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Welcome

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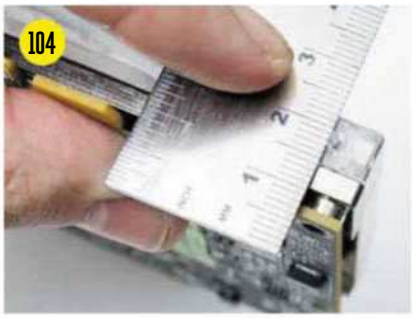

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BEN HARDWIDGE / FROM THE EDITOR

MORE THAN A DIE SHRINK

Ryzen has fully matured into a highly competitive CPU range, and Intel should be worried, argues Ben Hardwidge

Only a few things in life excite me. Knowing that I'm going to see Iron Maiden later this year is one of them. My forthcoming honeymoon, and my first proper holiday in several years, is another one. In all my time on this planet, I don't think I've ever been sincerely excited about a die shrink, but that's all changed this month. Honestly, hear me out.

On the face of it, not much has changed with AMD's 2nd Gen Ryzen CPUs (see p21). They have the same underlying architecture as the original Ryzen CPUs from last year, with the same number of cores and the same amount of cache. It's really just an optical die shrink from a 14nm process to a 12nm process. Historically, a similar shrink would enable you to squeeze out some more clock speed, and possibly lower the power consumption too, but that's about it.

AMD has certainly upped the clock frequency, with the Ryzen 7 2700X now boosting to 4.3GHz, but that's not really why 2nd Gen Ryzen is such an important launch. Firstly, we've had no compatibility problems this time. We haven't spent several nights, tearing our hair out, trying to get various RAM kits to work. AMD has solved the memory compatibility problems that plagued the original Ryzen launch.

> We haven't spent several nights, tearing our hair out, trying to get RAM kits to work

Secondly, AMD has been much cleverer about the CPU line-up. The original flagship Ryzen 7 1800X was extremely overpriced at £489 inc VAT, with the £330 and highly overclockable Ryzen 7 1700 winning our Premium Grade award. AMD has learned its lesson this time – there's no 2800X and rightly so. Not only that, but the new flagship Ryzen 7 2700X is priced well below the launch price of even the Ryzen 7 1700.

With a price of just £283 inc VAT from **www.scan.co.uk**, the new Ryzen 7 2700X is an amazing deal, not only undercutting AMD's previous launch pricing, but also Intel's 6-core Core i7-8700K, a chip that the new Ryzen thrashes in heavily multi-threaded workloads, such as Handbrake video encoding. Intel still has the (slight) upper hand in gaming, but the difference a CPU makes to gaming at this level is generally so small that it's hardly worth considering.

Thirdly, AMD's new boosting algorithms are now so good that they've effectively made all-core overclocking redundant. The original Ryzen CPUs struggled in some game tests, because the boosting algorithms didn't account for lightly threaded software, such as games, spawning off less demanding threads, separate from the main two threads, which we've discussed no p21. The new boosting algorithms fix this problem – you just need decent cooling.

The upshot is that a traditional all-core overclock actually makes the CPU slower in some software. It's still worth doing if you really need to run heavily multi-threaded workloads as fast as possible, but for most people, you may as well just run the CPU at stock speed – the boost will be quicker than an all-core overclock in most cases. We haven't had an opportunity to test the non-X 2nd Gen Ryzen CPUs yet, but the fact you can get such good performance without even touching the settings in the EFI is a big bonus for the X-series chips.

Ryzen has fully matured into a fast, efficient and formidable CPU, and for a surprisingly low price. Intel really needs to watch its back now. CPC

Ben Hardwidge is the editor of Custom PC. He likes PCs, heavy metal, real ale and Warhammer 40,000. editor@custompcmag.org.uk @custompcmag

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RICHARD SWINBURNE / VIEW FROM TAIWAN

WE WANT HDR GAMING

Richard Swinburne is glad to see gaming monitors finally focusing on colour reproduction and image quality

If you were a first-generation **CPC** reader, and were into PC gaming around 2004-2005, let me reach in and pull a few memory strings. Do you remember the release of Far Cry 1.3 and Half-Life 2 Lost Coast? Six months after Far Cry launched, and with Nvidia's help, Crytek dropped the 1.3 patch in late 2004, which introduced DirectX 9c support, complete with Shader Model 3 and gorgeously bright HDR lighting.

Meanwhile Valve, which was continuing to co-work with ATI since the launch of Half-life 2, introduced the Lost Coast demo, with an alternative effect that approximated HDR using Shader Model 2b. Later, in 2005, Valve updated the Source engine with full support for DirectX 9c and Shader Model 3.

On the hardware front, following the disastrous GeForce FX series, Nvidia was trying to make up for lost ground by shouting from the rooftops about its unique Shader Model 3 capability in the more capable 6000 series of GeForce GPUs, versus ATI's Radeon X800 cards, which were limited to Shader Model 2b. Why this trip down memory lane? Well you'll be pleased to know that, 14 years later, gaming monitors (which weren't a thing in the early 2000s) can now, finally, accurately display that HDR content!

Looking back, it was really just a storm in a tea cup, when you consider that the colour reproduction of early LCD monitors was extremely poor at best. Many of us were holding onto our high-end CRTs, which had better colour, contrast and pixel density (especially if you had a Trinitron or Diamondtron tube), at the expense of having all the display sharpness of a woolly jumper.

Coming back to today, the latest gaming monitors to launch from Acer and Asus' ROG division are the Predator X27 and PG27UQ respectively. Both monitors break the 4K 60Hz barrier by providing a refresh rate of up to 144Hz, and their brightness can peak at 1,000-nits to enable the extreme contrast needed to properly display HDR content without it looking washed out.

Inside both monitors, the same AUO AVHA panel is still just an 8-bit affair with frame rate control (FRC), rather than a full 10-bit panel, so it's still 'only' producing millions rather than billions of colours. However, the Quantum Dot coating gives it 90 per cent coverage of the professional-grade DCI-P3 colour-space, which makes up for it.

> It will still be years before many of us gamers can experience this tech for ourselves

On the downside, since these monitors target the super-premium end of the price spectrum, they will likely cost around £2,000 inc VAT, so it will still be years before many of us gamers get the chance to experience this tech for ourselves. Of course, you'll also need a silly amount of GPU power to consistently generate that level of frame rate at 4K – a pair of GeForce GTX 1080 Ti cards might just about do it.

Sadly, giving these displays a lower resolution or refresh rate wouldn't make them more affordable either. Other technologies that enable HDR displays, such as the Full Array Local Dimming (FALD) tech found in these monitors (precisely controlling the illumination of hundreds of backlight LEDs) is inherently expensive.

There's some good news for the rest of us though. The new HDR displays are finally changing the way manufacturers think about building displays; moving away from increasing size, resolution and speed (the big number on the box), and moving towards colour accuracy and image quality. That's a positive change we've been needing since we started dumping our old CRTs for LCDs all those years ago. CPC

Richard has worked in tech for over a decade, as a UK journalist, on Asus' ROG team and now as an industry analyst based in Taiwan @Bindibadgi

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TRACY KING / SCEPTICAL ANALYSIS

FAREWELL, LOOT CRATES

Britain will soon be regulating some gaming micro transactions, argues Tracy King

Say a fond farewell to loot crates, they're on their way out. Although the British government hasn't yet declared loot boxes to be gambling, I've long been predicting they will (sadly without putting any money on it), and the latest news from The Netherlands is the biggest sign yet that Brits will soon have some types of micro transactions regulated by the government.

The Dutch gaming authority has decided that loot crates are gambling, and given publishers and developers until June to comply with the Betting and Gaming Act. That's a big deal, because it means that loot crates are officially games of chance rather than skill, and that they have a value outside of the game itself, also known as cashing out.

Wesley Yin Poole of Eurogamer wrote an investigation last year into the real-world cash value of FIFA Ultimate Team Coins, pointing out that the websites that buy the Coins are essentially turning the in-game currency into a real-world black market. EA prohibits this external trading, but the key question is whether its very existence means the game now falls afoul of gambling law.

> The Dutch gaming authority has decided that loot crates are gambling

Obviously, this problem isn't exclusive to FIFA (the Dutch authorities found four of the ten games they analysed were technically gambling), and the real-world trading value of digital items such as weapons or armour has been much discussed as a cultural or even philosophical phenomenon, but those items are usually gained as the result of having at least some skill.

Loot crates are controversial because the player is straight up buying random chance, like a slot machine. Yes, you always win a 'prize', but if that prize has a real-world value then it's no longer defensible as not gambling. The games industry has relied on the 'can't cash out' defence for as long as loot crates have existed, but it's always been a wobbly house of cards.

In Britain, there are two major contributing factors to whether loot crates will be subject to gambling regulation. The first is mostly straightforward – whether or not the loot won by chance can be cashed out for real money. The Gambling Commission states that 'where prizes are successfully restricted for use solely within the game, such in-game features would not be licensable gambling', which is most likely to be the point over which legalese publishers fight hardest. Lawyers will argue that publishers aren't responsible for third-party websites; the government will argue that 'successfully restricted' means they are.

The second factor is a matter of public opinion. Once the media starts reporting on terrible outcomes from micro-transactions, the public starts complaining and the government takes notice. I don't know whether loot crates encourage the same addictive behaviours of other gambling types, such as slot machine (the 2005 Gambling Act vaguely says it's 'protecting children and other vulnerable persons from being harmed or exploited by gambling'). However, while video game addiction generally isn't really a thing, addiction to gambling certainly is, with serious outcomes for vulnerable players.

If or when loot crates and other types of micro-transactions become subject to gambling regulation in the UK, we can expect to see some major changes, although not an end to the transactions themselves. After all, the UK gambling industry is worth £14 billion a year, and a not insignificant chunk of that sum goes to the government. Regulation can be lucrative. There are only two things in life worth betting on as a certainty: death and taxes. CPC

Gamer and science enthusiast Tracy King dissects the evidence and statistics behind popular media stories surrounding tech and gaming @tkingdot

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Incoming

We take a look at the latest newly announced products

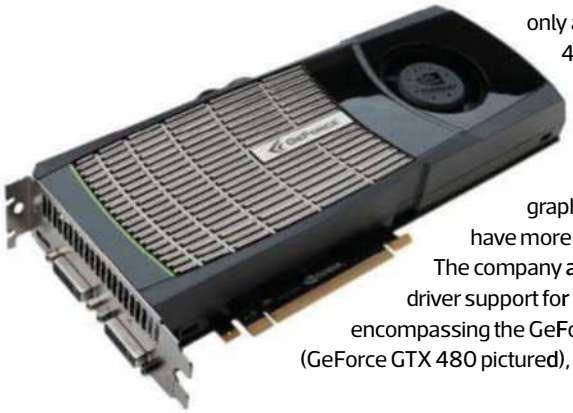
Corsair unveils 'Contrast' memory

Corsair has unleashed a brand-new special-edition range of its Dominator Platinum memory, called Contrast. Finished in what Corsair calls 'an elegant high-contrast design of pearlescent white and high-gloss black', the memory certainly looks good and it has a white LED bar at the top, although there's no RGB lighting.

The Platinum Special Edition Contrast will come in 32GB dual-channel and quad-channel kits, based on Samsung modules, and will be rated to run at 3466MHz. The dual-channel kit is currently available to buy from **www.corsair.com/uk** for £380 inc VAT, while the quad-channel kit costs £415 inc VAT.

Nvidia halts 32-bit Windows and Fermi support

GPU maker Nvidia has officially confirmed that it will no longer update its 32-bit GPU drivers for performance improvements or bug fixes in 32-bit versions of Windows, Linux and FreeBSD. The 391.35 WHQL driver, optimised for Far Cry 5, being the last full Windows update, although the company will continue to release critical security updates for 32-bit operating systems until January 2019. In addition, Nvidia will also no longer update its GeForce Experience software for 32-bit versions of Windows.



As 32-bit operating systems can only address a maximum of 4GB of memory, including both system and graphics memory, this move isn't a massive surprise, as many graphics cards alone now have more than 4GB of memory. The company also announced that driver support for its Fermi series of GPUs, encompassing the GeForce 400 and 500-series (GeForce GTX 480 pictured), will be ceasing as well.

AMD Vega APU price drop

As if the price of AMD's Ryzen APUs with RX Vega graphics chips weren't low enough, they're now available for absolute bargain prices. The quad-core (four threads) Ryzen 3 2200G can now be bought for just £80 inc VAT from **www.scan.co.uk**, with the quad-core (eight threads) Ryzen 5 2400G now only costing £129 inc VAT from the same retailer. The latter APU cost £150 inc VAT at launch, with the 2200G costing £89 inc VAT. If you were thinking of building a super low-budget PC, now is the time do it.

AOC announces FreeSync 2 HDR monitor

AOC's latest Agon AG322QC4 monitor not only has a massive 31.5in VA panel, but also supports AMD's latest FreeSync 2 active refresh technology, while supporting the VESA DisplayHDR 400 standard. DisplayHDR 400 is considered the entry point to HDR, and is still based on an 8-bit (per channel) image. However, a DisplayHDR 400 screen also needs a peak luminance of 400cd/m^2, and it needs to support global dimming to improve the dynamic contrast ratio. Meanwhile, the minimum contrast and colour gamut requirements mean that a DisplayHDR400 monitor should offer superior image quality to standard dynamic range (SDR) monitors.

The Agon AG322QC4 only has a 2,560 x 1,440 resolution, which might look a bit chunky on the large screen, but it also offers a fast 144Hz refresh rate, and your graphics hardware is more likely to hit 144fps at 2,560 x 1,440 than at a 4K resolution. The AOC Agon AG322QC4 is scheduled to be available in the UK in June 2018, with a suggested retail price of £529 inc VAT.

RUMOUR CONTROL

Intel planning 40th anniversary '8086' CPU

A few online sources are claiming to have seen samples of an Intel Core i7-8086K CPU, commemorating 40 years since the first Intel 8086 CPUs were launched in the 1970s. If the rumours are to be believed, the CPU will have six cores and 12 threads via Hyper-Threading. Meanwhile, CPU-Z screenshots and a photo from **www.baidu.com**, watermarked 'DDAA117', show it being based on the Coffee Lake architecture, and coming with a 4GHz base clock, a 5GHz boost clock and an unlocked multiplier. An alleged photo of the CPU carries the SR3QQ part number.

We'll have to wait and see whether the rumours are true or not, but Intel has released anniversary editions of its CPUs before, including the Haswell-based Pentium G3258 to coincide with the 20th anniversary of the Pentium brand in 2014.

AMD sneaks out Radeon RX 500X-series GPUs

In a bid to enable system builders to counteract the effect of currency mining on GPU pricing, AMD has released a new series of OEM-only Radeon RX GPUs, featuring an 'X' suffix to distinguish them. As far as we can tell, the new X-branded GPUs are basically the same as their X-branded counterparts, with the RX 580X having the same 36 compute units (2,304 stream processors) as the RX 580 (pictured), for example, as well as the same base and boost frequencies of 1257MHz and 1340MHz respectively. The only exception is the RX 550X, which has a quote boost clock of 1287MHz, compared to the RX 500's 1183MHz boost frequency.

Intel releases budget Coffee Lake chipsets

After rushing the original Coffee Lake launch forward, Intel has finally released some budget, non-overclocking chipsets for its locked Coffee Lake CPUs. The new H370 chipset doesn't support Nvidia's SLI technology, and can only run one PCI-E slot with 16 lanes, but some boards have two 16x PCI-E slots and can link two AMD cards together in CrossFire configuration, with four lanes allocated to the second slot. The chipset also supports up to four USB 3.1 Gen 2 ports, eight USB 3.1 Gen 1 ports, 14 USB 2 ports and six SATA ports, and can output to up to three displays.

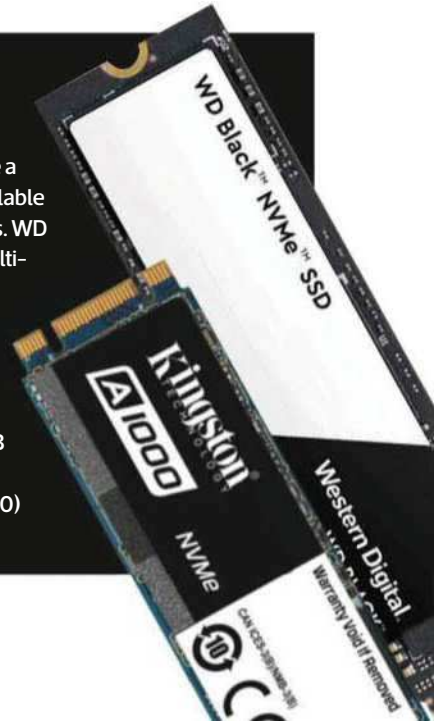
The price of an ATX H370 board starts at £89 inc VAT for an ASRock H370 Pro4 from **www.scan.co.uk**, making for a much more appropriate partner for a multiplier-locked Core i5 CPU than an expensive X370 board.

The next step down is Intel's B360 chipset, which only provides 12 PCI-E lanes, compared with the 20 from the H370 chipset, but is still a capable good-value chipset, with micro-ATX board prices starting from just £58 inc VAT for a Gigabyte B360M H (pictured). Finally, at the bottom of the scale is the H310 chipset, which only supports single-channel memory, and only has six PCI-E 2 lanes at its disposal, in addition to the PCI-E 3 lanes in your CPU. The boards are cheap, though, with an ASRock H310M-HDV micro-ATX board going for £51 inc VAT at **www.scan.co.uk**

New NVMe SSDs

Both Kingston and WD have just announced some new M.2 NVMe SSDs. Kingston's new A100 is designed to offer double the performance of a SATA SSD, but without costing much more money. Billed as an 'entry-level' NVMe drive, it uses a 2x PCI-E 3 interface (rather than the 4x interface used by Samsung's latest drives), and comes with a four-channel Phison 5008 controller. Kingston says the drives can read at up to 1,500MB/sec, with write speeds varying between 800MB/sec and 1,000MB/sec, depending on capacity. Available in 240GB, 480GB and 980GB capacities, with the 480GB version currently priced at £156 inc VAT from **www.box.co.uk**

Meanwhile, WD's new Black 3D NVMe SSDs are aimed at the higher end of the market, with claimed read speeds of up to 3,400MB/sec, and write speeds varying between 1,600MB/sec and 2,800MB/sec, depending on capacity. The new M.2 drives feature a full 4x PCI-E 3 interface and are available in 250GB, 500GB and 1TB capacities. WD says the new drives are 'ideal for multi-threaded applications and data-intensive multitasking environments'. There's no word on UK pricing yet, but the suggested US retail prices are $120 US (around £85) for the 250GB drive, $230 (around £163) for the 500GB drive and $450 (around £320) for the 1TB drive.



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Letters

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Wot, no DVD drive?

I jumped at the chance to try to build my own PC, as suggested by the cover of Issue 176, but I was disappointed by the price difference on the Scan website to that which you gave. I've gone ahead anyhow, but I'd like to draw your attention to the absence of a DVD drive, which would be imperative if I wanted to load games. The prices on Ebuyer were better, and I await delivery of the parts I ordered from there to mix with parts I also bought from Aria PCs, and my own power supply. I'm excited to see the result and look forward to future articles in your excellent magazine.

ALEXANDER O' REILLY

Ben: Thanks, Alexander. In terms of pricing, we can only go with what's correct at the time of going to press, and component prices sometimes fluctuate over the period that each issue of the magazine is on sale. We encourage readers to shop around to find the best deal, just taking our specs list as a guideline, so you've done the right thing.

Regarding the DVD drive, I think the optical drive has pretty much had its day now on the PC, unless you live in an area with severely restricted broadband. You can easily install Windows 10 from a USB thumb drive now (as we recommend on our Elite list), and far more PC games are available to download on Steam now than you can buy on disc. Even boxed PC games often contain just a download code these days, rather than a disc. I still have a DVD drive in my PC for occasional use, but I think it's a long way from being an essential these days.

Even some boxed PC games come with download codes rather than physical discs

Massive monitors please

Apart from a short time away, I've subscribed to your worthy magazine since its debut, and I use it shamelessly to shortlist high-grade components for the top-performing computers that I like to build. I don't overclock nor do I play games, so I don't personally need the high performance that I crave. Even so, I read every word of Rick Lane's stuff and watch with envy while our youngsters demonstrate their hand-eye coordination and supersonic thumbs.

I use your Elite lists because I just like to buy nice gear from reputable people. The sterling performance is a bonus; it streamlines my work and minimises those everyday chores such as backups. In the early days, I complained about the infuriating din emanating from those 80mm fans, which whined away in every computer case. I was delighted when you spearheaded the drive to the near- silent systems that we have today.

A 43in monitor, such as this Dell model, will enable you to have loads of software open, and still clearly read the text and see detail

But I still have a rant from time to time, and now my rants concern the ridiculously small screen sizes. A 24in screen is still much too small; you can't be serious about computing with anything less than a 40in monitor. I always look optimistically at your reviews in the hope that you'll be able to advise me about which 40in+ screen I ought to buy, but alas I've had to gamble and dip into the bran tub three times now to replace my 24in and 30in monitors with reasonably sized displays.

I now use a 40in Iiyama, a 43in Philips and a 43in LG monitor. They're all superb 4K computer monitors that would justify an honourable mention in **Custom PC**, but they've never received a word of praise from you. Agreed: they are expensive; but it makes sense to buy them for the long term. We should act as though computers are here to stay, like hot and cold running water, electricity and gas central heating.

These bigger monitors can also use remote controls to switch among several DisplayPort and HDMI inputs, and they can also access CCTV, broadcast TV and other recorded sources.

Picture-in-picture and other features help to make these monitors ever more versatile.

Spending money on good software determines the content and quality of what you get, and spending money on top computer hardware determines how swiftly you get those goodies that the

> The big companies need to get together and sort out compatibility, rather than yapping about who's the best

software provides. But all of that outlay remains invisible until you follow through by spending a sufficient sum on the monitor to display the output at its best.

That's where a big 4K monitor will maximise your reward. These step-up sizes have been made usable from across a narrow desk by the development of 4K screens, and now they enable punters to work with several windows open, to see fine detail and to read small text. I'll bet they are good for games too, although they'll be a bit tricky to get to a party.

Anyway, I hope that **Custom PC** will review, and encourage more use of these decent-sized monitors, so that the next one I buy can be chosen from a well-researched shortlist.

TONY EVANS

Ben: Thank you very much for your kind comments, Tony, and for continuing to read **Custom PC** since the early days – I still remember those horrible-sounding 80mm fans and corporate beige cases – we've come a long way since then! Regarding larger monitors, the price isn't really an issue, and I agree that it's worth spending more money on a quality monitor as a long-term commitment. The main reason we haven't covered them so far is because I'm just not sure home users really want 43in screens on their desk.

Those screen sizes are really engineered to be viewed from a distance – you can't really see the whole panel in your vision when it's that big and right in front of you. I've always thought they were just too big and overwhelming to have on your average desk – even the 34in ones we've reviewed seemed like overkill – my 28in 4K screen at home seems about right. That said, I'm always happy to be proved wrong. If any other readers would like to see coverage of 40in+ monitors in **Custom PC**, then email us and let us know – we're always open to new ideas.

VR problems

It's great to see the mag that got me into VR start exploring VR again. However, I struggle with my VR system every day, with problems with overheating, tracking and so on. I've chatted with lots of people in the trade, who have made various suggestions, but it seems there's no collaboration between the big parties involved – HTC, Oculus, Valve and Bethesda.

The one game I've been anxiously awaiting is Skyrim VR – the first few hours were awesome, and Bethesda may have learned from all the complaints about Fallout 4 VR. My big issue now is that just playing the basic Skyrim with Vorpx causes my head-mounted display (HMD) to overheat. Should this be happening? Of course not! I believe it's happening because the hardware hasn't been truly tested by gamers. I've been onto HTC, and my HMD will soon be sent for repair, but will it help?

The big companies need to get together and sort out compatibility too, rather than yapping about who's the best. Regardless of hardware, we should be able to use and buy hardware and software from whatever store – locking you into one format will end up neglecting your sales. Anyway, that's my unhappy two cents with VR. Long live the Oasis.

PAUL BAITSON

Ben: Your headset definitely shouldn't be overheating, Paul. We've done a lot of testing with the Vive over the past year or so, and we've never experienced any of these issues, but a quick Google shows that you're definitely not alone in experiencing tracking and overheating problems. Hopefully, your HMD will come back working fine from HTC, but let us know if it doesn't – we're always keen to know about readers' problems with the kit we review – we can only report on our own findings, and it's often hard to assess how products will fare long-term under other conditions.

I also agree with your point about being able to buy VR hardware and software anywhere, and be able to use it, and I think we're getting somewhere on that front. After a frustrating start with various proprietary systems, most of the main VR headsets now work fine with SteamVR, for example.

Windows Mixed Reality also has strict compatibility requirements, which is why all the headsets have basically the same hardware. The problem is that manufacturers need unique selling points to distinguish their products from those of their competitors. It may be a while before it all settles down with firm standards. CPC

WHEN'S THE NEXT MAG COMING OUT?

Issue 179 of **Custom PC** will be on sale on Thursday, 14 June, with subscribers receiving it a few days beforehand.

Send your feedback and correspondence to letters@custompcmag.org.uk

Reviews

Our in-depth analysis of the latest PC hardware

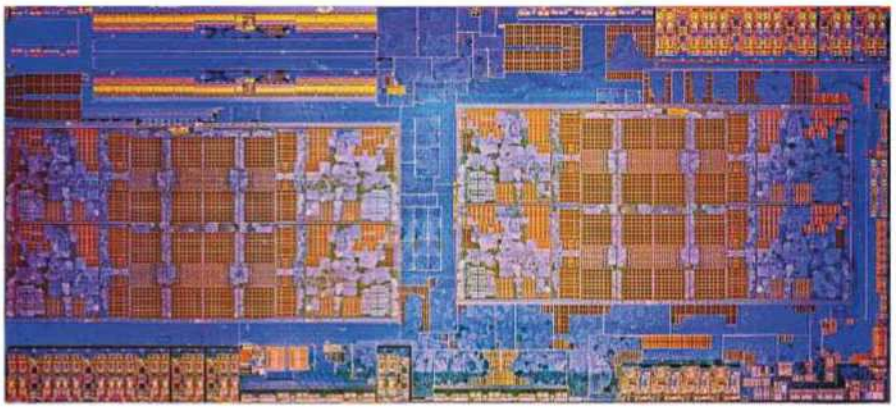
Contents

AMD Ryzen – the next generation

Antony Leather takes a look at what's new in AMD's 2nd Gen Ryzen chips

When AMD launched its first Ryzen CPUs a little over a year ago, the company was quite clear about the product it was launching in terms of expectations and its future development. AMD basically said that the first iteration of the Zen core and its implementation in Ryzen was a worst-case scenario, given that the company was dealing with an entirely new architecture and feature set in its SenseMI technologies. It was also true that Ryzen presented some challenges in the early days, with poor memory support above frequencies of 2666MHz, as well as a plethora of other issues.

AMD has aimed to resolve all these issues with 2nd Gen Ryzen. Indeed, even some X370 motherboards with the latest BIOS updates will now enable you to hit memory speeds over 3400MHz quite easily, but AMD has specifically focused on these types of issues with the X470 chipset.



The 2nd Gen Ryzen chips have the same die layout as their predecessors, but with 12nm transistors

Smaller transistors

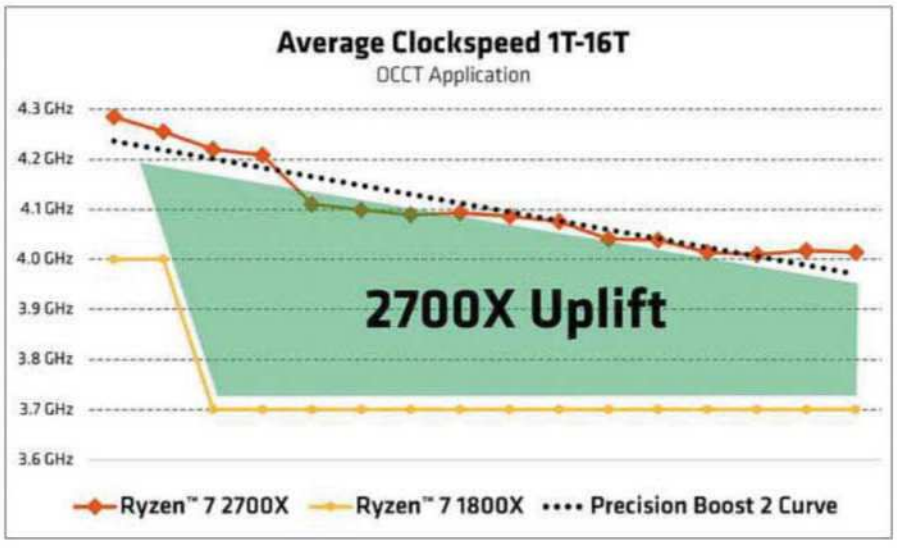
There are plenty of other new features with 2nd Gen Ryzen too. The CPUs now use a 12nm as opposed to a 14nm manufacturing process, and AMD has also cut latencies across the platform. However, the two changes that are likely to result in the largest performance gains are higher frequencies and improvements to the frequency boosting algorithms.

The original Ryzen CPUs' SenseMI features, called Precision Boost and Extended Frequency Range (XFR), could only be applied across a small number of cores and threads. That wasn't an issue in itself, but the algorithms didn't account for the fact that many applications, including some games, will have one or two main threads, but will often spawn off several other less demanding threads. When these threads were spawned, the CPU would assume all those threads were high load and cut the frequency, unnecessarily in many situations.

All-core boost

With 2nd Gen Ryzen, not only has the boosting system been made more aggressive in order to deal with this issue, but Precision Boost 2 and XFR 2 can now apply across all cores and threads at the same time – the only limitations are the power delivered to the CPU and, of course, the temperature. As a result, if you have decent cooling, the multi-threaded performance of the new CPUs should be much better than that of the previous generation.

AMD told us that you'll even see benefits below 80°C, but below 50°C, the CPU will usually be ramping up all its cores to the maximum boost frequency. That said, as other factors can come into play, you won't see the maximum XFR frequency across all cores for most of the time. Sadly, as with Intel CPUs, as soon as you overclock your CPU, you'll switch off boosting. As we saw with Ryzen Threadripper last year, though, depending on your requirements, it may actually be more beneficial to leave the CPU at stock speed, where it will achieve higher frequencies than an all-core overclock.



2nd Gen Ryzen CPUs can not only hit higher frequencies than their predecessors, but their boosting algorithms are now more sophisticated too

Higher overclocks

The Ryzen Master overclocking utility has more options with the new CPUs now too. You're finally able to adjust the frequency of individual cores, and the most overclockable core on each Core Complex is highlighted by a star, allowing you to maximise lightly threaded performance. There's more overclocking headroom too – AMD claims that all-core overclocks reaching 4.2GHz should now be more common too, and there's been a 50mv reduction in core voltage across the range.

To deal with the slightly higher TDPs of the new CPUs, X470 motherboards have enhanced power circuitry, and while you'll be able to use first-generation Ryzen CPUs in X470 motherboards, as well as the new CPUs in older X370 motherboards, you'll need the latest technology on both fronts to see all these benefits.

ELITE NEW ENTRY P66

AMD SOCKET AM4 CPU

AMD Ryzen 7 2700X / £282 inc VAT

SUPPLIER www.scan.co.uk

Only four new CPUs are being released by AMD for now, with the fastest 2nd Gen Ryzen model being the Ryzen 7 2700X, meaning there's no direct replacement for the Ryzen 7 1800X. The new CPU has a 100MHz advantage in base frequency, but while the Ryzen 7 1800X could reach a maximum frequency of 4.1GHz using XFR, the new CPU can reach a lofty 4.3GHz, and across more than just one core too. As such, it's potentially not just quicker than the 1800X in lightly threaded tasks, but it could be significantly faster in multi-threaded tasks too.

You can now overclock single cores in Ryzen Master

There isn't much new in terms of basic hardware. The new chip's Zen core has had a fairly paltry die shrink from 14nm to 12nm, and while AMD has reduced latencies across the board, we're still dealing with an 8-core, 16-thread CPU with the same amount of cache as the Ryzen 7 1800X.

The bigger news is the higher frequencies, which are accompanied by the introduction of AMD's new Precision Boost 2 and XFR2 technologies, which aim to iron out some of the issues with AMD's previous frequency boosting algorithms. Previously, when more than more than one or two cores were under load, typically in games and lightly threaded applications, the CPU would rein in their frequencies even if those cores were under light loads.

Now, irrelevant of load, the CPU will actually be able to boost all of a Ryzen CPU's cores to the maximum XFR frequency, which in the Ryzen 7 2700X's case is 4.3GHz. You're also now able to overclock single cores in AMD's Ryzen Master software, and AMD even identifies cores that will overclock the furthest, allowing you to pay them special attention.

In our tests, the Ryzen 7 2700X spent a lot of the time boosting numerous cores up to 4.3GHz, making it a significant 13 per cent quicker than the 1800X in our image editing test at stock speed – just a fraction behind the Intel CPUs. Our heavily multi-threaded video encoding test saw an identical boost too, with the system score being over 14 per cent quicker than that of the old CPU. Games were also quicker, with Fallout 4 gaining several frames to the minimum frame rate and Deus Ex: Mankind Divided's minimum frame rising from 61fps to 66fps too.

Intel's Core i7-8700K was still faster in some tests, though, managing a quicker multi-tasking score and 75fps minimum in Deus Ex, but elsewhere it was soundly beaten or matched by the cheaper AMD CPU.

We also managed to overclock the 2700X to 4.25GHz across all cores using a vcore of 1.425V, but this overclock meant that some tests were slower, as the stock speed boost can reach 4.3GHz. The overclock did see the Cinebench score rise from 1,810 to 1,907, but the single-core score in this test dropped from 178 to 177, so fiddling with single-core overclocking is likely to be the way forward here.

Conclusion

AMD has given the Ryzen 7 2700X the tools to close the gap to the Core i7-8700K, and while it doesn't beat it in every test, it now has a huge lead in heavily multi-threaded tests and is a huge step up from the Ryzen 7 1800X across the board. Intel is still faster in some games, but not all titles see much difference anyway, and any gaps are narrower than before. Even better, the Ryzen 7 2700X costs under £300 inc VAT (compared with the 1800X's £489 launch price), which is £35 less than the Intel CPU. If your primary focus is multi-threaded performance, the Ryzen 7 2700X offers excellent performance for a surprisingly generous price.

ANTONY LEATHER

/SPECIFICATIONS

Base frequency 3.7GHz
Max boost frequency 4.3GHz
Core Zen
Manufacturing process 12nm
Number of cores 8 x physical (16 threads)
Simultaneous Multithreading (SMT) Yes
Cache 16MB L3, 4MB L2
Memory controller Dual-channel DDR4, up to 2933MHz
Packaging AMD Socket AM4
Thermal design power (TDP) 105W
Features Precision Boost 2, XFR2, FMA3, F16C, SHA, BMI / BMI1 + BMI2, AVX-512, AVX2, AVX, AES, SSE4a, SSE4, SSSE3, SSE3, SSE2, SSE, MMX

PERFORMANCE 47/50
FEATURES 15/15
VALUE 33/35
OVERALL SCORE 95%

VERDICT

Faster than the Ryzen 7 1800X at everything, and it costs less than £300. The Ryzen 7 2700X is a superb all-round CPU.

ELITE
NEW ENTRY
P66

AMD SOCKET AM4 CPU

AMD Ryzen 5 2600X / £193 inc VAT

SUPPLIER www.scan.co.uk

The sweet spot of AMD's first Ryzen CPUs were found in its range of 6-core Ryzen 5 models, and thankfully, the replacement for the Ryzen 5 1600 and 1600X is one of the first chips out of the starting blocks with 2nd Gen Ryzen. Incredibly, AMD's launch price for the Ryzen 5 2600X means that it can be found for under £200 inc VAT, which is barely any more than the quad-core Ryzen 5 1500X cost at launch, and a substantial £50 less than its predecessor.

The system score bettered the Core i5-8600K

The higher frequencies and improved boosting algorithms found in the 2700X (see opposite) are also present with the Ryzen 5 2600X. Its base frequency is the same as its predecessor at 3.6GHz, but its maximum boost frequency is 100MHz higher at 4.2GHz. Critically, it can boost more cores to this frequency too. The cache amounts stay the same at 16MB L3 and 4MB L2, as does the TDP at 95W, and we're still dealing with a 6-core, 12-thread product.

As there are two quad-core Core Complexes inside this CPU, with two cores disabled, AMD's Ryzen Master software will also identify the two best cores for overclocking, as with the Ryzen 7 2700X.

We saw a similar performance boost between the Ryzen 5 1600X and 2600X as we saw between the Ryzen 7 chips, with a 12 per cent boost to the image editing score, a 10 per cent boost to the video encoding score and a 14 per cent increase to the multi-tasking score. The system score of 169,556 was also enough to better the Core i5-8600K, which scored 156,104, although the Intel CPU was quicker in the multi-tasking test.

The additional threads compared to Intel's 6-core CPU also saw the Ryzen 5 2600X retain its lead in Cinebench, with a score of 1,372 compared to 1,003. In Fallout 4, the small gains added by AMD's higher frequencies and better boosting saw the Ryzen 5 2600X come close to matching the Core i5-8600K as well, and it wasn't far behind in Ashes of the Singularity either. However, in Deus Ex: Mankind Divided, the Intel CPU managed a minimum frame rate of 75fps compared to 66fps for the Ryzen 5 2600X. That said, it's still an improvement on the 61fps managed by the Ryzen 5 1600X.

In terms of overclocking, we managed to push the CPU to 4.2GHz across all cores using a vcore of 1.425V. We also managed to push its starred core in Ryzen Master all the way up to 4.35GHz, but we didn't have time to test the performance improvement before we went to press. With all cores pushed to 4.2GHz, though, we ended up having to force them to stick to their maximum boost frequency, which saw 1fps added to the minimum frame rates in Deus Ex and Ashes of the Singularity, and 3 per cent added to the system score.

Conclusion

With a lower maximum boosting frequency than its Ryzen 7 sibling, the Ryzen 5 2600X isn't quite as impressive in some of our benchmarks, but it's still significantly quicker than its predecessor across the board, and is also superior to Intel's Core i5-8600K in all but a couple of tests. Even overclocking the Intel CPU to 5GHz couldn't see it get close to the AMD CPU's multi-threaded prowess, making the Ryzen 5 2600X a great CPU for the cash unless you're building a PC purely for games.

ANTONY LEATHER

/SPECIFICATIONS

Base frequency 3.6GHz
Max boost frequency 4.2GHz
Core Zen
Manufacturing process 12nm
Number of cores 6 x physical (12 threads)
Simultaneous Multithreading (SMT) Yes
Cache 16MB L3, 4MB L2
Memory controller Dual-channel DDR4, up to 2933MHz
Packaging AMD Socket AM4
Thermal design power (TDP) 95W
Features Precision Boost 2, XFR2, FMA3, F16C, SHA, BMI / BMI1 + BMI2, AVX-512, AVX2, AVX, AES, SSE4a, SSE4, SSSE3, SSE3, SSE2, SSE, MMX

PERFORMANCE 42/50
FEATURES 15/15
VALUE 33/35
OVERALL SCORE 90%

VERDICT

AMD's 6-core CPU is now even faster, and costs less than £200, making it a veritable bargain.

ELITE
NEW ENTRY
P66

2nd Gen Ryzen memory

Fast memory yields limited gains on Intel systems, especially as you move above a 2666MHz, with 3000MHz or 3200MHz memory usually sitting in the sweet spot. Conversely, AMD's high-speed data link, also known as Infinity Fabric, is linked to memory speed. In theory, the faster your memory, the faster your Ryzen CPU will perform in many tasks.

The trouble has been that achieving any memory frequency much over 3000MHz has been previously tricky with AMD Ryzen systems, due to a lack of optimisation and memory support. However, this situation has changed in recent months, with new motherboard EFI updates sporting code that better supports memory speeds above 3000MHz. In fact, clock speeds above 3200MHz are now widely supported on AMD systems, and not just with Samsung B-die modules.

All of which means that we have to ask whether there's now a strong case for spending more money on memory for an AMD system than for an Intel system. To answer this question, we've tested a Ryzen 2nd Gen system with three memory speeds – 2666MHz, 3000MHz and 3400MHz to see which frequency offers the best bang per buck.

