX dimensions and 99% through hole components. Which made the board very easy to assemble. After that came a smaller Mini-ITX version, still with through hole components. This design was still pretty easy to assemble, but due to the smaller size and complexity of keeping a through hole design the cost was just

to high for volume production. Finally after countless hours of hard work came the first 2-layer, Mini-ITX motherboard based on SMD support components. Of course the original custom chips are still through hole. But the rest are modern, easy obtainable and relatively cheap surface mounted components. Today (rev. 1.8) Amy is a **very** sleek, optimized and compatible 4-layer **high quality** motherboard capable of running most, if not all software compatible with AmigaOS 1.x to 3.x.

# At a glance

- Original custom chips by CBM (OCS and ECS supported)
- Elegant Mini-ITX design with standard 24-pin ATX power supply connector
- 2x Zorro II compatible expansion slots
- Standard 56-pin expansion header (A500 Chip RAM & RTC. Custom board included in package (*****Original A500 Trapdoor expansions is NOT supported and might damage your system******)
- Support for Amiga and PC keyboard and scroll wheel mouse. DB9 and PS/2.
- Support for standard Amiga high/double density floppy drives
- Standard DB25 serial and parallel ports
- Space optimized A/V output supporting both OCS/ECS, SCART RGB and stereo sound in a single DB15 connector (*cable not included in kit*)
- External standard 3.5 mm Stereo audio jack as well as internal AC'97 header (*only one port active at any one time*)

# Build guide

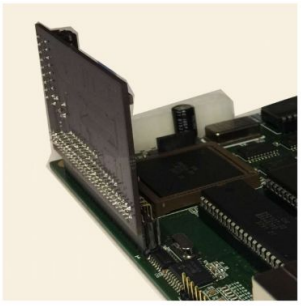
Start assembling your Amy in the following steps to be as efficient as possible.

## Chip RAM board

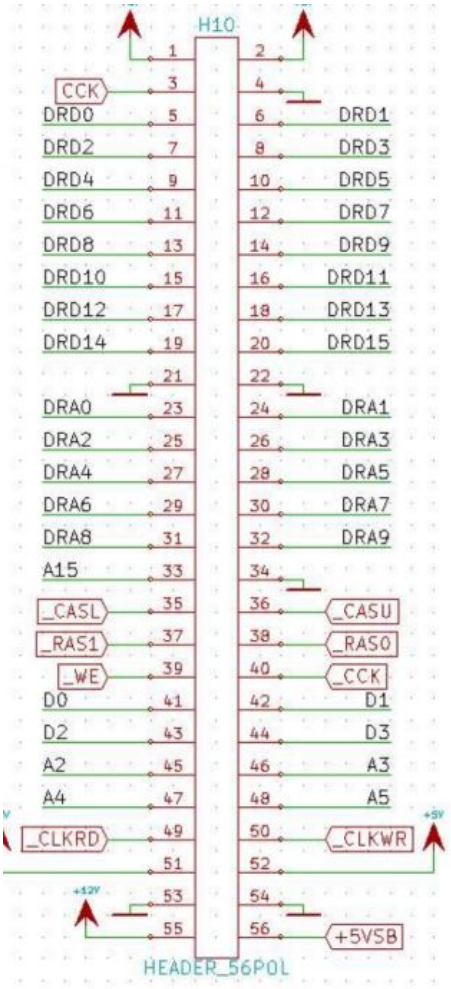
1. Start with small components, i.e. 0603 capacitors (C1, C2, etc.)
2. Then take the smaller SMD IC's as long as they're not in the way of anything else.
3. Then solder the DRAM capsules - ***** These are very sensitive for ESD and heat, so take care! *****
4. Then take the rest of the SMDs
5. And lastly all through hole components.

Please note that the female connector H1 (Wurth 613064243121) has to be manually and carefully cut to 56 pins or use a "Samtec SSW-128-02-G-D-RA" as suggested by @rlake.

