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PLUS

Has Intel fixed Sandy Bridge? p35

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Crysis 2 & Homefront reviewed ★ Intel Core i7-990X, fastest CPU ever?

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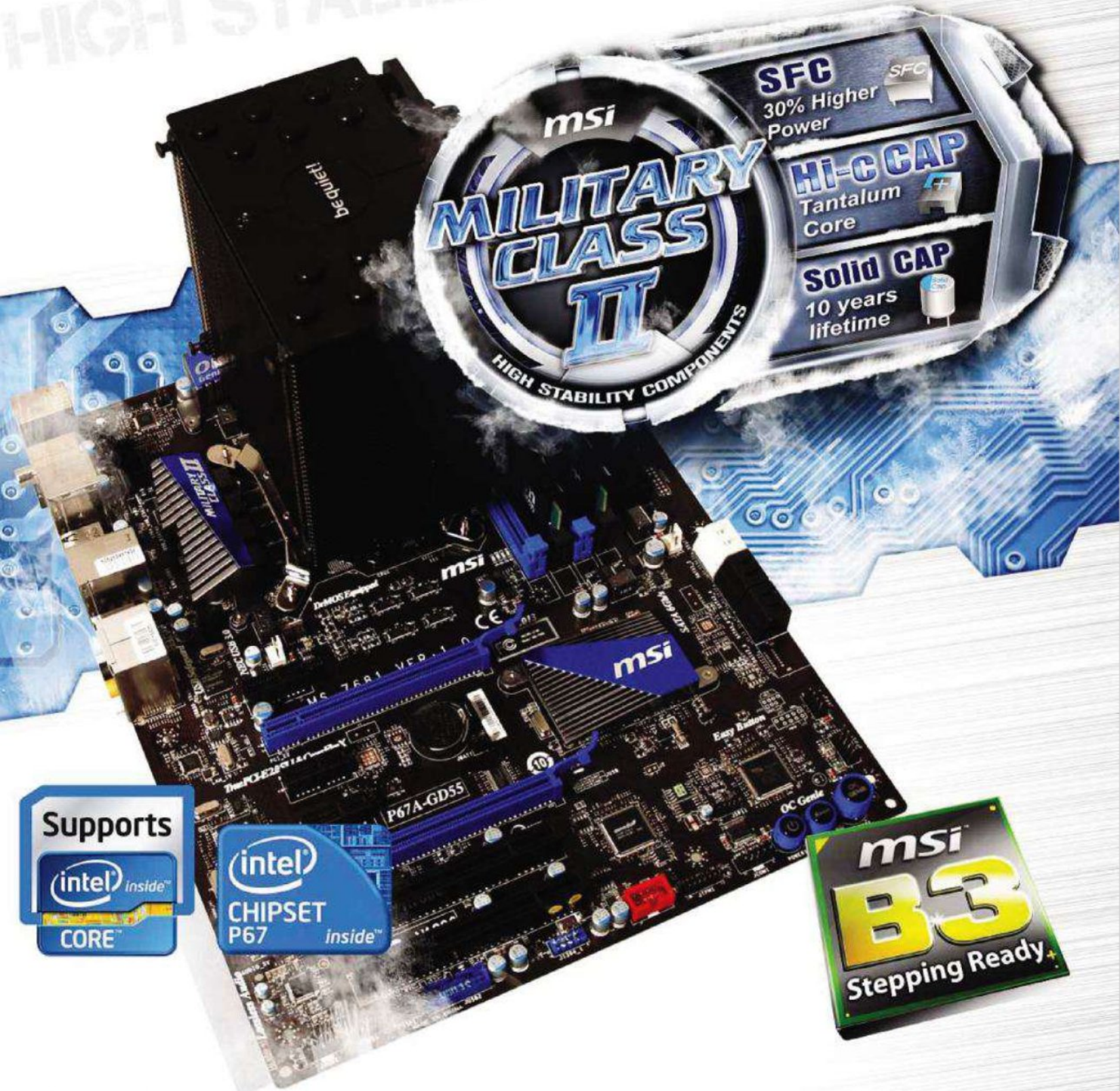

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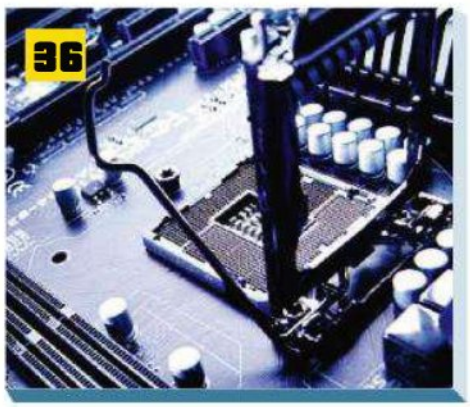
Contents

Welcome to Issue 93

Cover story

Graphics card megatest

66 If you're a keen gamer then it's crucial that you buy a good graphics card. However, with over 20 cards from which to choose, and prices ranging from £90 to £580, it's important that you don't buy the wrong card for your requirements. Our 23-page Labs test will take you through the buying process and reveal all you need to know about buying a new graphics card.



highlights

35 IS SANDY BRIDGE FIXED?
Intel has finally released a B3-stepping version of the faulty P67 motherboard chipset that it recalled earlier in the year. We test the new version to see if it introduces any new problems.

40 ASUS RAMPAGE III BLACK EDITION
Asus throws every tech and trick in the book at a single motherboard. We put it through its paces with a water chiller to see if it really is the best motherboard ever made.

44 INTEL CORE i7-990X EXTREME EDITION
Intel has produced yet another ludicrously expensive and overclockable CPU, but is it too little, too late to save the LGA1366 platform from the retirement home?

46 GREEN GADGETS LP-170 PICO-ITX
We review one of the smallest PCs in the world, but is it too small to be useful for anything?

56 DREMEL TRIO
Don't waste time cutting your case by hand; use the awesome new Dremel Trio instead; this is possibly the best modding tool ever made.

64 CUSTOM KIT
This month's gadget roundup includes a robot that will clean your house and the board game version of the PC gaming classic Civilization.

ISSUE 093

cover guide

104 CRYSIS 2
The sequel to the most hardware-breaking game makes its debut, switching the action from a lush jungle island to the concrete jungle of New York.

106 HOMEFRONT
Fed up of invading small islands in the Pacific, North Korea has decided to invade the USA in this fictional and totally preposterous first-person shooter. You have been warned ...

Regulars

7 From the Editor
9 Device manager
10 Hardware preview
12 Download
15 Incoming
18 CPC Elite products
62 How we test
101 Grumpy Gamer
114 Value Added
115 Required Playing

Community

134 Reader's Drives
138 How to make a fan blowhole
140 Mod of the Month
141 Folder of the Month
142 Your Folding milestones
143 Where's Wendel?
143 What's That?
144 For the Win!
146 PC Heaven
146 PC Hell

Reviewed this month

45 PRODUCTS REVIEWED

Hardware

PC

30 Scan 3XS Scorpion-X

HARDWARE INVESTIGATION

35 Sandy Bridge B3 chipset

MOTHERBOARD

36 Gigabyte GA-P67A-UD4-B3
40 Asus Rampage III Black Edition

PROCESSOR

44 Intel Core i7-990X Extreme Edition

SMALL FORM FACTOR BARE BONES

46 Green Gadgets LP-170 Pico-ITX

CPU COOLER

49 Be Quiet! Dark Rock Pro

CASE

52 Lian Li PC-V2120

MODDING TOOL

56 Dremel Trio

HEADSET

56 Corsair HS1A

SPEAKERS

60 Teufel Concept D 500 THX

Custom Kit

64 iLuv iSP170 Boom Cubes
64 iRobot Roomba 581
64 Bigtrak
65 Jaybird Sportsband 2
65 ION Discover Drums
65 Sid Meier's Civilization

Graphics card Labs test

68 AMD Radeon HD 6850 1GB
69 AMD Radeon HD 6870 1GB
70 AMD Radeon HD 6950 1GB and 2GB
73 AMD Radeon HD 6970 2GB
74 AMD Radeon HD 6990 4GB
76 Nvidia GeForce GTX 550 Ti 1GB
78 Nvidia GeForce GTX 560 Ti 1GB
79 Nvidia GeForce GTX 570 1.3GB
80 Nvidia GeForce GTX 580 1.5GB
82 Nvidia GeForce GTX 590 3GB

Games

102 Crysis 2
104 Shift 2: Unleashed
106 Homefront
108 Blight of the Immortals
111 Brink
112 Witcher 2: Assassin of Kings

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FROM the EDITOR

WELCOME TO CUSTOM PC

Editor James Gorbold invites you to join him on a journey exploring this redesigned and enlarged issue of **Custom PC**

Welcome to this special edition of **Custom PC**. Whether you're new to the magazine or a regular reader, you may have already noted that this edition of **Custom PC** is presented in an all-new form factor.

Custom PC has always stood out in newsagents – it was the first PC publication to be printed on oversized A4 paper and to make extensive use of glorious full-bleed images that allowed you to get up close and personal with the amazing hardware that we review. However, after producing 92 issues in this format, we felt it was high time for **Custom PC** to evolve further.

Therefore, from this issue onwards **Custom PC** will be presented in this compact new form factor, making it much easier to carry around with you and archive at home.

This isn't the only change we've made though; we've also added 16 more pages so that you can read about more hardware, overclocking, modding and gaming in every issue. In the modern world of VAT increases and inflation, you'll also be pleased to hear that you can acquire all this extra valuable editorial content without paying a penny more.

> We've also added 16 more pages so that you can read about more hardware, overclocking, modding and gaming

Speaking of content, we've also restructured **Custom PC** so that you can find related articles more easily. For example, we've created a new gaming section focusing on the best new releases, plus highlights from the gaming community in the shape of the most interesting mods and web games.

We've also created a new modding section, which includes an easy-to-follow, step-by-step guide, and the best in-progress and complete mods by other readers of **Custom PC**. If you continue to buy **Custom PC** every month, you'll soon learn all the skills you need to make your own eye-catching mod or scratch-built PC.

Finally, we've taken a long hard look at the Elite section – our shopping guide to the best components and peripherals that we've reviewed. The old design has been replaced by a sleek new shopping list-style guide that makes it far easier to decide which components work best together, and which upgrades are the most worthwhile.

Complementing all this brilliant new content is a fresh look for the entire magazine. The intention behind this redesign was to clean up the look and feel of **Custom PC** – the old design was showing its age and the pages were becoming strewn with an ever-increasing number of elements.

I'm confident that once you've read through and experienced this new and enlarged edition of **Custom PC** that you'll agree the new look is considerably more pleasing to the eye. It allows you to find the information you need more easily, whether it's an at-a-glance overview of a single product, or its key tech specs and scores in our benchmarks. Similarly, the new structure will allow you to find the subjects in which you're interested more quickly.

I hope you enjoy reading the new issue as much as we enjoyed crafting it for you. Let me know what you think.

EDITOR@CUSTOMPC.CO.UK

James is the group editor of **Custom PC**, **bit-tech** and **bit-gamer**, but he still finds time to acquire the latest CPUs from AMD and Intel in the dimly lit corners of London nightclubs.

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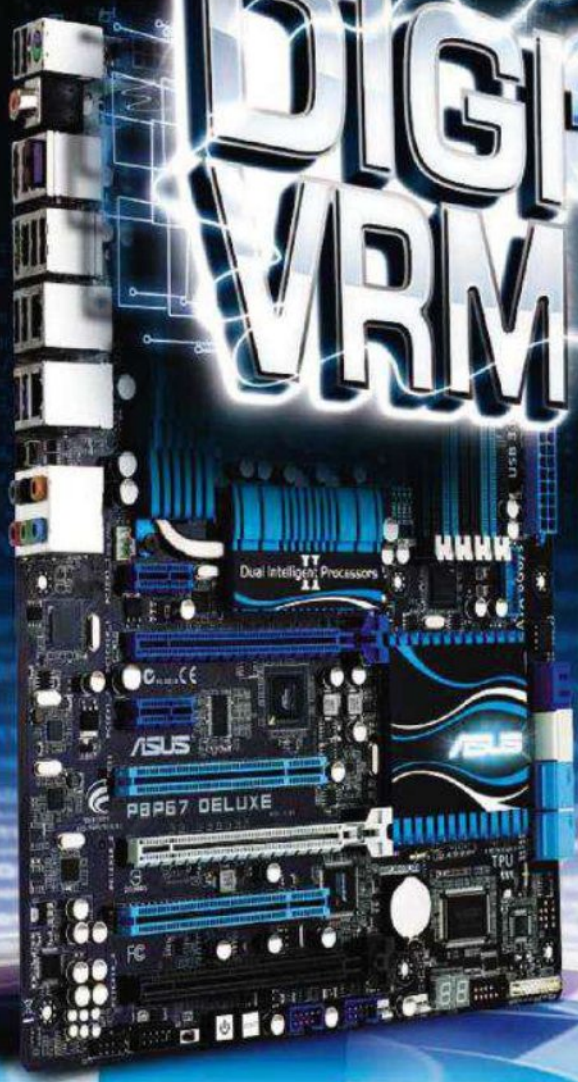

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YOUR PC ISN'T FAST ENOUGH

Deputy editor Clive Webster gives you some ammo for the next time someone says that you don't need a faster PC

Mention that you're running an overclocked Core i7 PC with a GeForce GTX 570 1.3GB graphics card and most people will look at you in bewilderment. They'll trot out some line about all PC games just being console ports, and that their three-year-old Dell is 'fast enough'. Don't agree with them – they're wrong.

It isn't only dedicated **Custom PC** readers and staff that think so. We're not deluded show-offs with nothing better to do with our cash – the entire IT industry believes that PCs need to be faster. AMD, Intel and Nvidia's latest products illustrate this. Intel's Turbo Boost is a way of cheating to deliver more performance. A few years ago, the idea of a CPU that runs beyond its default spec was unthinkable, but it's now the norm, with AMD adding similar technology to its latest CPUs. Even better, while Intel says it developed its Sandy Bridge range of LGA1155 CPUs for laptops and power efficiency, it also made them incredibly fast at processing data.

Then there's the graphics market, with both Nvidia and AMD chucking the PC rulebook in the bin in the quest for more speed. Not only do the two latest dual-GPU cards (see p74 and p82) break the PCI Express 2.0 power draw spec, but both companies have developed ways of delivering higher default frequencies than they strictly should have. Previously, the default speeds of a GPU were set with a worst-case power draw and thermal tolerance in mind, using applications that are essentially thermal viruses.

However, as games are less demanding, both Nvidia and AMD have used less taxing applications to define the default frequencies of their latest generations of GPUs. They've also built in a way of reducing the frequency should the card encounter a harsher workload. Add in quick-response SSDs and faster memory, and you can see that speed matters to the people who design and make the innards of PCs.

Your sceptical friend might well retort that of course the likes of Intel, AMD and Nvidia are making increasingly faster products – that's what they do. Here's where you spring the trap: speed sells, otherwise these companies, with their primary objectives of increasing the performance of their products, would have folded ages ago. There's huge and widespread demand for faster PC components, because PCs still aren't fast enough.

> A few years ago, the idea of a CPU that runs beyond its default spec was unthinkable, but it's now the norm

If your friend still isn't swayed, consider the trends of the industry – touch-screen PCs aim to make using a PC more immediate and responsive, while Microsoft and Apple are constantly researching quicker, more intuitive user interfaces. Swedish company Tobii Technologies even thinks that the mouse is too slow to control your cursor, and has developed a device that lets you browse a GUI almost instantly using only your eyes. Once your friend is convinced of the need for faster PC hardware, you can show them the Overclocking Masterclass in Issue 91 and point out that a subscription to **Custom PC** costs just £1 for the first three issues.

CLIVE@CUSTOMPC.CO.UK

Having bought the Battlestar Galactica box set, I'm wondering whether it's healthy to watch three hours of top-notch sci-fi every night. Answers on a postcard with all the corners cut off please.

Preview

We take a look at the hottest new hardware

DRIVE BAY HEAVEN

The TJ11 has a mass of external 5.25in drive bays – nine in total. There are also six internal 3.5in drive bays in hot-swappable cages and three 2.5in mounts for SSDs.

JUST IN... SILVERSTONE TEMJIN TJ11

Our favourite case for a water-cooled PC has competition – its big brother has just arrived

DROP TOP

The motherboard is rotated by 90 degrees, as in the Raven RV02. This means that the I/O panel is at the top of the case. The roof is detachable, providing access to the cables.

CHAMBER OF SECRECTS

Two drive cages in the base are removable, providing a huge chamber for water-cooling hardware. A quad 120mm-fan radiator fits in with plenty of room to spare.

ALL-ALU

Apart from the side window and plastic detail, the entire case is made of thick aluminium sheet, which has been powder-coated black. The case still weighs a hefty 17kg though.

download

A roundup of the hottest tech news

Asus ships Transformer hybrid tablet

Asus is already attempting to combat the new iPad 2 with the announcement that it's shipping its hybrid tablet-netbook, the Eee Pad Transformer. Despite the name, however, there's sadly no Decepticon or Autobot badge to be found on it.

The Transformer's design separates the tablet portion of the device from the main body, which houses a keyboard and touchpad. According to Asus, the Transformer is 'the best tablet choice for users looking for both media consumption and mobile productivity', but then Asus would say that, wouldn't it?

As if a neat keyboard docking unit wasn't enough, both the tablet and the keyboard portions of the Transformer are fitted with batteries, with Asus claiming that it has a 'combined battery life of up to 16 hours.*' The star leads to some small print stating that '9.5 and 16 hour battery life estimated under certain conditions'.

The Transformer uses a combination of Asus' Waveshare user interface and Android 3.0 operating system, and Asus hopes that the Transformer will be a 'trendsetting tablet experience' due to its Flash support. The latter feature is an infamous omission on Apple's iPads.

The screen of the Transformer sports an IPS panel covered with scratch-resistant glass, as well as a pair of cameras, just like the iPad 2. The rear-mounted camera is a 5-megapixel unit, while the front-facing camera captures only 1.2 megapixels. The keyboard unit also has two USB ports and an SD card reader, making it more flexible than the iPad's proprietary connection.

Under the hood, the Transformer is powered by an Nvidia Tegra 2 dual-core processor and GPU, so it should be capable of running high-quality 3D games.

We've already had a look at some Asus Eee pads and liked their minimalist design. However, the battery life in real-world use remains a mystery until we can test the Transformer in our lab.

+2 LORE

Firefox 4 downloaded 24 million times in three days

Mozilla Foundation's Firefox 4 web browser has already been downloaded more than 24 million times in just three days, according to Mozilla's download statistics.

Firefox 4 was officially announced on Tuesday, 22 March, and netted 7.1 million downloads in the first 24 hours it was available. This is three times as many downloads as Microsoft's new Internet Explorer 9 browser managed during the first day of its launch on 14 March.

At the 25 million download mark, Europe had the highest number with 9.75 million downloads. Next in line was North America with 8.34 million, followed by Asia with 4.25 million downloads.

Meanwhile, Google released version 10 of its forthcoming Chrome browser earlier this month. The next few months could see significant changes in browser usage, with the three companies vying for market share with greatly improved browsers.

BioWare warns of The Old Republic scams

BioWare has warned gamers that it has become aware of scams that claim to offer access to a beta of its upcoming MMO, Star

OCZ buys Indilinx

OCZ surprised the tech industry by announcing that it had acquired controller chip manufacturer Indilinx for $32 million.

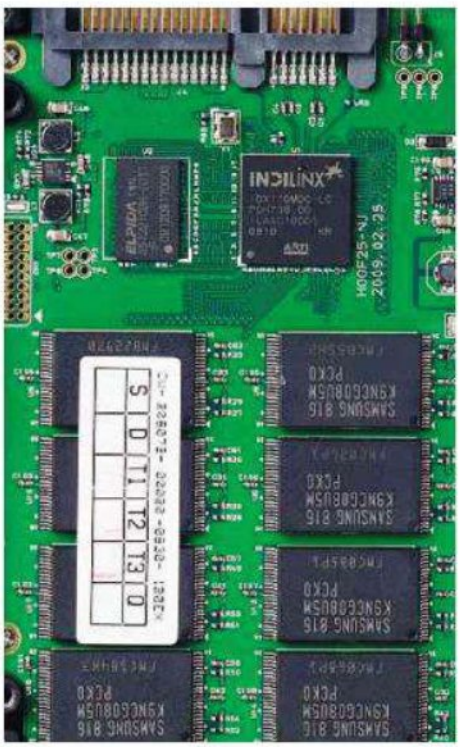
OCZ paid for the deal with shares in the company, meaning that former Indilinx shareholders now own a substantial 9.5 per cent stake in OCZ Technology Group Inc. The deal also safeguards all facets of the Indilinx business, with its founder and president Bumsoo Kim remaining in charge of the company's 45 employees.

Part of the motivation for the deal on OCZ's part seems to be the acquisition of around 20 patents and patent applications, which are currently held by Indilinx.

OCZ also claims that the deal will 'extend OCZ's capabilities with advanced controller technology including Tinkerbell, a high-performance eMMC 4.4 x controller that replaces SSDs in consumer electronic devices such as smartphones, tablet PCs, GPS units and netbooks'.

The move also raises the question of what OCZ has planned for its SSD business. The company has had a long-standing relationship with both Indilinx and SandForce, and both companies have supplied controller chips for various models in OCZ's SSD range.

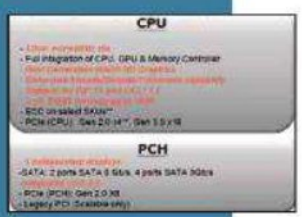
OCZ has attempted to reassure partners



such as SandForce via a press statement, which firmly states that it will continue to use other controller chips, and that Indilinx will continue to supply chips to other SSD manufacturers. How long this is likely to last is open to debate, though, as OCZ will want to see a tangible benefit from its purchase at some point.

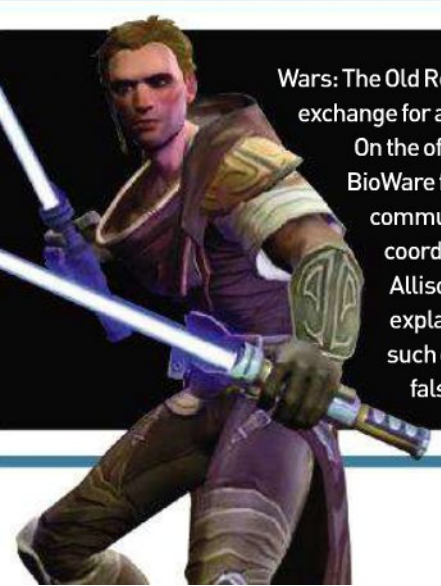
RUMOUR CONTROL

A leaked slide from an Intel presentation detailing its forthcoming 22nm Ivy Bridge LGA1155 processors and chipset has appeared online. If genuine, the slide confirms that the new range of processors will introduce support for PCI-E 3.0. Like Intel's current LGA1155 CPUs, they'll supply just 16 lanes, but each lane will offer 1GB/sec of bandwidth in each direction, as opposed to the 500MB/sec offered by PCI-E 2.0 lanes.



However, this is unlikely to make much difference to your current graphics card's performance; even top-end cards struggle to max out the bandwidth on offer from PCI-E 2.0 slots.

In addition to the PCI-E upgrade, the slide also says the new processors will have a refresh of the Intel HD graphics core built into the chip. The slide also seems to back up a previous leaked presentation that allegedly confirmed native USB 3 compatibility from the Panther Point chipset, which will accompany the new processors.



Wars: The Old Republic, in exchange for a small fee. On the official BioWare forums, community coordinator Allison Berryman explains that all such offers are false and that the only way to obtain beta access would be with an invitation from the developer itself, which wouldn't incur a charge.

'It has come to our attention that there are multiple individuals and sites claiming to sell testing accounts, "beta keys", or other offers of access to our Game Testing Program,' reads the full statement.

'All of these offers are false. BioWare is not issuing invites to Game Testing via any method other than those we outline here on SWTOR.com.'

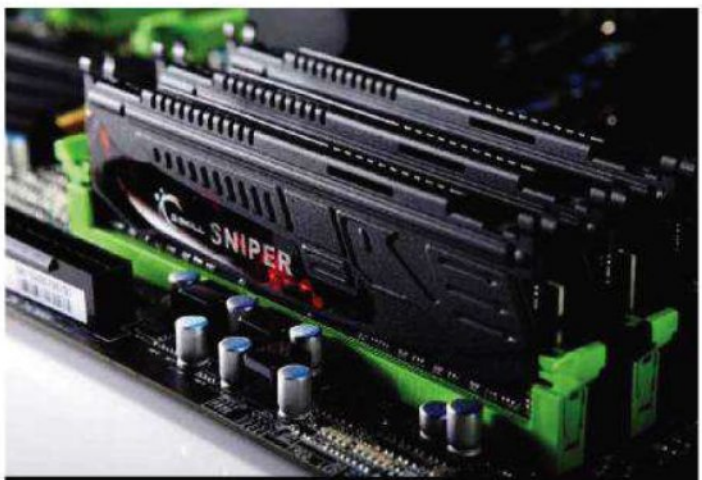
'You may also encounter email scams that indicate you've been invited to the Game Testing Program. If you are invited to the real Game Testing Program, you will receive an email with instructions from no-reply@bioware.swtor.com. Any other email address claiming to offer an invitation is likely to be a scam.'

incoming

We take a look at the best newly announced products

SCREAMING FOR VENGEANCE

If you're looking for a cheap route to super-fast overclockable memory, Corsair's 2GHz (PC3-16000) additions to its Vengeance range (see Issue 91, p49) could be just the ticket. Our tests show that you won't see much performance benefit from anything above 1,600MHz on Sandy Bridge systems, but you can't complain when a 4GB dual-channel 2GHz kit costs just £52 inc VAT from **www.scan.co.uk**.



LOW VOLTAGE, ROCK 'N' ROLL

Memory overvolting is less appealing since Intel introduced its integrated memory controller, not to mention the associated heat problems, but now you needn't use a silly amount of power to achieve a good overclock. G.Skill's Sniper memory is designed for low-voltage overclocking, with speeds of up to 1,600MHz with 9-9-9-24 latency timings, all with just 1.25V.

MASSIVE MEDIA SERVER

Western Digital's My Book Live is only the size of a typical hardback book, but it now has a library-sized 3TB capacity. With Gigabit Ethernet, it also offers much quicker transfer speeds than your average USB 2 drive. Built-in media server features enable it to stream your media collection to any PC on your network, as well as an Xbox 360 or PS3, while bundled software helps it to interact with Apple and Android devices. It's available from **www.shopwd.co.uk** for £230 inc VAT.

BEN HARDWIDGE

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Fractal Design's new Arc Midi Tower is an ATX case designed with water cooling in mind, but measures just 230 x 515 x 460mm (W x D x H). Despite its size, the Arc Midi has room for a dual 120mm-fan radiator in the roof, and there's space for eight fans too.

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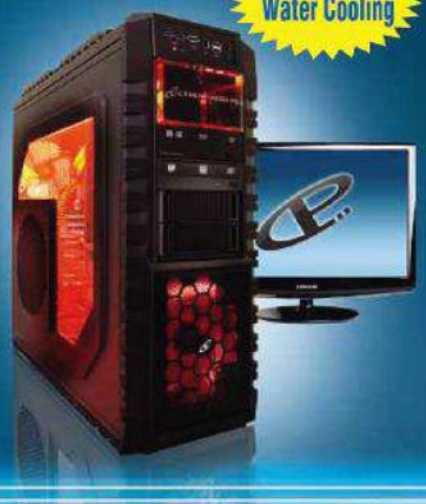

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	i7-2600 3.4/3.Ghz	£889
i5	i5-2500K 3.3/3.7Ghz	£815
	i5-2500 3.3/3.7Ghz	£805
	i5-2400 3.1/3.4Ghz	£789
	i5-2300 2.8/3.1Ghz	£785
i3	i3-2100 3.1Ghz	£725

From **£725** Incl. Del & VAT

Infinity Apollo SE

Great Value for Money Home PC with Water Cooling
Intel® Core™ i3 Processor

Genuine Microsoft™ Windows® 7 Home Premium 64-bit Edition

ASUS® H67 chipset MB

4GB Corsair DDR3 1333Mhz Memory

500GB 7200rpm SATA II 3.0Gb/S 16BM Cache HDD

Integrated Intel HD Graphic (HDMI)

Thermaltake V3 Mid-Tower Case

Asetek 510LC CPU Water Cooling System
LCD monitor is not included but optional

Intel® Core™ i7 Processor		
i7	i7-2600K 3.4/3.8Ghz	£649
	i7-2600 3.4/3.Ghz	£635
i5	i5-2500K 3.3/3.7Ghz	£565
	i5-2500 3.3/3.7Ghz	£555
	i5-2400 3.1/3.4Ghz	£539
	i5-2300 2.8/3.1Ghz	£535
i3	i3-2100 3.1Ghz	£475

From **£475** Incl. Del & VAT

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www.cyberpowersystem.co.uk

Gamer Xplorer X6-9100

Gaming Laptop with 2nd Generation
Intel® Core™ i3-2310M Processor

Intel® HM65 Chipset
WiFi Link 802.11 A/B/G/N

1x HDMI

Genuine Microsoft™ Windows® 7 Home Premium 64-bit Edition

1x IEEE 1394

4GB DDR3-1333 SODIMM Memory

3x USB 2.0

320GB SATA II HDD

3 hr

15.6 WSXGA Full HD Display 1920x1080

Intel Integrated GeForce® PCI-Express Video card

1 PCMCIA Type II Slot
2.0 Mega Pixels Webcam

6.83 Lbs

Intel® Core™ i7 Processor		
i7	i7-2920XM Extreme	£1039
	i7-2820QM	£929
	i7-2720QM	£799
	i7-2630QM	£659
i5	i5-2410M	£645
i3	i3-2310M	£599

From **£599**

Gamer Xplorer X6-9200

Gaming Laptop with 2nd Generation
Intel® Core™ i7-2630M Processor

Intel® HM65 Chipset
WiFi Link 802.11 A/B/G/N

1x HDMI

Genuine Microsoft™ Windows® 7 Home Premium 64-bit Edition

1x IEEE 1394

8GB DDR3-1333 SODIMM Memory

3x USB 2.0

500GB SATA II HDD

3 hr

15.6 WSXGA Full HD Display 1920x1080

Intel Integrated GeForce® PCI-Express Video card

1 PCMCIA Type II Slot
2.0 Mega Pixels Webcam

5.51 Lbs

Intel® Core™ i7 Processor		
i7	i7-2920XM Extreme	£629
	i7-2820QM	£1095
	i7-2720QM	£995
	i7-2630QM	£819

From **£819**

intel inside™
CORE™ i7
Visibly Smart
NEW

CYBERPOWER

Windows®. Life without Walls™, CyberPower recommends Windows 7

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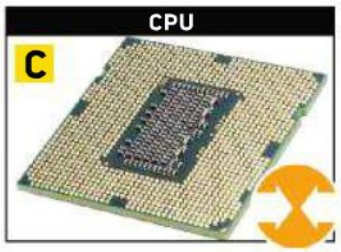
Our choice of the best hardware available

budget PC

You don't have to spend an astronomical sum to get a decent PC. Our stunning value build includes 4GB of branded memory and a dual-core Intel CPU that can be easily overclocked to 4GHz



	NAME	SUPPLIER	MANUFACTURER	REVIEWED	PRICE (inc VAT)
A	Antec One Hundred	www.scan.co.uk	www.antec.com	Issue 92, p59	£42
B	Asus P7H55-M	www.scan.co.uk	http://uk.asus.com	Issue 83, p112	£67
C	Intel Pentium G6950	www.scan.co.uk	www.intel.co.uk	Issue 84, p44	£73
D	Corsair Vengeance 4GB PC3-12800	www.yoyotech.co.uk	www.corsair.com	Issue 91, p49	£41
E	Zotac GTX 550 Ti 1GB	www.ebuyer.com	www.zotac.com	Issue 93, p76	£120
F	Arctic Cooling Freezer 7 Pro Rev.2	www.cclonline.com	www.arctic-cooling.com	Issue 76, p110	£15
G	Antec TruePower New TP-650	www.ebuyer.com	www.antec.com	Issue 78, p86	£85
H	Western Digital WD3200AAJS Caviar Blue	www.ebuyer.com	www.wdc.com	Issue 83, p112	£31
I	Samsung SH-S223C	www.cclonline.com	www.samsung.com	Issue 86, p113	£12
J	Microsoft Windows 7 Home Premium 64-bit	www.scan.co.uk	www.microsoft.com	Issue 75, p46	£115
				TOTAL SYSTEM PRICE	£601 £132

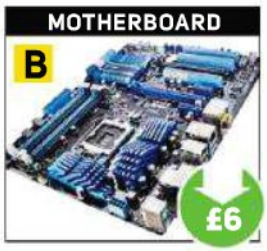
PRICE TRACKING £100 Indicates price drop since last issue

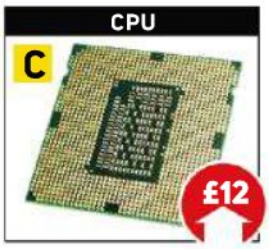
£100 Indicates price rise since last issue

Indicates no price change since last issue

mid-price gaming PC

As Core i7 motherboards and high-end graphics cards command a premium price, here are some components for a Core i5 PC that offer great performance and won't break the bank





	NAME	SUPPLIER	MANUFACTURER	REVIEWED	PRICE (inc VAT)
A	Fractal Design Define R3	www.ebuyer.com	www.fractal-design.com	Issue 88, p57	£82
B	Asus P8P67	www.ebuyer.com	http://uk.asus.com	Issue 90, p46	£120
C	Intel Core i5-2500K	www.yoyotech.co.uk	www.intel.co.uk	Issue 90, p38	£174
D	Corsair Vengeance 4GB PC3-12800	www.yoyotech.co.uk	www.corsair.com	Issue 91, p49	£41
E	Be Quiet! Dark Rock Advanced	www.scan.co.uk	www.be-quiet.net	Issue 91, p 74	£41
F	MSI GTX 560 Ti	www.ebuyer.com	http//uk.msi.com	Issue 91, p38	£201
G	Antec TruePower New TP-650	www.ebuyer.com	www.antec.com	Issue 78, p86	£85
H	Samsung SpinPoint F3 1TB	www.aria.co.uk	www.samsung.com	Issue 76, p62	£38
I	Asus Xonar DX	www.aria.co.uk	http://uk.asus.com	Issue 80, p63	£55
J	Samsung SH-S223C	www.cclonline.com	www.samsung.com	Issue 86, p113	£12
K	Microsoft Windows 7 Home Premium 64-bit	www.scan.co.uk	www.microsoft.com	Issue 75, p46	£115
				TOTAL SYSTEM PRICE	£961 £140

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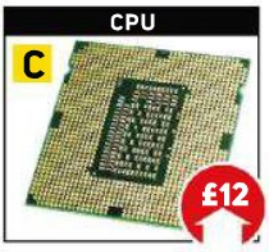
Our choice of the best hardware available

PERFORMANCE PC

The PC has the potential to be the finest gaming machine going – as well as an excellent all-round computer for office work, digital photography, video production and media playback



	NAME	SUPPLIER	MANUFACTURER	REVIEWED	PRICE (inc VAT)
A	SilverStone FT02B V1.4	www.scan.co.uk	www.silverstonetek.com	Issue 85, p88	£201
B	Asus P8P67	www.ebuyer.com	http://uk.asus.com	Issue 90, p46	£120
C	Intel Core i5-2500K	www.yoyotech.co.uk	www.intel.co.uk	Issue 90, p38	£174
D	Corsair Vengeance 4GB PC3-12800	www.yoyotech.co.uk	www.corsair.com	Issue 91, p49	£41
E	Be Quiet! Dark Rock Advanced	www.scan.co.uk	www.be-quiet.net	Issue 91, p 74	£41
F	Gainward GeForce GTX 570 Phantom	www.scan.co.uk	www.gainward.com	Issue 92, p53	£304
G	Corsair HX850	www.cclonline.com	www.corsair.com	Issue 83, p81	£121
H	Samsung SpinPoint F3 1TB	www.aria.co.uk	www.samsung.com	Issue 76, p62	£38
I	Asus Xonar DX	www.aria.co.uk	http://uk.asus.com	Issue 80, p63	£55
J	Samsung SH-S223C	www.cclonline.com	www.samsung.com	Issue 86, p113	£12
K	Microsoft Windows 7 Home Premium 64-bit	www.scan.co.uk	www.microsoft.com	Issue 75, p46	£115
				TOTAL SYSTEM PRICE	£1,222 £122

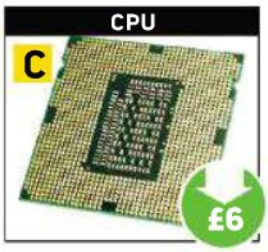
PRICE TRACKING £100 Indicates price drop since last issue

£100 Indicates price rise since last issue

Indicates no price change since last issue

extreme ultra PC

If you find budgets boring and saving pennies soporific, try this list of the finest, fastest and craziest components around, which will combine to create the ultimate gaming PC



	NAME	SUPPLIER	MANUFACTURER	REVIEWED	PRICE (inc VAT)
A	SilverStone TJ07B-W	www.yoyotech.co.uk	www.silverstonetek.com	Issue 63, p87	£233
B	Asus P8P67	www.ebuyer.com	http://uk.asus.com	Issue 90, p46	£120
C	Intel Core i7-2600K	www.scan.co.uk	www.intel.co.uk	Issue 90, p38	£228
D	Crucial Ballistix Smart Tracer 4GB	www.crucial.com	www.crucial.com	Issue 92, p72	£67
E	Your favourite waterblocks, radiator, pump, tubing and reservoir				
F	Asus GeForce GTX 590 3GB	www.yoyotech.co.uk	http://uk.asus.com	Issue 93, p82	£587
G	Enermax Revolution 85+ 1.25kW	www.scan.co.uk	www.enermax.co.uk	Issue 83, p81	£214
H	Crucial C300 256GB	www.dabs.com	www.crucial.com	Issue 84, p69	£347
I	Creative X-Fi Titanium Fatal1ty Pro	www.scan.co.uk	www.uk.europe.creative.com	Issue 62, p61	£99
J	Samsung SpinPoint F3 1TB	www.aria.co.uk	www.samsung.com	Issue 76, p62	£38
K	Microsoft Windows 7 Home Premium 64-bit	www.scan.co.uk	www.microsoft.com	Issue 75, p46	£115
				TOTAL SYSTEM PRICE	£2,048 £675

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Our choice of the best hardware available

graphics cards

TYPE	GRAPHICS CARD	GRAPHICS CARD	GRAPHICS CARD	GRAPHICS CARD
NAME	Zotac GTX 550 Ti 1GB	MSI GTX 560 Ti 1GB Twin Frozr II/OC	Gainward GeForce GTX 570 Phantom	Asus GeForce GTX 590 3GB
SUPPLIER	www.ebuyer.com	www.ebuyer.com	www.scan.co.uk	www.yoyotech.co.uk
MANUFACTURER	www.zotac.com	http//uk.msi.com	www.gainward.com	www.crucial.com
REVIEWED	Issue 93, p76	Issue 91, p38	Issue 92, p53	Issue 93, p82
PRICE (inc VAT)	£120	£201	£304	£587

gaming components

TYPE	CPU	MOTHERBOARD	COOLER	RAM
NAME	Intel Core i5-2500K	Asus P8P67	Be Quiet! Dark Rock Advanced	Corsair Vengeance 4GB PC3-12800
SUPPLIER	www.yoyotech.co.uk	www.ebuyer.com	www.scan.co.uk	www.yoyotech.co.uk
MANUFACTURER	www.intel.co.uk	http://uk.asus.com	www.be-quiet.net	www.corsair.com
REVIEWED	Issue 90, p38	Issue 90, p46	Issue 91, p 74	Issue 91, p49
PRICE (inc VAT)	£174	£120	£41	£41

PRICE TRACKING £100 Indicates price drop since last issue

£100 Indicates price rise since last issue

Indicates no price change since last issue

LGA1366 components

TYPE	CPU	MOTHERBOARD	COOLER	RAM
NAME	Intel Core i7-990X	Asus Sabertooth X58	Thermaltake Frio	Crucial Ballistix Smart Tracer 6GB
SUPPLIER	www.scan.co.uk	www.scan.co.uk	www.yoyotech.co.uk	http://shop.crucial.com/uk
MANUFACTURER	www.intel.co.uk	http://uk.asus.com	http://uk.thermaltake.eu	www.crucial.com
REVIEWED	Issue 93, p44	Issue 88, p53	Issue 86, p91	Issue 92, p72
PRICE (inc VAT)	£797	£152	£37	£102

Socket AM3 components

TYPE	CPU	MOTHERBOARD	COOLER	RAM
NAME	AMD Phenom II X6 1100T Black Edition	Asus M4A89GTD PRO/USB 3	Thermaltake Frio	Corsair Vengeance 4GB PC3-12800
SUPPLIER	www.yoyotech.co.uk	www.dabs.com	www.yoyotech.co.uk	www.yoyotech.co.uk
MANUFACTURER	www.amd.com	http://uk.asus.com	http://uk.thermaltake.eu	www.corsair.com
REVIEWED	Issue 90, p51	Issue 80, p48	Issue 86, p91	Issue 91, p49
PRICE (inc VAT)	£180	£103	£37	£41

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Our choice of the best hardware available

cases

TYPE	BUDGET CASE	AIR-COOLING CASE	WATER-COOLING CASE
NAME	Antec One Hundred	SilverStone FT02B V1.4	SilverStoneTJ07B-W
SUPPLIER	www.scan.co.uk	www.scan.co.uk	www.yoyotech.co.uk
MANUFACTURER	www.antec.com	www.silverstonetek.com	www.silverstonetek.com
REVIEWED	Issue 92, p59	Issue 85, p88	Issue 63, p87
PRICE (inc VAT)	£42	£201	£233

power supplies

TYPE	650W PSU	1.25kW PSU
NAME	Antec TruePower New TP-650	Enermax Revolution 85+ 1.25kW
SUPPLIER	www.ebuyer.com	www.scan.co.uk
MANUFACTURER	www.antec.com	www.enermax.com
REVIEWED	Issue 78, p86	Issue 83, p92
PRICE (inc VAT)	£85	£214

storage

TYPE	HARD DISK	SSD	NAS BOX
NAME	Samsung SpinPoint F3 1TB	Crucial C300 128GB	Synology DiskStation DS211j
SUPPLIER	www.aria.co.uk	www.cclonline.com	www.aria.co.uk
MANUFACTURER	www.samsung.com	www.crucial.com	www.synology.com
REVIEWED	Issue 76, p62	Issue 88, p62	Issue 90, p72
PRICE (inc VAT)	£38	£170	£154

monitors

TYPE	23IN MONITOR	27IN MONITOR
NAME	Viewsonic VP2365wb	Dell U2711
SUPPLIER	www.scan.co.uk	www.yoyotech.co.uk
MANUFACTURER	www.viewsoniceurope.com	www.dell.co.uk
REVIEWED	Issue 90, p79	Issue 81, p56
PRICE (inc VAT)	£202	£719

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Our choice of the best hardware available

audio

TYPE	SOUND CARD	2.1 SPEAKERS	5.1 SPEAKERS	HEADSET
				
NAME	Asus Xonar DX	Corsair SP2500	Logitech Z-5500	Razer Carcharias
SUPPLIER	www.aria.co.uk	www.ebuyer.com	www.play.com	www.ebuyer.com
MANUFACTURER	http://uk.asus.com	www.corsair.com	www.logitech.com	www.razerzone.com
REVIEWED	Issue 80, p63	Issue 92, p79	Issue 55, p85	Issue 87, p94
PRICE (inc VAT)	£55	£199	£312	£70

peripherals

TYPE	KEYBOARD	MOUSE	STEERING WHEEL	JOYSTICK
				
NAME	Cyborg V5	Mionix Naos 3200	Logitech G27	Logitech Flight System G940
SUPPLIER	www.scan.co.uk	www.cclonline.com	www.yoyotech.co.uk	www.ebuyer.com
MANUFACTURER	www.cyborggaming.com	www.mionix.net	www.logitech.com	www.logitech.com
REVIEWED	Issue 92, p108	Issue 92, p109	Issue 92, p108	Issue 92, p109
PRICE (inc VAT)	£34	£38	£231	£221

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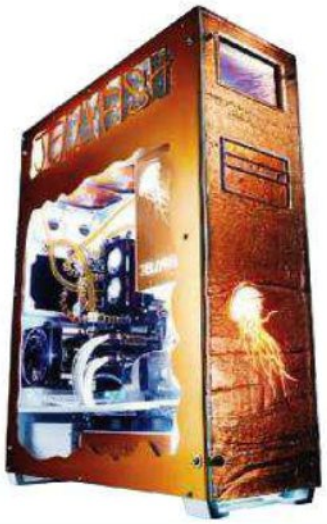
dream PC

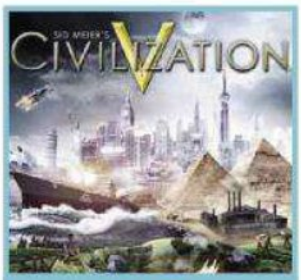


TYPE	DREAM PC
NAME	Scan Jellyfish
SUPPLIER	www.scan.co.uk
MANUFACTURER	www.scan.co.uk
REVIEWED	Issue 75, p90
PRICE (inc VAT)	From £7,016

SPECIFICATIONS

CPU cooling: XSPC Delta V3 CPU waterblock and 18 TECs.
Graphics cards cooling: 2 x full-cover GPU waterblocks.
Motherboard cooling: fully water-cooled.
1 x triple 140mm-fan Monsta radiator in roof,
1 x single 120mm-fan radiator in rear,
1 x dual 120mm-fan radiator in floor.
Misc: 1.25kW Enermax Revolution power supply,
7in Lilliput touch-screen.

games



TYPE	RPG	FPS	STRATEGY	UNDERDOG
NAME	Mass Effect 2	Battlefield: Bad Company 2	Civilization V	Chime
DEVELOPER	www.bioware.com	www.dice.se	www.firaxis.com	www.onebiggame.com
PUBLISHER	www.ea.com	www.ea.com	www.2kgames.com	
REVIEWED	Issue 79, p90	Issue 81, p90	Issue 87, p96	Issue 89, p95
PRICE (inc VAT)	£20	£20	£30	£4

Windows®. Life without walls™, PC Specialist recommends Windows 7

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you dream it... we'll build it

The Ideal starting point if you're new to the gaming scene, enjoy extreme performance for under £600!

Fusion 600 Elite PC

- AMD® Phenom™ II X4 955 Processor
- Genuine Windows 7 Home Premium
- 4GB Samsung DDR3 1333MHz RAM
- 1TB WD Caviar Green Serial ATA II Hard Drive
- 1GB ATI Radeon HD5770 Graphics
- 24x Dual Layer DVD-RW
- CoolerMaster Elite 310 Blue Case
- 19" Widescreen Monitor (1440 x 900)
- Logitech® Keyboard, Mouse & Speakers

from £599*

An AMD Hex-Core based PC with the all new HD6850 Graphics, let AMD Vision power your gaming experience.

Fusion 1000 X6 PC

- AMD® Phenom II X6 1100T Processor
- Genuine Windows 7 Home Premium
- 4GB Samsung® DDR3 1333MHz RAM
- ASUS® M4A89TD PRO/USB3 Motherboard
- 2GB AMD Radeon HD6850 Graphics
- 1TB WD Caviar Black HDD
- Corsair TX650 Power Supply
- 24x DVD RW + CD-RW
- 22" Widescreen Monitor (1920 x 1080)
- Logitech Keyboard, Mouse & Speakers

from £999*

An extremely powerful Core i7 ready laptop. Paired with the GeForce GTX460M, this Laptop is a great gaming machine, with desktop rivalling performance!

Vortex i7 Gaming Laptop

- 2nd Gen Intel® Core™ i7 Processor i7-740QM
- 17.3" Full HD Widescreen Display (1920 x 1080)
- Genuine Windows 7 Home Premium
- 4GB Samsung DDR3 1333MHz RAM
- 500GB WD Scorpio Black HDD
- 1.5GB nVidia GeForce GTX460M
- Intel Ultimate Wireless-N Network Card
- 8x DVD-RW + CD-RW
- Integrated Bluetooth & Firewire Port

from £1129*

The Enigma i7 is seen as an all-rounder. With solid gaming performance and a full HD LED backlit display, very little can compete at this price!