The difference between 2666MHz and 3000MHz memory was fairly noticeable, with Deus Ex: Mankind Divided's minimum and average frame rates of 64fps and 86fps rising to 67fps and 89fps respectively. However, jumping to 3400MHz saw the frame rate increase even further to 71fps and 91fps – that's the minimum frame rate rising by a significant 11 per cent just by using faster memory.

Ashes of the Singularity saw an even bigger minimum frame rate boost of 23 per cent, rising from 35fps at 2666MHz, to 41fps at 3000MHz and finally 43fps at 3400MHz. Meanwhile, our RealBench system score rose from 198,849 at 2666MHz to 207,055 at 3400MHz, which is an increase of 4 per cent, with the biggest increase seen in the multi-tasking test, which rose by 6 per cent. The Cinebench score rose by just 24 points, though, from the lowest to the highest memory frequency.

Memory prices are eye-wateringly high at the moment, but the price difference between 3000MHz and kits up to 3600MHz is comparatively small, especially when you consider the gains we've seen. For example, Corsair's 16GB 3000MHz Vengeance RGB kit cost £184 inc VAT at the time of going to press, but the 3466MHz kit costs just £16 more. Sadly, prices tend to skyrocket once you get beyond that point.

Corsair's dual-channel 3466MHz Vengeance RGB kit currently offers the best bang per buck if you want to build an AMD 2nd Gen Ryzen system

Of course, if you're up for some overclocking, some 3200MHz kits will reach at least 3400MHz anyway, and fairly easily given the results we saw in our recent RGB memory group test. That said, if you just want to set the XMP profile and forget about your memory, we recommend buying a kit guaranteed to reach 3466MHz.

We used 3400MHz memory for testing, but as this frequency is less commonly found than 3466MHz memory, we suggest aiming for the latter to give you a broader choice of kits. One of the cheapest kits at this frequency, and with RGB lighting too, is Corsair's Vengeance RGB, making it our recommended option for an AMD system.

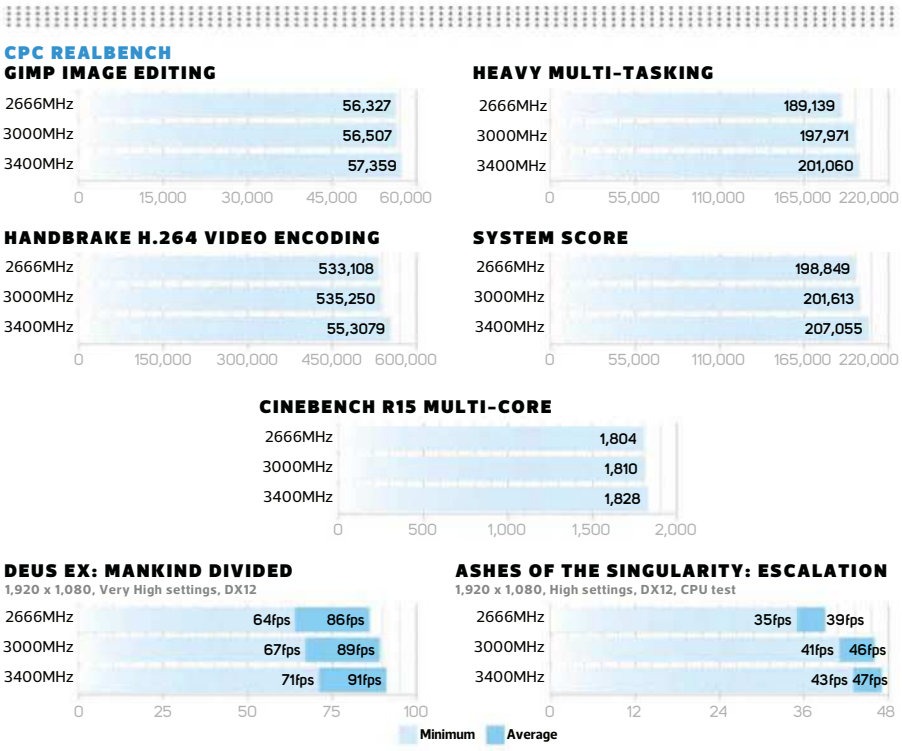
ANTONY LEATHER

Recommended memory speed

3400MHz or 3466MHz

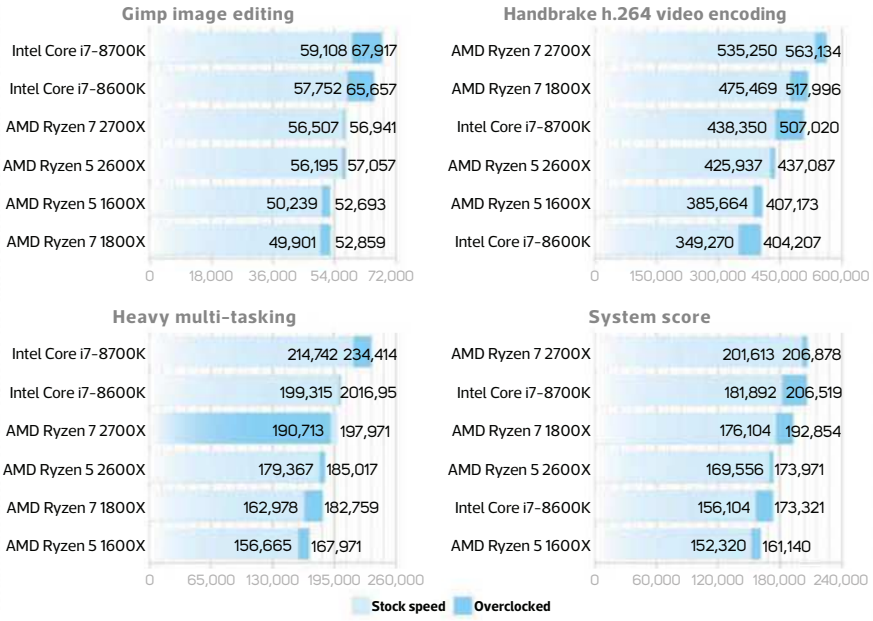
Recommended memory kit

16GB (2 x 8GB) 3466MHz Corsair Vengeance RGB (CMR16GX4M2C3466C16)
£198 inc VAT, **www.scan.co.uk**

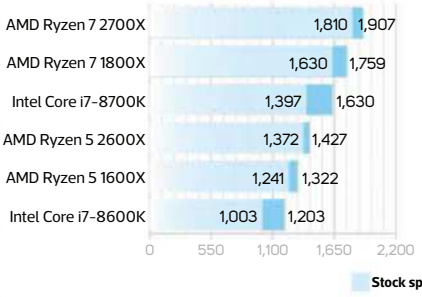


AMD 2nd Gen Ryzen results

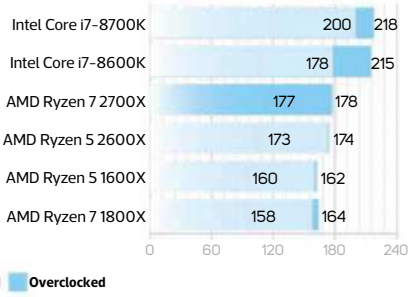
CPC REALBENCH 2015



CINEBENCH R15 MULTI-CORE

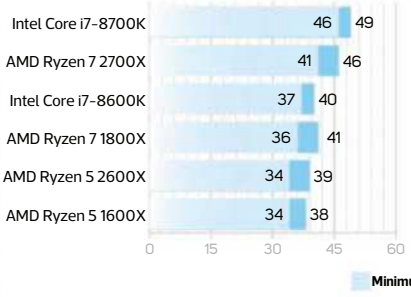


CINEBENCH R15 SINGLE-CORE



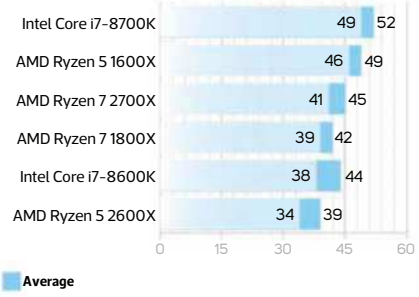
STOCK SPEED ASHES OF THE SINGULARITY: ESCALATION (FPS)

1,920 x 1,080, High settings, DX12, CPU test



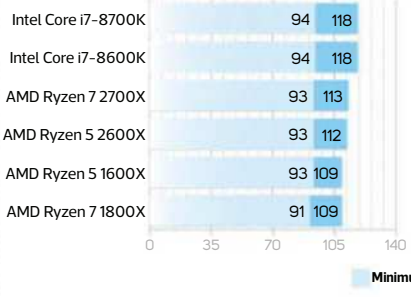
OVERCLOCKED ASHES OF THE SINGULARITY: ESCALATION (FPS)

1,920 x 1,080, High settings, DX12, CPU test



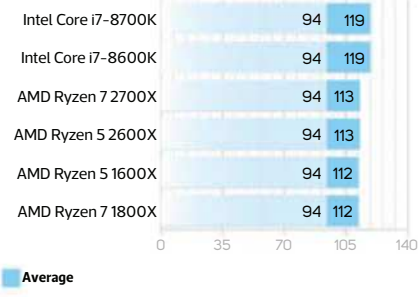
STOCK SPEED FALLOUT 4 (FPS)

1,920 x 1,080, Ultra settings



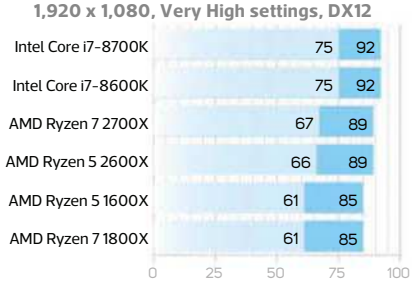
OVERCLOCKED FALLOUT 4 (FPS)

1,920 x 1,080, Ultra settings



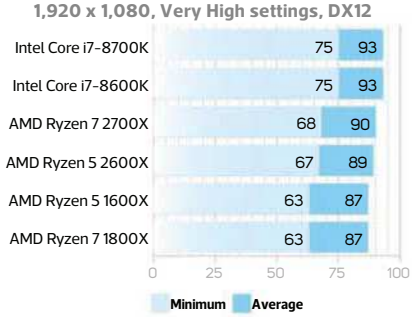
STOCK SPEED DEUS EX: MANKIND DIVIDED (FPS)

1,920 x 1,080, Very High settings, DX12

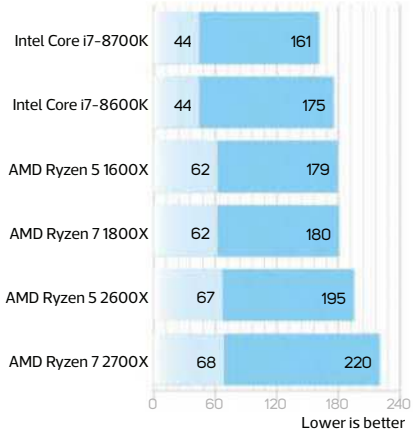


OVERCLOCKED DEUS EX: MANKIND DIVIDED (FPS)

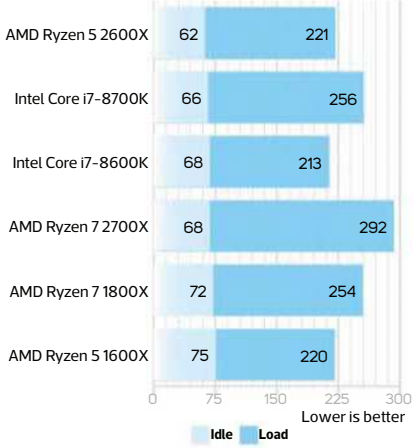
1,920 x 1,080, Very High settings, DX12



STOCK SPEED TOTAL SYSTEM POWER CONSUMPTION (WATTS)



OVERCLOCKED TOTAL SYSTEM POWER CONSUMPTION (WATTS)



How to overclock 2nd Gen Ryzen

When it comes to overclocking, a lot has changed with 2nd Gen Ryzen chips compared with the original Ryzen CPUs, although all-core overclocks are still achieved in the same way, by increasing the multiplier and vcore. You don't really need to touch much else, and you can perform these tweaks either in your motherboard's EFI, or in AMD's Ryzen Master Windows-based overclocking software.

One major change is that AMD's new Ryzen CPUs and Ryzen Master software allow for per-core overclocking. Not only that, but like Intel's Turbo Boost Max 3, you're also able to identify the best-performing and most overclockable cores on each Core Complex (CCX). There are four cores per CCX and Ryzen Master will identify a single core on each one as the core you should attempt to overclock higher than the others, flagging them with a yellow star.

You'll likely be able to achieve an even higher frequency with these cores than with a typical all-core overclock, so it's worth playing around with these cores first. Having one or two cores at much higher frequencies can be useful for boosting lightly threaded performance, while keeping the other cores at lower speeds for reduced temperatures and power consumption when performing multi-threaded tasks.

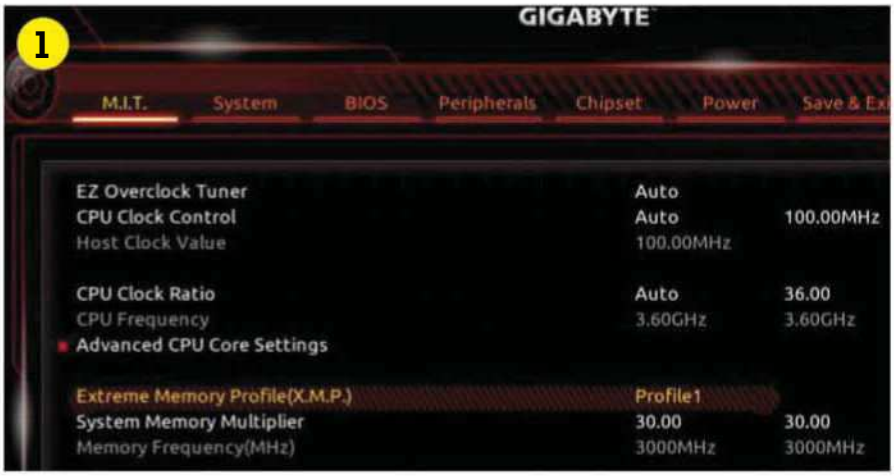
We'll be overclocking our system using both our motherboard's EFI and Ryzen Master to suit both methods here, not least of all because using Ryzen Master means you'll need to make sure the program loads and applies your overclock every time you boot your PC. Unlike Intel systems, there doesn't currently seem to be a way of overclocking single cores within the EFI, so if you want to push the starred cores to their limits, you'll need to use Ryzen Master.

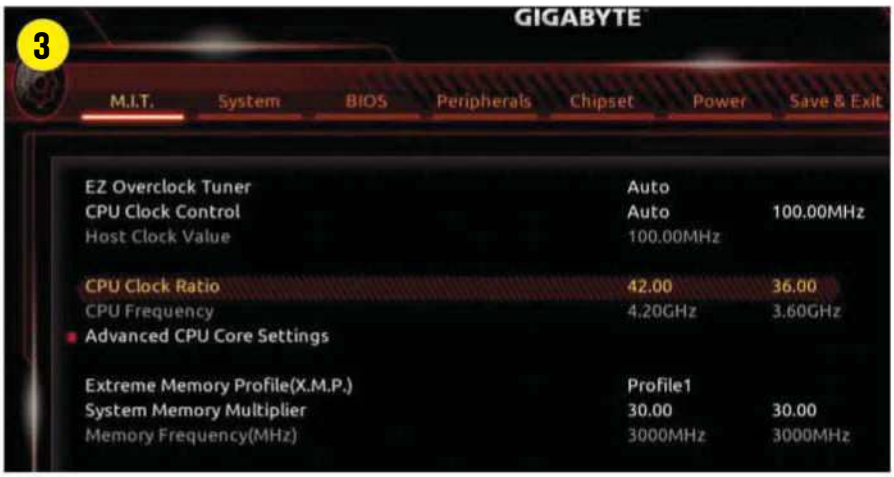
First steps

Start by heading into the EFI and applying the XMP profile for your memory (1), which will allow the system to run with the best performance when overclocked.

Once the XMP profile has been applied, check that the frequency and timings are correct and then locate the DDR voltage. It's best to manually set this voltage to 1.35V (2), as you can otherwise end up with stability issues.

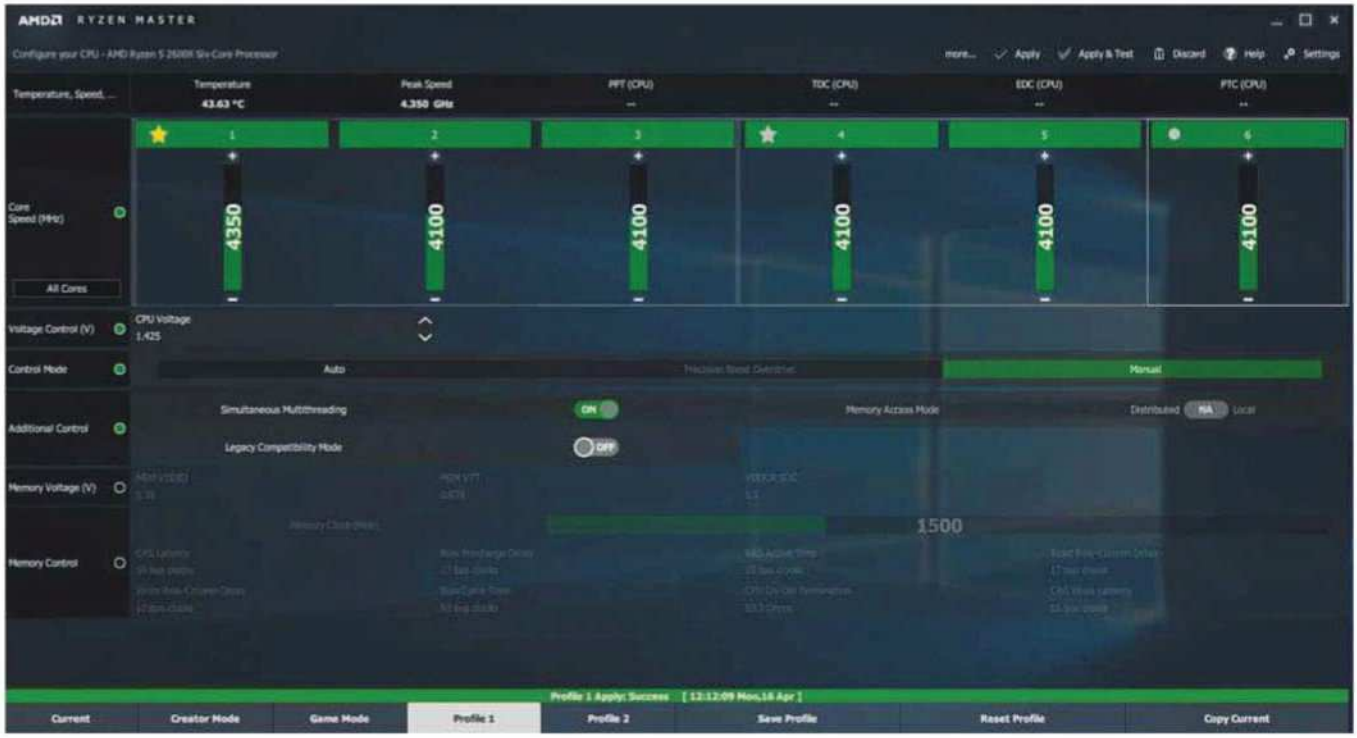
Then head back into Windows and download Prime95 version 26.6 from **https://tinyurl.com/prime95-266** and also Ryzen Master from **www.amd.com/en/technologies/ryzen-master**. Run Prime95's smallfft test and use Ryzen Master to monitor the temperature, so you can make sure your CPU cooler has enough headroom. As long as the temperature doesn't go well above 60°, you'll have enough headroom for an overclock, but we'll test the temperatures again later.





All-core overclocking

Your next step is to adjust the multiplier, which you can achieve using either Ryzen Master or your motherboard's EFI. If you want to do it in the EFI, start with a frequency of 4.2GHz and a vcore of 1.425V (3). You can work up from there, but that voltage is at the upper limits of what you should be using for an everyday overclock, with AMD stating that



Ryzen Master now marks the cores that are likely to overclock the furthest with stars

a 1.45V vcore should only be used for short-term overclocking.

To start overclocking in Ryzen Master, click on one of the generic profile tabs at the bottom – only then will you gain access to the overclocking controls. You can also alter some memory settings, but they'll require a restart. Conversely, all the CPU controls should be applied automatically, which makes overclocking much quicker and easier than constantly rebooting and using the EFI.

If you just want to apply an all-core overclock, go ahead and increase one of the slider bars to your desired frequency. We suggest starting at 4.2GHz with a vcore of 1.425V. Our Ryzen 5 2600X was perfectly stable at this setting, while our Ryzen 7 2700X managed 4.25GHz.

Once you've applied this setting, you can use Ryzen Master's new stability test to quickly check over your system, but for a proper temperature and stability test, run Prime95's smallfft test for ten minutes and record the temperature in Ryzen Master, as well as running our RealBench suite's video encoding test (**https://tinyurl.com/realbench-cpc**). You should aim to have load temperatures below 85°C in Ryzen Master after ten minutes under full load in Prime95.

Single-core overclocking

Overclocking single cores is relatively easy. Start by resetting the EFI multiplier you may have already applied, letting Ryzen Master take control of clock frequencies in Windows. This step is important, as you may not be able to achieve the same overclock on the slower cores if one of them is running a few hundred megahertz higher. You'll need to click the All Cores button to the left of the frequency bars in Ryzen Master to give you single-core control.

To start, apply 1.425V – our recommended maximum vcore for an everyday overclock. Starting at 4.2GHz, increase the frequency of the yellow starred core in 25MHz steps, running AMD's stress test, Prime95 and the video encoding test each time to check stability and temperatures. If it's not stable at the start, lower the frequency to 4.1GHz and double-check that your RAM is set to the correct frequency, timings and voltage.

When you encounter instability, or when you see your core temperatures under load reaching 85°C, it's time to knock back the multiplier by 50MHz. Once you've established the maximum overclocked frequency of that first core, go ahead and do the same for the second starred core and then again for the rest of the cores.

You may find you achieve a slightly lower overclock on the rest of the cores than you can manage across all of them, but the starred cores will be able to reach much higher frequencies, providing a benefit in lightly threaded applications.

For example, we managed to achieve a maximum all-core overclock on the Ryzen 5 2600X of 4.2GHz, but reached 4.35GHz on the core identified as the best one for overclocking.

Memory overclocking

As Ryzen CPUs benefit from faster memory (see p24), it's also worth considering overclocking your memory. If you're up for some memory overclocking, set the DDR voltage to 1.4V in the EFI and increase the memory speed in single multiplier notches, testing for stability with a full run of our RealBench tests each time until you encounter stability issues. When you encounter instability, knock back the memory frequency by one multiplier notch before testing again to confirm it's stable. **CPC**

PC Specialist recommends Windows Windows 10

15.6" RECOIL II PRO

Intel® Core™ i7-8750H
16GB Corsair 2400MHz
6GB GeForce GTX 1060
1TB SEAGATE 7mm SATA HDD (5,400)
250GB WD Black M.2 SSD
60Hz FHD Panel (1920 x 1080)
Narrow Bezel Design
Per-Key RGB Mechanical Keyboard
Windows 10 Home

This spec from **£1,269.99***

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1TB SEAGATE FIRECUDA SSHD
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RGB Backlit Keyboard
Windows 10 Home

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ome features require Windows 10. Update available through Windows Store. Internet access required; fees may apply.
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CPC78

ATX X470 MOTHERBOARD

Gigabyte X470 Aorus Gaming 7 WiFi / £223 inc VAT

SUPPLIER www.awd-it.co.uk

It's clear from our testing that AMD's new CPUs offer great performance and value for money, but you'll need an X470 motherboard to take full advantage of them. We've managed to get hold of Gigabyte's X470 Aorus Gaming 7 WiFi just before we went to press, and it's a stunning-looking motherboard. Gigabyte has tweaked its colour scheme a little, but it's still obviously an Aorus-branded board, with splashes of orange, which is also the default colour for the board's extensive RGB lighting.

The lighting stretches to every corner of the PCB

As usual, the lighting stretches to every corner of the PCB, including the PCI-E and DIMM slots, PCH heatsink and I/O shroud. Gigabyte is also now following in Asus' footsteps with a multi-LED lighting strip above the I/O panel too, which can create rainbow effects by controlling each LED separately.

At £223 inc VAT, it's relatively pricey for an AMD mainstream board, but it looks set to retail for around £10 less than Asus' new Crosshair VII Hero, which we'll be testing next month. Gigabyte has upped the ante with features too, and the board is bristling with buttons, ports and switches. It has a considerable count of eight 4-pin Gigabyte Hybrid Fan Headers, with the ability to switch off system fans at loads, and support for either fans or water-cooling pumps, with a maximum output of 24W.

It's slightly annoyingly that there's no on-board reset button, but you do get a power button on the rear I/O panel, along with a clear-CMOS button, with the PCB sporting an LED POST code display plus switches for flitting between its two on-board BIOS chips. You get a pair of 2-pin thermal probe headers with a pair of probes included in the box as well, plus a pair of RGB LED connectors. It should be good for overclocking too. It has a 10+2 power phase design and an excellent cooling arrangement, with two large heatsinks connected via a heatpipe, plus there's an additional 4-pin power connector for the CPU.

Both of the board's M.2 ports are equipped with large heatsinks too, with the top slot providing both SATA and PCI-E M.2 SSD compatibility. However, you're likely to be better off placing your PCI-E SSD in the lower slot anyway, as the top slot will sit directly under your graphics card.

/SPECIFICATIONS

Chipset AMD X470
CPU socket AMD Socket AM4
Memory support 4 slots: max 32GB DDR4 (up to 3600MHz)
Expansion slots Two 16x PCI-E 3, one 16x PCI-E 2, two 1x PCI-E 2
Sound 8-channel Realtek 1220
Networking Intel Gigabit LAN, 802.11ac Wi-Fi
Overclocking Max CPU multiplier 63x; base clock overclocking enabled; max voltages: CPU 1.7V, RAM 2V
Ports 4x SATA 6Gbps (X370), 2 x M.2, 6 x USB 3, 2 x USB 2, 1 x USB 3.1 Type-A, 1 x USB 3.1-TypeC, 1 x LAN, 3 x surround audio out
Dimensions (mm) 305 x 244

That's because Gigabyte has chosen to place one of the board's two 1x PCI-E slots above the graphics card, while there's also a third 16x slot at the base of the board, which is limited to four PCI-E lanes. Meanwhile, the board's six SATA 6Gbps ports will be enough for most people, with motherboard manufacturers clearly preferring to focus on next-gen storage these days. The box also provides a magnetic aerial for the board's on-board 802.11ac Wi-Fi adaptor, which supports the 160MHz version of this standard for data speeds up to 1.73Gbps.

AMD's X470 chipset can also support USB 3.1 Gen 2, and on the X470 Aorus Gaming 7 WiFi, you get USB 3.1 Gen 2 Type-A and Type-C ports on the rear I/O panel, but there's a header for USB 3.1 Type-C Gen 2 case ports as well, which are starting to appear on some models such as Corsair's Obsidian 500D.

Meanwhile, the rear panel offers the full array of audio outputs plus plenty of USB ports. You get nine Type-A ports in total, with six USB 3 ports, including two dedicated ports for USB DACs that provide isolated adjustable power. It's also good to see the on-board audio sporting the ALC1220 audio codec, along with an ESS SABRE 9018Q2C DAC.

Performance

Gigabyte's EFI still feels quite dated compared with MSI and Asus' recent efforts, but its Smart Fan 5 section is extremely detailed and fairly easy to use. From here, you can control each fan's speed curve, plus switch off any fan under certain temperatures. You're also able to change the temperature

ELITE
NEW ENTRY
P66

1 Both of the board's M.2 ports come equipped with large heatsinks

2 The multi-LED strip above the I/O shroud can create rainbow effects

3 The power circuitry has two large heatsinks, linked with a heatpipe

input of the system fans to different points on the motherboard, including the thermal probe header.

It was fairly easy finding the limit of our Ryzen 7 2700X using the EFI, though, which turned out to be 4.25GHz with a vcore of 1.425V. At stock speed, the system managed a system score of 201,613, which rose to 206,878 once overclocked. Ashes of the Singularity didn't see a boost, though, likely because this all-core frequency is slower than the maximum XFR2 boost frequency.

Meanwhile, power consumption sat at 68W idle at stock and overclocked speeds, rising from load amounts of 220W to 292W at stock and overclocked. Memory compatibility is good too – the board had no problems reaching 3466MHz by overclocking a set of 3200MHz memory. It pushed our Samsung 960 Evo M.2 SSD to its limits too, reaching a 3,382MB/sec read speed and 1,867MB/sec write speed.

Finally, the Gigabyte's audio performance displayed the typical excellence we expect from the Realtek ALC1220 audio codec, with a noise level of -112.6dBA and dynamic range of 111.8dBA, measured using RightMark's Audio Analyzer software.

Conclusion

While the extensive RGB LED lighting might not be everyone's cup of tea, the X470 Aorus Gaming 7 WiFi looks absolutely fantastic when not illuminated too. It has a hefty set of features and will particularly appeal to enthusiasts wanting to kit out their PC with an extensive, tweakable cooling system. Its EFI might still lag behind the competition, but the X470 Aorus Gaming 7 WiFi also trumps its predecessor – the AX370-Gaming K7 – in a number of areas. It offers more in the way of next-gen storage support, as well as heatsinks for both its M.2 SSDs, a more elaborate CPU power circuitry cooling system and more CPU power phases too.

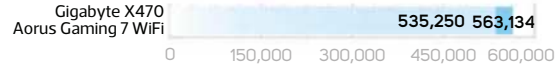
We'd only had a quick look at other X470 motherboards when we wrote this review, and we'll be delving into those boards in depth in next month's Labs test, but with solid CPU and memory overclocking abilities, a tonne of features and superb aesthetics, the Gigabyte X470 Aorus Gaming 7 WiFi is already an excellent foundation for a shiny new 2nd Gen Ryzen CPU.

ANTONY LEATHER

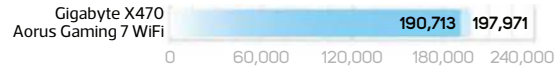
CPC REALBENCH 2015

GIMP IMAGE EDITING

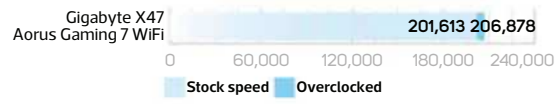
HANDBRAKE H.264 VIDEO ENCODING



MULTI-TASKING

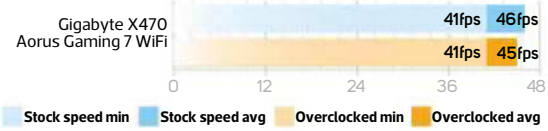


OVERALL



ASHES OF THE SINGULARITY

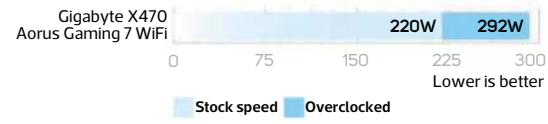
DX12 CPU Benchmark, 1,920 x 1,080, High Settings



TOTAL SYSTEM POWER CONSUMPTION

Idle

Load



PERFORMANCE 33/35

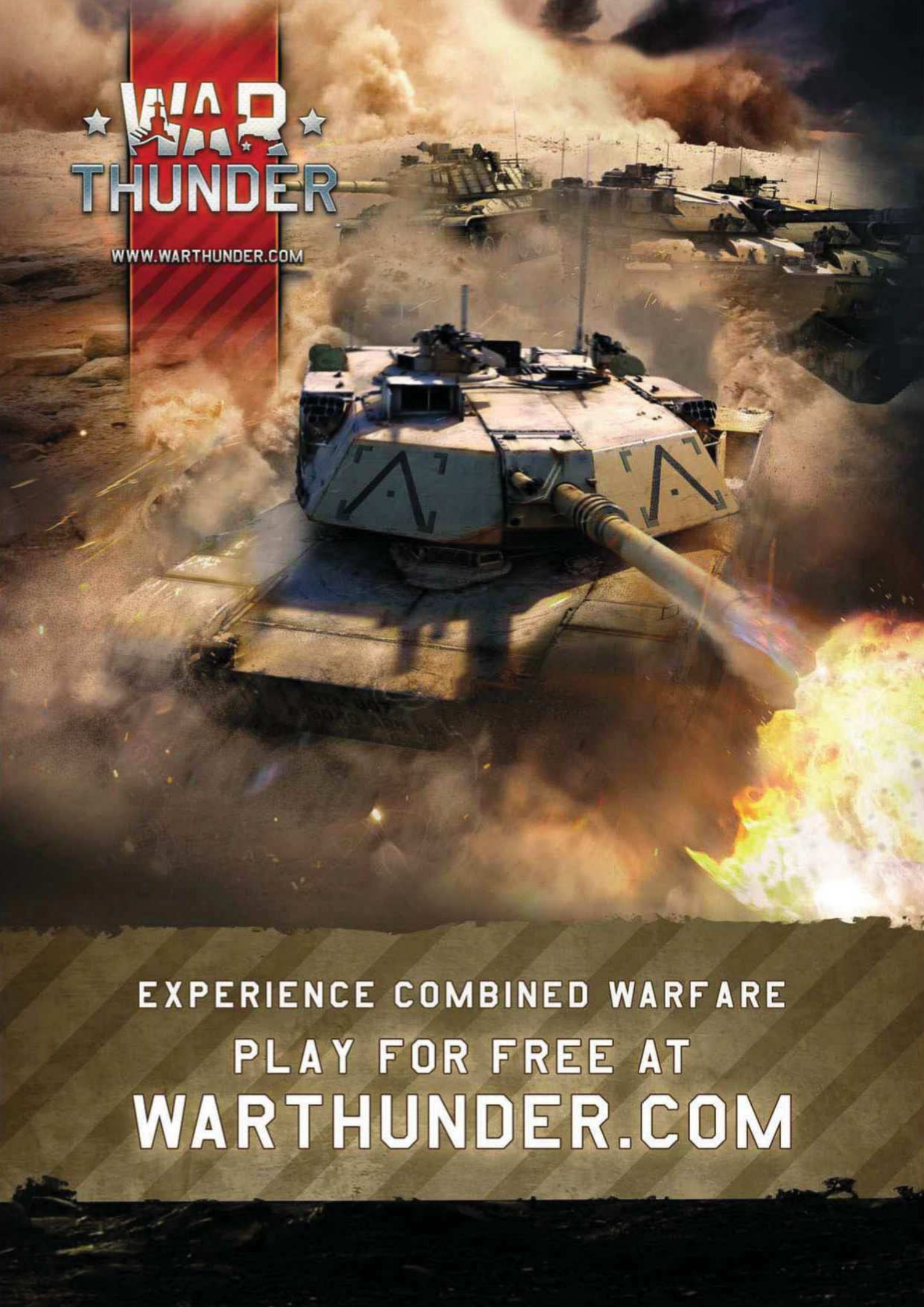
FEATURES 32/35

VALUE 26/30

OVERALL SCORE 91%

VERDICT

A fabulous-looking motherboard with plenty of features and good overclocking performance.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Gaijin

STEAM Oculus VIVE PC PS4 Mac

12

www.pegi.info

MINI-ITX CASE

Kolink Rocket / £160 inc VAT

SUPPLIER www.overclockers.co.uk

If you view the empty room in your PC as wasted space, then the Kolink Rocket will probably appeal to you, simply because more of its volume can be filled with hardware than almost any other case on the market. It's also one of the smallest cases we've reviewed, and has an even smaller volume than Raijintek's tiny Metis. Despite the fact it's the same size as a typical shoebox, though, it can still house a 310mm graphics card. That's enough for most GeForce GTX 1080 Ti cards.

What we have here, then, is one of the smallest cases into which you can actually fit 4K-capable gaming hardware, making cases such as Cooler Master's Elite 130 and Fractal Design's Core 500 look like warehouses by comparison.

Of course, as with many small cases, there are some compromises. For starters, the Rocket is made entirely from aluminium, resulting in a huge asking price. A £160 inc VAT, it's the most expensive mini-ITX case we've ever reviewed, even topping In Win's luscious 901 by at least a tenner. However, it's important to consider that the Rocket is essentially a slightly larger clone of the Dan Case A4-SFX, which is made in partnership with Lian Li and costs a ridiculous £260 inc VAT.

Despite its size, it can still house a 310mm graphics card

With the Rocket's tiny dimensions, ATX PSUs are out of the question, but SFX and SFX-L PSUs are supported, so you can house up to an 800W PSU inside the Rocket, secured to a long vent in the roof at the front of the case. A 3-pin extension cable then runs around from the PSU to the rear of the Rocket, so you can use a normal kettle lead to plug your machine into the mains.

Most of the chassis is screwed together, so getting at the innards and creating some space to work is easy. However, we found that installing the storage first and PSU last – the opposite to the instructions – made our build process much easier. The panels have some fairly sharp edges too, which is a tad disappointing at this price, but they fit together wonderfully and the titanium-grey, brushed anodised finish looks fantastic.

To reduce vibration, the Rocket comes with small adhesive rubber pads, which can be fitted to the base. As the case can be mounted in upright or horizontal modes, eight pads are included in case you change your mind and need to fit more.

There are few other creature comforts, though, with no dust filters being a glaring omission, and an extra we'd definitely add to the inside of each panel, covering the CPU cooler and graphics card.

To cram all the hardware into this space, Kolink has used a PCI-E riser cable that links the motherboard to the graphics card. This cable also adds considerably to the price tag, but is necessary, as your motherboard and graphics card will need to be positioned on opposite sides of the case, both facing a side panel. Thanks to huge vents in both panels, both the CPU and graphics card are practically in the open air, so despite being such a tiny case, cooling shouldn't be too much of an issue, at least for graphics cards.

The CPU is another matter, as the CPU cooler height limit stands at just 54mm. That's still 6mm more than the aforementioned Dan case, but it still meant our test cooler was actually touching the case panel. You'll be limited to using very low-profile coolers, with a cooling capacity of 100W or under, meaning that Intel's high-end desktop CPUs will be out of the question and overclocking could be tricky too. That said, Intel's low-end chipsets for its Coffee Lake CPUs have now landed, and there are already plenty of Z370 and B350 mini-ITX motherboards.

Meanwhile, storage options are fairly limited, with space for just two 2.5in SSDs that sit in a slide-out tray at the base of the case. There's also no room for an all-in-one liquid cooler, as the only fan mount in the case is an 80mm one located in the roof, which is thankfully occupied out of the box, potentially helping the CPU cooler to get rid of some heat.

/SPECIFICATIONS

Dimensions (mm) 125 x 328 x 235 (W x D x H)
Material Aluminium
Available colours Titanium grey
Weight 3.5kg
Front panel Power, 2 x USB 3
Drive bays 2 x 2.5in
Form factor(s) Mini-ITX
Cooling 1 x 80mm roof fan mount (fan included)
CPU cooler clearance 54mm
Maximum graphics card length 310mm

HOW WE TEST
PAGE 44

1 A PCI-E riser cable that links the motherboard to the graphics card

2 The only fan mount in the case is an 80mm one located in the roof

3 The titanium-grey, brushed anodised finish looks fantastic

Performance

As we suspected, the close proximity of the CPU cooler and graphics card to the vented side panels actually resulted in some reasonable cooling performance, with the CPU delta T of 60°C being only 1°C off the Fractal Design Define Nano S, and improving over than the NZXT Manta too.

The GPU delta T was also surprisingly low for a case with just a single 80mm cooling fan, and the Rocket's GPU delta T of 48°C beats the results from the NZXT Manta, Phanteks Enthoo Evolv ITX and Phanteks Evolv Shift.

There's one issue with placing the coolers next to the side panels, though, which is noise, and the graphics card cooler was particularly noticeable during stress testing. As a result, we strongly recommend opting for a quiet graphics card with a decent third-party cooler.

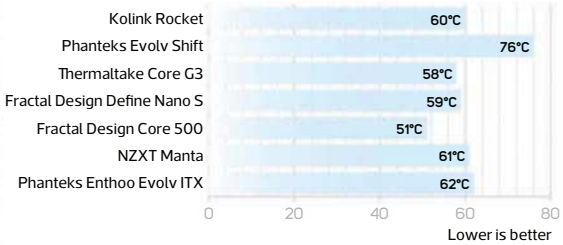
Conclusion

The Kolink Rocket is rather special, despite its high price and a few design quibbles. If you can do without a 3.5in hard disk and don't mind investing in an SFX PSU, it can house a Ryzen 7 CPU or Core i7-8700K system, plus with a GeForce GTX 1080 Ti – a fantastic feat that practically no other case this size can manage. Of course, the likes of Raijintek's Metis Plus and Fractal Design's Core 500 are much cheaper and have the potential to be quieter, but they're also twice the size.

