Atari
Coldfire
Project

Specifications / technical Information, Version 1.2, 15th of May 2009

Technical Background about the planned ColdFire-Computer

- Processor: Coldfire MCF5474, 266 MHz, 400 MIPS
- RAM: DDR, 512 MB Main- + 128 MB dedicated Ram for Video and special tasks on Board, Speed: 1 GB/s
- SRAM 512 kB, for DSP and other tasks, 200 MB/sec
- Flash: 8 MB on Board for Operating Systems
- Operating system: TOS 3.06
- Atari compatible interface ports:
  - Falcon-IDE,
  - ST/TT-Floppy
  - TT-SCSI (but faster),
  - ACSI
  - ROM-Port: 2 x 2 mm Connector
  - Printer,
  - ST/TT-serial,
  - Midi,
  - ST-Sound over AC'97
  - ST/TT/Falcon-Video
  - Atari-Keyboard with Mouse
- Other Ports:
  - Ethernet 10/100, 1 Port
  - USB 2.0 Host (ISP1563), 4 Ports
  - Compact-Flash, 1 Port
  - SD-Card, 1 Port
  - AC'97 Stereo Codec with DMA-Sound Output and 48 kHz Sampling Input
  - Sound-Connectors: LineIn, LineOut, Mic (Mono); DVD/CD internal
  - Video Modes: about 2 MegaPixel, true color
  - PS2 Mouse/ Keyboard Port
- Battery Powered (optional)
- PCI 33 MHz direct Edge for passive backplane
- Power controller with real time clock, PIC18F46K20
- Expansion Socket: 60 Contact SPI, serial synchronous or asynchronous approximately 33 Mbaud, 26 bit I/O approximately 133MHz, I^2C Bus
- Already planned extensions for the future: Falcon DSP running in the FPGA
- Format: Card 90 mm x 260 mm x 20 mm
- Power consumption 3–5 Watt

- **Processor: Freescale ColdFire MCF5474, 266 MHz,400 MIPS**

The Freescale ColdFire is the successor to the original 68k Motorola processor. The instruction set is a subset of the 68k-instruction set, which only slightly differs from it. Important software components for use of the ColdFire are already at our disposal, for example GCC, MiNT and a patched TOS. For those instructions which are treated differently than with the 68k, we need to consider possibilities for conversion.

The ColdFire V4e supports standard equipment as DDR-RAM, PCI, Ethernet, etc. Another great advantage is that the processors are available at a favourable price! Further it should be possible to compile programs that run directly on both the ColdFire and original Atari machines. We expect each clean GEM-Application to run on the ColdFire right from the beginning. Beyond that, we hope to let any Atari program run on the computer. Both Fredi Aschwanden and Wolfgang Förster are convinced of the fact that it will be more compatible than the Hades right from the start.

With sufficiently large demand also an MCF5484 with 200 MHz and CAN bus could be used. The ColdFire under a full load capacity should require less than 1.5 Watts!

- **FPGA Altera Cyclone III EP3C40**

The Field Programmable gate array (FPGA) represents the second heart of the new computer. An FPGA is a modifiable logic component, in which through ("software" -) configurations highly complex circuits can be formed. The functionality of the FPGA is specified in VHDL. In this way functions can be created for which there are no chips, and chips which are no longer available can be copied. Thus we will use for example many VHDL descriptions of the original Atari chips of the Suska project. On the other hand the FPGA makes it possible also to have the video on board. Parts of our team are already working to configure the 56001 DSP in VHDL in order to come closer to the goal of Falcon-compatibility. However, we can't promise any fast development here!

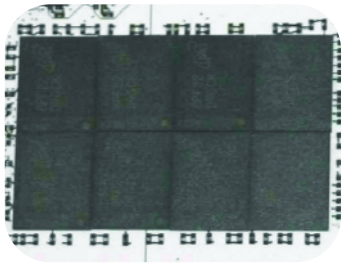
Ideally we can also implement an ST-compatibility-mode and offer the Motorola 68000 processor in the FPGA, for example for old Atari games and such things, since we are cooperating closely with the developers of the Suska board. Whoever is just looking for a replacement for their beloved ST and doesn't need large applications is better served with the Suska board though.