Enigma i7 Gaming Laptop

- Intel® Core™ i7 Processor i7-740QM
- 15.6" Widescreen Display (1920 x 1080)
- Genuine Windows 7 Home Premium
- 4GB Corsair® DDR3 1333MHz RAM
- 500GB WD Scorpio Black HDD
- 512MB ATi Radeon® HD 5650
- Wireless N Network Card
- 8x DVD-RW + CD-RW

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intel inside
CORE i5
Visibly Smart
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Vortex 3D Vision Laptop

- 15.6" Full HD LED Backlit Screen (1920 x 1080)
- Intel® Core™ Core i7 Processor i7-740QM
- **Genuine Windows 7 Home Premium**
- 4GB Samsung DDR3 1333MHz RAM
- 1GB nVidia GeForce GTX285M
- 500GB WD Scorpio Black HDD
- Onboard Gigabit LAN & Wireless N Card
- Integrated Bluetooth & 2.0 Megapixel Webcam
- Vortex 8 Cell Lithium Ion Battery
- **nVidia GeForce 3D Vision Kit**

from £1379*

This gaming beast has an nVidia 3D Vision Kit AND a ViewSonic VX2268 Monitor. Gaming will never be the same!

3D Vision 1600 PC

- Intel® Core™ Core i7 Processor i5-2500k
- **Genuine Windows 7 Home Premium**
- 8GB Samsung DDR3 1333MHz RAM
- ASUS® P8P67 Pro Motherboard
- 1536MB nVidia GeForce GTX570
- 80GB Intel® X25-M SSD
- 1TB WD Caviar Black SATA III HDD
- CoolerMaster HAF 922 Gaming Case
- Corsair TX650 PSU + CooliT ECO A.L.C Cooler
- **GeForce 3D Vision Kit & ViewSonic VX2268wm Monitor**

from £1599*

3D STARTS HERE!
NVIDIA® 3D VISION™

Extreme Overclocked Gaming PCs

The hugely powerful Intel Core i7-2500k is taken to the extreme with an **overclock up to 4.8GHz** and kept cool with the Coolit ECO liquid cooler!

O.C Gaming Desktop

- Intel® Core™ Core i7 Processor i7-2600k **@ 4.8GHz!**
- **Genuine Windows 7 Home Premium**
- 8GB Kingston Hyper-X 1600MHz RAM
- ASUS® P8P67 Pro Motherboard
- 80GB Intel® X25-M SSD
- 1TB WD Caviar Black SATA III HDD
- 1536MB nVidia GeForce GTX580
- CoolerMaster HAF-X Gaming Case
- 850W Corsair TX850 PSU
- CooliT ECO A.L.C + Arctic Cooling MX-3

from £1599*

The new Intel i5-2500k CPU taken to the extreme with a huge **overclock to 4.8GHz!** Coupled with the GTX560Ti, this will blow the competition away!

Gaming Desktop PC

- Intel® Core™ i5 Processor i5-2500k **@ 4.8GHz!**
- **Genuine Windows 7 Home Premium**
- 4GB Samsng DDR3 1600MHz RAM
- ASUS® P8P67 Motherboard
- 1TB WD Caviar Green SATA II HDD
- 1GB AMD Radeon HD6850
- CoolerMaster CM690 MKII Advanced Case
- 650W Corsair TX650 PSU
- CooliT ECO A.L.C + Arctic Cooling MX-3

from £999*

Overclocking on a budget? Look no further, the **Fusion 750 OC** is ideal for you. The extra boost in performance will help out in those tricky situations!

Budget Gaming Base Unit

- AMD Phenom II X6 Processor 1090T **@ 3.8GHz!**
- **Genuine Windows 7 Home Premium**
- 4GB Samsung DDR3 1600MHz RAM
- ASUS® M4A87TD/USB3 Motherboard
- 1TB WD Caviar Green SATA II HDD
- 1GB AMD Radeon HD6950
- 22x DVD RW + CD-RW
- PCS Maelstrom Gaming Case
- 650W Corsair TX650 PSU

from £849*

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Reviews

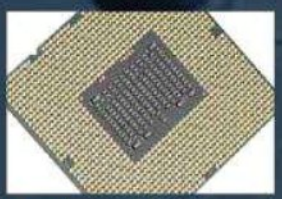
Our in-depth analysis of the latest PC hardware

Reviewed this month

32 SCAN 3XS SCORPION-X
Water-cooled PC with a 4.8GHz quad-core CPU and a GeForce GTX 590 3GB

35 SANDY BRIDGE B3 CHIPSET
The new B3 revision of the P67 chipset

40 ASUS RAMPAGE III BLACK EDITION
Asus' highest-specification X58 motherboard



44 INTEL CORE i7-990X EXTREME EDITION
Intel's new fastest 6-core LGA 1366 CPU

46 GREEN GADGETS LP-170 PICO-ITX
Tiny, Intel Atom-based PC from Israel

49 BE QUIET! DARK ROCK PRO
An effective CPU cooler with low noise levels

52 LIAN LI PC-V2120
£400 super-sized case can house even the most ambitious builds

56 DREMEL TRIO
The modder's best friend returns with a new tool for cutting up cases

59 CORSAIR HS1A
Corsair's gaming headset receives an analogue makeover

60 TEUFEL CONCEPT D 500 THX
Luxury 2.1 speakers that produce fantastic audio

HOW WE TEST, PAGE 62

Gigabyte GA-P67A-UD4-B3

The first B3-revision Sandy Bridge P67 motherboard to arrive 36

SCAN
3XS Scorpion-X

An overclocked, water-cooled, game-eating monster of a PC

+ SCORPION
Epic performance; great build quality; elite components

– SPIDER
No sound card; CPU gets very hot; exhausts hot air downwards

HOW MUCH?
Price £3,699 inc VAT
Supplier www.scan.co.uk
Manufacturer www.scan.co.uk

IN DETAIL
CPU 3.4GHz Intel Core i7-2600K overclocked to 4.8GHz
Motherboard Asus Maximus IV Extreme Rev3
Memory 8GB Corsair Vengence 1,600MHz DDR3
Graphics Nvidia GeForce GTX 590 3GB, overclocked
Sound Realtek ALC889 with 8-channel support
Storage 120GB Intel Elmcrest SSD, 2 x 1TB WD Caviar Black hard disks (RAID 1), LG BD-RW
Case SilverStone Fortress FT02B, modded
Cooling EK-Supreme HF CPU waterblock, EK-FC590 GTX waterblock, EK-Coolstream XT 360 Radiator, Swiftech MCP355 Pump, XSPC 200ml Reservoir, 6 x Akasa Black Apache fans (5 x exhaust, 1 x intake)
PSU 1.2kW Corsair AX1200
Extras Windows 7 Home Premium, Aquaero LCD monitoring system, Acronis True Image Home 2011

Thanks to the Sandy Bridge motherboard recall, we haven't had the opportunity to test a PC based around potentially the fastest CPUs for gaming ever made. Hearing of our dismay, no sooner had Scan taken delivery of its first batch of revised B3-stepping motherboards (see p35) than it started work on a super-luxury LGA1155 system with which to wow us. The result is the Scorpion-X, which sports a Core i7-2600K and the Nvidia GeForce GTX 590 3GB (see p82), both of which are water-cooled.

To house the Scorpion-X, Scan has extensively modified both side panels and the front panel of the SilverStone FT02B (see Issue 85, p88). The black aluminium has been laser-cut with the same great-looking scorpion motif on both sides, before being backed with metal mesh and painted glossy white.

The result is a beautiful case, with the black and white contrasting stylishly. The case's fascia also has its own smaller, scorpion laser-cut motif and venting.

The Scorpion-X's build is immaculate. Scan has used angled barbs to connect the various parts of the water loop, which has led to minimal tubing clutter and no chance of kinks in the loop. The black tubing looks fantastic, and the large EK-CoolStream XT 360 radiator dominates the base of the case. The radiator is sandwiched between two banks of 120mm Akasa Black Apache fans, with three below and two above (the graphics card is 11in long, meaning that a third fan can't be fitted on top).

Oddly, the fans are configured to exhaust air out of the base of the case, reversing the FT02's default cooling layout, whereby air is sucked in through the floor and exhausted through the roof. When we asked Scan the reason behind this decision, it replied that while exhausting heat upwards makes more sense, the hot air rising through the chassis effectively cooked the hardware. Exhausting air out through the bottom of the case might not be intuitive, but it means that heat is expelled out of the case. The 120mm roof fan is configured as an exhaust, which could lead to airflow contention.

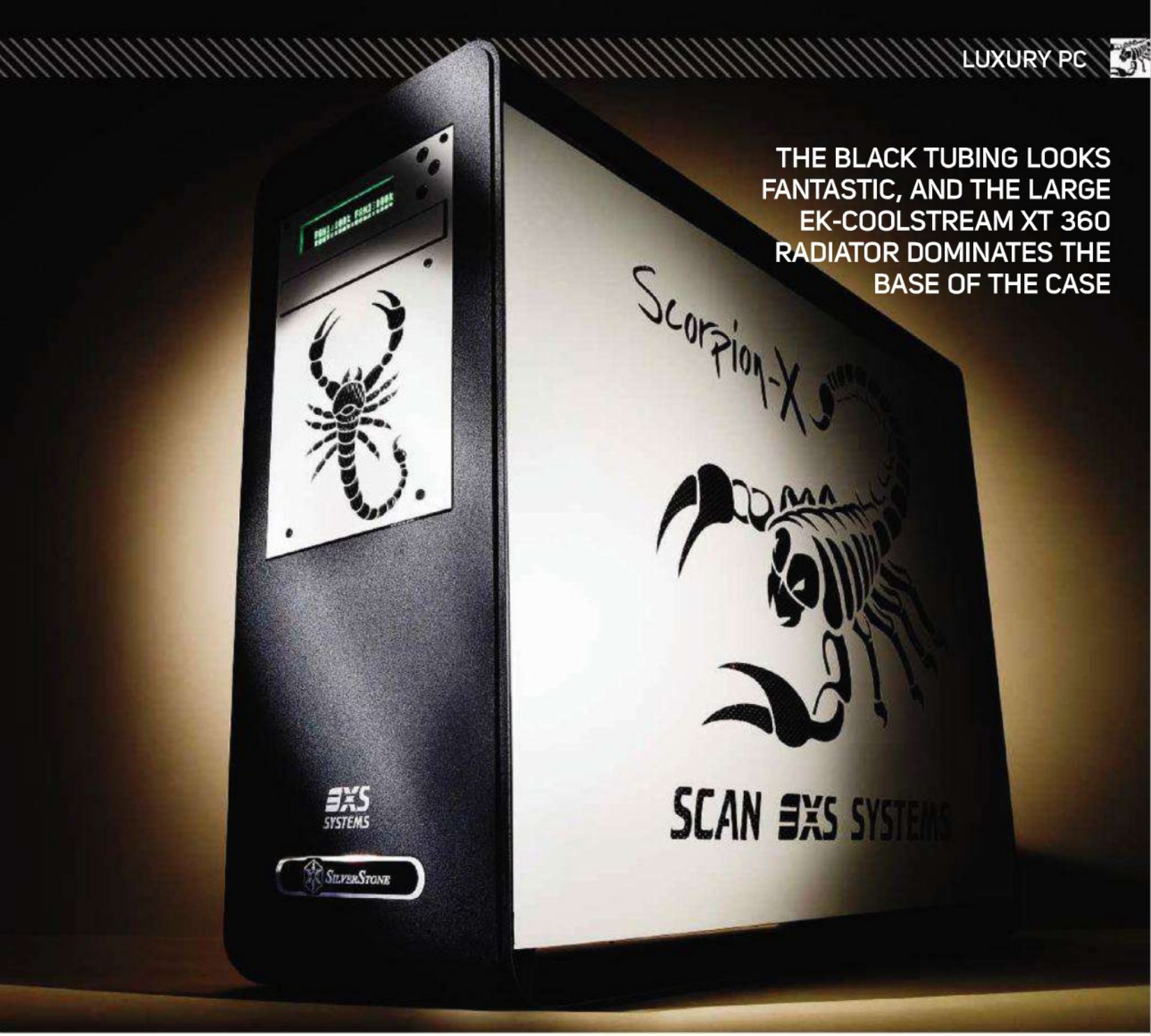
Scan has used an EK-Supreme HF CPU waterblock and a full-cover EK-FC590GTX waterblock for the graphics card. The coolant is driven through these by a Swiftech MCP355 pump, which has a flow rate of 454 litres per hour at 22psi, which is easily sufficient to make the coolant flow through the loop back to the XSPC reservoir on top of the pump. There's even a separate fill port tube tucked behind the drive bays to make draining and refilling the loop easier.

Behind the tubing is some of the very best hardware currently available. The base for the build is the Asus Maximum IV Extreme Rev3 motherboard – it's so new that we received our sample from Asus a few days after the Scorpion-X arrived. This RoG board has every cutting-edge feature you can think of, from two Gigabit Ethernet ports to six USB 3 ports on the rear I/O block and remote overclocking via RoG Connect.

The board also offers more overclocking options than we could shake an arachnid at, which is appropriate considering that the 3.4GHz Intel Core i7-2600K CPU has been overclocked to 4.8GHz. This is more than a 40 per cent increase in clock speed, and matches the best overclocks we've managed with the same CPU. This excellent overclock is achieved by using a Base Clock of 100MHz, a CPU multiplier of 48x and a vcore of 1.425V.

However, this vcore is higher than the 1.35V we've typically found we need to push a Core i7-2600K to 4.8GHz. Alongside the CPU sits 8GB of Corsair Vengeance DDR3 1,600MHz memory.

Rounding off the list of awesome hardware is an Nvidia GeForce GTX 590



THE BLACK TUBING LOOKS FANTASTIC, AND THE LARGE EK-COOLSTREAM XT 360 RADIATOR DOMINATES THE BASE OF THE CASE

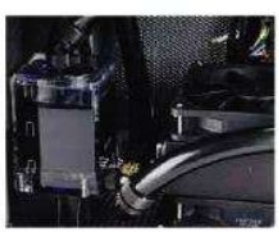
3GB graphics card. The card is equipped with two GF110 GPUs, each with access to 1.5GB of GDDR5 memory – this is a monster of a graphics card, as we found out in this month's GPU Labs test (see p66).

As standard, the GTX 590 3GB runs with a GPU core frequency of 607MHz and a stream processor clock of 1,214MHz, while the memory operates at 853MHz (3.4GHz effective). However, Scan has overclocked the card to have a GPU core clock of 650MHz and a stream processor frequency of 1,300MHz.

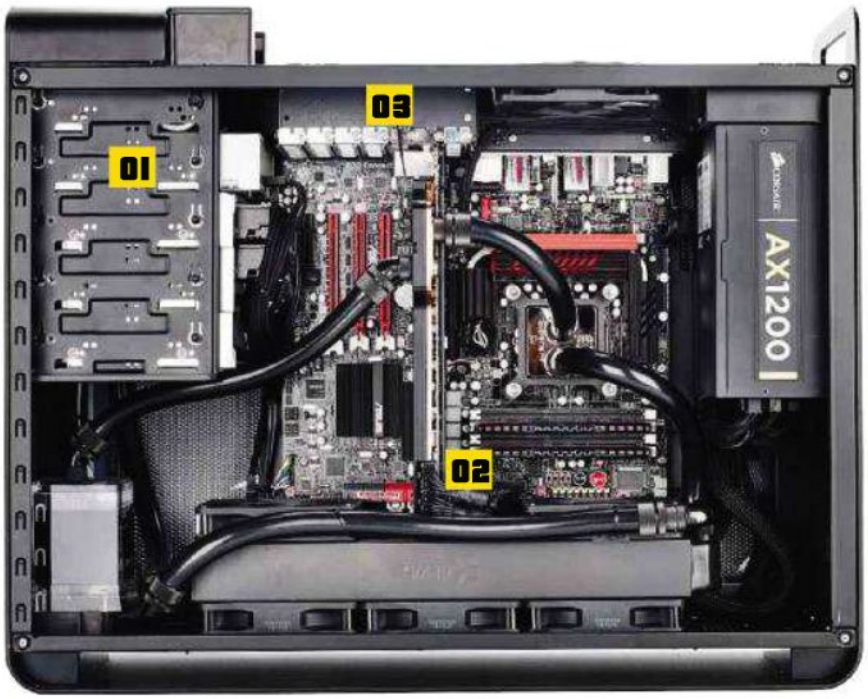
Disappointingly, considering the Scorpion-X's price, Scan hasn't included a sound card with the PC. This leaves it with just the motherboard's on-board Realtek ALC889 audio codec, which wouldn't be our first choice of sound device. Considering that the excellent Asus Xonar DX can be found for around £55, its omission is extremely stingy.

For storage, the Scorpion-X is equipped with a 256GB Intel Elmcrest SSD, which uses the same Marvell drive controller as that found in the Crucial C300, and provides sequential read speeds of up to 450MB/sec. For bulk storage, there are two Western Digital 1TB Caviar Black hard disks in a mirrored RAID 1 configuration.

Also housed in the Scorpion-X's drive bays is an Aquaero control system, with its VF display fitted in a 5.25in drive bay. The Aquaero can monitor and adjust any of the case's fan voltages (they're set to 12V by default), as well as report from one of four temperature sensors dotted throughout the case; there's even a temperature sensor fitted into the water-cooling loop to report coolant temperature. While not the most intuitive piece of equipment to use, it's well fitted and very configurable.



Scan has used angled barbs for a neater build



01 The Aquaero display installed in the top 5.25in drive bay displays fan voltages, system temperatures and even coolant temperature

02 The 11in-long graphics card means that a third exhaust fan won't fit on top of the radiator

03 The SilverStone T02 is vertically orientated, so the motherboard and expansion cards are accessed via the top of the case rather than the rear

Rounding off the build is a Corsair AX1200 PSU, complete with individually braided SATA and Molex power cables. The Scorpion-X has some of the very best hardware we've seen in the past few months.

PERFORMANCE

The Scorpion-X tore through our Media Benchmarks suite, scoring 2,168 in the image editing test, 4,066 in the video encoding test and 1,903 in the multi-tasking test. These scores are all slightly higher than those we'd expect from a system running a Core i7-2600K and resulted in a superb overall score of 2,712, the highest score we've recorded from a retail PC.

Gaming performance was even better. We saw an incredible minimum frame rate of 82fps in Arma II: Operation Arrowhead at 1,920 x 1,080 with 4x AA. This is a stupendously high frame rate. We also saw epic performance in Battlefield: Bad Company 2, with a minimum frame rate of 90fps at the same settings.

However, all this performance comes at a cost: heat, and lots of it. Running our standard 24-hour stress test of Prime95 and Unigine Heaven, we saw the CPU temperature reach 95°C in our air-conditioned lab, which is just 3°C shy of the CPU's Tjmax thermal limit. The GPUs of the GTX 590 3GB were much better behaved, though, and peaked at just 44°C above room temperature.

The Scorpion-X isn't the quietest PC we've used, but neither is it a wind tunnel. The five floor-mounted exhaust fans and the meshed side panels mean that the system was clearly audible when switched on, but the PC is significantly quieter than the reference cooler of a GTX 590 3GB.

The fact that the Scorpion-X exhausts all of its heat through the bottom of the case makes the FT02's floor plate and any surrounding surface hot to the touch, although neither became worrying toasty. The SilverStone FT02 isn't an ideal case for a water-cooled PC given its bottom-to-top airflow, although we can't argue with its gorgeous aesthetics.

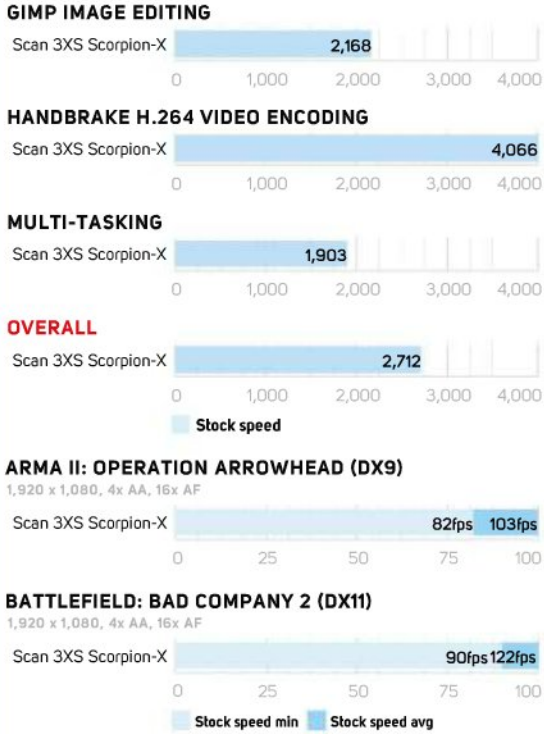
CONCLUSION

At £3,699, the Scorpion-X has to work hard to justify itself, and its incredible performance goes a long way towards that. There's also the excellent presentation of the Scorpion-X: the clean laser cutting of the scorpion motifs and the immaculate interior build. Add in the two-year warranty, and the price is reasonable.

However, high CPU temperatures, the lack of a sound card, and the amount of heat kicked out of its base are problems. Scan is looking into these issues, but we'd drop the CPU vcore to around 1.35V, even if that meant having to reduce the overclock.

HARRY BUTLER

Results



Scores

SPEED 28/30
DESIGN 22/30
HARDWARE 22/25
VALUE 10/15

Custom PC 82% OVERALL

IS SANDY BRIDGE FIXED?

Intel's fixed B3-stepping P67 chipset is finally here – we find out if it's as fast as the flawed original

+ B-52
Just as fast as the original B2 Cougar Point chipset; won't corrupt data

– B-2 SPIRIT
Took long enough to arrive

The billion dollar cock-up, Intel's shame, the great SATA headache; however you want to describe the recall of the first round of LGA1155 motherboards, the good news is that boards with the fixed B3-stepping silicon are finally on sale. The question now is whether Intel had to make any compromises to ensure the SATA 3Gbps ports are safe. The fault that caused the recall was due to a transistor within the chipset that sometimes leaked too much voltage and therefore harmed any storage devices that it controlled. The fix required a manufacturing redesign, so we wanted to determine if the new chipset was as fast (or faster) than the old.

To ascertain if the B3 and B2 steppings perform differently, we grabbed a quarantined B2 Asus P8P67 Deluxe and compared it with a similar, though less luxurious, B3-revision Asus P8P67-M Pro. As both motherboards are members of the same range from the same manufacturer and share very similar EFIs, this is a fair comparison. To test them, we used the dependable Crucial RealSSD C300 256GB SSD, which is capable of extraordinary read speeds in excess of 340MB/sec on high-speed SATA 6Gbps ports.

We were happy to find that there was virtually no difference between the performance of the SATA 6Gbps ports on the recalled B2 and the shiny new B3 chipsets. This was to be expected, as the chipset flaw only applied to the SATA 3Gbps ports. AS SSD measured the C300's sequential read speeds at 344MB/sec and 345MB/sec on the B2 and B3 chipsets respectively, which are superb results.

Moving on to SATA 3Gbps testing, there was again minimal difference between the performance of the B2 and B3 steppings. In AS SSD, the B2 stepping produced a sequential read speed of 267MB/sec compared to the 268MB/sec of the B3 board. Sequential write speeds were also similar, with the B2 board managing 208MB/sec compared to the 210MB/sec of the B3. Random performance was also unaffected by the silicon fix. Both boards produced a single-threaded random 4KB write speed of 47MB/sec in AS SSD, and a single-threaded 4KB read speed of 24MB/sec.

CONCLUSION

It's clear that Intel's B3 stepping of the 6-series chipset has no ill effects on sequential and random read and write speeds. The B2 and B3 boards performed similarly, with the SATA 6Gbps ports still fast. Hopefully, this will be the last we hear of the B2-stepping P67 chipset, and you can grab a super-fast P67 system without the worry of corrupted data on devices plugged into the SATA 3Gbps ports.

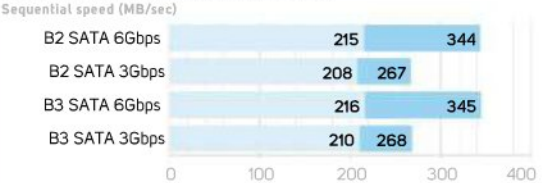
HARRY BUTLER

THE FIX REQUIRED A MANUFACTURING REDESIGN SO WE WANTED TO DETERMINE IF THE NEW CHIPSET WAS AS FAST AS THE OLD

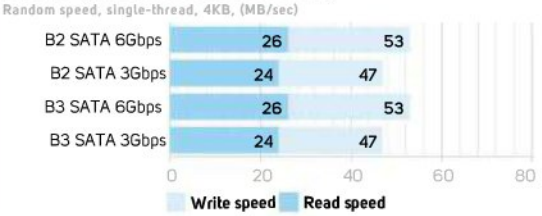
TEST KIT
3.3GHz Intel Core i5-2500K CPU, 4GB Crucial Ballistix Tracer 1,600MHz DDR3 memory, 512MB Nvidia GeForce GT 240 graphics card, PC Power and Cooling Silencer 750W PSU, Windows 7 Home Premium 64-bit, Windows AHCI driver (msahci.sys)

Results

AS SSD (UNCOMPRESSIBLE DATA)
Sequential speed (MB/sec)



AS SSD (UNCOMPRESSIBLE DATA)
Random speed, single-thread, 4KB, (MB/sec)



GIGABYTE GA-P67A-UD4-B3

The first Gigabyte LGA1155 board we've seen is a little disappointing

+ BLACK
Looks great; excellent power circuitry

– BLUE
Doesn't overclock well; no EFI; mediocre SATA performance

HOW MUCH?
Price £148 inc VAT
Supplier www.novatech.co.uk
Manufacturer www.gigabyte.com
SKU number GA-P67A-UD4-B3

IN DETAIL
Chipset Intel P67
CPU support LGA1155 Core i3, Core i5 and Core i7
Memory support 4 slots: max 32GB DDR3 (2,133MHz)
Expansion slots Two 16x PCI-E 2.0 slots (16x or two 8x), two PCI, three 1x PCI-E
Sound Intel HD Audio via Realtek ALC892/889 with 8-channel support
Networking Realtek RTL8111E Gigabit Ethernet
Overclocking CPU clock 80 – 300MHz; max voltages, CPU 1.7V, QPI VTT 1.7V, System Agent 1.305V, PCH 1.94V, RAM 2.6V, PLL 2.52V
Ports 4 x SATA 3Gbps, 2 x SATA 6Gbps, PS/2, 14 x USB 2, 4 x USB 3, LAN, 4 x surround audio out, line in, mic, optical and coaxial S/PDIF out, 2 x eSATA 6Gbps
Dimensions (mm) 305 x 244 (ATX)

We haven't seen any new LGA1155 motherboards in the **Custom PC** lab for a couple of months. This is because we've been taking a hard line with manufacturers, refusing to test any motherboards that were based on the faulty B2-stepping 6-series chipsets. There's no point in testing products that are both known to be flawed and will soon be superseded by new models.

Fortunately for the IT industry, the crisis seems to be at an end, as boards based on the updated and fixed B3 stepping of the P67 and H67 chipsets are now available to buy. The first of these boards to hit our lab is the grandly titled Gigabyte GA-P67A-UD4-B3, which retails for a smidgen under £150.

That nomenclature may seem incomprehensible at first, but to those with an educated eye it tells us that it's a motherboard based on the P67 chipset. The UD4 portion of the name reveals that the board resides in the middle of Gigabyte's collection of LGA1155 motherboards; these boards range from the budget UD2 to the premium UD7. We're also pleased to see the B3 suffix added to the name of the board – this denotes that the board carries the latest version of the P67 chipset. This makes it fairly clear – as long as you know your chipset steppings – that this is a board based on the fixed B3 silicon.

Visually, the UD4-B3 is very striking in its all-black livery. This is a major change for a Gigabyte board, whose traditional blue-and-white colour scheme has been a fixture in our lab for years. The change is for the better, as the board looks cutting edge and the new colours help to differentiate Gigabyte's more exciting boards from its budget offerings, which will retain the traditional blue-and-white colours.

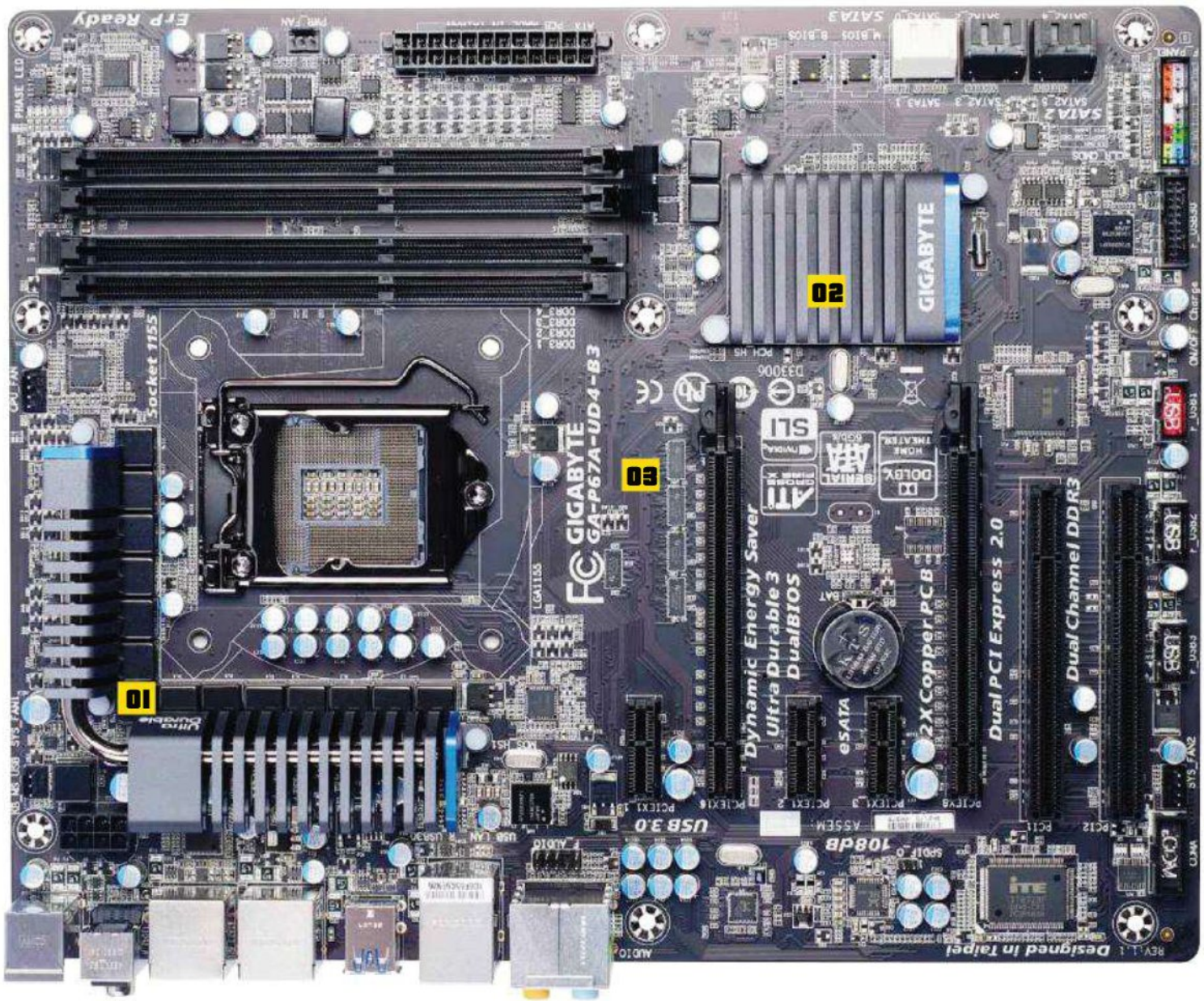
The heatsinks attached to the board also look good; we liked their chunky, futuristic styling and dull gun-metal finish. The two heatsinks that skirt the CPU socket are linked by a heatpipe and are responsible for cooling the generous 12 power phases with which the board is equipped. Power circuitry is an area that Gigabyte has paid a lot of attention to for the UD4-B3 as the board includes two fancy new Gigabyte technologies – Driver MOSFETs and Dual CPU Power. The former technology helps to reduce clutter around the CPU socket by combining the Driver IC and MOSFET components of traditional power circuitry into one single module. Gigabyte claims that this allows the VRM circuitry to run cooler and more efficiently.

Meanwhile, Gigabyte's Dual CPU Power technology is aimed at extending the operating life of the board. It does this by splitting the 12 power phases into two groups of six phases between which it alternates each time the board boots. When under load, the board unleashes all 12 phases to keep the CPU supplied with power.

The rest of the board is a more standard affair. The two SLI- and CrossFireX-enabled 16x PCI-E slots are well spaced, meaning that you can use cards with dual-slot coolers and that two water-cooled cards have plenty of breathing space. A slight niggle is that the CMOS battery will be hidden if you choose to install a dual-slot graphics card in the primary 16x PCI-E slot. The other expansion slots are well chosen and placed, though, as you can see from the photo. The board is also equipped with Gigabyte's 3x USB Power technology, which claims to supply more power to USB devices, leading to shorter charge times.

THE NEW COLOURS HELP TO DIFFERENTIATE GIGABYTE'S MORE EXCITING BOARDS FROM ITS BUDGET OFFERINGS

The rear I/O panel of the UD4-B3 is well connected with a healthy ten USB connections, two of which are blue USB 3 ports. Also located here is a single PS/2 port, optical and coaxial S/PDIF outputs, a pair of eSATA 6Gbps ports and a single LAN port. These are complemented by three internal USB 2 headers and an extra USB 3 header, each of which can support up to two ports.



PERFORMANCE

Storage connections are handled by the now familiar pair of SATA 6Gbps and four SATA 3Gbps ports. These performed fairly well, with a read speed of 192MB/sec and a write speed of 278MB/sec for the SATA 3Gbps ports and of 214MB/sec read and 356MB/sec write for the SATA 6Gpbs ports. The pair of white SATA 6Gbps ports were around 10MB/sec slower than other P67 motherboards (see p35).

Happily, we found that the UD4-B3 offered the same blistering performance in our Media Benchmarks to which we've become accustomed to seeing from LGA1155 boards. Its score of 1,614 points in the image-editing portion of the suite is the best stock speed result we've seen, though admittedly only by 12 points.

The performance of the UD4-B3 declined a little in the video encoding portion of the suite, however; its result of 2,667 is well below the 2,719 that the B2-stepping MSI P67A-GD65 scored. A late rally in the multi-tasking test saw the UD4-B3 romp home with an overall score of 1,911. This is a little way away from the best result we've seen from an LGA1155 board, but it's still pretty darn swift.

As the UD4-B3 is aimed at fast PCs, it needed to perform well in games, which fortunately it did. The minimum frame rate of 37fps in Crysis meant that the UD4-B3 tied with the GD65 was the quickest board we've seen in this test, although it was fractionally slower than the MSI board when it came to its average frame rate.

Obviously, the main advantage of LGA1155 motherboards and CPUs is their overclockability, so we'd be derelict in our duty if we didn't ramp up the voltages and attempt to push the UD4-B3 to breaking

01 Gigabyte has put a lot of focus on the power circuitry on the UD4-B3. Unfortunately this didn't prevent it from being a poor overclocker

02 Under this small heatsink is the new B3 stepping of the P67 chipset

03 We like the new black colour scheme that the UD4-B3 sports. Gigabyte is going to use this scheme to denote its more enthusiast-focused boards from now on

The heatsinks on the UD4-B3 did an effective job of cooling the P67 chipset and VRM circuitry, and look great too

point. To do this, you'll have to enter the BIOS – and yes we do mean BIOS; Gigabyte boards currently lack the EFI of the Asus and MSI boards we've seen.

This, Gigabyte claims, is because the company isn't yet happy with its implementation of EFI, as it doesn't offer anything over and above its current BIOS. This is a tricky situation for Gigabyte, though, as EFI is part of the Intel spec for LGA1155 boards; it therefore had to perform some coding gymnastics to get the BIOS running on an LGA1155. This mainly revolves around adding in support for 3TB hard disks. Fortunately, we know our way around a BIOS, so it wasn't a problem, even if it means that the UD4-B3 lacks the wow factor of a flashy EFI.

Our time overclocking the UD4-B3 wasn't as productive as it could have been, as the board proved to be slightly temperamental when pushed. This meant that we could only push our test chip – which is capable of running at 4.9GHz – to a maximum stable frequency of 4.6GHz. We could boot the PC at 4.8GHz but no amount of extra voltage or cooling could stabilise the overclock enough for it to complete our Media Benchmarks. It's probably little comfort for Gigabyte, but the board did at least recover from failed overclocks elegantly, dropping us straight into the BIOS whenever anything went wrong.

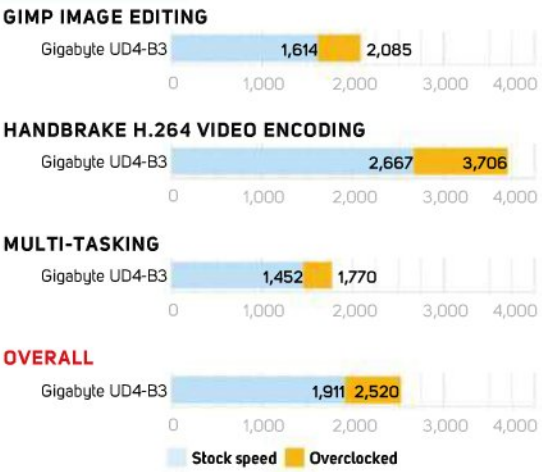
The board clocked up a score of 2,520 in our Media Benchmarks, which is as quick as an Asus X58 Sabertooth with a 4.4GHz Intel Core i7-980X Extreme Edition CPU installed in it. It's testament to the speed of LGA1155 processors, however, that this was still a disappointing result – the score is more than 110 points slower than the MSI GD65. The lower clock speed also meant less of a performance boost in games.

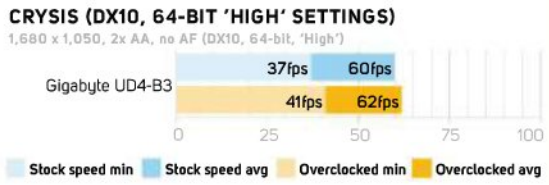
CONCLUSION

We get the impression that the UD4-B3 is really very close to being a good board – it's attractive, fast at stock speeds and has a number of useful features. Unfortunately, it isn't a thoroughbred overclocker – it was only able to push our test CPU to 4.6GHz rather than the 4.9GHz that other boards have managed. That wouldn't be too much of a problem if the board were cheap, but close to £150 is well above the price for which a bargain LGA1155 should sell. As such, our quest for a great LGA1155 with the new B3-stepping chipset continues.

PAUL GOODHEAD

Results





Scores

SPEED 35 / 45

FEATURES 23 / 30

VALUE 15 / 25

TEST KIT
3.3GHz Intel Core i5-2500K CPU, 4GB 1,600MHz Corsair DDR3 memory, 1TB Western Digital Caviar Black hard disk, AMD Radeon HD 5870 1GB graphics card, Crucial RealSSD C300 256GB (SATA speed test), Windows 7 64-bit, Catalyst 10.11 WHQL, Intel inf 9.2.0.1021

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	Normal price £59.00 ex VAT	Normal price £79.00 ex VAT	Normal price £119.00 ex VAT	Normal price £149.00 ex VAT	Normal price £209.00 ex VAT	Normal price £349.00 ex VAT
	2.8GHz Intel® Dual Core CPU	2.8GHz Intel® Dual Core CPU	2.5GHz Intel® Quad Core CPU	2.66GHz Intel® Xeon® Quad Core CPU	2x 2.5GHz Intel® Xeon® Quad Core CPUs	2x 2.1GHz AMD Opteron™ 12 Core CPUs
	2 CPU Cores	2 CPU Cores	4 CPU Cores	4 CPU Cores	8 CPU Cores	24 CPU Cores
	500GB SATA HDD	2x 250GB SATA HDD	2x 300GB SATA HDD	2x 300GB SAS HDD	2x 300GB SAS HDD 1x 500GB SATA HDD	2x 300GB SAS HDD 2x 500GB SATA HDD
	-	RAID 1	RAID 1	RAID 1	RAID 1	RAID 1
	2GB RAM	4GB RAM	8GB RAM	8GB RAM	16GB RAM	32GB RAM
	100Mbps connectivity	100Mbps connectivity	100Mbps connectivity	100Mbps connectivity	100Mbps connectivity	100Mbps connectivity
	Unlimited bandwidth	Unlimited bandwidth	Unlimited bandwidth	Unlimited bandwidth	Unlimited bandwidth	Unlimited bandwidth
	2 IPs	2 IPs	2 IPs	2 IPs	2 IPs	2 IPs

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ASUS
Rampage III Black Edition

Asus throws every tech and trick in the book at a single motherboard

BLACK & WHITE Overclockable and very fast; extreme overclocking

GREY SCALE Not as overclockable as the R3E; lots of superfluous features

HOW MUCH?

Price £380 inc VAT

Supplier www.scan.co.uk

Manufacturer http://uk.asus.com

SKU number RAMPAGE III BLACK

IN DETAIL

Chipset Intel X58

CPU support LGA1366 Core i7 and Core i7 Extreme Edition

Memory support 6 slots: max 24GB DDR3 (2,200MHz)

Expansion slots Four 16x PCI-E 2.0 slots (16x and 16x, 16x, 8x and 8x or four 8x), two 1x PCI-E

Sound Creative SupremeFX X-Fi with 8-channel support, Asus Thunderbolt (Xonar) with 2-channel support

Networking Asus Thunderbolt (Killer NPU) Ethernet, Intel Gigabit Ethernet, WiFi 802.11b/g/n, Bluetooth 3.0 + HS

Overclocking CPU clock 100 – 500MHz; max voltages, CPU 2.3V, CPU PLL 2.05375V, QPI DRAM 2.5V, DRAM 2.50425V, IOH 2.1995V, IOH PCIE 2.7825V, ICH 2.00075V, ICH PCIE 2.05375V, QPI/PIE Tuning, CPU Differential Amplitude 700-1,000mV, CPU and IOH Clock skew, Extreme Engine Digi+, QPI, IOH, DRAM frequency: 1x or 1.33x

Ports 6 x SATA 3Gbps, 2 x SATA 6Gbps, PS/2, 11 x USB 2, 4 x USB 3, 2 x LAN, 6 x surround audio out, 2 x line in, 2 x mic, 2 x eSATA 6Gbps

Dimensions (mm) 305 x 269

Every now and then it's useful to lift up your head from the relentless torrent of faster, better technology and look at where we've come from. This is one of those moments, as the Rampage III Black Edition (R3B) is the pinnacle of Asus' motherboard range; it sits above even the mental Rampage III Extreme in terms of gimmicks, gizmos, overclocking prowess and anything else the company's fearsomely innovative design team can think of. If you like your review less hyperbolic, think of the R3B as the Rampage Kitchen Sink Edition.

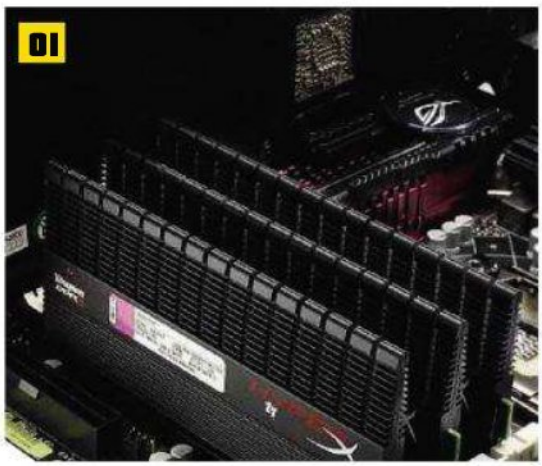
That may sound a bit mean-spirited, but the R3B just has so much technology squeezed into its 305 x 269mm (W x D) PCB. And then there's the new Thunderbolt add-in card, which incorporates a Killer NIC processor and an Asus Xonar two-channel sound chip. Both processors might not actually be that useful, as we've found Killer NICs do not improve online game performance much in these days of reliable high-speed broadband. Furthermore, the motherboard itself has 802.11n WiFi and Intel Gigabit LAN built in, plus an eight-channel Creative SupremeFX X-Fi 2 audio codec. This might support all the fancy EAX 5.0 game audio effects, but it does so in software and there's no Crystalizer either. With Bluetooth 3.0 also provided, there are four network controllers, two audio processors and more overclocking tools than you could possibly use – the lack of tea-making facilities seems almost stingy.

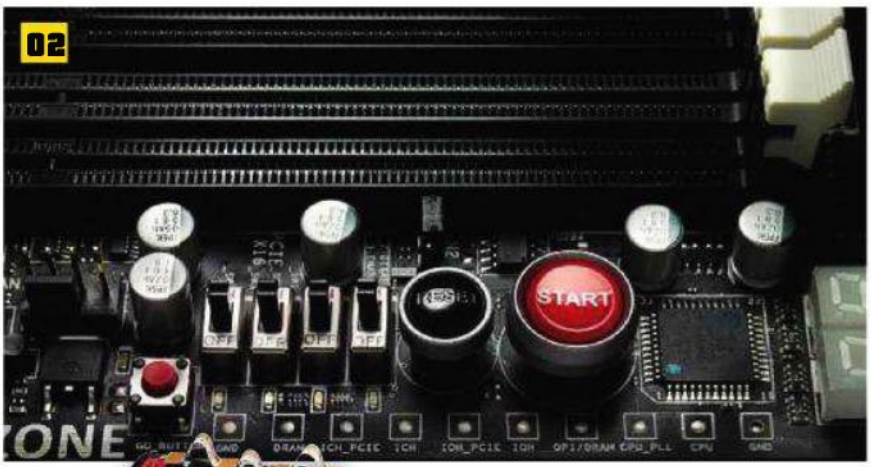
WITH TWO AUDIO PROCESSORS AND MORE OVERCLOCKING TOOLS THAN YOU COULD POSSIBLY USE, THE LACK OF TEA-MAKING FACILITIES SEEMS ALMOST STINGY

Whether or not the Thunderbolt card is useful brings us onto the thorny issue of what exactly the R3B is for – or rather, whom it is for. The Thunderbolt card has gamer tech written all over it, and yet the board has a plethora of extreme overclocking, LN2-friendly features. There is an OC Zone towards the top of the front edge of the board that not only has an LN2 mode jumper (to remedy the cold-boot bug at sub-zero temperatures), but also eight voltage readout points. There's also a bank of switches to enable and disable the four 16x PCI-E slots individually to troubleshoot faults without having to remove cards – next to each switch is an LED to show whether or not the slot is active. Nearby, you'll find a Go button to load a memory overclock profile automatically, as well as conveniently placed power and reset buttons.

Elsewhere you'll find two 8-pin EPS12V power connectors for the CPU, a button to switch to another saved BIOS profile (LEDs nearby tell you which one you're using) and a jumper to enable QPI loadline calibration. And if you're really struggling with your LN2 to the point where the board won't even POST, there's a Q Reset button to kill the power for a bit 'to help the CPU recover from a frozen condition'. To round off the list of crazy overclocking features on the board before we even delve into the BIOS, there's the RoG Connect port on the rear I/O that lets you overclock the board remotely from a laptop (or from a smartphone via the Bluetooth link). This really isn't a motherboard for typical PC gamers – it's an overclocking leviathan.

Beyond the overt additions and extras strewn around the PCB, the actual construction of the board itself tells you it's for extreme overclockers. The heatsinks are of the new Republic of Gamers design, with rows of finely detailed extrusions and notches rather than the Escher-esque angled blocks of the previous generation. Underneath the chipset and VRM heatsinks are eight power phases, controlled by the RoG Extreme Engine Digi+ processor. This also controls the three-phase memory, chipset and QPI





link power circuits, and lets you change the frequency at which these operate, just as with Asus' P67 range.

If the extreme overclocker status wasn't clear from just looking at the board and reading the detailed manual, the BIOS really sets the R3B apart. This isn't just because the background colour is as black as the board and its branding, but because the range of options presented in the AI Tweaker menu is as extensive as we've seen from a motherboard. Only some of DFI's infamously overstuffed BIOSes can compete with the feeling of being overwhelmed, and only then because DFI's BIOSes were notoriously esoteric in how they referred to components and options.

After scouring the AI Tweaker menu over a cup of tea (alas, made by a human rather than the R3B), it's clear that a fair amount of logic has been applied. Options are grouped around function, so that essential frequencies are all collated in the top section and then each section down deals with another aspect of the overclockability of the board. We saw a fair bit of repetition from features already served via the buttons and switches on the board itself – a second-level menu oddly titled GPU.DIMM Post lists which PCI Express slots are filled, and the status of each card installed in them (a quick way to tell if a graphics card has died). However, as the name cryptically suggests, this section is joined by a similar section for the six memory sockets, letting you troubleshoot faulty DIMMs quickly too.

PERFORMANCE

As this is a super-overclockable motherboard, we've deployed our turbo-nutter test gear to really push the R3B to its limits – see Test Kit on p42. As expected, the R3B was able to run the QPI at the usual 220MHz maximum that we've seen from the best X58 motherboards. Even pushing the QPI to 225MHz was too much, as it was on every other board we've tested – no matter what voltages we used or BIOS tweaks we made. With that established, we moved on to the main event: CPU overclocking under pre-chilled water.

