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Welcome

Custom PC Issue 210

/ FROM THE EDITOR

Happier New Year

Happy New Year, fellow devotees of PC hardware! And let's hope there is indeed some quality happiness to be found in this year. It seems crass to complain about the supply of PC components when people are losing their loved ones to the pandemic, as well as their jobs, but while it's nowhere near as important, fixing the stock issues would bring a welcome dose of happiness to us in a time when it's in short supply.

As we put the finishing touches to this issue in mid-December, we're hoping that January will bring us a slightly less dire supply of components in some areas, although we're not expecting the whole situation to settle down for a while yet. As such, we've devoted a large chunk of this issue to choosing the components for a sub-£1,400 gaming PC based on the latest tech, as well as constructing and overclocking the system.

We're really pleased with the end system, which prioritises gaming, but doesn't skimp on the supporting hardware. This mid-range system features a GeForce RTX 3070, but also contains 1TB of super-fast PCI-E 4 solid state storage, 16GB of 3600MHz memory, a decent liquid cooler for the CPU and a superb case.

There's a school of thought that says you need to match your GPU with a similarly priced CPU and the best motherboard you can afford. After all, your PC can only go as fast as its slowest component. However, the truth, as always, is slightly more complicated. If you want to build the best system possible for your needs, and you have a limited budget, then you need to know where to cut costs.

For gaming, the CPU is a key area here, where you don't need 12 cores, but you do need clock speed and a high rate of instructions per clock – AMD's sub-£300 Ryzen 5 3600X is ideal. Likewise, you don't need an X570 motherboard to run the latest CPUs, GPUs and SSDs – a B550 motherboard will do this job absolutely fine.

At the time of going to press, Scan's pre-orders for the Ryzen 5 3600X have all cleared, and new stock is on the way – we're hoping you'll be able to pick one up at a fair price now. If not, though, have a good read through our feature (as well as all the other quality content in this issue!), and keep this issue handy for when the latest hardware is available to buy again. CPC

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CUSTOM PC

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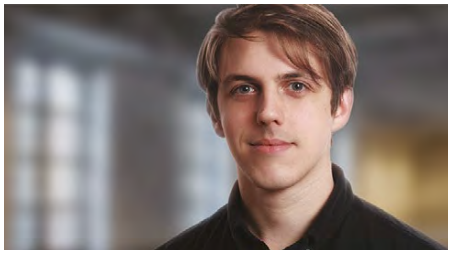

RICHARD SWINBURNE / VIEW FROM TAIWAN

DDR5 TO ARRIVE BY JULY

TeamGroup says it will have DDR5 memory by the middle of the year, and Richard Swinburne thinks he's worked out which platform will support it

Memory maker TeamGroup is currently getting ahead of the competition. A year ahead, in fact. In a recent press release the firm said it was taking a global lead on DDR5, which is surprising since there's no supporting platform announced from either AMD or Intel yet. However, TeamGroup's statement says the firm 'will coordinate its releases with the DDR5 platforms of the top two CPU manufacturers, Intel and AMD. The company's DDR5 memory is expected to be available as early as Q3 2021'.

This clearly reveals that DDR5 platforms are coming from both AMD and Intel during this year, with at least one potentially dropping as early as this July. So, what is it? Intel has already announced that it's releasing its 12th-gen Core (Rocket Lake) CPUs in April. These CPUs fit into existing LGA1200 motherboards, which have DDR4 memory, so this platform won't add DDR5 by the middle of the year.

Several leaks suggest Intel's Alder Lake platform, using hybrid (Atom + Core) CPUs will support DDR5 with a new LGA1700 socket that's expected to arrive late this year, going into early 2022. Potentially, we could see a HEDT replacement for the antiquated X299 platform, which would be surprising if you read my column last month, but it's still in the realm of possibility if we consider that DDR4 launched on the Intel X99/Haswell-E platform in 2015.

On the AMD front, its first Zen 4 CPUs are slated to arrive late this year. We can strongly assume that Zen 4 won't launch as early as mid-2021 for other reasons too. The Ryzen 5000 series only launched a few months ago, and AMD will want to milk it for all its worth, seeing as it has performance leadership. Intel is still expected to have trouble delivering 10nm desktop-class CPUs in volume this year, which will also encourage AMD to defer Zen 4 to later rather than sooner.

My expectation is that AMD will launch an 'AM5' socket platform that supports DDR5, accompanied by a series of refreshed Ryzen 5000 CPUs that fit the new socket. Its chiplet design allows AMD to use the same Zen 3 CPU dies with a new IO die equipped with a DDR5 memory controller. DDR5 would benefit AMD's 12-core and 16-core CPUs in particular, giving each core more effective memory bandwidth and boosting multi-core performance.

AMD refreshed its Ryzen 3000-series CPUs with XT models in mid-2020, and the X570 chipset will be two years old by mid-2021, so there's clearly room for this new platform. If AMD were to continue its existing naming schemes, it could launch a series of Ryzen 5000-series 'XT' CPUs on an 'AM5' platform with a DDR5-supporting 'X670' chipset in July, or thereabouts, and still have a six-month buffer before the Zen 4 launch.

> My expectation is that AMD will launch an 'AM5' socket platform that supports DDR5 memory

TeamGroup is expecting initial DDR5 module frequencies of 4800-5200MHz (effective), although the JEDEC specification extends to effective speeds of 6400MHz – a big boost over today's premium DDR4 modules. Also, dual-channel kits start at 32GB capacities (16GB per module), which will be ample for most people.

No doubt the frequencies will rise towards the upper boundary quickly, as the DRAM market always sees intense competition from the likes of Corsair, G.Skill, Crucial, HyperX and so on. However, the bad news is that long-term forecasts for the DRAM industry expect memory prices to begin rising again by mid-2021, which will make DDR5 an increasingly expensive upgrade. **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 @ricswi

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TRACY KING / SCEPTICAL ANALYSIS

GOOD SCIENCE

2020 might have been horrible for the most part, but Tracy King is pleased that it's also been a good year for gaming science

The Queen once referred to a bad year as 'annus horribilis', which gave everyone exactly the laugh we needed to counter the horrible year, even if just for a moment. 2020 has been the most horribilis of all the annuses, but it's also had some amazing gaming science, and that cheers me immensely. Science is how we'll beat the 'rona, but it's also still ticking along nicely elsewhere.

While some of the headlines have been a little overblown (as is often the case with tech headlines), late 2020 heralded the news that Google's Deep Mind has made major progress towards solving a decades-old protein-folding puzzle with potentially huge implications for medicine – it's worth seeking out Professor Mohammed AlQuraishi's blog on the implications and limitations.

Meanwhile, the original Folding@home is currently being used in the fight against coronavirus, so if you've not yet signed up, head to **foldingathome.org**. I'm a huge fan of the Folding@home project (see p105), and have participated for many years.

I've mentioned gaming psychology a lot this year, from the addictive nature of loot crates to whether gamers should be punished for swearing, but the fact remains that data is scant and the quality of gaming studies hasn't always been high.

A new study from Oxford University has shown that video games can be good for mental health. Well, we all suspected that was the case, particularly in 2020 when virtual worlds have become some people's only escape from the pandemic, but it's essential to have proof in order to counteract the 'games are bad and make kids evil' narrative that still sticks around (you'd think politicians and concerned parent groups would be lining up to read my column!).

> Science is how we'll beat the 'rona, but it's ticking along nicely elsewhere

The Oxford study uses actual gameplay data, and is led by Professor Andrew Przybylski, who goes on as many angry Twitter rants about anti-gaming propaganda as me. I like him, but more importantly, he does good science, and he actually understands gaming.

He's upfront that his study results aren't a free pass for game developers to just do what they want and call their games healthy (there are definitely some aspects, such as loot crates, that seem linked to negative outcomes). However, he says he hopes to pave the way for better science and less kneejerk rhetoric. In a recent Guardian interview, he said:

'You have really respected, important bodies, like the World Health Organization and the NHS, allocating attention and resources to something that there's literally no good data on. And it's shocking to me, the reputational risk that everyone's taking, given the stakes. For them to turn around and be like, "hey, this thing that 95% of teenagers do? Yeah, that's addictive, no, we don't have any data," that makes no sense.'

Agreed! My final bit of good gaming science news is that we all have the chance to participate in a gaming study! Professor Pete Etchells (another scientist gamer who doesn't treat us like weird alien specimens) is running a study on gaming, gambling and mental health, and has put out a call for participants. If you've played a game that contains loot boxes in the past month, consider taking five minutes to complete the survey. It's not often we get to do LIVE SCIENCE so I'm excited about this. You can sign up at **custompc.co.uk/LiveScience**

As we head into 2021, let's be heartened by all the progress. As long as good people are doing good science, we'll be okay. Happy new year! 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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CORSAIR RELEASES AMPERE WATERBLOCKS

The options for water-cooling a GeForce RTX 3000-series card have just widened, as Corsair has announced a new line-up of waterblocks for GeForce RTX 3080 and 3090 cards from a number of board makers, including Nvidia's Founders Editions.

The blocks feature a full-length aluminium backplate, 50 high-density cooling fins and 16 individually addressable RGB LEDs.

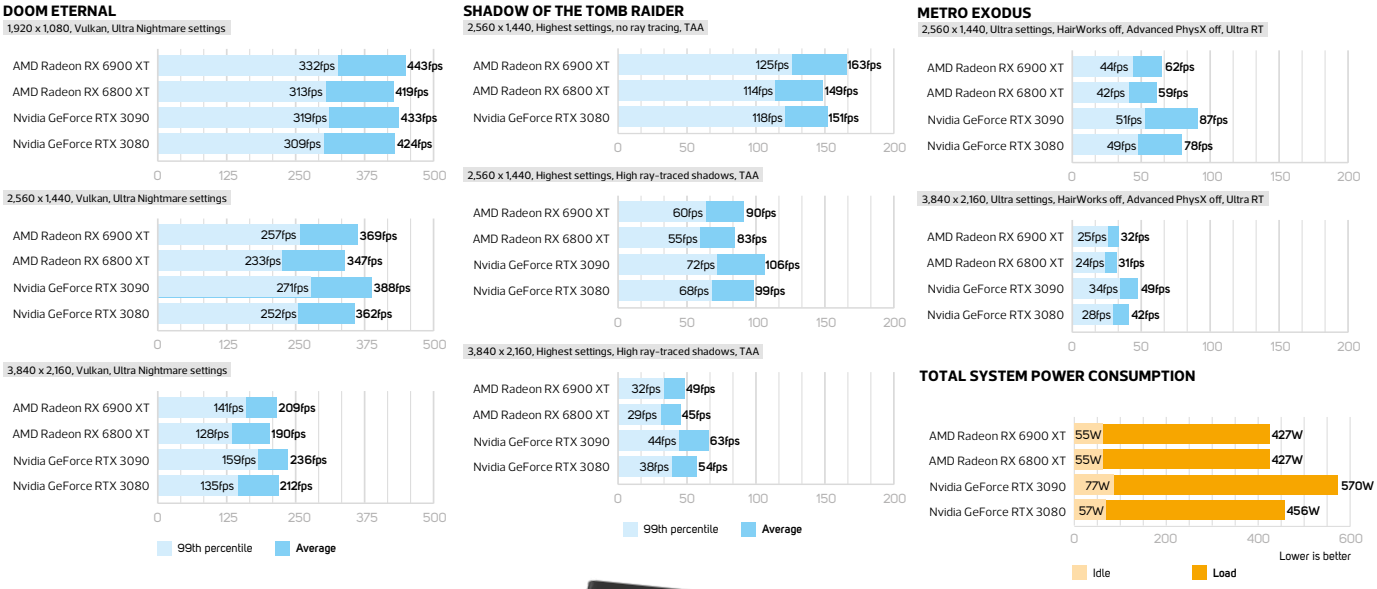
Corsairs says that the Hydro X Series XG7 RGB blocks will cool all of your card's components, including the memory and VRMs, as well as the GPU. Meanwhile, the lighting can be controlled by Corsair's iCUE software, as can the limited integrated lighting on the Founders Edition cards. The blocks are available to buy now from **corsair.com**, starting at £145 inc VAT for a GeForce RTX 3080 Founders Edition block.

VULKAN GETS RAY-TRACING SDK

There's now a solid open alternative to DirectX 12 for enabling ray tracing in games, as the Khronos Group has released the full SDK and tools for ray tracing in Vulkan. What's more, it's already supported across the latest drivers for both Nvidia and AMD's GPUs with supporting hardware.

We've already seen some games using Vulkan for ray tracing, including Wolfenstein: Youngblood and Nvidia's Quake II RTX, but they've been reliant on Nvidia's own extensions and couldn't run on AMD's latest 'Big Navi' GPUs. However, the latest (1.4.0) update of Quake II RTX now supports the full Vulkan ray-tracing extensions, and will run on the latest AMD hardware. Hopefully we'll see more ray-traced Vulkan games following suit.

BENCHMARK RESULTS



PREVIEW

AMD RADEON RX 6900 XT / £999 inc VAT

SUPPLIER Haha, don't be silly

Just as we were going to press this month, we managed to get hold of a sample of AMD's new top-end 'Big Navi' graphics card, the Radeon RX 6900 XT. We didn't have time to run the full suite of tests on it, but we've managed to quickly get some numbers to see how it fares. We'll do a full review of it in a future issue.

As you'll read in James Gorbold's column on p114, supply of these cards is basically non-existent. In fact, one (large) anonymous etailer told us they received only 20 Radeon RX 6900 XT cards on its launch day, compared to several hundred GeForce RTX 3060 Ti cards the previous week. Both Nvidia and AMD are having stock problems, but it looks as though the problems are much bigger for the Radeon RX 6900 XT.

AMD's new flagship card is based on the same Navi 21 GPU as the 6800-series cards, but with all 80 of its compute units enabled, giving it a total of 5,120 stream processors and 80 of AMD's Ray Accelerator (RA) units. It's equipped with a whopping 16GB of GDDR6 memory running at 16GHz (effective), and AMD quotes a game clock of 2050MHz and a boost clock of 2250MHz.

We'll start with the good news, which is that this is a killer GPU in games without ray tracing enabled. Its average of 443fps in Doom Eternal at 1,920 x 1,080 is simply amazing, beating Nvidia's much more (nominally) expensive GeForce RTX 3090. It also beats the GeForce RTX 3080 in Shadow of the Tomb Raider at 2,560 x 1,440 without ray tracing enabled.

As with AMD's other Big Navi GPUs, though, the Radeon RX 6900 XT can't keep up with the competition when it comes to ray tracing. Despite its 16GB of memory, it was still only marginally faster than the Radeon RX 6800 XT in Metro Exodus at Ultra settings, and it was significantly behind Nvidia's Ampere competition in this test, including the cheaper GeForce RTX 3080.

It was stronger in Shadow of the Tomb Raider with ray-traced shadows, where it carved out a more respectable lead over the Radeon RX 6800 XT, but the Nvidia cards were still well ahead in these tests.

We'll give our full judgement on the Radeon RX 6900 XT in a future issue, but our first look was a little disappointing. On the one hand, it's great to see AMD competing in the high-end graphics arena, and the Radeon RX 6900 XT has great power efficiency too. However, it isn't much faster than the GeForce RTX 3080 or Radeon RX 6800 XT in most tests, and it falls behind the former when it comes to ray tracing.

Letters

Please send us your feedback and correspondence to
custompc@raspberrypi.com

Cheap memory alert

Earlier on today I was putting together a PC Part Picker list for my friend, and I saw you could get 32GB of Corsair Vengeance Pro RGB RAM for under £150! I also want to add that I always look forward to the delivery of your magazine. Keep up the good work.
MARCUS WHITE

Ben: Indeed, while it's a truly rubbish time if you want to upgrade your graphics card right now, it's an awesome time to upgrade your memory – the prices are amazing. There's 16GB of Corsair Vengeance Pro RGB RAM in our build guide this month, and at current prices, it costs just £81 inc VAT for a dual-channel 3600MHz kit.

Heat of battle

I just had a GeForce RTX 2080 Ti card crash three times in VR. I did notice it was hitting 80°C at this point, so I contacted Nvidia, as it was a Founders Edition. After I'd returned it to Nvidia, I had to replace it with my old GeForce GTX 1080 Ti SLI setup, and I noticed that the main card was running at 85°C, which seems very hot for just running Skyrim VR.

I'm really curious to know why my cards were reaching such high temperatures – I do know 90°C is about the limit of a card. I've since used MSI Afterburner to reduce the voltage of my cards to keep the temps lower. Thanks for a great mag.
PAUL BAITSON

Now is a great time to pick up some Corsair Vengeance Pro RGB memory on the cheap

Ben: The GeForce RTX 2080 Ti Founders Edition does get hot – I've not experienced one crashing, but that chip really pushed the limits of Nvidia's in-house Turing cooler – it becomes really hot after an hour or so of benchmarking in our tests.

However, it's also worth bearing in mind that while the original Skyrim isn't particularly demanding on a standard monitor, your graphics card will need to maintain a high frame rate across two screens for it to work properly in VR. It's likely that your primary GTX 1080 Ti card is still working fairly hard, but you shouldn't have to resort to undervolting it.

I'd look at a couple of areas here. The first is the cooling in your case – make sure there's plenty of room between the two cards for air to get in and out of them, and that there's a good amount of air flowing from the front to the back of your case, with both intake and exhaust fans. If you're confident with dismantling your graphics card, it's also worth checking the thermal paste under the cooler and replacing it if necessary, so you can ensure firm contact between the GPU die and the cooler. Antony Leather wrote a guide to doing this in Issue 208, p100.

When's the next issue out?

CUSTOM PC

FEB 04

Issue 211
On sale on Thursday, 4 February

Does the Vicar of Dibley subscribe to Custom PC too?

The start of Advent

It's dropped through the letterbox. Every year at this time we so look forward to the mince pie test. It's sad but true that it's a bit of a highlight in the year and has become an important marker at the start of Advent in the vicarage.

I wonder if the Vicar of Dibley subscribes to **Custom PC** too? I'm certain she would love the review as well. I'll look out for a product placement in the Christmas specials! I just hope my namesake knows about this wonderful annual treat. Keep safe and well in these challenging times, best wishes,
RICHARD CURTIS
Team Rector,
The Cannings and Redhorn Team,
Devizes Deanery, Salisbury Diocese

Ben: Wow, thank you Richard – this letter has made the team so proud! We're honoured that our festive pie-tasting test has become an important marker at the start of Advent at the vicarage. We hope you all had a fabulous Christmas.

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Reviews

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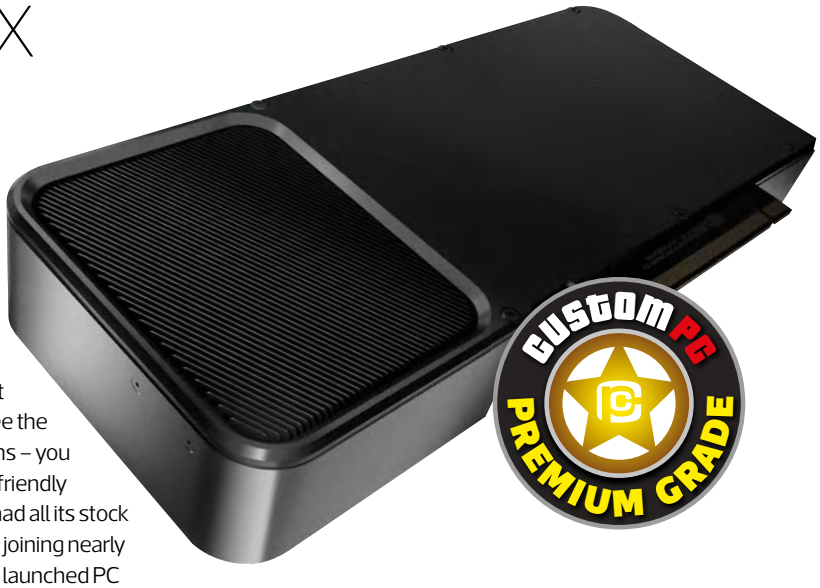
SUPPLIER nvidia.com



Roll up, roll up. Get your imaginary graphics cards here! Come gaze at the barren warehouse shelves. See the overpriced cards on eBay. GeForces, Radeons – you name it, it's gone! Yes, Nvidia's new budget-friendly Ampere GPU was yet another product that had all its stock hoovered up within an hour of going on sale, joining nearly every other recently launched PC enthusiast component in a miraculous disappearing act.

In a world that makes sense, this £369 card would be a no-brainer, but sadly that's definitely not the world in which we currently reside. Indeed, this card should be vaguely affordable, but the only way you'll currently pick one up is by handing over £550 to an eBay seller, if you're lucky. That's a damn shame, because Nvidia clearly had all the right intentions when it developed the RTX 3060 Ti.

Based on the same GA104 Ampere GPU that powers the RTX 3070, the 3060 Ti has 38 of the GPU's potential maximum of 48 streaming multiprocessors (SMs) enabled, compared to 46 on the RTX 3070. That gives you a grand total of 4,864 CUDA cores, along with 38 2nd-gen RT cores and 152 3rd-gen Tensor cores. That's a formidable spec for a card that's supposed to cost just £360 inc VAT.

SPEC

Graphics processor
Nvidia GeForce RTX 3060 Ti, 1410MHz base clock, 1665MHz boost clock

Pipeline
4,864 CUDA cores, 80 ROPS

RT cores
38 (2nd-gen)

Tensor cores
152 (3rd-gen)

Memory
8GB GDDR6, 14GHz effective

Memory interface
256-bit

Card interface
16x PCI-E 4

Bandwidth
448GB/sec

Outputs/inputs
3 x DisplayPort 1.4a, 1 x HDMI 2.1

Power connections
1 x 12-pin (1 x 8-pin adaptor included)

Number of slots
2

Card length
242mm

It's also good to see 8GB of memory coming with it as standard, compared to the paltry 6GB that came with the GeForce RTX 2060. Like the memory on the RTX 3070, the 3060 Ti's GDDR6 memory has an effective clock speed of 14GHz and it's attached to the same 256-bit wide memory interface, giving you a total memory bandwidth of 448GB/sec.

The Founders Edition card we're reviewing is basically the same as the GeForce RTX 3070 Founders Edition we reviewed last month (see Issue 209, p22). It has two fans mounted on its front, which push air over the components, and out through a vent in the I/O plate, as well as through a vent on the right-hand side of the top edge. You also get a 12-pin power connector in the middle of the card, along with an 8-pin adaptor in the box, which only has metal contacts in six of the 12 pins that plug into the graphics card.

Performance

If you can wait for the current stock situation to subside before purchasing a sub-£400 graphics then it will be absolutely worth it, as the GeForce RTX 3060 Ti completely rewrites the mid-range rules. Of course, it's slower than the RTX 3070, though not by much, and it's still enormously powerful for the normal retail price. It even (usually) beats the GeForce RTX 2080 Super, which was a high-end £800 card just a few months ago.

If you're gaming at 1,920 x 1,080 then this is a fantastic card if you want to enable all the bells and whistles in your games. Not only are games playable with ray tracing at high settings at this resolution, but our Shadow of the Tomb Raider and Battlefield V benchmarks stayed above 60fps at all times in these games, with the frame rate averaging 89-98fps, and that's without any help from DLSS.

Our highly demanding Metro Exodus test with Ultra settings (including Ultra ray tracing) dropped down to a 99th percentile result of 42fps with the RTX 3060 Ti, and an average of 71fps, but that's still a stellar result for a card at this price – run the game at High settings, rather than Ultra, and it will be smooth.

If you enable DLSS, you can also get some great frame rates at 2,560 x 1,440 with ray tracing, with Shadow of the Tomb Raider producing a 99th percentile result of 58fps, and an average of 76fps. Even Metro Exodus still averaged 60fps at Ultra settings at 2,560 x 1,440 with DLSS, although it did sometimes drop down to 37fps. Again, though, this is a very demanding test – you'll only need to drop the settings a little to make it smooth with ray tracing at 2,560 x 1,440.

If you're prepared to sacrifice ray tracing then you'll also get some fantastic frame rates. At 1,920 x 1,080, Doom Eternal averaged an amazing 323fps, with a 99th percentile result of 213fps – great if you have a high-speed monitor. You can comfortably run this game at 4K at maximum settings too, with a 99th percentile result of 77fps and an average of 116fps. It's only at 4K that the RTX 2080 Super has an advantage over the RTX 3060 Ti – it's otherwise largely beaten by Nvidia's new mid-range contender.

It's at 2,560 x 1,440 that the RTX 3060 Ti is at is most comfortable. Without ray tracing, it stayed above 100fps in Battlefield V at this resolution, and 155fps in Doom Eternal. Its lowest result was an 80fps 99th percentile in Shadow of the Tomb Raider, and that's still a great result for a card at this (nominal) price. The Radeon RX 6800 is quicker in terms of raw shading power but, like the RTX 3070, it's also a fair bit more expensive.

The only oddity we noticed was strangely high power draw when our test system was idle, with our rig drawing 85W from the mains – nearly 30W more than with the RTX 3070 installed. However, at full load, our system drew just 307W from the mains, which is again a great result showing solid performance per watt.

Conclusion

If it weren't for the calamitous stock situation, the GeForce RTX 3060 Ti would be a superb mid-range GPU. It should only cost £369 inc VAT, yet it largely beats the RTX 2080 Super, which cost the best part of a grand earlier this year. It doesn't just enable you to enable ray tracing in games, but you can also enable ray tracing at well above 60fps at 1,920 x 1,080, and still get smooth frame rates at 2,560 x 1,440 with DLSS enabled.

Meanwhile, its non ray-traced gaming results are superb at 2,560 x 1,440, and you can even squeeze some 4K gaming out of this card in less demanding titles. If and when the stock situation is sorted, and you can buy this card for a sensible price, it's a brilliant buy for the money.

BEN HARDWIDGE

TITANIUM

- \+ Amazing retail price
- \+ Beats the RTX 2080 Super
- \+ Decent 1080p ray-tracing performance

TITANIC

- – No stock anywhere
- – Seriously, there's no stock at all
- – Sort it out Nvidia

VERDICT

The GeForce RTX 3060 Ti rewrites the mid-range GPU rules, with fantastic frame rates and smooth ray-tracing performance for a surprisingly low price. All this would be great if you could actually buy one anywhere.

PERFORMANCE **32/40**

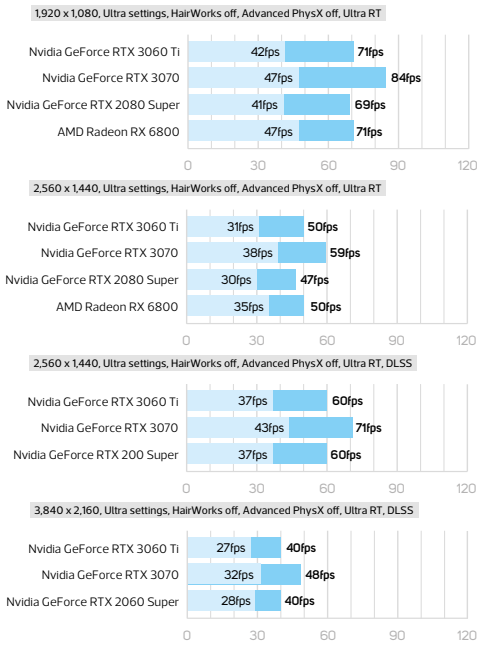
FEATURES **19/20**

VALUE **37/40**

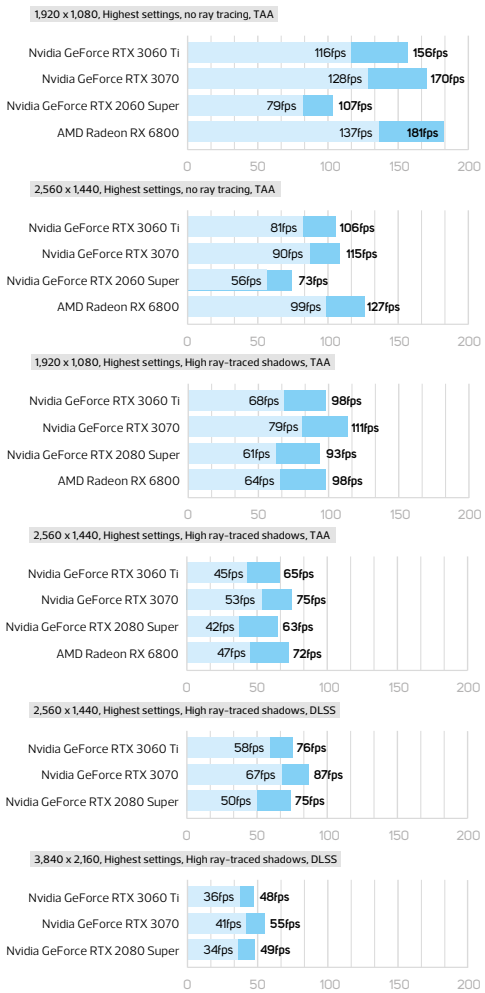
OVERALL SCORE **88%**

BENCHMARK RESULTS

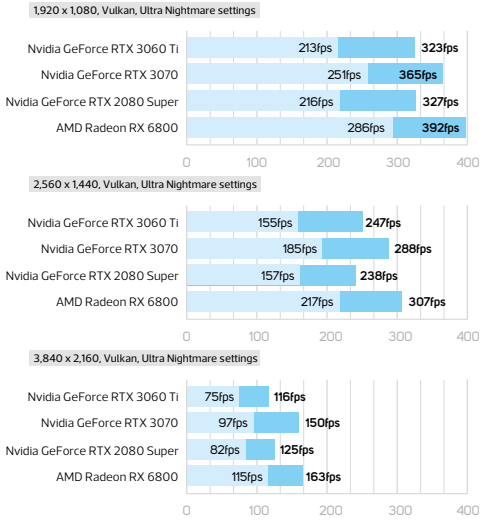
METRO EXODUS



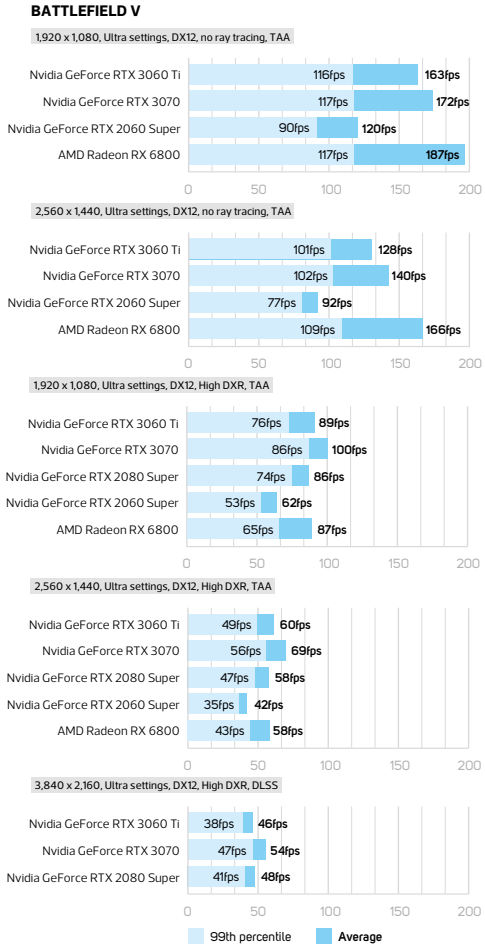
SHADOW OF THE TOMB RAIDER



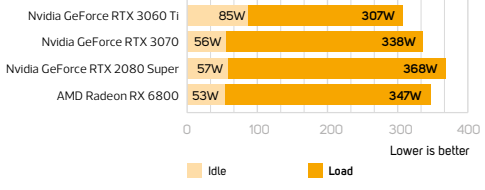
DOOM ETERNAL



BATTLEFIELD V



TOTAL SYSTEM POWER CONSUMPTION



FREE CHILLBLAST AERO RGB GAMING MOUSE

WITH A 12-MONTH SUBSCRIPTION TO CUSTOM PC

SPEC

- **Sensor** PixArt PAW3327DB
- **DPI levels** 800,1,600, 2,400, 3,200, 4,800 and 6,200
- **Switches** Huano (10-million click lifetime)
- **RGB lighting** 11 modes switchable
- **Software programmable** Supports macro for all buttons
- **Polling rate** 125, 250, 500 and 1000Hz switchable
- **Tracking speed** 220 inches per second
- **Acceleration** 30G
- **Weight** 72g
- **Ascended cord** Light and flexible
- **Dimensions (mm)** 67 x 128 x 38 (W x D x H)

Our generous pals at Chillblast are kindly offering an award-winning Aero RGB gaming mouse (see Issue 208, p33) to anyone who takes out a 12-month UK subscription to **Custom PC** magazine.

Designed in Poole, Dorset, by Chillblast's team of gaming experts, the Aero RGB is designed for competitive gaming. Its honeycomb mesh design retains incredible strength, while allowing ventilation to keep your palm cool and fresh. Meanwhile, its carefully optimised 72g weight is ideal for gamers who want the fastest possible reaction times.

The PixArt PAW3327DB sensor allows for high DPI levels, while the all-Huano switches provide longevity and a tactile click response. Chillblast's braided, ascended cord also means you're never impeded by the cable, while support for horizontal acceleration of up to 30G means even professional esports players will never overwhelm its tracking hardware.

A plethora of customisation also awaits in the software, where you can program sensitivity, polling rate, recordable macros and RGB lighting effects. The Aero RGB is an awesome weapon for your favourite MOBA, FPS or strategy title.

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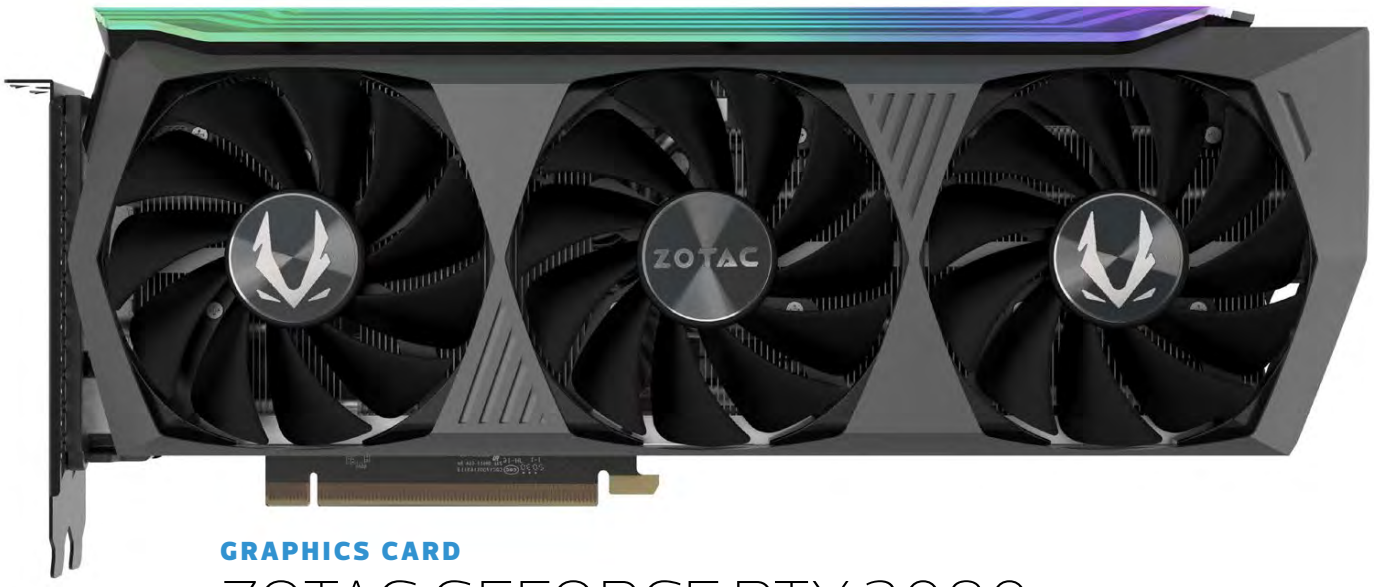
Chillblast

£45 for 12 months – UK ONLY use code **CPCMOUSE**

01293 312182

custompc.co.uk/chillblast

Mouse will be delivered within 28 days of signing up for subscription. Limited quantities available. This subscription gift will be awarded on a first come first served basis.



GRAPHICS CARD

ZOTAC GEFORCE RTX 3080 AMP HOLOBLACK / £860 inc VAT

SUPPLIER overclockers.co.uk

According to the marketing spiel on Zotac's website, its GeForce RTX 3080 AMP HoloBlack has 'inspiring electroplated workmanship on a translucent flourish', along with 'a unique design embracing an iridescent holographic finish.' It's a needlessly wordy statement worthy of a Dan Brown novel, particularly as the HoloBlack's finish is neither iridescent nor holographic.

That's not to say it doesn't look good though. The HoloBlack is packed with RGB lighting and it still looks classy. The chunky metal die-cast backplate has several strips of RGB lighting flowing through it, while the lighting strips on the top edge are topped with a plastic diffuser that fades from green to purple, apparently inspired by the Aurora Borealis. That's presumably the 'iridescent' bit, but while purple and green are the right colours, they don't actually shimmer and change in the light – it's always purple and green in the same places, but it still looks attractive.

Inside the card is a mighty cooling system, comprising three stacks of aluminium fins, linked with a complex bending heatpipe system. It's topped with three 11-blade fans, which don't power up until they're needed. As a result, the card is completely silent when idle, and we didn't hear any coil whine either.

The lighting effects and fan speeds can all be controlled in Zotac's FireStorm Utility, where you can also tweak the card's clock frequencies. The lighting looks bright and vibrant, although the animated lighting effects can look a bit clunky in action, with comparatively slow and sudden movements between the LEDs, despite the diffuser strip. The colours are good, but the movement isn't as smooth as the effects on Razer's Chroma peripherals, for example.

The end result of all this lighting and cooling equipment is a massive chunk of graphics card. The HoloBlack measures 318mm long, and its cooler takes up the space of 2.5 (effectively three) expansion slots. As such, you won't want to put this card in a vertical graphics card mount next to a tempered glass side panel, but you could also say the same for the Founders Edition cooler. We measured a peak GPU core temperature of 72°C during benchmarking, and it drops to 38°C when idle. That's all fine, particularly when you consider the tiny amount of noise it makes.

The cooler is silent when idle, but it hardly makes any noise at full load either. By default, the fans very gradually spin up and down with a gentle curve, rather than suddenly oscillating. You can hear it when you've been gaming for a while, but the noise is never annoying.

Performance

Thanks to the extra cooling power on offer, Zotac has raised the GPU's boost clock from 1710MHz to 1770MHz. That's only a small boost, though, and it made no discernible difference in our benchmarks. In some cases, the HoloBlack was a bit slower than our Founders Edition results, but these differences are more likely to be down to newer drivers and

SPEC

Graphics processor
Nvidia GeForce RTX 3080, 1440MHz base clock, 1770MHz boost clock

Pipeline
8,704 CUDA cores, 96 ROPS

RT cores
68 (2nd-gen)

Tensor cores
272 (3rd-gen)

Memory
10GB GDDR6X, 19GHz effective

Memory interface
320-bit

Card interface
16x PCI-E 4

Bandwidth
760GB/sec

Outputs/inputs
3 x DisplayPort 1.4a, 1 x HDMI 2.1

Power connections
2 x 8-pin (4 x 6-pin adaptor included)

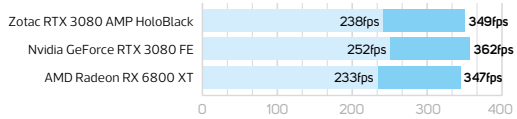
Number of slots
2.5

Card length
318mm

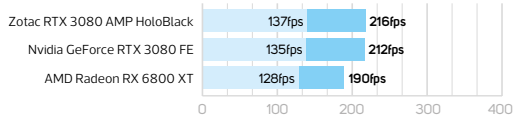
BENCHMARK RESULTS

DOOM ETERNAL

2,560 x 1,440, Vulkan, Ultra Nightmare settings

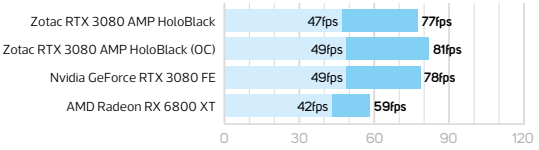


3,840 x 2,160, Vulkan, Ultra Nightmare settings

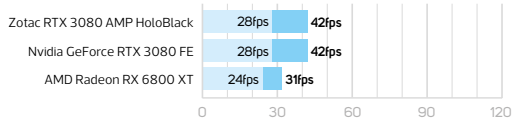


METRO EXODUS

2,560 x 1,440, Ultra settings, HairWorks off, Advanced PhysX off, Ultra RT

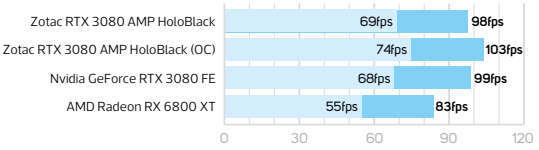


3,840 x 2,160, Ultra settings, HairWorks off, Advanced PhysX off, Ultra RT

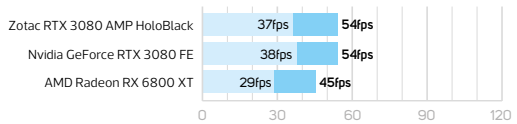


SHADOW OF THE TOMB RAIDER

2,560 x 1,440, Highest settings, High ray-traced shadows, TAA

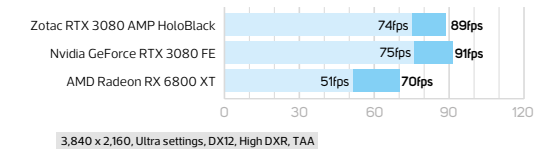


3,840 x 2,160, Highest settings, High ray-traced shadows, TAA

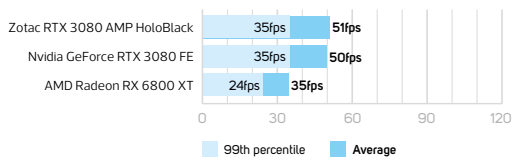


BATTLEFIELD V

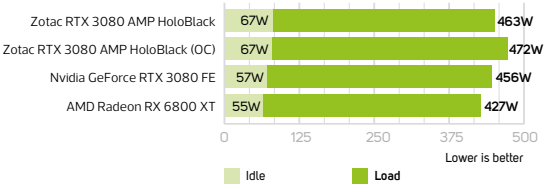
2,560 x 1,440, Ultra settings, DX12, High DXR, TAA

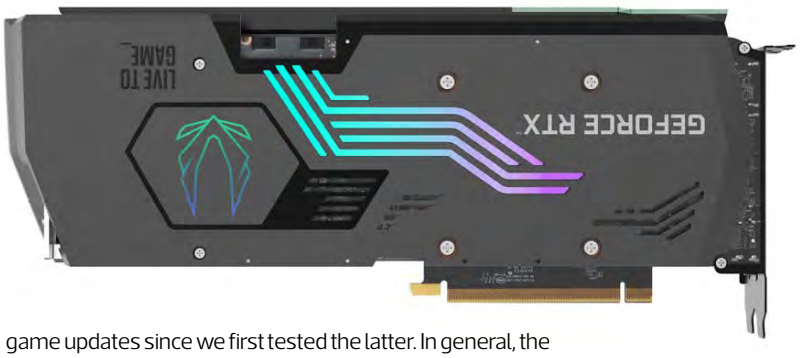


3,840 x 2,160, Ultra settings, DX12, High DXR, TAA



TOTAL SYSTEM POWER CONSUMPTION





game updates since we first tested the latter. In general, the HoloBlack offers the performance you would expect from an RTX 3080 card.