We decided to equip the computers with the "bigger" FPGA which has 40000 gates (instead of 16000) and offers enough free space for future developments. A graphics card, all Atari custom chips and the 56001 DSP use the 16k gates already. If yet another 68030-Processor or something similar should also find its way into the

FPGA, it would become tight. This FPGA alone costs approximately 100 Euros, but it leaves much development clearance for the future, for example for DVD decoders, further DSPs, parallel systems etc.

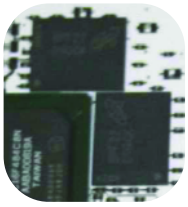
The best thing about FPGAs is: they can be configured while working, which will presumably please the demo scene. For us this offers the possibility to make "Hardware" updates available free of charge in the future by software.

- **RAM: DDR, 512 MB (8 chips 32 M x 16 bit)**



The main memory will be onboard. On the one hand because 32 bit DDR-RAMs are not available in the retail trade, on the other hand because of electrical conditions, and last but not least, because experience shows that Atari clones run more stably if the main memorys' continuous quality is ensured. Actually, once more than 512 MB RAM is needed, which we do not expect for the next 5 to 10 years, then this could be extended over the Extension Socket existing on the board.

- **128 MB Video- and Special-RAM on Board, Speed: 1 GB/s**



This RAM is exclusively at the FPGAs disposal. For the time being it will serve primarily as video RAM. It can however be used by programmers for any task (for example as main memory of a DSP) running in the FPGA, too.

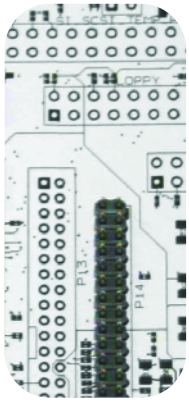
- **Flash: 8 MB on Board for the Operating System**

The parallel High speed Flash will contain – completely in original Atari tradition – the operating system, the boot code and further components such as drivers.

- **Operating System: TOS 3.06 for the start-up.**

At present we can guarantee that the TOS 3.06 – for which Medusacomputer possesses a licence – will run on the computer. However we are hoping to be able to use also TOS 4 and EmuTOS. First evaluations in this direction are already promising. For example Didier Méquignon already adapted the FireTOS (his already for the CT60 patched TOS 4.04) to our new hardware. With TOS 4 perhaps even the possibility would exist of compiling it directly for the ColdFire since Michael Schwingen, with whom we are in contact, has carried out great preliminary work and TOS 4 already is compilable with GCC. Nevertheless at present we can't assure that TOS 4 or EmuTOS will be usable on the computer in short.

- **Atari compatible interfaces:**



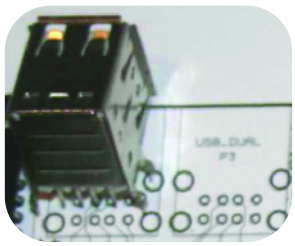
- Falcon-IDE
- ST/TT-Floppy
- TT-SCSI (but faster)
- ACSI
- ROM-Port: 2 x 2 mm connection
- Printer
- ST/TT-serial
- MIDI
- ST-Sound over AC'97
- ST/TT/Falcon-Video
- Atari-Keyboard with Mouse

The interfaces of the original Ataris are present in order to make the connections to all peripheral devices possible. Beyond that we think that a more recent Atari compatible computer should also be as compatible as possible to original Atari computers. A retention of all interfaces would add a maximum cost per board of 50 Euros. Therefore we decided to have all interfaces on board. And in addition: an Atari compatible without MIDI would not be a worthy successor – would it?

- **Ethernet 10/100, 1 Port**

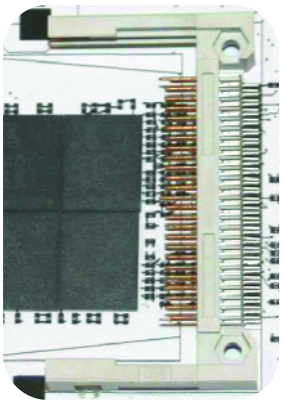
Ethernet is supported directly by the processor. An RJ45 plug is placed onboard so that it is always accessible. We regard networkability as a very important part of modern computers and will integrate these right from the beginning.