Overclocking the R3B can be a quick process or a hugely lengthy one – you can either scroll down the AI Tweaker menu to the Asus OC Profile entry and hit Enter, or you can go through the 20-odd individual overclocking settings to see which are useful. We did both. However, after playing with everything from the CPU QPI Strength to the CPU Differential Amplitude, and from the CPU PWM frequency to the QPI PWM frequency, we found that the automatically loaded Asus OC Profile got the various settings just right.

We did most of our fiddling with the plethora of fine-tuning settings with our CPU overclocked to 4.738GHz via a combination of a 206MHz QPI and a 23x CPU multiplier. To make this stable we had to push plenty of voltage through the board – you can see the list of our voltages in the Final Overclock box, right. However, we would only use such high voltages in combination with water-cooling and the Hailea water-chiller – please don't use such absurdly high voltages with air-cooling. As well as chilling the CPU, we positioned two high-airflow fans over the chipset and CPU VRM heatsinks, and a third fan over the Southbridge heatsink.

As the CPU was overclocked 46MHz less in the R3B than we achieved with the Rampage III Extreme (see Issue 84, p120) we saw slightly lower scores from the R3B. It was 0.078 seconds slower in WPrime, for example, and 0.187 seconds slower in SuperPi – that

01 Kingston has made some black Hyper-X T1 memory to go with this Goth-tastic motherboard. The range includes the 1,600MHz kit pictured, as well as some loony-fast 2,333MHz DIMMs. For testing, we used the same Corsair kit we've used with previous extreme motherboards, however

02 The OC Zone collects most of the handy overclocking-specific features of the board in one easy-to-access place. We really liked the chunky buttons and the graphics card switches and lights

03 The R2B can handle up to four graphics cards (though fitting these means sacrificing the Thuderbolt card). Note the arrangement of CrossFireX connectors, as connecting the cards the other way means that CrossFireX doesn't work

THE FINAL OVERCLOCK

Frequency 23 x 206MHz = 4.738GHz

CPU vcore 1.5375V

CPU PLL 1.961V

QPI/DRAM Core voltage 1.375V

DRAM 1.65625V

IOH voltage 1.47075V

ICH voltage 1.36475V

Warning: this is a very high overclock with extreme amounts of overvolting. Do not copy these values unless you have a powerful cooling system or a reckless deathwish.

We unboxed the awesome Hailea HC-500A water chiller to achieve sub-ambient cooling. This allowed us to overclock the CPU from 3.33GHz to 4.738GHz rather than the 4.4GHz limit we hit on air cooling

might not sound much, but it's the difference between winning and losing in an overclocking competition. The R3B was also 89 points slower than the R3E in our Media Benchmarks.

After remembering that it's necessary to sacrifice a goat to the pagan gods, we finally managed to get four Radeon HD 5870 graphics cards working together in CrossFireX in the R3B. We also had to plug in an additional Molex cable to provide sufficient power to the last two PCI-E slots. Interestingly, unlike its performance in the 2D tests, the R3B screamed through 3DMark Vantage. Its score of 46,476 is not only the fastest we've seen from an X58 motherboard with four HD 5870s, but also12 per cent faster than the R3E. The R3B also ran 3DMark 11 without any complaints, although at this time we don't have any other systems with which to compare its score of 5,600.

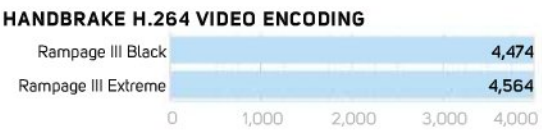
The R3B has a few quirks when overclocking it to its limits too, which made it a frustrating board to use – especially when time is short. It occasionally became stuck in POST loops that required us to power down the board – a neater recovery system would have been appreciated. Introducing four graphics cards also made the board lazy – after failed 3DMark runs, we regularly had to power down the board for five to 10 seconds before powering it back up again. However, the LEDs and the GPU.DIMM menu were godsends when trying to troubleshoot failed CrossFireX setups – we could easily see whether all four cards were receiving the expected eight lanes of bandwidth via the BIOS tool, and whether a card had fallen over during boot or testing via the LEDS next to the GPU switches.

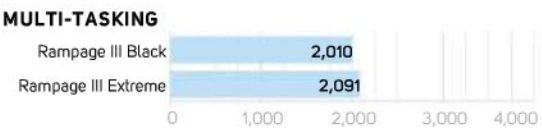
CONCLUSION

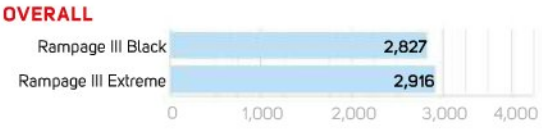
The Rampage III Black Edition is a ludicrous piece of kit, but that's exactly what it's meant to be – the best of the best. However, it failed to surpass the Rampage III Extreme for overclockability, and the additions are gimmicky – a gamer-friendly ISP will make more of a difference than a Killer NIC, for example. In terms of raw performance too, the R3B isn't an automatic step up from the R3E; yes, it's much faster in the 3D benchmarks but it's slower in the 2D benchmarks. With the kind of power circuitry, feature list and price that's overkill for an everyday PC, and not enough overclocking ability to topple the R3E, the R3B doesn't match its billing as the best motherboard ever made.

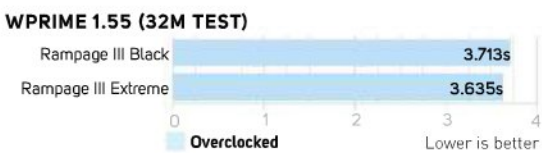
CLIVE WEBSTER

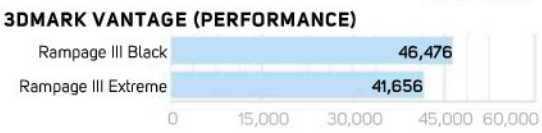
Results

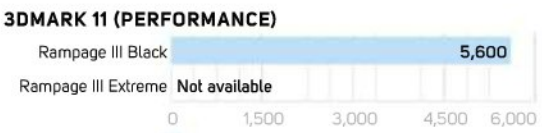












Scores

SPEED 50/60

FEATURES 22/25

VALUE 10/15

TEST KIT
3.33GHz Intel Core i7-980X CPU, Hailea HC-500A water-chiller, 6GB Corsair Dominator XT 2,000MHz DDR3 memory, 256GB Crucial RealSSD C300 SSD, 4 x AMD Radeon HD 5870 1GB graphics cards, Windows 7 64-bit, Catalyst 10.6 WHQL and 11.2 WHQL, Intel inf 9.1.1.1025

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INTEL
Core i7-990X Extreme Edition

Six cores but Sandy Bridge is faster and cheaper

+ GULFTOWN
Very quick, incredible performance in multi-threaded applications

– GOLFTOWN
Very expensive; i5-2500K performs better in games

HOW MUCH?
Price £797 inc VAT
Supplier www.scan.co.uk
Manufacturer www.intel.com
SKU number BX80613I7990X

IN DETAIL
Frequency 3.46GHz
Core Gulftown
Manufacturing process 32nm
GPU None
Number of cores 6 x physical, 6 x logical
Cache L1: 32KB + 32KB (each core), L2: 256KB (each core), L3: 12MB (shared)
Packaging LGA1366
Thermal Design Power (TDP) 130W
Features SSE, SSE2, SSE3, SSE4.2, EM64T, EIST, Execute Disable Bit, Hyper-Threading, VT, Intel Turbo Boost, MMX, AES new instructions

There has been so much fuss about Intel's new LGA1155 processors recently that it's easy to forget about Intel's other range of LGA1366 CPUs. Intel actually pitches its X58 chipset and corresponding CPUs as its high-end offerings; theoretically, this means they reside above Sandy Bridge-based processors in the performance tree.

As we've seen, though, LGA1155 CPUs and motherboards are incredibly quick and outrageously overclockable, and can often put their LGA1366 stablemates to shame.

Processors at the top of the range such as the Core i7-970 and Core i7-980X Extreme Edition sport six Hyper-Threaded cores, allowing them to perform better than LGA1155 CPUs in highly multi-threaded applications. It's to this elite group of processors that Intel's new release, the Core i7-990X Extreme Edition, belongs.

As the i7-990X is part of Intel's Extreme Edition range of processors, it sports an unlocked CPU multiplier, which should allow you more freedom when overclocking the chip. For example, if you reach the QPI limit of your motherboard when overclocking, an unlocked processor allows you to increase the multiplier so that you can push the processor as far as possible.

Sitting at the top of Intel's range, the i7-990X is now the fastest LGA1366 processor, with a stock speed of 3.46GHz. This is a slight increase over the i7-980X, which runs at 3.33GHz. This higher default frequency has resulted in an equivalent increase in the theoretical maximum speed to which the processor can Turbo Boost, meaning that the i7-990X should be able to reach 3.73GHz when it's only being loaded on one core.

Unfortunately, this is where the differences between the two processors end, as in every other respect the i7-990X is identical to the i7-980X. It has the same 256KB of Level 2 cache per core and the same large pool of 12MB Level 3 cache. It also, impressively, has an identical maximum TDP rating of 130W and is made on the same 32nm-scale production process as the other LGA1366 processors. The i7-990X is even based on the same B1 stepping as its predecessor, meaning that there haven't even been any significant tweaks or changes to the die design for this new CPU.

PERFORMANCE

Given the frequency advantage the i7-990X has over the i7-980X, it was no surprise to see it edge out its older stablemate in all of our stock speed tests. In Cinebench 11.5, it was 0.25 points ahead of the i7-980X, a result that was mirrored by the slight 0.117 of a second advantage it demonstrated in WPrime. The i7-990X also demolished Intel's LGA1155 CPUs in these tests, thanks to its 12 processing threads.

Its higher stock clock speed and extra Turbo Boost headroom also meant that the i7-990X managed a slight lead over the i7-980X in our Media Benchmarks. Its overall score of 2,145 was 7 per cent faster than the 2,002 points of the i7-980X, which is an excellent result given the 4 per cent nominal clock speed advantage of the i7-990X. However, the i7-990X faced stiff competition from the top-end Intel Sandy Bridge CPUs, only narrowly beating the i5-2500K and losing out to the i7-2600K – clearly Turbo Boost worked well on the new CPU.

WE TRIED OVERCLOCKING, STARTING WITH A 1GHZ OVERCLOCK, WHICH THE i7-990X TOOK IN ITS STRIDE

Games showed less benefit from the extra clock speed on offer from the i7-990X, with Crysis showing no sign of a frame rate increase. This meant that the i7-990X lagged slightly behind the vastly cheaper LGA1155 based i5-2500K and i7-2600K.

Next, we tried overclocking, starting with an aggressive 1GHz overclock, which the i7-990X easily took in its stride. Encouraged by this success, we continued to push the chip further, eventually settling on a stable overclock of 4.6GHz with a QPI of 200MHz and a 23x CPU multiplier. This represents a 1.14GHz boost over the i7-990X's stock speed. The i7-990's

overclock is also superior to the 1.07GHz stable overclock of the i7-980X.

To stabilise this overclock, we had to pump 1.412V through the CPU, 1.96V and 1.375V through the CPU PLL and QPI/DRAM voltages respectively and 1.3V and 1.2V to the IOH and ICH. We also had to set the UCLK frequency to 3,208MHz and the QPI link frequency to 7,218MT/s. We had the CPU happily booting at just under 4.8GHz, but couldn't get this overclock stable using air cooling; this is a good sign that there was still some headroom left in the chip that could be unlocked with more exotic methods of cooling.

At these speeds, the i7-990X demolished our test suite, clocking in record results in both Cinebench 11.5 and WPrime. We also saw a healthy 23 per cent increase in the CPU's overall Media Benchmarks score, with an impressive 2,645 points. However, the i5-2500K returned a score of 2,687 when overclocked, while the overclocked i5-2600K scored 2,702.

The i7-990X's power consumption during our testing proved interesting, as it drew far less power than the i7-980X. This is due to the lower 1V vid of our sample, which places the CPU at the lower end of the range of vids with which LGA1366 CPUs ship.

CONCLUSION

We lauded the i7-980X when it launched, as it justified its exorbitant price with its two extra cores and better overclocking potential compared with other LGA1366 CPUs. The i7-990X shares these features but enters a changed market, due to Intel's own LGA1155 CPUs.

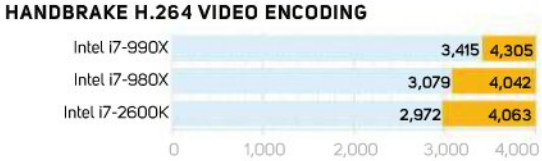
The i5-2500K is roughly as quick as, and sometimes quicker than, the i7-990X in all but the most heavily multi-threaded tasks. It's also very overclockable. As a result, only those running professional-grade multi-thread-optimised applications should consider the i7-990X, and even then, you'd be better off buying an i7-980X, which is nearly as fast but £50 cheaper.

PAUL GOODHEAD

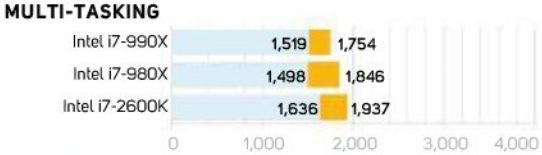
RESULTS

GIMP IMAGE EDITING

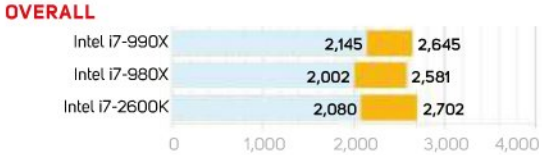
HANDBRAKE H.264 VIDEO ENCODING



MULTI-TASKING

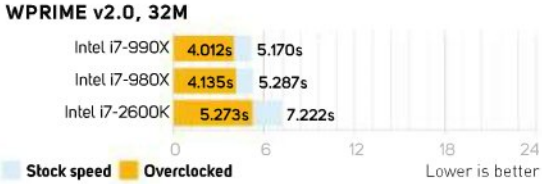


OVERALL



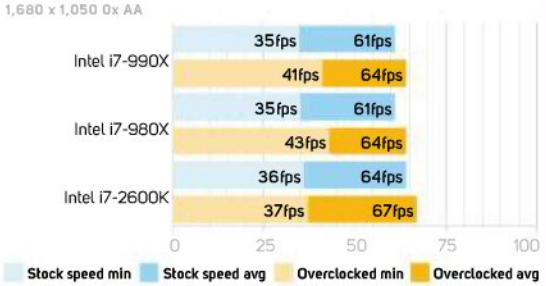
CINEBENCH R11.5

WPRIME v2.0, 32M



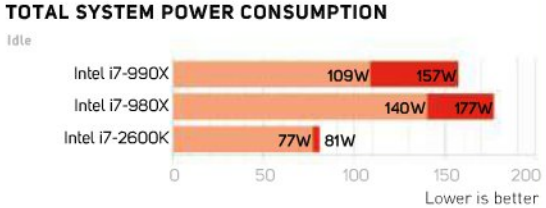
CRYSIS (DX10, 64-bit)

1,680 x 1,050 0x AA

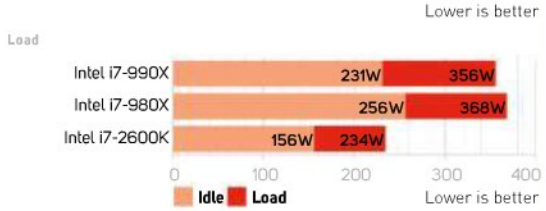


TOTAL SYSTEM POWER CONSUMPTION

Idle



Load



SCORES

SPEED 47/50

FEATURES 12/15

VALUE 23/35

TEST KIT

Asus P6TD motherboard, 6GB Corsair 1,600MHz DDR3 memory, 1TB Western Digital Black hard disk, AMD Radeon HD 5870 1GB graphics card, OCZ Silencer 750W PSU, Windows 7 64-bit, Intel inf 9.1.1020, Catalyst 10.11 WHQL (chipset and graphics)

GREEN GADGETS
LP-170 Pico-ITX

A pocket-sized PC that can be customised to suit almost any task

+ ADORABLE
Tiny; wide range of connections; highly customisable; potentially silent

– RUNTY
Runs very hot; this model can't handle HD video; expensive

HOW MUCH?
Price £419
Supplier www.aleutia.com
Manufacturer www.greengadgets.co.il
SKU number LP-170 Pico-ITX

IN DETAIL
CPU 1.8GHz Intel Atom D525
Motherboard Commell LP-170
Memory Not supplied
Graphics Intel GMA 3150
Sound Intel HD Audio via Realtek ALC888 with 8+2-channel support
Hard disk(s) Not supplied
Optical drive(s) None
Case Green Gadgets LP-170
Cooling CPU: Passive heatsink, GPU: passive heatsink
PSU Not supplied (12V, 3A unit required)
Ports Front: 4 x USB 2, headphone, mic. Rear: LAN, PS/2, D-Sub, 2 x USB 3, Serial
Extras None

It's unlikely that you'll have heard of Green Gadgets, as the company is a small Israeli start-up that specialises in – yes, you've guessed it – environmentally responsible PCs. This doesn't mean that all the components are made of recycled bike tyres or are solar-powered though; it simply means that the company produces a range of low-powered PCs that are designed to be tiny, efficient replacements for current desktop systems. Interestingly, the company offers its low-power systems in two flavours: pre-built in its own custom-made, passively cooled case (as in this review), or as an OEM component kit that doesn't include the case.

If you opt for the former version, the only parts you'll need to add on its arrival will be your own 2.5in hard disk or SSD and a single stick of SODIMM DDR2 memory. If you buy the system directly from Green Gadgets, you'll also need to add a 12V, 3A power adaptor, as it says that omitting the power brick allows it to lower postage costs and avoid many of the stringent import restrictions that countries impose regarding such items. However, the UK distributor Aleutia will ship the system with a power adaptor.

At the heart of the tiny system is the Pico-ITX Commell LP-170 motherboard. The tiny PCB measures only 100 x 72mm and has a 1.8GHz Intel Atom D525 processor soldered to it. Inside the D525 is an Intel GMA 3150 GPU. If the D525 doesn't suit your needs then the LP-170 is available with other Atom chips embedded. The rest of the PCB of the LP-170 looks unusual, with no clearly labelled connectors to be seen. Instead, the board has so many bare headers that it looks like a bed of nails made for mice.

Confusingly, Green Gadgets merely calls its bare-bones system the LP-170 (the same name as the motherboard used), so when referring to the bare-bones system, we'll call it the GG LP-170. The tiny box has an amazing number of ports and connections – there are four USB 2 ports, microphone and headphone jacks, a D-Sub output, a serial port, a LAN port and a single PS/2 port. Our system also had a pair of USB 3 ports and an additional D-Sub port via the optional bracket – these were powered by a Commell MPX-7202 mini-PCI-E card.

Green Gadgets' custom-built case is finished in an attractive matt black. The top of the case is covered in fins and makes contact with the CPU and Southbridge, which sit just below it, via a large copper contact plate. This transmits heat into the top of the case to be emitted passively; as long as you fit an SSD rather than a hard disk, the GG LP-170 will be silent.

PERFORMANCE

The GG LP-170 is perhaps the smallest PC we've tested but that doesn't excuse it from running a gauntlet of application and game tests – we're

OPTIONAL UPGRADES

Commell makes a number of different mini-PCI-E cards for the LP-170 motherboard. These tiny cards can add almost any type of connection to the system, and there are brackets that fit into a vacant slot at the back of the case to provide the sockets for whichever connections the PCI-E card provides.

The system we tested included a USB 3 card to add two USB 3 ports, but it's also possible to add dual Gigabit LAN sockets, dual FireWire ports, four serial ports or an 802.11b/g/n WiFi card and bracket. The Commell MPX-TP4R touch-screen controller module and the Broadcom BCM70015 HD video acceleration module are interesting, as these can radically change the way you use the PC.

These cards offer the option of building a relatively cheap touch-screen PC, and the GG LP-170 is so small that you could easily attach it to the back of a touch-screen display. The Broadcom card can turn the GG LP-170 into a tiny media PC capable of HD playback that would be ideal for the living room. Inserting the card offloads the video decoding legwork from the CPU to the card, reducing CPU load during 1080p playback from around 70 per cent to about 15 per cent, and makes HD playback a smoother experience.

immune to cute here at **Custom PC**. For testing, Green Gadgets provided a 60GB Patriot Inferno SSD with a copy of Windows 7 Ultimate 64-bit pre-installed, and a 4GB SODIMM of 667MHz DDR2 memory.

Unfortunately, the Intel Atom processor made typically slow work of the tests. Its score of 194 in the image editing test was particularly low, especially when compared with a system based around AMD's similarly low-power E-350 APU.

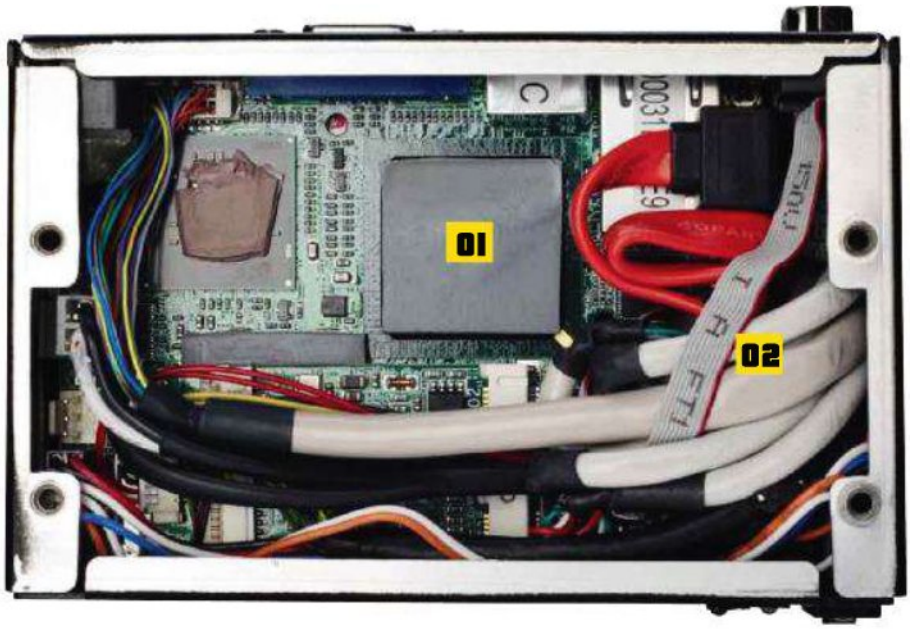
Predictably, gaming was also too much of a challenge for the GG LP-170, due to its woeful Intel GMA 3150 GPU. The system couldn't return playable frame rates in any of our three test games, even when we dropped the settings and resolutions to low.

However, you'd be masochistic to expect the GG LP-170 to encode video all day – the system is more likely to spend its time as a small media PC, controlling a POS system or as a basic office PC, and for these purposes, the GG LP-170's performance is fine. A less demanding OS than Windows 7, such as Xubuntu or Damn Small Linux, would also help.

Even with Windows 7 installed, the PC was able to browse Flash-heavy websites, play music, and create and edit Word and PowerPoint documents as long as it only performed one task at a time. Unfortunately, some of our high bit-rate test videos were noticeably choppy. However, you can add a Broadcom video acceleration mini-PCI-E card to cure this problem.

The GG LP-170 was one of the most power-frugal PCs we've tested, drawing just 18W at idle and 25W when fully loaded.

Despite drawing little power, the CPU idled at around 94°C and hit 109°C once the PC was loaded for a few hours. This is still below the 125°C thermal limit of the Atom CPU, but we measured even the sides of the case (let alone the heatsink portion of it) as exceeding the 60°C recommended operating temperature of the Commell motherboard inside.



Clearly, the heatsink element of the case struggled to dispose of the waste heat of the Atom CPU, as it hit a scorching 85°C when the PC was under load. This wouldn't be a major issue on a standard CPU heatsink, as it would be housed inside a case, but having such a hot surface on your desk could be dangerous. Stuffing the GG LP-170 into a tight space, such as a glove box so that it can act as a car PC, will exacerbate this issue.

CONCLUSION

The idea of a tiny, passively cooled PC is easy to get excited about. Sadly, the Green Gadgets LP-170 runs very hot and is only quick enough for basic tasks. You'll also need to give the system plenty of room to breathe, or even mod a fan to the external heatsink. Finally, after you've added a storage device, a SODIMM and an operating system, you'll be spending over £500.

PAUL GOODHEAD

01 The dual-core 1.8GHz Intel Atom D525 processor at the heart of the LP-170 Pico-ITX isn't up to much, but it can handle basic desktop work

02 The system is available as either a bare bones kit or a full PC with a variety of add-ons

03 The PC's connectivity options are extensive; our sample was equipped with USB 3 ports and a second VGA output

Results

GIMP IMAGE EDITING

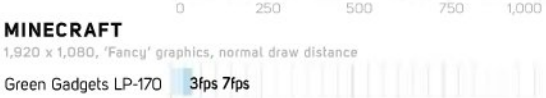
HANDBRAKE H.264 VIDEO ENCODING

MULTI-TASKING

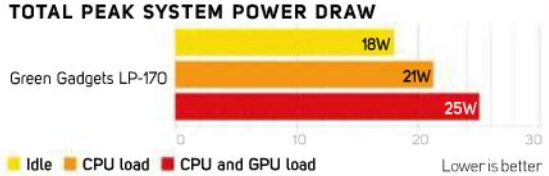
OVERALL

MINECRAFT

1,920 x 1,080, 'Fancy' graphics, normal draw distance



TOTAL PEAK SYSTEM POWER DRAW



Scores

SPEED	13/20
DESIGN	22/30
HARDWARE	15/25
VALUE	15/25

CUSTOM PC 65% OVERALL

TRANSFORM
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GAME INCLUDED

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ZOTAC® It's Time to Play

BE QUIET!
Dark Rock Pro

This huge cooler matches great performance with whisper-quiet operation

PROFESSIONAL
Excellent cooling; very quiet; great build quality

AMATEUR
May not fit in your case; tricky mounting; expensive

We looked at Be Quiet!'s first CPU cooler, the Dark Rock Advanced, in our CPU cooler Labs test (Issue 91, p74) and found it lived up to the company's name by being very quiet while still delivering plenty of cooling. As capable as the Dark Rock Advanced was, its performance was still a little way off that of the dual-fan, high airflow Thermaltake Frio. The Dark Rock Pro is Be Quiet!'s shot at the top of the air-cooling market, aiming to offer exceptional cooling with the same whisper-quiet noise levels of the Advanced.

INTEL LGA1155
AMD SOCKET AM3

In order to compete with other monstrous super-coolers, Be Quiet! has chosen to use two fans, each mounted to a stack of cooling fins, making the cooler very large and heavy. Weighing in at 1.55kg and measuring 166mm from CPU contact plate to its top, the Dark Rock Pro may struggle to fit in some cases. With a depth of 150mm, it dominates the inside of any PC.

The cooler's CPU contact plate is made from nickel-plated copper finished to a smooth mirror shine. The contact plate is topped by an aluminium mounting block onto which the cooler's various socket brackets are screwed. Through the base run seven 6mm, U-shaped, nickel-plated copper heatpipes. The fit around the heatpipes is very tight, with no visible gaps in the CPU contact block; the build quality of the cooler's contact plate is superb.

After emerging from either side of the contact plate, the heatpipes then splay out before turning 90 degrees upwards and running through the Black Rock Pro's two banks of black-burnished aluminium fins. Each stack comprises 44 fins, with each fin measuring roughly 132 x 40mm. This means that the Dark Rock Pro has a gigantic surface area of approximately 90m² from which to dissipate heat.

Rather than leaving the sealed ends of the heatpipes exposed, Be Quiet has topped the cooler with an attractive brushed aluminium plate, with the heatpipe tops covered with individual metal caps. This certainly makes the cooler look very imposing when installed.

With two fin stacks, Be Quiet! has taken the opportunity to use two of its 120mm SilentWings PWM cooling fans, arranged in a push-pull configuration. The fans are pre-fitted to the cooler via high-tension mounting wires, sparing you the trouble of fitting them yourself, but they can be replaced with any 25mm-thick, 120mm fan you like. The exterior 120mm fan may project over your memory sockets, so it could clash with tall memory modules; there's plenty of room for standard-sized DIMMs, though.

BE QUIET! HAS USED TWO OF ITS 120MM SILENTWINGS PWM COOLING FANS, ARRANGED IN A PUSH-PULL CONFIGURATION

The cooler makes use of a multi-socket backplate for mounting, with screws threaded through from the backside of the motherboard and into the interchangeable brackets that are screwed onto the cooler's aluminium base. This is a pretty unintuitive method, as it involves threading the screws through the backplate and motherboard, adding rubber washers to prevent the screws from falling out, flipping the motherboard to fit the cooler into place, and then flipping the board again to fasten the screws. As a result, there were more than a few expletives being uttered during mounting, when screw threads failed to line up with holes or when rubber washers fell off.

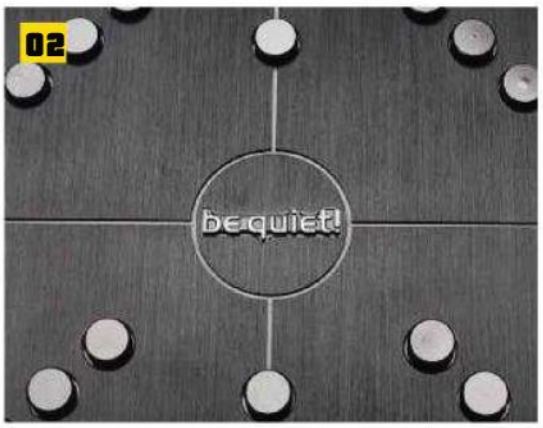
Despite the tricky mounting, at least you don't have to then attach the two fans. Also, the cooler is very

50

HOW MUCH?
Price £57 inc VAT
Supplier www.aria.co.uk
Manufacturer www.be-quiet.net
SKU number BK016

IN DETAIL
Compatibility AMD: Socket 754, 939, 940, AM2/AM2+/AM3; Intel: LGA775, LGA1155, LGA1156, LGA1366
Weight 1.55kg
Size (mm) 133 x 150 x 166 (W x D x H)
Fan 2 x 120mm SilentWings PWM (PWM, 400rpm - 1,500rpm)
Stated noise 25.9dBA

01 Be Quiet!'s SilentWings PWM cooling fans provide plenty of airflow while remaining very quiet



02 Aluminium caps for the heatpipe tips give the Dark Rock Pro a classy look

03 The cooler's base is finished to a pleasing mirror shine, and well fitted around the six heatpipes

securely attached to the motherboard and CPU, and evenly distributes pressure across the CPU. The mounting process is similar regardless of whether you fit the cooler to an AMD Socket AM3 or Intel LGA1155 motherboard, with the only difference being the use of the appropriate mounting bracket holes.

COOLING

In our LGA1155 test rig, the Dark Rock Pro performed magnificently, with a superb idle delta T of 14°C, only 1°C hotter than the Thermaltake Frio at its noisy high-speed setting. Under load, the Dark Rock Pro was just 1°C hotter than the Frio at its high-speed setting, with a delta T of 50°C. This is a fantastic achievement considering that, unlike the Frio's high-speed setting, the Dark Rock Pro was very quiet indeed.

Installed in our Socket AM3 rig, the Dark Rock Pro again impressed us, with an idle delta T of just 2°C and a peak load delta of 23°C. While this is still 1°C warmer than the Frio with its fans at low-speed, it's again a great result considering the Dark Rock Pro was as quiet at its highest fan speed as the Frio at its lowest fan speed.

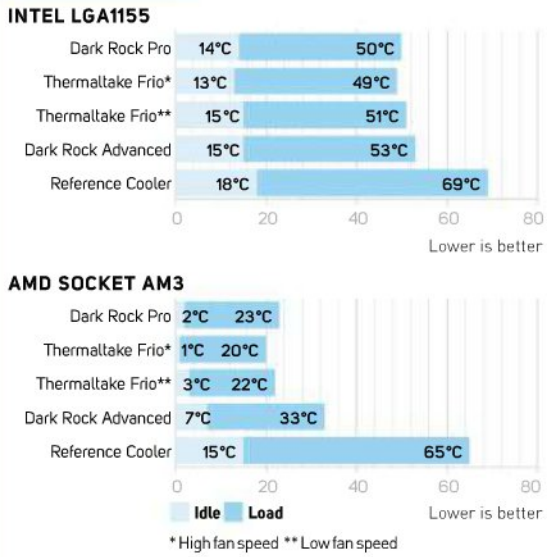
CONCLUSION

The Be Quiet! Dark Rock Pro manages to achieve the holy grail of CPU cooling by delivering superb cooling performance with very little noise. The pair of Be Quiet! SilentWings PWM fans – despite running at 1,500prm at full speed and shifting 57.2cfm each – were very quiet during our testing. We can certainly believe the 25.9dBA noise rating quoted by Be Quiet!, as we were only just able to hear the fans over the background hum of our lab. If you run the cooler with its PWM setting enabled, rather than at the full 12V we use for testing, the cooler is almost inaudible.

The glorious union of performance and acoustic splendour doesn't come cheap though. At £57, the Dark Rock Pro is £13 more expensive than the Thermaltake Frio and double the price of the similarly serene Gelid Tranquillo. However, the Tranquillo doesn't have the same cooling ability and the Frio isn't as quiet. If you're trying to coax as much speed as possible from your CPU while keeping it quiet, the Dark Rock Pro is an excellent choice.

HARRY BUTLER

Results



Scores: LGA1155

COOLING 39/40
DESIGN 26/30
VALUE 23/30
FITTING BAD

Custom PC 88% OVERALL

Scores: Socket AM3

COOLING 37/40
DESIGN 26/30
VALUE 24/30
FITTING BAD

Custom PC 87% OVERALL

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LIAN LI
PC-V2120B

The largest and one of the most expensive PC cases we've seen

+ HULK
Great build quality; HPTX; cavernous interior

– BULK
Missing vital extras; fan cables don't reach fan controller

HOW MUCH?
Price £389 inc VAT
Supplier www.scan.co.uk
Manufacturer www.lian-li.com
SKU number PC-2120B

IN DETAIL
Dimensions (mm) 235 x 630 x 635 (W x D x H)
Material Aluminium
Available colours Black, silver, black interior and exterior
Weight 14.4kg
Front panel Power, reset, 4 x USB 3, stereo, microphone
Drive bays 2 x external 5.25in drive bays, 13 x internal 3.5in drive bays
Form factor(s) HPTX, E-ATX, ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm front fan mount (fans supplied), 1 x 140mm internal fan mount (fan supplied) 1 x 120mm rear fan mount (fan supplied), 1 x 120mm 5.25in drive bay fan mount (fan supplied), 3 x 120mm roof fan mounts (fans not supplied)
CPU cooler clearance 295mm
Maximum graphics card length 360mm
Extras Single-channel 4-fan fan controller, lockable door

When EVGA released the super-sized Classified SR-2 dual Xeon motherboard last year (see Issue 86, p38), few case manufacturers took up the challenge of making a chassis capable of housing its massive dimensions. Lian Li didn't shirk from the task, though, and the result is the PC-V2120, an enormous cavern of aluminium plating, with many features and drive bays.

The V2120 really is huge. Measuring 235 x 630 x 635mm (W x D x H), it's even bigger than humongous cases such as the Cooler Master ATCS 840. Just man-handling it around a desk during testing was tricky, although the inclusion of lockable wheels fitted to the base helped. Being a Lian Li chassis means that the V2120 is made almost entirely of aluminium, so although it's huge, it weighs only 14.4kg.

The exterior of the case is furnished in gorgeous black (or silver, should you prefer the V2120S) anodised aluminium and, as with most Lian Li cases, has a minimalistic apearance. The massive side panels don't have venting or fan mounts, and the case's front fascia is hidden behind a sturdy corrugated aluminium door. The door is lockable and includes light tubes for the power and hard disk activity LEDs inside. The door is also lined with sound-deadening foam, which is also fitted to the inside of both side panels.

Behind the door is venting for the two 140mm front intake fans; there's a vented section at the base of the door to allow airflow into the case even with the door closed. However, we doubt that this will be particularly effective, as air doesn't like to travel in contorted right-angles. Both intake fans are fitted with removable dust filters (accessed internally) and the five 5.25in drive bay blanking plates above are also fitted with washable, removable dust filters.

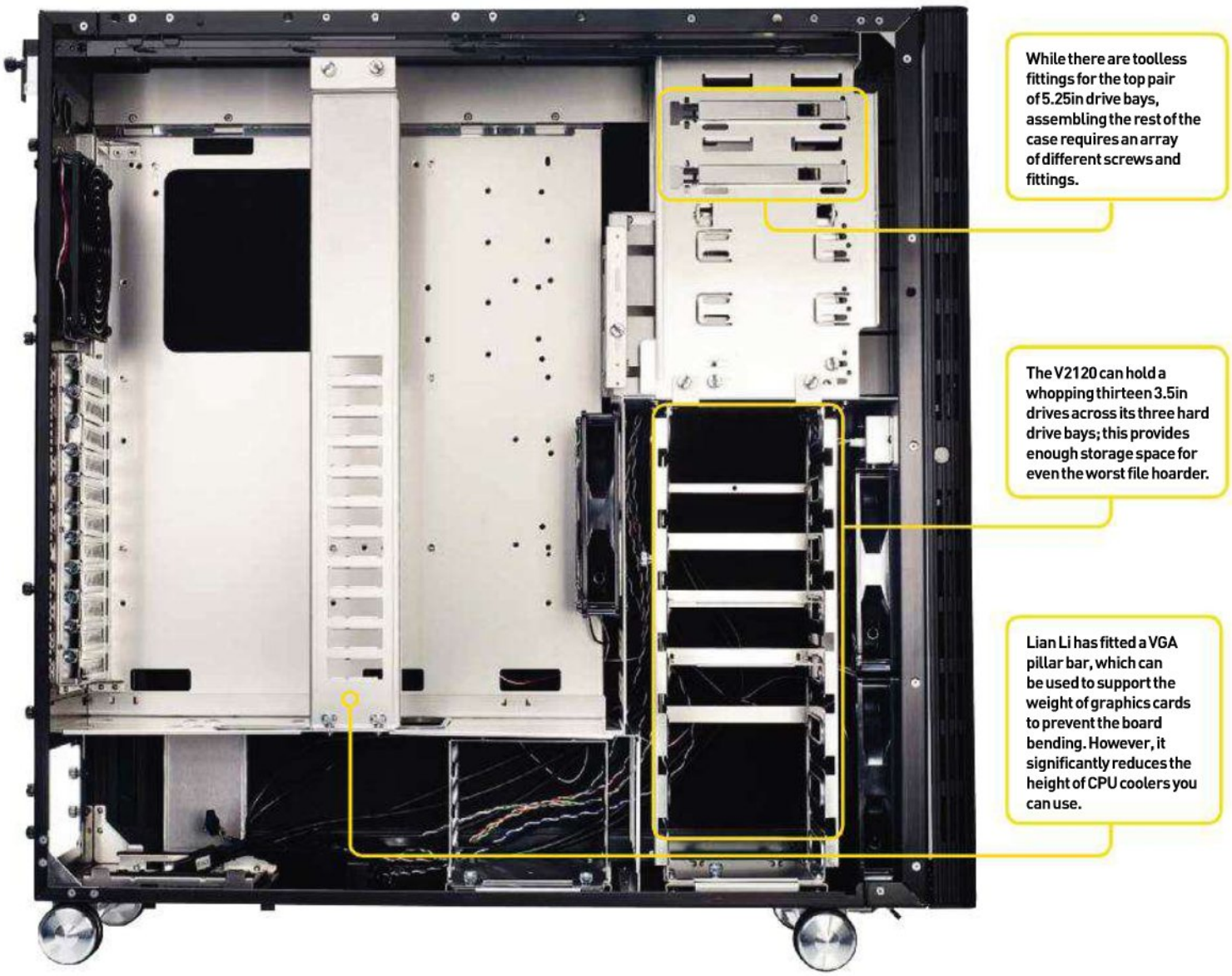
On top of the case's fascia is a single-channel, 4-fan fan controller. Sadly, not only does the fan controller need to be physically removed from its mount to access it's 3-pin fan headers, but only one of the V2120's five fans has cables that are long enough to reach it. This makes the fan controller an almost redundant inclusion, especially as 3-pin fan extension cables aren't included.

Hidden behind a flip-up hatch at the front of the roof is the front panel. With the power and reset buttons placed centrally in the case's front fascia (behind the door), the front panel offers eSATA, four USB 3 ports, and both microphone and headphone jacks. Usefully, you can either power the USB 3 ports via their external connectors or plug both of these into an internal convertor so that you don't need to loop cables out through the back of the case.

The V2120's long roof panel is fitted with three 120mm fan mounts, spaced to accommodate up to a triple 120mm-fan radiator. As standard, these fan mounts are filled with aluminium blanking plates that retain the V2120's sleek looks, but disappointingly, Lian Li doesn't include any fan grilles should you choose to use the mounts, leaving large square holes along the top of the case.

THE LIAN LI V2120 IS MADE ALMOST ENTIRELY OF ALUMINIUM, SO ALTHOUGH IT'S HUGE, IT WEIGHS A REASONABLY LIGHT 14.4KG

Having popped off the side panels via the clever single-screw latch system, you really get a sense of how big this case is. The interior is opulently spacious and dwarfed our ATX-sized test gear. Should you go to town and fit an HPTX motherboard such as the EVGA SR-2, you can slide the V2120's entire motherboard tray out of the case's rear, allowing for easy motherboard, CPU cooler and graphics card installation outside of the case.



Sadly though, there's only a cut-out for a single CPU cooler, which is a shame considering the V2120 is capable of accommodating dual-CPU motherboards.

Unlike the exterior, the V2120's interior is furnished in plain aluminium rather than luscious anodised aluminium. Lian Li sells an anodised inside-and-out variant called the V2120X – but it costs roughly £30 more. Considering the already eye-watering £390 price, though, why wouldn't you pay the extra for an anodised interior?

Rising the height of the case is what Lian Li calls a VGA pillar bar, a strut of aluminium that can be used to support the weight of larger graphics cards. However, the fittings for doing this are fiddly and the fact that the pillar bar intrudes into the case – reducing CPU cooler clearance considerably – means that it's a waste of aluminium. Ditching it is no major loss, though, as it does little to reinforce the case's structure which, impressively for such a large aluminium case, is reassuringly sturdy.

The V2120's PSU mount is in the floor of the case, and is fitted with rubber strips on the mounting rails to reduce vibrations; a plastic cable tidy strip makes tidying your PSU cables easier. There's a dust filter-equipped vent underneath the PSU, while an aluminium plate divides the PSU and motherboard compartments. This divider has plenty of pre-cut cable-routeing holes, but while the cabling in the main chamber looks tidy, and the case's front panel cabling is hidden, we'd prefer to hide our power cables behind the motherboard tray. More frustrating was the fact that Lian Li doesn't include any 8-pin EPS12V extension cables – an essential extra considering the size of the case. We tried some spare PSUs and none of their 8-pin cables could stretch the distance.

As well as the two 140mm intake fans fitted into the front of the V2120, there's also a 140mm fan mounted on the inside of the case's large removable hard disk caddy. Lian Li also includes a pair of 120mm fans, one of which is fitted into a repositionable triple-bay 3.5in

The front panel boasts four USB 3 ports, but the fan controller below it is poorly placed

The use of 140mm fans on both sides of the hard drive cage ensures direct airflow to the core hardware despite the size of the case

drive caddy that occupies three of the case's five 5.25in drive bays, and a second fitted as a rear exhaust. This is a logical layout, with the 140mm fan mounted inside the case ensuring direct airflow over hot components despite the case's size.

Also impressive is the V2120's titanic drive capacity. The aforementioned five 5.25in drive bays are joined by thirteen 3.5in drive bays split between a single large caddy, a smaller second caddy next to the PSU, and the triple-bay 3.5in drive mount that can occupy three of the five 5.25in drive bays. This makes the V2120 well equipped for even the most massive of home server builds; we reckon that 39TB of data should be enough for even the worst HDTV pack-rat. While not toolless, all the hard disk mounts are fitted with rubber grommets to reduce vibrations.

COOLING

With our test hardware installed – and looking comparatively tiny inside the V2120's cavernous interior – we turned to thermal testing, and the results weren't as positive as we had hoped considering the five fans pre-fitted to the case.

Under load, the CPU peaked at 53°C above room temperature, placing the case some way behind the best cooling cases we've tested.

GPU cooling was better, no doubt thanks to the internal 140mm fan delivering sustained airflow to the graphics card, with a delta T of 41°C. This is just 1°C warmer than the GPU of the SilverStone Raven RV02 with its fans at low speed (see Issue 85, p87). As the V2120's fan cables aren't long enough to reach its fan controller, we only tested them at their full speed setting, which means that our results are a best-case scenario for cooling. However, it also meant that the V2120 was rather loud – while the noise-deadening foam of the side panels may have helped to reduce noise, the case was still clearly audible over the background hum of the lab.

CONCLUSION

Due to the very limited market for super-sized motherboards such as the EVGA Classified SR-2, it's a credit to Lian Li that the PC V2120 has even been made. However, while the idea behind creating a case of this size is admirable, the execution lacks attention to detail. Despite the V2120 being very well made and having plenty of features, mistakes such as none of the fan cables being able to reach the fan controller, the omission of any 8-pin EPS12V extension cables and an effectively redundant graphics card support bar disappointed us.

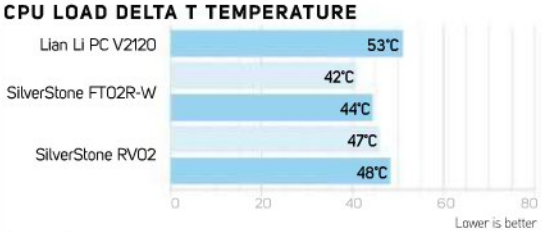
These are especially galling when you consider that Lian Li is charging £390 for this basic version of the V2120 and around £420 for the internally anodised model. This makes the V2120 one of the most expensive cases we've seen – when you pay this much money for a case, you expect all the extras you might need to be included in the box.

With so many great and cheaper ATX and E-ATX cases, the only reason for considering this case is if you've stumped up for the dual-CPU delights of an EVGA SR-2 motherboard. However, even then, the single cut-out in the motherboard tray to fit only one of the two CPU coolers is a huge oversight. While the Lian Li V2120 is the only case we've seen that will fit the SR-2, it doesn't do so particularly well and lacks effective cooling; as such, it isn't worth considering.

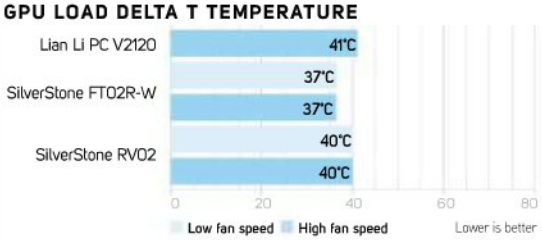
HARRY BUTLER

Results

CPU LOAD DELTA T TEMPERATURE



GPU LOAD DELTA T TEMPERATURE



Scores

COOLING	21/30
FEATURES	13/20
DESIGN	21/30
VALUE	7/20

CUSTOM PC 62% OVERALL

TEST KIT
3.4GHz Intel Core i7-870 CPU, AMD Radeon HD 5870 2GB Eyefinity graphics card, Biostar TPower I55 motherboard, 2GB OCZ PC3 15000 DDR3 memory, 160GB Seagate Barracuda 7200.9 hard disk, Gelid Tranquillo CPU cooler with Noctua NF-S12B ULN 120mm fan, Seasonic M12D SS-850EM PSU

DREMEL
Trio

Cutting side panels and blowholes just became a whole lot easier

+ ALUMINIUM
Hundreds of uses; variable speed; easier to use and more versatile than a jigsaw

– STEEL
Expensive; vacuum attachment isn't compatible with all vacuum cleaners

While Dremel's rotary tool with its endless number of attachments is very popular for more ambitious mods, it can't do everything. Accurately cutting long lengths of materials is difficult, and sometimes impossible with rotary tools. A jigsaw is usually the tool of choice for this job, but Dremel has created a device called the Trio, which claims to be far more flexible. The Trio is smaller than the average jigsaw and much lighter too. It feels solid and sturdy, though, and offers a firm hand grip. This is just as well, as the Trio isn't limited to cutting straight lines. The kit includes a vacuum attachment, which Dremel claims attaches to standard vacuum cleaner hoses, sucking up debris while you're cutting. Unfortunately, this didn't fit our Dyson vacuum cleaner, so we were unable to try it out.

Also included are cutting, routing and sanding attachments as well as a combined circle cutter and edge guide. The TR563 cutting attachment included with the Trio is easily able to deal with sheet steel. The steel side panel in our modding guide this month (see p138) was certainly no match for it, and we were able to cut a blowhole for a 120mm fan in less than ten minutes.

The Trio has five speed settings ranging between 10,000 and 20,000rpm, and you're able to switch between these using a dial at the end of the hand grip. The power switch is located on the underside of the hand grip and the grip itself can rotate upwards by 90 degrees, making working on vertical surfaces such as walls far easier. The Trio also has a telescopic foot, which decreases or increases the depth of the cut.

