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Chapter 1

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1.1 Accelerators for Beginners

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                          Accelerator Guide for Beginners v3.0

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      - Apr 22 2000

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1.2 Amigas and Processors

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The Amiga at the present uses the Motorola 68000 CISC (Complex Instruction
Set  Chip)  series  at the heart of the system. The Amiga Operating System
```

(AmigaOS, Workbench or AmigaDOS) requires this processor as all the programs and OS routines are compiled for that particular chip.

The Amiga has a number of models and each has its own processor, as time has progressed since the A1000, newer models featured faster processors:

Amiga Model	Chip Set	OS	Processor	MHz
A1000	OCS	1.x	68000	7
A2000	OCS	1.x	68000	7
A1500	OCS	1.x	68000	7
A500	OCS	1.x	68000	7
CDTV	OCS	1.x	68000	7
A500+	ECS	2.x	68000	7
A3000	ECS	2.x	68030	16/25
A3000T	ECS	2.x	68030	16/25
A600	ECS	2.x	68000	7
A4000/040	AGA	3.x	68040	25
A4000/030	AGA	3.x	680EC30	25
A1200	AGA	3.x	680EC20	14
CD^32	AGA	3.x	680EC20	14
A4000T/040	AGA	3.x	68040	25
A4000T/060	AGA	3.x	68060	50
BoXeR	AGA	3.x	68040/060	25/40/50

The newer Chip Sets required a faster processor as more colours need to be processed and more data moved around so Commodore selected a 32-bit processor for that task ie the 68020 and above. Commodore also used EC (Economy) versions of some processors which have some features missing, usually no MMU and smaller addressing space.

The faster processor the Amiga can have is the 68060 which is at least 40 times faster than the original 68000.

Although the clock speed hasn't increased that much, the speed has been increased through the use of 32 bit architecture rather than 16 bit, the use of larger and faster caches, inclusion of FPU (Floating Point Units) and MMU (Memory Management Units) onto the chip itself and better memory and instruction processing.

For the Amiga to improve a new processor is to be used. For example, when Motorola finished developing the 68000 range, they designed the PowerPC processor. The PowerPC is a RISC or Reduced Instruction Set Chip which means that it has fewer complex instructions than CISC chips, it has more registers and it can do those instructions much much faster at higher and higher speeds.

For the Amiga to use such a processor requires two things:

1. Programs to be written and compiled for that processor

2. The Operating System has to support and even rewritten in PowerPC code to make full use of the PowerPC chip.

There are three operating systems in use that are written for the PowerPC and they are:

```
                        MacOS (System 7, 8)
                        Windows NT 3.x (now discontinued)
                        BeOS
                        Solaris 2.4
                        Linux
```

We have yet to see a version of AmigaOS for the PowerPC other than the PPC
library and WarpOS addons.

1.3   List of Accelerators

                    For   the   Amiga   to   grow   and   expand, some Amiga companies have ←
                        produced
Accelerator cards which replace your old processor with a faster version.

Currently, the AGA machines and the A600 have the best support for
accelerators. Accelerators for the older OCS/ECS Amigas are no longer
being produced as they are less common and not considered worth while
supporting.

There are currently five major makes of Accelerators:

```
                    Blizzard by Phase 5/DCE
                    Cyberstorm by Phase 5/DCE
                    Apollo
                    Magnum
                    Viper
```

There are some other makes but they are less common these days and
unlikely to be sold anymore. This is NOT a complete list as some older
cards may been left out.


```
            Accelerators for A500

            Accelerators for A600

            Accelerators for A1200

            Accelerators for A1500/2000/2500

            Accelerators for A3000

            Accelerators for A4000

            Accelerators for CD32
```


1.4   A500 Accelerators

68020 Accelerators

```
ICD ADSpeed
68020 14MHz Accelerator.

Viper 520CD
Has  a  33Mhz 68020 EC processor with room for 33Mhz FPU, space for a 2.5"
IDE  hard disk, 2 x 40 pin CD ROM socket and 8MB of RAM on board. Includes
3.0 ROM and software.

Solid State Leisure A5000
Includes  a  16.67  68020 processor which uses 256x4 DRAMs (total of 4 1MB
chips ie 5MB). Doesn't autoconfig or use DMA.

Supra 28 Turbo
Uses  a  28MHz 68HC000 processor with high speed static RAM cache. Fits on
the side expansion slot. Also, compatible with A2000.

