HARDWARE PCW BENCHTEST

Acorn 3010/3020/4000

Acorn has replaced the ageing A3000 with a trio of machines aimed at its market niches — games, education and the home business. The hurriedly assembled A4000 looks like being the star of the range, says Graham Bell.

In the past four years, Acorn's Archimedes range has built up a steady following, especially in schools where the A3000 has taken up the mantle formerly worn by the BBC Micro. But in the home, it has a strong appeal only at the more technical or committed end of the market; twin criticisms being the high price and the lack of software. The latter gripe is now less justified; but while prices have plummeted in the market, Acorn's A3000 machines have retained their original levels.

A trio of revamped machines has been announced to replace the ageing A3000, each aimed at specific parts of the existing Acorn market. The inspirationally named A3010, A3020 and A4000 vary in detail, but each carries features intended to excite either the games, the school or the home business niche.

The A3010 and A3020 share a case design, with power supply, motherboard and keyboard in a single plastic moulded unit. The look is compact, strangely reminiscent of the Amiga games machines, and less angular and deep than the old Acorn A3000. The keyboard is raked sharply upwards, and the grooves on the case's rear are familiar, being carried over from the A4 portable. The whole case is weighty and solid, largely due to the sheet metal that shields the electronics inside.

On the A3010, the case moulding is light grey, with two shades of grey keys on the main part of the keyboard. The function keys are in a striking green. The A3020 follows a more traditional Acorn colour scheme: the company feels that a cream case with bright red function keys is a strong recognition factor in the conservative schools market.

The 103-key keyboard is standard Acorn —enhanced PC style, with 12 function keys, separate cursor and editing block, and full numeric keypad. Like other Archimedes keyboards, Caps Lock is below Shift, and Ctrl above: only the A4 portable follows PC practice in putting Ctrl at the bottom. The keys have a full travel, but feel light and springy, and lack a positive 'click'.

To the right is a single high-density floppy disk drive, detailed with a tiny green eject button. Under the floppy drive are ventilation slots where an optional hard disk, a Conner-built 60Mb 2.5in unit, can be fitted to the A3020. The space is unused in the A3010.

At the back, a row of connectors includes a 25-pin D parallel port and 9-pin D serial port. Both are PC style, so there's no problem getting cables.

▽ **The A3010**

There's also a sound port: you can plug your Walkman headhones straight in, or connect the lot up to your hi-fi amplifier, a mouse port, and a 15-pin D connector for a monitor. The mouse supplied with all machines is the familiar three-button Logitech rounded design.

On the A3010 games machine, there are also two Atari-style joystick ports and a TV modulator output that can be connected straight to your TV aerial socket. The A3020 lacks the TV modulator and joystick ports, but has a network port that lets the machine be attached to either Acorn's proprietary Econet network or to Ethernet. Both require a card be fitted inside the machine. The final hole in the left side of the case hides a hardware reset switch, which you can operate with a pencil.

Opening the case exposes nothing. Chunky metal shielding covers almost everything, with just two peepholes for adding expansion options.

Persistence with a screwdriver lays the whole thing bare. The keyboard pops off and unplugs at two flimsy plastic edge connectors, and the shielding can be removed. Under the keyboard is the single speaker, which can be disabled if you choose to use the external sound port.

To the left is the power supply, though there's no switched output for a monitor: you need two mains plugs. To the right is the disk drive. In between is very little. A single chip dominates the centre of the remarkably bare board: this is the ARM 250 (see panel). There's a Chips & Technologies 82C711 controller to look after the hard and floppy disk drives and the parallel and serial ports, plus a small Intel keyboard controller. Two large ROMs hold the RISC OS operating system, and there are two 80ns RAM chips making up the complement of 1 or 2Mb in the front right. Next to the RAM are two sockets for additional memory. The A3010 can be upgraded from 1 to 2Mb, the A3020 from 2 to 4Mb.

At the board's rear is a smattering of surface-mounted components, making up the display support and joystick hardware. On the A3020, the board layout is much the same, but the TV modulator and joystick ports are missing and along the right of the board is the IDE connector for the optional hard disk drive.