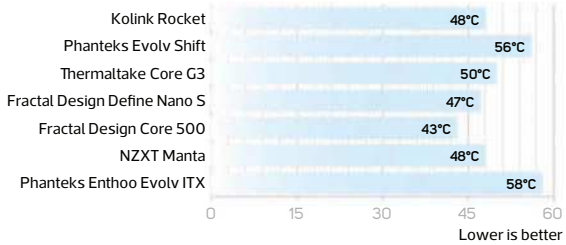
If you're looking to build the smallest, most powerful air-cooled PC possible, the Kolink Rocket is your best option. You can build a 4K gaming PC in this shoebox-sized case, and it also offers generally great build quality and looks, making it a supremely lustworthy case for any small form factor fan.

ANTONY LEATHER

CPU LOAD DELTA T TEMPERATURE



GPU LOAD DELTA T TEMPERATURE



COOLING	FEATURES	OVERALL SCORE
26/30	14/20	81%
DESIGN	VALUE	
27/30	14/20	

VERDICT

Remarkably good cooling for such a small case, and its ability to house a monster PC is a massive boon. It's not cheap, though, and the CPU cooling options are limited.

M.2 SSD cooler shootout

ADATA XPG Storm RGB / £27 inc VAT

SUPPLIER www.amazon.co.uk

ADATA's XPG Storm RGB appears to tick several boxes. It has RGB lighting, it looks fantastic and even sports a tiny fan. Sadly, there's a huge gap between the clips on one end of the heatsink and the SSD, so once it's installed in your M.2 mount, the other end lifts off the SSD.

Even when we'd adjusted the screw so it sat evenly, cooling was disappointing. We tested all heatsinks in two ports – one among the CPU socket and memory, and another at our motherboard's base with better airflow. It recorded the second warmest delta T in the cramped M.2 port at 37°C and could only match the warmest results in the open port at 31°C. Combined with a mass of cables required for the noisy fan and lighting, we suggest steering clear of this one. **AL**

COOLING	DESIGN	VALUE
29/35	21/35	16/30

VERDICT

Despite its fan and high price, the ADATA offers poor cooling and a flawed mounting system.

OVERALL SCORE 66%

Alphacool HDX – M.2 SSDM01 / £13 inc VAT

SUPPLIER www.aquatuning.co.uk

The first company to offer a third-party M.2 heatsink, Alphacool's fairly simple example comprises just two aluminium plates with no fins. As a result, its height is under 3mm including its thermal pad, and it also cools the underside of the SSD. Installation is fiddly, though, with four metal clips installed in each corner requiring a large amount of force to fit compared with the EK heatsink.

The lack of fins hurt it in testing too, with the delta T in our cramped M.2 port coming up 10°C warmer than the best result at 41°C; in the open port, it managed 33°C – both are the worst results on test. It's worth a look if you need a short heatsink, but otherwise, there are plenty of better all-round alternatives. **AL**

COOLING	DESIGN	VALUE
25/35	27/35	23/30

VERDICT

Offers an extremely low profile, but cooling is poor and the installation process is fiddly.

OVERALL SCORE 75%

Aqua Computer KryoM.2 / £9 inc VAT

SUPPLIER www.overclockers.co.uk

Leaving you with enough change from a tenner for a trip to Poundland, the Aqua Computer KryoM.2 is well made and measures just over 5mm tall, sporting a simple heatsink design compared with the larger SilverStone. It's only available in black, like the TP02-M2, but is trickier to install. Aqua Computer's instructions tell you to slide on its metal clips, but doing so damaged the protective tape for sticking to the underside of our SSD, as well as the SSD's label, potentially voiding the warranty. We found it easier to just clip them on from the side.

Cooling ability was excellent, though, with delta Ts of 33°C in the cramped M.2 port and 29°C in the open port, second only to the SilverStone heatsink. If the SilverStone TP02-M2 is too tall, but you still want the best cooling possible, this is the M.2 heatsink for you. **AL**

COOLING	DESIGN	VALUE
32/35	27/35	25/30

VERDICT

Fairly slim, well priced and good at cooling, but watch out for the mounting clips.

OVERALL SCORE 84%

ELITE
NEW ENTRY
P66

EK Water Blocks EK-M.2 NVMe Heatsink / £11 inc VAT

SUPPLIER www.overclockers.co.uk

Available in seven anodised colours, EK's heatsink is well made and its glossy sheen easily makes it the best-looking cooler on test. You get heatsinks for both sides of an M.2 SSD, plus thermal pads. The heatsink attaches using metal U-clips with different tops on either side, allowing you to clip them on from one side at a time through grooves in the base heatsink – it's easier than Alphacool's method. The heatsink is still fairly shallow at 8mm tall, and sits easily beneath graphics cards.

A delta T of 38°C in our toasty top M.2 slot and 32°C in the more open lower slot were 14°C and 13°C better respectively than having no heatsink. Both the AquaComputer and SilverStone heatsinks were cooler and cheaper, but looks are often just as important here, making the EK an excellent buy. **AL**

COOLING	DESIGN	VALUE
29/35	34/35	25/30

VERDICT

A beautiful, good-performing heatsink. There are cheaper, cooler alternatives, but they don't look as good as this one.

OVERALL SCORE 88%

Gelid SubZero M.2 / £8 inc VAT

SUPPLIER www.quietpc.com

The SubZero M.2 comes in black or an anodised red, which has more of a pink hue. It will leave you with change from a tenner too, at just £8, and measures under 5mm thick including its thermal pad, so it can fit into much tighter spaces than the SilverStone.

Installation is blissfully easy, thanks to the use of three rubber O-rings that hold the heatsink onto the SSD. This also means there's no risk of short circuits, so it could potentially be used in laptops too. Its delta T of 36°C in the cramped M.2 port was better than the EK heatsink, while switching to the more open port saw this result fall to 32°C, matching the EK. It's a decent cooler, but there are both better-looking and better-performing heatsinks available. **AL**

COOLING	DESIGN	VALUE
30/35	29/35	26/30

VERDICT

A reasonably low-profile heatsink that's easy to install and won't break the bank.

OVERALL SCORE 85%

SilverStone TP02-M2 / £5 inc VAT

SUPPLIER www.overclockers.co.uk

Including its thermal pad, SilverStone's TP02-M2 rises to over 12mm, making it the tallest passive heatsink on test. It struggles to fit under a graphics card, but does have much more surface area than EK and Alphacool's heatsinks. Amazingly, it also only costs £5 inc VAT. It's extremely easy to install too, with two textured rubber bands holding it in place.

The downside is that the EK knocks spots off it aesthetically. If you want the best cooling for you M.2 SSD, though, the TP02-M2 was the coolest heatsink on test in either of our M.2 slots, managing delta Ts of 31°C and 28°C respectively – 21°C and 16°C lower than when not using the heatsink. It might not be the best-looking or thinnest heatsink, but it's cheap, simple to install and offers fantastic cooling. **AL**

COOLING	DESIGN	VALUE
34/35	29/35	29/30

VERDICT

Fairly slim, well priced and good at cooling, but watch out for the mounting clips.

OVERALL SCORE 92%

GAMING LAPTOP

Asus ROG Strix GL702ZC / £1,300 inc VAT

SUPPLIER www.ebuyer.com

Bucking the usual trend for gaming laptops to be based on Intel CPUs and Nvidia GPUs, Asus' ROG Strix GL702ZC has an all-AMD core spec. It doesn't use the latest 2nd Gen Ryzen silicon (see p21), but it does have an 8-core Ryzen 7 1700 at its disposal, along with a Radeon RX 580 GPU. Asus intends this system to be used for multimedia and creative tools as well as gaming. To that end, this 3GHz CPU has eight cores and 16 threads via SMT, and it can hit a turbo peak of 3.7GHz.

The 1700 supports twice as many threads as Intel's Core i7-7700HQ, which is used in most gaming laptops, although it has a quicker turbo peak of 4GHz. Meanwhile, the Radeon RX 580 has 2,304 stream processors, 4GB of memory and Asus has reduced the clock speed from 1257MHz to 1077MHz, so it doesn't overheat in the laptop.

It has a Ryzen 7 1700 CPU, along with a Radeon RX 580 GPU

The rest of this Strix laptop's specification is more in tune with mobile sensibilities. There's 16GB of DDR4 memory, a 256GB SSD and a 1TB hard disk. Disappointingly, though, the memory is single-channel.

The components are all installed inside a typical Asus Strix design: you'll find logos, dramatic slashes and plenty of air vents. The keyboard has a red backlight, and there's a crimson ring around the touchpad.

Build quality is mixed. The screen feels a little flimsy, and there's a bit of bounce around the trackpad. The base is stronger, but the similarly priced, Intel-based Dell Inspiron 15 7000 Gaming (see Issue 177, p32) was sturdier in all departments, while also being nearly a centimetre slimmer and 0.5kg lighter.

The Asus' extra size doesn't mean easy internal access or more ports either. Asus says it's possible to get inside this machine, but we couldn't get the base to budge. External connections are fine, though, with three USB 3 ports, a USB 3.1 Type-C socket, plus HDMI and mini-DisplayPort outputs.

The Dell didn't have DisplayPort, but it was possible to remove the base panel by taking out a single screw. On the plus side, the Asus' keyboard is fine. The buttons have 1.6mm of travel, which is 0.2mm more than the Dell, and the buttons have a firm, consistent and rapid action – mechanical units still rule the roost, but this is one of the better membrane laptop keyboards we've used.

The key action is surprisingly quiet too, and the base is sturdy. They're paired with a smooth touchpad and a couple of buttons that are shallow and snappy. Our only complaints with the keyboard are that the cursor and number keys are slimmed down, and the power button is on the keyboard itself. Also, while the backlight is adjustable, the LEDs aren't RGB.

/SPECIFICATIONS

CPU 3GHz AMD Ryzen 7 1700
Memory 16GB 2400MHz DDR4
Graphics AMD Radeon RX 580 4GB
Screen size 17.3in 1,920 x 1,080 IPS FreeSync 60Hz
Storage 256GB SanDisk SD8SN8U256G-1002 SSD, 1TB hard disk
Weight 3kg
Ports 3 x USB 3, 1 x USB 3.1 Type-C, 1 x audio jack, HDMI, mini-DisplayPort, SD card reader
Networking Dual-band 802.11ac Wi-Fi
Dimensions (mm) 415 x 280 x 34 (W x D x H)
Operating system Windows 10 Home 64-bit
Warranty One year parts and labour return to base

Performance

The Ryzen 7 1700's extra cores gave it an advantage in multi-threaded tests. Its video encoding result is miles ahead of the Dell's i7-7700HQ, which bodes well for heavily multi-threaded productivity software, However, the Ryzen's lesser single-core speed saw it falter. The Asus scored 28,956 in image editing – but the Dell managed 36,280. Another disappointment is the Kingston SATA SSD, which returned disappointing read and write speeds of 441MB/sec and 405MB/sec, much slower than the latest NVMe drives.

Meanwhile, the desktop-class Radeon RX 580 GPU is fine for gaming at the laptop's native 1080p resolution too, with minimums over 40fps in both Fallout 4 and The Witcher 3. The 29fps minimum in Deus Ex: Mankind Divided is only borderline playable, but a little tweaking in the graphics settings will sort it out. There were only minor differences between the Asus and the aforementioned Dell, with its GeForce GTX 1060 Max-Q graphics system.

That said, while the Asus can play games at 1080p, you'll struggle to get some games running consistently at 60fps to take advantage of the screen's 60Hz FreeSync. The IPS screen stretches its 1080p resolution across a 17.3in diagonal too, which is great. Its brightness level of 391cd/m^2 is huge, and the black level of 0.34cd/m^2 is fine.

The former figure is better than the Dell, while the latter is worse, so while the Asus may seem punchier, the Dell will prove more adept with dark shades. The Asus' contrast level of 1,150:1 is great too, and not far off the Dell's screen. It maintains those levels well too; its backlight uniformity only varied by around 7 per cent, which is excellent. Colour results are mixed. The Asus' delta E of 8.4 is average, and its colour temperature of 7,688K is cooler than the Dell. However, the Asus rendered 83.7 per cent of the sRGB gamut – miles more than the Dell's 56.7 per cent. All in all, the Asus has a decent screen, especially for a laptop of this price.

HOW WE TEST
PAGE 44

The speakers are surprisingly punchy as well, with loads of volume and bass, despite the lack of a subwoofer. The bass masks the top end a little, which makes audio sound a little muddy, but they're otherwise fine. We can't say the same for the battery though. The Asus lasted for 50 minutes in a gaming test and an hour in an application benchmark. That's less than half the longevity of the Dell, but it's not surprising when the Asus uses desktop components.

This machine isn't a good thermal performer either. The CPU and GPU idle delta Ts of 25°C and 27°C are high, and those figures rose to 47°C and 57°C when gaming. In a full-system test, the CPU delta T topped out at 71°C with the GPU running 8°C cooler. Those figures are too high for comfort, but at least no heat made its way to the outside. The big issue is noise. The Asus was louder than the Dell in a gaming scenario, and the Strix's noise went up another notch in a full-system test. The GL702ZC sounds louder than almost any other laptop we've tested recently, like a throwback to older gaming laptops. Even the wrist rest vibrated as the fans spun up.

If you're running this machine at full pelt, you'll struggle to drown the noise out with speakers or a headset. Throttling was evident too, with the CPU's cores jumping between 1.5GHz and 3.2GHz. None of that's a surprise when the Ryzen 7 1700's TDP of 65W is 20W higher than Intel's mobile CPUs, but it shows the downside of using AMD desktop components in a laptop.

Conclusion

The Asus ROG Strix GL702ZC's desktop processor may deliver great multi-threaded performance, but this power-hungry CPU, as well as the desktop Radeon RX 580 GPU, also contribute excessive heat and noise.

The Asus also looks lumbering when compared with the Dell, which offers comparable gaming pace and single-threaded speed in a slimmer, lighter, quieter and more accessible design. It's great to see some new ideas in the gaming laptop arena, but right now you're better off settling for a laptop with a mobile Intel CPU.

MIKE JENNINGS

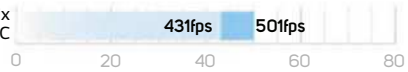
CPC REALBENCH 2015

28,956	373,295	67,222
GIMP IMAGE EDITING	HANDBRAKE H.264 VIDEO ENCODING	LUXMARK OPENCL

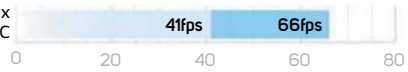
127,597	135,823
HEAVY MULTI-TASKING	SYSTEM SCORE

PERFORMANCE	DESIGN	OVERALL SCORE
17/25	17/25	67%
HARDWARE	VALUE	
16/25	17/25	

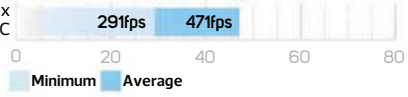
FALLOUT 4
1,920 x 1,080, Ultra Detail, TAA



THE WITCHER 3: WILD HUNT
1,920 x 1,080, High Detail, Nvidia HairWorks off



DEUS EX: MANKIND DIVIDED
1,920 x 1,080, Very High detail, DX12



VERDICT

The use of desktop components proves problematic in several areas, while offering little advantage in terms of performance.

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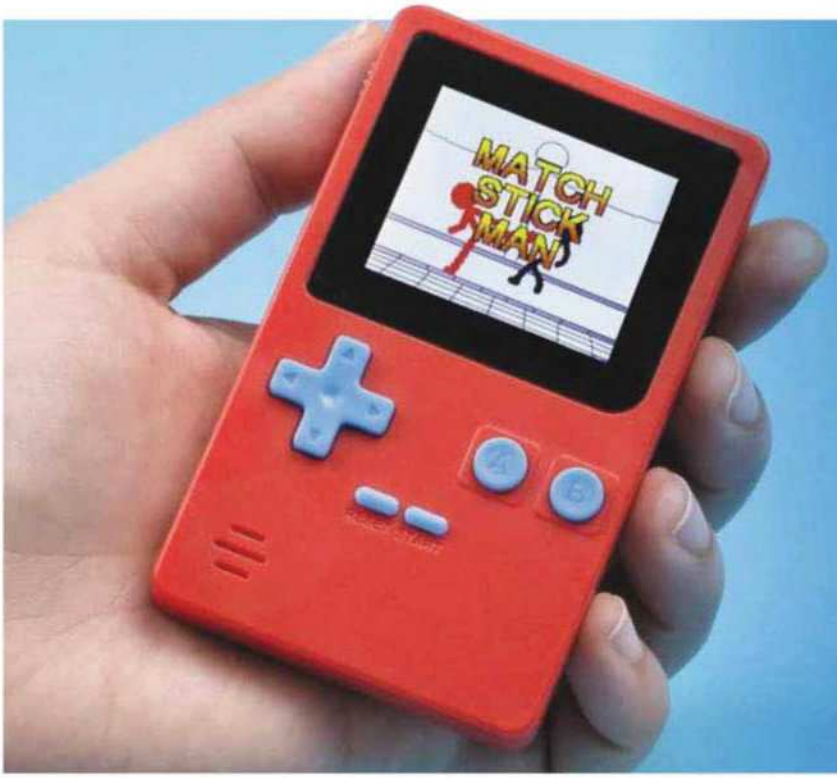
Custom Kit

Phil Hartup checks out the latest gadgets, gizmos and geek toys



Thumbs Up Retro Gaming Console / £17.99 inc VAT

The Thumbs Up Retro Gaming Console crams a huge amount of old-style games into a tiny handheld device. It would have been amazing if you'd had one in the 1980s – it's much smaller than an old LCD Game and Watch, and it not only offers better games, but you get 150 of them.

There's an eclectic mix of games, from shooting galleries and Space Invaders knockoffs to assorted puzzle games and primitive platformers, all played with the classic D-Pad and two-button interface.

There are no standout classics, and it's all fairly rudimentary, but the nature of the system means the games are accessible, making for some cheap occasional fun.

●●●○○

SUPPLIER www.asos.com

Mionix Sargas 400 / £19.99 inc VAT

The Mionix Sargas 400 is a gaming mousepad that does a remarkable job of going unnoticed on the desktop. It has a black microfibre surface suitable for laser and optical sensors, and a rubbery base to keep it stable. What's more, it does all this while only being 2mm thick, making the pad not only easily portable, but also surprisingly stable – unlike thicker pads, it's hard to jog it laterally. The only flaw this brings is that if you have any significant imperfections on the desktop surface itself, you might be able to feel them through the pad. Otherwise, the Sargas 400 provides a small, lightweight and low-profile gaming surface that works really well.

●●●●○

SUPPLIER www.amazon.co.uk

Urbanista Seattle / £99 inc VAT

One of the underappreciated benefits of headphones is that when people see you wearing them they (usually) know not to bother you. If somebody is wearing the Urbanista Seattle headphones, then that's doubly true. They're big. Not gaming headset big, but chunky and ostentatious, prioritising sound quality and comfort way higher than portability and elegance.

The sound quality is superb, and the size of the Seattle allows for a better wireless signal relative to Bluetooth ear buds, plus it has the option of running on a wire if needs be. The headphones are charged by micro-USB and have 20 hours of battery life, but will run off their cable indefinitely. Opinions may differ on how much convenience it's worth sacrificing for sound quality, but the Seattle goes big on the latter and it pays off.

●●●●○

SUPPLIER www.urbanista.com

Infinity VR Headset/ **£29.99** inc VAT

The main aspect of the Infinity VR Headset that's bang on is the adjustable plastic clamp built into the front, locking your smartphone in place when you open and shut the front panel. It might sound like a small detail, but trying to readjust a phone into the proper place once a VR headset is on your head is a nightmare.

Unfortunately, while the Infinity knocks that particular design bugbear on its backside, there are niggling problems elsewhere. The headset itself is quite small and narrow, so you can't wear it over glasses, and while you can adjust the focus to compensate for some sight problems a little, it's still not ideal. The Infinity also lacks an interaction button, which limits what you're able to do with it outside of watching videos, and even then, you don't have any pause or skip controls once the phone is locked in the headset. If you have a Bluetooth controller you can use for games and media controls, and you don't wear glasses, then the VR headset itself works remarkably well for the money, but the whole package could be much better.

●●○○○

SUPPLIER www.firebox.com

Game Boy Alarm Clock/ **£24.99** inc VAT

As you can guess from the name, this digital alarm clock is built into a replica of a classic Nintendo Game Boy case. You set the time and the alarm with the controls and then it sits, looking all Game Boy-like, and tells you the time. There's not much more to it than that. The alarm it plays is the music from Super Mario Land, which is absurdly cheerful – it's genuinely nice to wake up to this tune, and is so disarming that it's hard to stay angry at your alarm clock for too long. For fans of the Game Boy, and specifically ones with fond memories of Super Mario Land, it's a great, albeit expensive, clock, but for everybody else, it's a small, pricey grey box that tells the time and plays a nice tune.

●●●●●

SUPPLIER
www.firebox.com

InfiniteBook Reusable Notebook/ **£13.75** inc VAT

If you still harbour lingering feelings of disappointment that The NeverEnding Story did, in fact, end some 30 years ago then brace yourself, because the InfiniteBook isn't entirely infinite either. It's a cross between an A6 notebook and a whiteboard, offering 15 pages on which you can write, erase, then write all over again. It's a nifty design, with a high-quality feel to the pages and binding, and writing on it is comfortable too. It's a step up over a regular pen and paper notepad for some situations, which is to be expected for the price difference.

●●●●○

SUPPLIER www.amazon.co.uk

Seen something worthy of appearing in Custom Kit? Send your suggestions to editor@custompcmag.org.uk

How we test

PROCESSORS

INTEL LGA1151-V2


Intel LGA1151-V2 CPU

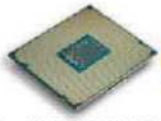

Asus ROG Strix Z370-E Gaming


16GB Corsair Vengeance LED 3000MHz DDR4


480GB Crucial MX500


Zotac GeForce GTX 1080 AMP! Edition

INTEL LGA2066


Intel LGA2066 CPU


Asus ROG Strix X299-E Gaming


32GB Corsair Vengeance LED 3000MHz DDR4


256GB Crucial MX100


Zotac GeForce GTX 1080 AMP! Edition

AMD AM4


AMD AM4 CPU

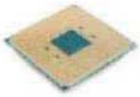

Gigabyte X470 Aorus Gaming 7 WiFi


16GB Corsair Vengeance LED 3000MHz DDR4


256GB Crucial MX100


Zotac GeForce GTX 1080 AMP! Edition

AMD AM4 (APU)


AMD APU


MSI B350I Pro AC


16GB Corsair Vengeance LED 3000MHz DDR4


256GB Crucial MX100

Radeon RX Vega integrated GPU

AMD TR4


AMD TR4 CPU


Asus ROG Zenith Extreme


32GB Corsair 3000MHz Vengeance LED DDR4


256GB Crucial MX100


Zotac GeForce GTX 1080 AMP! Edition

TESTS: We use Custom PC RealBench 2015, Cinebench and Ashes of the Singularity: Escalation, installed on Windows 10 Home 64-bit, and record the power draw of the test PC. These tests cover a broad range of performance characteristics, including image editing, gaming, video encoding and 3D rendering. We run all tests at stock speed and at the CPU's highest overclocked 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.


4.4GHz Intel Core i5-6600K


16GB Corsair Vengeance LED 3000MHz DDR4


Asus Maximus VIII Hero


Windows 10 64-bit

The graphics card we're reviewing

CUSTOM PC REALBENCH 2015

INTEL REFERENCE

Intel Core i7-4790K | 16GB of Corsair 2400MHz DDR3 | 240GB OCZ 150 | Asus Maximus Gene VII | Nvidia GeForce GTX 780 3GB = 100%

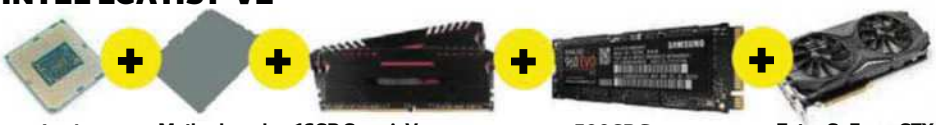
AMD REFERENCE

AMD A10-7850K | 8GB of Corsair 2133MHz DDR3 | 256GB Plextor M5 Pro | Asus A88X-Pro = 100%

Our benchmark suite, co-developed with Asus, simulates how people really use PCs – a higher score is better. You can download them from www.asus.com/campaign/Realbench

MOTHERBOARDS

INTEL LGA1151-V2



Intel Core i7-8700K | Motherboard on test | 16GB Corsair Vengeance LED 3000MHz DDR4 | 500GB Samsung SSD 960 Evo | Zotac GeForce GTX 1080 AMP! Edition

INTEL LGA2066

Intel Core i9-7900X | Motherboard on test | 32GB Corsair Vengeance LED 3000MHz DDR4 | 256GB Crucial MX100 SSD | 500GB Samsung SSD 960 Evo | 2 x Asus Strix Radeon RX 480 8GB

AMD AM4

AMD Ryzen 7 2700X | Motherboard on test | 16GB Corsair Vengeance LED 3000MHz DDR4 | 500GB Samsung SSD 960 Evo | Zotac GeForce GTX 1080 AMP! Edition

AMD TR4

AMD Threadripper 1920X | Motherboard on test | 32GB Corsair 3000MHz Vengeance LED DDR4 | 500GB Samsung SSD 960 Evo | 2 x Asus Strix Radeon RX 480 8GB

TESTS: We use Custom PC RealBench 2015 and Ashes of the Singularity installed on Windows 10 Home 64-bit, and also test the board's SATA and M.2 ports. We try to overclock every motherboard by overclocking our test CPU to its maximum air-cooled level.

TESTS: By using the fast PC detailed on the left, we can be sure that any limitations are due to the graphics card on test, rather than being CPU limited. We test Deus Ex: Mankind Divided, Doom, Crysis 3, Fallout 4 and The Witcher 3: Wild Hunt at their maximum detail settings, in their highest DirectX mode, at several resolutions. High-end cards should be able to sustain playable frame rates at 2,560 x 1,440, while 1,920 x 1,080 is more important for mid-range cards; we also test at 3,840 x 2,160 for 4K monitors, and try to overclock every graphics card we test to assess the performance impact.

The Awards

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

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

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

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

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

LABS TEST

Liquid assets

Antony Leather puts the latest 120mm all-in-one liquid coolers through their paces on the three main CPU sockets

Contents

How we test

When testing CPU coolers, it's important to examine performance across a range of sockets, as mounting mechanisms vary between them. Some coolers perform well on some CPU sockets, but not on others. For this reason, we now test cooling on LGA115x, LGA2011 and AM4 motherboards. As this is **Custom PC**, all our CPUs are overclocked too, so we can weed out the wheat from the chaff.

Our LGA115x test system uses a Core i7-4770K overclocked to 4.3GHz with a 1.15V vcore, a Gigabyte Z97X-UD5H motherboard, 4GB of 1600MHz Crucial Ballistix DDR3 RAM and a 240GB Intel SSD 730. Meanwhile, our LGA2011 rig has a Core i7-3960X overclocked to 4.2GHz with a 1.275V vcore, an MSI X79A-GD45 motherboard, 16GB of G.Skill Ripjaws 1600MHz RAM and a Samsung 830 SSD.

Finally, our AM4 system sports a Ryzen 7 1700 overclocked to 3.8GHz using a 1.34V vcore on an Asus ROG Strix B350 Gaming motherboard, with 16GB of 3000MHz Corsair Vengeance LPX memory and a Crucial MX100 SSD. We've also rehoused our test systems in Fractal Design's Meshify C case, using a be quiet! PurePower 400W PSU, a Sapphire Radeon 5700 graphics card and Windows 10.

We use CoreTemp to measure the CPU temperature, before subtracting the ambient air temperature to give a delta T result, allowing us to test in a lab that isn't temperature controlled. We use Prime95's smallfft test to load the CPU and take the reading after ten minutes.

We've also taken sound readings from 70cm away. Once with the fans and pumps at full speed, and again at low speed with the motherboard fan profile set to silent, to help us gauge each cooler's ability to cool at various fan speeds while minimising noise, although the noise results are only comparable within the confines of this group test.

There's a separate score for each CPU socket, to take into account the different cooling and mounting mechanisms as well as value for money. The feature score includes aspects such as software control, lighting, expansion possibilities and PWM fans, while the design score considers installation, noise and aesthetics. Finally, the value score takes all these results into account with the price.

Akasa Venom R10 / £55 inc VAT, £74 inc VAT with Vegas X7 RGB fan

SUPPLIER www.overclockers.co.uk

A relative newcomer to the all-in-one liquid cooler scene, Akasa has opted for an unusual approach to the Venom R10 – it doesn't come equipped with a fan, resulting in a relatively low price of just £55 inc VAT. That price is especially low when you consider that the Akasa has RGB lighting and full mounting mechanisms for all three of our test systems, while some coolers this month have opted to use the standard AMD AM4 plastic mount.

Sadly, there aren't enough screws in the box to mount two fans to the R10, but these screws are available for a couple of quid should you wish to push the R10's cooling to its limits. With no fan in the box, the world is your oyster, but Overclockers UK currently offers the Venom R10 in several fan bundles, and Akasa sent us its Vegas X7 RGB 120mm fan for review, making for a combined total of £74 inc VAT. Once you hook up the fan and pump to an RGB lighting controller, in this case our Asus motherboard and its Aura software, the Akasa's aesthetics wipe the floor with likes of the ARCTIC Liquid Freezer, and with accurate colours too.

Installation was fairly painless on all three of our CPU sockets, with a backplate being used to mount four pins on LGA115x and AMD systems, while you just need to screw these pins into the threaded holes of Intel LGA2011 sockets. These screws are topped off by thumb screws that lock the pump into place, using separate plates for AMD and Intel systems.

The radiator is a typical half-height affair at 27mm thick, and it has densely packed fins. Like all the other pumps on test, the Venom R10's sports a copper base, while Akasa has opted for a rubber-based tube.

Meanwhile, the RGB lighting on the pump and on Akasa's Vegas X7 fan are compatible with Asus, ASRock, Gigabyte and MSI's RGB lighting software.

What the Venom R10 lacks in airflow, though, it counters with quietness

The Vegas X7 RGB fan is limited to a speed of 1,200rpm, though, which puts it at something of a disadvantage compared with other fans on test, especially with the tightly packed radiator fins. Corsair's Hydro Series H60, for example, can run at an extra 500rpm. What the Venom R10 lacks in airflow, though, it counters with quietness. It was supremely quiet at full speed, dishing out just 39dBA, which is less than NZXT's Kraken M22 using our motherboard's silent setting, and far quieter than any other cooler on test. The pump is similarly quiet too.

Cooling, though, was hampered by the fan, with the LGA115x CPU delta T of 60°C being a whole 11°C off the top spot, with similar losses in the other test systems.

These results are mostly down to the fan speed, as using Akasa's slightly faster Apache Black fan resulted in a 5°C drop in our AMD system, cutting its deficit in half just by adding another 100rpm.

Conclusion

While its cooling isn't the best on test, the Venom R10's results are clearly down to the slow-spinning fans we were sent as samples to test the otherwise fanless cooler. It came within spitting distance of other coolers by adding a slightly more powerful fan, and it's supremely quiet. However, many other coolers undercut it, even in its fanless configuration, so it doesn't offer particularly good value for money.

VERDICT

Extremely quiet, but the R10 needs at least a 1,300rpm fan to be competitive, and it's a tad pricey once you buy a fan for it too.

/ SPECIFICATIONS

Compatibility Intel: LGA2011, LGA2011-v3, LGA2066, LGA115x; AMD: Socket AM4, AM3/+, AM2/+, FM2/+, FM1

Radiator size with fans (mm) 120 x 153 x 52 (W x D x H)

Fans None / 1 x 120mm

Stated noise N/A

LGA115X SCORES

COOLING	FEATURES	DESIGN	VALUE	FITTING	OVERALL SCORE
28/40	13/20	19/20	12/20	MEDIUM	72%

LGA2011 SCORES

COOLING	FEATURES	DESIGN	VALUE	FITTING	OVERALL SCORE
29/40	13/20	17/20	9/20	EASY	68%

AM4 SCORES

COOLING	FEATURES	DESIGN	VALUE	FITTING	OVERALL SCORE
29/40	13/20	17/20	12/20	MEDIUM	71%

Antec Kühler H20 K120 / £40 inc VAT

SUPPLIER www.ebuyer.com

We were amazed to see that Antec's latest 120mm all-in-one liquid cooler – the Kühler H20 K120 – costs just £40 inc VAT. This super-low price makes the Antec cheaper than many current mid-range air coolers, and it even undercuts ARCTIC's bargain-tastic effort with the Liquid Freezer 120 (see p49). In fact, the Antec Kühler H20 K120 retails for less than half the price of NZXT's Kraken M22 (see p52).

Despite the low price, the Kühler feels well made, and even the package even includes a blue glowing fan equipped with anti-vibration mounts to add some pizazz. In addition, Antec has also managed to route the pump's power cable underneath the tubing's braided cover, so there are no cables protruding from the pump at all, with the cable instead protruding from the top of the radiator.

Sadly, the cable has a SATA power plug, so you can't control the pump speed using your motherboard, although at least the fan has a 4-pin PWM connector for speed control. There are also only four fan screws in the box, so you'll need to buy more screws if you want to fit a second fan. Like all the coolers on test, there are also four shorter screws for securing the radiator directly to your case.

The Antec's mounting system uses a backplate for Intel LGA115x sockets, secured using four pins and thumbscrews, along with an attractive metal bracket that surrounds the pump. This system made it one of the easiest coolers on test to install into either of our Intel systems. With AMD motherboards, though, the exact opposite was true, with Antec opting for a hideous metal clip that's difficult to fit and even trickier to remove.

In terms of noise, the Kühler H20 K120 was pleasantly quiet at full speed, with its sound measurement of 44dBA only coming second to the Akasa Venom R10 and its slow-spinning fan. However, we found that the noise didn't tail off as much as we'd hoped when we switched to our motherboard's silent fan speed profile, with the 41dBA recorded here being a whole 10dBA louder than the Cooler Master MasterLiquid ML120L RGB and also louder than Akasa's cooler at its maximum fan speed.

Cooling wasn't particularly potent in our AM4 and LGA115x systems either, with the Antec coming second from bottom, with results of 50°C and 45°C respectively. However, it fared a little better in our LGA2011 system, with its delta T of 52°C only 1°C adrift of Corsair's H60 and 2°C warmer than the Cooler Master MasterLiquid ML120L RGB.

Conclusion

The Antec Kühler H20 K120 is certainly cheap compared with the competition, and it coped well with all our overclocked CPUs, while also being the second quietest cooler on test under load. It's also well made and good-looking, and it has decent mounting options for Intel systems. Antec should also be commended for routing the pump power cable through the tubing, as this setup makes the finished product look very neat once installed. However, it lacks pump speed control, it was the loudest cooler when we switched to our motherboard's silent profile and its AM4 mounting mechanism is hideous. It might cost less than the competition, but the small amount of extra cash for the Cooler Master MasterLiquid ML120L RGB or ARCTIC Liquid Freezer 120 is definitely worth it.

VERDICT

Cheap, well made and relatively good cooling, but it can be noisy and its AMD mount is dreadful.

/ SPECIFICATIONS

Compatibility Intel: LGA775, LGA2011, LGA2011-v3, LGA2066, LGA115x, LGA1366; AMD: Socket AM4, AM3/+, AM2/+, FM2/+, FM1
Radiator size with fans (mm) 120 x 154 x 52 (W x D x H)
Fans 1 x 120mm
Stated noise Up to 30dBA

LGA115X SCORES

COOLING	FEATURES	OVERALL SCORE
31/40	10/20	75%
DESIGN	VALUE	
16/20	18/20	
FITTING		
EASY		

LGA2011 SCORES

COOLING	FEATURES	OVERALL SCORE
35/40	10/20	75%
DESIGN	VALUE	
15/20	15/20	
FITTING		
EASY		

AM4 RSCORES

COOLING	FEATURES	OVERALL SCORE
33/40	10/20	73%
DESIGN	VALUE	
12/20	18/20	
FITTING		
HARD		

ARCTIC Liquid Freezer 120 / £55 inc VAT

SUPPLIER www.novatech.co.uk

ARCTIC's Liquid Freezer 120 was featured in our last 120mm all-in-one liquid cooler group test, but ARCTIC hasn't updated it since, and we're largely glad about that. Despite its low price, the package manages to include two 120mm fans, along with a large, 50mm-thick radiator that makes for the most potent cooling system on test. There's no RGB lighting here, though, and build quality feels a little light in places, but we've been using this cooler ourselves for several months and it's held up well.

The Liquid Freezer 120 uses the standard Asetek mount, which comprises a bunch of pins and thumbscrews for all CPU sockets. You get a backplate for LGA115x systems, while for AM4 systems you reuse the standard backplate included with your motherboard.

The ARCTIC was also one of the first coolers to offer compatibility with AMD's Socket AM4, but weirdly, the company still hasn't opted to include the right mounting pins and plate for AMD's new socket (which is slightly different to older AMD sockets) out of the box. Thankfully, you only need to apply for a free upgrade kit once you've bought your cooler to get these parts, although the ARCTIC is the only model on test this month where you don't get the AM4 bits in the box as standard.

With two 120mm fans in tow, you get all the gear to use both fans at the same time. ARCTIC has also made the genius move of allowing both fans and the pump to be daisy-chained together, so they can all be powered using a single 4-pin PWM fan header, although you can also power them all separately if you want.

The two fans and the added girth of the radiator make for a large volume, though, stretching to a depth of 99mm, which is twice the depth of many other coolers on test. You'll need to make sure your case has enough clearance to avoid any embarrassing rage quits when you find it doesn't fit. We also suggest installing the pump and first fan at the start, before installing the rear fan, as the bulk of the second fan can prevent access to the pump once it's installed.

> Both the fans and the pump can be daisy-chained together

Cooling was excellent, as we've come to expect from this cooler, and it topped two out of our three graphs by 2°C. The only time it gave up its crown was in our AM4 system, where it was beaten by the NZXT Kraken M22 and matched by Cooler Master's MasterLiquid ML120L RGB, but it's still a potent AM4 cooler.

Noise-wise, the Liquid Freezer 120 was middle of the road at full speed, with the 45dBA reading on our sound meter sitting halfway between the blissful Akasa Venom R10 and MasterLiquid ML120L RGB, which posted 50dBA. It was a tad noisier on the meter compared with the other coolers using our motherboard's silent fan speed mode, recording 38dBA, but it still sounded very quiet to our ears.

Conclusion

Despite its lack of RGB lighting, ARCTIC's Liquid Freezer 120 is still a force with which to be reckoned in the 120mm liquid cooler market, and it scores highly in every area.

It offers excellent value for money at £55 inc VAT, it has the best cooling on test, a well thought-out design, and you can control both the fans and the pump. It also has good mounting mechanisms for all major CPU sockets – it's a shame the AM4 gear isn't included in the box as standard, but it's easy enough to get hold of it. Look no further if you need a 120mm all-in-one liquid cooler.

VERDICT

Still the best 120mm all-in-one liquid cooler around. The only downside is the lack of RGB lighting.

SPECIFICATIONS

Compatibility Intel: LGA2011, LGA2011-v3, LGA115x, LGA1366; AMD: Socket AM4, AM3/+, AM2/+, FM2/+, FM1

Radiator size with fans (mm) 120 x 155 x 99 (W x D x H)

Fans 2 x 120mm

Stated noise Up to 0.3 sones

LGA115X SCORES

COOLING	FEATURES	OVERALL SCORE
38/40	16/20	90%
DESIGN	VALUE	
17/20	19/20	
FITTING		
EASY		

LGA2011 SCORES

COOLING	FEATURES	OVERALL SCORE
38/40	16/20	86%
DESIGN	VALUE	
16/20	16/20	
FITTING		
EASY		

AM4 SCORES

COOLING	FEATURES	OVERALL SCORE
36/40	16/20	85%
DESIGN	VALUE	
14/20	19/20	
FITTING		
EASY		

Cooler Master MasterLiquid ML120L RGB / £45 inc VAT

SUPPLIER www.box.co.uk

The last 120mm all-in-one liquid cooler we saw from Cooler Master was its MasterLiquid 120, which put in a decent effort. However, not only has the company since revised the design and included a plethora of RGB lighting, but the new cooler also costs just £45 inc VAT, which undercuts the original cooler by £20 and comes close to making the ML120L the cheapest cooler on test.