- **USB 2.0 Host (ISP1563), 4 Ports**



The ISP1563 USB chip is compatibly for the ISP1160 which is also used on some other Atari projects. Since still no low level driver for an Atari USB exists at present, we hope that a development will be usable for all projects with USB. We judge the missing USB driver to be the most important task at present. First tests certainly have taken place, but we don't want to promise fast development here. Anyhow we think that USB will be possible also under single TOS.

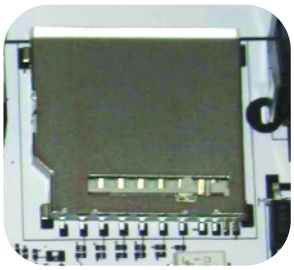
- **Compact-Flash, 1 Port**



Compact Flash (CF) cards exist currently up to 128 GB – an unbelievable size for Ataris. We recommend pursuing CF as the main mass storage following the idea of the computer without mechanical components. In addition CF should be used to keep the current consumption low. Anyone who would like to work on their own Atari

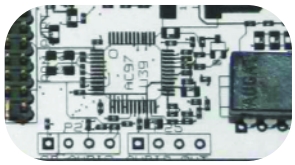
system, including the operating system configuration as well as all programs and data, and to continue exactly where he or she has stopped work would just require to put their CF-card into another ColdFire computer ;)

- **SD-Card, 1 Port**



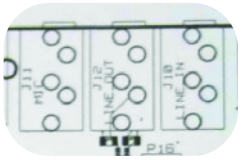
Our SD-Card will work exclusively in the DRM free SPI mode. Miroslav Nohaj (Ultra Satan) also permitted us to adapt his SD-driver for TOS to the ColdFire computer. By that it will be possible to contain complete games collections on these wide-spread cards, or to exchange data in a fast way.

- **AC'97 Stereo Codec with DMA-Sound Output and 48kHz Sampling Input**



On board, externally accessible, and attached to the AC´97-Chip are a sound IN/OUT in 48KHz, one microphone as well as internal connectors for CD/DVD. The YM2149 sound chip is also attached over the AC97-Codec in VHDL. High-end audio solutions are over PCI and are available at any time – drivers presupposed.

- **Sound connections: LineIn, LineOut, Mic (Mono); internal DVD/CD**

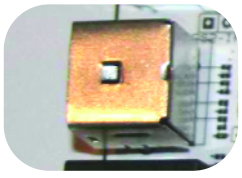


Because the board is a "stand alone device", for example in a keyboard, or as a laptop, in order to make sound possible, we decided after long consideration to attach these sound connections also directly to the board.

- **Video Modes 2MegaPixel, true color**

The basic video functions will be done in the FPGA with the above described 128 MB of video RAM. This makes it possible for us to make future updates free of charge. Additional solutions, for example the Radeon-driver of Didier Mequignon, are possible and in Tower systems over PCI surely also worthwhile.

- **PS2 Mouse/Keyboard Port**



At present the still common interface for input devices, is at the slot bracket beside Ethernet, VGA and Atari keyboard. Mouse and keyboard can be attached through standard adapters at the same time.