In the centre of the motherboard is a row of connectors into which you can plug a single expansion card. Cards designed for the old A3000, known as mini-podules, can be used in the new machines. You can easily add a SCSI port or scanner interface, but because of the shielding metalwork, space is more restricted in the A3010 than the A3000 so some of the old expansion cards don't fit. In particular, there are a number of 'hardcards' already available which typically have a 40Mb hard disk drive and IDE interface on a small expansion card: this is the only way to add an internal hard disk to the A3000, and will doubtless be a popular addition to the A3010 too. Beebug's hardcard cannot be put into an A3010, whereas a similar unit from ICS can.

The major problem is you can only fit one minipodule, so putting a hard disk into an A3010 rules out any other development. Though the 82C711 controller can handle the drive, the separate IDE connections used in the A3020 are simply not there. So while the A3020 can have both internal

△ **The A3020**

The A4000

The third new Acorn is the A4000. It shares all the internals of the A3020 — 12MHz ARM 250, 2Mb of RAM, network ability rather than joysticks. The only significant internal change is that the optional hard disk is a 3.5in Conner 80Mb unit rather than the 60Mb drive on the smaller computer. From the outside, the two machines can't be confused. The A4000 comes with separate keyboard and system case. The keyboard is the

same as that supplied with the A5000, and the main case looks similar too: elegant, very low and sleek.

Why is the A4000 important? Because from the end of this year, ergonomic regulations on the use of computers at work will prohibit new machines without separate, adjustable keyboards. In many circumstances an A3020 wouldn't be acceptable. It is vital to remember that despite appearances, the A4000 is not a cut-down A5000. It lacks ARM 3 performance and real podule slots — the internal expansion is limited to an A3000-style mini-podule and a hard disk. But at £1115 (including VAT) including monitor and hard disk, it is nearly £500 cheaper than the equivalent A5000. £50 more than a similarly equipped A3020 looks like money well spent. It may be that the A4000, which smacks of being hurriedly assembled, becomes the star of the range.

The ARM 250 — Archimedes on a chip

The microprocessor in the A3010, A3020 and A4000 is a new chip from Advanced Risc Machines, the Acorn spin-off jointly owned by Acorn, Apple and VLSI Technology. The ARM 250 combines the functions of the ARM 2 used in the first generation of Archimedes micros with the three existing parts of the Archimedes chipset — VIDC, IOC and MEMC. The ARM 2a core of ARM 250 is essentially the same 32-bit integer RISC processor used in the Acorn Archimedes since 1987.

The VIDC video chip combines a DMA controller for retrieving data from memory for the video display and sound generation with 16 palette registers, digital to analog converters for video and sound, and a hardware sprite used to display the mouse pointer. It is flexible enough to generate anything between TV-standard 640x256 pixels and an 800 x600 SuperVGA display, with either 2, 4, 16 or 256 colours on screen.

MEMC and IOC glue the ARM processor to the rest of the system. The former is a memory manager, translating logical addresses generated by the processor into physical memory addresses to drive the memory array, using a CAM (contents-addressable memory) lookup table. It divides the available memory (1, 2 or 4Mb) into 128 'pages', each of which can be assigned by the RISC OS operating system to one task and protected from interference by other tasks. The IOC interfaces the fast processor and memory system to slower the data buses used by the keyboard and drive controllers, and is used for expansion cards (podules).

Four such chips have been used in all Archimedes machines to date, although ARM 3, which includes a 4K read cache, is used instead of ARM 2 in the most recent. ARM 250 integrates these separate chips into a single new package: possible because with fewer than 30,000 transistors, the ARM 2 is such a simple processor. But unlike the ARM 3 used in Acorn's higher-performance A5000 and A4, there is no on-chip cache memory, so the speed of the system is limited by the speed of affordable RAM chips. With today's commodity RAM having an 80ns access time, the ARM 250 in the A3010 is run at 12MHz, half as fast again as previous ARM 2 computers. This produces a performance of about 6 mips, roughly equivalent to a 25MHz 386SX.