That cooler gives you plenty of headroom for overclocking though. With the power and thermal limits maxed out, we were easily able to take the memory frequency to 1313MHz (21GHz effective), and we could stably overclock the GPU core by a further 170MHz, giving it a 1940MHz boost clock, which regularly hit 2025MHz during game testing. Despite this, the GPU temperature still remained at 72°C, and the card didn't get massively louder when overclocked either.

This overclock brought us some great gaming results too, with a 5fps boost to the 99th percentile frame rate in Shadow of the Tomb Raider at 2,560 x 1,440 with High ray-traced shadows – that makes for a total figure of 74fps compared to 68fps on the Founders Edition.

Conclusion

Zotac has gone all out on the GeForce RTX 3080 AMP HoloBlack. It's rammed full of RGB lighting and neat touches, it's highly overclockable, and the cooler is quiet and attractive. There's just one problem, and that's its price. Okay, so all pricing for RTX 3080 cards is nominal at the moment, given the dire stock situation, but assuming a return to normality at some point, the HoloBlack costs £211 more than the Founders Edition at standard retail pricing.

That's a huge premium for a fancy cooler and a small overclock, particularly when the lighting animations can look a bit clunky in action. That said, it's still significantly cheaper than RTX 3090 cards, and there was plenty of overclocking headroom on our sample. It might not be iridescent or holographic, but the AMP HoloBlack is a good-looking, quiet and highly capable card if you can afford it.

BEN HARDWIDGE

HOLOGRAM

+ Highly overclockable
+ Very quiet
+ All the lights

GOALPOST HEAD

– Animated light effects can look clunky
– Expensive
– No stock

PERFORMANCE **37/40**

FEATURES **20/20**

VALUE **25/40**

OVERALL SCORE **82%**

VERDICT

Cool, quiet and very pretty, the HoloBlack is a great RTX 3080 card, but it struggles to justify its high premium.

MINI-ITX CASE

STREACOM DA2 V2 / £189 incVAT

SUPPLIER quietpc.com

As you shrink mini-ITX cases, it becomes increasingly difficult to cater for both air and water-cooled systems. A lot of cases become larger as a result, or are limited to specific scenarios such as 240mm all-in-one liquid coolers or limited heatsink heights. Some offer a degree of flexibility in being able to mount your graphics card vertically or horizontally, choose between ATX and SFX PSUs or switch between vented and glass side panels.

Streacom has hit upon another way of tweaking your dinky PC's innards, though, with the DA2 V2 using a rail and bracket system that makes mounting fans, radiators and storage highly flexible. At £189, it's certainly not cheap, and that's partly thanks to the aluminium construction. It's beautifully crafted, though, and there are both silver and black options available.

Rather than trying to be as small as possible, the case has a large rounded outer panel that provides enough clearance above and below the case for fan mounts to be useful in both locations. One benefit of this approach is that you can leave objects on top of the case, or place it between narrow shelves, without killing airflow.

The exterior is spartan, with just a single Type-C USB port available. Sadly, this uses a USB 3 header as standard, but Streacom does offer a USB 3.1 upgrade kit, so you can get full-fat speeds and power from a proper USB 3.1 Type-C header on your motherboard.

Measuring 34cm long and 29cm tall, it's not the smallest mini-ITX case on the market, but it still compares favourably with the likes of the excellent Cooler Master MasterCase NR200P, which also has a modicum of flexibility inside, but nothing like that on offer with the Streacom.

The panels sport large vented areas on both sides to aid airflow, and there's a vertical riser and acrylic side panel window kit available, although the fact that Cooler Master includes these with the far cheaper NR200P further adds to that case's appeal. However, we love the tool-free nature of the DA2 V2's panels, which are held in place with rubber grips, so removing them is extremely easy, as they just pull off.

Inside, there are various rail systems to which you can attach components. The primary rails run the length of the chassis on the top and bottom on either side, with two brackets attached to them and running vertically. The latter can slide back and forth along the rails, and at their widest point allow for a 280mm radiator to be installed horizontally, while moving them closer together allows for combinations of hard disks, reservoirs, SSDs or fans to be used.

A combined PSU and storage bracket can be attached to the roof rails, straddling the top of the case, and it can house an SFX, SFX-L or ATX PSU, with the latter occupying the whole bracket. If you opt for an SFX PSU then the bracket can also house up to three hard disks or six 2.5in SSDs. This makes the DA2 V2 one of the best small cases for large storage arrays, as many other cases of this size are limited to one or two hard disks at most.

SPEC

Dimensions (mm)
180 x 340 x 286 (W x D x H)

Material
Aluminium, steel

Available colours
Black, silver

Weight
3.9kg

Front panel
Power, 1 x USB 3 Type-C

Drive bays
1 x 3.5in, 1 x 2.5/3.5in, 2 x 2.5in

Form factor(s)
Mini-ITX, mini-DTX

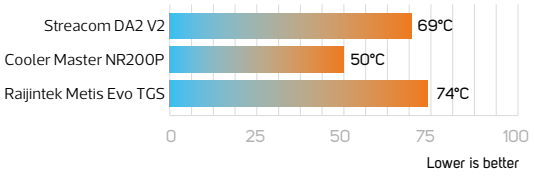
Cooling
2 x 120/140mm roof fan mounts (fans not included), 1 x 92mm rear fan mounts (fan not included), 2 x 120mm/140mm base fan mounts (fan not included), 2 x 120/140mm or 1 x 180mm side fan mounts (fan not included)

CPU cooler clearance
145mm

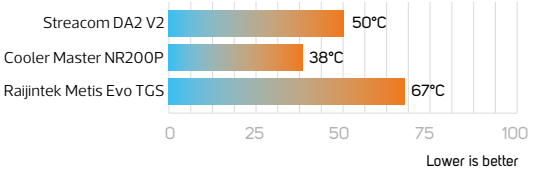
Maximum graphics card length
330mm

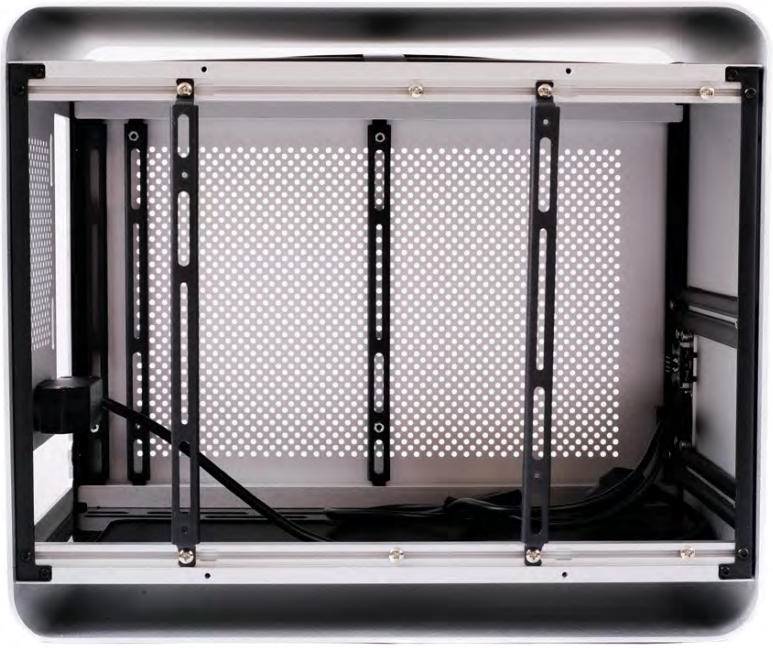
TEMPERATURE RESULTS

CPU DELTA T



GPU DELTA T





You can make numerous smaller tweaks as well. Two sets of standoffs are included, which can lower the PSU mount to make the power button more accessible with certain PSUs, and it can be lowered further to fit a 120mm fan above it too.

Meanwhile, the roof area is limited to a pair of slim 15mm-thick fans, which are now available from several manufacturers such as Noctua and SilverStone, while the base can do the same, but only if the graphics card is mounted vertically. There's only 145mm CPU cooler clearance, but that's more than enough to house the likes of ARCTIC's Freezer 13X coolers that we reviewed in this month's CPU cooler Labs test (see p42).

Other fan options include the dual 120mm and 140mm side mounts, as well as a single 180mm fan mount that can be created using the side brackets in this location. The rear offers space for a single 92mm fan, which could be useful in swinging airflow towards the positive end if you end up having two pairs of fans acting as intakes and exhausts. The side panels, roof and base vents are also protected by large dust filters, which are easy to remove.

Performance

Sadly, no fans are included with the Streacom as standard, so out-of-the-box cooling was never going to be stellar. However, with the GPU located right next to the lower vent, it only has to draw in air from a small distance, which kept the delta T at 50°C, while the similarly fanless Raijintek Metis Evo TGS hit 67°C. Still, in the fan-assisted Cooler Master MasterCase NR200P, that figure fell further to a delta T of just 38°C.

The CPU delta T of 69°C was a similar story. It was 5°C cooler than the Raijintek case, while the Cooler Master case knocked an additional 19°C off that delta T thanks to it including several fans out of the box.

Conclusion

While the out-of-the-box cooling is poor given that no fans are included, the Streacom DA2 V2 lacks them for a reason. It's one of the most adjustable and flexible cases we've seen, meaning that the majority of possible configurations will see potential owners using a variety of different fan sizes depending on their needs.

It's expensive compared with the Cooler Master MasterCase NR200P, and we'd have preferred to see at least USB 3.1 support included as standard, but even the latter can't compete with the sheer flexibility on offer from Streacom. It's undoubtedly a case that's begging to be water-cooled too, and has more cooling potential than the Cooler Master case. If you need a flexible home for a small, but extremely potent water-cooled mini-ITX PC then the Streacom DA2 V2 is absolutely fantastic.

ANTONY LEATHER

VERDICT

An incredibly flexible mini-ITX case, but it comes at a price.

CHECKMATE

- \+ Flexible layout
- \+ Excellent water-cooling support
- \+ Superb build quality

CHECK OUT

- – No USB 3.1 Type-C support
- – Expensive
- – Limited CPU cooler height support

COOLING **21/30**

FEATURES **17/20**

DESIGN **29/30**

VALUE **15/20**

OVERALL SCORE **82%**

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27IN MONITOR

LG 27QN880 / £380 inc VAT

SUPPLIER ebuyer.com

FULL TILT

+ Versatile ergonomic stand
+ Good overall image quality
+ Useful USB Type-C connection
+ Saves desk space

FULL CIRCLE

– Basic gaming performance
– Pointless HDR credentials

The LG 27QN880 is one of a new trend of business and productivity-focused monitors that have a compact desk-clamp stand rather than a desktop stand. The idea is that it offers more ergonomic adjustment than typical desktop stands, freeing up desk space in the process. The counterpoint is that you could just buy any other monitor and attach it to an aftermarket desk-clamp stand, but the 27QN880 has a few advantages.

First, there's the fact that you don't have to spend extra money on a good-quality third-party stand. These stands start at around £30, with the better-quality options usually going for £50-£100.

As such, if you know you're never going to use a desktop stand, you'll save some money. The second advantage is that you get a stand that matches the screen and is also easy to fit to it. The 27GN880 may have a plain, all-black finish but that's no guarantee that a third-party stand would match it properly.

As for the quality of the stand, it looks very smart, and has a simple, strong and easily adjustable clamp mechanism for attaching to your desk – it will accommodate desk thicknesses from just a few millimetres to several inches. The gas-assisted height-adjust system is perfectly balanced too, while the rotation mechanism is all but effortless. Only the tilt and pivot movements are a little stiffer.

The rotation here comes via three joints, with the stand itself spinning 180 degrees, and two small arm joints allowing the display to spin fully 280 degrees around itself.

Those arms also allow the display to extend out or compress back in against the wall. You don't quite get the flat-to-the-wall ability of the Samsung Space Monitor here, but the LG's stand is more versatile.

The other big addition here is a USB Type-C connection for video and providing up to 60W of power to attached devices. You get a cable in the box too. DisplayPort and two HDMI ports are also on hand for standard PC connections, and there's a 2-port USB 3 hub.

SPEC

Screen size
27in

Resolution
2,560 x 1,440

Panel technology
IPS

Maximum refresh rate
75Hz

Response time
5ms

Contrast
1,000:1

Adaptive sync
FreeSync and G-Sync support

Display inputs
1 x DisplayPort 1.4, 2 x HDMI, USB Type-C

Audio
2 x 5W speakers, headphone out

Stand adjustment
Height, pivot, rotation, tilt

Extras
Desk-clamp stand, 100 x 100mm VESA mount, 2-port USB 3 hub

Meanwhile, the screen itself is a fairly standard 27in model with a 2,560 x 1,440 pixel resolution. It uses LG's IPS LCD technology, giving it great viewing angles and colour reproduction. Indeed, image quality overall is as good as you'd hope for the business/creative market at which this screen is aimed.

Out of the box, colour balance (6,772K) and gamma (2.18) are close enough to ideal for most work. Truly colour critical work will require the screen to be calibrated but most users will get by without a colorimeter.

We measured contrast at 936:1, which is typical for an IPS panel, although a long way from giving any credence to the HDR claims LG makes about this display. Likewise, the up to 112 per cent sRGB colour space coverage isn't properly HDR-ready. This display is recommended to run at 60Hz, but it can also run at 75Hz and includes FreeSync support (that works with G-Sync too). That gets you slightly smoother gaming performance if you want it, but gaming clearly isn't this monitor's focus.

Conclusion

A versatile compact stand, a handy USB Type-C connection and excellent image quality make the LG 27QN880 a great general productivity display. Gaming performance is as limited as you'd expect, but if you want a decent monitor that will save you desk space, then the 27QN880 is a solid option.

EDWARD CHESTER

VERDICT

Ideal for working from home, especially if you have limited desk space.

IMAGE QUALITY
25/30

PERFORMANCE
4/10

FEATURES
34/40

VALUE
18/20

OVERALL SCORE
81%

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WIRELESS GAMING MOUSE

RAZER DEATHADDER V2 PRO / £130 inc VAT

SUPPLIER razer.com

LORD FLASHHEART

- + Very comfortable shape
- + Stylish
- + Wired/wireless/Bluetooth connections

BALDRICK

- – Expensive
- – Large right-handed shape
- – Middling battery life

The Razer DeathAdder, in its various guises, has been one of the most popular gaming mice ever made, with Razer boasting about sales of over ten million units. Now it's back in yet another tweaked format, this time including the company's latest low-latency 2.4GHz wireless connection, as well as Bluetooth and conventional wired connection options too.

The heart of the mouse is, of course, its iconic design. With its large, flared left and right buttons, wide, offset back end and left-to-right tilted profile, it has the ultimate ergonomic shape for right-handed users. Whether you use a claw, fingertip or palm grip, it provides a comfortable shape on which your hand can relax, as long as your hands are reasonably large – this is a fairly chunky mouse with dimensions of 127 x 62 x 43mm.

Helping with its overall usability are the rubber-coated sides, which provide a secure grip. Plus, despite its size and the inclusion of a battery for wireless operation, it's still surprisingly light, weighing in at just 88g.

For buttons, you get your standard back and forward buttons under the thumb, plus a scroll wheel click and two small DPI buttons behind the scroll wheel. It's a basic arrangement, but while gaming, we found that all the buttons were in just the right places to press effortlessly. The scroll wheel is also very well weighted for gaming, with a balanced, soft and notched feel when rotating. It's also easy to press the button without nudging the wheel, unlike many mice.

Flip over the mouse and all its many extra features come to the fore. There's a tiny covered compartment for stowing the wireless dongle, a switch for toggling between wired, wireless and Bluetooth connections, a profile button, the micro-USB socket in the front edge for the cable, and two gold contacts that allow the DeathAdder V2 Pro to be charged with the Razer Mouse Dock Chroma (£50 from **razer.com**). It's quite the hit list of features, which all combine to make this a truly universal mouse, left-handed use aside.

In the box, you get a 1.8m long 'Speedflex' cable, which is one of those new-style lightweight braided cables, along with a dongle for plugging the wireless adaptor into the end of the cable (potentially to improve the signal over plugging the dongle into the back of your PC).

Under the left and right buttons are Razer's latest optical switches, which supposedly deliver even faster responses than conventional electronic contact switches. They're also rated to a massive 70 million clicks. We couldn't detect any meaningful advantage when gaming with them, but they do feel good. Likewise, the mammoth 20,000dpi rating on the optical sensor is fairly meaningless for most people, but this mouse certainly performed under pressure, providing gaming performance that we couldn't fault.

Meanwhile, the battery life is rated at up to 120 hours and we found that to be optimistic. With regular use, charging every three to five days was required, but thanks to the wired connection option, you can carry on using the mouse while it's charging anyway.

SPEC

Weight
88g

Dimensions (mm)
127 x 62 x 43 (W x D x H)

Sensor
Razer optical - 20,000 DPI, 50g acceleration, 650IPS

Buttons
8 (left, right, scroll wheel, back, forward, two DPI, profile)

Cable
1.8m, lightweight braided

Wireless connections
Razer HyperSpeed, Bluetooth

Extras
RGB lighting, charging dock compatibility

Conclusion

We're very impressed by the DeathAdder V2 Pro. It has a wonderfully comfortable shape, it looks great, it's super-versatile with all its connection options, it's light and it has excellent gaming performance. It's a shame there's no left-handed option, and it's also very expensive, but it's an amazing mouse if you're a right-handed gamer with cash to spare.

EDWARD CHESTER

VERDICT

An all-round fantastic wireless gaming mouse, although it also has a price to match.

DESIGN 18/20
FEATURES 18/20
PERFORMANCE 26/30
VALUE 20/30

OVERALL SCORE 82%

GAMING LAPTOP

RAZER BLADE 15 / £1,599 inc VAT

SUPPLIER amazon.co.uk

BLADE

+ Reasonable gaming pace
+ High-quality chiclet keyboard
+ Sleek, solid exterior
+ Decent screen and speakers

BLADE: TRINITY

– AMD's CPUs are quicker
– Poor battery life
– Some heat and throttling issues
– Expensive

Few companies aim as high as Razer when it comes to laptops, with the company nearly always trying to provide huge computing power inside slick chassis designs. The Blade 15 looks the part, with familiar black aluminium used throughout the build, and the glowing green Razer logo on the lid. The classy design is paired with superb build quality and dimensions too – this sturdy machine weighs just 2.1kg and is 20mm thick.

Connection options are reasonable, with three full-sized USB 3.2 Gen 2 ports and two USB-C ports, one of which supports Thunderbolt 3. There's Gigabit Ethernet, dual-band Wi-Fi 6, a sole headphone jack and an HDMI output, plus a 720p IR webcam.

On the inside, the Razer has an Nvidia GeForce RTX 2070 Max-Q GPU, which cuts back the full-fat RTX 2070's clock speeds to 900MHz with a 1125MHz boost. That's joined by an Intel Core i7-10750H CPU, which has six cores and a 5GHz boost speed. The specification is concluded by 16GB of dual-channel 2933MHz DDR4 memory and a 512GB SSD.

Meanwhile, the keyboard doesn't have a numberpad, and it only uses single-zone RGB LED lighting. Elsewhere, the layout is better – the arrow keys have shrunk to make way for a larger right-shift button than previous models, and the power switch isn't included on the keyboard.

The chiclet keyboard itself is great: there's only moderate travel, but the buttons are fast and snappy, and they strike a fantastic balance between comfort and crispness. It's solid for most gaming scenarios it's solid - you'll only want mechanical hardware if you crave more heft. The trackpad is large and accurate too, although the buttons push down too deeply for fast gaming use.

SPEC

CPU
2.6GHz Intel Core i7-10750H

Memory
16GB 2933MHz DDR4

Graphics
Nvidia GeForce RTX 2070 Max-Q 8GB

Screen
15.6in 1,920 x 1,080 IPS 144Hz

Storage
512GB Lite-On CA5-8D512 M.2 SSD

Networking
Dual-band 802.11ax Wi-Fi, Gigabit Ethernet, Bluetooth 5.1

Weight
2.1kg

Ports
3 x USB 3.2 Gen 2, 1 x USB 3.2 Gen 2 Type-C/Thunderbolt 3, 1 x audio, 1 x HDMI

Dimensions (mm)
355 x 235 x 20 (W x D x H)

Operating system
Windows 10 Home 64-bit

Warranty
One year parts and labour return to base

The Blade reviewed here is the Base model, which will cost £1,599 inc VAT at big online retailers – a better price than the £1,939 listing on Razer's website. That lower price is better, but it's not the cheapest way to get this specification. Acer's Predator Triton 300 (see Issue 209, p36) may not have Razer's mature design but it mirrors the spec for £100 less.

Also bear in mind that this Base version omits features compared with the Advanced model, which has charging USB Type-C ports, an SD card reader, per-key RGB LEDs and a bigger battery in a slimmer chassis. However, not surprisingly, the Advanced machine is more costly – the cheapest Advanced model costs £2,379 with an RTX 2070 Super alongside a 300Hz display, for example.

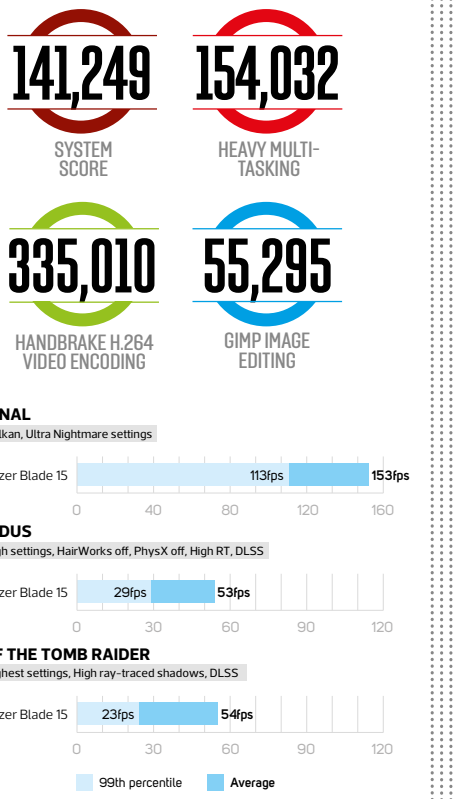
Performance

The RTX 2070 played Doom Eternal well, with a 99th percentile minimum of 113fps, which is comfortably better than the Acer. The Razer struggled in Metro Exodus, even at High rather than Ultra settings, although its 99th percentile minimum of 29fps is bolstered by a 53fps average, and switching to the Razer's Performance mode saw that minimum improve to 31fps. Drop the ray tracing down another notch and it should be playable.

The Razer's poorest result came in Shadow of the Tomb Raider, where its 99th percentile minimum faltered to 23fps. The RTX 2070 Max-Q isn't the fastest laptop GPU, but it will handle single-player titles at frame rates between 30fps and 60fps, and with decent quality levels, especially if you dial back the ray tracing. Esports titles won't be a problem for this laptop either, and slightly older, less demanding games will run easily.

Meanwhile, the CPU returned an overall benchmark score of 141,249, which is reasonable, and the NVMe SSD's

BENCHMARK RESULTS



read and write speeds of 3,056MB/sec and 2,252MB/sec are good. However, the Razer is slower than Acer in our application benchmarks, despite having the same CPU. AMD's latest 4000-series mobile Ryzen CPUs are also far better for multi-tasking and content creation, but they're not available in any Razer laptops.

The CPU performance can be explained by throttling issues. In a single-core work test the CPU ran at a reasonable 4.6GHz, but in an all-core test, the chip was throttled to 3GHz. In a full-system stress test, the CPU frequency dived to 2.3GHz, and when gaming, the processor ran at 4.2GHz.

These various throttling situations were paired with heat issues. In tough gaming and work tests the metal above the keyboard became too hot to touch, and the underside was uncomfortably warm. The thermal situation isn't all bad – it won't be a problem if you're sitting at a desk, the noise levels were always low and the GPU remained cool. And, of course, many games and tasks won't push the hardware to these worst case-scenario limits.

Meanwhile, the 1080p IPS display's 144Hz refresh rate ensures smooth gameplay in undemanding games. Its brightness level of 433cd/m^2 is also huge, and basically permits both indoor and outdoor use. The delta E of 2.13 and colour temperature of 6,913K are decent too, meaning colours are accurate.

The display's biggest issue is contrast. At full brightness the panel delivered a ratio of 884:1, and with the brightness dialled back, it hit 957:1. Those figures are acceptable for mainstream gaming, but they're middling results that leave this display feeling bright and breezy, while lacking a little depth. This display also handled 95 per cent of the sRGB gamut, which is fine, but only the Advanced model comes with a 100 per cent sRGB screen.

The display is joined by decent audio gear: the speakers sound surprisingly loud and punchy, and not tinny. They could do with more bass, but they're good enough for gaming, music and media. As ever, don't expect this machine to deliver good battery life when gaming. If you're handling your normal work tasks, the Blade will last for four hours, but during gameplay, you'll only get around 90 minutes of usage.

Conclusion

The Razer Blade 15 offers reasonable gaming pace if you don't whack up the ray tracing to full, along with a stylish exterior, top-notch build quality and an impressive keyboard. However, it also has throttling and heat issues, poor battery life and a comparatively high price for the spec. AMD-based laptops provide more CPU power, and the screen is acceptable rather than exceptional. Razer's machine is a sleek, good-looking machine for mainstream gaming, but it doesn't get an unreserved recommendation.

MIKE JENNINGS

PERFORMANCE 17/25

DESIGN 20/25

HARDWARE 16/25

VALUE 18/25

OVERALL SCORE 71%

VERDICT

Slick, sturdy and pretty quick, but it's hot, expensive and undermined by missing features.

AMD X570 GAMING PC

CYBERPOWER ULTRA 7 RTX ELITE / £1,599 inc VAT

SUPPLIER cyberpowersystem.co.uk

CyberPower's Ultra 7 RTX Elite is one of two systems in this issue to arrive with Nvidia's new GeForce RTX 3060 Ti – the most affordable Ampere card we've seen yet. CyberPower's machine costs £1,599, which plants it firmly in the mid-range when it comes to gaming systems.

The RTX 3060 Ti has an impressive count of 4,864 CUDA cores, and it serves up 8GB of memory and 38 RT cores. This machine's MSI-made card also has a generous overclock, with the boost speed rising from 1665MHz to 1830MHz.

Meanwhile, processing power comes from AMD's Ryzen 7 5800X – a Zen 3 CPU with eight cores, a 3.8GHz base clock and a 4.7GHz boost speed. There's 16GB of memory running at 3200MHz, dual-band 802.11ax Wi-Fi and a 2TB hard disk. It's all powered by a middling Corsair CV650 power supply – it's not modular, but it does at least have an 80 Plus Bronze efficiency rating.

One disappointment at this system's price, though, is the SSD. The 1TB WD SN550 drive is capacious, and its read and write speeds of 2,406MB/sec and 1,967MB/sec are well in front of SATA drives, but it's not a PCI-E 4 SSD despite the MSI X570-A Pro motherboard supporting the newer standard on one of its M.2 sockets.

The motherboard itself is nothing special, but it does cover all the essentials, with a trio of 1x PCI-E slots and decent Realtek ALC1220 audio. However, the second PCI-E slot only runs at 4x speed and the second M.2 connector doesn't use PCI-E 4. These aren't issues for the supplied spec, though, and it's otherwise a decent, if basic, X570 motherboard.

CyberPower's biggest rival this month comes from Chillblast's Fusion Commando 3060 Ti (see p34). That rig also pairs Nvidia's new GPU with the Ryzen 7 5800X, but the two machines differ elsewhere. Chillblast's GPU overclock is more modest and its B550-based micro-ATX motherboard has fewer features, but it does have 32GB of memory and a PCI-E 4 SSD.

CyberPower has slotted the components inside its own-brand Onyxia II chassis. It's a conventional case, with tempered glass panels and a PSU shroud. The front is dominated by the 240mm radiator for the Cooler Master MasterLiquid Lite cooler with two 120mm fans, and there are four more fans around the chassis. They're all illuminated with RGB LEDs set to yellow, with three glowing through the front panel.

Those fans make the CyberPower look bolder than the Chillblast, and this case is larger too. It's mediocre on the inside though. The build is neat at the front and there are two 2.5in drive mounts, but the cables are messy at the rear, there's not much expansion room and the fan-synchronisation box is largely occupied. The side panels are a little awkward to remove too, as the case's feet have obtrusive plastic ridges.

Finally, the three year labour warranty with two years of parts coverage is reasonable, but the CyberPower only has six months of collect and return service. Chillblast is better, thanks to a five year labour deal with two years of parts and collect and return cover.

SPEC

CPU
3.8GHz AMD Ryzen 7 5800X

Motherboard
MSI X570-A Pro

Memory
16GB Kingston HyperX Fury 3200MHz DDR4

Graphics
MSI GeForce RTX 3060 Ti 8GB

Storage
1TB WD Blue SN550 M.2 SSD, 2TB Seagate Barracuda hard drive

Networking
Gigabit Ethernet, dual-band 802.11ax Wi-Fi

Case
CyberPower Onyxia II

Cooling
CPU: Cooler Master MasterLiquid Lite 240 with 2 x 120mm fans; GPU: 3 x 80mm fans; front: 1 x 120mm; base: 1 x 120mm; rear: 1 x 120mm; roof: 1 x 120mm

PSU
Corsair CV650 650W

Ports
Front: 2 x USB 3.1 Gen 1, 2 x audio; rear: 1 x USB 3.2 Gen 2, 1 x USB 3.2 Gen 2 Type-C, 4 x USB 3.2 Gen 1, 2 x USB 2, 1 x PS/2, 1x optical S/PDIF, 5 x audio

Operating system
Microsoft Windows 10 Home 64-bit

Warranty
Three years labour with two years parts and six months collect and return

Performance

Nvidia's new GPU is excellent. In Metro Exodus at 1080p and 2,560 x 1,440, it returned 99th percentile minimums of 38fps and 31fps (increasing to 35fps with DLSS), and in Shadow of the Tomb Raider it hit 63fps and 44fps (52fps with DLSS). Remarkably, those Metro results are only a

BENCHMARK RESULTS

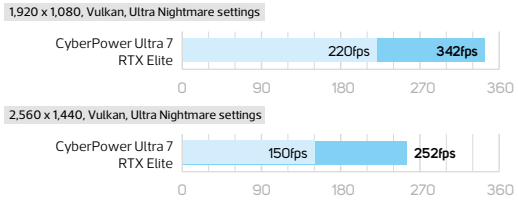
297,880 SYSTEM SCORE

333,890 HEAVY MULTI-TASKING

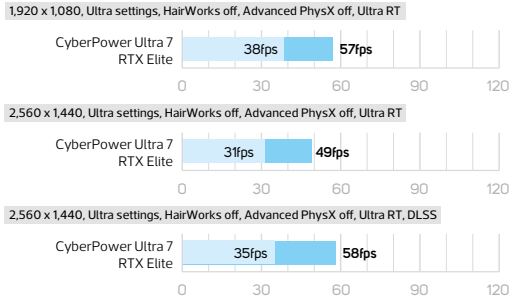
755,105 HANDBRAKE H.264 VIDEO ENCODING

73,991 GIMP IMAGE EDITING

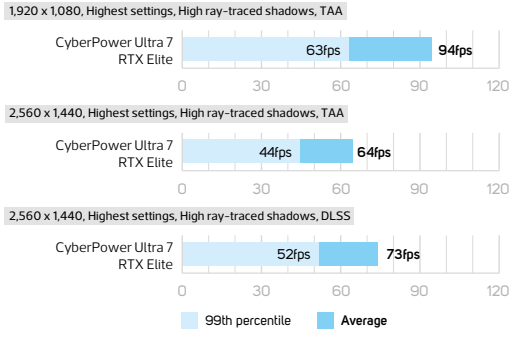
DOOM ETERNAL



METRO EXODUS



SHADOW OF THE TOMB RAIDER



AMPED UP

- \+ Fantastic AMD processor
- \+ Decent gaming performance
- \+ Reasonably quiet operation

AMPHIBIOUS

- − Basic PSU
- − No PCI-E 4 SSD
- − Mediocre chassis

couple of frames per second behind results we've seen from the RTX 2080 Super, and the Tomb Raider scores are marginally better.

The CyberPower's significant GPU overclock means that this PC was usually 1-2fps quicker than the Chillblast, and the CyberPower will play any game at 1080p or 2,560 x 1,440, and it will scythe through esports titles at high frame rates, as you can see from the 1080p average of 342fps.

This rig's Ryzen 7 5800X CPU was also consistently quicker than the chip in the Chillblast, likely thanks to its superior cooling system allowing more boosting. Its Handbrake video encoding benchmark offered the same speed as an Intel Core i9-10900K, and it outpaced Intel's chips in our single-threaded image editing test. It's an extremely capable processor for any task, whether it's everyday computing or tougher content creation workloads.

The CyberPower's benchmarks are rounded out by mixed thermal performance. The GPU delta T of 46°C is fine, and this rig is quiet. The CPU's stress test delta T of 67°C is high, though, and brings the processor up against its maximum temperature limit of 90°C. At this point, the chip throttled to around 4.15GHz. Chillblast's machine suffered from this issue too, and it's only a problem if the CPU is stressed at 100 per cent load for prolonged periods – this is, to be fair, an unlikely scenario, even during tough workloads.

Conclusion

CyberPower's machine is faster and quieter than the Chillblast, and it has a better motherboard. Disappointingly, though, the CyberPower doesn't have a PCI-E 4 SSD, and the Chillblast has more memory and a better warranty, as well as being cheaper. Neither machine is perfect, but the Chillblast offers a slightly better balance for the asking price.

MIKE JENNINGS

VERDICT

Very fast and a decent build, but cheaper rivals are available with a better-balanced spec.

PERFORMANCE **22/25**

DESIGN **20/25**

HARDWARE **21/25**

VALUE **20/25**

OVERALL SCORE **83%**

AMD B550 GAMING PC

CHILLBLAST FUSION COMMANDO 3060 Ti

/ £1,500 inc VAT

SUPPLIER chillblast.com

The Chillblast Fusion Commando is one of two systems in this issue that pair an AMD Ryzen 7 5800X with an Nvidia GeForce RTX 3060 Ti. Impressively, this machine also adds a PCI-E 4 SSD, and it's nearly £100 cheaper than its key rival. The Fusion Commando deploys a Gigabyte-made RTX 3060 Ti card with a modest overclock, adding an extra 30MHz to the 1665MHz stock boost speed. That's not a huge boost, but the RTX 3060 Ti already has a storming specification for the price, including 4,864 CUDA cores and 8GB of memory.

Elsewhere, the Ryzen 7 5800X serves up eight cores and 16 threads via SMT, and it runs at its stock base and boost speeds of 3.8GHz and 4.7GHz. Chillblast has also geared this modestly priced machine towards content creation by using 32GB of 3200MHz DDR4 memory, a 512GB Seagate FireCuda 520 PCI-E 4 SSD and a 4TB secondary drive.

That SSD is a great inclusion – its read and write speeds of 4,963MB/sec and 2,521MB/sec are a boon for sequential file transfers, and the former easily beats PCI-E 3 drives. It's all powered by a Chillblast-branded 700W PSU, which has an 80 Plus Bronze efficiency rating but no modular cabling.

The Chillblast's weakest component is its motherboard. The micro-ATX Asus Prime B550M-A does have dual-band 802.11ax Wi-Fi, four memory slots, two M.2 connectors and two spare 1x PCI-E slots, but it has no secondary 16x PCI-E slot, no USB-C ports and no optical S/PDIF connector alongside its basic set of three rear audio jacks. You only get entry-level Realtek ALC887 audio as well, and the second M.2 connector doesn't support PCI-E 4.

SPEC

CPU
3.8GHz AMD Ryzen 7 5800X

Motherboard
Asus Prime B550M-A (Wi-Fi)

Memory
32GB Corsair Vengeance LPX 3200MHz DDR4

Graphics
Gigabyte GeForce RTX 3060 Ti 8GB

Storage
512GB Seagate FireCuda 520 M.2 SSD; 4TB Seagate Barracuda hard drive

Networking
Gigabit Ethernet, dual-band 802.11ax Wi-Fi

Case
Chillblast Crystal M-ATX

Cooling
Chillblast 120 cooler with 1 x 120mm fan; GPU: 2 x 90mm fans; front: 3 x 120mm

PSU
Chillblast 700W

Ports
Front: 1 x USB 3.2 Gen 1, 2 x USB 2, 2 x audio; rear: 2 x USB 3.2 Gen 2, 4 x USB 3.2 Gen 1, 1 x PS/2, 3 x audio

Operating system
Microsoft Windows 10 Home 64-bit

Warranty
Five years labour with two years collect and return and parts

The CyberPower's mid-range X570-based board is better, with decent-quality audio and a far superior rear I/O panel. Elsewhere the two machines trade blows: the CyberPower has a higher GPU overclock, but it doesn't have a PCI-E 4 SSD and it only has 16GB of memory.

Meanwhile, Chillblast's Crystal chassis is a conventional mid-tower enclosure. Much like the CyberPower's case, it has tempered glass side and front panels, and a PSU shroud on the inside. It's smaller than the CyberPower's case, and it looks more subdued – its three 120mm intake fans glow with red lighting, but that's it for illumination.

Chillblast has kept its cabling neat throughout – it's better here than the CyberPower – and cooling is provided by a Chillblast-branded all-in-one liquid cooler with one 120mm fan on its radiator, which occupies the exhaust mount. Around the rear, there are single free 3.5in and 2.5in drive bays and a fan synchronisation module. There's little difference between this smaller case and the larger CyberPower enclosure; both are straightforward and conventional. The neater Chillblast has easier storage upgrade access, but this smaller case makes the bottom of the motherboard harder to reach.

Chillblast outpaces its rival when it comes to warranty though. The Fusion Commando is protected by an excellent five year labour deal with two years of parts coverage and collect and return service.

Performance

The GeForce RTX 3060 Ti is a fantastic mid-range GPU – even without DLSS, the Chillblast stayed above 60fps in Shadow of the Tomb Raider at 1080p with ray-traced

shadows, and this only dropped to 51fps (with a solid 71fps average) at 2,560 x 1,440 with DLSS. Our demanding Metro Exodus test on Ultra settings was a tougher challenge, but it still returned a playable frame rate at 2,560 x 1,440 with DLSS. The relatively small overclock on this card does mean that the Chillblast's GPU was consistently a little slower than the CyberPower's more potent card, but the gaps are small.

Meanwhile, the AMD Ryzen 7 5800X helped the Chillblast to score 71,707 in the image editing test and 718,145 in the Handbrake video encoding benchmark – the former score easily beats Intel's pricier Core i9 chips and the latter is barely slower. For everyday workloads and multi-threaded content creation, this chip is excellent. The only disappointment here comes when this PC is compared with the CyberPower – despite the Chillblast's extra memory and faster SSD, the CyberPower was a little faster, likely down to the Chillblast's lesser CPU cooling hindering boosting.

That also explains why the Chillblast is a little poorer in thermal tests too. The GPU's delta T of 59°C is higher than that of the CyberPower, and this PC was consistently louder – the noise levels aren't overwhelming, but they're more noticeable.

The Chillblast's CPU attained its peak temperature of 90°C during a fully loaded stress test before throttling to 4.15GHz – just like the CyberPower. It's unlikely to become an issue during conventional workloads, where CPU usage fluctuates, and the machine isn't in the danger zone, but the CPU clearly doesn't have much thermal headroom.

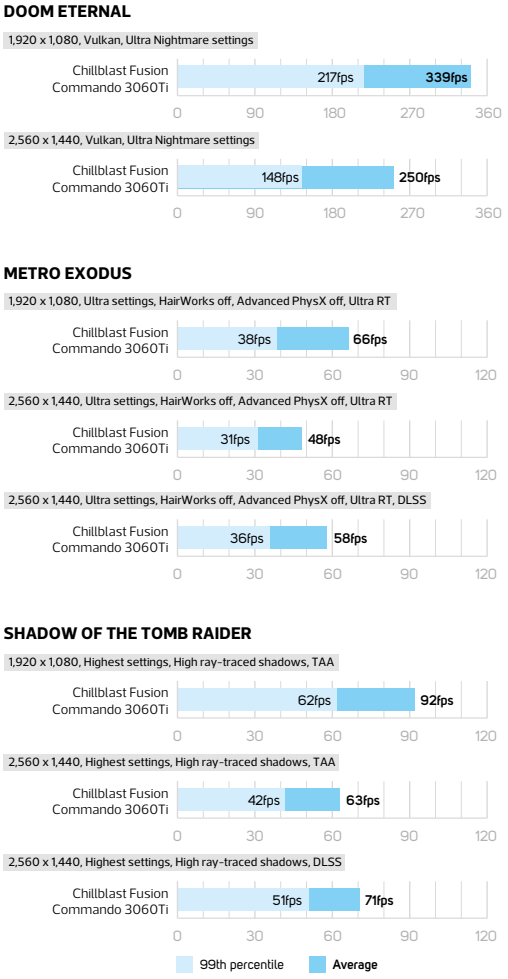
COMMANDO

- \+ PCI-E 4 SSD and huge hard disk
- \+ Compact, neat case
- \+ Great warranty

SUBURBAN COMMANDO

- – Rivals are quicker
- – CPU cooling could be better
- – Noisier than competitors

BENCHMARK RESULTS



284,689
SYSTEM SCORE

316,433
HEAVY MULTI-TASKING

718,145
HANDBRAKE H.264 VIDEO ENCODING

71,707
GIMP IMAGE EDITING

Conclusion

This PC may be a little louder than its rival, and it's a tiny bit slower in benchmarks – but there's still plenty to like. The combination of new AMD and Nvidia parts still delivers more than enough speed for the vast majority of gaming and work situations, and the Chillblast goes beyond the competition by offering a PCI-E 4 SSD, a larger hard disk, more memory and a longer warranty.