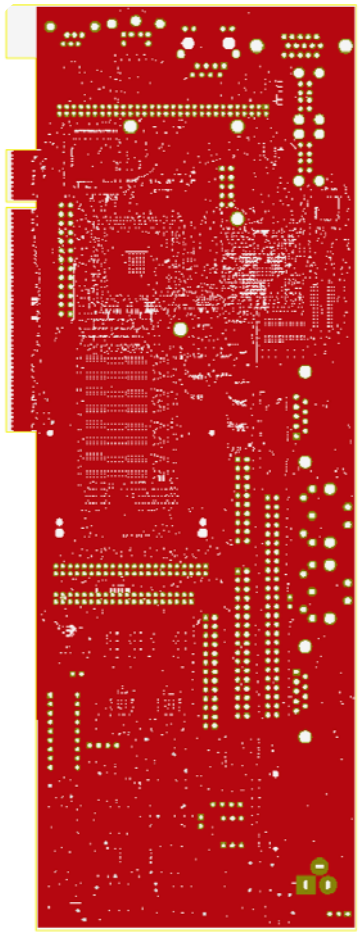
- **Battery power supply (optional)**

This is a masterpiece, which Fredi Aschwanden and Wolfgang Förster invented. The computer can, if desired, operate completely by battery. This opens various possibilities. For example the computer can be operated as a stand alone solution, at times without mains voltage. If the computer is used in a host system, the host system could be switched off, and the Atari compatible could take over tasks without mains voltage (as for example noiseless current saving downloads over night, MP3 play in the living room etc.). Amateurs could even make an Atari laptop possible.

- **Format: Card 90 mm x 260 mm x 20 mm**

The complete computer fits on the size of a PCI Card. PCI is connectible through the plug at the lower edge of the computer. This system, which in the industry is called SBC, makes it possible for us to use the computer several different ways.

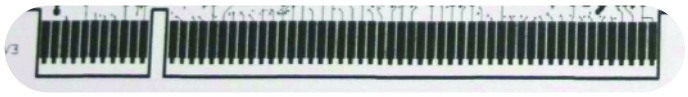
- Stand alone, for example in a keyboard, a laptop housing, a Pizza box etc. To highlight it again: This concerns a complete computer with all necessary construction units on board, which can work completely independently. It must only be attached to power either through main voltage or battery. PCI can be attached alternatively or not. We save thereby the additional costs of fixed up-soldered PCI card locations as on ATX boards and make placement much more flexible.



- If we want however a normal Tower system, then simply a passive PCI Backplane is attached (for example with 6 or 8 card locations, and the computer takes even the first card location). Thus we can save expensive PCB space and the computers are nevertheless usable in each Tower system through backplanes. Alternatively we could have blocked only a set number of PCI card locations, which would have made the use outside of towers extremely complicated. Thus those who need PCI use the backplane they want. The other possibility of building a single PCI card location on the board and putting into it a riser card, would have meant that the PCI card stands at an 180° angle to the board and again making use in standard towers impossible. With our solution everything is feasible, with a normal 90° angle.

- With this form factor, it is also theoretically possible to use the ColdFire in a host computer. The complete computer is packed into a free PCI card slot and is usable parallel to the PC, it can however share its periphery, like the Janus card or PC cards for Apple computers. This solution became possible after the PCI bus master problems were eliminated. In addition a solder joint must be set, so that the computer is not unintentionally damaged because of supply voltage (over PCI). The software for the PC doesn't exist yet and does not have high priority for us.

- **PCI 33MHz direct Edge for passive Backplane**



The PCI bus gets attached over a commercial PCI Backplane (64 bits, starting from 40 Euros). Then the use of all PCI extension cards that meet the PCI 2,2 specifications. This means in particular that the bus must have 3.3 V. For this reason it is unfortunately impossible to offer the computer additionally as an "Upgrade" for the Hades or Milan. Since it is not yet clear to what extent the use of DMA-Devices will be possible, we are still thinking about whether or not to provide our own backplane in the order. We will make this decision at a later time. At present commercial solutions are anyhow possible with one DMA device.

- **Power Controller with real time clock, PIC18F46K20**

The RISC microcontroller PIC18F contains the real-time clock, serves as power controller, and can be used for further small tasks. We use the PIC also for prosessing the PS/2 signals as well as those from Atari gameport.