ARM 250 epitomises ARM's pick 'n' mix approach to chip design — pasting together a selection of ready-made modules to form a single unit closely matched to the overall system design. ARM 610, the heart of the Apple Newton PDA, similarly combines processor core, 4K read cache, write buffer and memory management. And because ARM 250 has all the main parts of an Archimedes, it needs only memory, keyboard and disk drive controllers to make a complete machine.

hard disk and a separate mini-podule, with the A3010 you have to choose one or the other. Putting in a SCSI interface on a mini-podule is one way out: you can then fit an external disk drive and almost any other peripheral. But SCSI devices tend to be more expensive.

The final set of connectors on the A3020 is for a network interface card. Acorn is designing a pair of Econet and Ethernet cards, but these were not available for review. Again, network capability is missing from the A3010.

None of the machines has a socket for Acorn's forthcoming floating point accelerator chip, which can be fitted to the A5000. However, in the A3010's market, this is unimportant.

RISC OS

Like all Archimedes machines before them, these units run Acorn's proprietary RISC OS operating system. Booting up is a familiar experience: it's quick, and even on a floppy-only computer you

don't need a disk because the whole operating system is in ROM. RISC OS provides a Mac or Windows-like desktop with windows, icons and pop-up menus controlled with the mouse. It's multitasking and easy to control.

The initial display is a blank grey desktop with a row of icons along a bar at the bottom of the screen — it's a facilities list, hardware peripherals and filing systems on the left, applications on the right. But unlike the Mac or Windows, the screen is not cluttered with menus. These appear by pointing at an object on the desktop, then pressing the middle mouse button: a menu relevant to that object appears. Point to a file and the menu gives you the option to copy, rename, delete, change the access rights, find the file size and re-datestamp the file. Point at a floppy disk drive icon and you get a menu that lets you format, verify and backup .

Clicking the left mouse button on a disk drive icon opens a window showing files, applications and directories on that disk; double-clicking on a directory icon (shown as a blue folder) opens another window showing that directory's contents. Files can be copied or moved from one subdirectory to another, or even from one disk to another, by dragging their file icons from one window to another with the mouse.

Double-clicking on an application icon loads that application ready for use — it appears on the icon bar at the bottom of the screen. And double-clicking on a file loads whichever application created it, then loads the file and opens a window letting you edit it. Each RISC OS application runs in a window, and many can handle several files at a time. So you could load a word processor application and edit one, two or more documents at the same time, each in its own window.

Although RISC OS has its own 1.6Mb floppy disk format, it reads and writes DOS disks too. Unlike the Mac, the files appear on the desktop, as if the disk was in Archimedes format. If the DOS files have the right filename extensions, they appear with the correct RISC OS file icons. Double-clicking on a .txt file on a DOS disk can load it straight into a RISC OS text editor.

Dragging files is an important part of RISC OS —typing is kept to a minimum. As well as dragging files to copy them from one disk to another, they can be dragged to the printer icon to print them; data files are loaded by dragging them to an application on the icon bar; saving a file is done by dragging a file icon from its application window to the disk directory window where you want to save it; data can be transferred from one application to another by 'saving' and dragging the icon to another application window instead of to the disk window. You can load both a word processor and a drawing package, then drag drawing files directly from one to the other, to embed the drawing in your text.

As well as RISC OS itself, the RISC OS 3 ROMs have a selection of core applications including Draw, an object-oriented drawing package; Paint, an icon editor; and a simple text editor, Edit. There's also a set of outline fonts corresponding to Times, Helvetica and Courier which are used for screen display and printing. These run from ROM, so take up virtually none of the computers' limited RAM. Drivers for dot-matrix, LaserJet and Post-

Script printers are included on the RISC OS support disks.

RISC OS is in much the same league as Macintosh System 7 or perhaps Windows 3.1. Each offers windowing, multi-tasking and memory management. In some areas RISC OS excels: its frugal use of memory — a 2Mb machine can multi-task two or more significant applications where a 2Mb Mac can barely run the operating system; drag-and-drop features; and support for outline fonts on screen. In others, like dynamic data exchange, it lags.

A major question mark against the new machines is performance. In raw terms it's clear—the new A3010 is 50% faster than the old A3000, due to the 12MHz clock speed of the ARM 250 processor. And compared to other domestic-grade machines, all Archimedes are fast. But it's more complex than that. Because the video controller and the ARM processor compete for access to the memory, the machine slows in 'bigger' screen modes. The video system requires four times more of the available memory bandwidth in a 640x512 pixel, 256-colour mode 21 than in a 640 x 256 16-colour mode 12, so the slowing is four times greater. While in TV-style screen mode, the machine is about half as fast again as an old A3000; in bigger modes, it can be over twice as fast. This transforms the usability of the VGA modes, which were particularly slow on an A3000.