The CyberPower rig does offer more raw speed and quieter operation, alongside an X570 ATX motherboard – it's marginally better for performance and future upgrades because of those attributes. However, the Chillblast's cheaper price, superior storage, extra warranty protection and 32GB of memory offer a better balance.

MIKE JENNINGS

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

VERDICT

A little noisy, but this PC offers fast gaming and storage performance for a cheaper price than its key rival this month.

Custom kit

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

MOFT MULTI-FUNCTION PHONE STAND / £19.99 inc VAT

SUPPLIER amazon.co.uk

The MOFT Multi-Function Phone Stand is a combination of a wallet and a smartphone stand in one foldable piece. You attach it to the back of your phone using a reusable sticky pad, which is pretty strong and can also adhere to a case, so you don't have to forgo armouring your phone.

As a wallet, the MOFT is a minimalist affair, and not entirely in a good way. You can stash three cards inside it, but there's nothing else wallet-like about it, and the cards aren't particularly accessible either.

Meanwhile, the phone stand option works in portrait or landscape configurations – you simply fold the back into a foot that attaches to the rest of the stand with a magnet. This magnet also allows phones with a MOFT holder attached to them to lock onto magnetic phone holders in cars. Overall, though, the device feels rather flimsy, which is at odds with how much folding and fiddling you have to perform in order to get it to stand up in the first place.

There's a kernel of a great idea here for people who don't want to carry a separate card holder and smartphone stand in the same pocket, but it doesn't feel entirely there yet.

Wobble ●●○○○ **Stand**

KLIM AIRFLOW+ LAPTOP COOLER / £32.97 inc VAT

SUPPLIER amazon.co.uk

Rather than having a grated cover with a bunch of fans behind it, the KLIM Airflow+ is designed around a cavernous open interior. This gaping open space, reminiscent of the air intake on a supercharger, sits under your laptop, while a 24cm cross-flow fan blasts air through the space, across the underside of the laptop, and out through a vent in the front. The fan is powerful and quite noisy, but the effect is substantial, creating fast-moving airflow under the laptop.

There are also feet that can be adjusted to three different heights, as well as fold-up rests at the bottom to prevent your laptop from sliding off it. There's also a speed control for the fan in case you want to dial it down from 11. Despite its low-key design, the Airflow+ offers heavy-duty cooling, to the extent that even the noise is forgivable. If you need this sort of setup, you're probably gaming, and if you're gaming, you can wear a headset, so the noise is everybody else's problem rather than yours.

Surcharge ●●●●○ **Supercharge**

D-LINE CABLE TIDY BOX / £8 inc VAT

SUPPLIER amazon.co.uk

The D-Line Cable Tidy Box basically clears up your cables by hiding them. This rounded box is 32cm long, which is just long enough to comfortably accommodate an ordinary four-way bar of power sockets. It has a removable lid, two large holes (one on each side) and a central hole at the top. The idea is that you put a four-way extension – or theoretically any potential rat-king of wires, such as a USB hub – inside it, with the connections feeding in and out through the available holes. The lid of the box is vented, which mitigates any issues with devices that might get hot. It's quite a neat approach – power plugs can be unsightly and the D-Line helps to keep cabling tidy without too much effort.

Beeline ●●●●○ **D-Line**

LITTLELF WI-FI CAMERA / £25.49 inc VAT

SUPPLIER amazon.co.uk

The Littlelf is a compact Wi-Fi camera that operates as both an internal security camera and as a sort of fixed-point telepresence device. The setup process is incredibly simple – you install the app, power up the device and show it a QR code that the app puts on your phone screen – it then loads up your Wi-Fi settings and you're off to the races.

The Littlelf is powered by micro-USB, and is supplied with a 2m cable and a wall socket adaptor, so it's easy to plonk down the device next to your PC, or on a table near a socket. A wall mount is supplied, but that's not a whole lot of use when the device needs a cable attached to it.

The camera itself offers HD video, motion sensing, motion tracking, 360 degrees of rotation, 8x zoom and IR night vision, plus it can send alerts and pictures to your phone when it's activated by movement. There's also an optional cloud storage facility, or you can install a 128GB micro-SD card for storing pictures and footage.

In addition, the Littlelf functions as a two-way communications device, so you can tell people and pets to get off furniture, put down forbidden objects, or even share your true feelings through the distancing effect afforded by a tiny rotating camera – whatever gets you through the day. The Littlelf is cheap, works well and the software is easy to use. If you want to keep an eye on your house, the Littlelf is a big help that isn't too expensive.

Big Brother ●●●●○ **Littlelf**

BANGOO MOBILE PHONE COOLER

/ £16.90 inc VAT

SUPPLIER amazon.co.uk

There's several design challenges in the idea of making a cooler for a smartphone, and the Bangoo mobile phone cooler attempts to confront most of them, but it unfortunately largely fails. The first challenge is attaching the device in a way that means it can do its cooling job but also stay out of the way, and the Bangoo often feels in the way. It also seldom feels stable on the back of your phone, due to its insecure mounting clips.

The second challenge is power. The Bangoo doesn't have a battery, instead drawing power from a USB Type-C connection that needs to be connected to a USB 3 power source. This means you need a power bank or mains socket handy, so your phone is on a wire attached to whatever powers the cooling. It's hardly mobile in this respect

Lastly, the fan is quite loud and annoying, with no controls other than the ability to switch it on or off. At best, the heat-conducting properties of the Bangoo enable it to get hot, so you have a hot cooler on a hot phone on a wire making tiny angry fan noises at you. It's clearly not easy to design one of these gizmos, and the Bangoo winds up buried under a pile of hurdles that it can't clear.

Bangoo ●○○○○ **Baloo**

Seen something worthy of appearing in Custom Kit? Send your suggestions to phil.hartup@gmail.com

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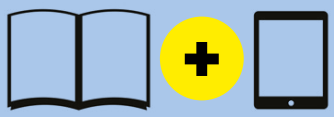

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LABS TEST

Handy heatsinks

Antony Leather puts eight of the latest sub-£35 air coolers to the test

How we test

When testing CPU coolers, it's important to examine performance across a range of sockets due to the fact that mounting mechanisms vary between them. We've seen differences here in the past and this Labs test is no different, so be very wary of any tests you see that don't test on the specific socket for which you're looking to buy a cooler.

This month, we're focusing on the new kids on the block: Intel's LGA1200, which of course features great gaming CPUs such as the Core i9-10900K, and AMD's Socket AM4, using its Zen 3 Ryzen CPUs.

We're focusing on affordable air-powered cooling this month, using eight of the latest sub-£35 heatsinks. However, we haven't skimped on the hardware they'll need to cool. Our LGA1200 test system uses an Intel Core i9-10900K, with a static 4.9GHz applied to all ten cores with a vcore of 1.2V, and an MSI MEG Z490 Tomahawk with 16GB of Corsair Vengeance RGB Pro memory. The system also uses a 256GB Samsung 960 Evo and Corsair CM550 PSU.

Meanwhile, our AMD system uses a Ryzen 9 5900X overclocked to 4.5GHz using a vcore of 1.25V on an MSI MEG X570 Unify with the same memory, SSD and PSU. Both systems are housed in a Fractal Design Meshify C case and use the latest versions of Windows, plus the latest BIOS and driver versions.

We use CoreTemp to measure the CPU temperature before subtracting the ambient air temperature to give a delta T result. Measuring this way allows us to test in a lab that isn't temperature controlled. We use Prime95's smallfft test with AVX instructions disabled to load the CPU and take the reading after ten minutes.

For the Intel system, we take an average reading across all ten cores to iron out any hot spots that might be misleading. AMD only lists a single temperature reading rather than on a per-core basis, so we list what's reported in CoreTemp. We calculate scores based on cooling performance, noise, features, ease of installation and value, with a weighted calculation giving an overall score.

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- Scythe Kotetsu II / p47
- SilverStone AR12 RGB / p48

ALPENFÖHN BEN NEVIS ADVANCED BLACK RGB / £30 inc VAT

SUPPLIER overclockers.co.uk

With an asking price of £30, the Alpenföhn Ben Nevis is one of the pricier options this month, and correspondingly early impressions were very good. It has a jet black heatsink as well as heatpipes, rather than the plain aluminium and copper of cheaper units, and the heatpipes are angled to offset the heatsink away from your memory modules, giving them full clearance.

However, the heatsink isn't quite full size and has several sections cut out of the fins to the rear, although it does sport five rather than the usual four heatpipes. The fifth of these is a straight vertical pipe running from the centre of the direct contact plate all the way up through the centre of the heatsink, which isn't something we've seen before.

For the extra cash you also get RGB fan lighting, albeit this is fairly restrained and doesn't emanate from the entire fan blades in the way Deepcool and Jonsbo's coolers do. It's also limited to standard non-digital lighting, so you can only control all LEDs at the same time in a single colour. However, you do get a 4-way RGB cable splitter as well as a separate controller should you wish to not use your motherboard's software.

The 1,500rpm fan is reasonably powerful and fairly quiet at 44dBA, which puts it fourth quietest, with the be quiet! Pure Rock 2, Scythe Kotetsu II and ARCTIC i13X all noticeably quieter at full speed.

Installation on our Intel LGA1200 motherboard was simple enough, requiring plates with sprung screws to be attached to the cooler, which then screw into an included backplate. However, the solution for Socket AM4 was nothing short of diabolical. Here you use clips that use the stock mounts on AMD motherboards, but the force required to install them was far too much and made even harder by the close proximity of VRM heatsinks. Even removing the cooler was difficult and definitely not something we'd want to do again in a hurry.

In our Intel system, the Ben Nevis Advanced Black RGB managed a CPU delta T of 69°C, which was decidedly poor and bettered by the smaller and cheaper ARCTIC Freezer i13X with only the Jonsbo CR-1000 GT performing worse. In the AMD system pitched against our overclocked Ryzen 9 5900X, it wasn't much better, again only managing to match the ARCTIC Freezer A13X with the quieter be quiet! Pure Rock 2 offering a 7°C advantage for lower noise and less cash.

Conclusion

We had high hopes for this £30 cooler given its decent build quality and funky heatpipe arrangement, but the Alpenföhn Ben Nevis Advanced Black RGB proved to be a poor performer against other coolers on test and wasn't the quietest either despite also costing more. This means that there are ultimately numerous better options depending on whether you want to prioritise noise or cooling, but the likes of the be quiet! Pure Rock 2 and Scythe Kotetsu II are both cooler and quieter, while the Deepcool Gammaxx GTEV2 offers snazzier RGB lighting and is a much better performer, if not as quiet at full speed.

MOUNT EVEREST

- \+ Jet black heatsink
- \+ Simple Intel installation
- \+ RGB lighting

MOLE HILL

- − Poor cooling performance
- − Terrible AMD mounting mechanism
- − More expensive than quieter, better coolers

SPEC

Compatibility
AMD: AM4, AM3/+, AM2/+, FM2/+, FM1
Intel: LGA2011/V3, LGA1200, LGA115x

Heatsink size with fans (mm)
130 x 74 x 159 (W x D x H)

Fans 1 x 120mm

Stated noise 26dBA

VERDICT

An interesting heatpipe arrangement fails to translate into winning cooling.

LGA1200

COOLING	FEATURES	OVERALL SCORE
28/40	14/20	73%
DESIGN	VALUE	
16/20	15/20	

FITTING: Easy

AM4

COOLING	FEATURES	OVERALL SCORE
29/40	14/20	62%
DESIGN	VALUE	
6/20	13/20	

FITTING: Hard

ARCTIC A13X / I13X / £22 inc VAT

SUPPLIER overclockers.co.uk

If you have less than £20 to spend, ARCTIC's Freezer 7 X has been our go-to cooler for years now. It offers affordable cooling that beats the pants off stock coolers and produces low noise levels too. If something isn't broken, then it's generally better not to try to fix it (that's the pithy version of the old saying – Ed.), but ARCTIC has taken the bold move of tweaking the design a little and creating a more potent cooler. The result is the 13X, which still costs a very wallet-friendly £22 but has a slightly beefed-up specification.

To start with, though, there are two versions of the cooler – one for Intel and the other for AMD systems, designated i13X and A13X respectively. We've reviewed both here, but they cost the same and are identical, so just be sure to pick the right one. The key difference between it and the Freezer 7 X is more heat-killing power courtesy of an extra heatpipe, with the cheaper cooler making do with two while the new model gets three 6mm heatpipes.

There's an extra 10mm of depth and 5mm added to the height as well, but while it's taller, it still sits at just 137mm, making it by far the smallest cooler on test and one that's likely to fit into plenty of cases with severe cooler height limitations such as those of the mini-ITX variety.

The same fan is used too, which is just 92mm rather than the 120mm fans used with all the other coolers on test. It sports a fluid dynamic bearing and can spin at up to 2,000rpm.

Despite this, it produced just 42dBA, which is the third quietest result on test, so in terms of being pleasant to sit next to and affordable, so far so good.

The mounting mechanism has changed too, and uses a pair of plates that secure to an included Intel backplate or the stock AMD plate, with fixed sprung screws on the cooler attaching to these. It's a little fiddlier than the cheaper model, but still simple to deal with, where the only tricky part is removing the fan housing to get at one of the mounting screws. This proved to be a bit tough to unclip, but it's something that you'll rarely need to do.

This cooler's CPU delta T of 67°C when dealing with our Core i9-10900K was better than several larger coolers and while toasty, it did tame Intel's 10-core flagship. However, both the Deepcool Gammaxx GTE V2 and be quiet! Pure Rock 2 offered significantly lower temperatures for slightly lower noise levels. Our AMD system saw the A13X variant just about deal with our overclocked Ryzen 9 5900X, but again, the Be Quiet! and Deepcool coolers offered noticeably lower temperatures.

Conclusion

For just £22, what you get with the ARCTIC A13X and i13X are coolers that can cope with some of the most potent mainstream desktop CPUs, even with a modicum of overclocking involved. That's seriously impressive for such a small, quiet and affordable cooler, so if it's as far as your budget or case allows, they're a great choice. However, the Deepcool Gammaxx GTE V2 and be quiet! Pure Rock 2 are both cooler, quieter and only cost a little more.

SPEC

Compatibility

AMD (A13X): AM4, AM3/+, AM2/+, FM2/+, FM1

Intel (i13X): LGA1200, LGA115x

Heatsink size with fans (mm)

108 x 85 x 137 (W x D x H)

Fans 1 x 92mm

Stated noise 0.3 sones

ARCTIC CIRCLE

+ Reasonable cooling
+ Super-compact
+ Cheap

ARCTIC ROLL

– Better suited to 6-core and 8-core CPUs
– Not much cheaper than larger more capable coolers
– No RGB lighting

VERDICT

A good choice for a super-compact and affordable cooler, but larger, slightly more expensive models are better still.

LGA1200

COOLING	FEATURES	OVERALL SCORE
30/40	13/20	78%
DESIGN	VALUE	
16/20	19/20	

FITTING: Easy

AM4

COOLING	FEATURES	OVERALL SCORE
29/40	13/20	77%
DESIGN	VALUE	
16/20	19/20	

FITTING: Easy

BE QUIET! PURE ROCK 2 / £29 inc VAT

SUPPLIER cclonline.com

Few coolers are as instantly recognisable as be quiet!'s and, despite leaving you with change from £30, the Pure Rock 2 is no different. You get the smart capped heatpipes, brushed metal top and of course the signature all-black finish. A quality Pure Wings 2 fan is also on hand and yet, despite all these premium touches, it's far from being the most expensive cooler on test.

The fan isn't particularly powerful, topping out at 1,500rpm, but the heatsink fins are quite densely packed and sport angled edges to direct airflow through the entire length.

The direct contact plate is perfectly finished, with no gaps, though it's not polished to a shine like with more premium coolers. It's a much larger plate than some of the other coolers on test too, which could mean it will deal better with our AMD CPU's larger heatspreader. The contact plate is also equipped with fins/grooves to further bolster heat dissipation.

The whole cooler's fairly compact at 155mm tall too, but if you're looking for RGB lighting you'll be disappointed. The only extras are an extra set of fan clips to allow you to install a second fan in a pull position at the rear. The front fan benefits from angled heatpipes to move the heatsink clear of memory slots on dual-channel boards too.

The mounting mechanism is quite involved, but simple enough to deal with and parts are separated handily into bags for each socket so it's easy to find the ones you need. You use the stock AMD backplate but then there are two plates that attach to the backplate and a further metal bar that's slipped between the cooler's four heatpipes and attaches to the plates. For Intel systems it's a similar arrangement plus you'll need to attach the supplied backplate.

The fan was the quietest on test, producing just 40dBA at full speed, which was 1dBA quieter than the Scythe Kotetsu II and a whole 9dBA quieter than the Deepcool Gammaxx GTEV2. Despite this, the Pure Rock 2 performed remarkably well, hitting the second lowest temperature in our Intel system, cooling our Core i9-10900K to a delta T of 62°C.

This was a match for the louder SilverStone AR12 RGB and significantly better than the Gelid Tornado, ARCTIC i13X and Alpenföhn Ben Nevis. Only the Deepcool Gammaxx GTEV2 performed better, but only by a single degree.

In our AMD system, the extra fan power of the Deepcool Gammaxx GTEV2 counted for more, outstripping the Pure Rock 2 by 5°C with a delta T of 54°C versus 59°C for be quiet!, but this was still a joint second place result and again noticeably better than the ARCTIC i13X and Alpenföhn Ben Nevis.

Conclusion

We're pleasantly surprised by the be quiet! Pure Rock 2 as it pairs smart aesthetics with great build quality, low noise and good cooling performance. It was the quietest cooler on test and the only cooler to offer more cooling power was the Deepcool Gammaxx GTEV2, which was significantly louder. There's not much between it and the Scythe Kotetsu II except for a few pounds in price, which ultimately cost Scythe a win here and while the Deepcool Gammaxx GTEV2 picks up our top award for AMD systems where it was by far the best performer, it's the Pure Rock 2 that comes out on top for our Intel LGA1200 system.

SPEC

Compatibility
AMD: AM4, AM3/+, AM2/+, FM2/+, FM1
Intel: LGA2011/V3, LGA1200, LGA115x

Heatsink size with fans (mm)
130 x 74 x 159 (W x D x H)

Fans 1 x 120mm

Stated noise 27dBA

BE QUICK

+ Great build quality
+ Low noise
+ Excellent cooling on Intel systems

BE DEAD

- Middling performance with Ryzen CPUs
- No RGB lighting
- Slow fan speed limits cooling in some situations

VERDICT

Supremely quiet at full speed without sacrificing performance.

LGA1200

COOLING	FEATURES	OVERALL SCORE
38/40	11/20	86%
DESIGN	VALUE	
19/20	18/20	
FITTING		
Easy		

CUSTOM PC PREMIUM GRADE

AM4

COOLING	FEATURES	OVERALL SCORE
33/40	11/20	80%
DESIGN	VALUE	
19/20	17/20	
FITTING		
Easy		

CUSTOM PC APPROVED

DEEPCOOL GAMMAXX GTE V2 / £26 inc VAT

SUPPLIER amazon.co.uk

You'll need to pay careful attention to Deepcool's line-up of 120mm air coolers, if you intend to buy the Gammaxx GTE V2, as it has a staggering number of options available, which can make finding the right one a bit tricky. We initially thought we'd made a mistake when we saw the price, as £26 for a full-sized 120mm heatsink and RGB-enabled fan seemed too good to be true, but sure enough this cooler really is this modestly priced.

The Gammaxx GTE V2 has a standard 4-pin RGB connector, so there's no rainbow effects on show like that on the Jonsbo CR-1000 GT, nor an illuminated heatsink top like the latter offers as well. However, the lighting is bright and vivid, and there's also a cable splitter included if you want to add a second RGB fan.

The heatsink doesn't exude quality, as the black top plate moves when touched, but thankfully this didn't result in any rattles once the fan span up. The heatsink incorporates four 6mm heatpipes and is reasonably compact at 158mm tall. However, it's just 50mm thick, which is much less than other coolers on test. However, this can also mean it can be more efficient and coupled with a peak fan speed of nearly 1,700rpm, we still expect it to be quite potent if the rest of the heatsink performs well.

The mounting kit uses a single backplate for Intel and AMD systems, so you'll need to remove the socket paraphernalia on your AMD motherboard first, unlike many of the other coolers on test. There are quite a few bits to deal with in the installation too with 15 parts including the backplate plus nuts and cooler mounting plates, but nothing is particularly tricky or needs brute force, although the fan clips were a little stiff.

The Gammaxx GTE V2 was fairly noisy at full speed, with the fan topping the decibel chart at 70dBA, so anyone who will be pushing their CPU to the limits on a regular basis may want to factor this in. However, this did at least result in superb cooling.

In our Intel system, the CPU delta T of 61°C was the best on test, although the Be Quiet! Pure Rock 2 was only a degree behind as was the Scythe Kotetsu II. It was in our AMD system, cooling the mighty overclocked Ryzen 9 5900X, that we saw the Gammaxx GTE V2's best result, though, with a delta T of just 54°C. That's a full 5°C better than the next best cooler, which was the Pure Rock 2 followed by the Scythe Kotetsu II again.

Conclusion

While it's a tad loud at full speed, we can't argue with the performance on offer from the Deepcool Gammaxx GTE V2. It was simply stunning in our AMD system and sports RGB lighting too, and while it was less dominant in our Intel system, it still managed to just take top spot.

FRESHLY GROUND

- \+ Vibrant RGB lighting
- \+ Simple installation
- \+ Excellent cooling

INSTANT

- − Above-average noise at full speed
- − Only fan is illuminated
- − Other coolers are cooler and quieter on Intel systems

SPEC

Compatibility
AMD: AM4, AM3/+, AM2/+, FM2/+, FM1
Intel: LGA2011/V3, LGA1200, LGA115x

Heatsink size with fans (mm)
129 x 77 x 158 (W x D x H)

Fans 1 x 120mm

Stated noise 28dBA

VERDICT

Excellent cooling for AMD and Intel mainstream sockets, but it's not the quietest.

LGA1200

COOLING	FEATURES	OVERALL SCORE
39/40	13/20	81%
DESIGN	VALUE	
11/20	18/20	
FITTING		
Easy		

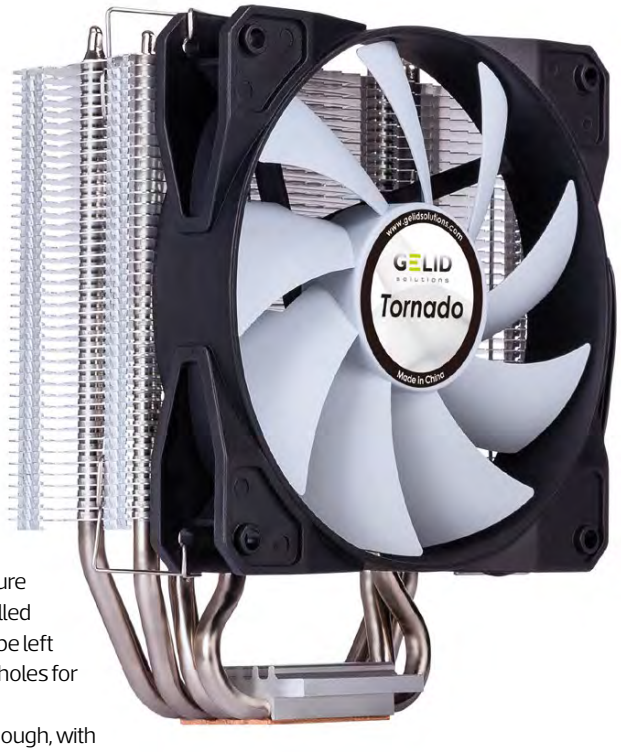
AM4

COOLING	FEATURES	OVERALL SCORE
39/40	13/20	81%
DESIGN	VALUE	
11/20	18/20	
FITTING		
Easy		

GELID TORNADO

/ £25 inc VAT

SUPPLIER quietpc.com



We haven't reviewed anything from Gelid in a while but its Tranquillo coolers have picked up plenty of awards in the past thanks to their great value and good cooling performance, so with a name like Tornado, we were intrigued to see how one of its latest affordable coolers performed.

The included 120mm fan only hits 1,600rpm at full speed, which isn't exactly tornado-like and the heatsink is quite skinny too, at just 45mm thick. However, there's plenty of other factors that can come into play with air coolers.

The direct contact plate is well machined with no big gaps between the heatpipes and the area available to contact is just big enough to encompass the entire heatspreader on Ryzen CPUs.

It has the usual quartet of 6mm heatpipes as well, so there are certainly no real standout features as far as cooling is concerned.

At just £25, the Tornado is certainly wallet-friendly, but there's no RGB lighting with the only extras being clips for an additional fan. However, the clips were quite fiddly to use, especially compared with those on the Scythe Kotetsu II, and had an annoying habit of springing off.

The mounting mechanism is fairly straightforward, but we found an issue with removing the backplate pins that are pre-installed for Intel sockets. These have large plastic clips on them that required learning a specific technique to remove in order not to practically rip our fingernails off. We're not sure why these had to be pre-installed for Intel systems and couldn't be left in a bag to install in the correct holes for your CPU.

The rest was plain sailing, though, with just a couple of plates to fit to the heatsink and thumbscrews to deal with. The heatsink is relatively compact too at just 153mm, so it's one of the shorter 120mm heatsinks on test.

Noise-wise, the Tornado was thankfully not trying to live up to its namesake, dishing out 44dBA at full speed, which was reasonably quiet. It didn't really offer standout performance in our Intel system, with a delta T of 67°C being decidedly mid-table. The Deepcool Gammaxx GTE V2, be quiet! Pure Rock 2 and Scythe Kotetsu II are all comfortably cooler by at least 5°C.

It performed much better in our AMD system compared with the rest of the pack, though, with a delta T of 59°C being second only to the Gammaxx GTE V2 and matching the other two aforementioned coolers.

Conclusion

While it offered reasonable cooling on both our test systems, the Gelid Tornado didn't better the two key players this month, which were the Deepcool Gammaxx GTE V2 and be quiet! Pure Rock 2. The former outperformed it on both sockets while costing around the same, although being quite a bit louder, while the latter was quieter still and offered similar or better performance for a couple of pounds more. It's a solid effort that was just a few points short of an award, but ultimately there are several slightly better buys.

SPEC

Compatibility
AMD: AM4, AM3/+, AM2/+, FM2/+, FM1
Intel: LGA1200, LGA115x

Heatsink size with fans (mm)
125 x 70 x 153 (W x D x H)

Fans 1 x 120mm

Stated noise 27dBA

TORNADO

- \+ Reasonably quiet
- \+ Attractive price
- \+ Good cooling

BREEZE

- – Fiddly AM4 installation
- – No lighting
- – Lacks standout cooling performance

VERDICT

Decent cooling, but no standout performances and slightly fiddly installation lets the side down.

LGA1200

COOLING	FEATURES	OVERALL SCORE
31/40	14/20	75%
DESIGN	VALUE	
13/20	17/20	

FITTING: Easy

AM4

COOLING	FEATURES	OVERALL SCORE
33/40	14/20	77%
DESIGN	VALUE	
12/20	18/20	

FITTING: Medium

JONSBO CR-1000 GT / £25 inc VAT

SUPPLIER overclockers.co.uk

If you're looking for an affordable 120mm cooler and must have RGB lighting then the Jonsbo CR-1000 GT ticks a lot of boxes. It doesn't just have RGB lighting constrained to the fan hub, but it's equipped with 3-pin digital RGB lighting that extends to the top of the heatsink too, which is remarkable given it costs just £25.

You also get a SATA-powered RGB controller that you can use instead of your motherboard to change colours and lighting effects, and the lighting itself looks fantastic with vibrant, accurate colours spread over the fan blades and heatsink top. There's also a full-sized 120mm heatsink and fan, and attaching the latter is fairly pain-free, requiring a couple of fan clips.

It's not quite as compact as the likes of the Scythe Kotetsu II at 158mm tall, but should be compact enough to sit inside cases that dip below the usual 160-170mm cooler height clearance. There's a fairly typical four 6mm heatpipes, but the RGB lighting on top does mean that there's fewer heatsink fins than the Kotetsu II, with the top of the fan blades simply blowing onto a plastic shroud. However, it might make up for this with a powerful fan that can hit 1,800rpm at full speed, which is 600rpm faster than the Kotetsu II.

Installation was fairly straightforward, with the cooler using an included backplate for our Intel system and making use of the stock AMD backplate, just requiring the removal of the Socket AM4 mounting clips. However, we felt there wasn't quite enough reach with the mounting pins with our AMD setup and this made securing it quite difficult.

It was fairly noisy at full speed, dishing out 47dBA, but the Deepcool Gammaxx GTEV2 was a louder still. However, the noise didn't translate into cooling performance, with the CR-1000 GT offering the second highest CPU delta T in the AMD system at 60°C, with the Deepcool Gammaxx GTEV2 offering an extra 6°C off the temperature with just a little more noise and for a few pounds more.

It was also the warmest cooler in the Intel rig, with a delta T of 70°C – the Deepcool shaves a massive 9°C off this result, and much quieter coolers such as the be quiet! Pure Rock 2 also outperform it. We removed it, and reapplied thermal paste and checked the mounting mechanism but got the same result.

Conclusion

On paper the Jonsbo CR-1000 GT looked like a winner. It offers a full-sized 120mm heatsink and fan, extensive RGB lighting, reasonable installation all for just £25. However, despite its fast-spinning fan and higher than average noise levels, it wasn't able to offer enough cooling ability to better the rest of the field.

We're not sure why, but we suspect other coolers make better use of their heatsink and have more secure mounting mechanisms.

The Deepcool Gammaxx GTEV2 is ultimately a better buy if you want RGB lighting while the be quiet! Pure Rock 2 is cooler and quieter on both Intel and AMD systems.

SPEC

Compatibility
AMD: AM4, AM3/+, AM2/+, FM2/+, FM1
Intel: LGA2011/v3, LGA2066, LGA1200, LGA115x

Heatsink size with fans (mm)
128 x 76 x 158 (W x D x H)

Fans 1 x 120mm

Stated noise 37dBA

ICE LATTE

- \+ Great-looking RGB lighting
- \+ Fairly easy installation
- \+ Compact

BLACK ICE

- – High noise levels
- – Poor cooling
- – Haphazard AMD mounting

VERDICT

Great RGB lighting but the noise and cooling are disappointing.

LGA1200

COOLING	FEATURES	OVERALL SCORE
27/40	19/20	75%
DESIGN	VALUE	
12/20	17/20	

FITTING: Easy

AM4

COOLING	FEATURES	OVERALL SCORE
32/40	19/20	78%
DESIGN	VALUE	
9/20	18/20	

FITTING: Medium

SCYTHE KOTETSU II / £33 inc VAT

SUPPLIER overclockers.co.uk

As an old-timer when it comes to coolers, Scythe is usually a safe bet when it comes to decent, affordable cooling performance. The Scythe Kotetsu II isn't the cheapest cooler on test, though, and actually sits at the top of the price list at £33. You also don't get any RGB lighting for your money either, which is something other coolers such as the Deepcool Gammaxx GTEV2 have in abundance and for less cash too. However, what you do get is rather good.

This is a full-fat 120mm cooler with a large heatsink and quality fluid dynamic bearing Kaze Flex 120mm PWM fan. The fan tops out at just 1,200rpm and as a result, it was the second quietest on test, recording just 41dBA using our sound meter.

It has four 6mm heatpipes and an indirect contact base that's offset from the radiator section using angled heatpipes. This is to shift the heatsink away from the memory slots, allowing you to use any height of memory modules. It also angled away from the GPU, so even those with large backplates shouldn't pose problems. Furthermore, at only 154mm tall it, even cases with slight CPU cooler height limitations should be able to house it.

The fan was easy to install too, with the wire clips handily slotting into the fan's anti-vibration pads without too much hassle. They also didn't need too much force to clip into place either. On many other coolers these clips can all too frequently be tricky to fit.

The baseplate mounting mechanism did involve quite a few parts and you can't secure the cooler with the fan in place, but it's nothing ten minutes of dealing with backplates, screws and nuts can't solve. First, you need to secure mounting plates to the motherboard, with AMD users needing to remove the topside plastic mounting clips and use the stock AMD backplate. The cooler is equipped with a large securing bar that straddles the contact plate and this has two fixed sprung screws that secure it to the plates on the motherboard.

When dealing with our overclocked Ryzen 9 5900X, the Kotetsu II managed a delta T of 59°C, which was enough to match the noisier Gelid Tornado and SilverStone AR12 RGB with only the be quiet! Pure Rock 2 offering similar noise levels, but slightly better cooling.

When dealing with our Core i9-10900K, the delta T of 62°C was again not far off the top slot, matching the Be Quiet! Pure Rock 2, while the noisier Deepcool Gammaxx GTEV2 was only one degree cooler.

Conclusion

If you don't need RGB lighting and just want a good-performing compact and affordable heatsink then the Scythe Kotetsu II is definitely worth adding to your shortlist. It's quiet and can handle the latest desktop CPUs even when overclocked. The fact it's just 154mm tall gives it better compatibility too. It's a great CPU for Intel systems, where it kept our Core i9-10900K in check, but we found a couple of more appealing options if you have a Ryzen CPU that offered better cooling or lower noise levels.

SABRE

- \+ Good cooling
- \+ Hassle-free installation
- \+ Low noise levels

POCKET KNIFE

- – Other coolers perform better on AMD
- – More expensive than the competition.
- – No RGB lighting

SPEC

Compatibility
AMD: AM4, AM3/+, AM2/+, FM2/+, FM1
Intel: LGA2011/v3, LGA2066, LGA1200, LGA115x

Heatsink size with fans (mm)
130 x 83 x 154 (W x D x H)

Fans 1 x 120mm

Stated noise 36dBA

VERDICT

A good balance of low noise, cooling and quality materials.

LGA1200

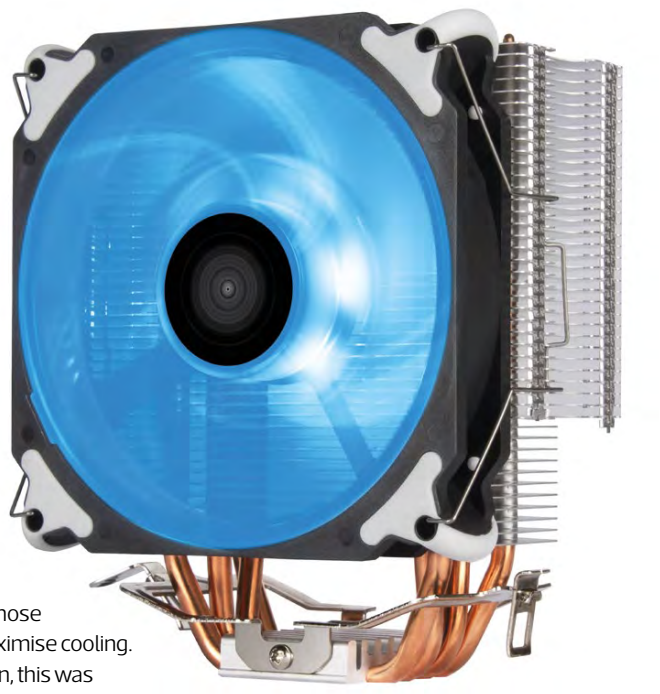
COOLING	FEATURES	OVERALL SCORE
38/40	11/20	81%
DESIGN	VALUE	
17/20	15/20	
FITTING		
Easy		

AM4

COOLING	FEATURES	OVERALL SCORE
33/40	11/20	75%
DESIGN	VALUE	
17/20	14/20	
FITTING		
Easy		

SILVERSTONE AR12 RGB / £23 inc VAT

SUPPLIER overclockers.co.uk



As the second cheapest cooler on test, the SilverStone AR12 RGB might appear to need to cut corners somewhere, but when you open the box there's little to suggest that's the case. It's one of the few coolers on test to include an actual tube of thermal paste, meaning you should be good for a couple of applications. It also has 4-pin RGB lighting, albeit the actual LEDs aren't as vivid as some other coolers on test. However, you get a splitter cable too, allowing you to add another fan or LED strip to the mix.

The fan also includes anti-vibration mounts and the direct contact plate is not only polished smooth, but is large enough to encompass the larger heatspreaders on Ryzen CPUs too. You also get the standard four 6mm heatpipes.

However, SilverStone has removed sections at the bottom of the reasonably compact 154mm heatsink that don't sit directly behind the fan. This provides a little extra room to work but means that there's ultimately less surface area than some other coolers.

SILVER LINING

+ Good value
+ Decent cooling
+ RGB lighting

OVERCAST

− Not particularly quiet
− Terrible mounting mechanism
− Poor noise to cooling ratio

SPEC

Compatibility
AMD: AM4, AM3/+, AM2/+, FM2/+, FM1
Intel: LGA 2011/V3. LGA1200, LGA115x

Heatsink size with fans (mm)
128 x 75 x 154 (W x D x H)

Fans 1 x 120mm

Stated noise 29dBA

The 120mm fan can spin up to a hefty 2,200rpm, which is the fastest on test so we expect big things. With such massive airflow, we suspect it would have been to SilverStone's benefit to keep those extra slivers of heatsink to maximise cooling.

When it comes to installation, this was the main sticking point for the AR12 RGB. SilverStone employs a similar clip mechanism to the Alpenföhn Ben Nevis that hooks over the mounts on AMD CPU sockets and fits to a similar mount for Intel sockets that's included in the box.

Just like the Alpenföhn cooler, the force needed to get the clip hooked onto the mounts makes installing it very difficult indeed and we were left with a very sore thumb. The fan clips weren't much better and we wonder why the clever rubber fan clips SilverStone has used in the past weren't included here too. At the very least they would have given our thumbs a rest.

Noise levels weren't the highest on test, despite the powerful fan, but it was far from quiet at 47dBA compared to just 40dBA for the be quiet! Pure Rock 2, for example.

However, the fan failed to boost cooling enough to better the competition, with the Intel delta T of 62°C only enough for a joint second space slot. Results were similar with our AMD system, with the SilverStone again matching the likes of the be quiet! Pure Rock 2 and Scythe Kotetsu II, but the Deepcool Gammaxx GTEV2 was significantly cooler for only slightly more noise.

Conclusion

While it offers solid cooling on both CPU sockets, the SilverStone AR12 RGB's hateful mounting mechanism means we simply can't recommend it. The clip mechanism can work in some situations, but here, the force needed is excessive. This is a shame, as its low price, RGB lighting and good cooling across the board would have otherwise bagged it an award, but we'd sooner deal with the be quiet! Pure Rock 2's Meccano set-like mounting kit and spend more time installing it than have thumbs that ache for hours afterwards. CPC

VERDICT

Decent cooling and low price but it's let down by its mounting mechanism.

LGA1200

COOLING	FEATURES	OVERALL SCORE
38/40	14/20	74%
DESIGN	VALUE	
4/20	18/20	

FITTING: Hard

AM4

COOLING	FEATURES	OVERALL SCORE
33/40	14/20	67%
DESIGN	VALUE	
4/20	16/20	

FITTING: Hard

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LABS TEST

Game, headset and match

Getting great gaming audio doesn't have to cost the earth. **Edward Chester** checks out seven of the latest gaming headsets that cost under £100

How we test

Gaming headsets have come a long way over the years, with the latest high-end models offering reliable wireless performance, excellent virtual surround sound, comfort and of course great sound quality. However, if your budget is a bit tighter, there are still plenty of good options.

All the headsets reviewed here are available for under £100, and while most only offer standard analogue stereo connections, some have digital USB connections with virtual surround too. Plenty also have extra features such as detachable cables, retractable microphones and more.

We started our testing by assessing the style and build quality of each headset, then looking at the practicality of its design. Is it easy to adjust to fit different head sizes and shapes? Is it awkward to get on and off, and are the various controls and extra features easy to access and use. We also weighed each headset with its microphone attached, but without the full length of cable, to gauge the on-head weight.

Next, we assessed the overall comfort for short and long-term use. Some headsets that initially feel comfy can start to feel heavy or uncomfortable over longer periods. All the headsets on test use a closed-back earcup design in order to offer decent noise isolation but this does mean they all suffered similarly from a lack of ventilation, so a bit of ear airing was required with long-term use of all the headsets.

Next up we tested the audio quality of the microphone by recording some voice lines and music, to assess the clarity of the microphone audio and its frequency range – most gaming headset microphones have quite a limited range that can make them sound a little lifeless.

Finally, we ran through a host of test tracks and gaming scenarios to analyse the headphone sound quality. Most gaming headsets tend to have a scooped sound, with boosted bass and treble to emphasise big explosions and highlight in-game noises, such as footsteps. However, some have a flatter, more natural response, or just handle that scooped sound with more finesse.

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ASUS TUF GAMING H7 / £70 inc VAT

SUPPLIER overclockers.co.uk

With both a USB connection and a 3.5mm jack socket input, plus options for both stereo and virtual 7.1 surround sound, Asus' TUF Gaming H7 certainly looks versatile on paper, but can it deliver in use?

It's certainly a bulky headset. Its sprung metal outer headband sits high above the suspended headband that nestles on your bonce, and its earcups are cavernous circular units that lack the space-saving contouring of more compact headsets (and they slosh around over your ears).

Putting that in numbers, while most of the other headsets on test this month measure under 200mm tall, the H7 stretches to 230mm. Also, most of the headsets have earcups that measure in the region of 80mm from front to back, whereas the H7's have 105mm diameters.

The headset is also on the heavy side, weighting in at 347g with its boom microphone attached. Thankfully, that weight is well distributed by the suspended inner headband. This style of headband automatically adjusts the height of the headset by stretching the band as you pull the headset onto your head. It largely works and does a good job of cushioning the weight, but it's nowhere near as secure or precise as traditional adjustable headbands.

The other problem with this style of headband is that the bent steel outer headband rings like a bell when knocked. The merest flick and you'll have a few seconds of an (admittedly rather charming, pure and calming) bell-like tone ringing through your head. While the noise might not be unpleasant, it's not ideal if a knock disturbs your gaming or conference call.

As for the styling, this headset's sheer bulk means it's not exactly sleek, but it's unobtrusive enough. It's available in three colour options, with yellow or grey accents in place of the red sections shown here.