It is extremely important that the Chip RAM card is mounted correctly. There is no "key" on the connector - so **please** make sure the pins align and the card is mounted the right way. (Chip RAM card on the pictures may differ from the final version)



*(**IMPORTANT!!**) Correctly mounted CHIP RAM card*



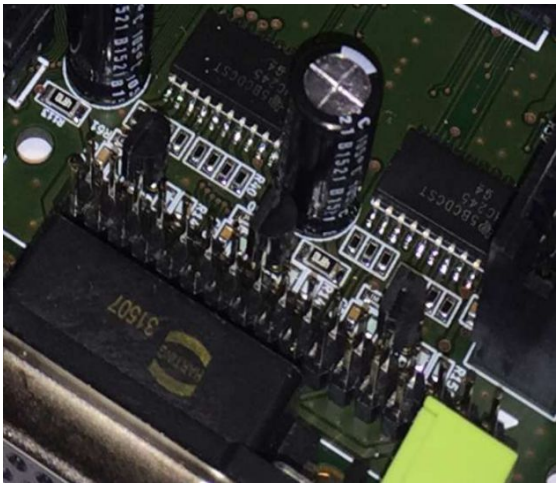
The Chip RAM card is equipped with 2Mb memory, RTC chip (MSM6242B) and a super capacitor backup to keep time when disconnected from AC power. The RTC and backup capacitor is “optional” if correct time is not required by the user. The Murata (TZ03P450F169B00) capacitor is used to adjust the time in detail. Should your system skew over time this is how to fix it. It can be replaced with a static capacitor, but then clock skew adjustment is not possible.

A minimal working system requires the Amy Spellbound motherboard and a CHIP-MEM card.

# Main board

Assembling Amy is possible without expensive equipment like hot air rework stations or PCB ovens. All you really need is patience and a steady hand. However if you’ve never used a soldering iron before you should really spend a few days or even weeks practising on some old broken hardware to make sure you get the feel for it. YouTube is full of really good soldering courses, take a look at the EEVblog (#189) for inspiration.

As with the Chip RAM card, start with the smaller SMD components. Capacitors, resistors and diodes.
Followed by all SMD ICs.
Now do through hole sockets and connectors.
Hold off with the following (Amy will start without them and testing without them makes it easier to find potential errors): CN4, CN5, CN6,
H2-H5 and H8.
Now mount Q5, Q6 and Q7 **as close to the motherboard as possible.** Make sure you get the alignment right!



If possible start off by powering Amy with a lab PSU with current limitation to avoid unnecessary damage if anything shorts out. Amy should run fine with just 5V connected (here you’ll have to manually do the power up reset)

## Microcontrollers

The motherboard has three microcontrollers that carries out different functions. One controls the mouse, one for keyboard support and the third (U21) is responsible for the following:

- Power-on reset
- ROM-bank switching - with the 27C800 (or larger) EPROM the reset switch can be used to switch between 1.3 and 3.1 for instance. Hold RESET while POWER on to switch.
- Floppy drive disable - If no floppy drive is connected this MCU will tell AmigaOS that a drive is connected but no floppy is inserted. This avoids the boot delay and an annoying icon on Workbench desktop. ** If a floppy drive is added later power **must** be removed (disconnect the AC cable) to correctly identify the drive. **
- Keyboard support.
- chassis buttons.

Please see a separate document for instructions on programming these microcontrollers.

# Obsolete components

As expected Amy requires a few obsolete components. Eight to be exact.

| | |
|---|---|
| **MC68000 DIP64** | **MOS8373 (ECS) recommended OR MOS8362 (OCS)** |
| **MOS8375** | **MOS8520 PLCC44** |
| **MOS5719** | **XTAL OSCILLATOR 28.37516MHz** |
| **MOS8364** | **ROM (or combo ROM in 27C800, 27C400, 27C160)** |

Important to note is that **the 8375 Agnus always is required** for Amy to function correctly!

The following p/n have been tested and verified: **318069-10, 390544-01, 390544-02**
The following haven't been tested by us but should work: *318069-11, 318069-18, 318069-19*.
Please report any inconsistencies to us!

## An important note on **XC1** and **XR1**

XC1 and XR1 are crucial components that should _only_ be mounted when required. An extensive explanation on this will be updated later, for now please consult the following diagram.