68030 Accelerators

GVP A530
Includes a 40MHz 68EC030 processor with room for FPU and uses GVP SIMMS.
Includes  a  on/off  switch with turns off the 030/RAM and HD for backward
compatibility. Up to 16/32 MB RAM.

Derringer 030
Uses  a  25MHZ 68030 processor with optional 25/50Mhz FPU and upto 32MB of
RAM using one 32 bit SIMM.

68040 Accelerators

Progressive Peripherals A500/040
This  includes a 25Mhz 68040 processor with 4 or 8 MB 32-bit ZIP Fast RAM.
Requires KS/WB 2.0 to work.
```

1.5   Accelerators for A600

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68030 Accelerators

Viper 630
Has a 33Mhz 68030 processor and FPU. One SIMM slot for upto 32MB of RAM.
```

1.6   Accelerators for A1200

```
68020 Accelerators

Blizzard 1204 or 1220/4
Has a 28MHz 68020 processor with optional FPU and upto 8MB RAM.

M-Tec T1230/28 RTC
Has  a  28MHz  68020  processor with 1 SIMM Slot, optional FPU and SCSI-II
card.

Viper 620
```

68020 14Mhz accelerator fitted over the 68000, allows for 4MB SIMM RAM.

68030 Accelerators

Apollo 68030
Has a 25, 33 or 50MHz 68030 processor and room for a FPU. One SIMM slot
for upto 64MB of Memory.

Blizzard 1230-II
Has a 68030 40 or 50MHz processor, optional FPU, upto 64MB RAM in 2 SIMM
slots and optional SCSI-II card.

Blizzard 1230-IV
Has a 50MHz 68030 processor and room for a FPU. One SIMM slot for upto
128MB of Memory. Inbuilt MMU. Optional SCSI II card with 2nd SIMM slot.

CSA 12-Gauge
Includes a 68030 50MHz processor with max of 32MB of RAM. Optional non-DMA
SCSI card.

GVP 1230-II
Uses a 40/50MHz 68030 with 2 SIMM slots for GVP RAM only, 32MB RAM.
Optional SCSI card.

Magnum 68030
Has a 40MHz 68030 processor and room for FPU. Upto 32MB of RAM can be
added and there is an optional SCSI II card.

Microbiotics MBX1230
Has a 33MHz 68030 processor with one SIMM slot for upto 128MB RAM,
optional SCSI card. (Not autoconfiguing)

Paravision MBX
Uses a 28/33/50MHz 68030 with one SIMM slot for upto 32MB RAM. SCSI
option. (Not autoconfiguring)

Viper MkII
Has a 40MHz 68030 EC processor and room for a FPU. One or two SIMM slots
for upto 64MB of Memory. No MMU.

68040 Accelerators

Apollo 68040
Has a 25,33 or 40MHz 68040 processor. One SIMM slot for upto 32MB RAM.
Optional 2nd SIMM (32MB) in a tower unit only and optional SCSI II card.

Blizzard 1240D
Desktop 1240 card. Uses 40Mhz 040, upto 128Mb RAM and optional SCSI-2
controller.

Blizzard 1240/TERC
Has a 68040 but due to heat problems it was designed for Towered A1200s.

DKB 1240 Cobra
Has a 40MHz 68040 with one SIMM slot for upto 128MB RAM. Optional SCSI-II
card.

```
Magnum 68040
Has  a  25 or 40Mhz 68040 processor. Upto 32MB of RAM and optional SCSI II
card.

68060 Accelerators

Apollo 1260
Uses a 50/66Mhz 68060.

Blizzard 1260
Uses  a 50Mhz 68060. Optional SCSI interface with 2nd SIMM slot (same SCSI
i/f as the one for the Blizzard 1230-IV).

Magnum 68060.
Has a 50/66Mhz 68060. Upto 32MB of RAM. Optional SCSI-II interface.

PowerPC Accelerators

All of these are dual-processor boards and come with 68040 or 68060 to run
the OS functions.

Blizzard 603e PPC
Includes  PowerPC  603e at 160/200/240MHz. No SCSI. Upto 128MB of RAM with
two SIMM slots. The plus (+) version includes SCSI interface.

AmiJoe G3
Includes PowerPC G3 (750) processor. No details available yet. Will include
a 680x0 emulation for AmigaOS programs.
```

1.7   Accelerators for the A1500/2000/2500

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68030 Accelerators

2030 Turbo
Has a 25 or 50Mhz 68030 with optional SCSI card.

Derringer 030
Uses  a  25MHZ 68030 processor with optional 25/50Mhz FPU and upto 32MB of
RAM using one 32 bit SIMM (Compatible with A1000).