Getting back to those features, this is where the H7 really impresses. In the box you get a USB adaptor that provides stereo and virtual surround output (with a switch to toggle modes) to its single 3.5mm jack output, and there's an extension cable and detachable bendable boom microphone that's notably longer than quite a few similar-style microphones. The headset also features a volume control, microphone mute button and secondary in-line microphone. However, the controls are all confined to an in-line dongle, so they're fiddly and far less convenient to locate than on-earcup controls. The main cable is tethered too, so it can't be replaced if damaged.

When it comes to sound quality, the H7's microphone isn't outstanding either. It's clear and has good enough directionality to passively block out most background noise (like most of the other microphones on test), but it lacks the clarity and range of better models.

As for the audio quality from the headphones, they offer an impressively flat frequency response for a gaming headset. Bass response is still strong, but not excessively boosted to the point where it muffles the rest of the sound.

Treble sounds a little forced, with particularly cymbals in music cutting through the sound a bit too much, but this also translates into subtle in-game sounds coming through clearly.

Conclusion

The Asus TUF Gaming H7 offers decent value for money, thanks to its inclusion of a USB dongle that provides virtual surround sound. It's also comfortable and produces a pleasingly flat sound, relative to some gaming headsets. However, its size, loose fit and annoying ringing headband dent its appeal.

HI-FI

- \+ Virtual surround and stereo
- \+ USB and analogue inputs
- \+ Decent sound quality

HIGH AND DRY

- – Very large headset
- – Insecure fit
- – Fixed cable

SPEC

Connections USB and 3.5mm stereo

Audio config Stereo and 7.1 surround

Frequency range 20-20,000Hz

Sensitivity/sound pressure Not stated

Mic frequency response 50-10,000Hz (boom and in-line)

Mic sensitivity -40dBV/Pa (boom), -45dBV/Pa (in-line)

Weight 347g

Extras In-line volume control, USB amp

VERDICT

The bells! The bells ... are not what you want from a gaming headset.

COMFORT	FEATURES	OVERALL SCORE
12/20	16/20	76%
SOUND QUALITY	VALUE	
32/40	16/20	

CORSAIR HS50 PRO / £50 inc VAT

SUPPLIER currys.co.uk

The Corsair HS50 Pro is one of the cheapest headsets in the company's line-up, and among the cheaper headsets on test this month. As such, it's no surprise that it has quite a basic feature set compared with some of the other models in this Labs test, with just a single fixed stereo input and the bare minimum of on-headset controls.

Although the HS50 Pro is basic, it's still a smart-looking headset, thanks to its generally minimalist and symmetrical design. The Corsair logo and metal grille on the earcups also elevates its appearance above the cheap-looking painted-on logos of the likes of the HyperX Cloud Alpha and Roccat ELO X Stereo. You can get it in the all-black livery as reviewed here, or with blue and green accents – the areas carrying the colour are a ring around the mesh on the outside of the earcup and the stitching on the headband.

Build quality is fine from a solidity point of view – the headband/earcup holders are particularly thick strips of metal – but there are clear signs this is a budget headset. These include the simplistic design, the modest amount of adjustment in the headband, the lack of headband padding and the socket for the detachable microphone being filled with a rubber bung, which you'll almost certainly lose immediately.

Sure enough, it's an arrangement that translates into uninspiring levels of comfort. The headband doesn't stretch far enough for particularly small or large heads, and it lacks the contouring, depth and softness of padding to really distribute the headset's middling 307g weight. The earcups do provide a good strong grip on your head, though, without overly squishing your ears.

This headset only offers a fixed 3.5mm stereo connection, with no options for USB audio or virtual surround, and the main cable measures 1.8m, and terminates in a combined headphone and microphone jack. A 230mm long converter cable is also included in the box, for splitting out the headphone and microphone signals. It's a shame the cable isn't removable, though, and it's finished in slightly grippy rubber, rather than smooth-gliding braiding.

On the left earcup, along with the main cable and socket for the removable microphone, you'll find a microphone mute button and an analogue volume wheel. Both these controls fall conveniently to hand when you reach for them, and they're also not too easy to knock accidentally. The removable microphone is a standard bendable unit with a unidirectional pickup pattern and basic frequency range. It gets the job done for voice comms, but it can't compete with more premium offerings for clarity.

When it comes to the headphones' sound quality, there's a strong bass response that muddies the sound quite noticeably. It's a fun sound that gives gunshots and explosions a satisfying thump, but spatial awareness and clarity is compromised by the boominess. This limits its appeal for critical game audio where crisp, high-end detail is also required for picking out footsteps and other directional cues. Likewise, music can sound a bit muffled through the HS50's headphones.

Conclusion

The Corsair HS50 Pro is a smart-looking and affordable headset that will get the job done, but it lacks the finesse of its competitors. It isn't particularly comfortable, the headband lacks much adjustment and the feature set is very basic. Build quality is adequate, and it sounds fun enough in games thanks to its strong bass response, but it also sounds very boomy as a result. We recommend spending a bit more on the Epos | Sennheiser GSP 300 if you can afford it.

PROFESSIONAL

- \+ Sleek design
- \+ Solid build quality
- \+ Convenient controls

PRETENDER

- – Poor fit and comfort
- – Boomy sound
- – Limited headband adjustment

SPEC

Connections 3.5mm stereo

Audio config Stereo

Frequency range 20-20,000Hz

Sensitivity/sound pressure 113dB

Mic frequency response 100-10,000Hz

Mic sensitivity -40dBV/Pa

Weight 307g

Extras Detachable mic

VERDICT

A perfectly usable gaming headset for a cheap price, but you don't need to spend much more money to get a much more comfortable headset with better sound.

COMFORT	FEATURES	OVERALL SCORE
10/20	12/20	60%
SOUND QUALITY	VALUE	
22/40	16/20	

CREATIVE SXFI GAMER / £99 inc VAT

SUPPLIER creative.com

As the most expensive headset on test, you'd expect big benefits from the SXFI Gamer, and by and large that's exactly what it delivers. Creative's latest headset packs in a host of features, including digital and analogue inputs, virtual surround and the company's head-measuring, custom-audio profile Super X-Fi headphone holography technology.

We might as well jump right into that SXFI technology, as it's this headset's most outstanding and divisive feature. Essentially, it creates a custom audio profile for the headset's virtual surround modes, taking the shape of your head and ears into account to make for an optimal effect.

To set it up, you have to download an app to your phone, create an SXFI account, then use that app to take pictures of your ears and face. Through some background wizardry, it will then spit out a custom profile that you can download to your PC. In order to do that, you'll also need to install Creative's SXFI Control software which, along with enabling the personalised audio profile, lets you apply a standard custom EQ, adjust the headset's RGB lighting and switch between stereo, 5.1 and 7.1 audio configurations.

The technology just about works, on some vague enough level that it's impossible to really say it's worth the hassle. However, the number of hoops through which you have to jump, and the personal data implications of handing over close-up pictures of yourself, is enough to get even the most casually data-secure users a bit hot under the collar.

Elsewhere, this headset thankfully still has plenty going for it. Its design is neat and smart, with even the RGB lighting on the outside of the earcups looking subtle and well integrated. Comfort levels are decent too. The earcups have deep padding, and they clamp firmly enough to our ears to take the strain off the headband, which is good, as the headband has minimal padding. The headset also stays securely on your head.

A detachable, bendable microphone offers slightly better audio quality than some microphones, but it still trails the likes of the Epos | Sennheiser GSP 300. It also has a red light on its end that flashes when it's muted and stays red when it's live. Some users have reported this light as being a major distraction, whereas we found it was easy enough to just bend down the microphone to put the light out of sight.

On the left earcup you'll find all the controls and connections, with the SXFI profile switching button at the top, then the digital volume wheel, microphone mute button, and stereo and USB Type-C inputs. You get both a 1.8m braided USB Type-C cable and a 1.5m non-braided stereo cable in the box, along with a Type-A to Type-C adaptor.

Sound quality from the headphones is clear, with a reasonably flat sound signature that doesn't result in boomy bass. Both the USB and stereo inputs have the same sound profile too, although the stereo input sounded just a touch clearer when used with our high-quality test amp than with the SXFI's on-board USB sound chip.

Conclusion

The Creative SXFI Gamer is a versatile, comfortable, stylish and decent-sounding headset. It's not one for bass heads but it provides clear, even sound in both stereo and virtual surround configurations. Its signature SXFI sound profile system is too much hassle and a bit invasive to be worth it for most people, but this is still a stylish and good-quality headset.

SCIENCE FICTION

- \+ Loads of features
- \+ Good overall sound quality
- \+ Stereo and virtual surround

ALTERNATIVE FACTS

- – A bit heavy
- – SXFI audio profile awkward to setup

SPEC

Connections USB and 3.5mm stereo

Audio config Stereo and 7.1 surround

Frequency range 20-20,000Hz

Sensitivity/sound pressure Not stated

Mic frequency response 100-16,000Hz

Mic sensitivity -42dBV/Pa

Weight 330g

Extras RGB lighting

VERDICT

Versatile, comfortable and good sound quality, but this headset's signature trick won't be for everyone.

COMFORT	FEATURES	OVERALL SCORE
14/20	18/20	77%
SOUND QUALITY	VALUE	
30/40	15/20	

EPOS | SENNHEISER GSP 300 / £60 inc VAT

SUPPLIER eposaudio.com

The GSP 300 is Epos | Sennheiser's entry-level stereo headset, with seemingly the basic feature set you would expect for its modest price. However, just about every aspect of this headset offers better quality and a more considered design than its price and spec list would suggest.

Sadly, it's not pretty. This is a very utilitarian-looking headset with odd angles, lots of plastic and a thoroughly uninspiring grey colour. What this design lacks in style, though, it makes up in terms of practicality. That all-plastic construction makes for an impressively light headset – it weighed in at just 266g on our scales, despite its very large, permanently attached microphone. The headband adjustment also offers a wide range of settings, making the GSP 300 a headset that should fit on almost any head size.

That ungainly-looking microphone also makes for a wonderfully easy-to-use setup. Just rotate it down when you want to use it, and flip it up out of the way when it's not in use – it will auto-mute when upright too.

LEONIDAS

- + Lightweight
- + Comfortable
- + Great sound quality

XERXES I

- – Fussy design
- – Quite bass-heavy sound
- – Fixed cable

SPEC

Connections 3.5mm stereo

Audio config Stereo

Frequency range 15-26,000Hz

Sensitivity/sound pressure 113dB

Mic frequency response 10-24,000Hz

Mic sensitivity -41dBV/Pa

Weight 266g

Extras None

The rather compact and oddly shaped earcups also impress. They're deceptively deep towards the back edge, so your ears don't get squashed, yet they're also shaped in such a way that they provide a good tight grip and seal around the ample padding. For those with particularly large ears, the quite small opening might cause some trouble, but otherwise they're very comfortable.

Meanwhile, the headband uses a split design with relatively slim strips of padding, but the wide spacing distributes the weight well, and provides breathing room – the padding is also comfortable and soft. Combined with the excellent earcup design and ample adjustability in the headband, you end up with a headset that's quite close-fitting and noticeable when you first put it on your head, but it remains comfortable for long-term use.

For features, you don't get a great deal. On the right earcup there's a very large and easy-to-use volume control wheel, but that's about your lot. The main 2m cable is attached to the headset, and terminates in a split headphone/microphone set of jack plugs. In the box you then get an adaptor for recombining these plugs into a single combi-jack, so you can use the headset with a phone or console too.

The cable not being detachable means a damaged cable makes for an unusable headset, though, plus the use of a split-plug design, then an adaptor for mobile use, is the opposite way round to most competitors and to what we prefer - it makes the cable too long and unwieldy for mobile and console use.

The large microphone justifies its heft, however, with by far and away the best audio quality on test. The massive 10-24,000Hz frequency response provides depth and clarity that far surpasses the more compressed, boxy-sounding microphones on most rival headsets.

The headphones similarly deliver masses of detail, again with their wide frequency range being a key indicator of their prowess. The only caveat is that you're still subject to a 'gamer' sound profile with a fairly pronounced bass and treble boost. It doesn't muddy the sound as much as some other headsets, but you can clearly hear the way low-end rumble is amped up.

Conclusion

We looked at the Epos | Sennheiser GSP 300 previously back in Issue 194 and were impressed by it. Now that it's widely available for £10 cheaper than it was back then, we're even more wowed by this headset. It may not look too stylish, and it doesn't lend itself at all well to playing double duty as a set of headphones for taking out and about, but it's superly comfortable, easy to use, sounds great and it's keenly priced too.

VERDICT

Neither versatile nor stylish, but this is a very accomplished gaming headset for the price.

COMFORT 18/20	FEATURES 12/20
SOUND QUALITY 37/40	VALUE 18/20

OVERALL SCORE 85%

HYPERX CLOUD ALPHA / £80 inc VAT

SUPPLIER currys.co.uk

Sporting a very simple design and feature set, HyperX's Cloud Alpha is a headset that does away with the frills and instead concentrates on delivering where it counts: comfort and sound quality. It's a laudable approach and it's one that HyperX achieves with confidence.

What immediately strikes you when you remove the Cloud Alpha from its box is the compactness of the whole headset. The headband pulls the earcups closed onto each other, and the headband adjustment allows the earcups to move inwards a long way, making for a headset with a footprint of just 200 x 140mm.

What's more, the way the headband adjustment works means it's easy to just pull the headset down onto your head, and it will automatically adjust to the length you need. In contrast, most other headsets we've tested require you to either remove the headset in order to adjust the headband, or to awkwardly try to change it while in situ. All told, this ease of compact stowage makes the Cloud Alpha one of the more practical portable headset options, especially as the bendable microphone and main cable are both removable.

Comfort levels are decent too. The earcups have a lot of very plush padding, and the headband is well cushioned too. My ears did just touch the inside of the earcups at the back edge, though, suggesting HyperX could have done with angling the driver housing outwards towards the back, as Epos | Sennheiser has done with its GSP 300, for instance.

For on-headset features, you only get the sockets for the removable microphone and cable. Instead, volume control is provided by an in-line control on the main cable, which also houses a microphone and mute switch. This is perhaps this headset's biggest failing, as the volume control is fiddly to find and adjust (it's almost impossible to tell be feel alone which way to turn the two-sided dial) – by comparison, on-headset controls are generally far easier to use.

On the plus side, that main cable is a hefty braided affair, the first 1.3m length of which is terminated in a combined 4-pole microphone and headphone jack that's ideal for both mobile and console use. A lengthy 2m extension cable is also provided for splitting up the signal into separate microphone and headphone jacks, which is generally more convenient for PC use.

It's when it comes to sound quality, though, where the Cloud Alpha really impresses. There's masses of detail and clarity, making for a clear step up over most of the other headsets on test, bar the Epos | Sennheiser GSP 300. What you don't get here, though, is a large bass presence. It's certainly there, but it's not forced onto you as it is on other headsets, making for more of a muted presentation. The microphone here is a cut above the competition too, although again, it can't quite compete with that of the GSP 300.

ALFA ROMEO

- + Class-leading audio clarity
- + Compact design
- + Comfortable and easy-to-adjust fit
- + Detachable cable

ALF STEWART

- – Rather dull design
- – Modest bass response
- – Ears can touch inside of earcups

SPEC

Connections 3.5mm stereo

Audio config Stereo

Frequency range 13–27,000Hz

Sensitivity/sound pressure 98dB

Mic frequency response 50–18,000Hz

Mic sensitivity -43dBV/Pa

Weight 312g

Extras Detachable mic, detachable headset cable (1.3m + 2m extension)

Conclusion

The HyperX Cloud Alpha is an excellent no-frills headset that combines a compact practical design with decent comfort levels and top-notch sound quality. Its styling is a little dull and it lacks a huge bass kick, but it's right up there with the best in terms of detail and clarity. While the Epos | Sennheiser GSP 300 offers better value, it's worth spending the extra money on the HyperX if you prioritise portability, and want a detachable microphone and headphone cable.

VERDICT

Premium stereo sound quality and decent comfort make the Cloud Alpha a top-choice headset.

COMFORT	FEATURES	OVERALL SCORE
16/20	15/20	81%
SOUND QUALITY	VALUE	
36/40	14/20	

ROCCAT ELO X STEREO / £40 inc VAT

SUPPLIER argos.co.uk

Costing just £40 inc VAT, the Elo X Stereo has an astonishingly low price for a gaming headset, whichever way you look at it, but it's particularly impressive for a well-known brand such as Roccat. As you'd expect for such a modest price, there's plenty of compromises here, but when it comes to the important areas, there's a lot to like about this headset.

Styling is simple, with an all-black finish and painted-on grey logos on the earcups. There isn't the sleekness of the likes of the Corsair HS50 Pro or SteelSeries Arctis 3, but there are no garish touches to the design either.

Build quality is solid enough too, although we're a little concerned by the wires that connect each earcup to the headband. Twist the earcups so that they sit flat (as they're prone to do when you pick up the headset), and the wire almost pulls taught, potentially making for a point of failure where the cable joins to the earcup.

The headset uses the same style of headband as the Asus TUF Gaming H7, with a flexible, padded and elasticated inner headband suspended below a rigid, sprung steel outer band. It makes for a good distribution of weight on the top of your head but, like the Asus, it doesn't feel as secure as more traditional headband designs. The outer metal band also rings when knocked, although there's a little more natural damping on the Roccat than the Asus, so it doesn't ring as loud or as long.

The excellent earcups also help with that slightly looser fit. They fit much more snugly around your ears than the ones on the Asus, providing a firmer grip that takes some of the middling 304g weight of the headset off the headband and helps to prevent the headset from slipping. The padding is also very obviously contoured so that it tucks into place tight under your ear. Comparatively, many headsets with flat earcup padding can leave a bit of a gap in this location.

In terms of features, you get an on-headset volume control and microphone mute button, which might be small, but they're also easy to reach, while not being too easy to knock. The microphone is removable and bendable, and offers adequate but unremarkable audio quality. The main cable, though, is fixed, so a busted cable will mean a busted headset. Its 1.65m unbraided length terminates in a combi-jack that could be used for a mobile phone or console, and there's also a 1m splitter extension cable for separating the microphone and headphone signals.

The Elo X Stereo certainly isn't a festival of features, but along with its comfortable, relatively lightweight design, it also delivers that most important aspect when it comes to headsets – good sound quality. This headset can't compete with the likes of the HyperX Cloud Alpha and Sennheiser GSP 300 for clarity, but it's largely the equal of the other headsets on test, despite its low price. There's a stronger bass boost than on some headsets, but it's not overdone to the point of ruining the overall sound.

Conclusion

The Roccat Elo X Stereo makes for a really compelling gaming headset for the money. It's comfortable to wear, has all the essential features you'll need and offers a sound that, although a little bass heavy, is basically fine and certainly clear enough for gaming. For just £40 inc VAT, it offers great value, making it our top choice if you want to buy a truly low-cost gaming headset.

ROCKET LAUNCH

+ Comfortable lightweight design
+ Easy-going sound
+ Fantastic value

RAPID UNSCHEDULED DISASSEMBLY

– Tethered cable
– Dull design
– Few features

SPEC

Connections 3.5mm stereo

Audio config Stereo

Frequency range 20-20,000Hz

Sensitivity/sound pressure Not stated

Mic frequency response Not stated

Mic sensitivity Not stated

Weight 304g

Extras Removable mic

VERDICT

Simple but highly effective, this budget headset delivers where it counts. If you're on a limited budget, this is the headset to buy.

COMFORT 16/20	FEATURES 13/20
SOUND QUALITY 32/40	VALUE 20/20

OVERALL SCORE 81%

STEELSERIES ARCTIS 3 / £90 inc VAT

SUPPLIER steelseries.com

SteelSeries' Arctis line of headsets has, on the surface, remained largely unchanged for years now. Since their inception, they've sported the same compact, stylish, design that's more reminiscent of Beats by Dre headphones than the more angular styling of many other gaming headsets.

Although seemingly unchanged, though, there have been steady updates, with the most recent models arriving last year. The whole line-up received a tweak to its styling, a new sound profile with a stronger bass response and some more contoured, deeper padding on the earcups.

The Arctis 3 is the second cheapest product in the range, with the even cheaper Arctis 1 having a slightly different physical design to the rest of the range.

However, while the Arctis 3 is modestly priced for a SteelSeries headset, it's still the second most expensive headset on test this month – thankfully, it also has a handful of features that set it apart from the competition. The most obvious one is the nifty retractable microphone – you just pull it out to deploy the microphone and push it back to put it away. This is another feature that was updated last year, with the length and bendability of the microphone increasing slightly, so it's easier to position optimally than on the previous Arctis 3 models.

The main cable is also detachable and, like many of the other headsets on test, comes in two parts. The first length terminates in a 4-pole jack for microphone and headphone connection, and the second length splits the connections into two 3-pole jack plugs.

Just in front of where the main cable connects via its proprietary connection (a slightly annoying inclusion, but SteelSeries does sell spare cables and the same connection is used for digital versions of the headset) is a conventional 3.5mm jack socket. This lets you share your audio with a friend, as long as they have a set of headphones.

Joining the slightly higher-end feature set is a design and build that puts most competitors to shame. Although the company has dropped most of the outlandish colours from the Arctis line, both the black and white versions of the Arctis 3 look great. There's a confidence and purity to the overall shape, and the matt-finish plastics used in its construction feel lovely in your hand. Even the subtle patterns on the inner headband and earcup padding add to the whole experience.

Speaking of the headband, here you get a rigid plastic outer band and a floppy elasticated inner band. However, unlike the Asus TUF Gaming H7 and Roccat Elo X Stereo, the inner band is adjustable – you just tear open the Velcro that holds it in place and loosen or tighten the headband.

Despite this adjustability, this isn't the most secure feeling headset though. It sits a little loose on your head, although it remains comfortable, even if we found the various pleather earcup covers of the other headsets felt more pleasant than the slightly coarse fabric used by SteelSeries.

A complaint about the original Arctis line was its slightly weak bass response from its headphones, but that has been fixed with the latest iteration. You get a full-sounding headset that still doesn't sound too forced or boomy. There's not quite the detail of the GSP 300 or Cloud Alpha but it's up there with the best. The microphone is adequate if unexceptional too.

Conclusion

The Arctis 3 is a premium headset. It's stylish, well made, sounds great and has plenty of useful extra features. The downside is a higher price than other basic stereo headsets, but the extra flourishes you get justify the extra outlay if you can afford it. CPC

ARCTIC FOX

+ Loads of features
+ Stylish design
+ Great sound quality

ARCTIC BLAST

– Pricey
– Slightly loose fit

SPEC

Connections 3.5mm stereo

Audio config Stereo

Frequency range 20-22,000Hz

Sensitivity/sound pressure 98dB

Mic frequency response 100-10,000Hz

Mic sensitivity -48dB

Weight 304g

Extras Retractable mic, audio share socket, detachable cable

VERDICT

Pricey, but worth it for those seeking a headset with a little extra flair.

COMFORT	FEATURES	OVERALL SCORE
16/20	18/20	80%
SOUND QUALITY	VALUE	
34/40	12/20	

How we test

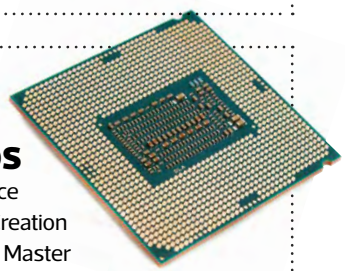
MOTHERBOARDS

TEST PROCESSORS

- **Intel LGA1200** Intel Core i9-10900K
- **Intel LGA2066** Intel Core i9-7900X
- **AMD AM4** AMD Ryzen 9 3900X
- **AMD TRX4** AMD Threadripper 3970X

Our test gear comprises a GeForce RTX 2070 Super Founders Edition and a 2TB Samsung 970 Pro SSD (or a PCI-E 4 1TB Corsair MP600 SSD on X570 and TRX40 boards). We also use Corsair Vengeance RGB 3466MHz DDR4 RAM – a 16GB dual-channel kit for mainstream systems, and a 32GB quad-channel kit for HEDT systems. All CPUs are cooled by a Corsair Hydro-X water-cooling loop, with two XR5 240mm radiators, an XD3 RGB reservoir and an XC7 RGB waterblock.

We test with our RealBench suite and Far Cry New Dawn on Windows 10 Home 64-bit. We also test the board's M.2 ports, and record the noise level and dynamic range of integrated audio using RightMark Audio Analyzer. Where possible, CPUs are overclocked and benchmarked again.



PROCESSORS

TEST MOTHERBOARDS

- **Intel LGA1200** MSI MEG Z490 Ace
- **Intel LGA2066** MSI MEG X299 Creation
- **AMD AM4** Gigabyte X570 Aorus Master
- **AMD AM4 (APU)** MSI X470 Gaming Pro Carbon
- **AMD TRX4** Asus ROG Zenith II Extreme

Our CPU test setup comprises a GeForce RTX 2070 Super Founders Edition (or an APU's integrated GPU), a 2TB Samsung 970 Pro SSD, and Corsair Vengeance RGB 3466MHz DDR4 memory – a 16GB dual-channel kit for mainstream systems, and a 32GB quad-channel kit for HEDT systems. A Corsair Hydro-X water-cooling loop, with two XR5 240mm radiators, an XD3 RGB reservoir and an XC7 RGB waterblock is also used.

We use Windows 10 Home 64-bit, and test with our RealBench suite, as well as Cinebench for 3D rendering and Adobe Premiere Pro for video export times. Far Cry New Dawn and Metro Exodus test gaming performance. Finally, we record the total power draw of the test PC. We run all tests at stock speed and at the highest stable overclocked frequency.

MONITORS

We test image quality with an X-Rite iDisplay Pro colorimeter and DisplayCal software to check for colour accuracy, contrast and gamma, while assessing more subjective details such as pixel density and viewing angles by eye. For gaming, we test a monitor's responsiveness subjectively and then also use Blur Buster's excellent ghosting UFO test to check the sharpness of the display in high-speed motion.

CPU COOLERS

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

TEST KIT
Fractal Design Meshify C case, 16GB of Corsair Vengeance RGB Pro memory, 256GB Samsung 960 Evo SSD, Corsair CM550 PSU, Windows 10 64-bit.

INTEL LGA1200
Intel Core i9-10900K CPU overclocked to 4.9GHz with 1.2V vcore, MSI MEG Z490 Tomahawk.

AMD AM4
AMD Ryzen 9 5900X overclocked to 4.5GHz with 1.25V vcore, MSI MEG X570 Unify motherboard.

INTEL LGA2066
Intel Core i9-7900X overclocked to 4.2GHz with 1.15V vcore, MSI X299M Gaming Pro Carbon AC motherboard.

AMD TRX4
AMD Threadripper 3960X overclocked to 4.2GHz with 1.265V vcore, 32GB of 3466MHz Corsair Vengeance RGB memory, Samsung 960 Pro SSD, Corsair RM850i PSU, ASRock TRX40 Taichi motherboard.

GRAPHICS CARDS

We mainly evaluate graphics cards on the performance they offer for the price. However, we also consider the efficacy and noise of the cooler, as well as the GPU's support for new gaming features, such as ray tracing.

Every graphics card is tested in the same PC, so the results are directly comparable. Each test is run three times, and we report the average of those results.

We test graphics cards at 1,920 x 1,080, 2,560 x 1,440 and 3,840 x 2,160, although we omit the latter resolution on cheaper cards that can't produce playable frame rates at this setting.

TEST KIT

Intel Core i7-8700K overclocked to 4.7GHz on all cores, 16GB Corsair Vengeance LED 3000MHz DDR4 memory, Gigabyte Z370 Aorus motherboard, Cooler Master MasterLiquid 240 CPU cooler, Corsair HX750 PSU, Cooler Master MasterCase H500M case, Windows 10 Home 64-bit.

GAME TESTS

Metro Exodus Tested at Ultra settings with Ultra ray tracing, but with Advanced PhysX and HairWorks disabled. We run the game's built-in benchmark, and report the 99th percentile and average frame rates.

Battlefield V Tested in DirectX 12 at Ultra settings on every card. If a GPU also supports real-time ray tracing, we then test it with DXR enabled on High settings with TAA, and also with DLSS if it's supported. We run through a one-minute custom benchmark in the 'Under No Flag' War Story, recording the 99th percentile and average frame rates with FrameView.

Shadow of the Tomb Raider Tested at the Highest settings preset with High ray-traced shadows enabled. We test with TAA, and also with DLSS if it's supported. We run the built-in benchmark and record the 99th percentile and average frame rates with OCAT.

Doom Eternal Tested at Ultra Nightmare settings, with resolution scaling disabled. We run a custom benchmark in the opening level of the campaign, and record the 99th percentile and average frame rates with FrameView.

POWER CONSUMPTION

We run Metro Exodus at Ultra settings with Ultra ray tracing at 2,560 x 1,440. We measure the power consumption of our whole graphics test rig at the mains during the test, and record the peak power draw. This result is for the whole system, not the graphics card alone.

CUSTOM PC AWARDS

EXTREME ULTRA
Some products are gloriously over the top. They don't always offer amazing value, but they're outstanding if you have money to spend.

PREMIUM GRADE
Premium Grade products are utterly desirable, offering a superb balance of performance and features without an over-the-top price.

PROFESSIONAL
These products might not be appropriate for a gaming rig, but they'll do an ace job at workstation tasks.

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

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

CUSTOM PC REALBENCH

Our own benchmark suite, co-developed with Asus, is designed to gauge a PC's performance in several key areas, using open source software.

GIMP IMAGE EDITING

We use GIMP to open and edit large images, heavily stressing one CPU core to gauge single-threaded performance. This test responds well to increases in CPU clock speed.

HANDBRAKE H.264 VIDEO ENCODING

Our heavily multi-threaded Handbrake H.264 video encoding test takes full advantage of many CPU cores, pushing them to 100 per cent load.

LUXMARK OPENCL

This LuxRender-based test shows a GPU's compute performance. As this is a niche area, the result from this test has just a quarter of the weighting of the other tests in the final system score.

HEAVY MULTI-TASKING

This test plays a full-screen 1080p video, while running a Handbrake H.264 video encode in the background.

Elite

Our choice of the best hardware available

Core component bundles

The fundamental specifications we recommend for various types of PC. Just add your preferred case and power supply, and double-check there's room in your case for your chosen components, especially the GPU cooler and graphics card. We've largely stopped reviewing power supplies, as the 80 Plus certification scheme has now effectively eliminated unstable PSUs. Instead, we've recommended the wattage and minimum 80 Plus certification you should consider for each component bundle. You can then choose whether you want a PSU with modular or captive cables.

Budget system with integrated graphics

Quad-core CPU, basic gaming

Needs a micro-ATX or ATX case.
We recommend a 350W 80 Plus power supply.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	AMD Ryzen 5 3400G	scan.co.uk	**#194** p20	£144
CPU COOLER	AMD Wraith air cooler included with CPU	N/A	**#194** p20	£0
GRAPHICS CARD	AMD Radeon RX Vega 11 integrated into CPU	N/A	**#194** p20	£0
MEMORY	16GB (2 x8 GB) Corsair Vengeance LPX Pro 3200MHz (CMK16GX4M2 Z3200C16)	scan.co.uk	**#204** p74	£70
MOTHERBOARD	Asus TUF B450M-Plus Gaming (micro-ATX)	awd-it.co.uk	**#204** p74	£79
STORAGE	500GB WD Blue SN550 (M.2 NVMe)	scan.co.uk	**#204** p24	£58
		Total £351		

Budget gaming system

Quad-core CPU, 1080p gaming

Needs a micro-ATX or ATX case. We recommend a 450W 80 Plus power supply. See Issue 204, p74 for an example build guide.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	AMD Ryzen 3 3300X	ebuyer.com	**#203** p28	£120
CPU COOLER	ARCTIC Freezer 7 X	scan.co.uk	**#202** p20	£18
GRAPHICS CARD	PowerColor Radeon RX 5600 XT	scan.co.uk	**#204** p74	£263
MEMORY	16GB (2 x8GB) Corsair Vengeance LPX Pro 3200MHz (CMK16GX4M2Z 3200C16)	scan.co.uk	**#204** p74	£70
MOTHERBOARD	Asus TUF B450M-Plus Gaming (micro-ATX)	awd-it.co.uk	**#204** p74	£79
STORAGE	500GB WD Blue SN550 (M.2 NVMe)	scan.co.uk	**#204** p24	£58
		Total £608		

UPGRADES				
SWAP GRAPHICS CARD	Nvidia GeForce RTX 3060 Ti	nvidia.com	**#210** p16	£369
SWAP STORAGE	1TB WD Blue SN550 (M.2 NVMe)	scan.co.uk	**#204** p24	£103

Entry-level RTX gaming system

6-core CPU, 2,560 x 1,440 gaming with real-time ray tracing

Needs an ATX case. We recommend a 550-600W 80Plus Bronze power supply (see p74 for an example build guide).

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	AMD Ryzen 5 5600X	scan.co.uk	**#209** p30	£299
CPU COOLER	Antec Neptune 240	scan.co.uk	**#204** p16	£80
GRAPHICS CARD	Nvidia GeForce RTX 3070 Founders Edition	nvidia.com	**#209** p22	£469
MEMORY	16GB (2 x 8GB) Corsair Vengeance RGB Pro 3600MHz (CMW16GX4M 2Z3600C20)	scan.co.uk	**#210** p74	£81
MOTHERBOARD	MSI MPG B550 Gaming Carbon WiFi (ATX)*	cclonline.com	**#210** p74	£160
STORAGE	1TB Gigabyte Aorus NVMe Gen4 M.2 SSD (M.2 NVMe)	ebuyer.com	**#220** p74	£140
	Total £1,229			
UPGRADES				
ADD SECONDARY STORAGE	Western Digital Blue 4TB	overclockers.co.uk	**#166** p54	£95

***This motherboard may require a BIOS update in order to recognise the new CPU.**

Mid-range gaming system

8-core CPU, 2,560 x 1,440 and some 4K gaming with real-time ray tracing

Needs an ATX case with room for a 240mm all-in-one liquid cooler. We recommend a 750W 80 Plus Bronze power supply.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	AMD Ryzen 7 5800X	overclockers.co.uk	**#208** p16	£450
CPU COOLER	Antec Neptune 240	scan.co.uk	**#204** p16	£80
GRAPHICS CARD	Nvidia GeForce RTX 3080 Founders Edition	nvidia.com	**#207** p16	£649
MEMORY	16GB (2 x 8GB) Corsair Vengeance RGB Pro 3600MHz (CMW16GX4M 2Z3600C20)	scan.co.uk	**#210** p74	£81
MOTHERBOARD	Asus ROG Strix X570-E Gaming (ATX)*	overclockers.co.uk	**#193** p44	£290
STORAGE	1TB Sabrent Rocket NVMe 4.0	amazon.co.uk	**#208** p51	£180
	Total £1,730			
UPGRADES				
SWAP CPU	AMD Ryzen 9 5900X (12 cores)	overclockers.co.uk	**#208** p18	£560
ADD SECONDARY STORAGE	Western Digital Blue 4TB	overclockers.co.uk	**#166** p54	£95
SWAP CPU COOLER	Corsair H100i RGB Platinum (240mm AIO liquid cooler)	scan.co.uk	**#185** p82	£125

***This motherboard may require a BIOS update in order to recognise the new CPU.**

Core component bundles cont ...

4K gaming system

12-core CPU, 4K gaming with real-time ray-tracing abilities

Needs an E-ATX case with room for a 240mm all-in-one liquid cooler. We recommend an 850W 80 Plus Gold power supply.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	AMD Ryzen 9 5900X	overclockers.co.uk	#208 p18	£560
CPU COOLER	Corsair H100i RGB Platinum (240mm AIO liquid cooler)	scan.co.uk	#175 p20	£125
GRAPHICS CARD	Nvidia GeForce RTX 3090	nvidia.com	#208 p24	£1,399
MEMORY	16GB (2 x 8GB) Corsair Vengeance RGB Pro 3600MHz (CMW16GX4M 2Z3600C20)	scan.co.uk	#210 p74	£81
MOTHERBOARD	MSI Prestige X570 Creation (E-ATX)*	overclockers.co.uk	#193 p48	£440
STORAGE	1TB Samsung 980 Pro	ebuyer.com	#208 p52	£182
	Total £2,787			
UPGRADES				
ADD SECONDARY STORAGE	4TB Western Digital Blue	overclockers.co.uk	#166 p54	£95
SWAP CPU	AMD Ryzen 9 5950X (16 cores)	overclockers.co.uk	#209 p31	£860

***This motherboard will require a BIOS update in order to recognise the new CPU.**

Heavy multi-threading workstation

Serious multi-threaded power, 1080p gaming

Needs an E-ATX case with room for a 280mm all-in-one liquid cooler. We recommend a 750W 80 Plus Gold power supply.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	AMD Threadripper 3960X	scan.co.uk	#197 p18	£1,250
CPU COOLER	NZXT Kraken X63 (280mm AIO liquid cooler)	scan.co.uk	#207 p47	£130
GRAPHICS CARD	Nvidia GeForce GTX 1660 Super	scan.co.uk	#199 p46	£230
MEMORY	32GB (4 x 8GB) Corsair Dominator Platinum RGB 3600MHz	scan.co.uk	#197 p20	£269
MOTHERBOARD	ASRock TRX40 Taichi (E-ATX)	overclockers.co.uk	#198 p44	£470
STORAGE	1TB Samsung 980 Pro	ebuyer.com	#208 p52	£182
	Total £2,531			
UPGRADES				
SWAP GRAPHICS CARD	Nvidia GeForce RTX 3070 Founders Edition (2,560 x 1,440 gaming with real-time ray tracing)	nvidia.com	#209 p22	£469
SWAP CPU	AMD Threadripper 3970X (32 cores - massive multi-threaded power)	scan.co.uk	#197 p19	£1,800
ADD SECONDARY STORAGE	4TB Western Digital Blue	cclonline.com	#166 p50	£95

Mini PCs

Our favourite components for building a micro-ATX or mini-ITX PC. Always double-check how much room is available in your chosen case before buying your components. Some mini-ITX cases don't have room for large all-in-one liquid coolers, for example, or tall heatsinks. You'll also need to check that there's room for your chosen graphics card. We've also recommended a small PSU and a low-profile CPU cooler, if your chosen case requires them.

Mini-ITX

Motherboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
Intel Z490 (LGA1200)	Asus ROG Strix Z490-I Gaming	scan.co.uk	**#206** p40	£280
AMD B550 (AM4 budget)	Asus ROG Strix B550-I Gaming	scan.co.uk	**#206** p44	£201
AMD X570 (AM4 mid-range)	Asus ROG Strix X570-I Gaming	overclockers.co.uk	**#198** p20	£290

Cases

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
ALL-PURPOSE	Cooler Master MasterBox NR200P	overclockers.co.uk	**#206** p18	£90
PREMIUM	NZXT H1	scan.co.uk	**#201** p24	£299

CPU coolers

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
LOW-PROFILE	Noctua NH-D9L	amazon.co.uk	**#143** p17	£45

ATX cases

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET	Phanteks Eclipse P300 Glass	overclockers.co.uk	**#176** p28	£55
BUDGET QUIET	be quiet! Pure Base 500	scan.co.uk	**#196** p24	£70
SUB-£100	be quiet! Pure Base 500DX	scan.co.uk	**#202** p39	£95
COMPACT	Fractal Design Define 7 Compact	overclockers.co.uk	**#203** p32	£100
MID-RANGE	Phanteks Eclipse P600S	overclockers.co.uk	**#202** p44	£128
SUB-£150	Fractal Design Define 7	overclockers.co.uk	**#204** p18	£140
PREMIUM	Phanteks Enthoo Evolv X	overclockers.co.uk	**#187** p24	£200

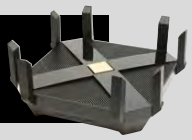
Micro-ATX

Motherboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
AMD X399 (TR4)	ASRock X399M Taichi	scan.co.uk	**#179** p28	£320
AMD B550 (AM4)	MSI MAG B550M Mortar	ebuyer.com	**#204** p42	£145

Cases

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET	Fractal Design Focus G Mini	scan.co.uk	**#180** p46	£40
MID-RANGE	Fractal Design Define Mini C	scan.co.uk	**#161** p26	£70



Networking

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
ROUTER (WI-FI 6)	TP-Link Archer AX6000	overclockers.co.uk	**#196** p57	£230
MESH ROUTER (WI-FI 6)	Asus AiMesh AX6100	amazon.co.uk	**#196** p54	£350
WI-FI ADAPTOR	TP-Link Archer TX3000E	overclockers.co.uk	**#196** p58	£60
SINGLE-BAY NAS BOX	Synology DS118	box.co.uk	**#174** p34	£155
DUAL-BAY NAS BOX	Synology DS220j	box.co.uk	**#200** p22	£152
DUAL-BAY MEDIA NAS BOX	Synology DS218play	box.co.uk	**#174** p34	£200

F – FREESYNC, G – G-SYNC, W – ULTRAWIDE

Monitors

Up to 25in

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
24IN, 144Hz, TN, 1,920 x 1,080, F, G	AOC G2590FX	scan.co.uk	#190 p53	£178
24IN, 144Hz, VA, 1,920 x 1,080, F	AOC C24G1	cclonline.com	#191 p28	£185
25IN, 240Hz, IPS, 1,920 X 1,080, F, G	Acer Predator XB253Q	currys.co.uk	#209 p57	£329

Over 28in

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
31.5IN, 60Hz, VA, 4K, F	iiyama ProLite XB3288UHSU	scan.co.uk	#205 p43	£350
34IN, 144Hz, IPS, 3,440 x 1,440, W, F	iiyama G-Master GB3461WQSU	cclonline.com	#206 p53	£334
34IN, 144Hz, IPS, 3,440 x 1,440, W, F, G	LG UltraGear 34GN850	overclockers.co.uk	#206 p55	£970
38IN, 144Hz, IPS, 3,840 X 1,600, W, F, G, HDR	LG UltraGear 38GN950	currys.co.uk	#208 p30	£1,500
35IN, 200Hz, VA, 3,440 x 1,440, W, G, HDR	Asus ROG Swift PG35VQ	scan.co.uk	#198 p58	£2,499
43IN, 120Hz, VA, 4K, F, G	Asus ROG Strix XG438Q	amazon.co.uk	#205 p39	£1,117

Up to 28in

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
27IN, 144Hz, IPS, 1,920 x 1,080, F, G	AOC 27G2U	overclockers.co.uk	#201 p53	£215
27IN, 240Hz, IPS, 1,920 X 1,080, F, G	Asus TUF Gaming VG279QM	scan.co.uk	#209 p60	£349
27IN, 240Hz, IPS, 1,920 X 1,080, F, G	Acer Nitro XV273	alza.co.uk	#204 p25	£378
27IN, 144Hz, IPS, 2,560 x 1,440, F, G	Asus TUF Gaming VG27AQ	overclockers.co.uk	#201 p54	£480
27IN, 165Hz, IPS, 2,560 x 1,440, F, G	Gigabyte Aorus FI27Q	overclockers.co.uk	#201 p55	£475
27IN, 240Hz, TN, 2,560 x 1,440, F, G	AOC AG273QZ	overclockers.co.uk	#202 p27	£470

Non-gaming

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
27IN, 75Hz, IPS, 2,560 X 1,440, F	LG 27QN880	ebuyer.com	#210 p26	£379

Peripherals and audio

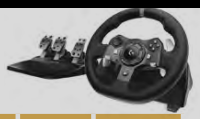
Gaming keyboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
MEMBRANE	Corsair K55 RGB	amazon.co.uk	#201 p45	£49
BUDGET TKL MECHANICAL	HyperX Alloy FPS Pro	amazon.co.uk	#201 p46	£80
MECHANICAL	Corsair K68 RGB	scan.co.uk	#181 p53	£90
OPTICAL ESPORTS	Asus ROG Strix Scope RX	overclockers.co.uk	#209 p43	£125
MECHANICAL MMO	Corsair K95 RGB Platinum	overclockers.co.uk	#164 p26	£150
PREMIUM MECHANICAL	Corsair K70 Mk.2 Low Profile	scan.co.uk	#193 p56	£150
PREMIUM TKL MECHANICAL	Asus ROG Strix Scope TKL Deluxe	scan.co.uk	#202 p24	£140
LUXURY MECHANICAL	Razer Hunstman Elite	box.co.uk	#193 p59	£185
LUXURY WIRELESS MECHANICAL	Razer BlackWidow V3 Pro	scan.co.uk	#208 p60	£230

Gaming mice

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET GAMING	Corsair M55 RGB Pro	amazon.co.uk	#200 p24	£35
FIRST-PERSON SHOOTER	SteelSeries Rival 600	box.co.uk	#184 p59	£65
MMO	Razer Naga Trinity	scan.co.uk	#186 p52	£70
WIRELESS	Corsair Dark Core RGB Pro	amazon.co.uk	#202 p25	£97
PREMIUM WIRELESS	Razer Deathadder V2 Pro	razer.com	#210 p28	£130
AMBIDEXTROUS	Razer Lancehead Tournament Edition	amazon.co.uk	#177 p53	£75
ULTRA LIGHTWEIGHT	Glorious PC Gaming Race Model O	overclockers.co.uk	#195 p58	£53

Peripherals and audio cont ...