Dremel includes an edge guide, which fastens onto the Trio and allows you to follow the edge of the object you're cutting, or the surface on which you're working, making it easier to cut in a straight line. In a similar fashion, the guide also caters for cutting circles; a pivot pin and hand grip provide the means to fix the guide into position, with the Trio following it around in a circle.

Using the Trio is remarkably easy, even when cutting through steel – a task that often proves difficult with other tools and leaves your hands aching. Due to the fact that the cutting tool moves horizontally to the object you're cutting, unlike a jigsaw, which cuts vertically, there's little juddering. This makes it much easier and neater to use than a jigsaw, and far less likely to annoy the neighbours too. The Trio is one of the best tools we've seen for cutting along odd lines such as s-shapes and zigzags. Again, thanks to the cutting tool chipping away horizontally, you can cut in any direction, and can even change direction instantly – something you can't do with a jigsaw.

THE TRIO IS ONE OF THE BEST TOOLS WE'VE SEEN FOR CUTTING ODD LINES SUCH AS S-SHAPES AND ZIGZAGS

CONCLUSION

The Trio is more expensive than a traditional Dremel rotary tool, and around twice the price of a good jigsaw. Replacement attachments are also pricey at around £15. The Trio is probably overkill for just cutting in straight lines, but if you're cutting curved shapes, and using the sanding and routing extras, it's fantastic.

ANTONY LEATHER

HOW MUCH?
Price £120 inc VAT
Supplier www.diy.com
Manufacturer www.dremel.com
SKU number 6800-01

IN DETAIL
Cutting speed 10,000 - 20,000rpm
Weight 1.27kg
Accessories Cutting attachment, routing attachment, 60-grit, 120-grit and 240-grit sanding bands, vacuum attachment, edge guide, protective carry box
Warranty Two years

SCORES

DESIGN	35 / 40
FEATURES	28 / 30
VALUE	24 / 30

CUSTOM PC 87% OVERALL

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- ☑ SATA: **up to 5x**
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- ☑ SafeGuard
- ☑ Silent Thermal Cooling
- ☑ ErP Lot 6 Ready!
- ☑ 3 year warranty

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- ☑ Efficiency: up to **86%**
- ☐ Modular
- ☑ Multi-Rail: **2x 12V**
- ☑ PCI-E 6+2P: **up to 2x**
- ☑ SATA: **up to 7x**
- ☑ HeatGuard
- ☑ SafeGuard
- ☑ Silent Thermal Cooling
- ☑ ErP Lot 6 Ready!
- ☑ 3 year warranty

750 / 850W

- ☑ Efficiency: up to **88%**
- ☑ Modular
- ☑ Multi-Rail: **up to 4x 12V**
- ☑ PCI-E 6+2P: **up to 6x**
- ☑ SATA: **10x**
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- ☑ SafeGuard
- ☑ Silent Thermal Cooling
- ☐ ErP Lot 6 Ready!
- ☑ 3 year warranty

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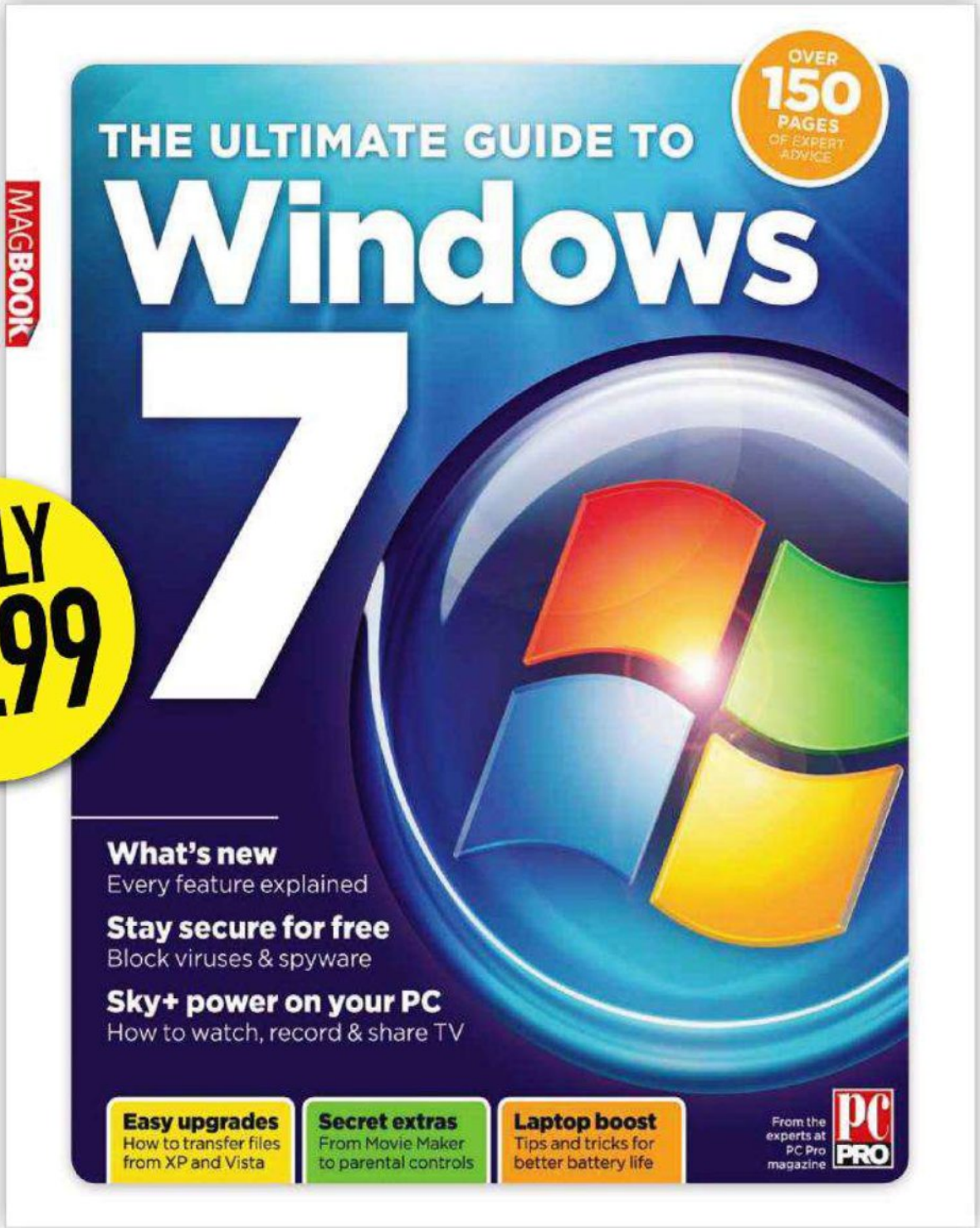

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CORSAIR
HS1A

Excellent detailed audio in the mid and high range but sadly lacking when it comes to bass

HEADBANGER
Lots of detail; 3.5mm jacks

HEADACHE
Lack of bass oomph; not as much volume as we'd like

The HS1A is Corsair's follow-up to the HS1 headset (see Issue 87, p93), but replaces its predecessor's USB connector with a more conventional pair of 3.5mm mini-jacks for the benefit of a £17 price cut.

Both the HS1 and the HS1A have 50mm drivers housed in large, comfortable circumaural ear cups, which are closed-back in design; the HS1A's cups are silver, while the HS1's cups are black.

The HS1A's ear cups are connected by the same thick, soft headband that we saw on the HS1 and, as a result, are equally comfortable. This is a real boon, as the level of comfort that the HS1 set offered was one of our favourite features about them.

Further enhancing the comfort level are the soft, microfibre-covered memory foam ear pads, which do an excellent job of sealing out external noise. The HS1A includes an additional pair of leatherette-covered ear pads – an extra that the more expensive HS1 set lacks.

The only other difference between the HS1A and the HS1 is the fact that the HS1A's cable terminates in a pair of 3.5mm jacks for the microphone and headphones, instead of the USB connector of the HS1. This also means that the HS1A misses out on the positional audio emulation of Dolby Headphone that was included with the HS1's on-board USB audio processor. Considering the price difference between the two sets, it shows just how much of a royalty Dolby must demand from headset makers for such support.

We didn't mourn the loss of Dolby Headphone support as the use of analogue connectors allowed us to plug the headset into any sound card or 3.5mm output. This meant that we could take advantage of the dedicated Asus Xonar DX sound card and its own 3D-positional emulation in our test rig. We also didn't need to install any extra Dolby Headphone drivers.

When we strapped the HS1A to our head, we were pleased but also slightly frustrated to find that the HS1A was very similar to the HS1 acoustically.

The clarity and acuity of the sound produced by the headset was brilliant, with clear mid and high tones; as with its sibling, though, this quality and depth wasn't replicated in the bass scale. It's a frustrating arrangement, as the quality of the high end throws the lack of bass into sharp relief. This resulted in piano or acoustic music sounding bright and alive, while rock or drum and bass was tinny and underwhelming.

The guns and grenades in Call of Duty 4: Modern Warfare also sounded distinctly tinny. Dirt 2 fared equally badly, with the throaty roar of our rally car's exhaust sounding more like an effeminate whine.

Adding a little bass-boost to the audio via Windows 7 control panel helped matters, but resulted in a loss of volume. Even with everything dialled up to full, the HS1A's audio output level was only moderate at best.

CONCLUSION

The HS1A is affordable, comfortable, and has excellent sound clarity and detail. Unfortunately, it lacks the bass notes that provide the wow factor in games, music and movies. If you can only spend around £50 then the HS1A is in with a shout, but you'll enjoy your PC's audio far more if you stump up £70 and buy the Razer Carcharias instead.

PAUL GOODHEAD

HOW MUCH?
Price £54 inc VAT
Supplier www.scan.co.uk
Manufacturer www.corsair.com
SKU number CA-HS1AEU

IN DETAIL
Cup type Circumaural, closed back
Connection Wired, 2 x 3.5mm mini-jack
Driver(s) 50mm
Frequency response 20Hz to 20KHz
Impedence 32 ohms

SCORES

SOUND	32 / 40
DESIGN	27 / 30
VALUE	24 / 30

CUSTOM PC 83% OVERALL

TEUFEL
Concept D 500 THX

Custom PC Extreme Ultra

Audiophile sound quality and aesthetics to enhance your PC experience

+ BISMARK
Stunning audio quality at every level; integrated headphone amp; separate subwoofer and volume controls; looks great

– KAISER
Eye-wateringly expensive

Most PC speakers aim for maximum bang per buck: ear-splitting top volume, booming bass and a rock-bottom price seem to be the features that sell. Into this crowd of boy racers, Teufel's latest 2.1 set glides into view like an Aston Martin, albeit with German plates.

Teufel speakers are only available direct from Berlin, which helps to keep down costs. However, at £449, this is the most expensive 2.1 PC speaker system we've seen to date.

It looks every bit as good as the price suggests – elegant and understated, with a premium finish. There's a solitary analogue stereo input, and it deserves a signal from a high-fidelity sound card to do the speakers justice. An S/PDIF input would have offered a workaround, but those who already own a decent sound card will be thankful not to have to shell out for another premium DAC chip. Unfortunately, there are no speaker cables included in the box.

The wired remote has volume and subwoofer level controls, although the latter is calibrated too high by default. Useful settings were around 10 per cent, and the ratcheted design made fine adjustments imprecise. The remote also houses a headphone output and microphone input – a socket on the subwoofer passes the microphone signal to the sound card. The integrated headphone amp sounded clear with plenty of headroom, but emitted a violent clunk while switching on and off.

The amplifier is a Class D design, a relatively unusual approach that's more energy-efficient than traditional amplifiers. It seems to do its job in this instance, as this system exhibited an openness and clarity that cheaper PC speakers can't match. The crossover circuitry and speakers can take some credit, of course. The tweeters' recessed surrounds help to reduce reflections and maintain phase with the mid-frequency drivers, and their focused sound created an immaculate stereo image with a sense of space and depth.

There's a gentle presence lift at around 3-4KHz, which flattered most sources but risked making intense music, games and films a little fatiguing at high volumes. These frequencies were extremely precise and focused, though, so the tone was generally more vibrant and exciting than fatiguing.

The subwoofer was spine-tinglingly impressive: it took drum and bass swoops in its stride, but was controlled enough to flatter gentler music. The 150Hz crossover between the subwoofer and satellites is a little higher than is ideal, though, so bass frequencies could be traced to the subwoofer rather than blending seamlessly with the satellites. Keeping the sub tucked well under the desk minimised the issue.

Feeding the set with test tones revealed a solid, even response from 40Hz, passing seamlessly over to the satellites. The crossover between the satellites' mid-range and high-frequency drivers (quoted at 2KHz) was smooth, although we noticed a little harmonic distortion between 300Hz and 800Hz.

FREQUENCIES WERE PRECISE AND FOCUSED, SO THE TONE WAS GENERALLY VIBRANT AND EXCITING

CONCLUSION

This set is a far better option than hi-fi separates – it's compact and dispenses with unnecessary extras such as DSP processing and surround amplification. It isn't cheap, but it should last through multiple PC upgrades and easily rivals the Corsair SP2500 (see Issue 92, p79) as the best set of 2.1 PC speakers.

BEN PITT

HOW MUCH?
Price £449 inc VAT
Supplier www.teufelaudio.com
Manufacturer www.teufelaudio.com
SKU number D500THX

IN DETAIL
Speakers 2 x 35W satellites, 200W subwoofer
Satellite size (mm) 115 x 240 x 290mm (W x D x H)
Subwoofer size (mm) 210 x 455 x 475mm (W x D x H)
Frequency response 35Hz - 22KHz (-3dB)
Connectors Subwoofer: stereo phono input; remote: headphone output, mic pass-through
Extras Wired remote

SCORES

SOUND	48 / 40
DESIGN	18 / 20
VALUE	17 / 30

Custom PC 83% OVERALL

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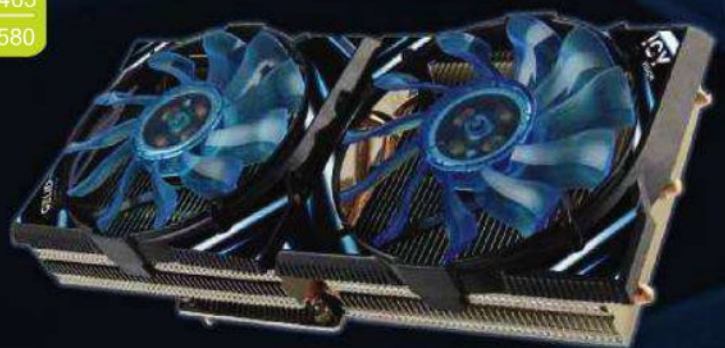
ATI™ (CrossFire)	HD4850, HD4870, HD4890, HD5830, HD5850 HD5870, HD6850, HD6870, HD6950*, HD6970*

*In combination with ICY Vision HD6900 VRM Cooling Enhancement Kit



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how we test

Thorough testing and research is the key to evaluating whether a product is worth buying, and whether there's a better alternative

Processors

We judge CPUs on whether they offer sufficient speed for the price. Part of a CPU's speed score comes from how overclockable it is. Every type of CPU is tested in the same PC, so all results are directly comparable.

Intel LGA1155

Intel LGA1155 | Asus P8P67 | 4GB of Corsair 1,600MHz DDR3

Intel LGA1366

Intel LGA1366 | Asus P6TD Deluxe | 6GB of OCZ 1,600MHz DDR3

AMD Socket AM3

AMD Socket AM3 | Asus Crosshair IV Formula | 4GB of Corsair 1,600MHz DDR3

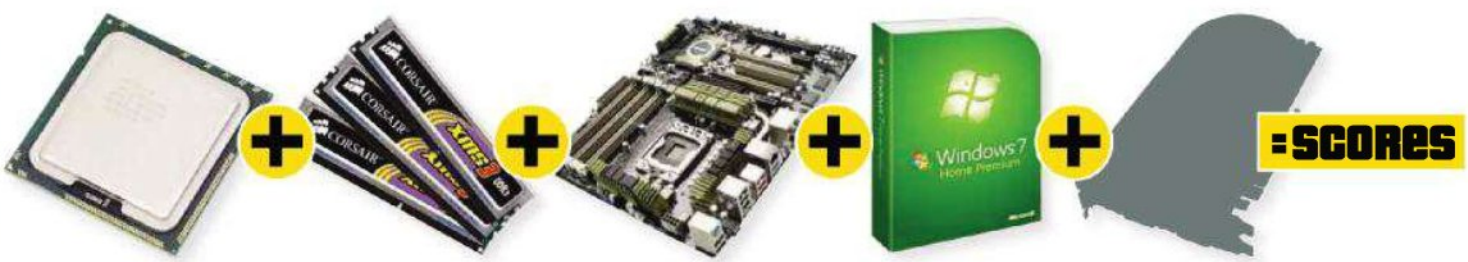
Common components

AMD Radeon HD 5870 1GB | 2TB Western Digital Caviar Black | Windows 7 64-bit

TESTS: We use the **Custom PC** Media Benchmarks, Cinebench R11.5, WPrime and Crysis. We also test the resultant power draw of the test PC with the CPU installed. These tests reveal a broad range of performance characteristics for the CPU, from image editing to gaming and from video encoding to 3D rendering. We run all the tests with the CPU at stock speed and again when overclocked to its highest frequency.

Graphics cards

Graphics cards are mainly evaluated on how fast they are for their price. However, we also consider the efficacy and quietness of the cooler. Every graphics card is tested in the same PC, so all results are directly comparable.



3.2GHz Intel Core i7-965 Extreme Edition | 6GB of Corsair 1,600MHz DDR3 | Asus Sabertooth X58 | Windows 7 64-bit | The graphics card we're reviewing

Custom PC media benchmarks

2.66GHz Intel Core 2 Duo E6750 | 2GB of Corsair 1,066MHz DDR2 | 250GB Samsung SpinPoint P120S | Asus P5K Deluxe WiFi-AP | = 1,000

Our benchmark suite simulates how people really use PCs, a higher score is better. You can download the suite from: www.tinyurl.com/benchies

motherboards

Motherboards are evaluated on everything from layout and features to overclockability and value for money. Every motherboard is tested with the same components, so all results are directly comparable.

Intel LGA1155

Intel Core i5-2500K | Motherboard on test | 4GB of Corsair 1,600MHz DDR3

Intel LGA1366

Intel Core i7-980X Extreme Edition | Motherboard on test | 6GB of Corsair 1,600MHz DDR3

AMD Socket AM3

AMD Phenom II X3 720 BE | Motherboard on test | 4GB of Corsair 1,600MHz DDR3

Common components

AMD Radeon HD 5870 1GB | 2TB Western Digital Caviar Black | Windows 7 64-bit

TESTS: We use the **Custom PC** Media Benchmarks and Crysis, and also test the speeds of the board's SATA ports. We try to overclock every motherboard we review by testing for a maximum QPI, Base Clock or HTT as well as overclocking the CPU to its maximum air-cooled level. We run our tests at stock speed and with the CPU overclocked.

TESTS: By using the fast PC detailed on the left, we can be sure that any limitations we see are due to the graphics card on test. We test the four games (right) at their maximum detail settings, in their highest DirectX mode, and at three resolutions. High-end cards should be able to sustain playable frame rates at 2,560 x 1,600, while 1,920 x 1,080 is more important for mid-range cards, and 1,680 x 1,050 is a bare minimum for any new card. We also try to overclock every graphics card we test to see what difference this makes to the card's performance.

the awards

Some products are gloriously over the top. These items of excellent overkill earn our Extreme Ultra award.

Premium Grade products are utterly desirable – we'd eat nothing but beans until we could afford them.

Products worthy of the Professional award make you and your business appear even more awesome.

Approved products are those that do a great job for the money; they're the canny purchase for a great PC.

For those gadgets and gizmos that really impress us, or that we can't live without, there's the Custom Kit award.

Custom Kit

We check out the latest gadgets, gizmos and geek toys

PORTABLE SPEAKERS

iLUV iSP170 Boom Cubes

01 These iLuv Boom Cubes are a pair of portable speakers designed to beef up the sound on a laptop. They're two perfect cubes, each measuring around 1.25 Rubiks – the **CPC**-standard size for a cube. There's a 3.5mm stereo mini-jack for plugging into a sound source and a USB cable through which the speakers are powered. Hook up the Boom Cubes to a laptop and they're surprisingly loud, given the limited juice available from a USB connector. Push the volume too far and they'll distort, but there's enough power between them to fill the room. If you have a mains-to-USB adaptor with sockets, you could use it to power the speakers while you use an MP3 player or similar device for sound, but there's no mains adaptor included. **SH**

SQUARES ●●●○○ **CUBES**

Price £14.99 inc VAT **Supplier** www.argos.co.uk
Manufacturer www.i-luv.com

ROBOT VACUUM CLEANER

iROBOT Roomba 581

02 We doubt that Asimov was thinking of vacuum cleaners when he devised the three rules of robotics, but they seem to apply to iRobot's Roomba vacuum cleaner. Therefore, it didn't kill us, vacuumed when we told it to and managed not to self-destruct. The 581 is the range-topping model, which includes three 'virtual wall lighthouses' that you place around your home to help guide it on its rounds. It can cope with carpets or hard floors, covering about four rooms before returning to its base to charge. The Roomba lurches around a bit, but it generally detects and avoids obstacles such as furniture. It isn't as powerful as a normal vacuum and at £400, it's pricey – but we're lazy and it's a robot. An actual robot. We want one and so do you. **SH**

TEH SUCK ●●●●● **ROXXOR!**

Price £399.99 inc VAT **Supplier** www.irobot.com
Manufacturer www.irobot.com

RETRO TOY

BIGTRAK

03 Anyone who tells you to leave the past alone has never owned a BigTrak – the tank-like vehicle which, in 1979, felt as though it had travelled through a time warp from the future. This re-release is a faithful recreation of the original toy, accurate down to the decals, sounds and a curious attraction to table legs. Programming BigTrak involves entering a sequence of commands that will be carried out once you press the Go button. Movement forwards or backwards is specified in lengths, while turns are entered like the minutes of a clock face, so a full turn is 60 minutes. Watching BigTrak carry out instructions can be deeply satisfying, or involve a sprint across the room before it knocks the cat down the stairs. Toys never got better than this. **SH**

BOYZONE ●●●●● **BATTLEZONE**

Price £34.99 inc VAT **Supplier** www.firebox.com
Manufacturer www.zeonltd.co.uk

Edited by
Harry Butler

Writers:
Simon Handby
and Joe Martin

BLUETOOTH HEADPHONES

JAYBIRD Sportsband 2

04 If you're anything like us, your biggest workout probably consists of placing a gaming laptop in its bag. As such, Jaybird's Sportsband Bluetooth headphones might be of limited appeal – they're designed to stay in place during exercise, and even have a lifetime warranty against sweat. For commuters and joggers, though, this is a decent if expensive headset with reasonable sound quality. Pair them via Bluetooth with a smartphone and you can take calls too, using the built-in mic. The fit is comfortable, and the lack of a lead is a blessing when you're pushing through crowds. If all that sounds too much like hard work, just tilt them forwards over your eyes and pretend you're Geordi La Forge. **SH**

SNICKERS ●●●○○ **MARATHON**

Price £99 inc VAT
Supplier www.advancedmp3players.co.uk
Manufacturer www.jaybirdgear.com

ELECTRONIC DRUMS

ION Discover Drums

05 If you've always wanted to be in Kraftwerk, all you need is a black tie, slicked hair and this electronic drum kit from ION. It has four velocity-sensitive pads, 26 built-in kit sounds and includes a pair of plastic drumsticks. While it sounds good on paper, in reality it's disappointing. There's considerable background noise over the speaker and headphone output, making it unlikely that you'd use it for anything other than as a toy. You can't assign sounds to individual pads, so you're stuck with drums where ION thinks they should be – typically, the kick drum's on the left and the snare is on one of the two middle pads, so it isn't ideal for left-handed use. Ultimately, we'd pay more – and expect to have more fun – from a game of Rock Band. **SH**

DRUM ●○○○○ **BASS**

Price £49.99 inc VAT **Supplier** www.firebox.com
Manufacturer www.ionaudio.com

BOARD GAME

SID MEIER'S CIVILIZATION

06 As you'd expect, Sid Meier's Civilization: The Board Game is incredibly complex – and that forces some limitations on its structure, such as a four-player limit. There are so many dials, counters, charts and boards to keep track of that a single turn around the table can last for an hour. But it's still a lot of fun. As with the computer game, players take on the role of different countries and try to be the first to achieve either economic, cultural, scientific or military victories. That there are so many paths to success – along with the randomised map and range of player traits – is what gives Civilization amazing tactical depth. This is something you can play repeatedly if you have the patience to learn it. **JM**

BORED ●●●●○ **BOARD**

Price £36.78 **Supplier** www.amazon.com
Manufacturer www.fantasyflightgames.com

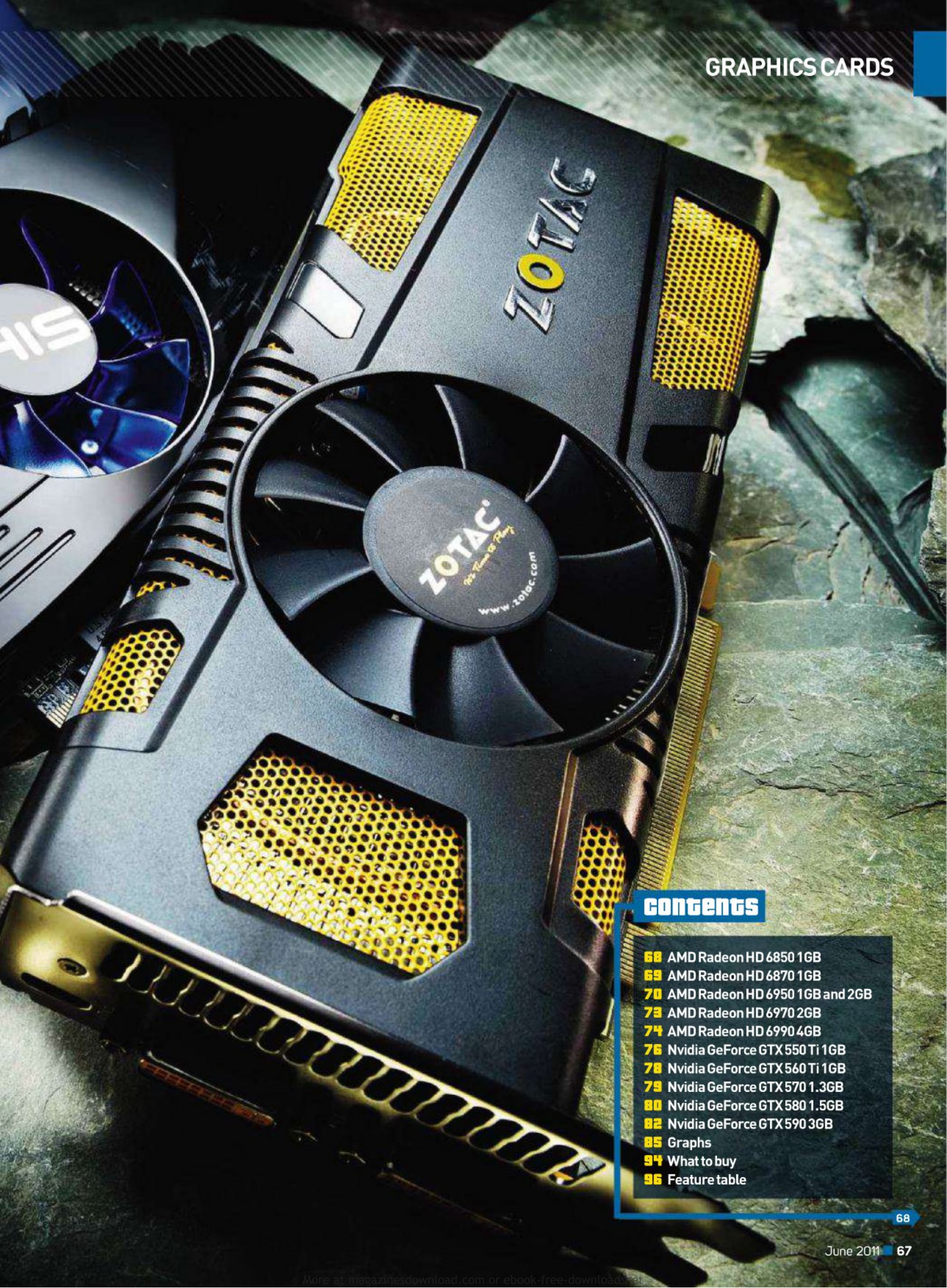
Graphics card MEGATEST

With so many great games due over the next few months, now is the time to upgrade your graphics card

Building a balanced PC is important, but it's even more essential to cater your build to suit your needs. If you're interested in gaming, it's the graphics card you need to pay most attention to. The technology of these cards moves at a furious pace, so choosing which one is best for your budget is always tricky.

Custom PC comes to the rescue with this comprehensive megatest of every new card, plus a load of previous-generation cards so that you can see if it's worth upgrading. After all, it's pointless spending any amount of money if the gains are tiny. In total, we've run 22 graphics cards through a gruelling suite of tests to separate the underpowered GPUs from the gaming powerhouses. We've also got folding results for those more interested in ppd than fps, and the full complement of power consumption and temperature results, too. Whether you're in the market for a graphics upgrade or you're building your first PC, this Labs Test is essential reading.

CONTRIBUTORS: CLIVE WEBSTER, ANTONY LEATHER, HARRY BUTLER, PAUL GOODHEAD



Contents

68 AMD Radeon HD 6850 1GB
69 AMD Radeon HD 6870 1GB
70 AMD Radeon HD 6950 1GB and 2GB
73 AMD Radeon HD 6970 2GB
74 AMD Radeon HD 6990 4GB
76 Nvidia GeForce GTX 550 Ti 1GB
78 Nvidia GeForce GTX 560 Ti 1GB
79 Nvidia GeForce GTX 570 1.3GB
80 Nvidia GeForce GTX 580 1.5GB
82 Nvidia GeForce GTX 590 3GB
85 Graphs
94 What to buy
96 Feature table

AMD Radeon 6850 1GB

Cool and quiet but only because it lacks gaming grunt

+ 1080P
Quiet; can play some games at 1,920 x 1,080

– 720P
Can't play Bad Company 2 without sacrificing AA; poor value

✓ BEST GAMING RESOLUTION
Not even 1,680 x 1,050

The AMD Radeon HD 6850 1GB launched back in October 2010 and shook up the mid-range of the market in the process. Seven months' worth of water has passed under the bridge since then, though, which makes it the oldest of AMD's HD 6000-series graphics cards.

With cards currently costing around £140, the 980 stream processors of the Barts Pro GPU seem generous. These stream processors work alongside the 48 texture units which, like the rest of the GPU, run at 775MHz. Coupled to the GPU is 1GB of 1GHz (4GHz effective) GDDR5 memory, which operates on a 256-bit bus, giving a theoretical maximum memory bandwidth of 128GB/sec.

Black Ops proved no problem for the HD 6850 1GB; even at 2,560 x 1,600 with 4x AA applied, the card returned a minimum frame rate of 58fps. The HD 6850 1GB was faster than the £190 GeForce GTX 560 Ti 1GB (see p78) at 1,920 x 1,080 with 4x AA, but managed a lower average frame rate at the other two test settings, despite the minimums of the two cards being similar. At least the HD 5850 1GB was consistently faster than the £115 GeForce GTX 550 Ti 1GB (see p76).

The HD 6850 1GB performed poorly in Dirt 2, managing to be slower than the cheaper GTX 550 Ti 1GB at every resolution. Bad Company 2 proved too much for the HD 6850 1GB too; even at 1,680 x 1,080, you'll have to lose the AA to achieve a playable frame rate. Worse still, the GTX 550 Ti 1GB can just about play the game at 1,680 x 1,050 with 4x AA – even a GeForce GTX 460 1GB managed a minimum frame rate of 32fps.

The HD 6850 1GB could run Arma II smoothly at 1,920 x 1,080 with 4x AA, but only just, with a minimum of 25fps. The GTX 460 1GB was 1fps slower, while the GTX 550 Ti 1GB was considerably slower. However, an extra £50 nets you a GTX 560 Ti 1GB and a minimum frame rate of 30fps.

The HD 6850 1GB also struggled when it came to folding, as did all its Radeon cousins. The meagre 2,983ppd was the third lowest on test. At least the HD 6850 1GB didn't draw much power while it was folding – our test system drew only 213W from the wall with it installed. This number jumped up slightly to 226W when gaming, however.

Thankfully, the stock cooler of the HD 6850 1GB is easy to live with, as the relatively junior GPU means that the fan doesn't have to spin up to keep the chip cool. The HD 6850 1GB's idle delta T of 14°C was the second best on test, while its gaming delta T of 48°C was also towards the top of the table.

CONCLUSION

While the HD 6850 1GB breezed through Black Ops and performed reasonably well in Arma II, it couldn't play Bad Company 2 at our lowest test settings and was outpaced by the cheaper GTX 550 Ti 1GB in both this game and Dirt 2. While the £140 price means that there's no direct competitor to the HD 6850 1GB, it isn't worth the extra £25 over the GTX 550 Ti. The next step up the performance ladder from this GPU is the £190 GTX 560 Ti 1GB.

PAUL GOODHEAD

HOW MUCH?
Typical street price
£140 inc VAT
Manufacturer
www.amd.com

AMD Radeon HD 6870 1GB

Still quick if you have one, but not worth buying now

If you bought an AMD Radeon HD 6870 1GB at launch then you'd have paid around £200 for the large black slab of graphics processing goodness. It's a competent card, as demonstrated by the fact that prices have only dropped a measly £20 over the past seven months; graphics cards usually depreciate faster than a shiny new showroom-bought Alfa Romeo.

Powering the HD 6870 1GB is the Barts XT GPU, with 1,120 stream processors zipping along at a healthy 900MHz. This means that the HD 6870 1GB is actually the highest-clocked GPU in AMD's current range. These stream processors are complemented by 56 texture units – eight more than the Radeon HD 6850 1GB – and 32 ROPs. Rounding all this off is 1GB of GDDR5 memory running at 1.05GHz (4.2GHz effective), which provides the GPU with a memory bandwidth of 134GB/sec.

AMD cards love Black Ops, so it was no surprise to see the HD 6870 1GB perform well in this game. Even those with 30in monitors would see playable frame rates – we saw a minimum frame rate of 65fps at 2,560 x 1,600 with 4x AA. The similarly priced GeForce GTX 560 Ti 1GB (see p78) could only manage a minimum of 57fps at the same resolution.

Bad Company 2 is a more punishing game to run and here the HD 6870 1GB struggled. Its minimum frame rate of 28fps at 1,920 x 1,080 with 4x AA was a significant 4fps slower than that of the GTX 560 Ti 1GB.

We saw a repeat of this pattern in Arma II, with the HD 6870 1GB returning a minimum of 28fps at 1,920 x 1,080. This was enough to play the game smoothly, but the GTX 560 Ti 1GB was 2fps faster, giving you a little more leeway should the action become crazy on screen.

Dirt 2 generally favours Nvidia hardware, so it was no surprise to see the HD 6870 1GB beaten by even the £115 Nvidia GeForce GTX 550 Ti 1GB at 1,680 x 1,050 and 1,920 x 1,080. The GTX 560 Ti 1GB eclipsed the HD 6870 1GB by an even greater amount – even if the HD 6870 1GB could play the game smoothly at up to 2,560 x 1,600 with 4x AA.

The woeful 3,476ppd that we gained from the HD 6870 1GB was less than even the three-year-old GeForce GTX 260 (rev 2) 896MB, although serious folders should know not to bother with AMD cards until Stanford updates its client. Given that the HD 6870 1GB caused our PC to draw the same amount of power as with the older Nvidia card installed, you'd be insane to buy an HD 6870 1GB purely for folding.

CONCLUSION

The HD 6870 1GB is a capable card, but it was only just able to play Bad Company 2 and Arma II at 1,920 x 1,080. This indicates that there isn't much performance left in the tank if you have a 23in screen. With so many great games coming out this year, we'd like a little insurance to make sure that they're all playable. If you already own one of these cards, however, you'll need to spend a fair amount of money to get a worthwhile upgrade.

PAUL GOODHEAD

+ HIGH DEF
Has aged well

– HIGH PITCH
Loud when gaming

✓ BEST GAMING RESOLUTION
1,920 x 1,080

HOW MUCH?
Typical street price
£180 inc VAT
Manufacturer
www.amd.com

70

AMD Radeon HD 6950 1GB and 2GB

Decent enough, but the GeForce GTX 560 Ti 1GB is cheaper and as fast

SWEET
Solid performance at 1,920 x 1,080; competitive price

SOUR
2GB version is pointless; GTX 560 Ti 1GB is cheaper

BEST GAMING RESOLUTION
1,920 x 1,080

HOW MUCH?
Typical street price £205 inc VAT (1GB), £230 (2GB)
Manufacturer
www.amd.com

At the start of this year, the AMD Radeon HD 6950 2GB had the price area between £200 and £300 to itself, but then the Nvidia GeForce GTX 560 Ti 1GB (see p78) appeared, offering comparable performance for around £200. In response, AMD released a cheaper 1GB version of the card to undercut the 2GB version by around £25. As the two cards are identical apart from memory size, and perform very similarly, we're bundling them together on the same page.

Both cards are based on the same Cayman Pro GPU, which runs at a reasonable 800MHz. Inside this GPU are 1,408 stream processors and 88 texture units. The memory of the cards runs at the same 1.25GHz (5GHz effective) through the same 256-bit bus. This gives the two cards the same 160GB/sec memory bandwidth.

Predictably, both cards could play Black Ops and Dirt 2 at the native 2,560 x 1,600 resolution of a 30in monitor. The two cards are 5-8fps faster in Dirt 2 and 14-15fps slower in Black Ops than the £190 Nvidia GTX 560 Ti 1GB (see p78). The 2GB version was an insignificant 1fps faster than the 1GB version.

Arma II is a sterner test for a GPU and more indicative of how a graphics card will deal with a hardcore PC-only game. The HD 6950s again performed well in this respect; the 2GB and 1GB versions managed a minimum frame rate of 33fps and of 32fps respectively at 1,920 x 1,080 with 4x AA, while the GTX 560 Ti 1GB could only produce a minimum of 30fps at the same settings.

Bad Company 2 saw the GTX 560 Ti 1GB gain a lead over both cards, with a minimum of 32fps at 1,920 x 1,080 with 4x AA. The 2GB version could only produce a minimum of 30fps and the 1GB version a minimum of 29fps. This isn't terrible news for the 1GB card, as it's only £15 more expensive than the GeForce, but it makes the £230 2GB version poor value for money.

If folding is your primary concern when looking at a graphics card then we're unsure as to why you're even reading this page. Stanford has yet to release a folding client to better address the CAL API that AMD insists on using, so folding performance is poor across all Radeon cards. Both cards managed less than 4,000ppd, and were eclipsed by cheap GeForce cards.

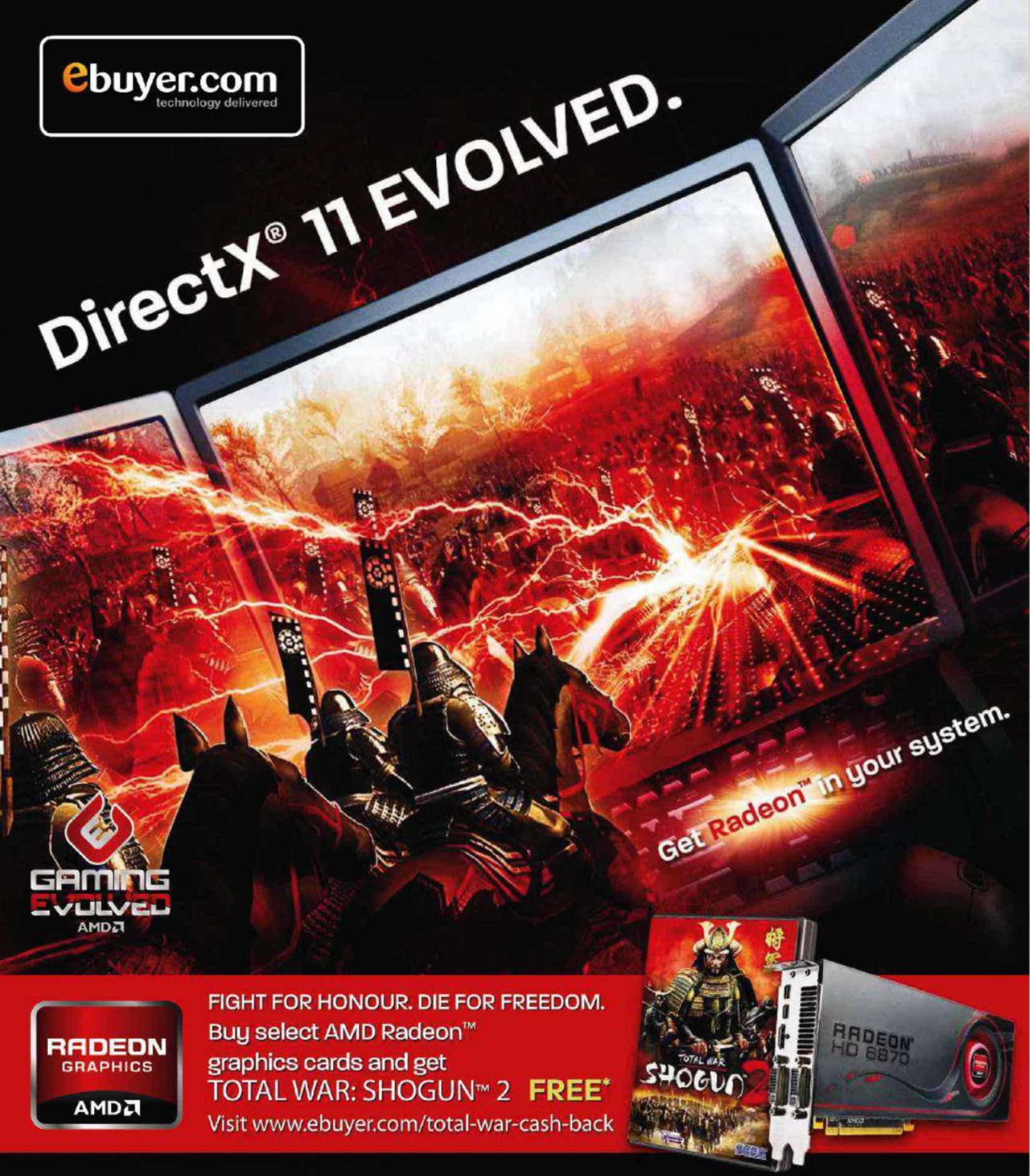
Power consumption for the two cards was, as you'd expect, similar; the 1GB version of the card caused our test PC to draw 254W when gaming, which rose to 272W with the 2GB card installed. At least the much-used reference cooler was quiet, even if the denser memory of the 2GB card caused its GPU to run a little hotter than that of the 1GB version.

CONCLUSION

If you own an HD 6950, you probably don't need to upgrade – each card was capable of running the latest games at 1,920 x 1,080. If you're building from scratch, the GTX 560 Ti 1GB is as fast and £15 cheaper. Some HD 6950 2GB cards can be upgraded to a HD 6970 2GB via a vBIOS flash, but overclocking a GTX 560 Ti 1GB is a more reliable way to unlock more performance.

PAUL GOODHEAD

73



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AMD ATI ASUS intel Arbico Computers Strongly Recommends Windows 7

AMD Radeon HD 6970 2GB

Fast at 1,920 x 1,080 – but the GeForce GTX 570 1.3GB is slightly faster

SUPERNOVA
Fairly quiet; great at 1,920 x 1,080

WHITE DWARF
High power draw; runs fairly hot; terrible at folding

BEST GAMING RESOLUTION
1,920 x 1,080

HOW MUCH?
Typical street price
£285 inc VAT
Manufacturer
www.amd.com

The Cayman XT GPU of the AMD Radeon HD 6900-series is a different design to that of the HD 6800-series GPUs. It has two entire front-end units, which allow for twice as much work per clock to be sent to the stream processors than before. Although there are 64 fewer stream processors in this GPU than in AMD's previous-generation top-end card, the Radeon HD 5870 1GB, each processor is capable of the high-precision maths that only a fifth of the HD 5870 1GB's units could manage.

AMD claims that the new layout is 10 per cent faster per square millimetre of GPU die than that of the HD 5870 1GB. Despite the naming of AMD's HD 6000-series, this GPU is the successor to the HD 5870 1GB. The GPU has a frequency of 880MHz and 2GB of GDDR5 RAM operating at 1.375GHz (5.5GHz effective) over a 256-bit memory interface. This may sound paltry compared with the 384-bit interfaces of the GeForce GTX 570 1.3GB (see p79), and the GeForce GTX 580 1.5GB (see p80) but the high memory frequency gives the HD 6970 2GB a respectable 176GB/sec of memory bandwidth.

At 1,920 x 1,080, the HD 6970 2GB traded blows with the GTX 570 1.3GB, which currently costs £10 less. In Arma II, we saw identical minimum frame rates from both cards, while Black Ops ran similarly fast on both cards, with minimums of 95fps from the Radeon and of 94fps from the GeForce. The GTX 570 1.3GB raced into the lead in Dirt 2 with a minimum of 91fps rather than 75fps, and was 4fps faster in Bad Company 2 with a minimum of 42fps.

When we increased the resolution to 2,560 x 1,600, neither the HD 6970 2GB nor the GTX 570 1.3GB could cope with Arma II or Bad Company 2. Both cards managed the same 18fps minimum in the former game, while the GTX 570 1.3GB managed a minimum of 21fps compared to 19fps in Bad Company 2. We saw the usual pattern of Dirt 2 favouring a GeForce card and Black Ops favouring a Radeon card, however, and both games ran at very high frame rates on both cards.

The folding output of the HD 6970 2GB was dire, however, with just 4,328ppd generated, for a total system power draw of 294W. Even the GeForce GTX 260 (rev 2) 768MB was faster at folding, and that's a three-year-old card. The GTX 570 1.3GB powered through 14,756ppd while using 10W less power than the HD 6970 2GB. The GTX 570 1.3GB may have consumed 24W more when gaming than the HD 6970 2GB, but both reference coolers were reasonably quiet for such powerful cards.

CONCLUSION

GeForce GTX 570 1.3GB cards used to cost slightly more than HD 6970 2GB cards, but a recent price drop by Nvidia has made its card even more attractive. It's slightly faster than the HD 6970 2GB overall, better at folding and now costs £10 less. However, if you already own an HD 6970 2GB, only a GeForce GTX 580 1.5GB or one of the leviathan dual-GPU cards represents a significant upgrade – it's still a very capable card so we doubt that you'll be retiring it any time soon.

ANTONY LEATHER

74

AMD Radeon HD 6990 4GB

Huge and very fast, but the GeForce GTX 590 1.5GB is quicker

DOUBLE
Very fast

TROUBLE
Slower than the GTX 590; loud; runs hot; consumes more power than Belgium; driver issues

BEST GAMING RESOLUTION
2,560 x 1,600

The Radeon HD 6990 4GB is a dual-GPU behemoth that measures a titanic 12in long. As with previous AMD dual-GPU cards, the basis for the card is two top-end GPUs – it uses the same Caymen XT GPUs as the (single-GPU) Radeon HD 6970 2GB (see p73). However, the two GPUs operate at lower frequencies than in the HD 6970. With the HD 6990 4GB, this means that the 3,072 stream processors run at 830MHz rather than 880MHz. Similarly, the 4GB of GDDR5 memory (2GB per GPU) is clocked at 1.25GHz (5GHz effective) rather than 1.375GHz (5.5GHz effective).

By selecting such high-end, high-power GPUs, AMD has given itself a significant challenge when it comes to both powering and cooling this beast. As a result, the card breaks the PCI Express 2.0 power specification, which states that no expansion card should consume more than 300W of power. The HD 6990 4GB in its factory configuration draws up to 375W of power, and can draw up to 450W if you flick the Antilles Overclocking Switch, which increases the GPU frequency from 830MHz to 880MHz and adds an extra 0.055V to each GPU. Rather unhelpfully, AMD says that you automatically void your warranty by using the Antilles Unlocking Switch – this is a ridiculous decision considering that the switch is a standard feature of all cards. Even at its default speed, you'll need a hefty PSU to power the card.

To deal with all the heat produced by the two GPUs, AMD has had to use phase-change TIM, which cures and hardens. AMD claims this TIM improves thermal performance by 8 per cent in comparison to ordinary TIM. However, we were advised that disassembling the card breaks this cured TIM, which can't be reset. Each GPU is also cooled by a vapour-chamber-based heatsink, which we've found to be extremely effective in the past.

Cooling the card's memory has also required a more complex arrangement than usual. AMD has had to mount half of the memory for each GPU on the back of the card – each GPU is serviced by eight 256MB modules, which won't all fit on one side of the PCB. As such, a backplate has been used to passively cool the memory fitted on the back of the card, and this is probably the reason why the HD 6990 4GB ships with a comparatively conservative memory speed of 5GHz (effective).