GVP GForce 030 Combo (accelerator + SCSI) models:

030/22, 030/25, 030/33, 030/40, 030/50, 040.

The  slower  030  models (upto 25???) used the 68EC030 to reduce cost, but
the chip is replaceable by a regular 030 as field upgrade. Even the FPU is
field upgrade-able to faster speed with an appropriate crystal change.

Boards with 1MB memory on board are expandable to 13MB, boards with 4MB on
board are expandable to 16MB. All use GVP proprietary 64-pin SIMMs.

CBM 2630 models:
030/25 and 030/28 Maximum of 4MB RAM

68040 Accelerators
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```
Blizzard 2040
Uses 40Mhz 68040 with built in MMU/FPU and upto 128M RAM.

Fusion Forty
Includes a 40MHz 68040 processor with 2 SIMM Sockets for upto 4 SIMMS each
allowing upto 128MB of RAM. RAM doesn't autoconfigure.

68060 Accelerators

Blizzard 2060
Uses 50Mhz 68060 with built in MMU/FPU and upto 128M RAM.

DKB Wildfire
Uses a 50MHz 68060 and includes SCSI, PCI bus, Ethernet and RAM Slots.
```

1.8   Accelerators for A3000

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NB: Some A4000 accelerator cards can be used in the A3000!

68040 Accelerators

GVP G-Force
Uses a 28MHz 68040 with upto 8MB of RAM using GVP SIMMS. Requires 2.04 ROM
and Setpatch 38.31 or higher.

PPI Mercury 68040
Uses  a  28  or 35MHz 68040 processor with upto 32MB of RAM. Requires 2.04
ROM.

WarpEngine 3040
Uses  a  40MHz  68040  processor with SCSI-II controller and RAM expansion
upto 64MB RAM.
```

1.9   Accelerators for A4000

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68040 Accelerators

Warp Engine
Has  a  28,33 or 40Mhz 68040 processor. Has 4 SIMM slots for upto 128MB of
memory. Includes fast SCSI II host adaptor. Will fit in a A3000T

Zeus 68040
Includes a 68040 processor with SCSI-II controller using upto 64MB of RAM.
Runs at 28 or 33MHz. Can use 1x8 or 4x8 SIMMS in groups of four.

68060 Accelerators

Cyberstorm II/III
Uses a 50MHz 68060 with 4 SIMM slots for upto 128MB of RAM. Includes SCSI.