Game controllers

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
RACING WHEEL	Logitech G29 Driving Force	currys.co.uk	**#202** p50	£250
PREMIUM RACING WHEEL	Fanatec CSL Elite PS4 Starter Kit	fanatec.com	**#202** p49	~£507
GAMEPAD	Microsoft Xbox One Wireless Controller	argos.co.uk	**#191** p56	£50
BUDGET FLIGHT STICK	Logitech Extreme 3D Pro Joystick	currys.co.uk	**#207** p52	£34
FLIGHT STICK	Thrustmaster T.1600M FCS HOTAS	thrustmaster.com	**#207** p56	£140

Gaming headsets

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET STEREO	Roccat Elo X Stereo	argos.co.uk	**#210** p56	£40
STEREO	Epos | Sennheiser GSP 300	eposaudio.com	**#210** p54	£60
WIRELESS	Corsair Virtuoso RGB Wireless	ebuyer.com	**#204** p50	£160

Speakers

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
STEREO	Edifier R1280DB	cpc.farnell.com	**#192** p57	£100

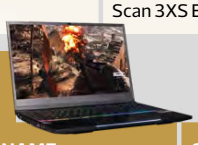
Non-gaming keyboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
WIRELESS MULTI-DEVICE	Logitech K780	currys.co.uk	**#203** p58	£80
WIRELESS TKL MECHANICAL	Keychron K2 Version 2	keyboardco.com	**#208** p57	£84
TKL MECHANICAL	Majestouch Convertible 2 Tenkeyless	keyboardco.com	**#203** p55	£140

PCs and laptops

Pre-built PC systems

CATEGORY	NAME	CPU	GPU	SUPPLIER	ISSUE	PRICE (inc VAT)
ENTRY-LEVEL RAY TRACING	Chillblast Fusion Commando 3060Ti	AMD Ryzen 7 5800X	Nvidia GeForce 3060 Ti	chillblast.com	**#210** p34	£1,500
8-CORE RTX 3080 GAMING	PC Specialist Obsidian I	Intel Core i7-10700KF	Nvidia GeForce RTX 3080	pcspecialist.co.uk	**#209** p40	£1,899
10-CORE RTX 3080 GAMING	CyberPower Infinity 910 RTX	Intel Core i9-10850K	Nvidia GeForce RTX 3080	cyberpowersystem.co.uk	**#208** p42	£2,285
PREMIUM MINI-ITX	Corsair One i160	Intel Core i9-9900K	Nvidia GeForce RTX 2080 Ti	corsair.com	**#190** p32	£3,250
WATER-COOLED 16-CORE GAMING	Scan 3XS Absorbere	AMD Ryzen 9 5950X	Nvidia GeForce RTX 3090	scan.co.uk	**#209** p46	£5,473
DREAM PC	Scan 3XS Barracuda	Intel Core i9-10980XE OC to 4.3GHz	Nvidia GeForce RTX 3090	scan.co.uk	**#145** p58	£13,818



Laptops

CATEGORY	NAME	CPU	GPU	SCREEN	SUPPLIER	ISSUE	PRICE (inc VAT)
THIN AND LIGHT GAMING	Asus ROG Zephyrus G14 GA401IV	AMD Ryzen 9 4900HS stock speed	Nvidia GeForce RTX 2060 Max-Q	14in 2,450 x 1,440 IPS 60Hz	overclockers.co.uk	**#202** p28	£1,800
GAMING	Chillblast Phantom 17	Intel Core i7-10875H stock speed	Nvidia GeForce RTX 2070	17.3in 1,920 x 1,080 IPS 144Hz	chillblast.com	**#197** p53	£1,660
HIGH-PERFORMANCE GAMING	Lenovo Legion 7i	Intel Core i7-10875H stock speed	Nvidia GeForce RTX 2080 Super Max-Q	15.6in 1,920 x 1,080 IPS 144Hz G-Sync	laptopsdirect.co.uk	**#208** p40	£2,050

RICK LANE / INVERSE LOOK

A SIMPLER LIFE

Rick Lane provides his tips to make your gaming life less frustrating and more entertaining this year

2020 was a challenging year, and it looks unlikely that 2021 is going to be much easier, at least for a while. As such, there's no reason to make your gaming life any more difficult than necessary. This might sound daft, but it's surprising how many arbitrary obstacles we put in front of ourselves in the name of entertainment. So for the start of a new year, I've put together a few tips to make your virtual life easier.

Firstly, play games on Easy mode. Unless the game is specifically about the challenge, such as Sekiro or Spelunky, there's no reason to make it any harder than necessary. What's the point in getting stuck on a boss in Assassin's Creed Valhalla when the game is mostly about exploration? With half of England to explore across 60-80 hours, why waste an hour bouncing off the same enemy over and over again?

Secondly, give yourself permission to not finish your games. When was the last time you were genuinely affected by a game ending? For me, it was probably Half-Life: Alyx, back in March. I haven't played a single game in nine months where the ending was significant.

Ultimately, games are about play. The true ending of a game isn't when the credits roll, but the moment you fully comprehend how those systems work. Beyond that, you're just repeating the same actions for the sake of reaching a climax you likely won't care about. Obviously, there are exceptions where the story is the main emphasis of the game, but choose your battles. Don't force yourself to continue a game that became work for you two hours ago.

> Whack up that screen brightness until you can comfortably see everything

Next, turn up your screen brightness! When you start most games, they'll direct you to adjust the screen brightness, usually so that a specified icon is 'barely visible'. This is supposedly the way the designers intend you to see the game. Whenever I do this, however, I find most games unplayably dark, and I give myself eyestrain squinting to see what's going on.

This is because it's largely nonsense. In a recent interview with Kotaku, former head of id Software Tim Willits said, 'It is really difficult to make a game that looks the way you want it to look for everyone. The biggest problem we have is that we love to work in the dark. In the old id days, we'd never turn the lights on.' Whack up that screen brightness until you can comfortably see everything in the game.

Finally, buy a gamepad. As PC gamers, we have an understandable affection for the keyboard and mouse, and many grand-strategy titles and first-person shooters are built specifically for this control scheme. But there are other games, such as racing games and platformers, that are designed specifically for a pad. Forcing yourself to play these with a keyboard and mouse is a recipe for frustration and hand-cramp.

Moreover, since most modern multiplayer games have a built-in aim-assistance system, playing with a keyboard and mouse in Fortnite, for example, can counter-intuitively put you at a disadvantage.

These little changes will make your gaming time less stressful and more fun. Because that, ultimately, is what games are supposed to provide. CPC

Rick Lane is Custom PC's games editor @Rick_Lane

Call of Duty: Black Ops – Cold War / £49.99 inc VAT

DEVELOPER Treyarch/Raven Software/Beenox/ **PUBLISHER** Activision

The awkwardly titled Black Ops – Cold War flings Call of Duty players back to the 1980s, where the Cold War is at its hottest time since the Cuban Missile Crisis. The single-player campaign opts for spy games as its dominant theme, revolving around a group of disavowed espionage agents working on the orders of Ronald Reagan to track down a mysterious terrorist known as Perseus.

The story is filled with twists and turns, double-crosses and fragile alliances. It has potential to be great, but there are too many characters, none of whom has much personality beyond 'Gung-ho American' and 'Posh Brit'. That said, the individual missions are surprisingly good. One sees you sneaking between checkpoints in East Berlin as you track a potential ally of Perseus, while another involves shooting your way through a gigantic Spetznatz training facility designed to look like a flatpack American town.

The highlight is a daring raid on the Kremlin itself. Played from multiple perspectives, the first half has a semi-open structure, more like a Hitman level than Call of Duty. The second half is more familiar, but it's still a well-choreographed heist. The campaign is short, and sometimes feels choppy, as if are pieces missing, but like a 1980s action movie, it succeeds as a disposable throwback.

Sadly, the multiplayer game doesn't benefit from the period setting. The commitment to contemporary technology holds back the shooting, as many weapon customisation options, such as advanced scopes and underbarrel attachments, aren't available. Weapons generally feel like a step backwards from Modern Warfare, feeling less weighty and powerful. Likewise, the maps are a marked step back from previous years, with Satellite in particular being one of the worst multiplayer maps in ages.

Treyarch does make a couple of notable additions, such as Wildcards that let you break the game's base ruleset, adding silly numbers of attachments to your gun, or carrying two primary weapons, but it isn't enough. Part of the problem is Cold War's multiplayer game fights in the shadow of Warzone, Call of Duty's massive, free-to-play Battle Royale mode that debuted earlier this year. The mix of traditional multiplayer modes, alongside a handful of new modes, such as VIP Escort, simply don't feel sufficient to justify dropping £50 when there's a huge, completely free Call of Duty multiplayer game available alongside it.

Call of Duty's structure has felt antiquated for a while, but now it's competing against itself, it desperately needs a reinvention to justify investing in it, rather that simply jumping into Warzone. Cold War isn't terrible, but aside from a mildly distracting campaign, there's little to get excited about.

RICK LANE

COMMANDO

+ Interesting campaign
+ Wildcards are a good multiplayer addition

COMANDON'T

– Campaign too short
– Multiplayer has little to recommend it over Warzone

/ VERDICT

Black Ops – Cold War has a few cool ideas, but it's ultimately frozen out by the bigger, better Warzone.

OVERALL SCORE

61%

Assassin's Creed Valhalla / £49.99 inc VAT

DEVELOPER Ubisoft / **PUBLISHER** Ubisoft

You'd be forgiven for thinking that little has changed about Assassin's Creed in Valhalla. The game has broadly the same structure as Ubisoft's previous open-world monsters, Origins and Odyssey, and actually removes some features seen in those games, most notably Odyssey's ship combat. It also has the worst introduction of the three, a multi-hour prologue set in Norway that, while breathtakingly pretty, keeps you at arm's length from the game's most interesting features and gives a false impression that Valhalla is a snowier retread of Ubisoft's prior work.

It isn't. Valhalla is comfortably the best game in the series to date, combining the earlier games' massive worlds with a story and characters you'll actually care about, along with a sense of progression that's far more rewarding than the hamster wheel-like experience of those earlier games.

Valhalla puts you in the role of Eivor, a Viking warrior who can be played either male or female. After his clan is massacred by a rival warchief, Eivor is adopted by a regional Norwegian ruler, and spends most of the game's intro seeking revenge for his murdered family. But when Eivor's adoptive father bends the knee to the self-proclaimed King of Norway, Eivor decides to flee his icy home, striking out with his brother Sigurd to the greener pastures of England.

While the introduction lays important groundwork, it's only when you arrive in England that Valhalla demonstrates its quality. One of the bigger problems with the more recent Assassin's Creed games was lending cohesion to your adventure. The worlds were a joy to explore, but the stories often felt fragmented and lacking in personality, while the characters you encountered were entertaining but ultimately disposable.

Valhalla attempts to redress this issue, and its solution is the Settlement. Shortly after arriving in England, Eivor and his clanmates establish Ravensthorpe, a village just south of modern-day Leicester. Starting out as a few tents surrounding a dilapidated longhouse, Ravensthorpe grows and evolves as you explore England, pillaging its wealth and getting involved in its politics.

The Settlement's most significant contribution is acting as a focal point for the story. Everything you do in Valhalla feeds back into Ravensthorpe and its gradually growing community. Building a new structure, for example, will often unlock a series of quests related to it. Meanwhile, completing missions further abroad will often result in non-player characters (NPCs) joining your settlement, who may form part of your longship crew or perform other important tasks around the village.

VALHALLA

+ Settlement is a triumph
+ Engaging, well told story
+ Much improved open-world design

HELHEIM

– Slow introduction
– Combat has a weak core
– Climactic moments can underwhelm

The Settlement's contribution to the story is most noticeable in the Alliance map, where Eivor and his companions plan their conquests of England's counties. Each county has its own unique story arc, which furthers Eivor's adventure and has choices that echo through the rest of the game. In Ledecestrescire, for example, Eivor must help an allied Viking clan to install a puppet king on the throne of Mercia, while in East Anglia, Eivor helps a reluctant Saxon Thegn named Oswald to find his mettle against a rogue group of Viking invaders.

Valhalla is as epic as any other Assassin's Creed title, but it never loses sight of the personal drama vital to telling a compelling story. Over the course of the campaign, you'll deal with betrayals within your clan, raids on your village, and navigating the increasingly frictional relationship with your brother Sigurd. The story isn't as well scribed as that of The Witcher 3 or Red Dead Redemption 2, but it does keep you consistently engaged throughout its considerable length, and that's no small achievement.

Valhalla's open world is much improved too. Loot is less abundant than in Odyssey, so acquiring new weapons and armour always feels like a reward, while maintaining your current equipment is as important as obtaining new toys. Meanwhile, the optional side-quests, known as Mysteries, are colourful and varied, including a wide range of environmental puzzles and quick-fire missions that range from quirky to downright bizarre.

There's little question that Valhalla is an extremely well-made game, but it doesn't completely escape its problems once its leaves Norway. One of the biggest issues is that the core combat simply isn't very good. The basic attacks with most weapons don't feel satisfying, while the newly introduced parry system (an import from Dark Souls and Sekiro), is inconsistent in terms of how enemies respond to being countered. Fortunately, the wide range of special skills and abilities, alongside some tremendously grisly finishing moves, compensate for the unsatisfying basic attacks.

In addition, while Valhalla improves the series with its subtle storytelling, the grander moments of its story are often undercut by poor design. Two of the game's more spectacular activities are raids and assaults. Raids can be performed on enemy camps and monasteries, seeing your longship crew charge the shore before killing guards and torching buildings as they help you plunder the resources you need to build Ravensthorpe. Assaults, meanwhile, typically occur at the end of a story arc, and involve besieging a fortified location, culminating in a boss fight.

Visually, these set pieces are stunning. The way monasteries turn from idyllic islands of peace into fiery hellscapes is particularly impressive. However, neither activity engages the player in a satisfying way from a play perspective. In both cases, it's largely possible to run past most enemies, making a beeline directly for the loot or the objective with no major obstacles put in your way.

It's unfortunate that Valhalla can't quite nail those climactic scenes, but it makes up for this shortfall with dozens of smaller moments that show a clear evolution in Ubisoft's approach to storytelling. Moments such as the weedy Thegn Oswald standing up to his massive Viking foe in a duel, or Eivor realising that he and his brother are not as close as he once thought, are genuinely affecting in a way we never expected from Assassin's Creed. Valhalla isn't just a massive and capably delivered open-world game, it's also a little bit special.

RICK LANE

/ VERDICT

Iterating upon previous games in (mostly) the best ways, Valhalla is the most complete and charismatic Assassin's Creed yet.

OVERALL SCORE

90%

EMPIRE OF SIN / £34.99 inc VAT

DEVELOPER Romero Games / **PUBLISHER** Paradox Interactive

AL CAPONE

+ Great concept
+ Neat RPG systems

AL FRESCO

– Bugs
– Confusing UI
– Contradictory design issues

Empire of Sin has a tantalising premise. Set in 1930s Chicago, it sees you select one of 14 different crime bosses and attempt to dominate the city's illegal alcohol trade through a combination of economy management, diplomacy and bloody combat.

The core of Empire of Sin revolves around acquiring and managing property in Chicago. Whether through funds or by force, you take control of buildings in the city's various districts, converting them into illicit speakeasies, brothels and casinos. By supplying these places with alcohol from your breweries, you generate income. The better you cater to clientele's changing tastes, the more profits you receive.

Empire of Sin may present as a strategy game, but its surprisingly involved role-playing element is more successful. Unlike most management games, your mob boss is physically present in Empire's game world. Moreover, you can explore and interact with the game world as you would an isometric RPG, taking on missions that further your character's story, and levelling up to unlock specific abilities.

This adds a level of personal investment that other management games lack, but Empire goes further still. Alongside your mob boss, you can recruit up to ten henchmen from a general pool of nascent gangsters. Each of them has their own unique backstory with accompanying missions. They fight with you and can even be promoted to control parts of your Empire, but they can also die in combat and become afflicted by ailments, such as alcohol dependency and PTSD.

As an experiment in emergent storytelling, Empire of Sin is fascinating. Unfortunately, it doesn't come together. To start, the game suffers from a wide array of bugs, ranging from small annoyances, such as animations not playing, to serious issues, such as henchmen disappearing entirely from the game.

Also, while the UI looks slick, it's confusing and hard to navigate, with crucial functions, such as changing your brewery's alcohol production, simply not explained. Meanwhile, the turn-based combat is decent, but there's far too much of it. Starting a war with another faction triggers countless tiny skirmishes, all of which need to be managed and take too long to resolve.

Perhaps the biggest problem, however, is that most of the game's management systems can be circumvented by walking into a rival boss safehouse and killing them outright. This immediately gives you control of their entire empire, without having to go to war or make any preparations beyond recruiting enough henchmen. You dominate Chicago simply by knocking off rival bosses with no consequences.

It's a real shame, because Empire of Sin is clearly a labour of love. Beyond its flaws, you can see an intoxicating and flavourful game, but this doesn't change the fact that, ultimately, Empire of Sin needed another year in the still.

RICK LANE

/ VERDICT

Empire of Sin's excellent gangster role playing is undermined by technical issues and iffy management systems.

OVERALL SCORE

50%

WATCH DOGS: LEGION / £49.99 inc VAT

DEVELOPER Ubisoft Toronto / **PUBLISHER** Ubisoft

Watch Dogs: Legion's is set in a post-Brexit London controlled by a private company named Albion, and this third game in Ubisoft's open-world hacking series lets players recruit and then assume control of virtually any non-player character (NPC) in the entire game.

Every NPC in London has a simulated life, with a job, routine and set of character traits semi-randomly assigned from a larger pool. You can walk up to any NPC and press 'E' to start a recruiting mission, where they'll ask you for help with a problem that usually involves infiltrating an area and hacking a device of some sort. Once completed, the NPC will join your hacking team DecSec, whereupon you can play as them.

You can recruit any NPC in the game, but some are better candidates than others. Most NPCs only have a couple of 'traits', such as access to a car or a unique weapon, but some have more established roles with far more useful abilities. Lawyers, for example, can spring your teammates from prison if they get arrested, while construction workers can walk onto construction sites undetected, alongside having access to a Cargo drone that can be used to hop over fences and access rooftops.

Through this system, the game encourages you to create your own solutions to mission objectives. If you need to infiltrate a hospital, you could sneak in with your expert hacker, or you could recruit a doctor and walk through the front gate with minimal interference. This dynamism in both choosing and approaching your missions is a huge amount of fun. Some of the NPCs you can recruit are truly ridiculous, from James Bond-style spies (complete with rocket-firing car) to Beekeepers, who can direct their swarms to attack enemies.

Legion is generally well presented. Despite its dystopian overlords, London looks extremely pretty, while the game boasts a surprisingly light and breezy tone despite the subject matter. One of its most impressive feats is how it seamlessly tells its story despite your chosen character. Whether you're a Romanian hitman or a Nigerian getaway driver, the game has unique scripting and voice acting for every cutscene and dialogue sequence.

Unfortunately, the Legion part of the game is dragged down by the Watch Dogs bit. Whoever you play, they all have access to Watch Dogs' core hacking mechanics, able to hack into cameras and remotely pilot drones. These tools are among the most powerful ones in the game. Despite all the fantastic work put into creating Legion's NPCs, the most useful character in the game is a remotely controlled spider drone that anyone can access.

Add in the fact that the story doesn't have much to say, and a final third that's sloppily executed, and Legion's brilliant mechanical wizardry isn't quite as magical as it deserves.

RICK LANE

LEGION

- \+ 'Play as anyone' concept works
- \+ Creative mission system
- \+ Generally good fun

LESION

- – Core mechanics undermine the Legion system
- – Story is breezy but superfluous
- – Weak final act

/ VERDICT

Legion's key gimmick is a triumph, but it deserves a game that better supports it.

OVERALL SCORE

70%

REALITY CHECK

Flight combat, sit-down 'walking' shoes and stories from the Star Wars universe. It's **Rick Lane's** monthly VR roundup

REVIEW

STAR WARS: TALES FROM THE GALAXY'S EDGE / £19.89 inc VAT

DEVELOPER ILMxLAB / **PUBLISHER** Oculus

Having previously brought us the Vader Immortal trilogy, Disney's ILMxLAB has encased another slice of VR Star Wars action in carbonite and shipped it our way. Assuming the role of a droid technician, Galaxy's Edge starts with the player's ship being attacked by space pirates in orbit above the planet Batuu. Forced to flee the ship as the pirates raid your cargo hold, you end up stranded in Batuu's Black Spire Outpost, a virtual recreation of the Disney World theme park experience of the same name.

Despite its origins, Galaxy's Edge isn't a glorified theme park ride. In fact, it's a full-on first-person shooter. The main campaign sees you exploring the Black Spire Outpost and its more rural outskirts, encountering Star Wars characters old and new, such as C-3PO and R2D2, and getting into fights with various enemies.

Compared with, say, Doom Eternal, the gunplay is relatively basic, but it makes up for this with its bespoke VR design. For example, weapons are battery-powered and must be recharged by pulling on a slider on the gun, rather than reloading them with magazines or power cells, which can be difficult in the middle of a VR gunfight. You can also throw thermal detonators, and gain access to a surprisingly nuanced multi-tool used for solving puzzles and opening weapon lockers.

It's a thoroughly enjoyable slice of Star Wars fiction, and it looks incredible even on the Quest's limited hardware. There's a truly impressive amount of detail on display, no doubt due to it being based on a 'real' world location. However, it's also extremely short, clocking in at around three hours.

This is where the 'Tales' bit of Galaxy's Edge kicks in. In Black Spire Outpost you'll find a bar run by an alien called Seezelslak. This six-eyed bartender will pour you a drink and then spin you a playable yarn from the Star Wars universe. Galaxy's Edge's first tale is set hundreds of years before the original trilogy, focusing on a Jedi apprentice being trained by Yoda.

Named Temple of Darkness, this tale imports all the mechanics from Vader Immortal, including the ability to wield a lightsaber. It's an entertaining distraction, but it's also extremely short at only half an hour long. As for the rest of the tales, you'll have to wait until they're released, then pay for them as DLC if you want to experience them.

Even for its sub-£20 price, 3.5 hours of play isn't a lot, and being forced to pay extra to 'complete' the experience feels like Disney quite literally taking the Mickey. Such nickel-and-diming for VR gaming might have been acceptable two years ago, when 'proper' VR games were still relatively scarce, but now there are many full-on experiences in VR, such as Half-Life Alyx, Asgard's Wrath and, of course, Star Wars: Squadrons.

Tales from the Galaxy's Edge might have a good core experience, but forcing VR players to pay a premium over and above what they've already paid for is the kind of deal Darth Vader would make.

CORE WORLDS

+ Superb production values
+ Proper Star Wars gaming

OUTER RIM

- Very short
- Paid DLC plan is unfair

VERDICT

Technically and mechanically, Galaxy's Edge is the best ILMxLAB game yet, but the DLC plan stinks like a Tonton's innards.

OVERALL SCORE

60%

NEWS

PROJECT WINGMAN

Between Elite Dangerous, No Man's Sky and Star Wars: Squadrons, we've had our fair share of VR-supported space combat games. Terrestrial flight, however, is still waiting for its VR wings. While Microsoft Flight Simulator will have launched its VR mode by the time you read this magazine, action-orientated players may want to check out Project Wingman.

This combat flight simulator is in the vein of the venerable Ace Combat series. It puts you in the role of a fighter-jet pilot embarking on daring missions ranging from aerial dogfights to large-scale ground assaults.

The game includes 20 different aircraft and 40 unique weapons, including experimental weaponry such as railguns. It also has a 21-mission campaign that sees you fighting in locales such as the Bering Straits and Yellowstone Park. Perhaps its most interesting feature is its Conquest Mode, a dynamic game mode taking inspiration from strategy games and RPGs. Here you need to capture territory by fighting battles and earn money to purchase new jets and equipment.

Like Star Wars: Squadrons, Wingman is a VR-supporting game rather than a VR exclusive one. It also only supports the headset itself, so you'll need either a flight stick or mouse and keyboard for the controls. The developers are considering adding support for touch controllers, if there's enough demand from the player-base.

Expect a review of Project Wingman in this section soon.

NEWS

CYBERSHOES

Just as photo-realism has long been the Holy Grail of graphics development, total immersion is the ultimate objective of VR games. From a physical perspective, current VR games are only two-thirds immersive. They account for your head and your hands through head-tracking and touch-controllers, but your legs and feet are always stuck in boring old reality.

There are solutions to this, but they're often ridiculous and expensive. Either you need to purchase a specialised treadmill so you can walk around in VR without running into walls, or you need a house large enough that you can dedicate a room entirely to VR gaming. Both are simply unfeasible for most people.

Cybershoes is the first reasonably priced foot-based peripheral we've encountered. Developed by a Viennese start-up, Cybershoes are sandal-like devices that strap to your feet with wheels in the bottom, with which you then slide on a low-friction mat to simulate walking. Unlike most foot peripherals, Cybershoes are used sitting down. This might sound odd, but it means less physical exertion and may even help to combat VR motion sickness. Cybershoes are also much more compact than a standard VR treadmill, as the mat can simply be folded away once you're finished.

Cybershoes recently launched a successful Kickstarter to develop a Quest-compatible version of its product, which has doubled its funding goal. Once produced, the shoes will be available for around $280 US, which is considerably cheaper than the circa-$700 for a full-sized locomotion treadmill. The big questions are whether they'll be robust enough for sustained use, and responsive enough for seamless movement. CPC

BUILD A KILLER GAMING PC FOR £1,396

ANTONY LEATHER SHOWS YOU HOW TO BUILD A FANTASTIC GAMING PC BASED ON THE LATEST AMD AND NVIDIA TECH FOR UNDER £1,400

It's both the best time to buy a PC, and one of the trickiest. AMD has brought out some fantastic new CPUs that yield tangible performance gains over previous generations of both Intel and AMD's chips, and its motherboards also offer PCI-E 4 support for speedy SSDs.

AMD and Nvidia haven't been idle when it comes to graphics cards over the past few months either. Nvidia has arguably stolen the show with its new RTX 3000-series GPUs, which offer massive gains over their predecessors across the board. Even the sub-£400 RTX 3060 Ti (see p16) can handle games at 2,560 x 1,440 with ray tracing enabled.

There's just one problem, which is that at the time we're writing this in December 2020, it's hard to find any of this gear on sale at the moment. We hope that as we move into 2021, and the pandemic loosens its grip, it won't be too long after you read this that you'll be able to buy them.

However, the hardware in this feature still represents what we expect to remain our favourite hardware top picks well into 2021, and we strongly advise against paying high prices to eBay scalpers, or paying current prices for Turing GPUs.

The PC we've assembled this month is perfect for a variety tasks. If you want high frame rates at 1080p for your shiny new high-refresh rate monitor, or want to use ray tracing and DLSS to game at higher resolutions in the latest high-profile titles, the RTX 3070 is much cheaper than the RTX 3080, and still manages smooth frame rates in lots of games at 2,560 x 1,440.

We've also picked AMD's Ryzen 5 5600X, which had the measure of both the Core i5-10600K and even the Core i9-10900K in games, and is much faster than the former in content creation if you stray occasionally into editing videos and photos, or 3D rendering.

Ultimately, if someone handed us £1,400 and we had to build a PC for ourselves, this is the system we'd choose. However, we appreciate that not everyone has this budget, and some may even be lucky enough to have a bit more to spend.

As such, we've also included other options for each piece of hardware that cost a little more or less, so you can tailor our picks to your own needs and budget. There are also plenty of tips and mini-guides in this feature that will benefit anyone planning to build a new Ryzen 5000-series PC.

TOP HARDWARE PICKS

CPU

AMD Ryzen 5 5600X

£299 inc VAT

scan.co.uk

The impact AMD's the Zen 3 architecture on performance was even bigger than with the move to Zen+ or Zen 2. Higher frequencies and lower latencies, thanks to a mature 7nm manufacturing process, plus a redesigned pipeline and a unified 8-core complex design, meant AMD didn't just match Intel in games, but blew straight past it in most titles.

Already dominant in terms of bang per buck in content creation, Zen 3 helped CPUs such as the Ryzen 5 5600X to become the perfect all-rounders. While the likes of the Ryzen 9 5900X and Ryzen 9 5950X are undoubtedly monstrously powerful, they don't offer much extra grunt for games.

In fact, the Ryzen 5 5600X mostly matched them in our game tests last month, so there's little point opting for more cores if gaming is your top priority. There are no cheaper Zen 3 CPUs just yet, and £300 is still quite a lot to pay, but it's rare that a CPU upgrade will have such an impact in performance across the board, so it's totally worth it.

Alternatives

We absolutely loved AMD's Ryzen 5 3600XT, simply because it's an overclocking champ and offered a compelling alternative to Intel's Core i5-10600K. If you can't stretch to £300 for the Ryzen 5 5600X, then the Ryzen 5 3600XT costs £70 less and is still a decent CPU. Intel's Core i5-10600K is also worth considering, since it costs £50 less and is still a good gaming CPU, plus Intel's LGA1200 socket will see at least one new generation of CPUs; the company claims this will offer sizeable performance boosts.

If you need more multi-threaded performance than the six cores and 12 threads of the Ryzen 5 5600X provide, the next step up is the Ryzen 7 5800X. It offers eight cores and 16 threads and a sizeable advantage in multi-threaded performance. However, you'll need to ask your wallet for another £140 for the privilege, and you won't see much benefit in games, except in the few titles where having eight or more cores is beneficial.

MOTHERBOARD

MSI MPG B550 Gaming Carbon WiFi

£160 inc VAT

cclonline.com

There have been some handy price cuts to motherboards since the B550 chipset launched earlier this year, and the MSI MPG B550 Gaming Carbon WiFi has gone from being a good buy to one of the best for £160. Our previous favourite, the Gigabyte B550 Aorus Pro, costs the same price, but lacks Wi-Fi and a USB 3.1 Type-C header, to name a few features, so while it was a better buy a few months ago, the MSI board has now usurped it.

The MPG B550 Gaming Carbon WiFi sports two M.2 ports, each with a large heatsink, and it has a generous count of seven Type-A USB ports on the I/O panel, as well as a full-fat Type-C port and 2.5 Gigabit Ethernet. There's Realtek 1220 audio with the full complement of audio ports, including an optical output, and seven fan headers too. You also get a clear-CMOS button and, more importantly, BIOS Flashback. The latter will allow you to update the BIOS to one compatible with Zen 3 CPUs if it's not up to date out of the box, and we'll explain how to use it in this guide.

Alternatives

MSI's MAG B550M Mortar offers great value at just £120 inc VAT, saving you some cash to buy a 1TB hard disk for extra storage, or a more feature-rich case. Upping the ante, if you need a motherboard with premium features and fantastic looks, the Asus ROG Strix X570 Gaming-E gets our vote, but it will set you back around £290. If you've decided to go down the Intel route instead then we recommend Asus' ROG Strix Z490-E Gaming, which currently costs £288 inc VAT from scan.co.uk

MEMORY

16GB (2 x 8GB) Corsair Vengeance Pro RGB 3600MHz (CMW16GX4M2Z3600C20)

£81 inc VAT

scan.co.uk

Corsair's Vengeance Pro RGB is some of the best-looking memory we've tested, plus it's overclockable and tied into Corsair's ever expanding RGB ecosystem. AMD's Ryzen 5000-series CPUs also have a higher memory frequency to Infinity Fabric ratio, meaning you can keep the two in sync up to 4000MHz in some cases. However, memory gets expensive once you get above 3600MHz, and we've found that the limited gains aren't worth it.

GRAPHICS CARD

Nvidia GeForce RTX 3070

£469 inc VAT

nvidia.com

If there's a single downside to all the great hardware that's launched in the past few weeks, it's the pandemic's effect on stock levels. It's affected Nvidia and AMD's GPUs, AMD's new Ryzen processors and a whole lot more besides.

However, we're hopeful that by the time you read this feature that the situation will have improved, or at the very least you'll be able to buy graphics cards at reasonable prices in early 2021. Needless to say, we absolutely do not recommend buying any components until prices have settled, as there are plenty of people looking to take advantage of the demand and applying massive mark-ups.

With that out of the way, it's time to discuss our choice. All of Nvidia's GPUs so far are generally excellent, with similar retail prices to their predecessors, but with a huge boost in performance. In fact, the sub-£500 GeForce RTX 3070's performance is comparable with the RTX 2080 Ti, which cost over a grand just a few months ago.

This GPU is the logical choice if you want to play the latest ray-traced games at high settings, and Nvidia's DLSS feature provides a handy boost to frame rates too. Even if you're gaming at lower resolutions and aiming for lofty frame rates for high refresh rate monitors, then it's a great choice there too, usually topping 100fps in most games at 1080p with high settings.

Alternatives

There's several options above and below the RTX 3070. If you want to play games at 4K in most games at high settings, the RTX 3080 is a much better bet, although it will cost you an extra couple of hundred quid. If you have a 2,560 x 1,440 monitor with a high refresh rate, the RTX 3080 is quicker here too. Below that, the RTX 3060 Ti is a great card for less cash. It has the same amount of memory as the RTX 3070, and is still capable of dealing with the latest games at 2,560 x 1,440, with the benefits of ray tracing and DLSS support.

CASE

Fractal Design Define 7 Compact

£100 inc VAT

overclockers.co.uk

For this build, we wanted a case that's easy to assemble, has space for a liquid-cooling radiator and doesn't take up half your gaming room. We liked the Fractal Design Define 7 Compact's construction, which allows you to lift away the top of the case for easy access.

It also lives up to its name with its compact dimensions, and it has excellent cable-tidying options and USB Type-C support on the front panel. It also comes with swappable roof panels, and we'll be using the vented panel to allow our RTX 3070 to direct its flow-through fan's exhaust towards the roof. Best of all, it costs £100.

Alternatives

The Fractal Design Define 7 is the bigger sibling of this case, and it sports a few extra features, making for a great upgrade if you have another £50 to spare.

Meanwhile, the be quiet! Pure Base 500DX is a superb, great-looking case that costs a little less money and still has room for a liquid-cooling radiator.

THE GEFORCE RTX 3070'S PERFORMANCE IS COMPARABLE WITH THE RTX 2080 Ti

CPU COOLER

Antec Neptune 240

£80 inc VAT

scan.co.uk

For just £80 inc VAT, Antec's Neptune 240 liquid cooler not only has a 240mm radiator with plenty of cooling headroom, but it also has TGB fans, and a fully fledged RGB with five 4-pin fan headers. A single input allows you to hook up the cooler's fans, plus three more fans, to a lone 4-pin header on your motherboard to control them, rather than a mass of spaghetti.

Its pump is illuminated too, and the radiator's 240mm size means you get more than enough cooling to handle our chosen CPU, so your PC will be quiet too. It might not have the cooling prowess of Corsair's 240mm liquid coolers, but it strikes a good balance of cooling and noise, reduces cable clutter and has full RGB lighting too.

Alternatives

If you want as much cooling as possible, but without the noise, Corsair's H115i RGB Pro XT is a seriously powerful liquid cooler, with its 280mm radiator offering additional cooling capacity, and its 140mm fans don't need to spin as fast as 120mm ones to offer similar cooling. You'll need to fork out another £50 or so for the benefit.

Meanwhile, ARCTIC's cheaper Liquid Freezer II 240 is just as powerful, but a little quieter and has a thicker radiator, so it can offer slightly better cooling for similar noise levels while costing the same. It also has a motherboard cooling fan embedded in the pump, but lacks RGB lighting. If you want to save as much cash as possible, then you can go for an air cooler instead. ARCTIC's Freezer 7X costs under £20 and is able to handle quad-core and 6-core CPUs, even when overclocked. It's also quieter and more powerful than the stock cooler included with the Ryzen 5 5600X.

POWER SUPPLY

Corsair CX550M

£67 inc VAT

scan.co.uk

Having a good PSU at the heart of your PC is extremely important, but there's also a huge amount of choice. It's true that you should aim to have some spare capacity above your PC's power requirements, so your PSU will operate quietly at a decent efficiency level, while providing headroom for future upgrades.

However, buying an 800W PSU for a PC that will usually draw little more than 350W from the mains is simply a waste of money. A PSU in the region of 500-600W is ideal for a 6-core PC with this GPU, and still offers space capacity. We've opted for Corsair's CX550M, which offers 550W of power and also has modular cables for its non-essential parts, allowing you to remove the cables you don't need. It's reasonably priced too.

SOLID STATE DRIVE

1TB Gigabyte Aorus NVMe Gen4 M.2 SSD

£140 inc VAT

ebuyer.com

The latest PCI-E 4 SSDs offer blistering sequential performance, and we've also spotted one that only costs a little more than a decent PCI-E 3 model too. The Gigabyte Aorus NVMe Gen 4 M.2 SSD originally sported a heatsink in our recent group test, but Gigabyte has since decided to offer it without one, instead relying on your motherboard's heatsink for cooling.

That shaves £30 off the price, meaning you can get 1TB of super-fast PCI-E 4 NVMe storage for just £140. That's only £30 more than the 1TB version of the Samsung 970 Evo, which peaks at 3,400MB/sec read speed, while the Aorus SSD can hit 5,000MB/sec.

TOTAL £1,396 INC VAT

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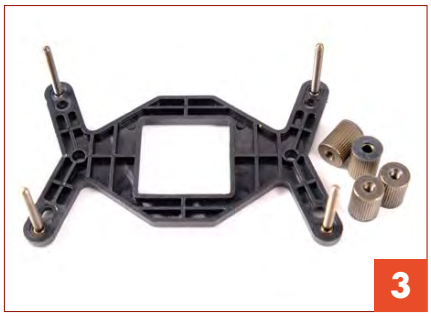
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BUILDING THE PC

1 INSTALL THE CPU

Lift the lever next to your motherboard's CPU socket, and carefully lower your CPU into the CPU socket. The CPU has arrow marks on the edge that line up with similar ones on the socket, but the Ryzen logo also sits upright below the socket hinge, with the top of the logo facing the memory slots.

2 REMOVE CPU SOCKET MOUNTS

Some CPU coolers, including our chosen one, require the removal of the stock AMD socket mounts. These are simple to uninstall – you just require a screwdriver to deal with four screws that secure to a backplate on the underside of the PCB.

3 CONSTRUCT COOLER BACKPLATE

Our cooler has specific mounting kits for different CPU sockets, and for this system you'll need to use the Socket AM4 kit, which comprises pins for the backplate and nuts to secure them on the top side. Place the backplate under the motherboard and secure the nuts on the other side.

4 INSTALL CPU COOLER PUMP

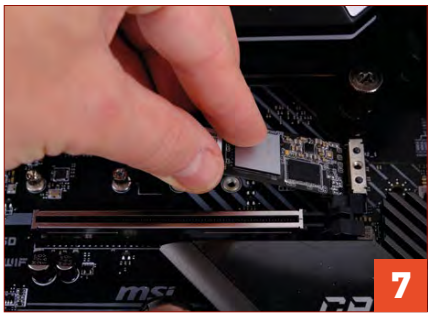
The Antec cooler's pump comes with thermal paste pre-applied, so you just need to attach the AM4 mounting plate to it and secure it using the thumbscrews. However, it's a good idea to now place your radiator roughly in the location you intend to install it, so you can angle the tubes correctly.

5 INSTALL MEMORY

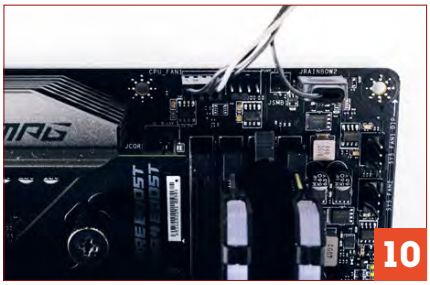
Install your two memory modules in the second and fourth slots away from the CPU socket, in order to enable dual-channel mode and maximise bandwidth. Push back the clips on the slots, align the modules correctly, with the pins in the slots and push each one firmly into place – the clips will then flip up to grip the modules.

