

Amiga Buddha and Catweasel IDE Driver

The Amiga Buddha and Catweasel IDE Driver (part of ide.c) was written by Geert Uytterhoeven based on the following specifications:

Register map of the Buddha IDE controller and the Buddha-part of the Catweasel Zorro-II version

The Autoconfiguration has been implemented just as Commodore described in their manuals, no tricks have been used (for example leaving some address lines out of the equations...). If you want to configure the board yourself (for example let a Linux kernel configure the card), look at the Commodore Docs. Reading the nibbles should give this information:

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Vendor number: 4626 ($1212)
product number: 0 (42 for Catweasel Z-II)
Serial number: 0
Rom-vector: $1000
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The card should be a Z-II board, size 64K, not for freemem list, Rom-Vektor is valid, no second Autoconfig-board on the same card, no space preference, supports "Shutup_forever".

Setting the base address should be done in two steps, just as the Amiga Kickstart does: The lower nibble of the 8-Bit address is written to \$4a, then the whole Byte is written to \$48, while it doesn't matter how often you're writing to \$4a as long as \$48 is not touched. After \$48 has been written, the whole card disappears from \$e8 and is mapped to the new address just written. Make sure \$4a is written before \$48, otherwise your chance is only 1:16 to find the board :-).

The local memory-map is even active when mapped to \$e8:

\$0-\$7e	Autokonfig-space, see Z-II docs.
\$80-\$7fd	reserved
\$7fe	Speed-select Register: Read & Write (description see further down)
\$800-\$8ff	IDE-Select 0 (Port 0, Register set 0)
\$900-\$9ff	IDE-Select 1 (Port 0, Register set 1)
\$a00-\$aff	IDE-Select 2 (Port 1, Register set 0)
\$b00-\$bff	IDE-Select 3 (Port 1, Register set 1)
\$c00-\$cff	IDE-Select 4 (Port 2, Register set 0, Catweasel only!)
\$d00-\$dff	IDE-Select 5 (Port 3, Register set 1, Catweasel only!)
\$e00-\$eff	local expansion port, on Catweasel Z-II the Catweasel registers are also mapped here. Never touch, use multidisk.device!
\$f00	read only, Byte-access: Bit 7 shows the level of the IRQ-line of IDE port 0.
\$f01-\$f3f	mirror of \$f00
\$f40	read only, Byte-access: Bit 7 shows the level of the IRQ-line of IDE port 1.
\$f41-\$f7f	mirror of \$f40
\$f80	read only, Byte-access: Bit 7 shows the level of the IRQ-line of IDE port 2. (Catweasel only!)
\$f81-\$fbf	mirror of \$f80
\$fc0	write-only: Writing any value to this register enables IRQs to be passed from the IDE ports to the Zorro bus. This mechanism has been implemented to be compatible with harddisks that are either defective or have a buggy firmware and pull the IRQ line up while starting up. If interrupts would always be passed to the bus, the computer might not start up. Once enabled, this flag can not be disabled again. The level of the flag can not be determined by software (what for? Write to me if it's necessary!).
\$fc1-\$fff	mirror of \$fc0
\$1000-\$fff	Buddha-Rom with offset \$1000 in the rom chip. The addresses \$0 to \$fff of the rom chip cannot be read. Rom is Byte-wide and mapped to even addresses.

The IDE ports issue an INT2. You can read the level of the IRQ-lines of the IDE-ports by reading from the three (two for Buddha-only) registers \$f00, \$f40 and \$f80. This way more than one I/O request can be handled and you can easily determine what driver has to serve the INT2. Buddha and Catweasel expansion boards can issue an INT6. A separate memory map is available for the I/O module and the sysop's I/O module.

The IDE ports are fed by the address lines A2 to A4, just as the Amiga 1200 and Amiga 4000 IDE ports are. This way existing drivers can be easily ported to Buddha. A move.l polls two words out of the same address of IDE port since every word is mirrored once. movem is not possible, but it's not necessary either, because you can only speedup 68000 systems with this technique. A 68020 system with fastmem is faster with move.l.

If you're using the mirrored registers of the IDE-ports with A6=1, the Buddha doesn't care about the speed that you have selected in the speed register (see further down). With A6=1 (for example \$840 for port 0, register set 0), a 780ns access is being made. These registers should be used for a command access to the harddisk/CD-Rom, since command accesses are Byte-wide and have to be made slower according to the ATA-X3T9 manual.

Now for the speed-register: The register is byte-wide, and only the upper three bits are used (Bits 7 to 5). Bit 4 must always be set to 1 to be compatible with later Buddha versions (if I'll ever update this one). I presume that I'll never use the lower four bits, but they have to be set to 1 by definition.

The values in this table have to be shifted 5 bits to the left and or'd with \$1f (this sets the lower 5 bits).

All the timings have in common: Select and IOR/IOW rise at the same time. IOR and IOW have a propagation delay of about 30ns to the clocks on the Zorro bus, that's why the values are no multiple of 71. One clock-cycle is 71ns long (exactly 70,5 at 14,18 Mhz on PAL systems).

value 0 (Default after reset)

497ns Select (7 clock cycles) , IOR/IOW after 172ns (2 clock cycles) (same timing as the Amiga 1200 does on it's IDE port without accelerator card)

value 1

639ns Select (9 clock cycles), IOR/IOW after 243ns (3 clock cycles)

value 2

781ns Select (11 clock cycles), IOR/IOW after 314ns (4 clock cycles)

value 3

355ns Select (5 clock cycles), IOR/IOW after 101ns (1 clock cycle)

value 4

355ns Select (5 clock cycles), IOR/IOW after 172ns (2 clock cycles)

value 5

355ns Select (5 clock cycles), IOR/IOW after 243ns (3 clock cycles)

value 6

1065ns Select (15 clock cycles), IOR/IOW after 314ns (4 clock cycles)

value 7

355ns Select, (5 clock cycles), IOR/IOW after 101ns (1 clock cycle)

When accessing IDE registers with A6=1 (for example \$84x), the timing will always be mode 0 8-bit compatible, no matter what you have selected in the speed register:

781ns select, IOR/IOW after 4 clock cycles (=314ns) active.

All the timings with a very short select-signal (the 355ns fast accesses) depend on the accelerator card used in the system: Sometimes two more clock cycles are inserted by the bus interface, making the whole access 497ns long. This doesn't affect the reliability of the controller nor the performance of the card, since this doesn't happen very often.

All the timings are calculated and only confirmed by measurements that allowed me to count the clock cycles. If the system is clocked by an oscillator other than 28,37516 Mhz (for example the NTSC-frequency 28,63636 Mhz), each clock cycle is shortened to a bit less than 70ns (not worth mentioning). You could think of a small performance boost by overclocking the system, but you would either need a multisync monitor, or a graphics card, and your internal diskdrive would go crazy, that's why you shouldn't tune your Amiga this way.

Giving you the possibility to write software that is compatible with both the Buddha and the Catweasel Z-II, The Buddha acts just like a Catweasel Z-II with no device connected to the third IDE-port. The IRQ-register \$f80 always shows a "no IRQ here" on the Buddha, and accesses to the third IDE port are going into data's Nirwana on the Buddha.

Jens SchÄ¶nfeld february 19th, 1997

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eMail: sysop@nostlgic.tng.oche.de