PERFORMANCE

As we've already seen graphics cards that cost half the price of the HD 6990 4GB manage playable frame rates in Dirt 2, it was no surprise to see it absolutely demolish the game. Even with 4x AA applied at 2,560 x 1,600, we saw a minimum frame rate of 89fps. This increased slightly to 96fps when the Antilles Switch was enabled. Even this result wasn't enough to beat the Nvidia GeForce GTX 590 3GB, though, which returned a triple-digit minimum frame rate (see p82).

Black Ops doesn't know what to do with any of the dual-GPU cards we tested, and they all tended to achieve a minimum frame rate of around 80fps no matter which resolution we used. However, the new GTX 590 3GB managed to push past this limit at 1,680 x 1,050, so perhaps driver updates will resolve this. All of this is moot, though, as a minimum frame rate of 81fps at 2,560 x 1,600 with 4x AA is still epic.

Arma II should be the kind of game in which the HD 6990 4GB shines, as it's a notorious resource hog. To its credit, the card was one of only two cards that could play the game at 2,560 x 1,600 with 4x AA and our punishing Very High settings. Unfortunately for AMD, it was the slower of the two cards by 5fps, and its minimum of 26fps was precariously close to being unplayable. Flicking the Antilles Switch didn't help either – the minimum frame rate didn't budge. It was interesting to see that the HD 6990 4GB managed higher average frame rates in Arma II than the GTX 590 3GB, which is possibly an indication that the driver isn't getting the most performance from the hardware.

WHEN UNDER LOAD, THE HD 6990 4GB WAS THE LOUDEST CARD – ALTHOUGH IT MANAGED TO BE JUST SHY OF HAIRDRYER LEVELS OF NOISE

Bad Company 2 again let the HD 6990 4GB stretch its legs and attempt to justify its humongous price tag, which it did to a degree. It was one of only two cards that managed a comfortably playable minimum frame rate at 2,560 x 1,600, with the GeForce GTX 580 1.5GB

HOW MUCH?
Typical street price
£540 inc VAT
Manufacturer
www.amd.com

(see p80) a little too close to the 25fps cut-off point for comfort. In its overclocked mode, the HD 6990 4GB was the fastest card on test. The card stuttered at 1,680 x 1,050, which made the game unplayable. AMD says it focuses its efforts on the higher resolutions with cards such as this, but we saw no such issues from the dual-GPU GTX 590 3GB, so we still have to place a question mark over the driver support of the HD 6990 4GB.

As you'd expect, given that it's an AMD card, folding performance was below par. The card only produced 8,330ppd at its stock speed and 8,408 in its overclocked mode. It caused our test rig to consume 411-454W (depending on whether or not it was overclocked) while producing this meagre output, so you'd have to be mad to use it for folding.

As you'd expect, it isn't easy to keep the waste heat from two large, fast GPUs under control, even if you use fancy TIM and a pair of vapour chambers. It didn't shock us to see a delta T of 60°C at stock speeds and of 63°C when overclocked. When under load, the HD 6990 4GB was the loudest of the cards reviewed this issue, although it managed to be just shy of hairdryer levels of noise.

CONCLUSION

There's no doubting the gaming performance of the HD 6990 4GB; it barely blinked at running our games at 2,560 x 1,600. This comes at a price, though. The HD 6990 4GB is loud and uses an obnoxious amount of power, throwing away the PCI Express rulebook in the process, and causing the fan to work hard to keep both GPUs cool. While the HD 6990 4GB is £40 cheaper than the GTX 590 3GB, the GeForce card is faster and we saw none of the slight driver issues that the HD 6990 4GB displayed in some tests.

PAUL GOODHEAD

NVIDIA GeForce GTX 550 Ti 1GB

Fine for gaming on a 22in screen, this is the best card for around £100

+ 4X AA
Cheap; reasonable blend of price and performance

– 0X AA
Likely to age quickly

✓ BEST GAMING RESOLUTION
Not even 1,680 x 1,050

Retailing for £115, the GeForce GTX 550 Ti 1GB resides at the bottom of Nvidia's current generation of GPUs and is aimed at the more budget-conscious gamer. The GPU is an evolution of the disappointing GeForce GTS 450 1GB, with a significantly improved back-end adding an extra eight ROPs (to bring the total to 24) and a wider 192-bit memory interface.

The GF116 processor runs at 900MHz (up from 783MHz) and the 192 stream processors zip along at 1,800MHz (up from 1,566MHz). All this adds up to giving the GTX 550 Ti 1GB a memory bandwidth of 99GB/sec – nearly double that of the GTX 450 1GB – to help it cope with post-processing effects such as AA.

The extra clock speed and resources have made the GTX 550 Ti 1GB a far more competent card than the GTS 450 1GB. In Dirt 2, it was capable of maintaining playable frame rates at every test resolution, even outperforming the £205 Radeon HD 6950 2GB at 1,680 x 1,050 and 1,920 x 1,080. The GTX 550 Ti 1GB was 29fps quicker than the £100 Radeon HD 5770 1GB at these two resolutions.

Playing Black Ops was also well within reach of the GTX 550 Ti 1GB. Its minimum frame rate of 42fps at 2,560 x 1,600 provided a smooth experience. Its performance at 1,920 x 1,080 was a particular highlight, as its 71fps minimum frame rate was quicker than that achieved by a £140 GeForce GTX 460 1GB and the HD 5770 1GB.

Unfortunately, the 192 stream processors of the GTX 550 Ti 1GB struggled with our PC-exclusive games, even with all the GPU back-end enhancements. The choppy 23fps minimum we saw in Arma II at 1,680 x 1,050 made the game difficult to play, but the card could run Bad Company 2 at 1,680 x 1,050. The HD 5770 1GB was a significant 2fps slower in Arma II at 1,680 x 1,050, and 8fps slower in Bad Company 2 at the same resolution.

At least the GTX 550 Ti 1GB is frugal when it comes to power consumption. It caused our test PC to draw 243W when gaming, which was one of the lowest results we saw. While 7,235ppd for a system power draw of 213W is fine, the GTX 460 768MB now costs £125 (£10 more) and produces 8,903ppd for a system power draw of 215W. At least the rudimentary cooler of the Zotac card we tested remained quiet throughout our testing, so we see little reason for hairdryer coolers for this card.

CONCLUSION

The GTX 550 Ti 1GB offers solid performance given its price – it could play all but the most demanding of our test games at 1,680 x 1,050 with 4x AA; lose the AA from Arma II and you'll be able to play this game on a 22in screen too. While the card is likely to age badly for PC-exclusive titles, it coped brilliantly with console ports. It isn't much of an upgrade from an HD 5770 or a fast previous-generation card, but if your current PC just can't run games or you're building a cheap gaming PC from scratch, this is the best card for around £100.

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HOW MUCH?
Typical street price
£115 inc VAT
Manufacturer
www.nvidia.com

78

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NVIDIA GeForce GTX 560 Ti 1GB

The best card for under £200 just about keeps its Radeon rival at bay

THE EMPEROR
Excellent at 1,920 x 1,080; generally as fast as the Radeon HD 6950 1GB

GRAND MOFF
High power consumption; no price cut yet

BEST GAMING RESOLUTION
1,920 x 1,080

We loved the Nvidia GeForce GTX 560 Ti 1GB when we first saw it (see Issue 91, p38) as it offered great performance for a not unreasonable £200. Annoyingly for Nvidia, the card dropped just as the Sandy Bridge chipset fiasco came to light; as a result, sales failed to live up to expectations. Thankfully, everything is back on track now (see p35) so the question is whether the card is still worth buying.

The heart of the GTX 560 Ti 1GB is the GF114 GPU, which is built around 384 stream processors. This may sound like a puny amount compared with some of the AMD GPUs, but AMD and Nvidia have slightly different definitions as to what constitutes a stream processor, so the numbers aren't directly comparable.

As with all the other Nvidia GPUs on test, the stream processors run at double the speed of the rest of the GPU; in this case that means a frequency of 1,640MHz. Working alongside the stream processors is a bank of 64 texture units and 32 ROPs; this is actually four more texture units than the vastly more expensive GeForce GTX 570 1.3GB (see p79). The 1GB of memory runs at 1GHz (4GHz effective) through a 256-bit interface, giving a total memory bandwidth of 128GB/sec.

The GTX 560 Ti 1GB demolished Black Ops and Dirt 2, producing minimums of 57fps and 55fps respectively at 2,560 x 1,600 with 4x AA. This was 8fps faster than the £205 Radeon HD 6950 1GB in Dirt 2, but 14fps slower in Black Ops.

Arma II is a noticeably tougher game to run, but the GTX 560 Ti 1GB managed a playable 30fps minimum and 35fps average at 1,920 x 1,080 with 4x AA. This is only 2fps slower than the £15 more expensive HD 6950 1GB and the last-generation flagship GeForce GTX 480 1.5GB. Playing the game at 2,560 x 1,600 was beyond any of these three cards, however.

Our results in Bad Company 2 made interesting reading, with the GTX 560 Ti 1GB becoming progressively faster than the HD 6950 1GB as we increased the resolution. The minimum frame rate of 32fps at 1,920 x 1,080 was 3fps quicker than its AMD rival, although neither card was capable of playing the game at 2,560 x 1,600 with 4x AA.

As expected, the GTX 560 Ti 1GB was very productive when it came to folding. Its 13,193ppd was the fifth highest result we saw, and only bettered by Nvidia's most expensive cards, all of which cost more than £270. However, the GTX 560 Ti 1GB consumed a lot of power during our testing; our PC drew 302W when gaming and 243W when folding. The HD 6950 1GB was better behaved, causing the test system to draw 254W when gaming. The custom-cooled Zotac card (not pictured) we used for testing was at least quiet though.

CONCLUSION

With performance that's roughly equivalent to that of a £205 HD 6950 1GB, it's the price of the GTX 560 Ti 1GB that makes it the better card for around £200. We've also found all the GTX 560 Ti 1GB cards we've tested to be very overclockable; in most cases they can almost match a GTX 570 1.3GB for speed at 1,920 x 1,080.

PAUL GOODHEAD

HOW MUCH?
Typical street price
£190 inc VAT
Manufacturer
www.nvidia.com

NVIDIA GeForce GTX 570 1.3GB

Quick, and the reference cooler is excellent

The GeForce GTX 570 1.3GB is part of Nvidia's second generation of Fermi architecture cards which, fortunately, run much cooler than the original Fermi GPUs. Part of the reason for this improvement is Nvidia's use of conventional fast-switching but leaky transistors for performance-critical areas, and slower, less leaky transistors for the other parts.

The GPU contains 480 stream processors – 96 more than the GeForce GTX 560 Ti 1GB but 32 less than the GeForce GTX 580 1.5GB (see p80) – which run at 1,464MHz. This is twice the speed of the rest of the GPU core, which runs at 732MHz. Also bundled in the GPU are 15 tessellation units and 60 texture units, which is only one less tessellation unit and four fewer texture units than the much more expensive GTX 580 1.5GB.

The GTX 570 1.3GB had no problem dealing with Dirt 2 or Black Ops, as these games were developed with five-year-old consoles in mind. The headline news therefore isn't that the card could play both games at 2,560 x 1,600 with 4x AA, but that its performance matched or bettered that of Nvidia's previous flagship card, the GeForce GTX 480 1.5GB (which is still available to buy for around £325). The GTX 570 1.3GB was 9fps faster than the Radeon HD 6970 2GB in Dirt 2, and 10fps slower in Black Ops – which is fine considering that the Radeon is £10 more expensive.

Performance in Bad Company 2 was solid, with a minimum of 42fps at 1,920 x 1,080 with 4x AA – the HD 6970 2GB was 4fps slower with a minimum of 38fps. While the GTX 560 Ti 1GB could also run Bad Company 2 smoothly at the same settings, its minimum of 32fps means that the GTX 570 1.3GB offers 31 per cent more performance for the extra £85. That's still a price increase of 45 per cent, however.

Arma II proved to be an interesting challenge for the GTX 570 1.3GB. At 1,680 x 1,050, the card was the third quickest on test but only managed a mid-table minimum of 33fps at 1,920 x 1,080. The HD 6970 2GB managed the same minimum but a slightly higher average of 42fps at 1,920 x 1,080.

The GTX 470 1.3GB proved to be an efficient folder, as it cranked out a massive 14,756ppd while causing our test rig to draw a reasonable 284W from the wall. The excellent reference cooler was easy to live with as well as being effective – the peak delta T of 54°C when gaming wasn't particularly high despite the power of the GPU.

CONCLUSION

The GTX 570 1.3GB traded blows with the HD 6970 2GB throughout our testing, making both fine cards to receive for a birthday. However, as the GTX 570 1.3GB has such an excellent cooler, is a brilliant folder and costs £10 less, it would be the card that we'd buy if we had around £300 to spend. You could argue that the much cheaper GTX 560 Ti 1GB can run all our games smoothly at the same settings as the GTX 570 1.3GB for £85 less, but it's worth spending a little extra on a new graphics card where possible, as the extra speed will stand up to new games for longer.

PAUL GOODHEAD

+ PITCH PERFECT
Excellent folding performance; great cooler; solid gaming performance

– CHINESE OPERA
You could opt for a GTX 560 Ti 1GB

✓ BEST GAMING RESOLUTION
1,920 x 1,080

HOW MUCH?
Typical street price
£275 inc VAT
Manufacturer
www.nvidia.com

80

NVIDIA GeForce GTX 580 1.5GB

Caught in limbo, it's too expensive for the speed on offer

WIND
Very fast at 1,920 x 1080; excellent for folding; fairly quiet; single-GPU design

COAL
Power-hungry; can't handle all games at 2,560 x 1,600

BEST GAMING RESOLUTION
1,920 x 1,080

HOW MUCH?
Typical street price
£390 inc VAT
Manufacturer
www.nvidia.com

After the disappointingly toasty GeForce GTX 480 1.5GB, Nvidia's Fermi-based successor, the GeForce GTX 580 1.5TB, has proved to be better in every way. Its GPU core runs 72MHz higher than the GPU it replaces at 772MHz, and it has 32 more stream processors that run at 1,544MHz. The GTX 580 1.5GB uses less power-hungry transistors in non-performance-critical areas of the GPU to keep down its power consumption, which means that it creates less waste heat than the phenomenally hot and loud GTX 480 1.5GB.

At £390, the GTX 580 1.5GB is the most expensive single-GPU card on test, so it has a price bracket all to itself. It's £115 more expensive than the GeForce GTX 570 1.3GB but £150 cheaper than the Radeon HD 6990 4GB, which is the next card up in the price scale.

The GTX 580 1.5GB breezed through our game tests at 1,920 x 1,080 – Arma II was the most demanding test, although the minimum frame rate was still a silky-smooth 38fps. This was only bettered by the two new (and extremely expensive) dual-GPU cards, and even then we had to use the warranty-voiding Antilles Unlocking Switch to achieve a superior frame rate from the HD 6990 4GB. Bad Company 2 was great fun on the GTX 580 1.5GB, with the frame rate never dipping below 42fps, while Black Ops and Dirt 2 also proved no problem for the GTX 580 1.5GB, with minimum frame rates of around 100fps.

At 2,560 x 1,600, the GTX 580 1.5GB was still able to play every game on test smoothly, apart from Arma II. The frame rate in Dirt 2 and Black Ops never dipped below 70fps, for example. However, Bad Company 2 was dangerously close to being unplayable, with the GTX 580 1.5GB only managing a minimum frame rate of 26fps. If you want to play Bad Company 2 without a hitch on a 30in screen, you'll need to consider the GeForce GTX 590 3GB (see p82) or the HD 6990 4GB.

Our test system drew a hefty 305W while folding, but at least the GTX 580 1.5TB recorded a huge score of 16,492ppd. This was second only to the GTX 590 3GB, which managed 25,780ppd thanks to its second GPU. While the GTX 580 1.5GB was one of the most power-hungry and hot single-GPU graphics card on test, this was only by a tiny margin. It remained fairly quiet – far more so than the tornado-like GTX 480 1.5GB.

CONCLUSION

The GTX 580 1.5GB found itself in an awkward situation, and not just because it has no direct competitor on price. The much cheaper GTX 570 1.3GB is more than capable at gaming at 1,920 x 1,080, yet the GTX 580 1.5TB struggled to run all our games smoothly at 2,560 x 1,600. It failed to do so with Arma II and only just managed a playable minimum of 26fps in Bad Company 2. While the extra performance over a GTX 570 1.3GB at 1,920 x 1,080 is welcome, it isn't enough to justify the price difference. The only reason to buy this card is if you're sceptical about multi-GPU setups, as single-GPU cards are less dependent on driver and game updates to deliver a decent amount of performance.

ANTONY LEATHER

82

NVIDIA GeForce GTX 590 3GB

Amazing performance – but will Nvidia keep the driver up to date?

THE FORCE
The fastest graphics card; excellent driver support at the moment

MIDICHLORIANS
Dumps a lot of waste heat in your case; loud under load; will Nvidia maintain its driver support?

BEST GAMING RESOLUTION
2,560 x 1,600

We haven't seen a new multi-GPU GeForce graphics card for more than two years, and since then Nvidia's fortunes have dipped and risen like the metaphorical rollercoaster. The first generation of Fermi GPUs, based on the GF100 architecture, proved much too hot, power-hungry and noisy even on single-GPU cards. However, with the use of low-leakage transistors for components that aren't performance critical, the revised GPUs of the GTX 500-series have made a dual-GPU card possible.

Unlike the GeForce GTX 295 1.8MB, which used two semi-skimmed GT200b GPUs, Nvidia has chosen to equip the GTX 590 3GB with two full-fat GF110 GPUs; this is the same GPU as used in GeForce GTX 580 1.5GB cards. However, the frequencies have been lowered to a GPU core of 607MHz compared to the 772MHz of the GTX 580 1.5GB. This is a 21 per cent drop, although having two GPUs running in tandem should make the GTX 590 3GB considerably faster. Even so, just like the HD 6990 4GB, this card also breaks the PCI Express 2.0 power draw spec.

The GTX 590 3GB cooler is similar to that of the Radeon HD 6990 4GB and Nvidia's single-PCB version of the GTX 295 1.8MB. The two GPUs are arranged at either end of the card, with the VRMs in the middle. Each GPU is topped by its own vapour chamber heatsink assembly, with a single radial fan in the centre of the card blowing air over both heatsinks. This means that half of the card's heat is exhausted directly into your case.

With board space at a premium, the card's 3GB of GDDR5 memory is split between both sides of the PCB, with six 128MB modules arranged around each GPU on either side resulting in a memory capacity of 3,072MB. Since the GTX 590 3GB is equipped with two full-sized GF110 GPUs, it boasts a whopping count of 1,024 stream processors. This also means the GTX 590 3GB boasts eight rasterisers, (four per GPU) and 32 tessellation units (16 per GPU). It also sports 128 texture units (64 each) and 96 ROPs (48 each).

PERFORMANCE

In Dirt 2, the GTX 590 3GB topped all three performance charts, and by a considerable margin at the crucial super-high resolution of 2,560 x 1,600. Even after flicking on the Antilles Unlocking Switch (and automatically voiding its warranty), the Radeon HD 6990 4GB couldn't compete – it delivered a minimum frame rate of 96fps compared to the 113fps of the GTX 590 3GB.

At the most pertinent resolution for cards costing over £500, the GTX 590 3GB was also triumphant in Black Ops, if only by 2fps, over the HD 6990 4GB in warranty-void mode. The minimum frame rate of 84fps was mighty, and the average of 136fps is frankly ludicrous. Again, we saw the performance bug at 1,920 x 1,080 though – all the dual-GPU cards struggled with the full-HD resolution, with their minimum frame rates refusing to go beyond 84fps.

Arma II is possibly the most interesting of our four test games for this card, as it's a system killer. The GTX 590 3GB launched a campaign of shock and awe on our test rig, pulling out playable frame rates even at the crippling resolution of 2,560 x 1,600. Considering that we insist on playing the game with its Very High detail settings and 4x AA, the card's minimum frame rate of 31fps was incredible.

LAUNCHING A CAMPAIGN OF SHOCK AND AWE ON OUR TEST RIG, THE GTX 590 3GB PRODUCED PLAYABLE FRAME RATES IN ARMA II

Even the overclocked HD 6990 4GB struggled at the same settings, managing a minimum frame rate of 26fps. At 1,920 x 1,080 with 4x AA, we saw an incredible minimum of 52fps from the GeForce card; a massive 14fps lead over the HD 6990 4GB at stock speeds, and an 11fps lead when the AMD card was in RMA-nightmare mode. Interestingly, the GTX 590 3GB typically achieved lower average frame rates than the HD 6990 4GB. We can't say for sure whether this means that the graphics driver of the GTX 590 3GB is written more effectively, or just that Nvidia's GPU architecture copes better with the demands of Arma II's taxing graphics engine than AMD's.

Only Bad Company 2 found a gap in the GTX 590 3GB's armour, with the warranty-flouting HD 6990 4GB beating its minimum frame rate by 1fps and the average by 7fps. At least the GTX 590 3GB didn't suffer

HOW MUCH?
Typical street price
£580 inc VAT
Manufacturer
www.nvidia.com

from any of the stuttering problems that we saw in this game with the HD 6990 4GB, which is a gold star for Nvidia's driver team.

It was no surprise to find that the two GPUs of the GTX 590 3GB ran rather hot, despite the pair of vapour chambers and a high-airflow fan. We saw an idle temperature of 21°C and a peak temperature of 59°C. As expected from a graphics card that breaks the PCI Express 2.0 power draw spec, our test system happily chugged through plenty of power when gaming – up to 491W, in fact. In contrast, the HD 6990 4GB caused our system to consume 417W of power at stock speeds and up to 463W when overclocked.

The GTX 590 3GB proved imperious when it came to folding performance, clocking in a titanic 25,780ppd. This stressed the card a lot, though, and Nvidia's stock cooler is hardly quiet when working hard – it may be quieter than the cooler of the HD 6990 4GB, but it was still clearly audible over the air conditioning in our lab, even from a distance of 5ft.

Annoyingly, as the fan is placed between the two heatsink elements of the cooler, it blows hot air out of both ends, like the HD 6990 4GB cooler. However, as the internal end of the GTX 590 3GB cooler is completely open, we could feel more airflow entering our test case than there was being exhausted. This means that a lot of heat is dumped inside your case, typically around the hard disk bays.

CONCLUSION

A card such as this is almost solely judged on its performance – whether it bashes every game known to man into submission with its brutal graphics power, or cringes at the likes of Arma II. The GeForce GTX 590 3GB is definitely of the former persuasion, topping our performance charts in almost every test we threw at it – no matter which resolution we used or which game we played.

As we saw no sign of poorly optimised driver support for the game, it has to receive our recommendation – it's the fastest card in the world and costs only £40 more than AMD's alternative. However, it's up to Nvidia to maintain this excellent level of support and optimisation during the lifetime of the GeForce GTX 590 3GB.

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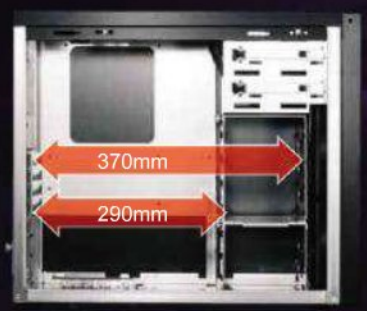

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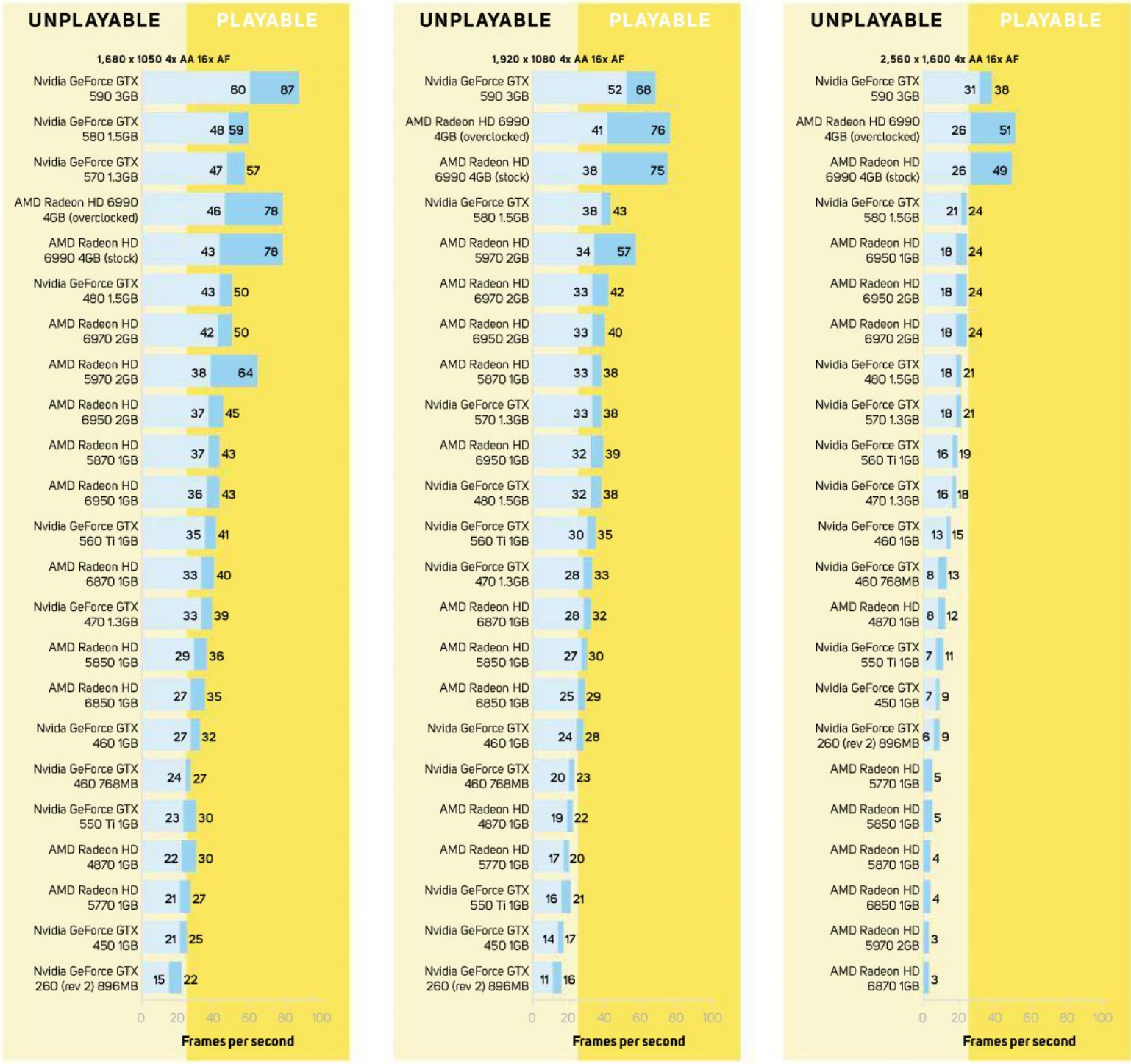
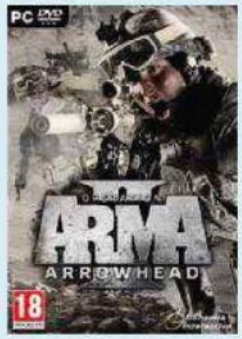
ARMA II: OPERATION ARROWHEAD



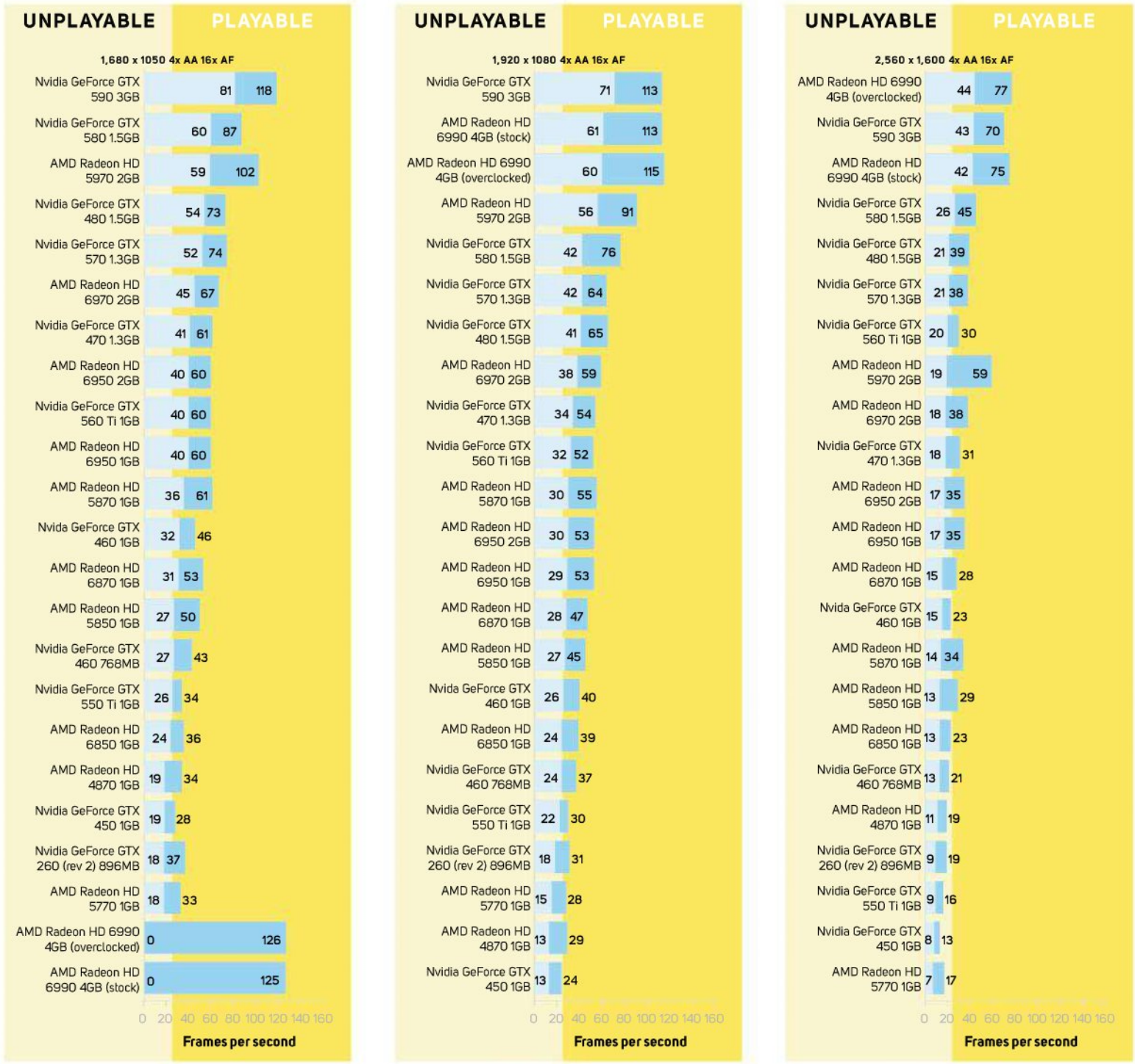


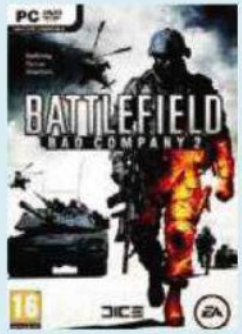
ARMA II: OPERATION ARROWHEAD

Arma II is the quintessential military sim, with super-realistic gameplay and ordinance. Unfortunately this also means that you need a killer PC to run the game at its best - this not only means a high-end graphics card, but also a fast, multi-core CPU. You can read our review of Arma II: Operation Arrowhead in Issue 84, p102.

Note: The AMD Radeon HD 6990 4GB was tested at its default speed (stock) and with the Antilles Switch enabled (overclocked).

BATTLEFIELD: BAD COMPANY 2





BATTLEFIELD: BAD COMPANY 2

Bad Company 2 is one of our favourite games of the past year or so, and still great fun to play either in single player or online. The demanding Frostbite 2.0 graphics engine also gives graphics cards a thorough workout. You can read our Bad Company 2 review in Issue 81, p90.

Note: The AMD Radeon HD 6990 4GB was tested at its default speed (stock) and with the Antilles Switch enabled (overclocked).

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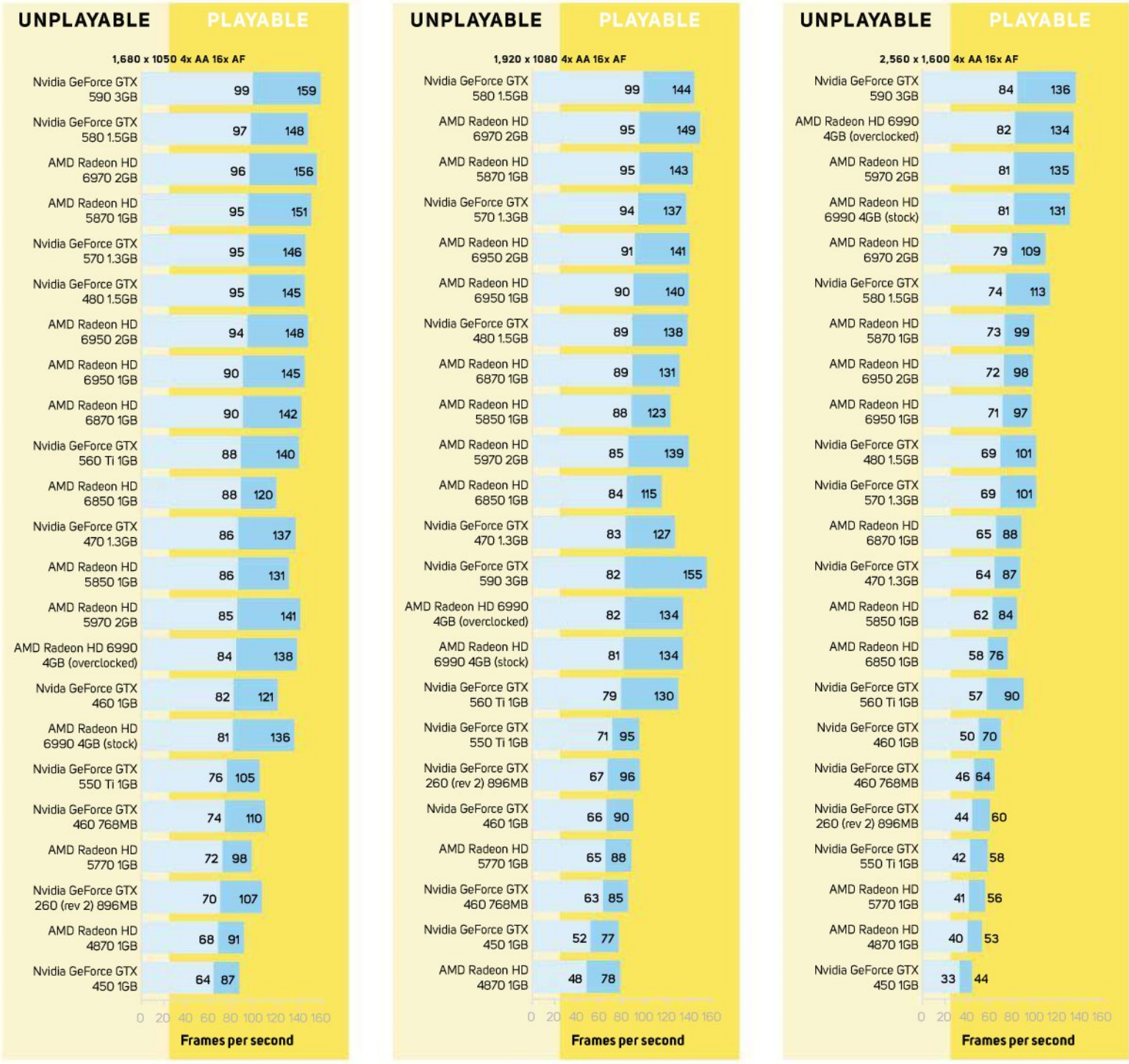
CALL OF DUTY: BLACK OPS

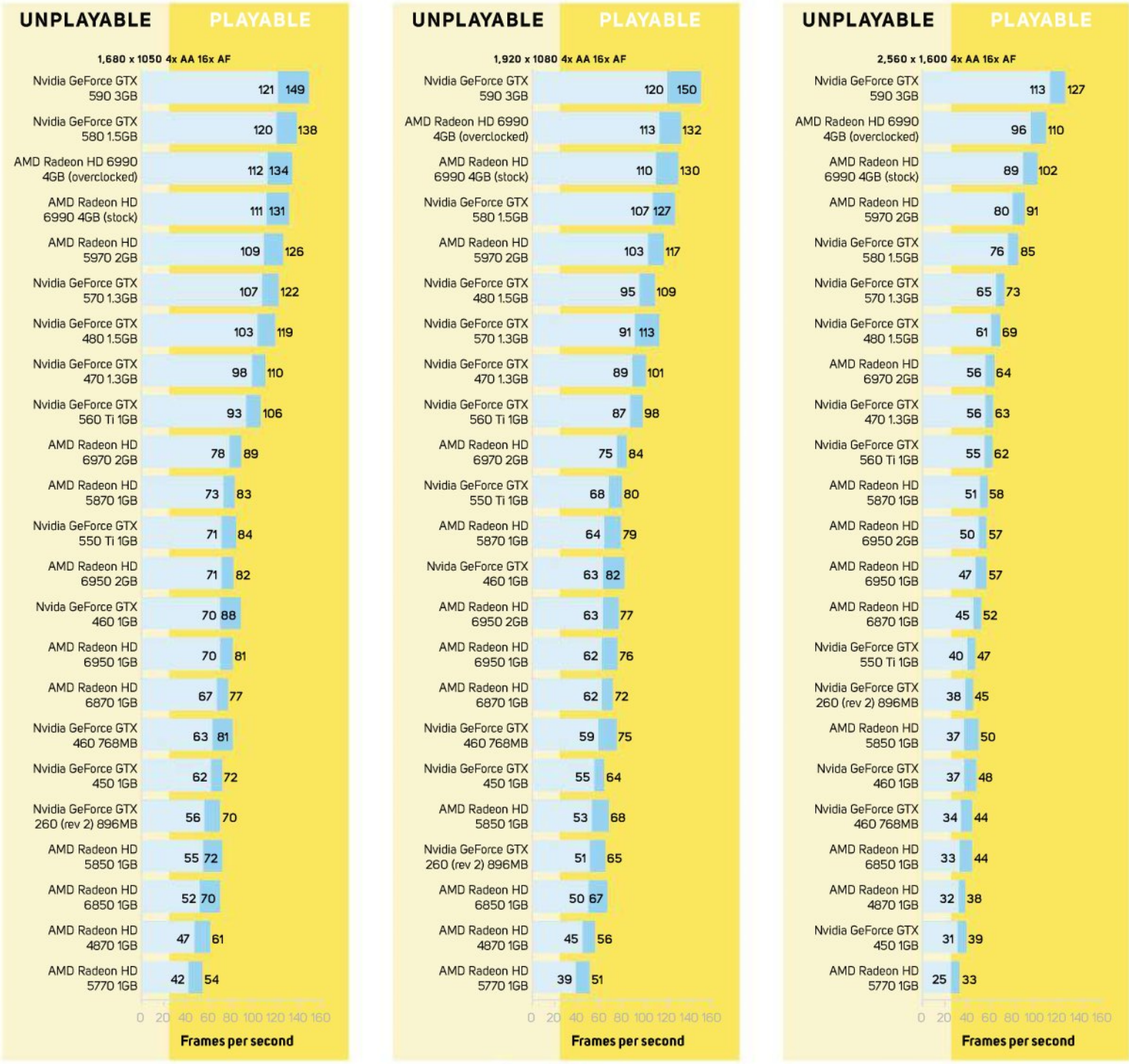


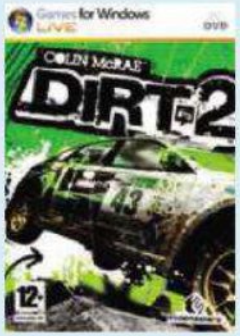
CALL OF DUTY: BLACK OPS

Black Ops is one of the most highly played games of the day, breaking sales records since it was launched a few months ago. As we want our testing to represent what people actually use their PCs for, it's an obvious game to test with. You can read our full review of Black Ops in Issue 89, p86

Note: The AMD Radeon HD 6990 4GB was tested at its default speed (stock) and with the Antilles Switch enabled (overclocked).

COLIN McRAE: DIRT 2





COLIN McRAE: DIRT 2

Dirt 2 is one of the best racing games currently available, with an active online community and a challenging variation of race types and vehicles. A card that performs well in this game should also cope well with the forthcoming (and imaginatively titled) sequel, Dirt 3. We didn't review Dirt 2 when it came out – Joe is doing a 24-hour endurance race as penance.

Note: The AMD Radeon HD 6990 4GB was tested at its default speed (stock) and with the Antilles Switch enabled (overclocked).

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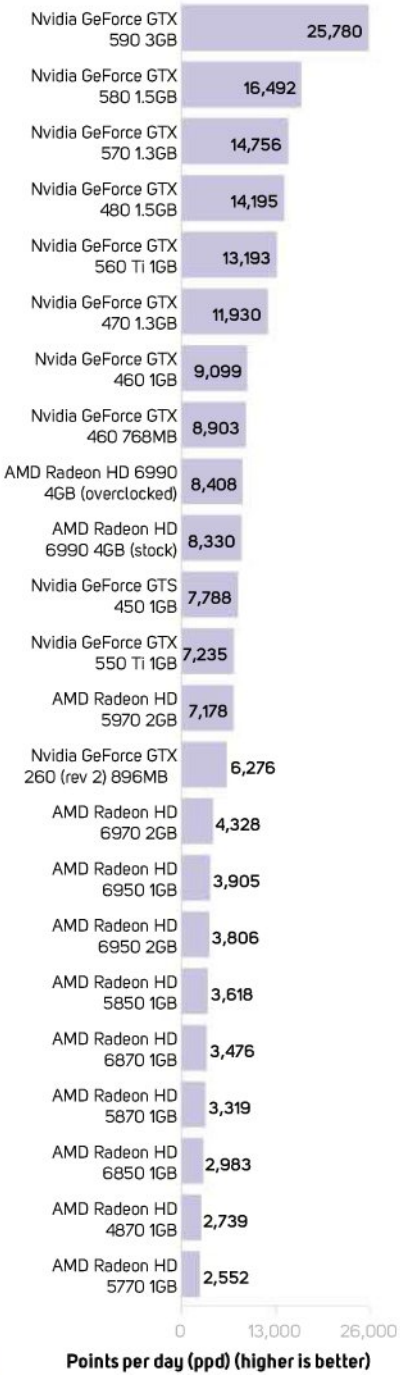
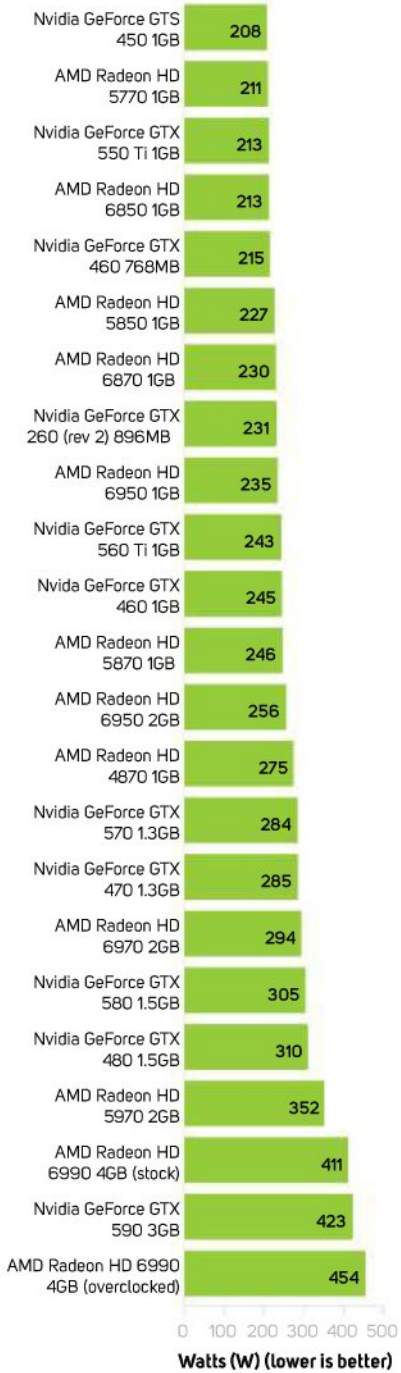
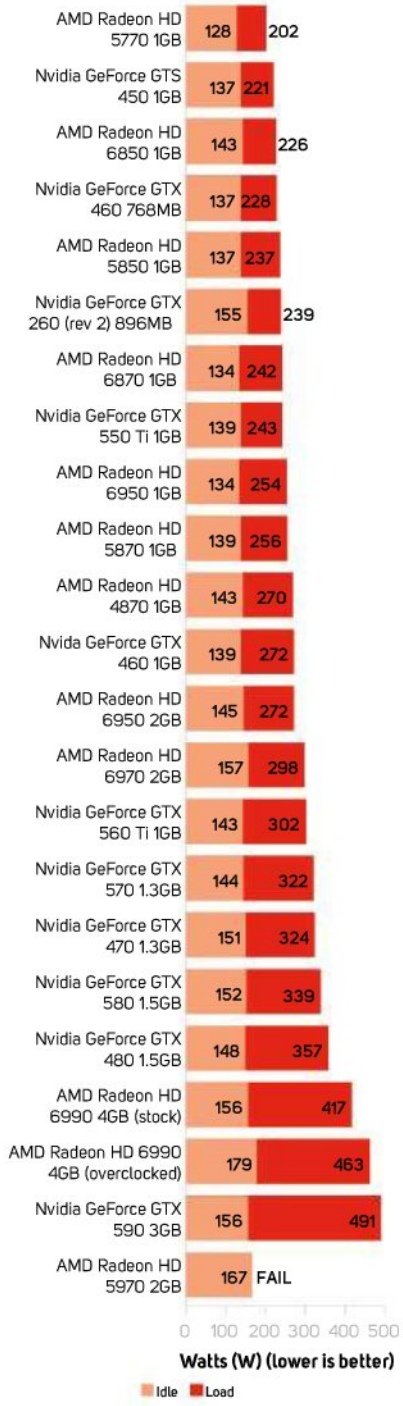


FOLDING POWER



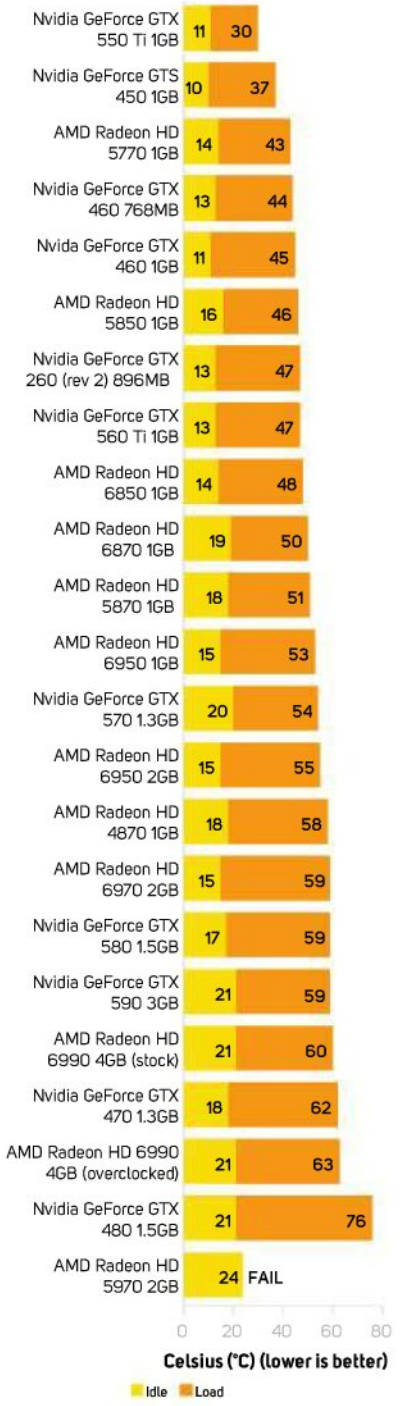
GAMING POWER

Total system power consumption



GPU DELTA T

Total system power consumption



what to buy

With over 700 tests, and 22 GPUs tested and 10 reviewed, it could be tricky to find which is the best for you. **Custom PC** comes to the rescue, as we break down your choices by budget and screen size

upgrade

You game at \ Your graphics card is	Two to three years old such as a GeForce GTX 260 (rev 2) 896MB or Radeon HD 4870 1GB	Mid-range, one to two years old such as a Radeon HD 5850 1GB or GeForce GTX 460 1GB	High-end, one to two years old such as a Radeon HD 5870 1GB or GeForce GTX 480 1.5GB
1,680 x 1,050	**Nvidia GeForce GTX 560 Ti 1GB (£190)** To see a decent performance boost across the board, the GTX 560 Ti 1GB is the card to buy. Anything cheaper won't be much faster than your current card. 	**You don't need to upgrade** Graphics cards such as the Radeon HD 5850 1GB and Radeon HD 5870 1GB achieved playable frame rates at this resolution in all our games. Fine tuning game settings and overclocking your card should provide a big enough boost if things are getting edgy.	
1,920 x 1,080	**Nvidia GeForce GTX 560 Ti 1GB (£190) or Nvidia GeForce GTX 570 1.3GB (£275)** The GTX 560 Ti 1GB held its own at this resolution too, providing playable frame rates in all games. The GTX 570 is £85 more but is even faster, meaning that it will cope with everything you throw at it over the next year or two. 		**You don't need to upgrade** Our tests showed that cards such as the HD 5870 1GB were more than capable of playing all our games at this resolution.
2,560 x 1,600	**Nvidia GeForce GTX 580 1.5GB (£390) or Nvidia GeForce GTX 590 3GB (£580)** The GTX 580 1.5GB was the only single-GPU graphics card to achieve playable frame rates in three of our four games at this resolution. Arma II was too much for it, but dropping the AA, lowering the in-game settings or overclocking the card should fix this. For awesome performance at this resolution, you can't beat the GTX 590 3GB though. This card made mincemeat of our games and is a substantial upgrade from any other graphics card, excluding its closest rival, the Radeon HD 6990 4GB. It's power-hungry however, and while the cooler isn't infuriatingly loud, it does dump a lot of heat into your case. We' recommend water-cooling the card to keep it in check. 		

building from scratch

You game at \ You have this to spend	Around £100	Around £200	Around £300	£400 or more
1,680 x 1,050	**Nvidia GeForce GTX 550 Ti 1GB (£120)** The GTX 550 Ti managed playable frame rates in all our tests except Arma II at this resolution. Dropping the AA should solve this. 	**Nvidia GeForce GTX 560 Ti 1GB (£190)** The GTX 560 Ti 1GB was very fast in all our games at this resolution, and has enough power to keep games smooth if you buy a larger monitor in the near future. 	**Not worth spending over £200 at this resolution**	**Not worth spending over £200 at this resolution**
1,920 x 1,080	**You'll need to spend more, unfortunately**	**Nvidia GeForce GTX 560 Ti 1GB (£190)** The GTX 560 Ti 1GB managed playable frame rates in all four of our test games at this resolution – not bad for a card that costs under £200. 	**Nvidia GeForce GTX 570 1.3GB (£275)** The GTX 570 1.3TB gives you plenty of performance to cope with the demands of future games, as well as your current favourites. 	**Nvidia GeForce GTX 580 1.5GB (£390)** The GTX 580 1.5GB is the fastest single-GPU card available, but it's only worth considering if you're not planning to get a higher resolution screen in the near future. 
2,560 x 1,600	**Even eBay can't help you**	**Even eBay can't help you**	**You'll still need to spend more**	**Nvidia GeForce GTX 590 3GB (£580)** With no sign of micro-stuttering and incredible performance, the GTX 590 3GB is epic. We just hope Nvidia can maintain the excellent driver support. 