6 FIT FANS TO RADIATOR

We'll be using our radiator as an exhaust in the roof of the case, so the fans will need to face into the main chamber. Use the included screws to attach them to the radiator, with the fan logos facing the same side as the coolant tubes. Align them so that the power and RGB cables will face the motherboard tray, making them easy to hide.



THE FRACTAL DESIGN DEFINE 7 COMPACT HAS A REMOVABLE ROOF SECTION THAT OPENS UP THE MAIN CHAMBER FOR EASIER ACCESS



7 INSTALL M.2 SSD

Locate the M.2 SSD installation screws in your motherboard box and use one to install your SSD into the top M.2 slot. The thermally conductive label can remain on the SSD, as we've found you still see a significant temperature drop using motherboard M.2 heatsinks with it in place. This also means you'll be able to sell the SSD at a later date with the label intact.

8 FIT M.2 HEATSINK

Grab the M.2 heatsink that comes with your motherboard. It will have a protective film over it that needs to be removed before you secure it. Once you've done that, secure the heatsink using the screws provided, ensuring you mount it the right way up.

9 REMOVE ROOF SECTION

The Fractal Design Define 7 Compact has a removable roof section that opens up the main chamber for easier access. This is very useful, especially when it comes to dealing with radiators in the roof. Locate the three screws holding it in place and lift it away.

10 CONNECT RGB AND PWM CABLES

The cooler fan and lighting hub include single cables to control the fans and RGB lighting. Connect these to the CPU fan header and nearby 3-pin RGB header, then thread them through a cable-routing hole in the case when you fit your motherboard.

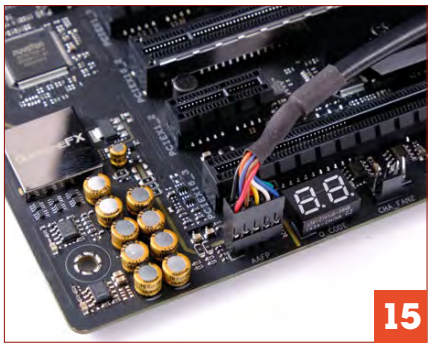
11 INSTALL MOTHERBOARD

Lay the case on its side, gently lower the motherboard into it and use the screws provided with your case to secure it in place. There's no need to install an I/O shield, as it's integrated onto the motherboard. Leave the cooler sat above the case for now.

12 INSTALL RADIATOR

With the cooler installed, secure the radiator to the top fan mounts using the included screws. These are smaller than the screws used to fit the fans, as they only need to pass through the thin metal fan mount, and not the entire fan. Don't fully tighten them, as you may want to adjust the position of the radiator in the roof once you've reattached the fan mount.

MAKE GOOD USE OF THE VELCRO TIES SUPPLIED WITH THE CASE TO BUNDLE YOUR CABLES TOGETHER



13 REATTACH ROOF SECTION

Slot the fan mount with the radiator attached back into the roof. Your aim is to have as little force on the tubes below as possible, so feel free to move the radiator back and forth, or even swap it round, if necessary. We've opted to have the tubes at the front the case. While you're here, go ahead and replace the dust filter too.

14 CONNECT USB FRONT PANEL CABLES

The case has both Type-C and Type-A USB front panel ports, which use different cables. Both can only be slotted in one way, so it's impossible to do this step incorrectly. However, it's worth threading the cables through cable-routing holes near to the corresponding headers on the motherboard, in order to reduce cable clutter. You can tie off any slack with cable ties behind the motherboard tray.

15 CONNECT FRONT PANEL AUDIO CABLE

The audio cable also needs to be connected in order to get the front audio jacks working. This is located on the other side of the motherboard. Use the motherboard diagram in the manual to identify it.

16 INSTALL FAN AND LIGHT HUB

The Antec fan and light hub included with the cooler is very useful for controlling multiple LED arrays and fans using single cables from your motherboard. We've mounted it in one of the SSD trays behind the motherboard tray, as this is the only flat location large enough to house it.

17 INSTALL GRAPHICS CARD

The Nvidia RTX 3070 Founders Edition card we used requires a proprietary 12-pin cable extension that connects to a single 8-pin power connector. Install the graphics card in the top 16x PCI-E slot, then connect the power extension to the socket on the side of the RTX 3070.

18 USE VENTED ROOF

The Fractal Design Define 7 Compact includes sealed and vented roof options, and you need to use the latter if you're mounting the radiator in the roof. You'll find it in the case's accessory box, and it simply pops into place, sitting around the front panel buttons. Don't ever block the roof vent by leaving anything on top of your PC, including the magazine you're holding now.

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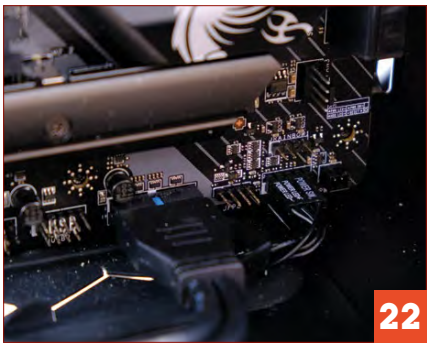
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19 INSTALL PSU

We only need the PCI-E and SATA power cables on our PSU, as well as the captive cables, so you can leave all the others in the box. Thread the cables into the chassis and out under the motherboard tray, ready to be secured, and then slide the PSU into the hole at the rear of the case. Secure the mounting bracket to it and then screw the whole setup into place.

20 CONNECT MOTHERBOARD POWER CABLES

Now connect the PSU's captive 24-pin ATX and 8-pin CPU power connectors to the motherboard, threading them through the cable routing holes nearest the sockets first. There's plenty of slack on each cable, so pay attention to where you're routing them behind the motherboard tray, so you can secure them later.

21 CONNECT GRAPHICS CARD POWER

The graphics card's power cable is best routed through the cable hole in the PSU cover, which offers the quickest way to get it out of sight, and it also then won't interfere with airflow between the intake or exhaust fans, which can be an issue if you thread it through holes next to the motherboard as usual.

22 CONNECT POWER AND RESET CABLES

Finally, connect the front panel power, reset and power LED connectors to the headers on the motherboard. These are identifiable using the motherboard manual, and they sit next to the USB 3 connector.

23 TIDY CABLES

Once all the gear is installed, make good use of the Velcro ties supplied with the case to bundle your cables together, get them out of the way and make the area around the rear of the motherboard try as neat as possible. Avoid large bunches of cables, as you want to be able to easily replace the side panel later.

24 YOU'RE DONE

With all your gear installed, and your cables tidied up, your PC's interior should now look like this. You're now ready to plug in your mains power cable, as well as your keyboard, mouse and monitor, and start setting up your PC.

USB BIOS FLASHBACK

Depending on when your motherboard was manufactured, the BIOS may or may not support AMD's latest Ryzen 5000-series CPUs out of the box.

However, many AMD 500-series chipset motherboards, including our chosen board, have a feature called USB BIOS Flashback. This allows you to update the BIOS without a compatible CPU. In fact, you usually don't even need a CPU in the socket at all.

To use the feature, download the latest BIOS for your motherboard onto a blank USB stick that's formatted with FAT32. Now rename the file MSI.ROM, with no other characters in the file name. For example, our original BIOS file was called E7C90AMD.151. You need to change 'E7C90AMD' to 'MSI 'and '151' to 'ROM'.

Once you've done that, locate the USB port on the I/O panel labelled BIOS Flashback. The feature will only work using this port. Plug your USB stick into this port, plug your PC into the mains, switch on the PSU and then press the BIOS Flashback button until the LED next to it starts blinking. This indicates that the BIOS file is being read and will be written to your motherboard.

Eventually, the LED will go out and you can remove the USB stick. The PC may power itself on as well, but make sure the LED is off before you remove it and power on your PC. If the flash is successful, your PC will power on as usual and you'll then be met with the BIOS (EFI) screen.

SETUP AND OVERCLOCKING

SET MEMORY PROFILE

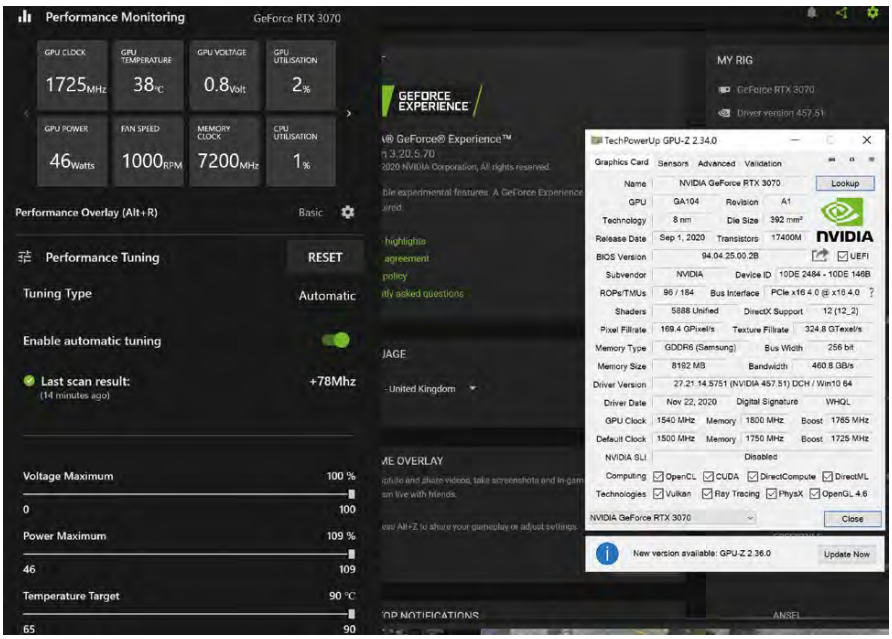
When your PC first boots, press the Delete key and you'll get into your motherboard's BIOS (EFI) – you need to set the XMP profile for your memory. Locate the XMP Memory profile option in the Overclocking section and select the speed for your memory, in our case this was 3600MHz, which was under profile 1.

OVERCLOCK YOUR CPU

Download and install AMD Ryzen Master from **amd.com** and the latest version of Prime95 from **mersenne.org**. In the latter, select Torture test under Options, then select the small FFTs test.

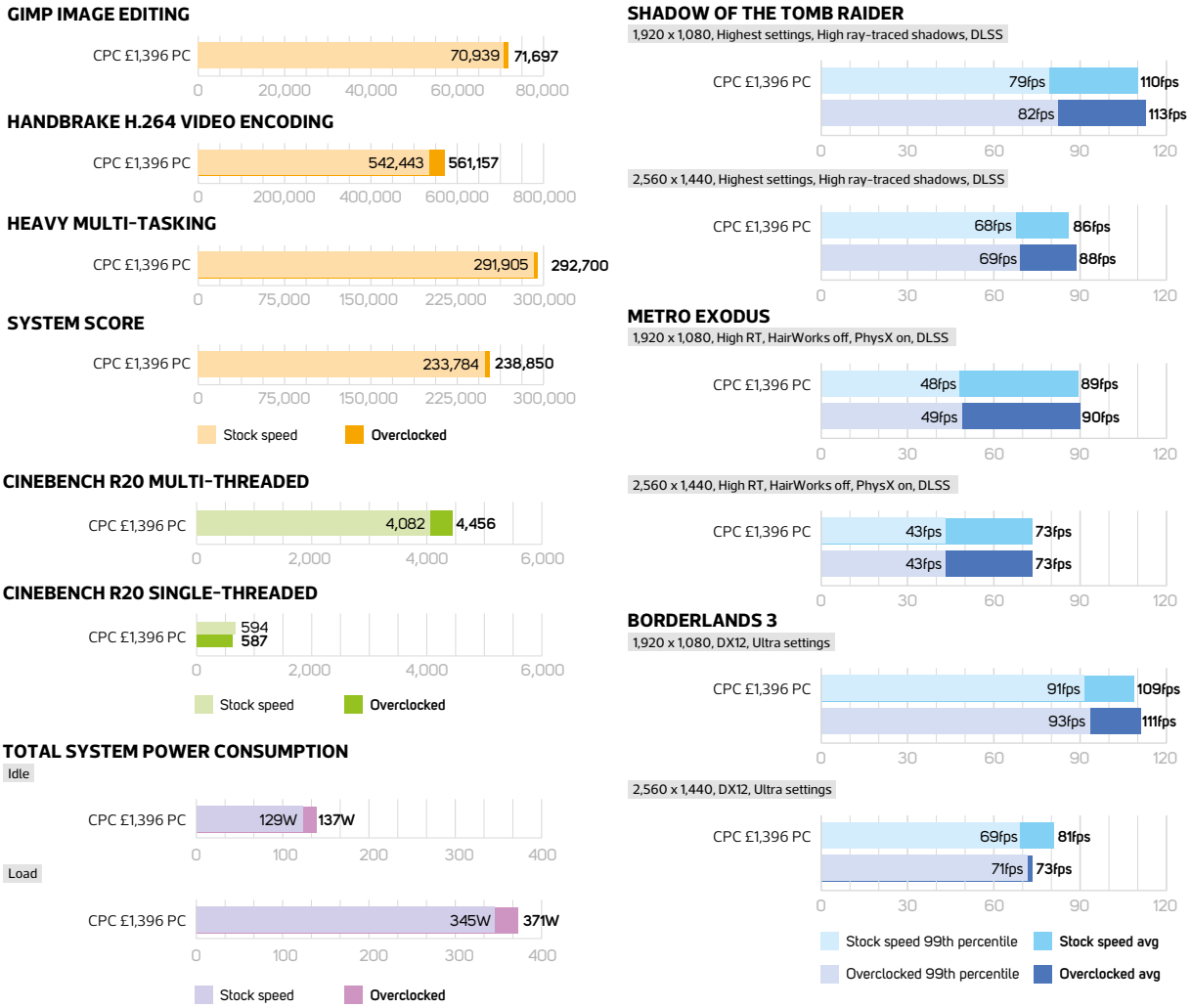
Now disable all AVX options at the bottom and click Run. Now, open Ryzen Master and check the CPU temperature. It should sit below 70°C at stock speed after ten minutes. We can now start overclocking, while using Ryzen Master to check stability and temperatures from the comfort of the desktop before inputting our settings into the EFI.

Apply a voltage of 1.225V and a CPU frequency of 4600MHz. Our CPU actually managed to hit 4.7GHz, but we're playing it a little safer here. Now rerun the Prime stress test. We found our CPU remained below 70°C after ten minutes, but you should lower the overclock if the temperature goes much above 80°C. If these settings appear to be fine, head back to the EFI and input 46.00 into the CPU Ratio setting (to run all your CPU's cores at 4600MHz) and then input 1.225V into the Override CPU Core Voltage field, with the CPU Core Voltage set to Override Mode.



You can use Nvidia's GeForce Experience software to automatically overclock your graphics card

BENCHMARK RESULTS



OVERCLOCK YOUR GRAPHICS CARD

We've used Nvidia's new overclocking tools in GeForce Experience to overclock our GeForce RTX 3070 card. Open GeForce Experience, go to Settings, then General and locate the tick box that enables experimental features. Now press Alt-Z to bring up the overlay and select Performance. At the bottom you'll see some overclocking tools. Start by increasing all the slider bars at the bottom to maximum. This raises the power and temperature limits, but they're still well within safe limits.

Now check the box to enable automatic tuning, and the software will start an overclock scan where it automatically overclocks your graphics card's GPU core and memory. The end result was a 40MHz increase to the stock speed boost frequency, and 50MHz (400MHz effective) added to the memory frequency, which now topped out at 14.4GHz (effective).

PERFORMANCE

At stock speed, all our test games were easily playable at decent frame rates on our sub-£1,400 PC at 2,560 x 1,440, even with ray tracing enabled. In Shadow of the Tomb Raider, our system didn't drop below 68fps, and it maintained a solid 43fps 99th percentile minimum in our demanding Metro Exodus ray-tracing benchmark.

The overclock saw the stock speed Cinebench score rise from 4,082 to 4,456, although the single-threaded score dipped slightly to 587 down from 594, although this is still miles faster than any Intel CPU. Borderlands and Shadow of the Tomb Raider saw small gains at every resolution after overclocking, but a bigger GPU overclock would be needed to see a worthwhile boost in Metro Exodus.

Meanwhile, in our RealBench tests, the image editing score rose from 70,939 to 71,697 after overclocking and the video encoding score increasing from 542,443 to 561,157. With the CPU under full load when overclocked, the system drew 210W, while it peaked at 371W in games. There's plenty of headroom with our chosen PSU for future upgrades, even if you overclock your system, with that figure rarely topping 350W at stock speed. CPC

WHAT LIES AHEAD

WE MADE IT OUT OF 2020 BY THE SKIN OF OUR TEETH, BUT WHAT CAN WE EXPECT FOR THE YEAR AHEAD, AT LEAST AS FAR AS TECH IS CONCERNED? EDWARD CHESTER EXPLORES WHAT'S COMING UP

From the lows of COVID-19 and lockdown to the highs of some stellar PC hardware launches (supply issues aside), 2020 is certainly the year that's kept us guessing. So, fully aware of the potential pitfalls of predicting what might happen in the year to come, we've nonetheless put out the feelers and tapped up our sources to see just what 2021 might hold for PC enthusiasts.

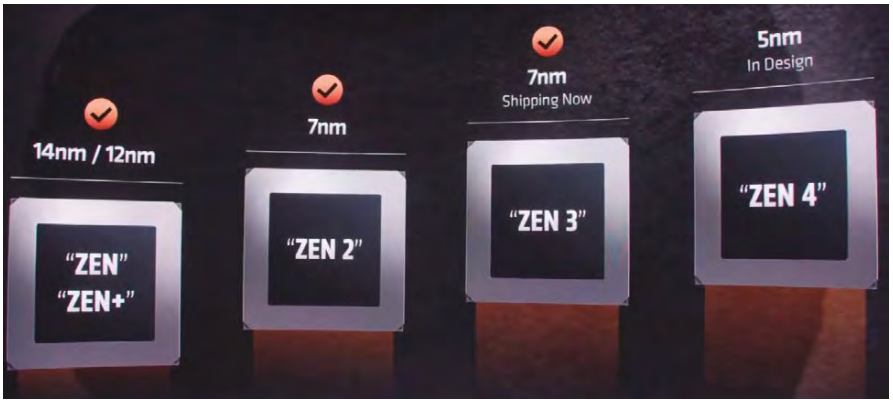
DDR5 due

Perhaps the most obvious place to start is an area that Richard Swinburne has covered in depth in his column this month on p8, which is the arrival of DDR5. The new standard, which will see maximum memory speeds jump from the 4600MHz at the current bleeding edge of DDR4 to upwards of 6400MHz, wasn't expected to arrive until 2022. However, the latest reports suggest we could see the new tech as soon as the middle of 2021.

The new memory will provide a solid boost in memory bandwidth that will have benefits across the board, but will certainly be felt strongly by AMD's current processors, which have generally responded well to fast memory.

Regardless of the exact performance advantages, the potential for a mid-2021 arrival puts an interesting spin on current upgrade paths. AMD's Ryzen 5000-series CPUs, and both AMD and Nvidia's latest graphics cards, have prompted many buyers to finally want to take the plunge on a system upgrade, but current stock shortages have meant long waits for many.

MAXIMUM MEMORY SPEEDS WILL JUMP FROM THE 4600MHz AT THE CURRENT BLEEDING EDGE OF DDR4 TO UPWARDS OF 6400MHz



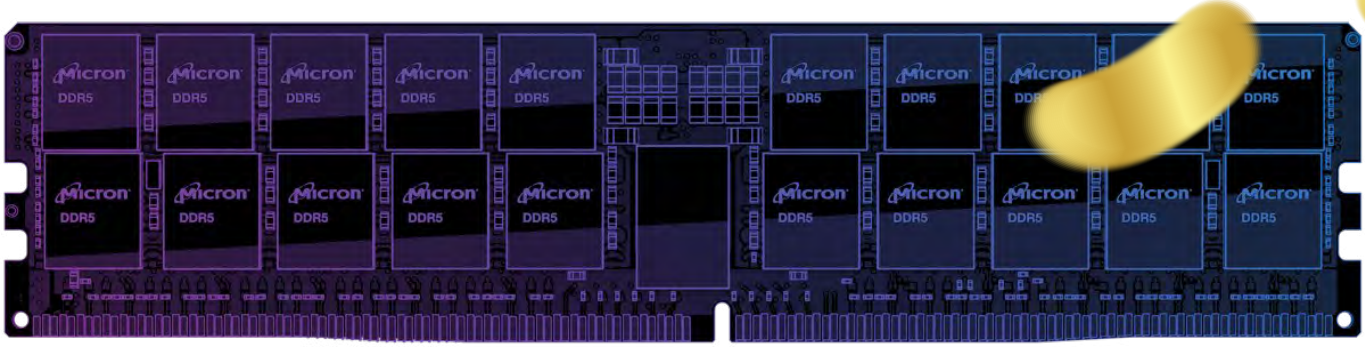
AMD's 5nm Zen 4 processors are expected to arrive towards the end of the year

With the prospect of such a central component – and one that's been reusable for several system upgrades for years – becoming imminently obsolete, many may want to hold off that upgrade a little longer. Of course, a graphics card upgrade will remain compatible with any new DDR5-based system, but any current CPU, memory or motherboard upgrade will be incompatible with the new standard.

Before we stoke your fears too much, though, it's worth remembering that while we might see the announcement of DDR5 and supporting platforms by the middle of this year, widespread availability will likely take a fair bit longer. It's always a fair bet that the holiday season of any given year will be ripe for a flurry of upgrades, so it seems likely that this time next year, the DDR5 revolution will begin in earnest.

AMD arrivals

Part of the potential rapid drive towards DDR5 memory might be a refresh of AMD's Ryzen 5000 processors to support the new memory. With AMD's Ryzen processors using a separate I/O chip for memory interaction, it's relatively easy to change the design to



DDR5 memory is expected to arrive at some point in 2021, ending seven years of steady DDR4 use

incorporate DDR5 support without even needing to produce new processing dies. The new processors would require a new accompanying motherboard chipset but one is overdue anyway, with X570 being a couple of years old now.

If such a mid-year refresh does occur, we can expect clock speeds to be bumped up as well, as the company is able to further speed-bin its Zen 3 chiplets. We're also likely to see the Zen 3 range filling out further to hit a few more price points. Towards the end of the year, we're also expecting to see either the full arrival of AMD's next-generation Zen 4 processors or a significant gearing-up towards their imminent arrival.

The new chips will see the arrival of TSMC's 5nm manufacturing process, down from the 7nm process used in Zen 3. In the announcement presentation for Zen 3, AMD said that its 5nm Zen 4 products were currently 'in design' and 'on track'.

The new process is expected to provide an 84 per cent boost in transistor density over 7nm chips, along with up to a 15 per cent increase in clock speeds or a 30 per cent reduction in power consumption. Add in any architecture changes – this isn't expected to be just a straight die shrink – and we can expect another healthy boost in performance from Zen 3 to Zen 4.

Intel fights back

2021 is set to be a crucial year for Intel. We're expecting to see at least two big new CPU launches, with the company's 11th-gen (Rocket Lake) Core processors arriving in the first quarter of 21 followed, by its 12th-gen (Alder Lake) designs later in the year.

Rocket Lake will bring support for PCI-E 4 with it, as well as a new processing core design based on the Cypress Cove architecture, rather than the old Skylake design. We say 'new', but it's actually been around since 2019 in Intel's low-power, mobile-orientated Ice Lake designs.

However, while those mobile CPUs used the company's latest 10nm manufacturing process node, Rocket Lake will be back-ported to the company's 3rd-gen 14nm process. Intel is still using the larger process node, as it more reliably delivers the fast clock speeds Intel requires for its desktop CPUs.

Rocket Lake is expected to bring the fight back to AMD, with a 10 per cent improvement in instructions per clock over Intel's previous designs, combined with the company's continued frequency advantage. It will also include Intel's latest Xe graphics and, perhaps more importantly, it will use the same LGA1200 socket as the current 10th-gen (Comet Lake) designs.

While Rocket Lake will certainly keep the CPU fight rolling, what's potentially set to be a far more significant launch for the industry as a whole is the Alder Lake architecture. This will see Intel combine its latest large, powerful 'Core' designs (Golden Cove) with its small, low-power Atom (Gracemont) core designs.

For the desktop, where speed rather than power saving is most important, the jury's very much still out as to whether this will really make a difference. If software had better multi-core support, the extra cores – even low-power ones – could provide a boost. However, by and large we're still yet to see a lot of software take advantage of much more than four cores outside of a few edge cases.

For the laptop market, though, where AMD is finally starting to make some in-roads, Alder Lake could be

Intel's Alder Lake combines the company's powerful 'Core' designs (Golden Cove) with its small, low-power Atom (Gracemont) designs

huge. We've just seen Apple's M1 processor successfully combine 'big' and 'little' cores to provide good performance with very long battery life, so we could be set to see similar leaps in battery life on Intel mobile devices.

Graphics card wars

With the first flourish of GeForce RTX 3000 and Radeon RX 6000-series graphics cards having had such a slow start due to stock shortages, 2021 is set to be a fascinating year for the graphics card market. Had AMD managed to get enough stock in hand this past holiday season, it could well have stolen a march on Nvidia as buyers tire of waiting for Ampere stock to arrive and instead go for the less ray tracing-capable, but otherwise fast AMD cards.

However, with that situation not having played out, we can instead expect to see Nvidia continue to command the most premium prices while AMD may be forced to start reducing prices, particularly for its RX 6800 XT and RX 6800 – that's assuming the supply problems get sorted for both line-ups.

Nvidia's GeForce RTX 3060 Ti is the first of the new wave of graphics cards to drop below £400, but 2021 should see many other cheaper cards arrive

With a £50-100 price drop, the two Radeon cards would significantly undercut the Nvidia competition, offsetting their weaker ray-tracing performance and lack of support for DLSS (AMD's equivalent, FidelityFX Super Resolution, is incoming but is yet to arrive and is unproven).

Beyond the tussle at the top, we can also expect to see both companies fill out their GPU ranges with mid and lower-tier cards. We've already seen the start of that movement with the arrival of the GeForce RTX 3060 Ti (see p16), which is the first of this new batch of cards to break through the sub-£400 barrier.

All this speculation will of course be moot if the supply issues aren't sorted out. There have been leaks hinting at the arrival of a slew of new Nvidia cards (RTX 3080 Ti, RTX 3070 Ti and RTX 3060), but if we still can't buy any of the existing models, months after launch, the arrival of even newer models likely won't help the situation.

The COVID conundrum

All the talk of graphics card supply issues of course overlooks the much broader potential impact of the year that has been 2020. While most manufacturers have managed to keep some form of production running, it has been

ROCKET LAKE WILL BRING SUPPORT FOR PCI-E 4 WITH IT, AS WELL AS A NEW PROCESSING CORE BASED ON THE CYPRESS COVE ARCHITECTURE

The Asus PG32UQX is expected to produce stunning HDR imagery, but with a price tag to match

slowed across the board. Shipping and imports have been slower too, all of which has an impact on the supply chain both immediately and down the line.

As such, there's a good chance we may see supply shortages in various areas well into 2021, even as vaccines and warmer weather start to change the course. Indeed, there are reports that it will be the very delivery of vaccines that puts more strain on the industry, as air freight space is taken up delivering the millions of vaccines and their sub-zero storage containers to destinations around the world.

All this delay and scarcity may also have an impact that will be felt even more acutely by some, as prices could rise. While many will be hoping that they will be able to grab a bargain with a post-Christmas discount, the reality is that demand will remain so high that prices likely won't fall, if indeed any stock is available anyway. It may then take all the way until summer for the situation to settle back down. We're not out of the woods yet, folks.

High demand for air freight may add delays and increase prices for tech products

Peripheral position

Looking away from the nitty-gritty of specific component roadmaps, there are other trends we might see play out over 2021. The lockdown of 2020 saw the whole tech industry boom as people set up home offices and played more games at home.

A couple of obvious successes were VR and Microsoft Flight Sim 2020, both of which put these niche pursuits (and the peripherals for them) back on the map. Could 2021 finally see the arrival of some updated flight stick designs? We have our doubts, but it would be great to see them bounce back again.

Regarding VR, thousands of headsets were bought and used in lockdown, which will have given the ecosystem a boost, but will people continue to use those headsets once they're regularly allowed to work and socialise in real life again? Ultimately, content will prove to be king. If more titles such as Half-Life: Alyx and Star Wars: Squadrons arrive, there's every reason to think people will maintain their interest.

In the world of monitors, we've already started to see how the many disparate requirements for a great screen – high refresh rate, fast response time, wide viewing angles and decent image quality – have come together with 144Hz and even 240Hz IPS monitors now commonplace.

We've also seen FreeSync and G-Sync essentially merge, with most new FreeSync monitors now able to sync with Nvidia GPUs. HDR continues to be a total mess, though, with just about every new monitor claiming some basic form of HDR support, despite not having the chops to make it meaningful.

One set of displays that will make the most of HDR, though, is the much anticipated mini-LED HDR monitors that Asus and Acer unveiled back in 2019. These displays will follow in the footsteps of the stunning (but very expensive) Asus PG27UQ and Acer X27 by using proper multi-zone backlights, which allow an LCD monitor to produce the contrast needed for true HDR.

Instead of those screens' 384 backlight zones, though, these displays are set to have 576 of them packed into 27in screens. Larger 32in versions are expected too, using 1,152 backlight zones. Sadly, like their predecessors, these displays will be ludicrously expensive, with rumoured prices of well over £2,000. Such is the price of true HDR. **CPC**

ROG Pagoda

JÁNOS KEREKES, AKA JONES965, GUIDES US THROUGH THE CREATION OF HIS PLEXI-PACKED PAGODA PC

I've been working with computers and modding them for 15 years. During this time, I've made many computers, starting by modifying prebuilt cases then gradually shifting the focus towards creating custom cases. The common feature in these cases was water cooling, which provides a building and aesthetic challenge, and of course, excellent cooling performance and low noise.

I was making these computers for personal use, and obviously there are only so many computers one person needs, so I had to find something to do with them. So, with the support of Asus Hungary I started making sponsored builds, enabling me to practise my craft without filling the house with a never-ending supply of computers.

Off the back of this initial sponsorship and my success in various modding competitions, I've earned the support of several more sponsors, such as Alphacool, Bitspower, Cooler Master, EKWB, FSP, Lian Li and Thermaltake.

SPEC

Sponsors Asus Hungary, EKWB

Motherboard Asus ROG Strix X570-F Gaming

CPU AMD Ryzen 5 3600X

RAM 16GB (2 x 8GB) HyperX Fury 3200MHz

Storage 256GB Kingston M.2 SSD

Graphics card Asus ROG Strix GTX 1650

Power supply Cooler Master MWE Gold 550

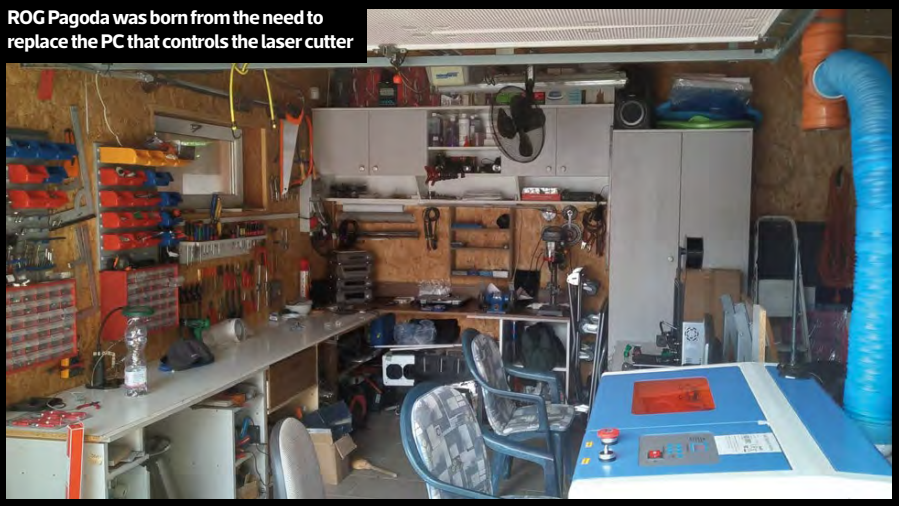
CPU waterblock EK-Quantum Velocity D-RGB - AMD Nickel + Plexi

Reservoir EK-Quantum Kinetic TBE 160 DDC Body D-RGB - Acetal

Radiator EK-CoolStream PE 240

Fans EK-Vardar X3M 120ER D-RGB - Black

Miscellaneous EK fittings, EK-CryoFuel Solid Fire Orange coolant



ROG Pagoda was born from the need to replace the PC that controls the laser cutter

The birth of ROG Pagoda

When it comes to the ROG Pagoda project, it might seem funny, but the idea for this case came when I was bored. I hadn't made a computer for almost two years, and seeing all the materials lying around in my workshop, I simply thought that maybe I should create something new again.

The other major motivation was the fact that I've upgraded my workshop with a 3D printer and a laser cutter. I controlled them with an old PC based on an LGA1156 motherboard, equipped with integrated graphics. It was slow and couldn't cope with the demands of the software needed to design the components – only to run the machines. As a result, I had to go back to my office to make changes to my designs, then come back to the workshop PC with a USB drive containing the new files. I then had to go there and back again if the file was the wrong format, and so on. It was exhausting and inefficient to have to go back and forth like this.

My aim, then, with the new PC, was to make a relatively small workstation that could handle these tasks and save me lots of round trips. Other than this basic requirement, the only certainty was that it would, of course, have to be water-cooled – I couldn't break with my tradition.

Let's start building

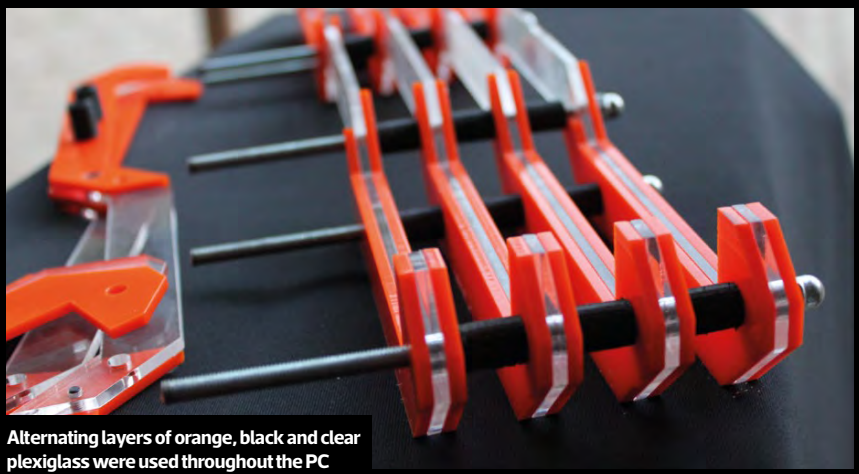
I started to build the frame without any final plan. I used aluminium box section to create a two-sided, inverted 'T' frame on which to mount the hardware. The sections were fixed together with corner braces and bolts then, to stabilise the frame and support the hardware, the sides were covered in aluminium sheeting that would be easy to drill and cut, so I could accommodate cable routes and mounting points.

Although it was functional, the aluminium wasn't much to look at, so the case needed to be dressed up. I chose a black and orange colour scheme that would be created largely with the use of coloured plexiglass.

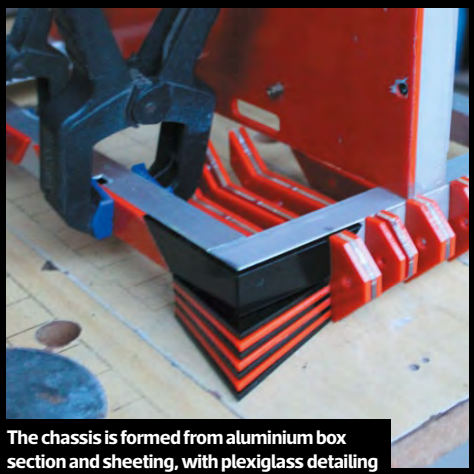
As well as being decorative, plexiglass made it easy to create custom brackets for the graphics card and power supply cabling

Thanks to the support of Asus Hungary, I received an ROG Strix X570 motherboard and ROG Strix GTX 1650 graphics card. The latter isn't the most powerful graphics card, but it's powerful enough for a workstation and some games, if I ever want to play games on this machine. The display to which it's attached only has a resolution of 1,680 x 1,050, so it doesn't really challenge the GPU.

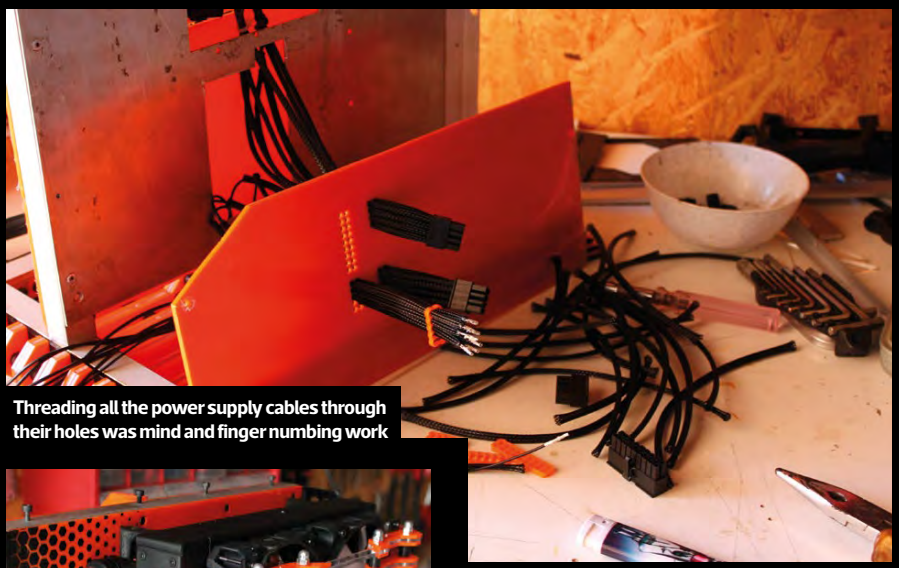
It wasn't easy for me to come up with a name for my mod, since the name should refer to the appearance of the concept, which was vague at that point, and it had to incorporate the 'ROG' prefix of its sponsor. In the end, I kept it simple, naming the system after its chief architectural influence, the pagoda. I've always admired those sophisticated yet robust architectural designs (I'm a mechanic) and it fitted with the open, angular design with which I'd started.



Alternating layers of orange, black and clear plexiglass were used throughout the PC



The chassis is formed from aluminium box section and sheeting, with plexiglass detailing



Threading all the power supply cables through their holes was mind and finger numbing work

A simple, short tubing arrangement was used for the water cooling

Plastic fantastic

After making the aluminium frame, I used plexiglass to form much of the rest of the case, as it's relatively easy to machine and is very decorative. I cut down the larger sheets so that they fitted on the work surface of the laser cutter, then cut out the designs with the laser cutter. I used various combinations of orange and black, or orange and clear plexiglass, sandwiched and bolted together to form most of the main sections of the case.

Having a laser cutter and 3D printer was crucial for this build. I could have made the parts by hand but it would have taken many days. With my new machines, it took just a few hours to make most of the parts.

As I was planning on making such a small PC, due to the size of my workshop, I had to think carefully and plan ahead with this build, in order to keep the overall design in harmony. A crucial part of this process was planning the position and cabling routing for the modular power supply.

I used individually sleeved cables for each conductor of the power supply's main cables, and threaded each cable through dedicated holes cut into various sections of the chassis. To keep these holes accurate and clean, I had to design them ahead of time and use the laser cutter to form them.

IT WAS NATURAL TO POSITION THE GRAPHICS CARD VERTICALLY. THANKFULLY, THAT'S EASY NOW – BLESS THE DESIGNER OF THE PCI-E RISER CABLE

Threading each cable through its holes and lining up all the cabling in a neat manner was extremely fiddly and intricate. It was such tedious, tricky work that by the second day my hands were cramping up. It's certainly something I'd think twice about doing again, even if the result does look good.

An edge-lit clear plexi panel was etched to show all the sponsors' names on the mod

Given the upright position of the motherboard and the lack of retaining brackets for any expansion cards, it was natural to position the graphics card vertically too. Thankfully, that's easy to do these days: I bless the designer of the PCI-E riser cable.

To hold the back end of the card, I used a bracket from a test bench, but I still needed to stabilise the front edge of the card. I went back to the laser cutter to cut another plexiglass sandwich into shape.

This piece bolts to the base of the chassis and just hooks round the PCB at the front of the graphics card.

Back to front

Now that I was finished with the front of the case, I turned my attention to the back of it. This area holds the power supply, but it's also where the all-important water-cooling hardware is mounted.

Because of the size of the concept, my plan was to have a simple water-cooling setup that cools only the CPU. The graphics card would use its stock cooler instead of being water-cooled.

This is where another one of this PC's sponsors came to the fore, with EKWB providing all the components for the water-cooling loop. Unfortunately, I initially managed to order a reservoir that didn't include a pump, which was quite the own goal, but eventually I had all the components I needed.

At the top of the cooling system is the 240mm radiator, which is mounted to the chassis via some 3D-printed plastic mounts that I designed. It was tricky to mount this part tidily due to the number of cables that needed to be hidden away. For this kind of work, you need a good nervous system and some dexterity.

Like the rest of the build, the radiator is left quite exposed, and while the fans that are mounted on it provide quite a spectacular view, they aren't safe to leave open to careless hands. So, in order to make this setup a little less dangerous, I made some custom fan grilles that look similar to the frame design.

To continue the overall look with the plastic coverings, I next tackled the power supply, which got a clear, laser-cut cover. Before mounting that, I also painted the power supply to match the orange and black colour scheme.

The next challenge was designing and fitting the hardline water-cooling tubing. The first consideration is, of course, that it has to be efficient and effective. Secondly, it has to look good and not be a tangled mess.

In the end, I kept this relatively simple. The tubes come straight down from the radiator, then through the chassis and up diagonally to the CPU waterblock. This creates a clean look with just enough interest created by the 45-degree angle on the front, without the tubing covering the graphics card.

Finishing touches

Practically, the computer was finished now, but I felt something was missing: it needed a few design finishing touches. So, I put on my thinking cap and tapped into my graphic design knowledge to come up with a few tweaks.