GVP T-Rexx 060
```

68060 Accelerator

PowerPC Accelerators

All of these are dual-processor boards and come with 68040 or 68060 to run
the OS functions.

Cyberstorm PPC
Includes PowerPC 604e at 180/200MHz with Ultra Wide SCSI-III interface.

1.10 CD32 Accelerators

68030 Accelerators

SX32-P40
SX32 Pro expander with 68030 40MHz Processor and FPU with upto 64MB RAM.

SX32-P50
SX32 Pro expander with 68030 50MHz Processor and FPU with upto 64MB RAM.

1.11 Processor Differences

68000
16-bit processor (bus is 16 bit, registers are 32bit internally), can
address up 9MB RAM. Runs at 7Mhz.

68010
Faster version of 68000 at 14Mhz. Very few differences between it and the
68000. The MOVE SR,<dest> instruction does not work this or higher processors.

68020
New 32-bit wide processor running at 14MHz. Has 256 bytes Instruction
Caches to speed up instruction flow. Allows a co-processor such as the
68881 or 68882 FPU units. MMU also comes on a seperate chip.

The 68EC020 in the A1200 is a 24bit (rather than the full 32bit)
addressing range.

68030
32-bit processor running from 16 to 50MHz. Has Data and Instruction caches
and includes Burst mode (reads consecutive bytes very fast).

68030 can use 68881/68882 FPU co-processors. Includes MMU on some versions
esp. the 33, 50MHz, the EC versions do not have a MMU.

68040
32-bit processor with in built FPU and MMU for maximum speed efficiency.
Includes two 4K caches for even faster speeds. Clocks at either 25 or
40Mhz. Includes Copyback made which allows cache memory to be written back
to main memory (causes problems with self-modifying code).

NB: There's an LC version with no built in FPU unit (mainly occurs on

Macs). The FPU has fewer instructions than the 68882 chip and the missing instructions have to be emulated in software.

68060
Similar to 68040 with built in FPU and MMU but has two 8k Caches. Clocks at either 50 or 66Mhz. Last in the 68000 series. Unlike the 68040 which can get very hot, the 68060 uses 3.3V and runs much cooler. Has to emulate some of the 'missing' 64 bit instructions that were present in earlier processors.

PPC 603/604
RISC based processor with speeds of 60MHz to 300MHz+. Some can access Gigabytes of memory. Not compatible with 680x0 at instruction level but with the correct software can emulate the 680x0 at 040 speeds.

PPC G3/G4
Next generation PowerPC 750 processors starting from 233Mhz with 512K or 1M caches gaining at least 50% more speed.

1.12   Choosing an Accelerator

Choosing an accelerator is based on a number of factors which may affect your choice:

a) Which model of Amiga you own.

The A1200 and A4000 are well supported with new boards. The older Amigas have a limited choice of accelerators. If accelerating your current amiga is next to impossible then upgrading your Amiga to an AGA Amiga would be advisable.

It is inadvisable to run an 040 board on a plain A1200 as the heat produced by the 040 board is quite high, if you do get an 040 then leaving the trapdoor lid off and attaching a fan unit will make it more usable though. b) What software you are planning to run on it.

Modern games these days now require much faster processors. An 68030 is considered to be minimum specification these days and they are very cheap (<£100). High end Graphics and 3D Rendering work would require a 68060 processor for maximum performance but it is also the most expensive. A 68040 processor would be a cheaper alternative for the best of both worlds (fast but cheap).

c) How much money you are willing to spend.

Always include in the price some memory, an accelerator without any Fast RAM would be like running a Ferrari with no petrol. If you don't own a SCSI card then buying the SCSI interface option should also be considered.

d) What other expansions you have or about to buy

Buying a faster processor is not the only way to get faster speed from your Amiga. AGA is considered to be too slow especially for quality graphics. A good Graphics card is considered to be essential to improve graphics speed.

Floppy disk systems are a rare breed these days and a Hard disk is
absolutely essential, the difference is incredible once you've installed
one.

e) Quality of the accelerator board.

It is important that the accelerator board is well built and that it
doesn't crash the Amiga every five minutes. Check that your Amiga can
handle a fast new processor, you may have to upgrade some other parts of
your Amiga to get the best out of it.

f) Acceleration isn't everything.

An accelerator will improve the speed of the programs but won't improve
drive speed or graphics speed. Buying a graphics card will substantially
improve graphics performance better than any fast processor. Some programs
will benefit more than others such as rendering programs which uses a lot
of processor time.

Getting a better accelerator may actually speed up your drive, especially
if you have an IDE drive, that's very dependent on the CPU. After all, the
controller used in Amigas can only do PIO (Programmed Input/Output).

1.13   Making the Most of your Accelerator

An accelerator can provide more options and features than your old
processor

 e.g. Floating Point Unit for math intense applications – e.g. Rendering

Memory Management Unit for Virtual Memory and FastROM (copies ROM image
into Fast RAM for speedy access) and using alternative Kickstarts
(Soft-kicking).

Workbench provides three methods to control features of your processor:

a) Early Startup Screen. Allows you to turn off/on caches for backward
    compatibility with older software esp. games.

b) The CPU command displays your current processor settings and allow you
    to set them eg. Caches, Burst Mode, Copyback, FastROM, Traps, MMU etc.
    You will need a newer version of CPU if using an 68060 processor.

c) 68040.library. Patches missing CPU instructons esp. FPU functons that
    exist on the 68882 but not on the 68040. Enabled with Setpatch program

There are loads of third party programs that can make use of your
accelerator:

Processor Based

  a) SysSpeed.   Latest benchmark util for all processors inc.
                   PPC (WarpOS only).
  b) AIBB.   Old benchmark program. Doesn't work on PPC, 060 requires