Both the powerful MF120R RGB 2,000rpm fan, which retails separately for around £10 inc VAT, and pump sport RGB LEDs. They can also both be controlled separately or together using an included three-way RGB LED splitter cable, allowing you to power an LED strip in addition to the fan and pump from one RGB LED header on your motherboard.

There's an extension cable for you to connect all the paraphernalia too, and Cooler Master has even managed to include a basic lighting controller in the box. This controller can switch between several colours, brightness setting and lighting effects, and will come in handy if your motherboard doesn't support RGB lighting.

You'll need a 4-pin Molex connector to power the controller, but the RGB lighting proved to be vibrant and accurate, working fine with the Asus Aura software we used with our motherboard.

Should you wish to expand the cooling potential, Cooler Master includes eight long fan screws allowing you to add a second fan to the radiator, but shorter screws are also included to mount the radiator directly to the case with the single included fan in push mode, blowing air through the radiator.

Installing the MasterLiquid ML120L RGB was relatively easy, although there's some construction work required to mount plates to the cooler. On Intel sockets, you'll need to hold the cooler in place while you deal with some small, fiddly thumbscrews. On AM4 motherboards, you only get a two-point clamp, as with this cooler's predecessor, but you can lock it down quite firmly using the included thumbscrews, and it's blissfully easy to fit too.

> Cooler Master has even included a basic lighting controller

Noise wasn't a strong point for the MasterLiquid ML120L RGB, which dished out 50dBA at full speed, although its noise is still preferable to the whiny pump on Corsair's H60 cooler (see p51). Amazingly, the exact opposite occurred when we switched to our motherboard's silent fan speed mode. Both the fan and pump can be controlled using fan headers, and the MasterLiquid ML120L responded well to our silent mode with the system at idle, with the noise bottoming out at just 31dBA, making it barely audible at all outside the case.

Cooling was good in all our test systems too, with second-place spots in our Intel systems and joint second place with ARCTIC's Liquid Freezer 120 (see p49) in our AMD system, with its CPU delta T of 42°C sitting behind the top 40°C result recorded by NZXT's Kraken M22 (see p52).

Conclusion

It might not have the cooling clout or low noise offered by the ARCTIC Liquid Freezer 120, but the MasterLiquid ML120L RGB still offers great value for money, dishing out decent cooling on all our CPU sockets, along with full RGB lighting. It's also especially quiet once the fan and pump spin down. If you're on a tight budget, you really want RGB lighting and you're prepared to reduce the top-end fan speed, the Cooler Master is the cooler for you.

VERDICT

Great lighting, superb value and decent cooling, although it's a tad loud at full speed.

/SPECIFICATIONS

Compatibility Intel: LGA775, LGA2011, LGA2011-v3, LGA2066, LGA115x, LGA1366; AMD: Socket AM4, AM3/+, AM2/+, FM2/+, FM1

Radiator size with fans (mm) 120 x 157 x 52 (W x D x H)

Fans 1 x 120mm

Stated noise Up to 30dBA

LGA115X SCORES

COOLING	FEATURES	OVERALL SCORE
36/40	19/20	87%
DESIGN	VALUE	
13/20	19/20	
FITTING		
EASY		

LGA2011 SCORES

COOLING	FEATURES	OVERALL SCORE
37/40	13/20	84%
DESIGN	VALUE	
18/20	16/20	
FITTING		
EASY		

AM4 SCORES

COOLING	FEATURES	OVERALL SCORE
36/40	13/20	84%
DESIGN	VALUE	
16/20	19/20	
FITTING		
EASY		

Corsair Hydro H60 (2018) / £75 inc VAT

SUPPLIER www.scan.co.uk

As one of the first companies to enter the all-in-one liquid cooler market, Corsair has had a stab at nearly every radiator size and has also been adding to its line-up this year, with monsters such as the Hydro H150i. However, the H60 probably sounds familiar, as the company has simply used the same name for multiple generations of coolers of this size. This version, which is new for 2018, has an updated mounting mechanism that differs from the usual Asetek design, although it works in a similar way.

There's a backplate for Intel LGA115x motherboards, with all Intel socket mounts requiring the usual mounting pins and thumbscrews. You also now get two pairs of separate slide-on plates to cater for AMD and Intel motherboards, although removing these plates proved quite tricky, as they're firmly locked in place. Corsair has also opted for a basic two-point mounting mechanism that makes use of the stock AMD mounts, which always feels a little flimsy and could hamper cooling. On the plus side, installing and removing the pump was blissfully easy on our AMD motherboard as a result.

Corsair includes a premium SP120 fan with the H60, and it's a bit of a monster, with a top speed of 1,700rpm. It needs to be controlled separately, but its 4-pin PWM fan header means most motherboards will be able to adjust its fan speed.

Sadly, the pump requires a SATA power connector, so it can't be adjusted, which is a shame, as slowing down the pump lead to noticeably quieter noise levels when a system is idle or under low loads.

The H60 has also received a makeover in the form of a graphite-coloured illuminated pump top, while the radiator has squared edges to give it a smarter look, although there's no RGB lighting. There's also only enough screws in the box to mount a single fan; you'll need to purchase additional screws to make use of the second fan mount on the radiator.

Corsair includes a premium SP120 fan with the H60

In terms of noise, the H60 has one of the quietest results on test at idle, recording just 35dBA, although this result doesn't reveal the full story. The fan might be quiet, but the pump is the loudest on test by far, and it exhibited an annoying whine that was audible outside of the case.

At full speed, the noise was similar to the NZXT Kraken at 48dBA, but even then the pump was still audible. On the plus side, cooling ability is reasonable, but the likes of the ARCTIC Liquid Freezer 120 and Cooler Master MasterLiquid ML120L RGB were a little cooler in all our test systems.

Conclusion

At £75 inc VAT, the H60 offers better value for money than NZXT's Kraken M22, but the fact that it costs £25 more than ARCTIC and Cooler Master's offerings means it's just too pricey for the cooling on offer. The biggest issue, though, is that the pump makes an annoying, loud noise. Unfortunately, you can't even rectify this problem, as there's no way to slow it down, which we've been able to do with other Corsair coolers in the past with dramatic results and little impact on cooling. There's also no software and no RGB lighting. While Corsair's new high-end all-in-one coolers are excellent, the cheaper H60 struggles to compete at its current price.

VERDICT

An attractive, well-made cooler, but the pump is too noisy and the price is too expensive compared with the competition.

/ SPECIFICATIONS

Compatibility Intel: LGA2011, LGA2011-v3, LGA2066, LGA115x, LGA1366; AMD: Socket AM4, AM3/+, AM2/+, FM2/+, FM1

Radiator size with fans (mm) 120 x 157 x 52 (W x D x H)

Fans 1 x 120mm

Stated noise Up to 28.3dBA

LGA115X SCORES

COOLING	FEATURES	OVERALL SCORE
35/40	11/20	70%
DESIGN	VALUE	
13/20	11/20	
FITTING		
EASY		

LGA2011 SCORES

COOLING	FEATURES	OVERALL SCORE
36/40	11/20	69%
DESIGN	VALUE	
13/20	9/20	
FITTING		
EASY		

AM4 SCORES

COOLING	FEATURES	OVERALL SCORE
35/40	11/20	68%
DESIGN	VALUE	
11/20	11/20	
FITTING		
EASY		

NZXT Kraken M22 / £90 inc VAT

SUPPLIER www.ebuyer.com

With so many solid offerings from NZXT's other cooler models, featuring great RGB lighting and software control, we had high hopes for the Kraken M22. However, while this 120mm cooler also sports the hologram-like lighting of its more expensive siblings, that's the only part of the cooler that can be controlled using NZXT's CAM software. The pump and fan sport 3-pin and 4-pin headers respectively, so you'll be relying on your motherboard to control them. Thankfully, though, that still means the Kraken M22 has an advantage over the likes of Corsair's H60, where the pump is powered by a SATA connector and its speed is fixed.

NZXT has clearly been listening to user feedback as well, and the company has accordingly ditched nearly every cable that was attached to the pump, except for the USB cable to control the RGB lighting. This change massively improves the tidiness around the CPU socket, which is usually covered in cables when you're using one of NZXT's other coolers.

The pump is powered by a cable that's fed within the tubing to a circuit on the rear of the radiator fins, allowing you to route the cable out of sight to a fan header on your motherboard. Thankfully, this circuit also sits directly behind the fan hub, so its impact on airflow performance should be minimal.

Meanwhile, you get enough fan screws in the box to install a second fan on the other side of the radiator and create a push-pull airflow setup and, unlike Corsair, NZXT has opted for a proper four-pin mount for AMD's Socket AM4 too. For some reason, the backplate has been made more complicated, though, as you now need to screw four pins to it prior to securing the cooler using four sprung screws. That said, the end result feels more solid than the typical mounts we've seen on Asetek-made coolers in recent years.

In terms of noise, the Kraken M22 was fairly loud at full speed, recording the highest number of decibels, although sitting next to it was a more pleasant experience than with the Corsair H60 and its loud pump.

> NZXT has ditched nearly every cable attached to the pump

The noise levels were certainly reduced when we opted for our motherboard's silent fan speed mode too, and again the noise experience was more pleasant than with the Corsair H60, but the NZXT was actually louder here than the Akasa Venom R10 at full speed – with results of 41dBA compared to 39dBA. Cooling ability was average on our Intel motherboards, but not far off the top spots. However, the NZXT Kraken M22 excelled at dealing with our AMD Ryzen 7 1700 CPU, posting the best cooling result by 2°C, and sitting a good 10°C below the warmest AM4 result on test.

Conclusion

Overall, the NZXT Kraken M22 is disappointing when you're accustomed to the superb quality of NZXT's larger, more expensive coolers. There's no way to control the fans using NZXT's CAM software, and the M22 didn't prove to be particularly quiet at full speed or using our motherboard's silent fan profile either.

Cooling was also mediocre in our Intel systems and while its AM4 cooling is great, there are still cheaper, quieter options that offer a better deal. Most notably, Cooler Master's MasterLiquid ML120L RGB and ARCTIC's Liquid Freezer 120 are both quieter than the M22, and will save you a fair amount of cash as well.

VERDICT

Not up to NZXT's usual high standards. The M22 offers great AMD cooling ability, but it's too loud and expensive overall.

/ SPECIFICATIONS

Compatibility Intel: LGA2011, LGA2011-v3, LGA2066, LGA115x, LGA1366; AMD: Socket AM4, AM3/+, AM2/+, FM2/+, FM1

Radiator size with fans (mm) 120 x 152 x 58 (W x D x H)

Fans 1 x 120mm

Stated noise Up to 36dBA

LGA115X SCORES

COOLING	FEATURES	OVERALL SCORE
35/40	16/20	74%
DESIGN	VALUE	
13/20	10/20	
FITTING		
EASY		

LGA2011 SCORES

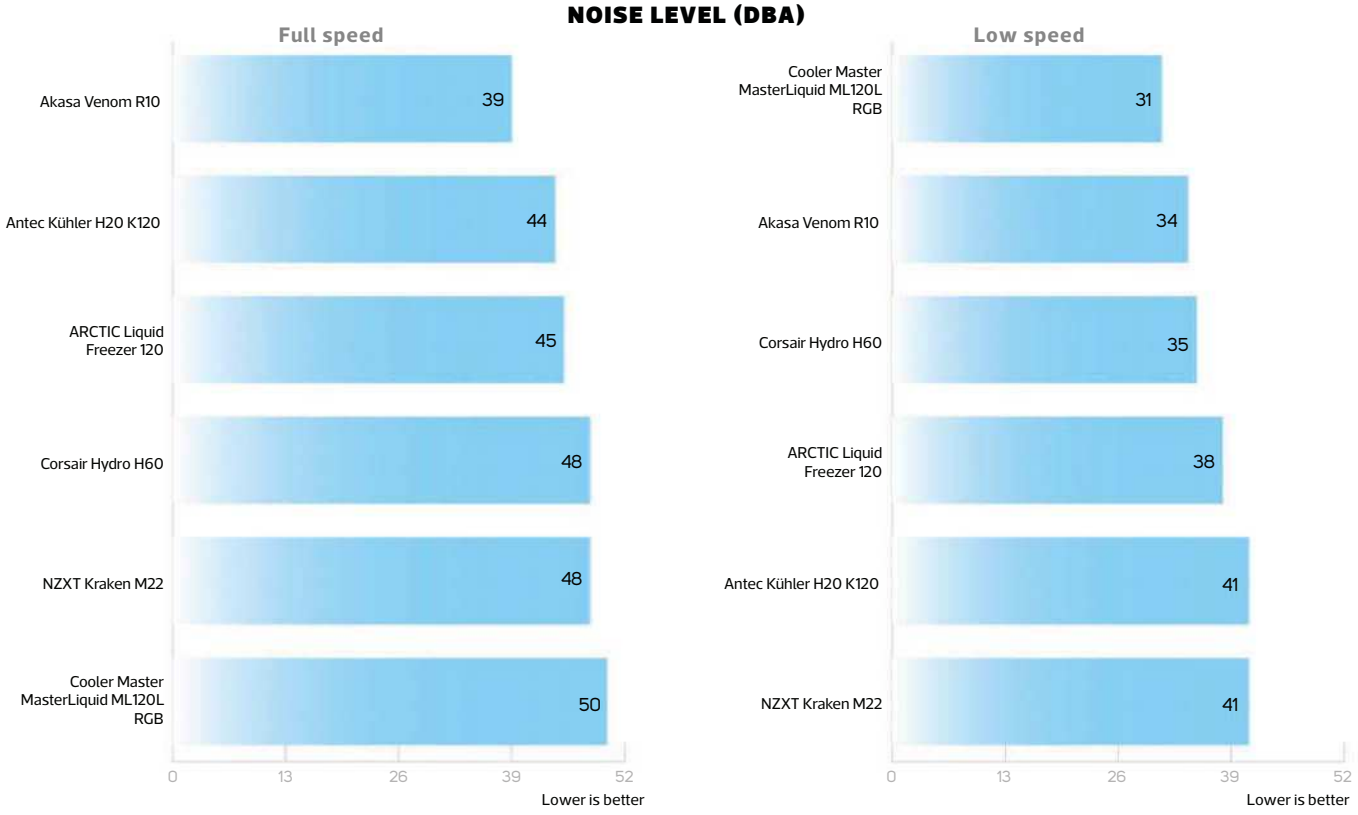
COOLING	FEATURES	OVERALL SCORE
35/40	16/20	72%
DESIGN	VALUE	
10/20	11/20	
FITTING		
EASY		

AM4 SCORES

COOLING	FEATURES	OVERALL SCORE
38/40	16/20	75%
DESIGN	VALUE	
10/20	11/20	
FITTING		
EASY		

TEMPERATURE DELTA T (°C)

NOISE LEVEL (DBA)



LABS TEST

Unwired for sound

Edward Chester checks out some of the latest sub-£200 wireless gaming headsets

Contents

How we test

Of all the peripherals in your gaming arsenal, the headset is the one that benefits most from being wireless while having the fewest drawbacks. They allow you to get up and stretch your legs in between rounds without missing out on team chat, you can sit back in comfort to watch a film without disturbing your neighbours and, of course, you don't have a cable dangling across your desk.

What's more, because our hearing isn't sensitive enough for millisecond delays to be noticeable, the usual problems with wireless mice and keyboards are a non-issue for headsets. Given that they're such a great idea, it's surprising how few options are available. Hugely popular headset brands such as HyperX, Roccat and Sennheiser don't even make wireless headsets at all, while the likes of Corsair, Razer and SteelSeries only have a couple of options each. Thankfully, though, there are enough available for us to pick out four priced between £100 and £150.

Not surprisingly, given their relatively narrow price range, they all offer similar features. Each has a pair of speakers with optional virtual surround sound, and they all offer some form of retractable or removable microphone. As such, our assessment will largely concern those devilish details. Build quality, styling and comfort will be the first areas to assess.

Then come the extra features. Are there any extra buttons, additional connection options or different modes? Does changing the surround sound require delving into software or is there a button for it? Wireless range is also a factor. Nearly all wireless headsets offer a good enough range for them to work fine for the vast majority of cases, but we'll see what happens if you really like to wander too.

Finally, there's sound quality. When it comes to the microphone, we want to hear a full, clear sound with good elimination of background noise.

Meanwhile, for the headphone portion, peoples' preference for sound quality varies greatly, but we're looking for a more even sound. All too often, gaming headsets pump up the bass and treble for an impactful sound, which is fine for a bit of shooting action, but it can get tiresome during long gaming sessions, and it can make some music sound outright bad.

Corsair HS70 / £100 inc VAT

SUPPLIER www.overclockers.co.uk

The HS70 is Corsair's brand-new entry-level wireless headset. Like its wired cousin the HS50, it offers a cheaper, simpler alternative to the company's more expensive Void range of headsets. As well as being the cheapest headset in Corsair's wireless range, it's also the cheapest headset in this test, and some of that cost saving is immediately clear.

While all the other headsets have earcup mounts that rotate left and right to a greater or lesser extent, the HS70 is fixed on this axis. The earcups still tilt up and down (or in and out, really), though, so there's still some allowance for different-shaped heads.

Nonetheless, the HS70 isn't the most comfortable headset we've ever used. Neither the earcup nor the headband padding is particularly thick, and the lack of grip from the earcups means there's a little more weight coming through the headband than on some headsets. It's by no means a bad fit, but some other headsets are definitely more comfortable.

When it comes to styling, though, Corsair has done an excellent job. The simple oval earcups, the all-black colouring and the generally uncluttered symmetrical look looks superb. If you do want your headset to show off a little more flare, there's also a white and black version, and an SE model that adds touches of rose gold.

As for build quality, the HS70 is fine in terms of ruggedness, and the fit and finish, but there are a couple of other areas where that slightly cheaper price shows through. The microphone, for instance, doesn't retract, but it's removable and there's just a rubber bung to cover the hole where it fits – an accessory that's likely to almost immediately get lost.

Other little areas such as the volume wheel and buttons also feel a bit cheap and generic. But then this headset's price is at least £25 cheaper than the rest of the pack this month.

In terms of overall features, you get that volume wheel, the microphone, a mute button and a micro-USB input, all of which are found on the left earcup. Meanwhile, the power button sits on the right earcup. The only notable missing feature is an analogue input, which means you can't plug this headset into your hi-fi amp, for example.

Sound quality from the microphone is just about adequate. The sound is a bit shrill, with little to no bottom end at all, but the directional pickup is decent, so background noise doesn't interrupt your speech too much. The sound quality from the headphone portion of the headset largely impressed though. Corsair has opted for a reasonably flat EQ, with just a little boost to bass and top-end frequencies. The latter can sometimes make cymbals in music sound a little shrill but it's far less pronounced than on some headsets.

> The sound quality from the headphone portion of the headset largely impressed

Finally, Corsair's claimed 16 hours battery life is about middling for a wireless headset, but it's enough that most users will be able to get away with charging it once a week or so.

Also, we have a spoiler alert regarding our wireless range test, which is that all the headsets on test performed identically, stretching to around 10m in the open but all failing within 5m as soon as a wall was in the way of the signal.

Conclusion

The Corsair HS70 is a decent entry-level wireless headset. It looks good, delivers solid audio performance and has all the essentials. However, the reason for its low price can be seen across the board. It isn't the most comfortable headset to wear, its feature list is the minimum required and the microphone's sound quality certainly isn't anything to write home about. It's a decent headset if you're on a tight budget, but we recommend spending a little more if you can afford it.

SOUND	FEATURES & DESIGN	VALUE	OVERALL SCORE
30/40	22/30	27/30	79%

VERDICT

A solid option if you're on a tight budget, but it's worth spending a little more money if you can afford it.

Logitech G933 Artemis Spectrum / £125 inc VAT

SUPPLIER: www.currys.co.uk

The G933 is Logitech's flagship gaming headset, and it comes with as many features as that status would imply. It's wireless, of course, plus it has lights and it's festooned with buttons. For £125 inc VAT, it certainly offers plenty of bang for your buck. However, it isn't subtle. Available in black or white versions, both models have a striking angular design with illuminated strips running down the front edge of each earcup, and a metallic paint job on the earcup holders. It turned out to be a bit of a divisive design in the office in terms of styling, but that's all down to your personal taste.

In terms of ergonomics, the earcups tilt up and down and fold flat ,and the headband then extends by about 40mm on either side. Combined with the angled earcup design and generous earcup padding, the result is a comfortable and versatile headset. There's plenty of space inside the earcups, so your ears aren't squished, and the grip on the sides of your head is well balanced, taking the strain off the headband without clamping your head too hard.

But, getting back to those features, the left earcup is festooned with buttons. The top one is the power switch and the bottom one is for muting the microphone. In between them you'll find three more buttons, which are programmable via Logitech's software. By default, these buttons alternate between EQ profiles, turn the surround sound on or off and cycle through the various sound effects. However, you can also set them to mute audio, change the microphone settings and perform dozens of other jobs, such as setting off gaming macros.

They're quite a useful addition in theory, but in practice they're all so clustered together, it can be difficult to hit them quickly and accurately, and it's all too easy to knock the volume wheel while you're trying.

On the underside of the left earcup, you'll find inputs for USB and analogue audio, so you also a couple of wired options for when the wireless battery runs out. Speaking of which, the battery sits below a removable panel in the left earcup. It's really easy to pop out and replace it, as long as you can find a replacement. Battery life is less impressive though – it's rated for just 12 hours with no lighting and 8 hours with lighting.

Meanwhile, under a similar flap on the right earcup there's a place where you can store the wireless transceiver when it's not in use. The final extra on the left earcup is a stowable microphone. It drops down then extends out. It picks up a far deeper, warmer sound than most headsets on test, making for a pleasant, natural-sounding voice delivery. It also does a decent job of ignoring background noise.

> There's plenty of space inside the earcups, so your ears aren't squished

However, when it comes to the audio from the headphones themselves, the default tuning of the G933 leaves little to be desired. The bass and treble have been boosted far too much, creating an unnatural and harsh sound that really doesn't work very well for a broad range of music. In games it's less immediately obvious, and the treble boost can sometimes pick out a little more detail here and there, but it's preferable to have a flat EQ and then dial in these boosts yourself later, rather than having it set in stone.

Conclusion

The Logitech G933 is packed with features, most of which are genuinely useful, such as the doors hiding the battery and wireless transceiver. It's also a very comfortable headset to wear, and microphone quality is excellent. However, there are just a few too many buttons to make them easily usable, and you can get better-rounded headphone sound quality elsewhere.

SOUND	FEATURES & DESIGN	VALUE	OVERALL SCORE
30/40	24/30	27/30	81%

VERDICT

Comfortable to wear and a great microphone, but the sound is a bit iffy and it's too

Razer Thresher / £150 inc VAT

Supplier www.razer.com

Razer offers a couple of wireless headset options. There's the PC-only Man O' War or the Thresher, which comes in PS4 and Xbox One versions. Don't be put off by the console branding, though, as both these headsets are also PC-compatible.

Besides, all three headsets offer essentially the same core features, and cost correspondingly similar amounts of money. For this review, we're looking at the PS4 flavour of the wireless Thresher.

What first strikes you about the Thresher when you pick it up is that the overall build quality feels a little lower than its price suggests. Like the Corsair HS70 (see p55), it's perfectly rugged, but there's no premium soft-touch finish, the padding doesn't feel quite as luxurious as the padding on some headsets, and the volume wheels in particularly are pathetic tiny controls.

It's still an attractive-looking headset though. The circular earpieces and symmetrical design looks far cleaner than the angled 'gamer' styling of the Logitech G933 (see p56). It's reasonably comfortable to wear too. The earcup padding is soft and deep so they won't squash your ears, and while the top padding isn't all that great, the sheer size of the headband provides good weight distribution. It's not the most secure headset we've worn, but it's adequate for all but the most violent of gamers.

Likewise, the middling selection of features seems a bit light for the asking price. There's a retractable microphone and volume controls for both the headphones and microphone, but you miss out on an analogue input and any of the extra buttons you'll find on the Logitech G933. We really can't overstate the annoyingness of the small volume wheels either. As well as controlling the volume, you can also press them to mute the two headphones or microphone, which actually serves to make the ergonomics even worse.

Setting up the headset with a PS4 is simple. You just plug in the wireless receiver and supplied optical cable, then just change a few settings on the console. It's a fine, easy setup procedure. Meanwhile, setting up the Thresher for PC use just involves using the included wireless transceiver.

When it comes to audio, as with the other headsets on test, you get a pair of stereo drivers, but the Thresher also has the option of virtual surround sound, and that's one area where the Razer trumps most of the competition this month. Razer's Windows driver includes a tool for changing the surround positioning.

> Razer's Windows driver includes a tool for changing the surround positioning

We sometimes find that surround headsets can over emphasise sounds to the rear, and the Thresher was no different, so being able to tweak the balance forward made for a much more accurate soundscape.

What's more, this headset produces very good sound quality. Razer claims a frequency response of 18-28,000Hz, which is quite a bit wider than the 20-20,000Hz of the other headsets, and while written frequency reproduction specs rarely give you the full picture, the Razer's sound definitely offers a little more depth and range then much of the competition.

The EQ is okay too. The bass and treble have been boosted, but not so much that they're ever distracting. The microphone audio quality is also up to snuff – it's not as good as the Logitech but much better than the Corsair. As for battery life, Razer's 16-hour claim seemed about right in our tests, putting this headset in the middle of the pack in this regard.

Conclusion

The Razer Thresher doesn't offer quite the build quality or features of some other headsets in its price league, but it's comfortable to wear and provides great sound quality. Its surround sound positional tool is also a real boon that makes all the difference when playing games using virtual surround sound.

SOUND	FEATURES & DESIGN	VALUE	OVERALL SCORE
35/40	22/30	26/30	83%

VERDICT

A little pricey for the build quality and features on offer, but the Razer Thresher delivers where it counts.

ELITE
NEW ENTRY
P66

SteelSeries Arctis 7 Wireless / £130 inc VAT

SUPPLIER www.amazon.co.uk

SteelSeries has made a point of largely keeping the core design and quality of its headsets the same, no matter which model you buy. As such, whether you just want a standard stereo wired headset, or one with all the wireless bells and whistles, you know that you don't have to compromise on build quality, design, comfort and sound quality.

The exception is the recent introduction of the Arctis Pro range, which bumps up the driver quality and audio circuitry, and end up costing nearly double the price of this headset – we'll be taking a look at one of these headsets next month. In the meantime, though, the Arctis 7 Wireless sits at the top of the non-Pro pile, providing analogue, USB and wireless connections, as well as virtual surround sound, plus it has a snazzy-looking metal headband, while the cheaper models' headbands are made of plastic.

The one notably missing feature is RGB illumination, which the USB-powered Arctis 5 does include. Otherwise you get the same signature Arctis design. The appearance is far more akin to fashionable headphones, such as Beats by Dr Dre sets, than to most gaming headsets. The earcups have quite a low profile, a simple stretched circle shape and are finished in a muted soft touch black, while the headband is just a plain piece of metal.

The only real embellishment is the elasticated band that provides the cushioning for the top of the headset. This band has a funky angular camo pattern that adds just the right amount of visual flare for our tastes. It also works surprisingly well in terms of comfort. Because the elastic distributes the weight of the headset right across its length, it's incredibly comfortable – far more so than any conventional padded headset. The same sadly can't be said of the earcups though. The padding is wonderfully soft but it isn't all that deep, meaning your ears press against the inside more than on some headsets.

The Arctis 7 offers more features than most of its immediate competitors too. You get a retractable microphone on the headset, along with a microphone mute button, inputs for USB analogue audio and two volume control wheels. One wheel just controls the overall headset volume, while the other one mixes between two audio sources. The headset actually shows as two audio sources on your PC, so you can assign one to game and one to chat, for instance. It's a really neat system.

In terms of frequency reproduction, the Arctis 7 has the most even sound on test

The transceiver that connects to your PC is a little more sophisticated than usual too. It attaches via a cable, so you can position it for better reception, plus it has line in and line out sockets.

SteelSeries also makes a big deal about the noise-cancelling properties of its microphone, and it had the best directionality of the microphones on test, almost totally cutting out any noise that wasn't directly in front of the microphone. Its sound quality is also good, with a reasonably full sound.

What's more, sound quality from the headphones is great too. In terms of frequency reproduction, the Arctis 7 is the most even sounding headset in this test, with the least over-egged bass and treble. It makes for a far less fatiguing sound, yet it still provides plenty of warmth and detail. Meanwhile, a massive 24hr battery life puts this headset clear out in front in this regard.

Conclusion

The SteelSeries Arctis 7 Wireless looks and feels great, its distinctive headband is comfortable, it has a great selection of features and it sounds good too. Our only real complaint is the lack of padding on the earcups, which can make the Arctis 7 a little uncomfortable during long gaming sessions, but it's otherwise easily the best of the batch.

SOUND	FEATURES & DESIGN	VALUE	OVERALL SCORE
37/40	27/30	27/30	91%

VERDICT

A really well thought-out wireless headset, with great sound and features, although it could do with better earcup padding.

PC system reviews

GAMING PC

Chillblast Fusion Huntsman / £1,250 incVAT

SUPPLIER www.chillblast.com

Chillblast's Fusion Huntsman packs an Nvidia Pascal GPU and Intel Coffee Lake CPU into a tiny Fractal Design Node 202 mini-ITX case. It measures 377mm wide and 88mm tall, so it's easy to slip inside a rucksack – and, at 7.1kg, it won't weigh you down too much. Those dimensions mean the Chillblast undercuts the Zotac MEK1, which was 118mm wide, 418mm tall and weighed 8.6kg – and the Chillblast's square shape makes it easier to manoeuvre too.

With its console-like shape and dimensions, the Fusion Huntsman can also sit comfortably beneath a TV. It can also stand vertically. What's more, Chillblast can wrap the Huntsman with your own design – so a whole eSports team can have rigs with the team logo, or you can show off the badge of your favourite team. It's free, and if you don't want a wrap then Chillblast will use a smart carbon-fibre pattern.

Five screws can be removed to reveal the Fractal case's clever interior. The mini-ITX motherboard and PSU are installed on one side of the case, and a divider along the middle separates those components from the graphics card. The GPU connects to the motherboard with a small PCI-E riser card, and a cage in the middle holds the hard disk. It's neater and tidier than the Zotac, and the rig is powered by a Fractal Integra 450W SFX unit with an 80 Plus Bronze rating.

Chillblast has used a 6GB Gigabyte GTX 1060 card inside this machine, putting 1,280 stream processors at your disposal. Gigabyte has improved the 1506MHz core to 1556MHz as well, and the card has an OC mode that further boosts the clock to 1582MHz.

The GPU is paired with a Core i5-8400 CPU. It's from the Coffee Lake range, which means it has Intel's latest architecture and six cores, but those cores aren't Hyper-Threaded, and the stock speed of 2.8GHz is modest. It's chilled by a Noctua NH-L9i, which is only 37mm tall and includes a near-silent 92mm fan.

The Chillblast's components trade blows with the Zotac. That machine had a Core i7-7700 processor with fewer cores and an older architecture, but it fought back with GTX 1070 Ti graphics, albeit at a higher price. Chillblast has paired those core components with 16GB of 2400MHz DDR4 memory, a 250GB Samsung 960 Evo NVMe SSD and a 2TB hybrid hard disk. That's the same memory as the Zotac, and better storage: the former drive is faster, and the latter is larger.

It all connects to a Gigabyte Z370N WIFI motherboard, which features dual-band 802.11ac Wi-Fi and loads of connections, including six USB 3.1 ports, a USB 3.1 Type-C connection and dual Ethernet ports. You only get three audio jacks and no optical S/PDIF, but that's a minor quibble.

Elsewhere, the board has the usual RGB LEDs, beefed-up audio circuits and a spare M.2 socket, but that's it when it comes to upgrades; the two memory slots and single PCI-E slot are occupied, and the Fractal chassis only has room for another 2.5in hard drive or SSD.

Finally, Chillblast protects this machine with its usual five year labour warranty, including two years of collect and return parts coverage.

/SPECIFICATIONS

CPU 2.8GHz Intel Core i5-8400

Motherboard Gigabyte Z370N-WIFI

Memory 16GB Crucial 2400MHz DDR4

Graphics Gigabyte GeForce GTX 1060 6GB

Storage 250GB Samsung 960 Evo M.2 SSD, 2TB Seagate FireCuda hard drive

Case Fractal Design Node 202

Cooling CPU: Noctua NH-L9i with 1x 92mm fan; GPU: 2 x 70mm fans

PSU Fractal Design Integra M 450W

Ports Front: 2 x USB 3, 2 x audio; rear: 6 x USB 3.1, 1 x USB 3.1 Type-C, 2 x Gigabit Ethernet, 3 x audio

Operating system Microsoft Windows 10 Home 64-bit

Warranty Two years parts and labour collect and return, plus three years labour only return to base

Performance

The GTX 1060 is adept with 1080p gaming. It zipped through Fallout 4 with a minimum of 54fps and handled The Witcher 3 without dropping below 68fps. Even our tough Deus Ex test ran at a 43fps minimum. The Chillblast ran most games at 2,560 x 1,440 too – only Deus Ex faltered with only a borderline playable 29fps minimum. Naturally, the Zotac's GTX 1070 Ti is quicker, being nearly 30fps faster in Fallout 4, and 20fps ahead in Deus Ex. The Chillblast easily has enough power for general 1080p eSports gaming, but the Zotac's GTX 1070 Ti is more likely to handle the frame rate demands of panels with very high refresh rates.

Thankfully, Chillblast's rig can be fitted with a GTX 1070 Ti, although it lifts the price to £1,525 inc VAT, which is more than the £1,399 Zotac. The Chillblast's Coffee Lake Core i5 chip is faster though. The extra CPU cores and beefed-up architecture saw it outperform the Zotac's Core i7 Kaby Lake chip in image editing, encoding and multi-tasking. It's ably supported by the Samsung SSD, which outpaced the Zotac's drive with read and write speeds of 3,096MB/sec and 1,697MB/sec respectively.

1 The Gigabyte GeForce GTX 1080 6GB card sits in a PCI-E riser

2 The Noctua NH-L9i is only 37mm tall and includes a near-silent 92mm fan

3 The Fractal Integra 450W SFX PSU sports an 80 Plus Bronze rating

The Chillblast is quiet too. The Huntsman was basically silent when idle, and hardly louder when gaming – you won't hear it at a LAN event, and it's no louder than a console. The rig was a little louder in a full-system stress test, but it was still on a par with consoles – and most people will hardly ever run this rig with the CPU and GPU at 100 per cent load. It's a similar noise output to the Zotac.

The Huntsman's temperature figures were a little less convincing though. The GPU delta T of 59°C is fine, and in a gaming test, the CPU delta T topped out at 31°C.

However, during a full-system test, the CPU rose to 69°C. That's high, and 6°C than the Zotac. However, it remains a minor concern because few people will stress the CPU this much, and even then it's still technically within the chip's thermal specification.

Conclusion

There's a lot to like about the Huntsman. It's better-looking, smaller and lighter than its rival, which makes it easier to transport, and Chillblast's design-wrapping service is a unique boon. The Coffee Lake processor offers more CPU power than the Zotac, and the SSD is faster. Both machines are similarly quiet too, and Chillblast's machine has enough pace for 1080p gaming and some 2,560 x 1,440 gaming.

However, Zotac's machine serves up much more power, which may be worth considering if you're a competitive player. That will likely be a minor issue for most people, though, and Chillblast's machine remains cheaper and smaller than the Zotac. Those are important issues for small form factor PCs, and the Huntsman's good performance in those key areas makes it a worthy contender if you're a frequent traveller.

MIKE JENNINGS

CPC REALBENCH 2015

51,198	327,254	70,503
GIMP IMAGE EDITING	HANDBRAKE H.264 VIDEO ENCODING	LUXMARK OPENCL
168,258	**140,202**	**122.5%**
HEAVY MULTI-TASKING	SYSTEM SCORE	INTEL PERFORMANCE INDEX SCORE

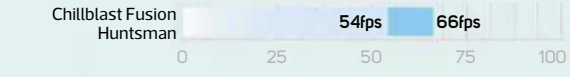
PERFORMANCE	DESIGN	OVERALL SCORE
19/25	22/25	84%
HARDWARE	VALUE	
21/25	22/25	

VERDICT

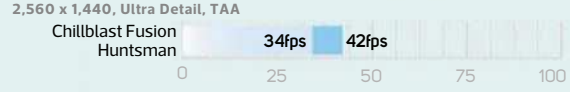
Good performance in a small, smart and subtle design, even if rivals are a little quicker in games.

FALLOUT 4

1,920 x 1,080, Ultra Detail, TAA

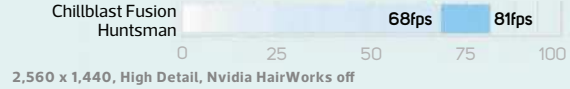


2,560 x 1,440, Ultra Detail, TAA

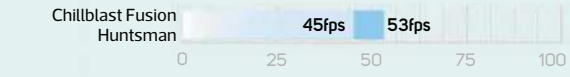


THE WITCHER 3: WILD HUNT

1,920 x 1,080, High Detail, Nvidia HairWorks off

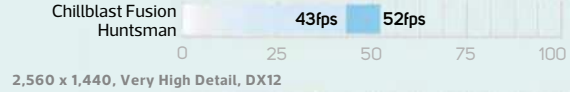


2,560 x 1,440, High Detail, Nvidia HairWorks off

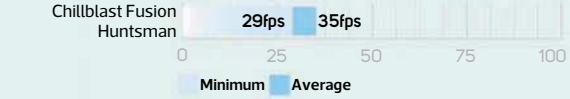


DEUS EX: MANKIND DIVIDED

1,920 x 1,080, Very High Detail, DX12



2,560 x 1,440, Very High Detail, DX12



Minimum Average

GAMING PC

CyberPower Infinity Xtreme Titanium GTX / £2,799 inc VAT

SUPPLIER www.cyberpowersystem.co.uk

The past few months' machines have been filled with Ryzen and Coffee Lake processors, but CyberPower's Infinity Xtreme Titanium GTX uses a Skylake chip – the Core i7-7800X. It's a 6-core chip with Hyper-Threading, roughly matching the core spec of the mainstream Core i7-8700K, although it's also lacking in some areas, with a lower clock speed and 8.25MB of cache compared to the 12MB in the i7-8700K. The i7-7800X's 140W TDP is also 45W higher than the Coffee Lake CPU.

This machine wins plaudits for its great design

However, CyberPower's Skylake-X processor offers advantages in other areas. Skylake-X processors offer at least 28 PCI-E lanes compared to the 16 provided by Coffee Lake, which means more scope for extra graphics cards and NVMe storage. Choosing the i7-7800X also means you get the X299 chipset, which supports quad- rather dual-channel memory. It handles more SATA connections too, plus there's more scope for upgrading. If you have a Core i7-8700K system then your CPU can't go much further, but the CyberPower's X299 motherboard can accept future CPU upgrades with eight, 12 or even 16 cores. Higher-end LGA2066 CPUs can also support up to 44 PCI-E lanes.

The CyberPower's niche benefits continue to the MSI X299 SLI Plus motherboard. It has eight DIMM slots rather than four, and support for Intel Optane memory, although that's currently of dubious benefit. There are also four 16x PCI-E slots. Meanwhile, the backplate has a clear-CMOS button, dual Ethernet ports and loads of USB 3.1 sockets, and there's a second M.2 connector and a U.2 port free on the inside. There's more room to grow here than on the usual Z470 systems we've reviewed recently.

There's also 32GB of 3000MHz memory in the CyberPower, along with a capacious 500GB Samsung 960 Evo NVMe SSD. The Corsair RM750x power supply offers an 80 Plus Gold rating and a fully modular design, and the MSI GTX 1080 Ti card has a small overclock too, with the core raised from 1480MHz to 1506MHz.

The main factor that bumps up this machine's price, however, is the full custom water-cooling loop. CyberPower has crammed an EKWB CoolStream SE 240mm radiator and two 120mm fans into the machine's roof, and a small bracket at the front holds a tiny 60mm reservoir. The CPU is topped by a Supremacy waterblock, while the GPU has another piece of acrylic EWKB hardware. The smaller reservoir allows the entire loop to be installed in the top half of the case, which makes it easier to access the bottom half of the motherboard. It's still relatively easy to access the spare memory slots too.

CyberPower has relied on the familiar Corsair Crystal 570X to house the system. Its side panels are made from strong tempered glass, and the steel skeleton is rock-solid, while the front and top panels are decorated with a honeycomb design that mixes a black plastic frame with fine mesh.