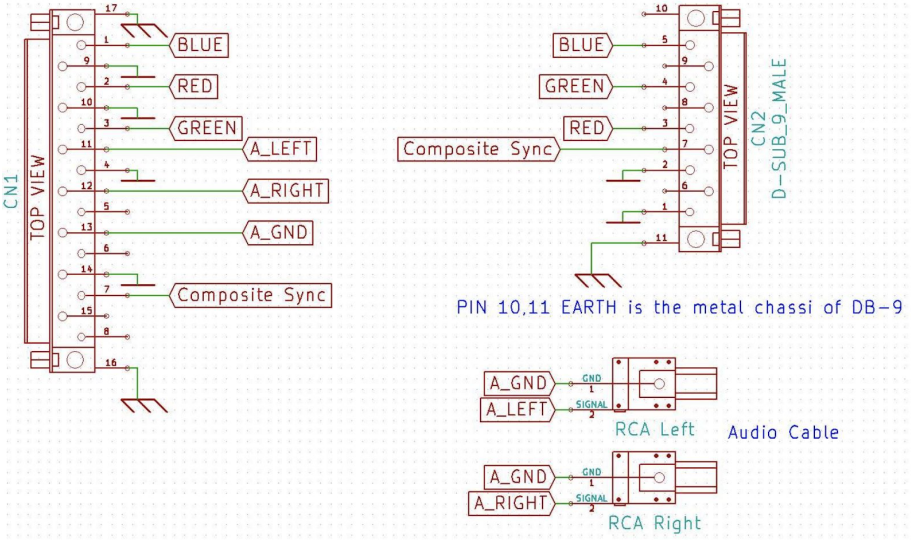
| IC Part number | Component to mount |
|---|---|
| Agnus 8375 **318069-10** | XC1 = 0.22uF |
| Agnus 8375 **390544-01** | XC1 = **leave empty** |
| Compatibility issues with old Zorro-cards | XR1 = (ALSO REMOVE R(?))!! |
| Most cases | XR1 = **leave empty** |

**IMPORTANT!** Please be aware that there are some bugs in the original Commodore IC's. To be 100% sure your components will work in Amy - **first make sure the combination of chips works in an original Amiga!** Simply scavenging ebay for chips might produce strange results. The simplest and best solution is to use a complete set of IC's from an old A500+ and get the PLCC44 IC from an A600/A4000 or as NOS/used part.

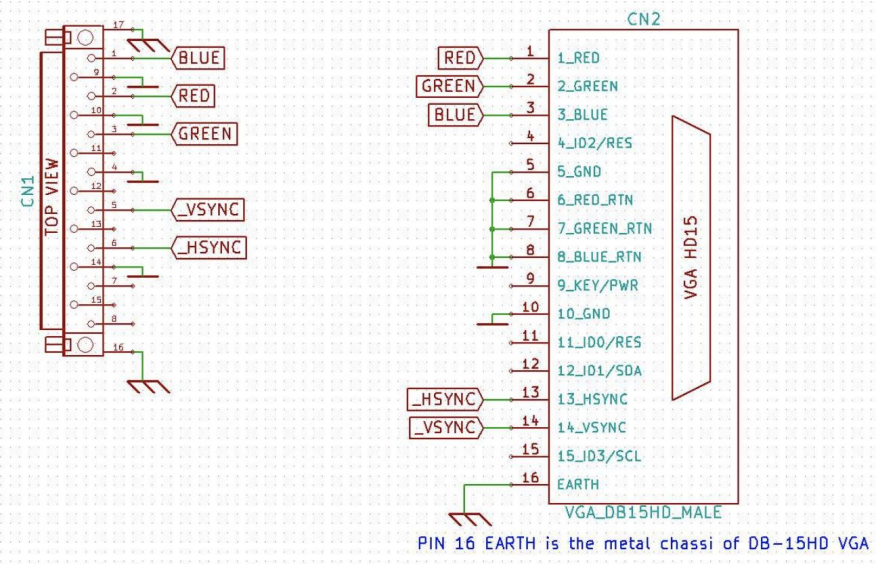
# Audio / Video port

This is a custom connector and a simple 'straight through' cable needs to be assembled. Since the DB15 connector on Amy contains all the signals for RGB and L/R Audio it can either be used with a standard VGA connector or DB9 as found on older Commodore monitors like the 1084S or Philips 8833-II. Obviously Amy does not contain a scandoubler - so any VGA monitor has to be able to handle 15 kHz / 50 Hz signals. Scandoublers like the Indivision ECS works fine with Amy.