FEATURE TABLE

	AMD Radeon HD 4870 1GB	AMD Radeon HD 5770 1GB	AMD Radeon HD 5850 1GB	AMD Radeon HD 5870 1GB	AMD Radeon HD 5970 2GB	
Typical street price[1] (inc VAT)	No longer on sale	£100	£140	£200	No longer on sale	
Manufacturer	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	
GPU						
Frequency (MHz)	750MHz	850MHz	725MHz	850MHz	725MHz	
Stream processors (frequency)	800 (750MHz)	800 (850MHz)	1,440 (725MHz)	1,600 (850MHz)	2 x 1,600 (725MHz)	
Layout	10 SIMD engines	10 SIMD engines	18 SIMD engines	20 SIMD engines	2 x 20 SIMD engines	
Texture units	40	40	72	80	2 x 80	
Rasterisers	1	1	1	1	2 x 1	
Tessellation units	None	1	1	1	2 x 1	
Render outputs (ROPs)	16	16	32	32	2 x 32	
Size	256mm²	166mm²	334mm²	334mm²	2 x 334mm²	
DirectX support	10.1	11	11	11	11	
Fabrication process (nm)	55	40nm	40nm	40nm	40nm	
Transistors	956 million	1.04 billion	2.154 billion	2.15 billion	2 x 2.15 billion	
Memory						
Amount (type)	1GB GDDR5	1GB GDDR5	1GB GDDR5	1GB GDDR5	2 x 1GB GDDR5	
Effective frequency	3.6GHz	4.8GHz	4GHz	4.2GHz	4GHz	
Interface	256-bit	128-bit	256-bit	256-bit	2 x 256-bit	
Bandwidth	115GB/sec	77GB/sec	128 GB/sec	134GB/sec	2 x 128GB/sec	
Card specifications						
PCI-E power connectors	2 x 6-pin	1 x 6-pin	2 x 6-pin	2 x 6-pin	1 x 6-pin, 1 x 8-pin	
Maximum power draw	160W	108W	151W	188W	294W	
Recommended PSU	500W	450W	500W	500W	600W	
CrossFireX/SLI compatible	CrossFireX	CrossFireX	CrossFireX	CrossFireX	CrossFireX	
Slots, length	Dual, 240mm	Dual, 215mm	Dual, 240mm	Dual, 282mm	Dual, 309mm	

	Nvidia GeForce GTX 260 (rev 2) 896MB	Nvidia GeForce GTS 450 1GB	Nvidia GeForce GTX 460 768MB	Nvida GeForce GTX 460 1GB	Nvidia GeForce GTX 470 1.3GB	
Typical street price[1] (inc VAT)	No longer on sale	£90	£125	£140	£195	
Manufacturer	www.nvidia.com	www.nvidia.com	www.nvidia.com	www.nvidia.com	www.nvidia.com	
GPU						
Frequency (MHz)	576MHz	783MHz	675MHz	775MHz	607MHz	
Stream processors (frequency)	216 (1,242MHz)	192 (1,566MHz)	336 (1,350MHz)	336 (1,350MHz)	448 (1,214MHz)	
Layout	9 TPCs	4 SMs, 1 GPC	7 SMs, 2 GPCs	7 SMs, 2 GPCs	14 SMs, 4 GPCs	
Texture units	80	32	56	56	56	
Rasterisers	None	1	2	2	4	
Tessellation units	None	4	7	7	14	
Render outputs (ROPs)	28	16	32	32	40	
Size	487mm²	238mm²	332mm²	332mm²	530mm²	
DirectX support	10	11	11	11	11	
Fabrication process (nm)	65nm	40nm	40nm	40nm	40nm	
Transistors	1.4 billion	1.17 billion	1.95 billion	1.95 billion	3 billion	
Memory						
Amount (type)	896MB GDDR3	1GB GDDR5	768MB GDDR5	1GB GDDR5	1.3GB GDDR5	
Effective frequency	1.998GHz	3.608GHz	3.6GHz	3.6GHz	3.3GHz	
Interface	448-bit	128-bit	192-bit	256-bit	320-bit	
Bandwidth	112GB/sec	58GB/sec	86GB/sec	115GB/sec	134GB/sec	
Card specifications						
PCI-E power connectors	2 x 6-pin	1 x 6-pin	2 x 6-pin	2 x 6-pin	2 x 6-pin	
Maximum power draw	182W	106W	150W	160W	215W	
Recommended PSU	500W	400W	450W	450W	550W	
CrossFireX/SLI compatible	SLI	SLI	SLI	SLI	SLI	
Slots, length	Dual, 267mm	Dual, 210mm	Dual, 210mm	Dual, 210mm	Dual, 241mm	

[1] Prices were correct at time of going to press

	AMD Radeon HD 6850 1GB	AMD Radeon HD 6870 1GB	AMD Radeon HD 6950 1GB	AMD Radeon HD 6950 2GB	AMD Radeon HD 6970 2GB	AMD Radeon HD 6990 4GB
	£140	£180	£205	£230	£285	£540
	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com
	775MHz	900MHz	800MHz	800MHz	880MHz	830MHz
	980 (775MHz)	1,120 (900MHz)	1,408 (800MHz)	1,408 (800MHz)	1,536 (880MHz)	2 x 1,536 (830MHz)
	12 SIMD engines	14 SIMD engines	22 SIMD engines	22 SIMD engines	24 SIMD engines	48 SIMD engines
	48	56	88	88	96	2 x 96
	2	2	2	2	2	2 x 2
	1	1	2	2	2	2 x 2
	32	32	32	32	32	2 x 32
	255mm²	255mm²	389mm²	389mm²	389mm²	2 x 389mm²
	11	11	11	11	11	11
	40nm	40nm	40nm	40nm	40nm	40nm
	1.7 billion	1.7 billion	2.6 billion	2.6 billion	3.6 billion	2 x 2.6 billion
	1GB GDDR5	1GB GDDR5	1GB GDDR5	2GB GDDR5	2GB GDDR5	2 x 2GB GDDR5
	4GHz	4.2GHz	5GHz	5GHz	5.5GHz	5GHz
	256-bit	256-bit	256-bit	256-bit	256-bit	2 x 256-bit
	128GB/sec	134GB/sec	160GB/sec	160GB/sec	176GB/sec	2 x 160GB/sec
	2 x 6-pin	2 x 6-pin	2 x 6-pin	2 x 6-pin	1 x 6-pin, 1 x 8-pin	2 x 8-pin PCI-E
	127W	151W	Not stated	Not stated	250W	375W
	500W	500W	500W	500W	550W	750W
	CrossFireX	CrossFireX	CrossFireX	CrossFireX	CrossFireX	CrossFireX
	Dual, 235mm	Dual, 250mm	Dual, 275mm	Dual, 275mm	Dual, 287mm	Dual, 305mm

	Nvidia GeForce GTX 480 1.5GB	Nvidia GeForce GTX 550 Ti 1GB	Nvidia GeForce GTX 560 Ti 1GB	Nvidia GeForce GTX 570 1.3GB	Nvidia GeForce GTX 580 1.5GB	Nvidia GeForce GTX 590 3GB
	£325	£115	£190	£275	£390	£580
	www.nvidia.com	www.nvidia.com	www.nvidia.com	www.nvidia.com	www.nvidia.com	www.nvidia.com
	700MHz	900MHz	820MHz	732MHz	772MHz	607MHz
	480 (1,400MHz)	192 (1,800MHz)	384 (1,640MHz)	480 (1,464MHz)	512 (1,544MHz)	2 x 512 (1,214MHz)
	15 SMs, 4 GPCs	4 SMs, 1 GPC	8 SMs, 2 GPCs	15 SMs, 4 GPCs	16 SMs, 4 GPCs	2 x 16 SMs, 4 GPCs
	60	28	64	60	64	2 x 64
	4	1	2	4	4	2 x 4
	15	4	8	15	16	2 x 16
	48	24	32	40	48	2 x 48
	530mm²	238mm²	332mm²	520mm²	530mm²	2 x 520mm²
	11	11	11	11	11	11
	40nm	40nm	40nm	40nm	40nm	40nm
	3 billion	1.17 billion	1.95 billion	3 billion	3 billion	2 x 3 billion
	1.5GB GDDR5	1GB GDDR5	1GB GDDR5	1.3GB GDDR5	1.5GB GDDR5	2 x 1.5GB GDDR5
	3.7GHz	4.104GHz	4GHz	3.8GHz	4.08GHz	3.414GHz
	384-bit	192-bit	256-bit	320-bit	384-bit	2 x 384-bit
	177GB/sec	99GB/sec	128GB/sec	152GB/sec	192GB/sec	2 x 164GB/sec
	1 x 6-pin, 1 x 8-pin	1 x 6-pin	2 x 6-pin	2 x 6-pin	1 x 6-pin, 1 x 8-pin	2 x 8-pin
	250W	116W	180W	219W	244W	365W
	600W	400W	500W	550W	600W	700W
	SLI	SLI	SLI	SLI	SLI	SLI
	Dual, 267mm	Dual, 209mm	Dual, 228mm	Dual, 267mm	Dual, 267mm	Dual, 280mm

games

The best (and worst) of PC gaming

this month

101 **GRUMPY GAMER**
Are gamers sexist?

102 **SHIFT 2: UNLEASHED**
Lap it up

104 **CRYSIS 2**
As consolified as we feared?

106 **HOMEFRONT**
THQ tackles COD

108 **BLIGHT OF THE IMMORTALS**
Neptune's Pride for wimps?

111 **BRINK**
A marriage of single-player and online?

112 **WITCHER 2: ASSASSIN OF KINGS**
Sex, thugs and dice rolls

114 **VALUE ADDED**
As simple as DLC

115 **REQUIRED PLAYING**
The freebies you need

Deus Ex: Human Revolution

Now set for an August 23 release, the third Deus Ex game is the game we want most this year. If you haven't seen the new Director's Cut trailer then watch it now to find out why – go to http://tinyurl.com/deusexDC

Readers' Night

Weds, 27 April, 9 till late

The place Our Counter-Strike: Source server
What you need An up-to-date Counter-Strike: Source installation

GAME SERVER IP ADDRESSES
32-player BC2 85.236.101.22:16667
32-player CS: Source 85.236.101.78: 27115

FIND US ON STEAM
Public group http://steamcommunity.com/groups/CustomPC
Modern Warfare 2 http://steamcommunity.com/groups/CustomWarfare2

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cnet BEST OF CES 2010 WINNER Gaming

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GRUMPY GAMER

SO SEXIST IT HURTS

Joe Martin is shocked to discover the lengths to which female gamers have to go to avoid sexist abuse

I've never hidden the fact that multiplayer gaming isn't something I do much beyond the lunchtime battles in the office and occasional community matches. I've played a lot of Jedi Knight and Call of Duty over the years, but nearly always with people I know in real life, and I tend to lose interest pretty quickly. Instead, single-player has always been my focus. That's probably why, when a female friend told me she always pretends to be a man when she plays online, I was a little taken back. Is this normal?

It was the reason for this masquerade that shocked me, however: sexist abuse. This friend told me that whenever she revealed her gender to strangers online, she was inevitably hit by a backlash of hatred and disbelief. She was mocked for being a woman and bombarded with a level of crude sexual insult that I can't possibly reprint here. None of it was good-natured banter or jibing of the kind Harry and I share when we play together; it was designed to hurt and scare. It was utterly despicable behaviour, and it came from strangers, without provocation.

A friend told me that whenever she revealed her gender to strangers online, she was inevitably hit by a backlash of hatred

Maybe I shouldn't have expected anything better. The power of anonymity can make even the most normal people behave like imbeciles. This ignorance and crassness is usually vented indiscriminately, however. To direct all that fury at someone just because of their gender – and especially to such a degree – strikes me as considerably worse.

I could look the other way if this were a one-off situation, of course. There have been times when I too, angry and frustrated, have let loose a barrage of curses and insults at whoever just murdered me, but that's not the same. There's a subtle but important difference between swearing at an enemy out of anger and sending sexually explicit, offensive private messages to someone for no reason.

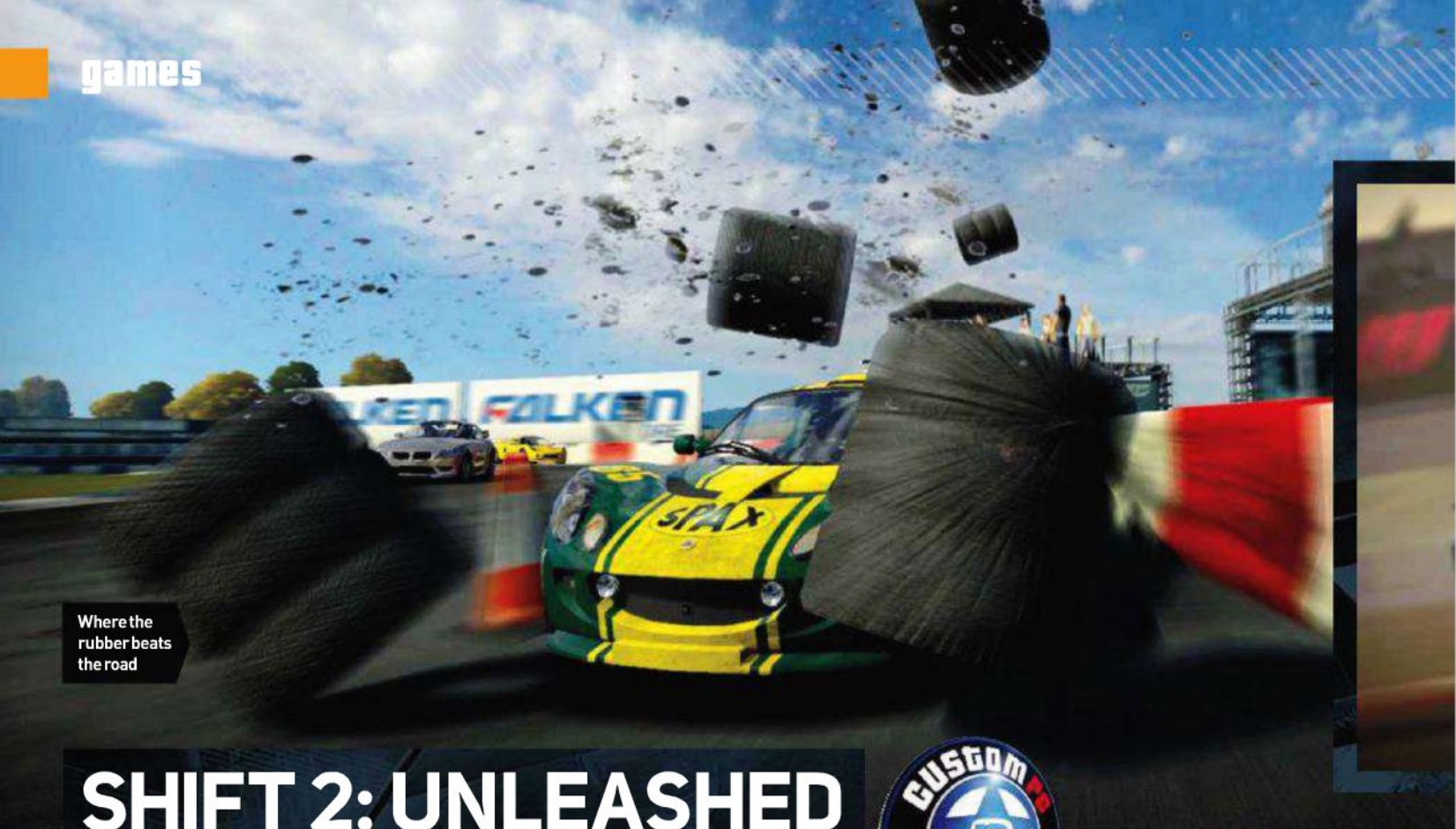
This isn't an isolated incident, either. Looking into the issue more closely, I found sites such as FatUglyOrSlutty.com, which has collected a vast library of abuse that female gamers have received and sent in. Some of it is seriously disturbing, although even the very least of it is enough to make me question how anyone can think such behaviour is acceptable. None of it is big, clever or provoked.

I grew up playing games with my sisters, as well as girlfriends and other female friends, so I hate the fact that this kind of abuse is so prevalent in online gaming circles. I hate that women should have to go out of their way to avoid undeserved hatred. Most of all, though, I hate the fact that I can't direct my comments and anger specifically at those who should be held responsible.

All I can do is hope that **CPC** readers are better people than that, while also saying that, if you've ever sent messages of such reckless hatred in this way, you should be ashamed. There's no way that gaming is ever going to improve when there are cretins like you clogging the audience.

JOE.MARTIN@BIT-TECH.NET

WHAT I'M PLAYING Jonathon Blow's Braid remains a classic in my eyes, even as I play it for the umpteenth time. This time I aim to unlock the secret ending.



Where the rubber beats the road

SHIFT 2: UNLEASHED

Lust for thrust

Custom PC Approved

+ SHIFT
Challenging; gorgeous

– SHAFT
Not for the faint-hearted

Shift 2 doesn't care about how you feel. Spun out on the last corner? Not cornering quite right? Smashed into the car in front? You lose, friend. If you can't keep up and adapt to the race, it will chew you up, spit you out, and laugh as you curl into the foetal position clutching a copy of Mario Kart while sobbing quietly.

This is a long way from the old Need for Speed games. The original arcade style is long gone, the neon lights and spoilers of Underground are put to one side – Shift 2 is a continuation of the not-super-serious racing sim; it's more GRID than iRacing. Authenticity is key, with a keen eye on track discipline, and a combination of the art and science of driving cars very fast around a track.

The career mode is where you spend most of your time. It starts with shoving you into a Nissan GTR and asking you to drive as best you can around a small circuit. Based on your performance here, Shift 2 takes a stab at choosing a handling model – assisted braking on or off? Traction control? Stability control? Damage modelling? The options let you tailor your experience and, with a little tweaking, you can set up the game to suit your taste.

For example, we want races to be authentic but not frustrating. We also don't want to come first without completely nailing a circuit, and nor do we want to gain a huge lead or be stuck at the back all the time. It took about half-an-hour of racing with intermittent tweaking to get the settings right, and since then, Shift 2 has been a constantly enjoyable challenge.

XP is rewarded after each race based on your performance, and, inevitably, XP means levels. Each level-up works towards entering you in more races, but it also unlocks extra stuff for your cars. After your initial spin in the GTR, you're given a choice of 'D Class Modern' races – fairly standard road cars with some kick, such as Leon Cupras, Focus STs, Golf GTIs and so forth. That's just for starters, however.

YOU MIGHT CHOOSE TO RESTART A RACE THAT DOESN'T GO YOUR WAY, BUT YOU WON'T SURRENDER

In fact, it's not long before you're given the really interesting cars – we bagged a Lotus Exige early on, then a Lamborghini Gallardo, and then a McLaren MP4. It's here, with the meatier cars, that Shift 2 really hits its stride – the engines blast through your speakers and you're banking around corners with reckless abandon.

The cars all handle as if they have real weight and momentum to them, so when you're driving fast, you can't help but lean into the arms of your chair as you tackle tight corners, or hold your breath as your back end swings just a little too wide.

HOW MUCH?
Price £28 inc VAT
Publisher Electronic Arts
Developer Slightly Mad Studios
Website www.needforspeed.com

He's left his lights on

Keeping your cool in those long, breathless, closely run races can be a struggle, but it breeds a desperation that's ultimately worthwhile and moreish.

And as each race in Shift 2 is a vicious battle, you will struggle. When you have the difficulty set up correctly then you'll have to push for every single corner just to stay even with the competition. You'll have to put the brakes on and try to ease in, you'll need to keep a level accelerator through the apex and you'll be required to push hard on the exit. If you don't do all these things then you'll either be too slow, or you'll skid out, throwing your chances out of the window and onto the compost heap like last week's leftovers.

If you're too slow then you can rely on the AI to let you know, usually by blasting past you in a blaze of colour or by rubbing your bumper passive-aggressively.

It's an important facet of Shift 2's challenge and not something that should be understated; your opponent is relentless. It wants to win, and it wants to shame you by covering you in dust and making you limp across the finishing line seconds behind it. It will do anything it can to achieve this goal – undercutting or blocking you. It will turn in and knock your back end out, and then stream past you in a smug manner.

Shift 2: Unleashed can transcend the idea of races if you let it. It can become a fight – one in which your only goal is to tell that omnipresent, constantly pushing robotic intelligence that you won't be crushed. You might choose to restart a race that doesn't go your way, but you won't surrender.

Everything about Shift 2 screams that it's a racing game in which you have to race hard and the AI is a massive contributor to that. You're fending it off, and looking for an opportunity to get around it without messing up the next corner.

You can help yourself out, of course, but never to the point where winning is easy. The cash you generate during your career can be spent on new cars, and there are extensive options for upgrading each car you buy. We don't know what a 'Feramic Puck Disk Assembly' is, or a 'Race differential standard - two-way adjustable' for that matter; but we now know that we can bolt them to our car and it goes faster. You can also buy new body kits and more standard fare such as better tyres, revamped interiors for a better racing view or firmer suspension.

You can even tweak the steering wheel responsiveness and tyre pressure; this took some of us out of our depth, but it's there if you want it.

'There if you want it' is something that Shift 2 achieves perfectly. Among these options are Very Easy and Very Hard settings, Drift and Muscle car races (you uncivilised brute), and Suspension settings. None of these is mandatory. It's a racing game that you can tailor to suit yourself and will evolve as you improve your skills.

There are some fancy multiplayer features, although we haven't been able to try these yet, thanks to empty servers. Between standard races you can set lap times, recommend tracks to your online friends, and be notified by email when your time is beaten. EA is hoping that it can spawn communities where this sort of competition can take hold. As always with online features, however, only time will tell whether or not it will work.

CONCLUSION

Shift 2 is an unapologetic, highly polished racing sim in a genre that's become more than a little soft over the past few years. If you make a mistake, you'll be punished and overtaking isn't something that just randomly happens – you have to work for it. You can't recover from screwing up a corner, your engine will blow up if you push your car too hard around Nurburgring, and the AI wants to win as much as you do. These aren't faults, however, but strengths – Shift 2 is a great game because it does these things.

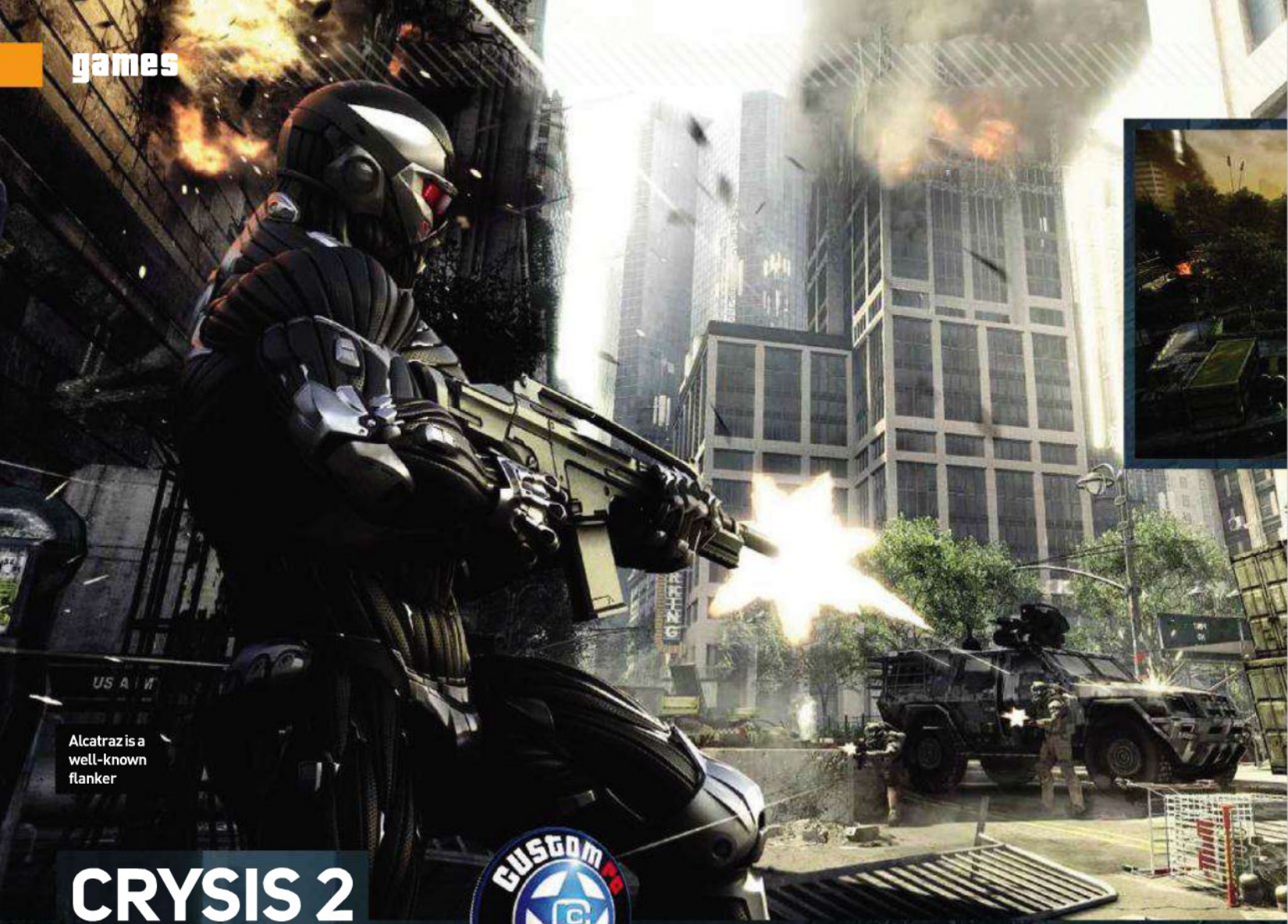
CRAIG LAGER

SCORE

CUSTOM PC

80%

OVERALL



Alcatraz is a well-known flanker

CRYSIS 2

Hello gorgeous

CUSTOM PC APPROVED

+ BEAUTY
Gorgeous; emergent; focused

– BEASTLY
Linear; untweakable

Crysis 2 isn't a clever game. Or at least, not as clever as it thinks it is anyway. There are plot holes big enough to drive a snow plough through, gaps in the level design and a lot of corners that have clearly been cut. For example, while the game opens with a barrage of news reports that establish New York is under alien attack, the squad of soldiers to which you belong seem to be ignorant of the fact that a global landmark has been all but wiped out. All they know is that they have to rescue a scientist, Dr Gould – although they aren't sure what they're rescuing him from.

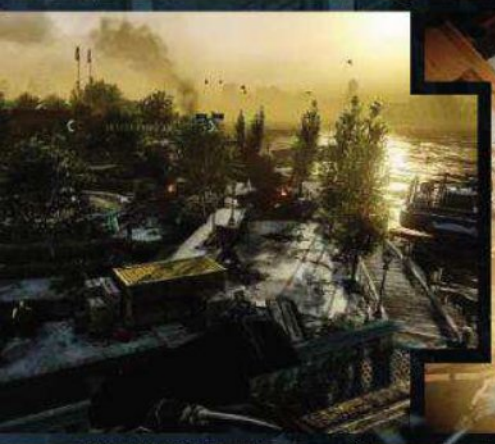
By the end of the intro cut scene, only the player character – a silent protagonist named Alcatraz – is left alive. Prophet, the enigmatic captain of the first game, then shows up and crams you into a new Nanosuit 2.0, before commanding you to finish your mission. The quest to find and save Gould before he's captured either by aliens or evil Crynet forces – who are out to get you too – then forms the first arc of the story.

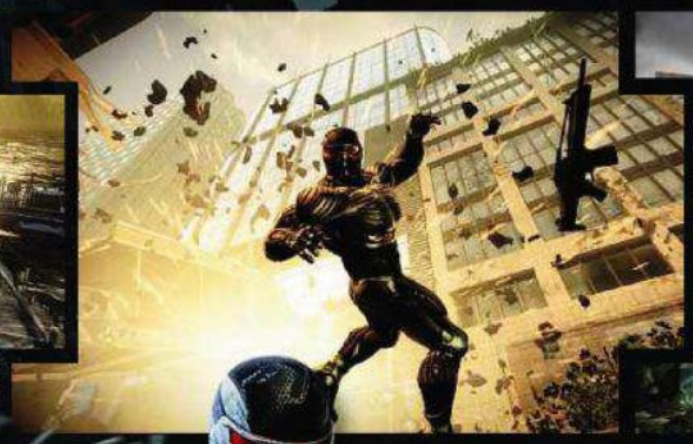
Sadly, while Crysis 2's plot seems decent enough when summarised in this way – Mystery! Aliens! Techno-babble! – it's brought down by the finer details that emerge as you play through it. For example, it's established in the first seconds of the game that Alcatraz can talk, but stays silent because he's hungover. That's a fine excuse for the first few minutes, but it quickly collapses. The only reason Alcatraz doesn't respond to Gould's radio messages is because he has a headache and upset tummy?

THE NEW NANOSUIT PROVIDES ALCATRAZ WITH A SUITE OF STEALTH AND DEFENSIVE POWERS

While Crysis 2 may not be clever, though, it's certainly big. The new Nanosuit provides Alcatraz with a streamlined suite of stealth and defensive powers – which may have been trimmed down for console controllers – plus some new abilities. Most of these new functions are informative rather than

HOW MUCH?
Price £25 inc VAT
Publisher Electronic Arts
Developer Crytek
Website www.ea.com/crysis-2





active, working to highlight enemies and different tactical options, but they serve their purpose well.

The new Nanosuit is modular too, letting you weave alien DNA into your armour in order to unlock new functions. These range from threat-recognition programs, which highlight bullet trails to help you spot snipers, to power-saving features that let your batteries last longer. Quite why you'd want to smear your clothing in alien guts is a mystery though. Likewise, it's puzzling as to why Crytek implemented the system with such an arcade feel. Every Martian murdered prompts a 'You collected 100 DNA points' message that shatters the immersive feeling that the gorgeous graphics work so hard to build.

Regardless of how the suit is upgraded, though, there's no denying that the Nanosuit works to breathe new life into what could have otherwise been a fairly standard shooter. Eschewing the jungle setting of the original game has made Crysis 2 a much more linear experience, with a lot of the action set in one-way streets or subways that don't provide the space to make thinking tactically a necessity. However, there's at least one big battlefield per level that shrugs off this trend and gives you the chance to stretch your legs – usually gloriously so. It's an empowering feeling to emerge at the top of a bombed-out skyscraper, look down on the enemies below, and use your Nanosuit's visor to tag threats and plan your assault.

Will you cloak yourself and assassinate your way through the flanks? Launch yourself into the fray and fling your super-powered fists with reckless abandon? How about kicking a van out of a multi-storey and onto a tank below, distracting enemies while you raid for supplies? These are the choices that the Nanosuit makes possible, and which are the root of Crysis 2's appeal.

Unfortunately, the multiplayer side of the game doesn't offer the same amount of sophistication and direction. Carrying Nanosuit abilities into a complex urban environment works wonders in single-player, as you can genuinely outwit the sometimes flaky AI and create exciting stories for yourself through battle. In multiplayer, that isn't true; it's more likely that you'll just be walking along when someone will de-cloak next to you and kill you before you can figure out what's happening. The levels just aren't big or open enough to balance the fluidity allowed by PC controls with the power provided by Nanosuits manned by real people.

On the issue of multiplayer, it's also worth mentioning that Crysis 2 has a disappointing reliance on third-party technologies. The game may play and look best on PC, but we envy console users who don't have to contend with both GameSpy and EA's Download Manager.

While niggles like this are a frustration, they can't dim the brilliance Crysis 2 reaches with some of its bigger battles. It's disappointing that Crytek has so clearly downgraded its vision, going from a sandbox-style tropical paradise to an urban setting that funnels you through on a set path. The advantage, however, is that not focusing solely on evolving the technology has allowed the gameplay and design to catch up to the prowess of the engine. The flaws may prevent us from labelling Crysis 2 a masterpiece, but it's a brilliant game that we recommend playing. If you can run it.

JOE MARTIN

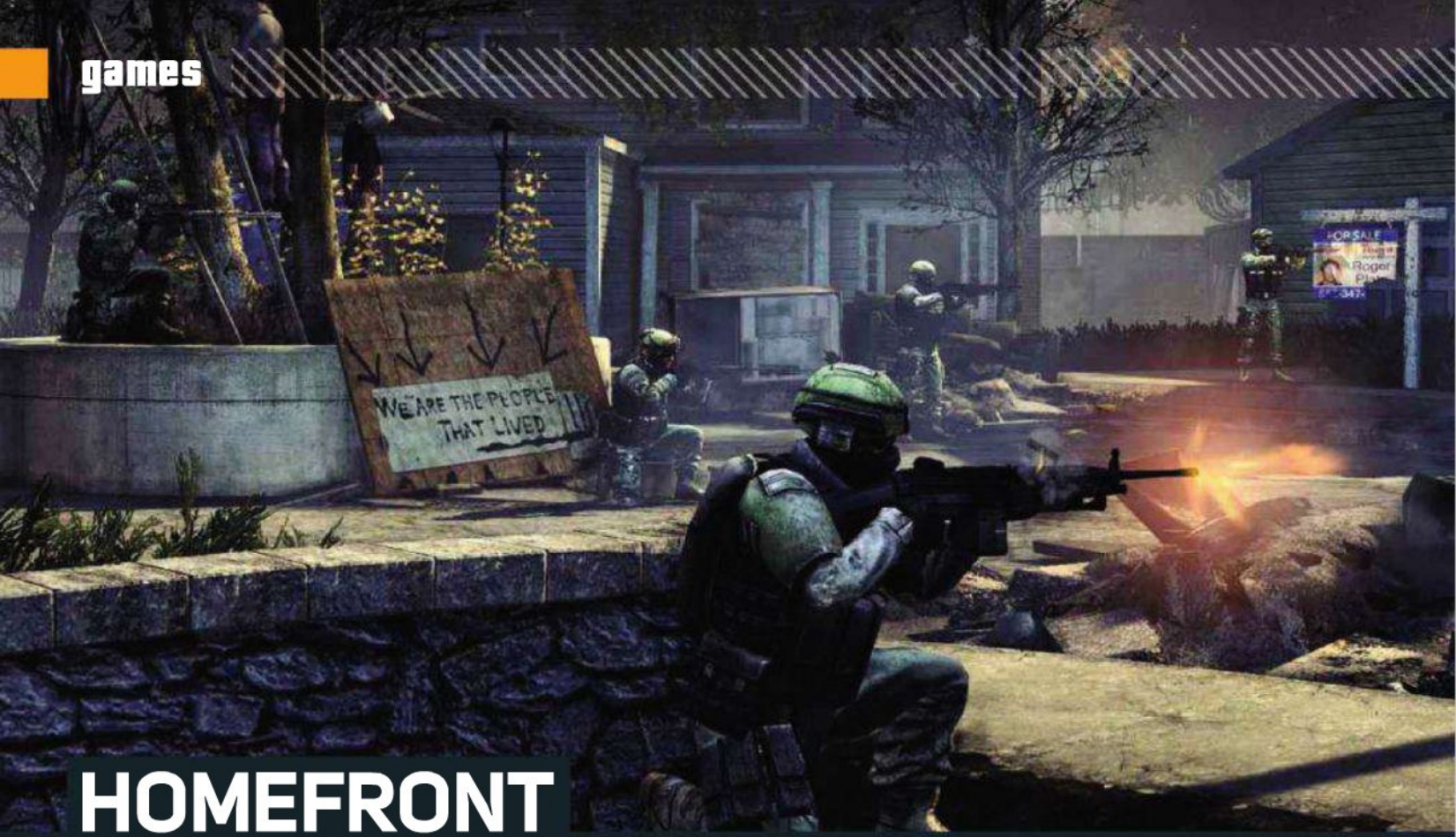
SKIN DEEP

It's finicky of us, but we were disappointed that Crysis 2 lacks decent graphical options. There are only three presets from which to choose, confusingly labelled as High, Very High and Extreme, with no option to delve deeper or enable DirectX 11 features. Thankfully, console commands let you accomplish much and fans have already created their own tools – visit **http://tinyurl.com/cryconfig** to start tweaking.

We'll have our own tweaking guide ready for next issue, but meanwhile, you can see how much better Crysis 2 looks on PC than on console at Bit-Gamer – **http://tinyurl.com/crycompare**

SCORE

CUSTOM PC 85% OVERALL



HOMEFRONT

There's no place like it

+ OCCUPATION
Good graphics; lots of vehicles

– UNEMPLOYED
Short, predictable single-player

Homefront is about as bland as they come. When you get right down to it, the only thing that really distinguishes this tale of American uprising against Korean occupation is that Kaos Studios has disguised some of the doors as fridges. As with other lacklustre super-linear shooters, such as Medal of Honor, Homefront often keeps you waiting in empty rooms before an NPC opens the next area and lets you continue. While other games use locked doors to block the way, Homefront litters the ruined levels with bulky fridges that only your allies can shift.

Fridges. When that's the limit of the game's creative reach, you know there's something wrong.

There's nothing wrong with linearity itself, of course, and it's easy to forget that some of the best FPS games ever made have been heavily directed and reliant on lots of scripted events, such as Half-Life. Unfortunately, Homefront's take on linearity is different from those lofty classics. Where Half-Life offered memorable set pieces and a variety of approaches, Homefront merely funnels players through a series of boring boxes, shuttering you in as you go. Looking back, it's hard to shake the feeling that we spent most of the game just waiting for NPCs to stop talking.

Kaos Studios has tried to compensate for this compartmentalised level design with some big set pieces, which are meant to help Homefront stand out from regular shooter fare. The approach is wounded, however, by the fact that we've seen all these set pieces before. A late helicopter mission where you have to identify and destroy targets with thermal vision cameras feels like a cheap copy of Modern Warfare's AC130 level, for example.

The core violence that drives the game is functional, at least. It's the now-standard setup in that you can carry two firearms at once, plus an instant-kill melée attack and a stack of grenades. You're accompanied throughout the entire game by at least one of three other freedom fighters too, though their value in battle is negligible at best. Mainly it's up to you to carve a path through hordes of faceless Korean soldiers, your backup trio only coming to the fore when the script demands they swear, bicker or move fridges to advance the plot.

HOW MUCH?
Price £25 inc VAT
Publisher THQ
Developer Kaos Studios
Website www.homefront-game.com

These were the only screenshots that didn't contain any fridges

It's hard to feel any attachment to any of these characters. Hopper is a quiet Asian-American geek who mostly drifts into the background, while Rhianna is the usual spunky-sexy-sensitive stereotype who flits between cutting throats and crying about all the senseless violence. Connor, ostensibly the leader of your group, stands out most – but for all the wrong reasons. He's loud and crude, best summed up by the sweary quips he makes as you play ('I thought I smelled Korean barbecue,' he chuckles as enemy soldiers are immolated around him). He's probably quite a realistic personality given the plot line, but in a game largely unconcerned with factual representation, that doesn't really add anything. We spent most of the between-fridge moments unsuccessfully shooting him in the face.

Other, often hilarious, flaws abound. Our personal favourite was when we were chasing fuel tankers in a helicopter and were ordered to fly our chopper through a small tunnel, rather than over the mountain. There was no reason for this, as the mountain was more of a hill and we could easily see the tankers on the other side, but invisible walls prevented us from taking any other route.

Thankfully, the helicopter controls were simple enough for us to drift through in one unhindered swoop.

Some of the problems that Homefront throws up aren't so laughable, however. There's the paltry length of the single-player campaign for starters – it took us just over three hours to finish on Normal difficulty – as well as the checkpoints that insist on saving just before long conversations.

Our biggest gripe is the shortness of the leash on which the players are kept, though, with the obligatory stealth mission being an excellent example. After you spend a few minutes dodging through enemies, you're ordered to cover the rest of the group with sniper fire while they mark targets for you. That isn't totally damning in itself, but Connor then goes the extra distance and tells you when to shoot too, removing any agency or player involvement.

There are only two elements that hold Homefront together and help to elevate it to the level of mediocrity. The first is the basic utility of the game – there may be a lot of waiting around and jumping through hoops, but the game does at least work and, when you are shooting, it's quite fun. The gunplay and level design isn't very strong, but neither is it the worst we've seen – it hums along as nothing more or less than average.

The second redeeming feature is the multiplayer. Again, this isn't spectacular and often feels like nothing more than an updated version of Kaos' last shooter, the similarly mediocre Frontlines: Fuel of War, but it isn't terrible. There's a focus on large battlefields and vehicular combat, which provides a nice contrast to the single-player, even if it will never top the Battlefield series.

Kaos has also introduced a variation on the usual Call of Duty level-up system too, where players earn Battle Points that can then be put towards unlocking upgrades of their choice. This means that, if you're desperate for a particularly powerful weapon, you just save up your points. It's a nice change from the standard strategy employed by most multiplayer shooters, even if it isn't reason enough to play Homefront over any of the other games clogging the shelves.

CONCLUSION

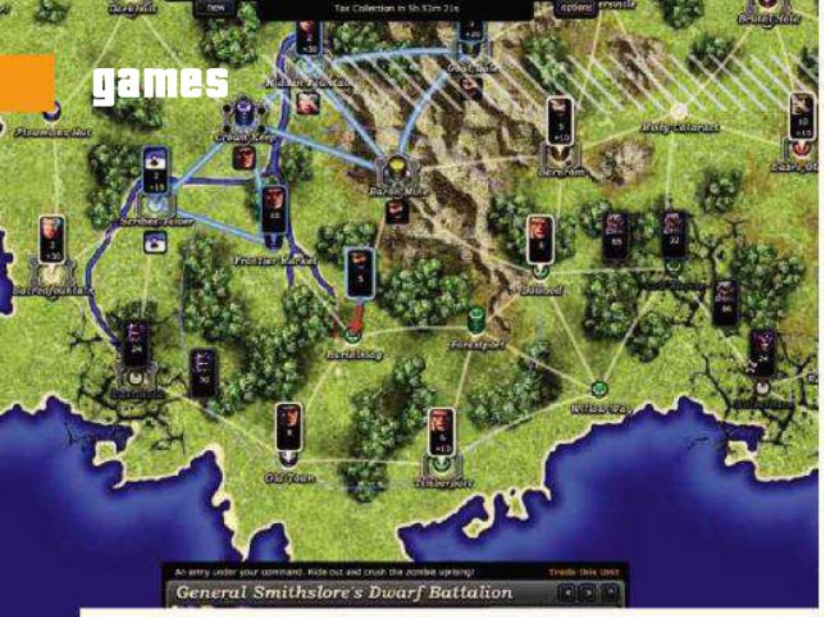
The worst thing about Homefront is how disappointing it is. It isn't an especially awful game most of the time, just a tedious and bland one that's incapable of standing out in an overpopulated market. If you've bought it already then there's some short-term fun to be salvaged from the painfully brief single-player and stumbling online game. Otherwise, Homefront is so dreadfully average that there are no real grounds on which we can recommend it – and a good few reasons we can list to avoid it.

JOE MARTIN

SCORE

CUSTOM PC

50% OVERALL



BLIGHT OF THE IMMORTALS

Strategy, diplomacy, zombies

After the great but terrible life-consuming spectacle that was Neptune's Pride, it was with both great trepidation and excitement that we approached Iron Helmet's second offering, Blight of The Immortals. The basic concept was similar enough to worry us; it's a very slow-burning strategy game that takes place over weeks rather than hours, but we quickly found out that it offers enough new ideas to make it stand apart.

Blight is firmly rooted in fantasy rather than Neptune's sci-fi tropes, for example. Elves, dwarves, ents, wizards, orcs, goblins – all the Tolkien staples are present – as well as the titular blight, which are AI-controlled zombies that run rampant. It's these undead forces that make the most noticeable difference between Neptune's Pride and Blight of the Immortals; whereas the former was strictly competitive, the latter is utterly collaborative. It's everyone together against the zombies.

The immediate benefit of this is that Blight is immediately less stressful and friendlier than the knife-chewing agony offered by Neptune's Pride. The downside is that, well, that was always part of the fun with Neptune's Pride, wasn't it?

Each game starts with the world divided up into rough sections for each of the players – the elves that we chose to play as, for example, were gifted a section of the southern forests. Other players were cast their lots too; dwarves in mountain ranges, men on the coasts, and orcs and goblins on plains.

While the appeal of orcs and giants is near universal, however, Blight of the Immortals still manages to divide audiences based on the complexity of the maths that rule the game. Battles appear simple at first – each unit has one attack and health point at base – but they become far more challenging when you consider

army levels, random factors and the unique abilities to which each faction has access.

One battle we fought, for example, saw us trying to hold off an army of 50 undead cyclops with only 20 standard elves. We were on the defensive, so we were able to add an extra ten points to our attack score, but were still in trouble even after we exhausted our special abilities. In the end, we had to call for help from another player, negotiating promises of future aid for necessary reinforcements; while Blight of the Immortals is theoretically a collaborative game, it's rife with negotiation and diplomacy.

It's only at this point that we can see what Iron Helmet is doing with Blight of the Immortals. It has essentially taken Neptune's Pride and made it nicer but more complex. Where Neptune's Pride was simple – every man for himself, one unit-type and no abilities – Blight of the Immortals is far more difficult to get your head around. Where Neptune's Pride was vicious – with players backstabbing and betraying each other constantly – Blight of the Immortals fosters friendship. Aww.

CRAIG LAGER

THE KNOWLEDGE
Release date TBA
Publisher Iron Helmet Studios
Developer Iron Helmet Studios
Website http://blight.ironhelmet.com

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Damned hippies!