Smartly, CyberPower has installed Akasa Vegas fans – two on the radiator, one in the exhaust mount and three at the front. They feature rubber pads to reduce noise, and they also look the part, with a ring of red lighting around their border. CyberPower has done a solid job keeping the rig tidy too – there's no cable braiding, but all the cable routing is discreet.

Finally, CyberPower's three year labour warranty with two years of parts coverage is fine, although it's a shame you only get a single month of collect and return cover.

Performance

The differences between 6-core Skylake-X and Coffee Lake chips are obvious in benchmarks. The relative lack of single-core speed, for instance, can be noticed in the image editing test. The CyberPower's score of 51,003 is fine, but the stock-speed Core i7-8700K in the Chillblast Fusion Fireblade (see issue 176, p58) was quicker – and the Stormforce Crystal i7 8700K GTX 1080 (see Issue 177, p58) hit more than 65,000 points with the 8700K overclocked to 4.8GHz.

Meanwhile, the CyberPower's six Hyper-Threaded cores returned a result of 405,041 in our heavily multi-threaded

/SPECIFICATIONS

CPU 3.5GHz Intel Core i7-7800X

Motherboard MSI X299 SLI Plus

Memory 32GB Corsair Vengeance LPX 3000MHz DDR4

Graphics MSI GeForce GTX 1080 Ti 11GB

Storage 500GB Samsung 960 Evo M.2 SSD, 2TB Seagate Barracuda hard drive

Case Corsair Crystal 570X

Cooling CPU: EKWB CoolStream SE-240 radiator with 2 x 120mm fans, EKWB Supremacy waterblock, EKWB XRES 100 SPC-60 MX PWM reservoir; GPU: EKWB GTX 1080 Ti waterblock; front: 3 x 120mm fans; rear: 1 x 120mm fan

PSU Corsair RM750x 750W

Ports Front: 2 x USB 3, 2 x audio; rear: 5 x USB 3.1, 1 x USB 3.1 Type-C, 4 x USB 2, 2 x Gigabit Ethernet, 1 x PS/2, 1 x optical S/PDIF, 5 x audio

Operating system Microsoft Windows 10 Home 64-bit

Warranty Two years parts and labour, plus one year labour only. One month collect and return, then return to base

1 **The small reservoir allows the entire loop to sit in the top half of the case**

2 **32GB of 3000MHz quad-channel DDR4 memory is installed**

3 **Six Akasa Vega fans at low speed keep the system cool and quiet**

Handbrake test. That's another fine score, but both the aforementioned Coffee Lake systems were again quicker.

Pleasingly, the CyberPower's overclocked GTX 1080 Ti card returned playable frame rates at 4K, never dropping below 37fps in any of our demanding tests, and that means it will happily handle VR headsets too. The SSD's read and write results of 3,121MB/sec and 1,865MB/sec are fine too.

One advantage of the CyberPower's lack of an overclock, of course, is cooling, especially with a custom loop at its disposal. The CPU's peak delta T of 60°C is great, and the graphics card topped out with a chilly delta T of 36°C and a boost clock that topped out just below 1900MHz.

Those delta T results are better than the Stormforce and Chillblast machines, and we had no noise issues either. The CyberPower was barely audible when idle, and hardly any louder in a full-system stress test.

Conclusion

CyberPower's decision to use 6-core Skylake-X silicon is curious when compared with the Coffee Lake chips deployed in rivals. The i7-7800X can't match the i7-8700K in our benchmarks, although the X299 chipset and LGA2066 socket mean a more versatile motherboard and better upgrade options. For most gamers and general-purpose users, Coffee Lake systems offer more immediate power for a lower price, while the serious content creators at which the X299 platform is aimed will likely want more than a 6-core CPU.

While the CPU choice is dubious, though, this machine wins plaudits for its great design, impressive water-cooling system and low-noise operation, as well as the versatility of the X299 platform. It's clear that CyberPower has some expert PC building skills; it's just a shame this PC's core spec doesn't quite hit the nail on the head.

MIKE JENNINGS

CPC REALBENCH 2015

51,003 GIMP IMAGE EDITING

405,041 HANDBRAKE H.264 VIDEO ENCODING

166,854 HEAVY MULTI-TASKING

155,724 SYSTEM SCORE

136.06% INTEL PERFORMANCE INDEX

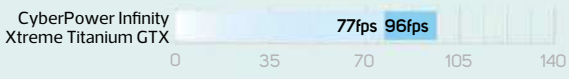
PERFORMANCE	DESIGN	OVERALL SCORE
20/25	25/25	86%
HARDWARE	**VALUE**	
21/25	20/25	

VERDICT

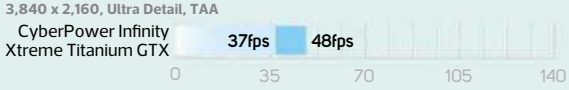
A curious choice of CPU, but the CyberPower offers plenty of versatility inside a classy, considered build.

FALLOUT 4

2,560 x 1,440, Ultra Detail, TAA

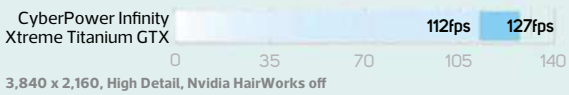


3,840 x 2,160, Ultra Detail, TAA

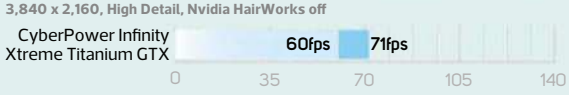


THE WITCHER 3: WILD HUNT

2,560 x 1,440, High Detail, Nvidia HairWorks off

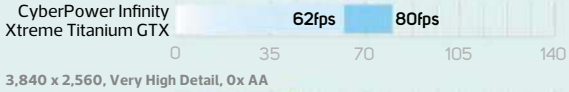


3,840 x 2,160, High Detail, Nvidia HairWorks off



DEUS EX: MANKIND DIVIDED

2,560 x 1,440, Very High Detail, 0x AA



3,840 x 2,560, Very High Detail, 0x AA

Minimum Average

GAMING PC

CCL RyzenX GT / £2,599 inc VAT

SUPPLIER www.cclonline.com

CCL's RyzenX GT is the first system we've seen with AMD's 2nd Gen Ryzen 7 2700X chip. This new CPU has eight cores and 16 threads just like last year's Ryzen 7 parts, but AMD has turbo-charged the chip in other departments. The new Zen CPU uses a 12nm manufacturing process rather than a 14nm process, and latencies have been improved across all caches. AMD has also increased clock frequencies, and refined the boost process, so you get more aggressive boosting across more cores. The 2700X runs at 3.7GHz with a boost peak of 4.3GHz, improving on the older 1800X.

CCL has turned to a serious case to house this RyzenX PC

Meanwhile, the CCL's Asus ROG Strix X470-F Gaming motherboard has the new X470 chipset and loads of features. It has a second spare M.2 slot and chunky heatsinks with RGB LEDs, as well as enhanced audio, steel-supported slots and on-board status LEDs. Versatility is improved by the wealth of on-board connectors, and the backplate serves up six USB 3.1 connectors and a Type-C port.

CCL's machine has plenty of CPU power, but it faces serious Intel-based competition. The Chillblast Fusion Fireblade deployed the 6-core Core i7-8700K for £1,999 inc VAT, for example, and the CyberPower Infinity Xtreme Titanium GTX (see p62) serves up the 8-core Core i7-7800X for £2,799 inc VAT.

The CCL is clearly designed for high-end tasks. The 2700X is paired with 32GB of DDR4 memory running at 3200MHz, and storage is provided by a 500GB Samsung 960 Evo SSD and a pair of 4TB hard disks. They're not in a RAID array, though, which means you get ample space but no extra data protection.

Graphical grunt comes from Asus' superb Strix GeForce GTX 1080 Ti card, which ups the 1480MHz GPU clock to 1569MHz, and a further boost to 1594MHz is available via the card's OC mode. Meanwhile, power comes from a semi-modular Corsair TX850M PSU with an 80 Plus Gold rating.

CCL has also turned to a serious case to house this RyzenX PC. The Fractal Design Define R6 is 543mm long and weighs 12.4kg on its own. It looks the part, with a reversible door and a roof entirely covered in vented plastic. The major panels are coated with sound-absorbing material, the front has four USB ports and there's even an optical drive – a rarity in 2018.

A PSU shroud stretches along the base of the case, and the front is covered by a vertical storage cage. Behind that metal you'll find four free drive bays. They're not tool-free, but they're sturdy, and there are two further 2.5in bays behind the motherboard. CCL has connected three 120mm intake fans to a controller at the rear, and there's a single exhaust fan.

The good design continues elsewhere. The 240mm Corsair Hydro H100x radiator sits in the roof, never in the way, and CCL has done a tidy job with cables. The main power cables are braided with black, white and purple, and the motherboard's LEDs and a row of strip lights also glow in purple.

The only minor issue may arise if you want to get hands-on. The Define is large, but the PSU shroud and storage cage mean it can be tricky to get to the slots and jumpers at the edges of the motherboard. There's no room to add more memory either. The Fractal case and CCL's cooling isn't as gregarious as the water-cooling loop in the CyberPower, but it should easily handle this rig's cooling requirements.

Finally, CCL protects this machine with a three year parts, labour and transit deal. That's a good offering; Chillblast may have a five year deal but you only get two years of collect and return coverage for parts.

Performance

The new Ryzen chip is a superb performer. The improvements to multi-core boosting saw the CCL score 549,479 in our heavily multi-threaded video encoding test – more than 100,000 points ahead of both Intel-powered rivals. The CCL scored 210,150 in the multi-tasking test, which was 20,000 points quicker than the stock-speed i7-8700K and miles beyond the CyberPower's i7-7800X.

/SPECIFICATIONS

CPU 3.7GHz AMD Ryzen 7 2700X

Motherboard Asus ROG Strix X470-F Gaming

Memory 32GB G.Skill Trident Z RGB 3200MHz DDR4

Graphics Asus GeForce GTX 1080 Ti 11GB

Storage 500GB Samsung 960 Evo M.2 SSD, 2 x 4TB Seagate Barracuda hard drives

Case Fractal Design Define R6

Cooling CPU: Corsair Hydro H100x with 2 x 120mm fans; GPU: 3 x 90mm fans; front: 3 x 120mm fans; rear: 1 x 120mm fan

PSU Corsair TX850M

Ports Front: 2 x USB 3, 2 x USB 2, 2 x audio; rear: 6 x USB 3.1, 1 x USB 3.1 Type-C, 1 x Gigabit Ethernet, 1 x PS/2, 1 x optical S/PDIF, 5 x audio

Operating system Microsoft Windows 10 Home 64-bit

Warranty Three years parts and labour collect and return

1 The main power cables are braided with black, white and purple

2 The 240mm Corsair H100x radiator sits in the roof, never in the way

3 AMD's latest 8-core Ryzen 7 2700X CPU sits under the Corsair waterblock

Those high scores in multi-threaded benchmarks are impressive, but the 2700X delivered modest gains in our mainly single-threaded image editing test. Its result of 56,882 is ahead of first-generation Ryzen systems, but Intel rigs remain faster here, which is no surprise given their extra clock speed headroom.

Gaming performance is fine too, with none of the gaming wobbles we saw this time last year with the first Ryzen chips. The CCL's scores mostly matched the Chillblast and CyberPower machines, trading blows by the odd frame here and there, but with no game-changing leads.

The RyzenX GT performed well in thermal tests too. Its peak CPU delta T of 43°C is superb, and better than both Intel-based rivals. During a gaming test, the 2700X's eight cores ran at 4025MHz, and in a full-system test, they ran at 3800MHz. The GPU was a solid performer too, with a peak delta T of 44°C and no throttling.

Sadly, the CCL was noisier than both competitors though. The noise was consistent and noticeable in a gaming test, and a little louder in a full-system test. The noise isn't awful, but it's noticeable – that's an area where the CyberPower's custom water-cooling loop really makes a difference.

Conclusion

AMD's 2nd Gen Ryzen chips are great. The 2700X delivers solid performance across games, and both single and multi-threaded software. The CCL's memory is capacious and quick, and there's loads of storage too.

The motherboard is feature-packed, the GPU is quick, and it's all packed into an enclosure that offers smart design and rock-solid build quality.

The noise is a slight issue, though, and the CCL machine is undeniably expensive. You get a lot for your money, but most people just won't need eight CPU cores, two vast hard disks and 32GB of memory. However, if you're a content creator, or if you run other multi-threaded applications, and you want a good quality, all-round PC, then we highly recommend the CCL RyzenX GT and the Ryzen 7 2700X.

MIKE JENNINGS

CPC REALBENCH 2015

56,882 GIMP IMAGE EDITING

549,479 HANDBRAKE H.264 VIDEO ENCODING

210,150 HEAVY MULTI-TASKING

204,127 SYSTEM SCORE

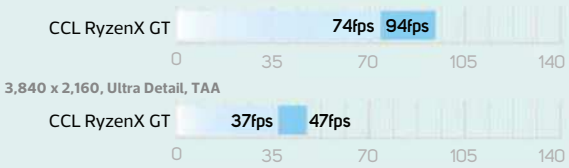
PERFORMANCE	DESIGN	OVERALL SCORE
23/25	22/25	88%
HARDWARE	**VALUE**	
22/25	21/25	

VERDICT

Huge power from AMD's improved Ryzen silicon, alongside loads of storage and a quality build, although it gets a bit noisy.

FALLOUT 4

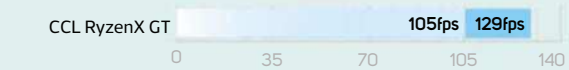
2,560 x 1,440, Ultra Detail, TAA



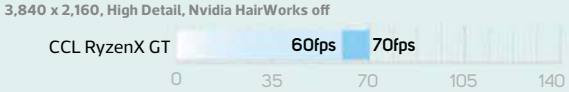
3,840 x 2,160, Ultra Detail, TAA

THE WITCHER 3: WILD HUNT

2,560 x 1,440, High Detail, Nvidia HairWorks off

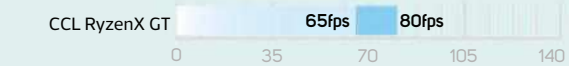


3,840 x 2,160, High Detail, Nvidia HairWorks off

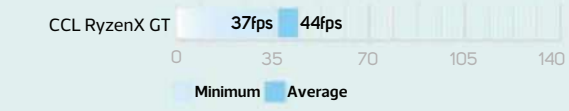


DEUS EX: MANKIND DIVIDED

2,560 x 1,440, Very High Detail, DX12



3,840 x 2,560, Very High Detail, DX12



Elite

Our choice of the best hardware available

Processors

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**ENTRY-LEVEL CPU WITH INTEGRATED GRAPHICS**	AMD Ryzen 3 2200G (AM4)	www.scan.co.uk	Issue 176, p22	£80
	**CPU WITH INTEGRATED GRAPHICS**	AMD Ryzen 5 2400G (AM4)	www.scan.co.uk	Issue 176, p23	£129
	**BUDGET GAMING CPU**	Intel Core i3-8350K (LGA1151-V2)	www.overclockers.co.uk	Issue 175, p46	£155
 NEW ENTRY	**ALL-ROUND 6-CORE CPU**	AMD Ryzen 5 2600X	www.scan.co.uk	Issue 178, p23	£193
 NEW ENTRY	**ALL-ROUND 8-CORE CPU**	AMD Ryzen 7 2700X	ww.scan.co.uk	Issue 178, p22	£282
	**GAMING 6-CORE CPU**	Intel Core i7-8700K (LGA1151-V2)	ww.scan.co.uk	Issue 175, p56	£314
	**HEAVY MULTI-THREADING CPU**	AMD Ryzen Threadripper 1950X (TR4)	www.ebuyer.com	Issue 170, p20	£784
	**EXTREME MULTI-THREADING CPU**	Intel Core i9-7980XE (LGA2066)	www.scan.co.uk	Issue 171, p20	£1,599

CPU coolers

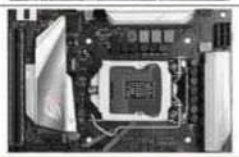
	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**BUDGET AIR COOLER (LGA115X)**	Raijintek Rhea	www.overclockers.co.uk	Issue 163, p86	£13
	**MID-RANGE AIR COOLER (LGA115X, LGA2011, AM4)**	ARCTIC Freezer 33 eSports One	www.amazon.co.uk	Issue 175, p21	£35
	**LOW-PROFILE AIR COOLER (LGA115X, LGA2011)**	Noctua NH-D9L	www.amazon.co.uk	Issue 143, p17	£45
	**120MM ALL-IN-ONE LIQUID COOLER (LGA115X, LGA2011, AM4)**	ARCTIC Liquid Freezer 120	www.novatech.co.uk	Issue 178, p49	£55
	**240MM ALL-IN-ONE LIQUID COOLER (LGA115X, LGA2011, AM4)**	Fractal Design Celsius S24	www.scan.co.uk	Issue 167, p25	£110
	**280MM ALL-IN-ONE LIQUID COOLER (LGA115X, LGA2011)**	NZXT Kraken X62	www.overclockers.co.uk	Issue 160, p52	£130
	**360MM ALL-IN-ONE LIQUID COOLER (AM4, LGA115X, LGA2011)**	Corsair H150i Pro	www.scan.co.uk	Issue 175, p29	£165
	**THREADRIPPER AIR COOLER**	Noctua NH-U14S TR4-SP3	www.overclockers.co.uk	Issue 173, p30	£75

Virtual reality

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**VR GAMING HEADSET**	Oculus Rift Touch bundle	www.overclockers.co.uk	Issue 177, p82	£399

Motherboards

LGA1151-V2

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	ATX BUDGET Z370	MSI Z370 SLI Plus	www.scan.co.uk	Issue 175, p24	£126
	ATX MID-RANGE Z370	Gigabyte Z370 Aorus Ultra Gaming	www.scan.co.uk	Issue 172, p46	£157
	ATX HIGH-END Z370	Asus ROG Maximus X Hero	www.scan.co.uk	Issue 172, p43	£230
	MINI-ITX BUDGET Z370	Gigabyte Z370N WiFi	www.ebuyer.com	Issue 174, p44	£137
	MINI-ITX MID-RANGE Z370	Asus ROG Strix Z370-I Gaming	www.cclonline.com	Issue 174, p43	£178

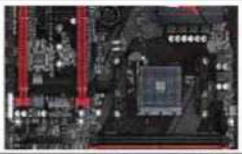
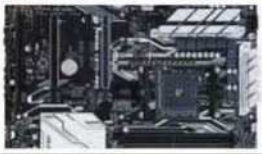
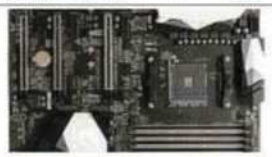
LGA2066

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	ATX PREMIUM X299	Asus Prime X299 Deluxe	www.scan.co.uk	Issue 168, p52	£382
	ATX MID-RANGE X299	Asus ROG Strix X299-E Gaming	www.scan.co.uk	Issue 168, p50	£300
	ATX BUDGET X299	ASRock X299 Killer SLI	www.scan.co.uk	Issue 171, p22	£217
	MICRO-ATX X299	MSI X299M Gaming Pro Carbon AC	www.cclonline.com	Issue 174, p24	£255
	MINI-ITX X299	ASRock X299E-ITX/ac	www.overclockers.co.uk	Issue 174, p26	£380

TR4

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**ATX MID-RANGE X399**	MSI X399 Gaming Pro Carbon AC	www.scan.co.uk	Issue 170, p50	£322
	**ATX PREMIUM X399**	Asus ROG Zenith Extreme	www.ebuyer.com	Issue 170, p48	£464

AM4

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**ATX X470**	Gigabyte X470 Aorus Gaming 7 WiFi	www.awd-it.co.uk	Issue 178, p30	£223
	**ATX BUDGET B350**	Asus ROG Strix B350-F Gaming	www.overclockers.co.uk	Issue 167, p20	£107
	**MICRO-ATX BUDGET B350**	Gigabyte AB350M-Gaming 3	www.ebuyer.com	Issue 169, p28	£71
	**MINI-ITX B350**	MSI B350I Pro AC	www.alza.co.uk	Issue 177, p22	£113
	**MINI-ITX X370**	Asus ROG Strix X370-I Gaming	www.cclonline.com	Issue 173, p32	£163
	**ATX BUDGET X370**	Asus Prime X370-Pro	www.scan.co.uk	Issue 165, p50	£131
	**ATX MID-RANGE X370**	Gigabyte Aorus AX370-Gaming 5	www.cclonline.com	Issue 165, p52	£159

Memory

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	8GB DUAL-CHANNEL DDR4	8GB Corsair Vengeance LPX 2666MHz DDR4	www.scan.co.uk	Issue 163, p86	£93
	16GB DUAL-CHANNEL DDR4	16GB Corsair Vengeance LPX 3000MHz DDR4	www.scan.co.uk	Issue 166, p90	£170
	16GB DUAL-CHANNEL DDR4 RGB	16GB G.Skill Trident Z RGB 3200MHz DDR4	www.cclonline.com	Issue 177, p45	£254
	32GB QUAD-CHANNEL DDR4 RGB	Corsair Vengeance RGB 3200MHz DDR4 (CMR32GX4M4C3200C16)	www.overclockers.co.uk	Issue 177, p48	£390
 NEW ENTRY	16GB DUAL-CHANNEL RGB (AMD RYZEN)	16GB (2 x 8GB) 3466MHz Corsair Vengeance RGB (CMR16GX4M2C3466C16)	www.scan.co.uk	Issue 178, p24	£198

Software

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	OPERATING SYSTEM	Microsoft Windows 10 Home Retail USB drive	www.scan.co.uk	Issue 146, p17	£100

Graphics cards

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	JUST 1,920 X 1,080 GAMING	Zotac GeForce GTX 1050 Ti 4GB Mini	www.ebuyer.com	Issue 163, p86	£160
	1,920 X 1,080 AND SOME 2,560 x 1,440 GAMING	Nvidia GeForce GTX 1060 3GB	www.scan.co.uk	Issue 159, p43	£209
	2,560 X 1,440 GAMING	Nvidia GeForce GTX 1060 6GB	www.scan.co.uk	Issue 159, p23	£266
	SMOOTH 2,560 X 1,440 GAMING	Asus ROG Strix GeForce GTX 1070 Ti	www.scan.co.uk	Issue 173, p20	£530
	4K GAMING	Asus ROG Strix GeForce GTX 1080 Ti OC	www.scan.co.uk	Issue 168, p28	£995

Cases

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**BUDGET ATX**	Phanteks Eclipse P300	www.overclockers.co.uk	Issue 176, p28	£55
	**SUB-£100 ATX PERFORMANCE**	Phanteks Enthoo Pro M Glass	www.overclockers.co.uk	Issue 161, p24	£110
	**SUB-£150 ATX QUIET**	Fractal Design Define R6	www.scan.co.uk	Issue 174, p20	£135
	**SUB-£150 FULL-SIZED ATX**	Phanteks Enthoo Luxe	www.awd-it.co.uk	Issue 144, p53	£131
	**SUB-£150 MID-SIZED ATX**	Cooler Master Cosmos SE	www.scan.co.uk	Issue 144, p41	£130
	**PREMIUM ATX CASE**	Phanteks Enthoo Evolv ATX Glass	www.overclockers.co.uk	Issue 169, p43	£175
	**MINI-ITX TOWER**	Fractal Design Define Nano S	www.scan.co.uk	Issue 153, p22	£57
	**MINI-ITX CUBE**	Fractal Design Core 500	www.scan.co.uk	Issue 150, p20	£40
	**MICRO-ATX**	Fractal Design Define Mini C	www.scan.co.uk	Issue 161, p26	£60
	**PREMIUM MICRO-ATX**	NZXT H400i	www.overclockers.co.uk	Issue 175, p32	£120

Case fans

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**120MM QUIET FAN (BEST RUN AT 5V)**	Corsair SP120 Quiet Edition	www.scan.co.uk	Issue 155, p56	£15
	**120MM PERFORMANCE FAN (BEST RUN AT 12V)**	Thermaltake Pure S 12 LED	www.amazon.co.uk	Issue 155, p58	£10

Power supplies

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**BUDGET 400W**	XFX XT Series 400W 80 Plus Bronze	www.awd-it.co.uk	Issue 163, p86	£36
	**MID-RANGE 450W**	Corsair CX450M	www.scan.co.uk	Issue 164, p84	£50
	**MID-RANGE 550W**	EVGA SuperNova GS 550W	www.alza.co.uk	Issue 146, p50	£79
	**HIGH-END 550W**	Super Flower Leadex Platinum 550W	www.overclockers.co.uk	Issue 146, p52	£103
	**MID-RANGE 750W**	Corsair RM750i	www.scan.co.uk	Issue 146, p55	£120
	**HIGH-END 1.2KW**	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£310

Storage

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**MAINSTREAM HARD DISK**	Western Digital Blue 4TB	www.overclockers.co.uk	Issue 166, p54	£95
	**PERFORMANCE HARD DISK**	Seagate BarraCuda Pro 6TB	www.overclockers.co.uk	Issue 166, p50	£218
	**500GB SATA SSD**	Crucial MX500 500GB	www.ebuyer.com	Issue 176, p43	£107
	**HIGH-PERFORMANCE M.2 SSD**	Samsung SSD 960 Evo 500GB	www.scan.co.uk	Issue 168, p59	£207
 NEW ENTRY	**M.2 HEATSINK**	EK Water Blocks EK-M.2 NVMe Heatsink	www.overclockers.co.uk	Issue 178, p87	£11
	**SINGLE-BAY NAS BOX**	Synology DS118	www.box.co.uk	Issue 174, p34	£164
	**DUAL-BAY NAS BOX**	Synology DS216j	www.box.co.uk	Issue 154, p28	£160
	**DUAL-BAY MEDIA NAS BOX**	Synology DS218play	www.box.co.uk	Issue 174, p34	£220

Monitors

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**BUDGET 24IN FREESYNC MONITOR**	AOC G2460VQ6	www.ebuyer.com	Issue 174, p52	£138
	**24IN MONITOR**	Dell UltraSharp U2417H	www.scan.co.uk	Issue 162, p58	£215
	**24IN 144Hz FREESYNC ESPORTS MONITOR**	Samsung C24FG70	www.ebuyer.com	Issue 176, p34	£200
	**24IN FREESYNC MONITOR**	ViewSonic XG2401	www.amazon.co.uk	Issue 167, p52	£278
	**24IN G-SYNC MONITOR**	AOC AGON AG241QG	www.currys.co.uk	Issue 169, p55	£420
	**27IN 2,560 X 1,440 FREESYNC MONITOR**	Samsung C27HG70	www.overclockers.co.uk	Issue 171, p28	£549
	**27IN 2,560 X 1,440 G-SYNC MONITOR**	Asus ROG Swift PG279Q	www.scan.co.uk	Issue 155, p48	£693
	**27IN 4K FREESYNC MONITOR**	ViewSonic XG2700-4K	www.amazon.co.uk	Issue 157, p26	£574
	**34IN ULTRA-WIDE CURVED G-SYNC MONITOR**	Asus ROG Swift PG348Q	www.ebuyer.com	Issue 157 , p42	£985

Networking

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**ROUTER**	Netgear Nighthawk X4S R7800	www.ebuyer.com	Issue 160, p44	£153
	**BUDGET MESH NETWORK**	BT Whole Home Wi-Fi	www.currys.co.uk	Issue 172, p54	£189
	**PREMIUM MESH ROUTER**	Netgear Orbi (RBK50)	www.amazon.co.uk	Issue 172, p57	£299
	**WI-FI ADAPTOR**	Asus PCE-AC68	www.scan.co.uk	Issue 128, p88	£59
	**PREMIUM ROUTER**	Asus ROG Rapture GT-AC5300	www.overclockers.co.uk	Issue 170, p35	£380

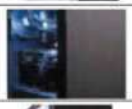
Peripherals

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	MEMBRANE GAMING KEYBOARD	Corsair Gaming K55 RGB	www.overclockers.co.uk	Issue 176, p52	£50
	MECHANICAL GAMING KEYBOARD	Cooler Master MasterKeys Pro L White	www.scan.co.uk	Issue 165, p55	£80
	PREMIUM MECHANICAL GAMING KEYBOARD	Corsair Gaming K70 RGB Rapidfire	www.ebuyer.com	Issue 154, p21	£133
	MMO KEYBOARD	Corsair Gaming K95 RGB Platinum	www.ebuyer.com	Issue 164, p26	£174
	GAMING MOUSE	Corsair Glaive RGB	www.box.co.uk	Issue 167, p19	£65
	AMBIDEXTROUS GAMING MOUSE	Razer Lancehead Tournament Edition	www.ebuyer.com	Issue 177, p53	£75
	MMO GAMING MOUSE	Corsair Scimitar Pro RGB	www.box.co.uk	Issue 164, p24	£70
	WIRELESS GAMING MOUSE	Logitech G403 Prodigy Wireless	www.overclockers.co.uk	Issue 171, p40	£90
	STEERING WHEEL AND PEDALS	Logitech G920 Driving Force	www.currys.co.uk	Issue 159, p55	£220

Audio

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	PCI-E SOUND CARD	Asus Strix Raid DLX	www.scan.co.uk	Issue 148, p28	£159
	2.1 SPEAKERS	Acoustic Energy Aego^3	www.amazon.co.uk	Issue 164, p49	£200
	SOUNDBAR	Razer Leviathan	www.overclockers.co.uk	Issue 142, p57	£175
	HEADSET	HyperX Cloud Alpha	www.currys.co.uk	Issue 173, p50	£70
	SURROUND-SOUND HEADSET	Asus ROG Centurion	www.cclonline.com	Issue 163, p49	£189
 NEW ENTRY	WIRELESS HEADSET	SteelSeries Arctis 7	www.amazon.co.uk	Issue 178, p58	£130

Systems

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	AMD APU PC	Falcon Raptor RX	www.falconcomputers.co.uk	Issue 176, p56	c.£570
	SKYLAKE-X PC	Scan 3XS Carbon Aura	www.scan.co.uk	Issue 168, p66	c.£2,750
	BUDGET COFFEE LAKE PC	PC Specialist Ultima X01	www.pcspecialist.co.uk	Issue 172, p60	c.£1,479
	MID-RANGE COFFEE LAKE PC	Wired2Fire Diablo Aurora	www.wired2fire.co.uk	Issue 173, p56	c.£2,499
	WATER-COOLED COFFEE LAKE PC	CCL Iris Fusion LQ	www.cclonline.com	Issue 175, p62	c.£3,100
	PREMIUM COFFEE LAKE PC	Scan 3XS Vengeance Aura SLI	www.scan.co.uk	Issue 172, p64	c.£3,799
	DREAM PC	Scan 3XS Barracuda	www.scan.co.uk	Issue 145, p58	c.£9,499
 NEW ENTRY	AMD RYZEN 7 PC	CCL RyzenX GT	www.cclonline.com	Issue 178, p64	£2,599
	THREADRIPPER PC	CyberPower Ultra Threadripper Xtreme	www.cyberpowersystem.co.uk	Issue 171, p62	c.£3,469
	EXTREME THREADRIPPER PC	Chillblast Fusion Centauri Ryzen Threadripper Ultimate	www.chillblast.co.uk	Issue 173, p58	c.£7,500
	MINI-ITX GAMING PC	Corsair One Elite	www.corsair.co.uk	Issue 177, p60	£2,799
	PREMIUM MINI-ITX PC	Overclockers 8Pack Asteroid	www.overclockers.co.uk	Issue 154, p56	c.£3,990
	PREMIUM PC	Scan 3XS Carbon Fluid Extreme SLI	www.scan.co.uk	Issue 170, p58	c.£4,950
	HIGH-PERFORMANCE GAMING LAPTOP	Scan 3XS LG17 Carbon Extreme	www.scan.co.uk	Issue 159, p30	c.£2,550
	THIN AND LIGHT GAMING LAPTOP	Alienware 13	www.alienware.co.uk	Issue 168, p32	c.£1,849
	BUDGET GAMING LAPTOP	MSI GE72 7RE Apache Pro	www.saveonlaptops.co.uk	Issue 167, p28	c.£1,137
	ULTRABOOK LAPTOP	Razer Blade Stealth	www.razerzone.com	Issue 167, p36	c.£1,350

Games

Contents

RICK LANE / INVERSE LOOK

THEME HOSPITAL

Games such as Far Cry 5 need to more actively engage with their chosen themes if they're to be taken seriously, argues Rick Lane

Far Cry is one of my favourite game series. I love first-person shooters and games that produce interesting scenarios from their own systems. Since Far Cry 3, however, the themes each game purports to explore have had little to do with the player's actual actions.

At a systems level, the Far Cry games prioritise letting a bunch of different mechanics crash together to create unique, entertaining and often silly events, such as unleashing a tiger into a compound of mercenaries, or blowing up a convoy of enemy vehicles with a rocket launcher while flying a gyrocopter. However, this over-the-top and fantastically entertaining fun is often set within a far more serious theme. Far Cry 4 took place amid a civil uprising in a fictional Himalayan country based on Tibet, which has long struggled for sovereignty as a nation against neighbouring China. Far Cry 5, meanwhile, pits the player against a Christian Cult in rural Montana, in a setting that plays fast and loose with the worrying emergence of the far right in the USA.

They're bold and politically charged settings, and both games place considerable emphasis on storytelling, featuring lavish cutscenes and eloquently written dialogue. Ubisoft Montreal even hired an expert in cult behaviour to consult on Far Cry 5. But bizarrely, all of this effort results in little more than surface glitz, and both games ultimately wash their hands of any meaningful exploration or commentary of their chosen issues.

Their narratives and dialogue use lots of words to say basically nothing, while the underlying games are the same silly mechanical playgrounds that bear little relevance to the chosen theme. Consequently, the games feel crass and immature, seeming to want to be taken seriously without doing anything to merit it. Now, there's no requirement for games to make grand political statements, but I do think all games should use their art and systems to engage with their own chosen subject.

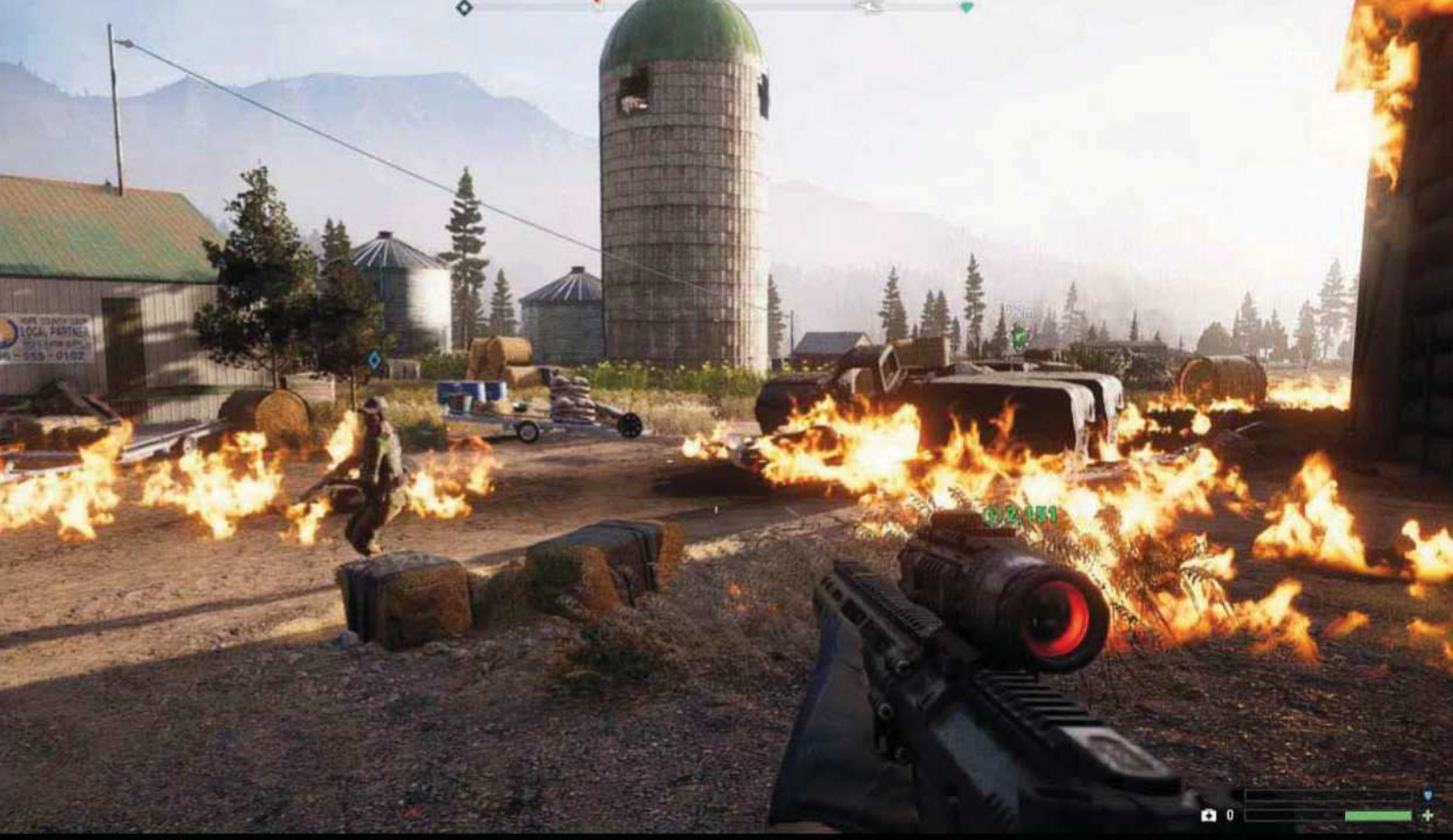
This subject doesn't have to be complicated. Doom is about shooting demons in the face on Mars, but every facet of that game is directed towards that idea, from movement to how the guns feel, to how demons react when shot. Compare it with Doom 3, which was also about shooting demons in the face on Mars, but tried to tell a more serious, narrative-driven horror story that directly conflicted with the series' thrilling and over-the-top gunplay, resulting in mediocre storytelling and shooting.

> If a game purports to be profound, it needs to do the right work to reach that objective

It's harder to make an open-world feel thematically coherent, because of the amount of space that needs filling, but it's certainly possible. The Witcher 3 uses its open world to great effect. Its themes of the politics of war and the monster of mankind are communicated by almost every aspect of the game. From the art to the landscape design, from the way the player interacts with the narrative and the way the world reacts to Geralt, it's not just in touch with its theme, but fundamentally driven by it.

At a time when almost every game features beautiful art and oodles of content, this is the key difference between a great game and a merely passable one, and we need to be more discerning about this particular gap. It's fine for a game to be meaningless fun, but in such cases the game in question should be pushing its art, mechanics and writing to support that goal. If a game purports to be more profound, it needs to do the right work to reach that objective, otherwise you end up like Far Cry 5 – swaggering, silly and ultimately hollow. CPC

Rick Lane is Custom PC's games editor. @Rick_Lane



Far Cry 5 / £39.99 inc VAT

DEVELOPER Ubisoft Montreal/Toronto / **PUBLISHER** Ubisoft / **WEBSITE** https://far-cry.ubisoft.com

The Far Cry series offers some of the best virtual playgrounds, but over the years, the gap between its mechanical and narrative aspirations has steadily widened. Far Cry 2 saw players fighting in the midst of an African civil war, with the gritty characters and messy, unpleasant gunfights reflecting that situation. Far Cry 4, meanwhile, put players at the centre of a Himalayan rebel uprising, but also allowed them to shoot rockets from the back of an elephant. Rural Montana forms the backdrop of Far Cry 5, in the largest and most varied Far Cry map to date.

Its fictional community of Hope County is a mishmash of Pacific Northwestern landscapes, ranging from flat agricultural planes dotted by red barns and picket-fenced towns, to rugged, forest-covered mountains that seem to have been plucked directly from the opening credits of Twin Peaks. It's less exotic than Far Cry 3 and less dramatic than Far Cry 4, but no less meticulously crafted for it.