## Amy to RGB-monitor cable



# Amy to VGA-monitor cable

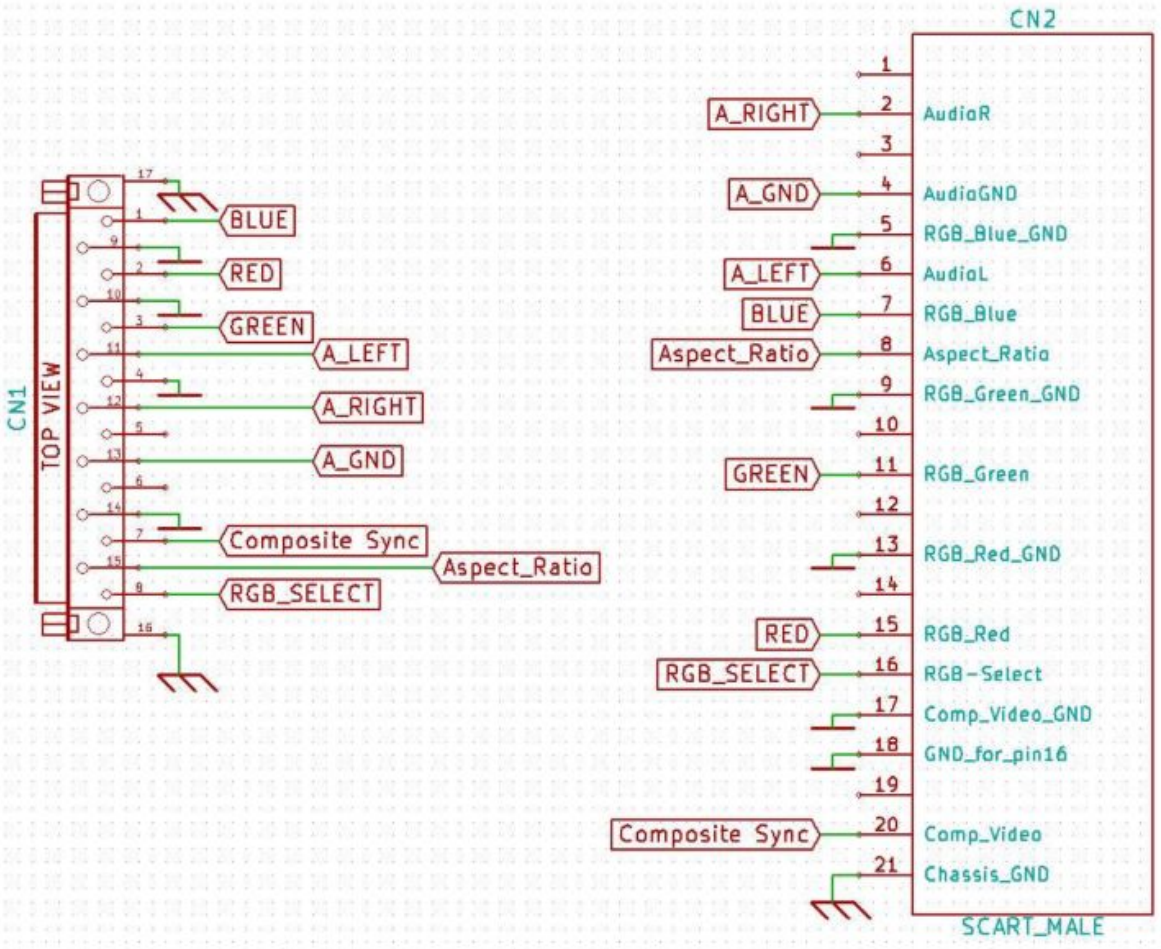



The finished cable(s) can look like this.