```
                        CPU=68060 tooltype.
     c) SysInfo.      System benchmark and information for older Amigas only.
                      Benchmarks aren't very accurate.
     d) Speedychip.   Speeds up chipmem writes for 060.
     e) Board216.     Recognises 370+ expansion boards.
     f) BlizKick.     Maps ROM into RAM for Blizzard boards
     g) FastExec.     Moves exec.library into fastest memory
     h) BlizMagic.    Softkicker for Blizzard boards
     i) MCP.          Includes some CPU preferences
     j) System.       Preferences program for your CPU.
     k) PCM_1_0       Patch Copymem/Quick for 68040
     l) FastROM       Enhance 040 system performance
     m) QuickROM      Boost kickstart speed on 040/060
     n) 68060-V43     68060 libraries
     o) Make060       Set AFF_68060 flag in ExecBase
     p) CPUBlit       Replaces BltBitmap routine
     q) CPUClr31      Replaces BltClear routine
     r) FBlit         Replaces Blitter with CPU routines
     s) CPU112        CPU Control utility
     t) Stepdown_10   CPU Degrader system
     u) CacheControl CPU Cache control utility
     v) CPUControl    CPU Preferences
     w) SystemPrefs   CPU Preferences

FPU Based

     a) TMathTrans.   Speeds up FPU mathtrans functions.
     b) FFPPatch.     MathFFP FPU speed up patch
     c) MSBPatch.     Mathieeesingbas FPU patch
     d) Mult64Patch. 060 patches for UMult64/SMult64
     e) MathPatch.    Bug fix for 68040