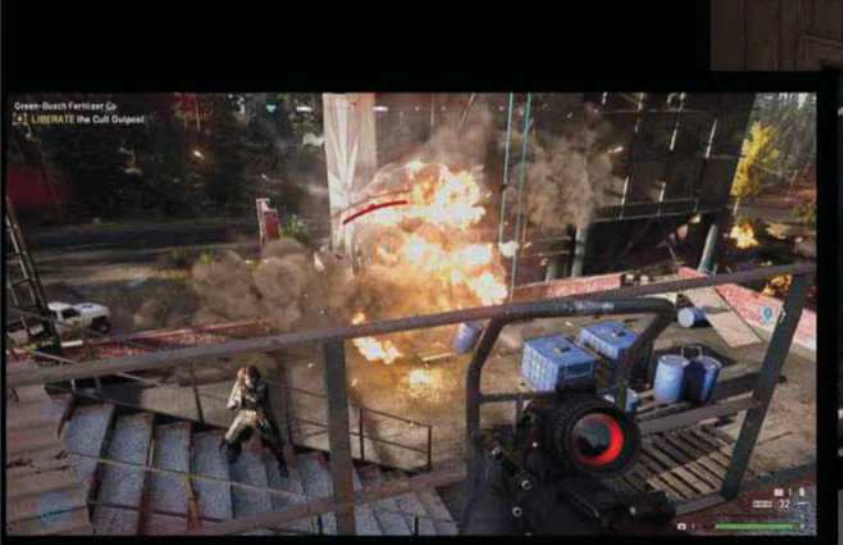
Despite the idyllic landscape, Hope County is far from peaceful, having been largely overtaken by a zealous doomsday cult called Eden's Gate. Led by the enigmatic Joseph Seed, who looks like he should be managing an artisan coffee shop rather than a pseudo-Christian sect, the cult's apparent aim is to save humanity by absolving people of their sins, which it seems to achieve by amassing a small army to torture, drug and brainwash the local inhabitants. You're part of a local law enforcement team dispatched to arrest Seed, and when this job inevitably goes awry, you engage in a guerrilla war against the cult to liberate the three provinces of Hope County from the control of Seed's family.

Words such as 'apparent' and 'seems' are necessary here because the game fails to explain the cult's motivations in any significant detail, or how the members justify their frequent acts of atrocity. A drug called Bliss, manufactured from a white flower, features substantially in the cult's beliefs, as does an obsession with the seven deadly sins.

There's little depth beyond these surface details, however. The cult's primary antagonists – many of whom are related to Seed, do an awful lot of talking but rarely say anything of substance. That's particularly the case with Faith Seed, a beautiful but supposedly highly manipulative woman, whose Bliss-induced attempts at brainwashing are utterly vacuous and entirely unconvincing.

OVERALL SCORE
60%

/ VERDICT
Poor storytelling and chaotic systems make Far Cry 5 the weakest game in the series.



It would simply be another case of poor video game storytelling, were it not for the fact that Far Cry 5 rides so proudly on the back of current political crises in America. The cult's obsession with God and guns mirrors many of the beliefs of the American Right, while the 'Real Americans' of rural Montana – small-town, low-income communities of farmers, truck-drivers and so on are precisely the people courted by the Trump election campaign. Far Cry 5 even makes jokes about 'liberals' and 'pee-tapes', so the choice of setting clearly isn't coincidental.

Whatever your political persuasion, the game still fails to deliver on this front. It's all framed around some highly topical issues, but it just dances around them, pointing and laughing while refusing to seriously engage with its own theme. Previously, Far Cry's political dabbling was just disappointing, but here it comes across as crass and craven.

It's a shame because the game sometimes has the capacity to be very good indeed, albeit less frequently than earlier entries. Far Cry 5 makes lots of small changes to the previous games' systems. The fundamental mechanic of conquering outposts using the tools available to you remains, but is now just one of several ways you can accrue 'Resistance Points' to take over one of the game's three regions. The climbing towers that dominated Far Cry 3 and 4 have been excised, with key locations now revealed by exploring the map and talking to NPCs.

It all gives Far Cry 5 a far more organic and less formatted feel, although it takes a while to get your head around it. One of the best new features is the reintroduction of AI squad mates. Almost any NPC on your side can accompany you on missions, but the game also includes nine 'Specialist' squad mates. They range from human allies such as Grace Armstrong the sniper and Nick Rye the pilot, to animal allies such as Boomer the dog and Peaches the cougar.

But the game's strongest new aspects are its 'Prepper' stashes, little first-person puzzles that conceal big rewards of money and skill points. There are dozens, possibly hundreds, of them dotted around the game world, and each one is unique. One will have you navigating a theme park-style haunted house, while finding the next one might require climbing a mountain or spelunking in a cave.

The Prepper caches also stand out for less positive reasons. The emergent play on which Far Cry has built its reputation isn't as enjoyable as previously, mainly because its systems are far too chaotic. You can barely take three steps forward without being attacked by an animal, a group of cultists or both. Sometimes this setup results in some great incidental events, but mostly it's the same or similar events happening over and over again. Far Cry 5's enemy AI is so incessant that NPCs often have to repeat themselves three or four times to complete a line of dialogue, as they're interrupted yet again by *another* pickup truck full of cultists attacking the area.

Ultimately, Far Cry 5 is too busy, too messy and too thematically slapdash to have a real impact. It can be enormous fun, but that's hardly a mark of excellence in today's crowded open-world market. Moreover, the game's disregard for its own politically charged theme borders on distasteful.

That's not to say that Far Cry 5 or any other game has to make a grand political statement, but you could set a Far Cry game on the moon and its systems would probably be just as enjoyable. If Far Cry wants to be pulpy, silly fun, that's great. If it wants to be actively engaged in current events, that's even better. But for Ubisoft to choose this specific setting with the implications it has, and then wash its hands of the subject, is at best crummy storytelling, and at worst, outright cowardice.

RICK LANE

A Way Out / £24.99 inc VAT

DEVELOPER Hazelight Studios / **PUBLISHER** EA / **WEBSITE** Price: www.ea.com/games/a-way-out

On paper, A Way Out sounds fantastic. It's a two-player, story-driven adventure designed specifically to play in split-screen format, which sees two convicts plan a prison break and go on the run from the law. It's a little bit The Fugitive, a little bit the Shawshank Redemption, and a little bit Uncharted. Sadly, nearly all of it is absolutely terrible, in what's surely the biggest missed opportunity of the year.

You play as either Vincent Moretti or Leo Caruso, two criminals who have recently arrived in prison. The game is designed specifically with local cooperative play in mind and is best played on a TV with a gamepad. It's possible to play the game with a friend online, but you can't play on a random server. Developer Hazelight clearly intends for the game to be enjoyed (or in our case, withstood), with someone you know.

Creating a game to fill this specific niche is a splendid idea, and initially, the sheer novelty of A Way Out's concept is enough to be engaging. The game is viewed from the perspective of both characters at the same time. In the opening scene, Vincent arrives at the prison for the first time. We watch as he's processed and shown to his cell, both from his viewpoint and that of Leo, who can follow the path Vincent takes by crossing the exercise yard and watching from the gantries that run along the cell-block walls.

A Way Out is also notable for its dynamic approach to split-screen play. The game's creative lead, Josef Fares, was originally a film director, and his previous work is reflected in the game's distinctive camera work. The split-screen ratio alters in size depending on which character is the focus of the action, while in certain scenes, the game reverts to a single screen, with the camera panning between each character as the scene plays out.

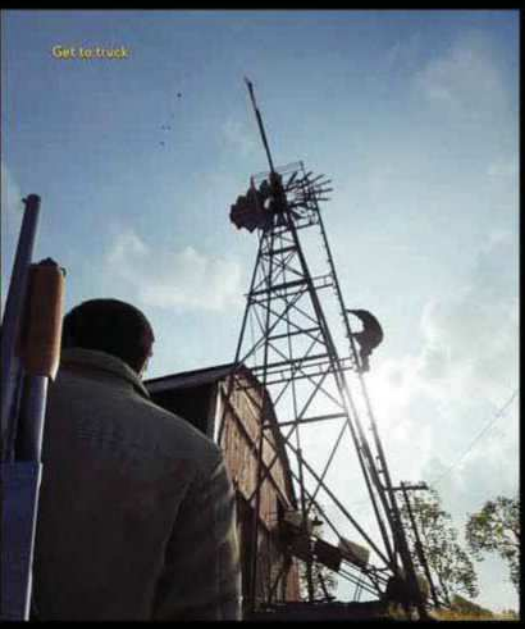
Unfortunately, that's about as far as the positive comments extend. As an exercise in narrative storytelling, A Way Out is a disaster.

The script is irredeemably awful. Not only is its dialogue almost completely devoid of either subtlety or wit, but it also seems to have little comprehension of how people speak to one another. Almost every word Leo and Vincent say feels forced and artificial, whether they're arguing with each other, talking about their wives or coming up with a plan.

To give an example, early in the tale both characters discover they share a mutual enemy in the form of a gang boss named Harvey. They decide to break out of prison to kill Harvey, and both characters are clearly resolute in their decision. Yet after busting out of prison together, they repeatedly question one another's commitment to the plan, despite neither character having demonstrated any reservations about their intentions.

OVERALL SCORE
35%

/ VERDICT
This cooperative prison break is busted by dreadful storytelling and shallow mechanics.



Clearly, the game wants to generate tension and conflict between the two characters, but it has no idea what they should say or how they should say it. It only seems to know that this type of behaviour is what often happens in films, and so it attempts to mimic that central tension without doing any of the groundwork.

For a game that wants to tell a Hollywood-inspired crime epic, the car crash of a script is seriously damaging to Hazelight's aspirations. But perhaps A Way Out could be saved in the playing? Sadly, that's not the case. While listening to A Way Out may make you cringe with embarrassment, playing the game is simply boring.

A Way Out has no systemic core whatsoever. There are no consistent tools or mechanics or ideas. Instead, the game is structured as a sequence of around 30 playable vignettes, each of which occurs in a small area and requires you to complete a certain task. In the prison break, these scenes are all concerned with preparing your escape. One scene has you collecting sheets from the laundry to make a rope, while another sees you stealing a wrench from the prison workshop.

> Almost every word Leo and Vincent say feels forced and artificial

Each of these scenes is based around a highly simplistic puzzle that sees you working together in some way, such as one player distracting an NPC while the other pockets an item, or working together to navigate past an obstacle.

There's no creativity to any of it though. You can only do exactly what the game requires you to do at that time, while any other interactive elements in the scene are annoying red herrings that serve no purpose other than to make the game feel more interactive. Once you escape from the prison, A Way Out does manage to increase the variety of its play. You'll sneak through the bushes on the outskirts of the prison, participate in a police chase, navigate river rapids in a rowboat and rob a petrol station.

However, all of these sequences amount to little more than cooperative mini-games loosely stitched together. By far, the weakest segments are the hand-to-hand fight scenes, which amount to a collection of quick-time events.

It isn't until you get to the final third of the game that it gives you a proper set of mechanics with which to play, specifically those of a rudimentary third-person cover shooter. It's not in the least bit special, but it's at least mildly enjoyable to play, because you are actually *playing* with your co-op partner, rather than following the game's instructions in tandem. The conclusion also twists the cooperative play in a way that would be quite clever, were it not for the depressingly dull experience of the previous seven hours.

Ultimately, the key issue with A Way Out is that it's too focused on telling a cinematic tale rather than telling one that's enjoyable for the player to participate in. It seems to figure out this problem around two thirds of the way into the game, but by that point it's far too late. The idea of a cooperative prison break game may be enthralling, but this particular jailbird is best left behind bars.

RICK LANE

Jalopy / £10.99 inc VAT

DEVELOPER Minskworks / **PUBLISHER** Excalibur Games /
WEBSITE www.excalibur-publishing.com/products/jalopy

Jalopy is a good game about driving a bad car. Set in Eastern Europe during the last years of the Soviet Union, it sees you embark on a road trip with your kindly uncle from Germany to Istanbul, driving a fictional variant of the East German Trabant. It's a curious blend of light-hearted driving simulator and challenging rogue-like (or should that be 'road-like'?). Like the world-famous car upon which it's based, it's likeable even when it doesn't completely work.

The game's self-proclaimed 'Grand Journey East' commences in your uncle's scrapyard in Dresden, and sees you travel through the Czech Republic, Hungary, Yugoslavia and Bulgaria, before finally arriving in Turkey for the final leg to Istanbul. Jalopy isn't intended to be a realistic portrayal of those countries. Instead the game presents the world as a lo-fi, textureless abstraction that's pretty in the sunshine and oppressive in the rain. Jalopy won't win awards for its environment design, but the style fits its theme of travelling through the Eastern Bloc in those moody and uncertain years after the fall of the Berlin Wall.

Your little Laika requires regular refuelling and maintenance

These landscapes are also procedurally generated. Before crossing the border into the next country, you can select one of three travelling routes, all of which are cobbled together from an assortment of environmental Lego pieces. These routes range from busy(ish) highways to muddy countryside tracks, and see you travel through open countryside, small towns and unique sights, such as a road that travels through a cave system. Each route also has a different length, and varies in terms of weather and useful locations such as petrol stations or scrapyards.

It's important to choose your route carefully, because your little Laika is a temperamental machine that requires regular refuelling and maintenance. Jalopy's car simulation is a tactile blend of arcade driving and mechanical realism. Your engine is made of multiple components, all of which can break down and will need repairing or replacing. Meanwhile, tyres will wear down and eventually burst. Maintaining your car costs money, as does fuel and accommodation. Fortunately, your kindly uncle ensures you never run out completely, and you can earn money to upgrade your car by collecting packages and scrap from the side of the road, and selling it for profit at shops.

Jalopy is hardly a pulse-pounding thrill ride, but there's plenty of satisfaction from keeping your car on the road, and the adventures you have on the way. Its systems can be frustrating, however. There are times when you have to stop every 30 seconds to solve a problem with the car, and you can only pick up three items at a time, which can make shopping and repairing your car a fiddly process.

Also, the days are far too short considering the number of interruptions to your journey, so you spend an awful lot of time driving at night.

Jalopy is a refreshingly low-key mix of adventure gaming and driving simulation, and although it sometimes threatens to fall apart, it does get there in the end.

RICK LANE

OVERALL SCORE
75%

/ VERDICT
A novel blend of scenic driving and mechanical tinkering make Jalopy a fascinating, if occasionally wonky, adventure.

Future plans for Dagor include remodelled explosions and particle effects

RICK LANE / THE ENGINE ROOM

Dagor

Rick Lane investigates the story of the engine behind Wings of Prey and War Thunder

Engines often outgrow the games they were originally designed to support. Unreal Engine, for example, has long since moved beyond the series of 3D shooters that it originally powered. Indeed, this situation is more or less the reason why the idea of engine licensing came about, as developers realised that their technology could be given to other developers (for a price, naturally) to create new games.

It's much rarer for a game to outgrow its engine, mainly because most games are fixed creations, whereas engines constantly evolve. But it does happen, especially with games that have long lives, such as Counter-Strike and RuneScape. Such is the case with Dagor, the engine created by Russian developer Gaijin Entertainment. A proprietary engine that has powered all manner of different games, in the past half-decade, Dagor's evolution has been dictated largely by a single project – War Thunder.

Dagor has become adept at realistically simulating flight

The history of the Dagor engine stretches back 15 years. Gaijin Entertainment was founded in 2002, and released its first Dagor-powered game, Adrenalin, in 2005. Ironically, the engine was created because other available engines hadn't sufficiently outgrown the games on which they were based. 'When Gaijin was founded, basically three engines were available for licensing, namely Unreal Engine, idTech and RenderWare,' says Gaijin. 'The first two, albeit having all the features we needed, provided no support for consoles and came at a licensing cost of one million US dollars each, and while the latter was a little cheaper and did provide console support, it lacked several important features as well.'

The list of games Gaijin has developed using Dagor is fairly eclectic, including arcade racers, mobile ARPGs and the rather

Naval forces, the last of War Thunder's three main vehicle types, are currently in closed testing

eyebrow-raising X-Blades, in which you play a sword-wielding anime-girl dressed in what's basically a G-string. Over time, however, Gaijin has gradually developed a niche in combat-flight simulators. Commencing with the critically acclaimed Wings of Prey, Gaijin has since followed up with the console-exclusive Birds of Steel and the helicopter sim Apache: Air Assault.

Through these games, the Dagor engine has become specialised in simulating aerial combat. 'All the relevant characteristics of the involved aircraft are simulated in real time, including internal functions (such as engine thermodynamics), the effect of damage and the physical forces acting on them (drag, gravity, pressure and so on),' Gaijin says.

'We use an exhaustive list of technical parameters as a basis for our physics calculations, such as the machine's weight, its wingspan and other physical dimensions. This detailed simulation allows us to provide players with a sensation of flight that's very close to the real deal, even in the lower difficulty settings, where some simplifications apply, such as the inability of an aircraft to fall into a flat spin in "Arcade" mode.'

This aerial specialisation formed the backbone for 2012's War Thunder, a vehicular-multiplayer game with the aim of letting players fight in three arenas of combat – ground, air and sea – at the same time. This roster required the simulation of two additional vehicle-types – tanks and boats, each of which presented Gaijin with its own obstacles.

'For ground forces, for example, we implemented accurate interactions between a vehicle and the terrain on which it moves (for example, mud vs a paved road). We also developed a complex system to represent armour and the subsequent effect of penetration, introduced much more visually vivid ground locations (in comparison to aircraft maps), increased the level of detail of landscapes more than 200 times, and so on.' Naval vessels are still in closed testing, but Gaijin says it's approaching ships with a similar bespoke simulation, including 'detailed interactions between vessels and water surfaces' and 'extending buoyancy simulation'.

New weather effects include rain and fog, which can affect visibility and used to the player's advantage

Displacement mapping produces realistic bumps and grooves in terrain

Realising the full vision of War Thunder has taken Gaijin over half a decade. As a result, the developer has needed to maintain and improve the engine's rendering technology alongside the development of the actual game. Last month, Gaijin released Dagor 5, which provides an extensive visual overhaul for War Thunder.

This overhaul includes what Gaijin claims to be a unique approach to global illumination (GI). 'Generally speaking, GI is the common term for a complex series of algorithms dedicated to calculating the lighting in an in-game scene,' Gaijin explains. 'Usual algorithms require the objects in a scene, for which lighting is to be calculated, to be static or come with the need to pre-calculate a so-called lightmap, to save processing power while playing.

'In a game that features vehicular combat on destructible environments, lighting only static objects is obviously unsatisfactory. With our new implementation, we've been able to realise a truly real-time global illumination system for dynamic and destructible objects, which doesn't require pre-calculation. It will work on all War Thunder maps, independent of their size, and it's planned to be the default setting for players using the highest graphics settings.' Because of the complexity of implementing real-time global illumination, Gaijin is approaching the release in batches throughout the remainder of this year.

Meanwhile, Dagor 5 makes many other updates to the core rendering engine, including terrain displacement mapping for more realistic-looking landscapes. There's also a new weather system that introduces dynamic fog, and several types of rainfall that can form puddles of water and mud on the game's 32 x 32km maps. Dagor 5 also introduces temporal anti-aliasing, which calculates anti-aliasing requirements across a previous number of frames, producing a smoother real-time image that features less visual 'noise' as the player moves around the world.

It's currently possible to play with joint ground and air forces, with naval units coming soon

The new weather system introduces dynamic fog, and several types of rainfall

It's an impressive graphical overhaul, and the changes aren't limited to visuals either. Accompanying the Dagor 5 update is a complete reproduction of the game's sound effects for ground forces. This update includes the addition of new sound effects, such as cannon-loading mechanisms, plus the remixing of existing sound effects. 'Firing sounds are now multi-layered and affected by the surrounding area,' says Gaijin.

'A firefight in a village now sounds much more different than combat on open terrain, and veteran tankers will be able to determine the calibre and location of a shot taken by another vehicle much more precisely now.'

These changes to Dagor are vital to keep War Thunder looking and feeling fresh in the face of competition from games such as World of Tanks. However, an equally important factor for Gaijin is ensuring that the game runs well on low-end machines. The developer cites the recent Steam hardware survey as an example of this requirement. 'Around 2 per cent of all users of this platform who participated in the survey use Nvidia's top graphics cards (GeForce GTX 1080 and 1080 Ti),' says Gaijin. 'Around 25 per cent of them are still using a CPU with one or two cores, and almost 70 per cent of them only gave access to 8GB of system RAM or less.'

Keeping War Thunder accessible to the broadest number of players possible is the biggest challenge that Gaijin faces. 'This situation becomes even more challenging for us as we introduce visual features that have to be available for all players, because they can influence gameplay, such as fog, or smoke grenades used to hide a ground vehicle.'

War Thunder has formed the core of both Gaijin and Dagor for over half a decade, and it looks like this situation will continue for the foreseeable future, as the developer plans to roll out its bespoke global illumination system over the course of the following year. 'We also plan to significantly improve the effects in the game, such as fire and explosions, while continuing to improve the visuals of water surfaces. That's not all, of course, and we'll announce what is coming to our players in due time,' Gaijin says. CPC

INDIECORNER

Teen horror, revolutions and psychotic drivers. It's another episode of Rick Lane's indie corner!

The Blackout Club

DEVELOPER Question / **RELEASE** 2019

Imagine you go to sleep at home but wake up somewhere else. You're covered in dirt with blood on your hands, but you've no memory of what happened. You trudge back to your house through the streets of your hometown, but then it happens every night. That's what's happening to the teenagers of the Blackout Club, and they're determined to find out why.

Developed by former Bioshock and Dishonored devs, The Blackout Club is a four-player-cooperative game that combines a bit of Left 4 Dead with the Goonies and Thief. Each night, you and your friends venture into the town on a procedurally generated mission, documenting the strange happenings to figure out what's causing your troubling night movements.

The game combines a blend of first-person stealth and tactics. The mysterious enemies are too physically powerful to fight directly, so instead you need to use a combination of sneaking, diversionary tactics and teamwork. Such enemies include 'sleepwalkers', adults controlled at night by the same entity that's assailing you. Your goal might be to retrieve a certain object, or record footage of a particular event, such as a specific enemy entering a specific location. Developer Question is still vague about many of the details, partly to keep the game surprising, but also because it's still in development.

Two Point Hospital

DEVELOPER Two Point Studios / **RELEASE** 2018

Two Point hospital is a spiritual successor to Theme Hospital, spearheaded by a group of Bullfrog and Lionhead alumni, some of whom worked on the original game. The premise is pretty much identical. You're tasked with building and maintaining a hospital, laying out rooms, purchasing medical equipment and hiring doctors, nurses and support staff. Your medical team must then process an increasing influx of patients, diagnosing them and treating them. At the same time, you must research treatments to stay competitive with rival clinics and pharmaceutical companies.

The aesthetic is vivid and colourful, with chunky, Playdo-like characters reminiscent of Nick Park's animations. At the same time, your doctors will treat a range of colourful diseases, such as 'light-headedness', symptoms of which include your patient's head literally turning into a light bulb.

Will the game will bring anything new to the mechanics? The developers have struggled to answer this question in press interviews, which hints that, beyond a visual upgrade, we won't be seeing anything radically new. However, assuming it's successful, Two Point Hospital is planned to be the first in a line of Two Point management sims that will share the same game world.

The Occupation

DEVELOPER White Paper Games / **RELEASE** 2018

It's 24 October, 1987. A bomb has gone off somewhere in northwest England, and Parliament is about to respond by passing new legislation that will severely curtail the UK's civil liberties. However, the circumstances surrounding the bombing are suspiciously vague and you, an investigative journalist, need to find out what happened.

Developed by Manchester-based White Paper Games, The Occupation is a first-person 'fixed time' adventure game. You have just four hours to explore the bombsite and the area surrounding it, avoiding guards, collecting evidence and solving puzzles. When that time is up, you'll need to use the evidence you've collected to make a call that will influence the vote on the upcoming Union Act.

The developers cite immersive sims such as Thief and Dishonored as influences, and you'll need to sneak into places to retrieve important objects. The game focuses more on storytelling and puzzle-solving than those games, however. Your character has no weapons, instead carrying a briefcase to store puzzle items such as notes and floppy disks. We won't know how the strict time limit will work until the game is out, but clearly there will be multiple endings and multiple ways of solving the game's political conundrum.

Deep Rock Galactic

DEVELOPER Ghost Ship Games / **RELEASE** Out now (Early Access)

Deep Rock Galactic is a four-player cooperative experience inspired by Left 4 Dead and Minecraft. It casts you and your friends as a group of spacefaring dwarves employed by an intergalactic mining company. Each mission sees players descend onto a remote alien rock, which they must mine for resources while fending off whatever alien wildlife lurks in the caverns.

Each level is procedurally generated, with algorithms designed to produce levels that encourage team-based play. Getting to your objective may mean blasting through cavern walls to create a passage, or navigating deep crevasses using ziplines or deployable bridges, all while being harried by insectoid alien enemies.

You can play as four classes, each with different abilities and equipment. The Driller, for example, is adept at creating new passageways through the rock, while the Engineer can build turrets and defensive structures to hold off alien critters. One of the most important classes is the Scout, who carries a light-source that illuminates the otherwise dark and shadowy cave spaces. After almost ten years, Left 4 Dead remains the pinnacle of cooperative gaming, but Deep Rock Galactic's blend of ideas may provide some much-needed innovation in the cooperative shooter genre.

Driving Survival

DEVELOPER Ondřej Švadlena / **RELEASE** TBA

Driving Survival is the working title for this in-development vehicular horror experience, in which you're chased along murky roads by mysterious cars, which try to run you off the road. It takes place in a non-specific rural backwater swathed in a fog so thick you could put it on a stick and sell it at a circus. You'll drive through dilapidated villages and brown, weed-strewn countryside, all washed in a sickly glow by the sepia streetlights overhanging the roads.

You must navigate this landscape while your rear-view mirror is filled with the headlights of your pursuers. If they get close enough, they'll try to ram your car, and if they manage to stop you, the passengers will leap from their seats and assault your vehicles with clubs.

The game's broader structure isn't yet clear, and we don't know whether it will have any story or narrative attached either. However, developer Ondřej Švadlena is keen to create a believable enemy AI that will pursue and harass the player in a convincing fashion, stating in a blog that there's a 'strong emphasis on programming the NPC cars to be as skilled as possible and building favourable conditions to allow for a gradual building-up of the tension'. EPG

MAKE YOUR OWN SMART HOME

YOU DON'T NEED TO SPEND A FORTUNE TO CREATE A SMART HOME. BARRY COLLINS REVEALS THE OPTIONS FOR BUDGETS UP TO £200, £1,000 AND £4,000

Fully automated homes, where you can switch on the lights with a click of your fingers were – until recently – the preserve of the rich. Now, however, a barrage of off-the-shelf smart home devices are on the market. In fact, it's possible to smarten up your home for less than a couple of hundred quid, although you may have to ask Alexa to turn on the lights, rather than snap your fingers.

In this feature, we've equipped a smart home for three different budgets. There's a budget smart home for under £200, a set of mid-range options for under £1,000 and a premium smart home where we've let rip with the budget, but still got all we need for less than £4,000. Obviously, our model smart homes aren't entirely prescriptive. You can mix and match elements from the different packages to find the smart home mix that suits you. From switching on the home heating from work to seeing whether your robot vacuum cleaner has managed to clear the dust from under the bed, we've got all the domestic options covered.

BUDGET SMART HOME UP TO £200

Google's Home Mini has a splash more style than the Dot, coming in three homely colours: chalk, charcoal and coral

VOICE ASSISTANT

The key to any modern smart home is your choice of voice assistant. If you're shooting for the low-budget end of the market, there are really only two options: Amazon or Google. The cheapest dedicated voice assistant in Amazon's range is the Echo Dot, which normally sells for £50 inc VAT but is regularly discounted to £35, and can be bought cheaper if you opt for a refurbished model.

The speaker on the Dot is puny, and certainly isn't ideal for listening to music. There's a 3.5mm audio out to connect the Dot to an external speaker system, however, or you can use Bluetooth. What's great about the Dot is that it's so cheap you can put one in every room if you have the budget, giving you voice control across the house. Indeed, Amazon sells a three-pack for £125. The Echo range is also compatible with a huge number of other smart home devices, including the Nest, Hive and Honeywell thermostats, Philips Hue lights, WeMo and TP-Link smart plugs and many more. There's a full list at **www.amazon.co.uk/alexasmarthome**

Google's Echo Dot rival is the Home Mini, which also retails for £50 inc VAT. It has a splash more style, coming in three homely colours: chalk, charcoal and coral. Unlike the Dot, you can also interact with it by touching its top surface, instead of using the wake word. There's no wired audio output, though, so you'll need to rely on Bluetooth if you want to connect it to a more powerful speaker. Its smart home device compatibility isn't quite as broad as Amazon's either, but most of the big names are there. You can read the full list at **https://tinyurl.com/GoogleHomePartners**

LIGHTS

Philips pioneered the market for plug-and-play smart lights when it launched the Hue range back in 2012. Now it has several different products in the range, the cheapest of which is the Hue White Wireless Bulbs Starter Kit, which currently costs £55 inc VAT from **www.amazon.co.uk**. This pack includes two smart bulbs and the boxy bridge required to make them talk to your router. The bridge comes with its own power cable and has to be hard-wired to your router via an Ethernet cable, so make sure you have a spare port.

While the bulbs aren't capable of producing the rainbow of colours on offer from the more expensive Hue kits, they can be set to a number of different colour temperatures and brightness levels. These settings include a 'calming glow' to help you unwind before bed, as well as a strong white reading light.

The lights are controlled from the accompanying smartphone app, but unlike the Ikea models (see below), the Hue starter kit doesn't include an independent remote control, which means everyone in the house will need access to a smartphone to control the lights. The Hue lights are also compatible with Alexa, Google Home and a wide range of other services, including IFTTT, allowing you to do clever stuff such as have the lights turn on automatically at sunset or when it detects that your phone has entered Wi-Fi range.

Ikea's Trådfri smart lights includes a dainty puck-style remote control

Ikea's Trådfri smart lights pack is very similar, and it comes in at £65 inc VAT from **www.ikea.com**. You get two white lights and the gateway box to plug into the router but, unlike the Hue pack, you also you get a dainty puck-style remote control, which means you don't have to get out your phone every time you want to dim the lights.

The Echo Dot is so cheap that you can put one in almost every room and have voice control across the house

Philips' smart lights can be set to a range of different colour temperatures via a smartphone app

Setting up the Ikea lights is a bit of a faff. To pair the remote control with the bulbs, you must hold the remote within 2cm of the switched-on bulb, so don't put on any large lampshades before you've completed the setup process.

Ikea's decent smartphone app guides you through the entire process though. After a long wait, the Ikea lights finally worked with our Amazon's Alexa. We've had one or two teething problems, however, with one forcing us to completely reinstall our light bulbs – a phrase we never thought we'd find ourselves writing. The Ikea lights also run on the same Zigbee standard as Hue, so you can use the Hue hub to control the Ikea lights and get all the benefits of IFTTT and so on.

If you want to avoid a hub altogether, TP-Link's Smart Wi-Fi LED Bulbs (£35 inc VAT for a single bulb) connect directly to your router, cutting out the unnecessary middleman. You can then use Alexa or your smartphone to control them.

SMART PLUGS

Smart plugs offer a cheaper way to get some of the benefits of smart lights. Instead of using Wi-Fi-enabled light bulbs, you simply plug an ordinary lamp into a smart plug and use the accompanying app to switch your lights on and off. Many smart plugs are also compatible with IFTTT, so you can have the lights switch on when it gets dark, or whenever someone rings a smart door bell, for instance.

Smart plugs have wider usage beyond lighting too. If you have a portable heater in a back bedroom or garden office, you can plug that into the smart plug and give yourself some of the benefits of smart heating without investing in a system such as Nest or Hive. Wi-Fi smart plugs are getting cheaper too.

We've been using the TP-Link HS100 WiFi Smart Plug for the best part of a year now, and it's been 100 per cent reliable. That plug now costs just £27 inc VAT from www.johnlewis.com, and TP-Link has just made its Kasa app compatible with IFTTT, opening up a range of new smart home scenarios.

The TP-Link HS100 WiFi Smart Plug is compatible with IFTTT, opening up a range of smart home options

Check the compatibility of the smart plug you choose with your chosen voice assistant before you buy though. Beware that some plugs are directly supported, while others require a voice-assistant 'skill'. The former lets you simply yell commands such as, 'Alexa, turn the heater off,' while the latter forces you to first bark at Alexa to open the skill, wait a few seconds for that to happen and then issue your command. It may sound like a small difference, but it's a big obstacle in practice.

SHOPPING

At the risk of making this budget section a bit of an Amazon love-in, the company's Dash buttons are a cheap – arguably, free – way to add some more smart features to your home shopping. They're also the ultimate one-trick pony. You simply press a button to re-order a product from a particular brand and (provided you're an Amazon Prime subscriber) a driver arrives at your door with said product around 24 hours later.

Amazon now has an enormous number of brands signed up for the Dash button scheme, including Finish, Andrex, Ariel, Gillette, Duracell, Nescafe and even Heineken. Most brands allow you to choose from a range of products to which you can assign the button. The Andrex button, for example, can be set to re-order 11 different products, ranging from loo rolls to wipes. Most Dash button brands give you the cost of the button off your first order too, so it's effectively cost-free.

It sounds like the ultimate exercise in laziness, but having used them around our house for the past year, it definitely cuts down on the number of times you run out of a product because you forgot to pick it up in town. Just keep an eye on the prices, as the prices of Dash button products do have a habit of gently creeping upwards.

Amazon Dash buttons may be one-trick ponies, but they're useful for ordering life's necessities

TELEVISION

Our budget won't stretch to a smart TV, but it can manage a dongle to make your TV smarter. The Amazon Fire TV Stick with Alexa Voice Remote costs £40 inc VAT, and includes an Alexa-enabled remote. You can press a button, ask Alexa to play Jessica Jones from Netflix and Alexa does the rest.

The Fire TV Stick supports all the main terrestrial broadcasters and streaming services, including BBC iPlayer, ITV, All 4, Netflix and Amazon Video, so you could hand over your entire on-demand TV viewing requirements to the Stick. The Alexa-enabled remote can control other smart devices too, so you can tell your voice assistant to dim the lights before a movie. If there's one disappointment with the Fire TV Stick, it's that the standard version doesn't support 4K TVs, although you can buy a 4K-enabled Fire TV dongle and Alexa-enabled remote for £60 inc VAT.

Amazon's Fire TV Stick has support for all of the main streaming services, including Netflix, BBC iPlayer and Amazon Video

BUDGET SMART HOME COSTS	
Amazon Echo Dot or Google Home Min	£50 inc VAT
Philips Hue White Wireless Bulbs Starter Kit	£55 inc VAT
TP-Link HS100 WiFi Smart Plug	£27 inc VAT
Amazon Fire TV Stick with Alexa voice remote	£40 inc VAT
Amazon Dash buttons	Free (£5 price deducted from first order)
TOTAL	**£172** inc VAT

MID-RANGE SMART HOME UP TO £1,000

VOICE ASSISTANT

Now we've loosened the purse strings, we can start talking about voice assistants that include a proper speaker, and Amazon has recently expanded the mid-range of Echo devices. The new Amazon Echo, a more squat, fabric-covered version of the original Echo, costs only £90 inc VAT and almost made it into our budget category. It has the same 2.5in subwoofer as its bigger sibling and a slightly smaller tweeter (0.6in compared to 0.8in).

Given that's unlikely to make an earth-shattering difference to sound quality, why would you still opt for the taller design of the now renamed Echo Plus at £140 inc VAT? Well, the Echo Plus now has a Zigbee hub built into the device, so if you have compatible devices such as the Philips Hue smart lights, you no longer need Philips' own bridge device plugged into your router, saving space and a smidgen of electricity. Indeed, at the time of writing, Amazon was even including a Philips Hue bulb with the Echo Plus. Whether that's worth the extra £50 is debatable, though, and remember that the Echo will have to be kept in range of the other Zigbee smart devices.

Thanks to a built-in Zigbee hub, the Echo Plus removes the need for bridge devices for smart lights

Google's mid-range voice assistant is the Google Home, which is very similar in stature and feature set to the Echo, but currently £40 more expensive at £130 inc VAT. However, we rate Google's assistant more highly than Amazon's for two main reasons.

Firstly, it's much more contextually aware than Alexa – it can answer a wider range of queries and is better at handling follow-up questions, such as 'how long will it take me to get there?' after you've been told about your next appointment. The Google Home also has better physical controls, allowing you to pause music or hold your finger down on top of the unit to activate the device instead of yelling at it.

LIGHTS

Upping the budget in the lighting department enables you to make your smart lights even smarter. It's not so much the bulbs themselves that change, but the accessories that come with them. Having said that, if you like to bathe your living room in red light, or if you sleep better when the bedroom has a gentle blue glow, then you might want to check out the coloured version of the Philips Hue starter kit, which will set you back £150 inc VAT from **www.amazon.co.uk** for three colour-changing bulbs and the controller.

In terms of accessories, the Hue Intelligent Motion Sensor (£30 inc VAT from **www.amazon.co.uk**) is a great addition to the setup, particularly if you have kids in the house. Stick the battery-operated motion sensor on the upstairs landing, for example, and it can turn on the lights automatically if the kids get up in the night to go to the toilet, helping to avoid fits of screaming because it's too dark.

The £150 colour version of the Philips Hue starter kit lets you bathe rooms in a gentle pink glow

DOORBELL

Another luxury that the extra budget affords us is to make our front door smarter. I first installed a Ring doorbell 18 months ago, and it's the one item every visitor to our house wants for themselves. Also, anyone who sees me answer the door to couriers from my smartphone, so I can direct them where to leave packages while I'm out, is instantly smitten. I should genuinely be on commission.

The Ring Chime Pro doubles as a Wi-Fi extender, and is a lot louder than its predecessor

That said, the first-generation Ring devices were flawed. I had to use additional Wi-Fi extenders to help the Wi-Fi signal reach the doorbell, while having to unscrew and remove the entire doorbell unit to recharge the battery was less than convenient. Ring has addressed both problems with its latest devices.

The Ring Doorbell 2 (£145 inc VAT from **www.amazon.co.uk**) has a removable battery – you simply twiddle one screw to free it for recharging. The battery also genuinely lasts for months if you turn off the faintly useless motion detection – who needs an alert for every postman visit? The doorbell now comes with two different, angled mounts as well as a different colour

skin to help match your décor. If you bought the original Ring doorbell, an adaptor plate means you won't need to drill a new set of holes in the wall to mount the new device.

Meanwhile, the Wi-Fi reach problem has been solved with Ring's Chime Pro (£40 inc VAT from **www.amazon.co.uk**). The previous door chime was simply a dumb terminal that alerted you to someone at the door – handy for occupants who don't have the Ring app on their smartphone. The new Chime Pro doubles as a Wi-Fi extender, completely removing the need for a dedicated Wi-Fi extender in our modestly sized house. The new Chime is also much louder – we struggled to hear the previous model from upstairs.

Use a Ring doorbell to answer the door to couriers from your smartphone, and direct them where to leave packages while you're out

The Ring app can still be a little temperamental, especially the Windows version, but it's quickly become an absolute essential in our house. Compatibility with IFTTT also allows you to do clever tricks with smart lights, such as automatically turning on a light in the downstairs hallway every time someone's at your front door.

HEATING

Our enlarged budget allows for a smart thermostat, which have dropped in price recently. Nest's thermostats are the king of the market, and the latest third-generation Learning model will set you back £279 inc VAT with professional installation, or £219 inc VAT if you want to fit it yourself, from **https://store.nest.com/uk**. Unlike its predecessor, it also ditches the fixed chrome surround of the original Nest Thermostat, giving you a choice of white, black, copper and stainless steel surrounds, so it will blend in more easily on the white emulsion walls of a kitchen rather than the living room, although that will obviously depend where your current thermostat is located. It can also control your hot water as well as your heating.

The Nest Thermostat has all the features we've come to expect, including the option to turn on/off the heating remotely from your smartphone, and intelligent features such as turning down the heating when it detects that all the occupants have left the house (by tracking their smartphone location). Nest claims the average US customer knocks 10 per cent off their heating bills after installing such a thermostat, so it could end up paying for itself, although it's hard for us to verify those figures. It will also work with loads of other smart home gear, including Amazon Alexa, Google Home, Philips Hue lights and it works with IFTT too.

The idea is that the Nest Thermostat simply replaces your existing thermostat, whether it's wired or wireless, and it's compatible with a wide range of heating systems, including combi boilers, system and heat-only boilers, air-source and ground-source heat pumps, biomass boilers and hydronic underfloor systems. Nest says the thermostat is compatible with the 'vast majority' of European boilers that use radiators or in-floor pipes, but if in doubt, check the website first and pay for the professional installation.

HOME SENSORS

You can have lights, doorbells, heaters, smart plugs and other gadgets dotted around your home, but sometimes it's not the gadgets you need to track, but the people in the house. Or people trying to break into it. Samsung's SmartThings Starter Kit (£100 inc VAT from **www.amazon.co.uk**) is one of several similar kits on the market, offering a range of sensors that can tell you when people are home, if doors have been opened unexpectedly or if there's a flood in the kitchen.