*Assembled Amy DB15 to VGA / Amiga DB9/Audio cables.*

# Amy to SCART cable

The RGB signals are of course suited for SCART as well. In case you wish to connect your Amy to a TV with SCART (or some older C=1084) please use the diagram below. If you're using a cable with separate and dedicated GND, please connect it to GND as close as possible to the corresponding signal. Unlike an original Amiga from Commodore, Amy s AV port *contains* the SCART activation signal. So no extra components are needed in the cable. Please be aware that Amy does **not** produce a composite video signal. So putting a composite adapter on the SCART cable will not give video output.




# Power and PSU

Amy utilizes a 24-pin standard ATX power connector (20-pin works fine). So basically *any* standard PC PSU will do the trick. However do take care when it comes to ultra cheap power supplies and low end “Pico PSUs”. Some are missing the -12V which affects Amy’s audio quality, and more often than not is the 5V rail too weak. Despite Amy’s very modest power consumption.

## Minimal power requirements

The following **minimal currents are required** for Amy to run properly. Additional accessories like mechanical hard drives, CPU accelerators or ZorroII cards will of course raise the bar substantially. So please don’t be cheap in the worst possible place. Get a quality PSU for your Amy system.

| | |
|---|---|
| **3.3V** | *not used* |
| **+5V** | **2A** |
| **+12V** | **350mA** |
| **-12V** | **40mA** |

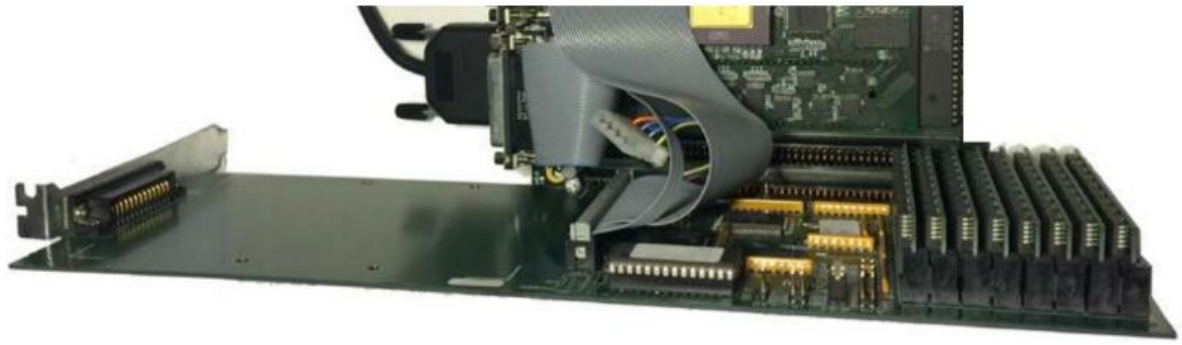
# Compatibility

Just a few quick words on compatibility. Since Amy isn't an exact match to any of the existing Amiga models (it's closest sibling would be the Amiga 500+) we cannot guarantee 100% hardware or software compatibility. Having said that we would like to think that Amy is **the** most Amiga-compatible "post Commodore/Escom" design made to date. In the same way an application, game or demo might have issues with RTG in an A2000 - the same application will have issues on Amy.

Most (all?) well designed CPU cards that connects to the 68000 socket in the A500(+) AND A2000 should work with Amy. However, we've only tested the VXL30, Vampire V2 V500+ as well as our own "A-Turbo 030" accelerator. Other accessories that connects to chip sockets like Indivision ECS should also work as expected.

## Regarding DMA ZorroII cards

Since Amy lacks a Bus Master controller chip - **only one** DMA enabled expansion card is supported. Using two SCSI-cards for example *might* work at any one instance - but strange things **will happen.** And you will probably damage your data on the drives this way.
On the other hand, combining for instance a RTG card with a network card or IDE/SCSI card will work fine.



*A GVP Impact A2000-HC+8 Series II card works but isn't very practical :)*

# Jumpers and Pinouts

A few of the Amy specific features can be configured with jumpers. Below you will find the different settings possible. We also provide easy access to the the most useful signals that's required on some IDE-cards that connects to the CPU-socket, etc.

_TURBOCFG = This is the [autoconfig] signal “first in line”. This allows any expansion in the CPU-slot to autoconfigure before any ZorroII card.