BRINK

Killing on the edge

THE KNOWLEDGE
Release date 20 May
Publisher Bethesda Softworks
Developer Splash Damage
Website www.brinkthegame.com

Developed by the London-based Splash Damage, Brink is a fierce multiplayer shooter that paints a stylish if bleak picture of the not-so-distant future – one in which understanding the story is oddly integral to the multiplayer. Brink creates a world where the human race is pushed to desperation by an environmental crisis and launches a floating, self-sustaining city called The Ark as a last bastion of civilisation. It's overrun with refugees, so it isn't long before a civil war breaks out between the security forces that are trying to keep the overpopulated city under control and the masses who can't survive anywhere else.

This is where you join in the fray – at the tipping point of the conflict between the security services and the armed populace. You immediately have to choose your loyalties after the intro cutscene – Option 1: Save the Ark, Option 2: Escape the Ark.

Whichever side you choose to join, you'll be confronted with a bewildering array of character customisation options and choices, some of which affect the way you play the game while others are merely cosmetic. As usual, winning matches rewards you with XP, which you can use to unlock more items to distinguish yourself from the crowd in online battles.

Brink uses these customisation options to help tie the single and multiplayer experiences together, letting players earn and spend XP across both modes. There's also a series of offline challenges similar to Call of Duty's Special Ops mode, which offer a nice training ground to newcomers.

The multiplayer, however, is where the real meat of the game lies – and 'slick' is the best word to describe it judging from what we've seen. Combatants in Brink can perform speedy parkour moves across the colourful and complex environment of The Ark, leading to some very stylish firefights. The wall-running, vaulting and jumping isn't as smooth as that in Mirror's Edge –an obvious benchmark for such mechanics – but sliding around corners and unloading on enemies is always satisfying.

Brink also boasts customised objectives – an evolution of the one Splash Damage tried in 2007's Quake Wars. These are presented as small side missions which, while not compulsory, will help your team to win the match. These range from building machine-gun nests to opening new paths or blocking the enemy. Some are tailored to specific classes – there are four on offer – while others are open to anyone.

COMBATANTS IN BRINK CAN PERFORM SPEEDY PARKOUR MOVES ACROSS THE COLOURFUL, COMPLEX ENVIRONMENT OF THE ARK

Online matches are limited to 8v8, which is disappointing for PC players accustomed to larger battles. This is largely remedied by the intimacy of the small maps, however, which help to support the fierce if not large-scale conflicts.

PAUL GOODHEAD

THE WITCHER 2: ASSASSIN OF KINGS

Who's the witchiest of them all?

Sex. Lots of sex. That's always been The Witcher's schtick and it's something CD Projekt hasn't sought to change for the new game in the series, Assassin of Kings. That's either wearying or supremely gratifying depending on whether or not you're 13 years old. Although we usually fall into the former category, we were happy to see that CD Projekt is at least using sex appeal for a purpose in the latest build of The Witcher 2.

We played through a side quest that saw famed monster hunter and personality vacuum Geralt of Rivia hunting a succubus. Geralt didn't know what he was chasing at the start of the mission, however. All he knew was that a string of murders had left young women without their significant others, so the first step in the quest was to check out the crime scene for clues. The smell of sulphur clues Geralt into demonic causes and a later examination of the corpses further identifies the culprit.

This might not seem like a thrilling start to a quest; walking around a small clearing looking for blood spatters and weird smells isn't many people's idea of a good time, we bet. However, this was one of our favourite parts of the preview, as it's perfectly suited to the tone and characters.

Geralt is an emotionless monster hunter, so it makes sense that he would dispassionately investigate in this way. At the same time, since Geralt's actions are unusual to everyone except him, he comes across as being very cool – giving him an injection of much-needed charisma.

Still, if playing a boiled-down version of medieval CSI doesn't do it for you, there's lots of the usual swordplay and magic in which to immerse yourself. The Witcher 2's combat system has been completely overhauled from the previous game, so there's no more need to click in a specific rhythm to achieve the best combos. Instead, tactics come much more from the choice of weapons – silver for monsters, steel for natural foes – and your range of potions, poisons and bombs.

Spells are made more accessible too, with quick buttons that let you unleash your mana-based fury more easily from the third-person perspective. You can even use magic to interact with the physics of the world too – we had a lot of fun ploughing through ruined tomb walls with the magical equivalent of a physics gun, for example.

CD Projekt has abandoned the old Aurora engine that the original used too, opting instead to create its own new engine. As a result, The Witcher 2 not only looks fabulous but also performs brilliantly. We didn't see a single load screen during our game except for a few seconds' pause when moving to and from interior areas.

We were initially concerned that the plot and writing might be a tad incomprehensible at times (a flaw that occasionally reared up in the original game) but what we've seen so far doesn't suggest this. In fact, we admire the game even more – but whether that's because CD Projekt is only showing us the good bits remains to be seen.

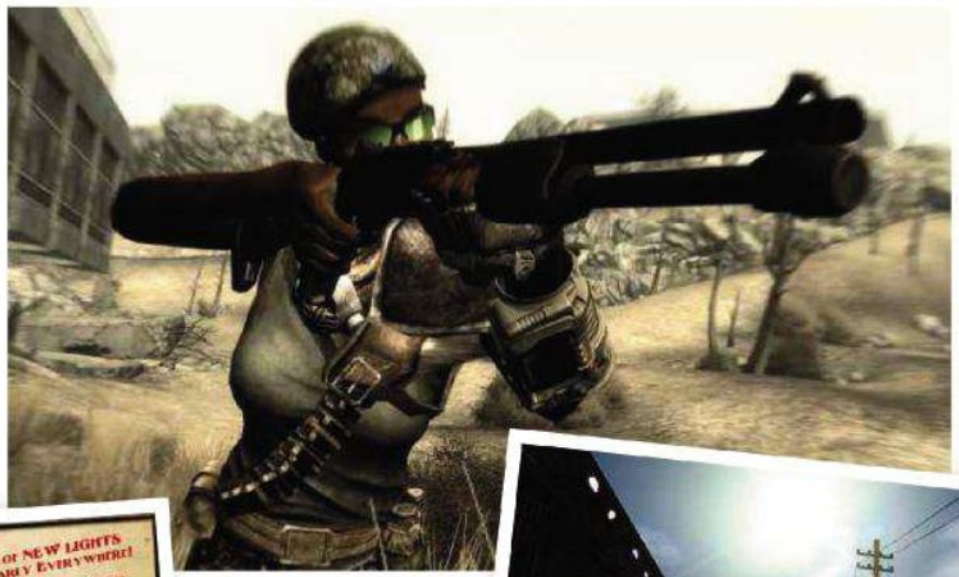
JOE MARTIN

THE KNOWLEDGE
Release date 17 May
Publisher Namco Bandai
Developer CD Projekt
Website www.thewitcher.com

value added

Phil Hartup looks at the latest game mods

Fallout: new vegas



The big news for fans of New Vegas so far this year wasn't the release of the Dead Money DLC mod, but rather the latest version of the Fallout Overhaul kit, or FOOK, which is now compatible. We looked at FOOK when the first version appeared soon after the game launched, but many of its improvements were carried over from the Fallout 3 mod, and not built specifically for New Vegas. The latest version is far more fleshed out and features retextures of existing weaponry and armour, new items, and changed weapon names that fit in with their real-world equivalents.

While FOOK invigorates the gameplay and makes the characters in the game more presentable, it doesn't exactly revolutionise the visuals, however. Thankfully, other mods stack on top of FOOK to bring it up to par. We'd recommend three of these in particular.

The first is the Nevada Skies mod, which improves the skyboxes while also adding desert sandstorms and making the nights darker. This makes the world feel far more alive, if not necessarily more friendly.

The Electro-City mod improves electric lighting effects, so it's the perfect complement to the darker nights of Nevada Skies. The two mods combine to create an excellent contrast between the areas where humans still cling to technology for safety and the wild, dark wastes.

The last visual mod, called FNV Enhanced Shaders, does what you'd expect, and makes the game look superb. The improved visuals come with a big performance hit, though.

Another mod we'd consider a necessity – especially for veteran Fallout players – is the Classic Fallout Weapons pack. This includes a gigantic array of guns from the earlier games and is compatible with FOOK with the addition of a tiny patch. The Classic Fallout Weapons pack requires a second mod, CaliberX, to work, though. CaliberX allows mods to use custom ammunition, and improves details such as the graphics for spent shell casings.

With a beautiful game world and a player sufficiently tooled up to take on the work of three of the four horsemen of the apocalypse single-handed, the only thing missing is a suitable place to combine all these elements. This brings us to the World of Pain, which repopulates and expands the core game with 90 new areas, complete with new quests and NPCs. It's not exactly a subtle addition – most of its quests involve mass murder – but it's a stylish and sizeable expansion.

You can find all these modifications at **http://newvegasnexus.com**

Required playing

Joe takes a look at the free games you need to play

Give Up Robot 2

http://tinyurl.com/giverobot2

It's held back by fiddly controls and a fussy understanding of momentum, but Give Up Robot 2 is nonetheless an intelligent and witty platformer. Use your grappling hook to swing your droid through a variety of levels, altering missile trajectories and dragging enemies into mines as you go.

GNOP

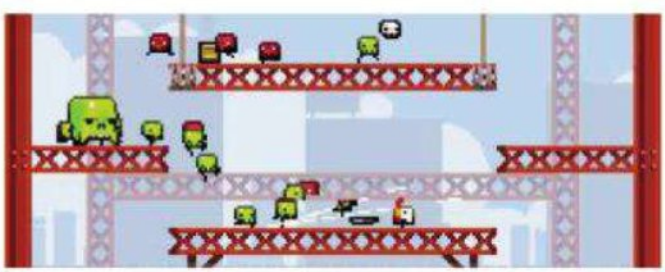
http://tinyurl.com/gnop-game

GNOP is Pong, but where you're placed in control of the ball, not the paddles. This turns the game into a sly puzzler in which you have to dodge the paddles using a variety of tactics to reach the next screen. Minimalist and elegant, Bit Battalion's GNOP proves there's still life in the classics yet.

Spent

http://playspent.org

Designed to raise awareness for poverty charities, Spent casts you as one of the downtrodden millions and tasks you with surviving for one month below the poverty line. You can invite Facebook friends to help you out if you need it and aren't too proud as you make decisions that will shape your future.



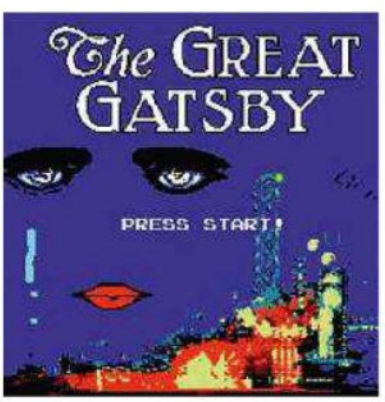
Super Crate Box

http://tinyurl.com/supercrate

What's that noise? It's Games Editor Joe screaming in frustration as he dies in Super Crate Box – again. This game is devilishly difficult, but strangely moreish, as you work to grab crates before being swamped by immortal beasties. Definitely worth a look.

The Great Gatsby

http://greatgatsbygame.com



An odd choice of novel on which to base a game, The Great Gatsby was originally developed for the NES, but never actually made it to the shelves. Thankfully, someone found a developer's copy and made it work in Flash. The result is a strange and surreal platformer with a very catchy theme tune.

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VOXEL UNIVERSES
ELLIPSOID 3D
VIRTUAL REALITY

DEAD END THRILLS

As games technology continues to evolve, Richard Cobbett considers some of the dead ends we've seen along the way

Not every idea has its day. Sometimes, it just lands at the wrong time. Perhaps it took too long in development to impress anyone, or it arrived too early for anyone to take advantage of it. Some products are given their due on release, but for whatever reason, nobody feels the need to take them any further, and the world moves on in a new direction. Even a bad game can contain great ideas that are worth stealing, while smaller ones are simply overshadowed.

We've dug up some old games in our search for examples of these ideas; some appear in just one game, but others temporarily took the world by storm before dying out. A few are still around, but in support roles rather than leading the way to the future. All are worth recalling, not just for what they did, but also for what they could have done if things had turned out differently.

VOXEL UNIVERSES

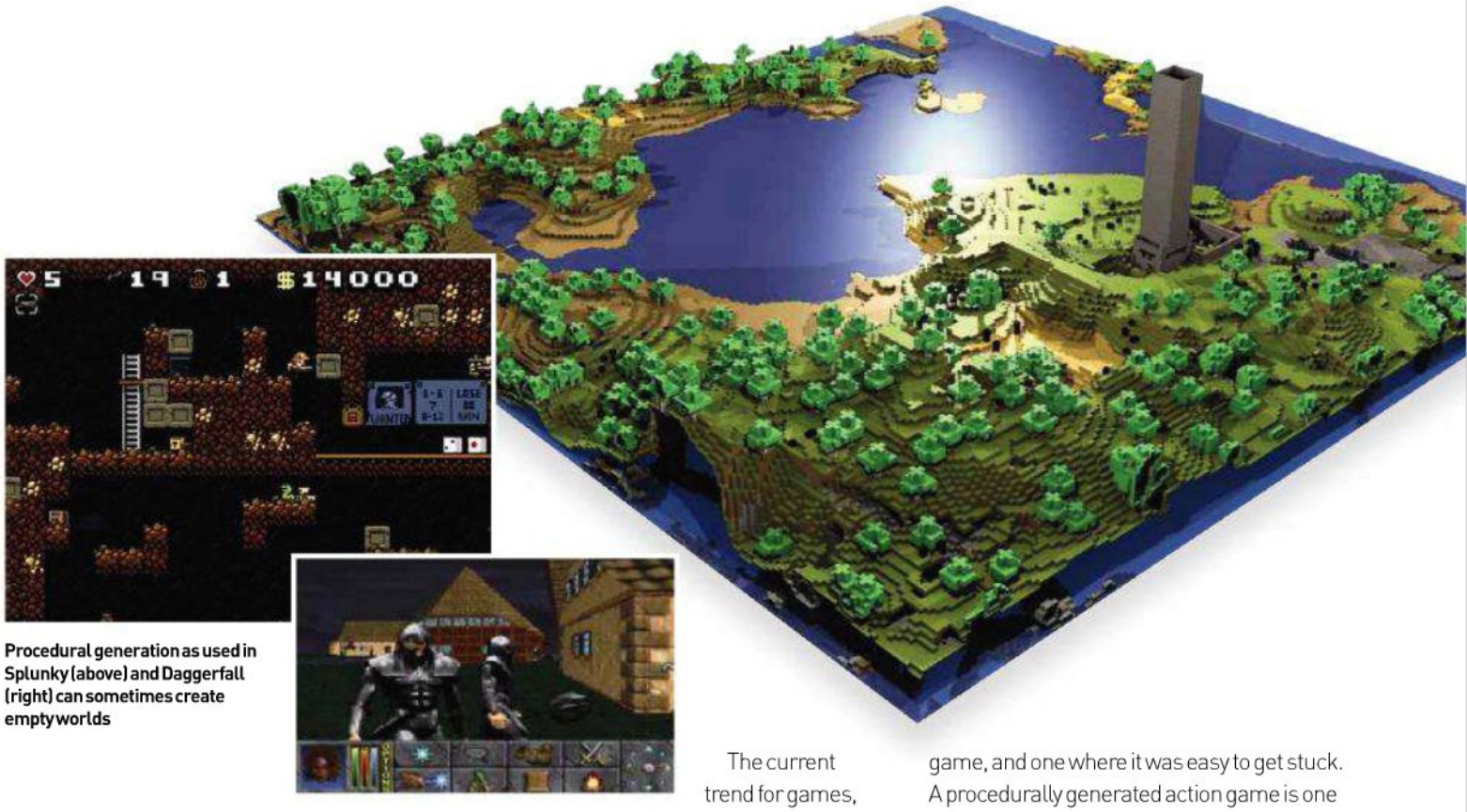
The main reason that triangular-polygon based graphics took off was that the original 3D accelerator cards were built to give them a boost. Before that happened, all the most impressive-looking games used voxels instead – pixels, but with depth. Their major debut was in the 1992 Commanche game, a helicopter simulator that offered rolling hills and countryside while other games were stuck with simple flat planes of land. Voxels were even flexible enough to allow for advanced effects such as real-time terrain destruction and deformation, although surprisingly few games actually bothered with these features.

Voxels were often deployed for non-terrain-based assets too, including characters in Blade Runner, and as replacements for certain sprites in shooters such as Shadow Warrior. They served as a halfway house between software rendering and the more system-intensive polygons. Even today, they show up in areas you wouldn't necessarily expect to find them. Minecraft and Crysis, for example, both use voxel landscapes. However, they fell out of favour as the standard format for building worlds for two reasons; computers and graphics cards became powerful enough to simply throw polygons at any problem, making it easier to fake the organic look of voxels, and the majority of tools used for creating assets are geared around doing exactly that.

Voxels' fate is best summed up by the game Outcast. Much like Crysis, it was an absolute system crusher on release, but an incredibly beautiful one – everything from the huge landscapes to the ripples in the water when you swam gave a sense of stepping into another world. It was very CPU-intensive as a result, though, performing badly on the systems in use at the time. It was so stressful for systems that, despite voxels being the game's biggest selling point, the developer opted for polygons in the sequel, which was later sadly cancelled.

Outcast's Cutter Slade is a distant relative of Geordi La Forge

120



Procedural generation as used in Splunky (above) and Daggerfall (right) can sometimes create empty worlds

Polygons were more console-friendly; they were where the technology was heading and they sounded cooler. Voxels may still be with us, but they never managed to regain the spotlight.

PROCEDURAL GENERATION

As with voxels, procedural generation didn't fall off the stage entirely – it merely stumbled into a supporting role. It's often used to scatter elements such as trees, or to create a basic starting point that designers can use as a springboard, but it's very rarely employed to create entire worlds in a flash, no matter how much time it saves.

The reason for this is that developers have learned that quantity is nowhere near as important as quality. Procedural generation is great for making lots of content but it can't create unique areas.

The current trend for games, however, is for smaller experiences, carefully balanced and polished to a fine sheen – or something close to that. Or merely tolerable, but often not even that.

No series demonstrates this better than The Elder Scrolls. Oblivion offers a play area of 16 square miles that's filled with towns, dungeons, quests and other goodies. Its predecessor, Daggerfall, offered more than 62,394 square miles. Oblivion had just nine towns to explore, while Daggerfall claimed 15,000 of them. And no, that isn't a misprint.

The penalty for this excess was that the multitude of elements became irrelevant. Daggerfall may have been the size of Great Britain, but there was precious little to find in it. It had no real personality, and nothing was very memorable, except the scope itself and a ridiculous amount of low-res nudity. In addition, Daggerfall was an incredibly buggy game, and one where it was easy to get stuck. A procedurally generated action game is one that has to bend over backwards not to make itself unwinnable.

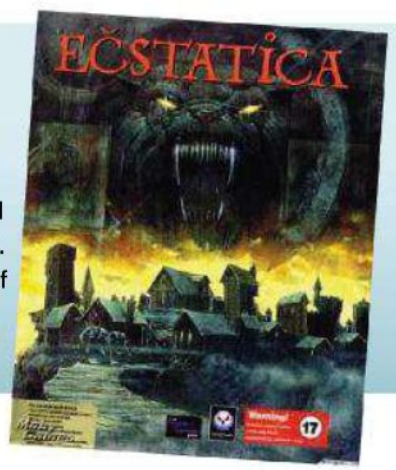
However, this doesn't always matter. Since we expect space to be mostly empty, Elite could easily create its entire universe based on a random seed. Minecraft's world compensates for its emptiness by presenting it as a blank canvas, ready for you to fill with interesting content.

However, for the most part, the experiences that commercial games want to offer require a much more structured, tested approach to level design.

Independent games, on the other hand, have more freedom – and none shows it off better than Derek Yu's Spelunky. It uses randomly generated worlds made out of set pieces, such as the Snake Pit and the Store, and adds layers of challenge as you move through the game. The resulting game

ELLIPSOID 3D

Triangles quickly established themselves as the polygon of choice for game artists, and with good reason. Even ignoring the hardware boost, the games that tried other shapes simply looked ridiculous – and none more so than Ecstatica. This 18-rated adventure was nasty. It was a brutal, horrific world of pain, torture, misery and death, set in a village controlled by the Devil, with inverted crucifixions to welcome you into its clutches. And it was all rendered in balls – great big blobby balls. No evil monster can hope to survive that humiliation. The cover art depicted a hand-painted world of menace and brooding horror. In the actual game, it just wasn't going to happen, no matter how many scenes of torture the developer tried to include.



Facade was a brave experiment, but it reinforced how far we still have to go to achieve believable character interaction

combines designer-led progression with the bonus of unlimited maps, and becomes almost impossibly addictive. At least until you finally get fed up and quit.

Chatterbot AI breathed life into Starship Titanic's robot crew, but didn't convince anyone else to steal the idea

CHATTERBOT AI

Douglas Adams' Starship Titanic was largely forgettable, except for one amazing feature called Spookitalk, a chatterbot that handled your conversations with the ship's robotic crew. Instead of working through dialogue trees or simply selecting options, you keyed in full sentences and could shoot the breeze about whichever topic you liked.

At least, that was the idea. In practice, it wasn't desperately convincing; most questions would simply be greeted by each robot's version of 'Huh?', and you quickly hit the limits of what you could do. It helped that any lapses could be excused by the fact that you were talking to broken or glitchy robots instead of other people, and that the dialogue was funny enough that you didn't mind.

The areas in which it was successful were mainly due to the developer gathering enough people in front of the system before the game's release to form a good idea of what consumers were going to type, and then writing the responses accordingly. Needless to say, it was especially open to Hitch Hiker's Guide references and almost any form of abuse you could throw its way.

It isn't difficult to see why the idea didn't catch on with other adventure games. It was a great inclusion and a fantastic idea, but one that largely impeded the action once the novelty had worn off.

The 10,000 lines of recorded dialogue weren't enough to cover the range of potential options, and the moment that characters failed to react to something they should have, the effect was broken. A standard, boring dialogue tree may not be very immersive, but neither is it jarring, and ultimately, that's more important to the gameplay.

The text adventure genre is the only one that continues, occasionally, to aim for this level of complexity, albeit via direct scripting rather than anything pretending to be AI.

The most successful example is Emily Short's Galatea, a game centred around simply talking to a living statue. The number of responses required to make even this

VIRTUAL REALITY

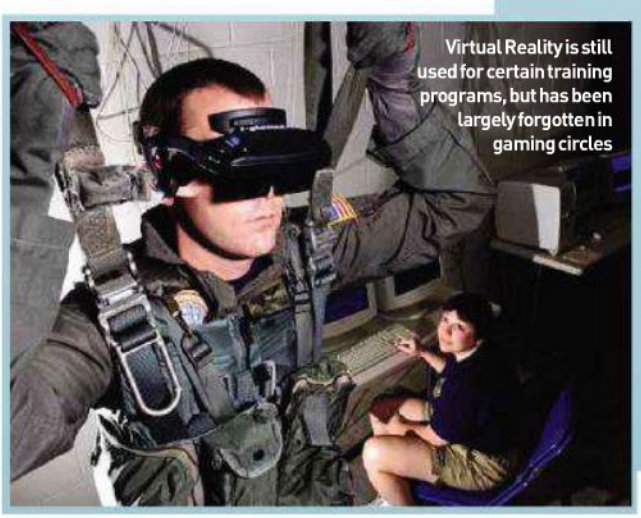
Virtual Reality is a lot like current 3D tech; it's expensive, immature, gimmicky and gives you a crashing headache. It was huge in the early 1990s, but only as a sideshow. You strapped on a very heavy helmet and immediately became immersed in a whole new world. The problems can be best summed up in the following way: 276 x 372 resolution, powered by an Amiga 3000, at least £1 per game.

There were quite a few games around at the time, although only a handful are particularly memorable. The main ones are VTOL, a flight simulator that may as well have been renamed 'You Will Crash Immediately', and a simple RPG called Legend Quest. The first was a sit-down game, while the second had you standing in a protective donut, waving your hands around.

Virtual Reality games offered little fun; there was nothing but simple, untextured 3D worlds and very little playtime for your money. The arcade units were a big hit, though, and the technology trickled down onto desktop PCs. There were many problems, though, and few people were willing to invest in virtual reality games.

In the arcade, for instance, you could look down at your virtual hand and see it move along with your real one more or less in real time. At home, you could play a standard game such as Doom and have a decent time, but only with your shotgun effectively embedded in your forehead.

The appeal quickly wore off. Playing games in VR wasn't convincing, but it was often nauseating; your eyes told you that you were moving, but your body remained firmly stuck in one place. It was too expensive and the industry failed to show strong support for it, rendering it a historical curiosity. Still, at the time, it felt like The Future.



Virtual Reality is still used for certain training programs, but has been largely forgotten in gaming circles

122

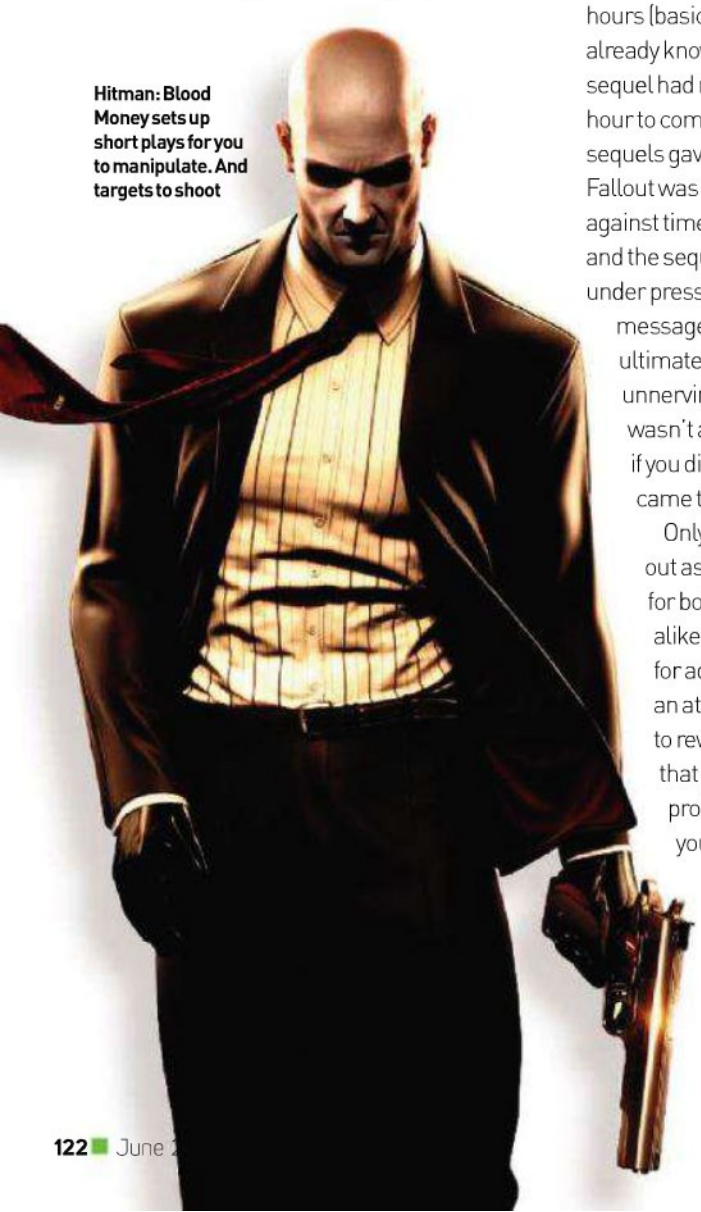
encounter feel convincing makes it clear as to why no commercial game has given it a try.

Elsewhere, a student project called Facade tried something even more ambitious, featuring a real-time environment with two characters arguing and interacting, and the player stuck in the middle. It was a convincing effect to begin with, but it quickly collapsed.

REAL-TIME PRESSURE

If AI is one of the tougher challenges that a narrative-heavy game can tackle, going fully real-time is one of the toughest sells. On paper, it seems like a great idea – take too long to save the kingdom and there won't be one left to save. It makes sense, raises the stakes and increases the pressure.

Unfortunately, it also usually saps much of the fun out of the game for players. Even in instances where the time limit is incredibly generous, it's impossible to forget that it's there, or not to worry that you might be falling behind, or have forgotten something. The first time you play, you have no idea how long it's going to take you to accomplish goals, and you don't have the luxury of actually enjoying whatever freedom the game mechanics give you. In the case of an RPG, that might be hunting around for gold and sub-quests. In an adventure, it could be exploration, or the luxury of time to think over a problem and try out different ways to resolve it.



Hitman: Blood Money sets up short plays for you to manipulate. And targets to shoot

Almost without exception, every game that has offered time-pressure or real-time challenges has dropped the idea almost immediately. System Shock gave you just six hours (basically impossible if you didn't already know the game backwards), while the sequel had none. Prince of Persia gave you an hour to complete the entire game, while its sequels gave you as long as you needed. Fallout was built around a desperate race against time to repair your nuclear bunker, and the sequel simply pretended you were under pressure by constantly sending you messages to hurry but which were ultimately meaningless. It proved unnerving if you didn't know there wasn't a limit, and incredibly annoying if you did, but at least the game never came to a close.

Only two games have really stood out as making real-time action fun for both hardcore and regular players alike. The Last Express achieved it for adventure gaming by being largely an atmosphere piece, with the option to rewind time at any point. This meant that missing something wasn't a problem, and you could play at your leisure while still enjoying the other characters going about their lives.

More recently, Hitman: Blood Money designed its levels so that the best route through each mission usually involved being at the right place at the right time. For instance, taking a sniper shot at a target on a stage, synced with a prop gun being fired at him, but there's always another route, such as running in with a machine gun. You won't receive full points, but you'll kill a lot of innocent people, so that's okay.

FULL-MOTION VIDEO

For a while, FMV was the cutting edge of gaming, making bad actors, poor direction, cheap effects, awful scripts and blue-screens seem like The Future. Thankfully, it didn't last long. FMV was expensive to produce – Wing Commander 4 clocked in at $12 million, mostly due to having to build the sets. They rarely looked good (although a few games, such as Tex Murphy and Gabriel Knight made it work well) and offered few gameplay opportunities. As soon as polygon characters

125

ALWAYS UNPOPULAR

Some ideas that will simply never work...

TEXT TO SPEECH

As seen in: Maupiti Island

- Every character can talk out loud!
- They all sound like the same robot

CO-OP ADVENTURING

As seen in: Neverwinter Nights

- Story and puzzling fun with friends!
- One smart-arse will always ruin it

AUTOSTEREOGRAMS

As seen in: Magic Carpet

- 3D without the glasses, Magic Eye style!
- The worst migraines in the history of pain

BI-NEURAL BEATS

As seen in: Bejewelled III

- Positive mental reinforcement while you play!
- It's a load of codswallop. Probably

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There's nothing like firing phasers like a real Captain

became good enough to act instead of just staring at each other while a sound file played, FMV became history.

Mostly history anyway. FMV still hangs around in one common form – pre-rendered cut-scenes to handle exciting events or subtle animation that action game engines can't handle in real time. However, actual actors in front of blue-screens are very much a thing of the past. Only Command and Conquer, and a few adventures such as Conspiracies and Fate By Numbers still use them, and even then, it's very much a legacy nod to fans of older games.

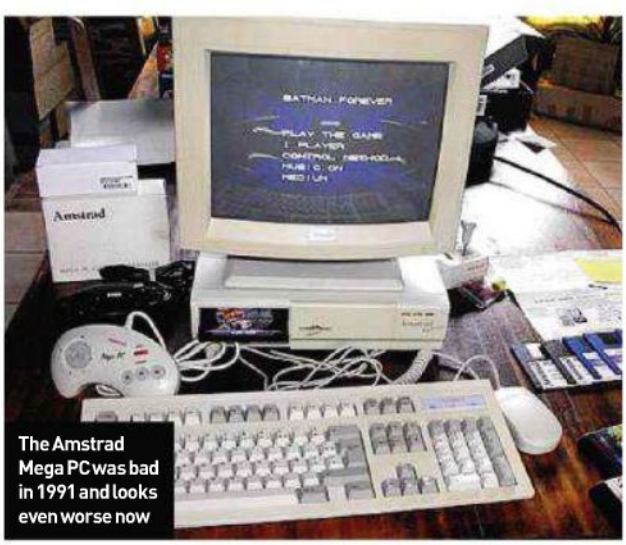
Despite their many weaknesses, which ultimately resulted in the words 'interactive movie' being banned forever, FMV games have a certain nostalgic appeal. They were often funny, intentionally or otherwise, and they served an important purpose in the industry's development. Getting caught by the Hollywood bug was a necessary step for gaming to take, if only to realise that it could go its own way, and create far better experiences by doing so.

THE CONSOLE PC

As impossible as it seems now, the PC wasn't always the undisputed king of gaming. In the early 1990s, before Doom changed the world, you needed a console to really enjoy the latest arcade and action games – unless, of course, you thought outside the box. Both Amstrad and IBM produced PCs that could play Mega Drive/Genesis games – the MegaPC and SEGA TeraDrive respectively, released in 1993 and 1991. Neither took the world by storm, which was mostly because they were very expensive for what was basically just a PC with Mega Drive components in the case (the two platforms didn't interact, they just shared living space). Still, the idea was compelling before the days of easy software emulation.

And then there was the 3DO Blaster. This was a dedicated ISA expansion card that could install in your PC and play amazing 3DO exclusive games. It might have been more successful had the 3DO itself taken the world by storm. Instead, it was the last attempt to turn your PC into a virtual time-share, until Bleem showed up – an emulator designed to let you play PlayStation games from the comfort of Windows. This was pretty popular, despite many compatibility issues, until it inevitably fell foul of Sony's lawyers.

Emulation continues, of course, but aside from a few packs of Spectrum games and similar retro fare, it's dead on the shelves. Pity. Just think of all those Xbox and PS3 games we could be playing in high-resolution, with anti-aliasing and everything. CPC

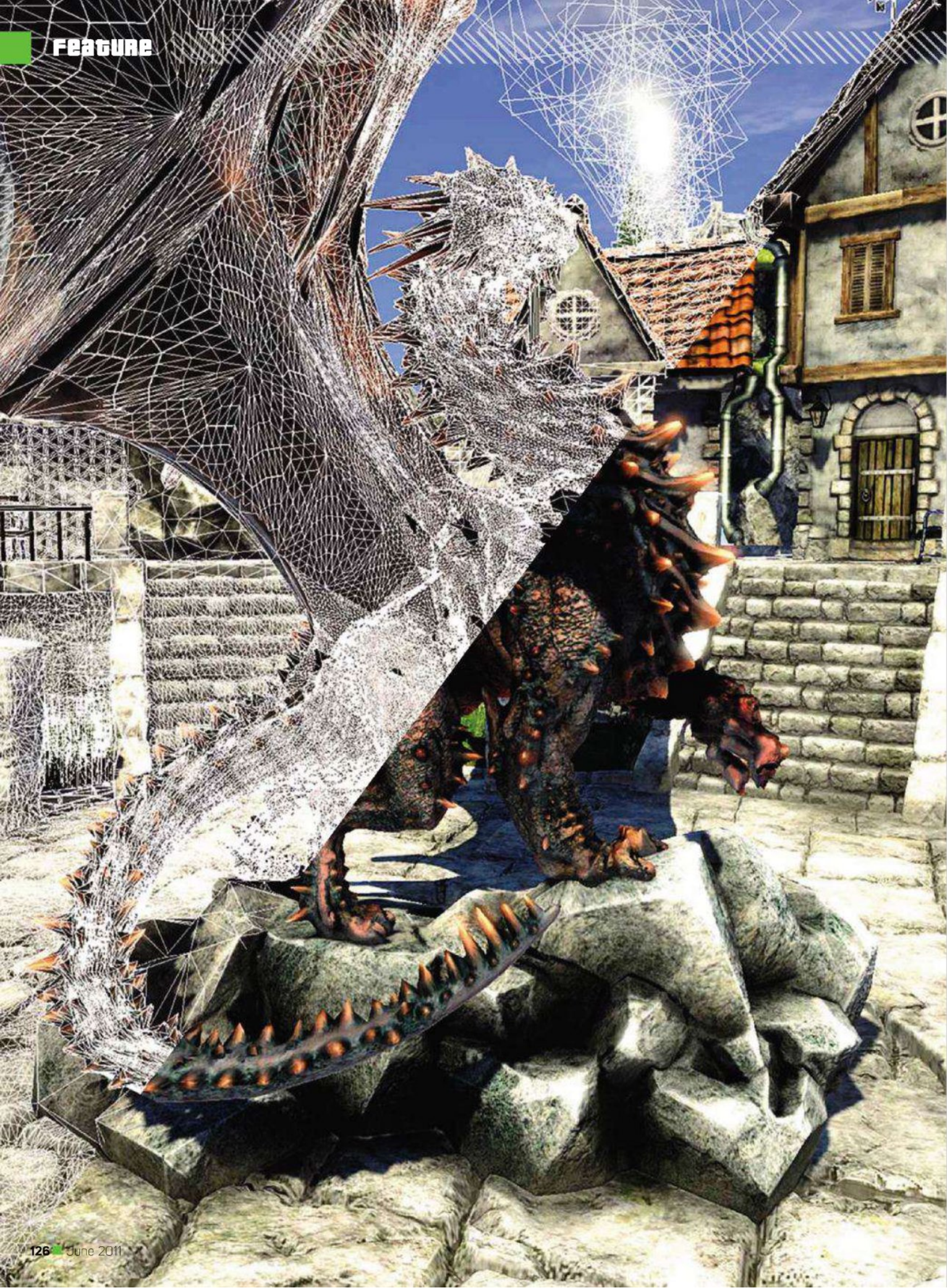


The Amstrad Mega PC was bad in 1991 and looks even worse now

VOICE CONTROL

Back in 1997, Bill Gates claimed that within ten years, we'd have perfect speech recognition and it would be a standard part of computer interfaces. Needless to say, that hasn't happened – but a number of games have attempted to pull it off with variable success.

The most ambitious remains Konami's Lifeline, a PS2 game that was entirely controlled by microphone. On the PC, Tom Clancy's EndWar gave it a brave attempt, as did Star Trek: Bridge Commander. It's never really worked, though, for a few key reasons. Even assuming excellent speech processing, calm and clear orders aren't the hallmark of an exciting game situation. No conversion program does a great job with accents from around the world. Voice controls are much slower than simply clicking an icon or handing out an order. There's nothing more frustrating than simply being ignored by your character when things are going wrong. Finally, controlling a game by yelling 'FIRE! FIRE! LEFT! SHOOT THAT! DIE! DIE! DIE!' until the early hours is something you can only get away with if you live alone or have the luxury of gaming in a soundproof booth. Even if the core technology works perfectly, you'll probably be lynched by Level 3.



OpenGL

OpenGL was once the king of 3D graphics APIs, but most PC game developers are now shunning it in favour of Direct3D. **Ben Hardwidge** investigates the reasons behind the mass switchover

OpenGL isn't dying, dead or any other adjective that you can imagine John Cleese reciting in a silly voice. The open-source 3D graphics API is still immensely popular with 3D workstation users, and OpenGL ES is also proving to be a hit with mobile game developers. It's important that we establish this first, before anyone thinks – even for a second – that we're hammering out OpenGL's funeral march on the office organ.

However, there's also no escaping the fact that this alternative 3D API seems to have fallen out of favour with PC game developers. With the notable exception of games based on id's Tech Engines, World of Warcraft and occasional indie games such as Minecraft, most PC games are now based on Microsoft's Direct3D API.

New GPU architectures are marketed on the basis of which version of DirectX they support in hardware, while support for the latest DirectX version is also a selling point of new games for enthusiasts.

When it comes to PC gaming, Direct3D is sitting comfortably in a stretch limo, taunting OpenGL as it attempts to keep up on its BMX. This is a remarkable achievement for an API that only 12 years ago was seen as a poor man's renderer compared with superior alternatives such as OpenGL and 3dfx's GLide. Why are PC game developers now turning their backs on OpenGL?


John Carmack, co-founder of id software

WHEN OPENGL WAS KING

To understandthe reasons for this mass switchover, we need to look at the early history of 3D APIs. 'We have traditionally had several reasons for using OpenGL over Direct3D,' says CEO and co-founder of id Software, John Carmack. Id has stuck with OpenGL for decades, despite Direct3D's increasing popularity. 'In the early days, Direct3D was just awful,' says Carmack, 'and OpenGL provided less of an API-overhead.'

Back then, there was a palpable sense of competition between 3D graphics APIs. Look at the graphics options in Valve's original Half-Life game – not only are you able to choose the resolution and the usual graphics settings, but you also have a choice of rendering modes. This includes Direct3D and OpenGL (the latter performed much better at the time), as well as support for the 3dfx mini-GL system. Perhaps more importantly, though, it also includes the option for software rendering.

128

At this time, 3D accelerators were seen as luxury add-ons for gamers, rather than a standard feature of all graphics chips, so game developers had to include support for software (CPU) rendering as well as hardware 3D rendering. This made sense for all 3D graphics APIs in the late 1990s, but support for software rendering has since become one of the major differences between OpenGL and Direct3D. Basically, OpenGL supports it, but Direct3D hasn't supported software rendering for over a decade.

'One of the better features of DirectX is that it doesn't allow software fallbacks,' explains AMD's worldwide developer relations manager for GPUs, Richard Huddy. 'In the workstation area, where you need to know that a pixel will be rendered according to the spec, it's okay to insist on software fallback, but that would be irresponsible for games. I remember those dialogues back in the days of DirectX 3 and 5, when people asked, "Should we have software fallback if the hardware can't do such and such?" and the flat answer is no – the correct answer for DirectX was definitely no.'

This trend with regards to backward compatibility continues today. It's important for OpenGL to retain backwards compatibility so that 3D professionals know their code will work. Although the Khronos Group boasted that it had stripped out a great deal of the legacy code in OpenGL 3, some games developers we spoke to said that this stripping process hadn't gone far enough.

'DirectX doesn't care about backwards compatibility between major releases,' says Michael Glueck, R&D technical director at Crytek. 'For example, Direct3D 9 and 10 are very different. Although this can be annoying for developers at first, it makes the API cleaner and consistent, and allows you to fix former design mistakes. OpenGL never had such a hard cut, as backwards compatibility is important for the non-gaming 3D industry. There are definitely improvements in OpenGL 3, but even though some ancient features were dropped from the core profile, the API style is still the same.'

In the late 1990s, many 3D games ran on 3dfx's GLide API or OpenGL, rather than DirectX. After all, id Software was the king of 3D engines then, and the Quake engines used OpenGL as standard. As Carmack pointed out, OpenGL was ahead of Direct3D for a long time, particularly in terms of performance.

As such, it made sense for cutting-edge game developers to use OpenGL, rather than DirectX, at this time. However, if you look at the OpenGL spec now, you can see that it's playing a gradual game of catch-up with Direct3D in terms of new hardware 3D gaming features.

'The actual innovation in graphics has definitely been driven by Microsoft in the past ten years or so,' says Huddy. 'OpenGL has largely been tracking that, rather than coming up with new methods. The geometry shader, for example, which came in with Vista and DirectX10, is wholly Microsoft's invention in the first place, and exposing it in OpenGL makes good sense.'

Huddy also adds the caveat that the development of features such as the geometry shader isn't just down to Microsoft, but is also helped by game developers and GPU makers at Microsoft's graphics advisory board (GAB) meetings, which we'll discuss later on.

So while OpenGL may offer what looks like a rough feature parity with DirectX, this usually arrives considerably later. For example, OpenGL 3.2 introduced support for the geometry shader, but this didn't turn up until August 2009 – a year and a half after the release of DirectX 10 with Windows Vista.

DEATH BY EXTENSIONS

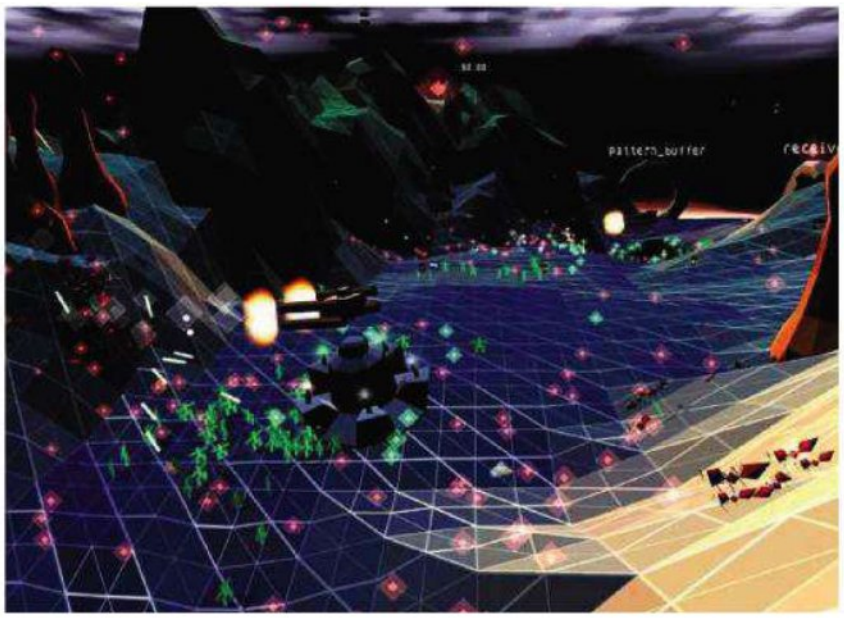
The introduction of these new features isn't as straightforward as you might think, either. While support for new shaders is an integral part of DirectX, new technology such as this can usually only be introduced to OpenGL through its extensions system.

'The extension system was written around 15 years ago – long before anybody knew what a shader was,' explains Introversion's lead designer and developer, Chris Delay. 'It was designed for quirky platform extensions that you might use every now and then, whereas now if you write your graphics engine in OpenGL, your entire graphics engine will be going through that extension system.'


AMD's Richard Huddy

This isn't a big issue for Introversion, as its simple but stylish graphics in games such as Darwinia don't use shaders anyway. In fact, Darwinia was programmed in OpenGL first, and ported across to DirectX later. However, the extensions system can be a pain for cutting-edge game developers, and not just because it's a clunky way of bringing shaders into the API.

'You don't get competition on extensions,' points out Huddy. 'One of the scary things about OpenGL – it's part of its power, but it's also part of its problem – is extensions. It's a natural way to handle the fact that



> While OpenGL looks as if it has a rough feature parity with Direct3D, the reality is more complicated

sometimes you'll come up with a piece of hardware that has an ability that's just a little greater than OpenGL, so you expose it through an extension. But the trouble is that the extensions aren't approved by anyone – they're a private development, so it's difficult for an ISV [independent software vendor] to know which one to choose.

'Which extension should a game developer choose for efficiently handling vertex buffer arrangements in memory – Nvidia's extension, or AMD's extension? That's a tricky mess. The vertex buffer is properly integrated into OpenGL 2, but relatively new innovations such as tessellation have to be exposed through extensions in the first place – and that's difficult for the ISVs, especially if they're working with multiple extensions from different people that might handle other areas in different ways.'

In some ways, extensions are also a benefit of OpenGL, however. They give the API a degree of flexibility, as well as giving game developers a choice about how they manage certain aspects of the 3D pipeline. 'We still hope to get some extensions for improved VBL (vertical blank) sync and possibly some direct texture access extensions for Id Tech 5,' says Carmack, with regard to the development of id's latest 3D engine, which will form the basis of its new game Rage.

However, even this benefit of OpenGL is becoming less pronounced, as so many graphics cards feature similar hardware support. AMD and Nvidia may have different GPU architectures, but they still basically support the same features, as they need to support DirectX. 'The ability of individual vendors to make extensions isn't as valuable as it used to be,' says Carmack, 'due to the generally more complete coverage that they all have.'

Basically, while OpenGL looks as if it has a rough feature parity with Direct3D, the reality is more complicated. The game developers we spoke to also pointed out that there are other areas where OpenGL is lacking in comparison with Direct3D.

'Although OpenGL has caught up in recent years, it's still not fully on the same feature level as the latest version of Direct3D,' says Crytek's Michael Glueck, citing 'multi-threading support and API consistency' as weak areas for OpenGL. Carmack agrees, saying that 'Direct3D handles multi-threading better, and newer versions manage state better'.

ACCESS TO GPGPU COMPUTE

In addition to its superior handling of multi-threading, DirectX has another major feature in its favour – Direct Compute. While GPGPU computing is still in the fledgling stage when it comes to mainstream general-purpose software, it's already a big deal for cutting-edge game developers, as it in effect opens up the power of the GPU for any task, and it's all in the same API too.

'The Direct Compute part of DirectX 11 has been one of the best-used parts of DirectX,' explains Huddy. 'When you're post-processing your frame buffer, which almost everyone does these days, to convert from one kind of format to another, or to add various effects such as depth-of-field or blur, the logical way to do it is not through some convoluted pixel shader; this way, you have quite a difficult job of picking up the adjacent pixels, processing them and turning them into the final colour result that you want. It's much more natural to do that in the Compute Shader – you don't typically want access to the Z-buffer, but even that can be arranged if you write your compute shader the right way.'