The kit includes a motion sensor that can either be used to alert you to the presence of burglars or to perform more mundane tasks, such as activating smart lights when you walk into the room. The moisture sensor could be invaluable in the winter, sending out an alert if it detects moisture from a broken pipe or other leak while you're out of the house.

The Nest Thermostat lets you flick the heating on or off from your smartphone

There's also a presence sensor that can detect when you enter and leave the house, which could again be linked to your heating or lights. You could even attach the fob to a dog collar and get a warning if Fido decides to walk himself around the block, although it's a little chunky for smaller pooches.

All of this gear is controlled by a hub that plugs into your router and Samsung's smartphone app. The app has a simple layout, with no-jargon descriptions and easy-to-create IF/AND rules. It shouldn't take more than 15 minutes to set up with motion-controlled lighting, notifications when the kids come home from school, or a boiled kettle first thing in the morning using the supplied smart plug.

The £160 SmartThings Starter Kit from Samsung is a useful tool for monitoring your house, and dog, remotely

MID-RANGE SMART HOME COSTS	
Amazon Echo Plus	£140 inc VAT
Philips Hue Colour Starter Kit + Intelligent Motion Sensor	£180 inc VAT
Ring Doorbell 2 + Ring Chime Pro	£185 inc VAT
Nest Thermostat with installation	£279 inc VAT
Samsung SmartThings Starter Kit	£100 inc VAT
TOTAL	**£884 inc VAT**

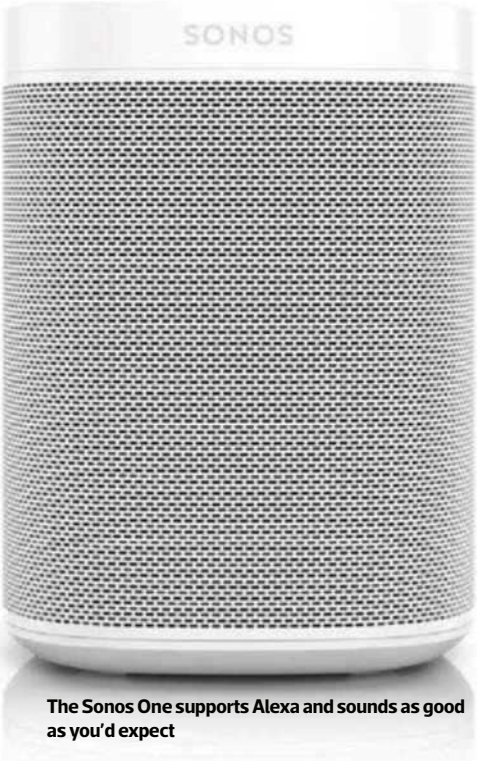
PREMIUM SMART HOME £1,000 PLUS

VOICE ASSISTANTS

Now we're really cutting the purse strings, all manner of premium voice assistant options become available. Sonos has long been the sophisticate's sound system of choice, and it appears to have taken an 'if you can't beat 'em' attitude with the Sonos One – a new speaker with Amazon Alexa built into it, which costs £199 inc VAT from **www.johnlewis.com** Sonos will also be adding Google Assistant support later this year.

The Sonos One is the same size and weight as the company's Play:1 and the design is near identical, which means it will have no trouble blending into an existing Sonos system. Incidentally, an Echo Dot plugged into a Play:1 will achieve much the same effect, if less elegantly. The sound quality is top-notch too; the sound blends perfectly with the other speakers in the Play family.

If you're embedded in the Apple ecosystem, the Apple HomePod is also a strong contender. Apple is putting a huge emphasis on the HomePod's audio quality, fitting it with a high-excursion woofer with its own dedicated amplifier, seven horn-loaded tweeters each with its own amplifier and a six-array microphone so that it can detect your voice over the music.



The Sonos One supports Alexa and sounds as good as you'd expect

Apple claims the HomePod will also adjust its acoustics depending on where it's positioned in the room, steering audio in the optimal direction if it's placed in the corner of a bookshelf, for instance. We've yet to test one properly, but the indications from early demonstrations are that the sound quality is excellent – although for £300, it needs to be.

In a similar price bracket is the Google Home Max, which is available for $399 in the USA and has yet to be exported to the UK. This 337 x 190 x 154mm slab of a speaker has two 114mm high-excursion dual-voice-coil woofers and two 18mm custom-designed tweeters, and it also promises to adjust the sound quality depending on its surroundings.

It can be stood in either landscape or portrait orientation and comes with a magnetic pad to stop it slipping on shiny shelves. We've yet to even get a demo of this speaker, but it could be a high-end contender for Android homes.

TELEVISION

Given that money is now no object, you're perhaps expecting us to endorse a super-expensive, voice-controlled 4K television. You couldn't be more wrong. In our experience so far, smart technology integrated into long-lasting devices such as televisions begins to look tired after two, three or four years, when the manufacturer has long since given up on firmware updates and is concentrating on newer models.

Our advice on televisions is to buy the device with the best picture quality you can afford and get your smart features from plug-in devices such as the Amazon Fire TV Stick we mentioned earlier, with the new 4K Fire TV dongle and Alexa remote currently going for £60 inc VAT on **www.amazon.co.uk**

Google's voice assistants can also deliver instructions to the Chromecast and Chromecast Ultra (the latter of which supports 4K screens). The recently revamped Apple TV 4K also comes with a Siri remote for anyone firmly rooted in the fruity camp.

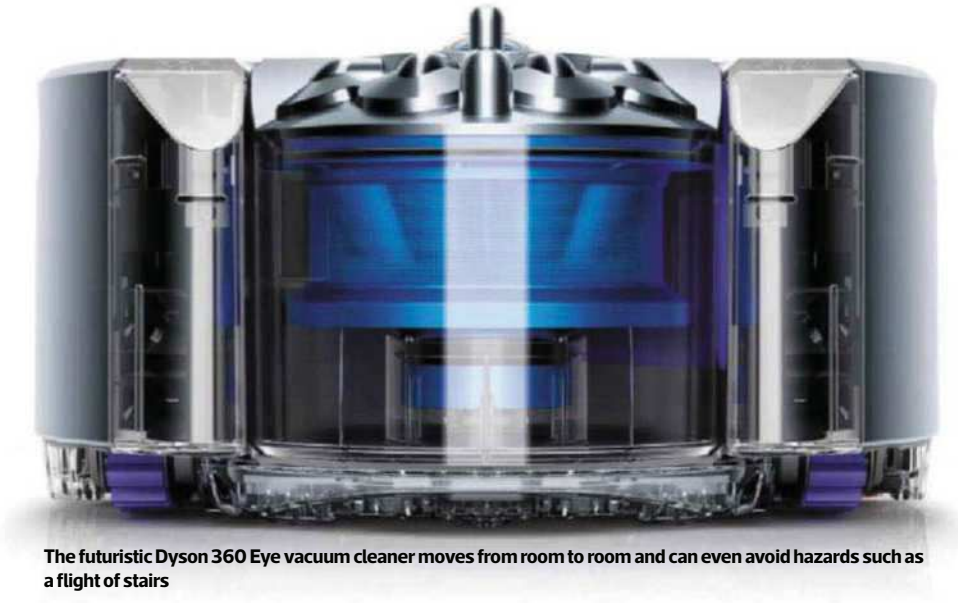
Amazon's new 4K Fire TV dongle bundle includes an Alexa remote control

ROBOT CLEANER

Robots and AI will make us all redundant one day, according to the doom-mongers, but cleaners really should be worried about the Dyson 360 Eye. This device is smarter than your average robo-vacuum. It cleans by using an outwards spiral pattern divided into blocks, ensuring that it covers every bit of floor surface to which it has access.

The Eye 360's navigation is so advanced that it can even move from room to room, provided you leave doors open. However, it's also smart enough to avoid pitfalls such as tumbling down a set of stairs. Naturally, it returns back to its dock when the batteries need topping up after 40 minutes of hard sucking.

The accompanying app is excellent. As well as letting you start a clean before you leave the office in the evening, the app also lets you schedule one-off or recurring cleans. It will also pop up a notification if there's something wrong: it alerted us immediately when a stray set of headphones ended up wrapped around its rollers. The app also displays the area covered by each clean, allowing you to check if the Dyson managed to get under the bed, for example.



The futuristic Dyson 360 Eye vacuum cleaner moves from room to room and can even avoid hazards such as a flight of stairs

Its cleaning performance is sparkling, removing baking powder from a tiled floor without smudging or swirling it all over the place (unlike other cleaners) and generally powering through cleaning duties. Despite being expensive at £800 inc VAT from **www.dyson.co.uk**, the Dyson 360 Eye is still cheaper in the long term than paying someone to do it. Although it won't pick your pants off the floor. Yet.

COFFEE MACHINE

If you're getting a robot to vacuum your carpets, it seems almost churlish to make your own coffee. Of course, there's only so much automation that can go into the coffee-making process (unless you're more of a Nescafé guy or gal), so we asked Expert Reviews' resident coffee machine tester for his choice of 'smart' models.

The Smarter Coffee machine costs £180 inc VAT from **www.amazon.co.uk** and is app-driven. As well as demanding one-off brews, you can also set the app to set alarms, prompting it to ask you at set times if you want it to make you a coffee. The message is a little odd and not that well personalised. At 5pm, it said, 'Good morning'. Still, it's a neat little addition if you want the option to have coffee when you wake up, but retain the option to say no: manual timers on other machines can't be overridden so easily, meaning you sometimes end up with a pot of coffee that you don't want.

The machine's Home mode can do something similar, although it uses your location to prompt you if you want to make a coffee as you get home, sending the signal over the Internet, meaning you've got coffee waiting for you when you get in. The machine is, however, quite pricey and a prompt to update the firmware actually halted the machine mid-brew, wasting coffee and resources. Welcome to the modern world.

If money were no object, our resident barista would choose the Bluetooth-operated Nivona 778 CafeRomatica Super Automatic Espresso Machine (£649 inc VAT from **www.thecoffeemate.co.uk**) instead. It lets you choose the size and precise flavour of your brew from the accompanying Nivona app, allowing you to tweak parameters such as the amount of milk, coffee and strength from its menus, instead of using the machine's TFT screen and dials. It also features automatic descaling and rinsing, as well as cup illumination – in blue, obviously.

You can tell the Smarter Coffee machine to have your coffee waiting for you when you get in from work or when you wake up

WASHING MACHINE

Our final smart gadget is another one that resides in the kitchen: the Samsung WW9000 washing machine. The machine connects to the home Wi-Fi and can be controlled via a smartphone app available for either Android or iOS. If you're on the same network as your washing machine, you can simply control it remotely from your phone. The app allows you to set the wash type, start and pause the machine, and view how much time is left on a wash. It's this latter feature that's particularly useful, as you don't have to get up to find out how long is left before your washing has finished.

If you want to control your washing machine from outside the home, you have to register your washing machine to a free Samsung account, which you'll be prompted to create if you don't have one. Outside the home, you can do all the same things you do can from inside. This is clever, as it means you can just throw your clothes into the machine before you leave for work. Then, when you're about to head home, you can turn on your machine so you that you arrive to freshly clean clothes that haven't been sitting in the machine for ages; it's a better system than using a delay timer, where you still have to guess roughly when you'll be home.

You don't even need to worry about filling up the detergent before you go out, as the Samsung can hold a month's worth of it at a time. When you put on a wash, the WW9000 determines how dirty your clothes are and how much softener they'll need. The height of washing machine technology will, however, take you to the cleaners – to the tune of £1,499 inc VAT from **www.ao.com** CPC

Throw your dirty togs into the Samsung WW9000 and you can start a wash remotely via the app

PREMIUM SMART HOME COSTS	
Sonos One	£199
Amazon Fire TV with 4K Ultra HD and Alexa Voice Remote	£60 inc VAT
Dyson 360 Eye	£800
Nivona 778 CafeRomatica Espresso Machine	£649
Samsung WW9000 washing machine	£1,499
TOTAL	**£3,207 inc VAT**

GARETH HALFACREE'S

Hobby tech

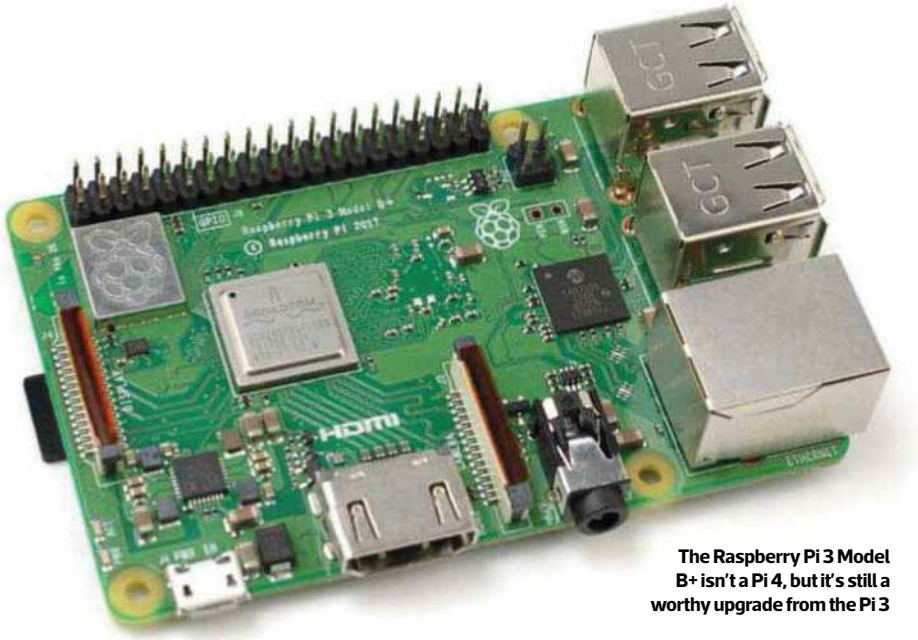
The latest tips, tricks and news in the world of computer hobbyism, from Raspberry Pi, Arduino and Android to retro computing

REVIEW
Raspberry Pi 3 Model B+

Let's start with a clarification: the Raspberry Pi 3 Model B+ isn't a Raspberry Pi 4, which is now unlikely to appear before 2019. The core of the Pi 3 B+ is the same Broadcom BCM2837 processor that powers the Pi 3, although you'd be forgiven for not recognising it, thanks to a design overhaul, which sees the plastic chip package ditched in favour of a more desktop-like, silicon-die-under-heatspreader approach.

That shift in design, which gives the BCM2837 its B0 suffix, is responsible for two key advantages. The first is that, along with a new custom-designed power management integrated circuit (PMIC), which provides more accurate and stable voltage regulation while considerably simplifying the circuitry, the Pi 3 B+ runs at 1.4GHz to the Pi 3's 1.2GHz. The second, more important, advantage is that the BCM2837B0 is now significantly more efficient at ridding itself of heat.

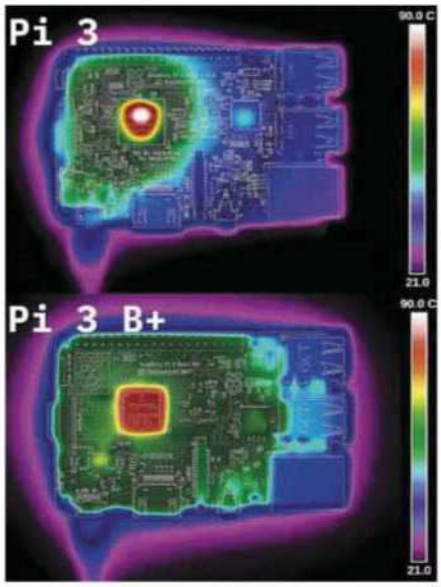
A comparative look at the two boards under the thermal camera tells the full story. After a ten-minute, all-cores benchmark run, the processor cores show up clear as day on the Pi 3 as 100°C hotspots on the plastic package, while the relatively thin PCB heats up only on one side. The Pi 3 B+'s new packaging, improved bonding and thicker PCB – resulting in a weight gain from 40g to 50g – dispense with these hotspots, keeping the package temperature well below fingertip-burning levels, and bleeding off the heat from the entire PCB.



The Raspberry Pi 3 Model B+ isn't a Pi 4, but it's still a worthy upgrade from the Pi 3

That has two further impacts, which are less immediately obvious. The first is that, thanks to the heat now being spread more evenly throughout the die, the on-board temperature sensor now reports the system-on-chip (SoC) temperature more accurately. Comparatively, the Pi 3 could hit over 100°C externally while reporting a sub-80°C internal temperature. The second is that thermal throttling is now more accurate and stable.

In real-world terms, this all translates into measurable gains in burst and sustained



Thermal imaging shows the significant impact of the new design on heat dissipation

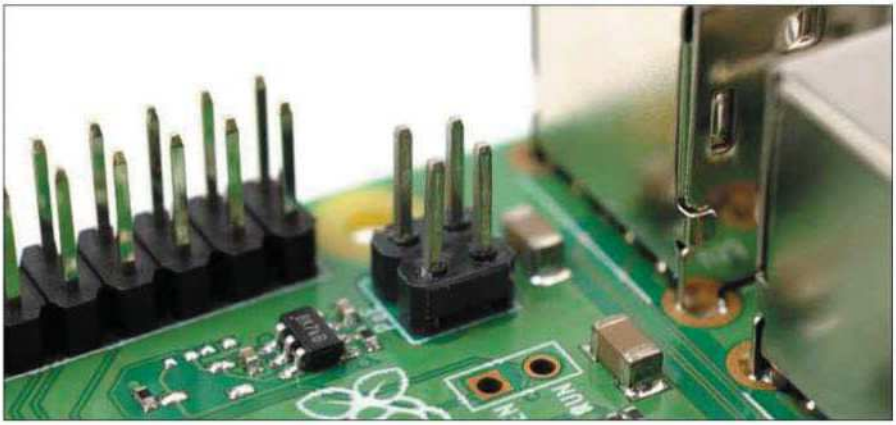
A new, smarter PMIC chip means a simplification to the board layout and a reduction in the overall component count

performance. The Pi 3 B+ is the fastest Raspberry Pi I've tested by some margin – though far from the fastest single-board computer overall. A SysBench CPU test shows a 30.04-second completion time in four-thread mode, to the Pi 3's 34.97 seconds and the Pi 2's 54.55 seconds.

Meanwhile, memory benchmarks hit 857.96MB/sec read and 632.26MB/sec write, compared to the Pi 3's 719.76MB/sec and 547.9MB/sec respectively.

It's the networking side, though, where the biggest advantages can be found. For the first time, the Raspberry Pi is now available with a Gigabit Ethernet connection. Sadly, however, it's still hamstrung by a shared USB 2 channel to the SoC. In real-world terms, this setup results in a 'Gigabit' connection that maxes out around the 212.9Mb/sec mark, a disappointment for all but the folks who have struggled with the 89Mb/sec peak of the older models. There's even support for Power over Ethernet (PoE), although it requires the purchase of an optional add-on HAT.

Wi-Fi, too, is improved. The chip antenna of the Pi 3 has been ditched in favour of the same ground-plane antenna design used for the Pi Zero W, and it offers a slight but reliable improvement in signal quality. The radio itself now supports both 2.4GHz and 5GHz operation, a first for the Raspberry Pi family, and it's received an upgrade to Bluetooth 4.2 as well as the latest Bluetooth Low Energy (BLE) specification.



A Power-over-Ethernet (PoE) header is a welcome addition, but needs add-on hardware to operate

Perhaps the what's most significant about the Pi 3 B+, though, is how little has changed. The board layout, bar the new PoE header, matches its predecessors exactly, and is compatible with all accessories. On the software front, it's still possible to burn the latest Raspbian operating system to a micro-SD card and insert it into any Pi, from the original launch model with its single-core BCM2835 and 256MB of RAM, right up to the new Pi 3, and have it operate perfectly.

Sadly, that also means many of the issues with the standard Pi design are still present: the 3.5mm AV jack's quality is still poor, there's that single USB 2 channel to the SoC for the Ethernet and USB ports, no 4K video support, just 1GB of RAM and no high-speed connections for peripherals.

That said, when this board has an asking price of just £32 inc VAT from suppliers, including **https://shop.pimoroni.com** (but not including a few unnamed chancers who hiked the price as high as £36), these issues pale into insignificance.

The Raspberry Pi family remains the best-supported pocket-money microcomputer family, and the Pi 3 B+ is a worthy successor to the rather flawed Pi 3 design.

The new Ethernet and USB controller provides a Gigabit Ethernet connection, but sadly not Gigabit throughputs

New packaging and bonding has improved the thermal characteristics of the BCM2837 SoC considerably

REVIEW

Gamebuino Meta

It's hard to believe that it's been nearly four years since the launch of the Gamebuino (reviewed in Issue 134), Aurélien Rodot's open-design Arduino-compatible handheld games console. In that time, Rodot has been quiet but not resting on his laurels, and now he's back with a follow-up, the Gamebuino Meta.

The Gamebuino Meta is undeniably swish, and it fits perfectly in a pocket

Designed to sit alongside the existing Gamebuino design rather than replace it, the Meta is a considerable upgrade. Where the original Gamebuino used an 8-bit ATmega microcontroller equivalent to the one you'd find on an Arduino Uno development board, the Meta switches it out for a 32-bit ARM Cortex-M0+. The recycled Nokia single-colour, edge-lit LCD display has also been replaced with a 1.8in backlit colour panel capable of either an 80 x 64 resolution in 16-bit RGB colour or a 160 x 128 resolution in 16-colour indexed mode – a throwback to the multiple screen modes available on classic 8-bit microcomputers.

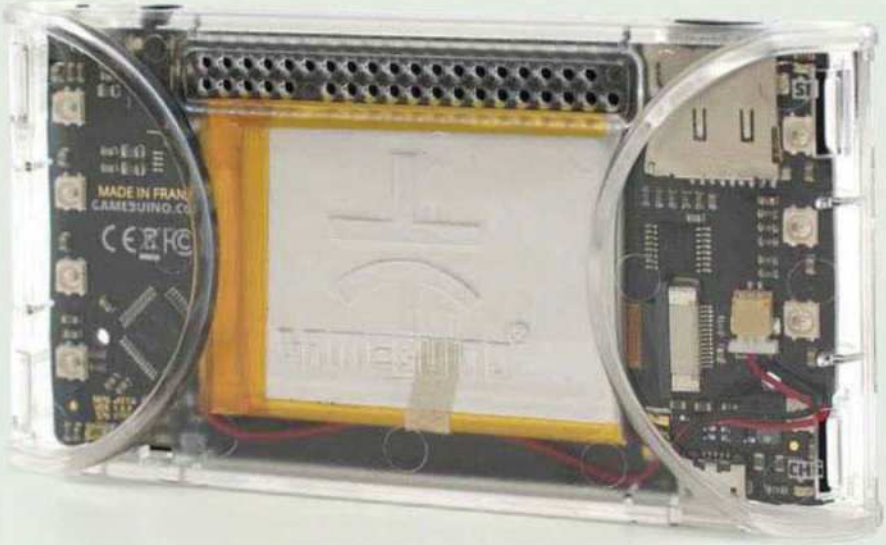
The extra power offered by the new microprocessor – an Atmel ATSAMD21 – has given the Meta room for a few additional extras, too. A 10-bit digital-to-analogue converter (DAC) provides multi-channel audio playback through a 2.5W class-D amplifier to a built-in speaker, or via a 3.5mm jack. There are also eight independently controllable RGB LEDs on the rear of the board – a replacement for the single-colour, user-controllable display lighting of the original Gamebuino. The Deluxe version even gives you the option to kit out your Meta with real-wood skins, for those who dislike the look of bare plastic.

The original Gamebuino also included user-accessible Inter-Integrated Circuit (I^2C) headers, but the Meta takes this setup to the next logical step, breaking out every pin of the board at the rear, using a female header located underneath the translucent plastic housing. This header is designed to be paired with the Developper (sic) Backpack, an add-on which takes the cleverly keyed pins at the rear of the console and breaks them out into headers compatible with standard Arduino shields, while also providing a handy prototyping area with power rails at its centre.

The only gotcha is that the Gamebuino Meta is a 3.3V device, meaning that any shield designed for use with a 5V device, such as the Arduino Uno, at best won't work and at worst could potentially damage the Gamebuino Meta.

Gameplay operates in much the same way as with the original Gamebuino – a micro-SD card filled with games is inserted into the back, and a clever menu system lets you browse through the titles, now including a looping video clip, which you can capture on-device with a quick press of the Home button, along with static screenshots. Pick your title, hit a button and the game is flashed into the device's memory and booted, with no USB cable or desktop PC required. It's a feature that put the original Gamebuino head and shoulders above Nintendo-inspired rival the Arduboy at launch, and it's a pleasure to see it return in its successor.

It's not just the console that's been overhauled either. The Gamebuino website now includes a workshop section that will, it has been promised, include step-by-step tutorials to making your own games –



The rear includes full GPIO pin access, designed for use with the add-on 'backpack' board

The screen still has a very low resolution – marginally lower than that of the Game Boy Color – but it's now in glorious colour

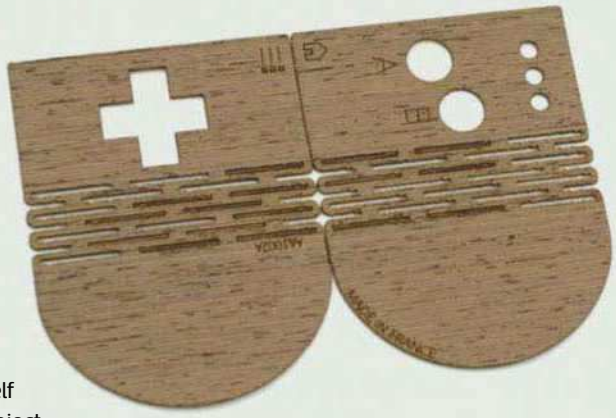
although, at the time of writing, these tutorials were only available in Rodot's native French language.

The documentation will likely be the key feature by which the project lives or dies. While the original Gamebuino was relatively simple, thanks to its low-resolution single-colour display and relatively limited specifications, the new Meta's extra power means added complexity. It's still entirely possible to sit down with the code for one of the existing games and work it all out, building up your own games by borrowing bits from other titles, but the promised step-by-step tutorials will make this job a lot easier as and when – or, indeed, if – they appear.

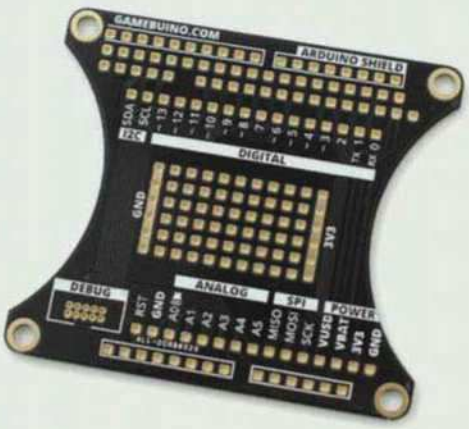
For anyone who already has a Gamebuino and enjoys it, the upgrade is recommended. The improved display opens up whole new avenues, and the easier access to the general-purpose input/output (GPIO) ports – the self-same ports you'd find on the ATSAMD21-based Arduino Zero, although the DAC is reserved for audio work – makes the Gamebuino Meta a shoo-in for any project where control and display are required.

The sound is a great improvement too, and the presence of a 3.5mm jack – one of the areas in which the MAKERbuino, a solder-it-yourself spin-off from the Gamebuino project, improved on the original – makes it better suited to playing in public. It's even possible to port a game directly from the original Gamebuino, now known as the Classic, to the Meta with nothing more than a couple of new #include lines.

If you picked up the original Gamebuino and left it in a drawer after a brief fiddle, though, you're likely better off saving your money. Specifically, the money you'll need is €99 for the Meta Deluxe (around £87 inc VAT) from **https://shop.gamebuino.com** – a hike over the Gamebuino's selling price of €49 (around £43 inc VAT), but inclusive of the smart wooden skin and GPIO backpack board.



The Deluxe variant includes laser-cut wooden 'skins' to stick over the sides of the plastic case



The 'Developper Backpack' provides Arduino shield-compatible break-outs and a handy prototyping area

NEWS IN BRIEF

Maplin enters administration

Maplin Electronics, founded in 1972 in an Essex bedroom and quickly established as a staple of overpriced electrical components and bizarre Chinese plastic tat, has officially entered into administration and will close. Following financial troubles, the chain had been looking for a buyer, but as of late March, had failed to find investment and confirmed it was closing its UK stores as a result, resulting in the loss of around 2,500 jobs. The news came at the same time as toy retailer Toys R Us made a similar announcement, closing its own stores globally.

REVIEW

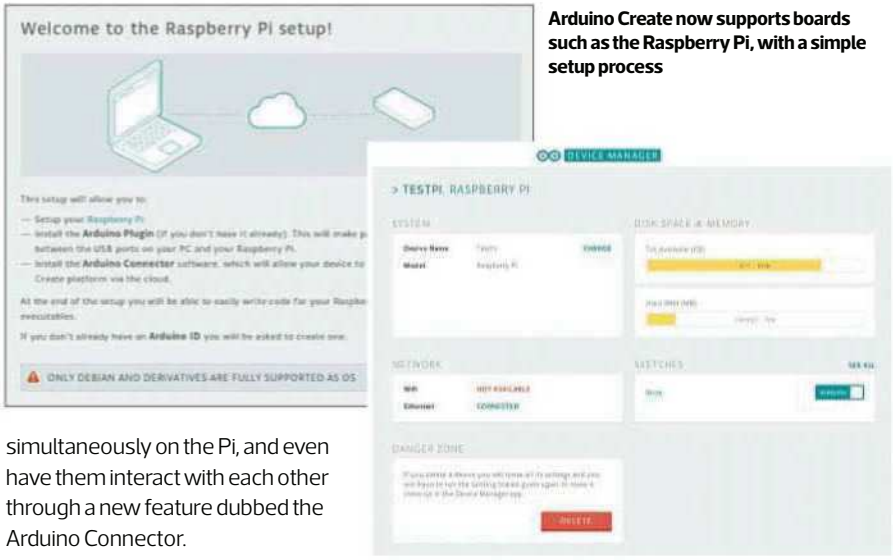
Arduino Create

For years, the Arduino IDE (Integrated Development Environment) was the gold standard for ease of use when it came to programming embedded platforms, which wasn't saying much. Cross platform by dint of being written in Java, the IDE grew over the years, adding support for multiple boards in the Arduino family – and, later, other microcontroller-based development board families, via third-party board support packages (BSPs).

Create is the Arduino project's attempt to replicate the success of the Arduino IDE as an in-browser package, and now it has a feature that makes it hard to ignore: the ability to take almost any Arduino sketch and port it to a range of powerful single-board computers, including the Aaeon UP^2, BeagleBone and – naturally – the Raspberry Pi.

There are obviously trade-offs. The biggest is that a Raspberry Pi, for example, has no real-time capabilities. Comparatively, even the cheapest Arduino clone operates in a wholly real-time manner, so a task that takes a second to complete will always take a second to complete. ON a Pi, though, that task may take more or less than a second depending on a wide variety of factors.

There are advantages, too. A Raspberry Pi 3 B+, with its 1.4GHz quad-core 64-bit CPU and 1GB of RAM, is rather more powerful than an Arduino Uno with its 16MHz single-core 8-bit processor and 2kB (not a typo) of RAM. As a result, it's possible to run multiple sketches simultaneously on the Pi, and even have them interact with each other through a new feature dubbed the Arduino Connector.



Arduino Create now supports boards such as the Raspberry Pi, with a simple setup process

The management interface is neat, but lacks some relatively basic features, such as remote power-off

Using Arduino Create is about as straightforward as possible; visit **https://create.arduino.cc** in any modern browser, and you can create a free account. Log in, and you have immediate access to the web editor – a browser-based successor to the Arduino IDE – and a new Device Manager section. Adding a new device runs you through a wizard in which, if your Pi is configured for SSH access, you can install the required software by simply entering the IP address, username and password. If it doesn't have SSH access, you're given manual installation instructions instead.

Once installed, the software talks to Arduino Create automatically, with a simple dashboard for monitoring disk space, memory and any sketches uploaded. These can be toggled on and off with a simple mouse click, and updated or replaced remotely across as many devices as you like.

The dashboard also links through to a few (currently basic) maintenance functions, too. You can install or update packages through a web interface and add or remove repositories, although there's no option to launch a secure shell for browser-based interactivity. That's a disappointment when allowing you to add custom software repositories is already a security concern.

There are a few rough edges though. Aside from small niggles such as spelling mistakes, the software currently feels slightly unfinished. Loading example sketches makes no attempt to ensure they're suitable for your particular board – the 'Blink' sketch, for example, relies on a pin name that doesn't exist outside the true Arduino boards, and must be manually edited before it can be compiled and uploaded. There's also no readily accessible documentation on what pin numbers correspond to which physical pins on a given board.

It's an impressive first attempt, though, and it will be worth watching as the Arduino team continue to build up its feature set. CPC

NEWS IN BRIEF

Guild of Makers launched

Scientist, tinkerer and former Robot Wars judge Dr Lucy Rogers has officially launched the Guild of Makers, a limited company designed to provide support for the maker industry.

Described as having a mission 'to promote growth of the Maker Industry by celebrating and encouraging excellence and by supporting professional Makers and those aspiring to be', membership is open to all for £59 inc VAT per year. Benefits are said to include networking support, event discounts, members-only discussions and plans for peer-to-peer accreditation in the future. More information is available on the website at **www.guildofmakers.org**

Gareth Halfacree is the news reporter at www.bit-tech.net, and a keen computer hobbyist who likes to tinker with technology. @ghalfacree

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★★★★★
Lisa, 21 October

"Very impressed and was smooth and hassle free from start to finish"
★★★★★
David, 9 September

"Thank you and we would buy through you again"
★★★★★
Clancy, 21 August

"I'm loving my new ride. I would recommend this service to anyone"
★★★★★
Tatiana, 8 September

ANTONY LEATHER'S

Customised PC

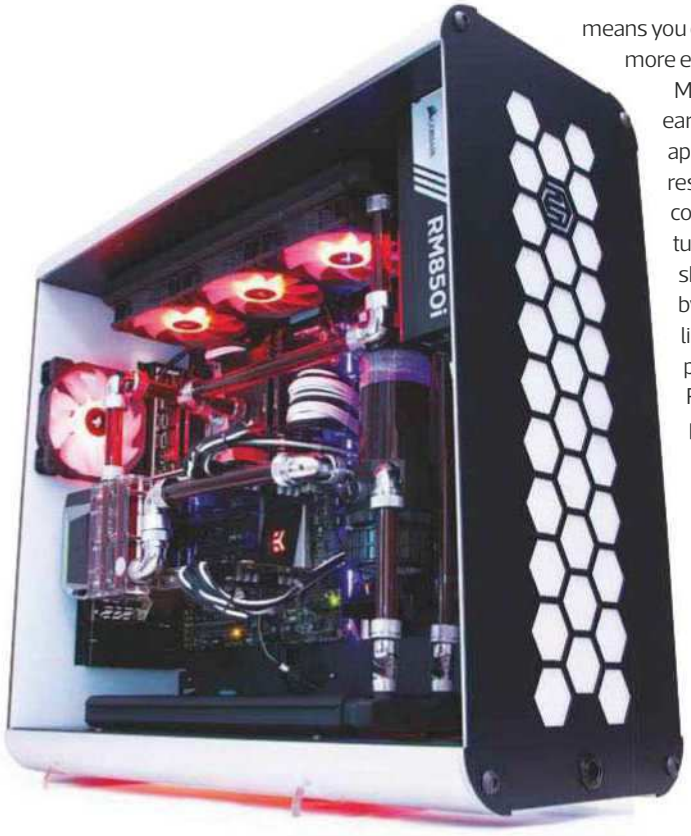
Case mods, tools, techniques, water-cooling gear and everything to do with PC modding

PETG vs acrylic tubing

I've been dabbling with rigid tubing for a few years now, and while installation does take a lot more effort compared with flexible tubing, both clear and metal rigid tubing look fantastic. The straight lines create a super clean-looking loop, while clear rigid tubing really allows your coolant to shine. It can be trickier to work with metal tubing, and it's more expensive too, but it can also look even better.

Plastic-based tubing offers another perk, of course, which is that it can be bent to shape to create a completely custom loop. This tubing can be useful for creating a loop that works specifically with your hardware or case, or for simply creating a great-looking loop design. There's a couple of downsides to acrylic tubing, though, which was the first plastic-based tubing to become popular with water-cooling enthusiasts. It's very brittle and can crack easily. It's not an issue most of the time, but if your system is moved, or sometimes if a fitting is tightened too much, the acrylic tube can crack. There are obvious consequences to this problem if your system is filled with coolant at the time.

Acrylic tubing has a relatively high melting point too, which not only results in its brittleness at room temperature, but makes it tricky to heat and bend, requiring lots of practice.



Our recent dream PC build used PETG tubing, and working with it was comparatively easy

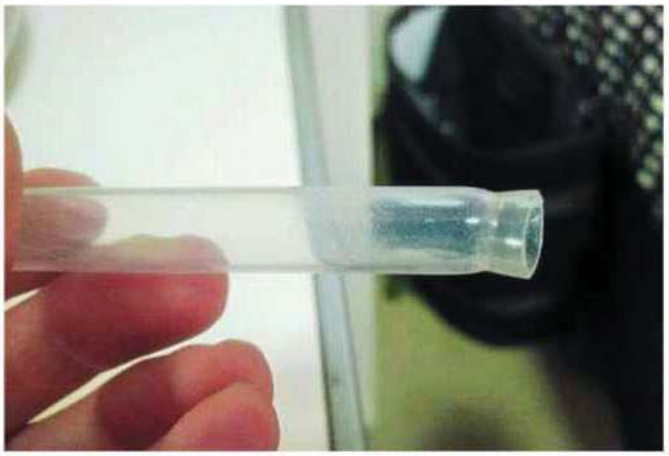
There is a new kid on the block, though, in the form of polyethylene terephthalate glycol-modified (PETG) tubing. In short, PETG tubing looks mostly the same as acrylic tubing and comes in the same sizes. However, it has one key property that makes working with it much easier – it has a lower melting temperature, which means you can heat and bend it far more easily.

More importantly, though, early tests showed what appeared to be an incredible resistance to shattering compared with acrylic tubing. The latter will easily shatter using a hammer, but by contrast, a hammer will likely bounce off an identical piece of tubing made from PETG. The lower melting point not only means it's easier to bend, but also that it's closer to a liquid state at room temperature than acrylic tubing, making it more elastic and crackproof as a result.

It's no wonder, then, that many manufacturers have focused on PETG tubing as their primary tubing, including Thermaltake, which has been busy releasing its own large range of water-cooling gear recently. For the most part, it was a wise decision. It's easier to work with PETG tubing, and of course it's far more shatterproof.

However, you'll note that I don't say that it's stronger than acrylic tubing, which is true. It doesn't have a

Rigid tubing uses similar compression fittings to normal tubing



PETG tubing can end up becoming compressed in tube fittings at high coolant temperatures, causing leaks, as shown in this photo from Linustechtips forum user Smollie1

molecular structure that's physically stronger or stiffer, its benefits are purely down to its lower melting point and the fact that it's closer to being a liquid at room temperature.

Unfortunately, the lower melting point does pose one significant issue. At room temperature, PETG tubing is tough enough to handle any job a liquid-cooling loop can throw at it. However, horrific photos have appeared online of the tubing seemingly bent out of shape and compressed, even inside the compression fittings themselves.

It's a situation that has led to leaks, but it's important to understand why the tubing acted in this way. In each case, or at least certainly the ones I've read about anyway, there has been a fairly clear reason for this behaviour. A failure in the system, specifically a pump or fans, will see the coolant temperature skyrocket, but it might then take several minutes before your PC actually crashes. By then, the damage will have been done.

Much more worryingly, the coolant temperature can get too high even in a working, stable system. Linustechtips forum user Smollie1 revealed that his small form factor water-cooled PC, built into a Fractal Design Node 202 case, suddenly sprung a leak. On closer inspection, his PETG tubing had become compressed in the fittings due to high coolant temperatures. This compression was simply caused by a lack of airflow in a small, cramped system, but the issue is that the CPU and GPU temperatures were well away from their thermal limits.

Their temperatures were very high for a custom water-cooled PC, though, with the GPU approaching 70°C under load, instead of a more typical temperature of 40-50°C for a water-cooled GPU, and the CPU temperature being even higher. For normal flexible tubing, and probably acrylic tubing too, these temperatures would likely be fine, but unfortunately, PETG tubing can start to lose its shape at these temperatures, whereas acrylic tubing generally isn't affected in this way.