JP1 and JP2 is used to configure the on board microcontroller for utilizing different keyboards and mice (PS/Amiga).

PC-keyboard:

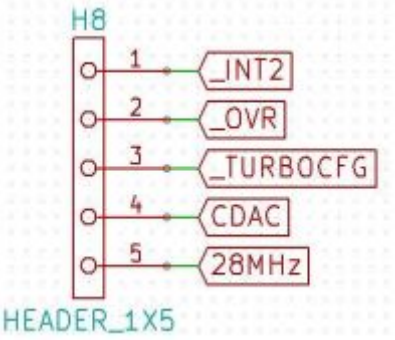
| | |
|---|---|
| JP1 | 1-2 |
| JP2 | 1-2 |

Amiga-keyboard:

| | |
|---|---|
| JP1 | 2-3 |
| JP2 | 2-3 |

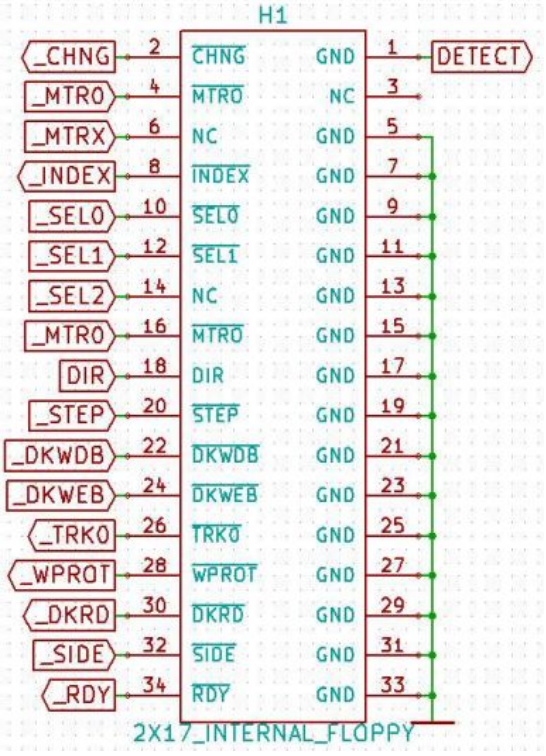
## Configuration signals

There’s also a custom pin array (**H8**) with very important functions if you want to expand your Amy system with accessories that require the _INT2 or _OVR signals.



# Floppy connector features

Another useful feature is the extra signals connected to NC pins on the floppy drive connector (**H1**). It's the _MTRX & _SEL2 signals that will allow your system to both have an internal floppy (DF0:) as well as maximum supported external ones (DF1-DF*n*).



# Troubleshooting

| | |
|---|---|
| Starts but chassis buttons acts strange | Control the FUSE-bits in U21 (ATTINY24A) |
| Starts and initiates floppy but no image | Check Q5, Q6, Q7 and U11, U12 |
| Won't start and current limit on PSU is activated | Probably a short somewhere. Check all solder joints closely. |
| Works but audio is bad | Check your PSU for +12V and -12V |
| Starts but shows a GREEN image | Check CHIP-ram card and the DRAM chips |
| Starts but shows a GREY image | Check all pull-up resistors |