However, GPGPU post-processing is a little more complicated in OpenGL, as again it isn't built into the API as standard. 'In the OpenGL world, my understanding is that you'd lean on OpenCL for that compute approach to the GPU,' says Huddy, 'which is actually a little unfriendly.'

When you add it all up, you can see why OpenGL looks less appealing to top-end PC game developers. In fact, even Carmack, who's stuck faithfully by OpenGL for years, told us, 'I actually think that D3D is a rather better API today. Microsoft had the courage to continue making significant

130

incompatible changes to improve the API, while OpenGL has been held back by compatibility concerns.'

Carmack is sticking with OpenGL, despite the apparent superiority of DirectX for games, but other developers have abandoned the open-source API. One example is Crytek. The company's first big game, Far Cry, ran on OpenGL, but Crysis only ran on Direct3D. 'OpenGL lost its feature parity with Direct3D several years ago,' says Crytek's Michael Glueck, 'and only started catching up again recently. Considering that, there was no reason for Crysis to support two different graphics APIs, as it would just have complicated development.'

THE DIRECTX FACTOR

Technically, Direct3D is now a superior API to OpenGL for PC game development, and it's also the trendsetter for new graphics features, but these aren't the only reasons for its success. A major reason for DirectX's popularity is simply the way it's marketed, not just by Microsoft, but also by hardware manufacturers and game developers.

Huddy likens the launch of a new version of Direct X to the launch of a new console; customers, software developers and hardware manufacturers are excited by the potential of the new technology. There's a set timetable for the launch of a new version of DirectX, which is sometimes also accompanied by the launch of a new operating system.

'As Microsoft has become more predictable about hitting its timetables with a new OS or DirectX update, so the partners involved on the hardware side have found it easier to target their stuff,' says Huddy. 'We now aim to come along two or three months before the operating system will be ready to ship with our candidate piece of hardware, and that actually gives us a good chance to work with the ISVs and make sure that their launch games are ready when the OS arrives.'

This brings us back to Microsoft's GAB meetings that we mentioned earlier. These occur annually, or sometimes on a six-monthly schedule, and bring together software developers, hardware manufacturers and Microsoft staff to discuss the specification of the next version of DirectX. According to Huddy, the original idea was to develop a new version of DirectX every year, but this has since been extended to around three years.

When everyone can safely predict that there will be a new version of DirectX every three years, companies can organise the development of their products and marketing to coincide with it. 'The predictability is very helpful for hardware vendors,' explains Huddy. 'If we're trying to design a new piece of hardware, then knowing when the next version of DirectX will arrive, and having the game developers coordinated on that kind of timing, particularly if they don't just hit regularity but hit the inflection points, like arriving in time for back-to-school sales that we see in the late summer, that's a really big driver of sales.'

This doesn't just affect GPU manufacturers and game developers though. When the launch of a new version of DirectX coincides with a new operating system, you also have motherboard partners and PC manufacturers jumping on board to make sure their latest kit can be advertised as supporting all the latest features in the new OS.

The notable cock-up with this strategy was, of course, the Windows Vista launch. Not only did Vista's new driver model create a lot of problems with multi-graphics cards setups initially, but the new version of DirectX (10) also only worked with the new OS. This created a lot of issues for game developers, who had to create games using two renderers if they wanted to use the latest DirectX 10 features, and still provide compatibility with the far more widespread DirectX 9-only Windows XP operating system.

'Targeting Vista for DirectX 10 was a major issue,' says Huddy, 'since Vista's take-up wasn't terribly good and, most importantly, Microsoft targeted a new operating system with a new version of DirectX. That was problematic, as you just couldn't tell how many DirectX 10 machines would be out there.'

> Technically, Direct3D is now a superior API to OpenGL for PC game development, and it's also the trendsetter

The teams behind DirectX have clearly learned from this mistake, though. Running on both Windows 7 and Vista at its launch, DirectX 11 was safely accompanied by plenty of new games. In fact, both Stalker: Call of Pripyat and Battleforge had DirectX 11 support before Windows 7 was even launched.

In simple terms, the launch of a new version of DirectX is very carefully

coordinated, generating a lot of excitement and money for the industry, and effectively creating an opportunity to sell a lot of gear and software for those involved. Compare this with the launch of a new version of OpenGL, which recently has simply involved a few announcements from The Khronos Group (the group that controls the specification of the API), and adding support for features already found in Direct3D. You're not going to sell a new gaming PC based on its support for OpenGL 4, but you'll certainly incite interest with support for DirectX 11, particularly at the time of launch.

Once you have so many games and hardware manufacturers on board, the rest follows. 'Direct3D is more proven in game development,' says Crytek's Michael Glueck. 'It offers more useful development tools and the graphics driver quality is better in general, due to the huge number of shipped games. OpenGL is catching up in all these areas but at a relatively slow pace.'

The quality of drivers is a key issue, and OpenGL has had a bumpy time with this in recent times. Even now, Huddy says he isn't 'sure whether our DirectX 11 features are fully matched in the OpenGL drivers at the moment - I'm not sure where our OpenGL drivers stand right now on tessellation behaviour, for example'.

However, OpenGL driver support is better now than it has been in the past. 'Around the time when DirectX reached version 5 or 6, a lot of developers switched to it en masse, since at the time OpenGL had a bit of a driver support problem,' says Introversion's Chris Delay. 'Some of the new graphics cards that were coming out supported OpenGL really well, and some of them didn't; also, especially with libraries, you required specialist drivers to get OpenGL to work.'

SO WHY USE OPENGL?

Despite all these apparent advantages, though, some PC game developers still stick faithfully by OpenGL. Why?

There are several reasons, depending on the developer, but one of the key features of OpenGL is cross-platform compatibility. After all, DirectX only gives you immediate compatibility with Windows and the Xbox 360; if you want your game to also run on Mac OS or Linux then OpenGL is your best option. OpenGL also works on the PlayStation 3, although game developers such as Crytek say they prefer to use Sony's low-level 3D API, and build a DirectX-style software layer on top of this to make cross-platform programming easier. Basically, you can write a game in Direct3D and still port it across to the PlayStation 3 easily enough.

Either way, OpenGL's cross-platform nature is a clear benefit to game developers looking to run their games on every platform possible, especially when it comes to mobile games. 'All our games are available for Mac and Linux as well as Windows,' says Introversion's Chris Delay. 'We've also been experimenting with the iPad and iPhone, again using OpenGL, so all those new mobile platforms - and in fact, all consoles except for the Xbox - have wonderful OpenGL support. So for that reason alone, I think OpenGL has a strong future.'

That's fine for Introversion, as its games don't really challenge the latest PC graphics hardware, and it's beneficial for the developer to get its games onto as many platforms as possible. However, the cross-platform nature of OpenGL isn't such an obvious benefit for top-end PC game developers.

'OpenGL offers portability to PC, Mac and Linux platforms,' notes Carmack, 'but Direct3D 9 offers portability between the PC and Xbox 360, which is clearly a more powerful argument.' Carmack is also notable for having created mobile versions of some of id's franchises, such as Rage for the iPhone, but this doesn't benefit from OpenGL's cross-compatibility. 'Mobile uses OpenGL ES,' says Carmack, 'but there really isn't much of any code sharing between our mobile and console efforts.'

While OpenGL can be run on multiple platforms, however, it doesn't always offer the same features on each platform when it comes to binary shader support. Conversely, Glueck says that while DirectX only runs on Microsoft platforms, it's at least consistent on different versions of Windows, which enables it to run efficiently on a large number of Windows PCs.

'The Direct3D shader binaries work on all Windows platforms,' explains Glueck, 'so we have a server that generates every possible shader combination based on our features and it takes some time. For OpenGL, with no binary shader support across all platforms, and especially no guaranteed compatibility on future devices even from the same vendor, the player would have to wait

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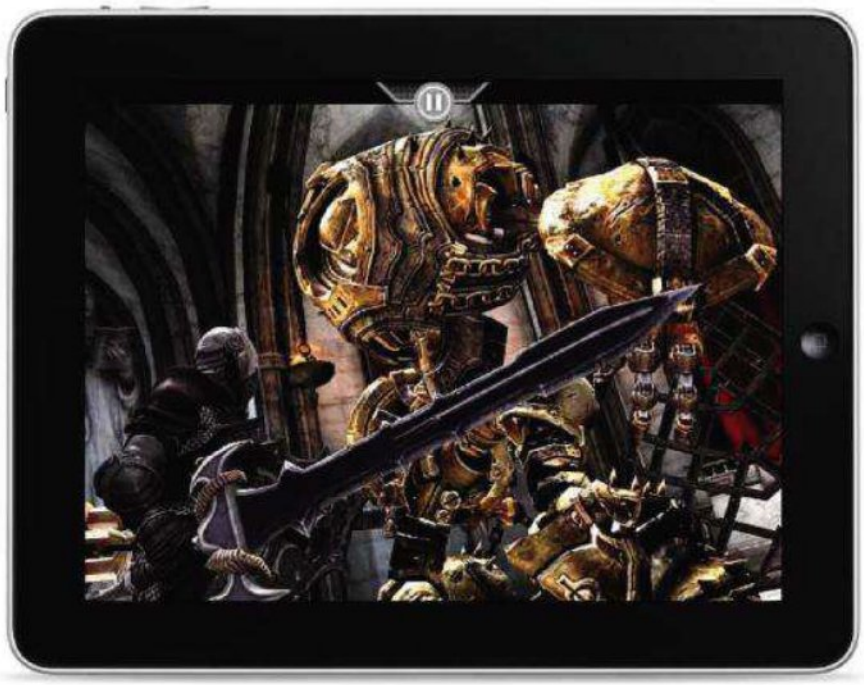


until all those shaders were generated on his local machine. Nobody wants that. Sadly, even the binary shader support in OpenGL 4.1 doesn't seem to be cross-platform.'

So what's keeping Carmack and id in the OpenGL camp? 'It's really just inertia that keeps us on OpenGL at this point,' admits Carmack. 'OpenGL still works fine, and we wouldn't see any huge benefits by making the switch, so I can't work up much enthusiasm for cleaning it out of our codebase. If it were just a matter of the game code, we could quickly produce a DirectX PC executable, but all our tool code has to share resources with the game renderer, and I wouldn't care to go over all of that for a dubious win.'

Once a developer has built its entire codebase and development expertise around OpenGL, there seems little point in shifting over to another API for the sake of a few extra features, particularly if you're a big developer such as id, which will sell plenty of games whether they're based on OpenGL or Direct3D.

Introversion's Chris Delay also put his inclination towards OpenGL down to personal preference. 'It's like Canon vs Nikon with photographers,' says Delay. 'Once you've chosen one, you stay with it forever, and I think that might be true with graphics APIs.'

In Delay's case, OpenGL was the API with which he started 3D programming in the late 1990s. 'It was really big then,' says Delay, 'and DirectX kind of sucked – it was pretty dreadful – so OpenGL was a clear choice. I just stuck with it ever since – I know OpenGL really well now, and I don't know DirectX nearly as well. Whenever I try to use DirectX, I always think this is all new, and I'd rather go back to OpenGL.'

As Introversion isn't currently using any complex shader extensions in its games, its main focus is the core API, which Delay describes as 'an absolute joy to work with'. According to Delay, part of the appeal of the basic OpenGL core is its ability to run simple prototypes of code with minimal effort.

'In OpenGL, you can use graphics the proper way, with a decent frame rate and hardware compliance, just as you can with DirectX, and it's very fast,' says Delay. 'But the crucial difference is that OpenGL will also let you program in a much less efficient method, which is much quicker to get running – a sort of prototyping method, if you like.

'It's like an immediate mode, so you can basically just render something very quickly using OpenGL with very simple code. It's extremely inefficient, but it's perfect for prototyping when you just want it to be up and running quickly, and you don't really care about running it at a poor frame rate. However, DirectX doesn't really let you do that at all – DirectX insists that you always execute it in the proper way.'

> 'It's really just inertia that keeps us on OpenGL at this point,' admits Carmack. 'OpenGL still works fine'

COMPETITION IS GOOD

Despite its current unpopularity with many PC game developers, there are plenty of reasons why OpenGL still has a strong future ahead of it. Its strong backwards compatibility makes it popular with 3D professionals, and OpenGL ES is also very popular with mobile 3D game developers. After all, nobody wants to be solely tied to Windows in the mobile software market at the moment.

However, now that DirectX is so far ahead of OpenGL in terms of adding new features, as well as strong driver support, there's little reason for a PC game developer to use it, other than familiarity or the need for cross-platform support. This is particularly true for games that don't make high demands of the hardware – OpenGL could give you an easy way to make your iPad game work on a desktop PC, particularly as it won't be using complicated shader binaries.

Also, while OpenGL is currently tracking the development of DirectX, rather than overtaking it, the fact that there's still a strong second API is also good for competition in the industry. OpenGL may not command the massive share of the games market that it had a decade ago, but the fact that OpenGL is still nipping at Direct3D's heels continues to put pressure on Microsoft to innovate further.

'It's not a battle of ideologies as it was ten or 15 years ago,' says Huddy, 'but in any market, competition is a good thing. If we dropped our support for OpenGL, and said that we're never going to release another OpenGL driver, there's a sense in which Microsoft's decisions start to dictate to us. By keeping the competition there, we keep both of those groups honest, and that's only a good thing.' CPC

Reader's drives PC-BETO

meet thy maker

Name Hans Peder Sahl

Age 22

Occupation Studying design and development at the University of Southern Denmark

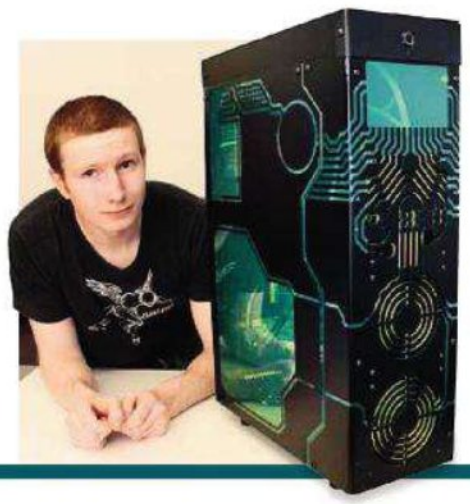
Location Odense, Denmark

Main uses for PC Web browsing, gaming, movies, music

Likes Music, diving, photography, computers, food

Dislikes Noisy PCs, messy cables, cold weather, the price of hardware

We first came across PC-Beto when it won Mod of the Month early last year. With its fantastic use of lights and green acrylic, Hans Peder Sahl's final creation looks electrifying



The first PC I owned was a little beige-coloured box, and my first foray into modding involved cutting a skull into one of its side panels. I also added enough green lights to make the local disco envious. My modding tastes have matured considerably since then, but I was still pleased with the result – it looked totally different to other machines. My latest project, PC-Beto, echoes some of my early forays in modding, though, especially with the excessive use of green lighting.

I obtained the case from a friend who'd had it for nearly a decade. When I was 12 years old, he became the happy owner of a new PC. Nine years later, he decided to build a new one and while I was in the process of helping him build it, he asked what I wanted in return. I asked if I could keep the case from his old PC. He looked at me as though I'd come out in spots, and understandably so. All that was left of the original tall, beige server tower was the inner steel frame. It had been through a lot, and even had a small fire inside the computer at one point. It looked as if it was ready for the scrap yard, not the basis for a shiny new modding project. He eventually agreed to give it to me though.

I felt quite sentimental about the case, which had once housed cutting-edge hardware. This spurred me on to try to make the case the centre of attention. I spent the next month coming up with ideas and making drawings, and decided on three aims that I wanted to achieve with the project: better cable management than anything I'd done before; it had to be water-cooled; and the exterior of the case should be as striking and unique as possible.

The inspiration for the exterior came from a wallpaper that I downloaded on my mobile phone. It illustrated a circuitboard, and as soon as I saw it I knew it was the perfect design for the case. The theme was now set, and ideas for other features for the project started flowing. I used a program called Cinema 4D to create all the sketches and CAD files. I spent nearly a month working on the planning stage, putting in many hours every day.

The designs were ambitious and I needed help making the various parts. I asked the Danish water-cooling store, Coolbits.dk, if it

FULL SYSTEM SPECS

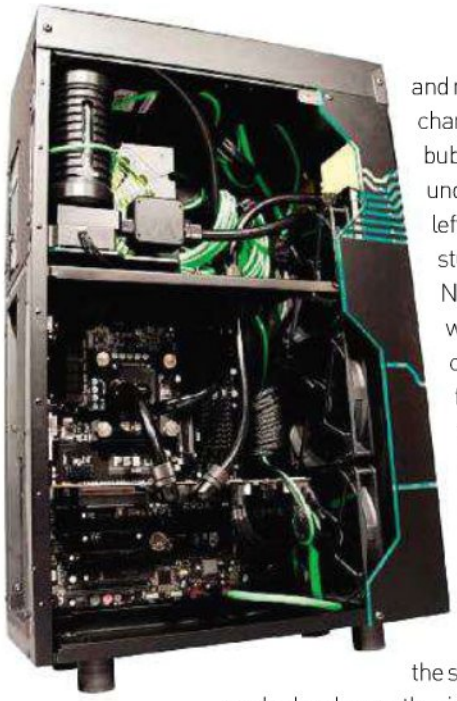
CPU Intel Core i5-750
GPU AMD Radeon HD 4870 X2
Hard disks Corsair F60 SSD
Memory 8GB Mushkin Ridgeback DDR3
Motherboard EVGA P55
Sound card On-board
PSU XFX 850W Black Edition
Cooling Triple 140mm-fan radiator, Noiseblocker PK3 140mm fans, Aquacomputer Kryos CPU waterblock, Bitspower fittings, Bitspower GPU waterblock, Aquaero 4.0 display controller, LUND reservoir, Laing DDC 18W pump

would be interested in sponsoring water-cooling hardware. It had already sponsored two previous projects and, thankfully, agreed. A week later, I had a huge triple 140mm-fan radiator, a pump and several other parts. I also needed lights for the project. From previous experience, I knew that to obtain the best lighting effects, you need to use LED strips rather than cathodes. A store called Matronics.dk offered to sponsor a remote controlled light, and RGB LED strips, so that the case could be illuminated in any colour I chose. Luckily, a friend happened to own a company that used many expensive tools I needed. I spent many hours driving to and from his shop, picking up parts that had been cut out using the CAD files I'd made. The heavy snowfall in Denmark made that task quite difficult. Thankfully, I had access to a four-wheel-drive Land Rover Defender, which made the journeys possible.

The first setback came when I attempted to route the cables – my planning turned out to be a little inaccurate. I thought I'd be able to route all the cables round the rear of the motherboard tray. An error in the measurements I'd been using meant that there was only a 3mm gap through which to route all the cables. It was a nightmare to make them all fit, but I managed it in the end, even if it wasn't as neat as I'd planned. I'm very proud of the power cabling in this project. Instead of the wires passing directly from the power supply to the various components, I made a tray that acts as a router. The cables from the PSU are hidden and connect to the tray.

Extension cables, which are visible, then run from the tray to the components. Using this method meant that if I needed to change the PSU, I wouldn't have to sleeve and tidy all the cables again.

Sleeving the cables proved to be quite a challenge. I recommend that if you're building a new system and intend to sleeve the power cables, to buy a fully modular power supply. This way, you can remove each cable and work on it separately, instead of having to remove the entire power supply each time you work on



it. It's also easier to have a small cable, rather than a mass of them.

I worked in a factory last year, soldering circuitboards together before programming and testing them. I convinced my boss to let me stay on for a few hours after work to cut the power supply cables to length so that they fitted perfectly. With the soldering equipment available where I worked, it was safer and more convenient than doing it with my old soldering iron in my small dorm room.

Another major part of the project was the foil that covers the exterior acrylic shell. I planned to make the shell out of two layers of acrylic – a layer of 3mm transparent green acrylic and a layer of 1mm black acrylic. The intention was for the internal lighting to shine through the green acrylic. Intricate details cut into the black acrylic would then only let light through certain areas. This would create the circuitboard design, which I mentioned earlier. I realised that covering the green acrylic in a layer of foil, with the patterns already cut into it, would achieve a better result. I cut the foil out using a Roland foil cutter. It has two layers, the top one needing to be separated and transferred to the shell. Soaking the foil in soapy water separates the two layers. Applying water to the shell creates a slippery surface, which aids manoeuvring the foil into position, and reduces the chance of air bubbles forming underneath. I then left it to dry so that it stuck to the shell. Next I fitted the water-cooling components and filled the loop with coolant without any issues. In hindsight, I should have left this task until the end – the system now worked and my enthusiasm was waning. Thankfully, I'd promised myself that I'd finish it before January 2011 so that I could start a new project. I applied the finishing touches, and fitted the shell to the case for the first time. Once I'd finished PC-Beto, I struggled to understand what exactly I'd made, given that I'd started with so little. Having spent so much time designing and making the case, I suddenly had nothing to do. I was pleased with what I'd achieved, though, and have already started on my next project. However, I plan to make a video of PC-Beto, so make sure you check my project log on **bit-tech** during the coming weeks to see it.

I must thank my sponsors, including Aquacomputer, Bitspower, Coolbits, Matonics, Mushkin and Noiseblocker. Without them, this project wouldn't have been possible. I'd also have come unstuck without the help from **bit-tech**'s modding community. Thank you to everyone who commented in my project log, whether it was with praise or feedback – it was all appreciated. CPC

BE A WINNER!

To enter for Reader's Drives, your mod needs to be fully working and, ideally, based in the UK. Simply log on to **bit-tech** at **www.bit-tech.net** and head over to the forums. Post a write-up of your mod, along with some pics, in the Project Logs forum. Make sure you read the relevant rules and advice sticky threads before you post. The best entrant each month will be featured here, and for UK-based projects we'll even send our roving photographer around to photograph you and your PC. Fame isn't the only prize; the write-up and pictures will also appear on **bit-tech**, and you'll be able to get your hands on a fabulous selection of prizes – see right.

Win all these prizes!

We've teamed up with some of the world's leading PC component manufacturers to offer this great range of prizes to each lucky Readers' Drives winner. The winner will walk away with all three prizes listed below, so get your entries in!

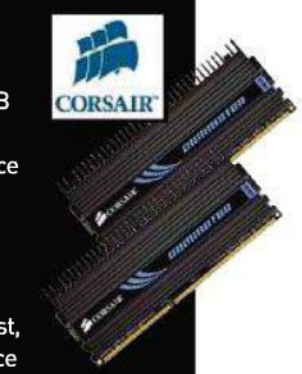
Fractal Design Newton R2 650W Modular Power Supply and Define R3 Case

Total value £190 inc VAT
Manufacturer
www.fractal-design.com
www.quietpc.com/manufacturers/fractaldesign
The Fractal Design Define R3 case reaches new heights in Swedish design and function. Its perfect partner is the Newton R2 650W power supply, which offers unrivalled reliability, 80-PLUS certification, effective cable management and a five-year warranty.

Biostar TA870+

Value £80 inc VAT
Manufacturer Biostar, www.biostar.com.tw
The Biostar TA870+ is packed with new technologies that support the AMD multi-core (4x and 2x), including the new Phenom II X6 core processor. With AMD 140W CPU support and a 100 per cent X.D.C Japanese capacitor, this board offers high-quality components and excellent performance. On-board 8-channel audio with Blu-ray support, a Bio-Remote utility for HTPC and AMD OverDriveTM with ACC all make the Biostar TA870+ a great choice for gamers and overclockers.

Corsair Dominator CMP4GX3M2A1600C8



Value £120 inc VAT
Manufacturer Corsair, www.corsairmemory.com
This 4GB matched set of two 2GB DDR3 memory modules comes from Corsair's high-performance Dominator family of memory, which includes Intel's Extreme Memory Profiles (XMP 1.2). Verified to run at 1,600MHz with latencies of 8-8-8-24, it's a robust, profile-based, high-performance DDR3 memory kit.

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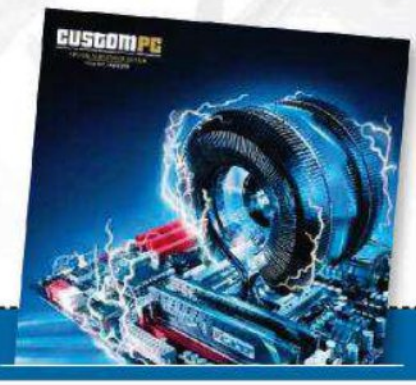

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OFFER CODE: P1106

how to... make a fan blowhole

Cutting a hole in your case is easy, but making it look good requires a little more skill and planning. Antony Leather shows you how it's done

A side panel fan is a good addition to your PC for several reasons. It can improve your case's cooling, but it can also help an otherwise dull-looking case appear more exciting. In this guide, we show you step by step how to cut a blowhole and install a fan, complete with dust filter, in a side panel.

tools you'll need

- **Cutting tool (jigsaw, holesaw or Dremel Trio) with appropriate blade or attachment for cutting steel or aluminium**
  From www.diy.com
- **Drill and drill bit**
  From www.diy.com
- **Fan grille**
  From www.aqua-tuning.co.uk
- **Fan filter**
  From www.watercoolinguk.co.uk
- **Blowhole trim**
  From www.chilledpc.co.uk
- **Metal file**
  From www.chilledpc.co.uk
- **Masking tape**
  From any DIY store

CHECK THERE'S CLEARANCE

It's important to ascertain whether your case has room for a fan in the side panel. Check the clearance behind the spot in the panel where you want to mount the fan – your CPU cooler or graphics card might foul the fan when you try to attach your side panel. Stick a fan to the inside of your side panel using a small amount of double-sided tape. Then try to close the panel – if there's enough room, you should be able to secure the panel as usual.

MARK UP

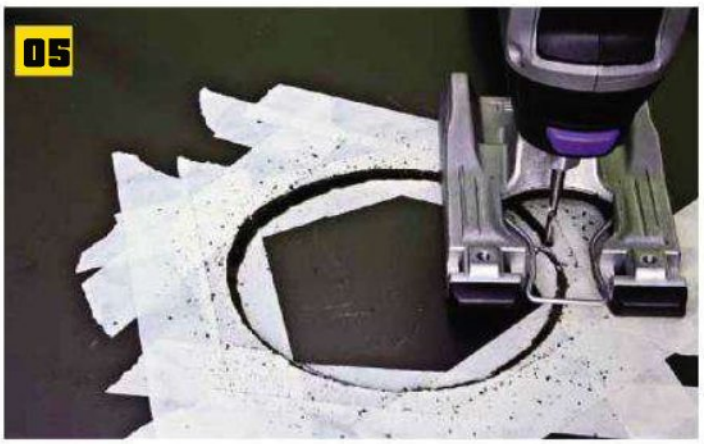
The easiest way to mark up the side panel is to use a standard circular fan grille. Place the grille over the fan to see which ring best matches the diameter of the fan's exhaust hole. With a pencil, use the grille to draw a guideline to mark the fan blowhole.

PROTECT YOUR PAINTWORK

Take precautions to prevent your side panel getting scratched. Cover the outer side with newspaper to protect it while you're cutting. Use a ruler to mark the position where your fan is to be mounted, then mask off the area on the inside of the panel with generous helpings of masking tape. This prevents any slips from scratching the paint.

DRILL PILOT HOLES

We used a Dremel Trio to cut our blowhole, but a jigsaw with a metal-cutting blade will work too. Alternatively, consider using a large holesaw attachment for your power drill – they typically cost less than £10. However, this isn't the best tool for the job, particularly if your case is made of steel. If you need to drill a pilot hole for your blade, make it a little way in from the guide line you drew earlier – this will give you some margin for error. If possible, practice by cutting a piece of scrap metal first.



START CUTTING

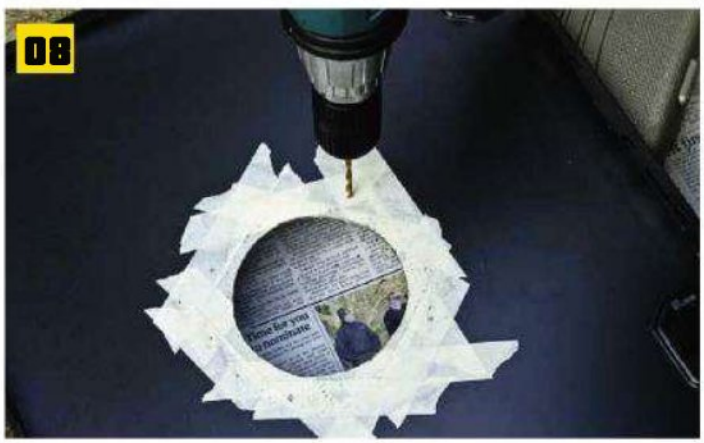
Cut on a solid surface and use safety goggles. Don't try to perform the entire cut in one attempt. Stop at regular intervals to check your progress. As you come to the end of the guideline, take the process slowly – all tools have a tendency to jerk at this stage. We used tiny bursts of power on the Dremel Trio, gradually eating into the last few millimetres of metal. There may be large metal protrusions between the start and end cutting points. If you can, use the tool to gently cut these away, as this can save you a lot of time filing.

FILE THE EDGES

There will be sharp metal shards around the edge of the blowhole. Be careful not to cut yourself on these. To remove them, use a metal file. Work your way around the hole using long, firm strokes until the hole is smooth with no protruding metal shards.

MARK THE FAN SCREW HOLES

Place the fan grille over the hole you've made and line up the rings so that they're equidistant from the hole all the way around. Use a pencil to mark the four mounting holes on the masking tape.

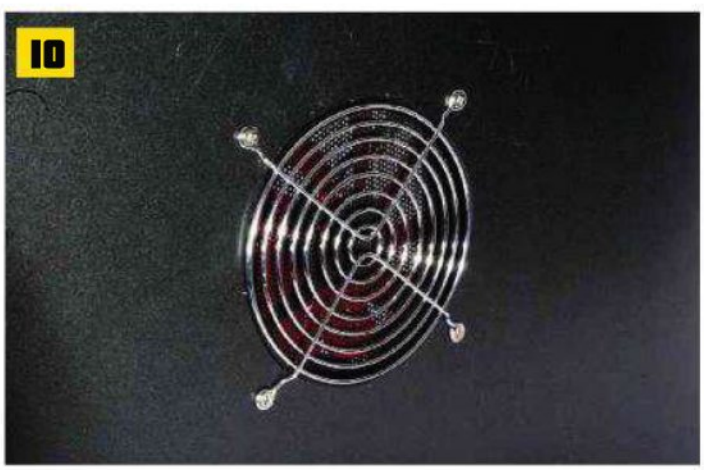


CUT THE FAN SCREW HOLES

Select a drill bit that matches the size of the thread on the screws you're using. It's worth making absolutely sure that the markings for the screw holes are aligned properly before you drill the holes. Then fit the drill bit to the drill and make the holes for the fan screws.

FIT THE FAN BLOWHOLE TRIM

Push the fan blowhole trim onto the edge of the blowhole. Cut it at a point where the ends overlap by 1-2mm. Then prise the end in behind the rest of the trim. This will ensure that there's no gap between the two ends, which would look unsightly.



INSTALL FAN, FILTER AND GRILLE

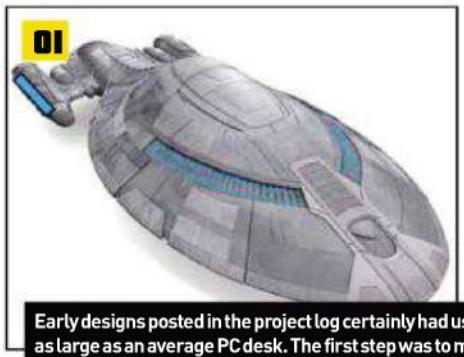
All that's left to do is to fit the grille, filter and fan. Your panel will look best with the filter mounted on the inside of the side panel. Place the filter on top of the fan, and lay the side panel on top. Place the grille on the side panel, lining up the holes, and secure it to the fan beneath using the fan's screws.

mod of the month

We take a look at the best mod on the bit-tech forums

USS EURISKO – Intrepid Mark II Class

A fantastic mix of projects graced **bit-tech**'s latest Mod of the Month competition. These included water-cooled tower PCs and a fully submerged oil-cooled PC. The winner was Sander van der Velden from the Netherlands, who is making a PC in the shape of a starship from Star Trek.



Early designs posted in the project log certainly had us salivating. The size of the model was exciting too – it's as large as an average PC desk. The first step was to make a frame out of MDF but Sander later abandoned this idea and opted to use foam instead.

The starship was fashioned out of the shaping foam using a combination of sanding and cutting to reduce the foam to the required shape.

The foam was then covered in layers of filler and epoxy creating a smooth, hard shell. The hardware in the project will be water-cooled and Sander has already fitted two large reservoirs, which form the nacelles of the starship. Both these and the main deflector dish on the front of the starship emit a blue glow, which looks fantastic.

Sander used a similar foam method to create the other parts of the starship. We can also see the cooling system's two radiators being test-fitted on a newly made mid-section. In one of his most recent updates, Sander has installed parts of the project's cooling system, including six glowing fans in the saucer section in front of the main deflector. The project is looking fantastic so far and we can't wait to see the final result.

TO SEE MORE of Sander's project and the competition, head over to **http://tinyurl.com/motmfeb**. MOTM winners can choose one of three incredible prizes from **www.quietpc.com**: A Zalman ZM-MFC1 Plus Black Multi Fan Controller, a Scythe Mugen 2 Quiet CPU Cooler or a Scythe Kama Connect 2 USB2.0 IDE and SATA External Adapter.

Folding@home

Join our folding@home team and help to save lives

June 2011

WHAT IS FOLDING?

Folding@home uses the spare processing cycles from your PC's CPU and graphics cards for medical research. You can download the client from **http://folding.stanford.edu/download.html** and our team's ID is 35947. Once you pass the 20,000-point milestone, you'll get your name in the mag. You can also discuss folding with us and other readers on the **www.bit-tech.net** forums.

TOP TEN OVERALL

Rank	User name	Points	Work units
1	phoenicis	156,938,570	91,321
2	coolamasta	103,944,152	124,078
3	DocJonz	102,208,291	110,050
4	Dave_Goodchild	80,450,522	70,912
5	Lizard	75,661,671	56,140
6	StreetSam	56,841,921	59,025
7	saspro	50,683,958	44,169
8	greenfrog.biz	46,282,361	153,545
9	Justin_Wells	40,373,133	72,158
10	PS3/LanDi	36,951,306	76,754

TOP TEN PRODUCERS

Rank	Username	Daily points average	Overall score
1	phoenicis	446,022	156,808,715
2	Dave_Goodchild	371,185	80,431,835
3	StreetSam	312,759	56,818,701
4	BennieboyUK	290,300	36,285,839
5	DocJonz	258,515	102,190,854
6	coolamasta	223,398	103,923,383
7	Christopher_N._Lewis	143,320	35,202,753
8	jondi_hanluc	132,301	13,858,674
9	Wallace	116,570	10,374,309
10	Standin_wave	113,365	15,883,730

Folder of the month

We catch up with the folder of the month: StreetSam

CPC: Who are you and what do you do?
StreetSam: My name is Stephen Bridges (StreetSam comes from the RPG Shadowrun). I'm an outside broadcast engineer for BBC Radio.

CPC: What made you decide to start folding?
StreetSam: I was a member of a forum called Overclock.co.uk. Some of the members started a folding team and I joined, as it seemed like fun. When the forum lost members and I was one of only two left folding, I transferred my allegiance to **Custom PC**, as I'd always read the magazine.

CPC: What excites you most about folding?
StreetSam: I love to fiddle with computers and it just adds another dimension to it. I also enjoy the camaraderie and the competition.

CPC: How many PCs do you have folding?
StreetSam: Anywhere between eight and 11 machines, but I still have my old farm of ten Athlon 64 X2 3800+ PCs, which I no longer run after the introduction of the GPU client. Plus one of them caught fire after the HSF failed.

CPC: What's the average spec of your PCs?
StreetSam: I have five very similar folding machines, with Core 2 Duo E6300s and three GeForce 9600 GSOs, although I'm currently upgrading the 9600 GSOs to GTS 450s. I may try a few GTX 460s, as the new 6800/6811 WUs don't run well on GTS 450s. I also have a Q6600 with two GTS 450s, which is my main machine, a Q9550 with a GTX 280, which is my machine for work, and a phase-change cooled Q6600 with two 9600 GSOs. The rest of my farm comprises a Q6600 with an 8800 GTX, a Core i7 with a GTX 295, which is my gaming machine, and a Core i7 with a GTX 280 that I built because I had most of the parts lying around. All of these are water-cooled to some degree.

CPC: You've been producing quite a few points recently – do you intend to maintain this sort of production level?
StreetSam: I don't see why not, but anything can happen. My main aim now is to stay in the top five producers and get into the top five in the team. I'd quite like to get ahead of Lizard, but that might take a while.

CPC: Any tips for fellow team members?
StreetSam: When I first started, I had ten XP 3200 (Bartons) running the Linux client; I upgraded these to X2 3800+s when the Linux SMP client came out. Then GPU folding started and they became obsolete in terms of ppd/watts. I found that the 9600 GSO was the sweet spot for ppd per pound, so I built my new farm around them. Then Core i7s with Linux and bigadv arrived. The new Fermi cards (460/450/430) now seem to be the most economical option.

Team rank 6 **World rank** 142
Score 58,742,173 **Work units** 59,988
Daily points average 130,961

TOP FOLDERS
This month's shout-outs go to standin-wave and abysm who are storming the producers chart. If this is you, email james@custompc.co.uk, as we'd love to profile you.

142

MILESTONES THIS MONTH

Username	Points Milestone
coolamasta	100000000
DocJonz	100000000
Dave_Goodchild	80000000
saspro	50000000
BennieboyUK	30000000
Lordsoth	10000000
Wallace	10000000
billytf	9000000
apeman556	8000000
BJS	8000000
IwantAbetterPC	8000000
TomBaxter	7000000
narwen	6000000
Promethus26	6000000
Unicorn	6000000
Paddi70	5000000
Ph4lanx	5000000
Scruffy_Dog	5000000
abysm	4000000
prodigalchild	4000000
SpeckleD	4000000
BeauchN	3000000
Dave_Wallsworth	3000000
dazlanc_101	3000000
gcwebbyuk	3000000
Kerno	3000000
Maximiser	3000000
Bongo_Fury	2000000
fatchef	2000000
GeorgeStorm	2000000
holzj17	2000000
NoPrisoners	2000000
Paul_Candi	2000000
Poozle	2000000
aleake	1000000
Goku	1000000
Imladris	1000000
julianvt	1000000
nbbhav	1000000
CheekyWeMonkey	900000
MahaTarD	900000

Username	Points Milestone
Tommye123	900000
DARKS7AR42	800000
Incanus	800000
mmorr	800000
Saliaunce	800000
AndrewBenfield	700000
bertbrownbear	600000
Lipgi_Tang	600000
Nariman_Amin	600000
Optimusprime1985	600000
Pete	600000
bru7al	500000
Cmaxx	500000
cynicaltaf	500000
Dolphin(CPC)	500000
Orpeus	500000
queluomo1	500000
RedRingRico	500000
Splinkter	500000
boiled_elephant	400000
DigitalSniper	400000
Dr_C	400000
DrDaveSell	400000
godad	400000
meandmymouth	400000
TheAbyssDragon	400000
warejon9	400000
zukomonitor	400000
CJTheBrave	300000
Fata1_666	300000
Gothic-Yoshi	300000
lankuzo	300000
Lord-of-the-Nazgul	300000
MadTyke	300000
Oatyflapjack	300000
Robbie_Coomber	300000
Shmegory	300000
wragged	300000
Written_In_C	300000
CambridgeDavo	200000
crazy95	200000

Username	Points Milestone
ferrish07	200000
J3llyf1sh-UK	200000
littlesmoke222	200000
masterjonnyx	200000
n3x_uk_pl	200000
rob123456	200000
Acanuck	100000
CopperHead1960	100000
Daniel_Selley	100000
mowgli	100000
pbpcsa	100000
sco0by	100000
skippyadam	100000
theoneandonlymrk	100000
ToRReVeZ	100000
Vo0Ds	100000
Witness	100000
yes	100000
alcocp	90000
Bloodhill4	90000
Damfoose	90000
G0UDG	90000
manawell	90000
Melvyn_Davies	90000
Mr_Jonny_T	90000
Cream_Puff	80000
m1rr0rMan	80000
NoizDaemon666	80000
timbobbow	80000
Zoidy	80000
Count_Stex	70000
Killbucket	70000
baggins	60000

Username	Points Milestone
bobnxn	60000
Daytona178	60000
Jezydude	60000
JonathanEdwards	60000
maxrealism	60000
Tea_Man	60000
The_Professor	60000
Themonkey39	60000
Unreal2will	60000
Osiris_Blue	50000
robocow	50000
Skelly1983	50000
Tony_Lokier	50000
a.f.dawson	40000
Flat-Six	40000
Stefan_Allen	40000
Beanman	30000
murraynt	30000
SD-Quickstream	30000
Snowy190uk	30000
TechHead	30000
Tommehnet	30000
Barry_White	20000
ConKbot	20000
CookieJar	20000
Karl_Patschinsky	20000
seaford-college	20000
smark123	20000
ysarn	20000

THE NEXT OVERTAKE

World rank	Team name	Points	Daily points average	Time until overtake
6	TSC! Russia	3,002,404,765	5,366,563	7.1 Years
5	Maximum PC Magazine	3,418,274,965	4,932,711	3 Years
7	Custom PC & bit-tech	2,898,574,389	5,406,910	0

what's that?

Guess which piece of hardware is pictured and you could win kit from Quiet PC. This image is a piece of hardware reviewed in this issue. If you guess what it is, and you're the first picked out of the virtual hat, you can choose one of three prizes from **www.quietpc.com**: Noctua NH-U12P SE2 Dual Fan Quiet CPU Cooler; Scythe Musashi Dual Fan Graphics Card Cooler or a Zalman ZM-MFC3 Multi Fan Controller.

HOW TO ENTER
Email your answer, plus your choice of prize, to **whatsthat@custompc.co.uk** with the subject line 'What's that? 93'. Only one entry per person per month is allowed, and the Editor's decision is final.

LAST MONTH'S WINNER
Well done to Che Izzat for spotting the Antec Rockus 3D speakers on p79. Enjoy your prize.

where's wendel?

Every month, Wendel takes a break from pwning n00bs to hide somewhere in the pages of the magazine. The world's most famous pro gamer is hiding somewhere in this issue, and if you can find him (see sample, right), you could win a Gigabyte Green Max 650W PSU worth around £90. If you think you spot him, send your answer (including the location and page number) to **wendel@custompc.co.uk** with 'Wendel 93' as the subject line.

LAST MONTH'S WINNER
Well done to Richard Willis for spotting Wendel being fired out of a cannon on p18. Enjoy your PSU, Richard!

FOR the win!

WIN! Roccat Extreme Gaming bundles

WORTH £200 EACH

Founded in 2007, Roccat develops high-quality and innovative accessories for ambitious PC gamers. The company designs its outstanding input devices and headsets, which excel through their first-class precision, ease of use and unique design, at Roccat Studios in Hamburg in close collaboration with the gaming community. The Roccat Kone Gaming Mouse was the first product to be launched by the company, and this played a leading role from the outset in the world's premiere league of gaming mice. A host of international awards are testament to the first-class quality and outstanding range of functions that Roccat products provide. The Extreme Gaming bundle features the Kone+ gaming mouse for maximum precision and ultimate tracking, the Valo Gaming keyboard for total customisation and the Vire gaming headset for a perfect fusion of gaming, communications and music.

For more information, visit **www.roccat.org**

Q **Which was the first product to be launched by Roccat?**
a) The Kone **b)** The Cone **c)** The Kone+

To enter, go to
http://competitions.bit-tech.net
Closing date: 5 June, 2011

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Coming next month in CUSTOM PC*

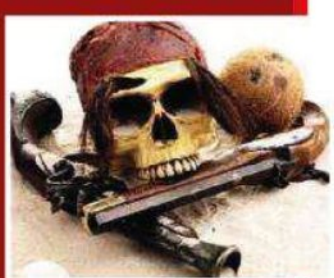
Sandy Bridge motherboards

Now that Sandy Bridge motherboards with the fixed B3-stepping P67 chipset have finally started to appear, we round up all the latest models to see which is worth upgrading to.

Sandy Bridge PCs

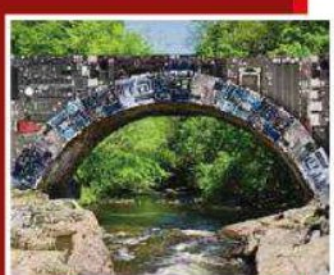
If you aren't convinced that Intel has fixed the P67 chipset and don't want the hassle of RMA'ing a load of components separately if everything goes wrong, we have the answer – a Labs test of five keenly priced Sandy Bridge PCs.

Is DRM working?



DRM might be as a popular among gamers as a great white shark at a seal convention, but publishers believe it's the only way to protect their products. We investigate how successful DRM has been at tackling game piracy.

Sandy bridges



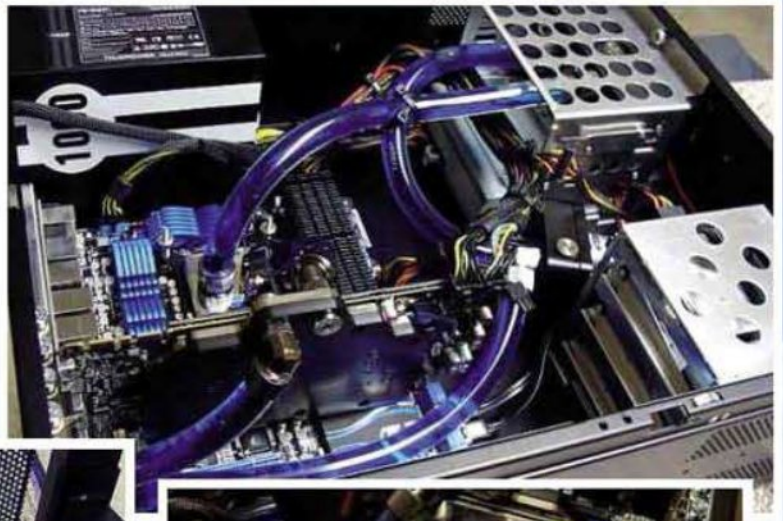
Metal and stone are generally considered the best materials for building a bridge, but with so many recalled Sandy Bridge boards sitting around in warehouses, we find out if they make a good bridge-building material.

On sale 19 May, 2011

*Please note that all these stories are subject to product delays, Tube strikes, the outbreak of a zombie plague, Colonel Gaddafi opening his mouth and our own fickle minds. Also, one of these is a fake.

PC Heaven

YOUR BEST BUILDS...



Forum member musicjerm fitted his two double 120mm-fan water-cooling radiators to the side of an old rack-mount cabinet, rather than squeezing them into his Lian Li C32B rack-mount case. The result is a great-looking water-cooled Sandy Bridge PC.

PC HELL

... AND WORST NIGHTMARE

When Captain Cameron Zucker's house burned down in a fire, he returned to find the only item the fire didn't want – a Dell PC. While the rest of the house was reduced to cinders, the Dell was still intact and exactly where Cameron had left it, surrounded by the charred remnants of his office.

SHOW US YOURS Send your pictures of PC heaven and hardware hell to heavenandhell@custompc.co.uk and you could show off your great build or share your computing disaster in the pages of **Custom PC**.

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Advanced technology with Composite Heatpipe reaches extremely High Qmax (300W) you have never experienced.

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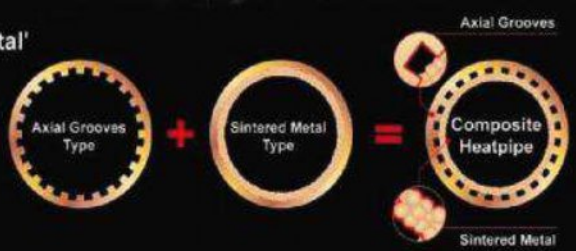
CNPS9900MAX-BLUE

COMPOSITE HEATPIPE

Zalman's 'Composite Heatpipe' features a 'Sintered Metal' type wick, resulting in outstanding capillary pumping performance, and a high thermal conductive design of 'Axial Grooves' which increases the heat transfer rate by 50% compared to ordinary heatpipes.



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Lightning Strikes Twice. NVIDIA® GeForce® GTX 590

PhysX by NVIDIA

Introducing the new NVIDIA® GeForce® GTX 590 – the most powerful DirectX 11 graphics card ever built. With a sleek exterior that houses dual 512-core GTX 500 GPUs and a custom vapor chamber cooler, the GeForce GTX 590 delivers high-end performance with style.

Great Looking, Great Overclocking Memory at a Great Price

Corsair's Vengeance DDR3 memory modules use high performance RAM, run at 1.5V, and have the aggressive look you want, all at an attractively low price.

Experience Visibly Smart Performance. The 2nd Generation Intel® Core™ Processor Family

These new Intel® processors feature improved adaptive performance that adds speed when you need it and built-in visual capabilities for a better PC experience you can see.

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