MMU Based

     a) CheckMMU      Check if MMU exists
     b) VirtualMEM    Virtual memory utility
     c) FastROM       MMU tool to enhance perf.
     d) VMM_3_3a      Virtual Memory
     e) MMUList       Display MMU tables
     f) MMUX32        Analysis MMU tables and translations
```

There are some commercial software available for accelerators, some come
with the accelerator and some seperately:

a) CPU060. Newer version of CPU command which recognises the 060 properly.

b) CyberPatcher. Replaces missing 040/060 instructions with emulated ones.

c) 68060.library. Called via a dummy 68040.library to replace missing FPU
   instructions. Enabled via Setpatch.

d) OxyPatcher. Commercial 68060 instruction patcher. Faster than other
   patch programs available and more compatible with some programs.

A lot of programs these days can come in different versions, some are
optimised to run faster on newer processors. The installer will allow you
to choose the best program to install and in some cases install an FPU

version. You can achieve big speed ups upgrading from a 16-bit 68000 version to a 32-bit version 020 or better and you will need an 040/060 version for FPU functions.

1.14 PowerPC Acceleration

The latest Accelerator cards now have PowerPC 603e and 604e Processors as well as 68040/060 processors.The most recent cards now just have a G3 PPC processor and uses a emulator for the old 680x0 processors.

Those who are considering buying one of these cards must realise this:

Standard 68000 Programs will NOT run faster on the PowerPC cards except the new G3 cards.

This is because Amiga programs are written in 680x0 code which the PowerPC cannot run because it uses a completely different instruction set. The Programs must be written specifically for the PowerPC to run on the PowerPC otherwise they will run normally on the 680x0 processor on the card like other 68k accelerators.

There are two different methods of running PowerPC programs on the Amiga.

Phase 5 has a ppc.library which has a range of functions written for the PPC including Exec type functions for memory management and 64 bit math functions. PPC programs are loaded via ELFLoadSeg which resides in memory.

WarpOS by Haage and Partner is a different system to access the PPC. It consists of the three libraries powerpc.library (hardware independent part) and warp.library/warpHW.library (HAL), a manufacturer of a new PPC Board has only to rewrite the 1.3 KB Sized warpHW.library to support WarpUP. WarpUP also supports "a range of functions... and 64 Bit math functions and quite some more things like memory protection, Supervisormode, Cswitch, a PPC Native Message System,...)". Something like elfloadseg is not needed, as WarpUP uses directly the fileformat of the Amiga, unlike ppc.library.

1.15 Common Problems

1. My machine keeps crashing after installing my accelerator.

There are a number of factors that can cause this to happen, some are hardware related or software related:

Software:

a) You may be trying to use software which breaks under a new processor. This will especially occur with WB 1.3 software, demos and games.

b) You are using a patch program which no longer works or trying to patch some thing which is incompatible.

c) Make sure that appropiate software is installed before attaching the
    board. Copy the files onto other bootable disks in case of emergency.

Hardware:

a) The accelerator is using too much power. IF using a standard 23W A1200
    PSU, it is advisable to remove other devices or upgrade the PSU to a
    higher wattage.

b) The accelerator isn't fitted properly. You must ensure that the
    accelerator is plugged in correctly. For the A1200 it may help to
    dismantle the casing to allow you to fit in the accelerator.

c) The processor is getting too hot and it is shutting itself down (thus
    causing a crash). Make sure enough air is getting to the processor. It
    is advisable to leave the trapdoor lid off. If using a 040 or PPC
    processor that a fan is fitted to the processor to keep it cool.
    Placing the system in a tower unit will allow for more air to get to
    the processor. Also, lifting the unit off the desk will allow more
    fresh air to get to the processor.

    If you are using a fan, make sure that it is spinning fully and that
    it is the right way up (it has happened to one person!).

d) Other hardware is too old or incompatible with the new accelerator
    card. Check custom chip versions and upgrade them if necessary. Check
    docs for these things. This will occur on older OCS and ECS amigas.

e) Get the right kind of RAM. Most Amiga accelerators will use 32-bit
    Fast Paged non-parity SIMM memory. Single sided SIMMs will fit better than
    double-sided SIMMS (chips on both sides). There are newer types of RAM
    eg. EDO and SDRAM but check with the manufacturer/dealer before buying
    these kind as may or may not work on your accelerator.

2. My accelerator isn't as fast as it should be.

Check that all the caches are enabled and that other features are enabled.
Some features like Burst modes and Copyback can cause problems with some
programs. Make sure that if using a Benchmark program, that you are using
a more recent version (AIBB and SysInfo won't work on 060 processors).
   Also, get programs such as OxyPatcher or CyberPatcher to improve FPU
performance on 040 and 060 processors.

3. I cannot get older software to work.

Disable some of the new features of the board eg Caches and Copyback are
the best ones to disable. Disable AGA for really old games or programs,
KILLAGA2 and Degrader are good programs to get for this. On the 060, it has
a SuperScalar mode, disable this with the CPU060 command or equivalent,
particularly with Mac emulation.

4. The MMU doesn't work on my machine.

The MMU is only used for ROM kicking and Virtual Memory. The 68030 will
probably won't have it enabled on processors slower than 50MHz. The 68040
and 060 has it inbuilt. To check that the MMU works, use a virtual memory
type program to check eg GigaMem, VMM, VMEM. Anything that says EC or LC

do not have MMUs.

5. Can I overclock my processor to a faster speed.

This is possible by replacing the clock oscillator to a faster clock
speed. Whether it works and for how long depends the processor. Some can
work at faster speeds than others upto 10-15% faster in some cases. So it
may be possible to speed up a 25MHZ processor to a 28Mhz clock rate, a
33MHZ to 37Mhz and a 50MHz to 55Mhz. Bigger clocks speeds may cause you
machine to crash as the processor may fail to run at the higher speed,
reduce the clock speed if this occurs.

6. Can I replace my processor with a different one directly.

Only if the new processor is pin and volt compatible. For example, it may
be possible to replace a 25MHz 68030 with a 50MHz 68030 if the oscillator
AND the processor where changed. This is desirable if the curent chip is
an EC version and you can replace it will a MMU enabled version. The chip
itself usually indicates the recommended clock speed on the end of the
number eg 68EC030-50 for a 50Mhz 030. A 040 and 060 are pin compatible but
the 040 runs at 5V and the 060 runs at 3.3V so replacing it is not
possible.

1.16   The Author

Thanks to all those who have contributed to this guide and for spotting
the odd error!

This guide was written by Peter J Hutchison on a...

A1200 with Blizzard 1230-IV, 16MB RAM, 1.1GB 2.5" HD, Microvitec 1440, 12x
CDROM, ZyFi Speakers.

Disclaimer:

Information in this guide is accurate as far as I know. Any modifications
made to your system is done at your own risk. I cannot claim
responsibility for any damage caused directly or indirectly by the advice
given in this guide.

Other Guides in the series:

                         Foozle
                         Workbench1.3
                         Workbench3.1
                         PC Task 4.x
                         Printer Guide
                         Upgrading WB
                         Expanding the Amiga
                         Hard Drive
                         Graphics Cards
                         Accelerators

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