## Contact and community support

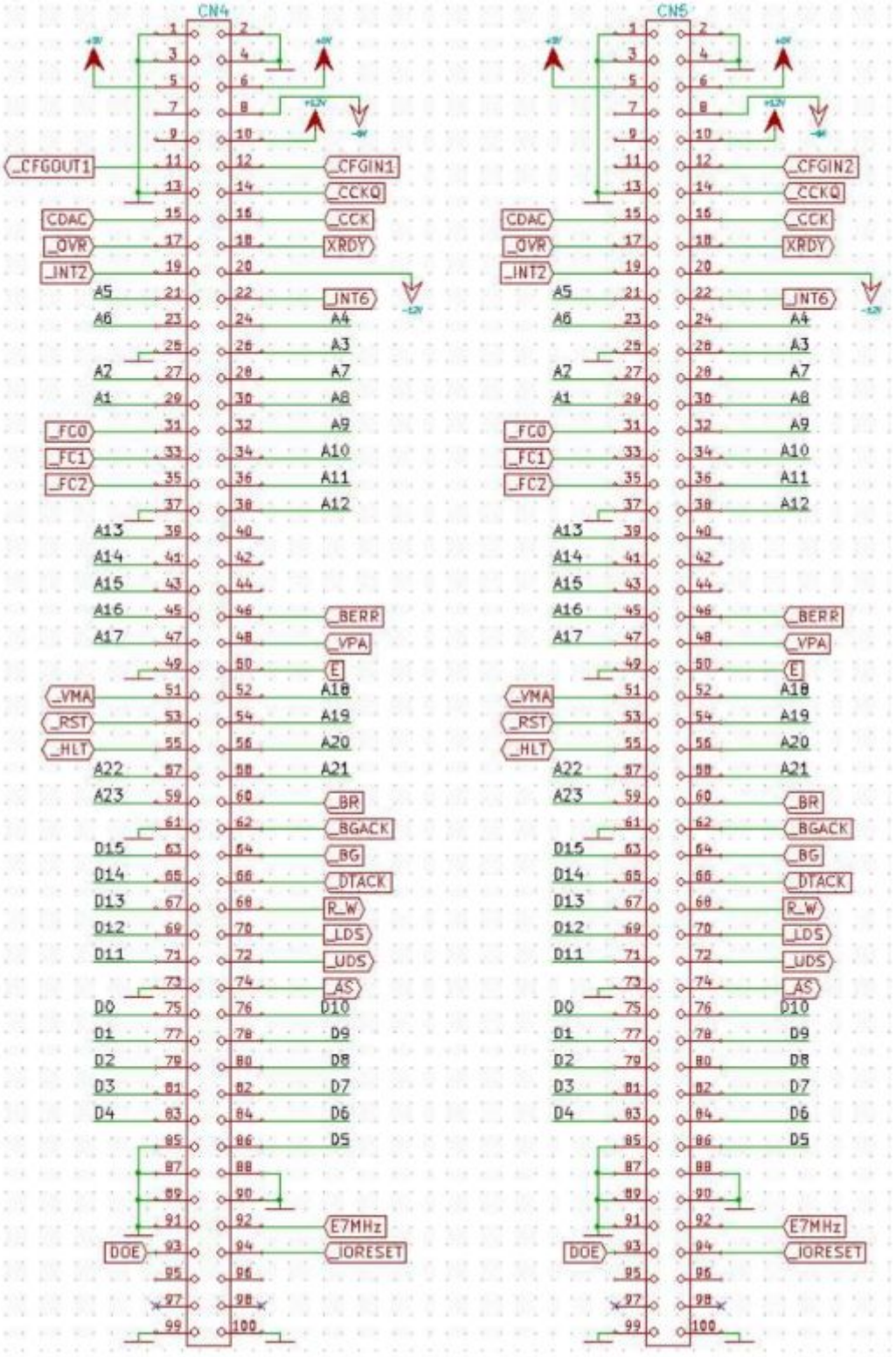
For further information and online resources please check www.amy-itx.com and register at www.amigaos.se to gain access to our private community support forums.
This document will probably be updated continuously, so please make sure you're looking at the latest available online version, since critical corrections might be made without notice.

## DISCLAIMER

*No one affiliated with this project can be held accountable for any form of damage to equipment or individuals as a consequence of assembling or using the hardware provided. The Amy Spellbound & Friends PCBs are designed and tested by professional and experienced hardware engineers. But as a Do It Yourself (DIY) platform we cannot and will not provide any form of warranty regardless of cause. Please be aware of this and respect our privacy and limited resources to get involved in support cases.*

# Appendix A

100-pos ZorroII Compatible Card Edge connectors pinout.



# Document history

| **Date** | **Changes** | **Author** |
|---|---|---|
| 2018-06-08 | First rev | shoe |
| 2018-06-13 | Corrected VGA-cable schematics and minor corrections. Name change to ‘Amy Spellbound’ since the -ITX is misleading (Amys a MINI-ITX board, not “ITX”.) Also added this history. | shoe |
| 2018-06-18 | Corrections as suggested by @rlake on Safir | shoe |
| 2018-08-03 | Fixed SCART pinout picture | shoe |
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