First, I came up with the idea for the hexagonal painted design on the side panel, to lessen the domination of the orange colour. I cut a template with my plotter and fixed it to the chassis with transfer paper. I then masked the parts that I didn't want to paint and spray-painted the design.

Next, I added a laser engraved, edge-lit, clear plexiglass piece that hangs over the front of the case and shows off the names of the project's sponsors. To hold it in place, I used a 3D-printed mount with RGB LEDs integrated into the bracket. The whole assembly was then fixed in place with hidden bolts.

The final touch was adding illumination to the underside of the chassis. For this I just used DRGB led strips mounted on the underside. At this point I felt the design was done and I was happy attaching my name to it.

Epilogue

I'm happy with the way the PC turned out. It's maybe not the last word in PC design but it has a certain style, and it's compact and practical for what I need. Generally, after calling a project done, I find myself thinking of how I might like to have done things differently, but I've yet to find a part that I would change. Of course, the graphics card could be more powerful, but it made the sponsorship support possible and it can always be upgraded later.

During the production process, not all of it went to plan. The 24-pin ATX cable parts had to be done several times because I didn't like the first versions. Also, several plexiglass elements were damaged during the assembly. Other than this, though, the build went smoothly.

I published the process of building this project on **bit-tech.net**, and in doing so, managed to get nominated for and win its 'Mod of the Month' competition. It made me so happy that the site acknowledged my work. I've also been lucky enough to win some other awards with previous projects, gaining two Guru3D Mod of the Month, two **bit-tech.net** Mod of the Month awards, and a second and third place at the DCMM awards.

These awards have also gained me several sponsors, and it's thanks to these sponsors that my next project is already underway in my head. I hope it's going to be arriving in real life soon too, this time with even higher-end hardware. CPC

A precision-cut mask was used to spray paint on a hexagonal pattern

The orange colour and lighting finishes off the colour scheme

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

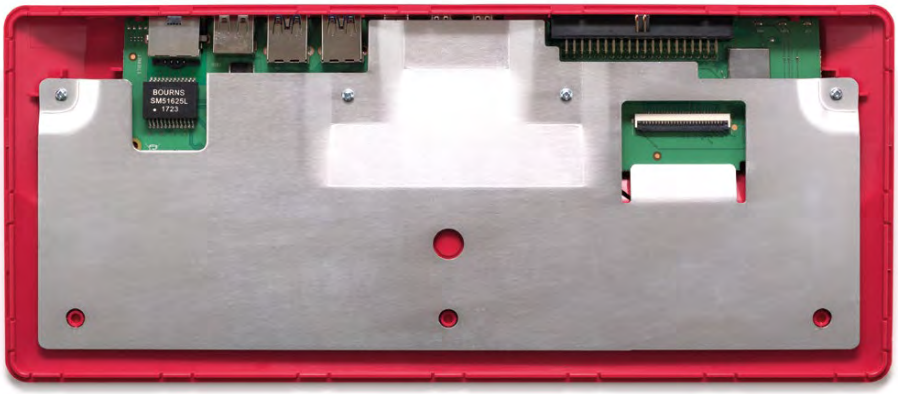
REVIEW
Raspberry Pi 400

It's not just a keyboard, but an entire desktop computer powered by Raspberry Pi 4 tech

Ever since the launch of the original Raspberry Pi Model B, the Raspberry Pi range has been known as the 'credit-card-size computer'. Its dimensions have shifted a little in the years since launch, but overall, the design goal has always been a device with a footprint roughly equal to that of a credit card.

The Raspberry Pi 400 doesn't have a footprint roughly equal to that of a credit card. Even shucked from its housing, it's by far the largest device the Raspberry Pi Foundation has ever created. That's because it's not a single-board computer at all, but an all-in-one device inspired by the classic keyboard-based computers of the 1980s.

Developed under the initial codename Project C64, until its designer Simon Martin pointed out that naming the super-secret project after one of the most famous microcomputers of all time might be a bit of a giveaway and renamed it Project Gamma, the Raspberry Pi 400 takes the core technology of the Raspberry Pi 4 and puts it in a keyboard housing. Add a USB Type-C power supply, micro-SD card, mouse and a display, and you're away.



The large internal heatsink does a great job of cooling the processor

First, though, there are some caveats for anyone jumping from an earlier Raspberry Pi system. The big one is a loss of several key ports. You'll find no Display Serial Interface or Camera Serial Interface (DSI or CSI) connections – there's only one USB 2 port alongside two USB 3 ports, and no support for analogue audio and video. The Gigabit Ethernet port has also lost its support for Power-over-Ethernet, though this admittedly requires the purchase of the optional PoE HAT add-on in the Raspberry Pi 4 range.

There are advantages to the redesign too. All the ports are now located around

the rear of the keyboard housing, resulting in far neater wiring than is possible with an uncased Raspberry Pi 4. The GPIO header remains intact, although the fact it's facing away from the user and is upside down means you'll need a 40-pin extension cable to make the most of it. There's even a Kensington-compatible locking slot for security.

The biggest advantage of them all is a massive block of metal that provides passive cooling for the system-on-chip. It's extraordinarily effective – during the thermal torture-test benchmark, which saw an uncased Raspberry Pi 4 throttle within minutes, the Raspberry Pi 400 barely broke a sweat. That's despite it coming with a 300MHz speed boost, running its four 64-bit Arm Cortex-A72 processing cores at 1.8GHz compared to the Raspberry Pi 4's 1.5GHz.

That hike in clock speed gives the Raspberry Pi 400 the edge over its predecessor in almost all benchmark workloads, but it's tempered by the fact the Raspberry Pi 400 is only available with 4GB of RAM. Those looking to save money by dropping down to 2GB or store more data in memory with the 8GB model are left with no choice but the classic Raspberry Pi 4 range.

The extra speed is also available to the Raspberry Pi 4, providing you're willing to add third-party cooling or the PoE HAT with its built-in fan. Most examples can easily hit 2GHz with added cooling, and 2.2GHz isn't unknown either, for the Raspberry Pi 4 or the new Raspberry Pi 400.

Despite this, the Raspberry Pi 400 impresses. The build quality is excellent, and the keyboard is comfortable to use despite its small size. For fans of vintage gaming through emulators, it's close to being a perfect machine – it's ideal to get out and power up for a quick blast of a game that would normally have required a separate keyboard. The form factor is also likely to tempt education and corporate users, by not only reducing desk clutter but also the temptation to start poking and prodding at exposed components.

The Raspberry Pi 400 stands as a great introduction to the Raspberry Pi ecosystem. A Personal Computer Kit variant comes with all the gear bar a display, and even includes a copy of Raspberry Pi OS installed on a micro-SD card already inserted into the slot at the rear of the Raspberry Pi 400.

The pricing is keen too. Both the Raspberry Pi 400 and Raspberry Pi 400 Personal Computer Kit are available from the usual resellers, including **pimoroni.com**, for £66.90 and £93.90 respectively (both inc VAT). That works out cheaper than buying a Raspberry Pi 4 Model B 4GB, keyboard and accessories in either case.

However, the Raspberry Pi 400 won't replace the Raspberry Pi 4. The Raspberry Pi Foundation has confirmed that the two will be produced side by side for the foreseeable future, with the Raspberry Pi 4 targeting embedded and enthusiast users, while the Raspberry Pi 400 aims to tempt people looking for a ready-to-run, off-the-shelf experience.

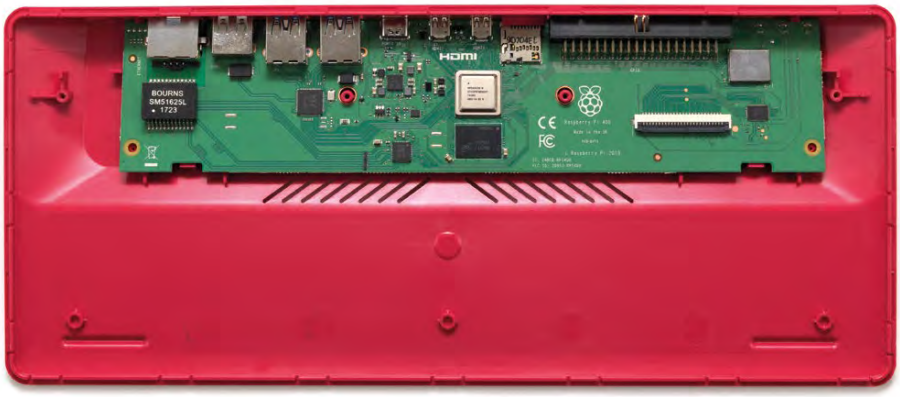
There's a decent amount of connection options, but no DSI, CSI or analogue AV

The CPU side of the BCM2711 system-on-chip runs at 1.8GHz

NEWS IN BRIEF

SiFive launches HiFive Unmatched RISC-V PC

SiFive has made good on its promise to release a high-performance RISC-V board for desktop PC use, unveiling the HiFive Unmatched in a mini-ITX form factor. Based on the company's latest 64-bit FU740 system-on-chip, the board includes four high-performance U74 cores alongside a real-time S7 core, 8GB of DDR4 RAM, Gigabit Ethernet and PCI-E expansion. It also accepts standard ATX power supplies as well as micro-SD and M.2 storage devices. Pricing has been set at $665 US (around £500 ex VAT) board-only. You can visit **sifive.com** for more information.



The board inside the keyboard is the largest Raspberry Pi yet

REVIEW

RetroFlag NESPi 4

RetroFlag's latest case is a convincing NES replica with a few unfortunate design flaws

The standardised form factor of the Raspberry Pi family of single-board computers – or, at least, the Model B variants – has given rise to a wealth of interesting case designs, many of which try to add new features alongside protecting the circuitboard.

The launch of the Raspberry Pi 4, which altered the layout just enough to make older cases incompatible, was a time for manufacturers to refresh and rethink their designs, and RetroFlag has stepped up to the challenge.

Designed as an update to the NESPi, a Raspberry Pi 2 and 3 housing that mimics the outward appearance of a shrunken Nintendo Entertainment System (NES) console, the NESPi 4 is a complete redesign. That much is obvious at first glance: the case is around twice the size of the original, despite housing a Raspberry Pi board that's no bigger than its predecessor.

Some of the additional bulk has gone on creating a more logical layout. The front-facing Ethernet port, bizarrely hidden under the fake cartridge flap on the original, is gone, in favour of having the port at the back, next to two micro-HDMI ports, a 3.5mm analogue audio jack and a USB Type-C power input.

You also get a physical, and fully removable, replica NES cartridge. Far from being a showpiece, the cartridge has a real-world purpose – to house a 2.5in hard drive or solid-state drive SSD, which connects to a SATA-to-USB bridge found inside the case. It's a neat trick, although it only supports drives with a 7mm thickness – you can only install a 9mm-thick drive if you're willing to remove the upper half of the cartridge housing and risk not being able to remove the drive again once it's installed.

Putting a cartridge under the cartridge slot has come at a cost though. Where the original NESPi has four front-facing USB ports, the NESPi 4 has only two – one USB 2 and one USB 3. The Raspberry Pi 4's remaining USB 3 port powers the SATA-to-USB bridge.

The case includes a screwdriver, plus an active heatsink-and-fan assembly, designed – like the majority – to make contact with the system-on-chip and cool-running RAM module, but ignore the hot-running power management circuitry.

The fan gets its power from a dedicated daughterboard, which

The cartridge flap opens to reveal a shrunken NES cart, housing an optional 2.5in drive

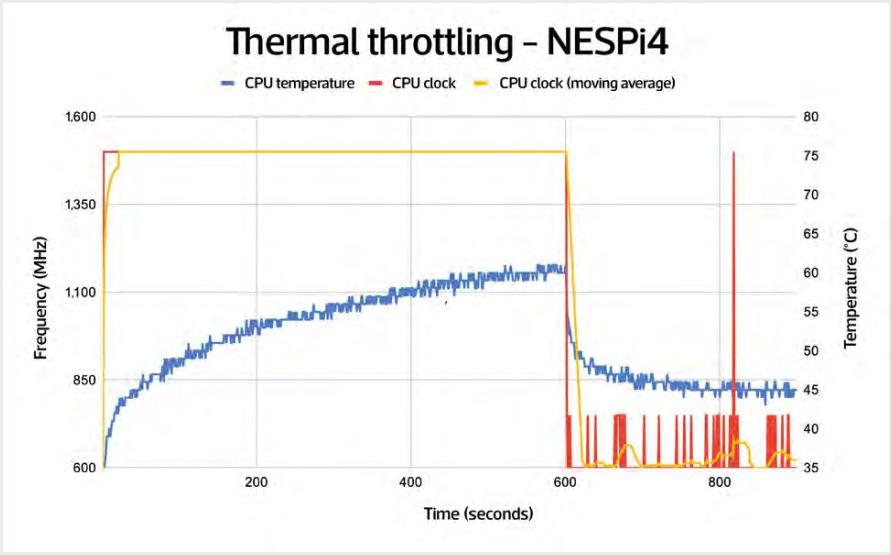
NEWS IN BRIEF

Arduino unveils Oplà kit

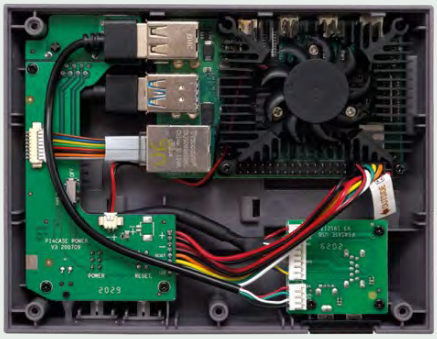
Arduino has launched a new kit designed to ease hobbyist and educational developers into the Internet of Things, called Oplà. Based on the company's MKR WiFi 1010 development board, the kit includes a custom-built carrier board with capacitive touch buttons, a colour LCD, RGB LEDs and sensing capabilities for temperature, humidity, pressure, light, gesture and proximity. There are also parts and documentation for building eight connected projects with smartphone remote control. The kit is available to purchase online now from **store.arduino.cc** for €99 (around £90 ex VAT) with a year's subscription to the Arduino IoT Cloud platform.

hooks into the Raspberry Pi 4 via its 40-pin GPIO header. The board sports a switch for 'safe power', which alternates between two modes. In the default mode, the front-facing power button acts as a physical toggle, providing power when depressed and cutting

The bundle is undeniably attractive, and feels pleasingly solid



The fan might be annoying, but it's also effective at preventing thermal throttling



The fan runs constantly in an attempt to fight the case's poor ventilation

the power when released. In its alternative mode, the switch triggers a safe shutdown script instead.

You'll need to choose wisely during installation – switching between the modes means unscrewing and reinstalling six case screws in order to remove the upper half of the case.

There are other signs that mistakes have been made in the case's design too. Ventilation is extremely poor for starters, which may go some way to explain why the fan is permanently powered on – there's no temperature-sensitive trigger or speed control. While it's not exactly loud, the fan does make an ever-present whine.

A bigger problem is in the use of a JMicron SATA-to-USB bridge, which is known to be incompatible with the Raspberry Pi's USB Attached SCSI (UAS) implementation. In testing, this reared its head when the read performance from a 2.5in SSD was measured in kilobytes, rather than megabytes, per second.

To be fair to RetroFlag, it's a relatively easy fix to switch from the UAS driver to USB Mass Storage. However, doing so limits the overall throughput, hitting 191MB/sec read and 173MB/sec write in testing compared to over 350MB/sec on a UAS-compatible bridge chip.

Another odd design choice can be seen in the front-facing USB ports. They're mirrored, meaning that a cable should be inserted into one with the USB logo to the right, but into the other with the USB cable to the left.

There are definite positives to RetroFlag's design. The housing is convincingly NES-like, although hopefully differentiated enough to appease Nintendo's legal team. The micro-SD storage compartment from the original is retained, now doubling as a hook to ease removal of the replica cartridge from its slot. Once it's assembled, the case has a pleasing heft and no flex or gaps to be found.

Whether these make up for its shortcomings is arguable. The core concept of the case is clever, but it feels like it needed more time on the drawing board before being released to manufacturing. A revised design with improved ventilation, a more compatible USB-to-SATA bridge, more USB ports and a fan with temperature-based speed control would be easy to recommend.

However, as it is, the NESPi 4 feels more like a missed opportunity than a must-buy. The NESPi 4 is available now from **pimoroni.com** for £28.50 (inc VAT).

REVIEW

Ubuntu 20.10 for Raspberry Pi

Canonical made a surprise announcement last year, pledging that it would support the Raspberry Pi family of single-board computers as a first-class citizen in its Ubuntu Linux distribution. While the company had already released Ubuntu images for the systems, it had initially concentrated on the embedded Internet of Things (IoT) sector.

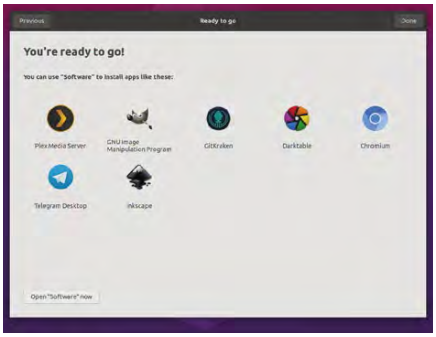
Even when general-purpose images of Ubuntu 19.10 'Eoan Ermine' were released for the boards, they arrived a month after general availability for the operating system and in server-only variants, although installing a graphical desktop was always a single command away.

Now, the company is making good on its pledge. Ubuntu 20.10 'Groovy Gorilla' was released for the Raspberry Pi at the same time as more mainstream computing systems, and includes a desktop image for the first time. 'In this release, we celebrate the Raspberry Pi Foundation's commitment to put open computing in the hands of people all over the world,' said Mark Shuttleworth, Canonical chief executive, at the time of the release. 'We are honoured to support that initiative by optimising Ubuntu on the Raspberry Pi, whether for personal use, educational purposes, or as a foundation for their next business venture.'

What that means for users is that it's now possible to write the Ubuntu 20.10 image to a micro-SD card, insert it into a Raspberry Pi and immediately boot into a graphical user interface with the same user-friendly configuration and installation wizard as you'd see on a desktop or laptop system.

Server images for Ubuntu 20.10 are available for the Raspberry Pi 3 and 4 families, including the new Raspberry Pi 400, and by switching to a 32-bit build, it's also installable on a Raspberry Pi 2T. The new desktop image, by contrast, is only compatible with the Raspberry Pi 4 and Raspberry Pi 400. The compatibility shrinks further when you look at Canonical's recommended specifications too – the company advises that the image is used only with models offering 4GB of RAM or above, with the 8GB model preferred.

It's an interesting warning, given that the Ubuntu Server image is supported so widely and can easily run a graphical desktop, but it appears to be the result of that 'first-class citizen' promise. Ubuntu Desktop 20.10 uses the same GNOME Shell desktop on Raspberry Pi as it does elsewhere, and it's not the lightest of interfaces. It's also not the most responsive: head-to-head testing between Ubuntu Desktop 20.10 and the latest Raspberry Pi OS on a Raspberry Pi 4 Model B 8GB showed a big gap in responsiveness in Raspberry Pi OS' favour.

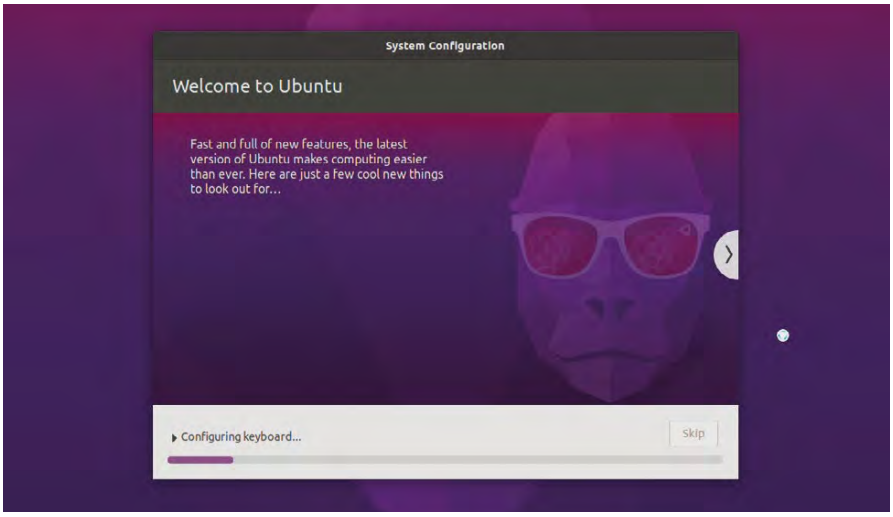


You can install a range of applications quickly and easily, including 'snap' packages

There are advantages to using Canonical's Ubuntu Desktop image, though, not least of which is the fact that it's identical in appearance and operation to its mainstream builds. If you can use Ubuntu on a desktop or laptop, you can now use it on a Raspberry Pi with no learning curve. For most users, though, the relatively poor responsiveness – even against using the Ubuntu Server 20.10 image and manually installing a lightweight desktop environment such as LXDE or Xfce – could lead to frustration.

In the majority of Raspberry Pi use-cases, Raspberry Pi OS remains the operating system to beat – and the introduction of a 64-bit build, currently progressing through public beta, wipes away one of the last remaining reasons to use any other OS. Its memory footprint is lower, its responsiveness higher and the overwhelming majority of commonly requested software packages are readily available in its repositories.

Ubuntu Desktop 20.10 for Raspberry Pi is available from **ubuntu.com/download/raspberry-pi** now. CPC



Unlike earlier images, the Ubuntu Desktop build offers a graphical configuration wizard

Gareth Halfacree is a keen computer hobbyist, journalist, and author. His work can be found at **freelance.halfacree.co.uk** @ghalfacree

WIN

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Hey you, would you like a brand-new 34in gaming monitor absolutely free? Then you'll want to enter our competition this month, where one lucky **Custom PC** reader will get a curved iiyama G-Master GB3466WQSU Red Eagle monitor sent to their home.

SPEC

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- 3,440 x 1,440 resolution
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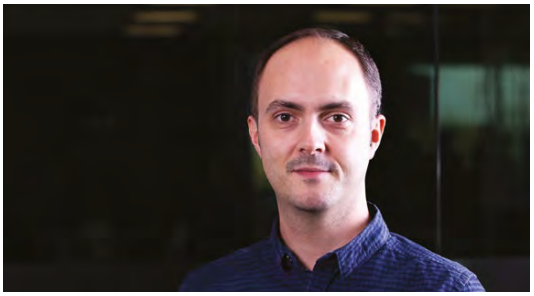
- Stereo 3W speakers
- USB 3 hub

Immerse yourself in the game with the iiyama GB3466WQSU Red Eagle with FreeSync Premium Pro. The 1500R curved VA panel, with its 144Hz refresh rate, 1ms MPRT and 3,440 x 1,440 resolution, guarantees superb image quality and a comfortable, realistic viewing experience.

The height-adjustable stand ensures total flexibility for your perfect screen position. Customise the screen settings using the predefined and custom gaming modes, along with the Black Tuner function to give you total control over the dark scenes and make sure details are always clearly visible.

Meanwhile, the VA panel guarantees an excellent contrast ratio, making all the nuances between light and dark colours clearly visible.

SUBMIT YOUR ENTRY AT **CUSTOMPC.CO.UK/WIN**



ANTONY LEATHER'S

Customised PC

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

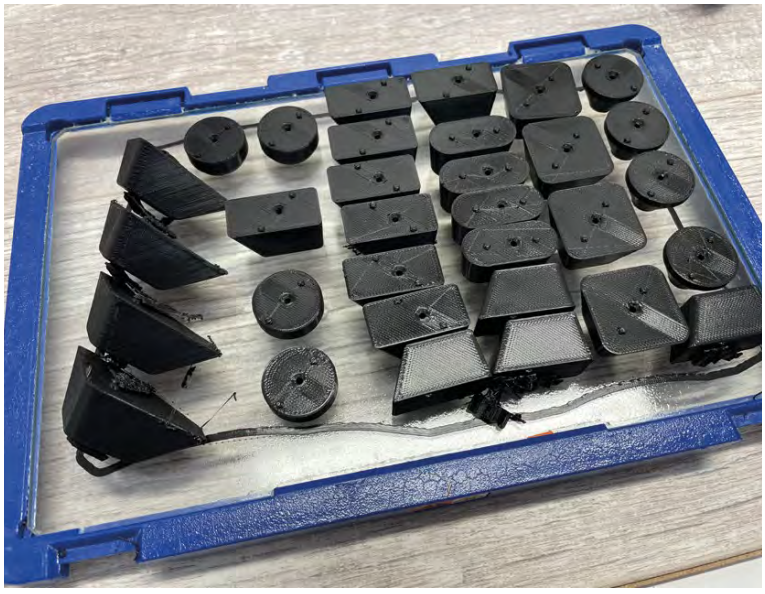
Get a 3D printer

I've touched on 3D printing numerous times in **Custom PC** and reviewed a few 3D printers as well. They're fantastic nerd toys, but also highly useful tools that can create replacement parts for all manner of objects, as well as creating new parts to make devices look or work better.

The ease with which you can design and print your own objects is amazing these days, and it's not hard to transition from downloading prerendered files to creating your own ones.

I can thoroughly recommend Tinkercad (**tinkercad.com**) as a free online tool that's surprisingly detailed and flexible. There's plenty of 3D printers that are up to the task of dishing out high-quality prints in a variety of materials too, and you certainly don't need to spend thousands of pounds.

I've had a few issues with certain materials, though, such as PETG, which I found tricky to get to stick to the print plate. Some of the wood-effect materials also needed a lot of research to get working well, but it's easier to work with materials such as PLA, which seem to be more forgiving. The fact that the print spools leave you with plenty of change from £20 mean this practice won't cost the earth either.



Cooler Master offers a range of different case feet designs for the Master Case NR200P

There are admittedly some moderately steep learning curves, but as soon as you make the transition to creating your own objects, the sky is the limit, and I've even started making objects that I use regularly, as well as parts for my PC. These can include motherboard I/O shrouds, plus mounting points for case modding parts and water-cooling components.

For this reason, I can thoroughly recommend owning a 3D printer, especially if you like PC modding. Some projects on which I've worked would either have taken a lot longer without

it, or would not be possible at all. My 3D printer is that valuable and useful.

One part that's easy to make and install on any case are feet. Even if your case comes with them, you can create your own feet in a wide range of colours and shapes. Companies such as Cooler Master offer various 3D-printable design files too, so there are already some options to get you started. In this month's guide (see p100), I take a look at designing and printing your own case feet, as well as discussing where to download files others have created, plus how to fit them to your case.

It's a fun project that doesn't take long, and you can even tweak aspects such as the height to lower or raise your PC too.

You can make all manner of objects with 3D printers, including very useful desk tidies

Excited for AMD's Precision Boost Overdrive 2

I haven't had a chance to play with AMD's Precision Boost Overdrive 2 yet, but this latest boosting technology to land on the AM4 platform, specifically for Ryzen 5000-series CPUs, is intriguing for a number of reasons.

Firstly, unlike many previous iterations of AMD tools that achieve high boost speeds without manual overclocks, it can impact on the peak single-core boost speed too, seeing frequencies top 5GHz. In addition, there's the potential to cut power and thermals by undervolting your CPU, reducing the power it draws and cutting heat in turn.

That could be especially useful to owners of small form factor PCs, where clunky manual undervolting is commonplace.

It's an interesting move from AMD, and I wonder why it wasn't released alongside its Zen 3 CPUs at launch. However, given that widespread compatible BIOS versions are still not here yet, it's likely that it wasn't quite ready for release, possibly because of the current pandemic.

Just as interesting is the fact that this extra layer of tweaking can be performed on a per-core basis, so there's scope for fine-tuning your CPU's best cores while still allowing the others to behave normally – this hasn't been possible before with Ryzen overclocking. I'll be taking a look over the next few weeks, so hopefully I'll have a full report on Precision Boost Overdrive 2 in our next issue.

Hands-on with EKWB's FLT reservoirs

The reservoir can often make or break a water-cooling loop, especially when it comes to smaller systems. The ability to find a reservoir that fits into a small case, or allows you to use features such as extra hard disk trays is important, as normal pump/reservoir combos are huge.

There's plenty of smaller options, though, and I've used many in my time water-cooling PCs. My current favourite is the relatively new EKWB FLT design. A flat, square reservoir, the FLT needs minimal space to install and thanks to its flat sides, it can be secured using heavy-duty mounting tape if necessary. However, mounting plates are also included that enable you to fit it to 120mm fan mounts.

The reservoir comes in various guises, all with digital RGB lighting by way of a standard 3-pin connector, so it can be controlled using your motherboard. There are either D5 or DDC pre-installed pump options, both with PWM control, a third option that works as a standalone reservoir, and a fourth version that has a vacant pump port allowing you to install your own D5 or DDC model. There are 120mm, 240mm and 360mm sizes too.

EKWB's FLT reservoirs look great and can act as standalone or pump combinations

It's a handy gadget, with its total of six ports allowing you to run tubing from various directions.

It does a good job of bleeding loops of air, and is easy to fill thanks to a top-mounted fill port on the front of the main reservoir. AMD fans may well like this new AMD-branded model with an illuminated logo too.

They're a tad pricey at £150 inc VAT for the smallest 120mm model, which includes either pump type, with the pumpless model still demanding £100. However, they're extremely well made and look edgier than typical tube reservoirs. CPC

Antony Leather is Custom PC's modding editor @antonyleather

How to 3D-print case feet

Antony Leather shows you how design, download and 3D-print a new set of feet for your case

TOTAL PROJECT TIME / 4 HOURS

If you want to customise your PC's case, but don't want to drastically alter its appearance, or mess with spray paints and Dremel tools, then 3D printing could be for you. It's easy to design and 3D-print objects such as case feet, which can add a subtle difference to your case compared with its out-of-the-box configuration, and you can create feet in all manner of shapes and colours too.

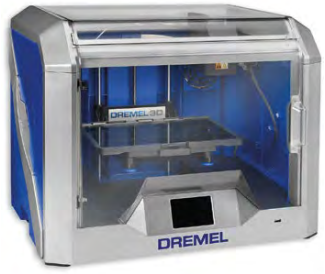
They're especially effective on smaller builds, but you can also use your own custom feet to raise your case off the floor for better cooling, or to allow extra fans to be installed. Some case manufacturers even offer pre-rendered case feet files for you to download for free and print at home. In this guide, we'll look at where you can find pre-rendered files, how to design them yourself in Tinkercad and how to fit your finished feet to your case.

TOOLS YOU'LL NEED

3D filament (if printing at home)
amazon.co.uk

Self-adhesive neoprene
ebay.co.uk

Self-tapping screws
Most hardware stores

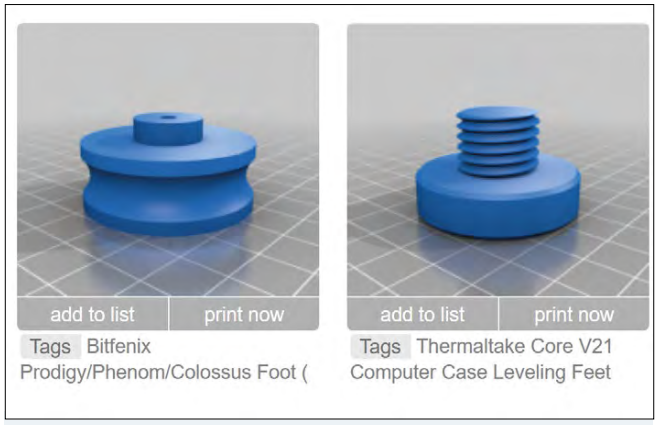


3D printer or print service
3dprint-uk.co.uk

Gorilla Mounting tape
Most hardware stores

1 / CHECK MANUFACTURER'S WEBSITE

Many case manufacturers offer downloadable files for 3D printers, which makes it super-easy to create your own feet. Cooler Master has half a dozen designs ready to go for its Master Case NR200P, for example.



2 / CHECK 3D OBJECT DATABASES

Failing that, you can search the vast databases of 3D objects for files that other hobbyists have created first. Be sure to check for any instructions, and ensure that they're for your specific case model.

3 / DECIDE ON COLOUR

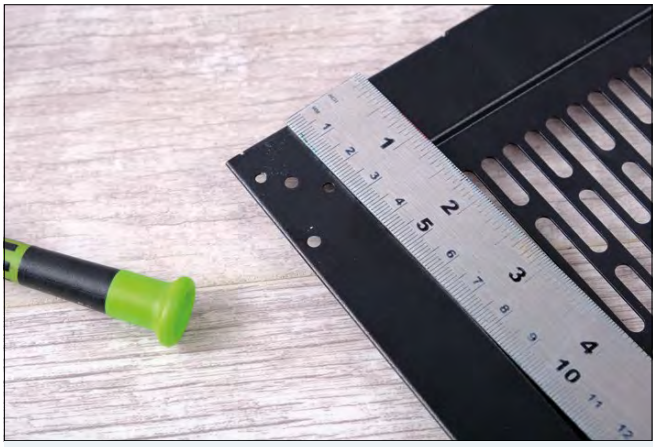
Whether you're printing at home or sending your files away to be professionally printed, there are dozens of colours from which to choose, and you can even get 3D printing filaments with wood and metal effects.

4 / CHECK FOR SCREWS

To remove your stock case feet, first identify any screws or bolts holding them in place. They will likely be located above the case feet inside the chassis.

5 / REMOVE CASE FEET

Remove any hardware blocking your efforts, then unscrew any bolts or screws and detach the case feet. Keep them in the case's box, so you know where they're located in case you want to sell the case at some point in the future.

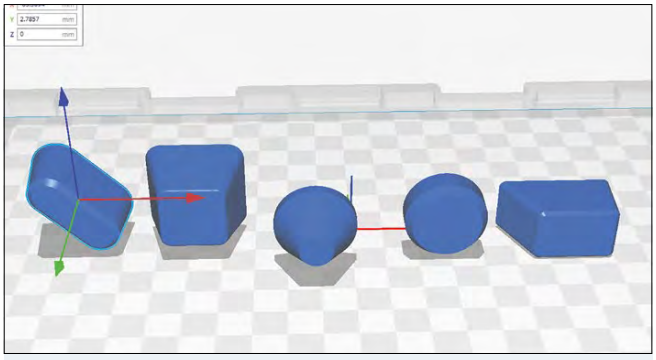


6 / MEASURE DIMENSIONS

If your case has specific mounting points, use a ruler to accurately measure the size of these areas. Alternatively, measure the areas that you could potentially use to mount a new set of feet.

7 / CHECK FOR RUBBER PADS

If your case uses rubber pads to reduce vibrations then it's well worth adding these pads to the new case feet. Most of them are embedded into the feet, so you'll want to create a similar design with your new feet.



8 / CHOOSE FEET DESIGN

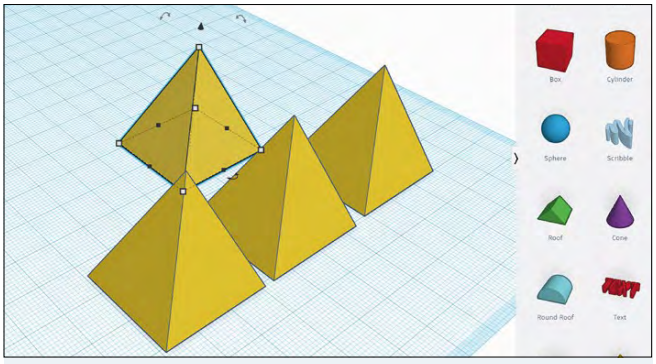
You can create feet of almost any shape, but avoid any spindly designs, especially if you'll be moving the case a lot. You'll also need to make it 3D printing-friendly, so ensure there's one flat side for the base with no large holes or overhangs.

9 / CONSIDER EXTERNAL COMPONENTS

You can lower your case by using thinner feet than the stock ones, or raise it with taller ones, perhaps making way for an external fan or even a radiator. Now is the time to consider doing the latter and working out how much room you'll need.

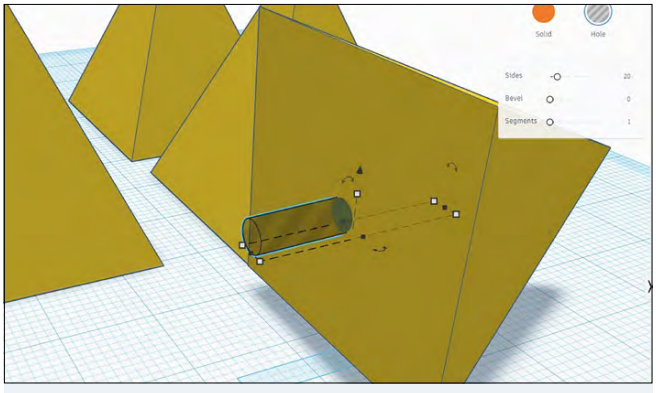
10 / MEASURE CASE

If you want to add fans underneath your case, put them in place and allow at least 15mm between them and the floor, so there's room for them to breathe. Make sure your feet are tall enough to allow for that amount of breathing space.



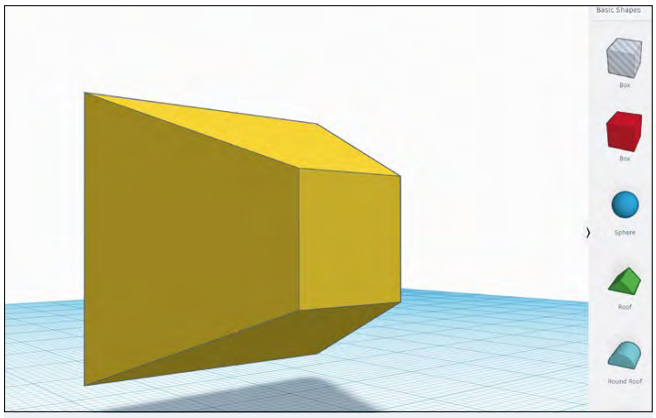
11 / CHOOSE MOUNTING METHOD

If you're making your own feet design, first consider how you'll mount them. It's possible to use heavy-duty mounting tape, especially with large feet, but it's usually best to create mounting points such as screw holes. We recommend using Tinkercad (**tinkercad.com**) to create 3D-printable objects.



12 / INSERT MOUNTING POINTS

To create a screw hole, make a cylinder object a little smaller than the thread of the screws you intend to use. Place it in the right location and then convert it to a hole object. Group the projects and you'll have a small, neat hole in your case foot.

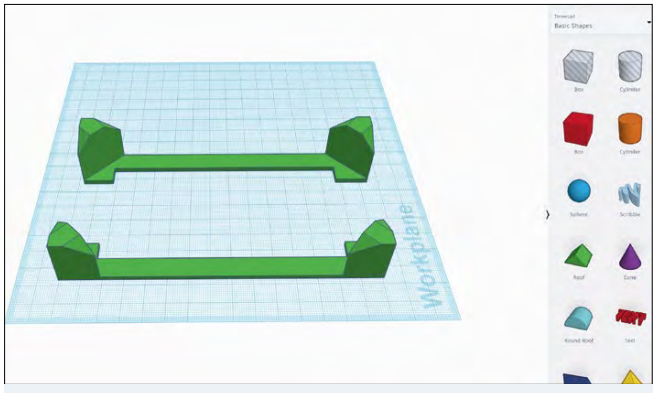


13 / ALLOW FOR RUBBER PADS

It's always a good idea to install some kind of anti-vibration pads between the case feet and floor or desk. Create small flat areas in the design to apply rubber pads.

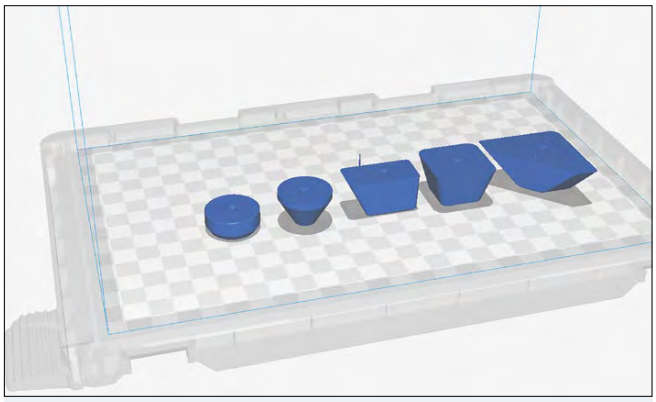
14 / MEASURE LARGER CONTACT AREA

If you want to use mounting tape to avoid drilling holes, it's a very good idea to link your feet together across your case, from side to side, rather than front to back. This allows you to use more tape and provides extra support.



15 / CREATE LINKED FEET

Creating linked feet will provide better support, especially if they're small. Create your feet using the cube tool, then link them with a long, flat rectangular section using the same tool. Click the Group button at the top of the page to join them into a single object.



16 / ALIGN FOR PRINTING

Your feet need to be aligned for problem-free printing, so you need a flat base with no large overhangs. Rotate them until they're in position, then group them close together to reduce print times. For example, the feet for the NR200P case have small pins on one end, which will need to face upwards.

17 / PRINT YOUR FEET

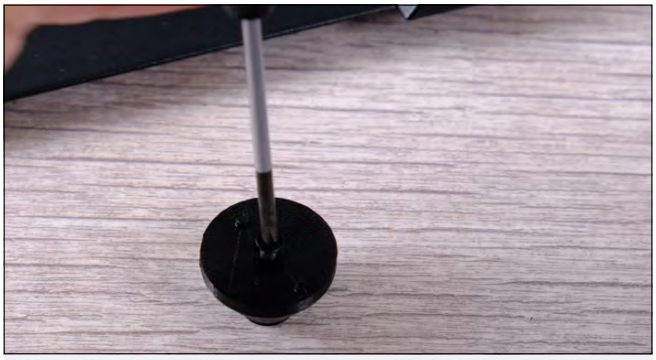
Now go ahead and print your feet using your printer. PETG is a good material, as it's tough, but PLA also works well. If you don't have a printer, there are plenty of online services such as **3dprint-uk.co.uk**, which can do this job for you.

18 / REMOVE SUPPORTS AND STRAY FILAMENT

Once the feet are printed, remove any stray filament and supports used to fill in holes and overhangs. You can use a cocktail stick to dig out support material from smaller openings.

19 / TEST-FIT FEET

Once your objects are clean, test-fit them on the case. The Cooler Master case feet come with small support pins, so make sure they slot into place correctly if your feet also use support pins.