Conclusion

An A3010 will costs £499, in a bundle known as The Family Pack. This includes a simple word processor, Easiword 2, and a game — at the outset an Olympic sport simulation, but due to be changed regularly. RISC OS and user manuals complete the picture. For a 1Mb, floppy-only games machine,

More from Acorn

At the same time as rolling out the new A3000s and the A4000, the A5000 line has also been extended: there are now models with 2 or 4Mb of RAM, storage is network only or a 40, 80 or 120Mb hard disk. All share the same case and basic A5000 motherboard, with the 25MHz ARM 3 processor, single 3.5in 1.6Mb floppy disk drive and four expansion slots.

The latest version of RISC OS, 3.1, is included with all the new machines. And it is at last available as an upgrade for previous machines . The new 2Mb ROMs fit right into all previous Arcs, with the exception of the early A310 and A440 which require a small carrier board to hold them. There's a set of new manuals and application disks included too.

With an initial price tag of £49, it's clear that many Archimedes owners will not upgrade at once. But RISC OS 3 does offer a great deal: disk copies and formats are multi-tasking; the core applications, many common modules including the shared C library, and a few fonts are in the ROM so don't use much memory; windows can be 'minimised' and stuck to the desktop background yet stay active. It's a much improved system, and faster at most operations than RISC OS 2. Printer support and applications have all been improved.

Specifications
Acorn 3010/3020/4000
Processor
12MHz ARM 250
RAM
A3010, 1Mb upgradable to 2Mb; A3020 and A4000, 2Mb upgradable to 4Mb
ROM
2Mb with RISC OS 3.1 operating system, application software, fonts
Mass storage
3.5in high density floppy disk drive, 1.6Mb RISC OS format. Reads and writes previous RISC OS formats and 1.4Mb, 720K DOS formats
Keyboard
103-key PC style
Display
A3010 via TV modulator — 640x256 pixels by 16 or 256 colours; all models via multiscanning monitor, up to 800x600 by 16 colours or 640x480 by 256 colours
Bundled software
RISC OS applications (Draw, Paint, Edit, Alarm). Bundles have selection of Easiword or Easiwriter word processor, database, PC emulator with DRDOS 6, games, Genesis
Price
A3010, from £499 inc VAT without monitor; A3020, from £880 inc VAT with monitor; A4000, from £1115 with 80Mb hard disk and monitor
Manufacturer
Acorn (0223) 245200

like the A3000 before it, this looks expensive.

Budget-priced Amigas face the same problem: it remains to be seen whether a family buying a Nintendo or Sega console for £150 will be convinced of the merits of owning 'a real computer'. And if they are, will they be prepared to pay a premium for RISC OS and Archimedes performance? The argument that it encourages educational use 'because it's the same as the one in school' is a bit thin; the Amiga is cheaper and has more games. In the high street on a Saturday morning, reasoning is unlikely to be more sophisticated than that. And for the machine to succeed, it must tap this market.

With the A3010, Acorn has tried to price as low as possible. But has the company thrown the baby out with the bathwater? The limited expansion —2Mb max, one mini-podule — will certainly worry Acorn's existing users.

There is a second problem that isn't so obvious: no escape from ARM 250. With the old A3000, you can add an ARM 3 in place of the ARM 2. For a couple of hundred pounds, it more than doubles the speed of the basic machine, bringing it within hailing distance of real ARM 3 machines like the A5000. (The remaining difference is because in adding an ARM 3, the memory continues to run at the original A3000 speed of 8MHz rather than the 12MHz of the A5000.) But there is no prospect of an ` ARM 350'. If you decide after a year of owning an A3010 that you need more mph, you have to change machine.

The A3020 should fare better. It's cleverly targeted at Acorn's existing market in schools, particularly primaries. A retail price of £880 including Philips colour monitor is relatively meaningless: schools will pay only £649. And with the hard disk not ruling out further expansion, it has everything a school needs.