- **Expansion Socket: 60 Contact SPI**

At the "Expansion Socket" are the following Signals

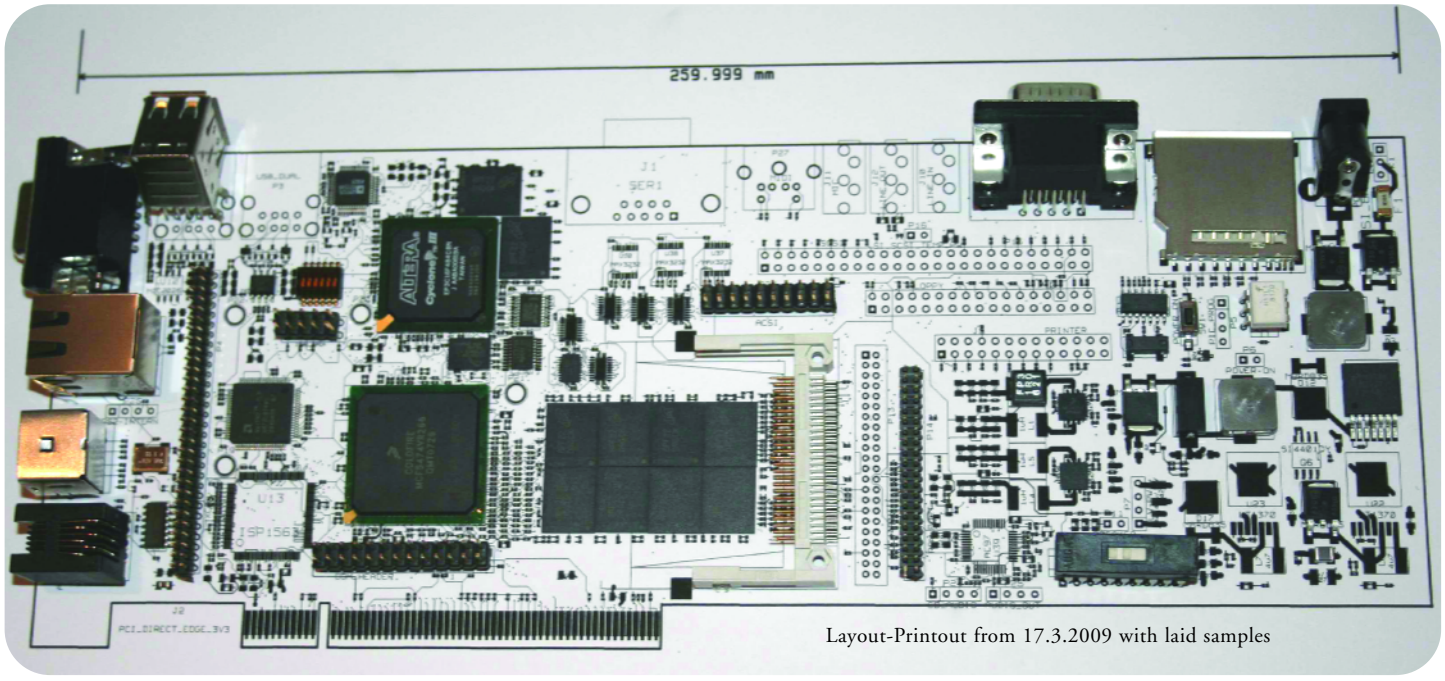
- DSPI serial synchronous or asynchrnous approximately 33Mbaud, control up to 4 devices
- I2C Bus, version not told, max. 1.65 MBaud
- Serial port from processor: max. 33 MBaud
- 26Bit I/O approximately 133 MHz
  - 8 I/O-Port wires from processor: max. 100 MBaud
  - 18 wires from FPGA: max. 500 Mbaud

- **power consumption**

The complete computer needs at present under full load between 3 and 5 Watts (without keyboard, or Compact Flash). This creates undreamt-of possibilities, one thinks only of mobile devices, Embedded employment, applications of servers etc. Commercial tower PCs normally have, in comparison, a 400 Watt power supply built in. A further advantage of the computer is that we do not need not one single heat sink, let alone a cooling fan! The entire system is completely noiseless!

- **PCB**

The computer consists of one eightfold Multilayer-PCB. We would like to stress that it concerns no classical "Homebrew", which would anyway not be possible with the modern construction units. So for example ball Grid arrays are blocked, which have a pitch distance so close that it was already difficult to find companies which can build this PCB. Now the computer will likely be ordered from a Swiss company. Personal modifications of the prototypes are unfortunately hardly possible, which means we need to make still more accurate computations before we will put the first two prototypes on order. The routing of the PCB is basically ready, and we expect no big changes.



Layout-Printout from 17.3.2009 with laid samples