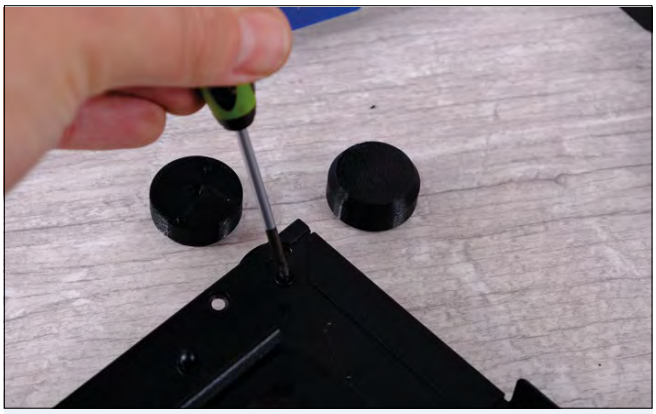


20 / TAP IN SCREW

Check the screw holes line up correctly, and then insert a screw with a reasonable amount of force out of the case first. Our Cooler Master example case uses self-tapping screws, which will need to bite into the plastic, and we recommend using these screws for your feet too.

21 / ALIGN FEET CORRECTLY

Some feet are aligned to the right or left side of the case, so identify the right location first before mounting them. The pins on top can only be aligned one way, so use them as guides.

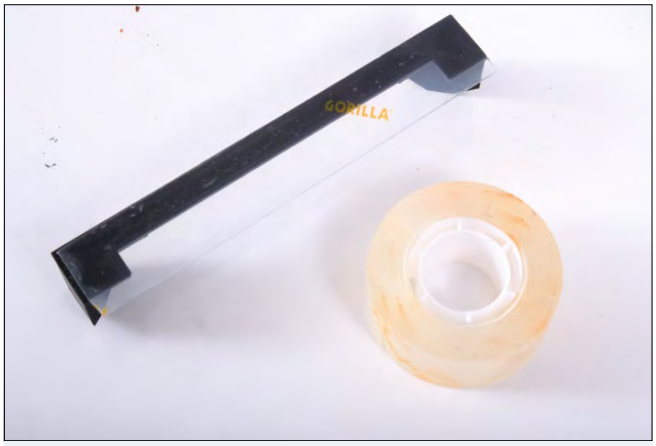


22 / SCREW IN PLACE

With the thread hole-tapped using the screw, go ahead and insert the foot into the case, then insert the screw firmly to secure it.

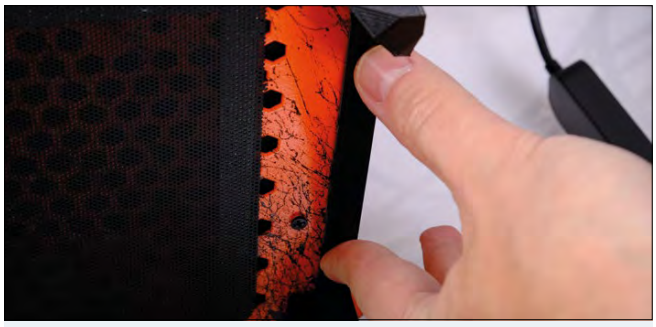
23 / TEST-FIT LINKED FEET

If you've chosen to create linked feet without screws, test-fit them on the base of the case before you reach for the mounting tape. Make sure the surface is even and that no protrusions will prevent the adhesive from doing its job.



24 / APPLY MOUNTING TAPE

We've used Gorilla mounting tape to secure the feet in our example. Place strips covering the entire top side of the feet and then trim them to size. Avoid removing or touching the tape, as this can affect its adhesion.



25 / PRESS ONTO CASE

Press the feet firmly into place with reasonable pressure, making sure to apply force along the entire length. The whole section should feel firm, and not wobble back and forth.

26 / CUT RUBBER PAD TO SIZE

Finally, whatever feet you decided to print, cut the rubber pads to size, so they fit on the ends of the feet. We've used 3mm self-adhesive neoprene for ours. Remove the backing and then press firmly to stick the pads in place.

27 / TEST CASE FEET

Even small cases can weigh a considerable amount once packed full with hardware, so it's important to test the feet to make sure they're up to the job. Place an object such as a book under the PC so it won't have far to fall if the feet fail. CPC

Folding@home

Join our folding team and help medical research

ACTIVE USER MILESTONES

USERNAME	POINTS MILESTONE
Desertbaker	3,000,000,000
BeezaBob	900,000,000
Jobjohn	600,000,000
BurnedFastfood	400,000,000
gKitchen	100,000,000
mort6dav3	100,000,000
meandmymouth	100,000,000
dis80786	90,000,000
phys1csb0y	90,000,000
40138	90,000,000
fatchef	90,000,000
Macrosb	70,000,000
Bedders	70,000,000
Count_Stex	60,000,000
Will_Walton	60,000,000
GreenPig	50,000,000
Liaw_Jun_Xian	50,000,000
YCDCN22	40,000,000
Manda_Chuva	30,000,000
bytemarq	30,000,000
TokerRizla	20,000,000
Bluce_Ree	20,000,000
ArtMovesTheSoul	20,000,000
PeteUKLancs	20,000,000
andysroms.com	10,000,000
crazystuntman	10,000,000
Curtis.Perdue	10,000,000
sparrowm7	10,000,000

USERNAME	POINTS MILESTONE
markdiss	9,000,000
Pedro8888	8,000,000
TheLimey	7,000,000
G4zm4n	7,000,000
leeoliver24	6,000,000
Drystan14	5,000,000
jettison_theory	4,000,000
Shiny-Robot	4,000,000
TheTalisman	3,000,000
Braeden	1,000,000
Bloo_Town	1,000,000
Bazil	1,000,000
raptor4216	800,000
Wenna	700,000
filreed	600,000
geofftswin	600,000
neo-internalforce	300,000
battletux	100,000
topshed	90,000
Tom	40,000
dhhowells	30,000
l3oris	8,000
giobusca	6,000

WHAT IS FOLDING?

Folding@home uses the spare CPU and GPU cycles for medical research, with a current focus on COVID-19. You can get the client from **foldingathome.org/start-folding** and our team's ID is 35947. Once you pass a significant milestone, you'll get your name in the mag – we'll print all the milestones we can fit on the page. You can discuss folding with us and other readers online at the bit-tech forums (**custompc.co.uk/FoldingForum**).

TOP 20 PRODUCERS

RANK	USERNAME	DAILY POINTS AVERAGE	OVERALL SCORE
1	Dave_Goodchild	22,041,995	2,582,498,006
2	DocJonz	16,091,327	13,637,105,011
3	Desertbaker	8,404,549	3,164,070,857
4	tarka_dahl	6,727,003	1,244,011,215
5	Lordsoth	5,948,947	4,906,066,711
6	Slavcho	4,907,794	3,468,846,064
7	Shirty	4,097,180	5,181,021,813
8	BurnedFastfood	3,082,214	428,320,552
9	Votick	2,360,228	284,758,832
10	sonic_vortex	1,679,003	631,779,150
11	kcanti	1,629,795	894,315,896
12	GWallace	1,492,560	297,612,949
13	Curtis.Perdue	1,368,523	15,358,122
14	KevinWright	1,287,052	1,290,471,920
15	rjcman	1,164,183	320,289,062
16	Dickie	1,159,243	1,178,255,900
17	madmatt1980	1,142,832	766,297,304
18	Little_Willie	1,138,271	372,388,676
19	gKitchen	1,129,567	124,203,189
20	PC_Rich	1,021,569	6,347,878,947

TOP 15 OVERALL

RANK	USERNAME	POINTS	WORK UNITS
1	DocJonz	13,637,105,011	332,915
2	PC_Rich	6,347,878,947	163,840
3	Shirty	5,181,021,813	39,335
4	Lordsoth	4,906,066,711	177,625
5	Nelio	4,638,586,520	523,610
6	HHComputers	3,544,050,839	85,007
7	Slavcho	3,468,846,064	70,550
8	Desertbaker	3,164,070,857	64,210
9	piers_newbold	2,703,256,197	107,638
10	Dave_Goodchild	2,582,498,006	155,089
11	Scorpuk	2,544,545,152	57,727
12	clanseven	2,223,720,446	33,156
13	Unicorn	1,753,462,654	57,079
14	daxchaos	1,637,104,710	41,302
15	Laguna2012	1,527,029,380	51,930

Retro tech

WINDOWS 1

35 years ago Microsoft finally launched the first version of Windows. **Stuart Andrews** looks back to where Windows started, and tries using Windows 1 again for himself

It's now more than 35 years since Windows launched in November 1985, 18 months behind schedule and almost three years after Apple's Lisa had introduced the first commercial GUI. It wasn't exactly a hit; it flopped commercially, while reviewers criticised its performance and wondered whether some of its most powerful features were really that useful. Yet less than five years later Windows dominated the operating system market, running on over 70 per cent of all personal computers sold. You can see Windows 1 as the ugly duckling that was to transform into the, well, still gruesome but enormously successful swan.

It wouldn't require a hard drive and it would run with just 192KB of RAM

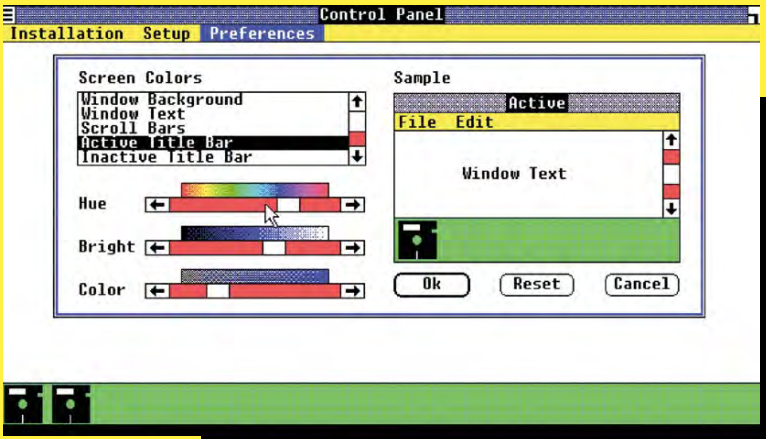
MAKING WINDOWS

Windows began its journey in the autumn of 1982. Microsoft's CEO Bill Gates was already aware of research into mouse-driven, graphical user interfaces at the legendary Xerox PARC, and of Apple's continuing work on the same principles. However, the story goes that Gates attended the autumn 1982 Comdex trade show in Las Vegas, where he saw VisiCorp demonstrate Visi On: a GUI for the IBM PC. Gates is said to have watched the demo several times, back-to-back, before suggesting that other Microsoft personnel needed to come out to Comdex and take a look. If GUIs were the future, Microsoft wanted a piece of the action.

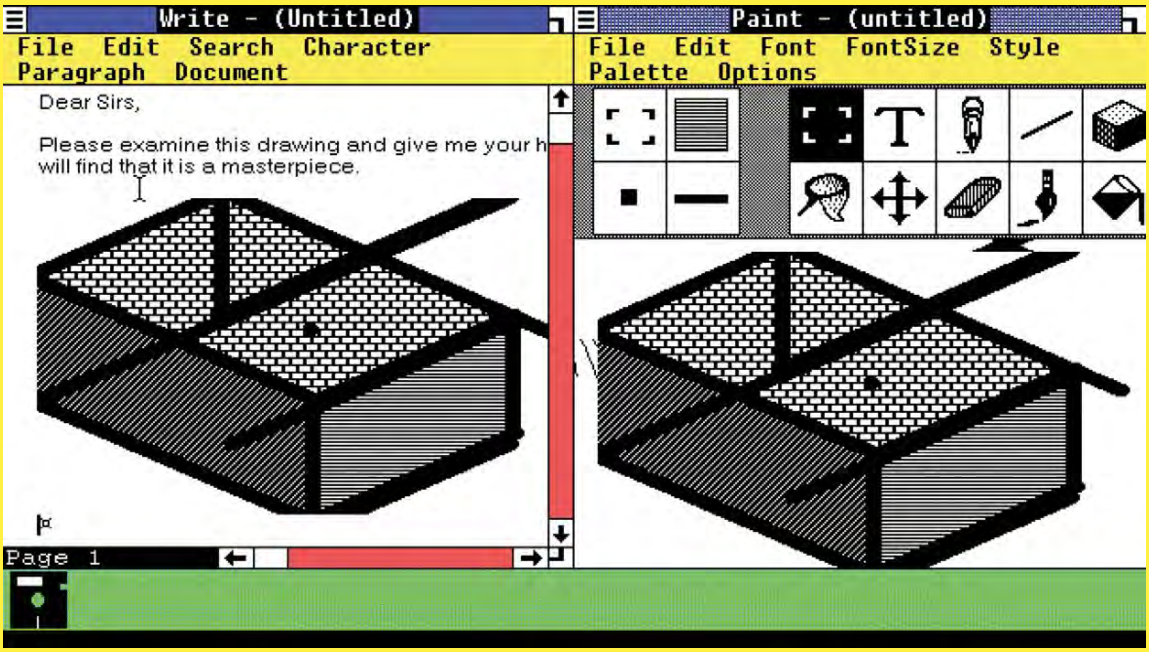
At this point Microsoft wasn't the huge tech monolith we know today. It was still a small company that had grown successful on the back of Microsoft BASIC and MS-DOS. Gates saw an appetite for a new and easier way to work with the personal computer, and that rival systems were either too expensive – an Apple Lisa cost around $10,000 US, while you could buy a PC for under $3,000 – or too demanding in their system requirements. If it wasn't bad enough that Visi On needed a staggering 512KB of RAM and a hard disk, its applications needed to be coded in a specific version of C using Unix tools. This left space for an alternative.

Gates hired Scott McGregor, one of the key developers at Xerox PARC, and set a team to work on a project codenamed Interface Manager. Crucially, it wasn't seen as a complete OS, but as a graphical environment that ran on top of MS-DOS. In November 1983, Gates announced Windows and set its release date for April 1984.

The hype said Windows would bring a new way to use PCs. It wouldn't require a hard drive – just two floppy disk drives – and it would run with just 192KB of RAM. By December 1983, an early version was previewed for an article in Byte magazine, with its writer, Phil Lemmon, arguing that 'Microsoft Windows seems to offer remarkable openness, reconfigurability and transportability, as well as modest requirements and pricing'. The result,



Even in the first release, there were options to personalise Windows, although good luck finding a colour scheme that didn't look horrific



Cutting, copying and pasting were revolutionary new ideas, enabling you to move information from one app to another

Lemmon thought, could bring computing to a new, non-technical audience.

Why, then, did it take another two years to get finished? For a start, there were some major technical challenges. When development started, standard CGA screen resolutions were limited to 640 x 200 in monochrome, and it was only with the development of EGA graphics boards in late 1984 that you had enough pixels to make Windows effective. The slow speeds and limited capacity of floppy disks had an impact, while the Intel 8088 CPUs used in most PCs weren't exactly bursting with firepower.

Perhaps worst of all, there was a challenge in building industry support. As Gates said in 1983, 'the primary focus of the company and the speeches I gave, the promotion I did, was to get people to believe in the graphics interface whether it was Macintosh or Windows, and that was a tough thing because people like WordPerfect and Lotus refused to put the resources into doing applications'.

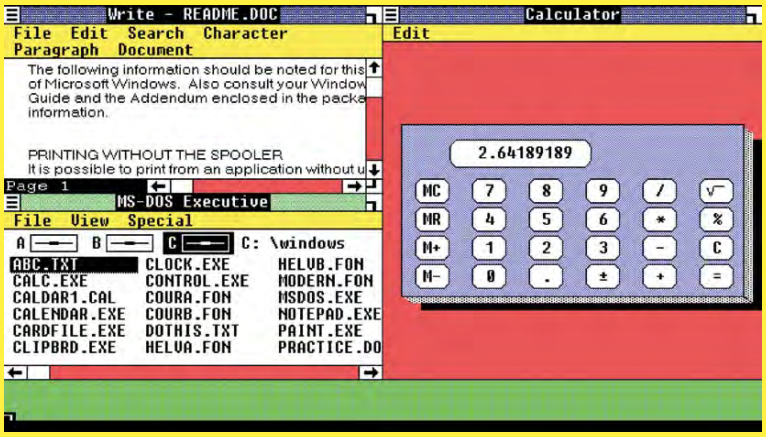
Some believe that other factors were in play. By 1984 Microsoft was working with Apple on Macintosh software, and had signed licensing agreements for specific UI elements, but not others, including overlapping windows and the Recycle Bin. It's possible that Microsoft reworked Windows to avoid including these elements and triggering future litigation. If so, Microsoft wouldn't admit it. A November 1983 article in the US computing mag, Infoworld, suggested that Microsoft's Steve Ballmer saw tiled windows as delivering a neater desktop.

A DEVELOPMENT DISASTER

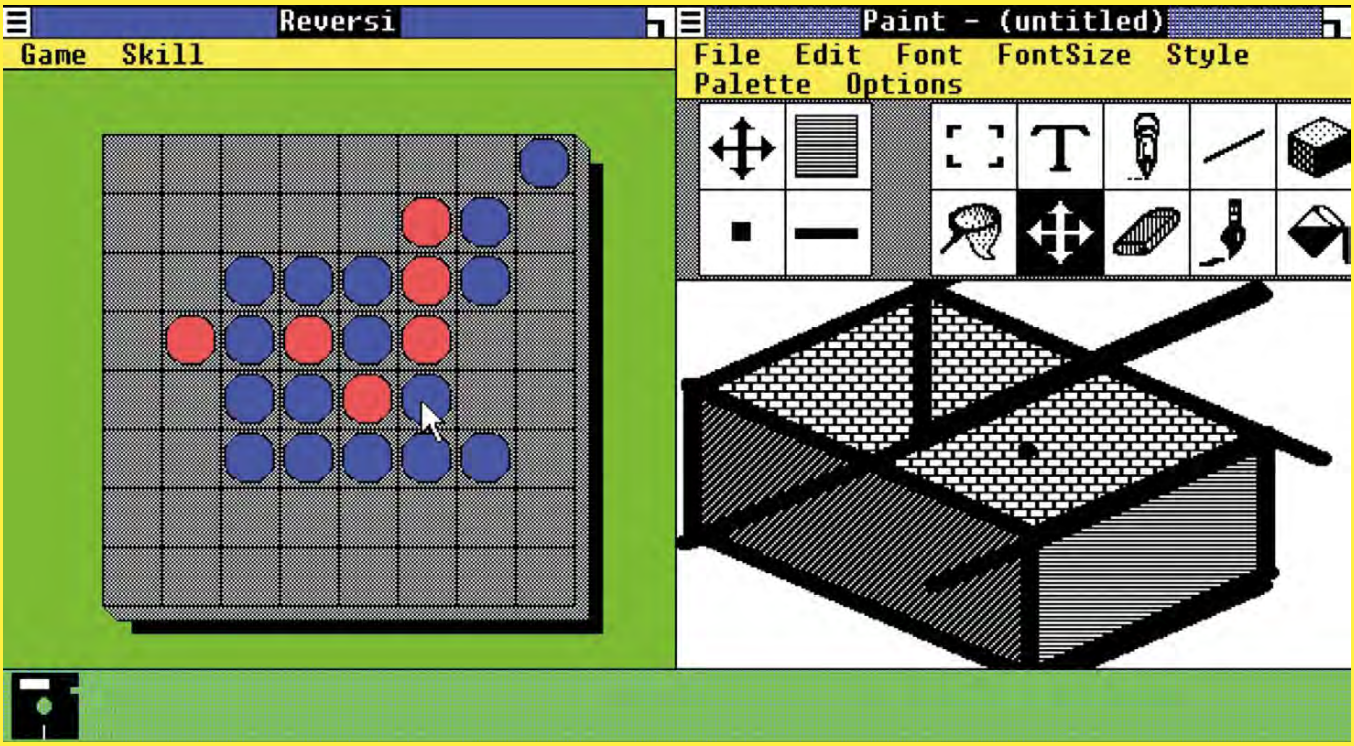
Whatever the case, the development of Windows was definitely troubled. Tandy Trower came in as the product manager in autumn 1984, at a point where Windows was seen externally as vapourware and internally as an embarrassment. Trower even saw being put in charge of the project as a step towards getting fired. By this point Scott McGregor had resigned, and while the core components were in place, elements of the design and the look weren't working. More seriously, there weren't any applications.

'Even at Microsoft, getting developers to write Windows software was a challenge,' said Trower in a 2010 interview. 'I couldn't even get my former team to build a version of BASIC.' However, there was a prototype of a simple bitmap drawing program, while Trower persuaded Gates and Ballmer that Windows needed a set of simple applets, including a word processor, calendar and business card database.

What's more, Trower made it a requirement that Windows could run existing DOS applications. This in itself proved awkward – many DOS apps exploited tricks or workarounds that caused problems for Windows memory management – but it was a major boost to Windows in the future.



You could run three or four applications at once, provided you could tolerate painful slowdowns and a lack of screen real estate



Lack of app support was such a problem that the Windows team developed its own paint programs, utilities and games

By the early summer of 1985 Windows still wasn't finished, but Ballmer decided to release a 'Premiere Edition' to application developers and members of the press. The team went into crunch, to the extent that one young program manager, Gabe Newell (yes, that one) started sleeping in the office. Even at the last stages, new defects were found in the memory management code, delaying the release even further. It was only in November that testing Windows was finished, to be released at Comdex 1985 with a comedy roast where Microsoft poked fun at its own product's lateness.

Even selecting from a pull-down menu is different, involving a click, button-hold, select and release process

MALIGNED AND MISUNDERSTOOD

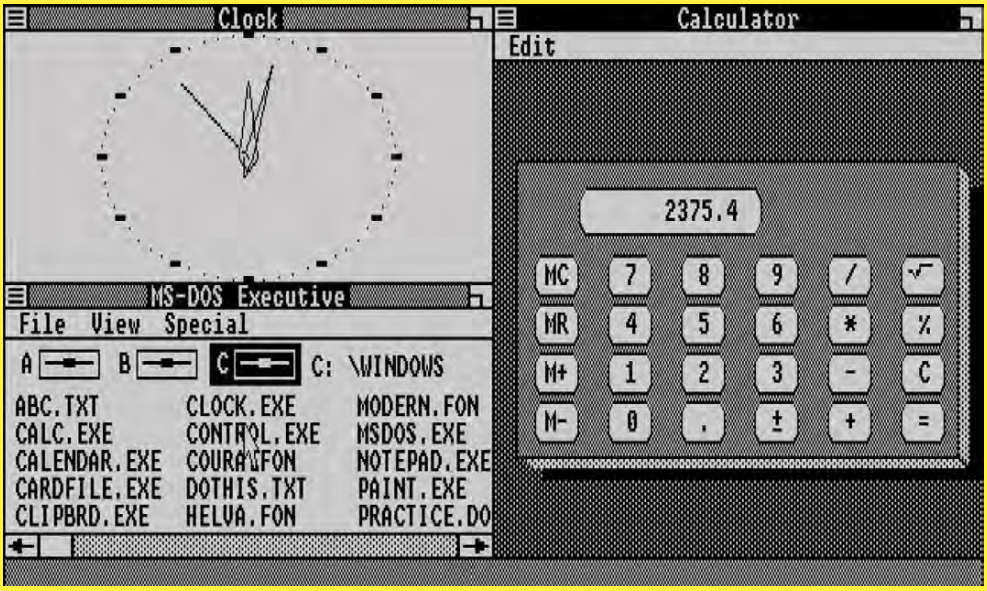
You might have expected the response to be rapturous, but – as with so many Microsoft products – there was disappointment and bemusement. InfoWorld ran its review with the headline 'Windows Requires Too Much Power' and gave it 4.5 out of 10. A piece by Erik Sandberg-Diment for The New York Times called Windows extremely memory-hungry. 'Running Windows on a PC with 512K of memory', he noted 'is akin to pouring molasses in the Arctic. Also, the more windows you activate, the more sluggishly the program makes its moves'.

Most of all, pundits weren't convinced that Windows solved any genuine problems. Some didn't see the point of the mouse or the GUI. Sandberg-Diment had his doubts about dialogue boxes, suspecting that most people would prefer 'a more direct means of executing commands.' He also felt that multi-tasking was a waste of effort. 'Most people use but one program most of the time, if not all the time,' he suggested. That's aged well.

USING WINDOWS

So how successfully did Windows 1 lay down the foundations for the Windows we know and sort of love today? Well, it has to be said that it's a very different experience. There's no desktop and the management of windows is incredibly primitive. While it is mouse-driven, icons don't play a starring role. Instead, you launch applications by double clicking on a list in the MS-DOS Executive – a simple file manager that lists not just the programs, but all your MS-DOS files.

The first application you launch occupies the whole screen, and subsequent applications split the screen into two, three or four. Once windows are in place you can close, maximise or resize them, or move them from one half or corner of the



If you didn't have the cash for a new-fangled EGA card, you were stuck with the even lower-res, black and white CGA version

screen to another. But with no overlapping, space gets tight pretty quickly, and the size of the fonts and the blocky graphics mean you don't always get enough room per application to make head or tail of what's going on.

There's no taskbar, but icons for the MS-DOS Executive and any minimised applications appear in a space at the bottom of the screen, where a double click will bring them back into view. There's also a Control Panel where you can set the time and date, adjust your cursor preferences, add fonts and set up your colour scheme. Of course, the EGA standard only supported a maximum of 16 colours from a gamut of 64, while only seven fonts were available on release.

Even some Windows fundamentals don't work like we expect these days. Drag and drop is as non-existent as the old Recycle Bin. Today, we also forget how Windows was so keen to demand double clicks when a single click would do. The menu bar is in place, with a button in the top-left corner where you can resize, move, close, maximise and minimise the window, but the latter two options are called Icon and Zoom. Even selecting from a pull-down menu is different, involving a click, button-hold, select and release process that feels utterly alien now.

The next shock is the primitive built-in applications. Calculator is a simple calculator with only the most basic functions. Calendar has a single field where you can add appointments on the hour or add alarms, but nothing else. The Notepad is your classic no-frills text editor – and we mean no-frills – while Terminal is the kind of baffling, text-driven comms program that only ever looked good in WarGames. Seriously, people used this stuff?

The highlights are Paint, Windows Write and Reversi, not because they're any good but because they bear some vague resemblance to modern applications. Paint has a palette of tools, plus drop-down menus to handle fonts and options. It also has virtually no room to actually do anything with the tools, unless you're keen on drawing in a low-resolution, widescreen aspect ratio, or your favourite drawing subjects are sausage dogs and snakes.

Windows Write is recognisably a word processor, but there's no spell check or anything beyond basic formatting features, much like the Windows Write we all carried on not using before Windows 95. And as for Reversi, well it's a variant of the classic black and white disc strategy game Othello, but – let's face it – it's no Minesweeper or Solitaire.

LOOKING TO THE FUTURE

What's most striking about using Windows 1 now is that it feels less like an operating system than a fancy front-end for MS-DOS. It still runs from an MS-DOS command prompt, it still works with the MS-DOS file and directory structures and it was still partly designed to run MS-DOS applications, principally because Microsoft had little faith in anyone developing native Windows ones. They were right, as until Windows 3.0 took off, barely any of the major software vendors made Windows software.

Yet there are aspects of Windows that show its potential. We'll be kind and say that Microsoft 'borrowed' Apple's concept of a clipboard, allowing you to cut and paste text or pictures from one application to another. Microsoft's early Windows adverts go big on copying contact details from a database and pasting them into a letter in Windows Write, then adding a graph from Microsoft Chart or Lotus 1-2-3 which, at that point, was the T-Rex of business applications.

Microsoft designed Windows to be compatible with a range of applications – not just its own – and to promote interoperability, so that you didn't have to work with just one application, or even one specific suite. Windows wanted you to mix and match. Microsoft also designed Windows as a GUI that could work across PCs with different hardware, and this in turn helped to make the PC market more competitive. Even at that point, Bill Gates' ambition was 'to create the software that puts a computer on every desk and in every home'.

Sure, Microsoft wanted to build the system software and the most important applications, but it also understood the necessity of bringing other software-makers on board. As Gates said in 1993, 'Our vision, we shared; we didn't view that as some competitive edge. We just wanted to talk about it and get other people to share the same ideas so that they would help make it all come true.'

Of course, Microsoft has never been shy about monopolising, but Windows has always been stronger when Microsoft opened up and led the way. You can see Windows 1 as the start of that process, even if it's not an OS that you'd want to use today. CPC

Readers' Drives

Jack Daniel's #OnTheRocks

Craig Ferrie built this wooden case from scratch for his Jack Daniel's-themed build, which incorporates authentically whiskey-coloured coolant, as well as a bottle and glass as part of the loop

SEE THE FULL PROJECT LOG AT
custompc.co.uk/JDMod

/MEET THY MAKER

Name Craig Ferrie

Age 32

Occupation Engraver

Location Scotland

Main uses for PC Gaming and movies

Likes Ha, does McDonald's count? I really have a passion for gaming and working with computers

Dislikes Veggies – yuck! Oh, and Fortnite

CPC: Firstly, why Jack Daniel's?
Craig: Honestly, I just wanted to do something different! Jack Daniel's is arguably the most well-known whiskey.

CPC: What sort of look were you trying to achieve, and what were your whiskey-related design cues?
Craig: Right from the get-go, it had to be wooden and contain enough space in the back to allow the graphics card to be mounted, and for the water-cooling system to be neat, while somehow still keeping the whiskey barrel theme. Obviously, I could have just hacked out a regular whiskey barrel, but where would the originality be in that?

CPC: Take us through the woods you used for the main chassis, and how you went about cutting, prepping and finishing them to achieve this look.
Craig: I'll be as honest as possible here. I was throwing out a double bed frame and was looking at the slats. My brain tingled and the idea came to me. I had no previous experience with woodworking, and I'd never done a scratch build before either (at least, not like this one).

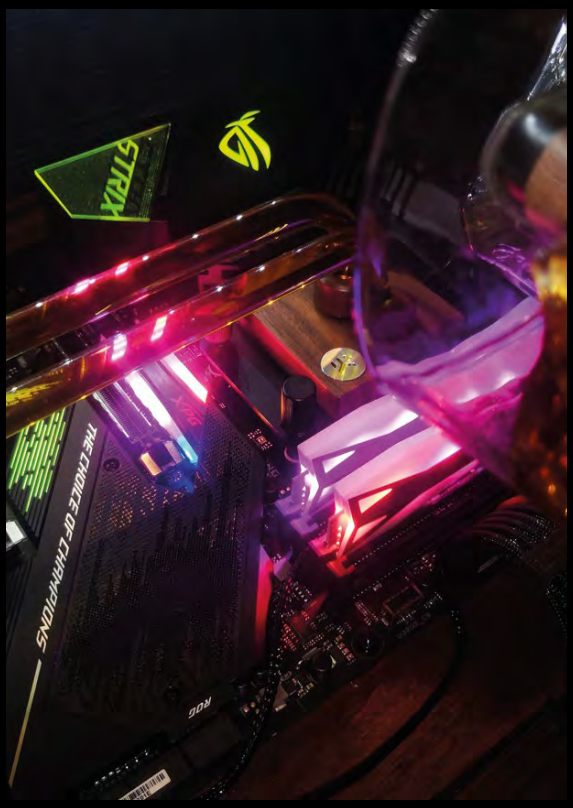
I took the wooden slats and began by cutting up them up, mostly just winging the initial process – I didn't do much measuring.

I used a jigsaw to cut the slats to matching sizes, sanded down all the edges, wood-glued the slats onto a basic frame and then screwed them together.

Once it was all looking good, I stained the wood with mahogany wood stain, using a household sponge. I actually had to stain it around three times to get the right effect.

There were some gaps in the slats, due to irregularities in the wood shape, which I filled with wood filler, and then stained the filler to match the wood. The frame is pine and the flat top, bottom and mid-section are birch plywood.

CPC: Did you build the case completely from scratch?
Craig: Yes. I actually gave up on case modding around a year ago, as I was always working with black boxes – they're all the same these days. There are pretty lights here and there, but the layout remains roughly the same. For this, I wanted pure originality.



CPC: How did you cut out the logos and the No.7?
Craig: For these, I used 3mm-thick birch plywood, and cut them with my own laser cutter/engraver (my personal business uses it). They're then stained to match the rest of the case, and stuck on with wood glue.

CPC: What other materials did you use in this build?
Craig: The case is 100 per cent wood – there's no extra support, absolutely everything is wooden.

CPC: How did you get the coolant to look so much like whiskey?
Craig: Ahh, the good old 'is that really whiskey?' question! Unfortunately, it's not whiskey. It is, in fact, EK CryoFuel coolant. EK was kind enough to also supply me with its CryoFuel dye pack. Getting this colour requires an unusual dye mix. First, you need to add blue and yellow to make a nice green, and then you slowly add red until you get that really dark amber look of whiskey.

I was throwing out a double bed frame and was looking at the slats. My brain tingled and the idea came to me

CPC: How did you make the authentic-looking Jack Daniel's logos and writing on the front and side?
Craig: These were tricky – I was running out of slats of wood, so it was crucial to get them right. I had to test the laser engraver setup on paper multiple times, before I finally put the panels in the engraver. It was a shot in the dark, where I hoped the wood would burn and not just leave markings. I turned the laser speed down and the power up, and ended up with some really nice results.

CPC: Let's talk about the bottle of Jack Daniel's at the front, pouring 'whiskey' into the glass. Is this just for show, or is it actually a reservoir?
Craig: I've been getting this question quite a lot on social media. The pouring Jack Daniel's bottle is 100 per cent a part of the loop. There are multiple filters to avoid debris getting into the loop, and 'no return' valves under the shroud that prevent the coolant from returning to the lowest points of the loop (I got this idea from a kitchen sink).

There's a second reservoir bottle I can switch in and out for at-home use, which is closed, allowing me to play games on the machine without worrying about dust and evaporation.

CPC: How did you go about planning the cable routing, and getting the cable colours to fit in with the wooden design?
Craig: When I started working on the case, I knew I wanted this build to look classy and clean. I reached out to my friend Matt at CableMod and asked him if I could get some made-to-length cables for this build. He had them made and sent out to me within a couple of weeks.

I knew that regular cable combs wouldn't cut it here, so I designed my own 9mm-thick combs that had enough surface area to attach to the case. As for the cable colour, CableMod has a fantastic website (**cablemod.com**) that provides accurate images of its available colours, so it was really a breeze.

CPC: How did you make that wooden plate for the GPU waterblock?
Craig: Originally, I wanted to use EK's Lignum Walnut block, but unfortunately that didn't work out, so I had to make a wooden panel that would fit on an EK Acetyl+Nickel waterblock for this card. After learning I was going to be using the EK Vector Strix block, I got the measurements of the backplate, drew up a template on my laptop and then designed a nice Strix/EK logo combination for etching. I sent them out to the cutter and then stained them to match the case.

CPC: Where do you plug in your monitor, keyboard and mouse?
Craig: There are three 15cm USB extensions, which are braided in the top middle of the case – they go from the motherboard to the top panel of the case. I have an 8-port USB hub, so I really only needed one free USB port. The monitor plugs directly into the graphics card – I do have a 15cm HDMI extension I was planning to add to the build, but I can't decide if I want the case front-facing or back-facing, as all the sides look good!

CPC: How did you plan the routing and positioning for the hardline water-cooling tubing?
Craig: Again, right off the bat, I knew I wanted it to look sleek, sexy and classy. Basically, you only see two runs of tubing – the 'to' and 'from' – it's a little more complex under the shroud, with the return valves and so on. For cutting and measuring, I mark the tube where

SYSTEM SPECS

CPU AMD Ryzen 7 3800X

Graphics card Asus ROG Strix GeForce RTX 2080 OC

Storage 512GB XPG Spectrix D40G M.2 SSD

Memory 16GB XPG Spectrix D60G DDR4 3200MHz

Motherboard Asus ROG Strix X570-E Gaming

PSU 1,000W be quiet! Dark Power Pro 11 2

Cooling Custom water-cooling loop, featuring the following EK components: Lignum Walnut CPU waterblock, Quantum Vector Strix RTX 2080 D-RGB Nickel + Acetyl GPU waterblock, Vector Strix RTX 2080 black GPU backplate, HTC Lignum 10/12mm Walnut fittings, CoolStream Classic PE 360 radiator, Quantum Inertia D5 PWM D-RGB Acetyl pump, AF Classic Angled 90-degree black fittings, AF Classic Angled 45-degree black fittings, CryoFuel Clear coolant, AF Extender M-M G1/4 Black, AF ALU T-splitter 3F G1/4 - Natural Grey, CryoFuel Dye Pack, HD PETG Tube 10/12mm 500mm

Fans Cooler Master SF360R fans

I want the bend to start and just play it by eye from that point. For cutting, I use basic tools such as a rotating cutter and deburring tool.

CPC: How does the airflow system work?
Craig: There are three Cooler Master fans at the top, all in one unit – the SF360R. There's one other vent under the case for the power supply. Other than that, being an open-air case, there's hardly any need for additional airflow – the system runs extremely cool.

CPC: Did you come across any major difficulties?
Craig: There were quite a few, such as the legs for the case. I had no idea what to do here – should I get custom ones made, or stick with the original wood? In the end, I stuck with the wood of the frame and it seems to have paid off. The other main issue was leaks (and the fear of them), as this build doesn't have an easy-access loop – it's certainly not easy to drain – the return valves don't allow water to recede, making traditional draining near impossible.

CPC: How long did it take you to complete this build, from start to finish?
Craig: From start to finish, it took roughly three months. This includes planning, building and waiting for parts. The pandemic definitely didn't help with couriers and orders.

CPC: Are you completely happy with the end result, or do you wish you'd done some of it differently in retrospect?
Craig: I'm very satisfied with the final look. Is there anything I would change? Absolutely, but that's just a part of the process when you're designing something new. I'd certainly like to look into making a loop that's easier to manage. I'd also look into using a better wood in the future, should I revisit this idea. CPC

WIN CORSAIR HYDRO X WATER-COOLING GEAR

To enter your rig for possible inclusion in Readers' Drives, your build needs to be fully working and, ideally, based in the UK. Simply send us a couple of photos on Twitter (**@CustomPCMag**) or Facebook (**CPCMagazine**), or email low-res ones to **ben.hardwidge@raspberrypi.com**. Fame isn't the only prize; you'll also get your hands on some fabulous prizes, courtesy of Corsair.

Corsair Hydro X Series XD3 RGB Pump/Reservoir C

WORTH £151

The Corsair Hydro X Series XD3 RGB Pump/Reservoir Combo features a high-performance DDC PWM pump, integrated RGB lighting and in-loop temperature sensor to drive even the most compact custom cooling systems. It has a high-performance Xylem DDC PWM pump controlled via PWM to deliver the perfect flow balance for your loop. There are also 16 individually addressable RGB LEDs, which light up the pump head to produce stunning, customisable lighting effects to match your build.

Corsair Hydro X Series XC7 RGB CPU Water Block

WORTH £70

The Corsair Hydro X Series XC7 RGB CPU Water Block combines premium construction, vivid RGB lighting and extreme cooling performance to become the centrepiece of your water-cooling loop. It has a nickel-plated copper cold plate and more than 60 high-efficiency micro-cooling fins, which efficiently draw heat away from your CPU, lowering operating temperatures and allowing for maximum overclocks. You can choose the AM4/LGA1151 or LGA2066 version.

Corsair Hydro X Series XR5 240mm Radiator

WORTH £55

The Corsair Hydro X Series XR5 240mm Water Cooling Radiator delivers extreme custom cooling performance, with a 30mm radiator thickness and premium copper core. Its dual 120mm fan mounts on each side are ready for your most ambitious custom cooling build, and its 25 micron-thick cooling fins offer a high thermal transfer rate.

JAMES GORBOLD / HARDWARE ACCELERATED

SHAMBOLIC LAUNCHES

Having a good product doesn't matter if you can't actually buy it, argues James Gorbold

As I've stated in this column previously, the gaming market has been booming for the past few months, with unprecedented sales of gaming PCs and components. The recent Nvidia GeForce RTX 3000-series GPU launches, the AMD Ryzen 5000-series CPU launch and the Sony PlayStation 5 launch have all been extremely challenging, with demand far outstripping supply.

That said, at least there has been some supply of all three of the above. We haven't received the thousands of units that have been required, but hundreds of units were available at launch, with hundreds more arriving every week afterwards. This gave us the confidence to enable customers to pre-order these products for a limited time. I say limited, because we closed sales as soon as we had taken more pre-orders than could be fulfilled within a few weeks.

However, AMD's Radeon RX 6000-series GPU launches have been a shambles from start to finish. The first models, the Radeon RX 6800 and 6800 XT, had staggered launches, with custom-design cards launching a few days later than reference cards. Even so, the quantities received in the UK were truly abysmal, with double-digit deliveries from most brands, and some delivering less than a handful of graphics cards.

> The quantities received in the UK were abysmal, with double-digit deliveries from most brands

To make matters worse, weeks after launch, AMD and its board partners have yet to provide any information on additional shipments of the Radeon RX 6800 and 6800 XT. We're still not taking pre-orders of these cards, as we can't inform customers how long they would have to wait for them. In contrast, Nvidia and its board partners, AMD's CPU division and Sony are at least providing shipping forecasts, which you can see at **custompc.co.uk/ScanStock**

As I write this column, we're preparing for the launch of another new AMD GPU, the Radeon RX 6900 XT. The supply, or lack thereof, is frankly ridiculous, with so few cards received or incoming that I seriously question the validity of calling it a launch at all.

It may just be my old age and the tendency to look back at previous events through rose-tinted glasses, but even the bad old Intel and AMD CPU paper launches weren't this bad. At least then there was no pretence that stock was or would be available soon – they were simply spoiler launches.

The tragedy is that, despite their lacklustre ray-tracing performance, the new AMD 6000-series GPUs are actually quite compelling. After all, ray tracing is still in its infancy, and while it's likely to eventually become mainstream, it's still only supported in a minority of games. However – and let me be utterly clear on this point – having a good product doesn't matter if you can't actually buy it. At least in the days of paper launches you could convince yourself it was worth waiting for the new product to become available, but that's simply not possible with a 6000-series GPU.

Plus, while I can sympathise to some extent with AMD for wanting to launch these new GPUs at this time, the process from sampling to shipping has been diabolical. What on earth is going on? If AMD's plan was to spoil the launch of the Nvidia 3000-series, it hasn't worked at all, with the latter enjoying stratospheric sales and AMD failing to make a dent in its market share. Likewise, if the plan was to boost AMD's share price, that hasn't really worked either. Ultimately, even if AMD may have got the product right, without a proper launch strategy and stock it's all been for naught. CPC

James Gorbold has been building, tweaking and overclocking PCs ever since the 1980s. He now helps Scan Computers to develop new systems.

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