It's not just a case of avoiding pump or fan failure, which isn't common but far from a rare occurrence, especially with Laing DDC-based pumps. It's mainly down to being aware if your PC's water-cooling system will be operating at higher temperatures than usual – for example, in a small form factor PC. There's a bit of forethought required if you plan to use bendable, plastic-based tubing. It's trickier to work with acrylic tubing, and it's more prone to shattering, although it will be fine in 99.9 per cent of situations.

However, if you've seen the various hammer-test videos online, which compare PETG with acrylic tubing, it's important to realise that PETG isn't stronger, and the lower melting point means you need to be aware of your coolant temperature as well. If you have a normal tower PC with ample radiator cooling capacity, you need to have an active warning system for pump or fan failure.

In addition, in systems that might be operating at higher coolant temperatures (such as small form factor rigs), it would be wise to invest in a fan controller such as Lamptron's CW611, which has the ability to monitor coolant temperature and ramp up fan speeds when required. Thermaltake states that its PETG tubing will start to become malleable at 62°C, so you'll want to keep your coolant at least 15°C below this temperature under load if you use PETG tubing. CPC

A fan controller that reacts to coolant temperature would be a wise investment if you're using PETG tubing

Antony Leather is Custom PC's modding editor @antonyleather

How to

Make a graphics card backplate

Antony Leather shows you how to make a custom backplate for your graphics card

TOTAL PROJECT TIME / 3 HOURS

Many premium graphics cards have backplates on the rear of the PCB on the opposite side to the cooler. They can serve several purposes, including cooling and protecting the PCB. Another factor, of course, is that they also look a lot better than the usual mass of resistors and knobbly bits on the rear of a PCB.

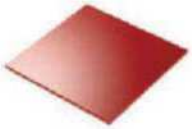
Some graphics cards don't include them, though, and if you water-cool your graphics card, you'll likely need to remove the stock backplate too, as waterblocks often use different screws. It's quite easy to create your own custom backplate, though, and we'd like to thank **CPC** reader Murdoch McCrum for suggesting this guide in our letters section last month. We'll be showing you how to use coloured acrylic, along with spray paint and even a vinyl cutter, to create a custom backplate with your own design. We'll also show you how to safely mount it to the rear of your graphics card.

TOOLS YOU'LL NEED

Masking and edging tape / www.ebay.co.uk

Dremel or saw / Most hardware stores

Screws and plastic washers / www.ebay.co.uk



Acrylic sheet / www.ebay.co.uk

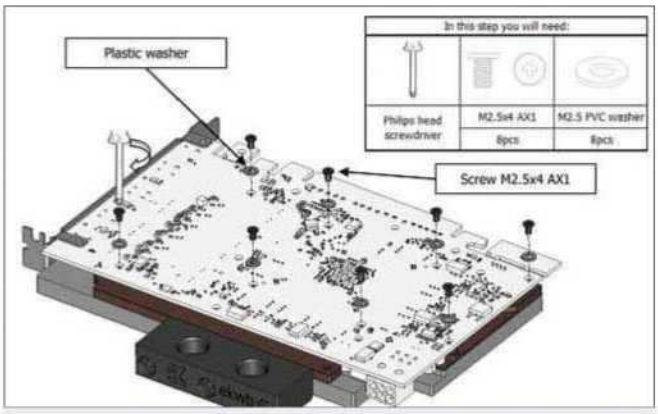
Spray paint, primer and clear coat / Most hardware stores

Vinyl cutter and vinyl / www.yolo.co.uk

FIRST STEPS

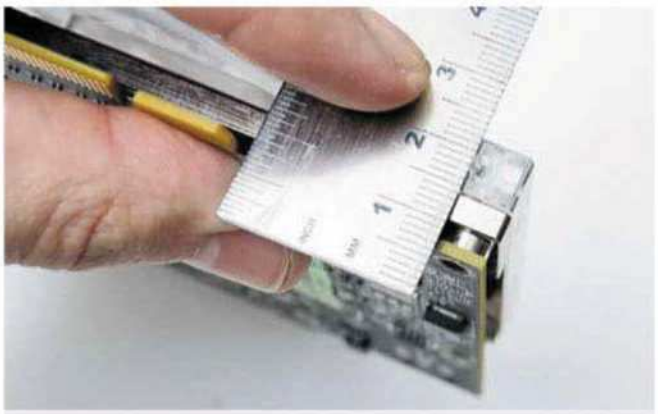
1 / IDENTIFY MOUNTING POINTS

Locate the mounting points for your existing backplate or, in the case of a cooler or waterblock without a backplate, locate the screws that secure your cooler in place.



2 / CHECK THREAD TYPE

We'll replace the existing screws with longer ones so they pass through our acrylic backplate to hold it in place. Remove one to identify the thread type. Alternatively, check the manufacturer's website. Our EK waterblock used M2 threads.

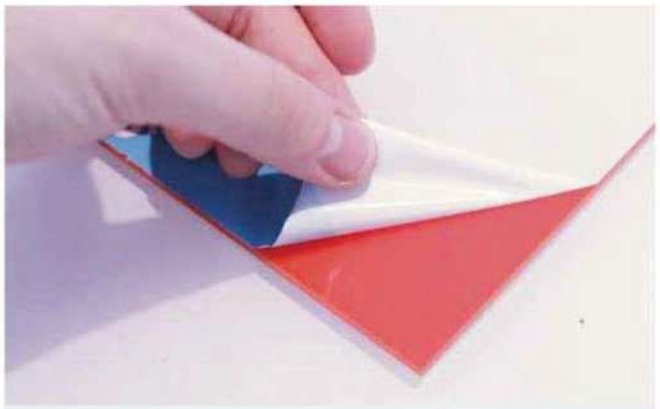


3 / MEASURE SCREW LENGTH

Work out the required length of screw thread to pass through the acrylic as well as the washer you'll be using as a standoff support. We needed 10mm threads for our 3mm acrylic.

4 / MEASURE BACKPLATE AREA

Measure the area you need to cover on your graphics card. You can use an A4-sized sheet of acrylic to cover most graphics cards, which is fairly cheap.



5 / BUY ACRYLIC

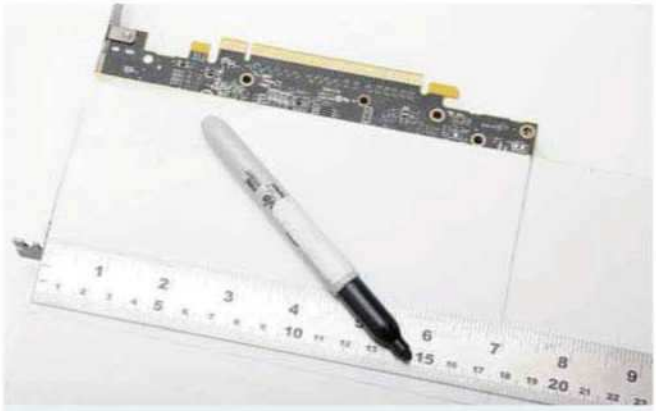
We're using solid-colour acrylic, as you can spray over it with masking to make a custom design. A thickness of 3mm is perfect for the job. Some eBay shops and retailers will even cut the sheet to size, but it can be much more expensive.

6 / BUY SCREWS

Once you know the thread length of screws required, buy your replacement screws. You'll have several head type options from which to choose – we've opted for button-head screws with hex sockets.

7 / USE WASHERS

It's important to use washers to ensure the backplate sits evenly and spaced away from components on the PCB. Measure the tallest component on the PCB and use appropriately sized washers for your screws, so they fit and clear the components.



8 / MARK UP ACRYLIC

Measure the exact area of PCB you need to cover, then draw an outline of this area onto the protective sheet on the acrylic, so you can use it as a guide.

9 / CUT TO SIZE

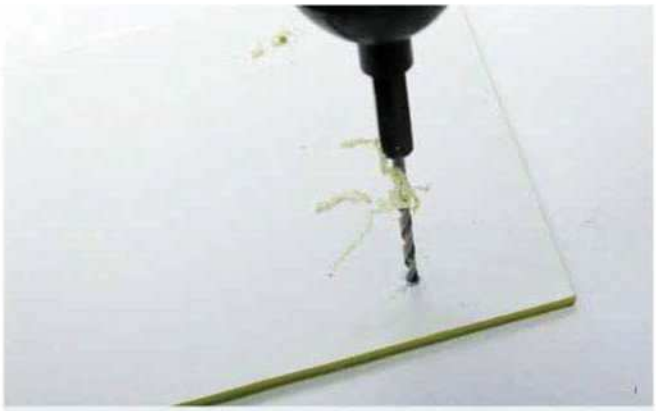
Now it's time to cut the acrylic sheet to size. You can use a table saw, a Dremel on a low cutting speed or a hacksaw with a fine blade.

10 / SAND BACKPLATE

The edges will likely be rough, so use 800-grit sandpaper to smooth them down. We'll be painting out backplate, but if you want to use bare acrylic, it's worth using finer-grit sandpaper, followed by flame polishing using a mini blow torch.

11 / MARK UP SCREW HOLES

Measure the distances between the screw holes and mark them onto the acrylic. Alternatively, remove your waterblock or cooler and use the appropriate holes in the PCB to mark the positions directly onto the acrylic.



12 / DRILL SCREW HOLES

Use an appropriately sized drill bit to drill the screw holes. Use a slow speed and light pressure to ensure the acrylic doesn't crack or melt.

13 / CLEAN PAINT AREAS

Once you've sanded and drilled your acrylic sheet, clean the entire surface to prepare for the paint. Use warm soapy water and rinse it off thoroughly. From here, it's a good idea to use protective gloves as well.

USING MASKING

1 / APPLY MASKING

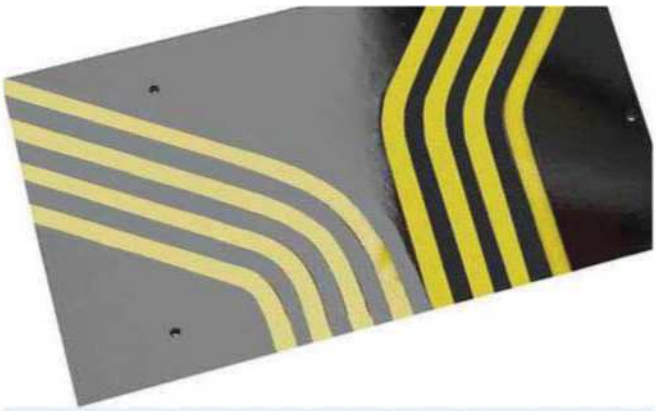
We'll covering the use of a vinyl cutter in later steps, but for now we're using masking and line tape to create a mask to sit under the paint. This mask can then be removed to reveal a pattern.

2 / SPRAY PLASTIC PRIMER

A plastic primer works like a normal primer, but improves paint adhesion on glossy plastic surfaces. Apply three light coats, sanding lightly with 1,000-grit sandpaper between them (after around ten minutes of drying time) to achieve a smooth surface.

3 / APPLY COLOUR COAT

We're using a black coat of paint over the coloured acrylic to provide the best contrast, and to make the backplate look like an off-the-shelf product. Apply as many coats as you need to ensure the acrylic colour no longer shows through the paint.



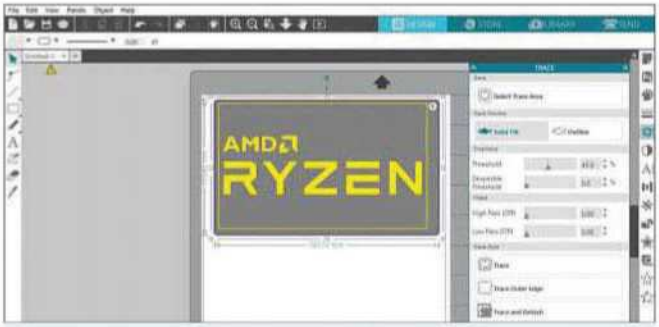
4 / REMOVE MASKING

As soon as you finish spraying, remove the masking gently, pulling at right angles to the paint to prevent it from tearing. If necessary, use a scalpel to separate the paint at the masking edges.

5 / APPLY CLEAR COAT

A clear coat isn't absolutely necessary, but will help to protect the paint and create a shiny, even surface. Apply three generous coats, allowing each one to dry for 30 minutes, and then leave the panel to dry for at least 24 hours.

USING A VINYL CUTTER

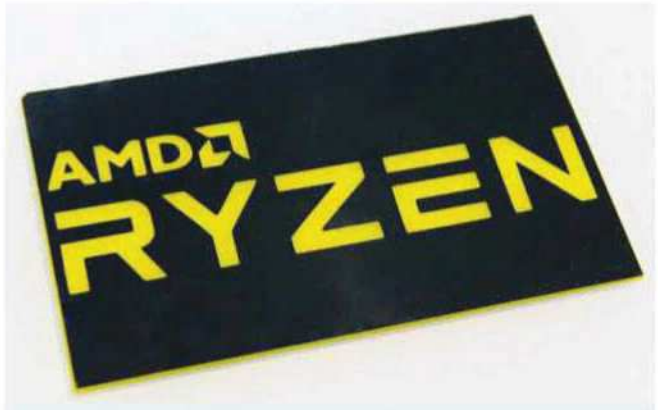


1 / CREATE YOUR DESIGN

Using a vinyl cutter can help you to create more elaborate designs with your masking than simple tape. You can even use vinyl instead of paint to create an overlay on top of the acrylic.

2 / USE TRANSFER TAPE

Transfer tape is essential when moving your newly cut vinyl design to the acrylic. Place the adhesive side face down on the vinyl, and lift off the pattern, so the adhesive side faces downwards.



3 / APPLY VINYL PATTERN

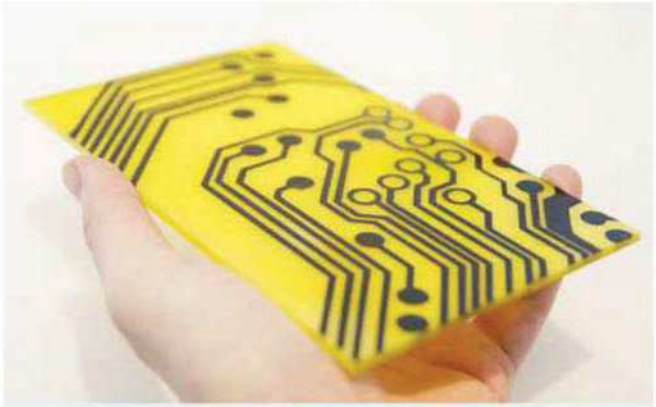
Line up the vinyl so the pattern is the right way around, then press it firmly onto the acrylic. Use a credit card to wipe over the design with a good amount of pressure before removing the transfer tape.

4 / USE VINYL MASK

You can also use vinyl masking instead of masking tape, enabling you to create far more detailed and accurate designs than doing it by hand. You can use the same method as in step 2 to move the masking material to your backplate.

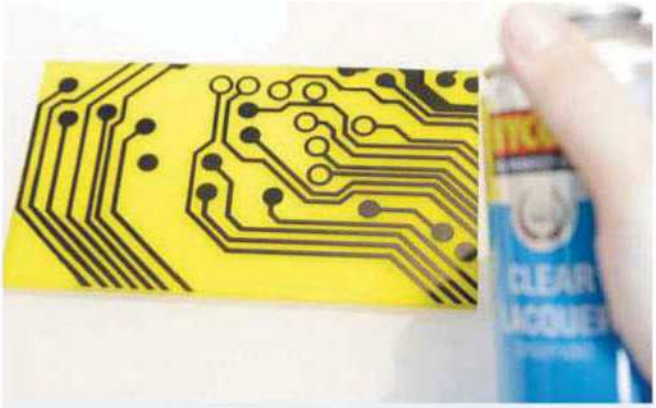
5 / SPRAY PRIMER AND COLOUR COATS

With the masking material in place, spray the plastic primer and colour coats in the same way as in steps 2 and 3 of the 'Using masking' section.



6 / REMOVE VINYL MASK

The vinyl mask will come off in one piece, so start at one corner and pull it off, taking care with any thin or complicated parts that have lots of bends and points.



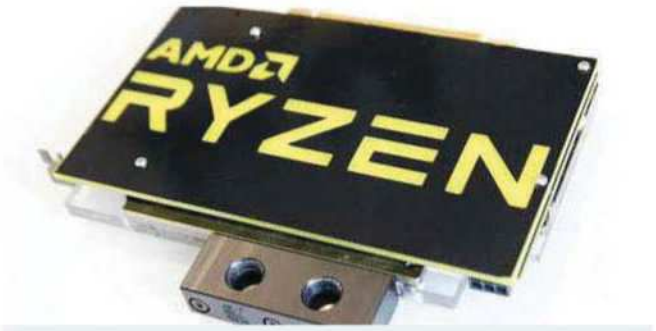
7 / APPLY CLEAR COAT

Apply clear coat, as in step 5 of the 'Using masking' section. You can also apply clear coat over a vinyl pattern, as it helps to level out the surface between the vinyl and acrylic, while protecting the vinyl details and preventing edges from lifting.

FIT THE BACKPLATE

1 / APPLY WASHERS

We've used 3mm-high washers, with holes wide enough to allow our screws to pass through them. These washers can be purchased on eBay in a variety of heights and widths.



2 / SCREW BACKPLATE TO GRAPHICS CARD

Finally, place the backplate onto the graphics card with the washers, and use the screws to secure it in place. CPC

Folding@Home

Join our folding team and help medical research

MILESTONES THIS MONTH

USERNAME	POINTS MILESTONE
Sam943	20000
DiddyDave	30000
Drexial	40000
Oniks	40000
Smartwasp69	50000
StoneColdJay	50000
WillTheVideoMan	100000
Matt_Livermore	200000

USERNAME	POINTS MILESTONE
ashg1988	300000
Nitro3d	300000
reidmarc	700000
Granby	800000
whiskeyecho	900000
~Jinx~	2000000
anadir	2000000
Faster[ac]	2000000

USERNAME	POINTS MILESTONE
TokerRizla	2000000
JonLancsLad	3000000
Mr_Blue_Jam	8000000
mort6dav3	10000000
kornvdd	20000000
Wibb	20000000
chubarker	30000000
davmonk	30000000

USERNAME	POINTS MILESTONE
Jazajay	40000000
Aardwork	90000000
GWallace	90000000
clanseven	800000000
KevinWright	800000000

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** and our team's ID is 35947. Once you pass a significant milestone, you'll get your name in the mag. You can also discuss folding with us and other readers online at the **www.bit-tech.net** forums.

TOP 20 OVERALL

RANK	USERNAME	POINTS	WORK UNITS
1	DocJonz	6,397,576,349	267,309
2	Nelio	4,144,016,553	462,713
3	HHComputers	3,541,552,293	84,834
4	PC_Rich	2,877,149,584	126,630
5	piers_newbold	2,321,142,650	100,460
6	Lordsoth	1,980,502,837	138,808
7	Scorpuk	1,678,744,515	47,835
8	Slavcho	1,350,125,952	53,164
9	Unicorn	1,335,902,827	50,940
10	daxchaos	1,111,306,567	33,255
11	Laguna2012	1,088,330,781	43,960
12	coolamasta	1,008,368,694	190,492
13	apeman556	987,542,899	44,660
14	Desertbaker	882,828,016	39,175
15	KevinWright	818,551,883	45,303
16	clanseven	818,226,215	17,324
17	Roveel	653,319,645	11,452
18	BeezaBob	642,926,624	28,371
19	StreetSam	571,113,589	90,251
20	The_M2B	569,541,142	73,077

TOP 20 PRODUCERS

RANK	USERNAME	DAILY POINTS AVERAGE	OVERALL SCORE
1	DocJonz	6,684,423	6,397,576,349
2	PC_Rich	3,310,513	2,877,149,584
3	Scorpuk	2,881,761	1,678,744,515
4	clanseven	2,591,737	818,226,215
5	Nelio	2,509,686	4,144,016,553
6	piers_newbold	2,316,346	2,321,142,650
7	daxchaos	2,017,270	1,111,306,567
8	Lordsoth	1,867,870	1,980,502,837
9	Slavcho	1,665,854	1,350,125,952
10	Laguna2012	1,026,640	1,088,330,781
11	KevinWright	994,243	818,551,883
12	Desertbaker	978,841	882,828,016
13	apeman556	909,610	987,542,899
14	kcanti	899,109	299,747,103
15	GWallace	813,684	98,481,453
16	Unicorn	793,351	1,335,902,827
17	Allan_Smith	569,834	223,678,655
18	ggyenyen	302,601	27,081,434
19	Aardwork	298,269	95,954,736
20	Mr_Blue_Jam	296,667	8,453,684

Readers' Drives

Red Tesseract

Modders Nik Taylor and Jansen Benoit had a mission to make HP's Omen X case even more extreme, adding custom glass panels, a temperature display and a full PETG water-cooling system

CPC: What inspired you to use the HP Omen X case?
Nik and Jansen: It all started with an idea from one of our customers, Arif Kara. He had a bold new case that wasn't yet out in the media or being discussed in the computer world. On first arrival, we saw this cube, which we could only think was some sort of server case – when we got it out of the box, it was on the floor in multiple pieces. After further inspection, we realised that this bizarre-looking thing was actually HP's latest top-end creation, selling for over £500. Arif knew that he wanted this case, but he didn't have any idea how to make it stand out from the crowd – that's where we at ExtremePCUK could help.

/MEET THY MAKERS

Name Nik Taylor and Jansen Benoit

Age Both 37

Location London

Occupation Modders at ExtremePCUK.co.uk

Main uses for PC Media centre and gaming

Likes Gaming, movies and car modding

Dislikes Consoles and slow Internet

CPC: Where does the name come from?
Nik and Jansen: With the geometric shape of the case, and our love for the Marvel franchise, it had to be called Red Tesseract. The purpose of the Tesseract is to make a wish a reality, and we feel we made Arif's wish a reality when he asked us for a totally unique PC. The first feature you'll notice when you see this machine in person is the three super-bright lighting systems, reminiscent of the Tesseract from the Marvel films.

Firstly, there's an Aura lighting system running directly from the RGB header on the Asus motherboard, which supplies light to the Phanteks reservoir, CPU waterblock and graphics card waterblock. Next we have NZXT's Hue+ box running the interior LEDs, radiator fans and the UI, with the temperatures displayed on our custom-made mini screen on the back of the PC. Our third lighting system is built into the case and provides RGB lighting for the front logo and panel, making the machine really stand out. With these three lighting systems, the PC can have unlimited colour variations, and it can also be set to change colour according to the frame rate, temperatures or sound.

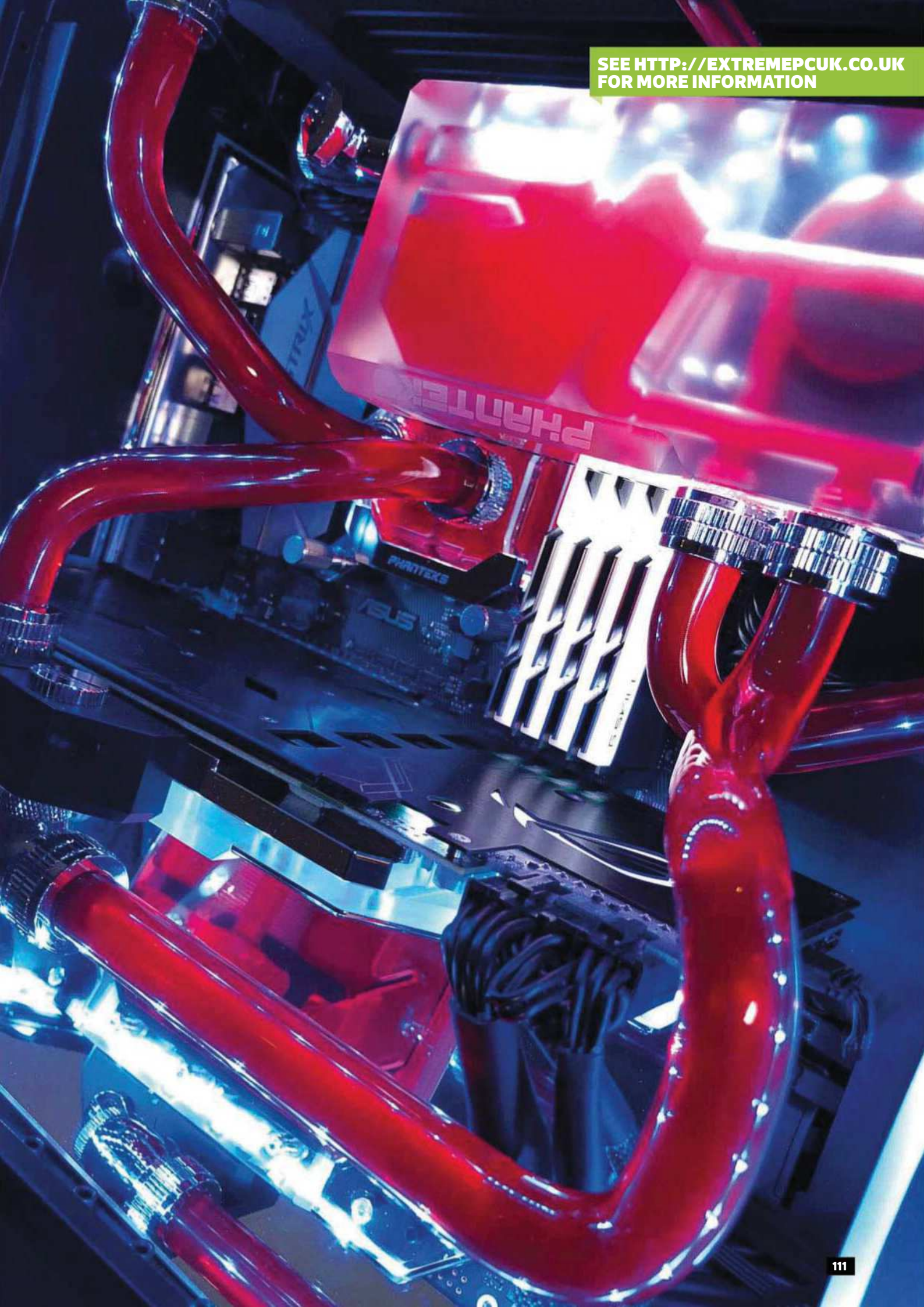
CPC: What specs did you choose?
Nik and Jansen: We decided to go with the Core i7-7700K, as we knew this powerhouse CPU had enough headroom to take us into the realms of a 5GHz clock speed. We also water-cooled an Asus Strix GeForce GTX 1080 Ti card with a Phanteks waterblock, enabling us to run the GPU core at 2GHz. We knew this machine would smash all games at Ultra settings. We also chose to go with 32GB of G.Skill Trident 3200MHz RAM as it was in keeping with all the top-end components.

CPC: What other mods have you built?
Nik and Jansen: We're always working to try new ideas that haven't been seen before. We're currently working on two other water-cooled PC builds, which I can assure you are different from anything you've seen before. Watch this space!

CPC: What difficulties did you come across?
Nik and Jansen: The main issue we needed to overcome was the tiny amount of space with which we had to work. Getting all the water-cooling gear and components fitted into such a tight cube was no easy task. We were lucky with the choice of a Phanteks reservoir and pump combo, as there are two different sizes from which to choose. We went with the R160, as it's smaller than the other one, but still allows the pump to be mounted on the reverse side, and then the whole unit can be mounted on the radiator.

The reservoir and radiator were assembled outside of the PC, including the hard piece of tubing from the radiator to the reservoir. Once this chunk of cooling, with the Aurora fluid, was in place, there was no turning back – there was no way to test the loop – it all had to be right first time. Another issue was getting the mini screen working without having a cable coming out of the machine to connect to the graphics card. To get around this issue, we used an HDMI to USB 3 converter, which allowed us to get power and an image without connecting extra cables to the graphics card.

CPC: How did you find working with rigid tubing?
Nik and Jansen: We went with EK PETG 16mm tubing, as we find working with it easier than with other tubing. We always try to go with thicker tubing for the wow factor, but this choice does have its advantages and disadvantages. We also wanted to make the tubing all



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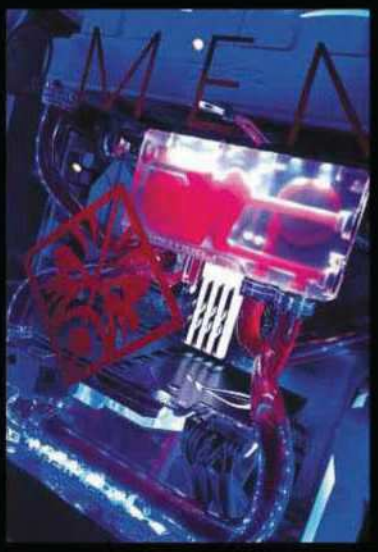
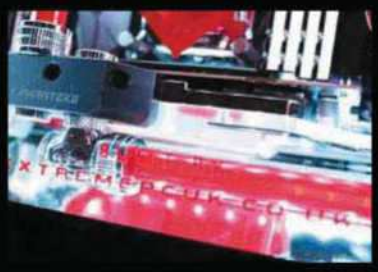




run in a similar direction, so whichever angle you look at the PC, the tubing will be shaped in a similar fashion. Symmetry is a must, and we love the challenge of getting unique bends into a rigid tubing system.

CPC: What tools did you use?
Nik and Jansen: The main tool, and the one we love the most, is our Dremel. This little gadget was used to modify the case for us to fit the screen, and to hold our custom 3D-printed grilles. The longest part of the build process was getting the custom, screwless glass made. The original Omen X case has a sealed metal front, and we couldn't work out why such a top-end PC case wouldn't show the components inside. The glass was sent to various different specialists to have it toughened, bevelled and the edge painted just like a car windscreen. This all took around a week.

With the glass fitted, we then came across another issue. That case panel usually curves around the back of the machine, but there was now an 8in gap we needed to cover. We chose to go with custom 3D-printed grilles to cover this gap. We designed the pattern on the grille to keep in sync with the small triangles on the front of the case. The grilles are also interchangeable, with a quick-release system. Once you remove the custom parts from the equation, the actual PC was built in around a day.

CPC: What did you learn from the build process?
Nik and Jansen: We learned that anything is possible when you put your mind to it. We had a vision to make this PC really stand out from the crowd. It was a matter of making it work and working around any problems that arise. We took a gamble, but the result really paid off.

CPC: Are you happy with the end result, and is there anything you'd do differently if you built it again?
Nik and Jansen: We absolutely love the end result, and seeing people's reactions gives you a feeling that makes all the problems seem worthwhile.

Our highlight so far is HP seeing our creation and inviting us to bring it to one of its shows. It was a great feeling when the creators of this top-end case contacted us, as our creation had such an impact on them.

If we were to build another version of the Red Tesseract, I think we would go with a mini projector in one of the removable hard drive trays. Because of the angle of the trays, the projection would go directly on the wall behind the PC. We were going to put in a projector initially, but there was really no spare room or headers for the HDMI connectors needed. CPC

BE A WINNER

To enter your machine for possible inclusion in Readers' Drives, your mod needs to be fully working and, ideally, finished based in the UK. Simply log on to **www.bit-tech.net** and head over to the forums. Once you're there, 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, where we'll print your photos of your project and also interview you about the build process. Fame isn't the only prize; you'll also get your hands on a fabulous selection of prizes – see the opposite page for details.

SYSTEM SPECS

CPU Intel Core i7-7700K overclocked to 5GHz

Graphics Asus Strix GeForce GTX 1080 Ti, GPU overclocked to 2GHz

Case HP Omen X

Memory 32GB G.Skill Trident 3200MHz

Motherboard Asus ROG Strix Z270 Gaming

Storage 2 x 500GB Samsung SSD 850 Evo

PSU Corsair HX1200I

Cooling Custom water-cooling loop, featuring Phanteks Glacier C350I RGB CPU waterblock, Phanteks Glacier G1080 RGB GPU waterblock, Phanteks R160 Glacier reservoir, EK PETG 16mm hard tubing, XSPC Crossflow radiator, XSPC chrome tap and drain, Mayhems Aurora 2 Coolant

Extras NZXT Hue + box with four LED strips and RGB fans, custom glass panel with vinyl, custom 3D-printed grille

Win all these prizes!

We've teamed up with some of the world's leading PC manufacturers and retailers to offer this great range of prizes to each lucky Readers' Drives winner. If your creation is featured in the magazine then you'll walk away with all of the prizes listed on this page, so get in your entries!

Corsair K70 LUX RGB keyboard with your choice of switches

TOTAL VALUE £160 inc VAT / **MANUFACTURER** www.corsair.com

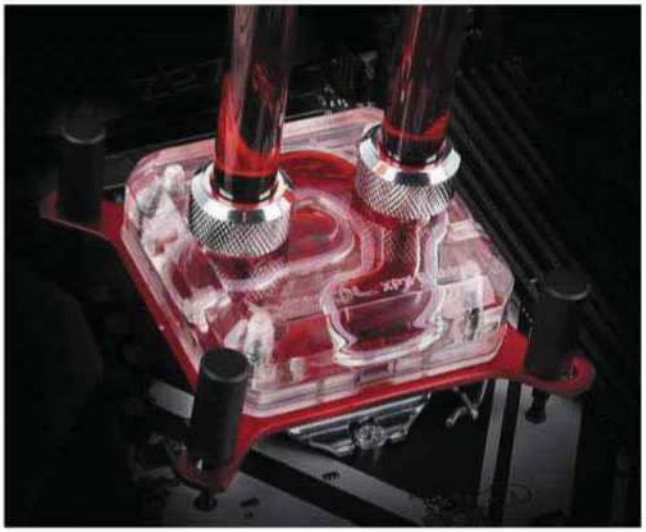
The K70 LUX RGB is a part of Corsair's LUX flagship line of gaming keyboards, featuring Cherry MX key switches backed by a lightweight, durable aluminium frame and dynamic, multi-coloured lighting. The USB pass-through port is positioned for uninterrupted gameplay, and ready for your mouse or wireless headset adaptor. You can also harness the power of CUE for sophisticated macro programming and dramatic lighting effects and animations.

Meanwhile, 100 per cent anti-ghosting with full key rollover on USB helps to ensure accuracy, so every keystroke translates directly into accurate gameplay. The contoured, textured FPS and MOBA keycap sets keep you in control, while the Cherry MX key switches give you a linear response and fast actuation. Corsair will provide a keyboard with your own choice of Cherry MX switches – both Brown and Red RGB models are available.

Alphacool water-cooling gear

VALUE £150 inc VAT / **MANUFACTURER** www.alphacool.com, www.aqua-tuning.co.uk

Water-cooling hardware manufacturer Alphacool is offering a choice of £150-worth of its water-cooling components to every featured Readers' Drives modder. The company is behind some great products we've seen recently, including all-in-one liquid coolers and external radiators. For your prize, you can select from DIY water-cooling kits, the Eiswolf and Eisbaer all-in-one CPU and GPU liquid coolers, as well as a vast range of individual components, including waterblocks (pictured), fittings, reservoirs, pumps and radiators. Alphacool also makes coolant, tubing and fans, as well as modding and water cooling-related tools.



JAMES GORBOLD / HARDWARE ACCELERATED

SPRING IS IN THE AIR

And some big changes to the PC industry are coming with it, says James Gorbold

What can I tell you about the inner workings of the PC industry in April 2018? I'd imagine that most PC enthusiasts would consider the launch of AMD's 2nd Gen Ryzen processors to be the biggest story this month. After all, it's that very story that adorns the cover of this mag, and receives many pages of reviews and much analysis.

The 2nd Gen Ryzen CPUs are a big improvement over the original chips. So much so, in fact, that if my current system died, I'd be quite tempted to build a Ryzen system myself. However, for the wider PC market, the launch of Intel's cheaper H310, H370, B360 chipsets for Coffee Lake processors is likely to have a larger impact.

Until now, there was only the comparatively expensive Z370 chipset for Coffee Lake CPUs, making mid-range, non-overlocked PCs significantly more expensive than necessary. For instance, the Asus ROG Strix B360-F Gaming motherboard will set you back just £116 inc VAT, compared to £172 inc VAT for the equivalent-spec Z370 board. The only noteworthy features you'd lose are CrossFire and SLI support, which is more or less a statistical anomaly in today's market and so largely irrelevant to the mass market.

Sticking with the topic of graphics cards, the past few weeks have seen the beginning of a slowdown in demand for new cards from cryptocurrency miners. This trend is apparent with cards based on both AMD and Nvidia GPUs, although it's certainly not an equal trend. For instance, demand for the ever-popular GeForce GTX 1080 Ti is still much higher than supply, and there are still stock shortages in the channel.

As of yet, card manufacturers haven't really started to cut prices yet, so it's likely to be a while before we see a significant drop in the price of retail graphics cards. As an example, the popular 6GB version of the GeForce GTX 1060 still costs Scan considerably more to buy than it did a year ago. That's a very unusual situation in the tech market, as products such as graphics cards typically devalue over time until they become end-of-life. A few retailers have clearly got twitchy bum syndrome over this slowdown, dropping their prices as they become stuck with excess inventory, which is a surefire way of gaining a few sales, although it may hurt their bottom line.

If we truly have reached the peak of GPU-mining demand, though, the situation should now get better for gamers looking to upgrade. That said, I'm still disappointed that neither AMD nor Nvidia have announced any concrete plans to release new consumer GPUs any time soon, or at least any products that can be discussed in public yet.

The past few weeks have seen the beginning of a slowdown in demand for new GPUs from miners

That's not to say that both companies are keeping still. Nvidia in particular was extremely active in April, releasing the DGX-2 deep learning supercomputer and Quadro GV100 graphics card. These products are both based on the Volta architecture, which Nvidia developed specifically for deep learning and AI – a hugely profitable and exciting marketplace.

It might not be exciting to all gamers, but the importance of this market can't be overstated. It already accounts for over 20 per cent of Nvidia's revenue, making it the company's second biggest moneymaker after gaming. That figure will continue to grow, plus it's important to remember that the gaming numbers are unusually high for the past few quarters thanks to cryptocurrency miners. Not that a Volta-based GeForce would make a whole lot of sense anyway, as its main feature – Tensor cores – do nothing for gaming. Even so, I'd prefer a slew of new graphics cards to appear sooner rather than later. CPC

James Gorbold has been building, tweaking and overclocking PCs ever since the 1980s. He now helps Scan Computers to develop new systems.

iiyama
G-MASTER
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gmaster.iiyama.com

RED EAGLE™

GB2488HSU | GB2788HS

Panel	TN LED / 1920 x 1080
Response time	1 ms, 144Hz, FreeSync™
Features	OverDrive, Black Tuner, Blue Light Reducer, Predefined and Custom Gaming Modes
Inputs	DVI-D, HDMI, DisplayPort
Audio	speakers and headphone connector
Height adjustable	13 cm

24" | 27" | 144Hz | FreeSync

BLACK HAWK™

GE2288HS[1] | GE2488HS-B1[2] | GE2488HS-B2[1,2]
GE2788HS-B1[2] | GE2788HS-B2[1,2]

Panel	TN LED / 1920 x 1080
Response time	1 ms, 60Hz
Features	FreeSync™[3], OverDrive, Black Tuner, Blue Light Reducer, Predefined and Custom Gaming Modes
Inputs	VGA[2], DVI-D, HDMI
Audio	speakers and headphone connector
Height adjustable	-

24" | 27" | 1ms | headphones

GOLD PHOENIX™

GB2888UHSU

Panel	TN LED / 3840 x 2160
Response time	1 ms, FreeSync™
Features	OverDrive, Black Tuner, Blue Light Reducer, Predefined and Custom Gaming Modes
Inputs	DVI-D, HDMI, DisplayPort
Audio	speakers and headphone connector
Height adjustable	13 cm

28" | 4K | 1ms | FreeSync

SILVER CROW™

GB2783QSU

Panel	TN LED / 2560x1440, QHD
Response time	1 ms, 60Hz
Features	FreeSync™, OverDrive, Black Tuner, Blue Light Reducer, Predefined and Custom Gaming Modess
Inputs	DVI-D, HDMI, DisplayPort
Audio	speakers and headphone connector
Height adjustable	13 cm

27" | 2560 x 1440 | 1ms | FreeSync

3XS SYSTEMS PRO GAMING

Gaming on the go

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- ✓ Intel 8th gen Core i7 processor
- ✓ NVIDIA GeForce GTX 1060 graphics
- ✓ RGB lighting
- ✓ Mechanical gaming keyboard
- ✓ Super-thin; less than 20mm thick

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